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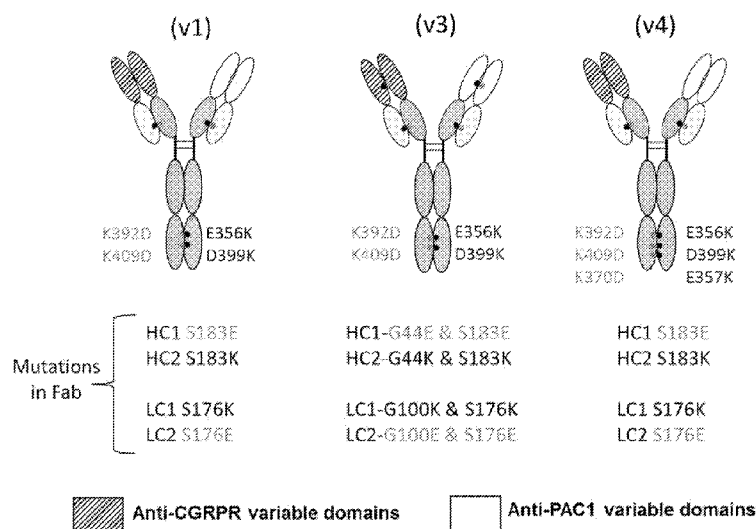
(54) **Title:** BI-SPECIFIC ANTI-CGRP RECEPTOR/PAC1 RECEPTOR ANTIGEN BINDING PROTEINS AND USES THEREOF

FIG. 1

(57) **Abstract:** The present invention relates to bispecific antigen binding proteins that are capable of binding to both the human CGRP receptor and the human PAC1 receptor. Pharmaceutical compositions comprising the bispecific antigen binding proteins as well as methods for producing them are also disclosed. Methods of using the bispecific antigen binding proteins to ameliorate or treat conditions associated with the two receptors, such as chronic pain, migraine, and cluster headache, are also described.



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BI-SPECIFIC ANTI-CGRP RECEPTOR/PAC1 RECEPTOR ANTIGEN BINDING PROTEINS AND USES THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/050,737, filed September 15, 2014, which is hereby incorporated by reference in its entirety.

DESCRIPTION OF THE TEXT FILE SUBMITTED ELECTRONICALLY

[0002] The present application contains a Sequence Listing, which has been submitted electronically in ASCII format and is hereby incorporated by reference in its entirety. The computer readable format copy of the Sequence Listing, which was created on September 8, 2015, is named A-1922-WO-PCT_ST25.txt and is 1,091 kilobytes in size.

FIELD OF THE INVENTION

[0003] The present invention relates to the field of biopharmaceuticals. In particular, the invention relates to bispecific antigen binding proteins that are capable of specifically binding to human calcitonin gene-related peptide (CGRP) receptor and human pituitary adenylate cyclase-activating polypeptide type I (PAC1) receptor, pharmaceutical compositions comprising the bispecific antigen binding proteins, and methods of producing and using such bispecific antigen binding proteins.

BACKGROUND OF THE INVENTION

[0004] Migraine is a complex, common neurological condition that is characterized by severe, episodic attacks of headache and associated features, which may include nausea, vomiting, sensitivity to light, sound or movement. In some patients, the headache is preceded or accompanied by sensory warning signs or symptoms (i.e. auras). The headache pain may be severe and may also be unilateral in certain patients. Migraine attacks are disruptive to daily life and cost billions of dollars each year in missed work days and impaired performance (Modi and Lowder, Am. Fam. Physician, Vol. 73:72-78, 2006).

[0005] Migraine is a highly prevalent disease worldwide with approximately 15% of the European population and 12% of the United States population suffering from migraine attacks

(Lipton *et al.*, *Neurology*, Vol. 68:343-349, 2007). Additionally, migraines have been found to be associated with a number of psychiatric and medical comorbidities such as depression and vascular disorders (Buse *et al.*, *Neurol. Neurosurg. Psychiatry*, Vol. 81:428-432, 2010; Bigal *et al.*, *Neurology*, Vol. 72:1864-1871, 2009).

[0006] Migraine headache is commonly treated acutely, primarily with analgesics and a class of drugs called triptans (Humphrey *et al.* *Ann NY Acad Sci.*, Vol. 600:587-598, 1990; Houston and Vanhoutte, *Drugs*, Vol. 31:149-163 1986). The triptans, which are selective serotonin 5-HT_{1B/1D} agonists, are effective drugs for acute migraine and are generally well tolerated, but are contraindicated in the presence of cardiovascular disease due to their potential for coronary vasoconstriction. In addition, many migraine patients do not respond favorably to triptans. In a meta-analysis of 53 trials, up to a third of all people with migraine and 40% of all migraine attacks did not respond to triptans (Ferrari *et al.*, *Lancet*, Vol. 358:1668-1675, 2001).

[0007] Migraine prophylaxis is an area of large unmet medical need. Approximately 40% of the migraine patient population would benefit from preventive therapy (Lipton *et al.*, *Neurology*, Vol. 68:343-349, 2007). However, only approximately 12% of patients receive any preventive therapy due in part to limited efficacy and significant tolerability and safety issues with available preventive therapies. Topiramate, an anticonvulsant that blocks voltage-dependent sodium channels and certain glutamate receptors (AMPA-kainate), is the medication most often used for migraine prophylaxis in the United States. Topiramate is the only migraine prophylactic agent with demonstrated efficacy in both episodic and chronic migraine patients through randomized placebo-controlled trials (Diener *et al.*, *Cephalalgia*, Vol. 27:814-823, 2007; Silberstein *et al.*, *Headache*, Vol. 47:170-180, 2007). However, approximately 50% of patients fail to respond to topiramate and it is poorly tolerated. Common adverse events associated with topiramate treatment include paresthesia, anorexia, and cognitive adverse events, including psychomotor slowing, somnolence, language difficulties, and difficulties with memory and concentration (Brandes *et al.*, *JAMA*, Vol. 291:965-973, 2004; Adelman *et al.*, *Pain Med.*, Vol. 9:175-185 2008; Silberstein *et al.*, *Arch Neurol.*, Vol. 61:490-495, 2004). In an open-label, flexible-dose study, 20% of patients withdrew from topiramate because of adverse effects (Nelles *et al.*, *Headache*, Vol. 49:1454-1465, 2009). Thus, migraine sufferers have an urgent medical need for more effective and/or tolerable treatment options.

[0008] Calcitonin gene-related peptide (CGRP) belongs to the calcitonin family of peptides, which also includes calcitonin, amylin, and adrenomedullin. CGRP is a 37-amino acid peptide expressed in both the central and peripheral nervous systems, and has been implicated as a key mediator in the initiation and progression of migraine pain. In addition to its ability to act as a vasodilator, CGRP also acts as a neurotransmitter in the trigeminal ganglion and the trigeminal nucleus caudalis, facilitating synaptic transmission and pain responses (Durham *et al.*, *Curr Opin Investig Drugs*, Vol. 5:731-735, 2004; Zimmermann *et al.*, *Brain Res.*, Vol. 724:238-245, 1996; Wang *et al.*, *Proc Natl Acad Sci USA.*, Vol. 92:11480-11484, 1995; Poyner, *Pharmacol. Ther.*, Vol. 56:23-51, 1992).

[0009] The CGRP receptor is a complex composed of the G-protein coupled calcitonin-like receptor (CLR) and a single transmembrane domain protein receptor activity modifying protein (RAMP1). The CGRP receptor complex is located at sites that are relevant to migraine including the cerebrovasculature, the trigeminocervical complex in the brainstem, and the trigeminal ganglion (Zhang *et al.*, *J. Neurosci.*, Vol. 27: 2693-2703, 2007; Storer *et al.*, *Br J Pharmacol.*, Vol. 142:1171-1181, 2004; Oliver *et al.*, *J Cereb Blood Flow Metab.*, Vol. 22:620-629, 2002). Several lines of evidence indicate that CGRP is a potent vasodilator and nociceptive modulator that has been associated with migraine pathophysiology: (1) it is expressed in the trigeminal system, which is implicated in the pathophysiology of migraines; (2) CGRP levels are elevated in migraineurs during an attack (Bellamy *et al.*, *Headache*, Vol. 46:24-33, 2006; Ashina *et al.*, *Pain*, Vol. 86:133-138, 2000; Gallai *et al.*, *Cephalalgia*, Vol.15:384-390, 1995; Goadsby *et al.*, *Ann Neurol.*, Vol. 28:183-187, 1990; Goadsby *et al.*, *Ann Neurol.*, Vol. 23:193-196, 1988); (3) acute migraine therapies such as triptans restore CGRP levels to normal after treatment (Juhasz *et al.*, *Cephalalgia*, Vol. 25:179-183, 2005); (4) CGRP infusion triggers the onset of migraine headaches in migraine sufferers (Petersen *et al.*, *Br J Pharmacol.*, Vol. 143:1074-1075, 2004; Lassen *et al.*, *Cephalalgia*, Vol. 22:54-61, 2002); and (5) CGRP antagonists have demonstrated efficacy in acute migraine reversal (Connor *et al.*, *Neurology*, Vol. 73:970-977, 2009; Hewitt *et al.*, Abstract for the 14th Congress of the International Headache Society, 2009; LBOR3; Ho *et al.*, *Lancet*, Vol. 372:2115-2123, 2008a; Ho *et al.*, *Neurology*, Vol. 70:1304-1312, 2008b). Additionally, small-molecule CGRP receptor antagonists and antibody CGRP ligand antagonists have demonstrated clinical efficacy in episodic migraine prevention (Dodick *et al.*, *Lancet Neurol.*, Vol. 13:1100-1107, 2014a; Dodick *et al.*, *Lancet Neurol.*, Vol. 13:885-892 2014b; Ho *et*

al., Neurology, Vol. 83:958-966, 2014). Taken together, these data suggest a role for the CGRP neuropeptide and its receptor in the pathogenesis of migraine.

[0010] Pituitary adenylate cyclase-activating polypeptide (PACAP) belongs to the VIP/secretin/glucagon superfamily. The sequence of PACAP 27 corresponds to the 27 N-terminal amino acids of PACAP 38 and shares 68% identity with vasoactive intestinal polypeptide (VIP) (Pantaloni *et al.*, J. Biol. Chem., Vol. 271: 22146-22151, 1996; Pisegna and Wank, Proc. Natl. Acad. Sci. USA, Vol. 90: 6345-49, 1993; Campbell and Scanes, Growth Regul., Vol. 2:175-191, 1992). The major form of PACAP peptide in the human body is PACAP 38 and the pharmacology of PACAP 38 and PACAP 27 has not been shown to be different from each other. Three PACAP receptors have been reported: one receptor that binds PACAP with high affinity and has a much lower affinity for VIP (PAC1 receptor), and the other two receptors that recognize PACAP and VIP equally well (VPAC1 and VPAC2 receptors) (Vaudry *et al.*, Pharmacol Rev., Vol. 61:283-357, 2009). PACAP is capable of binding all three receptors with similar potency and is thus not particularly selective. VIP, on the other hand, binds with significantly higher affinity to VPAC1 and VPAC2, as compared with PAC1. In addition to endogenous agonists PACAP and VIP, maxadilan, a 65 amino acid peptide originally isolated from the sand-fly, is exquisitely selective for PAC1 compared with VPAC1 or VPAC2.

[0011] Human experimental migraine models using PACAP as a challenge agent to induce migraine-like headaches support the role of PAC1 receptor antagonism as a potential treatment for migraine prophylaxis. Infusion of PACAP 38 causes headaches in healthy subjects and migraine-like headaches in migraine patients (Schytz *et al.*, Brain, Vol. 132:16-25, 2009). In addition, in the same model, VIP does not cause migraine-like headaches in migraine patients (Rahmann *et al.*, Cephalalgia, Vol. 28:226-236, 2008). The lack of migraine-like headache induction from VIP infusion suggests that PAC1 receptor, but not VPAC1 or VPAC2 receptors, is involved in migraine because VIP has a much higher affinity at the latter two receptors. These data suggest that a selective PAC1 antagonist has the potential to treat migraine.

[0012] There is a need in the art to develop migraine-specific prophylactic therapies having novel mechanisms of action that are directed to targets that underlie migraine pathophysiology. In particular, therapeutic molecules having a dual function in antagonizing both the CGRP/CGRP receptor and PACAP/PAC1 receptor pathways would be particularly beneficial.

SUMMARY OF THE INVENTION

[0013] The present invention is based, in part, on the design and generation of bispecific antigen binding proteins capable of blocking both the human CGRP receptor and the human PAC1 receptor. Such bispecific antigen binding proteins comprise a first binding domain that specifically binds to human CGRP receptor and a second binding domain that specifically binds to human PAC1 receptor. In some embodiments, each of the binding domains comprises variable regions from immunoglobulin light and heavy chains. The binding domains may be prepared from anti-CGRP receptor and anti-PAC1 receptor antibodies.

[0014] In certain embodiments, one of the binding domains is a Fab fragment and the other binding domain is a single-chain variable fragment (scFv). In other embodiments, both binding domains are Fab fragments. The bispecific antigen binding proteins may also comprise an immunoglobulin constant region or Fc region, which, in some embodiments, is derived from a human immunoglobulin IgG1 or IgG2. In certain embodiments, the constant region comprises one or more amino acid substitutions that reduce glycosylation and/or effector function of the bispecific antigen binding protein.

[0015] In some embodiments, the bispecific antigen binding proteins are monovalent for each target. In such embodiments, the bispecific antigen binding protein can be an antibody where one antigen binding domain or arm binds to the CGRP receptor and the other antigen binding domain or arm binds to the PAC1 receptor. In other embodiments, the bispecific antigen binding proteins are bivalent for each target. In such embodiments, one binding domain is positioned at the amino terminus of an immunoglobulin Fc region and the other binding domain is positioned at the carboxyl terminus of the Fc region such that, when dimerized, the antigen binding protein comprises two antigen binding domains that bind to the CGRP receptor and two antigen binding domains that bind to the PAC1 receptor.

[0016] In some embodiments, the bispecific antigen binding protein is an antibody, such as a heterodimeric antibody. The heterodimeric antibody may comprise a first light chain and a first heavy chain from a first antibody that specifically binds to human CGRP receptor and a second light chain and second heavy chain from a second antibody that specifically binds to human PAC1 receptor. In certain embodiments, the first and second heavy chains comprise one or more charge pair mutations in the constant region (e.g. CH3 domain) to promote heterodimer formation. In related embodiments, the first light chain and first heavy chain (or second light

chain and second heavy chain) comprise one or more charge pair mutations to facilitate correct light-heavy chain pairing. In some such embodiments, the first heavy chain comprises an amino acid substitution introducing a charged amino acid (e.g. glutamic acid) that has the opposite charge of the amino acid introduced into the first light chain (e.g. lysine) so that the first light chain and first heavy chain are attracted to each other. The charged amino acid introduced into the second light chain (e.g. glutamic acid) would preferably have the same charge as the amino acid introduced into the first heavy chain (e.g. glutamic acid), but the opposite charge of the amino acid introduced into the second heavy chain (e.g. lysine) so that the second light chain would be attracted to the second heavy chain, but repelled from the first heavy chain.

[0017] In certain embodiments of the invention, the bispecific antigen binding protein is comprised of an antibody against a first target (e.g. CGRP receptor or PAC1 receptor) and a scFv derived from an antibody against a second target (e.g. PAC1 receptor or CGRP receptor). In this IgG-scFv format, the bispecific, multivalent antigen binding protein comprises (i) a light chain and a heavy chain from a first antibody and (ii) a scFv comprising a light chain variable region (VL) and a heavy chain variable region (VH) from a second antibody, wherein the scFv is fused at its amino terminus to the carboxyl terminus of the heavy chain optionally through a peptide linker to form a modified heavy chain, and wherein the first or second antibody specifically binds to human CGRP receptor and the other antibody specifically binds to human PAC1 receptor. In some embodiments, the scFv comprises, from N-terminus to C-terminus, a VH region, a peptide linker, and a VL region. In other embodiments, the scFv comprises, from N-terminus to C-terminus, a VL region, a peptide linker, and a VH region.

[0018] In other embodiments of the invention, the bispecific antigen binding protein is comprised of an antibody against a first target (e.g. CGRP receptor or PAC1 receptor) and a Fab fragment derived from an antibody against a second target (e.g. PAC1 receptor or CGRP receptor). In this IgG-Fab format, the bispecific, multivalent antigen binding protein comprises (i) a light chain from a first antibody, (ii) a heavy chain from the first antibody, wherein the heavy chain is fused at its carboxyl terminus optionally through a peptide linker to a first polypeptide comprising VL-CL domains or VH-CH1 domains of a second antibody to form a modified heavy chain, and (iii) a second polypeptide comprising VH-CH1 domains or VL-CL domains of the second antibody, wherein the first or second antibody specifically binds to human CGRP receptor and the other antibody specifically binds to human PAC1 receptor. In particular

embodiments, the first polypeptide, which is fused to the carboxyl terminus of the heavy chain, comprises VL and CL domains (i.e. a light chain) from the second antibody, and the second polypeptide comprises VH and CH1 domains (i.e. a Fd fragment) from the second antibody. In other particular embodiments, the first polypeptide, which is fused to the carboxyl terminus of the heavy chain, comprises VH and CH1 domains (i.e. a Fd fragment) from the second antibody, and the second polypeptide comprises VL and CL domains (i.e. a light chain) from the second antibody. The CL and CH1 domains may be switched in some embodiments between the first and second polypeptide. Thus, in some embodiments, the first polypeptide, which is fused to the carboxyl terminus of the heavy chain, comprises VL and CH1 domains from the second antibody, and the second polypeptide comprises VH and CL domains from the second antibody. In other embodiments, the first polypeptide, which is fused to the carboxyl terminus of the heavy chain, comprises VH and CL domains from the second antibody, and the second polypeptide comprises VL and CH1 domains from the second antibody.

[0019] The present invention includes one or more nucleic acids encoding any of the bispecific antigen binding proteins described herein or components thereof, as well as vectors comprising the nucleic acids. Also encompassed within the invention is a recombinant host cell, such as a CHO cell, that expresses any of the bispecific antigen binding proteins.

[0020] The bispecific antigen binding proteins described herein can be used in the manufacture of a pharmaceutical composition or medicament for the treatment of conditions associated with CGRP receptor and/or PAC1 receptor, such as headache, migraine, and chronic pain. Thus, the present invention also provides a pharmaceutical composition comprising a bispecific antigen binding protein and a pharmaceutically acceptable diluent, excipient or carrier.

[0021] In some embodiments, the present invention provides a method for treating or preventing headache in a patient in need thereof comprising administering to the patient an effective amount of a bispecific antigen binding protein described herein. In some embodiments, the headache is migraine headache. The migraine can be episodic migraine or chronic migraine. In other embodiments, the headache is cluster headache. In particular embodiments, the methods provide prophylactic treatment for these conditions.

[0022] In another embodiment, the present invention provides a method for treating chronic pain in a patient in need thereof comprising administering to the patient an effective amount of a bispecific antigen binding protein described herein. The chronic pain syndromes to be treated

according to the methods of the invention can include arthritic pain, such as pain associated with osteoarthritis or rheumatoid arthritis.

[0023] The use of the bispecific antigen binding proteins in any of the methods disclosed herein or for preparation of medicaments for administration according to any of the methods disclosed herein is specifically contemplated. For instance, the present invention includes a bispecific antigen binding protein for use in a method for treating or preventing a condition associated with CGRP receptor and/or PAC1 receptor in a patient in need thereof. The condition can include headache (e.g. migraine headache or cluster headache) and chronic pain.

[0024] The present invention also includes the use of a bispecific antigen binding protein in the preparation of a medicament for treating or preventing a condition associated with CGRP receptor and/or PAC1 receptor in a patient in need thereof. The condition can include headache (e.g. migraine headache or cluster headache) and chronic pain.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] **Figure 1** shows a schematic representation of three bispecific hetero immunoglobulin formats used to generate anti-CGRP receptor/PAC1 receptor bispecific antibodies. The Kabat-EU numbering scheme is used to denote the positions of charge pair mutations within each of the chains. This IgG-like bispecific antibody format is a heterotetramer comprising two different light chains and two different heavy chains. HC1 and LC1 refer to the heavy chain and light chain, respectively, of one Fab binding arm and HC2 and LC2 refers to the heavy chain and light chain, respectively, of the second Fab binding arm. For example, in the schematic, HC1 and LC1 correspond to the anti-CGRP receptor binding arm and HC2 and LC2 correspond to the anti-PAC1 binding arm. However, the two binding arms can be switched such that HC1 and LC1 correspond to the anti-PAC1 binding arm and HC2 and LC2 correspond to the anti-CGRP receptor binding arm.

[0026] **Figure 2** depicts a schematic representation of an IgG-scFv format used to generate anti-CGRP receptor/PAC1 receptor bispecific antigen binding proteins. In this format, a single-chain variable fragment (scFv), which comprises variable domains from a second antibody linked together by a glycine-serine linker, is fused to the carboxyl terminus of the heavy chain of a first antibody through a peptide linker to produce a modified heavy chain. Although the VH-VL orientation of the variable domains within the scFv is shown, the variable domains may also be

organized in a VL-VH orientation. The complete molecule is a homotetramer comprising two modified heavy chains and two light chains from the first antibody.

[0027] **Figure 3** depicts a schematic representation of an IgG-Fab format used to generate anti-CGRP receptor/PAC1 receptor bispecific antigen binding proteins. In this format, one polypeptide chain of a Fab fragment from a second antibody (e.g. the light chain (VL2-CL)) is fused to the carboxyl terminus of the heavy chain of a first antibody through a peptide linker to produce a modified heavy chain. The complete molecule is homo-hexamer comprising two modified heavy chains, two light chains from the first antibody, and two polypeptide chains containing the other half of the Fab fragment from the second antibody (e.g. the Fd chain (VH2-CH1)). Charge pair mutations (represented by the circles) can be introduced into the Fab regions of the first antibody (Fab 1) or second antibody (Fab 2) to promote correct heavy chain-light chain pairs. Although the light chain of the second antibody is shown as the fusion partner for the heavy chain of the first antibody in the schematic, the Fd region (VH-CH1) of the second antibody can be fused to the carboxyl terminus of the heavy chain with the light chain of the second antibody completing the Fab domain at the carboxyl terminus of the Fc region.

DETAILED DESCRIPTION

[0028] The present invention is directed to bispecific antigen binding proteins that specifically bind to both the human CGRP receptor and the human PAC1 receptor. As both CGRP receptor and PAC1 receptor signaling are implicated in the control of cerebral vascular tone, the bispecific binding proteins of the invention provide a means to simultaneously modulate both signaling cascades to ameliorate conditions associated with dysregulation of the cranial vasculature, such as cluster headache and migraine. Accordingly, in one embodiment, the present invention provides a bispecific antigen binding protein comprising a first binding domain that specifically binds to human CGRP receptor and a second binding domain that specifically binds to human PAC1 receptor.

[0029] As used herein, the term “antigen binding protein” refers to a protein that specifically binds to one or more target antigens. An antigen binding protein can include an antibody and functional fragments thereof. A “functional antibody fragment” is a portion of an antibody that lacks at least some of the amino acids present in a full-length heavy chain and/or light chain, but which is still capable of specifically binding to an antigen. A functional antibody fragment

includes, but is not limited to, a single-chain variable fragment (scFv), a nanobody (*e.g.* VH domain of camelid heavy chain antibodies; VHH fragment, *see* Cortez-Retamozo *et al.*, Cancer Research, Vol. 64:2853-57, 2004), a Fab fragment, a Fab' fragment, a F(ab')₂ fragment, a Fv fragment, a Fd fragment, and a complementarity determining region (CDR) fragment, and can be derived from any mammalian source, such as human, mouse, rat, rabbit, or camelid. Functional antibody fragments may compete for binding of a target antigen with an intact antibody and the fragments may be produced by the modification of intact antibodies (*e.g.* enzymatic or chemical cleavage) or synthesized *de novo* using recombinant DNA technologies or peptide synthesis.

[0030] An antigen binding protein can also include a protein comprising one or more functional antibody fragments incorporated into a single polypeptide chain or into multiple polypeptide chains. For instance, antigen binding proteins can include, but are not limited to, a diabody (*see, e.g.*, EP 404,097; WO 93/11161; and Hollinger *et al.*, Proc. Natl. Acad. Sci. USA, Vol. 90:6444-6448, 1993); an intrabody; a domain antibody (single VL or VH domain or two or more VH domains joined by a peptide linker; *see* Ward *et al.*, Nature, Vol. 341:544-546, 1989); a maxibody (2 scFvs fused to Fc region, *see* Fredericks *et al.*, Protein Engineering, Design & Selection, Vol. 17:95-106, 2004 and Powers *et al.*, Journal of Immunological Methods, Vol. 251:123-135, 2001); a triabody; a tetrabody; a minibody (scFv fused to CH3 domain; *see* Olafsen *et al.*, Protein Eng Des Sel., Vol. 17:315-23, 2004); a peptibody (one or more peptides attached to an Fc region, *see* WO 00/24782); a linear antibody (a pair of tandem Fd segments (VH-CH1-VH-CH1) which, together with complementary light chain polypeptides, form a pair of antigen binding regions, *see* Zapata *et al.*, Protein Eng., Vol. 8:1057-1062, 1995); a small modular immunopharmaceutical (*see* U.S. Patent Publication No. 20030133939); and immunoglobulin fusion proteins (*e.g.* IgG-scFv, IgG-Fab, 2scFv-IgG, 4scFv-IgG, VH-IgG, IgG-VH, and Fab-scFv-Fc).

[0031] The antigen binding proteins of the present invention are “bispecific” meaning that they are capable of specifically binding to two different antigens, human CGRP receptor and human PAC1 receptor. As used herein, an antigen binding protein “specifically binds” to a target antigen when it has a significantly higher binding affinity for, and consequently is capable of distinguishing, that antigen, compared to its affinity for other unrelated proteins, under similar binding assay conditions. Antigen binding proteins that specifically bind an antigen may have an equilibrium dissociation constant (K_D) $\leq 1 \times 10^{-6}$ M. The antigen binding protein specifically

binds antigen with “high affinity” when the K_D is $\leq 1 \times 10^{-8}$ M. In one embodiment, the antigen binding proteins of the invention bind to human CGRP receptor and/or human PAC1 receptor with a K_D of $\leq 5 \times 10^{-7}$ M. In another embodiment, the antigen binding proteins of the invention bind to human CGRP receptor and/or human PAC1 receptor with a K_D of $\leq 1 \times 10^{-7}$ M. In yet another embodiment, the antigen binding proteins of the invention bind to human CGRP receptor and/or human PAC1 receptor with a K_D of $\leq 5 \times 10^{-8}$ M. In another embodiment, the antigen binding proteins of the invention bind to human CGRP receptor and/or human PAC1 receptor with a K_D of $\leq 1 \times 10^{-8}$ M. In certain embodiments, the antigen binding proteins of the invention bind to human CGRP receptor and/or human PAC1 receptor with a K_D of $\leq 5 \times 10^{-9}$ M. In other embodiments, the antigen binding proteins of the invention bind to human CGRP receptor and/or human PAC1 receptor with a K_D of $\leq 1 \times 10^{-9}$ M. In one particular embodiment, the antigen binding proteins of the invention bind to human CGRP receptor and/or human PAC1 receptor with a K_D of $\leq 5 \times 10^{-10}$ M. In another particular embodiment, the antigen binding proteins of the invention bind to human CGRP receptor and/or human PAC1 receptor with a K_D of $\leq 1 \times 10^{-10}$ M.

[0032] Affinity is determined using a variety of techniques, an example of which is an affinity ELISA assay. In various embodiments, affinity is determined by a surface plasmon resonance assay (e.g., BIAcore[®]-based assay). Using this methodology, the association rate constant (k_a in $M^{-1}s^{-1}$) and the dissociation rate constant (k_d in s^{-1}) can be measured. The equilibrium dissociation constant (K_D in M) can then be calculated from the ratio of the kinetic rate constants (k_d/k_a). In some embodiments, affinity is determined by a kinetic method, such as a Kinetic Exclusion Assay (KinExA) as described in Rathanaswami *et al.* Analytical Biochemistry, Vol. 373:52-60, 2008. Using a KinExA assay, the equilibrium dissociation constant (K_D in M) and the association rate constant (k_a in $M^{-1}s^{-1}$) can be measured. The dissociation rate constant (k_d in s^{-1}) can be calculated from these values ($K_D \times k_a$). In other embodiments, affinity is determined by an equilibrium/solution method. In certain embodiments, affinity is determined by a FACS binding assay. WO 2010/075238 and WO 2014/144632, both of which are hereby incorporated by reference in their entireties, describe suitable affinity assays for determining the affinity of a binding protein for human CGRP receptor and human PAC1 receptor. In certain embodiments of the invention, the antigen binding protein specifically binds to human CGRP receptor and/or human PAC1 receptor expressed by a mammalian cell (e.g., CHO, HEK 293, Jurkat), with a K_D

of 20 nM (2.0×10^{-8} M) or less, K_D of 10 nM (1.0×10^{-8} M) or less, K_D of 1 nM (1.0×10^{-9} M) or less, K_D of 500 pM (5.0×10^{-10} M) or less, K_D of 200 pM (2.0×10^{-10} M) or less, K_D of 150 pM (1.50×10^{-10} M) or less, K_D of 125 pM (1.25×10^{-10} M) or less, K_D of 105 pM (1.05×10^{-10} M) or less, K_D of 50 pM (5.0×10^{-11} M) or less, or K_D of 20 pM (2.0×10^{-11} M) or less, as determined by a Kinetic Exclusion Assay, conducted by the method described in Rathanaswami *et al.* Analytical Biochemistry, Vol. 373:52-60, 2008. In some embodiments, the bispecific antigen binding proteins described herein exhibit desirable characteristics such as binding avidity as measured by k_d (dissociation rate constant) for human CGRP receptor or human PAC1 receptor of about 10^{-2} , 10^{-3} , 10^{-4} , 10^{-5} , 10^{-6} , 10^{-7} , 10^{-8} , 10^{-9} , 10^{-10} s $^{-1}$ or lower (lower values indicating higher binding avidity), and/or binding affinity as measured by K_D (equilibrium dissociation constant) for human CGRP receptor or human PAC1 of about 10^{-9} , 10^{-10} , 10^{-11} , 10^{-12} , 10^{-13} , 10^{-14} , 10^{-15} , 10^{-16} M or lower (lower values indicating higher binding affinity).

[0033] In some embodiments of the invention, the antigen binding proteins are multivalent. The valency of the binding protein denotes the number of individual antigen binding domains within the binding protein. For example, the terms “monovalent,” “bivalent,” and “tetravalent” with reference to the antigen binding proteins of the invention refer to binding proteins with one, two, and four antigen binding domains, respectively. Thus, a multivalent antigen binding protein comprises two or more antigen binding domains. In some embodiments, the bispecific antigen binding proteins of the invention are bivalent. Thus, such bispecific, bivalent antigen binding proteins contain two antigen binding domains: one antigen-binding domain binding to human CGRP receptor and one antigen-binding domain binding to human PAC1 receptor. In other embodiments, the bispecific antigen binding proteins are multivalent. For instance, in certain embodiments, the bispecific antigen binding proteins are tetravalent comprising four antigen-binding domains: two antigen-binding domains binding to human CGRP receptor and two antigen-binding domains binding to human PAC1 receptor.

[0034] As used herein, the term “antigen binding domain,” which is used interchangeably with “binding domain,” refers to the region of the antigen binding protein that contains the amino acid residues that interact with the antigen and confer on the antigen binding protein its specificity and affinity for the antigen. In some embodiments, the binding domain may be derived from the natural ligands of the human CGRP receptor and the human PAC1 receptor. For example, the binding domain that specifically binds to human CGRP receptor may be derived from human α -

CGRP and comprise peptide antagonists, such as the CGRP8-37 antagonist peptide and variants thereof described in Chiba *et al.*, Am. J. Physiol., Vol. 256: E331-E335, 1989 and Taylor *et al.*, J. Pharmacol. Exp. Ther., Vol. 319: 749-757, 2006. Similarly, the binding domain that specifically binds to human PAC1 receptor may be derived from PACAP38 or PACAP27 and may comprise peptide antagonists such as those described in Bourgault *et al.*, J. Med. Chem., Vol. 52: 3308-3316, 2009 and U.S. Patent No. 6,017,533.

[0035] In certain embodiments of the bispecific antigen binding proteins of the invention, the binding domain may be derived from an antibody or functional fragment thereof. For instance, the binding domains of the bispecific antigen binding proteins of the invention may comprise one or more complementarity determining regions (CDR) from the light and heavy chain variable regions of antibodies that specifically bind to human CGRP receptor or human PAC1 receptor. As used herein, the term “CDR” refers to the complementarity determining region (also termed “minimal recognition units” or “hypervariable region”) within antibody variable sequences. There are three heavy chain variable region CDRs (CDRH1, CDRH2 and CDRH3) and three light chain variable region CDRs (CDRL1, CDRL2 and CDRL3). The term “CDR region” as used herein refers to a group of three CDRs that occur in a single variable region (i.e. the three light chain CDRs or the three heavy chain CDRs). The CDRs in each of the two chains typically are aligned by the framework regions to form a structure that binds specifically with a specific epitope or domain on the target protein (*e.g.*, human CGRP receptor or human PAC1 receptor). From N-terminus to C-terminus, naturally-occurring light and heavy chain variable regions both typically conform with the following order of these elements: FR1, CDR1, FR2, CDR2, FR3, CDR3 and FR4. A numbering system has been devised for assigning numbers to amino acids that occupy positions in each of these domains. This numbering system is defined in Kabat Sequences of Proteins of Immunological Interest (1987 and 1991, NIH, Bethesda, MD), or Chothia & Lesk, 1987, *J. Mol. Biol.* 196:901-917; Chothia *et al.*, 1989, *Nature* 342:878-883. Complementarity determining regions (CDRs) and framework regions (FR) of a given antibody may be identified using this system. In some embodiments, the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention comprise all six CDRs of the heavy and light chain variable regions of an anti-CGRP receptor antibody and the anti-PAC1 receptor binding domain of the bispecific antigen binding proteins of the invention comprise all six CDRs of the heavy and light chain variable regions of an anti-PAC1 receptor antibody.

[0036] In some embodiments of the bispecific antigen binding proteins of the invention, the binding domains (the anti-CGRP receptor binding domain, the anti-PAC1 receptor binding domain or both) comprise a Fab, a Fab', a F(ab')₂, a Fv, a single-chain variable fragment (scFv), or a nanobody. In one embodiment, both binding domains are Fab fragments. In another embodiment, one binding domain is a Fab fragment and the other binding domain is a scFv.

[0037] Papain digestion of antibodies produces two identical antigen-binding fragments, called “Fab” fragments, each with a single antigen-binding site, and a residual “Fc” fragment which contains the immunoglobulin constant region. The Fab fragment contains all of the variable domain, as well as the constant domain of the light chain and the first constant domain (CH1) of the heavy chain. Thus, a “Fab fragment” is comprised of one immunoglobulin light chain (light chain variable region (VL) and constant region (CL)) and the CH1 region and variable region (VH) of one immunoglobulin heavy chain. The heavy chain of a Fab molecule cannot form a disulfide bond with another heavy chain molecule. The Fc fragment displays carbohydrates and is responsible for many antibody effector functions (such as binding complement and cell receptors), that distinguish one class of antibody from another. The “Fd fragment” comprises the VH and CH1 domains from an immunoglobulin heavy chain. The Fd fragment represents the heavy chain component of the Fab fragment.

[0038] A “Fab' fragment” is a Fab fragment having at the C-terminus of the CH1 domain one or more cysteine residues from the antibody hinge region.

[0039] A “F(ab')₂ fragment” is a bivalent fragment including two Fab' fragments linked by a disulfide bridge between the heavy chains at the hinge region.

[0040] The “Fv” fragment is the minimum fragment that contains a complete antigen recognition and binding site from an antibody. This fragment consists of a dimer of one immunoglobulin heavy chain variable region (VH) and one immunoglobulin light chain variable region (VL) in tight, non-covalent association. It is in this configuration that the three CDRs of each variable region interact to define an antigen binding site on the surface of the VH-VL dimer. A single light chain or heavy chain variable region (or half of an Fv fragment comprising only three CDRs specific for an antigen) has the ability to recognize and bind antigen, although at a lower affinity than the entire binding site comprising both VH and VL.

[0041] A “single-chain variable antibody fragment” or “scFv fragment” comprises the VH and VL regions of an antibody, wherein these regions are present in a single polypeptide chain, and

optionally comprising a peptide linker between the VH and VL regions that enables the Fv to form the desired structure for antigen binding (*see e.g.*, Bird *et al.*, Science, Vol. 242:423-426, 1988; and Huston *et al.*, Proc. Natl. Acad. Sci. USA, Vol. 85:5879-5883, 1988).

[0042] A “nanobody” is the heavy chain variable region of a heavy-chain antibody. Such variable domains are the smallest fully functional antigen-binding fragment of such heavy-chain antibodies with a molecular mass of only 15 kDa. *See* Cortez-Retamozo *et al.*, *Cancer Research* 64:2853-57, 2004. Functional heavy-chain antibodies devoid of light chains are naturally occurring in certain species of animals, such as nurse sharks, wobbegong sharks and *Camelidae*, such as camels, dromedaries, alpacas and llamas. The antigen-binding site is reduced to a single domain, the VHH domain, in these animals. These antibodies form antigen-binding regions using only heavy chain variable region, i.e., these functional antibodies are homodimers of heavy chains only having the structure H₂L₂ (referred to as “heavy-chain antibodies” or “HCAbs”). Camelized VHH reportedly recombines with IgG2 and IgG3 constant regions that contain hinge, CH2, and CH3 domains and lack a CH1 domain. Camelized VHH domains have been found to bind to antigen with high affinity (Desmyter *et al.*, J. Biol. Chem., Vol. 276:26285-90, 2001) and possess high stability in solution (Ewert *et al.*, Biochemistry, Vol. 41:3628-36, 2002). Methods for generating antibodies having camelized heavy chains are described in, for example, U.S. Patent Publication Nos. 2005/0136049 and 2005/0037421. Alternative scaffolds can be made from human variable-like domains that more closely match the shark V-NAR scaffold and may provide a framework for a long penetrating loop structure.

[0043] In particular embodiments of the bispecific antigen binding proteins of the invention, the binding domains comprise an immunoglobulin heavy chain variable region (VH) and an immunoglobulin light chain variable region (VL) of an antibody or antibody fragment which specifically binds to the desired antigen. For instance, the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention comprises a VH region and VL region from an anti-CGRP receptor antibody and the anti-PAC1 receptor binding domain comprises a VH region and VL region from an anti-PAC1 receptor antibody.

[0044] The “variable region,” used interchangeably herein with “variable domain” (variable region of a light chain (VL), variable region of a heavy chain (VH)) refers to the region in each of the light and heavy immunoglobulin chains which is involved directly in binding the antibody to the antigen. As discussed above, the regions of variable light and heavy chains have the same

general structure and each region comprises four framework (FR) regions whose sequences are widely conserved, connected by three CDRs. The framework regions adopt a beta-sheet conformation and the CDRs may form loops connecting the beta-sheet structure. The CDRs in each chain are held in their three-dimensional structure by the framework regions and form, together with the CDRs from the other chain, the antigen binding site.

[0045] The binding domains that specifically bind to human CGRP receptor or human PAC1 receptor can be derived a) from known antibodies to these antigens or b) from new antibodies or antibody fragments obtained by *de novo* immunization methods using the antigen proteins or fragments thereof, by phage display, or other routine methods. The antibodies from which the binding domains for the bispecific antigen binding proteins are derived can be monoclonal antibodies, polyclonal antibodies, recombinant antibodies, human antibodies, or humanized antibodies. In certain embodiments, the antibodies from which the binding domains are derived are monoclonal antibodies. In these and other embodiments, the antibodies are human antibodies or humanized antibodies and can be of the IgG1-, IgG2-, IgG3-, or IgG4-type.

[0046] The term “monoclonal antibody” (or “mAb”) as used herein refers to an antibody obtained from a population of substantially homogeneous antibodies, i.e., the individual antibodies comprising the population are identical except for possible naturally occurring mutations that may be present in minor amounts. Monoclonal antibodies are highly specific, being directed against an individual antigenic site or epitope, in contrast to polyclonal antibody preparations that typically include different antibodies directed against different epitopes. Monoclonal antibodies may be produced using any technique known in the art, e.g., by immortalizing spleen cells harvested from the transgenic animal after completion of the immunization schedule. The spleen cells can be immortalized using any technique known in the art, e.g., by fusing them with myeloma cells to produce hybridomas. Myeloma cells for use in hybridoma-producing fusion procedures preferably are non-antibody-producing, have high fusion efficiency, and enzyme deficiencies that render them incapable of growing in certain selective media which support the growth of only the desired fused cells (hybridomas). Examples of suitable cell lines for use in mouse fusions include Sp-20, P3-X63/Ag8, P3-X63-Ag8.653, NS1/1.Ag 4 1, Sp210-Ag14, FO, NSO/U, MPC-11, MPC11-X45-GTG 1.7 and S194/5XXO Bul; examples of cell lines used in rat fusions include R210.RCY3, Y3-Ag 1.2.3,

IR983F and 4B210. Other cell lines useful for cell fusions are U-266, GM1500-GRG2, LICR-LON-HMy2 and UC729-6.

[0047] In some instances, a hybridoma cell line is produced by immunizing an animal (e.g., a transgenic animal having human immunoglobulin sequences) with a CGRP receptor or PAC1 receptor immunogen; harvesting spleen cells from the immunized animal; fusing the harvested spleen cells to a myeloma cell line, thereby generating hybridoma cells; establishing hybridoma cell lines from the hybridoma cells, and identifying a hybridoma cell line that produces an antibody that binds CGRP receptor or PAC1 receptor.

[0048] Monoclonal antibodies secreted by a hybridoma cell line can be purified using any technique known in the art, such as protein A-Sepharose, hydroxylapatite chromatography, gel electrophoresis, dialysis, or affinity chromatography. Hybridomas or mAbs may be further screened to identify mAbs with particular properties, such as the ability to bind cells expressing CGRP receptor or PAC1 receptor, ability to block or interfere with the binding of the CGRP ligand or PACAP ligand to their respective receptors, or the ability to functionally block either of the receptors, e.g., using a cAMP assay, e.g., as described herein.

[0049] In some embodiments, the anti-PAC1 receptor and anti-CGRP receptor binding domains of the bispecific antigen binding proteins of the invention may be derived from humanized antibodies against the PAC1 receptor and CGRP receptor, respectively. A “humanized antibody” refers to an antibody in which regions (e.g. framework regions) have been modified to comprise corresponding regions from a human immunoglobulin. Generally, a humanized antibody can be produced from a monoclonal antibody raised initially in a non-human animal. Certain amino acid residues in this monoclonal antibody, typically from non-antigen recognizing portions of the antibody, are modified to be homologous to corresponding residues in a human antibody of corresponding isotype. Humanization can be performed, for example, using various methods by substituting at least a portion of a rodent variable region for the corresponding regions of a human antibody (see, e.g., United States Patent Nos. 5,585,089 and 5,693,762; Jones *et al.*, Nature, Vol. 321:522-525, 1986; Riechmann *et al.*, Nature, Vol. 332:323-27, 1988; Verhoeven *et al.*, Science, Vol. 239:1534-1536, 1988). The CDRs of light and heavy chain variable regions of antibodies generated in another species can be grafted to consensus human FRs. To create consensus human FRs, FRs from several human heavy chain or light chain amino acid sequences may be aligned to identify a consensus amino acid sequence.

[0050] New antibodies generated against the human CGRP receptor or the human PAC1 receptor from which binding domains for the bispecific antigen binding proteins of the invention can be derived can be fully human antibodies. A “fully human antibody” is an antibody that comprises variable and constant regions derived from or indicative of human germ line immunoglobulin sequences. One specific means provided for implementing the production of fully human antibodies is the “humanization” of the mouse humoral immune system.

Introduction of human immunoglobulin (Ig) loci into mice in which the endogenous Ig genes have been inactivated is one means of producing fully human monoclonal antibodies (mAbs) in mouse, an animal that can be immunized with any desirable antigen. Using fully human antibodies can minimize the immunogenic and allergic responses that can sometimes be caused by administering mouse or mouse-derived mAbs to humans as therapeutic agents.

[0051] Fully human antibodies can be produced by immunizing transgenic animals (usually mice) that are capable of producing a repertoire of human antibodies in the absence of endogenous immunoglobulin production. Antigens for this purpose typically have six or more contiguous amino acids, and optionally are conjugated to a carrier, such as a hapten. *See, e.g.,* Jakobovits *et al.*, 1993, *Proc. Natl. Acad. Sci. USA* 90:2551-2555; Jakobovits *et al.*, 1993, *Nature* 362:255-258; and Bruggermann *et al.*, 1993, *Year in Immunol.* 7:33. In one example of such a method, transgenic animals are produced by incapacitating the endogenous mouse immunoglobulin loci encoding the mouse heavy and light immunoglobulin chains therein, and inserting into the mouse genome large fragments of human genome DNA containing loci that encode human heavy and light chain proteins. Partially modified animals, which have less than the full complement of human immunoglobulin loci, are then cross-bred to obtain an animal having all of the desired immune system modifications. When administered an immunogen, these transgenic animals produce antibodies that are immunospecific for the immunogen but have human rather than murine amino acid sequences, including the variable regions. For further details of such methods, *see*, for example, WO96/33735 and WO94/02602. Additional methods relating to transgenic mice for making human antibodies are described in United States Patent No. 5,545,807; No. 6,713,610; No. 6,673,986; No. 6,162,963; No. 5,939,598; No. 5,545,807; No. 6,300,129; No. 6,255,458; No. 5,877,397; No. 5,874,299 and No. 5,545,806; in PCT publications WO91/10741, WO90/04036, WO 94/02602, WO 96/30498, WO 98/24893 and in EP 546073B1 and EP 546073A1.

[0052] The transgenic mice described above, referred to herein as “HuMab” mice, contain a human immunoglobulin gene minilocus that encodes unrearranged human heavy (mu and gamma) and kappa light chain immunoglobulin sequences, together with targeted mutations that inactivate the endogenous mu and kappa chain loci (Lonberg *et al.*, 1994, *Nature* 368:856-859). Accordingly, the mice exhibit reduced expression of mouse IgM or kappa and in response to immunization, and the introduced human heavy and light chain transgenes undergo class switching and somatic mutation to generate high affinity human IgG kappa monoclonal antibodies (Lonberg *et al.*, *supra.*; Lonberg and Huszar, 1995, *Intern. Rev. Immunol.* 13: 65-93; Harding and Lonberg, 1995, *Ann. N.Y. Acad. Sci.* 764:536-546). The preparation of HuMab mice is described in detail in Taylor *et al.*, 1992, *Nucleic Acids Research* 20:6287-6295; Chen *et al.*, 1993, *International Immunology* 5:647-656; Tuailon *et al.*, 1994, *J. Immunol.* 152:2912-2920; Lonberg *et al.*, 1994, *Nature* 368:856-859; Lonberg, 1994, *Handbook of Exp. Pharmacology* 113:49-101; Taylor *et al.*, 1994, *International Immunology* 6:579-591; Lonberg and Huszar, 1995, *Intern. Rev. Immunol.* 13:65-93; Harding and Lonberg, 1995, *Ann. N.Y. Acad. Sci.* 764:536-546; Fishwild *et al.*, 1996, *Nature Biotechnology* 14:845-851; the foregoing references are hereby incorporated by reference in their entirety for all purposes. *See*, further United States Patent No. 5,545,806; No. 5,569,825; No. 5,625,126; No. 5,633,425; No. 5,789,650; No. 5,877,397; No. 5,661,016; No. 5,814,318; No. 5,874,299; and No. 5,770,429; as well as United States Patent No. 5,545,807; International Publication Nos. WO 93/1227; WO 92/22646; and WO 92/03918, the disclosures of all of which are hereby incorporated by reference in their entirety for all purposes. Technologies utilized for producing human antibodies in these transgenic mice are disclosed also in WO 98/24893, and Mendez *et al.*, 1997, *Nature Genetics* 15:146-156, which are hereby incorporated by reference. For example, the HCo7 and HCo12 transgenic mice strains can be used to generate additional fully human anti-CGRP receptor and anti-PAC1 receptor antibodies.

[0053] Human-derived antibodies can also be generated using phage display techniques. Phage display is described in e.g., Dower *et al.*, WO 91/17271, McCafferty *et al.*, WO 92/01047, and Caton and Koprowski, *Proc. Natl. Acad. Sci. USA*, 87:6450-6454 (1990), each of which is incorporated herein by reference in its entirety. The antibodies produced by phage technology are usually produced as antigen binding fragments, e.g. Fv or Fab fragments, in bacteria and thus lack effector functions. Effector functions can be introduced by one of two strategies: The

fragments can be engineered either into complete antibodies for expression in mammalian cells, or into bispecific antibody fragments with a second binding site capable of triggering an effector function, if desired. Typically, the Fd fragment (VH-CH1) and light chain (VL-CL) of antibodies are separately cloned by PCR and recombined randomly in combinatorial phage display libraries, which can then be selected for binding to a particular antigen. The antibody fragments are expressed on the phage surface, and selection of Fv or Fab (and therefore the phage containing the DNA encoding the antibody fragment) by antigen binding is accomplished through several rounds of antigen binding and re-amplification, a procedure termed panning. Antibody fragments specific for the antigen are enriched and finally isolated. Phage display techniques can also be used in an approach for the humanization of rodent monoclonal antibodies, called “guided selection” (*see* Jespers, L. S., et al., *Bio/Technology* 12, 899-903 (1994)). For this, the Fd fragment of the mouse monoclonal antibody can be displayed in combination with a human light chain library, and the resulting hybrid Fab library may then be selected with antigen. The mouse Fd fragment thereby provides a template to guide the selection. Subsequently, the selected human light chains are combined with a human Fd fragment library. Selection of the resulting library yields entirely human Fab.

[0054] The bispecific antigen binding proteins of the invention comprise a binding domain that specifically binds to the human PAC1 receptor. The human PAC1 receptor (also referred to herein as “human PAC1,” “hPAC1,” and “hPAC1 receptor”) is a 468 amino acid protein designated as P41586 (PACR_HUMAN) in the UniProtKB/Swiss-Prot database and is encoded by the *ADCYAP1R1* gene. PACAP-27 and PACAP-38 are the principal endogenous agonists of PAC1. The amino acid sequence of the human PAC1 receptor is set forth below:

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MAGVVHVSLA ALLLLPMAPA MHSDCIFKKE QAMCLEKIQR ANELMGFNDS
SPGCPGMWDN ITCWKPAHVG EMVLVSCPEL FRIFNPDQVW ETETIGESDF
GDSNSLDLSD MGVVSRNCTE DGWSEPFPHY FDACGFDEYE SETGDQDYYY
LSVKALYTVG YSTSLVTLTT AMVILCRFRK LHCTRNFHIM NLFVSFMLRA
ISVFIKDWIL YAEQDSNHCF ISTVECKAVM VFFHYCVVSN YFWLFIEGLY
LFTLLVETFF PERRYFYWYT IIGWGTPTVC VTVWATLRLY FDDTGCWDMN
DSTALWWVIK GPVVGSIMVN FVLFIGIIVI LVQKLQSPDM GGNESSIYLR
LARSTLLLIP LFGIHYTVFA FSPENVSKRE RLVFELGLGS FQGFVVAVLY
CFLNGEVQAE IKRKWRSWKV NRYFAVDFKH RHPSLASSGV NGGTQLSILS
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KSSSQIRMSG LPADNLAT (SEQ ID NO: 339)

[0055] In certain embodiments, the anti-PAC1 binding domain of the bispecific antigen binding proteins of the invention comprises the VH region and/or the VL region or CDR regions from an anti-PAC1 receptor antibody or functional fragment thereof. Preferably, the anti-PAC1 receptor antibody or functional fragment thereof specifically binds to human PAC1 receptor and prevents or reduces binding of the receptor to PACAP-38 and/or PACAP-27. In some embodiments, the anti-PAC1 receptor antibody or functional fragment thereof specifically binds to an extracellular region of the human PAC1 receptor. In one particular embodiment, the anti-PAC1 receptor antibody or functional fragment thereof specifically binds to the amino-terminal extracellular domain of the PAC1 receptor (i.e. amino acids 21-155 of SEQ ID NO: 339).

[0056] In some embodiments, the anti-PAC1 antibody or functional fragment thereof from which the anti-PAC1 binding domain of the bispecific antigen binding proteins of the invention is derived selectively inhibits the human PAC1 receptor relative to the human VPAC1 and human VPAC2 receptors. An antibody or functional fragment thereof “selectively inhibits” a specific receptor relative to other receptors when the IC₅₀ of the antibody in an inhibition assay of the specific receptor is at least 50-fold lower than the IC₅₀ in an inhibition assay of another “reference” receptor, e.g., a hVPAC1 or hVPAC2 receptor. An “IC₅₀” is the dose/concentration required to achieve 50% inhibition of a biological or biochemical function. With radioactive ligands, IC₅₀ is the concentration of a competing ligand that displaces 50% of the specific binding of the radioligand. The IC₅₀ of any particular substance or antagonist can be determined by constructing a dose-response curve and examining the effect of different concentrations of the drug or antagonist on reversing agonist activity in a particular functional assay. IC₅₀ values can be calculated for a given antagonist or drug by determining the concentration needed to inhibit half of the maximum biological response of the agonist. Thus, the IC₅₀ value for any anti-PAC1 antibody or functional fragment thereof can be calculated by determining the concentration of the antibody or fragment needed to inhibit half of the maximum biological response of the PACAP ligand (PACAP-27 or PACAP-38) in activating the human PAC1 receptor in any functional assay, such as the cAMP assay described in the Examples. An antibody or functional fragment thereof that selectively inhibits a specific receptor is understood to be a neutralizing antibody or neutralizing fragment with respect to that receptor. Thus, in some embodiments, the anti-PAC1 receptor antibody or functional fragment thereof from which the anti-PAC1 binding

domain of the bispecific antigen binding proteins of the invention is derived is a neutralizing antibody or fragment of the human PAC1 receptor.

[0057] The variable regions or CDR regions of any anti-PAC1 receptor antibody or functional fragment thereof can be used to construct the anti-PAC1 binding domain of any of the bispecific antigen binding proteins described herein. For instance, the anti-PAC1 binding domain of the bispecific antigen binding proteins of the invention may comprise VH and/or VL regions or one or more CDRs from any of the anti-human PAC1 receptor antibodies described in WO 2014/144632, which is hereby incorporated by reference in its entirety. In certain embodiments, the anti-PAC1 antibody from which the anti-PAC1 binding domain is derived competes for binding of the human PAC1 receptor with one or more of the human anti-PAC1 antibodies described in WO 2014/144632 or one or more of the anti-PAC1 antibodies described below. The term “compete” refers to the ability of an antibody or other antigen binding protein to interfere with the binding of other antibodies or binding fragments to a target (e.g. the human PAC1 receptor or the human CGRP receptor). The extent to which an antibody or binding fragment is able to interfere with the binding of another antibody or binding fragment to a target (e.g. the human PAC1 receptor or the human CGRP receptor), and therefore whether it can be said to compete, can be determined using competition binding assays. Numerous types of competitive binding assays can be used, including for example: solid phase direct or indirect radioimmunoassay (RIA), solid phase direct or indirect enzyme immunoassay (EIA), sandwich competition assay (*see, e.g.,* Stahli *et al.*, 1983, *Methods in Enzymology* 9:242-253); solid phase direct biotin-avidin EIA (*see, e.g.,* Kirkland *et al.*, 1986, *J. Immunol.* 137:3614-3619); solid phase direct-labeled assay, solid phase direct-labeled sandwich assay (*see, e.g.,* Harlow and Lane, 1988, *Antibodies, A Laboratory Manual*, Cold Spring Harbor Press); solid phase direct label RIA using I-125 label (*see, e.g.,* Morel *et al.*, 1988, *Molec. Immunol.* 25:7-15); solid phase direct biotin-avidin EIA (*see, e.g.,* Cheung, *et al.*, 1990, *Virology* 176:546-552); and direct labeled RIA (Moldenhauer *et al.*, 1990, *Scand. J. Immunol.* 32:77-82). Typically, a competitive binding assay involves the use of purified antigen bound to a solid surface or cells bearing the antigen, an unlabeled test antibody or other antigen binding protein, and a labeled reference antibody or other antigen binding protein. Competitive inhibition is measured by determining the amount of label bound to the solid surface or cells in the presence of the test antibody or other antigen binding protein. Usually the test antibody or other antigen binding protein is

present in excess. Antibodies or other antigen binding proteins identified by competition assay (i.e. competing antibodies and antigen binding proteins) include antibodies and antigen binding proteins binding to the same epitope as the reference antibody or antigen binding protein.

Usually, when a competing antibody or other antigen binding protein is present in excess, it will inhibit specific binding of a reference antibody or other antigen binding protein to a target antigen by at least 40%, 45%, 50%, 55%, 60%, 65%, 70% or 75%. In some instances, binding of the reference antibody or other antigen binding protein is inhibited by at least 80%, 85%, 90%, 95%, or 97% or more. In some embodiments, a competing antibody or binding fragment thereof reduces human PAC1 receptor binding of a reference antibody between about 40% and 100%, such as about 60% and about 100%, specifically between about 70% and 100%, and more specifically between about 80% and 100%.

[0058] A particularly suitable quantitative assay for detecting competitive binding uses a Biacore machine which measures the extent of interactions using surface plasmon resonance technology. An exemplary Biacore-based competitive binding assay involves the immobilization of a reference antibody to a sensor chip. The target antigen is then contacted with the sensor chip where the target antigen is captured by the immobilized reference antibody. Test antibodies are then injected over the captured target antigen. If the injected test antibody recognizes a distinct epitope from that recognized by the immobilized antibody, then a second binding event is observed and the test antibody would be considered not to compete for binding to the target antigen with the reference antibody. Another suitable quantitative competition binding assay uses a FACS-based approach to measure competition between antibodies in terms of their binding to the human PAC1 receptor.

[0059] Light chain and heavy chain variable regions and associated CDRs of exemplary human anti-PAC1 receptor antibodies from which the anti-PAC1 binding domain of the bispecific antigen binding proteins of the invention can be derived or constructed are set forth below in Tables 1A and 1B, respectively.

Table 1A. Exemplary Anti-PAC1 Receptor Light Chain Variable Region Amino Acid Sequences

Antibody ID.	VL Group	VL Amino Acid Sequence	CDRL1	CDRL2	CDRL3
01A, 01C, 01D	LV-01	DIQMTQSPSSLSASVGDRITITCRA SQSISRYLNWYQQKPGKAPKLLIY AASSLQSGIPSRFSGSGSGTDFTLT INSLQPEDFATYFCQQSYSPPTFG PGTKVDIKR (SEQ ID NO: 28)	RASQISRYLN (SEQ ID NO: 1)	AASSLQS (SEQ ID NO: 14)	QQSYSPPT (SEQ ID NO: 20)
01B	LV-02	DIQMTQSPSSLSASVGDRITITCRA SQSISRYLNWYQQKPGKAPKLLIY AASSLQSGIPSRFSGSGSGTDFTLT INSLQPEDFATYFCQQSYSPPTFG EGTKVDIKR (SEQ ID NO: 29)	RASQISRYLN (SEQ ID NO: 1)	AASSLQS (SEQ ID NO: 14)	QQSYSPPT (SEQ ID NO: 20)
02A, 02C	LV-03	DIQMTQSPSSLSASVGDRITITCRA SQSISRYLNWYQQKPGKAPKLLIY AASSLQSGIPSRFSGSGSGTDFTLT INSLQPEDFATYFCQQSYSPPTFG QGTKVDIKR (SEQ ID NO: 30)	RASQISRYLN (SEQ ID NO: 1)	AASSLQS (SEQ ID NO: 14)	QQSYSPPT (SEQ ID NO: 20)
03A, 03C, 03D	LV-04	DIQLTQSPSFLSASVGDRVITITCRA SQSIGRSLHWYQQKPGKAPKLLIK YASQSLSGVPSRFSGSGSGTEFTL TISSLQPEDFATYYCHQSSRLPFTF GPGTKVDIKR (SEQ ID NO: 31)	RASQSIGRSLH (SEQ ID NO: 2)	YASQSL (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
03B	LV-05	DIQLTQSPSFLSASVGDRVITITCRA SQSIGRSLHWYQQKPGKAPKLLIK YASQSLSGVPSRFSGSGSGTEFTL TISSLQPEDFATYYCHQSSRLPFTF GEGTKVDIKR (SEQ ID NO: 32)	RASQSIGRSLH (SEQ ID NO: 2)	YASQSL (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
04A, 04C, 04D	LV-06	EIVLTQSPATLSLSPGERATLSCRA SQSVGRSLHWYQQKPGQAPRLLI KYASQSLSGIPARFSGSGSGTDFT LTISLQPEDFAVYYCHQSSRLPFT FGPGTKVDIKR (SEQ ID NO: 33)	RASQSVGRSLH (SEQ ID NO: 3)	YASQSL (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
04B	LV-07	EIVLTQSPATLSLSPGERATLSCRA SQSVGRSLHWYQQKPGQAPRLLI KYASQSLSGIPARFSGSGSGTDFT LTISLQPEDFAVYYCHQSSRLPFT FEGTKVDIKR (SEQ ID NO: 34)	RASQSVGRSLH (SEQ ID NO: 3)	YASQSL (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
05A, 05C, 05D	LV-08	DIVMTQSPDSLAVSLGERATIHCK SSQSVLYSSNNKNFLTQYQQKPG QPPKLLIYRASTRESGVPDRFSGS GSGTDFTLTISLQAEDVAVYFCQ QYYSAFTFGPGTRVDIKR (SEQ ID NO: 35)	KSSQSVLYSSN NKNFLT (SEQ ID NO: 4)	RASTRES (SEQ ID NO: 16)	QYYSAFT T (SEQ ID NO: 22)
05B	LV-09	DIVMTQSPDSLAVSLGERATIHCK SSQSVLYSSNNKNFLTQYQQKPG QPPKLLIYRASTRESGVPDRFSGS GSGTDFTLTISLQAEDVAVYFCQ QYYSAFTFGPGTRVDIKR (SEQ ID NO: 36)	KSSQSVLYSSN NKNFLT (SEQ ID NO: 4)	RASTRES (SEQ ID NO: 16)	QYYSAFT T (SEQ ID NO: 22)
06A, 06C	LV-10	DIVMTQSPDSLAVSLGERATINCK SSQSVLYSSNNKNFLTQYQQKPG QPPKLLIYRASTRESGVPDRFSGS	KSSQSVLYSSN NKNFLT	RASTRES (SEQ ID NO: 16)	QYYSAFT T

Antibody ID.	VL Group	VL Amino Acid Sequence	CDRL1	CDRL2	CDRL3
		GSGTDFTLTISSLQAEDVAVYFCQ QYYSAFPTFGPGTRVDIKR (SEQ ID NO: 37)	(SEQ ID NO: 4)	16)	(SEQ ID NO: 22)
06B	LV-11	DIVMTQSPDSLAVSLGERATINCK SSQSVLYSSNNKNFLTQYQQKPG QPPKLLIYRASTRESGVPDRFSGS GSGTDFTLTISSLQAEDVAVYFCQ QYYSAFPTFGEGTRVDIKR (SEQ ID NO: 38)	KSSQSVLYSSN NKNFLT (SEQ ID NO: 4)	RASTRES (SEQ ID NO: 16)	QYYSAFPT T (SEQ ID NO: 22)
07	LV-12	EIVLTQSPDFQSVTPKEKVTITCRA SQSIGSSLHWYQQKPDQSPKLLIK YASQSLSGIPSRFSGSGSGTFTLT INSLEAEDAATYYCHQSSRLPFTF GPGTKVDIKR (SEQ ID NO: 39)	RASQSIGSSLH (SEQ ID NO: 5)	YASQSLS (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
08, 09, 10	LV-13	EIVLTQSPDFQSVTPKEKVTITCRA SQSVGRSLHWYHQKPDQSPKLLI KYASQSLSGVPSRFSGSGSGTDFT LIINSLEAEDAATYYCHQSSRLPFT FGPGTKVDIKR (SEQ ID NO: 40)	RASQSVGRSLH (SEQ ID NO: 3)	YASQSLS (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
11	LV-14	DIQLTQSPSFLSASVGDRVITITCRA SQSIGRSLHWYHQKPGKAPKLLIK YASQSLSGVPSRFSGSGSGTEFTLI ISSLQPEDFATYYCHQSSRLPFTFG PGTKVDIKR (SEQ ID NO: 41)	RASQSIGRSLH (SEQ ID NO: 2)	YASQSLS (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
12, 13, 14	LV-15	EIVLTQSPDFQSVTPKEKVTITCRA SQSVGRSLHWYQQKPDQSPKLLI KYASQSLSGVPSRFSGSGSGTDFT LTINSLEAEDAATYYCHQSSRLPF TFGPGTKVDIKR (SEQ ID NO: 42)	RASQSVGRSLH (SEQ ID NO: 3)	YASQSLS (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
15, 16, 17, 18	LV-16	EIVLTQSPGTLSPGERATLSCRA SQSVGRSLHWYQQKPGQAPRLLI KYASQSLSGIPDRFSGSGSGTDFT LTISRLEPEDFATYYCHQSSRLPFT FGQGTKVEIKR (SEQ ID NO: 43)	RASQSVGRSLH (SEQ ID NO: 3)	YASQSLS (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
19	LV-17	EIVLTQSPDFQSVTPKEKVTITCRA SQSIGRSLHWYQQKPDQSPKLLF KYASQSLSGVPSRFSGSGSGTDFT LTINSLEAEDAATYYCHQSSRLPF TFGPGTKVDIKR (SEQ ID NO: 44)	RASQSIGRSLH (SEQ ID NO: 2)	YASQSLS (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
20	LV-18	DIQLTQSPSFLSASVGDRVITITCRA SQSIGRSLHWYQQKPGKAPKLLF KYASQSLSGVPSRFSGSGSGTEFT LTISLQPEDFATYYCHQSSRLPFT FGPGTKVDIKR (SEQ ID NO: 45)	RASQSIGRSLH (SEQ ID NO: 2)	YASQSLS (SEQ ID NO: 15)	HQSSRLPFT (SEQ ID NO: 21)
21	LV-19	EIVLTQSPGTLSPGERATLSCRA SQSVSSSYLAQYQQKPGQAPRL	RASQSVSSSYL A	GASSRAT	QRYGSSRT

Antibody ID.	VL Group	VL Amino Acid Sequence	CDRL1	CDRL2	CDRL3
		IYGASSRATGIPDRFSNSGSGTDFTLTISRLEPEDFAVYYCQRYGSSRTFGQGTKVEIKR (SEQ ID NO: 46)	(SEQ ID NO: 6)	(SEQ ID NO: 17)	(SEQ ID NO: 23)
22	LV-20	DIVMTQSPLSLPVTGPGEPAISCRSSQSLHNSNGYNYLDWYLQKPGQSPQLLLYLGSNRASGVPDRFSGSGSGTDFTLQISRVEAEDVGYYCMQTLQTPFTFGPGTKVDIKR (SEQ ID NO: 47)	RSSQSLLHSNGYNYLD (SEQ ID NO: 7)	LGSNRAS (SEQ ID NO: 18)	MQTLQTPFT (SEQ ID NO: 24)
23	LV-21	DIVMTQSPLSLPVTGPGEPAISCRSSQSLHNSNGYNYLDWYLQKPGQSPQLLLYLGSNRASGVPDRFSGSGSGTDFTLQISRVEAEDVGYYCMQTLQTPFTFGPGTKVDIKR (SEQ ID NO: 48)	RSSQSLLHSNGYNYLD (SEQ ID NO: 7)	LGSNRAS (SEQ ID NO: 18)	MQTLQTPFT (SEQ ID NO: 24)
24	LV-22	EIVLTQSPGTLSPGERATLSCRASTVSRSYLAWYQQKPGQAPRLLIYGASSRATGIPDRFSGSGSGTDFTLTISRLEPEDFAVFYCCQFGSSPWTFGQGTKVEIKR (SEQ ID NO: 49)	RASQTVSRSYLA (SEQ ID NO: 8)	GASSRAT (SEQ ID NO: 17)	QQFGSSPWT (SEQ ID NO: 25)
25	LV-23	DIVMTQSPDSLAVSLGERATIHCKSSQNVLYSSNNKNFLTQYQQKPGQPPKLLIYRASTRESGVPDRFSGSGSGTDFTLTISLQAEDVAVYFCQQYYSAFPFTFGPGTKVDIKR (SEQ ID NO: 50)	KSSQNVLYSSNNKNFLT (SEQ ID NO: 9)	RASTRES (SEQ ID NO: 16)	QQYYSAFPFT (SEQ ID NO: 22)
26	LV-24	DIVMTQSPDSLAVSLGERTTIKCKSSQSVLYRSNNNNFLAWYQQKPGQPPKLLIYWASTRESGVPDRFSGSGSGTDFTLTISLQAEDVAVYFCQQYYISPLTFGGGKVEIKR (SEQ ID NO: 51)	KSSQSVLYRSNNNNFLA (SEQ ID NO: 10)	WASTRES (SEQ ID NO: 19)	QQYYISPLT (SEQ ID NO: 26)
27	LV-25	DIVMTQSPDSLAVSLGERATINCKSSQSVLYSSNNKNHYLAWYRQKPGQPPKLLIYRASTRESGVPDRFSGSGSGTDFTLTISLQPEDVAVYYCQQYYSSPFTFGPGTKVDIKR (SEQ ID NO: 52)	KSSQSVLYSSNNKNHYLA (SEQ ID NO: 11)	RASTRES (SEQ ID NO: 16)	QQYYSSPFT (SEQ ID NO: 27)
28	LV-26	DIVMTQSPDSLAVSLGERATIHCKSSQSVLYSSNNRNFLSWYQQKPGQPPKLLIYRASTRESGVPDRFSGSGSGTDFTLTISLQAEDVAVYFCQQYYSAFPFTFGPGTTVDIKR (SEQ ID NO: 53)	KSSQSVLYSSNNRNFLS (SEQ ID NO: 12)	RASTRES (SEQ ID NO: 16)	QQYYSAFPFT (SEQ ID NO: 22)
29	LV-27	DIVMTQSPDSLAVSLGERATINCKSSQSVLYSSNNKNYLAWYRQKPGQPPKLLIYRASTRESGVPDRFSGSGSGTDFTLTISLQAEDVAVYHCQQYYSSPFTFGPGTKVDIKR (SEQ ID NO: 54)	KSSQSVLYSSNNKNYLA (SEQ ID NO: 13)	RASTRES (SEQ ID NO: 16)	QQYYSSPFT (SEQ ID NO: 27)

Table 1B. Exemplary Anti-PAC1 Receptor Heavy Chain Variable Region Amino Acid Sequences

Antibody ID.	VH Group	VH Amino Acid Sequence	CDRH1	CDRH2	CDRH3
01A, 01C, 01D, 02A, 02C	HV-01	QVQLQQSGPGLVKPSQTLSTLCAI SGDSVSSNSATWNWIRQSPSRGL EWLGRTYYRSKWSNHYAVSVKS RITINPDTSKSQFSLQLNSVTPEDT AVYYCARGTWKQLWFLDHWGQ GTLVTVSS (SEQ ID NO: 83)	SNSATWN (SEQ ID NO: 55)	RTYYRSKW SNHYAVSV KS (SEQ ID NO: 66)	GTWKQLW FLDH (SEQ ID NO: 74)
01B	HV-02	QVQLQQSGPGLVKPSQTLSTLCAI SGDSVSSNSATWNWIRQSPSRKL EWLGRTYYRSKWSNHYAVSVKS RITINPDTSKSQFSLQLNSVTPEDT AVYYCARGTWKQLWFLDHWGQ GTLVTVSS (SEQ ID NO: 84)	SNSATWN (SEQ ID NO: 55)	RTYYRSKW SNHYAVSV KS (SEQ ID NO: 66)	GTWKQLW FLDH (SEQ ID NO: 74)
03A, 03C, 03D, 09, 13, 15	HV-03	QVQLVESGAEEVVKPGASVKVSK ASGFTFSRFAMHWVRQAPGQGLE WMGVISYDGGNKYYAESVKGRV TMTRDTSTSTLYMELSSLRSEDTA VYYCARGYDVLTGYPDYWGQGT LTVTVSS (SEQ ID NO: 85)	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 67)	GYDVLTYG PDY (SEQ ID NO: 75)
03B	HV-04	QVQLVESGAEEVVKPGASVKVSK ASGFTFSRFAMHWVRQAPGQKLE WMGVISYDGGNKYYAESVKGRV TMTRDTSTSTLYMELSSLRSEDTA VYYCARGYDVLTGYPDYWGQGT LTVTVSS (SEQ ID NO: 86)	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 67)	GYDVLTYG PDY (SEQ ID NO: 75)
04A, 04C, 04D	HV-05	QVQLVESGGGVVQPGSRSLRLSCA ASGFTFSRFAMHWVRQAPGKGLE WVAVISYDGGNKYYAESVKGRF TISRDNSKNTLYLQMNSLRAEDT ALFYCARGYDVLTYGYPDYWGQG TLVTVSS (SEQ ID NO: 87)	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 67)	GYDVLTYG PDY (SEQ ID NO: 75)
04B	HV-06	QVQLVESGGGVVQPGSRSLRLSCA ASGFTFSRFAMHWVRQAPGKKLE WVAVISYDGGNKYYAESVKGRF TISRDNSKNTLYLQMNSLRAEDT ALFYCARGYDVLTYGYPDYWGQG TLVTVSS (SEQ ID NO: 88)	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 67)	GYDVLTYG PDY (SEQ ID NO: 75)
05A, 05C, 05D	HV-07	QVQLQESGPGLVKPSQTLSTLCTV SGGSISSGGYYWSWIRQHPGKGL EWIGYIYYSGNTYYNPSLKSRTVI SGDTSKNQFSLKLRSVTAADTAV YYCTRGGAARGMDVWGQGT TVSS (SEQ ID NO: 89)	SGGYYWS (SEQ ID NO: 57)	YIYYSGNT YYNPSLKS (SEQ ID NO: 68)	GGAARGM DV (SEQ ID NO: 76)
05B	HV-08	QVQLQESGPGLVKPSQTLSTLCTV SGGSISSGGYYWSWIRQHPGKKL EWIGYIYYSGNTYYNPSLKSRTVI SGDTSKNQFSLKLRSVTAADTAV YYCTRGGAARGMDVWGQGT TVSS (SEQ ID NO: 90)	SGGYYWS (SEQ ID NO: 57)	YIYYSGNT YYNPSLKS (SEQ ID NO: 68)	GGAARGM DV (SEQ ID NO: 76)

Antibody ID.	VH Group	VH Amino Acid Sequence	CDRH1	CDRH2	CDRH3
06A, 06C	HV-09	QVQLQESGPGLVKPSSETLSLTCTV SGGSISSGGYYWSWIRQPPGKGLE WIGYIYYSGNTYYNPSLKSRTIS VDTSKNQFSLKLRSVTAADTAVY YCTRGGGAARGMDVWGQGT T V T VSS (SEQ ID NO: 91)	SGGYYS (SEQ ID NO: 57)	YIYYSGNT YYNPSLKS (SEQ ID NO: 68)	GGAARGM DV (SEQ ID NO: 76)
06B	HV-10	QVQLQESGPGLVKPSSETLSLTCTV SGGSISSGGYYWSWIRQPPGKGLE WIGYIYYSGNTYYNPSLKSRTIS VDTSKNQFSLKLRSVTAADTAVY YCTRGGGAARGMDVWGQGT T V T VSS (SEQ ID NO: 92)	SGGYYS (SEQ ID NO: 57)	YIYYSGNT YYNPSLKS (SEQ ID NO: 68)	GGAARGM DV (SEQ ID NO: 76)
07	HV-11	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSYIAHWVRQAPGKGLE WVAVISYDGSNKYYADSVKGRF TISRDN SKNTLYLQMNSLRAEDT AVYYCARGYDLLTGYPDYWGQG TLVTVSS (SEQ ID NO: 93)	YYAIH (SEQ ID NO: 58)	VISYDGSN KYYADSVK G (SEQ ID NO: 69)	GYDLLTGY PDY (SEQ ID NO: 77)
11, 14	HV-12	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSRFAMHWVRRAPGKGLE WVAVISYDGGNKYYAESVKGRF TISRDN SKNTLNLLMNSLRAEDT ALFYCARGYDVL TGYPDYWGQG TLVTVSS (SEQ ID NO: 94)	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 67)	GYDVL TG Y PDY (SEQ ID NO: 75)
08, 12	HV-13	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSRFAMHWVRQAPGKGLE WVAVISYDGGNKYYAESVKGRF TISRDN SKNTLNLLMNSLRAEDT ALFYCARGYDVL TGYPDYWGQG TLVTVSS (SEQ ID NO: 95)	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 67)	GYDVL TG Y PDY (SEQ ID NO: 75)
10	HV-14	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSRFAMHWVRRAPGKGLE WVAVISYDGGNKYYAESVKGRF TISRDN SKNTLNLLMDSLRAEDT ALFYCARGYDVL TGYPDYWGQG TLVTVSS (SEQ ID NO: 96)	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 67)	GYDVL TG Y PDY (SEQ ID NO: 75)
16	HV-15	QVQLVQSGAEVKKPGASVKVSC KASGFTFSRFAMHWVRQAPGQG LEWMGVISYDGGNKYYAESVKG RVTMTRDTSTSTAYMELSSLRSE DTAVYYCARGYDVL TGYPDYWG QGT L V T V S S (SEQ ID NO: 97)	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 67)	GYDVL TG Y PDY (SEQ ID NO: 75)
17	HV-16	QVQLVQSGAEVKKPGASVKVSC AASGFTFSRFAMHWVRQAPGQG LEWMGVISYDGGNKYYAESVKG RVTMTRDN SKNTAYMELSSLRSE DTAVYYCARGYDVL TGYPDYWG QGT L V T V S S (SEQ ID NO: 98)	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 67)	GYDVL TG Y PDY (SEQ ID NO: 75)
18	HV-17	EVQLLES GGLVQPGGSLRLSCA ASGFTFSRFAMHWVRQAPGKGLE WVAVISYDGGNKYYAESVKGRF TISRDN SKNTLYLQMNSLRAEDT AVYYCARGYDVL TGYPDYWGQ	RFAMH (SEQ ID NO: 56)	VISYDGGN KYYAESVK G (SEQ ID NO: 75)	GYDVL TG Y PDY (SEQ ID NO: 75)

Antibody ID.	VH Group	VH Amino Acid Sequence	CDRH1	CDRH2	CDRH3
		GTLVTVSS (SEQ ID NO: 99)		67)	
19, 20	HV-18	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSRYAMHWVRQASGKGL EWVAVISYDGSNKYYADSVKGR FTISRDNSKNTLYLLMSSLRAEDT AVFYCARGYDILTGYPDYWGQG TLVTVSS (SEQ ID NO: 100)	RYAMH (SEQ ID NO: 59)	VISYDGSN KYYADSVK G (SEQ ID NO: 69)	GYDILTGY PDY (SEQ ID NO: 78)
21	HV-19	QVQLVQSGAEVKKPGASVKVSC KASGYTFTSYGISWVRQAPGQGL EWMGWINAYNGHTNYAQTFQGR VTMTTDTSTSTAYMELRSLRSD TAVYYCARELELRSFYFYGMDV WGQGTTPVSS (SEQ ID NO: 101)	SYGIS (SEQ ID NO: 60)	WINAYNGH TNYAQTFQ G (SEQ ID NO: 70)	ELELRSFYF FGMDV (SEQ ID NO: 79)
22	HV-20	QVQLVQSGAEVKKSGASLKVSCK ASGYIFTRYGVSWVRQAPGQGLE WMGWITTYNGNTNYAQKLQGR VTMTTDTSTSTAYMELRSLRSD TAVYYCARRVRYSGGYSFDNWGQ GTLVTVSS (SEQ ID NO: 102)	RYGVS (SEQ ID NO: 61)	WITTYNGN TNYAQKLQ G (SEQ ID NO: 71)	RVRYSGGY SFDN (SEQ ID NO: 80)
23	HV-21	QVQLVQSGAEVKKSGASLKVSCK ASGYIFTRYGVSWVRQAPGQGLE WMGWITTYNGNTNYAQKLQGR VTMTTDTSTSTAYMELRSLRSD TAVYYCARRVRYSGGYSFDNWG QGTTLVTVSS (SEQ ID NO: 103)	RYGVS (SEQ ID NO: 61)	WITTYNGN TNYAQKLQ G (SEQ ID NO: 71)	RVRYSGGY SFDN (SEQ ID NO: 80)
24	HV-22	QVQLQESGPGLVKPSQTLSTCTV SGGSISSYYWSWIRQAPGKLEWI GRIYTSNSTNPNPSLKSRTMSIG TSKNQFSLKLSSVTAADTAVYYC AIIASRGWYFDLWGRGTLVTVSS (SEQ ID NO: 104)	SYIWS (SEQ ID NO: 62)	RIYTSNST NPNPSLKS (SEQ ID NO: 72)	IASRGWYF DL (SEQ ID NO: 81)
25, 28	HV-23	QVQLQESGPGLVKPSQTLSTCTV SGGSISSGGYYWSWIRQHPGKGL EWIGYIYSGNTYYNPSLKSRTI SGDTSKNQFSLKLRSVTAADTAV YYCARGGAARGMDVWGQGT TVSS (SEQ ID NO: 105)	SGGYYWS (SEQ ID NO: 57)	YIYSGNT YYNPSLKS (SEQ ID NO: 68)	GGAARGM DV (SEQ ID NO: 76)
26	HV-24	QVQLQQSGPGLVKPSQTLSTCAI SGDSVSSNSAAWNWIRQSPRGL EWLGRTYYRSRWYNDYAVSVKS RITINPDTSKNQFSLQLNSVTPEDT AVYYCARGVFYSKGAFDIWGQG TMVTVSS (SEQ ID NO: 106)	SNSAAWN (SEQ ID NO: 63)	RTYYRSRW YNDYAVSV KS (SEQ ID NO: 73)	GVFYSKGA FDI (SEQ ID NO: 82)
27	HV-25	QVQLQESGPGLVKPSQTLSTCTV SGGISRGGYYWSWIRQHPGKGL EWIGYIYSGNTYYNPSLKSRTIIS GDTSKNQSLKLRSVTAADTAVY YCARGGAARGMDVWGQGT VSS (SEQ ID NO: 107)	RGGYYWS (SEQ ID NO: 64)	YIYSGNT YYNPSLKS (SEQ ID NO: 68)	GGAARGM DV (SEQ ID NO: 76)
29	HV-26	QVQLQESGPGLVKPSQTLSTCTV SGGSISSGGFYWSWIRQHPGKGL WIGYIYSGNTYYNPSLKSRTIIS	SGGFYWS (SEQ ID NO: 65)	YIYSGNT YYNPSLKS	GGAARGM DV

Antibody ID.	VH Group	VH Amino Acid Sequence	CDRH1	CDRH2	CDRH3
		GDTSKNQFSLKLSSVTAADTAVY YCARGGAARGMDVWGQGTVT VSS (SEQ ID NO: 108)		(SEQ ID NO: 68)	(SEQ ID NO: 76)

[0060] The anti-PAC1 receptor binding domain of the bispecific antigen binding proteins may comprise one or more of the CDRs presented in Table 1A (light chain CDRs; i.e. CDRLs) and Table 1B (heavy chain CDRs, i.e. CDRHs). For instance, in certain embodiments, the anti-PAC1 receptor binding domain comprises one or more light chain CDRs selected from (i) a CDRL1 selected from SEQ ID NOs: 1 to 13, (ii) a CDRL2 selected from SEQ ID NOs: 14 to 19, and (iii) a CDRL3 selected from SEQ ID NOs: 20 to 27, and (iv) a CDRL of (i), (ii) and (iii) that contains one or more, e.g., one, two, three, four or more amino acid substitutions (e.g., conservative amino acid substitutions), deletions or insertions of no more than five, four, three, two, or one amino acids. In these and other embodiments, the anti-PAC1 receptor binding domain comprises one or more heavy chain CDRs selected from (i) a CDRH1 selected from SEQ ID NOs: 55 to 65, (ii) a CDRH2 selected from SEQ ID NOs: 66 to 73, and (iii) a CDRH3 selected from SEQ ID NOs: 74 to 82, and (iv) a CDRH of (i), (ii) and (iii) that contains one or more, e.g., one, two, three, four or more amino acid substitutions (e.g., conservative amino acid substitutions), deletions or insertions of no more than five, four, three, two, or one amino acids amino acids.

[0061] In certain embodiments, the anti-PAC1 receptor binding domain may comprise 1, 2, 3, 4, 5, or 6 variant forms of the CDRs listed in Tables 1A and 1B, each having at least 80%, 85%, 90% or 95% sequence identity to a CDR sequence listed in Tables 1A and 1B. In some embodiments, the anti-PAC1 receptor binding domain includes 1, 2, 3, 4, 5, or 6 of the CDRs listed in Tables 1A and 1B, each differing by no more than 1, 2, 3, 4 or 5 amino acids from the CDRs listed in these tables.

[0062] In particular embodiments, the anti-PAC1 receptor binding domain of the bispecific antigen binding proteins of the invention comprises a light chain variable region comprising a CDRL1, a CDRL2, and a CDRL3, wherein: (a) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 1, 14 and 20, respectively; (b) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 2, 15 and 21, respectively; (c) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 3, 15 and 21, respectively; (d) CDRL1, CDRL2, and CDRL3 have the sequence

of SEQ ID NOs: 4, 16 and 22, respectively; (e) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 5, 15 and 21, respectively; (f) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 6, 17 and 23, respectively; (g) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 7, 18 and 24, respectively; (h) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 8, 17 and 25, respectively; (i) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 9, 16 and 22, respectively; (j) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 10, 19 and 26, respectively; (k) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 11, 16 and 27, respectively; (l) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 12, 16 and 22, respectively; or (m) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 13, 16 and 27, respectively.

[0063] In other particular embodiments, the anti-PAC1 receptor binding domain of the bispecific antigen binding proteins of the invention comprises a heavy chain variable region comprising a CDRH1, a CDRH2, and a CDRH3, wherein: (a) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 55, 66 and 74, respectively; (b) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 56, 67 and 75, respectively; (c) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 57, 68 and 76, respectively; (d) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 58, 69 and 77, respectively; (e) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 59, 69 and 78, respectively; (f) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 60, 70 and 79, respectively; (g) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 61, 71 and 80, respectively; (h) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 62, 72 and 81, respectively; (i) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 63, 73 and 82, respectively; (j) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 64, 68 and 76, respectively; or (k) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 65, 68 and 76, respectively.

[0064] In certain embodiments, the anti-PAC1 receptor binding domain of the bispecific antigen binding proteins of the invention comprises a light chain variable region comprising a CDRL1, a CDRL2, and a CDRL3 and a heavy chain variable region comprising a CDRH1, a CDRH2, and a CDRH3, wherein:

(a) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 1, 14 and 20, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 55, 66 and 74, respectively;

(b) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 2, 15 and 21, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 56, 67 and 75, respectively;

(c) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 3, 15 and 21, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 56, 67 and 75, respectively;

(d) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 4, 16 and 22, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 57, 68 and 76, respectively;

(e) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 5, 15 and 21, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 58, 69 and 77, respectively;

(f) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 2, 15 and 21, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 59, 69 and 78, respectively;

(g) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 6, 17 and 23, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 60, 70 and 79, respectively;

(h) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 7, 18 and 24, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 61, 71 and 80, respectively;

(i) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 8, 17 and 25, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 62, 72 and 81, respectively;

(j) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 9, 16 and 22, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 57, 68 and 76, respectively;

(k) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 10, 19 and 26, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 63, 73 and 82, respectively;

(l) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 11, 16 and 27, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 64, 68 and 76, respectively;

(m) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 12, 16 and 22, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 57, 68 and 76, respectively; or

(n) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 13, 16 and 27, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 65, 68 and 76, respectively.

[0065] In some embodiments, the anti-PAC1 receptor binding domain of the bispecific antigen binding proteins of the invention comprises a light chain variable region comprising a CDRL1, a CDRL2, and a CDRL3 and a heavy chain variable region comprising a CDRH1, a CDRH2, and a CDRH3, wherein:

(a) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 1, 14 and 20, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 55, 66 and 74, respectively;

(b) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 2, 15 and 21, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 56, 67 and 75, respectively;

(c) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 3, 15 and 21, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 56, 67 and 75, respectively; or

(d) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 4, 16 and 22, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 57, 68 and 76, respectively.

[0066] The anti-PAC1 receptor binding domain of the antigen binding proteins of the invention may comprise a light chain variable region selected from the group consisting of LV-01, LV-02, LV-03, LV-04, LV-05, LV-06, LV-07, LV-08, LV-09, LV-10, LV-11, LV-12, LV-13, LV-14,

LV-15, LV-16, LV-17, LV-18, LV-19, LV-20, LV-21, LV-22, LV-23, LV-24, LV-25, LV-26, and LV-27, as shown in Table 1A, and/or a heavy chain variable region selected from the group consisting of HV-01, HV-02, HV-03, HV-04, HV-05, HV-06, HV-07, HV-08, HV-09, HV-10, HV-11, HV-12, HV-13, HV-14, HV-15, HV-16, HV-17, HV-18, HV-19, HV-20, HV-21, HV-22, HV-23, HV-24, HV-25, and HV-26 as shown in Table 1B, and functional fragments, derivatives, muteins and variants of these light chain and heavy chain variable regions.

[0067] Each of the light chain variable regions listed in Table 1A may be combined with any of the heavy chain variable regions shown in Table 1B to form an anti-PAC1 receptor binding domain suitable for incorporation into the bispecific antigen binding proteins of the invention. Examples of such combinations include, but are not limited to: LV-01 and HV-01; LV-02 and HV-02; LV-03 and HV-01; LV-04 and HV-03; LV-05 and HV-04; LV-06 and HV-05; LV-07 and HV-06; LV-08 and HV-07; LV-09 and HV-08; LV-10 and HV-09; LV-11 and HV-10; LV-12 and HV-11; LV-13 and HV-13; LV-13 and HV-03; LV-13 and HV-14; LV-14 and HV-12; LV-15 and HV-13; LV-15 and HV-03; LV-15 and HV-12; LV-16 and HV-03; LV-16 and HV-15; LV-16 and HV-16; LV-16 and HV-17; LV-17 and HV-18; LV-18 and HV-18; LV-19 and HV-19; LV-20 and HV-20; LV-21 and HV-21; LV-22 and HV-22; LV-23 and HV-23; LV-24 and HV-24; LV-25 and HV-25; LV-26 and HV-23; and LV-27 and HV-26. In certain embodiments, the anti-PAC1 receptor binding domain comprises: (a) LV-01 (SEQ ID NO: 28) and HV-01 (SEQ ID NO: 83); (b) LV-03 (SEQ ID NO: 30) and HV-01 (SEQ ID NO: 83); (c) LV-04 (SEQ ID NO: 31) and HV-03 (SEQ ID NO: 85); (d) LV-06 (SEQ ID NO: 33) and HV-05 (SEQ ID NO: 87); (e) LV-08 (SEQ ID NO: 35) and HV-07 (SEQ ID NO: 89); or (f) LV-10 (SEQ ID NO: 37) and HV-09 (SEQ ID NO: 91).

[0068] In some embodiments, the anti-PAC1 receptor binding domain comprises a light chain variable region comprising a sequence of contiguous amino acids that differs from the sequence of a light chain variable region in Table 1A, i.e. a VL selected from LV-01, LV-02, LV-03, LV-04, LV-05, LV-06, LV-07, LV-08, LV-09, LV-10, LV-11, LV-12, LV-13, LV-14, LV-15, LV-16, LV-17, LV-18, LV-19, LV-20, LV-21, LV-22, LV-23, LV-24, LV-25, LV-26, and LV-27 at only 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15 amino acid residues, wherein each such sequence difference is independently either a deletion, insertion or substitution of one amino acid, with the deletions, insertions and/or substitutions resulting in no more than 15 amino acid changes relative to the foregoing variable domain sequences. The light chain variable region in

some anti-PAC1 binding domains comprises a sequence of amino acids that has at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 97% or at least 99% sequence identity to the amino acid sequences of SEQ ID NOs: 28-54 (i.e. the light chain variable regions in Table 1A).

[0069] In these and other embodiments, the anti-PAC1 receptor binding domain comprises a heavy chain variable region comprising a sequence of contiguous amino acids that differs from the sequence of a heavy chain variable region in Table 1B, i.e., a VH selected from HV-01, HV-02, HV-03, HV-04, HV-05, HV-06, HV-07, HV-08, HV-09, HV-10, HV-11, HV-12, HV-13, HV-14, HV-15, HV-16, HV-17, HV-18, HV-19, HV-20, HV-21, HV-22, HV-23, HV-24, HV-25, and HV-26 at only 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15 amino acid residues, wherein each such sequence difference is independently either a deletion, insertion or substitution of one amino acid, with the deletions, insertions and/or substitutions resulting in no more than 15 amino acid changes relative to the foregoing variable domain sequences. The heavy chain variable region in some anti-PAC1 receptor binding domains comprises a sequence of amino acids that has at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 97% or at least 99% sequence identity to the amino acid sequences of SEQ ID NOs: 83-108 (i.e. the heavy chain variable regions in Table 1B).

[0070] The term “identity,” as used herein, refers to a relationship between the sequences of two or more polypeptide molecules or two or more nucleic acid molecules, as determined by aligning and comparing the sequences. “Percent identity,” as used herein, means the percent of identical residues between the amino acids or nucleotides in the compared molecules and is calculated based on the size of the smallest of the molecules being compared. For these calculations, gaps in alignments (if any) must be addressed by a particular mathematical model or computer program (i.e., an “algorithm”). Methods that can be used to calculate the identity of the aligned nucleic acids or polypeptides include those described in Computational Molecular Biology, (Lesk, A. M., ed.), 1988, New York: Oxford University Press; Biocomputing Informatics and Genome Projects, (Smith, D. W., ed.), 1993, New York: Academic Press; Computer Analysis of Sequence Data, Part I, (Griffin, A. M., and Griffin, H. G., eds.), 1994, New Jersey: Humana Press; von Heinje, G., 1987, Sequence Analysis in Molecular Biology, New York: Academic Press; Sequence Analysis Primer, (Gribskov, M. and Devereux, J., eds.), 1991, New York: M. Stockton Press; and Carillo et al., 1988, SIAM J. Applied Math. 48:1073. For example, sequence

identity can be determined by standard methods that are commonly used to compare the similarity in position of the amino acids of two polypeptides. Using a computer program such as BLAST or FASTA, two polypeptide or two polynucleotide sequences are aligned for optimal matching of their respective residues (either along the full length of one or both sequences, or along a pre-determined portion of one or both sequences). The programs provide a default opening penalty and a default gap penalty, and a scoring matrix such as PAM 250 (a standard scoring matrix; see Dayhoff et al., in Atlas of Protein Sequence and Structure, vol. 5, supp. 3 (1978)) can be used in conjunction with the computer program. For example, the percent identity can then be calculated as: the total number of identical matches multiplied by 100 and then divided by the sum of the length of the longer sequence within the matched span and the number of gaps introduced into the longer sequences in order to align the two sequences. In calculating percent identity, the sequences being compared are aligned in a way that gives the largest match between the sequences.

[0071] The GCG program package is a computer program that can be used to determine percent identity, which package includes GAP (Devereux et al., 1984, Nucl. Acid Res. 12:387; Genetics Computer Group, University of Wisconsin, Madison, WI). The computer algorithm GAP is used to align the two polypeptides or two polynucleotides for which the percent sequence identity is to be determined. The sequences are aligned for optimal matching of their respective amino acid or nucleotide (the “matched span”, as determined by the algorithm). A gap opening penalty (which is calculated as 3x the average diagonal, wherein the “average diagonal” is the average of the diagonal of the comparison matrix being used; the “diagonal” is the score or number assigned to each perfect amino acid match by the particular comparison matrix) and a gap extension penalty (which is usually 1/10 times the gap opening penalty), as well as a comparison matrix such as PAM 250 or BLOSUM 62 are used in conjunction with the algorithm. In certain embodiments, a standard comparison matrix (see, Dayhoff et al., 1978, Atlas of Protein Sequence and Structure 5:345-352 for the PAM 250 comparison matrix; Henikoff et al., 1992, Proc. Natl. Acad. Sci. U.S.A. 89:10915-10919 for the BLOSUM 62 comparison matrix) is also used by the algorithm.

[0072] Recommended parameters for determining percent identity for polypeptides or nucleotide sequences using the GAP program include the following:

Algorithm: Needleman et al., 1970, J. Mol. Biol. 48:443-453;

Comparison matrix: BLOSUM 62 from Henikoff et al., 1992, *supra*;

Gap Penalty: 12 (but with no penalty for end gaps)

Gap Length Penalty: 4

Threshold of Similarity: 0

[0073] Certain alignment schemes for aligning two amino acid sequences may result in matching of only a short region of the two sequences, and this small aligned region may have very high sequence identity even though there is no significant relationship between the two full-length sequences. Accordingly, the selected alignment method (GAP program) can be adjusted if so desired to result in an alignment that spans at least 50 contiguous amino acids of the target polypeptide.

[0074] The bispecific antigen binding proteins of the invention comprise a binding domain that specifically binds to the human CGRP receptor. The human CGRP receptor (also referred to herein as “CGRPR,” “CGRP R,” “hCGRPR,” and “huCGRPR”) is a heterodimer that comprises the human calcitonin receptor-like receptor (CRLR) polypeptide (Genbank Accession No. U17473.1) and the human receptor activity modifying protein 1 (RAMP1) polypeptide (Genbank Accession No. AJ001014). The amino acid sequences for the full-length human CRLR and RAMP1 polypeptides as well as extracellular domains from both polypeptides are set forth in Table 2 below.

Table 2. Sequences of human CRLR and human RAMP1 polypeptides

Polypeptide	Sequence
Human CRLR	MLYSIFHFGLMMEKKCTLYFLVLLPFFMILVTAELEESPEDSIQLGVTRNKIMTAQYE CYQKIMQDPIQQAEGVYCNRTWDGWLCWNDVAAGTESMQLCPDYFQDFDPSEKVT KICDQDGNWFRHPASNRTWTNYTQCNVNTHEKVKTAALNLFYLTIIHGHLASLLISL GIFYFKSLSCQRITLHKNLFFSFVCNSVVTIIHLTAVANNQALVATNPVSCKVSQFIH LYLMGCNYFWMLCEGIYLTIVVAVFAEKQHLMWYYFLGWGFPLIPACIHAIARS LYYNDNCWISSDTHLLYIIHGPICAALLVNLFLLNIVRVLITKLKVTHQAESNLYMK AVRATLILVPLLGIEFVLIPWRPEGKIAEEVVDYIMHILMHFQGLLVSTIFCFFNGEVQ AILRRNWNQYKIQFGNSFSNSEALRSASYTVSTISDGPYSHDCPSEHLNGKSIHDIEN VLLKPENLYN (SEQ ID NO: 340)
Human RAMP1	MARALCRLPRRGLWLLLAHHLFMTTACQEANYGALLRELCLTQFQVDMEAVGETL WCDWGRITIRSYRELADCTWHMAEKLGCFWPNAEVD RFFLAVHGRYFRSCPISGRA VRDPPGSILYPFIVVPITVTLVTALVVWQSKRTEGIV (SEQ ID NO: 341)
Extracellular Domain of Human CRLR	ELEESPEDSIQLGVTRNKIMTAQYECYQKIMQDPIQQAEGVYCNRTWDGWLCWNDV AAGTESMQLCPDYFQDFDPSEKVTKICDQDGNWFRHPASNRTWTNYTQCNVNTHE KVKTA (SEQ ID NO: 342)
Extracellular Domain of Human RAMP1	CQEANYGALLRELCLTQFQVDMEAVGETLWCDWGRITIRSYRELADCTWHMAEKL GCFWPNAEVD RFFLAVHGRYFRSCPISGRAVRDPPGS (SEQ ID NO: 343)

[0075] In certain embodiments, the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention comprises the VH region and/or the VL region or CDR regions from an anti-CGRP receptor antibody or functional fragment thereof. Preferably, the anti-CGRP receptor antibody or functional fragment thereof specifically binds to human CGRP receptor and prevents or reduces binding of the receptor to CGRP. In certain embodiments, the anti-CGRP receptor antibody or functional fragment thereof specifically binds to residues or sequences of residues, or regions in both human CRLR and human RAMP1 polypeptides. In one embodiment, the anti-CGRP receptor antibody or functional fragment thereof specifically binds to an epitope formed from amino acids in both human CRLR and human RAMP1 polypeptides. As used herein, an “epitope” refers to any determinant capable of being specifically bound by an antibody or functional fragment thereof. An epitope can be contiguous or non-contiguous (e.g., (i) in a single-chain polypeptide, amino acid residues that are not contiguous to one another in the polypeptide sequence but that within in context of the molecule are bound by the antibody or functional fragment, or (ii) in a multimeric protein, e.g., comprising two or more individual components, amino acid residues present on two or more of the individual components, but that within the context of the multimeric protein are bound by the antibody or functional fragment). In some embodiments, the epitope formed from amino acids in both human CRLR and human RAMP1 polypeptides comprises one or more cleavage sites for AspN protease, which cleaves peptides after aspartic acid residues and some glutamic acid residues at the amino end.

[0076] In certain embodiments, the anti-CGRP receptor antibody or functional fragment thereof from which the anti-CGRP receptor binding domain is derived specifically binds to an extracellular domain of human CRLR polypeptide comprising the amino acid sequence of SEQ ID NO: 342. Alternatively or additionally, the anti-CGRP receptor antibody or functional fragment thereof specifically binds to an extracellular domain of human RAMP1 polypeptide comprising the amino acid sequence of SEQ ID NO: 343. In some embodiments, the anti-CGRP receptor antibody or binding fragment specifically binds to an epitope within the human CRLR polypeptide comprising at least one sequence selected from SEQ ID NO: 344

(DSIQLGVTRNKIMTAQY; corresponding to amino acids 8-24 of SEQ ID NO: 342), SEQ ID NO: 345 (DVAAGTESMQLCP; corresponding to amino acids 55-67 of SEQ ID NO: 342), SEQ ID NO: 346 (DGNWFRHPASNRTWTNYTQCNVNTH; corresponding to amino acids 86-110 of SEQ ID NO: 342), SEQ ID NO: 347 (ECYQKIMQ; corresponding to amino acids 25-32 of

SEQ ID NO: 342), or SEQ ID NO: 348 (DGWLCWN; corresponding to amino acids 48-54 of SEQ ID NO: 342). For example, in some embodiments, the anti-CGRP receptor antibody or functional fragment thereof binds an epitope within a subregion of human CRLR polypeptide of SEQ ID NO: 342, wherein the epitope comprises SEQ ID NOs: 344-348, optionally in its native three-dimensional conformation. Alternatively or additionally, the anti-CGRP receptor antibody or functional fragment specifically binds to at least one epitope within the human RAMP1 polypeptide selected from SEQ ID NO: 349 (RELADCTWHMAE; corresponding to amino acids 41-52 of SEQ ID NO: 343), SEQ ID NO: 350 (DWGRTIRSYRELA; corresponding to amino acids 32-44 of SEQ ID NO: 343), SEQ ID NO: 351 (ELCLTQFQV; corresponding to amino acids 12-20 of SEQ ID NO: 343), or SEQ ID NO: 352 (DCTWHMA; corresponding to amino acids 45-51 of SEQ ID NO: 343). In some embodiments, the anti-CGRP receptor antibody or functional fragment thereof binds to an epitope within a subregion of human RAMP1 polypeptide of SEQ ID NO: 343, wherein the epitope comprises SEQ ID NOs: 349-352, optionally in its native three-dimensional conformation.

[0077] In some embodiments, the anti-CGRP receptor antibody or functional fragment thereof from which the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention is derived selectively inhibits the human CGRP receptor relative to the human adrenomedullin 1 (AM1), human adrenomedullin 2 (AM2), or human amylin receptors (e.g. human AMY1 receptor). The human AM1 receptor is comprised of a human CRLR polypeptide and a RAMP2 polypeptide, whereas the human AM2 receptor is comprised of a human CRLR polypeptide and a RAMP3 polypeptide. Thus, an antibody or other binding protein that binds only CRLR (and not RAMP1) would not be expected to *selectively* inhibit the CGRP receptor because the CRLR polypeptide is also a component of the AM1 and AM2 receptors. The human amylin (AMY) receptors are comprised of a human calcitonin receptor (CT) polypeptide and one of the RAMP1, RAMP2, or RAMP3 subunits. Specifically, the human AMY1 receptor is composed of the CT polypeptide and the RAMP1 polypeptide, the human AMY2 receptor is composed of the CT polypeptide and the RAMP2 polypeptide, and the human AMY3 receptor is composed of the CT polypeptide and the RAMP3 polypeptide. Thus, an antibody or other binding protein that binds only RAMP1 (and not CRLR) would not be expected to *selectively* inhibit the CGRP receptor because the RAMP1 polypeptide is also a component of the human AMY1 receptor. As described above, the ability of any antibody or functional fragment thereof

to selectively inhibit a particular receptor (e.g. human CGRP receptor) relative to a reference receptor (e.g. human AM1, AM2, or AMY1 receptors) can be assessed by determining the IC₅₀ value of the antibody or functional fragment in an inhibition assay for the target and reference receptors. The IC₅₀ value for any anti-CGRP receptor antibody or functional fragment thereof can be calculated by determining the concentration of the antibody or fragment needed to inhibit half of the maximum biological response of the CGRP ligand in activating the human CGRP receptor in any functional assay, such as the cAMP assay described in the Examples. In some embodiments, the anti-CGRP receptor antibody or functional fragment thereof from which the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention is derived is a neutralizing antibody or fragment of the human CGRP receptor.

[0078] The variable regions or CDR regions of any anti-CGRP receptor antibody or functional fragment thereof can be used to construct the anti-CGRP receptor binding domain of any of the bispecific antigen binding proteins described herein. For instance, the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention may comprise VH and/or VL regions or one or more CDRs from any of the anti-human CGRP receptor antibodies described in WO 2010/075238, which is hereby incorporated by reference in its entirety. In some embodiments, the anti-CGRP receptor antibody from which the anti-CGRP receptor binding domain is derived competes for binding of the human CGRP receptor with one or more of the human anti-CGRP receptor antibodies described in WO 2010/075238 or one or more of the anti-CGRP receptor antibodies described below. In some embodiments, a competing antibody or binding fragment thereof reduces human CGRP receptor binding of a reference antibody between about 40% and 100%, such as about 60% and about 100%, specifically between about 70% and 100%, and more specifically between about 80% and 100%. A particularly suitable quantitative assay for detecting competitive binding uses a Biacore machine which measures the extent of interactions using surface plasmon resonance technology. Another suitable quantitative competition binding assay uses a FACS-based approach to measure competition between antibodies in terms of their binding to the human CGRP receptor.

[0079] Light chain and heavy chain variable regions and associated CDRs of exemplary human anti-CGRP receptor antibodies from which the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention can be derived or constructed are set forth below in Tables 3A and 3B, respectively.

Table 3A. Exemplary Anti-CGRP Receptor Light Chain Variable Region Amino Acid Sequences

Antibody ID.	VL Group	VL Amino Acid Sequence	CDRL1	CDRL2	CDRL3
50A, 50C, 50D, 70	LV-101	QSVLTQPPSASGTPGQRTISCSG SSSNIGSNYVYWYQQLPGAAPKL LIFRNNQRPSGVPDRFSGSKSGTS ASLAISGLRSEDEADYYCAAWDD SLSGWVFGGGTKLTVLG (SEQ ID NO: 136)	SGSSSNIGSNYVY (SEQ ID NO: 109)	RNNQRPS (SEQ ID NO: 120)	AAWDDSLSGWV (SEQ ID NO: 127)
50B	LV-102	QSVLTQPPSASGTPGQRTISCSG SSSNIGSNYVYWYQQLPGAAPKL LIFRNNQRPSGVPDRFSGSKSGTS ASLAISGLRSEDEADYYCAAWDD SLSGWVFGGKTKLTVLG (SEQ ID NO: 137)	SGSSSNIGSNYVY (SEQ ID NO: 109)	RNNQRPS (SEQ ID NO: 120)	AAWDDSLSGWV (SEQ ID NO: 127)
51A, 51C, 51D	LV-103	QSVLTQSPSASGTPGQRTISCSG SSSNIGSNYVYWYQQLPGAAPKL LILRNNQRPSGVPDRFSGSKSGTS ASLTISGLRSEDEADYYCAAWDD SLSGWVFGGGTKLTVLG (SEQ ID NO: 138)	SGSSSNIGSNYVY (SEQ ID NO: 109)	RNNQRPS (SEQ ID NO: 120)	AAWDDSLSGWV (SEQ ID NO: 127)
51B	LV-104	QSVLTQSPSASGTPGQRTISCSG SSSNIGSNYVYWYQQLPGAAPKL LILRNNQRPSGVPDRFSGSKSGTS ASLTISGLRSEDEADYYCAAWDD SLSGWVFGGKTKLTVLG (SEQ ID NO: 139)	SGSSSNIGSNYVY (SEQ ID NO: 109)	RNNQRPS (SEQ ID NO: 120)	AAWDDSLSGWV (SEQ ID NO: 127)
52A, 52C, 52D, 53A, 53C	LV-105	QSVLTQPPSVSAAPGQKVTISCSG SSSNIGNNYVSWYQQLPGTAPKL LIYDNNKRPSGIPDRFSGSKSGTST TLGITGLQTGDEADYYCGTWDSR LSAVVFGGGTKLTVLG (SEQ ID NO: 140)	SGSSSNIGNNYVS (SEQ ID NO: 110)	DNNKRPS (SEQ ID NO: 121)	GTWDSRLS AVV (SEQ ID NO: 128)
52B, 53B	LV-106	QSVLTQPPSVSAAPGQKVTISCSG SSSNIGNNYVSWYQQLPGTAPKL LIYDNNKRPSGIPDRFSGSKSGTST TLGITGLQTGDEADYYCGTWDSR LSAVVFGGKTKLTVLG (SEQ ID NO: 141)	SGSSSNIGNNYVS (SEQ ID NO: 110)	DNNKRPS (SEQ ID NO: 121)	GTWDSRLS AVV (SEQ ID NO: 128)
54A, 54C, 56A, 56C, 71	LV-107	QSVLTQPPSVSAAPGQKVTISCSG SSSNIGNNYVSWYQQLPGTAPKL LIYDNNKRPSGIPDRFSGSKSGTS ATLGITGLQTGDEADYYCGTWDS RLSAVVFGGGTKLTVLG (SEQ ID NO: 142)	SGSSSNIGNNYVS (SEQ ID NO: 110)	DNNKRPS (SEQ ID NO: 121)	GTWDSRLS AVV (SEQ ID NO: 128)
54B, 56B	LV-108	QSVLTQPPSVSAAPGQKVTISCSG SSSNIGNNYVSWYQQLPGTAPKL LIYDNNKRPSGIPDRFSGSKSGTS ATLGITGLQTGDEADYYCGTWDS RLSAVVFGGKTKLTVLG (SEQ ID NO: 143)	SGSSSNIGNNYVS (SEQ ID NO: 110)	DNNKRPS (SEQ ID NO: 121)	GTWDSRLS AVV (SEQ ID NO: 128)

Antibody ID.	VL Group	VL Amino Acid Sequence	CDRL1	CDRL2	CDRL3
		NO: 143)			
55A, 55C	LV-109	QSVLTQPPSVSAAPGQKVTISCSG SSSNIGNNYVSWYQQLPGTAPKL LIYDNNKRPSGIPDRFSGSGSGTS ATLAITGLQTGDEADYYCGTWDS RLSAVVFGGGTKLTVLG (SEQ ID NO: 144)	SGSSSNIGNNY VS (SEQ ID NO: 110)	DNNKRPS (SEQ ID NO: 121)	GTWDSRLS AVV (SEQ ID NO: 128)
55B	LV-110	QSVLTQPPSVSAAPGQKVTISCSG SSSNIGNNYVSWYQQLPGTAPKL LIYDNNKRPSGIPDRFSGSGSGTS ATLAITGLQTGDEADYYCGTWDS RLSAVVFGGKTKLTVLG (SEQ ID NO: 145)	SGSSSNIGNNY VS (SEQ ID NO: 110)	DNNKRPS (SEQ ID NO: 121)	GTWDSRLS AVV (SEQ ID NO: 128)
57A, 57C, 57D, 58A, 58C	LV-111	EIVLTQSPGTLSPGERATLSCRA SQSVSSGYLTWYQQKPGQAPRLL IYGASSRATGIPDRFSGSGSGTDF LTISRLEPEDFAVYYCQQYGNSLS RFGQGTKLEIKR (SEQ ID NO: 146)	RASQSVSSGYL T (SEQ ID NO: 111)	GASSRAT (SEQ ID NO: 17)	QQYGNSLS R (SEQ ID NO: 129)
57B, 58B	LV-112	EIVLTQSPGTLSPGERATLSCRA SQSVSSGYLTWYQQKPGQAPRLL IYGASSRATGIPDRFSGSGSGTDF LTISRLEPEDFAVYYCQQYGNSLS RFGKGTKLEIKR (SEQ ID NO: 147)	RASQSVSSGYL T (SEQ ID NO: 111)	GASSRAT (SEQ ID NO: 17)	QQYGNSLS R (SEQ ID NO: 129)
59	LV-113	QSVLTQPPSVSEAPGQKVTISCSG SSSNIGNNYVSWYQQLPGTAPKL LIYDNNKRPSGIPDRFSGSGSGTS ATLGITGLQTGDEADYYCGTWDS RLSAVVFGGGTKLTVL (SEQ ID NO: 148)	SGSSSNIGNNY VS (SEQ ID NO: 110)	DNNKRPS (SEQ ID NO: 121)	GTWDSRLS AVV (SEQ ID NO: 128)
60	LV-114	QSVLTQPPSASGTPGQRVTISCSG SSSNIGSNYVYQQLPGAAPKL LIFRSNQRPSGVPDRFSGSGSGTS ASLAISGLRSEDEADYYCAAWDD SLSGWVFGGGTKLTVL (SEQ ID NO: 149)	SGSSSNIGSNYV Y (SEQ ID NO: 109)	RSNQRPS (SEQ ID NO: 122)	AAWDDSL GWV (SEQ ID NO: 127)
61	LV-115	DIQMTQSPSSLSASVGDRVTITCR ASQGIRNDLGWFQKPKGKAPKRL IYAASSLQSGVPSRFSGSGSGTEFT LTISLQPEDLATYYCLQYNIYPW TFGQGTKVEIK (SEQ ID NO: 150)	RASQGIRNDLG (SEQ ID NO: 112)	AASSLQS (SEQ ID NO: 14)	LQYNIYPW T (SEQ ID NO: 130)
62	LV-116	SSELTQDPTVSVALGQTVKTCQG DSLRSFYASWYQQKPGQAPVLVF YGKNNRPSGIPDRFSGSSSGNTAS LTITGAQAEDEADYYCNSRDSSV YHLVLGGGTKLTVL (SEQ ID NO: 151)	QGDLSLRSFYAS (SEQ ID NO: 113)	GKNNRPS (SEQ ID NO: 123)	NSRDSSVY HLV (SEQ ID NO: 131)
63	LV-117	DIILAQTPLSLSVTPGQPASISCKSS QSLLSAGKTYLYWYQKPGQPP QLLIYEVSNRFSGVPDRFSGSGSG TDFTLKISRVEAEDVGIYYCMQSF PLPLTFGGGKTKVEIK (SEQ ID NO: 152)	KSSQSLLHSAG KTYLY (SEQ ID NO: 114)	EVSNRFS (SEQ ID NO: 124)	MQSFPLPLT (SEQ ID NO: 132)
64	LV-	DIVMTQSPLSLPVTGPGEPAISCRS	RSSQSLLHSFG	LGSNRAS	MQALQTPF

Antibody ID.	VL Group	VL Amino Acid Sequence	CDRL1	CDRL2	CDRL3
	118	SQSLHSGFYNYLDWYLQKPGQS PQLLIYLGSNRASGVPDRFSGSGS GTDFTLKISRVEAEDVGVYYCMQ ALQTPFTFGPGTKVDIK (SEQ ID NO: 153)	YNYLD (SEQ ID NO: 115)	(SEQ ID NO: 18)	T (SEQ ID NO: 133)
65	LV- 119	DIILTQTPLSLSVTPGQPASISCKSS QSLHSDGKTYLYWYLQKPGQPP QLLIYEVSNRFSGEPRFSGSGSG TDFTLKISRVEAEDVGTYYYCMQS FPLPLTFGGGKTKVEIK (SEQ ID NO: 154)	KSSQSLLHSDG KTYLY (SEQ ID NO: 116)	EVSNRFS (SEQ ID NO: 124)	MQSFPLPLT (SEQ ID NO: 132)
66	LV- 120	QSVLTQPPSVSAAPGQKVTISCSG SSSNIGNNYVSWYQQFPGTAPKL LIYDNNKRPSGIPDRFSGSKSGTS ATLGITGLQTGDEADYYCGTWDS RLSAVVFGGKTKLTVL (SEQ ID NO: 155)	SGSSSNIGNNY VS (SEQ ID NO: 110)	DNNKRPS (SEQ ID NO: 121)	GTWDSRLS AVV (SEQ ID NO: 128)
67	LV- 121	QSVLTQPPSASGTPGQRTISCSG SSSNIGSNTVNWYQQLPGTAPKL LIYTNNQRPSGVPDRFSGSKSGTS ASLAISGLQSEADDFYCAARDES LNGVVFGGKTKLTVL (SEQ ID NO: 156)	SGSSSNIGSNTV N (SEQ ID NO: 117)	TNNQRPS (SEQ ID NO: 125)	AARDESLN GVV (SEQ ID NO: 134)
68	LV- 122	DITLTQTPLSLSVSPGQPASISCKS SQSLHSDGRNYLYWYLQKPGQP PQLLIYEVSNRFSGLPDRFSGSGS GTDFTLKISRVEAEDVGIYYCMQS FPLPLTFGGGKTKVEIK (SEQ ID NO: 157)	KSSQSLLHSDG RNYLY (SEQ ID NO: 118)	EVSNRFS (SEQ ID NO: 124)	MQSFPLPLT (SEQ ID NO: 132)
69	LV- 123	DIQMTQSPSSLSASVGDRTITCR ASQGIRKDLGWYQQKPGKAPKR LIYGASSLQSGVPSRFSGSGSGTEF TLTISSLQPEDFATYYCLQNSFP WTFGQGKTKVEIK (SEQ ID NO: 158)	RASQGIRKDLG (SEQ ID NO: 119)	GASSLQS (SEQ ID NO: 126)	LQYNSFPW T (SEQ ID NO: 135)

Table 3B. Exemplary Anti-CGRP Receptor Heavy Chain Variable Region Amino Acid Sequences

Antibody ID.	VH Group	VH Amino Acid Sequence	CDRH1	CDRH2	CDRH3
50A, 50C, 50D	HV- 101	EVQLVESGGGLVKPGGSLRLSCA ASGFTFGNAWMSWVRQAPGKGL EWVGRIKSKTDGGTTDYAAPVK GRFTISRDDSKNTLYLQMNSLKTE DTAVYFCTTDRTGYSISWSSYYY YYGMDVWGQGTITVTVSS (SEQ ID NO: 190)	NAWMS (SEQ ID NO: 159)	RIKSKTDG GTTDYAAP VKG (SEQ ID NO: 167)	DRTGYSIS WSSYYYYY GMDV (SEQ ID NO: 179)
50B	HV- 102	EVQLVESGGGLVKPGGSLRLSCA ASGFTFGNAWMSWVRQAPGKEL EWVGRIKSKTDGGTTDYAAPVK	NAWMS (SEQ ID NO: 159)	RIKSKTDG GTTDYAAP VKG	DRTGYSIS WSSYYYYY GMDV

Antibody ID.	VH Group	VH Amino Acid Sequence	CDRH1	CDRH2	CDRH3
		GRFTISRDDSKNTLYLQMNSLKTE DTAVYFCTTDRTGYSISWSSYYY YYGMDVWGQGTTVTVSS (SEQ ID NO: 191)	159)	(SEQ ID NO: 167)	(SEQ ID NO: 179)
51A, 51C, 51D	HV- 103	EVQLVESGGGLVKPGGSLRLSCA ASGFTFSNAWMSWVRQAPGKGL EWVGRIKSKTDGGTTDYTAPVKG RFTISRDDSKNTLYLQMNSLKA DTAVYYCTTDRTGYSISWSSYYY YYGMDVWGQGTTVTVSS (SEQ ID NO: 192)	NAWMS (SEQ ID NO: 159)	RIKSKTDG GTTDYTAP VKG (SEQ ID NO: 168)	DRTGYSIS WSSYYYYY GMDV (SEQ ID NO: 179)
51B	HV- 104	EVQLVESGGGLVKPGGSLRLSCA ASGFTFSNAWMSWVRQAPGKEL EWVGRIKSKTDGGTTDYTAPVKG RFTISRDDSKNTLYLQMNSLKA DTAVYYCTTDRTGYSISWSSYYY YYGMDVWGQGTTVTVSS (SEQ ID NO: 193)	NAWMS (SEQ ID NO: 159)	RIKSKTDG GTTDYTAP VKG (SEQ ID NO: 168)	DRTGYSIS WSSYYYYY GMDV (SEQ ID NO: 179)
52A, 52C, 52D, 54A, 54C, 55A, 55C, 59, 66	HV- 105	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSFGMHWRQAPGKGLE WVAVISFDGSIKYSVDSVKGRFTI SRDNSKNTLFLQMNSLRAEDTAV YYCARDRLNYYDSSGYYHYKYY GMAVWGQGTTVTVSS (SEQ ID NO: 194)	SFGMH (SEQ ID NO: 160)	VISFDGSIK YSVDSVKG (SEQ ID NO: 169)	DRLNYYDS SGYYHYKY YGMAY (SEQ ID NO: 180)
52B, 54B, 55B	HV- 106	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSFGMHWRQAPGKELE WVAVISFDGSIKYSVDSVKGRFTI SRDNSKNTLFLQMNSLRAEDTAV YYCARDRLNYYDSSGYYHYKYY GMAVWGQGTTVTVSS (SEQ ID NO: 195)	SFGMH (SEQ ID NO: 160)	VISFDGSIK YSVDSVKG (SEQ ID NO: 169)	DRLNYYDS SGYYHYKY YGMAY (SEQ ID NO: 180)
53A, 53C, 56A, 56C	HV- 107	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSFGMHWRQAPGKGLE WVAVISFDGSIKYSVDSVKGRFTI SRDNSKNTLFLQMNSLRAEDTAV YYCARDRLNYYESSGYYHYKYY GMAVWGQGTTVTVSS (SEQ ID NO: 196)	SFGMH (SEQ ID NO: 160)	VISFDGSIK YSVDSVKG (SEQ ID NO: 169)	DRLNYYES SGYYHYKY YGMAY (SEQ ID NO: 181)
53B, 56B	HV- 108	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSFGMHWRQAPGKELE WVAVISFDGSIKYSVDSVKGRFTI SRDNSKNTLFLQMNSLRAEDTAV YYCARDRLNYYESSGYYHYKYY GMAVWGQGTTVTVSS (SEQ ID NO: 197)	SFGMH (SEQ ID NO: 160)	VISFDGSIK YSVDSVKG (SEQ ID NO: 169)	DRLNYYES SGYYHYKY YGMAY (SEQ ID NO: 181)
57A, 57C, 57D	HV- 109	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSYGMHWVRQAPGKGL EWVAVIWDGSKNYYADSVKGR FIISRDKSKNTLYLQMNSLRAEDT AVYYCARAGGIAAAGLYYYGM DVWGQGTTVTVSS (SEQ ID NO: 198)	SYGMH (SEQ ID NO: 161)	VIWYDGSN KYYADSVK G (SEQ ID NO: 170)	AGGIAAAG LYYYGM DV (SEQ ID NO: 182)

Antibody ID.	VH Group	VH Amino Acid Sequence	CDRH1	CDRH2	CDRH3
57B	HV-110	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSSYGMHWVRQAPGKELE WVAVIWYDGSNKYYADSVKGRF IISRDKSKNTLYLQMNSLRAEDTA VYYCARAGGIAAAGLYYYYGMD VWGQGTTTVTVSS (SEQ ID NO: 199)	SYGMH (SEQ ID NO: 161)	VIWYDGSN KYYADSVK G (SEQ ID NO: 170)	AGGIAAAG LYYYYGM DV (SEQ ID NO: 182)
58A, 58C	HV-111	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSSYGMHWVRQAPGKGL EWVAVIWYDGSNKYYAESVKGR FIISRDKSKNTLYLQMNSLRAEDT AVYYCARAGGIAAAGLYYYYGM DVWGQGTTTVTVSS (SEQ ID NO: 200)	SYGMH (SEQ ID NO: 161)	VIWYDGSN KYYAESVK G (SEQ ID NO: 171)	AGGIAAAG LYYYYGM DV (SEQ ID NO: 182)
58B	HV-112	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSSYGMHWVRQAPGKELE WVAVIWYDGSNKYYAESVKGRF IISRDKSKNTLYLQMNSLRAEDTA VYYCARAGGIAAAGLYYYYGMD VWGQGTTTVTVSS (SEQ ID NO: 201)	SYGMH (SEQ ID NO: 161)	VIWYDGSN KYYAESVK G (SEQ ID NO: 171)	AGGIAAAG LYYYYGM DV (SEQ ID NO: 182)
60	HV-113	EVQLVESGGGLVKPGGSLRLSCA ASGFTFSNAWMSWVRQAPGKGL EWVGRIKSTTDGGTTDYAAPVKG RFTISRDDSKNTLYLQMNSLKTED TAVYYCTDRTGYSISWSSYYYY YGMDVWGQGTTTVTVSS (SEQ ID NO: 202)	NAWMS (SEQ ID NO: 159)	RIKSTTDGG TTDYAAPV KG (SEQ ID NO: 172)	DRTGYSIS WSSYYYY GMDV (SEQ ID NO: 179)
61	HV-114	EVQLLES GGGLVQPGESLRLSCA ASGFTFSSYAMSWVRQAPGKGLE WVSAISGSGGRTYYADSVKGRFT ISRDN SKNTLYLQMNSLRAEDTA VYYCAKDQREVGPYSSGWYDYY YGMDVWGQGTTTVTVSS (SEQ ID NO: 203)	SYAMS (SEQ ID NO: 162)	AISGSGGRT YYADSVKG (SEQ ID NO: 173)	DQREVGPY SSGWYDYY YGMDV (SEQ ID NO: 183)
62	HV-115	QVQLVQSGAEVKKPGASVKVSC KASGYTFTGYMHWRQAPGQG LEWMGWINPNSGGTNYAQKFQG RVTMTRDTSISTAYMELSRLRSD DTAVYFCARDQMSIIMLRGVFP YYYGMDVWGQGTTTVTVSS (SEQ ID NO: 204)	GYMH (SEQ ID NO: 163)	WINPNSGG TNYAQKFQ G (SEQ ID NO: 174)	DQMSIIML RGVFP YYYGMDV (SEQ ID NO: 184)
63, 65, 68	HV-116	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSSYGMHWVRQAPGKGL EWVAVISYDGSHEYSYADSVKGRF TISRDISKNTLYLQMNSLRAEDTA VYFCARERKRVTMSTLYYYFYY GMDVWGQGTTTVTVSS (SEQ ID NO: 205)	SYGMH (SEQ ID NO: 161)	VISYDGSHE SYADSVKG (SEQ ID NO: 175)	ERKRV TMS TLYYYFYY GMDV (SEQ ID NO: 185)
64	HV-117	EVQLVESGGGLVKPGRSLRLSCT ASGFTFGDYAMSWFRQAPGKGL EWIGFIRSRAYGGTPEYAASVK RFTISRDDSKTIAAYLQMNSLKTED	DYAMS (SEQ ID NO: 164)	FIRSRAYGG TPEYAASV KG	GRGIAARW DY (SEQ ID NO:

Antibody ID.	VH Group	VH Amino Acid Sequence	CDRH1	CDRH2	CDRH3
		TAVYFCARGRGIAARWDYWGGG TLVTVSS (SEQ ID NO: 206)		(SEQ ID NO: 176)	186)
67	HV-118	QVQLVQSGAEVKKPGASVKVSC KASGYTFTDYYMYWVRQAPGQG LEWMGWISPNSGGTNYAQKFQG RVTMTRDTSISTAYMELSLRSD DTAVYYCVRGGYSGYAGLYSHY YGMDVWGQGTTVTVSS (SEQ ID NO: 207)	DYYMY (SEQ ID NO: 165)	WISPNSGG TNYAQKFQ G (SEQ ID NO: 177)	GGYSGYAG LYSHYYGM DV (SEQ ID NO: 187)
69	HV-119	EVQLVESGGGLVKPGGSLRLSCA ASGYTFSTYSMNWVRQAPGKGL EWWSSISSSSSYRYADSVKGRFT ISRDNNAKNSLYLQMSSLRAEDTA VYYCAREGVSGSSPYSISWYDYY YGMDVWGQGTTVTVSS (SEQ ID NO: 208)	TYSMN (SEQ ID NO: 166)	SISSSSSYR YYADSVKG (SEQ ID NO: 178)	EGVSGSSP YSISWYDY YYGMDV (SEQ ID NO: 188)
70	HV-120	EVQLVESGGGLVKPGGSLRLSCA ASGFTFGNAWMSWVRQAPGKGL EWWGRIKSKTDGGTTDYAAPVK GRFTISRDDSKNTLYLQMNSLKTE DTAVYYCTTDRTGYSISWSSYYY YGMDVWGQGTTVTVSS (SEQ ID NO: 209)	NAWMS (SEQ ID NO: 159)	RIKSKTDG GTTDYAAP VKG (SEQ ID NO: 167)	DRTGYSIS WSSYYYYY GMDV (SEQ ID NO: 179)
71	HV-121	QVQLVESGGGVVQPGRSLRLSCA ASGFTFSSFGMHWVRQAPGKGLE WVAVISFDGSIKYSDSVKGRFTI SRDNSKNTLFLQMNSLRAEDTAV YYCARDRLNYYDSSGYHYHYKY GLAVWGQGTTVTVSS (SEQ ID NO: 210)	SFGMH (SEQ ID NO: 160)	VISFDGSIK YSVDSVKG (SEQ ID NO: 169)	DRLNYYDS SGYYHYKY YGLAV (SEQ ID NO: 189)

[0080] The anti-CGRP receptor binding domain of the bispecific antigen binding proteins may comprise one or more of the CDRs presented in Table 3A (light chain CDRs; i.e. CDRLs) and Table 3B (heavy chain CDRs, i.e. CDRHs). For instance, in certain embodiments, the anti-CGRP receptor binding domain comprises one or more light chain CDRs selected from (i) a CDRL1 selected from SEQ ID NOs: 109 to 119, (ii) a CDRL2 selected from SEQ ID NOs: 14, 17, 18, 120 to 126, and (iii) a CDRL3 selected from SEQ ID NOs: 127 to 135, and (iv) a CDRL of (i), (ii) and (iii) that contains one or more, e.g., one, two, three, four or more amino acid substitutions (e.g., conservative amino acid substitutions), deletions or insertions of no more than five, four, three, two, or one amino acids. In these and other embodiments, the anti-CGRP receptor binding domain comprises one or more heavy chain CDRs selected from (i) a CDRH1 selected from SEQ ID NOs: 159 to 166, (ii) a CDRH2 selected from SEQ ID NOs: 167 to 178, and (iii) a CDRH3 selected from SEQ ID NOs: 179 to 189, and (iv) a CDRH of (i), (ii) and (iii)

that contains one or more, e.g., one, two, three, four or more amino acid substitutions (e.g., conservative amino acid substitutions), deletions or insertions of no more than five, four, three, two, or one amino acids amino acids.

[0081] In certain embodiments, the anti-CGRP receptor binding domain may comprise 1, 2, 3, 4, 5, or 6 variant forms of the CDRs listed in Tables 3A and 3B, each having at least 80%, 85%, 90% or 95% sequence identity to a CDR sequence listed in Tables 3A and 3B. In some embodiments, the anti-CGRP receptor binding domain includes 1, 2, 3, 4, 5, or 6 of the CDRs listed in Tables 3A and 3B, each differing by no more than 1, 2, 3, 4 or 5 amino acids from the CDRs listed in these tables.

[0082] In particular embodiments, the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention comprises a light chain variable region comprising a CDRL1, a CDRL2, and a CDRL3, wherein: (a) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 109, 120 and 127, respectively; (b) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 110, 121 and 128, respectively; (c) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 111, 17 and 129, respectively; (d) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 109, 122 and 127, respectively; (e) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 112, 14 and 130, respectively; (f) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 113, 123 and 131, respectively; (g) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 114, 124 and 132, respectively; (h) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 115, 18 and 133, respectively; (i) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 116, 124 and 132, respectively; (j) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 117, 125 and 134, respectively; (k) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 118, 124 and 132, respectively; or (l) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 119, 126 and 135, respectively.

[0083] In other particular embodiments, the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention comprises a heavy chain variable region comprising a CDRH1, a CDRH2, and a CDRH3, wherein: (a) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 167 and 179, respectively; (b) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 168 and 179, respectively; (c) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 180, respectively; (d)

CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 181, respectively; (e) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 170 and 182, respectively; (f) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 171 and 182, respectively; (g) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 172 and 179, respectively; (h) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 162, 173 and 183, respectively; (i) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 163, 174 and 184, respectively; (j) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 175 and 185, respectively; (k) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 164, 176 and 186, respectively; (l) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 165, 177 and 187, respectively; (m) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 166, 178 and 188, respectively; or (n) CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 189, respectively.

[0084] In certain embodiments, the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention comprises a light chain variable region comprising a CDRL1, a CDRL2, and a CDRL3 and a heavy chain variable region comprising a CDRH1, a CDRH2, and a CDRH3, wherein:

(a) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 109, 120 and 127, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 167 and 179, respectively;

(b) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 109, 120 and 127, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 168 and 179, respectively;

(c) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 110, 121 and 128, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 180, respectively;

(d) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 110, 121 and 128, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 181, respectively;

(e) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 111, 17 and 129, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 170 and 182, respectively;

(f) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 111, 17 and 129, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 171 and 182, respectively;

(g) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 109, 122 and 127, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 172 and 179, respectively;

(h) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 112, 14 and 130, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 162, 173 and 183, respectively;

(i) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 113, 123 and 131, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 163, 174 and 184, respectively;

(j) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 114, 124 and 132, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 175 and 185, respectively;

(k) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 115, 18 and 133, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 164, 176 and 186, respectively;

(l) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 116, 124 and 132, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 175 and 185, respectively;

(m) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 117, 125 and 134, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 165, 177 and 187, respectively;

(n) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 118, 124 and 132, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 175 and 185, respectively;

(o) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 119, 126 and 135, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 166, 178 and 188, respectively; or

(p) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 110, 121 and 128, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 189, respectively.

[0085] In some embodiments, the anti-CGRP receptor binding domain of the bispecific antigen binding proteins of the invention comprises a light chain variable region comprising a CDRL1, a CDRL2, and a CDRL3 and a heavy chain variable region comprising a CDRH1, a CDRH2, and a CDRH3, wherein:

(a) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 109, 120 and 127, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 167 and 179, respectively;

(b) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 109, 120 and 127, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 168 and 179, respectively;

(c) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 110, 121 and 128, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 180, respectively;

(d) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 110, 121 and 128, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 181, respectively;

(e) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 111, 17 and 129, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 170 and 182, respectively; or

(f) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 111, 17 and 129, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 171 and 182, respectively.

[0086] The anti-CGRP receptor binding domain of the antigen binding proteins of the invention may comprise a light chain variable region selected from the group consisting of LV-101, LV-102, LV-103, LV-104, LV-105, LV-106, LV-107, LV-108, LV-109, LV-110, LV-111, LV-112,

LV-113, LV-114, LV-115, LV-116, LV-117, LV-118, LV-119, LV-120, LV-121, LV-122, and LV-123, as shown in Table 3A, and/or a heavy chain variable region selected from the group consisting of HV-101, HV-102, HV-103, HV-104, HV-105, HV-106, HV-107, HV-108, HV-109, HV-110, HV-111, HV-112, HV-113, HV-114, HV-115, HV-116, HV-117, HV-118, HV-119, HV-120, and HV-121, as shown in Table 3B, and functional fragments, derivatives, muteins and variants of these light chain and heavy chain variable regions.

[0087] Each of the light chain variable regions listed in Table 3A may be combined with any of the heavy chain variable regions shown in Table 3B to form an anti-CGRP receptor binding domain suitable for incorporation into the bispecific antigen binding proteins of the invention. Examples of such combinations include, but are not limited to: LV-101 and HV-101; LV-102 and HV-102; LV-103 and HV-103; LV-104 and HV-104; LV-105 and HV-105; LV-106 and HV-106; LV-105 and HV-107; LV-106 and HV-108; LV-107 and HV-105; LV-108 and HV-106; LV-109 and HV-105; LV-110 and HV-106; LV-107 and HV-107; LV-108 and HV-108; LV-111 and HV-109; LV-112 and HV-110; LV-111 and HV-111; LV-112 and HV-112; LV-113 and HV-105; LV-114 and HV-113; LV-115 and HV-114; LV-116 and HV-115; LV-117 and HV-116; LV-118 and HV-117; LV-119 and HV-116; LV-120 and HV-105; LV-121 and HV-118; LV-122 and HV-116; LV-123 and HV-119; LV-101 and HV-120; and LV-107 and HV-121. In certain embodiments, the anti-CGRP receptor binding domain comprises: (a) LV-101 (SEQ ID NO: 136) and HV-101 (SEQ ID NO: 190); (b) LV-103 (SEQ ID NO: 138) and HV-103 (SEQ ID NO: 192); (c) LV-105 (SEQ ID NO: 140) and HV-105 (SEQ ID NO: 194); (d) LV-105 (SEQ ID NO: 140) and HV-107 (SEQ ID NO: 196); (e) LV-107 (SEQ ID NO: 142) and HV-105 (SEQ ID NO: 194); (f) LV-109 (SEQ ID NO: 144) and HV-105 (SEQ ID NO: 194); (g) LV-107 (SEQ ID NO: 142) and HV-107 (SEQ ID NO: 196); (h) LV-111 (SEQ ID NO: 146) and HV-109 (SEQ ID NO: 198); or (i) LV-111 (SEQ ID NO: 146) and HV-111 (SEQ ID NO: 200).

[0088] In some embodiments, the anti-CGRP receptor binding domain comprises a light chain variable region comprising a sequence of contiguous amino acids that differs from the sequence of a light chain variable region in Table 3A, i.e. a VL selected from LV-101, LV-102, LV-103, LV-104, LV-105, LV-106, LV-107, LV-108, LV-109, LV-110, LV-111, LV-112, LV-113, LV-114, LV-115, LV-116, LV-117, LV-118, LV-119, LV-120, LV-121, LV-122, and LV-123 at only 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15 amino acid residues, wherein each such sequence difference is independently either a deletion, insertion or substitution of one amino

acid, with the deletions, insertions and/or substitutions resulting in no more than 15 amino acid changes relative to the foregoing variable domain sequences. The light chain variable region in some anti-CGRP binding domains comprises a sequence of amino acids that has at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 97% or at least 99% sequence identity to the amino acid sequences of SEQ ID NOs: 136-158 (i.e. the light chain variable regions in Table 3A).

[0089] In these and other embodiments, the anti-CGRP receptor binding domain comprises a heavy chain variable region comprising a sequence of contiguous amino acids that differs from the sequence of a heavy chain variable region in Table 3B, i.e., a VH selected from HV-101, HV-102, HV-103, HV-104, HV-105, HV-106, HV-107, HV-108, HV-109, HV-110, HV-111, HV-112, HV-113, HV-114, HV-115, HV-116, HV-117, HV-118, HV-119, HV-120, and HV-121 at only 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 or 15 amino acid residues, wherein each such sequence difference is independently either a deletion, insertion or substitution of one amino acid, with the deletions, insertions and/or substitutions resulting in no more than 15 amino acid changes relative to the foregoing variable domain sequences. The heavy chain variable region in some anti-CGRP receptor binding domains comprises a sequence of amino acids that has at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 97% or at least 99% sequence identity to the amino acid sequences of SEQ ID NOs: 190-210 (i.e. the heavy chain variable regions in Table 3B).

[0090] In certain embodiments, the bispecific antigen binding proteins of the invention are antibodies. As used herein, the term “antibody” refers to a tetrameric immunoglobulin protein comprising two light chain polypeptides (about 25 kDa each) and two heavy chain polypeptides (about 50-70 kDa each). The term “light chain” or “immunoglobulin light chain” refers to a polypeptide comprising, from amino terminus to carboxyl terminus, a single immunoglobulin light chain variable region (VL) and a single immunoglobulin light chain constant domain (CL). The immunoglobulin light chain constant domain (CL) can be kappa (κ) or lambda (λ). The term “heavy chain” or “immunoglobulin heavy chain” refers to a polypeptide comprising, from amino terminus to carboxyl terminus, a single immunoglobulin heavy chain variable region (VH), an immunoglobulin heavy chain constant domain 1 (CH1), an immunoglobulin hinge region, an immunoglobulin heavy chain constant domain 2 (CH2), an immunoglobulin heavy chain constant domain 3 (CH3), and optionally an immunoglobulin heavy chain constant domain 4

(CH4). Heavy chains are classified as mu (μ), delta (Δ), gamma (γ), alpha (α), and epsilon (ϵ), and define the antibody's isotype as IgM, IgD, IgG, IgA, and IgE, respectively. The IgG-class and IgA-class antibodies are further divided into subclasses, namely, IgG1, IgG2, IgG3, and IgG4, and IgA1 and IgA2, respectively. The heavy chains in IgG, IgA, and IgD antibodies have three domains (CH1, CH2, and CH3), whereas the heavy chains in IgM and IgE antibodies have four domains (CH1, CH2, CH3, and CH4). The immunoglobulin heavy chain constant domains can be from any immunoglobulin isotype, including subtypes. The antibody chains are linked together via inter-polypeptide disulfide bonds between the CL domain and the CH1 domain (i.e. between the light and heavy chain) and between the hinge regions of the antibody heavy chains.

[0091] In particular embodiments, the bispecific antigen binding proteins of the invention are heterodimeric antibodies (used interchangeably herein with “hetero immunoglobulins” or “hetero Igs”), which refer to antibodies comprising two different light chains and two different heavy chains. For instance, in some embodiments, the heterodimeric antibody comprises a light chain and heavy chain from an anti-PAC1 receptor antibody and a light chain and heavy chain from an anti-CGRP receptor antibody. *See* Figure 1.

[0092] The heterodimeric antibodies can comprise any immunoglobulin constant region. The term “constant region” as used herein refers to all domains of an antibody other than the variable region. The constant region is not involved directly in binding of an antigen, but exhibits various effector functions. As described above, antibodies are divided into particular isotypes (IgA, IgD, IgE, IgG, and IgM) and subtypes (IgG1, IgG2, IgG3, IgG4, IgA1 IgA2) depending on the amino acid sequence of the constant region of their heavy chains. The light chain constant region can be, for example, a kappa- or lambda-type light chain constant region, e.g., a human kappa- or lambda-type light chain constant region, which are found in all five antibody isotypes. Examples of human immunoglobulin light chain constant region sequences are shown in the following table.

Table 4. Exemplary Human Immunoglobulin Light Chain Constant Regions

Designation	SEQ ID NO:	CL Domain Amino Acid Sequence
CL-1	353	GQPKANPTVTLFPPSSEELQANKATLVCLISDFYPGAVTVAWKADGSPVKAGVETTKPSKQSNKYAASSYLSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPTECS
CL-2	354	GQPKAAPSVTLFPPSSEELQANKATLVCLISDFYPGAVTVAWKADSSPVKAGVETTPSKQSNKYAASSYLSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPTECS
CL-3	355	GQPKAAPSVTLFPPSSEELQANKATLVCLISDFYPGAVTVAWKADSSPVKAGV

Designation	SEQ ID NO:	CL Domain Amino Acid Sequence
		ETTTPSKQSNNKYAASSYLSLTPEQWKSHKSYSCQVTHEGSTVEKTVAPTECS
CL-7	356	GQPKAAPSVTLFPPSSEELQANKATLVCLVSDFYPGA VTVAWKADGSPVKVG VETTKPSKQSNNKYAASSYLSLTPEQWKSHRSYSCRVTHEGSTVEKTVAPAEC S

[0093] The heavy chain constant region of the heterodimeric antibodies can be, for example, an alpha-, delta-, epsilon-, gamma-, or mu-type heavy chain constant region, e.g., a human alpha-, delta-, epsilon-, gamma-, or mu-type heavy chain constant region. In some embodiments, the heterodimeric antibodies comprise a heavy chain constant region from an IgG1, IgG2, IgG3, or IgG4 immunoglobulin. In one embodiment, the heterodimeric antibody comprises a heavy chain constant region from a human IgG1 immunoglobulin. In another embodiment, the heterodimeric antibody comprises a heavy chain constant region from a human IgG2 immunoglobulin.

Examples of human IgG1 and IgG2 heavy chain constant region sequences are shown below in Table 5.

Table 5. Exemplary Human Immunoglobulin Heavy Chain Constant Regions

Ig isotype	SEQ ID NO:	Heavy Chain Constant Region Amino Acid Sequence
Human IgG1z	357	ASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALTSGVHTFPAV LQSSGLYSLSSVTVTPSSSLGTQTYICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCP APPELLGGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVH NAKTKPREEQYNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAK GQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTPP VLDSGDGSFFLYSKLTVDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGK
Human IgG1za	358	ASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALTSGVHTFPAV LQSSGLYSLSSVTVTPSSSLGTQTYICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCP APPELLGGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVH NAKTKPREEQYNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAK GQPREPQVYTLPPSRDELTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTPP VLDSGDGSFFLYSKLTVDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGK
Human IgG1f	359	ASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALTSGVHTFPAV LQSSGLYSLSSVTVTPSSSLGTQTYICNVNHKPSNTKVDKRVKPKSCDKTHTCPPCP APPELLGGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVH NAKTKPREEQYNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAK GQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTPP VLDSGDGSFFLYSKLTVDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGK
Human IgG1fa	360	ASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALTSGVHTFPAV LQSSGLYSLSSVTVTPSSSLGTQTYICNVNHKPSNTKVDKRVKPKSCDKTHTCPPCP APPELLGGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVH NAKTKPREEQYNSTYRVVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAK GQPREPQVYTLPPSRDELTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTPP VLDSGDGSFFLYSKLTVDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGK
Human	361	ASTKGPSVFPLAPCSRSTSESTAALGCLVKDYFPEPVTVSWNSGALTSGVHTFPAV

Ig isotype	SEQ ID NO:	Heavy Chain Constant Region Amino Acid Sequence
IgG2		LQSSGLYSLSSVVTVPSSNFGTQTYTCNVDPKPSNTKVDKTVERKCCVECPCPAP PVAGPSVFLFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVQFNWYVDGVEVHNAK TKPREEQFNSTFRVVSVLTVVHQDWLNGKEYKCKVSNKGLPAPIEKTISKTKGQPR EPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTTPMLDS DGSFFLYSKLTVDKSRWQQGNVFCFSVMHEALHNHYTQKSLSLSPGK

[0094] Each of the variable regions disclosed in Tables 1A, 1B, 3A, and 3B may be attached to the above light and heavy chain constant regions to form complete antibody light and heavy chains, respectively. Further, each of the so generated heavy and light chain polypeptides may be combined to form a complete bispecific antibody structure, e.g. a heterodimeric antibody. It should be understood that the heavy chain and light chain variable regions provided herein can also be attached to other constant domains having different sequences than the exemplary sequences listed above.

[0095] To facilitate assembly of the light and heavy chains from the anti-PAC1 receptor antibody and the light and heavy chains from the anti-CGRP receptor antibody into a bispecific, heterodimeric antibody, the light chains and/or heavy chains from each antibody can be engineered to reduce the formation of mispaired molecules. For example, one approach to promote heterodimer formation over homodimer formation is the so-called “knobs-into-holes” method, which involves introducing mutations into the CH3 domains of two different antibody heavy chains at the contact interface. Specifically, one or more bulky amino acids in one heavy chain are replaced with amino acids having short side chains (e.g. alanine or threonine) to create a “hole,” whereas one or more amino acids with large side chains (e.g. tyrosine or tryptophan) are introduced into the other heavy chain to create a “knob.” When the modified heavy chains are co-expressed, a greater percentage of heterodimers (knob-hole) are formed as compared to homodimers (hole-hole or knob-knob). The “knobs-into-holes” methodology is described in detail in WO 96/027011; Ridgway *et al.*, Protein Eng., Vol. 9: 617-621, 1996; and Merchant *et al.*, Nat, Biotechnol., Vol. 16: 677-681, 1998, all of which are hereby incorporated by reference in their entireties.

[0096] Another approach for promoting heterodimer formation to the exclusion of homodimer formation entails utilizing an electrostatic steering mechanism (*see* Gunasekaran *et al.*, J. Biol. Chem., Vol. 285: 19637-19646, 2010, which is hereby incorporated by reference in its entirety). This approach involves introducing or exploiting charged residues in the CH3 domain in each

heavy chain so that the two different heavy chains associate through opposite charges that cause electrostatic attraction. Homodimerization of the identical heavy chains are disfavored because the identical heavy chains have the same charge and therefore are repelled. This same electrostatic steering technique can be used to prevent mispairing of light chains with the non-cognate heavy chains by introducing residues having opposite charges in the correct light chain – heavy chain pair at the binding interface. The electrostatic steering technique and suitable charge pair mutations for promoting heterodimers and correct light chain/heavy chain pairing is described in WO2009089004 and WO2014081955, both of which are hereby incorporated by reference in their entireties.

[0097] In embodiments in which the bispecific antigen binding proteins of the invention are heterodimeric antibodies comprising a first light chain (LC1) and first heavy chain (HC1) from a first antibody that specifically binds to human CGRP receptor and a second light chain (LC2) and second heavy chain (HC2) from a second antibody that specifically binds to human PAC1 receptor, HC1 or HC2 may comprise one or more amino acid substitutions to replace a positively-charged amino acid with a negatively-charged amino acid. For instance, in one embodiment, the CH3 domain of HC1 or the CH3 domain of HC2 comprises an amino acid sequence differing from a wild-type IgG amino acid sequence such that one or more positively-charged amino acids (e.g., lysine, histidine and arginine) in the wild-type human IgG amino acid sequence are replaced with one or more negatively-charged amino acids (e.g., aspartic acid and glutamic acid) at the corresponding position(s) in the CH3 domain. In these and other embodiments, amino acids (e.g. lysine) at one or more positions selected from 370, 392 and 409 (EU numbering system) are replaced with a negatively-charged amino acid (e.g., aspartic acid and glutamic acid). Unless indicated otherwise, throughout the present specification and claims, the numbering of the residues in an immunoglobulin heavy chain or light chain is according to Kabat-EU numbering as described in Kabat *et al.*, Sequences of Proteins of Immunological Interest, 5th Ed. Public Health Service, National Institutes of Health, Bethesda, MD (1991). An amino acid substitution in an amino acid sequence is typically designated herein with a one-letter abbreviation for the amino acid residue in a particular position, followed by the numerical amino acid position relative to an original sequence of interest, which is then followed by the one-letter symbol for the amino acid residue substituted in. For example, “T30D” symbolizes a substitution of a threonine residue by an aspartate residue at amino acid position 30, relative to

the original sequence of interest. Another example, “S218G” symbolizes a substitution of a serine residue by a glycine residue at amino acid position 218, relative to the original amino acid sequence of interest.

[0098] In certain embodiments, HC1 or HC2 of the heterodimeric antibodies may comprise one or more amino acid substitutions to replace a negatively-charged amino acid with a positively-charged amino acid. For instance, in one embodiment, the CH3 domain of HC1 or the CH3 domain of HC2 comprises an amino acid sequence differing from wild-type IgG amino acid sequence such that one or more negatively-charged amino acids in the wild-type human IgG amino acid sequence are replaced with one or more positively-charged amino acids at the corresponding position(s) in the CH3 domain. In these and other embodiments, amino acids (e.g., aspartic acid or glutamic acid) at one or more positions selected from 356, 357, and 399 (EU numbering system) of the CH3 domain are replaced with a positively-charged amino acid (e.g., lysine, histidine and arginine).

[0099] In particular embodiments, the heterodimeric antibody comprises a first heavy chain comprising negatively-charged amino acids at positions 392 and 409 (e.g., K392D and K409D substitutions), and a second heavy chain comprising positively-charged amino acids at positions 356 and 399 (e.g., E356K and D399K substitutions). In other particular embodiments, the heterodimeric antibody comprises a first heavy chain comprising negatively-charged amino acids at positions 392, 409, and 370 (e.g., K392D, K409D, and K370D substitutions), and a second heavy chain comprising positively-charged amino acids at positions 356, 399, and 357 (e.g., E356K, D399K, and E357K substitutions). In related embodiments, the first heavy chain is from an anti-CGRP receptor antibody and the second heavy chain is from an anti-PAC1 receptor antibody. In other related embodiments, the first heavy chain is from an anti-PAC1 receptor antibody and the second heavy chain is from an anti-CGRP receptor antibody.

[0100] To facilitate the association of a particular heavy chain with its cognate light chain, both the heavy and light chains may contain complimentary amino acid substitutions. As used herein, “complimentary amino acid substitutions” refer to a substitution to a positively-charged amino acid in one chain paired with a negatively-charged amino acid substitution in the other chain. For example, in some embodiments, the heavy chain comprises at least one amino acid substitution to introduce a charged amino acid and the corresponding light chain comprises at least one amino acid substitution to introduce a charged amino acid, wherein the charged amino

acid introduced into the heavy chain has the opposite charge of the amino acid introduced into the light chain. In certain embodiments, one or more positively-charged residues (e.g., lysine, histidine or arginine) can be introduced into a first light chain (LC1) and one or more negatively-charged residues (e.g., aspartic acid or glutamic acid) can be introduced into the companion heavy chain (HC1) at the binding interface of LC1/HC1, whereas one or more negatively-charged residues (e.g., aspartic acid or glutamic acid) can be introduced into a second light chain (LC2) and one or more positively-charged residues (e.g., lysine, histidine or arginine) can be introduced into the companion heavy chain (HC2) at the binding interface of LC2/HC2. The electrostatic interactions will direct the LC1 to pair with HC1 and LC2 to pair with HC2, as the opposite charged residues (polarity) at the interface attract. The heavy/light chain pairs having the same charged residues (polarity) at an interface (e.g. LC1/HC2 and LC2/HC1) will repel, resulting in suppression of the unwanted HC/LC pairings.

[0101] In these and other embodiments, the CH1 domain of the heavy chain or the CL domain of the light chain comprises an amino acid sequence differing from wild-type IgG amino acid sequence such that one or more positively-charged amino acids in wild-type IgG amino acid sequence is replaced with one or more negatively-charged amino acids. Alternatively, the CH1 domain of the heavy chain or the CL domain of the light chain comprises an amino acid sequence differing from wild-type IgG amino acid sequence such that one or more negatively-charged amino acids in wild-type IgG amino acid sequence is replaced with one or more positively-charged amino acids. In some embodiments, one or more amino acids in the CH1 domain of the first and/or second heavy chain in the heterodimeric antibody at an EU position selected from F126, P127, L128, A141, L145, K147, D148, H168, F170, P171, V173, Q175, S176, S183, V185 and K213 is replaced with a charged amino acid. In certain embodiments, a preferred residue for substitution with a negatively- or positively- charged amino acid is S183 (EU numbering system). In some embodiments, S183 is substituted with a positively-charged amino acid. In alternative embodiments, S183 is substituted with a negatively-charged amino acid. For instance, in one embodiment, S183 is substituted with a negatively-charged amino acid (e.g. S183E) in the first heavy chain, and S183 is substituted with a positively-charged amino acid (e.g. S183K) in the second heavy chain.

[0102] In embodiments in which the light chain is a kappa light chain, one or more amino acids in the CL domain of the first and/or second light chain in the heterodimeric antibody at a position

(EU and Kabat numbering in a kappa light chain) selected from F116, F118, S121, D122, E123, Q124, S131, V133, L135, N137, N138, Q160, S162, T164, S174 and S176 is replaced with a charged amino acid. In embodiments in which the light chain is a lambda light chain, one or more amino acids in the CL domain of the first and/or second light chain in the heterodimeric antibody at a position (Kabat numbering in a lambda chain) selected from T116, F118, S121, E123, E124, K129, T131, V133, L135, S137, E160, T162, S165, Q167, A174, S176 and Y178 is replaced with a charged amino acid. In some embodiments, a preferred residue for substitution with a negatively- or positively- charged amino acid is S176 (EU and Kabat numbering system) of the CL domain of either a kappa or lambda light chain. In certain embodiments, S176 of the CL domain is replaced with a positively-charged amino acid. In alternative embodiments, S176 of the CL domain is replaced with a negatively-charged amino acid. In one embodiment, S176 is substituted with a positively-charged amino acid (e.g. S176K) in the first light chain, and S176 is substituted with a negatively-charged amino acid (e.g. S176E) in the second light chain.

[0103] In addition to or as an alternative to the complimentary amino acid substitutions in the CH1 and CL domains, the variable regions of the light and heavy chains in the heterodimeric antibody may contain one or more complimentary amino acid substitutions to introduce charged amino acids. For instance, in some embodiments, the VH region of the heavy chain or the VL region of the light chain of a heterodimeric antibody comprises an amino acid sequence differing from wild-type IgG amino acid sequence such that one or more positively-charged amino acids in wild-type IgG amino acid sequence is replaced with one or more negatively-charged amino acids. Alternatively, the VH region of the heavy chain or the VL region of the light chain comprises an amino acid sequence differing from wild-type IgG amino acid sequence such that one or more negatively-charged amino acids in wild-type IgG amino acid sequence is replaced with one or more positively-charged amino acids.

[0104] V region interface residues (i.e., amino acid residues that mediate assembly of the VH and VL regions) within the VH region include Kabat positions 1, 3, 35, 37, 39, 43, 44, 45, 46, 47, 50, 59, 89, 91, and 93. One or more of these interface residues in the VH region can be substituted with a charged (positively- or negatively-charged) amino acid. In certain embodiments, the amino acid at Kabat position 39 in the VH region of the first and/or second heavy chain is substituted for a positively-charged amino acid, e.g., lysine. In alternative embodiments, the amino acid at Kabat position 39 in the VH region of the first and/or second

heavy chain is substituted for a negatively-charged amino acid, e.g., glutamic acid. In some embodiments, the amino acid at Kabat position 39 in the VH region of the first heavy chain is substituted for a negatively-charged amino acid (e.g. G39E), and the amino acid at Kabat position 39 in the VH region of the second heavy chain is substituted for a positively-charged amino acid (e.g. G39K). In some embodiments, the amino acid at Kabat position 44 in the VH region of the first and/or second heavy chain is substituted for a positively-charged amino acid, e.g., lysine. In alternative embodiments, the amino acid at Kabat position 44 in the VH region of the first and/or second heavy chain is substituted for a negatively-charged amino acid, e.g., glutamic acid. In certain embodiments, the amino acid at Kabat position 44 in the VH region of the first heavy chain is substituted for a negatively-charged amino acid (e.g. G44E), and the amino acid at Kabat position 44 in the VH region of the second heavy chain is substituted for a positively-charged amino acid (e.g. G44K).

[0105] V region interface residues (i.e., amino acid residues that mediate assembly of the VH and VL regions) within the VL region include Kabat positions 32, 34, 35, 36, 38, 41, 42, 43, 44, 45, 46, 48, 49, 50, 51, 53, 54, 55, 56, 57, 58, 85, 87, 89, 90, 91, and 100. One or more interface residues in the VL region can be substituted with a charged amino acid, preferably an amino acid that has an opposite charge to those introduced into the VH region of the cognate heavy chain. In some embodiments, the amino acid at Kabat position 100 in the VL region of the first and/or second light chain is substituted for a positively-charged amino acid, e.g., lysine. In alternative embodiments, the amino acid at Kabat position 100 in the VL region of the first and/or second light chain is substituted for a negative-charged amino acid, e.g., glutamic acid. In certain embodiments, the amino acid at Kabat position 100 in the VL region of the first light chain is substituted for a positively-charged amino acid (e.g. G100K), and the amino acid at Kabat position 100 in the VL region of the second light chain is substituted for a negatively-charged amino acid (e.g. G100E).

[0106] In certain embodiments, a heterodimeric antibody of the invention comprises a first heavy chain and a second heavy chain and a first light chain and a second light chain, wherein the first heavy chain comprises amino acid substitutions at positions 44 (Kabat), 183 (EU), 392 (EU) and 409 (EU), wherein the second heavy chain comprises amino acid substitutions at positions 44 (Kabat), 183 (EU), 356 (EU) and 399 (EU), wherein the first and second light chains comprise an amino acid substitution at positions 100 (Kabat) and 176 (EU), and wherein

the amino acid substitutions introduce a charged amino acid at said positions. In related embodiments, the glycine at position 44 (Kabat) of the first heavy chain is replaced with glutamic acid, the glycine at position 44 (Kabat) of the second heavy chain is replaced with lysine, the glycine at position 100 (Kabat) of the first light chain is replaced with lysine, the glycine at position 100 (Kabat) of the second light chain is replaced with glutamic acid, the serine at position 176 (EU) of the first light chain is replaced with lysine, the serine at position 176 (EU) of the second light chain is replaced with glutamic acid, the serine at position 183 (EU) of the first heavy chain is replaced with glutamic acid, the lysine at position 392 (EU) of the first heavy chain is replaced with aspartic acid, the lysine at position 409 (EU) of the first heavy chain is replaced with aspartic acid, the serine at position 183 (EU) of the second heavy chain is replaced with lysine, the glutamic acid at position 356 (EU) of the second heavy chain is replaced with lysine, and/or the aspartic acid at position 399 (EU) of the second heavy chain is replaced with lysine.

[0107] In other embodiments, a heterodimeric antibody of the invention comprises a first heavy chain and a second heavy chain and a first light chain and a second light chain, wherein the first heavy chain comprises amino acid substitutions at positions 183 (EU), 392 (EU) and 409 (EU), wherein the second heavy chain comprises amino acid substitutions at positions 183 (EU), 356 (EU) and 399 (EU), wherein the first and second light chains comprise an amino acid substitution at position 176 (EU), and wherein the amino acid substitutions introduce a charged amino acid at said positions. In related embodiments, the serine at position 176 (EU) of the first light chain is replaced with lysine, the serine at position 176 (EU) of the second light chain is replaced with glutamic acid, the serine at position 183 (EU) of the first heavy chain is replaced with glutamic acid, the lysine at position 392 (EU) of the first heavy chain is replaced with aspartic acid, the lysine at position 409 (EU) of the first heavy chain is replaced with aspartic acid, the serine at position 183 (EU) of the second heavy chain is replaced with lysine, the glutamic acid at position 356 (EU) of the second heavy chain is replaced with lysine, and/or the aspartic acid at position 399 (EU) of the second heavy chain is replaced with lysine.

[0108] In still other embodiments, a heterodimeric antibody of the invention comprises a first heavy chain and a second heavy chain and a first light chain and a second light chain, wherein the first heavy chain comprises amino acid substitutions at positions 183 (EU), 392 (EU), 409 (EU), and 370 (EU), wherein the second heavy chain comprises amino acid substitutions at

positions 183 (EU), 356 (EU), 399 (EU), and 357 (EU), wherein the first and second light chains comprise an amino acid substitution at position 176 (EU), and wherein the amino acid substitutions introduce a charged amino acid at said positions. In related embodiments, the serine at position 176 (EU) of the first light chain is replaced with lysine, the serine at position 176 (EU) of the second light chain is replaced with glutamic acid, the serine at position 183 (EU) of the first heavy chain is replaced with glutamic acid, the lysine at position 392 (EU) of the first heavy chain is replaced with aspartic acid, the lysine at position 409 (EU) of the first heavy chain is replaced with aspartic acid, the lysine at position 370 (EU) of the first heavy chain is replaced with aspartic acid, the serine at position 183 (EU) of the second heavy chain is replaced with lysine, the glutamic acid at position 356 (EU) of the second heavy chain is replaced with lysine, the aspartic acid at position 399 (EU) of the second heavy chain is replaced with lysine, and/or the glutamic acid at position 357 (EU) of the second heavy chain is replaced with lysine.

[0109] Any of the constant domains, anti-PAC1 receptor variable regions, and anti-CGRP receptor variable regions described herein can be modified to contain one or more of the charge pair mutations described above to facilitate correct assembly of a heterodimeric antibody.

Exemplary full-length light chain sequences and full-length heavy chain sequences from anti-PAC1 receptor antibodies containing one or more charge pair mutations suitable for use in the heterodimeric antibodies of the invention are shown in Table 6A and Table 6B, respectively.

Table 6A. Exemplary Anti-PAC1 Receptor Light Chain Sequences

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
01A, 01C, 01D	LC-01	DIQMTQSPSSLSASVGDRTITCRA SQSISRYLNWYQQKPGKAPKLLIY AASSLQSGIPSRFSGSGSDFTLT INSLQPEDFATYFCQSQSYSPFTFG PGTKVDIKRTVAAPSVFIFPPSDEQ LKSGTASVVCLLNNFYPREAKVQ WKVDNALQSGNSQESVTEQDSK DSTYSLESTLTLSKADYEKHKVY ACEVTHQGLSSPVTKSFNRGEC (SEQ ID NO: 211)	GACATCCAGATGACCCAGTCTCCATCCTCCC TGTCTGCATCTGTAGGAGACAGAATCACCA TCACTTGCCGGGCAAGTCAGAGCATTAGCA GGTATTTAAATTGGTATCAACAGAAACCAG GGAAAGCCCCCTAAACTCCTGATCTATGCTG CATCCAGTTTGCAAAGTGGGATCCCATCAA GGTTCAGCGGCAGTGGATCTGGGACAGATT TCACTCTCACCATCAACAGTCTGCAACCTGA AGATTTTGCAACTTACTTCTGTCAACAGAGT TACAGTCCCCCATTCACTTTCGGCCCTGGGA CCAAAGTGGATATCAAACGTACGGTGGCTG CACCATCTGTCTTCATCTTCCCGCCATCTGA TGAGCAGTTGAAATCTGGAAGTGCCTCTGTT GTGTGCCTGCTGAATAACTTCTATCCCAGAG AGGCCAAAGTACAGTGGAAGGTGGATAAC GCCCTCCAATCGGGTAACTCCCAGGAGAGT GTCACAGAGCAGGACAGCAAGGACAGCAC

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
			CTACAGCCTCGAGAGCACCCCTGACGCTGAG CAAAGCAGACTACGAGAAACACAAAGTCTA CGCCTGCGAAGTCACCCATCAGGGCCTGAG CTCGCCCGTCACAAAGAGCTTCAACAGGGG AGAGTGT (SEQ ID NO: 222)
01B	LC-02	DIQMTQSPSSLSASVGDRTITCRA SQSISRYLNWYQQKPGKAPKLLIY AASSLQSGIPSRFSGSGSGTDFLT INSLQPEDFATYFCQQSYSPPTFG EGTKVDIKRTVAAPSVFIFPPSDE QLKSGTASVCLNNFYPREAKV QWKVDNALQSGNSQESVTEQDS KDSTYSLESTLTLSKADYEKHKV YACEVTHQGLSSPVTKSFNRGEC (SEQ ID NO: 212)	GACATCCAGATGACCCAGTCTCCATCCTCCC TGTCTGCATCTGTAGGAGACAGAATCACCA TCACTTGCCGGGCAAGTCAGAGCATTAGCA GGTATTTAAATTGGTATCAACAGAAACCAG GGAAAGCCCCCTAAACTCCTGATCTATGCTG CATCCAGTTTGCAAAGTGGGATCCCATCAA GGTTCAGCGGCAGTGGATCTGGGACAGATT TCACTCTCACCATCAACAGTCTGCAACCTGA AGATTTTGCAACTTACTTCTGTCAACAGAGT TACAGTCCCCCATTCACTTTCGGCGAGGGG ACCAAAGTGGATATCAAACGTACGGTGGCT GCACCATCTGTCTTCATCTTCCCGCCATCTG ATGAGCAGTTGAAATCTGGAAGTGCCTCTG TTGTGTGCCTGCTGAATAACTTCTATCCCAG AGAGGCCAAAGTACAGTGGAAGGTGGATA ACGCCCTCCAATCGGGTAACCTCCAGGAGA GTGTCACAGAGCAGGACAGCAAGGACAGC ACCTACAGCCTCGAGAGCACCCCTGACGCTG AGCAAAGCAGACTACGAGAAACACAAAGT CTACGCCTGCGAAGTCACCCATCAGGGCCT GAGCTCGCCCGTCACAAAGAGCTTCAACAG GGGAGAGTGT (SEQ ID NO: 223)
02A, 02C	LC-03	DIQMTQSPSSLSASVGDRTITCRA SQSISRYLNWYQQKPGKAPKLLIY AASSLQSGIPSRFSGSGSGTDFLT INSLQPEDFATYFCQQSYSPPTFG QGTKVDIKRTVAAPSVFIFPPSDE QLKSGTASVCLNNFYPREAKV QWKVDNALQSGNSQESVTEQDS KDSTYSLESTLTLSKADYEKHKV YACEVTHQGLSSPVTKSFNRGEC (SEQ ID NO: 213)	GACATCCAGATGACCCAGTCTCCATCCTCCC TGTCTGCATCTGTAGGAGACAGAATCACCA TCACTTGCCGGGCAAGTCAGAGCATTAGCA GGTATTTAAATTGGTATCAACAGAAACCAG GGAAAGCCCCCTAAACTCCTGATCTATGCTG CATCCAGTTTGCAAAGTGGGATCCCATCAA GGTTCAGCGGCAGTGGATCTGGGACAGATT TCACTCTCACCATCAACAGTCTGCAACCTGA AGATTTTGCAACTTACTTCTGTCAACAGAGT TACAGTCCCCCATTCACTTTCGGCCAGGGG ACCAAAGTGGATATCAAACGTACGGTGGCT GCACCATCTGTCTTCATCTTCCCGCCATCTG ATGAGCAGTTGAAATCTGGAAGTGCCTCTG TTGTGTGCCTGCTGAATAACTTCTATCCCAG AGAGGCCAAAGTACAGTGGAAGGTGGATA ACGCCCTCCAATCGGGTAACCTCCAGGAGA GTGTCACAGAGCAGGACAGCAAGGACAGC ACCTACAGCCTCGAAAGCACCCCTGACGCTG AGCAAAGCAGACTACGAGAAACACAAAGT CTACGCCTGCGAAGTCACCCATCAGGGCCT GAGCTCGCCCGTCACAAAGAGCTTCAACAG GGGAGAGTGT (SEQ ID NO: 224)
03A, 03C, 03D	LC-04	DIQLTQSPSFLSASVGDRTITCRA SQSIGRSLHWYQQKPGKAPKLLIK YASQSLSGVPSRFSGSGSGTEFTL TISSLQPEDFATYYCHQSSRLPFTF GPGTKVDIKRTVAAPSVFIFPPSDE	GATATCCAGCTCACTCAATCGCCATCATTTT TCTCCGCTTCGGTAGGCGACCGGGTCACGA TCACATGCAGGGCGTCGCAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCG GAAAGGCCCGAAACTTCTGATCAAATACG

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
		QLKSGTASVVCLLNNFYPREAKV QWKVDNALQSGNSQESVTEQDS KDSTYSLESTLTLSKADYEKHKV YACEVTHQGLSSPVTKSFNREGC (SEQ ID NO: 214)	CATCACAAAGCTTGAGCGGTGTGCCGTCGC GCTTCTCCGGTTCCGGAAGCGGAACGGAAT TCACGCTTACAATCTCCTCACTGCAGCCCGA GGATTTTCGCGACCTATTACTGTCACCAGTCA TCCAGACTCCCGTTTACTTTTGGCCCTGGGA CCAAGGTGGACATTAAGCGTACGGTGGCTG CACCATCTGTCTTCATCTTCCCGCCATCTGA TGAGCAGTTGAAATCTGGAAGTGCCTCTGTT GTGTGCCTGCTGAATAACTTCTATCCCAGAG AGGCCAAAGTACAGTGGAAGGTGGATAAC GCCCTCCAATCGGGTAACTCCCAGGAGAGT GTCACAGAGCAGGACAGCAAGGACAGCAC CTACAGCCTCGAGAGCACCTTGACGCTGAG CAAAGCAGACTACGAGAAACACAAAGTCTA CGCCTGCGAAGTCACCCATCAGGGCCTGAG CTCGCCCGTCACAAAGAGCTTCAACAGGGG AGAGTGT (SEQ ID NO: 225)
03B	LC-05	DIQLTQSPSFLSASVGDRVTITCRA SQSIGRSLHWYQQKPGKAPKLLIK YASQSLSGVPSRFSGSGSGTEFTL TISSLQPEDFATYYCHQSSRLPFTF GEGTKVDIKRTVAAPSVFIFPPSD EQLKSGTASVVCLLNNFYPREAK VQWKVDNALQSGNSQESVTEQD SKDSTYSLESTLTLSKADYEKHK VYACEVTHQGLSSPVTKSFNREGC (SEQ ID NO: 215)	GATATCCAGCTCACTCAATCGCCATCATTTC TCTCCGCTTCGGTAGGCGACCGGGTCACGA TCACATGCAGGGCGTCGAAAGCATTGGGA GGTCGTTGCATTGGTATCAGAGAAACCCG GAAAGGCCCGGAAACTTCTGATCAAATACG CATCACAAAGCTTGAGCGGTGTGCCGTCGC GCTTCTCCGGTTCCGGAAGCGGAACGGAAT TCACGCTTACAATCTCCTCACTGCAGCCCGA GGATTTTCGCGACCTATTACTGTCACCAGTCA TCCAGACTCCCGTTTACTTTTGGCGAGGGGA CCAAGGTGGACATTAAGCGTACGGTGGCTG CACCATCTGTCTTCATCTTCCCGCCATCTGA TGAGCAGTTGAAATCTGGAAGTGCCTCTGTT GTGTGCCTGCTGAATAACTTCTATCCCAGAG AGGCCAAAGTACAGTGGAAGGTGGATAAC GCCCTCCAATCGGGTAACTCCCAGGAGAGT GTCACAGAGCAGGACAGCAAGGACAGCAC CTACAGCCTCGAGAGCACCTTGACGCTGAG CAAAGCAGACTACGAGAAACACAAAGTCTA CGCCTGCGAAGTCACCCATCAGGGCCTGAG CTCGCCCGTCACAAAGAGCTTCAACAGGGG AGAGTGT (SEQ ID NO: 226)
04A, 04C, 04D	LC-06	EIVLTQSPATLSLSPGERATLSCRA SQSVGRSLHWYQQKPGQAPRLLI KYASQSLSGIPARFSGSGSGTDFT LTISSLEPEDFAVYYCHQSSRLPFT FPGTKVDIKRTVAAPSVFIFPPSD EQLKSGTASVVCLLNNFYPREAK VQWKVDNALQSGNSQESVTEQD SKDSTYSLESTLTLSKADYEKHK VYACEVTHQGLSSPVTKSFNREGC (SEQ ID NO: 216)	GAGATCGTACTTACTCAGTCACCCGCCACA TTGTCCCTGAGCCCGGGTGAACGGGCGACC CTCAGCTGCCGAGCATCCAGTCCGTCGGA CGATCATTTGCACTGGTACCAACAAAACCG GGCCAGGCCCCAGACTTCTGATCAAGTAT GCGTCACAGAGCTTGTGGGTATTCCCGCTC GCTTTTCGGGGTTCGGGATCCGGGACAGATT TCACGCTCACAATCTCCTCGCTGGAACCCG AGGACTTCGCGGTCTACTATTGTCATCAGTC ATCGAGGTTGCCTTTACGTTTGGACCAGG GACCAAGGTGGACATTAAGCGTACGGTGGC TGCACCATCTGTCTTCATCTTCCCGCCATCT GATGAGCAGTTGAAATCTGGAAGTGCCTCT GTTGTGTGCCTGCTGAATAACTTCTATCCA GAGAGGCCAAAGTACAGTGGAAGGTGGAT

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
			AACGCCCTCCAATCGGGTAACTCCCAGGAG AGTGTACAGAGCAGGACAGCAAGGACAG CACCTACAGCCTCGAGAGCACCCTGACGCT GAGCAAAGCAGACTACGAGAAACACAAAG TCTACGCCTGCGAAGTCACCCATCAGGGCC TGAGCTCGCCCGTCACAAAGAGCTTCAACA GGGGAGAGTGT (SEQ ID NO: 227)
04B	LC-07	EIVLTQSPATLSLSPGERATLSCRA SQSVGRSLHWYQQKPGQAPRLLI KYASQSLSGIPARFSGSGSTDFLT LTISSLEPEDFAVYYCHQSSRLPFT FGEGTKVDIKRTVAAPSVFIFPPSD EQLKSGTASVVCLLNNFYPREAK VQWKVDNALQSGNSQESVTEQD SKDSTYSLESTLTLSKADYEKHK VYACEVTHQGLSSPVTKSFNRGE C (SEQ ID NO: 217)	GAGATCGTACTTACTCAGTCACCCGCCACA TTGTCCCTGAGCCCGGGTGAACGGGCGACC CTCAGCTGCCGAGCATCCAGTCCGTCCGA CGATCATTGCACTGGTACCAACAAAAACCG GGCCAGGCCCCCAGACTTCTGATCAAGTAT GCGTCACAGAGCTTGTCTGGGTATTCCCCTC GCTTTTCGGGGTTCGGGATCCGGGACAGATT TCACGCTCACAATCTCCTCGCTGGAACCCG AGGACTTCGCGGTCTACTATTGTCATCAGTC ATCGAGGTTGCCTTTCACGTTTGGAGAAGG GACCAAGGTGGACATTAAGCGTACGGTGGC TGCACCATCTGTCTTCATCTTCCC GCCATCT GATGAGCAGTTGAAATCTGGAAGTGCCTCT GTTGTGTGCCTGCTGAATAACTTCTATCCCA GAGAGGCCAAAGTACAGTGGAAGGTGGAT AACGCCCTCCAATCGGGTAACTCCCAGGAG AGTGTACAGAGCAGGACAGCAAGGACAG CACCTACAGCCTCGAGAGCACCCTGACGCT GAGCAAAGCAGACTACGAGAAACACAAAG TCTACGCCTGCGAAGTCACCCATCAGGGCC TGAGCTCGCCCGTCACAAAGAGCTTCAACA GGGGAGAGTGT (SEQ ID NO: 228)
05A, 05C, 05D	LC-08	DIVMTQSPDSLAVSLGERATIHCK SSQSVLYSSNNKNFLTQYQQKPG QPPKLLIYRASTRESGVPDRFSGS GSGTDFTLTISSLQAEDVAVYFCQ QYYSAFPTFGPGTRVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLN NFYPREAKVQWKVDNALQSGNS QESVTEQDSKDSTYSLESTLTLSK ADYEKHKVYACEVTHQGLSSPVTK SFNRGEC (SEQ ID NO: 218)	GACATCGTGATGACCCAGTCTCCAGACTCC CTGGCTGTGTCTCTGGGCGAGAGGGCCACC ATCCACTGCAAGTCCAGCCAGAGTGTTTAT ACAGCTCCAACAATAAGAACTTCTTAACTT GGTACCAGCAGAAACCAGGACAGCCTCCTA AACTTCTCATTTACCGGGCATCTACCCGGGA ATCCGGGGTTCCTGACCGATTCACTGGCAG CGGGTCTGGGACAGATTTCACTCTCACCATC AGCAGCCTGCAGGCTGAAGATGTGGCAGTT TATTTCTGTGAGCAATATTATAGTGCTCCAT TCACTTTTCGGCCCTGGGACCAGAGTGGATA TCAAACGTACGGTGGCTGCACCATCTGTCTT CATCTTCCCGCCATCTGATGAGCAGTTGAA ATCTGGAAGTGCCTCTGTTGTGTGCCTGCTG AATAACTTCTATCCCAGAGAGGCCAAAGTA CAGTGGAAGGTGGATAACGCCCTCCAATCG GGTAACTCCCAGGAGAGTGTACAGAGCAG GACAGCAAGGACAGCACCTACAGCCTCGAG AGCACCTGACGCTGAGCAAAGCAGACTAC GAGAAACACAAAGTCTACGCCTGCGAAGTC ACCCATCAGGGCCTGAGCTCGCCCGTCACA AAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 229)
05B	LC-09	DIVMTQSPDSLAVSLGERATIHCK SSQSVLYSSNNKNFLTQYQQKPG	GACATCGTGATGACCCAGTCTCCAGACTCC CTGGCTGTGTCTCTGGGCGAGAGGGCCACC

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
		QPPKLLIYRASTRESGVPDRFSGS GSGTDFTLTISLQAEDVAVYFCQ QYYSAFPTFGEGTRVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLN NFYPREAKVQWKVDNALQSGNS QESVTEQDSKDYSLSTLTLSK ADYEKHKVYACEVTHQGLSSPVT KSFNRGEC (SEQ ID NO: 219)	ATCCACTGCAAGTCCAGCCAGAGTGTTTTAT ACAGCTCCAACAATAAGAACTTCTTAACTT GGTACCAGCAGAAACCAGGACAGCCTCCTA AACTTCTCATTTACCGGGCATCTACCCGGGA ATCCGGGGTTCCTGACCGATTCAAGTGGCAG CGGGTCTGGGACAGATTTCACTCTCACCATC AGCAGCCTGCAGGCTGAAGATGTGGCAGTT TATTTCTGTCAGCAATATTATAGTGCTCCAT TCACTTTCGGCGAGGGGACCAGAGTGGATA TCAAACGTACGGTGGCTGCACCATCTGTCTT CATCTTCCCGCCATCTGATGAGCAGTTGAA ATCTGGAAGTGCCTCTGTTGTGTGCCTGCTG AATAACTTCTATCCCAGAGAGGCCAAAGTA CAGTGGAAGGTGGATAACGCCCTCCAATCG GGTAACTCCCAGGAGAGTGTACAGAGCAG GACAGCAAGGACAGCACCTACAGCCTCGAG AGCACCTGACGCTGAGCAAAGCAGACTAC GAGAAACACAAAGTCTACGCCTGCGAAGTC ACCCATCAGGGCCTGAGCTCGCCCGTCACA AAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 230)
06A, 06C	LC-10	DIVMTQSPDSLAVSLGERATINCK SSQSVLYSSNNKNFLTWYQQKPG QPPKLLIYRASTRESGVPDRFSGS GSGTDFTLTISLQAEDVAVYFCQ QYYSAFPTFGPGTRVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLN NFYPREAKVQWKVDNALQSGNS QESVTEQDSKDYSLSTLTLSK ADYEKHKVYACEVTHQGLSSPVT KSFNRGEC (SEQ ID NO: 220)	GACATCGTGATGACCCAGTCTCCAGACTCC CTGGCTGTGTCTCTGGGCGAGAGGGCCACC ATCAACTGCAAGTCCAGCCAGAGTGTTTTA TACAGCTCCAACAATAAGAACTTCTTAACTT GGTACCAGCAGAAACCAGGACAGCCTCCTA AACTTCTCATTTACCGGGCATCTACCCGGGA ATCCGGGGTTCCTGACCGATTCAAGTGGCAG CGGGTCTGGGACAGATTTCACTCTCACCATC AGCAGCCTGCAGGCTGAAGATGTGGCAGTT TATTTCTGTCAGCAATATTATAGTGCTCCAT TCACTTTCGGCCCTGGGACCAGAGTGGATA TCAAACGTACGGTGGCTGCACCATCTGTCTT CATCTTCCCGCCATCTGATGAGCAGTTGAA ATCTGGAAGTGCCTCTGTTGTGTGCCTGCTG AATAACTTCTATCCCAGAGAGGCCAAAGTA CAGTGGAAGGTGGATAACGCCCTCCAATCG GGTAACTCCCAGGAGAGTGTACAGAGCAG GACAGCAAGGACAGCACCTACAGCCTCGAA AGCACCTGACGCTGAGCAAAGCAGACTAC GAGAAACACAAAGTCTACGCCTGCGAAGTC ACCCATCAGGGCCTGAGCTCGCCCGTCACA AAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 231)
06B	LC-11	DIVMTQSPDSLAVSLGERATINCK SSQSVLYSSNNKNFLTWYQQKPG QPPKLLIYRASTRESGVPDRFSGS GSGTDFTLTISLQAEDVAVYFCQ QYYSAFPTFGEGTRVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLN NFYPREAKVQWKVDNALQSGNS QESVTEQDSKDYSLSTLTLSK ADYEKHKVYACEVTHQGLSSPVT KSFNRGEC (SEQ ID NO: 221)	GACATCGTGATGACCCAGTCTCCAGACTCC CTGGCTGTGTCTCTGGGCGAGAGGGCCACC ATCAACTGCAAGTCCAGCCAGAGTGTTTTA TACAGCTCCAACAATAAGAACTTCTTAACTT GGTACCAGCAGAAACCAGGACAGCCTCCTA AACTTCTCATTTACCGGGCATCTACCCGGGA ATCCGGGGTTCCTGACCGATTCAAGTGGCAG CGGGTCTGGGACAGATTTCACTCTCACCATC AGCAGCCTGCAGGCTGAAGATGTGGCAGTT TATTTCTGTCAGCAATATTATAGTGCTCCAT

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
			TCACTTTTCGGCGAGGGGACCAGAGTGGATA TCAAACGTACGGTGGCTGCACCATCTGTCTT CATCTTCCCGCCATCTGATGAGCAGTTGAA ATCTGGAAGTGCCTCTGTTGTGTGCCTGCTG AATAACTTCTATCCCAGAGAGGCCAAAGTA CAGTGGAAGGTGGATAACGCCCTCCAATCG GGTAAGTCCCAGGAGAGTGTACAGAGCAG GACAGCAAGGACAGCACCTACAGCCTCGAA AGCACCTGACGCTGAGCAAAGCAGACTAC GAGAAACACAAAGTCTACGCCTGCGAAGTC ACCCATCAGGGCTGAGCTCGCCCGTCACA AAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 232)

Table 6B. Exemplary Anti-PAC1 Receptor Heavy Chain Sequences

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
01A, 02A	HC-01	QVQLQQSGPGLVKPSQTL SLTCAISGDSVSSNSATW NWIRQSPSRGLEWLGRTY YRSKWSNHYAVSVKSRIT INPDTSKSQFSLQLNSVTP EDTAVYYCARGTWKQL WFLDHWGQGLTVTVSSA STKGPSVFPLAPSSKSTSG GTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVTVPS SSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHT CPPCPAPELLGGPSVFLFP PKPKDTLMISRTPEVTCV VVDVSHEDPEVKFNWYV DGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDW LNGKEYKCKVSNKALPA PIEKTISKAKGQPREPQVY TLPPSREEMTKNQVSLTC LVKGFYPSDIAVEWESNG QPENNYDTTPVLDSGGS FFLYSDLTVDKSRWQQG NVFSCSVMHEALHNHYT QKSLSLSPGK (SEQ ID NO: 233)	CAGGTACAGCTGCAGCAGTCAGGTCCAGGACTGGT GAAGCCCTCGCAGACCCTCTCACTCACCTGTGCCAT CTCCGGGGACAGTGTCTCTAGCAACAGTGCTACTTG GAACTGGATCAGGCAGTCCCCATCGAGAGGCCTTG AGTGGCTGGGAAGGACATATTACAGGTCCAAGTGG TCTAATCATTATGCAGTATCTGTGAAAAGTCGAATA ACCATCAACCCCGACACGTCCAAGAGCCAGTTCTCC CTGCAGCTGAACTCTGTGACTCCCGAGGACACGGCT GTGTATTACTGTGCAAGAGGAACGTGGAAACAGCT ATGGTTCCTTGACCACTGGGGCCAGGGAACCCTGGT CACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGT CTCCCCCTGGCACCCCTCCTCCAAGAGCACCTCTGG GGGCACAGCGGCCCTGGGCTGCCTGGTCAAGGACT ACTTCCCCGAACCGGTGACGGTGTCTGTGAACTCA GGCGCCCTGACCAGCGGCGTGCACACCTTCCCGGCT GTCCTACAGTCCTCAGGACTCTACTCCCTCAAGAGC GTGGTGACCGTGCCCTCCAGCAGCTTGGGCACCCA GACCTACATCTGCAACGTGAATCACAAGCCCAGCA ACACCAAGGTGGACAAGAAAGTTGAGCCCCAAATCT TGTGACAAAACCTCACACATGCCACCGTGCCCGAGC ACCTGAACTCCTGGGGGGACCGTCAGTCTTCTCTT CCCCCAAAACCCAAGGACACCCTCATGATCTCCCG GACCCCTGAGGTACATGCGTGGTGGTGGACGTGA GCCACGAAGACCCTGAGGTCAAGTTCAACTGGTAC GTGGACGGCGTGGAGGTGCATAATGCCAAGACAAA GCCGTGTGAGGAGCAGTACGGCAGCACGTACCGTT GTGTCAGCGTCCTCACCGTCCTGCACCAGGACTGGC TGAATGGCAAGGAGTACAAGTGCAAGGTCTCCAAC AAAGCCCTCCCAGCCCCCATCGAGAAAACCATCTC CAAAGCCAAAGGGCAGCCCCGAGAACCACAGGTGT ACACCCTGCCCCCATCCCGGGAGGAGATGACCAAG AACCAGGTACGCTGACCTGCCTGGTCAAAGGCTTC TATCCCAGCGACATCGCCGTGGAGTGGGAGAGCAA TGGGCAGCCGGAGAACAACACTACGATACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTATA

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			GCGATCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTCTCCCT GTCTCCGGGTAAA (SEQ ID NO: 252)
01B	HC-02	QVQLQQSGPGLVKPSQTL SLTCAISGDSVSSNSATW NWIRQSPSRKLEWLGRTY YRSKWSNHYAVSVKSRIT INPDTSKSQFSLQLNSVTP EDTAVYYCARGTWKQL WFLDHWGQGLTVTVSSA STKGPSVFPLAPSSKSTSG GTAALGCLVKDYFPEPVT VSWNSGALTSKVHTFPA VLQSSGLYSLKSVTVPS SSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKHT CPPCPAPELLGGPSVFLFP PKPKDTLMISRTPEVTCV VVDVSHEDPEVKFNWYV DGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDW LNGKEYKCKVSNKALPA PIEKTISKAKGQPREPQVY TLPPSREEMTKNQVSLTC LVKGFYPSDIAVEWESNG QPENNYDTTPVLDSDGS FFLYSDLTVDKSRWQQG NVFSCSVMEALHNHYT QKSLSLSPGK (SEQ ID NO: 234)	CAGGTACAGCTGCAGCAGTCAGGTCCAGGACTGGT GAAGCCCTCGCAGACCCTCTCACTCACCTGTGCCAT CTCCGGGGACAGTGTCTCTAGCAACAGTGCTACTTG GAACTGGATCAGGCAGTCCCCATCGAGAAAGCTTG AGTGGCTGGGAAGGACATATTACAGGTCCAAGTGG TCTAATCATTATGCAGTATCTGTGAAAAGTCGAATA ACCATCAACCCCGACACGTCCAAGAGCCAGTTCTCC CTGCAGCTGAACTCTGTGACTCCCGAGGACACGGCT GTGTATTACTGTGCAAGAGGAACGTGGAAACAGCT ATGGTTCCTTGACCACTGGGGCCAGGGAACCCTGGT CACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGT CTCCCCCTGGCACCCCTCCTCAAGAGCACCTCTGG GGGCACAGCGGCCCTGGGCTGCCTGGTCAAGGACT ACTTCCCCGAACCGGTGACGGTGTCTGTGAACTCA GGCGCCCTGACCAGCGGCGTGCACACCTTCCCGGCT GTCTACAGTCTCAGGACTCTACTCCCTCAAGAGC GTGGTGACCGTGCCCTCCAGCAGCTTGGGCAACCA GACCTACATCTGCAACGTGAATCACAAGCCAGCA ACACCAAGGTGGACAAGAAAGTTGAGCCCAAATCT TGTGACAAAACCTCACACATGCCCACCGTGCCACAGC ACCTGAACTCCTGGGGGGACCGTCACTTCTCTCTT CCCCCAAAAACCAAGGACACCCTCATGATCTCCCG GACCCCTGAGGTCACATGCGTGGTGGTGGACGTGA GCCACGAAGACCCTGAGGTCAAGTTCAACTGGTAC GTGGACGGCGTGGAGGTGCATAATGCCAAGACAAA GCCGTGTGAGGAGCAGTACGGCAGCACGTACCGTT GTGTCAGCGTCTCACCCTCTGCACCAGGACTGGC TGAATGGCAAGGAGTACAAGTGAAGGTCTCCAAC AAAGCCCTCCCAGCCCCCATCGAGAAAACCATCTC CAAAGCCAAAGGGCAGCCCCGAGAACCACAGGTGT ACACCCTGCCCCCATCCCGGGAGGAGATGACCAAG AACCAGGTGACCTGACCTGCCTGGTCAAAGGCTTC TATCCAGCGACATCGCCGTGGAGTGGGAGAGCAA TGGGCAGCCGGAGAACAACTACGATACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTATA GCGATCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTCTCCCT GTCTCCGGGTAAA (SEQ ID NO: 253)
01C, 02C	HC-03	QVQLQQSGPGLVKPSQTL SLTCAISGDSVSSNSATW NWIRQSPSRGLEWLGRTY YRSKWSNHYAVSVKSRIT INPDTSKSQFSLQLNSVTP EDTAVYYCARGTWKQL WFLDHWGQGLTVTVSSA STKGPSVFPLAPSSKSTSG GTAALGCLVKDYFPEPVT VSWNSGALTSKVHTFPA VLQSSGLYSLKSVTVPS	CAGGTACAGCTGCAGCAGTCAGGTCCAGGACTGGT GAAGCCCTCGCAGACCCTCTCACTCACCTGTGCCAT CTCCGGGGACAGTGTCTCTAGCAACAGTGCTACTTG GAACTGGATCAGGCAGTCCCCATCGAGAGGCCTTG AGTGGCTGGGAAGGACATATTACAGGTCCAAGTGG TCTAATCATTATGCAGTATCTGTGAAAAGTCGAATA ACCATCAACCCCGACACGTCCAAGAGCCAGTTCTCC CTGCAGCTGAACTCTGTGACTCCCGAGGACACGGCT GTGTATTACTGTGCAAGAGGAACGTGGAAACAGCT ATGGTTCCTTGACCACTGGGGCCAGGGAACCCTGGT CACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGT

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		SSLGTQTYICNVNHNKPSN TKVDKKVEPKSCDKTHT CPPCPAPELLGGPSVFLFP PKPKDTLMISRTPEVTCV VVDVSHEDPEVKFNWYV DGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDW LNGKEYKCKVSNKALPA PIEKTISKAKGQPREPQVY TLPPSREEMTKNQVSLTCLVDGFYPSDIAVEWESNGQPENNYDTTPPVLDSDGSFFLYSDLTVDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGK (SEQ ID NO: 235)	CTTCCCCCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCGGTGACGGTGTCTGTGAACTCAGCGCCCTGACCAGCGGCGTGCACACCTTCCCCGGCTGTCCTACAGTCCTCAGGACTCTACTCCCTCAAGAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCACCCAACCTACATCTGCAACGTGAATCACAAGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTGTGACAAAACCTCACACATGCCACCGTGCCACGACCTGAACTCCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAAACCCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTACATGCGTGGTGGTGGACGTGAGCCACGAAGACCCCTGAGGTCAAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAACCGTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTGACGCTCCTCACCGTCTGACACAGGACTGGCTGAATGGCAAGGAGTACAAGTGAAGGTCTCCAACAAAGCCCTCCCAGCCCCCATCGAGAAAACCATCTCAAAGCCAAAGGGCAGCCCCGAGAACCAACAGGTGTACACCCCTGCCCCCATCCCGGGAGGAGATGACCAAGAACCAGGTACAGCCTGACCTGCCTGGTTCGATGGCTTCATCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGCCGAGAACAACTACGATACCACGCCTCCGTGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCGATCTCACCGTGGACAAGAGCAGGTGGCAGCAGGGAAACGTCTTCTCATGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTCTCCCTGTCTCCGGGTAAG (SEQ ID NO: 254)
01D	HC-04	QVQLQQSGPGLVKPSQTL SLTCAISGDSVSSNSATW NWIRQSPSRGLEWLGRTY YRSKWSNHYAVSVKSRIT INPDTSKSQFSLQLNSVTP EDTAVYYCARGTWKQL WFLDHWGQGLTVTVSSA STKGPSVFPLAPCSRSTSE STAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVTVPS SNFGTQTYTCNVNHNKPSN TKVDKTVERKCCVECPPC PAPPVAGPSVFLFPPKPKD TLMISRTPEVTCVVDVVS HEDPEVQFNWYVDGVEV HNAKTKPREEQFNSTFRV VSVLTVVHQDWLNGKEY KCKVSNKGLPAPIEKTISK TKGQPREPQVYTLPPSRE EMTKNQVSLTCLVDGFY PSDIAVEWESNGQPENNY DTTPPMLDSDGSSFFLYSD LTVDKSRWQQGNVFSCS VMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 236)	CAGGTACAGCTGCAGCAGTCAGGTCCAGGACTGGTGAAGCCCTCGCAGACCCTCTCACTCACCTGTGCCATCTCCGGGGACAGTGTCTCTAGCAACAGTGCTACTTGAAGTGGATCAGGCAGTCCCCATCGAGAGGCCTTGAAGTGGTGGGAAGGACATATTACAGGTCCAAGTGGTCTAATCATTATGCAGTATCTGTGAAAAGTCGAATAACCATCAACCCCGACACGTCCAAGAGCCAGTTCTCCCTGCAGCTGAACTCTGTGACTCCCGAGGACACGGCTGTGTATTACTGTGCAAGAGGAACGTGGAAACAGCTATGGTTCTTGACCACTGGGGCCAGGGAACCCCTGGTCACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCTGGCGCCCTGCTCCAGGAGCACCTCCGAGACACAGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCGGTGACGGTGTCTGTGAACTCAGCGCTCTGACCAGCGGCGTGCACACCTTCCCAGCTGTCTACAGTCCTCAGGACTCTACTCCCTCAAGAGCGTGGTGACCGTGCCCTCCAGCAACTTCGGCACCCAGACCTACACCTGCAACGTAGATCACAAGCCCAGCAACACCAAGGTGGACAAGACAGTTGAGCGCAAATGTTGTGTCGAGTGCCCAACCGTGCCAGCACCACTGTGTCAGGACCGTCAGTCTTCTCTTCCCCCAAACCCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTTCGTGCGTGGTGGTGGACGTGAGCCACGAAGACCCCGAGGTCCAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCCACGGGAGGAGCAGTTCAACAGCACGTTCCTGTGGTTCAGCGTCTCTCA

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			CCGTTGTGCACCAGGACTGGCTGAACGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGGCCTCCCAGC CCCCATCGAGAAAACCATCTCCAAAACCAAAGGGC AGCCCCGAGAACCACAGGTGTACACCCTGCCCCCA TCCCGGGAGGAGATGACCAAGAACCAGGTCAGCCT GACCTGCCTGGTTCGATGGCTTCTACCCCAGCGACAT CGCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAGA ACAACTACGATACCACACCTCCCATGCTGGACTCCG ACGGCTCCTTCTTCTCTACAGCGATCTCACCGTGG ACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTAC ACGCAGAAGAGCCTCTCCCTGTCTCCGGGTAAA (SEQ ID NO: 255)
03A	HC-05	QVQLVESGAIEVVKPGAS VKVSKASGFTFSRFAMH WVRQAPGQGLEWMGVIS YDGGNKYYAESVKGRVT MTRDTSTSTLYMELSSLR SEDTAVYYCARGYDVL GYPDYWGQGLTVTVSSA STKGPSVFPLAPSSKSTSG GTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVTVPS SSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHT CPPCPAPELLGGPSVFLP PKPKDTLMISRTPEVTCV VVDVSHEDPEVKFNWYV DGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDW LNGKEYKCKVSNKALPA PIEKTISKAKGQPREPQVY TLPPSREEMTKNQVSLT LVKGFYPSDIAVEWESNG QPENNYDTTPPVLDSDGS FFLYSDLTVDKSRWQQG NVFSCSVMEALHNHYT QKSLSLSPGK (SEQ ID NO: 237)	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGT AAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTAAG CAAGTGGATTACGTTTAGCCGCTTTGCCATGCATT GGGTGCGGCAAGCTCCCGGTACAGGGGTGGAGTGG ATGGGAGTTATTAGCTATGACGGGGGCAATAAGTA CTACGCCGAGTCTGTAAAGGTCGGGTCAACAATGA CACGGGACACCTCAACCAAGTACACTCTATATGGAA CTGTCTAGCCTGAGATCCGAGGACACCGCTGTGTAT TATTGCGCTAGGGGGTACGATGTATTGACGGGTAT CCTGATTACTGGGGGCAGGGGACACTCGTAACCGT CTCTAGTGCCTCCACCAAGGGCCCATCGGTCTTCCC CCTGGCACCTCCTCCAAGAGCACCTCTGGGGGCAC AGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCC CGAACCGGTGACGGTGTCTGTGAAGTACAGGCGCCC TGACCAGCGCGTGCACACCTTCCCGGCTGTCTAC AGTCCTCAGGACTCTACTCCCTCAAGAGCGTGGTGA CCGTGCCCTCCAGCAGCTTGGGCACCCAGACCTACA TCTGCAACGTGAATCACAAGCCCAGCAACACCAAG GTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCACCGTGCCAGCACCTGAACT CCTGGGGGGACCGTCAGTCTTCCCTCTTCCCCCAA ACCCAAGGACACCTCATGATCTCCCGGACCCCTGA GGTCACATGCGTGGTGGTGGACGTGAGCCACGAAG ACCCTGAGGTCAAGTTCAACTGGTACGTGGACGGC GTGGAGGTGCATAATGCCAAGACAAAGCCGTGTGA GGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCTTGCACCAAGGACTGGCTGAATGGCA AGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCTTGC CCCCATCCCGGGAGGAGATGACCAAGAACCAGGTC AGCCTGACCTGCCTGGTCAAAGGCTTCTATCCAGC GACATCGCCGTGGAGTGGGAGAGCAATGGGCAGCC GGAGAACAACCTACGATACCACGCTCCCGTGTCTGG ACTCCGACGGCTCCTTCTTCTCTATAGCGATCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAAC CACTACACGCAGAAGAGCCTCTCCCTGTCTCCGGGT AAA (SEQ ID NO: 256)
03B	HC-06	QVQLVESGAIEVVKPGAS VKVSKASGFTFSRFAMH	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGT AAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTAAG

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		WVRQAPGQKLEWMGVIS YDGGNKYYAESVKGRVT MTRDTSTSTLYMELSSLR SEDTAVYYCARGYDVL GYPDYWGQGLTVTVSSA STKGPSVFPLAPSSKSTSG GTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVVTVPS SSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKHT CPPCPAPELLGGPSVFLP PKPKDTLMISRTPEVTCV VVDVSHEDPEVKFNWYV DGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDW LNGKEYKCKVSNKALPA PIEKTISKAKGQPREPQVY TLPPSREEMTKNQVSLT LVKGFYPSDIAVEWESNG QPENNYDTTPPVLDSDGS FFLYSDLTVDKSRWQQG NVFSCSVMEALHNHYT QKSLSLSPGK (SEQ ID NO: 238)	CAAGTGGATTACGTTTACGCGCTTTGCCATGCATT GGGTGCGGCAAGCTCCCGGTCAGAAGTTGGAGTGG ATGGGAGTTATTAGCTATGACGGGGGCAATAAGTA CTACGCCGAGTCTGTAAAGGGTCGGGTCACAATGA CACGGGACACCTCAACCAGTACACTCTATATGGAA CTGTCTAGCCTGAGATCCGAGGACACCGCTGTGTAT TATTGCGCTAGGGGGTACGATGTATTGACGGGTTAT CCTGATTACTGGGGGCAGGGGACACTCGTAACCGT CTCTAGTGCCTCCACCAAGGGCCCCATCGGTCTTCCC CCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCAC AGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCC CGAACCGGTGACGGTGTCTGTGAACTCAGGCGCCC TGACCAGCGGCGTGCACACCTTCCCGGCTGTCTAC AGTCCTCAGGACTCTACTCCCTCAAGAGCGTGGTGA CCGTGCCCTCCAGCAGCTTGGGCACCCAGACCTACA TCTGCAACGTGAATCACAAGCCCAGCAACACCAAG GTGGACAAGAAAGTTGAGCCCCAAATCTTGTGACAA AACTCACACATGCCACCGTGCACCTCTTCCCTGAACT CCTGGGGGACCGTCACTCTTCTTCTTCCCCAAA ACCAAGGACACCCTCATGATCTCCCGGACCCCTGA GGTCACATGCGTGGTGGTGGACGTGAGCCACGAAG ACCCTGAGGTCAAGTTCAACTGGTACGTGGACGGC GTGGAGGTGCATAATGCCAAGACAAAGCCGTGTGA GGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCTGACCAGGACTGGCTGAATGGCA AGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCATCGAGAAAACCATCTCCAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCGGGAGGAGATGACCAAGAACCAGGTC AGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCAGC GACATCGCCGTGGAGTGGGAGAGCAATGGGCAGCC GGAGAACAACACTACGATACCACGCCTCCCGTGTCTG ACTCCGACGGCTCCTTCTTCTCTATAGCGATCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAAC CACTACACGCAGAAGAGCCTCTCCCTGTCTCCGGGT AAA (SEQ ID NO: 257)
03C	HC-07	QVQLVESGAIEVVKPGAS VKVSCKASGFTFSRFAMH WVRQAPGQGLEWMGVIS YDGGNKYYAESVKGRVT MTRDTSTSTLYMELSSLR SEDTAVYYCARGYDVL GYPDYWGQGLTVTVSSA STKGPSVFPLAPSSKSTSG GTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVVTVPS SSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKHT CPPCPAPELLGGPSVFLP PKPKDTLMISRTPEVTCV VVDVSHEDPEVKFNWYV DGVEVHNAKTKPCEEQY	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGT AAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTAAG CAAGTGGATTACGTTTACGCGCTTTGCCATGCATT GGGTGCGGCAAGCTCCCGGTCAGGGGTTGGAGTGG ATGGGAGTTATTAGCTATGACGGGGGCAATAAGTA CTACGCCGAGTCTGTAAAGGGTCGGGTCACAATGA CACGGGACACCTCAACCAGTACACTCTATATGGAA CTGTCTAGCCTGAGATCCGAGGACACCGCTGTGTAT TATTGCGCTAGGGGGTACGATGTATTGACGGGTTAT CCTGATTACTGGGGGCAGGGGACACTCGTAACCGT CTCTAGTGCCTCCACCAAGGGCCCCATCGGTCTTCCC CCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCAC AGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCC CGAACCGGTGACGGTGTCTGTGAACTCAGGCGCCC TGACCAGCGGCGTGCACACCTTCCCGGCTGTCTAC AGTCCTCAGGACTCTACTCCCTCAAGAGCGTGGTGA CCGTGCCCTCCAGCAGCTTGGGCACCCAGACCTACA

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		GSTYRCVSVLTVLHQDW LNGKEYKCKVSNKALPA PIEKTISKAKGQPREPQVY TLPPSREEMTKNQVSLTC LVDGFYPSDIAVEWESNG QPENNYDTTPVLDSGGS FFLYSDLTVDKSRWQQG NVFSCSVMEALHNHYT QKSLSLSPGK (SEQ ID NO: 239)	TCTGCAACGTGAATCACAAGCCCAGCAACACCAAG GTGGACAAGAAAGTTGAGCCCCAAATCTTGTGACAA AACTCACACATGCCACCGTGCCAGCACCTGAACT CCTGGGGGGGACCGTCAGTCTTCCTCTTCCCCCAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGA GGTCACATGCGTGGTGGTGGACGTGAGCCACGAAG ACCCTGAGGTCAAGTTCAACTGGTACGTGGACGGC GTGGAGGTGCATAATGCCAAGACAAAGCCGTGTGA GGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCTGCACCAGGACTGGCTGAATGGCA AGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCGGGAGGAGATGACCAAGAACCAGGTG AGCCTGACCTGCCTGGTTCGATGGCTTCTATCCCAGC GACATCGCCGTGGAGTGGGAGAGCAATGGGCAGCC GGAGAACAACACTACGATACCACGCCTCCCGTGCTGG ACTCCGACGGCTCCTTCTTCTCTATAGCGATCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGACACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAAC CACTACACGCAGAAGAGCCTCTCCCTGTCTCCGGGT AAA (SEQ ID NO: 258)
03D	HC-08	QVQLVESGAEVVKPGAS VKVSKASGFTFSRFAMH WVRQAPGQGLEWMGVIS YDGGNKYYAESVKGRVT MTRDTSTSTLYMELSSLR SEDTAVYYCARGYDVL GYPDYWGQGLTVTVSSA STKGPSVFPLAPCSRSTSE STAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVTVPS SNFGTQTYTCNVDHKPSN TKVDKTVVERKCCVECPPC PAPPVAGPSVFLFPPKPKD TLMISRTPEVTCVVVDVS HEDPEVQFNWYVDGVEV HNAKTKPREEQFNSTFRV VSVLTVVHQDWLNGKEY KCKVSNKGLPAPIEKTISK TKGQPREPQVYTLPPSRE EMTKNQVSLTCLVDGFY PSDIAVEWESNGQPENNY DTTPMMLDSGSSFLYSD LTVDKSRWQQGNVFSCS VMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 240)	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGT AAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTAAG CAAGTGGATTACGTTTAGCCGCTTTGCCATGCATT GGGTGCGGCAAGCTCCCGGTCAGGGGTTGGAGTGG ATGGGAGTTATTAGCTATGACGGGGGCAATAAGTA CTACGCCGAGTCTGTAAAGGGTCGGGTCACAATGA CACGGGACACCTCAACCAGTACACTCTATATGGAA CTGTCTAGCCTGAGATCCGAGGACACCGCTGTGTAT TATTGCGCTAGGGGGTACGATGTATTGACGGGTTAT CCTGATTACTGGGGGCAGGGGACACTCGTAACCGT CTCTAGTGCCTCCACCAAGGGCCCATCGGTCTTCCC CCTGGCGCCCTGCTCCAGGAGCACCTCCGAGAGCA CAGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCC CCGAACCGGTGACGGTGTCTGTGGAACCTCAGGCGCT CTGACCAGCGCGTGCACACCTTCCCAGCTGTCTTA CAGTCTCAGGACTCTACTCCCTCAAGAGCGTGGTG ACCGTGCCCTCCAGCAACTTCGGCACCCAGACCTAC ACCTGCAACGTAGATCACAAGCCCAGCAACACCAA GGTGGACAAGACAGTTGAGCGCAAATGTTGTGTGCG AGTGCCACCGTGCCAGCACCACTGTGGCAGGA CCGTGAGTCTTCTCTTCCCCCAAAACCAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTACGTGC GTGGTGGTGGACGTGAGCCACGAAGACCCCGAGGT CCAGTTCAACTGGTACGTGGACGGCGTGGAGGTGC ATAATGCCAAGACAAAGCCACGGGAGGAGCAGTTC AACAGCACGTTCCGTGTGGTCAGCGTCTCACCGTT GTGCACCAGGACTGGCTGAACGGCAAGGAGTACAA GTGCAAGGTCTCCAACAAAGGCCTCCCAGCCCCCA TCGAGAAAACCATCTCCAAAACCAAGGGCAGCCC CGAGAACCACAGGTGTACACCCTGCCCCCATCCCG GGAGGAGATGACCAAGAACCAGGTGACGCTGACCT GCCTGGTTCGATGGCTTCTACCCAGCGACATCGCCG

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			TGGAGTGGGAGAGCAATGGGCAGCCGGAGAACAA CTACGATACCACACCTCCCATGCTGGACTCCGACGG CTCCTTCTTCTCTACAGCGATCTCACCGTGGACAA GAGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCT CCGTGATGCATGAGGCTCTGCACAACCACTACACG CAGAAGAGCCTCTCCCTGTCTCCGGGTAAA (SEQ ID NO: 259)
04A	HC-09	QVQLVESGGGVVQPGRS LRLSCAASGFTFSRFAMH WVRQAPGKGLEWVAVIS YDGGNKYYAESVKGRFT ISRDN SKNTLYLQMNSLR AEDTALFYCARGYDVL TGYPDYWGQGLTVTVSSA STKGPSVFPLAPSSKSTSG GTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVTVPS SSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHT CPPCPAPELLGGPSVFLFP PKPKDTLMISRTPEVTCV VVDVSHEDPEVKFNWYV DGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDW LNGKEYKCKVSNKALPA PIEKTISKAKGQPREPQVY TLPPSREEMTKNQVSLT CLVKGFYPSDIAVEWESNG QPENNYDTTPPVLDSDGS FFLYSDLTVDKSRWQQG NVFSCSVMEALHNHYT QKSLSLSPGK (SEQ ID NO: 241)	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGT CCAGCCTGGGAGGTCCCTGCGACTCTCCTGTGCAGC CTCTGGATTACCTTCAGTAGATTTGCCATGCACTG GGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGGG TGGCAGTTATATCATATGATGGAGGAAATAAATAC TATGCAGAGTCCGTGAAGGGCCGGTTCACCATCTCC AGAGACAATTCCAAGAACACCCTGTATCTGCAAA TGAACAGCCTGAGAGCTGAGGACACGGCTCTGTTTT ACTGTGCGAGAGGATACGATGTTTTGACTGGTTACC CCGACTACTGGGGCCAGGGAACCCTGGTCACCGTC TCTAGTGCCTCCACCAAGGGCCCATCGGTCTTCCCC CTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCAC AGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCC CGAACCAGGTGACGGTGTCTGTGAACCTCAGGCGCC TGACCAGCGGCTGCACACCTTCCCGGCTGTCTTAC AGTCCTCAGGACTCTACTCCCTCAAGAGCGTGGTGA CCGTGCCCTCCAGCAGCTTGGGCACCCAGACCTACA TCTGCAACGTGAATCACAAGCCCAGCAACACCAAG GTGGACAAGAAAGTTGAGCCCAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACT CCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGA GGTCACATGCGTGGTGGTGGACGTGAGCCACGAAG ACCCTGAGGTCAAGTTCAACTGGTACGTGGACGGC GTGGAGGTGCATAATGCCAAGACAAAGCCGTGTGA GGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCTCTGCACCAGGACTGGCTGAATGGCA AGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCTGC CCCCATCCCGGGAGGAGATGACCAAGAACCAGGTC AGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCAGC GACATCGCCGTGGAGTGGGAGAGCAATGGGCAGCC GGAGAACAACACTACGATACACGCCTCCCGTGCTGG ACTCCGACGGCTCCTTCTTCTCTATAGCGATCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAAC CACTACACGCAGAAGAGCCTCTCCCTGTCTCCGGGT AAA (SEQ ID NO: 260)
04B	HC-10	QVQLVESGGGVVQPGRS LRLSCAASGFTFSRFAMH WVRQAPGKKLEWVAVIS YDGGNKYYAESVKGRFT ISRDN SKNTLYLQMNSLR AEDTALFYCARGYDVL TGYPDYWGQGLTVTVSSA STKGPSVFPLAPSSKSTSG	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGT CCAGCCTGGGAGGTCCCTGCGACTCTCCTGTGCAGC CTCTGGATTACCTTCAGTAGATTTGCCATGCACTG GGTCCGCCAGGCTCCAGGCAAGAAGCTGGAGTGGG TGGCAGTTATATCATATGATGGAGGAAATAAATAC TATGCAGAGTCCGTGAAGGGCCGGTTCACCATCTCC AGAGACAATTCCAAGAACACCCTGTATCTGCAAA TGAACAGCCTGAGAGCTGAGGACACGGCTCTGTTTT

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		GTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVTVPS SSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHT CPPCPAPELLGGPSVFLFP PKPKDTLMISRTPEVTCV VVDVSHEDPEVKFNWYV DGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDW LNGKEYKCKVSNKALPA PIEKTISKAKGQPREPQVY TLPPSREEMTKNQVSLTC LVKGFYPSDIAVEWESNG QPENNYDTPPVLDSDGS FFLYSDLTVDKSRWQQG NVFSCSVMEALHNHYT QKSLSLSPGK (SEQ ID NO: 242)	ACTGTGCGAGAGGATACGATGTTTTGACTGGTTACC CCGACTACTGGGGCCAGGGAACCCTGGTCACCGTC TCTAGTGCCTCCACCAAGGGCCCATCGGTCTTCCCC CTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCAC AGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCC CGAACCGGTGACGGTGTCTGTGAACTCAGGCGCCC TGACCAGCGGCGTGCACACCTTCCCGGCTGTCCTAC AGTCCTCAGGACTCTACTCCCTCAAGAGCGTGGTGA CCGTGCCCTCCAGCAGCTTGGGCACCCAGACCTACA TCTGCAACGTGAATCACAAGCCCAGCAACACCAAG GTGGACAAGAAAGTTGAGCCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACT CCTGGGGGGACCGTCAGTCTTCCCTCTTCCCCCAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGA GGTACATGCGTGGTGGTGGACGTGAGCCACGAAG ACCCTGAGGTCAAGTTCAACTGGTACGTGGACGGC GTGGAGGTGCATAATGCCAAGACAAAGCCGTGTGA GGAGCAGTACGGCAGCACGTACCGTTGTGTGACGG TCCTCACCGCTCCTGCACCGAGTGGCTGAATGGCA AGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCGGGAGGAGATGACCAAGAACCAGGTC AGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCAGC GACATCGCCGTGGAGTGGGAGAGCAATGGGCAGCC GGAGAACAACTACGATACCACGCCTCCCGTGTCTGG ACTCCGACGGCTCCTTCTTCTCTATAGCGATCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAAC CACTACACGCAGAAGAGCCTCTCCCTGTCTCCGGGT AAA (SEQ ID NO: 261)
04C	HC-11	QVQLVESGGGVVQPGRS LRLSCAASGFTFSRFAMH WVRQAPGKGLEWVAVIS YDGGNKYYAESVKGRFT ISRDNKNTLYLQMNSLR AEDTALFYCARGYDVL GYPDYWGQGLTVTVSSA STKGPSVFPLAPSSKSTSG GTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVTVPS SSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHT CPPCPAPELLGGPSVFLFP PKPKDTLMISRTPEVTCV VVDVSHEDPEVKFNWYV DGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDW LNGKEYKCKVSNKALPA PIEKTISKAKGQPREPQVY TLPPSREEMTKNQVSLTC LVDGFYPSDIAVEWESNG QPENNYDTPPVLDSDGS	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGT CCAGCCTGGGAGGTCCCTGCGACTCTCCTGTGCAGC CTCTGGATTCACCTTCAGTAGATTTGCCATGCACTG GGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGGG TGGCAGTTATATCATATGATGGAGGAAATAAATAC TATGCAGAGTCCGTGAAGGGCCGGTTCACCATCTCC AGAGACAATTCCAAGAACACCCTGTATCTGCAAT GAACAGCCTGAGAGCTGAGGACACGGCTCTGTTTT ACTGTGCGAGAGGATACGATGTTTTGACTGGTTACC CCGACTACTGGGGCCAGGGAACCCTGGTCACCGTC TCTAGTGCCTCCACCAAGGGCCCATCGGTCTTCCCC CTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCAC AGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCC CGAACCGGTGACGGTGTCTGTGAACTCAGGCGCCC TGACCAGCGGCGTGCACACCTTCCCGGCTGTCCTAC AGTCCTCAGGACTCTACTCCCTCAAGAGCGTGGTGA CCGTGCCCTCCAGCAGCTTGGGCACCCAGACCTACA TCTGCAACGTGAATCACAAGCCCAGCAACACCAAG GTGGACAAGAAAGTTGAGCCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACT CCTGGGGGGACCGTCAGTCTTCCCTCTTCCCCCAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGA GGTACATGCGTGGTGGTGGACGTGAGCCACGAAG

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		FFLYSDLTVDKSRWQQG NVFSCSVMHEALHNHYT QKSLSLSPGK (SEQ ID NO: 243)	ACCCTGAGGTCAAGTTCAACTGGTACGTGGACGGC GTGGAGGTGCATAATGCCAAGACAAAGCCGTGTGA GGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCCTGCACCAGGACTGGCTGAATGGCA AGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCGGGAGGAGATGACCAAGAACCAGGTC AGCCTGACCTGCCTGGTTCGATGGCTTCTATCCCAGC GACATCGCCGTGGAGTGGGAGAGCAATGGGCAGCC GGAGAACAACACTACGATACCACGCCTCCCGTGCTGG ACTCCGACGGCTCCTTCTTCCTCTATAGCGATCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAAC CACTACACGCAGAAGAGCCTCTCCCTGTCTCCGGGT AAA (SEQ ID NO: 262)
04D	HC-12	QVQLVESGGGVVQPGRS LRLSCAASGFTFSRFAMH WVRQAPGKGLEWVAVIS YDGGNKYYAESVKGRFT ISRDN SKNTLYLQMNSLR AEDTALFYCARGYDVL TGYPDYWGQGLTVTVSSA STKGPSVFPLAPCSRSTSE STAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPA VLQSSGLYSLKSVTVPS SNFGTQTYTCNVDHKPSN TKVDKTVERKCCVECPPC PAPPVAGPSVFLFPPKPKD TLMISRTPEVTCVVVDVS HEDPEVQFNWYVDGVEV HNAKTKPREEQFNSTFRV VSVLTVVHQDWLNGKEY KCKVSNKGLPAPIEKTISK TKGQPREPQVYTLPPSRE EMTKNQVSLTCLVDGFY PSDIAVEWESNGQPENNY DTPPMLDSGDGSFFLYSD LTVDKSRWQQGNVFCSS VMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 244)	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGT CCAGCCTGGGAGGTCCCTGCGACTCTCCTGTGCAGC CTCTGGATTACCTTCAGTAGATTTGCCATGCACTG GGTCCGCCAGGCTCCAGGCAAGGGGCTGGAGTGGG TGGCAGTTATATCATATGATGGAGGAAATAAATAC TATGCAGAGTCCGTGAAGGGCCGGTTCACCATCTCC AGAGACAATTCCAAGAACACCCTGTATCTGCAAAT GAACAGCCTGAGAGCTGAGGACACGGCTCTGTTTT ACTGTGCGAGAGGATACGATGTTTTGACTGGTTACC CCGACTACTGGGGCCAGGGAACCCTGGTCACCGTC TCTAGTGCCTCCACCAAGGGCCCATCGGTCTTCCCC CTGGCGCCCTGCTCCAGGAGCACCTCCGAGAGCAC AGCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCC CGAACCAGGTGACGGTGTCTGTGAAGTCAAGGCGCTC TGACCAGCGGCGTGCACACCTTCCCAGCTGTCTTAC AGTCCTCAGGACTCTACTCCCTCAAGAGCGTGGTGA CCGTGCCCTCCAGCAACTTCGGCACCCAGACCTACA CCTGCAACGTAGATCACAAGCCCAGCAACACCAAG GTGGACAAGACAGTTGAGCGCAAATGTTGTGTCTGA GTGCCCACCGTGCCCGAGCACCACTGTGGCAGGAC CGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTACAGTGCG TGGTGGTGGACGTGAGCCACGAAGACCCCGAGGTC CAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCA TAATGCCAAGACAAAGCCACGGGAGGAGCAGTTCA ACAGCAGTTCCTGTGGTACGCGTCTCACCCTTG TGACACAGGACTGGCTGAACGGCAAGGAGTACAAG TGCAAGGTCTCCAACAAAGGCCTCCAGCCCCCATC GAGAAAACCATCTCCAAAACCAAGGGCAGCCCCG AGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTGAGCCTGACCTGC CTGGTTCGATGGCTTCTACCCAGCGACATCGCCGTG GAGTGGGAGAGCAATGGGCAGCCGGAGAACAAC ACGATACCACACCTCCCATGCTGGACTCCGACGGCT CCTTCTTCTCTACAGCGATCTCACCCTGGACAAGA GCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCC GTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTCTCCCTGTCTCCGGGTAAA (SEQ ID

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			NO: 263)
05A	HC-13	QVQLQESGPGLVKPSQTL SLTCTVSGGSISSGGYYW SWIRQHPGKLEWIGYIY YSGNTYYNPSLKSRTIS GDTSKNQFSLKLRVTAA DTAVYYCTRGAARGM DVWGQGTTVTVSSASTK GPSVFPLAPSSKSTSGGTA ALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVL QSSGLYSLKSVVTVPSSSL GTQTYICNVNHNKPSNTKV DKKVEPKSCDKTHTCPPC PAPELLGGPSVFLFPPKPK DTLMISRTPEVTCVVVDV SHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTY RCVSVLTVLHQDWLNGK EYKCKVSNKALPAPIEKTI SKAKGQPREPQVYTLPPS REEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPEN NYDTTPPVLDSDGSFFLY SDLTVDKSRWQQGNVFS CSVMHEALHNHYTQKSL SLSPGK (SEQ ID NO: 245)	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGT GAAGCCTTCACAGACCCTGTCCCTCACCTGCACTGT CTCTGGTGGCTCCATCAGCAGTGGTGGTTACTACTG GAGCTGGATCCGCCAGCACCCAGGGAAGGGCCTGG AGTGGATTGGGTACATCTATTACAGTGGGAACACCT ACTACAACCCGTCCCTCAAGAGTCGAGTTACCATAT CAGGAGACACGTCTAAGAACCAGTTCTCCCTGAAG CTGAGGTCTGTGACTGCCGCGGACACGGCCGTGTAT TACTGTACGAGAGGAGGAGCAGCTCGCGGTATGGA CGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTA GTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCTGG CACCTCTCTCCAAGAGCACCTCTGGGGGCACAGCG GCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAA CCGGTGACGGTGTCTGGAAGTCAAGGCGCCCTGAC CAGCGCGTGCACACCTTCCCGGTGTCTACAGTC CTCAGGACTCTACTCCCTCAAGAGCGTGGTGACCGT GCCCTCCAGCAGCTTGGGCACCCAGACCTACATCTG CAACGTGAATCACAAGCCCAACACCAAGAGGTGG ACAAGAAAGTTGAGCCCAATCTTGAGCAAAA CACACATGCCACCGTGCCGACAGCTGAACCTCTG GGGGGACCGTCAGTCTTCTCTTCCCCCAAAACCC AAGGACACCCTCATGATCTCCCGGACCCCTGAGGTC ACATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTGG AGGTGCATAATGCCAAGACAAAGCCGTGTGAGGAG CAGTACGGCAGCACGTACCGTTGTGTACAGCGTCTC ACCGTCTGCACCAGGACTGGCTGAATGGCAAGGA GTACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAG CCCCATCGAGAAAACCATCTCCAAGCCAAAGGG CAGCCCCGAGAACCACAGGTGTACACCCTGCCCC ATCCCGGAGGAGATGACCAAGAACCAGGTACGCC TGACCTGCCTGGTCAAAGGCTTCTATCCCAGCGACA TCGCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACACGATACCACGCCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCGATCTCACCGTG GACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTC ATGCTCCGTGATGCATGAGGCTCTGCACAACCTA CACGCAGAAGAGCCTCTCCCTGTCTCCGGGTAAA (SEQ ID NO: 264)
05B	HC-14	QVQLQESGPGLVKPSQTL SLTCTVSGGSISSGGYYW SWIRQHPGKLEWIGYIY YSGNTYYNPSLKSRTIS GDTSKNQFSLKLRVTAA DTAVYYCTRGAARGM DVWGQGTTVTVSSASTK GPSVFPLAPSSKSTSGGTA ALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVL QSSGLYSLKSVVTVPSSSL GTQTYICNVNHNKPSNTKV DKKVEPKSCDKTHTCPPC PAPELLGGPSVFLFPPKPK	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGT GAAGCCTTCACAGACCCTGTCCCTCACCTGCACTGT CTCTGGTGGCTCCATCAGCAGTGGTGGTTACTACTG GAGCTGGATCCGCCAGCACCCAGGGAAGAAGCTGG AGTGGATTGGGTACATCTATTACAGTGGGAACACCT ACTACAACCCGTCCCTCAAGAGTCGAGTTACCATAT CAGGAGACACGTCTAAGAACCAGTTCTCCCTGAAG CTGAGGTCTGTGACTGCCGCGGACACGGCCGTGTAT TACTGTACGAGAGGAGGAGCAGCTCGCGGTATGGA CGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTA GTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCTGG CACCTCTCTCCAAGAGCACCTCTGGGGGCACAGCG GCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAA CCGGTGACGGTGTCTGGAAGTCAAGGCGCCCTGAC

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		DTLMISRTPEVTCVVVDV SHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTY RCVSVLTVLHQDWLNGK EYKCKVSNKALPAPIEKTI SKAKGQPREPQVYTLPPS REEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPEN NYDTTPPVLDSDGSFFLY SDLTVDKSRWQQGNVFS CSVMHEALHNHYTQKSL SLSPGK (SEQ ID NO: 246)	CAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTC CTCAGGACTCTACTCCCTCAAGAGCGTGGTGACCGT GCCCTCCAGCAGCTTGGGCACCCAGACCTACATCTG CAACGTGAATCACAAGCCCAGCAACACCAAGGTGG ACAAGAAAGTTGAGCCCAAATCTTGTGACAAAAC CACACATGCCCACCGTGCCCAGCACCTGAACTCCTG GGGGGACCGTCAGTCTTCTCTTCCCCCAAAACCC AAGGACACCCTCATGATCTCCCGGACCCCTGAGGTC ACATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTGG AGGTGCATAATGCCAAGACAAAGCCGTGTGAGGAG CAGTACGGCAGCACGTACCGTTGTGTCAGCGTCCTC ACCGTCCTGCACCAGGACTGGCTGAATGGCAAGGA GTACAAGTGCAAGGTCTCCAACAAAGCCCTCCAG CCCCATCGAGAAAACCATCTCCAAAGCCAAAGGG CAGCCCCGAGAACCACAGGTGTACACCCTGCCCC ATCCCGGGAGGAGATGACCAAGAACCAGGTACGCC TGACCTGCCTGGTCAAAGGCTTCTATCCCAGCGACA TCGCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACTACGATACCACGCCTCCCGTGTGGACTCC GACGGCTCCTTCTTCTCTATAGCGATCTCACCGTG GACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTC ATGCTCCGTGATGCATGAGGCTCTGCACAACCACTA CACGCAGAAGAGCCTCTCCCTGTCTCCGGGTAAA (SEQ ID NO: 265)
05C	HC-15	QVQLQESGPGLVKPSQTL SLTCTVSGGSISSGGYYW SWIRQHPGKLEWIGYIY YSGNTYYNPSLKSRTIS GDTSKNQFSLKLRVTAA DTAVYYCTRGAARGM DVWGQGTTVTVSSASTK GPSVFPLAPSSKSTSGGTA ALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVL QSSGLYSLKSVVTPSSSL GTQTYICNVNHKPSNTKV DKKVEPKSCDKTHTCPPC PAPELLGGPSVFLFPPKPK DTLMISRTPEVTCVVVDV SHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTY RCVSVLTVLHQDWLNGK EYKCKVSNKALPAPIEKTI SKAKGQPREPQVYTLPPS REEMTKNQVSLTCLVDG FYPSDIAVEWESNGQPEN NYDTTPPVLDSDGSFFLY SDLTVDKSRWQQGNVFS CSVMHEALHNHYTQKSL SLSPGK (SEQ ID NO: 247)	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGT GAAGCCTTCACAGACCCTGTCCCTCACCTGCACTGT CTCTGGTGGCTCCATCAGCAGTGGTGGTTACTACTG GAGCTGGATCCGCCAGCACCCAGGGAAGGGCCTGG AGTGGATTGGGTACATCTATTACAGTGGGAACACCT ACTACAACCCGTCCCTCAAGAGTCGAGTTACCATAT CAGGAGACACGTCTAAGAACCAGTTCTCCCTGAAG CTGAGGTCTGTGACTGCCGCGGACACGGCCCGTGAT TACTGTACGAGAGGAGGAGCAGCTCGCGGTATGGA CGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTA GTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCTGG CACCTCCTCCAAGAGCACCTCTGGGGGCACAGCG GCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAA CCGGTGACGGTGTCGTGGAACCTCAGGCGCCCTGAC CAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTC CTCAGGACTCTACTCCCTCAAGAGCGTGGTGACCGT GCCCTCCAGCAGCTTGGGCACCCAGACCTACATCTG CAACGTGAATCACAAGCCCAGCAACACCAAGGTGG ACAAGAAAGTTGAGCCCAAATCTTGTGACAAAAC CACACATGCCCACCGTGCCCAGCACCTGAACTCCTG GGGGGACCGTCAGTCTTCTCTTCCCCCAAAACCC AAGGACACCCTCATGATCTCCCGGACCCCTGAGGTC ACATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTGG AGGTGCATAATGCCAAGACAAAGCCGTGTGAGGAG CAGTACGGCAGCACGTACCGTTGTGTCAGCGTCCTC ACCGTCCTGCACCAGGACTGGCTGAATGGCAAGGA GTACAAGTGCAAGGTCTCCAACAAAGCCCTCCAG CCCCATCGAGAAAACCATCTCCAAAGCCAAAGGG

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			CAGCCCCGAGAACCACAGGTGTACACCCTGCCCC ATCCCGGGAGGAGATGACCAAGAACCAGGTCAGCC TGACCTGCCTGGTCGATGGCTTCTATCCCAGCGACA TCGCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACTACGATACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCGATCTCACCGTG GACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTC ATGCTCCGTGATGCATGAGGCTCTGCACAACCACTA CACGCAGAAGAGCCTCTCCCTGTCTCCGGGTAAA (SEQ ID NO: 266)
05D	HC-16	QVQLQESGPGLVKPSQTL SLTCTVSGGSISSGGYYW SWIRQHPGKLEWIGYIY YSGNTYYNPSLKSRTIS GDTSKNQFSLKLSVTAA DTAVYYCTRGAARGM DVWGQGTTVTVSSASTK GPSVFPLAPCSRSTSESTA ALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVL QSSGLYSLKSVVTVPSN FGTQTYTCNVDPKPSNT KVDKTVRKCCVECPKCP APPVAGPSVFLFPPKPKD TLMISRTPEVTCVVVDVS HEDPEVQFNWYVDGVEV HNAKTKPREEQFNSTFRV VSVLTVVHQDWLNGKEY KCKVSNKGLPAPIEKTISK TKGQPREPQVYTLPPSRE EMTKNQVSLTCLVDGFY PSDIAVEWESNGQPENNY DTTPPMLDSDGSEFLYSD LTVDKSRWQQGNVFCSS VMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 248)	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGT GAAGCCTTCACAGACCCTGTCCCTCACCTGCACTGT CTCTGGTGGCTCCATCAGCAGTGGTGGTTACTACTG GAGCTGGATCCGCCAGCACCCAGGGAAGGGCCTGG AGTGGATTGGGTACATCTATTACAGTGGGAACACCT ACTACAACCCGTCCCTCAAGAGTCGAGTTACCATAT CAGGAGACACGTCTAAGAACCAGTTCTCCCTGAAG CTGAGGTCTGTGACTGCCGCGGACACGGCCGTGTAT TACTGTACGAGAGGAGGAGCAGCTCGCGGTATGGA CGTCTGGGGCCAAAGGGACCACGGTCACCGTCTCTA GTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCTGG CGCCCTGCTCCAGGAGCACCTCCGAGAGCACAGCG GCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAA CCGGTGACGGTGTCTGTGGAACCTCAGGCGCTCTGAC CAGCGGCGTGCACACCTTCCCAGCTGTCTACAGTC CTCAGGACTCTACTCCCTCAAGAGCGTGGTGACCGT GCCCTCCAGCAACTTCGGCACCCAGACCTACACCTG CAACGTAGATCACAAGCCCAGCAACACCAAGGTGG ACAAGACAGTTGAGCGCAAATGTTGTGTCGAGTGC CCACCGTGCCCAGCACCACTGTGGCAGGACCGTC AGTCTTCTCTTCCCCCAAAACCCAAGGACACCCT CATGATCTCCCGGACCCCTGAGGTACAGTGCCTGGT GGTGGACGTGAGCCACGAAGACCCCGAGGTCCAGT TCAACTGGTACGTGGACGGCGTGGAGGTGCATAAT GCCAAGACAAAGCCACGGGAGGAGCAGTTCAACAG CACGTTCCGTGTGGTCAGCGTCCTACCGTTGTGCA CCAGGACTGGCTGAACGGCAAGGAGTACAAGTGCA AGGTCTCCAACAAAGGCCTCCCAGCCCCCATCGAG AAAACCATCTCCAAAACCAAAGGGCAGCCCCGAGA ACCACAGGTGTACACCCTGCCCCCATCCCGGGAGG AGATGACCAAGAACCAGGTACGCTGACCTGCCTG GTCGATGGCTTCTACCCAGCGACATCGCCGTGGAG TGGGAGAGCAATGGGCAGCCGAGAACAACTACGA TACCACACCTCCCATGCTGGACTCCGACGGCTCCTT CTTCCTCTACAGCGATCTCACCGTGGACAAGAGCAG GTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGA GCCTCTCCCTGTCTCCGGGTAAA (SEQ ID NO: 267)
06A	HC-17	QVQLQESGPGLVKPSQTL SLTCTVSGGSISSGGYYW SWIRQPPGKLEWIGYIY YSGNTYYNPSLKSRTIS VDTSKNQFSLKLSVTAA DTAVYYCTRGAARGM	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGT GAAGCCTTCAGAGACCCTGTCCCTCACCTGCACTGT CTCTGGTGGCTCCATCAGCAGTGGTGGTTACTACTG GAGCTGGATCCGCCAGCCCCAGGGAAGGGCCTGG AGTGGATTGGGTACATCTATTACAGTGGGAACACCT ACTACAACCCGTCCCTCAAGAGTCGAGTTACCATAT

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		DVWGQGTTTVTVSSASTK GPSVFPLAPSSKSTSGGTA ALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVL QSSGLYSLKSVVTVPSSSL GTQTYICNVNHKPSNTKV DKKVEPKSCDKHTHTCPPC PAPELLGGPSVFLFPPKPK DTLMISRTPEVTCVVDV SHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTY RCVSVLTVLHQDWLNGK EYKCKVSNKALPAPIEKTI SKAKGQPREPQVYTLPPS REEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPEN NYDTTPPVLDSDGSFFLY SDLTVDKSRWQQGNVFS CSVMHEALHNHYTQKSL SLSPGK (SEQ ID NO: 249)	CAGTGGACACGTCTAAGAACCAGTTCTCCCTGAAG CTGAGGTCTGTGACTGCCGCGGACACGGCCGTGTAT TACTGTACGAGAGGAGGAGCAGCTCGCGGTATGGA CGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTA GTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCTGG CACCTCCTCCAAGAGCACCTCTGGGGGCACAGCG GCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAA CCGGTGACGGTGTCTGTGGAACCTCAGGCGCCCTGAC CAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTC CTCAGGACTCTACTCCCTCAAGAGCGTGGTGACCGT GCCCTCCAGCAGCTTGCGGCACCCAGACCTACATCTG CAACGTGAATCACAAGCCCAGCAACACCAAGGTGG ACAAGAAAGTTGAGCCCAAATCTTGTGACAAAAC CACACATGCCCACCGTGCCCAGCACCTGAACTCCTG GGGGGACCGTCAGTCTTCTCTTCCCCCAAAACCC AAGGACACCCTCATGATCTCCCGGACCCCTGAGGTC ACATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGGTGG AGGTGCATAATGCCAAGACAAAGCCGTGCGAGGAG CAGTACGGCAGCACGTACCGTTGCGTCAGCGTCTC ACCGTCTGCAACCAGGACTGGCTGAATGGCAAGGA GTACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAG CCCCCATCGAGAAAACCATCTCCAAGCCAAAGGG CAGCCCCGAGAACCACAGGTGTACACCCTGCCCCC ATCCCGGGAGGAGATGACCAAGAACCAGGTGAGCC TGACCTGCCTGGTCAAAGGCTTCTATCCCAGCGACA TCGCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACACGACACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCGACCTCACCGTG GACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTC ATGCTCCGTGATGCATGAGGCTCTGCACAACCACTA CACGCAGAAGAGCCTCTCCCTGTCTCCGGGTA (SEQ ID NO: 268)
06B	HC-18	QVQLQESGPGLVKPSSETL SLTCTVSGGSISSGGYYW SWIRQPPGKKLEWIGYIY YSGNTYYNPSLKSRTVIS VDTSKNQFSLKLSVTAA DTAVYYCTRGAARGM DVWGQGTTTVTVSSASTK GPSVFPLAPSSKSTSGGTA ALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVL QSSGLYSLKSVVTVPSSSL GTQTYICNVNHKPSNTKV DKKVEPKSCDKHTHTCPPC PAPELLGGPSVFLFPPKPK DTLMISRTPEVTCVVDV SHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTY RCVSVLTVLHQDWLNGK EYKCKVSNKALPAPIEKTI SKAKGQPREPQVYTLPPS REEMTKNQVSLTCLVKG	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGT GAAGCCTTCAGAGACCCTGTCCCTCACCTGCACTGT CTCTGGTGGCTCCATCAGCAGTGGTGGTTACTACTG GAGCTGGATCCGCCAGCCCCAGGGAAGAAGCTGG AGTGGATTGGGTACATCTATTACAGTGGGAACACCT ACTACAACCCGTCCCTCAAGAGTCGAGTTACCATAT CAGTAGACACGTCTAAGAACCAGTTCTCCCTGAAG CTGAGGTCTGTGACTGCCGCGGACACGGCCGTGTAT TACTGTACGAGAGGAGGAGCAGCTCGCGGTATGGA CGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTA GTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCTGG CACCTCCTCCAAGAGCACCTCTGGGGGCACAGCG GCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAA CCGGTGACGGTGTCTGTGGAACCTCAGGCGCCCTGAC CAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTC CTCAGGACTCTACTCCCTCAAGAGCGTGGTGACCGT GCCCTCCAGCAGCTTGCGGCACCCAGACCTACATCTG CAACGTGAATCACAAGCCCAGCAACACCAAGGTGG ACAAGAAAGTTGAGCCCAAATCTTGTGACAAAAC CACACATGCCCACCGTGCCCAGCACCTGAACTCCTG GGGGGACCGTCAGTCTTCTCTTCCCCCAAAACCC

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		FYPSTDI AVEWESNGQPEN NYDTTPPVLDSDGSFFLY SDLTVDKSRWQQGNVFS CSVMHEALHNHYTQKSL SLSPGK (SEQ ID NO: 250)	AAGGACACCCTCATGATCTCCCGGACCCCTGAGGTC ACATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG AGGTGCATAATGCCAAGACAAAGCCGTGCGAGGAG CAGTACGGCAGCACGTACCGTTGCGTCAGCGTCCTC ACCGTCCTGCACCAGGACTGGCTGAATGGCAAGGA GTACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAG CCCCATCGAGAAAACCATCTCCAAAGCCAAAGGG CAGCCCCGAGAACCACAGGTGTACACCCTGCCCCC ATCCCGGGAGGAGATGACCAAGAACCAGGTCAGCC TGACCTGCCTGGTCAAAGGCTTCTATCCCAGCGACA TCGCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACACGACACCCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCGACCTCACCGTG GACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTC ATGCTCCGTGATGCATGAGGCTCTGCACAACCACTA CAGCAGAAGAGCCTCTCCCTGTCTCCGGGTA (SEQ ID NO: 269)
06C	HC-19	QVQLQESGPGLVKPSSETL SLTCTVSGGSISSGGYYW SWIRQPPGKGLEWIGYIY YSGNTYYNPSLKSRTVIS VDTSKNQFSLKLRSVTAA DTAVYYCTRGGAARGM DVWGQGTTVTVSSASTK GPSVFPLAPSSKSTSGGTA ALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVL QSSGLYSLKSVVTVPSSSL GTQTYICNVNHKPSNTKV DKKVEPKSCDKHTHTCPPC PAPELLGGPSVFLFPPKPK DTLMISRTPEVTCVVVDV SHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTY RCVSVLTVLHQDWLNGK EYKCKVSNKALPAPIEKTI SKAKGQPREPQVYTLPPS REEMTKNQVSLTCLVDG FYPSTDI AVEWESNGQPEN NYDTTPPVLDSDGSFFLY SDLTVDKSRWQQGNVFS CSVMHEALHNHYTQKSL SLSPGK (SEQ ID NO: 251)	CAGGTGCAGTGCAGGAGTCGGGCCCAGGACTGGT GAAGCCTTCAGAGACCCTGTCCCTCACCTGCACTGT CTCTGGTGGCTCCATCAGCAGTGGTGGTTACTACTG GAGCTGGATCCGCCAGCCCCAGGGAAGGGCCTGG AGTGGATTGGGTACATCTATTACAGTGGGAACACCT ACTACAACCCGTCCCTCAAGAGTCGAGTTACCATAT CAGTGGACACGTCTAAGAACCAGTTCTCCCTGAAG CTGAGGTCTGTGACTGCCGCGGACACGGCCGTGTAT TACTGTACGAGAGGAGGAGCAGCTCGCGGTATGGA CGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTA GTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCTGG CACCTCCTCCAAGAGCACCTCTGGGGGCACAGCG GCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAA CCGGTGACGGTGTCTGTGGAACCTCAGGCGCCCTGAC CAGCGGCGTGCACACCTTCCCGGCTGTCTTACAGTC CTCAGGACTCTACTCCCTCAAGAGCGTGGTGACCGT GCCCTCCAGCAGCTTGGGCACCCAGACCTACATCTG CAACGTGAATCACAAGCCCAGCAACACCAAGGTGG ACAAGAAAGTTGAGCCCAAATCTTGTGACAAAAC CACACATGCCCACCGTGCCCAGCACCTGAACTCCTG GGGGGACCGTCAGTCTTCTCTTCCCCCAAAACCC AAGGACACCCTCATGATCTCCCGGACCCCTGAGGTC ACATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG AGGTGCATAATGCCAAGACAAAGCCGTGCGAGGAG CAGTACGGCAGCACGTACCGTTGCGTCAGCGTCCTC ACCGTCCTGCACCAGGACTGGCTGAATGGCAAGGA GTACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAG CCCCATCGAGAAAACCATCTCCAAAGCCAAAGGG CAGCCCCGAGAACCACAGGTGTACACCCTGCCCCC ATCCCGGGAGGAGATGACCAAGAACCAGGTCAGCC TGACCTGCCTGGTCTGATGGCTTCTATCCCAGCGACA TCGCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACACGACACCCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCGACCTCACCGTG GACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTC

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			ATGCTCCGTGATGCATGAGGCTCTGCACAACCACTA CACGCAGAAGAGCCTCTCCCTGTCTCCGGGTAAA (SEQ ID NO: 270)

[0110] In some embodiments, the heterodimeric antibody of the invention comprises an anti-PAC1 receptor light chain from Table 6A and an anti-PAC1 receptor heavy chain from Table 6B. Exemplary pairs of anti-PAC1 receptor light and heavy chains that may be incorporated into a heterodimeric antibody include, but are not limited to: LC-01 (SEQ ID NO: 211) and HC-01 (SEQ ID NO: 233); LC-02 (SEQ ID NO: 212) and HC-02 (SEQ ID NO: 234); LC-01 (SEQ ID NO: 211) and HC-03 (SEQ ID NO: 235); LC-01 (SEQ ID NO: 211) and HC-04 (SEQ ID NO: 236); LC-03 (SEQ ID NO: 213) and HC-01 (SEQ ID NO: 233); LC-03 (SEQ ID NO: 213) and HC-03 (SEQ ID NO: 235); LC-04 (SEQ ID NO: 214) and HC-05 (SEQ ID NO: 237); LC-05 (SEQ ID NO: 215) and HC-06 (SEQ ID NO: 238); LC-04 (SEQ ID NO: 214) and HC-07 (SEQ ID NO: 239); LC-04 (SEQ ID NO: 214) and HC-08 (SEQ ID NO: 240); LC-06 (SEQ ID NO: 216) and HC-09 (SEQ ID NO: 241); LC-07 (SEQ ID NO: 217) and HC-10 (SEQ ID NO: 242); LC-06 (SEQ ID NO: 216) and HC-11 (SEQ ID NO: 243); LC-06 (SEQ ID NO: 216) and HC-12 (SEQ ID NO: 244); LC-08 (SEQ ID NO: 218) and HC-13 (SEQ ID NO: 245); LC-09 (SEQ ID NO: 219) and HC-14 (SEQ ID NO: 246); LC-08 (SEQ ID NO: 218) and HC-15 (SEQ ID NO: 247); LC-08 (SEQ ID NO: 218) and HC-16 (SEQ ID NO: 248); LC-10 (SEQ ID NO: 220) and HC-17 (SEQ ID NO: 249); LC-11 (SEQ ID NO: 221) and HC-18 (SEQ ID NO: 250); and LC-10 (SEQ ID NO: 220) and HC-19 (SEQ ID NO: 251).

[0111] The anti-PAC1 receptor light chain and/or heavy chain incorporated into a heterodimeric antibody of the invention may comprise a sequence of contiguous amino acids that differs from the sequence of a light chain in Table 6A or a heavy chain in Table 6B by 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 or more amino acid residues, wherein each such sequence difference is independently a deletion, insertion or substitution of one amino acid. In some embodiments, the anti-PAC1 receptor light chain incorporated into a heterodimeric antibody comprises a sequence of amino acids that has at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 97% or at least 99% sequence identity to the amino acid sequences of SEQ ID NOs: 211-221 (i.e. the anti-PAC1 receptor light chains in Table 6A). In certain embodiments, the anti-PAC1 receptor heavy chain incorporated into a heterodimeric antibody comprises a

sequence of amino acids that has at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 97% or at least 99% sequence identity to the amino acid sequences of SEQ ID NOs: 233-251 (i.e. the anti-PAC1 receptor heavy chains in Table 6B).

[0112] Exemplary full-length light chain sequences and full-length heavy chain sequences from anti-CGRP receptor antibodies containing one or more charge pair mutations suitable for use in the heterodimeric antibodies of the invention are shown in Table 7A and Table 7B, respectively.

Table 7A. Exemplary Anti-CGRP Receptor Light Chain Sequences

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
50A, 50C, 50D	LC-101	QSVLTQPPSASGTPGQRVTI SCSGSSSNIGSNYVYWYQQ LPGAAPKLLIFRNNQRPSGV PDRFSGSKSGTSASLAISGL RSEDEADYYCAAWDDSL GWVFGGKTKLTVLGQPKA NPTVTFLFPPSSEELQANKAT LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 271)	CAGTCTGTGCTGACTCAGCCACCCTCAGCGTCTGG GACCCCCGGGCAGAGAGTCACCATCTCTTGTCT GGAAGCAGCTCCAACATCGGCAGTAATTATGTAT ACTGGTACCAGCAGCTCCCAGGAGCGGCCCCCAA ACTCCTCATCTTTAGGAATAATCAGCGGCCCTCAG GGGTCCCTGACCGCTTCTCTGGCTCCAAGTCTGGC ACCTCAGCCTCCCTGGCCATCAGTGGGCTCCGGTC CGAGGATGAGGCTGATTATTACTGTGCAGCATGG GATGACAGCCTGAGTGGTTGGGTGTTTCGGCGGAG GGACCAAGCTGACCGTCCTAGGTCAGCCCAAGGC CAACCCCACTGTCACTCTGTTCCCGCCCTCCTCTG AGGAGCTCCAAGCCAACAAGGCCACACTAGTGTG TCTGATCAGTGACTTCTACCCGGGAGCTGTGACA GTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAGG CGGGAGTGGAGACCACCAACCCTCCAAACAGA GCAACAACAAGTACGCGGCCAAGAGCTACCTGAG CCTGACGCCCCGAGCAGTGGAAGTCCACAGAAGC TACAGCTGCCAGGTCACGCATGAAGGGAGCACCG TGGAGAAGACAGTGGCCCCTACAGAATGTTCA (SEQ ID NO: 283)
50B	LC-102	QSVLTQPPSASGTPGQRVTI SCSGSSSNIGSNYVYWYQQ LPGAAPKLLIFRNNQRPSGV PDRFSGSKSGTSASLAISGL RSEDEADYYCAAWDDSL GWVFGKTKLTVLGQPKA NPTVTFLFPPSSEELQANKAT LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 272)	CAGTCTGTGCTGACTCAGCCACCCTCAGCGTCTGG GACCCCCGGGCAGAGAGTCACCATCTCTTGTCT GGAAGCAGCTCCAACATCGGCAGTAATTATGTAT ACTGGTACCAGCAGCTCCCAGGAGCGGCCCCCAA ACTCCTCATCTTTAGGAATAATCAGCGGCCCTCAG GGGTCCCTGACCGCTTCTCTGGCTCCAAGTCTGGC ACCTCAGCCTCCCTGGCCATCAGTGGGCTCCGGTC CGAGGATGAGGCTGATTATTACTGTGCAGCATGG GATGACAGCCTGAGTGGTTGGGTGTTTCGGCAAGG GGACCAAGCTGACCGTCCTAGGTCAGCCCAAGGC CAACCCCACTGTCACTCTGTTCCCGCCCTCCTCTG AGGAGCTCCAAGCCAACAAGGCCACACTAGTGTG TCTGATCAGTGACTTCTACCCGGGAGCTGTGACA GTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAGG CGGGAGTGGAGACCACCAACCCTCCAAACAGA GCAACAACAAGTACGCGGCCAAGAGCTACCTGAG CCTGACGCCCCGAGCAGTGGAAGTCCACAGAAGC TACAGCTGCCAGGTCACGCATGAAGGGAGCACCG TGGAGAAGACAGTGGCCCCTACAGAATGTTCA

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
			(SEQ ID NO: 284)
51A, 51C, 51D	LC-103	QSVLTQSPASGTPGQRVTI SCSGSSSNIGSNYVYWYQQ LPGAAPKLLILRNNQRPSGV PDRFSGSKSGTSASLTISGL RSEDEADYYCAAWDDSL GWVFGGGTKLTVLGQPKA NPTVTFLPPSSEELQANKAT LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 273)	CAGTCTGTGCTGACTCAGTCACCCTCAGCGTCTGG GACCCCCGGGCAGAGAGTCACCATCTCTTGTCT GGAAGCAGCTCCAACATCGGCAGTAATTATGTAT ACTGGTACCAGCAGCTCCCAGGAGCGGCCCCCAA ACTCCTCATCCTTAGGAATAATCAGCGGCCCTCA GGGGTCCCTGACCGATTCTCTGGCTCCAAGTCTGG CACCTCAGCCTCCCTGACCATCAGTGGGCTCCGGT CCGAGGATGAGGCTGACTATTATTGTGCAGCATG GGATGACAGCCTGAGTGGTTGGGTGTTCCGGCGGA GGGACCAAGCTGACCGTCCTAGGTCAGCCCAAGG CCAACCCCACTGTCACTCTGTTCCCGCCCTCCTCT GAGGAGCTCCAAGCCAACAAGGCCACACTAGTGT GTCTGATCAGTGACTTCTACCCGGGAGCTGTGAC AGTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAG GCGGGAGTGGAGACCACCAAACCTCCAAACAG AGCAACAACAAGTACGCGGCCAAGAGCTACCTGA GCCTGACGCCCAGCAGTGGAAGTCCCACAGAAG CTACAGCTGCCAGGTCACGCATGAAGGGAGCACC GTGGAGAAGACAGTGGCCCCCTACAGAATGTTCA (SEQ ID NO: 285)
51B	LC-104	QSVLTQSPASGTPGQRVTI SCSGSSSNIGSNYVYWYQQ LPGAAPKLLILRNNQRPSGV PDRFSGSKSGTSASLTISGL RSEDEADYYCAAWDDSL GWVFGGKTKLTVLGQPKA NPTVTFLPPSSEELQANKAT LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 274)	CAGTCTGTGCTGACTCAGTCACCCTCAGCGTCTGG GACCCCCGGGCAGAGAGTCACCATCTCTTGTCT GGAAGCAGCTCCAACATCGGCAGTAATTATGTAT ACTGGTACCAGCAGCTCCCAGGAGCGGCCCCCAA ACTCCTCATCCTTAGGAATAATCAGCGGCCCTCA GGGGTCCCTGACCGATTCTCTGGCTCCAAGTCTGG CACCTCAGCCTCCCTGACCATCAGTGGGCTCCGGT CCGAGGATGAGGCTGACTATTATTGTGCAGCATG GGATGACAGCCTGAGTGGTTGGGTGTTCCGCAAG GGGACCAAGCTGACCGTCCTAGGTCAGCCCAAGG CCAACCCCACTGTCACTCTGTTCCCGCCCTCCTCT GAGGAGCTCCAAGCCAACAAGGCCACACTAGTGT GTCTGATCAGTGACTTCTACCCGGGAGCTGTGAC AGTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAG GCGGGAGTGGAGACCACCAAACCTCCAAACAG AGCAACAACAAGTACGCGGCCAAGAGCTACCTGA GCCTGACGCCCAGCAGTGGAAGTCCCACAGAAG CTACAGCTGCCAGGTCACGCATGAAGGGAGCACC GTGGAGAAGACAGTGGCCCCCTACAGAATGTTCA (SEQ ID NO: 286)
52A, 52C, 52D, 53A, 53C	LC-105	QSVLTQPPSVSAAPGQKVTI SCSGSSSNIGNNYVSWYQQ LPGTAPKLLIYDNNKRPSGI PDRFSGSKSGTSTTLGITGL QTGDEADYYCGTWDSRLS AVVFGGGTKLTVLGQPKA NPTVTFLPPSSEELQANKAT LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 275)	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGC GGCCCCAGGACAGAAGGTCAACCATCTCCTGCTCT GGAAGCAGCTCCAACATTGGGAATAATTATGTAT CCTGGTACCAGCAGCTCCCAGGAACAGCCCCCAA ACTCCTCATTTATGACAATAATAAGCGACCCTCA GGGATTCTGACCGATTCTCTGGCTCCAAGTCTGG CACGTCAACCACCCTGGGCATCACCGGACTCCAG ACTGGGGACGAGGCCGATTATTACTGCGGAACAT GGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCGG AGGGACCAAGCTGACCGTCCTAGGTCAGCCCAAG GCCAACCCCACTGTCACTCTGTTCCCGCCCTCCTC TGAGGAGCTCCAAGCCAACAAGGCCACACTAGTG TGTCTGATCAGTGACTTCTACCCGGGAGCTGTGAC

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
			AGTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAG GCGGGAGTGGAGACCACCAAACCCTCCAAACAG AGCAACAACAAGTACGCGGCCAAGAGCTACCTGA GCCTGACGCCCAGCAGTGGAAGTCCCACAGAAG CTACAGCTGCCAGGTCACGCATGAAGGGAGCACC GTGGAGAAGACAGTGGCCCCCTACAGAATGTTCA (SEQ ID NO: 287)
52B, 53B	LC-106	QSVLTQPPSVSAAPGQKVTI SCSGSSSNIGNNYVSWYQQ LPGTAPKLLIYDNNKRPSGI PDRFSGSKSGTSTTLGITGL QTGDEADYYCGTWDSRLS AVVFGKGTKLTVLGQPKA NPTVTLFPPSSEELQANKAT LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 276)	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGC GGCCCCAGGACAGAAGGTCACCATCTCCTGCTCT GGAAGCAGCTCCAACATTGGGAATAATTATGTAT CCTGGTACCAGCAGCTCCCAGGAACAGCCCCCAA ACTCCTCATTTATGACAATAATAAGCGACCCTCA GGGATTCTGACCGATTCTCTGGCTCCAAGTCTGG CACGTCAACCACCCTGGGCATCACCGGACTCCAG ACTGGGGACGAGGCCGATTATTACTGCGGAACAT GGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCAA GGGGACCAAGCTGACCGTCTAGGTCTAGCCCAAG GCCAACCCCACTGTCACTCTGTTCCCGCCCTCCTC TGAGGAGCTCCAAGCCAACAAGGCCACACTAGTG TGTCTGATCAGTGACTTCTACCCGGGAGCTGTGAC AGTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAG GCGGGAGTGGAGACCACCAAACCCTCCAAACAG AGCAACAACAAGTACGCGGCCAAGAGCTACCTGA GCCTGACGCCCAGCAGTGGAAGTCCCACAGAAG CTACAGCTGCCAGGTCACGCATGAAGGGAGCACC GTGGAGAAGACAGTGGCCCCCTACAGAATGTTCA (SEQ ID NO: 288)
54A, 54C, 56A, 56C	LC-107	QSVLTQPPSVSAAPGQKVTI SCSGSSSNIGNNYVSWYQQ LPGTAPKLLIYDNNKRPSGI PDRFSGSKSGTSATLGITGL QTGDEADYYCGTWDSRLS AVVFGGGTKLTVLGQPKA NPTVTLFPPSSEELQANKAT LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 277)	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGC GGCCCCAGGACAGAAGGTCACCATCTCCTGCTCT GGAAGCAGCTCCAACATTGGGAATAATTATGTAT CCTGGTACCAGCAGCTCCCAGGAACAGCCCCCAA ACTCCTCATTTATGACAATAATAAGCGACCCTCA GGGATTCTGACCGATTCTCTGGCTCCAAGTCTGG CACGTCAAGCCACCCTGGGCATCACCGGACTCCAG ACTGGGGACGAGGCCGATTATTACTGCGGAACAT GGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCGG AGGGACCAAGCTGACCGTCTAGGTCTAGCCCAAG GCCAACCCCACTGTCACTCTGTTCCCGCCCTCCTC TGAGGAGCTCCAAGCCAACAAGGCCACACTAGTG TGTCTGATCAGTGACTTCTACCCGGGAGCTGTGAC AGTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAG GCGGGAGTGGAGACCACCAAACCCTCCAAACAG AGCAACAACAAGTACGCGGCCAAGAGCTACCTGA GCCTGACGCCCAGCAGTGGAAGTCCCACAGAAG CTACAGCTGCCAGGTCACGCATGAAGGGAGCACC GTGGAGAAGACAGTGGCCCCCTACAGAATGTTCA (SEQ ID NO: 289)
54B, 56B	LC-108	QSVLTQPPSVSAAPGQKVTI SCSGSSSNIGNNYVSWYQQ LPGTAPKLLIYDNNKRPSGI PDRFSGSKSGTSATLGITGL QTGDEADYYCGTWDSRLS AVVFGKGTKLTVLGQPKA NPTVTLFPPSSEELQANKAT	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGC GGCCCCAGGACAGAAGGTCACCATCTCCTGCTCT GGAAGCAGCTCCAACATTGGGAATAATTATGTAT CCTGGTACCAGCAGCTCCCAGGAACAGCCCCCAA ACTCCTCATTTATGACAATAATAAGCGACCCTCA GGGATTCTGACCGATTCTCTGGCTCCAAGTCTGG CACGTCAAGCCACCCTGGGCATCACCGGACTCCAG

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
		LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 278)	ACTGGGGACGAGGCCGATTATTACTGCGGAACAT GGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCAA GGGGACCAAGCTGACCGTCTAGGTCAGCCCAAG GCCAACCCCACTGTCACTCTGTTCCCGCCCTCCTC TGAGGAGCTCCAAGCCAACAAGGCCACACTAGTG TGTCTGATCAGTGACTTCTACCCGGGAGCTGTGAC AGTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAG GCGGGAGTGGAGACCACCAAACCCTCCAAACAG AGCAACAACAAGTACGCGGCCAAGAGCTACCTGA GCCTGACGCCCAGCAGTGGAAGTCCCACAGAAG CTACAGCTGCCAGGTCACGCATGAAGGGAGCACC GTGGAGAAGACAGTGGCCCCCTACAGAATGTTCA (SEQ ID NO: 290)
55A, 55C	LC-109	QSVLTQPPSVSAAPGQKVTI SCSGSSSNIGNNYVSWYQQ LPGTAPKLLIYDNNKRPSGI PDRFSGSKSGTSATLAITGL QTGDEADYYCGTWDSRLS AVVFGGGTKLTVLGQPKA NPTVTLFPPSSEELQANKAT LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 279)	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGC GGCCCCAGGACAGAAGGTCACCATCTCCTGCTCT GGAAGCAGCTCCAACATTGGGAATAATTATGTAT CCTGGTACCAGCAGCTCCCAGGAACAGCCCCCAA ACTCCTCATTTATGACAATAATAAGCGACCCTCA GGGATTCTTGACCGATTCTCTGGCTCCAAGTCTGG CACGTCAGCCACCCTGGCCATCACCGGACTCCAG ACTGGGGACGAGGCCGATTATTACTGCGGAACAT GGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCGG AGGGACCAAGCTGACCGTCTAGGTCAGCCCAAG GCCAACCCCACTGTCACTCTGTTCCCGCCCTCCTC TGAGGAGCTCCAAGCCAACAAGGCCACACTAGTG TGTCTGATCAGTGACTTCTACCCGGGAGCTGTGAC AGTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAG GCGGGAGTGGAGACCACCAAACCCTCCAAACAG AGCAACAACAAGTACGCGGCCAAGAGCTACCTGA GCCTGACGCCCAGCAGTGGAAGTCCCACAGAAG CTACAGCTGCCAGGTCACGCATGAAGGGAGCACC GTGGAGAAGACAGTGGCCCCCTACAGAATGTTCA (SEQ ID NO: 291)
55B	LC-110	QSVLTQPPSVSAAPGQKVTI SCSGSSSNIGNNYVSWYQQ LPGTAPKLLIYDNNKRPSGI PDRFSGSKSGTSATLAITGL QTGDEADYYCGTWDSRLS AVVFGKGTCLTVLGQPKA NPTVTLFPPSSEELQANKAT LVCLISDFYPGAVTVAWKA DGSPVKAGVETTKPSKQSN NKYAAKSYLSLTPEQWKSH RSYSCQVTHEGSTVEKTVA PTECS (SEQ ID NO: 280)	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGC GGCCCCAGGACAGAAGGTCACCATCTCCTGCTCT GGAAGCAGCTCCAACATTGGGAATAATTATGTAT CCTGGTACCAGCAGCTCCCAGGAACAGCCCCCAA ACTCCTCATTTATGACAATAATAAGCGACCCTCA GGGATTCTTGACCGATTCTCTGGCTCCAAGTCTGG CACGTCAGCCACCCTGGCCATCACCGGACTCCAG ACTGGGGACGAGGCCGATTATTACTGCGGAACAT GGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCAA GGGGACCAAGCTGACCGTCTAGGTCAGCCCAAG GCCAACCCCACTGTCACTCTGTTCCCGCCCTCCTC TGAGGAGCTCCAAGCCAACAAGGCCACACTAGTG TGTCTGATCAGTGACTTCTACCCGGGAGCTGTGAC AGTGGCCTGGAAGGCAGATGGCAGCCCCGTCAAG GCGGGAGTGGAGACCACCAAACCCTCCAAACAG AGCAACAACAAGTACGCGGCCAAGAGCTACCTGA GCCTGACGCCCAGCAGTGGAAGTCCCACAGAAG CTACAGCTGCCAGGTCACGCATGAAGGGAGCACC GTGGAGAAGACAGTGGCCCCCTACAGAATGTTCA (SEQ ID NO: 292)
57A, 57C,	LC-111	EIVLTQSPGTLSPGERAT	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGT

Antibody ID.	LC Group	Light Chain Amino Acid Sequence	Light Chain Nucleic Acid Sequence
57D, 58A, 58C		LSCRASQSVSSGYLTWYQQ KPGQAPRLLIYGASSRATGI PDRFSGSGSGTDFTLTISRLE PEDFAVYYCQQYGNSLSRF GQGTKLEIKRTVAAPSVFIF PPSDEQLKSGTASVVCLLN NFYPREAKVQWKVDNALQ SGNSQESVTEQDSKDSTYS LKSTLTLSKADYEKHKVYA CEVTHQGLSSPVTKSFNRG EC (SEQ ID NO: 281)	CTTTGTCTCCAGGGGAAAGAGCCACCCTCTCCTGC AGGGCCAGTCAGAGTGTTAGCAGCGGCTACTTAA CCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAG ACTCCTCATCTATGGTGCATCCAGCAGGGCCACT GGCATCCCAGACAGGTTCACTGGCAGTGGGTCTG GGACGGACTTCACTCTCACCATCAGCAGACTGGA GCCTGAAGATTTTGCAGTGTATTACTGTCAGCAGT ATGGTAACTCACTGAGCAGGTTTGGCCAGGGGAC CAAGCTGGAAATCAAACGTACGGTGGCTGCACCA TCTGTCTTCATCTTCCCGCCATCTGATGAGCAGTT GAAATCTGGAAGTGCCTCTGTTGTGTGCCTGCTGA ATAACTTCTATCCCAGAGAGGGCCAAAGTACAGTG GAAGGTGGATAACGCCCTCCAATCGGGTAACTCC CAGGAGAGTGTACAGAGCAGGACAGCAAGGAC AGCACCTACAGCCTCAAGAGCACCTGACGCTGA GCAAAGCAGACTACGAGAAACACAAAGTCTACG CCTGCGAAGTCACCCATCAGGGCCTGAGCTCGCC CGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 293)
57B, 58B	LC-112	EIVLTQSPGTLSPGERAT LSCRASQSVSSGYLTWYQQ KPGQAPRLLIYGASSRATGI PDRFSGSGSGTDFTLTISRLE PEDFAVYYCQQYGNSLSRF GKGTKLEIKRTVAAPSVFIF PPSDEQLKSGTASVVCLLN NFYPREAKVQWKVDNALQ SGNSQESVTEQDSKDSTYS LKSTLTLSKADYEKHKVYA CEVTHQGLSSPVTKSFNRG EC (SEQ ID NO: 282)	GAAATTGTGTGACGCAGTCTCCAGGCACCCTGT CTTTGTCTCCAGGGGAAAGAGCCACCCTCTCCTGC AGGGCCAGTCAGAGTGTTAGCAGCGGCTACTTAA CCTGGTACCAGCAGAAACCTGGCCAGGCTCCCAG ACTCCTCATCTATGGTGCATCCAGCAGGGCCACT GGCATCCCAGACAGGTTCACTGGCAGTGGGTCTG GTACGGACTTCACTCTCACCATCAGCAGACTGGA GCCTGAAGATTTTGCAGTGTATTACTGTCAGCAGT ATGGTAACTCACTGAGCAGGTTTGGCAAGGGGAC CAAGCTGGAGATCAAACGTACGGTGGCTGCACCA TCTGTCTTCATCTTCCCGCCATCTGATGAGCAGTT GAAATCTGGAAGTGCCTCTGTTGTGTGCCTGCTGA ATAACTTCTATCCCAGAGAGGGCCAAAGTACAGTG GAAGGTGGATAACGCCCTCCAATCGGGTAACTCC CAGGAGAGTGTACAGAGCAGGACAGCAAGGAC AGCACCTACAGCCTCAAGAGCACCTGACGCTGA GCAAAGCAGACTACGAGAAACACAAAGTCTACG CCTGCGAAGTCACCCATCAGGGCCTGAGCTCGCC CGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 294)

Table 7B. Exemplary Anti-CGRP Receptor Heavy Chain Sequences

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
50A	HC-101	EVQLVESGGGLVKPGGSL RLSCAASGFTFGNAWMS WVRQAPGKGLEWVGRIKS KTDGGTTDYAAPVKGRFT ISRDDSKNTLYLQMNSLKT EDTAVYFCTTDRGTYSISW SSYYYYYGMVWGQGTT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY	GAGGTACAGCTGGTGGAGTCTGGGGGAGGCTTGG TAAAGCCTGGGGGGTCCCTCAGACTCTCCTGTGC AGCCTCTGGATTCACTTTTCGGTAACGCCTGGATGA GCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGGA GTGGGTTGGCCGTATTAAGCAAAACTGATGGT GGGACAACAGACTACGCTGCACCCGTGAAAGGCA GATTCACCATCTCAAGAGATGATTCAAAAAACAC GCTGTATCTGCAAATGAACAGCCTGAAAACCGAG GACACAGCCGTGTATTTCTGTACCACAGATCGGA

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKEMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFC SVMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 295)	CCGGGTATAGCATCAGCTGGTCTAGTTACTACTAC TACTACGGTATGGACGTCTGGGGCCAAGGAACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCG TGGAACCTCAGGCGCCCTGACCAGCGGCGTGACACA CCTTCCCCGGCTGTCCTACAGTCCTCAGGACTCTAC TCCCTCGAGAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCCAATCTTGTGACAAAACCTCACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAAGCCGTGCGAG GAGCAGTACGGCAGCAGTACCGTTGCGTGACCGC TCCTCACCGTCTGACCAGGACTGGCTGAATGG CAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCC CTCCCAGCCCCATCGAGAAAACCATCTCCAAG CCAAAGGGCAGCCCCGAGAACCACAGGTGTACAC CCTGCCCCCATCCCGGAAGGAGATGACCAAGAAC CAGGTACAGCTGACCTGCCTGGTCAAAGGCTTCT ATCCCAGCGACATCGCCGTGGAGTGGGAGAGCAA TGGGCAGCCGGAGAACAACACTACAAGACCACGCCT CCCGTGCTGAAGTCCGACGGCTCCTTCTTCTCTA TAGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT CTCCCTGTCTCCGGGTAAA (SEQ ID NO: 317)
50B	HC-102	EVQLVESGGGLVKPGGSL RLSCAASGFTFGNAWMS WVRQAPGKELEWVGRIKS KTDGGTTDYAAPVKGRFT ISRDDSKNTLYLQMNLSKT EDTAVYFCTTDRTGYSISW SSYYYYYGMVWGQGT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKEMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE	GAGGTACAGCTGGTGGAGTCTGGGGGAGGCTTGG TAAAGCCTGGGGGGTCCCTCAGACTCTCCTGTGC AGCCTCTGGATTCACTTTCCGTAACGCCTGGATGA GCTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGGA GTGGGTGGCCGTATTAAGCAAAACTGATGGT GGGACAACAGACTACGCTGCACCCGTGAAAGGCA GATTACCATCTCAAGAGATGATTCAAAAAACAC GCTGTATCTGCAAATGAACAGCCTGAAAACCGAG GACACAGCCGTGTATTTCTGTACCACAGATCGGA CCGGGTATAGCATCAGCTGGTCTAGTTACTACTAC TACTACGGTATGGACGTCTGGGGCCAAGGAACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCG TGGAACCTCAGGCGCCCTGACCAGCGGCGTGACACA CCTTCCCCGGCTGTCCTACAGTCCTCAGGACTCTAC TCCCTCGAGAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCCAATCTTGTGACAAAACCTCACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 296)	GACCGTCAGTCTTCCTCTTCCCCCAAACCCCAAG GACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGCGAG GAGCAGTACGGCAGCACGTACCGTTGCGTCAGCG TCCTCACCGTCCTGCACCAGGACTGGCTGAATGG CAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCC CTCCCAGCCCCCATCGAGAAAACCATCTCCAAAG CCAAAGGGCAGCCCCGAGAACCACAGGTGTACAC CCTGCCCCCATCCCGGAAGGAGATGACCAAGAAC CAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCT ATCCCAGCGACATCGCCGTGGAGTGGGAGAGCAA TGGGCAGCCGGAGAACAACTACAAGACCACGCCT CCCGTGCTGAAGTCCGACGGCTCCTTCTTCCTCTA TAGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACAGCAGAAGAGCCT CTCCCTGTCTCCGGGTAAA (SEQ ID NO: 318)
50C	HC-103	EVQLVESGGGLVKGPGSL RLSCAASGFTFGNAWMS WVRQAPGKGLEWVGRIKS KTDGGTTDYAAPVKGRFT ISRDDSKNTLYLQMNSLKT EDTAVYFCTTDRTGYSISW SSYYYYYGMVWVGQTT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKKMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 297)	GAGGTACAGCTGGTGGAGTCTGGGGGAGGCTTGG TAAAGCCTGGGGGGTCCCTCAGACTCTCCTGTGC AGCCTCTGGATTCACTTTTCGGTAACGCCTGGATGA GCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGGA GTGGGTTGGCCGTATTAAGCAAACTGATGGT GGGACAACAGACTACGCTGCACCCGTGAAAGGCA GATTCACCATCTCAAGAGATGATTCAAAAAACAC GCTGTATCTGCAAATGAACAGCCTGAAAACCGAG GACACAGCCGTGTATTTCTGTACCACAGATCGGA CCGGGTATAGCATCAGCTGGTCTAGTTACTACTAC TACTACGGTATGGACGTCTGGGGCCAAGGAACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCG TGGAACCTCAGGCGCCCTGACCAGCGGCGTGACA CCTTCCCCGGCTGTCCTACAGTCCCTCAGGACTCTAC TCCCTCGAGAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCCAATCTTGTGACAAAACCTACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCCTCTTCCCCCAAACCCCAAG GACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGCGAG GAGCAGTACGGCAGCACGTACCGTTGCGTCAGCG TCCTCACCGTCCTGCACCAGGACTGGCTGAATGG CAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCC CTCCCAGCCCCCATCGAGAAAACCATCTCCAAAG CCAAAGGGCAGCCCCGAGAACCACAGGTGTACAC CCTGCCCCCATCCCGGAAGAAGATGACCAAGAAC CAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCT ATCCCAGCGACATCGCCGTGGAGTGGGAGAGCAA

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			TGGGCAGCCGGAGAACAACACTACAAGACCACGCCT CCCGTGCTGAAGTCCGACGGCTCCTTCTTCCTCTA TAGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT CTCCCTGTCTCCGGGTAAA (SEQ ID NO: 319)
50D	HC-104	EVQLVESGGGLVKPGGSL RLSCAASGFTFGNAWMS WVRQAPGKGLEWVGRIKS KTDGGTTDYAAPVKGRFT ISRDDSKNTLYLQMNSLKT EDTAVYFCTTDRTGYSISW SSYYYYYGMVWVGQGT VTVSSASTKGPSVFPLAPC SRSTSESTAALGCLVKDYF PEPVTVSWNSGALTSGVH TFPAVLQSSGLYSLESVVT VPSSNFGTQTYTCNVDPK PSNTKVDKTVKCCVEEC PPCPAPPVAGPSVFLFPPKP KDTLMISRTPEVTCVVVD VSHEDPEVQFNWYVDGVE VHNAKTKPREEQFNSTFR VVSVLTVVHQDWLNGKE YKCKVSNKGLPAPIEKTIS KTKGQPREPQVYTLPPSRK KMTKNQVSLTCLVKGFYP SDIAVEWESNGQPENNYK TTPPMLKSDGSFFLYSKLT VDKSRWQQGNVFSCSVM HEALHNHYTQKSLSLSPG K (SEQ ID NO: 298)	GAGGTACAGCTGGTGGAGTCTGGGGGAGGCTTGG TAAAGCCTGGGGGGTCCCTCAGACTCTCCTGTGC AGCCTCTGGATTCACTTTTCGGTAACGCCTGGATGA GCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGGA GTGGGTTGGCCGTATTAAGCAAAACTGATGGT GGGACAACAGACTACGCTGCACCCGTGAAAGGCA GATTACCATCTCAAGAGATGATTCAAAAAACAC GCTGTATCTGCAAATGAACAGCCTGAAAACCGAG GACACAGCCGTGTATTTCTGTACCACAGATCGGA CCGGGTATAGCATCAGCTGGTCTAGTTACTACTAC TACTACGGTATGGACGTCTGGGGCCAAGGAACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCGCCCTGCTCCAGGAGCA CCTCCGAGAGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTGCG TGGAACCTCAGGCGCTCTGACCAGCGGCGTGCACA CCTTCCCAGCTGTCTACAGTCTCAGGACTCTAC TCCCTGGAGAGCGTGGTGACCGTGCCCTCCAGCA ACTTCGGCACCCAGACCTACACCTGCAACGTAGA TCACAAGCCCAGCAACACCAAGGTGGACAAGAC AGTTGAGCGCAAATGTTGTGTGTCGAGTGCCACCG TGCCACGACCACTGTGGCAGGACCGTCAGTCT TCTCTTCCCCCAAAACCCAAGGACACCCTCATG ATCTCCCGGACCCCTGAGGTACAGTGCCTGGTGG TGGACGTGAGCCACGAAGACCCCGAGGTCCAGTT CAACTGGTACGTGGACGGCGTGGAGGTGCATAAT GCCAAGACAAAGCCACGGGAGGAGCAGTTCAAC AGCACGTTCCGTGTGGTCAGCGTCTCACCGTTGT GCACCAGGACTGGCTGAACGGCAAGGAGTACAA GTGCAAGGTCTCCAACAAAGGCCTCCCAGCCCCC ATCGAGAAAACCATCTCCAAAACCAAGGGCAGC CCCGAGAACCACAGGTGTACACCTGCCCCCATC CCGGAAGAAGATGACCAAGAACCAGGTACGCT GACCTGCCTGGTCAAAGGCTTCTACCCACAGCGAC ATCGCCGTGGAGTGGGAGAGCAATGGGCAGCCG GAGAACAACACTACAAGACCACACCTCCCATGTGA AGTCCGACGGCTCCTTCTTCTCTACAGCAAGCTC ACCGTGGACAAGAGCAGGTGGCAGCAGGGGAAC GTCTTCTCATGCTCCGTGATGCATGAGGCTCTGCA CAACCACTACACGCAGAAGAGCCTCTCCCTGTCT CCGGGTAAA (SEQ ID NO: 320)
51A	HC-105	EVQLVESGGGLVKPGGSL RLSCAASGFTFSNAWMSW VRQAPGKGLEWVGRIKSK TDGGTTDYTAPVKGRFTIS RDDSKNTLYLQMNSLKA DTAVYYCTTDRTGYSISW SSYYYYYGMVWVGQGT	GAGGTGCAGCTGGTGGAGTCTGGGGGAGGCTTGG TAAAGCCTGGGGGGTCCCTTAGACTCTCCTGTGC AGCCTCTGGATTCACTTTTCAGTAACGCCTGGATGA GCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGGA GTGGGTTGGCCGTATTAAGCAAAACTGATGGT GGGACAACAGACTACACTGCACCCGTGAAAGGCA GATTACCATCTCAAGAGATGATTCAAAAAACAC

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKEMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNYHTQKSLSL SPGK (SEQ ID NO: 299)	GCTGTATCTGCAAATGAATAGCCTGAAAGCCGAG GACACAGCCGTGTATTACTGTACCACAGATCGGA CCGGGTATAGCATCAGCTGGTCTAGTTACTACTAC TACTACGGTATGGACGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCG TGGAACCTCAGGCGCCCTGACCAGCGGCGTGACACA CCTTCCCCGGCTGTCCTACAGTCCTCAGGACTCTAC TCCCTCGAGAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGACACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCCAAATCTTGTGACAAAACCTACACA TGCCACCGTGCCCGAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCCCTCTTCCCCCAAACCCAAAG GACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAAGCCGTGCGAG GAGCAGTACGGCAGCACGTACCGTTGCGTCAGCG TCCTCACCGTCTGCAACAGGACTGGCTGAATGG CAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCC CTCCCAGCCCCCATCGAGAAAACCATCTCCAAAG CCAAAGGGCAGCCCCGAGAACCACAGGTGTACAC CCTGCCCCCATCCCGGAAGGAGATGACCAAGAAC CAGGTACAGCCTGACCTGCCTGGTCAAAGGCTTCT ATCCCAGCGACATCGCCGTGGAGTGGGAGAGCAA TGGGCAGCCGGAGAACAACCTACAAGACCACGCCT CCCGTGCTGAAGTCCGACGGCTCCTTCTTCTCTA TAGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT CTCCCTGTCTCCGGGTAAA (SEQ ID NO: 321)
51B	HC-106	EVQLVESGGGLVKPGGSL RLSCAASGFTFSNAWMSW VRQAPGKELEWVGRIKSK TDGGTTDYTAPVKGRFTIS RDDSNTLYLQMNLSLAE DTAIVYYCTDRTGYISW SSYYYYYGMVWVGQGT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL	GAGGTGCAGCTGGTGGAGTCTGGGGGAGGCTTGG TAAAGCCTGGGGGGTCCCTTAGACTCTCCTGTGC AGCCTCTGGATTCACTTTAGTAACGCCTGGATGA GCTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGGA GTGGGTGGCCGTATTAAAAGCAAAACTGATGGT GGGACAACAGACTACACTGCACCCGTGAAAGGCA GATTACCATCTCAAGAGATGATTCAAAAAACAC GCTGTATCTGCAAATGAATAGCCTGAAAGCCGAG GACACAGCCGTGTATTACTGTACCACAGATCGGA CCGGGTATAGCATCAGCTGGTCTAGTTACTACTAC TACTACGGTATGGACGTCTGGGGCCAAGGAACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCG TGGAACCTCAGGCGCCCTGACCAGCGGCGTGACACA CCTTCCCCGGCTGTCCTACAGTCCTCAGGACTCTAC TCCCTCGAGAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGACACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		PPSRKEMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 300)	AGTTGAGCCCCAAATCTTGTGACAAAACCTCACACA TGCCACACCGTGCCAGCACCTGAACCTGGGGG GACCGTCAGTCTTCCTCTTCCCCCAAACCCAAG GACACCCTCATGATCTCCCGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGCGAG GAGCAGTACGGCAGCACGTACCGTTGCGTCAGCG TCCTCACCGTCTGACCAGGACTGGCTGAATGG CAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCC CTCCCAGCCCCCATCGAGAAAACCATCTCCAAG CCAAAGGGCAGCCCCGAGAACCACAGGTGTACAC CCTGCCCCCATCCCGGAAGGAGATGACCAAGAAC CAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCT ATCCCAGCGACATCGCCGTGGAGTGGGAGAGCAA TGGGCAGCCGGAGAACAACACTACAAGACCACGCCT CCCGTGCTGAAGTCCGACGGCTCCTTCTTCCTCTA TAGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGAGAAGAGCCT CTCCCTGTCTCCGGGTAAA (SEQ ID NO: 322)
51C	HC-107	EVQLVESGGGLVPGGSL RLSCAASGFTFSNAWMSW VRQAPGKGLEWVGRIKSK TDGGTTDYTAPVKGRFTIS RDDSNTLYLQMNSLKAE DTAVYYCTDRTGYSISW SSYYYYYGMVWGQGT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 301)	GAGGTGCAGCTGGTGGAGTCTGGGGGAGGCTTGG TAAAGCCTGGGGGGTCCCTTAGACTCTCCTGTGC AGCCTCTGGATTCACTTTTCACTAACCGCTGGATGA GCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGGA GTGGGTGGCCGTATTAAGCAAACTGATGGT GGGACAACAGACTACACTGCACCCGTGAAAGGCA GATTCACCATCTCAAGAGATGATTCAAAAACAC GCTGTATCTGCAAATGAATAGCCTGAAAGCCGAG GACACAGCCGTGTATTACTGTACCACAGATCGGA CCGGGTATAGCATCAGCTGGTCTAGTTACTACTAC TACTACGGTATGGACGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTGCG TGGAACCTCAGGCGCCCTGACCAGCGGCGTGACA CCTTCCCGGCTGTCCTACAGTCTCAGGACTCTAC TCCCTCGAGAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCCAAATCTTGTGACAAAACCTACACA TGCCACACCGTGCCAGCACCTGAACCTGGGGG GACCGTCAGTCTTCCTCTTCCCCCAAACCCAAG GACACCCTCATGATCTCCCGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGCGAG GAGCAGTACGGCAGCACGTACCGTTGCGTCAGCG TCCTCACCGTCTGACCAGGACTGGCTGAATGG CAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCC CTCCCAGCCCCCATCGAGAAAACCATCTCCAAG CCAAAGGGCAGCCCCGAGAACCACAGGTGTACAC CCTGCCCCCATCCCGGAAGAAGATGACCAAGAAC

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			CAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCT ATCCCAGCGACATCGCCGTGGAGTGGGAGAGCAA TGGGCAGCCGGAGAACAACACTACAAGACCACGCCT CCCGTGCTGAAGTCCGACGGCTCCTTCTTCTCTA TAGCAAGCTCACCCTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT CTCCCTGTCTCCGGGTAAA (SEQ ID NO: 323)
51D	HC-108	EVQLVESGGGLVKPGGSL RLSCAASGFTFSNAWMSW VRQAPGKGLEWVGRIKSK TDGGTTDYTAPVKGRFTIS RDDSKNTLYLQMNSLKAE DTAVYYCTTDRGTGYSISW SSYYYYYGMVWVGQGT VTVSSASTKGPSVFPLAPC SRSTSESTAALGCLVKDYF PEPVTVSWNSGALTSGVH TFPAVLQSSGLYSLESVVT VPSSNFGTQTYTCNVDPK PSNTKVDKTVKCCVEEC PPCPAPPVAGPSVFLFPPKP KDTLMISRTPEVTCVVD VSHEDPEVQFNWYVDGVE VHNAKTKPREEQFNSTFR VVSVLTVVHQDWLNGKE YKCKVSNKGLPAPIEKTIS KTKGQPREPQVYTLPPSRK KMTKNQVSLTCLVKGFYP SDIAVEWESNGQPENNYK TTPPMLKSDGSFFLYSKLT VDKSRWQQGNVFSQSV HEALHNHYTQKSLSLSPG K (SEQ ID NO: 302)	GAGGTGCAGCTGGTGGAGTCTGGGGGAGGCTTGG TAAAGCCTGGGGGGTCCCTTAGACTCTCCTGTGC AGCCTCTGGATTCACTTTCAGTAACGCCTGGATGA GCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGGA GTGGGTGGCCGTATTAAGCAAAACTGATGGT GGGACAACAGACTACACTGCACCCGTGAAAGGCA GATTCACCATCTCAAGAGATGATTCAAAAAACAC GCTGTATCTGCAAATGAATAGCCTGAAAGCCGAG GACACAGCCGTGTATTACTGTACCACAGATCGGA CCGGGTATAGCATCAGCTGGTCTAGTTACTACTAC TACTACGGTATGGACGTCTGGGGCCAAGGAACAA CAGTTACCGTCTCTAGTGCCTCCCAAGGGGCC ATCGGTCTTCCCCCTGGCGCCCTGTCCAGGAGCA CCTCCGAGAGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTG TGGAAGTCAAGGCGCTCTGACCAGCGGCGTGACA CCTTCCCAGCTGTCTACAGTCCTCAGGACTCTAC TCCCTGGAGAGCGTGGTGACCGTGCCCTCCAGCA ACTTCGGCACCCAGACCTACACCTGCAACGTAGA TCACAAGCCCAGCAACACCAAGGTGGACAAGAC AGTTGAGCGCAAATGTTGTGTGAGTGCCACCG TGCCCAGCACCACTGTGGCAGGACCGTCAGTCT TCCTCTTCCCCCAAAACCAAGGACACCCTCATG ATCTCCCGGACCCCTGAGGTACGTGCGTGGTGG TGGACGTGAGCCACGAAGACCCCGAGGTCCAGTT CAACTGGTACGTGGACGGCGTGGAGGTGCATAAT GCCAAGACAAAGCCACGGGAGGAGCAGTTCAAC AGCACGTTCCGTGTGGTCAGCGTCTCACCCTTGT GCACCAGGACTGGCTGAACGGCAAGGAGTACAA GTGCAAGGTCTCCAACAAAGGCCTCCAGCCCCC ATCGAGAAAACCATCTCCAAAACCAAGGGCAGC CCCGAGAACCACAGGTGTACACCTGCCCCCATC CCGGAAGAAGATGACCAAGAACCAGGTACGCT GACCTGCCTGGTCAAAGGCTTCTACCCACAGCAG ATCGCCGTGGAGTGGGAGAGCAATGGGCAGCCG GAGAACAACTACAAGACCACACCTCCCATGCTGA AGTCCGACGGCTCCTTCTTCTCTACAGCAAGCTC ACCGTGGACAAGAGCAGGTGGCAGCAGGGGAAC GTCTTCTCATGCTCCGTGATGCATGAGGCTCTGCA CAACCACTACACGCAGAAGAGCCTCTCCCTGTCT CCGGGTAAA (SEQ ID NO: 324)
52A, 54A, 55A	HC-109	QVQLVESGGGVVQPGRSL RLSCAASGFTFSFGMHW VRQAPGKGLEWVAVISFD GSIKYSVDSVKGRFTISR NSKNTLFLQMNSLRAEDT	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTGATGGAAGTATT

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		AVYYCARDRLNYYDSSGY YHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKEMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNNHYTQKSLSL SPGK (SEQ ID NO: 303)	AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGGACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCACCTCTCTCCAAGAGCACCTC TGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTCTGTGGA ACTCAGGCGCCCTGACCAGCGGCGTGCACACCTT CCCGGCTGTCTACAGTCTCAGGACTCTACTCCC TCGAGAGCGTGGTGACCGTGCCCTCCAGCAGCTT GGGCACCCAGACCTACATCTGCAACGTGAATCAC AAGCCCAGCAACACCAAGGTGGACAAGAAAGTT GAGCCCCAAATCTTGTGACAAAACCTCACACATGCC CACCGTGCCAGCACCTGAACTCCTGGGGGGACC GTCAGTCTTCTCTTCCCCCAAAACCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGC GTGGTGGTGGACGTGAGCCACGAAGACCCTGAGG TAAAGTTCAACTGGTACGTGGACGGCGTGGAGGT GCATAATGCCAAGACAAGCCGTGCGAGGAGCA GTACGGCAGCACGTACCGTTGCGTCAGCGTCCTC ACCGTCCTGCACCAGGACTGGCTGAATGGCAAGG AGTACAAGTGCAAGGTCTCCAACAAAGCCCTCCC AGCCCCCATCGAGAAAACCATCTCCAAAGCCAAA GGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCGGAAGGAGATGACCAAGAACCAGGT CAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCA GCGACATCGCCGTGGAGTGGGAGAGCAATGGGC AGCCGGAGAACAACTACAAGACCACGCCTCCCGT GCTGAAGTCCGACGGCTCCTTCTTCTCTATAGCA AGCTCACCGTGGACAAGAGCAGGTGGCAGCAGG GGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTCTCCC TGTCTCCGGGTAAG (SEQ ID NO: 325)
52B, 54B, 55B	HC-110	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSFGMHW VRQAPGKELEWVAVISFD GSIKYSVDSVKGRFTISR DSKNTLFLQMNSLRAEDT AVYYCARDRLNYYDSSGY YHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL	CAGGTGCAGCTGGTGGAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTCACCTTCACTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGGA GTGGGTGGCAGTTATATCATTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGGACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCACCTCTCTCCAAGAGCACCTC TGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTCTGTGGA ACTCAGGCGCCCTGACCAGCGGCGTGCACACCTT CCCGGCTGTCTACAGTCTCAGGACTCTACTCCC TCGAGAGCGTGGTGACCGTGCCCTCCAGCAGCTT

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKEMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 304)	GGGCACCCAGACCTACATCTGCAACGTGAATCAC AAGCCCAGCAACACCAAGGTGGACAAGAAAGTT GAGCCCAAATCTTGTGACAAAACCTCACACATGCC CACCGTGCCCAGCACCTGAACTCCTGGGGGGACC GTCAGTCTTCCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGC GTGGTGGTGGACGTGAGCCACGAAGACCCTGAGG TCAAGTTCAACTGGTACGTGGACGGCGTGGAGGT GCATAATGCCAAGACAAAGCCGTGCGAGGAGCA GTACGGCAGCACGTACCGTTGCGTCAGCGTCCTC ACCGTCCTGCACCAGGACTGGCTGAATGGCAAGG AGTACAAGTGCAAGGTCTCCAACAAAGCCCTCCC AGCCCCATCGAGAAAACCATCTCCAAAGCCAAA GGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCGGAAGGAGATGACCAAGAACCAGGT CAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCA GCGACATCGCCGTGGAGTGGGAGAGCAATGGGC AGCCGGAGAACTACAAGACACGCCTCCCGT GCTGAAGTCCGACGGCTCCTTCTCTCTATAGCA AGCTCACCGTGGACAAGAGCAGGTGGCAGCAGG GGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTCTCCC TGTCTCCGGGTAAA (SEQ ID NO: 326)
52C, 54C, 55C	HC-111	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSFGMHW VRQAPGKGLEWVAVISFD GSIKYSVDSVKGRFTISR NSKNTLFLQMNSLRAEDT AVYYCARDRLNYYDSSGY YHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPCPAPPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKKMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 305)	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTCACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGAACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCTC TGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTGCTGGA ACTCAGGCGCCCTGACCAGCGGCGTGCACACCTT CCCGGCTGTCTACAGTCTCAGGACTCTACTCCC TCGAGAGCGTGGTGACCGTGCCCTCCAGCAGCTT GGGCACCCAGACCTACATCTGCAACGTGAATCAC AAGCCCAGCAACACCAAGGTGGACAAGAAAGTT GAGCCCAAATCTTGTGACAAAACCTCACACATGCC CACCGTGCCCAGCACCTGAACTCCTGGGGGGACC GTCAGTCTTCCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGC GTGGTGGTGGACGTGAGCCACGAAGACCCTGAGG TCAAGTTCAACTGGTACGTGGACGGCGTGGAGGT GCATAATGCCAAGACAAAGCCGTGCGAGGAGCA GTACGGCAGCACGTACCGTTGCGTCAGCGTCCTC ACCGTCCTGCACCAGGACTGGCTGAATGGCAAGG AGTACAAGTGCAAGGTCTCCAACAAAGCCCTCCC AGCCCCATCGAGAAAACCATCTCCAAAGCCAAA

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			GGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCCGGAAGAAGATGACCAAGAACCAGGT CAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCA GCGACATCGCCGTGGAGTGGGAGAGCAATGGGC AGCCGGAGAACAACACTACAAGACCACGCCTCCCGT GCTGAAGTCCGACGGCTCCTTCTTCTCTATAGCA AGCTCACCGTGGACAAGAGCAGGTGGCAGCAGG GGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTCTCCC TGTCTCCGGGTAAA (SEQ ID NO: 327)
52D	HC-112	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSFGMHW VRQAPGKGLEWVAVISFD GSIKYSVDSVKGRFTISRD NSKNTLFLQMNSLRAEDT AVYYCARDRLNYYDSSGY YHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPC SRSTSESTAALGCLVKDYF PEPVTVSWNSGALTSGVH TFPAVLQSSGLYSLESVVT VPSSNFGTQTYTCNVDHK PSNTKVDKTVVERKCCVEC PPCPAPPVAGPSVFLFPPKP KDTLMISRTPEVTCVVVD VSHEDPEVQFNWYVDGVE VHNAKTKPREEQFNSTFR VVSVLTVVHQDWLNGKE YKCKVSNKGLPAPIEKTIS KTKGQPREPQVYTLPPSRK KMTKNQVSLTCLVKGFYP SDIAVEWESNGQPENNYK TTPPMLKSDGSFFLYSKLT VDKSRWQQGNVFSCSVM HEALHNHYTQKSLSLSPG K (SEQ ID NO: 306)	CAGGTGCAGCTGGTGGAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGGACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCGCCCTGCTCCAGGAGCACCTC CGAGAGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTGCTGGA ACTCAGGCGCTCTGACCAGCGGCGTGACACACCTT CCCAGCTGTCTTACAGTCTCAGGACTCTACTCCC TGGAGAGCGTGGTGACCGTGCCCTCCAGCAACTT CGGCACCCAGACCTACACCTGCAACGTAGATCAC AAGCCCAGCAACACCAAGGTGGACAAGACAGTT GAGCGCAAATGTTGTGTCGAGTGCCACCGTGCC CAGCACCACCTGTGGCAGGACCGTCAGTCTTCCT CTTCCCCCAAAACCCAAGGACACCCTCATGATC TCCCGGACCCCTGAGGTCACGTGCGTGGTGGTGG ACGTGAGCCACGAAGACCCCGAGGTCCAGTTCAA CTGGTACGTGGACGGCGTGGAGGTGCATAATGCC AAGACAAAGCCACGGGAGGAGCAGTTCAACAGC ACGTTCCGTGTGGTCAGCGTCCTCACCGTTGTGCA CCAGGACTGGCTGAACGGCAAGGAGTACAAGTGC AAGGTCTCCAACAAAGGCCTCCAGCCCCCATCG AGAAAACCATCTCCAAAACCAAAGGGCAGCCCCG AGAACCACAGGTGTACACCCTGCCCCCATCCCG AAGAAGATGACCAAGAACCAGGTACGCCTGACCT GCCTGGTCAAAGGCTTCTACCCAGCGACATCGC CGTGGAGTGGGAGAGCAATGGGCAGCCGGAGAA CAACTACAAGACCACACCTCCCATGCTGAAGTCC GACGGCTCCTTCTTCTCTACAGCAAGCTCACCGT GGACAAGAGCAGGTGGCAGCAGGGGAACGTCTT CTCATGCTCCGTGATGCATGAGGCTCTGCACAAC CACTACACGCAGAAGAGCCTCTCCCTGTCTCCGG GTAAA (SEQ ID NO: 328)
53A, 56A	HC-113	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSFGMHW VRQAPGKGLEWVAVISFD	CAGGTGCAGCTGGTGGAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		GSIKYSVDSVKGRFTISRDN NSKNTLFLQMNSLRAEDT AVYYCARDRLNYYESSGY YHYKYYGMAVWGQGTT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKEMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFC SVMHEALHNYHTQKSLSL SPGK (SEQ ID NO: 307)	ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGAGAGTAGTGGTTATTATCACTACAAATA CTACGGTATGGCCGTCTGGGGCCAAGGGACAACA GTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATC GGTCTTCCCCCTGGCACCTCCTCCAAGAGCACCT CTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAA GGACTACTTCCCCGAACCGGTGACGGTGTCTGG AACTCAGGCGCCCTGACCAGCGGCGTGACACACT TCCCGGCTGTCTACAGTCTCAGGACTCTACTCC CTCGAGAGCGTGGTGACCGTGCCCTCCAGCAGCT TGGGCACCCAGACCTACATCTGCAACGTGAATCA CAAGCCCAGCAACACCAAGGTGGACAAGAAAGT TGAGCCCCAAATCTTGTGACAAAACCTACACATGC CCACCGTCCCAGCACCTGAACCTCTGGGGGGAC CGTCAGTCTTCTCTTCCCCCAAAACCAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTACAT GCGTGGTGGTGGACGTGAGCCACGAAGACCCTGA GGTAAGTTCAACTGGTACGTGGACGGCGTGGAG GTGCATAATGCCAAGACAAAGCCGTGCGAGGAGC AGTACGGCAGCACGTACCGTTGCGTCAGCGTCCT CACCGTCTTGACACAGGACTGGCTGAATGGCAAG GAGTACAAGTGCAAGGTCTCCAACAAAGCCCTCC CAGCCCCCATCGAGAAAACCATCTCCAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTG CCCCCATCCCGGAAGGAGATGACCAAGAACCAGG TCAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCC AGCGACATCGCCGTGGAGTGGGAGAGCAATGGG CAGCCGGAGAACAACCTACAAGACCACGCCTCCCG TGCTGAAGTCCGACGGCTCCTTCTTCTCTATAGC AAGCTACCGTGGACAAGAGCAGGTGGCAGCAG GGAACGTCTTCTCATGCTCCGTGATGCATGAGG CTCTGCACAACCACTACACGCAGAAGAGCCTCTC CCTGTCTCCGGGTAAG (SEQ ID NO: 329)
53B, 56B	HC-114	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSFGMHW VRQAPGKELEWVAVISFD GSIKYSVDSVKGRFTISRDN NSKNTLFLQMNSLRAEDT AVYYCARDRLNYYESSGY YHYKYYGMAVWGQGTT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNHNK PSNTKVDKKVEPKSCDKT HTCPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTCACCTTACAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGAGAGTAGTGGTTATTATCACTACAAATA CTACGGTATGGCCGTCTGGGGCCAAGGGACAACA GTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATC GGTCTTCCCCCTGGCACCTCCTCCAAGAGCACCT CTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAA GGACTACTTCCCCGAACCGGTGACGGTGTCTGG AACTCAGGCGCCCTGACCAGCGGCGTGACACACT

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKEMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 308)	TCCCGGCTGTCTACAGTCCTCAGGACTCTACTCC CTCGAGAGCGTGGTGACCGTGCCCTCCAGCAGCT TGGGCACCCAGACCTACATCTGCAACGTGAATCA CAAGCCCAGCAACACCAAGGTGGACAAGAAAGT TGAGCCCCAAATCTTGTGACAAAACCTCACACATGC CCACCGTGCCCAGCACCTGAACTCCTGGGGGGAC CGTCAGTCTTCTCTTCCCCCAAAACCCAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTCACAT GCGTGGTGGTGGACGTGAGCCACGAAGACCCTGA GGTCAAGTTCAACTGGTACGTGGACGGCGTGGAG GTGCATAATGCCAAGACAAAGCCGTGCGAGGAGC AGTACGGCAGCACGTACCGTTGCGTCAGCGTCCT CACCGTCCTGCACCAGGACTGGCTGAATGGCAAG GAGTACAAGTGCAAGGTCTCCAACAAAGCCCTCC CAGCCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTG CCCCCATCCCGGAAGGAGATGACCAAGAACCAGG TCAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCC AGCGACATCGCCGTGGAGTGGGAGAGCAATGGG CAGCCGGAGAACAACACTACAAGACCACGCCTCCCG TGCTGAAGTCCGACGGCTCCTTCTTCTCTATAGC AAGCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGG CTCTGCACAACCACTACACGCAGAAGAGCCTCTC CCTGTCTCCGGGTAAG (SEQ ID NO: 330)
53C, 56C	HC-115	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSFGMHW VRQAPGKGLEWVAVISFD GSIKYSVDSVKGRFTISR NSKNTLFLQMNSLRAEDT AVYYCARDRLNYYESSGY YHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPS SKSTSGGTAALGCLVKDY FPEPVTVSWNSGALTSGV HTFPAVLQSSGLYSLESVV TVPSSSLGTQTYICNVNKH PSNTKVDKKVEPKSCDKT HTCPPCPAPELLGGPSVFL FPPKPKDTLMISRTPEVTC VVVDVSHEDPEVKFNWY VDGVEVHNAKTKPCEEQY GSTYRCVSVLTVLHQDWL NGKEYKCKVSNKALPAPI EKTISKAKGQPREPQVYTL PPSRKMTKNQVSLTCLV KGFYPSDIAVEWESNGQPE NNYKTTTPVLKSDGSFFLY SKLTVDKSRWQQGNVFSC SVMHEALHNHYTQKSLSL SPGK (SEQ ID NO: 309)	CAGGTGCAGCTGGTGGAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGAGAGTAGTGGTTATTATCACTACAAATA CTACGGTATGGCCGTCTGGGGCCAAGGAACAACA GTTACCGTCTCTAGTGCTTCCACCAAGGGCCCATC GGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCT CTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAA GGACTACTTCCCCGAACCGGTGACGGTGTCTGTGG AACTCAGGCGCCCTGACCAGCGGCGTGCACACCT TCCCGGCTGTCTACAGTCCTCAGGACTCTACTCC CTCGAGAGCGTGGTGACCGTGCCCTCCAGCAGCT TGGGCACCCAGACCTACATCTGCAACGTGAATCA CAAGCCCAGCAACACCAAGGTGGACAAGAAAGT TGAGCCCCAAATCTTGTGACAAAACCTCACACATGC CCACCGTGCCCAGCACCTGAACTCCTGGGGGGAC CGTCAGTCTTCTCTTCCCCCAAAACCCAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTCACAT GCGTGGTGGTGGACGTGAGCCACGAAGACCCTGA GGTCAAGTTCAACTGGTACGTGGACGGCGTGGAG GTGCATAATGCCAAGACAAAGCCGTGCGAGGAGC AGTACGGCAGCACGTACCGTTGCGTCAGCGTCCT CACCGTCCTGCACCAGGACTGGCTGAATGGCAAG

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			GAGTACAAGTGCAAGGTCTCCAACAAAGCCCTCC CAGCCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTG CCCCCATCCCGGAAGAAGATGACCAAGAACCAGG TCAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCC AGCGACATCGCCGTGGAGTGGGAGAGCAATGGG CAGCCGGAGAACAACACTACAAGACCACGCCTCCCG TGCTGAAGTCCGACGGCTCCTTCTTCTCTATAGC AAGCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGG CTCTGCACAACCACTACACGCAGAAGAGCCTCTC CCTGTCTCCGGGTAAG (SEQ ID NO: 331)
57A	HC-116	QVQLVESGGGVVQPGRL RLSCAASGFTFSSYGMHW VRQAPGKGLEWVAVIWY DGSNKYYADSVKGRFIISR DKSKNTLYLQMNSLRAED TAVYYCARAGGIAAAGLY YYYGMDVWGQGTITVTS SASTKGPSVFPLAPSSKSTS GGTAALGCLVKDYFPEPV TVSWNSGALTSGVHTFPA VLQSSGLYSLESVVTPSS SLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPP CPAPELLGGPSVFLFPPKP KDTLMISRTPEVTCVVVD VSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYR CVSVLTVLHQDWLNGKE YKCKVSNKALPAPIEKTIS KAKGQPREPQVYTLPPSR KEMTKNQVSLTCLVKGFY PSDIAVEWESNGQPENNY KTPPVLKSDGSFFLYSKL TVDKSRWQQGNVFCFSV MHEALHNHYTQKSLSLSP GK (SEQ ID NO: 310)	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCGTCTGGATTCACCTTCAGTAGCTATGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATGGTATGATGGAAGTAAT AAATACTATGCAGACTCCGTGAAGGGCCGATTCA TCATCTCCAGAGATAAATCCAAGAACACGCTGTA TCTGCAAATGAACAGCCTGAGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGCGGGGGTATAG CAGCAGCTGGCCTCTACTACTACTACGGTATGGA CGTCTGGGGCCAAGGGACAACAGTTACCGTCTCT AGTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCT GGCACCTCTCTCCAAGAGCACCTCTGGGGGCACA GCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCC CCGAACCGGTGACGGTGTCTGTGGAACCTCAGGCGC CCTGACCAGCGGCGTGCACACCTTCCCGGCTGTC CTACAGTCTCTCAGGACTCTACTCCCTCGAGAGCGT GGTGACCGTGCCCTCCAGCAGCTTGGGCACCCAG ACCTACATCTGCAACGTGAATCACAAGCCCAGCA ACACCAAGGTGGACAAGAAAGTTGAGCCCAAATC TTGTGACAAAACCTCACACATGCCACCGTGCCCA GCACCTGAACTCCTGGGGGGGACCGTCAGTCTTCC TCTTCCCCCCCCAAAACCAAGGACACCCTCATGAT CTCCCGGACCCCTGAGGTACATGCGTGGTGGTG GACGTGAGCCACGAAGACCCTGAGGTCAAGTTCA ACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGCGAGGAGCAGTACGGCAG CACGTACCGTTGCGTCAGCGTCTCACCCTCCTGC ACCAGGACTGGCTGAATGGCAAGGAGTACAAGTG CAAGGTCTCCAACAAGCCCTCCCAGCCCCCATC GAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCC GAGAACCACAGGTGTACACCTGCCCCCATCCCG GAAGGAGATGACCAAGAACCAGGTACGCCTGAC CTGCCTGGTCAAAGGCTTCTATCCAGCGACATC GCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACTACAAGACCACGCCTCCCGTGCTGAAGT CCGACGGCTCCTTCTTCTCTATAGCAAGCTCACC GTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAA CCACTACACGCAGAAGAGCCTCTCCCTGTCTCCG GGTAAA (SEQ ID NO: 332)
57B	HC-117	QVQLVESGGGVVQPGRL	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGG

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		RLSCAASGFTFSSYGMHW VRQAPGKELEWVAVIY DGSNKYYADSVKGRFIISR DKSNTLYLQMNSLRAED TAVYYCARAGGIAAAGLY YYYGMDVWGQGTTVTVS SASTKGPSVFPLAPSSKSTS GGTAALGCLVKDYFPEPV TVSWNSGALTSGVHTFPA VLQSSGLYSLESVVTVPSS SLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPP CPAPELLGGPSVFLFPPKP KDTLMISRTPEVTCVVD VSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYR CVSVLTVLHQDWLNGKE YKCKVSNKALPAPIEKTIS KAKGQPREPQVYTLPPSR KEMTKNQVSLTCLVKGFY PSDIAVEVESNGQPENNY KTTTPVLKSDGSFFLYSKL TVDKSRWQQGNVFCFSV MHEALHNHYTQKSLSLSP GK (SEQ ID NO: 311)	TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCGTCTGGATTACCTTCAGTAGCTATGGCATGC ACTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGGA GTGGGTGGCAGTTATATGGTATGATGGAAGTAAT AAATACTATGCAGACTCCGTGAAGGGCCGATTCA TCATCTCCAGAGATAAATCCAAGAACACGCTGTA TCTGCAAATGAACAGCCTGAGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGCGGGGGGTATAG CAGCAGCTGGCCTCTACTACTACTACGGTATGGA CGTCTGGGGCCAAGGGACAACAGTTACCGTCTCT AGTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCT GGCACCCTCCTCCAAGAGCACCTCTGGGGGCACA GCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCC CCGAACCAGGTGACGGTGTCTGTGGAAGTCAAGGCGC CCTGACCAGCGGCGTGCACACCTTCCCGGCTGTC CTACAGTCTCAGGACTCTACTCCCTCGAGAGCGT GGTGACCGTGCCCTCCAGCAGCTTGGGCAACCCAG ACCTACATCTGCAACGTGAATCACAAGCCCAAGCA ACACCAAGGTGGACAAGAAAGTTAGAGCCCAATC TTGTGACAAAACCTCACACATGCCACCGTGCCCA GCACCTGAACTCCTGGGGGGACCGTCAGTCTTCC TCTTCCCCCAAAAACCCAAGGACACCCTCATGAT CTCCCGGACCCCTGAGGTCACATGCGTGGTGGTG GACGTGAGCCACGAAGACCCTGAGGTCAAGTTCA ACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGCGAGGAGCAGTACGGCAG CACGTACCGTTGCGTCAGCGTCTCACCCTCCTGC ACCAGGACTGGCTGAATGGCAAGGAGTACAAGTG CAAGGTCTCCAACAAAGCCCTCCCAGCCCCCATC GAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCC GAGAACCACAGGTGTACACCCTGCCCCCATCCCG GAAGGAGATGACCAAGAACCAGGTACAGCCTGAC CTGCCTGGTCAAAGGCTTCTATCCCAGCGACATC GCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACTACAAGACCACGCCTCCCGTGCTGAAGT CCGACGGCTCCTTCTTCTCTATAGCAAGCTCACC GTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAA CCACTACACGCAGAAGAGCCTCTCCCTGTCTCCG GGTAAA (SEQ ID NO: 333)
57C	HC-118	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSYGMHW VRQAPGKLEWVAVIY DGSNKYYADSVKGRFIISR DKSNTLYLQMNSLRAED TAVYYCARAGGIAAAGLY YYYGMDVWGQGTTVTVS SASTKGPSVFPLAPSSKSTS GGTAALGCLVKDYFPEPV TVSWNSGALTSGVHTFPA VLQSSGLYSLESVVTVPSS SLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPP CPAPELLGGPSVFLFPPKP	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCGTCTGGATTACCTTCAGTAGCTATGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATGGTATGATGGAAGTAAT AAATACTATGCAGACTCCGTGAAGGGCCGATTCA TCATCTCCAGAGATAAATCCAAGAACACGCTGTA TCTGCAAATGAACAGCCTGAGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGCGGGGGGTATAG CAGCAGCTGGCCTCTACTACTACTACGGTATGGA CGTCTGGGGCCAAGGAACAACAGTTACCGTCTCT AGTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCT GGCACCCTCCTCCAAGAGCACCTCTGGGGGCACA GCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCC

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		KDTLMISRTPEVTCVVVD VSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYR CVSVLTVLHQDWLNGKE YKCKVSNKALPAPIEKTIS KAKGQPREPQVYTLPPSR KKMTKNQVSLTCLVKGFY PSDIAVEWESNGQPENNY KTPPVLKSDGSFFLYSKL TVDKSRWQQGNVFSCSV MHEALHNHYTQKSLSLSP GK (SEQ ID NO: 312)	CCGAACCGGTGACGGTGTCGTGGAACCTCAGGCGC CCTGACCAGCGGCGTGCACACCTTCCCGGCTGTC CTACAGTCCTCAGGACTCTACTCCCTCGAGAGCGT GGTGACCGTGCCCTCCAGCAGCTTGGGCACCCAG ACCTACATCTGCAACGTGAATCACAAGCCCAGCA ACACCAAGGTGGACAAGAAAGTTGAGCCCAAATC TTGTGACAAAACCTCACACATGCCCACCGTGCCCA GCACCTGAACTCCTGGGGGGGACCGTCAGTCTTCC TCTTCCCCCCTCAAGGACACCCCTCATGAT CTCCCGGACCCCTGAGGTCACATGCGTGGTGGTT GACGTGAGCCACGAAGACCCTGAGGTCAAGTTCA ACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGCGAGGAGCAGTACGGCAG CACGTACCGTTGCGTCAGCGTCCTCACCGTCCTGC ACCAGGACTGGCTGAATGGCAAGGAGTACAAGTG CAAGGTCTCCAACAAAGCCCTCCCAGCCCCCATC GAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCC GAGAACCACAGGTGTACACCCTGCCCCCATCCCCG GAAGAAGATGACCAAGAACCAGGTCAGCCTGAC CTGCCTGGTCAAAGGCTTCTATCCAGCGACATC GCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACTACAAGACCACGCCTCCCGTGCTGAAGT CCGACGGCTCCTTCTTCTCTATAGCAAGCTCACC GTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAA CCACTACACGCAGAAGAGCCTCTCCCTGTCTCCG GGTAAA (SEQ ID NO: 334)
57D	HC-119	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSYGMHW VRQAPGKGLEWVAVIWY DGSNKYYADSVKGRFIISR DKSKNTLYLQMNSLRAED TAVYYCARAGGIAAAGLY YYYGMDVWGQGTITVVS SASTKGPSVFPLAPCSRSTS ESTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAV LQSSGLYSLESVVTVPSSN FGTQYTCNVDPKPSNTK VDKTKVERKCCVECPCPA PPVAGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSH DPEVQFNWYVDGVEVHN AKTKPREEQFNSTFRVVS LTVVHQDWLNGKEYKCK VSNKGLPAPIEKTISKTKG QPREPQVYTLPPSRKKMT KNQVSLTCLVKGFYPSDIA VEWESNGQPENNYKTPP MLKSDGSFFLYSKLTVDK SRWQQGNVFSCSVMEAL HNHYTQKSLSLSPGK (SEQ ID NO: 313)	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCGTCTGGATTACCTTCAGTAGCTATGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATGGTATGATGGAAGTAAT AAATACTATGCAGACTCCGTGAAGGGCCGATTCA TCATCTCCAGAGATAAATCCAAGAACACGCTGTA TCTGCAAATGAACAGCCTGAGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGCGGGGGGTATAG CAGCAGCTGGCCTCTACTACTACTACGGTATGGA CGTCTGGGGCCAAGGGACAACAGTTACCGTCTCT AGTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCT GGCGCCCTGTCCAGGAGCACCTCCGAGAGCACA GCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCC CCGAACCGGTGACGGTGTCGTGGAACCTCAGGCGC TCTGACCAGCGGCGTGCACACCTTCCCAGCTGTCC TACAGTCCTCAGGACTCTACTCCCTGGAGAGCGT GGTGACCGTGCCCTCCAGCAACTTCGGGCACCCAG ACCTACACCTGCAACGTAGATCACAAGCCCAGCA ACACCAAGGTGGACAAGACAGTTGAGCGCAAAT GTTGTGTGCGAGTGCCACCGTGCCAGCACCACC TGTGGCAGGACCGTCAGTCTTCTCTTCCCCCCT AACCCAAGGACACCTCATGATCTCCCGGACCCC TGAGGTACAGTGCGTGGTGGTGGACGTGAGCCAC GAAGACCCCGAGGTCCAGTTCAACTGGTACGTGG ACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC ACGGGAGGAGCAGTTCAACAGCACGTTCCGTGTG

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			GTCAGCGTCTCACC GTTGTGCACCAGGACTGGC TGAACGGCAAGGAGTACAAGTGCAAGGTCTCCAA CAAAGGCCTCCCAGCCCCCATCGAGAAAACCATC TCCAAAACCAAAGGGCAGCCCCGAGAACCACAG GTGTACACCCTGCCCCCATCCCGGAAGAAGATGA CCAAGAACCAGGTCAGCCTGACCTGCCTGGTCAA AGGCTTCTACCCCAGCGACATCGCCGTGGAGTGG GAGAGCAATGGGCAGCCGGAGAACAACACTACAAG ACCACACCTCCCATGCTGAAGTCCGACGGCTCCTT CTTCTCTACAGCAAGCTCACC GTTGGACAAGAGC AGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCG TGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTCTCCCTGTCTCCGGGTAAA (SEQ ID NO: 335)
58A	HC-120	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSYGMHW VRQAPGKGLEWVAVIY DGSNKYYAESVKGRFIIS DKSKNTLYLQMNSLRAED TAVYYCARAGGIAAAGLY YYYGMDVWGQGTTVTVS SASTKGPSVFPLAPSSKSTS GGTAALGCLVKDYFPEPV TVSWNSGALTSGVHTFPA VLQSSGLYSLESVVTVPSS SLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPP CPAPELLGGPSVFLFPPKP KDTLMISRTPEVTCVVVD VSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYR CVSVLTVLHQDWLNGKE YKCKVSNKALPAPIEKTIS KAKGQPREPQVYTLPPSR KEMTKNQVSLTCLVKGFY PSDIAVEWESNGQPENNY KTPPVLKSDGSFFLYSKL TVDKSRWQQGNVFCSSV MHEALHNHYTQKSLSLSP GK (SEQ ID NO: 314)	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCGTCTGGATTCACCTTCAGTAGCTATGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATGGTATGATGGAAGTAAT AAATACTATGCAGAGTCCGTGAAGGGCCGATTCA TCATCTCCAGAGATAAATCCAACACACGCTGTA TCTGCAAATGAACAGCCTGAGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGCGGGGGGTATAG CAGCAGCTGGCCTCTACTACTACTACGGTATGGA CGTCTGGGGCCAAGGGACAACAGTTACCGTCTCT AGTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCT GGCACCTCCTCCAAGAGCACCTCTGGGGGCACA GCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCC CCGAACCGGTGACGGTGTCTGTGGAACCTCAGGCGC CCTGACCAGCGGCGTGCACACCTTCCCGGCTGTC CTACAGTCTCAGGACTCTACTCCCTCGAGAGCGT GGTGACCGTGCCCTCCAGCAGCTTGGGCACCCAG ACCTACATCTGCAACGTGAATCACAAGCCCAGCA ACACCAAGGTGGACAAGAAAGTTGAGCCCAAATC TTGTGACAAAACCTCACACATGCCACCGTGCCCA GCACCTGAACTCCTGGGGGGGACCGTCAGTCTTCC TCTTCCCCCAAAACCCAAGGACACCCTCATGAT CTCCCGGACCCCTGAGGTACATGCGTGGTGGTG GACGTGAGCCACGAAGACCCTGAGGTCAAGTTCA ACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGCGAGGAGCAGTACGGCAG CACGTACCGTTGCGTCAGCGTCCTCACCGTCCTGC ACCAGGACTGGCTGAATGGCAAGGAGTACAAGTG CAAGGTCTCCAACAAAGCCCTCCCAGCCCCCATC GAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCC GAGAACCACAGGTGTACACCCTGCCCCCATCCCG GAAGGAGATGACCAAGAACCAGGTGAGCCTGAC CTGCCTGGTCAAAGGCTTCTATCCAGCGACATC GCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACTACAAGACCACGCCTCCCGTGCTGAAGT CCGACGGCTCCTTCTTCTCTATAGCAAGCTCACC GTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAA CCTACACGCAGAAGAGCCTCTCCCTGTCTCCG

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
			GGTAAA (SEQ ID NO: 336)
58B	HC-121	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSYGMHW VRQAPGKELEWVAWIWY DGSNKYYAESVKGRFIISR DKSKNTLYLQMNSLRAED TAVYYCARAGGIAAAGLY YYYGMDVWGQGTITVTS SASTKGPSVFPLAPSSKSTS GGTAALGCLVKDYFPEPV TVSWNSGALTSGVHTFPA VLQSSGLYSLESVVTVPSS SLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPP CPAPELLGGPSVFLFPPKP KDTLMISRTPEVTCVVVD VSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYR CVSVLTVLHQDWLNGKE YKCKVSNKALPAPIEKTIS KAKGQPREPQVYTLPPSR KEMTKNQVSLTCLVKGFY PSDIAVEWESNGQPENNY KTPPVLKSDGSFFLYSKL TVDKSRWQQGNVFCFSV MHEALHNHYTQKSLSLSP GK (SEQ ID NO: 315)	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCGTCTGGATTACCTTCAGTAGCTATGGCATGC ACTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGGA GTGGGTGGCAGTTATATGGTATGATGGAAGTAAT AAATACTATGCAGAGTCCGTGAAGGGCCGATTCA TCATCTCCAGAGATAAATCCAAGAACACGCTGTA TCTGCAAATGAACAGCCTGAGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGCGGGGGGTATAG CAGCAGCTGGCCTCTACTACTACTACGGTATGGA CGTCTGGGGCCAAGGGACAACAGTTACCGTCTCT AGTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCT GGCACCTCCTCCAAGAGCACCTCTGGGGGCACA GCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCC CCGAACCGGTGACGGTGTCTGGAAGTCAAGGCGC CCTGACCAGCGGCGTGCACACCTTCCCGGCTGTC CTACAGTCTCAGGACTCTACTCCCTCGAGAGCGT GGTGACCGTGCCCTCCAGCAGCTTGGGCAACCCAG ACCTACATCTGCAACGTGAATCACAAGCCACGCA ACACCAAGGTGGACAAGAAAGTTGAGCCCAAATC TTGTGACAAAACCTCACACATGCCACCGTGCCCA GCACCTGAACTCCTGGGGGGGACCGTCAGTCTTCC TCTTCCCCCCTCAAGGACACCCCTCATGAT CTCCCGGACCCCTGAGGTCACATGCGTGGTGGTG GACGTGAGCCACGAAGACCTGAGGTCAAGTTCA ACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGCGAGGAGCAGTACGGCAG CACGTACCGTTGCGTCAGCGTCTCACCCTCCTGC ACCAGGACTGGCTGAATGGCAAGGAGTACAAGTG CAAGGTCTCCAACAAGCCCTCCCAGCCCCCATC GAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCC GAGAACCACAGGTGTACACCTGCCCCCATCCCG GAAGGAGATGACCAAGAACCAGGTCAGCCTGAC CTGCCTGGTCAAAGGCTTCTATCCAGCGACATC GCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACTACAAGACCACGCCTCCCGTGCTGAAGT CCGACGGCTCCTTCTTCTCTATAGCAAGCTCACC GTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAA CCACTACACGAGAAGAGCCTCTCCCTGTCTCCG GGTAAA (SEQ ID NO: 337)
58C	HC-122	QVQLVESGGGVVQPGRSL RLSCAASGFTFSSYGMHW VRQAPGKLEWVAWIWY DGSNKYYAESVKGRFIISR DKSKNTLYLQMNSLRAED TAVYYCARAGGIAAAGLY YYYGMDVWGQGTITVTS SASTKGPSVFPLAPSSKSTS GGTAALGCLVKDYFPEPV TVSWNSGALTSGVHTFPA VLQSSGLYSLESVVTVPSS SLGTQTYICNVNHKPSNTK	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCGTCTGGATTACCTTCAGTAGCTATGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATGGTATGATGGAAGTAAT AAATACTATGCAGAGTCCGTGAAGGGCCGATTCA TCATCTCCAGAGATAAATCCAAGAACACGCTGTA TCTGCAAATGAACAGCCTGAGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGCGGGGGGTATAG CAGCAGCTGGCCTCTACTACTACTACGGTATGGA CGTCTGGGGCCAAGGAACAACAGTTACCGTCTCT AGTGCCTCCACCAAGGGCCCATCGGTCTTCCCCCT

Antibody ID.	HC Group	Heavy Chain Amino Acid Sequence	Heavy Chain Nucleic Acid Sequence
		VDKKVEPKSCDKTHTCPP CPAPELLGGPSVFLFPPKP KDTLMISRTPEVTCVVVD VSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYR CVSVLTVLHQDWLNGKE YKCKVSNKALPAPIEKTIS KAKGQPREPQVYTLPPSR KKMTKNQVSLTCLVKGFY PSDIAVEWESNGQPENNY KTTTPVLKSDGSFFLYSKL TVDKSRWQQGNVFCSSV MHEALHNHYTQKSLSLSP GK (SEQ ID NO: 316)	GGCACCCTCCTCCAAGAGCACCTCTGGGGGCACA GCGGCCCTGGGCTGCCTGGTCAAGGACTACTTCC CCGAACCGGTGACGGTGTCGTGGAACCTCAGGCGC CCTGACCAGCGGCGTGCACACCTTCCCGGCTGTC CTACAGTCCTCAGGACTCTACTCCCTCGAGAGCGT GGTGACCGTGCCCTCCAGCAGCTTGGGCACCCAG ACCTACATCTGCAACGTGAATCACAAGCCCAGCA ACACCAAGGTGGACAAGAAAGTTGAGCCCAAATC TTGTGACAAAACCTCACACATGCCACCGTGCCCA GCACCTGAACTCCTGGGGGGGACCGTCAGTCTTCC TCTTCCCCCCTAAAACCCAAGGACACCCTCATGAT CTCCCGGACCCCTGAGGTCACATGCGTGGTGGTT GACGTGAGCCACGAAGACCCTGAGGTCAAGTTCA ACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGCGAGGAGCAGTACGGCAG CACGTACCGTTGCGTCAGCGTCCTCACCGTCCTGC ACCAGGACTGGCTGAATGGCAAGGAGTACAAGTG CAAGGTCTCCAACAAGCCCTCCCAGCCCCCATC GAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCC GAGAACCACAGGTGTACACCTGCCCTCCCG GAAGAAGATGACCAAGAACCAGGTCAGCCTGAC CTGCCTGGTCAAAGGCTTCTATCCAGCGACATC GCCGTGGAGTGGGAGAGCAATGGGCAGCCGGAG AACAACTACAAGACCACGCCTCCCGTGCTGAAGT CCGACGGCTCCTTCTTCTCTATAGCAAGCTCACC GTGGACAAGAGCAGGTGGCAGCAGGGGAACGTC TTCTCATGCTCCGTGATGCATGAGGCTCTGCACAA CCACTACACGCAGAAGAGCCTCTCCCTGTCTCCG GGTAAA (SEQ ID NO: 338)

[0113] In some embodiments, the heterodimeric antibody of the invention comprises an anti-CGRP receptor light chain from Table 7A and an anti-CGRP receptor heavy chain from Table 7B. Exemplary pairs of anti-CGRP receptor light and heavy chains that may be incorporated into a heterodimeric antibody include, but are not limited to: LC-101 (SEQ ID NO: 271) and HC-101 (SEQ ID NO: 295); LC-102 (SEQ ID NO: 272) and HC-102 (SEQ ID NO: 296); LC-101 (SEQ ID NO: 271) and HC-103 (SEQ ID NO: 297); LC-101 (SEQ ID NO: 271) and HC-104 (SEQ ID NO: 298); LC-103 (SEQ ID NO: 273) and HC-105 (SEQ ID NO: 299); LC-104 (SEQ ID NO: 274) and HC-106 (SEQ ID NO: 300); LC-103 (SEQ ID NO: 273) and HC-107 (SEQ ID NO: 301); LC-103 (SEQ ID NO: 273) and HC-108 (SEQ ID NO: 302); LC-105 (SEQ ID NO: 275) and HC-109 (SEQ ID NO: 303); LC-106 (SEQ ID NO: 276) and HC-110 (SEQ ID NO: 304); LC-105 (SEQ ID NO: 275) and HC-111 (SEQ ID NO: 305); LC-105 (SEQ ID NO: 275) and HC-112 (SEQ ID NO: 306); LC-105 (SEQ ID NO: 275) and HC-113 (SEQ ID NO: 307); LC-106 (SEQ ID NO: 276) and HC-114 (SEQ ID NO: 308); LC-105 (SEQ ID NO: 275) and

HC-115 (SEQ ID NO: 309); LC-107 (SEQ ID NO: 277) and HC-109 (SEQ ID NO: 303); LC-108 (SEQ ID NO: 278) and HC-110 (SEQ ID NO: 304); LC-107 (SEQ ID NO: 277) and HC-111 (SEQ ID NO: 305); LC-109 (SEQ ID NO: 279) and HC-109 (SEQ ID NO: 303); LC-110 (SEQ ID NO: 280) and HC-110 (SEQ ID NO: 304); LC-109 (SEQ ID NO: 279) and HC-111 (SEQ ID NO: 305); LC-107 (SEQ ID NO: 277) and HC-113 (SEQ ID NO: 307); LC-108 (SEQ ID NO: 278) and HC-114 (SEQ ID NO: 308); LC-107 (SEQ ID NO: 277) and HC-115 (SEQ ID NO: 309); LC-111 (SEQ ID NO: 281) and HC-116 (SEQ ID NO: 310); LC-112 (SEQ ID NO: 282) and HC-117 (SEQ ID NO: 311); LC-111 (SEQ ID NO: 281) and HC-118 (SEQ ID NO: 312); LC-111 (SEQ ID NO: 281) and HC-119 (SEQ ID NO: 313); LC-111 (SEQ ID NO: 281) and HC-120 (SEQ ID NO: 314); LC-112 (SEQ ID NO: 282) and HC-121 (SEQ ID NO: 315); and LC-111 (SEQ ID NO: 281) and HC-122 (SEQ ID NO: 316).

[0114] The anti-CGRP receptor light chain and/or heavy chain incorporated into a heterodimeric antibody of the invention may comprise a sequence of contiguous amino acids that differs from the sequence of a light chain in Table 7A or a heavy chain in Table 7B by 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 or more amino acid residues, wherein each such sequence difference is independently a deletion, insertion or substitution of one amino acid. In some embodiments, the anti-CGRP receptor light chain incorporated into a heterodimeric antibody comprises a sequence of amino acids that has at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 97% or at least 99% sequence identity to the amino acid sequences of SEQ ID NOs: 271-282 (i.e. the anti-CGRP receptor light chains in Table 7A). In certain embodiments, the anti-CGRP receptor heavy chain incorporated into a heterodimeric antibody comprises a sequence of amino acids that has at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 97% or at least 99% sequence identity to the amino acid sequences of SEQ ID NOs: 295-316 (i.e. the anti-CGRP receptor heavy chains in Table 7B).

[0115] Any of the anti-PAC1 receptor light and heavy chains listed in Tables 6A and 6B may be combined with any of the anti-CGRP receptor light and heavy chains listed in Table 7A and 7B to form a bispecific, heterodimeric antibody of the invention. The structural features (e.g. component anti-PAC1 receptor light and heavy chains and anti-CGRP receptor light and heavy chains) of exemplary bispecific, heterodimeric antibodies of the invention are set forth in Table 8 below. These antibodies contain one or more charge pair mutations as described herein to promote correct pairing of heavy and light chains as well as heterodimerization between an anti-

PAC1 receptor heavy chain and an anti-CGRP receptor heavy chain. Antibodies having an “A” designation comprise the “v1” electrostatic steering strategy shown in Figure 1, whereas antibodies having a “B” designation comprise the “v3” electrostatic steering strategy shown in Figure 1. Antibodies having a “C” or “D” designation comprise the “v4” electrostatic steering strategy shown in Figure 1, with “C” antibodies having an IgG1 constant domain and “D” antibodies having an IgG2 constant domain. The variable light and heavy chain designations (e.g. LV-01, LV-02, LV-101, LV-102, HV-01, HV-02, HV-101, HV-102, etc.) in Table 8 are defined by amino acid sequence in Tables 1A, 1B, 3A, and 3B and nucleotide sequence in Tables 11 and 12. The light and heavy chain designations (e.g. LC-01, LC-02, LC-101, LC-102, HC-01, HC-02, HC-101, HC-102, etc.) in Table 8 are defined by amino acid and nucleotide sequence in Tables 6A, 6B, 7A, and 7B. Thus, the full sequence information for each of the four chains of the exemplary heterodimeric antibodies in Table 8 can be obtained by cross-reference to these tables. By way of illustration, heterodimeric antibody iPS: 326417 comprises an anti-PAC1 receptor light chain comprising the amino acid sequence of SEQ ID NO: 211 (LC-01), an anti-PAC1 receptor heavy chain comprising the amino acid sequence of SEQ ID NO: 233 (HC-01), an anti-CGRP receptor light chain comprising the amino acid sequence of SEQ ID NO: 281 (LC-111) and an anti-CGRP receptor heavy chain comprising the amino acid sequence of SEQ ID NO: 310 (HC-116).

Table 8. Exemplary Anti-PAC1 Receptor/Anti-CGRP Receptor Heterodimeric Antibodies

Heterodimeric Antibody Designation	Anti-PAC1 Receptor Antibody ID.	Anti-PAC1 Receptor Full Light Chain	Anti-PAC1 Receptor VL	Anti-PAC1 Receptor Full Heavy Chain	Anti-PAC1 Receptor VH	Anti-CGRP Receptor Antibody ID.	Anti-CGRP Receptor Full Light Chain	Anti-CGRP Receptor VL	Anti-CGRP Receptor Full Heavy Chain	Anti-CGRP Receptor VH
iPS:326417	01A	LC-01	LV-01	HC-01	HV-01	57A	LC-111	LV-111	HC-116	HV-109
iPS:326626	01D	LC-01	LV-01	HC-04	HV-01	50D	LC-101	LV-101	HC-104	HV-101
iPS:326628	03D	LC-04	LV-04	HC-08	HV-03	50D	LC-101	LV-101	HC-104	HV-101
iPS:326634	03D	LC-04	LV-04	HC-08	HV-03	51D	LC-103	LV-103	HC-108	HV-103
iPS:327870	01D	LC-01	LV-01	HC-04	HV-01	52D	LC-105	LV-105	HC-112	HV-105

Heterodimeric Antibody Designation	Anti-PAC1 Receptor Antibody ID.	Anti-PAC1 Receptor Full Light Chain	Anti-PAC1 Receptor VL	Anti-PAC1 Receptor Full Heavy Chain	Anti-PAC1 Receptor VH	Anti-CGRP Receptor Antibody ID.	Anti-CGRP Receptor Full Light Chain	Anti-CGRP Receptor VL	Anti-CGRP Receptor Full Heavy Chain	Anti-CGRP Receptor VH
iPS:327871	03D	LC-04	LV-04	HC-08	HV-03	52D	LC-105	LV-105	HC-112	HV-105
iPS:326645	05D	LC-08	LV-08	HC-16	HV-07	50D	LC-101	LV-101	HC-104	HV-101
iPS:326648	04D	LC-06	LV-06	HC-12	HV-05	50D	LC-101	LV-101	HC-104	HV-101
iPS:326651	05D	LC-08	LV-08	HC-16	HV-07	51D	LC-103	LV-103	HC-108	HV-103
iPS:326631	01D	LC-01	LV-01	HC-04	HV-01	51D	LC-103	LV-103	HC-108	HV-103
iPS:326654	04D	LC-06	LV-06	HC-12	HV-05	51D	LC-103	LV-103	HC-108	HV-103
iPS:328000	05D	LC-08	LV-08	HC-16	HV-07	52D	LC-105	LV-105	HC-112	HV-105
iPS:328001	04D	LC-06	LV-06	HC-12	HV-05	52D	LC-105	LV-105	HC-112	HV-105
iPS:326661	01D	LC-01	LV-01	HC-04	HV-01	57D	LC-111	LV-111	HC-119	HV-109
iPS:326663	03D	LC-04	LV-04	HC-08	HV-03	57D	LC-111	LV-111	HC-119	HV-109
iPS:326666	05D	LC-08	LV-08	HC-16	HV-07	57D	LC-111	LV-111	HC-119	HV-109
iPS:326669	04D	LC-06	LV-06	HC-12	HV-05	57D	LC-111	LV-111	HC-119	HV-109
iPS:327017	05A	LC-08	LV-08	HC-13	HV-07	57A	LC-111	LV-111	HC-116	HV-109
iPS:327018	03A	LC-04	LV-04	HC-05	HV-03	57A	LC-111	LV-111	HC-116	HV-109
iPS:327019	04A	LC-06	LV-06	HC-09	HV-05	57A	LC-111	LV-111	HC-116	HV-109
iPS:327023	01B	LC-02	LV-02	HC-02	HV-02	57B	LC-112	LV-112	HC-117	HV-110
iPS:327024	05B	LC-09	LV-09	HC-14	HV-08	57B	LC-112	LV-112	HC-117	HV-110
iPS:327025	03B	LC-05	LV-05	HC-06	HV-04	57B	LC-112	LV-112	HC-117	HV-110
iPS:327026	04B	LC-07	LV-07	HC-10	HV-06	57B	LC-112	LV-112	HC-117	HV-110
iPS:327091	01C	LC-01	LV-01	HC-03	HV-01	57C	LC-111	LV-111	HC-118	HV-109
iPS:327092	05C	LC-08	LV-08	HC-15	HV-07	57C	LC-111	LV-111	HC-118	HV-109
iPS:327093	03C	LC-04	LV-04	HC-07	HV-03	57C	LC-111	LV-111	HC-118	HV-109
iPS:327094	04C	LC-06	LV-06	HC-11	HV-05	57C	LC-111	LV-111	HC-118	HV-109
iPS:326414	01A	LC-01	LV-01	HC-01	HV-01	50A	LC-101	LV-101	HC-101	HV-101
iPS:327102	05A	LC-08	LV-08	HC-13	HV-07	50A	LC-101	LV-101	HC-101	HV-101
iPS:327103	03A	LC-04	LV-04	HC-05	HV-03	50A	LC-101	LV-101	HC-101	HV-101

Heterodimeric Antibody Designation	Anti-PAC1 Receptor Antibody ID.	Anti-PAC1 Receptor Full Light Chain	Anti-PAC1 Receptor VL	Anti-PAC1 Receptor Full Heavy Chain	Anti-PAC1 Receptor VH	Anti-CGRP Receptor Antibody ID.	Anti-CGRP Receptor Full Light Chain	Anti-CGRP Receptor VL	Anti-CGRP Receptor Full Heavy Chain	Anti-CGRP Receptor VH
iPS:327104	04A	LC-06	LV-06	HC-09	HV-05	50A	LC-101	LV-101	HC-101	HV-101
iPS:327105	01B	LC-02	LV-02	HC-02	HV-02	50B	LC-102	LV-102	HC-102	HV-102
iPS:327106	05B	LC-09	LV-09	HC-14	HV-08	50B	LC-102	LV-102	HC-102	HV-102
iPS:327107	03B	LC-05	LV-05	HC-06	HV-04	50B	LC-102	LV-102	HC-102	HV-102
iPS:327108	04B	LC-07	LV-07	HC-10	HV-06	50B	LC-102	LV-102	HC-102	HV-102
iPS:327109	01C	LC-01	LV-01	HC-03	HV-01	50C	LC-101	LV-101	HC-103	HV-101
iPS:327110	05C	LC-08	LV-08	HC-15	HV-07	50C	LC-101	LV-101	HC-103	HV-101
iPS:327111	03C	LC-04	LV-04	HC-07	HV-03	50C	LC-101	LV-101	HC-103	HV-101
iPS:327112	04C	LC-06	LV-06	HC-11	HV-05	50C	LC-101	LV-101	HC-103	HV-101
iPS:327267	01A	LC-01	LV-01	HC-01	HV-01	51A	LC-103	LV-103	HC-105	HV-103
iPS:327268	05A	LC-08	LV-08	HC-13	HV-07	51A	LC-103	LV-103	HC-105	HV-103
iPS:327269	03A	LC-04	LV-04	HC-05	HV-03	51A	LC-103	LV-103	HC-105	HV-103
iPS:327270	04A	LC-06	LV-06	HC-09	HV-05	51A	LC-103	LV-103	HC-105	HV-103
iPS:327272	01B	LC-02	LV-02	HC-02	HV-02	51B	LC-104	LV-104	HC-106	HV-104
iPS:327273	05B	LC-09	LV-09	HC-14	HV-08	51B	LC-104	LV-104	HC-106	HV-104
iPS:327274	03B	LC-05	LV-05	HC-06	HV-04	51B	LC-104	LV-104	HC-106	HV-104
iPS:327275	04B	LC-07	LV-07	HC-10	HV-06	51B	LC-104	LV-104	HC-106	HV-104
iPS:327276	01C	LC-01	LV-01	HC-03	HV-01	51C	LC-103	LV-103	HC-107	HV-103
iPS:327277	05C	LC-08	LV-08	HC-15	HV-07	51C	LC-103	LV-103	HC-107	HV-103
iPS:327278	03C	LC-04	LV-04	HC-07	HV-03	51C	LC-103	LV-103	HC-107	HV-103
iPS:327279	04C	LC-06	LV-06	HC-11	HV-05	51C	LC-103	LV-103	HC-107	HV-103
iPS:327280	01A	LC-01	LV-01	HC-01	HV-01	52A	LC-105	LV-105	HC-109	HV-105
iPS:327281	05A	LC-08	LV-08	HC-13	HV-07	52A	LC-105	LV-105	HC-109	HV-105
iPS:327282	03A	LC-04	LV-04	HC-05	HV-03	52A	LC-105	LV-105	HC-109	HV-105
iPS:327283	04A	LC-06	LV-06	HC-09	HV-05	52A	LC-105	LV-105	HC-109	HV-105

Heterodimeric Antibody Designation	Anti-PAC1 Receptor Antibody ID.	Anti-PAC1 Receptor Full Light Chain	Anti-PAC1 Receptor VL	Anti-PAC1 Receptor Full Heavy Chain	Anti-PAC1 Receptor VH	Anti-CGRP Receptor Antibody ID.	Anti-CGRP Receptor Full Light Chain	Anti-CGRP Receptor VL	Anti-CGRP Receptor Full Heavy Chain	Anti-CGRP Receptor VH
iPS:327284	01B	LC-02	LV-02	HC-02	HV-02	52B	LC-106	LV-106	HC-110	HV-106
iPS:327285	05B	LC-09	LV-09	HC-14	HV-08	52B	LC-106	LV-106	HC-110	HV-106
iPS:327286	03B	LC-05	LV-05	HC-06	HV-04	52B	LC-106	LV-106	HC-110	HV-106
iPS:327287	04B	LC-07	LV-07	HC-10	HV-06	52B	LC-106	LV-106	HC-110	HV-106
iPS:327288	01C	LC-01	LV-01	HC-03	HV-01	52C	LC-105	LV-105	HC-111	HV-105
iPS:327289	05C	LC-08	LV-08	HC-15	HV-07	52C	LC-105	LV-105	HC-111	HV-105
iPS:327290	03C	LC-04	LV-04	HC-07	HV-03	52C	LC-105	LV-105	HC-111	HV-105
iPS:327291	04C	LC-06	LV-06	HC-11	HV-05	52C	LC-105	LV-105	HC-111	HV-105
iPS:327677	01A	LC-01	LV-01	HC-01	HV-01	58A	LC-111	LV-111	HC-120	HV-111
iPS:327678	05A	LC-08	LV-08	HC-13	HV-07	58A	LC-111	LV-111	HC-120	HV-111
iPS:327679	03A	LC-04	LV-04	HC-05	HV-03	58A	LC-111	LV-111	HC-120	HV-111
iPS:327680	04A	LC-06	LV-06	HC-09	HV-05	58A	LC-111	LV-111	HC-120	HV-111
iPS:327681	01B	LC-02	LV-02	HC-02	HV-02	58B	LC-112	LV-112	HC-121	HV-112
iPS:327682	05B	LC-09	LV-09	HC-14	HV-08	58B	LC-112	LV-112	HC-121	HV-112
iPS:327683	03B	LC-05	LV-05	HC-06	HV-04	58B	LC-112	LV-112	HC-121	HV-112
iPS:327684	04B	LC-07	LV-07	HC-10	HV-06	58B	LC-112	LV-112	HC-121	HV-112
iPS:327685	01C	LC-01	LV-01	HC-03	HV-01	58C	LC-111	LV-111	HC-122	HV-111
iPS:327686	05C	LC-08	LV-08	HC-15	HV-07	58C	LC-111	LV-111	HC-122	HV-111
iPS:327687	03C	LC-04	LV-04	HC-07	HV-03	58C	LC-111	LV-111	HC-122	HV-111
iPS:327688	04C	LC-06	LV-06	HC-11	HV-05	58C	LC-111	LV-111	HC-122	HV-111
iPS:327689	01A	LC-01	LV-01	HC-01	HV-01	53A	LC-105	LV-105	HC-113	HV-107
iPS:327690	05A	LC-08	LV-08	HC-13	HV-07	53A	LC-105	LV-105	HC-113	HV-107
iPS:327691	03A	LC-04	LV-04	HC-05	HV-03	53A	LC-105	LV-105	HC-113	HV-107
iPS:327693	04A	LC-06	LV-06	HC-09	HV-05	53A	LC-105	LV-105	HC-113	HV-107
iPS:327694	01B	LC-02	LV-02	HC-02	HV-02	53B	LC-106	LV-106	HC-114	HV-108

Heterodimeric Antibody Designation	Anti-PAC1 Receptor Antibody ID.	Anti-PAC1 Receptor Full Light Chain	Anti-PAC1 Receptor VL	Anti-PAC1 Receptor Full Heavy Chain	Anti-PAC1 Receptor VH	Anti-CGRP Receptor Antibody ID.	Anti-CGRP Receptor Full Light Chain	Anti-CGRP Receptor VL	Anti-CGRP Receptor Full Heavy Chain	Anti-CGRP Receptor VH
iPS:327696	05B	LC-09	LV-09	HC-14	HV-08	53B	LC-106	LV-106	HC-114	HV-108
iPS:327697	03B	LC-05	LV-05	HC-06	HV-04	53B	LC-106	LV-106	HC-114	HV-108
iPS:327698	04B	LC-07	LV-07	HC-10	HV-06	53B	LC-106	LV-106	HC-114	HV-108
iPS:327699	01C	LC-01	LV-01	HC-03	HV-01	53C	LC-105	LV-105	HC-115	HV-107
iPS:327700	05C	LC-08	LV-08	HC-15	HV-07	53C	LC-105	LV-105	HC-115	HV-107
iPS:327701	03C	LC-04	LV-04	HC-07	HV-03	53C	LC-105	LV-105	HC-115	HV-107
iPS:327702	04C	LC-06	LV-06	HC-11	HV-05	53C	LC-105	LV-105	HC-115	HV-107
iPS:327703	01A	LC-01	LV-01	HC-01	HV-01	54A	LC-107	LV-107	HC-109	HV-105
iPS:327704	05A	LC-08	LV-08	HC-13	HV-07	54A	LC-107	LV-107	HC-109	HV-105
iPS:327705	03A	LC-04	LV-04	HC-05	HV-03	54A	LC-107	LV-107	HC-109	HV-105
iPS:327706	04A	LC-06	LV-06	HC-09	HV-05	54A	LC-107	LV-107	HC-109	HV-105
iPS:327707	01B	LC-02	LV-02	HC-02	HV-02	54B	LC-108	LV-108	HC-110	HV-106
iPS:327708	05B	LC-09	LV-09	HC-14	HV-08	54B	LC-108	LV-108	HC-110	HV-106
iPS:327709	03B	LC-05	LV-05	HC-06	HV-04	54B	LC-108	LV-108	HC-110	HV-106
iPS:327710	04B	LC-07	LV-07	HC-10	HV-06	54B	LC-108	LV-108	HC-110	HV-106
iPS:327711	01C	LC-01	LV-01	HC-03	HV-01	54C	LC-107	LV-107	HC-111	HV-105
iPS:327712	05C	LC-08	LV-08	HC-15	HV-07	54C	LC-107	LV-107	HC-111	HV-105
iPS:327713	03C	LC-04	LV-04	HC-07	HV-03	54C	LC-107	LV-107	HC-111	HV-105
iPS:327714	04C	LC-06	LV-06	HC-11	HV-05	54C	LC-107	LV-107	HC-111	HV-105
iPS:327717	01A	LC-01	LV-01	HC-01	HV-01	55A	LC-109	LV-109	HC-109	HV-105
iPS:327718	05A	LC-08	LV-08	HC-13	HV-07	55A	LC-109	LV-109	HC-109	HV-105
iPS:327719	03A	LC-04	LV-04	HC-05	HV-03	55A	LC-109	LV-109	HC-109	HV-105
iPS:327721	04A	LC-06	LV-06	HC-09	HV-05	55A	LC-109	LV-109	HC-109	HV-105
iPS:327722	01B	LC-02	LV-02	HC-02	HV-02	55B	LC-110	LV-110	HC-110	HV-106
iPS:327724	05B	LC-09	LV-09	HC-14	HV-08	55B	LC-110	LV-110	HC-110	HV-106

Heterodimeric Antibody Designation	Anti-PAC1 Receptor Antibody ID.	Anti-PAC1 Receptor Full Light Chain	Anti-PAC1 Receptor VL	Anti-PAC1 Receptor Full Heavy Chain	Anti-PAC1 Receptor VH	Anti-CGRP Receptor Antibody ID.	Anti-CGRP Receptor Full Light Chain	Anti-CGRP Receptor VL	Anti-CGRP Receptor Full Heavy Chain	Anti-CGRP Receptor VH
iPS:327725	03B	LC-05	LV-05	HC-06	HV-04	55B	LC-110	LV-110	HC-110	HV-106
iPS:327726	04B	LC-07	LV-07	HC-10	HV-06	55B	LC-110	LV-110	HC-110	HV-106
iPS:327727	01C	LC-01	LV-01	HC-03	HV-01	55C	LC-109	LV-109	HC-111	HV-105
iPS:327728	05C	LC-08	LV-08	HC-15	HV-07	55C	LC-109	LV-109	HC-111	HV-105
iPS:327729	03C	LC-04	LV-04	HC-07	HV-03	55C	LC-109	LV-109	HC-111	HV-105
iPS:327730	04C	LC-06	LV-06	HC-11	HV-05	55C	LC-109	LV-109	HC-111	HV-105
iPS:327731	01A	LC-01	LV-01	HC-01	HV-01	56A	LC-107	LV-107	HC-113	LV-107
iPS:327732	05A	LC-08	LV-08	HC-13	HV-07	56A	LC-107	LV-107	HC-113	LV-107
iPS:327733	03A	LC-04	LV-04	HC-05	HV-03	56A	LC-107	LV-107	HC-113	LV-107
iPS:327734	04A	LC-06	LV-06	HC-09	HV-05	56A	LC-107	LV-107	HC-113	LV-107
iPS:327735	01B	LC-02	LV-02	HC-02	HV-02	56B	LC-108	LV-108	HC-114	LV-108
iPS:327736	05B	LC-09	LV-09	HC-14	HV-08	56B	LC-108	LV-108	HC-114	LV-108
iPS:327737	03B	LC-05	LV-05	HC-06	HV-04	56B	LC-108	LV-108	HC-114	LV-108
iPS:327738	04B	LC-07	LV-07	HC-10	HV-06	56B	LC-108	LV-108	HC-114	LV-108
iPS:327739	01C	LC-01	LV-01	HC-03	HV-01	56C	LC-107	LV-107	HC-115	LV-107
iPS:327740	05C	LC-08	LV-08	HC-15	HV-07	56C	LC-107	LV-107	HC-115	LV-107
iPS:327741	03C	LC-04	LV-04	HC-07	HV-03	56C	LC-107	LV-107	HC-115	LV-107
iPS:327742	04C	LC-06	LV-06	HC-11	HV-05	56C	LC-107	LV-107	HC-115	LV-107
iPS:327872	02A	LC-03	LV-03	HC-01	HV-01	58A	LC-111	LV-111	HC-120	HV-111
iPS:327874	06A	LC-10	LV-10	HC-17	HV-09	58A	LC-111	LV-111	HC-120	HV-111
iPS:327875	06B	LC-11	LV-11	HC-18	HV-10	58B	LC-112	LV-112	HC-121	HV-112
iPS:327876	02C	LC-03	LV-03	HC-03	HV-01	58C	LC-111	LV-111	HC-122	HV-111
iPS:327877	06C	LC-10	LV-10	HC-19	HV-09	58C	LC-111	LV-111	HC-122	HV-111
iPS:327878	02A	LC-03	LV-03	HC-01	HV-01	53A	LC-105	LV-105	HC-113	HV-107
iPS:327879	06A	LC-10	LV-10	HC-17	HV-09	53A	LC-105	LV-105	HC-113	HV-107

Heterodimeric Antibody Designation	Anti-PAC1 Receptor Antibody ID.	Anti-PAC1 Receptor Full Light Chain	Anti-PAC1 Receptor VL	Anti-PAC1 Receptor Full Heavy Chain	Anti-PAC1 Receptor VH	Anti-CGRP Receptor Antibody ID.	Anti-CGRP Receptor Full Light Chain	Anti-CGRP Receptor VL	Anti-CGRP Receptor Full Heavy Chain	Anti-CGRP Receptor VH
iPS:327880	06B	LC-11	LV-11	HC-18	HV-10	53B	LC-106	LV-106	HC-114	HV-108
iPS:327881	02C	LC-03	LV-03	HC-03	HV-01	53C	LC-105	LV-105	HC-115	HV-107
iPS:327882	06C	LC-10	LV-10	HC-19	HV-09	53C	LC-105	LV-105	HC-115	HV-107
iPS:327883	02A	LC-03	LV-03	HC-01	HV-01	54A	LC-107	LV-107	HC-109	HV-105
iPS:327884	06A	LC-10	LV-10	HC-17	HV-09	54A	LC-107	LV-107	HC-109	HV-105
iPS:327885	06B	LC-11	LV-11	HC-18	HV-10	54B	LC-108	LV-108	HC-110	HV-106
iPS:327886	02C	LC-03	LV-03	HC-03	HV-01	54C	LC-107	LV-107	HC-111	HV-105
iPS:327887	06C	LC-10	LV-10	HC-19	HV-09	54C	LC-107	LV-107	HC-111	HV-105
iPS:327888	02A	LC-03	LV-03	HC-01	HV-01	55A	LC-109	LV-109	HC-109	HV-105
iPS:327889	06A	LC-10	LV-10	HC-17	HV-09	55A	LC-109	LV-109	HC-109	HV-105
iPS:327890	06B	LC-11	LV-11	HC-18	HV-10	55B	LC-110	LV-110	HC-110	HV-106
iPS:327891	02C	LC-03	LV-03	HC-03	HV-01	55C	LC-109	LV-109	HC-111	HV-105
iPS:327892	06C	LC-10	LV-10	HC-19	HV-09	55C	LC-109	LV-109	HC-111	HV-105
iPS:327893	02A	LC-03	LV-03	HC-01	HV-01	56A	LC-107	LV-107	HC-113	LV-107
iPS:327894	06A	LC-10	LV-10	HC-17	HV-09	56A	LC-107	LV-107	HC-113	LV-107
iPS:327895	06B	LC-11	LV-11	HC-18	HV-10	56B	LC-108	LV-108	HC-114	LV-108
iPS:327896	02C	LC-03	LV-03	HC-03	HV-01	56C	LC-107	LV-107	HC-115	LV-107
iPS:327897	06C	LC-10	LV-10	HC-19	HV-09	56C	LC-107	LV-107	HC-115	LV-107
iPS:328031	02A	LC-03	LV-03	HC-01	HV-01	57A	LC-111	LV-111	HC-116	HV-109
iPS:328033	06A	LC-10	LV-10	HC-17	HV-09	57A	LC-111	LV-111	HC-116	HV-109
iPS:328034	06B	LC-11	LV-11	HC-18	HV-10	57B	LC-112	LV-112	HC-117	HV-110
iPS:328035	02C	LC-03	LV-03	HC-03	HV-01	57C	LC-111	LV-111	HC-118	HV-109
iPS:328036	06C	LC-10	LV-10	HC-19	HV-09	57C	LC-111	LV-111	HC-118	HV-109
iPS:328037	02A	LC-03	LV-03	HC-01	HV-01	50A	LC-101	LV-101	HC-101	HV-101
iPS:328038	06A	LC-10	LV-10	HC-17	HV-09	50A	LC-101	LV-101	HC-101	HV-101
iPS:328039	06B	LC-11	LV-11	HC-18	HV-10	50B	LC-102	LV-102	HC-102	HV-102
iPS:328040	02C	LC-03	LV-03	HC-03	HV-01	50C	LC-101	LV-101	HC-103	HV-101

Heterodimeric Antibody Designation	Anti-PAC1 Receptor Antibody ID.	Anti-PAC1 Receptor Full Light Chain	Anti-PAC1 Receptor VL	Anti-PAC1 Receptor Full Heavy Chain	Anti-PAC1 Receptor VH	Anti-CGRP Receptor Antibody ID.	Anti-CGRP Receptor Full Light Chain	Anti-CGRP Receptor VL	Anti-CGRP Receptor Full Heavy Chain	Anti-CGRP Receptor VH
iPS:328041	06C	LC-10	LV-10	HC-19	HV-09	50C	LC-101	LV-101	HC-103	HV-101
iPS:328042	02A	LC-03	LV-03	HC-01	HV-01	51A	LC-103	LV-103	HC-105	HV-103
iPS:328043	06A	LC-10	LV-10	HC-17	HV-09	51A	LC-103	LV-103	HC-105	HV-103
iPS:328044	06B	LC-11	LV-11	HC-18	HV-10	51B	LC-104	LV-104	HC-106	HV-104
iPS:328045	02C	LC-03	LV-03	HC-03	HV-01	51C	LC-103	LV-103	HC-107	HV-103
iPS:328046	06C	LC-10	LV-10	HC-19	HV-09	51C	LC-103	LV-103	HC-107	HV-103
iPS:328047	02A	LC-03	LV-03	HC-01	HV-01	52A	LC-105	LV-105	HC-109	HV-105
iPS:328048	06A	LC-10	LV-10	HC-17	HV-09	52A	LC-105	LV-105	HC-109	HV-105
iPS:328049	06B	LC-11	LV-11	HC-18	HV-10	52B	LC-106	LV-106	HC-110	HV-106
iPS:328050	02C	LC-03	LV-03	HC-03	HV-01	52C	LC-105	LV-105	HC-111	HV-105
iPS:328051	06C	LC-10	LV-10	HC-19	HV-09	52C	LC-105	LV-105	HC-111	HV-105

[0116] In certain embodiments, the bispecific antigen binding protein of the invention is a heterodimeric antibody selected from the antibodies designated as iPS:326417, iPS:326626, iPS:326628, iPS:326631, iPS:326634, iPS:327870, iPS:327871, iPS:326645, iPS:326648, iPS:326651, iPS:326654, iPS:328000, iPS:328001, iPS:326661, iPS:326663, iPS:326666, iPS:326669, iPS:327017, iPS:327018, iPS:327019, iPS:327023, iPS:327024, iPS:327025, iPS:327026, iPS:327091, iPS:327092, iPS:327093, iPS:327094, iPS:326414, iPS:327102, iPS:327103, iPS:327104, iPS:327105, iPS:327106, iPS:327107, iPS:327108, iPS:327109, iPS:327110, iPS:327111, iPS:327112, iPS:327267, iPS:327268, iPS:327269, iPS:327270, iPS:327272, iPS:327273, iPS:327274, iPS:327275, iPS:327276, iPS:327277, iPS:327278, iPS:327279, iPS:327280, iPS:327281, iPS:327282, iPS:327283, iPS:327284, iPS:327285, iPS:327286, iPS:327287, iPS:327288, iPS:327289, iPS:327290, iPS:327291, iPS:327677, iPS:327678, iPS:327679, iPS:327680, iPS:327681, iPS:327682, iPS:327683, iPS:327684, iPS:327685, iPS:327686, iPS:327687, iPS:327688, iPS:327689, iPS:327690, iPS:327691, iPS:327693, iPS:327694, iPS:327696, iPS:327697, iPS:327698, iPS:327699, iPS:327700, iPS:327701, iPS:327702, iPS:327703, iPS:327704, iPS:327705, iPS:327706, iPS:327707,

iPS:327708, iPS:327709, iPS:327710, iPS:327711, iPS:327712, iPS:327713, iPS:327714, iPS:327717, iPS:327718, iPS:327719, iPS:327721, iPS:327722, iPS:327724, iPS:327725, iPS:327726, iPS:327727, iPS:327728, iPS:327729, iPS:327730, iPS:327731, iPS:327732, iPS:327733, iPS:327734, iPS:327735, iPS:327736, iPS:327737, iPS:327738, iPS:327739, iPS:327740, iPS:327741, iPS:327742, iPS:327872, iPS:327874, iPS:327875, iPS:327876, iPS:327877, iPS:327878, iPS:327879, iPS:327880, iPS:327881, iPS:327882, iPS:327883, iPS:327884, iPS:327885, iPS:327886, iPS:327887, iPS:327888, iPS:327889, iPS:327890, iPS:327891, iPS:327892, iPS:327893, iPS:327894, iPS:327895, iPS:327896, iPS:327897, iPS:328031, iPS:328033, iPS:328034, iPS:328035, iPS:328036, iPS:328037, iPS:328038, iPS:328039, iPS:328040, iPS:328041, iPS:328042, iPS:328043, iPS:328044, iPS:328045, iPS:328046, iPS:328047, iPS:328048, iPS:328049, iPS:328050, or iPS:328051 as set forth in Table 8. In some embodiments, the heterodimeric antibody is an antibody selected from the antibodies designated as iPS:327730, iPS:327680, iPS: 328001, iPS:327741, iPS:326648, iPS:327689, iPS:327111, iPS:327742, iPS:327698, iPS:327272, iPS:327717, iPS:327702, iPS:327270, iPS:327026, iPS:327112, iPS:327283, iPS:327688, or iPS:327714 as set forth in Table 8. In other embodiments, the heterodimeric antibody is an antibody selected from the antibodies designated as iPS:327730, iPS:327680, iPS: 328001, iPS:327741, iPS:326648, iPS:327689, iPS:327111, iPS:327742, iPS:327698, iPS:327272, iPS:327717, iPS:327702, or iPS:327270 as set forth in Table 8. In particular embodiments, the heterodimeric antibody is an antibody designated as iPS:327689 or iPS:327742 as set forth in Table 8.

[0117] The inventive heterodimeric antibodies also encompass antibodies comprising the heavy chain(s) and/or light chain(s) described herein, where one, two, three, four or five amino acid residues are lacking from the N-terminus or C-terminus, or both, in relation to any one of the heavy and light chains set forth in Tables 6A, 6B, 7A, and 7B, e.g., due to post-translational modifications resulting from the type of host cell in which the antibodies are expressed. For instance, Chinese Hamster Ovary (CHO) cells frequently cleave off a C-terminal lysine from antibody heavy chains.

[0118] In certain embodiments, the antigen binding proteins of the invention comprise (i) a first binding domain that specifically binds to human CGRP receptor, (ii) a second binding domain that specifically binds to human PAC1 receptor, and (iii) a human immunoglobulin Fc region, wherein one of the binding domains is positioned at the amino terminus of the Fc region and the

other binding domain is positioned at the carboxyl terminus of the Fc region. In some such embodiments, each of the first and second binding domains comprises immunoglobulin variable regions. For instance, in certain embodiments, the first binding domain comprises a first light chain variable region (VL1) and a first heavy chain variable region (VH1) from an anti-CGRP receptor antibody and the second binding domain comprises a second light chain variable region (VL2) and a second heavy chain variable region (VH2) from an anti-PAC1 receptor antibody.

[0119] As used herein, the term “Fc region” refers to the C-terminal region of an immunoglobulin heavy chain which may be generated by papain digestion of an intact antibody. The Fc region of an immunoglobulin generally comprises two constant domains, a CH2 domain and a CH3 domain, and optionally comprises a CH4 domain. In certain embodiments, the Fc region is an Fc region from an IgG1, IgG2, IgG3, or IgG4 immunoglobulin. In some embodiments, the Fc region comprises CH2 and CH3 domains from a human IgG1 or human IgG2 immunoglobulin. The Fc region may retain effector function, such as C1q binding, complement dependent cytotoxicity (CDC), Fc receptor binding, antibody-dependent cell-mediated cytotoxicity (ADCC), and phagocytosis. In other embodiments, the Fc region may be modified to reduce or eliminate effector function as described in further detail herein.

[0120] In some embodiments of the antigen binding proteins of the invention, the binding domain positioned at the carboxyl terminus of the Fc region (i.e. the carboxyl-terminal binding domain) is a scFv. In certain embodiments, the scFv comprises a heavy chain variable region (VH) and light chain variable region (VL) connected by a peptide linker. The variable regions may be oriented within the scFv in a VH-VL or VL-VH orientation. For instance, in one embodiment, the scFv comprises, from N-terminus to C-terminus, a VH region, a peptide linker, and a VL region. In another embodiment, the scFv comprises, from N-terminus to C-terminus, a VL region, a peptide linker, and a VH region. The VH and VL regions of the scFv may contain one or more cysteine substitutions to permit disulfide bond formation between the VH and VL regions. Such cysteine clamps stabilize the two variable domains in the antigen-binding configuration. In one embodiment, position 44 (Kabat numbering) in the VH region and position 100 (Kabat numbering) in the VL region are each substituted with a cysteine residue.

[0121] In certain embodiments, the scFv is fused or otherwise connected at its amino terminus to the carboxyl terminus of the Fc region (e.g. the carboxyl terminus of the CH3 domain) through a peptide linker. Thus, in one embodiment, the scFv is fused to an Fc region such that the resulting

fusion protein comprises, from N-terminus to C-terminus, a CH2 domain, a CH3 domain, a first peptide linker, a VH region, a second peptide linker, and a VL region. In another embodiment, the scFv is fused to an Fc region such that the resulting fusion protein comprises, from N-terminus to C-terminus, a CH2 domain, a CH3 domain, a first peptide linker, a VL region, a second peptide linker, and a VH region. A “fusion protein” is a protein that includes polypeptide components derived from more than one parental protein or polypeptide. Typically, a fusion protein is expressed from a fusion gene in which a nucleotide sequence encoding a polypeptide sequence from one protein is appended in frame with, and optionally separated by a linker from, a nucleotide sequence encoding a polypeptide sequence from a different protein. The fusion gene can then be expressed by a recombinant host cell to produce the single fusion protein.

[0122] A “peptide linker” refers to an oligopeptide of about 2 to about 50 amino acids that covalently joins one polypeptide to another polypeptide. The peptide linkers can be used to connect the VH and VL domains within the scFv. The peptide linkers can also be used to connect a scFv, Fab fragment, or other functional antibody fragment to the amino terminus or carboxyl terminus of an Fc region to create bispecific antigen binding proteins as described herein. Preferably, the peptide linkers are at least 5 amino acids in length. In certain embodiments, the peptide linkers are from about 5 amino acids in length to about 40 amino acids in length. In other embodiments, the peptide linkers are from about 8 amino acids in length to about 30 amino acids in length. In still other embodiments, the peptide linkers are from about 10 amino acids in length to about 20 amino acids in length.

[0123] Preferably, but not necessarily, the peptide linker comprises amino acids from among the twenty canonical amino acids, particularly cysteine, glycine, alanine, proline, asparagine, glutamine, and /or serine. In certain embodiments, the peptide linker is comprised of a majority of amino acids that are sterically unhindered, such as glycine, serine, and alanine. Thus, linkers that are preferred in some embodiments, include polyglycines, polyserines, and polyalanines, or combinations of any of these. Some exemplary peptide linkers include, but are not limited to, poly(Gly)₂₋₈, particularly (Gly)₃, (Gly)₄ (SEQ ID NO: 362), (Gly)₅ (SEQ ID NO: 363) and (Gly)₇ (SEQ ID NO: 364), as well as, poly(Gly)₄Ser (SEQ ID NO: 365), poly(Gly-Ala)₂₋₄ and poly(Ala)₂₋₈. In certain embodiments, the peptide linker is (Gly_xSer)_n where x=3 or 4 and n= 2, 3, 4, 5 or 6. Such peptide linkers include “L5” (GGGGS; or “G₄S”; SEQ ID NO: 366), “L9” (GGGSGGGGS; or “G₃SG₄S”; SEQ ID NO: 367), “L10” (GGGSGGGGS; or “(G₄S)₂”; SEQ

ID NO: 368), “L15” (GGGGSGGGGSGGGGS; or “(G₄S)₃”; SEQ ID NO: 369), and “L25” (GGGGSGGGGSGGGGSGGGGSGGGGS; or “(G₄S)₅”; SEQ ID NO: 370). In some embodiments, the peptide linker joining the VH and VL regions within the scFv is a L15 or (G₄S)₃ linker (SEQ ID NO: 369). In these and other embodiments, the peptide linker joining the carboxyl-terminal binding domain (e.g. scFv or Fab) to the C-terminus of the Fc region is a L9 or G₃SG₄S linker (SEQ ID NO: 367) or a L10 (G₄S)₂ linker (SEQ ID NO: 368).

[0124] Other specific examples of peptide linkers that may be used in the bispecific antigen binding proteins of the invention include (Gly)₅Lys (SEQ ID NO: 371); (Gly)₅LysArg (SEQ ID NO: 372); (Gly)₃Lys(Gly)₄ (SEQ ID NO: 373); (Gly)₃AsnGlySer(Gly)₂ (SEQ ID NO: 374); (Gly)₃Cys(Gly)₄ (SEQ ID NO: 375); GlyProAsnGlyGly (SEQ ID NO: 376); GGEGGG (SEQ ID NO: 377); GGEEEGGG (SEQ ID NO: 378); GEEEG (SEQ ID NO: 379); GEEE (SEQ ID NO: 380); GGDGGG (SEQ ID NO: 381); GGDDDDGG (SEQ ID NO: 382); GDDDDG (SEQ ID NO: 383); GDDDD (SEQ ID NO: 384); GGGGSDDSDGSDGEDGGGGS (SEQ ID NO: 385); WEWEW (SEQ ID NO: 386); FEFEF (SEQ ID NO: 387); EEEWWW (SEQ ID NO: 388); EEEFFF (SEQ ID NO: 389); WEEEEWW (SEQ ID NO: 390); and FFEEFF (SEQ ID NO: 391).

[0125] In certain embodiments of the bispecific antigen binding proteins of the invention, the binding domain positioned at the amino terminus of the Fc region (i.e. the amino-terminal binding domain) is a Fab fragment fused to the amino terminus of the Fc region through a peptide linker described herein or through an immunoglobulin hinge region. An “immunoglobulin hinge region” refers to the amino acid sequence connecting the CH1 domain and the CH2 domain of an immunoglobulin heavy chain. The hinge region of human IgG1 is generally defined as the amino acid sequence from about Glu216 or about Cys226, to about Pro230. Hinge regions of other IgG isotypes may be aligned with the IgG1 sequence by placing the first and last cysteine residues forming inter-heavy chain disulfide bonds in the same positions and are determinable to those of skill in the art. In some embodiments, the amino-terminal binding domain is joined to the amino terminus of the Fc region through a human IgG1 hinge region. In other embodiments, the amino-terminal binding domain is joined to the amino terminus of the Fc region through a human IgG2 hinge region. Preferably, the amino-terminal binding domain (e.g. Fab fragment) is fused to the Fc region through the carboxyl terminus of the CH1 region of the Fab.

[0126] In some embodiments, the bispecific antigen binding protein of the invention comprises a first antibody that specifically binds to a first target (e.g. human CGRP receptor or human PAC1 receptor) where a scFv comprising variable domains from a second antibody that specifically binds to a second target (e.g. human CGRP receptor or human PAC1 receptor) is fused to the carboxyl terminus of the heavy chain of the first antibody. This format is referred to herein as the “IgG-scFv” format, and one embodiment of this type of molecule is shown schematically in Figure 2. Thus, in certain embodiments, the present invention includes a bispecific, multivalent antigen binding protein comprising: (i) a light chain and a heavy chain from a first antibody, and (ii) a scFv comprising VL and VH regions from a second antibody, wherein the scFv is fused at its amino terminus to the carboxyl terminus of the heavy chain through a peptide linker to form a modified heavy chain, and wherein the first or second antibody specifically binds to human CGRP receptor and the other antibody specifically binds to human PAC1 receptor. When dimerized, the bispecific antigen binding protein is a homotetramer comprising two light chains and two modified heavy chains.

[0127] As used herein, the term “modified heavy chain” refers to a fusion protein comprising an immunoglobulin heavy chain, particularly a human IgG1 or human IgG2 heavy chain, and a functional antibody fragment (e.g. scFv, Fab) or portion thereof (e.g. immunoglobulin light chain or Fd fragment), wherein the fragment or portion thereof is fused at its N-terminus, optionally through a peptide linker, to the C-terminus of the heavy chain.

[0128] In the IgG-scFv format of the bispecific antigen binding proteins of the invention, an anti-PAC1 receptor antibody can be the first antibody (i.e. the “IgG”) or the second antibody (i.e. from which the scFv is derived). Similarly, an anti-CGRP receptor antibody can be the first antibody (i.e. the “IgG”) or the second antibody (i.e. from which the scFv is derived). Any of the anti-PAC1 receptor antibody variable regions set forth in Tables 1A and 1B can be incorporated into either the IgG component or the scFv component of the bispecific antigen binding proteins of the invention. Any of the anti-CGRP receptor antibody variable regions set forth in Tables 3A and 3B can be incorporated into either the IgG component or the scFv component of the bispecific antigen binding proteins of the invention.

[0129] Amino acid sequences for light chains and modified heavy chains of exemplary antigen binding proteins of the invention in the IgG-scFv format are summarized in Table 9 below. The molecules listed in the first half of the table comprise an anti-PAC1 receptor IgG component and

an anti-CGRP receptor scFv, whereas the molecules listed in the second half of the table comprise an anti-CGRP receptor IgG component and an anti-PAC1 receptor scFv.

Table 9. Amino Acid Sequences of Exemplary Bispecific Antigen Binding Proteins in the IgG-scFv Format

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
<i>Anti-PAC1 Receptor IgG x Anti-CGRP Receptor scFv</i>		
iPS:386738	DIQLTQSPSFLSASVGD RVTITCRASQSIGRSLH WYQQKPGKAPKLLIK YASQSLSGVPSRFGSGS GSGTEFTLTISLQPED FATYYCHQSSRLPFTF GPGTKVDIKRTVAAPS VFIFPPSDEQLKSGTAS VVCLLNNFYPREAKV QWKVDNALQSGNSQE SVTEQDSKDSTYSLSS TLTLKADYEKHKVY ACEVTHQGLSSPVTKS FNRGEC (SEQ ID NO: 392)	QVQLVESGAEVVKPGASVKVSCASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSEDTAVYYCARGYDVLGTGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSFGMHWRQAPGKCLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYDSSGYYHYKYYGMAVWGQGTITVTVSSG GGGSGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSSNI GNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTST TLGITGLQTGDEADYYCGTWD SRLSAVVFGCGTKLTVL (SEQ ID NO: 396)
iPS:386764	SEQ ID NO: 392	QVQLVESGAEVVKPGASVKVSCASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSEDTAVYYCARGYDVLGTGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGGGGSQSVLTQ PPSVSAAPGQKVTISCSGSSSNI GN NYVSWYQQLPGTAPKLLIY DNNKRPSGIPDRFSGSKSGTSATLGITGLQTGDEADYYCGTWD SRLSAVVFGGGTKLTVLGGGGSGGGSGGGGSQVQLVESGG GVVQPGRSLRLSCAASGFTFSFGMHWRQAPGKGLEWVAVI SFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDTAVY YCARDRLNYYDSSGYYHYKYYGMAVWGQGTITVTVSS (SEQ ID NO: 397)
iPS:386762	SEQ ID NO: 392	QVQLVESGAEVVKPGASVKVSCASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSEDTAVYYCARGYDVLGTGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
		MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMEALHNHYTQKSLSLSPGSGGGSGGGGSQSVLTQ PPSVSAAPGQKVTISCSGSSSNIGNNYVSWYQQLPGTAPKLLIY DNNKRPSGIPDRFSGSKSGTSATLAITGLQTGDEADYYCGTWD SRLSAVVFGGGTKLTVLGGGGSGGGSGGGGSQVQLVESGG GVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPGKGLEWVAVI SFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDTAVY YCARDRLNYYDSSGYYHYKYYGMAVWGQGT TTVTVSS (SEQ ID NO: 398)
iPS:386760	SEQ ID NO: 392	QVQLVESGAIEVVKPGASVKVSKASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDK KVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMEALHNHYTQKSLSLSPGSGGGSGGGGSQSVLTQ PPSVSAAPGQKVTISCSGSSSNIGNNYVSWYQQLPGTAPKLLIY DNNKRPSGIPDRFSGSKSGTSATLGITGLQTGDEADYYCGTWD SRLSAVVFGGGTKLTVLGGGGSGGGSGGGGSQVQLVESGG GVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPGKGLEWVAVI SFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDTAVY YCARDRLNYYESSGYYHYKYYGMAVWGQGT TTVTVSS (SEQ ID NO: 399)
iPS:386758	SEQ ID NO: 392	QVQLVESGAIEVVKPGASVKVSKASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDK KVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMEALHNHYTQKSLSLSPGSGGGSGGGGSQSVLTQ PPSVSAAPGQKVTISCSGSSSNIGNNYVSWYQQLPGTAPKLLIY DNNKRPSGIPDRFSGSKSGTSTTLGITGLQTGDEADYYCGTWD SRLSAVVFGGGTKLTVLGGGGSGGGSGGGGSQVQLVESGG GVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPGKGLEWVAVI SFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDTAVY YCARDRLNYYESSGYYHYKYYGMAVWGQGT TTVTVSS (SEQ ID NO: 400)
iPS:386756	SEQ ID NO: 392	QVQLVESGAIEVVKPGASVKVSKASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
		TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMEALHNHYTQKSLSLSPGSGGGSGGGGSQSVLTQ PPSVSAAPGQKVTISCSGSSSNIGNNYVSWYQQLPGTAPKLLIY DNNKRPSGIPDRFSGSKSGTSTTLGITGLQTGDEADYYCGTWD SRLSAVVFGGGTKLTVLGGGGSGGGSGGGGSQVQLVESGG GVVQPGRSLRLSCAASGFTFSSFGMHVWRQAPGKGLEWVAVI SFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDTAVY YCARDRLNYYDSSGYYHYKYYGMAVWGQGT TTVTVSS (SEQ ID NO: 401)
iPS:386754	SEQ ID NO: 392	QVQLVESGAIEVVKPGASVKVSKASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMEALHNHYTQKSLSLSPGSGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSSFGMHVWRQAPGKGLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYESSGYYHYKYYGMAVWGQGT TTVTVSSG GGSGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSSN IGNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTST TLGITGLQTGDEADYYCGTWDSRLSAVVFGGGTKLTVL (SEQ ID NO: 402)
iPS:386752	SEQ ID NO: 392	QVQLVESGAIEVVKPGASVKVSKASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMEALHNHYTQKSLSLSPGSGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSSFGMHVWRQAPGKGLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYDSSGYYHYKYYGMAVWGQGT TTVTVSSG GGSGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSSN IGNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTSA TLGITGLQTGDEADYYCGTWDSRLSAVVFGGGTKLTVL (SEQ ID NO: 403)
iPS:386750	SEQ ID NO: 392	QVQLVESGAIEVVKPGASVKVSKASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALT

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
		SGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMEALHNHYTQKSLSLSPGSGGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPGKCLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYDSSGYYHYKYYGMAVWGQGT TTVTVSSG GGGSGGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSSNI GNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTSA TLGITGLQTGDEADYYCGTWDSRLSAVVFGCGTKLTVL (SEQ ID NO: 404)
iPS:386748	SEQ ID NO: 392	QVQLVESGAEEVVKPGASVKVSKASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSEDTAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALT SGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMEALHNHYTQKSLSLSPGSGGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPGKGLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYESSGYYHYKYYGMAVWGQGT TTVTVSSG GGGSGGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSSNI GNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTSA TLGITGLQTGDEADYYCGTWDSRLSAVVFGGGTKLTVL (SEQ ID NO: 405)
iPS:386746	SEQ ID NO: 392	QVQLVESGAEEVVKPGASVKVSKASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSEDTAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALT SGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMEALHNHYTQKSLSLSPGSGGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPGKGLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYDSSGYYHYKYYGMAVWGQGT TTVTVSSG GGGSGGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSSNI GNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTSA TLAITGLQTGDEADYYCGTWDSRLSAVVFGGGTKLTVL (SEQ ID NO: 406)
iPS:386744	SEQ ID NO: 392	QVQLVESGAEEVVKPGASVKVSKASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSEDTAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
		GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPVLDSGDSFFLYSKLTVDKSRWQQ GNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSFSGMHWVRQAPGKCLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYDSSGYHYKYYGMAVWGQGT TTVTVSSG GGGSGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSSNI GNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTSA TLAITGLQTGDEADYYCGTWDSRLSAVVFGCGTKLTVL (SEQ ID NO: 407)
iPS:386742	SEQ ID NO: 392	QVQLVESGAEVVKPGASVKVSCASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPVLDSGDSFFLYSKLTVDKSRWQQ GNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSFSGMHWVRQAPGKCLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYESSGYHYKYYGMAVWGQGT TTVTVSSG GGGSGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSSNI GNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTSA TLGITGLQTGDEADYYCGTWDSRLSAVVFGCGTKLTVL (SEQ ID NO: 408)
iPS:386740	SEQ ID NO: 392	QVQLVESGAEVVKPGASVKVSCASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME LSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTTPVLDSGDSFFLYSKLTVDKSRWQQ GNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSFSGMHWVRQAPGKCLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYESSGYHYKYYGMAVWGQGT TTVTVSSG GGGSGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSSNI GNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTST TLGITGLQTGDEADYYCGTWDSRLSAVVFGCGTKLTVL (SEQ ID NO: 409)
iPS:386736	SEQ ID NO: 392	QVQLVESGAEVVKPGASVKVSCASGFTFSRFAMHWVRQAP GQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYME

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
		LSSLRSEDTAVYYCARGYDVLGTGYPDYWGQGLTVTVSSASTK GPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVSWNSGALT SGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTYICNVNHKPSN TKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTL MISRTPEVTCVVDVSHEDPEVKFNWYVDGVEVHNAKTKPC EEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEK TISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDI AVEWESNGQPENNYKTPPVLDSDGSFFLYSKLTVDKSRWQQ GNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGGGGSQVQLVE SGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPGKGLEW VAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNSLRAEDT AVYYCARDRLNYYDSSGYHYKYYGMAVWGQGTITVTVSSG GGSGGGGGSGGGGSQSVLTQPPSVSAAPGQKVTISCSGSSNI GNNYVSWYQQLPGTAPKLLIYDNNKRPSGIPDRFSGSKSGTST TLGITGLQTGDEADYYCGTWDSRLSAVVFGGGTKLTVL (SEQ ID NO: 410)
<i>Anti-CGRP Receptor IgG x Anti-PAC1 Receptor scFv</i>		
iPS:386731	QSVLTQPPSVSAAPGQ KVTISCSGSSNIGNNY VSWYQQLPGTAPKLLI YDNNKRPSGIPDRFSG SKSGTSTTLGITGLQTG DEADYYCGTWDSRLS AVVFGGGTKLTVLGQ PKANPTVTLFPPSSEEL QANKATLVCLISDFYP GAVTVAWKADGSPVK AGVETTKPSKQSNNK YAASSYLSLTPEQWKS HRSYSCQVTHEGSTVE KTVAPTECS (SEQ ID NO: 393)	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYHYKYYGMAVWGQGT ITVTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVS NKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTPPVLDSDGSFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSDIQLTQSPSFLSASVGDRVITITCRASQSIGRSLHWYQQKPG KAPKLLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQPEDFATY YCHQSSRLPFTFGPGTKVDIKRGGGGSGGGGSQVQLV ESGAEVVKPGASVKVSKASGFTFSRFAMHWVRQAPGQGLE WMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYMELSSLR SEDTAVYYCARGYDVLGTGYPDYWGQGLTVTVSS (SEQ ID NO: 411)
iPS:386725	SEQ ID NO: 393	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYHYKYYGMAVWGQGT ITVTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVS NKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTPPVLDSDGSFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSDIQLTQSPSFLSASVGDRVITITCRASQSIGRSLHWYQQKPG KAPKLLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQPEDFATY YCHQSSRLPFTFGPGTKVDIKRGGGGSGGGGSQVQLV ESGAEVVKPGASVKVSKASGFTFSRFAMHWVRQAPGQGLE WMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYMELSSLR SEDTAVYYCARGYDVLGTGYPDYWGQGLTVTVSS (SEQ ID NO: 412)

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
iPS:386717	SEQ ID NO: 393	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYESSGYYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKV NKALPAIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSGFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSED TAVYYCARGYDVL TGYPDYWGQGT LVTVSS GGGGSGGGGSGGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPGKCPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISSLQPEDFATYYCHQSSRLPFTFGCGTKVDIKR (SEQ ID NO: 413)
iPS:386715	SEQ ID NO: 393	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKV NKALPAIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSGFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSED TAVYYCARGYDVL TGYPDYWGQGT LVTVSS GGGGSGGGGSGGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPGKCPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISSLQPEDFATYYCHQSSRLPFTFGCGTKVDIKR (SEQ ID NO: 414)
iPS:386707	SEQ ID NO: 393	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYESSGYYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKV NKALPAIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSGFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSED TAVYYCARGYDVL TGYPDYWGQGT LVTVSS GGGGSGGGGSGGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPGKAPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISSLQPEDFATYYCHQSSRLPFTFGPGTKVDIKR (SEQ ID

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
iPS:386705	SEQ ID NO: 393	NO: 415) QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYHYHYKYGMMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKV NKALPAIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSGFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSED TAVYYCARGYDVL TGYPDYWGQGT LVTVSS GGGSGGGSGGGSGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPGKAPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISLQPEDFATYYCHQSSRLPFTFGPGTKVDIKR (SEQ ID NO: 416)
iPS:386723	QSVLTQPPSVSAAPGQ KVTISCSGSSSNIGNNY VSWYQQLPGTAPKLLI YDNNKRPSGIPDRFSG SKSGTSATLGITGLQT GDEADYYCGTWDSRL SAVVFGGGTKLTVLG QPKANPTVTLFPPSSEE LQANKATLVCLISDFY PGAVTVAWKADGSPV KAGVETTKPSKQSNN KYAASSYLSLTPEQW KSHRSYSCQVTHEGST VEKTVAPTECS (SEQ ID NO: 394)	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYESSGYHYHYKYGMMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKV NKALPAIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSGFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSED TAVYYCARGYDVL TGYPDYWGQGT LVTVSS GGGSGGGSGGGSGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPGKCPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISLQPEDFATYYCHQSSRLPFTFGCGTKVDIKR (SEQ ID NO: 417)
iPS:386719	SEQ ID NO: 394	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYHYHYKYGMMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKV NKALPAIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSGFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSED TAVYYCARGYDVL TGYPDYWGQGT LVTVSS GGGSGGGSGGGSGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPGKCPKLLIKYASQSLSGVPSRFSGSGSGTEFT

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
		LTISSLQPEDFATYYCHQSSRLPFTFGCGTKVDIKR (SEQ ID NO: 418)
iPS:386713	SEQ ID NO: 394	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYESSGYYHYKYYGMAVWGQGTT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGGSFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSS GGGGSGGGGSGGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPGKAPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISSLQPEDFATYYCHQSSRLPFTFGPGTKVDIKR (SEQ ID NO: 419)
iPS:386709	SEQ ID NO: 394	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYYHYKYYGMAVWGQGTT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGGSFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSS GGGGSGGGGSGGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPGKAPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISSLQPEDFATYYCHQSSRLPFTFGPGTKVDIKR (SEQ ID NO: 420)
iPS:386727	SEQ ID NO: 394	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYYHYKYYGMAVWGQGTT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVVTVPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGGSFFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSED TAVYYCARGYDVL TGYPDYWGQGLTVTVSS GGGGSGGGGSGGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPGKAPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISSLQPEDFATYYCHQSSRLPFTFGPGTKVDIKRGGGGSGGGGSGGGGSGVQLVESGAEVVKPGASVKVSCKASGFTFSRFAMHWVRQAPGQGLE

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
		WMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYMELSSLR SEDTAVYYCARGYDVLGTGYPDYWGQGLTVTVSS (SEQ ID NO: 421)
iPS:386721	QSVLTQPPSVSAAPGQ KVTISCSGSSSNIGNNY VSWYQQLPGTAPKLLI YDNNKRPSGIPDRFSG SKSGTSATLAITGLQT GDEADYYCGTWDSRL SAVVFGGGTKLTVLG QPKANPTVTLFPPSSEE LQANKATLVCLISDFY PGAFTVAWKADGSPV KAGVETTKPSKQSN KYAASSYLSLTPEQW KSHRSYSCQVTHEGST VEKTVAPTECS (SEQ ID NO: 395)	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYYHYKYYGMAVWGQGT TVTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVTVTPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKV NKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSSFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSEDTAVYYCARGYDVLGTGYPDYWGQGLTVTVSS GGGGSGGGSGGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPKGKPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISSLQPEDFATYYCHQSSRLPFTFGCGTKVDIKR (SEQ ID NO: 422)
iPS:386711	SEQ ID NO: 395	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYYHYKYYGMAVWGQGT TVTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVTVTPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKV NKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSSFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSQVQLVESGAEVVKPGASVKVCKASGFTFSRFAMHWVR QAPGQGLEWMGVISYDGGNKYYAESVKGRVTMTRDTSTSTL YMELSSLRSEDTAVYYCARGYDVLGTGYPDYWGQGLTVTVSS GGGGSGGGSGGGGSDIQLTQSPSFLSASVGDRVITITCRASQSI GRSLHWYQQKPKGKPKLLIKYASQSLSGVPSRFSGSGSGTEFT LTISSLQPEDFATYYCHQSSRLPFTFGPGTKVDIKR (SEQ ID NO: 423)
iPS:386733	SEQ ID NO: 395	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSFGMHWVRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDN SKNTLFLQMNS LRAEDTAVYYCARDRLNYYESSGYYHYKYYGMAVWGQGT TVTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVTVTPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKV NKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSSFLYSKLT VDKSRWQQGNVFSCSVMHEALHNHYTQKSLSLSPGGGGSGG GGSDIQLTQSPSFLSASVGDRVITITCRASQSIGRSLHWYQQKPG KAPKLLIKYASQSLSGVPSRFSGSGSGTEFTLTISSLQPEDFATY YCHQSSRLPFTFGPGTKVDIKRGGGGSGGGSGGGGSGVQLV

IgG-scFv Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence
		ESGAEVVKPGASVKVSCASGFTFSRFAMHWVRQAPGGGLE WMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYMELSSLR SEDTAVYYCARGYDVLGTGYPDYWGQGTLLTVSS (SEQ ID NO: 424)
iPS:386729	SEQ ID NO: 395	QVQLVESGGGVVQPGRSLRLSCAASGFTSSFGMHWRQAPG KGLEWVAVISFDGSIKYSVDSVKGRFTISRDNKNTLFLQMNS LRAEDTAVYYCARDRLNYYDSSGYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLSSVTVTPSSSLGTQTY ICNVNHKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVF LFPPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFNWYVDGVE VHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVS NKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCL VKGFYPSDIAVEWESNGQPENNYKTTTPVLDSGSSFFLYSKLT VDKSRWQQGNVFCFSVMHEALHNHYTQKSLSLSPGSGGSGG GGSDIQLTQSPSFLSASVGDRVTITCRASQSIGRSLHWYQQKPG KAPKLLIKYASQSLSGVPSRFSGSGSGTEFTLTISSLQPEDFATY YCHQSSRLPFTFGPGTKVDIKRGGGSGGGGSGGGGSGVQLV ESGAEVVKPGASVKVSCASGFTFSRFAMHWVRQAPGGGLE WMGVISYDGGNKYYAESVKGRVTMTRDTSTSTLYMELSSLR SEDTAVYYCARGYDVLGTGYPDYWGQGTLLTVSS (SEQ ID NO: 425)

[0130] In certain embodiments, the first antibody (i.e. the IgG component) of the IgG-scFv bispecific antigen binding proteins is an anti-PAC1 receptor antibody and the second antibody (i.e. from which the scFv is derived) is an anti-CGRP receptor antibody. In such embodiments, the anti-PAC1 receptor antibody comprises a VL region from any of those described in Table 1A and a VH region from any of those described in Table 1B. For instance, in one embodiment, the anti-PAC1 receptor antibody from which the IgG component is derived comprises a LV-04 (SEQ ID NO: 31) VL region and a HV-03 (SEQ ID NO: 85) VH region.

[0131] In embodiments in which the scFv component is derived from an anti-CGRP receptor antibody, the anti-CGRP receptor antibody may comprise a VL region from any of those described in Table 3A and a VH region from any of those described in Table 3B. In one embodiment, the anti-CGRP receptor scFv comprises a LV-105 (SEQ ID NO: 140) VL region and a HV-105 (SEQ ID NO: 194) VH region. In another embodiment, the anti-CGRP receptor scFv comprises a LV-105 (SEQ ID NO: 140) VL region and a HV-107 (SEQ ID NO: 196) VH region. In another embodiment, the anti-CGRP receptor scFv comprises a LV-107 (SEQ ID NO: 142) VL region and a HV-105 (SEQ ID NO: 194) VH region. In yet another embodiment, the anti-CGRP receptor scFv comprises a LV-109 (SEQ ID NO: 144) VL region and a HV-105

(SEQ ID NO: 194) VH region. In still another embodiment, the anti-CGRP receptor scFv comprises a LV-107 (SEQ ID NO: 142) VL region and a HV-107 (SEQ ID NO: 196) VH region. **[0132]** In embodiments in which the IgG component of the bispecific antigen binding proteins is derived from an anti-PAC1 receptor antibody and the scFv component is derived from an anti-CGRP receptor antibody, the modified heavy chain of the bispecific antigen binding proteins comprises a sequence selected from SEQ ID NOs: 396 to 410. In related embodiments, the light chain of the bispecific antigen binding proteins comprises the sequence of SEQ ID NO: 392. In certain embodiments, the bispecific, multivalent antigen binding protein is an antigen binding protein designated as iPS:386738, iPS:386764, iPS:386762, iPS:386760, iPS:386758, iPS:386756, iPS:386754, iPS:386752, iPS:386750, iPS:386748, iPS:386746, iPS:386744, iPS:386742, iPS:386740, or iPS:386736 as set forth in Table 9. In other embodiments, the bispecific, multivalent antigen binding protein is an antigen binding protein designated as iPS:386738, iPS:386754, iPS:386750, iPS:386748, iPS:386746, iPS:386744, iPS:386740, or iPS:386736 as set forth in Table 9. In still other embodiments, the bispecific, multivalent antigen binding protein is an antigen binding protein designated as iPS:386744, iPS:386746, or iPS:386748 as set forth in Table 9.

[0133] In other embodiments of the invention, the first antibody (i.e. the IgG component) of the IgG-scFv bispecific antigen binding proteins is an anti-CGRP receptor antibody and the second antibody (i.e. from which the scFv is derived) is an anti-PAC1 receptor antibody. In such embodiments, the anti-CGRP receptor antibody comprises a VL region from any of those described in Table 3A and a VH region from any of those described in Table 3B. For example, in one embodiment, the anti-CGRP receptor antibody from which the IgG component is derived comprises a LV-105 (SEQ ID NO: 140) VL region and a HV-105 (SEQ ID NO: 194) VH region. In another embodiment, the anti-CGRP receptor antibody from which the IgG component is derived comprises a LV-105 (SEQ ID NO: 140) VL region and a HV-107 (SEQ ID NO: 196) VH region. In another embodiment, the anti-CGRP receptor antibody from which the IgG component is derived comprises a LV-107 (SEQ ID NO: 142) VL region and a HV-105 (SEQ ID NO: 194) VH region. In yet another embodiment, the anti-CGRP receptor antibody from which the IgG component is derived comprises a LV-109 (SEQ ID NO: 144) VL region and a HV-105 (SEQ ID NO: 194) VH region. In still another embodiment, the anti-CGRP receptor antibody

from which the IgG component is derived comprises a LV-107 (SEQ ID NO: 142) VL region and a HV-107 (SEQ ID NO: 196) VH region.

[0134] In embodiments in which the scFv component is derived from an anti-PAC1 receptor antibody, the anti-PAC1 receptor antibody may comprise a VL region from any of those described in Table 1A and a VH region from any of those described in Table 1B. In one embodiment, the anti-PAC1 receptor scFv comprises a LV-04 (SEQ ID NO: 31) VL region and a HV-03 (SEQ ID NO: 85) VH region.

[0135] In embodiments in which the IgG component of the bispecific antigen binding proteins is derived from an anti-CGRP receptor antibody and the scFv component is derived from an anti-PAC1 receptor antibody, the modified heavy chain of the bispecific antigen binding proteins comprises a sequence selected from SEQ ID NOs: 411 to 425. In related embodiments, the light chain of the bispecific antigen binding proteins comprises a sequence selected from SEQ ID NOs: 393 to 395. In one embodiment, the modified heavy chain comprises a sequence selected from SEQ ID NOs: 411 to 416 and the light chain comprises the sequence of SEQ ID NO: 393. In another embodiment, the modified heavy chain comprises a sequence selected from SEQ ID NOs: 417 to 421 and the light chain comprises the sequence of SEQ ID NO: 394. In yet another embodiment, the modified heavy chain comprises a sequence selected from SEQ ID NOs: 422 to 425 and the light chain comprises the sequence of SEQ ID NO: 395.

[0136] In certain embodiments, the bispecific, multivalent antigen binding protein is an antigen binding protein designated as iPS:386731, iPS:386725, iPS:386717, iPS:386715, iPS:386707, iPS:386705, iPS:386723, iPS:386719, iPS:386713, iPS:386709, iPS:386727, iPS:386721, iPS:386711, iPS:386733, or iPS:386729 as set forth in Table 9. In some embodiments, the bispecific, multivalent antigen binding protein is an antigen binding protein designated as iPS:386721, iPS:386723, or iPS:386733 as set forth in Table 9.

[0137] In some embodiments of the antigen binding proteins of the invention, the binding domain positioned at the carboxyl terminus of the Fc region (i.e. the carboxyl-terminal binding domain) is a Fab fragment. In such embodiments, the Fab is fused or otherwise connected to the carboxyl terminus of the Fc region (e.g. the carboxyl terminus of the CH3 domain) through a peptide linker through the amino terminus of the VL region or VH region of the Fab fragment. Thus, in one embodiment, the Fab is fused to an Fc region through the amino terminus of the VL region of the Fab such that the resulting fusion protein comprises, from N-terminus to C-

terminus, a CH2 domain, a CH3 domain, a peptide linker, a VL region, and a CL region. In another embodiment, the Fab is fused to an Fc region through the amino terminus of the VH region of the Fab such that the resulting fusion protein comprises, from N-terminus to C-terminus, a CH2 domain, a CH3 domain, a peptide linker, a VH region, and a CH1 region.

[0138] The peptide linker joining the Fc region to the carboxyl-terminal Fab can be any of the peptide linkers described herein. In particular embodiments, the peptide linker joining the Fc region to the carboxyl-terminal Fab fragment is at least 5 amino acids in length. In other embodiments, the peptide linker joining the Fc region to the carboxyl-terminal Fab fragment is at least 8 amino acids in length. Particularly suitable peptide linkers for joining the Fc region to the carboxyl-terminal Fab fragment are glycine-serine linkers, such as $(\text{Gly}_x\text{Ser})_n$ where $x=3$ or 4 and $n=2, 3, 4, 5$ or 6 . In one embodiment, the peptide linker connecting the Fc region to the carboxyl-terminal Fab fragment is a L10 $(\text{G}_4\text{S})_2$ linker (SEQ ID NO: 368). In another embodiment, the peptide linker connecting the Fc region to the carboxyl-terminal Fab fragment is a L9 or $\text{G}_3\text{SG}_4\text{S}$ linker (SEQ ID NO: 367).

[0139] In some embodiments of the bispecific antigen binding proteins of the invention in which the carboxyl-terminal binding domain is a Fab fragment, the binding domain positioned at the amino terminus of the Fc region (i.e. the amino-terminal binding domain) is also a Fab fragment. The amino-terminal Fab fragment can be fused to the amino terminus of the Fc region through a peptide linker or an immunoglobulin hinge region described herein. In some embodiments, the amino-terminal Fab fragment is joined to the amino terminus of the Fc region through a human IgG1 hinge region. In other embodiments, the amino-terminal Fab fragment is joined to the amino terminus of the Fc region through a human IgG2 hinge region. Preferably, the amino-terminal Fab fragment is fused to the Fc region through the carboxyl terminus of the CH1 region of the Fab.

[0140] In some embodiments, the bispecific antigen binding protein of the invention comprises a first antibody that specifically binds to a first target (e.g. human CGRP receptor or human PAC1 receptor) where one polypeptide chain (e.g. the light chain (VL-CL)) of a Fab fragment from a second antibody that specifically binds to a second target (e.g. human CGRP receptor or human PAC1 receptor) is fused to the carboxyl terminus of the heavy chain of the first antibody. The bispecific antigen binding protein in such embodiments also comprises a polypeptide chain containing the other half of the Fab fragment from the second antibody (e.g. the Fd chain (VH-

CH1)). This format is referred to herein as the “IgG-Fab” format, and one embodiment of this type of molecule is shown schematically in Figure 3. Thus, in certain embodiments, the present invention includes a bispecific, multivalent antigen binding protein comprising: (i) a light chain from a first antibody, (ii) a heavy chain from the first antibody, wherein the heavy chain is fused at its carboxyl terminus through a peptide linker to a first polypeptide comprising VL-CL domains or VH-CH1 domains of a second antibody to form a modified heavy chain, and (iii) a second polypeptide comprising VH-CH1 domains or VL-CL domains of the second antibody, wherein the first or second antibody specifically binds to human CGRP receptor and the other antibody specifically binds to human PAC1 receptor. When dimerized, the bispecific antigen binding protein is a homohexamer comprising two modified heavy chains, two light chains from the first antibody, and two polypeptide chains containing the other half of the Fab fragment from the second antibody (either the Fd fragment or light chain). In one embodiment, the first polypeptide, which is fused to the carboxyl terminus of the heavy chain, comprises VL and CL domains from the second antibody, and the second polypeptide comprises VH and CH1 domains from the second antibody. In another embodiment, the first polypeptide, which is fused to the carboxyl terminus of the heavy chain, comprises VH and CH1 domains from the second antibody, and the second polypeptide comprises VL and CL domains from the second antibody.

[0141] Charge pair mutations or complimentary amino acid substitutions as described herein can be introduced into the Fab regions of the first antibody (Fab 1) or second antibody (Fab 2) to promote correct heavy chain-light chain pairing. For instance, in some embodiments, the amino acid at Kabat position 38 of the VL domain in Fab 1 is replaced with a negatively-charged amino acid (e.g. glutamic acid) and the amino acid at Kabat position 39 of the VH domain in Fab 1 is replaced with a positively-charged amino acid (e.g. lysine). In other embodiments, the amino acid at Kabat position 38 of the VL domain in Fab 1 is replaced with a positively-charged amino acid (e.g. lysine) and the amino acid at Kabat position 39 of the VH domain in Fab 1 is replaced with a negatively-charged amino acid (e.g. glutamic acid). In certain embodiments, the amino acid at Kabat position 38 of the VL domain in Fab 2 is replaced with a negatively-charged amino acid (e.g. glutamic acid) and the amino acid at Kabat position 39 of the VH domain in Fab 2 is replaced with a positively-charged amino acid (e.g. lysine). In other embodiments, the amino acid at Kabat position 38 of the VL domain in Fab 2 is replaced with a positively-charged amino

acid (e.g. lysine) and the amino acid at Kabat position 39 of the VH domain in Fab 2 is replaced with a negatively-charged amino acid (e.g. glutamic acid).

[0142] In embodiments in which the VH-CH1 region (i.e. Fd fragment) from the second antibody is fused to the heavy chain of the first antibody, the heavy chain from the first antibody comprises a S183E mutation (EU numbering), the light chain from the first antibody comprises a S176K mutation (EU numbering), the light chain from the second antibody comprises a S176E mutation (EU numbering), and the Fd region from the second antibody (which is fused to the C-terminus of the heavy chain from the first antibody) comprises a S183K mutation (EU numbering). In other embodiments, the heavy chain from the first antibody comprises a G44E mutation (Kabat) and S183E mutation (EU numbering), the light chain from the first antibody comprises a G100K mutation (Kabat) and S176K mutation (EU numbering), the light chain from the second antibody comprises a G100E mutation (Kabat) and S176E mutation (EU numbering), and the Fd region from the second antibody (which is fused to the C-terminus of the heavy chain from the first antibody) comprises a G44K mutation (Kabat) and S183K mutation (EU numbering). The charges in the foregoing examples may be reversed so long as the charge on the corresponding light or heavy chain is also reversed so that the correct heavy/light chain pairs have opposite charges.

[0143] Additionally or alternatively, correct heavy-light chain pairing may be facilitated by swapping the CH1 and CL domains in the carboxyl-terminal Fab binding domain. By way of example, the first polypeptide, which is fused to the carboxyl terminus of the heavy chain, may comprise a VL domain and CH1 domain from the second antibody, and the second polypeptide may comprise a VH domain and CL domain from the second antibody. In another embodiment, the first polypeptide, which is fused to the carboxyl terminus of the heavy chain, may comprise a VH domain and a CL domain from the second antibody, and the second polypeptide may comprise a VL domain and CH1 domain from the second antibody.

[0144] In the IgG-Fab format of the bispecific antigen binding proteins of the invention, an anti-PAC1 receptor antibody can be the first antibody (i.e. the "IgG") or the second antibody (i.e. from which the C-terminal Fab is derived). Similarly, an anti-CGRP receptor antibody can be the first antibody (i.e. the "IgG") or the second antibody (i.e. from which the C-terminal Fab is derived). Any of the anti-PAC1 receptor antibody variable regions set forth in Tables 1A and 1B can be incorporated into either the IgG component or the C-terminal Fab component of the

bispecific antigen binding proteins of the invention. Any of the anti-CGRP receptor antibody variable regions set forth in Tables 3A and 3B can be incorporated into either the IgG component or the C-terminal Fab component of the bispecific antigen binding proteins of the invention.

[0145] Amino acid sequences for light chains, modified heavy chains, and second polypeptides of exemplary antigen binding proteins of the invention in the IgG-Fab format are summarized in Table 10 below. The molecules listed in the first half of the table comprise an anti-PAC1 receptor IgG component and an anti-CGRP receptor C-terminal Fab fragment, whereas the molecules listed in the second half of the table comprise an anti-CGRP receptor IgG component and an anti-PAC1 receptor C-terminal Fab fragment.

Table 10. Amino Acid Sequences of Exemplary Bispecific Antigen Binding Proteins in the IgG-Fab Format

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
<i>Anti-PAC1 Receptor IgG x Anti-CGRP Receptor Fab</i>			
iPS:392513	DIQLTQSPSFLSA SVGDRVITITCRAS QSIGRSLHWYQQ KPGKAPKLLIKY ASQSLSGVPSRFS GSGSGTEFTLTISS LQPEDFATYYCH QSSRLPFTFGPGT KVDIKRTVAAPS VFIFPPSDEQLKS GTASVVCLLNNF YPREAKVQWKV DNALQSGNSQES VTEQDSKDSTYS LESTLTLSKADYE KHKVYACEVTH QGLSSPVTKSFNR GEC (SEQ ID NO: 214)	QVQLVESGAEVVKPGASVKVSCKASGFTFSRF AMHWVRQAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLGTGYPDYWGQGLTVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHNKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTPPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSQSVLTQPPSVSAAPGQKVTIS CSGSSSNIGNNYVSWYQQLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLASTKGPS VFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVLQSSGLYSLKSVVTVP SSSLGTQTYICNVNHNKPSNTKVDKKV (SEQ ID NO: 428)	QVQLVESGGGVVQPP GRSLRLSCAASGFTF SSFGMHWRQAPG KGLEWVAVISFDGSI KYSVDSVKGRFTISR DNSKNTLFLQMNSL RAEDTAVYYCARDR LNYDSSGYYHYKY YGMVAVWGQGTITV VSSGQPKANPTVTLF PPSSEELQANKATLV CLISDFYPGAVTVA WKADGSPVKAGVE TTKPSKQSNNKYAA ESYLSLTPEQWKSH RSYSCQVTHEGSTV EKTVAPECS (SEQ ID NO: 452)
iPS:392514	SEQ ID NO: 214	QVQLVESGAEVVKPGASVKVSCKASGFTFSRF AMHWVRQAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLGTGYPDYWGQGLTVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHNKPSNTKVDKKVEPKS	QVQLVESGGGVVQPP GRSLRLSCAASGFTF SSFGMHWRVREAPGK GLEWVAVISFDGSIK YSVDSVKGRFTISR NSKNTLFLQMNSLR AEDTAVYYCARDRL

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
		CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTTTPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSQSVLTQPPSVSAAPGQKVTIS CSGSSSNIGNNYVSWYQKLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLASTKGPS VFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVLQSSGLYSLKSVVTP SSSLGTQTYICNVNHNKPSNTKVDKKV (SEQ ID NO: 429)	NYYDSSGGYYHYKY YGMVAVWGQGTITVT VSSGQPKANPTVTLF PPSSEELQANKATLV CLISDFYPGAVTVA WKADGSPVKAGVE TTKPSKQSNKNYAA ESYLSLTPEQWKSH RSYSCQVTHEGSTV EKTVAPECS (SEQ ID NO: 453)
iPS:392475	SEQ ID NO: 214	QVQLVESGAEEVVKPGASVKVSCASGFTFSRF AMHWVRQAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLTYGPDYWGQGTITVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHNKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTTTPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSQSVLTQPPSVSAAPGQKVTIS CSGSSSNIGNNYVSWYQQLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLASTKGPS VFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVLQSSGLYSLKSVVTP SSSLGTQTYICNVNHNKPSNTKVDKKV (SEQ ID NO: 430)	QVQLVESGGGVVQPP GRSLRLSCAASGFTF SSFGMHWRQAPG KGLEWVAVISFDGSI KYSVDSVKGRFTISR DNSKNTLFLQMNSL RAEDTAVYYCARDR LNYESSGGYYHYKY YGMVAVWGQGTITVT VSSGQPKANPTVTLF PPSSEELQANKATLV CLISDFYPGAVTVA WKADGSPVKAGVE TTKPSKQSNKNYAA ESYLSLTPEQWKSH RSYSCQVTHEGSTV EKTVAPECS (SEQ ID NO: 454)
iPS:392519	SEQ ID NO: 214	QVQLVESGAEEVVKPGASVKVSCASGFTFSRF AMHWVRQAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLTYGPDYWGQGTITVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHNKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTTTPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSQSVLTQPPSVSAAPGQKVTIS CSGSSSNIGNNYVSWYQKLPGTAPKLLIYDNN	QVQLVESGGGVVQPP GRSLRLSCAASGFTF SSFGMHWRVREAPGK GLEWVAVISFDGSIK YSVDSVKGRFTISR NSKNTLFLQMNSLR AEDTAVYYCARDRL NYYESSGGYYHYKYY GMVAVWGQGTITVT SSGQPKANPTVTLFP PSSEELQANKATLV CLISDFYPGAVTVA WKADGSPVKAGVE TTKPSKQSNKNYAA ESYLSLTPEQWKSH RSYSCQVTHEGSTV

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
		KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLASTKGPS VFPLAPSSKSTSGGTAALGCLVKDYFPEPVTVS WNSGALTSGVHTFPAVLQSSGLYSLKSVVTV SSSLGTQTYICNVNHNKPSNTKVDKKV (SEQ ID NO: 431)	EKTVAPECS (SEQ ID NO: 455)
iPS:392515	SEQ ID NO: 214	QVQLVESGAEEVVKPGASVKVSCASGFTFSRF AMHWVRQAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLGTGYPDYWGQGLTVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHNKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTTTPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSQSVLTQPPSVSAAPGQKVTIS CSGSSNIGNNYVSWYQQLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLGQPKANP TVTLFPPSSEELQANKATLVCLISDFYPGAVTV AWKADGSPVKAGVETTKPSKQSNNKYAAKSY LSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPT ECS (SEQ ID NO: 432)	QVQLVESGGGVVQPG GRSLRLSCAASGFTF SSFGMHWRQAPG KGLEWVAVISFDGSI KYSVDSVKGRFTISR DNSKNTLFLQMNLS RAEDTAVYYCARDR LNYYDSSGYYHYKY YGMVAVWGQGTITV VSSASTKGPSVFPLA PSSKSTSGGTAALGC LVKDYFPEPVTVSW NSGALTSGVHTFPA VLQSSGLYSLESVVT VPSSSLGTQTYICNV NHNKPSNTKVDKKV (SEQ ID NO: 456)
iPS:392516	SEQ ID NO: 214	QVQLVESGAEEVVKPGASVKVSCASGFTFSRF AMHWVRQAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLGTGYPDYWGQGLTVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHNKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTTTPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSQSVLTQPPSVSAAPGQKVTIS CSGSSNIGNNYVSWYQKLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLGQPKANP TVTLFPPSSEELQANKATLVCLISDFYPGAVTV AWKADGSPVKAGVETTKPSKQSNNKYAAKSY LSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPT ECS (SEQ ID NO: 433)	QVQLVESGGGVVQPG GRSLRLSCAASGFTF SSFGMHWRVREAPGK GLEWVAVISFDGSIK YSVDSVKGRFTISR NSKNTLFLQMNLSR AEDTAVYYCARDRL NYYDSSGYYHYKY YGMVAVWGQGTITV VSSASTKGPSVFPLA PSSKSTSGGTAALGC LVKDYFPEPVTVSW NSGALTSGVHTFPA VLQSSGLYSLESVVT VPSSSLGTQTYICNV NHNKPSNTKVDKKV (SEQ ID NO: 457)
iPS:392521	SEQ ID NO: 214	QVQLVESGAEEVVKPGASVKVSCASGFTFSRF AMHWVRQAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY	QVQLVESGGGVVQPG GRSLRLSCAASGFTF SSFGMHWRVREAPGK

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
		YCARGYDVLGTGYPDYWGQGLTVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTTPPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGGSQSVLTQPPSVSAAPGQKVITIS CSGSSNIGNNYVSWYQKLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLGQPKANP TVTLFPPSSEELQANKATLVCLISDFYPGAVTV AWKADGSPVKAGVETTKPSKQSNNKYAASYSY LSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPT ECS (SEQ ID NO: 434)	GLEWVAVISFDGSIK YSVDSVKGRFTISR NSKNTLFLQMNSLR AEDTAVYYCARDRL NYYESGGYYHYKYY GMAVWGQGTITVTV SSASTKGPSVFPLAP SSKSTSGGTAALGCL VKDYFPEPVTVSWN SGALTSGVHTFPAV LQSSGLYSLESVTV PSSSLGTQTYICNVN HKPSNTKVDKKV (SEQ ID NO: 458)
iPS:392520	SEQ ID NO: 214	QVQLVESGAIEVVKPGASVKVSCASGFTFSRF AMHWVRQAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLGTGYPDYWGQGLTVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTTPPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGGSQSVLTQPPSVSAAPGQKVITIS CSGSSNIGNNYVSWYQQLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLGQPKANP TVTLFPPSSEELQANKATLVCLISDFYPGAVTV AWKADGSPVKAGVETTKPSKQSNNKYAASYSY LSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPT ECS (SEQ ID NO: 435)	QVQLVESGGGVVQP GRSLRLSCAASGFTF SSFGMHWRQAPG KGLEWVAVISFDGSI KYSVDSVKGRFTISR DNSKNTLFLQMNSL RAEDTAVYYCARDRL LNYYESGGYYHYKY YGMAVWGQGTITV VSSASTKGPSVFPLA PSSKSTSGGTAALGC LVKDYFPEPVTVSW NSGALTSGVHTFPA VLQSSGLYSLESVTV VPSSSLGTQTYICNV NHKPSNTKVDKKV (SEQ ID NO: 459)
iPS:392517	DIQLTQSPSFLSA SVGDRVITITCRAS QSIGRSLHWYQE KPGKAPKLLIKY ASQSLSGVPSRFS GSGSGTEFTLTISS LQPEDFATYYCH QSSRLPFTFGPGT KVDIKRTVAAPS VFIFPPSDEQLKS GTASVVCLLNNF YPREAKVQWKV	QVQLVESGAIEVVKPGASVKVSCASGFTFSRF AMHWVRKAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLGTGYPDYWGQGLTVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE	SEQ ID NO: 456

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
	DNALQSGNSQES VTEQDSKDSTYS LESTLTLSKADYE KHKVYACEVTH QGLSSPVTKSFNR GEC (SEQ ID NO: 426)	WESNGQPENNYKTPPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSQSVLTQPPSVSAAPGQKVTIS CSGSSSNIGNNYVSWYQQLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLGQPKANP TVTLFPPSSEELQANKATLVCLISDFYPGAVTV AWKADGSPVKAGVETTKPSKQSNNKYAAKSY LSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPT ECS (SEQ ID NO: 436)	
iPS:392518	SEQ ID NO: 426	QVQLVESGAIEVVKPGASVKVSCKASGFTFSRF AMHWVRKAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLGTGYPDYWGQGLTVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTPPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSQSVLTQPPSVSAAPGQKVTIS CSGSSSNIGNNYVSWYQKLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLGQPKANP TVTLFPPSSEELQANKATLVCLISDFYPGAVTV AWKADGSPVKAGVETTKPSKQSNNKYAAKSY LSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPT ECS (SEQ ID NO: 437)	SEQ ID NO: 457
iPS:392522	SEQ ID NO: 426	QVQLVESGAIEVVKPGASVKVSCKASGFTFSRF AMHWVRKAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDNAVY YCARGYDVLGTGYPDYWGQGLTVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLN GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTPPVLDSDGSFFLYSKLTV DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSQSVLTQPPSVSAAPGQKVTIS CSGSSSNIGNNYVSWYQQLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLGQPKANP TVTLFPPSSEELQANKATLVCLISDFYPGAVTV AWKADGSPVKAGVETTKPSKQSNNKYAAKSY LSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPT	SEQ ID NO: 459

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
iPS:392523	SEQ ID NO: 426	ECS (SEQ ID NO: 438) QVQLVESGAIEVVKPGASVKVSCKASGFTFSRF AMHWVRKAPGQGLEWMGVISYDGGNKYYAE SVKGRVTMTRDTSTSTLYMELSSLRSEDTAVY YCARGYDVLGTGYPDYWGQGTLVTVSSASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLKSVVT VPSSSLGTQTYICNVNHKPSNTKVDKKVEPKS CDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLM ISRTPEVTCVVVDVSHEDPEVKFNWYVDGVEV HNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNL GKEYKCKVSNKALPAPIEKTISKAKGQPREPQV YTLPPSREEMTKNQVSLTCLVKGFYPSDIAVE WESNGQPENNYKTPPVLDSDGSFFLYSKLT DKSRWQQGNVFSCSVMHEALHNHYTQKSLSL SPGGGSGGGGSSQSVLTQPPSVSAAPGQKVTIS CSGSSSNIGNNYSWYQKLPGTAPKLLIYDNN KRPSGIPDRFSGSKSGTSTTLGITGLQTGDEAD YYCGTWDSRLSAVVFGGGTKLTVLGQPKANP TVTLFPPSSEELQANKATLVCLISDFYPGAVTV AWKADGSPVKAGVETTKPSKQSNKYYAAKSY LSLTPEQWKSHRSYSCQVTHEGSTVEKTVAPT ECS (SEQ ID NO: 439)	SEQ ID NO: 458
<i>Anti-CGRP Receptor IgG x Anti-PAC1 Receptor Fab</i>			
iPS:392524	QSVLTQPPSVSAA PGQKVTISCSGSS SNIGNNYSWYQ QLPGTAPKLLIYD NNKRPSGIPDRFS GSKSGTSTTLGIT GLQTGDEADYYC GTWDSRLSAVVF GGGTKLTVLGQP KANPTVTLFPPSS EELQANKATLVC LISDFYPGAVTVA WKADGSPVKAG VETTKPSKQSN KYAAKSYLSLTP EQWKSHRSYSCQ VTHEGSTVEKTV APTECS (SEQ ID NO: 275)	QVQLVESGGGVVQPGRLRLSCAASGFTFSSF GMHWVRQAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDNKNTLFLQMNSLRAEDTAVYY CARDRLNYYDSSGYYHYKYYGMAVWGQGT TVVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLF PPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFN WYVDGVEVHNAKTKPCEEQYGSTYRCVSVLT VLHQDWLNGKEYKCKVSNKALPAPIEKTISKA KGQPREPQVYTLPPSREEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPENNYKTPPVLDSDGSF FLYSKLTVDKSRWQQGNVFSCSVMHEALHNH YTQKSLSLSPGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQQKPGKAPK LLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQ EDFATYYCHQSSRLPFTFGPGTKVDIKRASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLESVVT VPSSSLGTQTYICNVNHKPSNTKVDKKV (SEQ ID NO: 440)	QVQLVESGAIEVVKP GASVKVSCKASGFT FSRFAMHWVRQAP GQGLEWMGVISYD GGNKYYAESVKGR VTMTTRDTSTSTLYM ELSSLRSEDTAVYYC ARGYDVLGTGYPDY WGQGTLVTVSSSTA APSVFIFPPSDEQLKS GTASVVCLLNNFYP REAKVQWKVDNAL QSGNSQESVTEQDS KDSTYSLKSTLTLSK ADYEKHKVYACEV THQGLSSPVTKSFNR GEC (SEQ ID NO: 460)
iPS:392525	SEQ ID NO: 275	QVQLVESGGGVVQPGRLRLSCAASGFTFSSF GMHWVRQAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDNKNTLFLQMNSLRAEDTAVYY CARDRLNYYDSSGYYHYKYYGMAVWGQGT TVVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHKPSNTK	QVQLVESGAIEVVKP GASVKVSCKASGFT FSRFAMHWVRKAP GQGLEWMGVISYD GGNKYYAESVKGR VTMTTRDTSTSTLYM ELSSLRSEDTAVYYC

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
		VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLMISRTPEVTCVVDVSHEDPEVKFNWYVDGVEVHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFLYSKLTVDKSRWQQGNVFCFSVMHEALHNHYTQKSLSLSPGSGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQEKPGKAPKLLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQPEDFATYYCHQSSRLPFTFGPGTKVDIKRASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLESVVT VPSSSLGTQTYICNVNHNKPSNTKVDKKV (SEQ ID NO: 441)	ARGYDVLTYGPDYWGQGLTVTSSTVAAPSVFIFPPSDEQLKSGTASVVCLLNNFYPREAKVQWKVDNALQSGNSQESVTEQDSKDYSTYLSKSTLTLSKADYEEKHKVYACEVTHQGLSSPVTKSFNRGEC (SEQ ID NO: 461)
iPS:392526	SEQ ID NO: 275	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVRQAPGKGLEWVAVISFDGSIKYSVDSVKGRFTISRDNKNTLFLQMNSLRAEDTAVYYCARDRLNYYESSGYYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLESVVTVPSSSLGTQTYICNVNHNKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLMISRTPEVTCVVDVSHEDPEVKFNWYVDGVEVHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFLYSKLTVDKSRWQQGNVFCFSVMHEALHNHYTQKSLSLSPGSGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQKPGKAPKLLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQPEDFATYYCHQSSRLPFTFGPGTKVDIKRASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLESVVT VPSSSLGTQTYICNVNHNKPSNTKVDKKV (SEQ ID NO: 442)	SEQ ID NO: 460
iPS:392527	SEQ ID NO: 275	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVRQAPGKGLEWVAVISFDGSIKYSVDSVKGRFTISRDNKNTLFLQMNSLRAEDTAVYYCARDRLNYYESSGYYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLESVVTVPSSSLGTQTYICNVNHNKPSNTKVDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLFPPKPKDTLMISRTPEVTCVVDVSHEDPEVKFNWYVDGVEVHNAKTKPCEEQYGSTYRCVSVLTVLHQDWLNGKEYKCKVSNKALPAPIEKTISKAKGQPREPQVYTLPPSREEMTKNQVSLTCLVKGFYPSDIAVEWESNGQPENNYKTTPPVLDSDGSFLYSKLTVDKSRWQQGNVFCFSVMHEALHNHYTQKSLSLSPGSGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQEKPGKAPK	SEQ ID NO: 461

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
		LLIKYASQSLSGVPSRFSGSGSGTEFTLTISSLQP EDFATYYCHQSSRLPFTFGPGTKVDIKRASTKG PSVFPLAPSSKSTSGGTAALGCLVKDYFPEPVT VSWNSGALTSGVHTFPAVLQSSGLYSLESVVT VPSSSLGTQTYICNVNHNKPSNTKVDKKV (SEQ ID NO: 443)	
iPS:392528	SEQ ID NO: 275	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVRQAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDNKNTLFLQMNSLRAEDTAVYY CARDRLNYYDSSGYYHYKYYGMAVWGQGT TVVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHNKPSNTK VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLF PPKPKDTLMISRTPEVTCVVDVSHEDPEVKFN WYVDGVEVHNAKTKPCEEQYGSTYRCVSVLT VLHQDWLNGKEYKCKVSNKALPAPIEKTISKA KGQPREPQVYTLPPSREEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPENNYKTTPPVLDSDGSF FLYSKLTVDKSRWQQGNVFCFSVMHEALHNH YTQKSLSLSPGGGGSGGGGSDIQLTQSPSFLSA SVGDRVITITCRASQSIGRSLHWYQQKPGKAPK LLIKYASQSLSGVPSRFSGSGSGTEFTLTISSLQP EDFATYYCHQSSRLPFTFGPGTKVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLNNFYPREAKV QWKVDNALQSGNSQESVTEQDSKDSTYSLEST LTLISKADYEKHKVYACEVTHQGLSSPVTKSFN RGEC (SEQ ID NO: 444)	QVQLVESGAEEVVKP GASVKVSCKASGFT FSRFAMHWVRQAP GQGLEWMGVISYD GGNKYYAESVKGR VTMTRDTSTSTLYM ELSSLRSEDVAVYYC ARGYDVLVTGYPDY WGQGLTVTVSSAST KGPSVFPLAPSSKST SGGTAALGCLVKDY FPEPVTVSWNSGAL TSGVHTFPAVLQSSG LYSLKSVVTVPSSSL GTQTYICNVNHNKPS NTKVDKKV (SEQ ID NO: 462)
iPS:392529	SEQ ID NO: 275	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVRQAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDNKNTLFLQMNSLRAEDTAVYY CARDRLNYYDSSGYYHYKYYGMAVWGQGT TVVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHNKPSNTK VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLF PPKPKDTLMISRTPEVTCVVDVSHEDPEVKFN WYVDGVEVHNAKTKPCEEQYGSTYRCVSVLT VLHQDWLNGKEYKCKVSNKALPAPIEKTISKA KGQPREPQVYTLPPSREEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPENNYKTTPPVLDSDGSF FLYSKLTVDKSRWQQGNVFCFSVMHEALHNH YTQKSLSLSPGGGGSGGGGSDIQLTQSPSFLSA SVGDRVITITCRASQSIGRSLHWYQEKPGKAPK LLIKYASQSLSGVPSRFSGSGSGTEFTLTISSLQP EDFATYYCHQSSRLPFTFGPGTKVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLNNFYPREAKV QWKVDNALQSGNSQESVTEQDSKDSTYSLEST LTLISKADYEKHKVYACEVTHQGLSSPVTKSFN RGEC (SEQ ID NO: 445)	QVQLVESGAEEVVKP GASVKVSCKASGFT FSRFAMHWVRKAP GQGLEWMGVISYD GGNKYYAESVKGR VTMTRDTSTSTLYM ELSSLRSEDVAVYYC ARGYDVLVTGYPDY WGQGLTVTVSSAST KGPSVFPLAPSSKST SGGTAALGCLVKDY FPEPVTVSWNSGAL TSGVHTFPAVLQSSG LYSLKSVVTVPSSSL GTQTYICNVNHNKPS NTKVDKKV (SEQ ID NO: 463)
iPS:392532	SEQ ID NO: 275	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVRQAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDNKNTLFLQMNSLRAEDTAVYY	SEQ ID NO: 462

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
		CARDRLNYYESSGYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLF PPKPKDTLMISRTPEVTCVVDVSHEDPEVKFN WYVDGVEVHNAKTKPCEEQYGSTYRCVSVLT VLHQDWLNGKEYKCKVSNKALPAPIEKTISKA KGQPREPQVYTLPPSREEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPENNYKTTPVLDSGDSF FLYSKLTVDKSRWQQGNVFSCSVMHEALHNH YTQKSLSLSPGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQQKPGKAPK LLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQ EDFATYYCHQSSRLPFTFGPGTKVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLNNFYPREAKV QWKVDNALQSGNSQESVTEQDSKDSTYSLEST LTLISKADYEKHKVYACEVTHQGLSSPVTKSFN RGEC (SEQ ID NO: 446)	
iPS:392533	SEQ ID NO: 275	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVRQAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDNSKNTLFLQMNSLRAEDTAVYY CARDRLNYYESSGYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLF PPKPKDTLMISRTPEVTCVVDVSHEDPEVKFN WYVDGVEVHNAKTKPCEEQYGSTYRCVSVLT VLHQDWLNGKEYKCKVSNKALPAPIEKTISKA KGQPREPQVYTLPPSREEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPENNYKTTPVLDSGDSF FLYSKLTVDKSRWQQGNVFSCSVMHEALHNH YTQKSLSLSPGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQEKPGKAPK LLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQ EDFATYYCHQSSRLPFTFGPGTKVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLNNFYPREAKV QWKVDNALQSGNSQESVTEQDSKDSTYSLEST LTLISKADYEKHKVYACEVTHQGLSSPVTKSFN RGEC (SEQ ID NO: 447)	SEQ ID NO: 463
iPS:392530	QSVLTQPPSVSAA PGQKVTISCSGSS SNIGNNYVSWYQ KLPGTAPKLLIYD NNKRPSGIPDRFS GSKSGTSTTLGIT GLQTGDEADYYC GTWDSRLSAVVF GGGKTLTVLGQP KANPTVTFLPPSS EELQANKATLVC LISDFYPGAVTVA	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVREAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDNSKNTLFLQMNSLRAEDTAVYY CARDRLNYYDSSGYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLF PPKPKDTLMISRTPEVTCVVDVSHEDPEVKFN WYVDGVEVHNAKTKPCEEQYGSTYRCVSVLT VLHQDWLNGKEYKCKVSNKALPAPIEKTISKA KGQPREPQVYTLPPSREEMTKNQVSLTCLVKG	SEQ ID NO: 462

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
	WKADGSPVKAG VETTKPSKQSN KYAAKSYLSLTP EQWKSHRSYSCQ VTHEGSTVEKTV APTECS (SEQ ID NO: 427)	FYPSDIAVEWESNGQPENNYKTPPVLDSDGSF FLYSKLTVDKSRWQQGNVFSCSVMHEALHNH YTQKSLSLSPGGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQQKPGKAPK LLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQ EDFATYYCHQSSRLPFTFGPGTKVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLNNFYPREAKV QWKVDNALQSGNSQESVTEQDSKSTYSLEST LTLSKADYEKHKVYACEVTHQGLSSPVTKSFN RGEC (SEQ ID NO: 448)	
iPS:392531	SEQ ID NO: 427	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVREAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDN SKNTLFLQMNSLRAEDTAVYY CARDRLNYYDSSGYYHYKYYGMAVWGQGT TVVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLF PPKPKDTLMISRTPEVTCVVDVSHEDPEVKFN WYVDGVEVHNAKTKPCEEQYGSTYRCVSVLT VLHQDWLNGKEYKCKVSNKALPAPIEKTISKA KGQPREPQVYTLPPSREEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPENNYKTPPVLDSDGSF FLYSKLTVDKSRWQQGNVFSCSVMHEALHNH YTQKSLSLSPGGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQEKPGKAPK LLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQ EDFATYYCHQSSRLPFTFGPGTKVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLNNFYPREAKV QWKVDNALQSGNSQESVTEQDSKSTYSLEST LTLSKADYEKHKVYACEVTHQGLSSPVTKSFN RGEC (SEQ ID NO: 449)	SEQ ID NO: 463
iPS:392534	SEQ ID NO: 427	QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVREAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDN SKNTLFLQMNSLRAEDTAVYY CARDRLNYYESSGYYHYKYYGMAVWGQGT TVVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLF PPKPKDTLMISRTPEVTCVVDVSHEDPEVKFN WYVDGVEVHNAKTKPCEEQYGSTYRCVSVLT VLHQDWLNGKEYKCKVSNKALPAPIEKTISKA KGQPREPQVYTLPPSREEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPENNYKTPPVLDSDGSF FLYSKLTVDKSRWQQGNVFSCSVMHEALHNH YTQKSLSLSPGGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQQKPGKAPK LLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQ EDFATYYCHQSSRLPFTFGPGTKVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLNNFYPREAKV QWKVDNALQSGNSQESVTEQDSKSTYSLEST LTLSKADYEKHKVYACEVTHQGLSSPVTKSFN	SEQ ID NO: 462

IgG-Fab Molecule Designation	Light Chain Amino Acid Sequence	Modified Heavy Chain Amino Acid Sequence	Second Polypeptide Amino Acid Sequence
iPS:392535	SEQ ID NO: 427	RGEC (SEQ ID NO: 450) QVQLVESGGGVVQPGRSLRLSCAASGFTFSSF GMHWVREAPGKGLEWVAVISFDGSIKYSVDS VKGRFTISRDNSKNTLFLQMNSLRAEDTAVYY CARDRLNYYESSGYYHYKYYGMAVWGQGT VTVSSASTKGPSVFPLAPSSKSTSGGTAALGCL VKDYFPEPVTVSWNSGALTSGVHTFPAVLQSS GLYSLESVVTVPSSSLGTQTYICNVNHKPSNTK VDKKVEPKSCDKTHTCPPCPAPELLGGPSVFLF PPKPKDTLMISRTPEVTCVVVDVSHEDPEVKFN WYVDGVEVHNAKTKPCEEQYGSTYRCVSVLT VLHQDWLNGKEYKCKVSNKALPAPIEKTISKA KGQPREPQVYTLPPSREEMTKNQVSLTCLVKG FYPSDIAVEWESNGQPENNYKTPPVLDSDGSF FLYSKLTVDKSRWQQGNVFCFSVMHEALHNH YTQKSLSLSPGGGSGGGGSDIQLTQSPSFLSA SVGDRVTITCRASQSIGRSLHWYQEKGPKAPK LLIKYASQSLSGVPSRFSGSGSGTEFTLTISLQP EDFATYYCHQSSRLPFTFGPGTKVDIKRTVAAP SVFIFPPSDEQLKSGTASVVCLLNNFYPREAKV QWKVDNALQSGNSQESVTEQDSKDSSTYSLEST LTLSKADYEKHKVYACEVTHQGLSSPVTKSFN RGEC (SEQ ID NO: 451)	SEQ ID NO: 463

[0146] In certain embodiments, the first antibody (i.e. the IgG component) of the IgG-Fab bispecific antigen binding proteins is an anti-PAC1 receptor antibody and the second antibody (i.e. from which the carboxyl-terminal Fab is derived) is an anti-CGRP receptor antibody. In such embodiments, the anti-PAC1 receptor antibody comprises a VL region from any of those described in Table 1A and a VH region from any of those described in Table 1B. For instance, in one embodiment, the anti-PAC1 receptor antibody from which the IgG component is derived comprises a LV-04 (SEQ ID NO: 31) VL region and a HV-03 (SEQ ID NO: 85) VH region.

[0147] In embodiments in which the carboxyl-terminal Fab component is derived from an anti-CGRP receptor antibody, the anti-CGRP receptor antibody may comprise a VL region from any of those described in Table 3A and a VH region from any of those described in Table 3B. In one embodiment, the anti-CGRP receptor Fab comprises a LV-105 (SEQ ID NO: 140) VL region and a HV-105 (SEQ ID NO: 194) VH region. In another embodiment, the anti-CGRP receptor Fab comprises a LV-105 (SEQ ID NO: 140) VL region and a HV-107 (SEQ ID NO: 196) VH region.

[0148] In embodiments in which the IgG component of the bispecific antigen binding proteins is derived from an anti-PAC1 receptor antibody and the carboxyl-terminal Fab component is

derived from an anti-CGRP receptor antibody, the modified heavy chain of the bispecific antigen binding proteins comprises a sequence selected from SEQ ID NOs: 428 to 439. In related embodiments, the light chain of the bispecific antigen binding proteins comprises the sequence of SEQ ID NO: 214 or SEQ ID NO: 426 and the second polypeptide (which contains the other half of the carboxyl-terminal Fab fragment) comprises a sequence selected from SEQ ID NOs: 452 to 459. In some embodiments, the bispecific, multivalent antigen binding protein comprises a light chain, a modified heavy chain, and a second polypeptide, wherein:

(a) the light chain comprises the sequence of SEQ ID NO: 214, the modified heavy chain comprises the sequence of SEQ ID NO: 428, and the second polypeptide comprises the sequence of SEQ ID NO: 452;

(b) the light chain comprises the sequence of SEQ ID NO: 214, the modified heavy chain comprises the sequence of SEQ ID NO: 429, and the second polypeptide comprises the sequence of SEQ ID NO: 453;

(c) the light chain comprises the sequence of SEQ ID NO: 214, the modified heavy chain comprises the sequence of SEQ ID NO: 430, and the second polypeptide comprises the sequence of SEQ ID NO: 454;

(d) the light chain comprises the sequence of SEQ ID NO: 214, the modified heavy chain comprises the sequence of SEQ ID NO: 431, and the second polypeptide comprises the sequence of SEQ ID NO: 455;

(e) the light chain comprises the sequence of SEQ ID NO: 214, the modified heavy chain comprises the sequence of SEQ ID NO: 432, and the second polypeptide comprises the sequence of SEQ ID NO: 456;

(f) the light chain comprises the sequence of SEQ ID NO: 214, the modified heavy chain comprises the sequence of SEQ ID NO: 433, and the second polypeptide comprises the sequence of SEQ ID NO: 457;

(g) the light chain comprises the sequence of SEQ ID NO: 214, the modified heavy chain comprises the sequence of SEQ ID NO: 434, and the second polypeptide comprises the sequence of SEQ ID NO: 458;

(h) the light chain comprises the sequence of SEQ ID NO: 214, the modified heavy chain comprises the sequence of SEQ ID NO: 435, and the second polypeptide comprises the sequence of SEQ ID NO: 459;

(i) the light chain comprises the sequence of SEQ ID NO: 426, the modified heavy chain comprises the sequence of SEQ ID NO: 436, and the second polypeptide comprises the sequence of SEQ ID NO: 456;

(j) the light chain comprises the sequence of SEQ ID NO: 426, the modified heavy chain comprises the sequence of SEQ ID NO: 437, and the second polypeptide comprises the sequence of SEQ ID NO: 457;

(k) the light chain comprises the sequence of SEQ ID NO: 426, the modified heavy chain comprises the sequence of SEQ ID NO: 438, and the second polypeptide comprises the sequence of SEQ ID NO: 459; or

(l) the light chain comprises the sequence of SEQ ID NO: 426, the modified heavy chain comprises the sequence of SEQ ID NO: 439, and the second polypeptide comprises the sequence of SEQ ID NO: 458. In certain embodiments, the bispecific, multivalent antigen binding protein is an antigen binding protein designated as iPS:392513, iPS:392514, iPS:392475, iPS:392519, iPS:392515, iPS:392516, iPS:392521, iPS:392520, iPS:392517, iPS:392518, iPS:392522, or iPS:392523 as set forth in Table 10.

[0149] In other embodiments of the invention, the first antibody (i.e. the IgG component) of the IgG-Fab bispecific antigen binding proteins is an anti-CGRP receptor antibody and the second antibody (i.e. from which the carboxyl-terminal Fab is derived) is an anti-PAC1 receptor antibody. In such embodiments, the anti-CGRP receptor antibody comprises a VL region from any of those described in Table 3A and a VH region from any of those described in Table 3B. For example, in one embodiment, the anti-CGRP receptor antibody from which the IgG component is derived comprises a LV-105 (SEQ ID NO: 140) VL region and a HV-105 (SEQ ID NO: 194) VH region. In another embodiment, the anti-CGRP receptor antibody from which the IgG component is derived comprises a LV-105 (SEQ ID NO: 140) VL region and a HV-107 (SEQ ID NO: 196) VH region. In embodiments in which the carboxyl-terminal Fab component is derived from an anti-PAC1 receptor antibody, the anti-PAC1 receptor antibody may comprise a VL region from any of those described in Table 1A and a VH region from any of those described in Table 1B. In one embodiment, the anti-PAC1 receptor Fab comprises a LV-04 (SEQ ID NO: 31) VL region and a HV-03 (SEQ ID NO: 85) VH region.

[0150] In embodiments in which the IgG component of the bispecific antigen binding proteins is derived from an anti-CGRP receptor antibody and the carboxyl-terminal Fab component is

derived from an anti-PAC1 receptor antibody, the modified heavy chain of the bispecific antigen binding proteins comprises a sequence selected from SEQ ID NOs: 440 to 451. In related embodiments, the light chain of the bispecific antigen binding proteins comprises the sequence of SEQ ID NO: 275 or SEQ ID NO: 427 and the second polypeptide (which contains the other half of the carboxyl-terminal Fab fragment) comprises a sequence selected from SEQ ID NOs: 460 to 463. In some embodiments, the bispecific, multivalent antigen binding protein comprises a light chain, a modified heavy chain, and a second polypeptide, wherein:

(a) the light chain comprises the sequence of SEQ ID NO: 275, the modified heavy chain comprises the sequence of SEQ ID NO: 440, and the second polypeptide comprises the sequence of SEQ ID NO: 460;

(b) the light chain comprises the sequence of SEQ ID NO: 275, the modified heavy chain comprises the sequence of SEQ ID NO: 441, and the second polypeptide comprises the sequence of SEQ ID NO: 461;

(c) the light chain comprises the sequence of SEQ ID NO: 275, the modified heavy chain comprises the sequence of SEQ ID NO: 442, and the second polypeptide comprises the sequence of SEQ ID NO: 460;

(d) the light chain comprises the sequence of SEQ ID NO: 275, the modified heavy chain comprises the sequence of SEQ ID NO: 443, and the second polypeptide comprises the sequence of SEQ ID NO: 461;

(e) the light chain comprises the sequence of SEQ ID NO: 275, the modified heavy chain comprises the sequence of SEQ ID NO: 444, and the second polypeptide comprises the sequence of SEQ ID NO: 462;

(f) the light chain comprises the sequence of SEQ ID NO: 275, the modified heavy chain comprises the sequence of SEQ ID NO: 445, and the second polypeptide comprises the sequence of SEQ ID NO: 463;

(g) the light chain comprises the sequence of SEQ ID NO: 275, the modified heavy chain comprises the sequence of SEQ ID NO: 446, and the second polypeptide comprises the sequence of SEQ ID NO: 462;

(h) the light chain comprises the sequence of SEQ ID NO: 275, the modified heavy chain comprises the sequence of SEQ ID NO: 447, and the second polypeptide comprises the sequence of SEQ ID NO: 463;

(i) the light chain comprises the sequence of SEQ ID NO: 427, the modified heavy chain comprises the sequence of SEQ ID NO: 448, and the second polypeptide comprises the sequence of SEQ ID NO: 462;

(j) the light chain comprises the sequence of SEQ ID NO: 427, the modified heavy chain comprises the sequence of SEQ ID NO: 449, and the second polypeptide comprises the sequence of SEQ ID NO: 463;

(k) the light chain comprises the sequence of SEQ ID NO: 427, the modified heavy chain comprises the sequence of SEQ ID NO: 450, and the second polypeptide comprises the sequence of SEQ ID NO: 462; or

(l) the light chain comprises the sequence of SEQ ID NO: 427, the modified heavy chain comprises the sequence of SEQ ID NO: 451, and the second polypeptide comprises the sequence of SEQ ID NO: 463. In certain embodiments, the bispecific, multivalent antigen binding protein is an antigen binding protein designated as iPS:392524, iPS:392525, iPS:392526, iPS:392527, iPS:392528, iPS:392529, iPS:392532, iPS:392533, iPS:392530, iPS:392531, iPS:392534, or iPS:392535 as set forth in Table 10. In other embodiments, the bispecific, multivalent antigen binding protein is an antigen binding protein designated as iPS:392524, iPS:392525, iPS:392526, iPS:392527, iPS:392532, iPS:392533, iPS:392534, or iPS:392535 as set forth in Table 10.

[0151] The heavy chain constant regions or the Fc regions of the bispecific antigen binding proteins described herein may comprise one or more amino acid substitutions that affect the glycosylation and/or effector function of the antigen binding protein. One of the functions of the Fc region of an immunoglobulin is to communicate to the immune system when the immunoglobulin binds its target. This is commonly referred to as “effector function.”

Communication leads to antibody-dependent cellular cytotoxicity (ADCC), antibody-dependent cellular phagocytosis (ADCP), and/or complement dependent cytotoxicity (CDC). ADCC and ADCP are mediated through the binding of the Fc region to Fc receptors on the surface of cells of the immune system. CDC is mediated through the binding of the Fc with proteins of the complement system, e.g., C1q. In some embodiments, the bispecific antigen binding proteins of the invention comprise one or more amino acid substitutions in the constant region to enhance effector function, including ADCC activity, CDC activity, ADCP activity, and/or the clearance or half-life of the antigen binding protein. Exemplary amino acid substitutions (EU numbering) that can enhance effector function include, but are not limited to, E233L, L234I, L234Y, L235S,

G236A, S239D, F243L, F243V, P247I, D280H, K290S, K290E, K290N, K290Y, R292P, E294L, Y296W, S298A, S298D, S298V, S298G, S298T, T299A, Y300L, V305I, Q311M, K326A, K326E, K326W, A330S, A330L, A330M, A330F, I332E, D333A, E333S, E333A, K334A, K334V, A339D, A339Q, P396L, or combinations of any of the foregoing.

[0152] In other embodiments, the bispecific antigen binding proteins of the invention comprise one or more amino acid substitutions in the constant region to reduce effector function.

Exemplary amino acid substitutions (EU numbering) that can reduce effector function include, but are not limited to, C220S, C226S, C229S, E233P, L234A, L234V, V234A, L234F, L235A, L235E, G237A, P238S, S267E, H268Q, N297A, N297G, V309L, E318A, L328F, A330S, A331S, P331S or combinations of any of the foregoing.

[0153] Glycosylation can contribute to the effector function of antibodies, particularly IgG1 antibodies. Thus, in some embodiments, the bispecific antigen binding proteins of the invention may comprise one or more amino acid substitutions that affect the level or type of glycosylation of the binding proteins. Glycosylation of polypeptides is typically either N-linked or O-linked. N-linked refers to the attachment of the carbohydrate moiety to the side chain of an asparagine residue. The tri-peptide sequences asparagine-X-serine and asparagine-X-threonine, where X is any amino acid except proline, are the recognition sequences for enzymatic attachment of the carbohydrate moiety to the asparagine side chain. Thus, the presence of either of these tri-peptide sequences in a polypeptide creates a potential glycosylation site. O-linked glycosylation refers to the attachment of one of the sugars N-acetylgalactosamine, galactose, or xylose, to a hydroxyamino acid, most commonly serine or threonine, although 5-hydroxyproline or 5-hydroxylysine may also be used.

[0154] In certain embodiments, glycosylation of the bispecific antigen binding proteins described herein is increased by adding one or more glycosylation sites, e.g., to the Fc region of the binding protein. Addition of glycosylation sites to the antigen binding protein can be conveniently accomplished by altering the amino acid sequence such that it contains one or more of the above-described tri-peptide sequences (for N-linked glycosylation sites). The alteration may also be made by the addition of, or substitution by, one or more serine or threonine residues to the starting sequence (for O-linked glycosylation sites). For ease, the antigen binding protein amino acid sequence may be altered through changes at the DNA level, particularly by mutating

the DNA encoding the target polypeptide at preselected bases such that codons are generated that will translate into the desired amino acids.

[0155] The invention also encompasses production of bispecific antigen binding protein molecules with altered carbohydrate structure resulting in altered effector activity, including antigen binding proteins with absent or reduced fucosylation that exhibit improved ADCC activity. Various methods are known in the art to reduce or eliminate fucosylation. For example, ADCC effector activity is mediated by binding of the antibody molecule to the FcγRIII receptor, which has been shown to be dependent on the carbohydrate structure of the N-linked glycosylation at the N297 residue of the CH2 domain. Non-fucosylated antibodies bind this receptor with increased affinity and trigger FcγRIII-mediated effector functions more efficiently than native, fucosylated antibodies. For example, recombinant production of non-fucosylated antibody in CHO cells in which the alpha-1,6-fucosyl transferase enzyme has been knocked out results in antibody with 100-fold increased ADCC activity (*see Yamane-Ohnuki et al.*, *Biotechnol Bioeng.* 87(5):614-22, 2004). Similar effects can be accomplished through decreasing the activity of alpha-1,6-fucosyl transferase enzyme or other enzymes in the fucosylation pathway, e.g., through siRNA or antisense RNA treatment, engineering cell lines to knockout the enzyme(s), or culturing with selective glycosylation inhibitors (*see Rothman et al.*, *Mol Immunol.* 26(12):1113-23, 1989). Some host cell strains, e.g. Lec13 or rat hybridoma YB2/0 cell line naturally produce antibodies with lower fucosylation levels (*see Shields et al.*, *J Biol Chem.* 277(30):26733-40, 2002 and Shinkawa *et al.*, *J Biol Chem.* 278(5):3466-73, 2003). An increase in the level of bisected carbohydrate, e.g. through recombinantly producing antibody in cells that overexpress GnTIII enzyme, has also been determined to increase ADCC activity (*see Umana et al.*, *Nat Biotechnol.* 17(2):176-80, 1999).

[0156] In other embodiments, glycosylation of the bispecific antigen binding proteins described herein is decreased or eliminated by removing one or more glycosylation sites, e.g., from the Fc region of the binding protein. Amino acid substitutions that eliminate or alter N-linked glycosylation sites can reduce or eliminate N-linked glycosylation of the antigen binding protein. In certain embodiments, the bispecific antigen binding proteins described herein comprise a mutation at position N297 (EU numbering), such as N297Q, N297A, or N297G. In one particular embodiment, the bispecific antigen binding proteins of the invention comprise a Fc region from a human IgG1 antibody with a N297G mutation. To improve the stability of

molecules comprising a N297 mutation, the Fc region of the molecules may be further engineered. For instance, in some embodiments, one or more amino acids in the Fc region are substituted with cysteine to promote disulfide bond formation in the dimeric state. Residues corresponding to V259, A287, R292, V302, L306, V323, or I332 (EU numbering) of an IgG1 Fc region may thus be substituted with cysteine. Preferably, specific pairs of residues are substituted with cysteine such that they preferentially form a disulfide bond with each other, thus limiting or preventing disulfide bond scrambling. Preferred pairs include, but are not limited to, A287C and L306C, V259C and L306C, R292C and V302C, and V323C and I332C. In particular embodiments, the bispecific antigen binding proteins described herein comprise a Fc region from a human IgG1 antibody with mutations at R292C and V302C. In such embodiments, the Fc region may also comprise a N297G mutation.

[0157] Modifications of the bispecific antigen binding proteins of the invention to increase serum half-life also may be desirable, for example, by incorporation of or addition of a salvage receptor binding epitope (e.g., by mutation of the appropriate region or by incorporating the epitope into a peptide tag that is then fused to the antigen binding protein at either end or in the middle, e.g., by DNA or peptide synthesis; *see, e.g.*, WO96/32478) or adding molecules such as PEG or other water soluble polymers, including polysaccharide polymers. The salvage receptor binding epitope preferably constitutes a region wherein any one or more amino acid residues from one or two loops of a Fc region are transferred to an analogous position in the antigen binding protein. Even more preferably, three or more residues from one or two loops of the Fc region are transferred. Still more preferred, the epitope is taken from the CH2 domain of the Fc region (e.g., an IgG Fc region) and transferred to the CH1, CH3, or VH region, or more than one such region, of the antigen binding protein. Alternatively, the epitope is taken from the CH2 domain of the Fc region and transferred to the CL region or VL region, or both, of the antigen binding protein. *See* International applications WO 97/34631 and WO 96/32478 for a description of Fc variants and their interaction with the salvage receptor.

[0158] The present invention includes one or more isolated nucleic acids encoding the bispecific antigen binding proteins and components thereof described herein. Nucleic acid molecules of the invention include DNA and RNA in both single-stranded and double-stranded form, as well as the corresponding complementary sequences. DNA includes, for example, cDNA, genomic DNA, chemically synthesized DNA, DNA amplified by PCR, and combinations thereof. The

nucleic acid molecules of the invention include full-length genes or cDNA molecules as well as a combination of fragments thereof. The nucleic acids of the invention are preferentially derived from human sources, but the invention includes those derived from non-human species, as well.

[0159] Relevant amino acid sequences from an immunoglobulin or region thereof (e.g. variable region, Fc region, etc.) or polypeptide of interest may be determined by direct protein sequencing, and suitable encoding nucleotide sequences can be designed according to a universal codon table. Alternatively, genomic or cDNA encoding monoclonal antibodies from which the binding domains of the bispecific antigen binding proteins of the invention may be derived can be isolated and sequenced from cells producing such antibodies using conventional procedures (e.g., by using oligonucleotide probes that are capable of binding specifically to genes encoding the heavy and light chains of the monoclonal antibodies).

[0160] An “isolated nucleic acid,” which is used interchangeably herein with “isolated polynucleotide,” is a nucleic acid that has been separated from adjacent genetic sequences present in the genome of the organism from which the nucleic acid was isolated, in the case of nucleic acids isolated from naturally- occurring sources. In the case of nucleic acids synthesized enzymatically from a template or chemically, such as PCR products, cDNA molecules, or oligonucleotides for example, it is understood that the nucleic acids resulting from such processes are isolated nucleic acids. An isolated nucleic acid molecule refers to a nucleic acid molecule in the form of a separate fragment or as a component of a larger nucleic acid construct. In one preferred embodiment, the nucleic acids are substantially free from contaminating endogenous material. The nucleic acid molecule has preferably been derived from DNA or RNA isolated at least once in substantially pure form and in a quantity or concentration enabling identification, manipulation, and recovery of its component nucleotide sequences by standard biochemical methods (such as those outlined in Sambrook *et al.*, Molecular Cloning: A Laboratory Manual, 2nd ed., Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1989)). Such sequences are preferably provided and/or constructed in the form of an open reading frame uninterrupted by internal non-translated sequences, or introns, that are typically present in eukaryotic genes. Sequences of non-translated DNA can be present 5' or 3' from an open reading frame, where the same do not interfere with manipulation or expression of the coding region. Unless specified otherwise, the left-hand end of any single-stranded polynucleotide sequence discussed herein is the 5' end; the left-hand direction of double-stranded polynucleotide

sequences is referred to as the 5' direction. The direction of 5' to 3' production of nascent RNA transcripts is referred to as the transcription direction; sequence regions on the DNA strand having the same sequence as the RNA transcript that are 5' to the 5' end of the RNA transcript are referred to as "upstream sequences;" sequence regions on the DNA strand having the same sequence as the RNA transcript that are 3' to the 3' end of the RNA transcript are referred to as "downstream sequences."

[0161] The present invention also includes nucleic acids that hybridize under moderately stringent conditions, and more preferably highly stringent conditions, to nucleic acids encoding polypeptides as described herein. The basic parameters affecting the choice of hybridization conditions and guidance for devising suitable conditions are set forth by Sambrook,, Fritsch, and Maniatis (1989, *Molecular Cloning: A Laboratory Manual*, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., chapters 9 and 11; and *Current Protocols in Molecular Biology*, 1995, Ausubel et al., eds., John Wiley & Sons, Inc., sections 2.10 and 6.3-6.4), and can be readily determined by those having ordinary skill in the art based on, for example, the length and/or base composition of the DNA. One way of achieving moderately stringent conditions involves the use of a prewashing solution containing 5 x SSC, 0.5% SDS, 1.0 mM EDTA (pH 8.0), hybridization buffer of about 50% formamide, 6 x SSC, and a hybridization temperature of about 55°C (or other similar hybridization solutions, such as one containing about 50% formamide, with a hybridization temperature of about 42°C), and washing conditions of about 60°C, in 0.5 x SSC, 0.1% SDS. Generally, highly stringent conditions are defined as hybridization conditions as above, but with washing at approximately 68°C, 0.2 x SSC, 0.1% SDS. SSPE (1 x SSPE is 0.15M NaCl, 10 mM NaH₂PO₄, and 1.25 mM EDTA, pH 7.4) can be substituted for SSC (1 x SSC is 0.15M NaCl and 15 mM sodium citrate) in the hybridization and wash buffers; washes are performed for 15 minutes after hybridization is complete. It should be understood that the wash temperature and wash salt concentration can be adjusted as necessary to achieve a desired degree of stringency by applying the basic principles that govern hybridization reactions and duplex stability, as known to those skilled in the art and described further below (*see, e.g., Sambrook et al., 1989*). When hybridizing a nucleic acid to a target nucleic acid of unknown sequence, the hybrid length is assumed to be that of the hybridizing nucleic acid. When nucleic acids of known sequence are hybridized, the hybrid length can be determined by aligning the sequences of the nucleic acids and identifying the region or regions of optimal sequence

complementarity. The hybridization temperature for hybrids anticipated to be less than 50 base pairs in length should be 5 to 10°C less than the melting temperature (T_m) of the hybrid, where T_m is determined according to the following equations. For hybrids less than 18 base pairs in length, $T_m (^{\circ}\text{C}) = 2(\# \text{ of A + T bases}) + 4(\# \text{ of G + C bases})$. For hybrids above 18 base pairs in length, $T_m (^{\circ}\text{C}) = 81.5 + 16.6(\log_{10} [\text{Na}^+]) + 0.41(\% \text{ G + C}) - (600/\text{N})$, where N is the number of bases in the hybrid, and $[\text{Na}^+]$ is the concentration of sodium ions in the hybridization buffer ($[\text{Na}^+]$ for 1 x SSC = 0.165M). Preferably, each such hybridizing nucleic acid has a length that is at least 15 nucleotides (or more preferably at least 18 nucleotides, or at least 20 nucleotides, or at least 25 nucleotides, or at least 30 nucleotides, or at least 40 nucleotides, or most preferably at least 50 nucleotides), or at least 25% (more preferably at least 50%, or at least 60%, or at least 70%, and most preferably at least 80%) of the length of the nucleic acid of the present invention to which it hybridizes, and has at least 60% sequence identity (more preferably at least 70%, at least 75%, at least 80%, at least 81%, at least 82%, at least 83%, at least 84%, at least 85%, at least 86%, at least 87%, at least 88%, at least 89%, at least 90%, at least 91%, at least 92%, at least 93%, at least 94%, at least 95%, at least 96%, at least 97%, at least 98%, or at least 99%, and most preferably at least 99.5%) with the nucleic acid of the present invention to which it hybridizes, where sequence identity is determined by comparing the sequences of the hybridizing nucleic acids when aligned so as to maximize overlap and identity while minimizing sequence gaps as described in more detail above.

[0162] Variants of the antigen binding proteins described herein can be prepared by site-specific mutagenesis of nucleotides in the DNA encoding the polypeptide, using cassette or PCR mutagenesis or other techniques well known in the art, to produce DNA encoding the variant, and thereafter expressing the recombinant DNA in cell culture as outlined herein. However, antigen binding proteins comprising variant CDRs having up to about 100-150 residues may be prepared by *in vitro* synthesis using established techniques. The variants typically exhibit the same qualitative biological activity as the naturally occurring analogue, e.g., binding to antigen. Such variants include, for example, deletions and/or insertions and/or substitutions of residues within the amino acid sequences of the antigen binding proteins. Any combination of deletion, insertion, and substitution is made to arrive at the final construct, provided that the final construct possesses the desired characteristics. The amino acid changes also may alter post-translational processes of the antigen binding protein, such as changing the number or position of

glycosylation sites. In certain embodiments, antigen binding protein variants are prepared with the intent to modify those amino acid residues which are directly involved in epitope binding. In other embodiments, modification of residues which are not directly involved in epitope binding or residues not involved in epitope binding in any way, is desirable, for purposes discussed herein. Mutagenesis within any of the CDR regions and/or framework regions is contemplated. Covariance analysis techniques can be employed by the skilled artisan to design useful modifications in the amino acid sequence of the antigen binding protein. *See, e.g.,* Choulrier, *et al.*, *Proteins* 41:475-484, 2000; Demarest *et al.*, *J. Mol. Biol.* 335:41-48, 2004; Hugo *et al.*, *Protein Engineering* 16(5):381-86, 2003; Aurora *et al.*, US Patent Publication No. 2008/0318207 A1; Glaser *et al.*, US Patent Publication No. 2009/0048122 A1; Urech *et al.*, WO 2008/110348 A1; Borrás *et al.*, WO 2009/000099 A2. Such modifications determined by covariance analysis can improve potency, pharmacokinetic, pharmacodynamic, and/or manufacturability characteristics of an antigen binding protein.

[0163] Table 11 shows exemplary nucleic acid sequences encoding light and heavy chain variable regions of anti-PAC1 receptor antibodies, and Table 12 shows exemplary nucleic acid sequences encoding light and heavy chain variable regions of anti-CGRP receptor antibodies. Polynucleotides encoding the anti-PAC1 receptor and anti-CGRP receptor variable regions can be used to construct the anti-PAC1 receptor and anti-CGRP receptor binding domains, respectively, of the bispecific antigen binding proteins described herein.

Table 11. Exemplary Anti-PAC1 Receptor Variable Region Nucleic Acid Sequences

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
<i>Light chain variable regions</i>			
01A, 01C, 01D	LV-01	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAG GAGACAGAATCACCATCACTTGCCGGGCAAGTCAGAGCATTAGCA GGTATTTAAATTGGTATCAACAGAAACCAGGGAAAGCCCCTAAAC TCCTGATCTATGCTGCATCCAGTTTGCAAAGTGGGATCCCATCAAG GTTTCAGCGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAAC AGTCTGCAACCTGAAGATTTTGCAACTTACTTCTGTCAACAGAGTT ACAGTCCCCCATTCACTTTCGGCCCTGGGACCAAAGTGGATATCAA ACGT	464
01B	LV-02	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAG GAGACAGAATCACCATCACTTGCCGGGCAAGTCAGAGCATTAGCA GGTATTTAAATTGGTATCAACAGAAACCAGGGAAAGCCCCTAAAC TCCTGATCTATGCTGCATCCAGTTTGCAAAGTGGGATCCCATCAAG GTTTCAGCGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAAC AGTCTGCAACCTGAAGATTTTGCAACTTACTTCTGTCAACAGAGTT	465

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		ACAGTCCCCCATTCACTTTCGGCGAGGGGACCAAAGTGGATATCA AACGT	
02A, 02C	LV-03	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAG GAGACAGAATCACCATCACTTGCCGGGCAAGTCAGAGCATTAGCA GGTATTTAAATTGGTATCAACAGAAACCAGGGAAAGCCCCCTAAAC TCCTGATCTATGCTGCATCCAGTTTGCAAAGTGGGATCCCATCAAG GTTCAGCGGCAGTGGATCTGGGACAGATTTCACTCTCACCATCAAC AGTCTGCAACCTGAAGATTTTGCAACTTACTTCTGTCAACAGAGTT ACAGTCCCCCATTCACTTTCGGCCAGGGGACCAAAGTGGATATCA AACGT	466
03A, 03C, 03D	LV-04	GATATCCAGCTCACTCAATCGCCATCATTTCTCTCCGCTTCGGTAG GCGACCGGGTCACGATCACATGCAGGGCGTCGCAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGGAAAGGCCCGAAAC TTCTGATCAAATACGCATCACAAAGCTTGAGCGGTGTGCCGTCGC GCTTCTCCGTTCCGGAAGCGGAACGGAATTCACGCTTACAATCTC CTCACTGCAGCCCGAGGATTTGCGGACCTATTACTGTCACCAGTCA TCCAGACTCCCGTTTACTTTTGGCCCTGGGACCAAGGTGGACATTA AGCGT	467
03B	LV-05	GATATCCAGCTCACTCAATCGCCATCATTTCTCTCCGCTTCGGTAG GCGACCGGGTCACGATCACATGCAGGGCGTCGCAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGGAAAGGCCCGAAAC TTCTGATCAAATACGCATCACAAAGCTTGAGCGGTGTGCCGTCGC GCTTCTCCGTTCCGGAAGCGGAACGGAATTCACGCTTACAATCTC CTCACTGCAGCCCGAGGATTTGCGGACCTATTACTGTCACCAGTCA TCCAGACTCCCGTTTACTTTTGGCGAGGGGACCAAGGTGGACATTA AGCGT	468
04A, 04C, 04D	LV-06	GAGATCGTACTTACTCAGTCACCCGCCACATTGTCCCTGAGCCCGG GTGAACGGGGCGACCCTCAGCTGCCGAGCATCCCAGTCCGTCGGAC GATCATTGCACTGGTACCAACAAAAACCGGGCCAGGCCCCCAGAC TTCTGATCAAGTATGCGTCACAGAGCTTGTCGGGTATTCCCGCTCG CTTTTCGGGGTCGGGATCCGGGACAGATTTACGCTCACAATCTCC TCGCTGGAACCCGAGGACTTCGCGGTCTACTATTGTCATCAGTCAT CGAGGTTGCCTTTCACGTTTGGACCAGGGACCAAGGTGGACATTA AGCGT	469
04B	LV-07	GAGATCGTACTTACTCAGTCACCCGCCACATTGTCCCTGAGCCCGG GTGAACGGGGCGACCCTCAGCTGCCGAGCATCCCAGTCCGTCGGAC GATCATTGCACTGGTACCAACAAAAACCGGGCCAGGCCCCCAGAC TTCTGATCAAGTATGCGTCACAGAGCTTGTCGGGTATTCCCGCTCG CTTTTCGGGGTCGGGATCCGGGACAGATTTACGCTCACAATCTCC TCGCTGGAACCCGAGGACTTCGCGGTCTACTATTGTCATCAGTCAT CGAGGTTGCCTTTCACGTTTGGAGAAGGGACCAAGGTGGACATTA AGCGT	470
05A, 05C, 05D	LV-08	GACATCGTGATGACCCAGTCTCCAGACTCCCTGGCTGTGTCTCTGG GCGAGAGGGCCACCATCCACTGCAAGTCCAGCCAGAGTGTTTTAT ACAGCTCCAACAATAAGAACTTCTTAACTTGGTACCAGCAGAAAC CAGGACAGCCTCCTAAACTTCTCATTTACCGGGCATCTACCCGGGA ATCCGGGGTTCCTGACCGATTCACTGGCAGCGGGTCTGGGACAGA TTCACTCTCACCATCAGCAGCCTGCAGGCTGAAGATGTGGCAGTT TATTTCTGTCAAGCAATATTATAGTGCTCCATTCACTTTCGGCCCTGG GACCAGAGTGGATATCAAACGT	471
05B	LV-09	GACATCGTGATGACCCAGTCTCCAGACTCCCTGGCTGTGTCTCTGG GCGAGAGGGCCACCATCCACTGCAAGTCCAGCCAGAGTGTTTTAT	472

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		ACAGTCCAACAATAAGAAGTCTTAACTTGGTACCAGCAGAAAC CAGGACAGCCTCCTAAACTTCTCATTTACCGGGCATCTACCCGGA ATCCGGGGTTCCTGACCGATTTCAGTGGCAGCGGGTCTGGGACAGA TTTCACTCTCACCATCAGCAGCCTGCAGGCTGAAGATGTGGCAGTT TATTTCTGTCAGCAATATTATAGTGCTCCATTCACTTTCGGCGAGG GGACCAGAGTGGATATCAAACGT	
06A, 06C	LV-10	GACATCGTGATGACCCAGTCTCCAGACTCCCTGGCTGTGTCTCTGG GCGAGAGGGCCACCATCAACTGCAAGTCCAGCCAGAGTGTTTTAT ACAGTCCAACAATAAGAAGTCTTAACTTGGTACCAGCAGAAAC CAGGACAGCCTCCTAAACTTCTCATTTACCGGGCATCTACCCGGA ATCCGGGGTTCCTGACCGATTTCAGTGGCAGCGGGTCTGGGACAGA TTTCACTCTCACCATCAGCAGCCTGCAGGCTGAAGATGTGGCAGTT TATTTCTGTCAGCAATATTATAGTGCTCCATTCACTTTCGGCCCTGG GACCAGAGTGGATATCAAACGT	473
06B	LV-11	GACATCGTGATGACCCAGTCTCCAGACTCCCTGGCTGTGTCTCTGG GCGAGAGGGCCACCATCAACTGCAAGTCCAGCCAGAGTGTTTTAT ACAGTCCAACAATAAGAAGTCTTAACTTGGTACCAGCAGAAAC CAGGACAGCCTCCTAAACTTCTCATTTACCGGGCATCTACCCGGA ATCCGGGGTTCCTGACCGATTTCAGTGGCAGCGGGTCTGGGACAGA TTTCACTCTCACCATCAGCAGCCTGCAGGCTGAAGATGTGGCAGTT TATTTCTGTCAGCAATATTATAGTGCTCCATTCACTTTCGGCGAGG GGACCAGAGTGGATATCAAACGT	474
07	LV-12	GAAATTGTGCTGACTCAGTCTCCAGACTTTCAGTCTGTGACTCCAA AGGAGAAAGTCACCATCACCTGCCGGGCCAGTCAGAGCATTGGTA GTAGCTTACACTGGTACCAGCAGAAACCAGATCAGTCTCCAAAGC TCCTCATCAAGTATGCTTCCCAGTCCTTGTGAGGGATCCCTCGAG GTTTAGTGGCAGTGGATCTGGGACACATTTACCCCTCACCATCAAT AGCCTGGAAGCTGAAGATGCTGCAACGTATTACTGTATCAGAGT AGTCGTTTACCATTCACTTTCGGCCCTGGGACCAAAGTGGATATCA AACGAAC	475
08, 09, 10	LV-13	GAAATTGTGCTGACTCAGTCTCCAGACTTTCAGTCTGTGACTCCAA AGGAGAAAGTCACCATCACCTGCCGGGCCAGTCAGAGCGTTGGTC GTAGTTTACACTGGTACCATCAGAAACCAGATCAGTCTCCAAAGC TCCTCATCAAGTATGCTTCCCAGTCCTTATCAGGGGTCCCTCGAG GTTCACTGGCAGTGGATCTGGGACAGATTTACCCCTCATTATCAAT AGCCTGGAAGCTGAAGATGCTGCAACGTATTACTGTATCAGAGT AGTCGTTTACCATTCACTTTCGGCCCTGGGACCAAAGTGGATATCA AACGAA	476
11	LV-14	GATATCCAGCTCACTCAATCGCCATCATTTCTCTCCGCTTCGGTAG GCGACCGGGTCACGATCACATGCAGGGCGTCGAAAGCATTGGGA GGTCGTTGCATTGGTATCACCAGAAACCCGGAAGGCCCGAAAC TTCTGATCAAATACGCATCACAAAGCTTGAGCGGTGTGCCGTCGC GCTTCTCCGGTTCGGAAGCGGAACGGAATTCACGCTTATCATCTC CTCACTGCAGCCCGAGGATTTGCGGACCTATTACTGTACCCAGTCA TCCAGACTCCCGTTTACTTTTGGCCCTGGGACCAAAGTGGACATTA AGCGTAC	477
12, 13, 14	LV-15	GAAATTGTGCTGACTCAGTCTCCAGACTTTCAGTCTGTGACTCCAA AGGAGAAAGTCACCATCACCTGCCGGGCCAGTCAGAGCGTTGGTC GTAGTTTACACTGGTACCAGCAGAAACCAGATCAGTCTCCAAAGC TCCTCATCAAGTATGCTTCCCAGTCCTTATCAGGGGTCCCTCGAG GTTCACTGGCAGTGGATCTGGGACAGATTTACCCCTCACTATCAAT AGCCTGGAAGCTGAAGATGCTGCAACGTATTACTGTATCAGAGT	478

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		AGTCGTTTACCATTCACTTTCGGCCCTGGGACCAAAGTGGATATCA AACGAAC	
15, 16, 17, 18	LV-16	GAGATCGTACTTACTCAGTCACCCGGCACATTGTCCCTGAGCCCGG GTGAACGGGGCGACCCTCAGCTGCCGAGCATCCCAGTCCGTCGGAC GATCATTGCACTGGTACCAACAAAAACCGGGCCAGGCCCCCAGAC TTCTGATCAAGTATGCGTCACAGAGCTTGTCTGGGTATTTCCCGATCG CTTTTCGGGGTTCGGGATCCGGGACAGATTTACGCTCACAATCTCC CGACTGGAACCCGAGGACTTCGCGACCTACTATTGTTCATCAGTCAT CGAGGTTGCCTTTCACGTTTGGACAGGGGACCAAGGTGGAGATTA AGCGTA	479
19	LV-17	GAAATTGTGCTGACTCAGTCTCCAGACTTTCAGTCTGTGACTCCAA AGGAGAAAGTCACCATCACCTGCCGGGCCAGTCAGAGCATTGGTC GTAGTTTACACTGGTACCAGCAGAAACCAGATCAGTCTCCAAAGC TCCTCTTCAAGTATGCTTCCCAGTCCTTATCAGGGGTCCCTTCGAG GTTCAGTGGCAGTGGATCTGGGACAGATTTACCCCTCACAATCAAT AGCCTGGAAGCTGAAGATGCTGCAACGTATTACTGTTCATCAGAGT AGTCGTTTACCATTCACTTTCGGCCCTGGGACCAAAGTGGATATCA AACGAA	480
20	LV-18	GATATCCAGCTCACTCAATCGCCATCATTTCTCTCCGCTTCGGTAG GCGACCGGGTCACGATCACATGCAGGGCGTCGCAAAGCATTGGGA GGTCTGTTGCATTGGTATCAGCAGAAACCCGGAAAGGCCCGAAAC TTCTGTTCAAATACGCATCACAAAGCTTGAGCGGTGTGCCGTCGCG CTTCTCCGGTTCCGGAAGCGGAACGGAATTACGCTTACAATCTCC TCACTGCAGCCCGAGGATTTTCGCGACCTATTACTGTCACCAGTCAT CCAGACTCCCGTTTACTTTTGGCCCTGGGACCAAGGTGGACATTAA GCGTAC	481
21	LV-19	GAAATTGTGTTGACGCAGTCGCCAGGCACCCTGTCTTTGTCTCCAG GGGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGAGTGTTAGCA GCAGCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCA GGCTCCTCATCTATGGTGCATCCAGCAGGGCCACTGGCATCCCAG ACAGGTTCAAGTAACAGTGGGTCTGGGACAGACTTCACTCTACCA TCAGCAGACTGGAGCCTGAAGATTTTGCAGTGTATTACTGTCAGA GGTATGGTAGCTCACGGACGTTTCGGCCAAGGGACCAAGGTGGAAA TCAAACGAA	482
22	LV-20	GATATTGTGATGACTCAGTCTCCACTCTCCCTGCCCCGTCACCCCTG GAGAGCCGGCCTCCATCTCCTGCAGGTCTAGTCAGAGCCTCCTGCA TAGTAATGGATACAACCTATTTGGATTGGTACCTGCAGAAGCCAGG GCAGTCTCCACAGCTCCTGCTCTATTTGGGTCTAATCGGGCCTCC GGGGTCCCTGACAGGTTCAAGTGGCAGTGGATCAGGCACAGATTTT AACTGCAAATCAGCAGAGTGGAGGCTGAGGATGTTGGGGTTTAT TACTGCATGCAAACCTCTACAACTCCATTCATTTTCGGCCCTGGGA CCAAAGTGGATATCAAACGT	483
23	LV-21	GATATTGTGATGACTCAGTCTCCACTCTCCCTGCCCCGTCACCCCTG GAGAGCCGGCCTCCATCTCCTGCAGGTCTAGTCAGAGCCTCCTGCA TAGTAATGGATACAACCTATTTGGATTGGTACCTGCAGAAGCCAGG GCAGTCTCCACAGCTCCTGCTCTATTTGGGTCTAATCGGGCCTCC GGGGTCCCTGACAGGTTCAAGTGGCAGTGGATCAGGCACAGATTTT AACTGAAAATCAGCAGAGTGGAGGCTGAGGATGTTGGGGTTTAT TACTGCATGCAAACCTCTACAACTCCATTCATTTTCGGCCCTGGGA CCAAAGTGGATATCAAACGT	484
24	LV-22	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAG GGGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGACTGTTAGCA	485

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		GGAGCTACTTAGCCTGGTACCAGCAGAAACCTGGCCAGGCTCCCA GGCTCCTCATCTATGGTGCATCCAGCAGGGCCACTGGCATCCCAG ACAGGTTCAAGTGGCAGTGGGTCTGGGACAGACTTCACTCTACCA TCAGCAGACTGGAGCCTGAAGATTTTGCCGTGTTTTACTGTCAGCA GTTTGGTAGCTCACCGTGGACGTTTCGGCCAAGGGACCAAGGTGGA AATCAAACGT	
25	LV-23	GACATCGTGATGACCCAGTCTCCAGACTCCCTGGCTGTGTCTCTGG GCGAGAGGGGCCACCATCCATTGCAAGTCCAGCCAGAATGTTTTAT ACAGTCCAACAATAAGAACTTCTTAACCTGGTACCAGCAGAAAC CAGGACAGCCCCCTAAACTGCTCATTTACCGGGCATCTACCCGGG AATCCGGGGTCCCTGACCGATTCAAGTGGCAGCGGGTCTGGGACGG ATTTCACTCTCACTATCAGCAGTCTGCAGGCTGAAGATGTGGCAGT TTATTTCTGTCAGCAATATTATAGTGCTCCATTCACTTTCGGCCCTG GGACCAAAGTGGATATCAAACGTAC	486
26	LV-24	GACATCGTGATGACCCAGTCTCCAGACTCCCTGGCTGTGTCTCTGG GCGAGAGGACCACCATCAAGTGAAGTCCAGCCAGAGTGTTTTAT ACAGATCCAACAATAACAACCTTCTTAGCTTGGTACCAGCAGAAAC CAGGACAGCCTCCTAAGCTGCTCATTTATTGGGCATCTACCCGGGA ATCCGGGGTCCCTGACCGATTCAAGTGGCAGCGGGTCTGGGACAGA TTTCACTCTCACCATCAGCAGCCTGCAGGCTGAAGATGTGGCTGTT TATTTCTGTCAGCAATATTATATTCTCCGCTCACTTTCGGCGGAG GGACCAAAGTGGAGATCAAACGTA	487
27	LV-25	GACATCGTGATGACCCAGTCTCCAGACTCCCTGGCTGTGTCTCTGG GCGAGAGGGGCCACCATCAACTGCAAGTCCAGCCAGAGTGTTTTAT ACAGTTCCAACAATAAGCACTACTTAGCTTGGTACCGGCAGAAAC CAGGACAGCCTCCTAAACTGCTCATTTACAGGGCATCTACCCGGG AATCCGGGGTCCCTGACCGATTCAAGTGGCAGCGGGTCTGGGACAG ATTTCACTCTCACCATCAGCAGCCTGCAGCCTGAAGATGTGGCAGT GTATTACTGTCAGCAATATTATAGTTCTCCATTCACTTTCGGCCCTG GGACCAAAGTGGATATCAAACGTA	488
28	LV-26	GACATCGTGATGACTCAGTCTCCAGACTCCCTGGCTGTGTCTCTGG GCGAGAGGGGCCACCATCCACTGCAAGTCCAGCCAGAGTGTTTTAT ACAGTCCAACAATAGGAACTTCTTAAGTTGGTACCAGCAGAAAC CAGGACAGCCTCCTAAACTGCTCATTTACCGGGCATCTACCCGGG AATCCGGGGTCCCTGACCGATTCAAGTGGCAGCGGGTCTGGGACAG ATTTCACTCTCACCATCAGCAGCCTGCAGGCTGAAGATGTGGCAGT TTATTTCTGTCAGCAATATTATAGTGCTCCATTCACTTTCGGCCCTG GGACCACAGTGGATATCAAACGTAC	489
29	LV-27	GACATCGTGATGACCCAGTCTCCAGACTCCCTGGCTGTGTCTCTGG GCGAGAGGGGCCACCATCAACTGCAAGTCCAGCCAGAGTGTTTTAT ACAGTTCCAACAATAAGAACTACTTAGCTTGGTACCGGCAGAAAC CAGGACAGCCTCCTAAGCTGCTCATTTACAGGGCATCTACCCGGG AATCCGGGGTCCCTGACCGATTCAAGTGGCAGCGGGTCTGGGACAG ATTTCACTCTCACCATCAGCAGCCTGCAGGCTGAAGATGTGGCAGT GTATCACTGTCAGCAATATTATAGTTCTCCATTCACTTTCGGCCCT GGGACCAAAGTGGATATCAAACGTAC	490
Heavy chain variable regions			
01A, 01C, 01D, 02A, 02C	HV-01	CAGGTACAGCTGCAGCAGTCAGGTCCAGGACTGGTGAAGCCCTCG CAGACCCCTCTCACTCACCTGTGCCATCTCCGGGGACAGTGTCTTA GCAACAGTGCTACTTGGAACTGGATCAGGCAGTCCCCATCGAGAG GCCTTGAGTGGCTGGGAAGGACATATTACAGGTCCAAGTGGTCTA ATCATTATGCAGTATCTGTGAAAAGTCGAATAAACCATCAACCCCG	491

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		ACACGTCCAAGAGCCAGTTCTCCCTGCAGCTGAACTCTGTGACTCC CGAGGACACGGCTGTGTATTACTGTGCAAGAGGAACGTGGAAACA GCTATGGTTCCTTGACCACTGGGGCCAGGGAACCCCTGGTCACCGTC TCTAGT	
01B	HV-02	CAGGTACAGCTGCAGCAGTCAGGTCCAGGACTGGTGAAGCCCTCG CAGACCCCTCTCACTCACCTGTGCCATCTCCGGGGACAGTGTCTCTA GCAACAGTGCTACTTGGAACTGGATCAGGCAGTCCCCATCGAGAA AGCTTGAGTGGCTGGGAAGGACATATTACAGGTCCAAGTGGTCTA ATCATTATGCAGTATCTGTGAAAAGTCGAATAAACCATCAACCCCG ACACGTCCAAGAGCCAGTTCTCCCTGCAGCTGAACTCTGTGACTCC CGAGGACACGGCTGTGTATTACTGTGCAAGAGGAACGTGGAAACA GCTATGGTTCCTTGACCACTGGGGCCAGGGAACCCCTGGTCACCGTC TCTAGT	492
03A, 03C, 03D, 09, 13, 15	HV-03	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCCAGGA GCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCACGTTTAGCC GCTTTGCCATGCATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGG AGTGGATGGGAGTTATTAGCTATGACGGGGGCAATAAGTACTACG CCGAGTCTGTAAAGGGTCGGGTCAACAATGACACGGGACACCTCAA CCAGTACACTCTATATGGAAGTGTCTAGCCTGAGATCCGAGGACA CCGCTGTGTATTATTGCGCTAGGGGGTACGATGTATTGACGGGTTA TCCTGATTACTGGGGGCAGGGGACACTCGTAACCGTCTCTAGT	493
03B	HV-04	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCCAGGA GCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCACGTTTAGCC GCTTTGCCATGCATTGGGTGCGGCAAGCTCCCGGTCAGAAGTTGG AGTGGATGGGAGTTATTAGCTATGACGGGGGCAATAAGTACTACG CCGAGTCTGTAAAGGGTCGGGTCAACAATGACACGGGACACCTCAA CCAGTACACTCTATATGGAAGTGTCTAGCCTGAGATCCGAGGACA CCGCTGTGTATTATTGCGCTAGGGGGTACGATGTATTGACGGGTTA TCCTGATTACTGGGGGCAGGGGACACTCGTAACCGTCTCTAGT	494
04A, 04C, 04D	HV-05	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGCGACTCTCCTGTGCAGCCTCTGGATTCACCTTCAGTA GATTTGCCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATCATATGATGGAGGAAATAAATACTATG CAGAGTCCGTGAAGGGCCGGTTCACCATCTCCAGAGACAATTCCA AGAACACCCTGTATCTGCAAATGAACAGCCTGAGAGCTGAGGACA CGGCTCTGTTTTACTGTGCGAGAGGATACGATGTTTTGACTGGTTA CCCCGACTACTGGGGCCAGGGAACCCCTGGTCACCGTCTCTAGT	495
04B	HV-06	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGCGACTCTCCTGTGCAGCCTCTGGATTCACCTTCAGTA GATTTGCCATGCACTGGGTCCGCCAGGCTCCAGGCAAGAAGCTGG AGTGGGTGGCAGTTATATCATATGATGGAGGAAATAAATACTATG CAGAGTCCGTGAAGGGCCGGTTCACCATCTCCAGAGACAATTCCA AGAACACCCTGTATCTGCAAATGAACAGCCTGAGAGCTGAGGACA CGGCTCTGTTTTACTGTGCGAGAGGATACGATGTTTTGACTGGTTA CCCCGACTACTGGGGCCAGGGAACCCCTGGTCACCGTCTCTAGT	496
05A, 05C, 05D	HV-07	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGTGAAGCCTTCA CAGACCCCTGTCCCTCACCTGCACTGTCTCTGGTGGTCCATCAGCA GTGGTGGTTACTACTGGAGCTGGATCCGCCAGCACCCAGGGAAGG GCCTGGAGTGGATTGGGTACATCTATTACAGTGGGAACACCTACT ACAACCCGTCCCTCAAGAGTCGAGTTACCATATCAGGAGACACGT CTAAGAACCAGTTCTCCCTGAAGCTGAGGTCTGTGACTGCCGCGG ACACGGCCCGTGTATTACTGTACGAGAGGAGGAGCAGCTCGCGGTA	497

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		TGGACGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTAGT	
05B	HV-08	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGTGAAGCCTTCA CAGACCCCTGTCCCTCACCTGCACTGTCTCTGGTGGCTCCATCAGCA GTGGTGGTTACTACTGGAGCTGGATCCGCCAGCACCCAGGGAAGA AGCTGGAGTGGATTGGGTACATCTATTACAGTGGAACACCTACT ACAACCCGTCCCTCAAGAGTCGAGTTACCATATCAGGAGACACGT CTAAGAACCAGTTCTCCCTGAAGCTGAGGTCTGTGACTGCCGCGG ACACGGCCGTGTATTACTGTACGAGAGGAGGAGCAGCTCGCGGTA TGGACGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTAGT	498
06A, 06C	HV-09	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGTGAAGCCTTCA GAGACCCCTGTCCCTCACCTGCACTGTCTCTGGTGGCTCCATCAGCA GTGGTGGTTACTACTGGAGCTGGATCCGCCAGCCCCCAGGGAAGG GCCTGGAGTGGATTGGGTACATCTATTACAGTGGAACACCTACT ACAACCCGTCCCTCAAGAGTCGAGTTACCATATCAGTGACACGT CTAAGAACCAGTTCTCCCTGAAGCTGAGGTCTGTGACTGCCGCGG ACACGGCCGTGTATTACTGTACGAGAGGAGGAGCAGCTCGCGGTA TGGACGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTAGT	499
06B	HV-10	CAGGTGCAGCTGCAGGAGTCGGGCCCAGGACTGGTGAAGCCTTCA GAGACCCCTGTCCCTCACCTGCACTGTCTCTGGTGGCTCCATCAGCA GTGGTGGTTACTACTGGAGCTGGATCCGCCAGCCCCCAGGGAAGA AGCTGGAGTGGATTGGGTACATCTATTACAGTGGAACACCTACT ACAACCCGTCCCTCAAGAGTCGAGTTACCATATCAGTAGACACGT CTAAGAACCAGTTCTCCCTGAAGCTGAGGTCTGTGACTGCCGCGG ACACGGCCGTGTATTACTGTACGAGAGGAGGAGCAGCTCGCGGTA TGGACGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTAGT	500
07	HV-11	CAGGTGCAGTTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTCACCTTCAGTT ACTATGCCATACACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTAG AGTGGGTGGCAGTTATCTCATATGATGGAAGTAATAAATACTATG CAGACTCCGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCA AGAACACGCTGTATCTGCAAATGAACAGCCTGAGAGCTGAGGACA CGGCTGTGTATTACTGTGCGAGAGGATACGATCTTTTACTGGTTA CCCCGACTACTGGGGCCAGGGAACCCTGGTCACCGTCTCCTCAG	501
11, 14	HV-12	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGCGACTCTCCTGTGCAGCCTCTGGATTCACCTTCAGTA GATTTGCCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATCATATGATGGAGGAAATAAATACTATG CAGAGTCCGTGAAGGGCCGGTTACCATCTCCAGAGACAATTCCA AGAACACCCTGAATCTGCTAATGAACAGCCTGAGAGCTGAGGACA CGGCTCTGTTTTACTGTGCGAGAGGATACGATGTTTTGACTGGTTA CCCCGACTACTGGGGCCAGGGAACCCTGGTCACCGTCTCCTCAGC	502
08, 12	HV-13	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGCGACTCTCCTGTGCAGCCTCTGGATTCACCTTCAGTA GATTTGCCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATCATATGATGGAGGAAATAAATACTATG CAGAGTCCGTGAAGGGCCGGTTACCATCTCCAGAGACAATTCCA AGAACACCCTGAATCTGCTAATGAACAGCCTGAGAGCTGAGGACA CGGCTCTGTTTTACTGTGCGAGAGGATACGATGTTTTGACTGGTTA CCCCGACTACTGGGGCCAGGGAACCCTGGTCACCGTCTCCTCAGC	503
10	HV-14	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGCGACTCTCCTGTGCAGCCTCTGGATTCACCTTCAGTA GATTTGCCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG	504

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		AGTGGGTGGCAGTTATATCATATGATGGAGGAAATAAATACTATG CAGAGTCCGTGAAGGGCCGGTTCACCATCTCCAGAGACAATTCCA AGAACACCCTGAATCTGCTAATGGACAGCCTGAGAGCTGAGGACA CGGCTCTGTTTTACTGTGCGAGAGGATACGATGTTTTGACTGGTTA CCCCGACTACTGGGGCCAGGGAACCCTGGTCACCGTCTCCTCA	
16	HV-15	CAAGTTCAGTTGGTGCATCTGGAGCCGAAGTAAAGAAGCCAGGA GCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCACGTTTAGCC GCTTTGCCATGCATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGG AGTGGATGGGAGTTATTAGCTATGACGGGGGCAATAAGTACTACG CCGAGTCTGTTAAGGGTCGGGTCACAATGACACGGGACACCTCAA CCAGTACAGCCTATATGGAAGTGTCTAGCCTGAGATCCGAGGACA CCGCTGTGTATTATTGCGCTAGGGGGTACGATGTATTGACGGGTTA TCCTGATTACTGGGGGCAGGGGACACTCGTAACCGTCTCTAGT	505
17	HV-16	CAAGTTCAGTTGGTGCATCTGGAGCCGAAGTAAAGAAGCCAGGA GCTTCAGTGAAAGTCTCTTGTCGCCGAAGTGGATTCACGTTTAGCC GCTTTGCCATGCATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGG AGTGGATGGGAGTTATTAGCTATGACGGGGGCAATAAGTACTACG CCGAGTCTGTTAAGGGTCGGGTCACAATGACACGGGACAACTCAA AAAATACAGCCTATATGGAAGTGTCTAGCCTGAGATCCGAGGACA CCGCTGTGTATTATTGCGCTAGGGGGTACGATGTATTGACGGGTTA TCCTGATTACTGGGGGCAGGGGACACTCGTAACCGTCTCTAGT	506
18	HV-17	GAGGTGCAGCTGCTGGAGTCTGGGGGAGGCCTGGTCCAGCCTGGG GGGTCCCTGCGACTCTCCTGTGCAGCCTCTGGATTCACCTTCAGTA GATTTGCCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATCATATGATGGAGGAAATAAATACTATG CAGAGTCCGTGAAGGGCCGGTTCACCATCTCCAGAGACAATTCCA AGAACACCCTGTATCTGCAAATGAACAGCCTGAGAGCTGAGGACA CGGCTGTGTATTACTGTGCGAGAGGATACGATGTTTTGACTGGTTA CCCCGACTACTGGGGCCAGGGAACCCTGGTCACCGTCTCCTCAGC	507
19, 20	HV-18	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGCGACTCTCCTGTGCAGCCTCTGGATTCACCTTCAGTC GCTATGCCATGCACTGGGTCCGCCAGGCTTCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATCATATGATGGAAGTAATAAATACTATG CAGACTCCGTGAAGGGCCGATTACCATCTCCAGAGACAATTCCA AGAACACCCTGTATCTGCTAATGAGCAGCCTGAGAGCTGAGGACA CGGCTGTGTTTTACTGTGCGAGAGGATACGATATTTTGACTGGTTA CCCCGACTACTGGGGCCAGGGAACCCTGGTCACCGTCTCCTCA	508
21	HV-19	CAGGTTCAGCTGGTGCAGTCTGGAGCTGAGGTGAAGAAGCCTGGG GCCTCAGTGAAGGTCTCCTGCAAGGCTTCTGGTTACACCTTTACCA GCTATGGTATCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTG AGTGGATGGGATGGATCAACGCTTACAATGGTCACACAACTATG CACAGACGTTCCAGGGCAGAGTCACCATGACCACAGACACATCCA CGAGCACAGCCTACATGGAGCTGAGGAGCCTGAGATCTGACGACA CGGCCGTGTATTACTGTGCGAGGGAACTGGAACCTACGCTCCTTCTA TACTTCGGTATGGACGTCTGGGGCCAAGGGACCACGGTCCCCGT CTCTAGTG	509
22	HV-20	CAGGTTCAGCTGGTGCAGTCTGGAGCTGAGGTGAAGAAGTCTGGG GCCTCTTTGAAGGTCTCCTGCAAGGCTTCTGGTTACATTTTACCC GCTATGGTGTCAGCTGGGTGCGACAGGCCCTGGACAAGGGCTTG AGTGGATGGGATGGATCACCACTTACAATGGTAACACAACTATG CACAGAAGCTCCAGGGCAGAGTCACCATGACCATAGACACATCCA CGAGCACAGCCTACATGGAAGTGAAGAAGCCTCAGATCTGACGACA	510

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		CGGCCGTGTATTACTGTGCGAGAAGAGTGCGGTATAGTGGGGGCT ACTCGTTTGACAACTGGGGCCAGGGAACCCTGGTCACCGTCTCTA GT	
23	HV-21	CAGGTTCAGCTGGTGCAGTCTGGAGCTGAGGTGAAGAAGTCTGGG GCCTCTTTGAAGGTCTCCTGCAAGGCTTCTGGTTACATTTTACCC GCTATGGTGTGAGCTGGGTGCGACAGGCCCCTGGACAAGGGCTTG AGTGGATGGGATGGATCACCATTACAATGGTAATACAACTATG CACAGAAGCTCCAGGGCAGAGTCACCATGACCACAGACACATCCA CGAGCACAGCCTACATGGAAGTGAAGGAGCCTCAGATCTGACGACA CGGCCGTGTATTACTGTGCGAGAAGAGTGCGGTACAGTGGGGGCT ACTCGTTTGACAACTGGGGCCAGGGAACCCTGGTCACCGTCTCTA GTGC	511
24	HV-22	CAGGTGCAGCTGCAGGAGTCGGGCCCCAGGACTGGTGAAGCCTTCG GAGACCCTGTCCCTCACCTGCACTGTCTCTGGTGGCTCCATCAGTA GTTACTACTGGAGCTGGATCCGGCAGCCCGCCGGGAAGGGACTGG AATGGATTGGGCGTATCTATACCAGTGGGAGCACCAACTACAACC CCTCCCTCAAGAGTCGAGTCACCATGTCAATAGGCACGTCCAAGA ACCAAGTCTCCCTGAAGCTGAGCTCTGTGACCGCCGCGGACACGG CCGTGTATTACTGTGCGATTATTGCATCTCGTGGCTGGTACTTCGA TCTCTGGGGCCGTGGCACCCCTGGTCACCGTCTCTAGTG	512
25, 28	HV-23	CAGGTGCAGCTGCAGGAGTCGGGCCCCAGGACTGGTGAAGCCTTCA CAGACCCTGTCCCTCACCTGCACTGTCTCTGGTGGCTCCATCAGCA GTGGTGGTTACTACTGGAGCTGGATCCGCCAGCACCCAGGGAAGG GCCTGGAGTGGATTGGGTACATCTATTACAGTGGGAACACCTACT ACAACCCGTCCCTCAAGAGTCGAGTTACCATATCAGGAGACACGT CTAAGAACCAGTTCTCCCTGAAGCTGAGGTCTGTGACTGCCGCGG ACACGGCCGTGTATTACTGTGCGAGAGGAGGAGCAGCTCGCGGTA TGGACGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTAGTGC	513
26	HV-24	CAGGTACAGCTGCAGCAGTCAGGTCCAGGACTGGTGAAGCCTTCG CAGACCCTCTCACTCACCTGTGCCATCTCCGGGGACAGTGTCTCTA GCAACAGTGCTGCTTGGAAGTGGATCAGGCAGTCCCCATCGAGAG GCCTTGAGTGGCTGGGAAGGACATACTACAGGTCCAGGTGGTATA ATGATTATGCAGTATCTGTGAAAAGTCGAATAACCATCAACCCAG ACACATCCAAGAACCAGTTCTCCCTGCAGCTGAAGTCTGTGACTCC CGAGGACACGGCTGTGTATTACTGTGCAAGAGGGGTCTTTTATAG CAAAGGTGCTTTTGATATCTGGGGCCAAGGGACAATGGTCACCGT CTCTAGTG	514
27	HV-25	CAGGTGCAGCTGCAGGAGTCGGGCCCCAGGACTGGTGAAGCCTTCA CAGACCCTGTCCCTCACCTGCACTGTCTCTGGTGGCTCCATCAGCC GTGGTGGTTACTACTGGAGCTGGATCCGCCAGCACCCAGGGAAGG GCCTGGAGTGGATTGGGTACATATATTACAGTGGGAATACCTACT ACAACCCGTCCCTCAAGAGTCGAGTTATCATATCAGGAGACACGT CTAAGAACCAGCTCTCCCTGAAGCTGAGGTCTGTGACTGCCGCGG ACACGGCCGTGTATTATTGTGCGAGAGGAGGAGCAGCTCGCGGTA TGGACGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTAGTGC	515
29	HV-26	CAGGTGCAGCTGCAGGAGTCGGGCCCCAGGACTGGTGAAGCCTTCA CAGACCCTGTCCCTCACCTGCACTGTCTCTGGTGGCTCCATCAGCA GTGGTGGTTTCTACTGGAGCTGGATCCGCCAGCACCCAGGGAAGG GCCTGGAGTGGATTGGGTACATCTATTACAGTGGGAATACCTACT ACAACCCGTCCCTCAAGAGTCGAGTTATCATATCAGGAGACACGT CTAAGAACCAGTTCTCCCTGAAGCTGAGCTCTGTGACGGCCGCGG ACACGGCCGTGTATTACTGTGCGAGAGGAGGAGCAGCTCGCGGTA	516

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		TGGACGTCTGGGGCCAAGGGACCACGGTCACCGTCTCTAGTGC	

Table 12. Exemplary Anti-CGRP Receptor Variable Region Nucleic Acid Sequences

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
<i>Light chain variable regions</i>			
50A, 50C, 50D, 70	LV-101	CAGTCTGTGCTGACTCAGCCACCCTCAGCGTCTGGGACCCCCGGGC AGAGAGTCACCATCTCTTGTCTGGAAGCAGCTCCAACATCGGCA GTAATTATGTATACTGGTACCAGCAGCTCCCAGGAGCGGCCCCCA AACTCCTCATCTTTAGGAATAATCAGCGGCCCTCAGGGGTCCCTGA CCGCTTCTCTGGCTCCAAGTCTGGCACCTCAGCCTCCCTGGCCATC AGTGGGCTCCGGTCCGAGGATGAGGCTGATTATTACTGTGCAGCA TGGGATGACAGCCTGAGTGGTTGGGTGTTTCGGCGGAGGGACCAAG CTGACCGTCCTAGGT	517
50B	LV-102	CAGTCTGTGCTGACTCAGCCACCCTCAGCGTCTGGGACCCCCGGGC AGAGAGTCACCATCTCTTGTCTGGAAGCAGCTCCAACATCGGCA GTAATTATGTATACTGGTACCAGCAGCTCCCAGGAGCGGCCCCCA AACTCCTCATCTTTAGGAATAATCAGCGGCCCTCAGGGGTCCCTGA CCGCTTCTCTGGCTCCAAGTCTGGCACCTCAGCCTCCCTGGCCATC AGTGGGCTCCGGTCCGAGGATGAGGCTGATTATTACTGTGCAGCA TGGGATGACAGCCTGAGTGGTTGGGTGTTTCGGCAAGGGGACCAAG CTGACCGTCCTAGGT	518
51A, 51C, 51D	LV-103	CAGTCTGTGCTGACTCAGTCACCCTCAGCGTCTGGGACCCCCGGGC AGAGAGTCACCATCTCTTGTCTGGAAGCAGCTCCAACATCGGCA GTAATTATGTATACTGGTACCAGCAGCTCCCAGGAGCGGCCCCCA AACTCCTCATCCTTAGGAATAATCAGCGGCCCTCAGGGGTCCCTGA CCGATTCTCTGGCTCCAAGTCTGGCACCTCAGCCTCCCTGACCATC AGTGGGCTCCGGTCCGAGGATGAGGCTGACTATTATTGTGCAGCA TGGGATGACAGCCTGAGTGGTTGGGTGTTTCGGCGGAGGGACCAAG CTGACCGTCCTAGGT	519
51B	LV-104	CAGTCTGTGCTGACTCAGTCACCCTCAGCGTCTGGGACCCCCGGGC AGAGAGTCACCATCTCTTGTCTGGAAGCAGCTCCAACATCGGCA GTAATTATGTATACTGGTACCAGCAGCTCCCAGGAGCGGCCCCCA AACTCCTCATCCTTAGGAATAATCAGCGGCCCTCAGGGGTCCCTGA CCGATTCTCTGGCTCCAAGTCTGGCACCTCAGCCTCCCTGACCATC AGTGGGCTCCGGTCCGAGGATGAGGCTGACTATTATTGTGCAGCA TGGGATGACAGCCTGAGTGGTTGGGTGTTTCGGCAAGGGGACCAAG CTGACCGTCCTAGGT	520
52A, 52C, 52D, 53A, 53C	LV-105	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGAC AGAAGGTCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGA ATAATTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCCA AACTCCTCATTTATGACAATAATAAGCGACCCTCAGGGATTCTGA CCGATTCTCTGGCTCCAAGTCTGGCACGTCAACCACCCTGGGCATC ACCGGACTCCAGACTGGGGACGAGGCCGATTATTACTGCGGAACA TGGGATAGCCGCTGAGTGTGTGGTTTTTCGGCGGAGGGACCAAG CTGACCGTCCTAGGT	521
52B, 53B	LV-106	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGAC AGAAGGTCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGA ATAATTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCCA	522

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		AACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCTGA CCGATTCTCTGGCTCCAAGTCTGGCACGTCAACCACCCTGGGCATC ACCGGACTCCAGACTGGGGACGAGGCCGATTATTACTGCGGAACA TGGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCAAGGGGACCAAG CTGACCGTCCTAGGT	
54A, 54C, 56A, 56C, 71	LV-107	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGAC AGAAGGTCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGA ATAATTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCCA AACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCTGA CCGATTCTCTGGCTCCAAGTCTGGCACGTGAGCCACCCTGGGCATC ACCGGACTCCAGACTGGGGACGAGGCCGATTATTACTGCGGAACA TGGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCGGAGGGACCAAG CTGACCGTCCTAGGT	523
54B, 56B	LV-108	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGAC AGAAGGTCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGA ATAATTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCCA AACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCTGA CCGATTCTCTGGCTCCAAGTCTGGCACGTGAGCCACCCTGGGCATC ACCGGACTCCAGACTGGGGACGAGGCCGATTATTACTGCGGAACA TGGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCAAGGGGACCAAG CTGACCGTCCTAGGT	524
55A, 55C	LV-109	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGAC AGAAGGTCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGA ATAATTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCCA AACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCTGA CCGATTCTCTGGCTCCAAGTCTGGCACGTGAGCCACCCTGGCCATC ACCGGACTCCAGACTGGGGACGAGGCCGATTATTACTGCGGAACA TGGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCGGAGGGACCAAG CTGACCGTCCTAGGT	525
55B	LV-110	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGAC AGAAGGTCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGA ATAATTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCCA AACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCTGA CCGATTCTCTGGCTCCAAGTCTGGCACGTGAGCCACCCTGGCCATC ACCGGACTCCAGACTGGGGACGAGGCCGATTATTACTGCGGAACA TGGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCAAGGGGACCAAG CTGACCGTCCTAGGT	526
57A, 57C, 57D, 58A, 58C	LV-111	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAG GGGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGAGTGTTAGCA GCGGCTACTTAACCTGGTACCAGCAGAAACCTGGCCAGGCTCCCA GACTCCTCATCTATGGTGCATCCAGCAGGGCCACTGGCATCCCAG ACAGGTTCAGTGGCAGTGGGTCTGGGACGGACTTCACTCTACCA TCAGCAGACTGGAGCCTGAAGATTTTGCAGTGTATTACTGTCAGCA GTATGGTAACTCACTGAGCAGGTTTGGCCAGGGGACCAAGCTGGA AATCAAACGT	527
57B, 58B	LV-112	GAAATTGTGTTGACGCAGTCTCCAGGCACCCTGTCTTTGTCTCCAG GGGAAAGAGCCACCCTCTCCTGCAGGGCCAGTCAGAGTGTTAGCA GCGGCTACTTAACCTGGTACCAGCAGAAACCTGGCCAGGCTCCCA GACTCCTCATCTATGGTGCATCCAGCAGGGCCACTGGCATCCCAG ACAGGTTCAGTGGCAGTGGGTCTGGTACGGACTTCACTCTACCAT CAGCAGACTGGAGCCTGAAGATTTTGCAGTGTATTACTGTCAGCA GTATGGTAACTCACTGAGCAGGTTTGGCAAGGGGACCAAGCTGGA	528

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		GATCAAACGT	
59	LV-113	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGAGGCCCCAGGA CAGAAGGTCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGG AATAATTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCC AAACTCCTCATTTATGACAATAATAAGCGACCCTCAGGGATTCCTG ACCGATTCTCTGGCTCCAAGTCTGGCACGTCAGCCACCCTGGGCAT CACCGGACTCCAGACTGGGGACGAGGCCGATTATTACTGCGGAAC ATGGGATAGCCGCCTGAGTGTGTGGTTTTCGGCGGAGGGACCAA GCTGACCGTCCTA	529
60	LV-114	CAGTCTGTGCTGACTCAGCCACCCTCAGCGTCTGGGACCCCCGGGC AGAGAGTCACCATCTCTTGTCTGGAAGCAGCTCCAACATCGGCA GTAATTATGTATACTGGTACCAGCAGCTCCCAGGAGCGGCCCCCA AACTCCTCATCTTTAGGAGTAATCAGCGGCCCTCAGGGGTCCCTGA CCGATTCTCTGGCTCCAAGTCTGGCACCTCAGCCTCCCTGGCCATC AGTGGGCTCCGGTCCGAGGATGAGGCTGATTATTACTGTGCAGCA TGGGATGACAGCCTGAGTGGTTGGGTGTTTCGGCGGAGGGACCAAG CTGACCGTCCTA	530
61	LV-115	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAG GAGACAGAGTCACCATCACTTGCCGGGCAAGTCAGGGCATTAGAA ATGATTTAGGCTGGTTTCAGCAGAAACCAGGGAAAGCCCCAAGC GCCTGATCTATGCTGCATCCAGTTTGCAAAGTGGGGTCCCATCAAG GTTTCAGCGGCAGTGGATCTGGGACAGAATTCACTCTCACAAATCAG CAGCCTGCAGCCTGAAGATTTAGCAACTTATTACTGTCTACAGTAT AATATTTACCCGTGGACGTTTCGGCCAAGGGACCAAGGTGGAAATC AAA	531
62	LV-116	TCTTCTGAGCTGACTCAGGACCCCTACTGTGTCTGTGGCCTTGGGAC AGACAGTCAAAATCACATGCCAAGGAGACAGCCTCAGAAGTTTTT ATGCAAGCTGGTACCAGCAGAAGCCAGGACAGGCCCTGTACTTG TCTTCTATGGTAAAAACAACCGGCCCTCAGGGATCCCAGACCGAT TCTCTGGCTCCAGCTCAGGAAACACAGCTTCCTTGACCATCACTGG GGCTCAGGCGGAAGATGAGGCTGACTATTATTGTAATTCCCGGGA CAGCAGTGTTTACCATCTGGTACTCGGCGGAGGGACCAAGCTGAC CGTCCTA	532
63	LV-117	GATATTATACTGGCCAGACTCCACTTTCTCTGTCCGTCACCCCTG GACAGCCGGCCTCCATCTCCTGCAAGTCTAGTCAGAGCCTCCTGCA CAGTGCTGGAAAGACCTATTTGTATTGGTACCTGCAGAAGCCAGG CCAGCCTCCACAGCTCCTGATCTATGAAGTTTCCAACCGGTTCTCT GGAGTGCCAGATAGGTTCAGTGGCAGCGGGTCAGGGACAGATTTC ACACTGAAAATCAGCCGGGTGGAGGCTGAGGATGTTGGGATTTAT TACTGCATGCAAAGTTTTCCGCTTCCGCTCACTTTCGGCGGAGGGA CCAAGGTGGAGATCAAA	533
64	LV-118	GATATTGTGATGACTCAGTCTCCACTCTCCCTGCCCCGTCACCCCTG GAGAGCCGGCCTCCATCTCCTGCAGGTCTAGTCAGAGCCTCCTGCA TAGTTTTGGGTACAACATTTGGATTGGTACCTGCAGAAGCCAGGG CAGTCTCCACAGCTCCTGATCTATTTGGGTTCTAATCGGGCCTCCG GGGTCCCTGACAGGTTCAGTGGCAGTGGATCAGGCACAGATTTTA CACTGAAAATCAGCAGAGTGGAGGCTGAGGATGTTGGGGTTTATT ACTGCATGCAAGCTCTACAACTCCATTCATTTTCGGCCCTGGGAC CAAAGTGGATATCAAA	534
65	LV-119	GATATTATCTGACCCAGACTCCACTTTCTCTGTCCGTCACCCCTG GACAGCCGGCCTCCATCTCCTGCAAGTCTAGTCAGAGCCTCCTGCA CAGTGATGGAAAGACCTATTTGTATTGGTACCTGCAGAAGCCCGG	535

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		CCAGCCTCCACAGCTCCTGATCTATGAAGTTTCCAACCGGTTCTCTGGAGAGCCAGATAGGTTCAAGTGGCAGCGGGTCAGGGACAGATTTCACACTGAAAATCAGCCGGGTGGAGGCTGAGGATGTTGGGACTTATTATGTCATGCAAAGTTTTCCGCTTCCGCTCACTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	
66	LV-120	CAGTCTGTGTTGACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGGTCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGAATAATTATGTATCCTGGTACCAGCAGTTCCCAGGAACAGCCCCCAACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCTGACCGATTCTCTGGCTCCAAGTCTGGCACGTCAGCCACCCTGGGCATCACCGGACTCCAGACTGGGGACGAGGCCGATTATTACTGCGGAACATGGGATAGCCGCCTGAGTGCTGTGGTTTTTCGGCGGAGGGACCAAGCTGACCGTCCTA	536
67	LV-121	CAGTCTGTGCTGACTCAGCCACCCTCAGCGTCTGGGACCCCCGGGCAGAGGGTCACCATCTCTTGTCTGGAAGCAGTTCCAATATCGGAAATAACTGTGAACTGGTACCAGCAGCTCCCAGGAACGGCCCCCAAACTCCTCATCTATACTAATAATCAGCGGCCCTCAGGGGTCCCTGACCGATTCTCTGGCTCCAAGTCTGGCACCTCAGCCTCCCTGGCCATCAGTGGACTCCAGTCTGAGGATGAGGCTGATTTTTACTGTGCAGCGCGGGATGAGAGCCTGAATGGTGTGGTATTTCGGCGGAGGGACCAAGCTGACCGTCCTA	537
68	LV-122	GATATTACACTGACCCAGACTCCACTTTCTCTGTCCGTCTCCCCTGGACAGCCGGCCTCCATCTCCTGCAAGTCTAGTCAGAGCCTCCTGCA CAGTGATGGAAGGAAGTATCTGTATTGGTACCTGCAGAAGCCAGGCCAGCCTCCACAGCTCCTGATCTATGAAGTGTCCAACCGGTTCTCTGGACTGCCAGATAGGTTCAAGTGGCAGCGGGTCAGGGACAGATTTCACACTGAAAATCAGCCGGGTGGAGGCTGAGGATGTTGGGATTTATTACTGTCATGCAAAGTTTTCCGCTTCCGCTCACTTTCGGCGGAGGGACCAAGGTGGAGATCAAA	538
69	LV-123	GACATCCAGATGACCCAGTCTCCATCCTCCCTGTCTGCATCTGTAGGAGACAGAGTCACCATCACTTGCCGGGCAAGTCAGGGCATTAGAAAGGATTTAGGCTGGTATCAGCAGAAACCAGGGAAAGCCCCCTAAGCGCCTGATCTATGGAGCATCCAGTTTGCAAAGTGGGGTCCCATCAAGGTTTCAGCGGCAGTGGATCTGGGACAGAATTCCTCTCACAATCAGCAGCCTGCAGCCTGAAGATTTTGCAACTTATTACTGTCTACAGTATAATAGTTTCCCGTGGACGTTCCGCCAAGGGACCAAGGTGGAATCAAA	539
Heavy chain variable regions			
50A, 50C, 50D	HV-101	GAGGTACAGCTGGTGGAGTCTGGGGGAGGCTTGGTAAAGCCTGGGGGGTCCCTCAGACTCTCCTGTGCAGCCTCTGGATTCACTTTCGGTACGCCTGGATGAGCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGGAGTGGGTGGCCGTATTAAGCAAACTGATGGTGGGACAACAGACTACGCTGCACCCGTGAAAGGCAGATTCACCATCTCAAGAGATGATTCAAAAAACACGCTGTATCTGCAAAATGAACAGCCTGAAAACCGAGGACACAGCCGTGATTTCTGTACCACAGATCGGACCGGGTATAGCATCAGCTGGTCTAGTTACTACTACTACGGTATGGACGTCTGGGCCAAGGAACAACAGTTACCGTCTCTAGT	540
50B	HV-102	GAGGTACAGCTGGTGGAGTCTGGGGGAGGCTTGGTAAAGCCTGGGGGGTCCCTCAGACTCTCCTGTGCAGCCTCTGGATTCACTTTCGGTACGCCTGGATGAGCTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGGAGTGGGTGGCCGTATTAAGCAAACTGATGGTGGGACAACAGACTACGCTGCACCCGTGAAAGGCAGATTCACCATCTCAAGAGATG	541

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		ATTCAAAAAACACGCTGTATCTGCAAATGAACAGCCTGAAAACCG AGGACACAGCCGTGTATTTCTGTACCACAGATCGGACCGGGTATA GCATCAGCTGGTCTAGTTACTACTACTACTACGGTATGGACGTCTG GGGCCAAGGAACAACAGTTACCGTCTCTAGT	
51A, 51C, 51D	HV-103	GAGGTGCAGCTGGTGGAGTCTGGGGGAGGCTTGGTAAAGCCTGGG GGGTCCCTTAGACTCTCCTGTGCAGCCTCTGGATTCACTTTCAGTA ACGCCTGGATGAGCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGG AGTGGGTGGCCGTATTAAGCAAACTGATGGTGGGACAACAG ACTACACTGCACCCGTGAAAGGCAGATTACCATCTCAAGAGATG ATTCAAAAAACACGCTGTATCTGCAAATGAATAGCCTGAAAGCCG AGGACACAGCCGTGTATTACTGTACCACAGATCGGACCGGGTATA GCATCAGCTGGTCTAGTTACTACTACTACTACGGTATGGACGTCTG GGGCCAAGGAACAACAGTTACCGTCTCTAGT	542
51B	HV-104	GAGGTGCAGCTGGTGGAGTCTGGGGGAGGCTTGGTAAAGCCTGGG GGGTCCCTTAGACTCTCCTGTGCAGCCTCTGGATTCACTTTCAGTA ACGCCTGGATGAGCTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGG AGTGGGTGGCCGTATTAAGCAAACTGATGGTGGGACAACAG ACTACACTGCACCCGTGAAAGGCAGATTACCATCTCAAGAGATG ATTCAAAAAACACGCTGTATCTGCAAATGAATAGCCTGAAAGCCG AGGACACAGCCGTGTATTACTGTACCACAGATCGGACCGGGTATA GCATCAGCTGGTCTAGTTACTACTACTACTACGGTATGGACGTCTG GGGCCAAGGAACAACAGTTACCGTCTCTAGT	543
52A, 52C, 52D, 54A, 54C, 55A, 55C, 59, 66	HV-105	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTACCTTCAGTA GCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATCATTTGATGGAAGTATTAAGTATTCTGT AGACTCCGTGAAGGGCCGATTACCATCTCCAGAGACAATTCAAA GAACACGCTGTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACAC GGCTGTGTATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGT AGTGGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACCGTCTCTAGT	544
52B, 54B, 55B	HV-106	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTACCTTCAGTA GCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGG AGTGGGTGGCAGTTATATCATTTGATGGAAGTATTAAGTATTCTGT AGACTCCGTGAAGGGCCGATTACCATCTCCAGAGACAATTCAAA GAACACGCTGTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACAC GGCTGTGTATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGT AGTGGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACCGTCTCTAGT	545
53A, 53C, 56A, 56C	HV-107	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTACCTTCAGTA GCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATCATTTGATGGAAGTATTAAGTATTCTGT AGACTCCGTGAAGGGCCGATTACCATCTCCAGAGACAATTCAAA GAACACGCTGTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACAC GGCTGTGTATTACTGTGCGAGAGATCGGCTCAATTACTATGAGAGT AGTGGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACCGTCTCTAGT	546
53B, 56B	HV-108	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTACCTTCAGTA GCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGG	547

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		AGTGGGTGGCAGTTATATCATTTGATGGAAGTATTAAGTATTCTGT AGACTCCGTGAAGGGCCGATTACCATCTCCAGAGACAATTCAAA GAACACGCTGTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACAC GGCTGTGTATTACTGTGCGAGAGATCGGCTCAATTACTATGAGAGT AGTGGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACCGTCTCTAGT	
57A, 57C, 57D	HV-109	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTCACCTTCAGTA GCTATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATGGTATGATGGAAGTAATAAATACTATG CAGACTCCGTGAAGGGCCGATTCATCATCTCCAGAGATAAATCCA AGAACACGCTGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACA CGGCTGTGTATTACTGTGCGAGAGCGGGGGGTATAGCAGCAGCTG GCCTCTACTACTACTACGGTATGGACGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGT	548
57B	HV-110	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTCACCTTCAGTA GCTATGGCATGCACTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGG AGTGGGTGGCAGTTATATGGTATGATGGAAGTAATAAATACTATG CAGACTCCGTGAAGGGCCGATTCATCATCTCCAGAGATAAATCCA AGAACACGCTGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACA CGGCTGTGTATTACTGTGCGAGAGCGGGGGGTATAGCAGCAGCTG GCCTCTACTACTACTACGGTATGGACGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGT	549
58A, 58C	HV-111	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTCACCTTCAGTA GCTATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATGGTATGATGGAAGTAATAAATACTATG CAGAGTCCGTGAAGGGCCGATTCATCATCTCCAGAGATAAATCCA AGAACACGCTGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACA CGGCTGTGTATTACTGTGCGAGAGCGGGGGGTATAGCAGCAGCTG GCCTCTACTACTACTACGGTATGGACGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGT	550
58B	HV-112	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCGTCTGGATTCACCTTCAGTA GCTATGGCATGCACTGGGTCCGCCAGGCTCCAGGGAAGGAGCTGG AGTGGGTGGCAGTTATATGGTATGATGGAAGTAATAAATACTATG CAGAGTCCGTGAAGGGCCGATTCATCATCTCCAGAGATAAATCCA AGAACACGCTGTATCTGCAAATGAACAGCCTGAGAGCCGAGGACA CGGCTGTGTATTACTGTGCGAGAGCGGGGGGTATAGCAGCAGCTG GCCTCTACTACTACTACGGTATGGACGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGT	551
60	HV-113	GAGGTGCAGCTGGTGGAGTCTGGGGGAGGCTTGGTAAAGCCTGGG GGGTCCCTTAGACTCTCCTGTGCAGCCTCTGGATTCACCTTCAGTA ACGCCTGGATGAGCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGG AGTGGGTGGCCGTATTAAGGACAACTGATGGTGGGACAACAG ACTACGCTGCACCCGTGAAAGGCAGATTACCATCTCAAGAGATG ATTCAAAAAACACGCTGTATCTGCAAATGAACAGCCTGAAAACCG AGGACACAGCCGTGTATTACTGTACCACAGATCGGACCGGATATA GCATCAGCTGGTCTAGTTACTACTACTACTACGGTATGGACGTCTG GGGCCAAGGGACCACGGTCACCGTCTCTAGT	552

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
61	HV-114	GAGGTGCAGCTATTGGAGTCTGGGGGAGGCTTGGTACAGCCTGGG GAGTCCCTGAGACTCTCCTGTGCAGCCTCTGGGTTCACCTTTAGCA GCTATGCCATGAGCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGG AGTGGGTCTCAGCTATTAGTGGTAGTGGTGGTTCGCACATACTACGC AGACTCCGTGAAGGGCCGGTTCACCATCTCCAGAGACAATTCCAA GAACACGCTGTATCTGCAAATGAATAGCCTGAGAGCCGAGGACAC GGCCGTATATTACTGTGCGAAAGATCAAAGGGAGGTAGGGCCGTA TAGCAGTGGCTGGTACGACTACTACTACGGTATGGACGTCTGGGG CCAAGGGACCACGGTCACCGTCTCTAGT	553
62	HV-115	CAGGTGCAGTTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGG GCCTCAGTGAAGGTCTCCTGCAAGGCTTCTGGATACACCTTCACCG GCTACTATATGCACTGGGTGCGACAGGCCCCTGGACAAGGGCTTG AGTGGATGGGATGGATCAACCCTAACAGTGGTGGCACAACCTATG CACAGAAGTTTCAGGGCAGGGTCACCATGACCAGGGACACGTCCA TCAGCACAGCCTACATGGAGCTGAGCAGGCTGAGATCTGACGACA CGGCCGTGTATTTCTGTGCGAGAGATCAAATGAGTATTATTATGCT TCGGGGAGTTTTTCCCCCTTACTATTACGGTATGGACGTCTGGGGC CAAGGGACCACGGTCACCGTCTCTAGT	554
63, 65, 68	HV-116	CAGGTGCAGCTGGTGGAGTCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTACCTTCAGTA GCTATGGCATGCACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATTTTCATATGATGGAAGTCATGAATCCTATGC AGACTCCGTGAAGGGCCGATTACCATCTCCAGAGACATTTCCAA GAACACGCTGTATCTGCAAATGAACAGCCTGAGAGCTGAGGACAC GGCTGTGTATTTCTGTGCGAGAGAGAGGAAACGGGTTACGATGTC TACCTTATATTACTACTTCTACTACGGTATGGACGTCTGGGGCCAA GGGACCACGGTCACCGTCTCTAGT	555
64	HV-117	GAGGTGCAGCTGGTGGAGTCTGGGGGAGGCTTGGTAAAGCCAGGG CGGTCCCTGAGACTCTCCTGTACAGCTTCTGGATTACCTTTGGTG ATTATGCTATGAGCTGGTTCGCCAGGCTCCAGGGAAGGGGCTGG AGTGGATAGGTTTCATTAGAAGCAGAGCTTATGGTGGGACACCAG AATACGCCGCGTCTGTGAAAGGCAGATTACCATCTCAAGAGATG ATTCCAAAACCATCGCCTATCTGCAAATGAACAGCCTGAAAACCG AGGACACAGCCGTGTATTTCTGTGCTAGAGGACGGGGTATTGCAG CTCGTTGGGACTACTGGGGCCAGGGAACCCTGGTCACCGTCTCTA GT	556
67	HV-118	CAGGTGCAGCTGGTGCAGTCTGGGGCTGAGGTGAAGAAGCCTGGG GCCTCAGTGAAGGTCTCCTGCAAGGCTTCTGGATACACCTTCACCG ACTACTATATGTACTGGGTGCGACAGGCCCCTGGACAAGGGCTTG AGTGGATGGGATGGATCAGCCCTAATAGTGGTGGCACAACCTATG CCCAGAAGTTTCAGGGCAGGGTCACCATGACCAGGGACACGTCTA TCAGCACAGCCTACATGGAGCTGAGTAGGCTGAGATCTGACGACA CGGCCGTGTATTACTGTGTGAGAGGAGGATATAGTGGCTACGCTG GGCTCTACTCCCCTACTACGGTATGGACGTCTGGGGCCAAGGGA CCACGGTCACCGTCTCTAGT	557
69	HV-119	GAGGTGCAGCTGGTGGAGTCTGGGGGAGGCCTGGTCAAGCCTGGG GGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATACACCTTCAGTA CCTATAGCATGAACTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGG AGTGGGTCTCATCCATTAGTAGTAGTAGTAGTTACAGATATTACGC AGACTCAGTGAAGGGCCGATTACCATCTCCAGAGACAACGCCAA GAACTCACTGTATCTGCAAATGAGTAGCCTGAGAGCCGAGGACAC	558

Antibody ID	Designation	Nucleic Acid Sequence	SEQ ID NO:
		GGCTGTGTATTACTGTGCGAGAGAAGGGGTGTCTGGCAGTTCGCC GTATAGCATCAGCTGGTACGACTACTATTACGGTATGGACGTCTGG GGCCAAGGGACCACGGTCACCGTCTCTAGT	
70	HV-120	GAGGTACAGCTGGTGGAGTCTGGGGGAGGCTTGGTAAAGCCTGGG GGGTCCCTTAGACTCTCCTGTGCAGCCTCTGGATTCACTTTCGGTA ACGCCTGGATGAGCTGGGTCCGCCAGGCTCCAGGGAAGGGGCTGG AGTGGGTGGCCGTATTAAAAAGCAAACTGATGGTGGGACAACAG ACTACGCTGCACCCGTGAAAGGCAGATTACCATCTCAAGAGATG ATTCAAAAACACGCTGTATCTGCAAATGAACAGCCTGAAAACCG AGGACACAGCCGTGTATTACTGTACCACAGATCGGACCGGGTATA GCATCAGCTGGTCTAGTTACTACTACTACTACGGTATGGACGTCTG GGCCAAGGGACCACGGTCACCGTCTCTAGT	559
71	HV-121	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCCTGGG AGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTCACTTCAGTA GCTTTGGCATGCATTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGG AGTGGGTGGCAGTTATATCATTTGATGGAAGTATTAAGTACTCTGT AGACTCCGTGAAGGGCCGATTACCATCTCCAGAGACAATTCAA GAACACGCTGTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACAC GGCTGTGTATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGT AGTGGTTATTACTACTACAAATACTACGGTCTGGCCGTCTGGGGCC AAGGACCACGGTCACCGTCTCTAGT	560

[0164] Isolated nucleic acids encoding anti-PAC1 receptor binding domains of the bispecific antigen binding proteins of the invention may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the nucleotide sequences listed in Table 11. In some embodiments, an isolated nucleic acid encoding an anti-PAC1 receptor light chain variable region comprises a sequence selected from SEQ ID NOs: 464 to 490. In related embodiments, an isolated nucleic acid encoding an anti-PAC1 receptor heavy chain variable region comprises a sequence selected from SEQ ID NOs: 491 to 516. Isolated nucleic acids encoding anti-CGRP receptor binding domains of the bispecific antigen binding proteins of the invention may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the nucleotide sequences listed in Table 12. In some embodiments, an isolated nucleic acid encoding an anti-CGRP receptor light chain variable region comprises a sequence selected from SEQ ID NOs: 517 to 539. In related embodiments, an isolated nucleic acid encoding an anti-CGRP receptor heavy chain variable region comprises a sequence selected from SEQ ID NOs: 540 to 560.

[0165] In embodiments in which the bispecific antigen binding protein of the invention is a heterodimeric antibody, the isolated nucleic acid encoding an anti-PAC1 receptor antibody light

chain may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the nucleotide sequences listed in Table 6A. In certain embodiments, the isolated nucleic acid encoding an anti-PAC1 receptor light chain of a heterodimeric antibody of the invention comprises a sequence selected from SEQ ID NOs: 222 to 232. In these and other embodiments, the isolated nucleic acid encoding an anti-PAC1 receptor antibody heavy chain may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the nucleotide sequences listed in Table 6B. In some embodiments, the isolated nucleic acid encoding an anti-PAC1 receptor heavy chain of a heterodimeric antibody of the invention comprises a sequence selected from SEQ ID NOs: 252 to 270.

[0166] In other embodiments in which the bispecific antigen binding protein of the invention is a heterodimeric antibody, the isolated nucleic acid encoding an anti-CGRP receptor antibody light chain may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the nucleotide sequences listed in Table 7A. In certain embodiments, the isolated nucleic acid encoding an anti-CGRP receptor light chain of a heterodimeric antibody of the invention comprises a sequence selected from SEQ ID NOs: 283 to 294. In these and other embodiments, the isolated nucleic acid encoding an anti-CGRP receptor antibody heavy chain may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the nucleotide sequences listed in Table 7B. In some embodiments, the isolated nucleic acid encoding an anti-CGRP receptor heavy chain of a heterodimeric antibody of the invention comprises a sequence selected from SEQ ID NOs: 317 to 338.

[0167] Nucleic acid sequences encoding the light chains and modified heavy chains (e.g., fusion proteins comprising a heavy chain and a scFv) of exemplary bispecific antigen binding proteins of the invention in the IgG-scFv format are listed in Table 13. In such embodiments, the isolated nucleic acid encoding the light chain of the IgG-scFv molecules may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the light chain nucleotide sequences listed in Table 13. For instance, in some embodiments, the isolated nucleic acid encoding the light chain of the IgG-scFv molecules comprises a sequence selected from SEQ ID NOs: 561 to 564. In related embodiments, the isolated nucleic acid encoding the modified heavy chain of the IgG-scFv molecules may

comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the modified heavy chain nucleotide sequences listed in Table 13. In certain embodiments, the isolated nucleic acid encoding the modified heavy chain of the IgG-scFv molecules comprises a sequence selected from SEQ ID NOs: 565 to 594.

Table 13. Nucleic Acid Sequences of Exemplary Bispecific Antigen Binding Proteins in the IgG-scFv Format

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
<i>Anti-PAC1 Receptor IgG x Anti-CGRP Receptor scFv</i>		
iPS:386738	GATATCCAGCTCAC TCAATCGCCATCAT TTCTCTCCGCTTCG GTAGGCGACCGGG TCACGATCACATGC AGGGCGTCGCAAA GCATTGGGAGGTCG TTGCATTGGTATCA GCAGAAACCCGGA AAGGCCCCGAAAC TTCTGATCAAATAC GCATCACAAGCTT GAGCGGTGTGCCGT CGCGCTTCTCCGGT TCCGGAAGCGGAA CGGAATTCACGCTT ACAATCTCCTCACT GCAGCCCAGGATT TCGCGACCTATTAC TGTCACCAAGTCATC CAGACTCCCCTTTA CTTTTGGCCCTGGG ACCAAGGTGGACA TTAAGCGTACGGTG GCTGCACCATCTGT CTTCATCTTCCCGC CATCTGATGAGCAG TTGAAATCTGGAAC TGCCTCTGTTGTGT GCCTGCTGAATAAC TTCTATCCAGAGA GGCCAAAGTACAG TGAAGCTTGGATA ACGCCCTCCAATCG GGTAACTCCAGGA GAGTGTACAGAG CAGGACAGCAAGG ACAGCACCTACAGC	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCGTGGAACCTCAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTCCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAACCTCTGGGGGGACCGTCAGTCTTCTCTTCCCCCCTAAA ACCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCCCTCACCGTCCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTCAGCCTGACCTGCCTGGTC AAAGGCTTCTATCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACCTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGATCGGGAG GTGGCGGATCCAGGTGCAGCTGGTGGGAATCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCCGC CAGGCTCCAGGCAAGTGTCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
	CTCAGCAGCACCCCT GACGCTGAGCAAA GCAGACTACGAGA AACACAAAGTCTAC GCCTGCGAAGTCAC CCATCAGGGCCTGA GCTCGCCCGTCACA AAGAGCTTCAACA GGGGAGAGTGT (SEQ ID NO: 561)	CCGATTCACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGTAGTG GTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACTGTCTCTAGTGGAGGCGGAGGATCT GGTGGCGGTGGTTCTGGCGGCGGAGGCTCCCAGTCTGTGTTG ACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGGT CACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGAATAA TTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCCAA ACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCC TGACCGATTCTCTGGCTCCAAGTCTGGCACGTCAACCACCCT GGGCATCACC GGACTCCAGACTGGGGACGAGGCGGATTATT ACTGCGGAACATGGGATAGCCGCCTGAGTGTCTGTGGTTTTCG GCTGTGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 565)
iPS:386764	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGTCTGGGTAC AATGACACGGGACACCTCAACCAGTACACTGTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGTGGAACCTCAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTCTCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCCGAGCACC TGAACCTCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCATCGAGAAAACCATCTCCAAGGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCCGG AGGAGATGACCAAGAACCAGGTGACGCTGACCTGCCTGGTGC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCAGTCTGTGTTGACGCAGCCGCCCTCAGTGT CTGCGGCCCCAGGACAGAAGGTCACCATCTCCTGCTCTGGA AGCAGCTCCAACATTGGGAATAATTATGTATCCTGGTACCAG CAGCTCCCAGGAACAGCCCCCAAACTCCTCATTATGACAAT AATAAGCGACCCTCAGGGATTCTTGACCGATTCTCTGGCTCC AAGTCTGGCACGTGACCCACCCTGGGCATCACC GGACTCCA

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		GACTGGGGACGAGGCCGATTATTACTGCGGAACATGGGATA GCCGCCTGAGTGCTGTGGTTTTTCGGCGGAGGGACCAAGCTG ACCGTGCTTGGAGGCGGAGGATCTGGTGGCGGTGGTTCTGG CGGCGGAGGCTCCCAGGTGCAGCTGGTGGGAATCTGGGGGAG GCGTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAG CCTCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCC GCCAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATA TCATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAG GGCCGATTACCATCTCCAGAGACAATTCAAAGAACACGCT GTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTG TGTATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGTA GTGGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGG GCCAAGGGACAACAGTTACTGTCTCTAGT (SEQ ID NO: 566)
iPS:386762	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGTGCGGTAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGTGGAACCTCAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTCCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAACCTCTGGGGGGACCGTCAGTCTTCCTCTTCCCCCAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAGGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTACGCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTCCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCAGTCTGTGTTGACGCAGCCGCCCTCAGTGT CTGCGGCCCCAGGACAGAAGGTACCATCTCCTGCTCTGGA AGCAGCTCCAACATTGGGAATAATTATGTATCCTGGTACCAG CAGCTCCCAGGAACAGCCCCCAAACCTCATTATGACAAT AATAAGCGACCCTCAGGGATTCTTGACCGATTCTCTGGCTCC AAGTCTGGCACGTACGCCACCCTGGCCATCACCGGACTCCA GACTGGGGACGAGGCCGATTATTACTGCGGAACATGGGATA

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		GCCGCCTGAGTGCTGTGGTTTTTCGGCGGAGGGACCAAGCTG ACCGTGCTTGGAGGCGGAGGATCTGGTGGCGGTGGTTCTGG CGGCGGAGGCTCCCAGGTGCAGCTGGTGGGAATCTGGGGGAG GCGTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAG CCTCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCC GCCAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATA TCATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAG GGCCGATTACCATCTCCAGAGACAATTCAAAGAACACGCT GTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTG TGTATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGTA GTGGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGG GCCAAGGGACAACAGTTACTGTCTCTAGT (SEQ ID NO: 567)
iPS:386760	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGTCGGGTAC AATGACACGGGACACCTCAACCAGTACACTTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGTATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGTGGAACCTCAGGCGCCCT GACCAGCGCGTGCACACCTTCCCGGCTGTCTACAGTCTCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAACCTCTGGGGGGACCGTCAGTCTTCTCTTCCCCCCTCA ACCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCATCGAGAAAACCATCTCCAAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTGACCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCTCAGTGT CTGCGGCCCCAGGACAGAAGGTACCATCTCCTGCTCTGGA AGCAGTCCAACATTGGGAATAATTATGTATCCTGGTACCAG CAGCTCCCAGGAACAGCCCCCAAACCTCATTATGACAAT AATAAGCGACCCTCAGGGATTCTGACCGATTCTCTGGCTCC AAGTCTGGCACGTGAGCCACCCTGGGCATCACCGGACTCCA GACTGGGGACGAGGCCGATTATTACTGCGGAACATGGGATA GCCGCCTGAGTGCTGTGGTTTTTCGGCGGAGGGACCAAGCTG

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		ACCGTGCTTGGAGGCGGAGGATCTGGTGGCGGTGGTTCTGG CGGCGGAGGCTCCCAGGTGCAGCTGGTGGGAATCTGGGGGAG GCGTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAG CCTCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCC GCCAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATA TCATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAG GGCCGATTACCATCTCCAGAGACAATTCAAAGAACACGCT GTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTG TGTATTACTGTGCGAGAGATCGGCTCAATTACTATGAAAGTA GTGGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGG GCCAAGGGACAACAGTTACTGTCTCTAGT (SEQ ID NO: 568)
iPS:386758	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTATTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGGAACCTCAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGTGTCTACAGTCCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAATCCTGGGGGGACCGTCAGTCTTCCTCTTCCCCCAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCCCTACCGTCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCATCGAGAAAACCATCTCCAAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTGACCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCCTCTATAGCAAGTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCAGTCTGTGTTGACGCAGCCGCCCTCAGTGT CTGCGGCCCCAGGACAGAAGGTCAACATCTCCTGCTCTGGA AGCAGTCCAACATTGGGAATAATTATGTATCCTGGTACCAG CAGCTCCCAGGAACAGCCCCAACTCCTCATTTATGACAAT AATAAGCGACCCTCAGGGATTCTGACCGATTCTCTGGCTCC AAGTCTGGCACGTCAACCACCCTGGGCATCACCGGACTCCA GACTGGGGACGAGGCCGATTATTACTGCGGAACATGGGATA GCCGCCTGAGTGCTGTGGTTTTCGGCGGAGGGACCAAGCTG ACCGTGCTTGGAGGCGGAGGATCTGGTGGCGGTGGTTCTGG

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		CGGCGGAGGCTCCCAGGTGCAGCTGGTGGGAATCTGGGGGAG GCGTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAG CCTCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCC GCCAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATA TCATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAG GGCCGATTACCATCTCCAGAGACAATTCAAAGAACACGCT GTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTG TGTATTACTGTGCGAGAGATCGGCTCAATTACTATGAAAGTA GTGGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGG GCCAAGGGACAACAGTTACTGTCTCTAGT (SEQ ID NO: 569)
iPS:386756	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAAGAGCACC TCTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCGTGGAACCTCAGGCGCCCT GACCAGCGCGTGCACACCTTCCCGGCTGTCTACAGTCCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAATCCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCCCTACCGTCCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTCAGCCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCAGTCTGTGTTGACGCAGCCGCCCTCAGTGT CTGCGGCCCCAGGACAGAAGGTCACCATCTCCTGCTCTGGA AGCAGTCCAAACATTGGGAATAATTATGTATCCTGGTACCAG CAGCTCCCAGGAACAGCCCCAACTCCTCATTTATGACAAT AATAAGCGACCCTCAGGGATTCTTGACCGATTCTCTGGCTCC AAGTCTGGCACGTCAACCACCCTGGGCATCACCGGACTCCA GACTGGGGACGAGGCCGATTATTACTGCGGAACATGGGATA GCCGCCTGAGTGCTGTGGTTTTCGGCGGAGGGACCAAGCTG ACCGTGCTTGGAGGCGGAGGATCTGGTGGCGGTGGTTCTGG CGGCGGAGGCTCCCAGGTGCAGCTGGTGGGAATCTGGGGGAG

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		GCGTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAG CCTCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCC GCCAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATA TCATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAG GGCCGATTACCATCTCCAGAGACAATTCAAAGAACACGCT GTTTCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTG TGTATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGTA GTGGTTATTACTACTACAAATACTACGGTATGGCCGTCTGGG GCCAAGGGACAACAGTTACTGTCTCTAGT (SEQ ID NO: 570)
iPS:386754	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGCACAGCGGCCCTGGGCTGGCTGGTCAAGACTA CTTCCCCGAACCGGTGACGGTGTCGTGGAACCTCAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTCCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCAA ATCTTGAGCAAACTCACACATGCCACCGTGCCAGCACC TGAATCCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTGTCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTCAGCCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCAGGTGCAGCTGGTGGAATCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCCGC CAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG CCGATTACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGAAAGTAGT GGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGC CAAGGGACAACAGTTACTGTCTCTAGTGGAGGCGGAGGATC TGGTGGCGGTGGTCTGGCGGCGGAGGCTCCCAGTCTGTGTT

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		GACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGG TCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGAATA ATTATGTATCCTGGTACCAGCAGCTCCAGGAACAGCCCCCA AACTCCTCATTTATGACAATAATAAGCGACCCTCAGGGATTC CTGACCGATTCTCTGGCTCCAAGTCTGGCACGTCAACCACCC TGGGCATCACCGGACTCCAGACTGGGGACGAGGCCGATTAT TACTGCGGAACATGGGATAGCCGCCTGAGTGCTGTGGTTTC GGCGGAGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 571)
iPS:386752	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGTGGAAGTCAAGGCGCCT GACCAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTCCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCAA ATCTTGAGCAAACTCACACATGCCACCGTGCCAGCACC TGAAGTCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTGCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTGACCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCCAGGTGCAGCTGGTGAATCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTCACCTTCAGTAGCTTTGGCATGCACTGGGTCCGC CAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG CCGATTACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGTAGTG GTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACTGTCTCTAGTGGAGGCGGAGGATCT GGTGGCGGTGGTTCTGGCGGCGGAGGCTCCAGTCTGTGTTG ACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGGT

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		CACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGAATAA TTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCAA ACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCC TGACCGATTCTCTGGCTCCAAGTCTGGCACGTGAGCCACCCT GGGCATCACCGGACTCCAGACTGGGGACGAGGCCGATTATT ACTGCGGAACATGGGATAGCCGCCTGAGTGCTGTGGTTTTTCG GCGGAGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 572)
iPS:386750	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCCCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGTGAAGTCAAGGCCCCCT GACCAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTCCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCCAA ATCTTGAGCAAACTCACACATGCCACCGTGCCAGCACC TGAATCCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAAA ACCCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAGGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTCAGCCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAATAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCCAGGTGCAGCTGGTGAATCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCCGC CAGGCTCCAGGCAAGTGTCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG CCGATTCACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGTAGTG GTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACTGTCTCTAGTGAGGCGGAGGATCT GGTGGCGGTGGTTCTGGCGGCGGAGGCTCCAGTCTGTGTTG ACGAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGGT CACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGAATAA

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		TTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCAA ACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCC TGACCGATTCTCTGGCTCCAAGTCTGGCACGTGAGCCACCCT GGGCATCACCGGACTCCAGACTGGGGACGAGGCCGATTATT ACTGCGGAACATGGGATAGCCGCCTGAGTGCTGTGGTTTTTCG GCTGTGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 573)
iPS:386748	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGGAAGTCAAGGCCCT GACCAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTCTCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCAACCAGACCTACATCTGCAACGTGAATCACA AGCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAACCTCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAAA ACCAAGGACACCCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCATCGAGAAAACCATCTCCAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTGACCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCAGGTGCAGCTGGTGGAAATCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTACCTTCAGTAGCTTTGGCATGCACCTGGGTCCGC CAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG CCGATTCACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGAAAGTAGT GGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGC CAAGGGACAACAGTTACTGTCTCTAGTGGAGGCGGAGGATC TGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCCAGTCTGTGTT GACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGG TCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGAATA ATTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCCA

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		AACTCCTCATTTATGACAATAATAAGCGACCCTCAGGGATTCTGACCGATTCTCTGGCTCCAAGTCTGGCACGTCAGCCACCC TGGGCATCACCGGACTCCAGACTGGGGACGAGGCCGATTAT TACTGCGGAACATGGGATAGCCGCCTGAGTGCTGTGGTTTC GGCGGAGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 574)
iPS:386746	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGTGGAAGTCAAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTCTCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAAGTCCCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAAA ACCCAAGGACACCCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTGCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCATCGAGAAAACCATCTCCAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGG AGGAGATGACCAAGAACCAGGTGACCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCAGGTGCAGCTGGTGGAAATCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCCGC CAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG CCGATTACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGTAGTG GTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACTGTCTCTAGTGGAGGCGGAGGATCT GGTGGCGGTGGTTCTGGCGGCGGAGGCTCCAGTCTGTGTTG ACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGGT CACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGAATAA TTATGTATCCTGGTACCAGCAGCTCCAGGAACAGCCCCCAA ACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCC

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		TGACCGATTCTCTGGCTCCAAGTCTGGCACGTGAGCCACCCT GGCCATCACCGGACTCCAGACTGGGGACGAGGCCGATTATT ACTGCGGAACATGGGATAGCCGCCTGAGTGCTGTGGTTTTCG GCGGAGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 575)
iPS:386744	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCTCCACCAAG GGCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGGAAGTCAAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGTGTCTACAGTCCCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAACCTCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAAA ACCCAAGGACACCCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCATCGAGAAAACCATCTCCAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTGACCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACCTACAAGACCACGCCTCCCC TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCCAGGTGCAGCTGGTGGAAATCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTACCTTCAGTAGCTTTGGCATGCACTGGGTCCGC CAGGCTCCAGGCAAGTGTCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG CCGATTCACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGTAGTG GTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACTGTCTCTAGTGGAGGCGGAGGATCT GGTGGCGGTGGTTCTGGCGGCGGAGGCTCCAGTCTGTGTTG ACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGGT CACCATCTCCTGTCTGGAAGCAGCTCCAACATTGGGAATAA TTATGTATCCTGGTACCAGCAGCTCCAGGAACAGCCCCCAA ACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCC TGACCGATTCTCTGGCTCCAAGTCTGGCACGTGAGCCACCCT

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		GGCCATCACC GGACTCCAGACTGGGGACGAGGCCGATTATT ACTGCGGAACATGGGATAGCCGCCTGAGTGCTGTGGTTTTTCG GCTGTGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 576)
iPS:386742	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGGAAGTCAAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGTGTCTACAGTCTCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAACCTCCTGGGGGACCGTCAGTCTTCTCTTCCCCCAA ACCCAAGGACACCCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTGACGCTGACCTGCCTGGTC AAAGGCTTCTATCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGAGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCAGGTGCAGCTGGTGGAACTCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTCACCTTCAGTAGCTTTGGCATGCACTGGGTCCGC CAGGCTCCAGGCAAGTGTCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG CCGATTACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGAAAGTAGT GGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGC CAAGGGACAACAGTTACTGTCTCTAGTGGAGGCGGAGGATC TGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCAGTCTGTGTT GACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGG TCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGAATA ATTATGTATCCTGGTACCAGCAGCTCCAGGAACAGCCCCCA AACTCCTCATTTATGACAATAATAAGCGACCCTCAGGGATTC CTGACCGATTCTCTGGCTCCAAGTCTGGCACGTACGCCACCC TGGGCATCACC GGACTCCAGACTGGGGACGAGGCCGATTAT

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		TACTGCGGAACATGGGATAGCCGCTGAGTGCTGTGGTTTTTC GGCTGTGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 577)
iPS:386740	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCTCCTCCAAGAGCACC TCTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGTGGAACCTCAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGCTGTCTACAGTCTCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCCGACACC TGAACCTCTGGGGGGACCGTCAGTCTTCTCTTCCCCCAA ACCAAGGACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTCCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCCATCGAGAAAACCATCTCCAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTGACGCTGACCTGCCTGGTC AAAGGCTTCTATCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACCTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCCAGGTGCAGCTGGTGGAACTCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTCACCTTCAGTAGCTTTGGCATGCACTGGGTCCGC CAGGCTCCAGGCAAGTGTCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG CCGATTCACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGAAAGTAGT GGTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGC CAAGGGACAACAGTTACTGTCTCTAGTGAGGCGGAGGATC TGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCCAGTCTGTGTT GACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGG TCACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGAATA ATTATGTATCCTGGTACCAGCAGCTCCAGGAACAGCCCCCA AACTCCTCATTTATGACAATAATAAGCGACCCTCAGGGATTC CTGACCGATTCTCTGGCTCCAAGTCTGGCACGTCAACCACCC TGGGCATCACCGGACTCCAGACTGGGGACGAGGCCGATTAT TACTGCGGAACATGGGATAGCCGCTGAGTGCTGTGGTTTTTC

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
iPS:386736		GGCTGTGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 578)
	SEQ ID NO: 561	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCC GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCTAGTGCCTCCACCAAG GGCCCATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACC TCTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAAGGACTA CTTCCCCGAACCGGTGACGGTGTCTGTGGAACCTCAGGCGCCCT GACCAGCGGCGTGCACACCTTCCCGGTGTCTACAGTCTCTC AGGACTCTACTCCCTCAGCAGCGTGGTGACCGTGCCCTCCAG CAGCTTGGGCACCCAGACCTACATCTGCAACGTGAATCACA AGCCCAGCAACACCAAGGTGGACAAGAAAGTTGAGCCCCAA ATCTTGTGACAAAACCTCACACATGCCACCGTGCCAGCACC TGAACCTCTGGGGGGACCGTCAAGTCTTCTCTTCCCCCAA ACCAAGGACACCCCTCATGATCTCCCGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCCTGAGGTC AAGTTCAACTGGTACGTGGACGGCGTGGAGGTGCATAATGC CAAGACAAAGCCGTGTGAGGAGCAGTACGGCAGCACGTACC GTTGTGTCAGCGTCTCACCCTGCTGCACCAGGACTGGCTGA ATGGCAAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCCTC CCAGCCCCATCGAGAAAACCATCTCCAAGCCAAAGGGCA GCCCCGAGAACCACAGGTGTACACCCTGCCCCCATCCCGGG AGGAGATGACCAAGAACCAGGTGACGCTGACCTGCCTGGTC AAAGGCTTCTATCCCAGCGACATCGCCGTGGAGTGGGAGAG CAATGGGCAGCCGGAGAACAACACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGCAAGCTCA CCGTGGACAAGAGCAGGTGGCAGCAGGGGAACGTCTTCTCA TGCTCCGTGATGCATGAGGCTCTGCACAACCACTACACGCA GAAGAGCCTAAGCTTGTCTCCGGGTGGTGGCGGATCGGGAG GTGGCGGATCCCAGGTGCAGCTGGTGGGAATCTGGGGGAGGC GTGGTCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGCAGCC TCTGGATTCACCTTCAGTAGCTTTGGCATGCACTGGGTCCGC CAGGCTCCAGGCAAGGGGCTGGAGTGGGTGGCAGTTATATC ATTTGATGGAAGTATTAAGTATTCTGTAGACTCCGTGAAGGG CCGATTCACCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACGGCTGTGT ATTACTGTGCGAGAGATCGGCTCAATTACTATGATAGTAGTG GTTATTATCACTACAAATACTACGGTATGGCCGTCTGGGGCC AAGGGACAACAGTTACTGTCTCTAGTGGAGGCGGAGGATCT GGTGGCGGTGGTTCTGGCGGCGGAGGCTCCAGTCTGTGTTG ACGCAGCCGCCCTCAGTGTCTGCGGCCCCAGGACAGAAGGT CACCATCTCCTGCTCTGGAAGCAGCTCCAACATTGGGAATAA TTATGTATCCTGGTACCAGCAGCTCCCAGGAACAGCCCCAA ACTCCTCATTATGACAATAATAAGCGACCCTCAGGGATTCC TGACCGATTCTCTGGCTCCAAGTCTGGCACGTCAACCACCCT GGGCATCACCGGACTCCAGACTGGGGACGAGGCCGATTATT ACTGCGGAACATGGGATAGCCGCCTGAGTGCTGTGGTTTTCG GCGGAGGGACCAAGCTGACCGTGCTA (SEQ ID NO: 579)

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
<i>Anti-CGRP Receptor IgG x Anti-PAC1 Receptor scFv</i>		
iPS:386731	CAGTCTGTGTTGAC GCAGCCGCCCTCAG TGTCTGCGGCCCCA GGACAGAAGGTCA CCATCTCCTGCTCT GGAAGCAGCTCCA ACATTGGGAATAAT TATGTATCCTGGTA CCAGCAGCTCCAG GAACAGCCCCCAA ACTCCTCATTTATG ACAATAATAAGCG ACCCTCAGGGATTC CTGACCGATTCTCT GGCTCCAAGTCTGG CACGTCAACCACCC TGGGCATCACCGGA CTCACAGCTGGGGA CGAGGCCGATTATT ACTGCGGAACATG GGATAGCCGCCTGA GTGCTGTGGTTTTT GGCGGAGGGACCA AGCTGACCGTCCTA GGTCAGCCCAAGG CCAACCCCACTGTC ACTCTGTTCCCGCC CTCCTCTGAGGAGC TCCAAGCCAACAA GGCCACACTAGTGT GTCTGATCAGTGAC TTCTACCCGGGAGC TGTGACAGTGGCCT GGAAGGCAGATGG CAGCCCCGTCAAGG CGGGAGTGGAGAC CACCAAACCTCCA AACAGAGCAACAA CAAGTACGCGGCC AGCAGCTACCTGAG CCTGACGCCCCGAG AGTGGAAGTCCCAC AGAAGCTACAGCT GCCAGGTCACGCAT GAAGGGAGCACCG TGGAGAAGACAGT GGCCCTACAGAAT GTTCA (SEQ ID NO: 562)	CAGGTGCAGCTGGTGAATCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTGTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGAAAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGGCCATCGGTCT TCCCCCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCTCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCAGCACTGAACCTCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAACCCAAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTGACGCG TCCTCACCGTCTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTACGCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACTACAAGACCACGCCTCCCGTGTCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC GATATCCAGCTCACTCAATCGCCATCATTTCTCTCCGCTTCG GTAGGCGACCGGGTCACGATCACATGCAGGGCGTCGCAAAG CATTGGGAGGTCTGTCATTGGTATCAGCAGAAACCCGGAA AGGCCCCGAACTTCTGATCAAATACGCATCACAAGTTTG AGCGGTGTGCCGTGCGCTTCTCCGGTTCCGGAAGCGGAAC GGAGTTCACGCTTACAATCTCCTCACTGCAGCCCCGAGGATTT CGCGACCTATTACTGTACCAAGTCACTCCAGACTCCCGTTTAC TTTTGGCCCTGGGACCAAGGTGGACATTAAGCGTGGAGGCG GAGGATCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCCAA GTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCCAGG AGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTACCGTT TAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCGGTCA GGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGGGGCA ATAAGTACTACGCCGAGTCTGTAAAGGGTTCGGGTACAAATG ACACGGGACACCTCAACCAGTACACTCTATATGGAAGTGTCT AGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCGCTAG GGGGTACGATGTATTGACGGGTTATCCTGATTACTGGGGGC AGGGGACACTCGTAACCGTGTCTTCA (SEQ ID NO: 580)

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
iPS:386725	SEQ ID NO: 562	CAGGTGCAGCTGGTGGAACTCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTGTGATGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGATAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGTGTCTACAGTCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACCTCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAACCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTGACGC TCCTCACCGTCTGACACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTACGCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACTACAAGACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC GATATCCAGCTCACTCAATCGCCATCATTTCTCTCCGCTTCG GTAGGCGACCGGGTCACGATCACATGCAGGGCGTCGCAAAG CATTGGGAGGTCTGTCATTGGTATCAGCAGAAACCCGGAA AGGCCCCGAACTTCTGATCAAATACGCATCACAAGTTTG AGCGGTGTGCCGTGCGCTTCTCCGGTTCCGGAAGCGGAAC GGAGTTCACGCTTACAATCTCCTCACTGCAGCCCCGAGGATT CGCGACCTATTACTGTACCAAGTACATCCAGATCCCGTTTAC TTTTGGCCCTGGGACCAAGGTGGACATTAAGCGTGGAGGCG GAGGATCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCCAA GTTCAAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCCAGG AGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTACGTT TAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCGGTCA GGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGGGGCA ATAAGTACTACGCCGAGTCTGTAAAGGGTTCGGGTACAAATG ACACGGGACACCTCAACCAGTACACTCTATATGGAAGTGTCT AGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCGCTAG GGGGTACGATGTATTGACGGGTTATCCTGATTACTGGGGGC AGGGGACACTCGTAACCGTGTCTTCA (SEQ ID NO: 581)
iPS:386717	SEQ ID NO: 562	CAGGTGCAGCTGGTGGAACTCTGGGGGAGGCGTGGTCCAGCC

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGAAAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGGCCATCGGTCT TCCCCCTGGCACCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGAAGTCAAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGTGTCTACAGTCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACCTCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAACCCAAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTACATGCGTGGTG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTGACGC TCCTCACCGTCTTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTACGCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACACTACAAGACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCACATGCAGGGCGTCGAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGGAAGTGCCCG AACTTCTGATCAAATACGCATCACAAGTTTGAGCGGTGT GCCGTGCGCTTCTCCGGTTCCGGAAGCGGAACGGAGTTCA CGCTTACAATCTCCTCACTGCAGCCCGAGGATTCGCGACCT ATTACTGTCACCAGTCATCCAGACTCCCGTTTACTTTTGGCT GTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 582)
iPS:386715	SEQ ID NO: 562	CAGGTGCAGCTGGTGGAACTCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		CTTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGATAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCTCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTCAAGTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACCTACAAGACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTTGACGGGTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCACATGCAGGGCGTCGAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGGAAGTGCCCG AAACCTTCTGATCAAATACGCATCACAAGTTTGAGCGGTGT GCCGTGCGCTTCTCCGGTTCCGGAAGCGGAACGGAGTTCA CGCTTACAATCTCCTCACTGCAGCCCGAGGATTTGCGGACCT ATTACTGTCACCAGTCATCCAGACTCCCGTTTACTTTTGGCT GTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 583)
iPS:386707	SEQ ID NO: 562	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGAAAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCCGAGCACCTGAACCTCTGG GGGACCGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCACATGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACTACAAGACCACGCCTCCCGTGTCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCACATGCAGGGCGTCGCAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGGAAGGCCCGG AACTTCTGATCAAATACGCATCACAAGTTTGAGCGGTGT GCCGTGCGGCTTCTCCGGTTCCGGAAGCGGAACGGAGTTCA CGTTACAATCTCCTCACTGCAGCCCGAGGATTTGCGACCT ATTACTGTCACCAGTCATCCAGACTCCCGTTTACTTTTGCC CTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 584)
iPS:386705	SEQ ID NO: 562	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGATAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGAACTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCCTACAGTCCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTACATGCGTGGTGG TGGACGTGAGCCACGAAGACCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCTGTCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACATAAGACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCACATGCAGGGCGTCGAAAGCATTGGGA GGTCTGTCATTGGTATCAGCAGAAACCCGGAAGGCCCCG AAACCTTCTGATCAAATACGCATCACAAGTTTGAGCGGTGT GCCGTCGCGCTTCTCCGGTTCCGGAAGCGGAACGGAGTTCA CGCTTACAATCTCCTCACTGCAGCCCGAGGATTCGCGACCT ATTACTGTCACCAGTCATCCAGACTCCCGTTTACTTTTGCC CTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 585)
iPS:386723	CAGTCTGTGTTGAC GCAGCCGCCCTCAG TGTCTGCGGCCCA GGACAGAAGGTCA CCATCTCCTGCTCT	CAGGTGCAGCTGGTGAATCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTCACTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
	GGAAGCAGCTCCA ACATTGGAATAAT TATGTATCCTGGTA CCAGCAGCTCCCAG GAACAGCCCCCAA ACTCCTCATTTATG ACAATAATAAGCG ACCCTCAGGGATTC CTGACCGATTCTCT GGCTCCAAGTCTGG CACGTCAGCCACCC TGGGCATCACCGGA CTCCAGACTGGGGA CGAGGCCGATTATT ACTGCGGAACATG GGATAGCCGCCTGA GTGCTGTGGTTTTTC GGCGGAGGGACCA AGCTGACCGTCCTA GGTCAGCCCAAGG CCAACCCCACTGTC ACTCTGTTCCCGCC CTCCTCTGAGGAGC TCCAAGCCAACAA GGCCACACTAGTGT GTCTGATCAGTGAC TTCTACCCGGGAGC TGTGACAGTGGCCT GGAAGGCAGATGG CAGCCCCGTCAAGG CGGGAGTGGAGAC CACCAAACCTCCA AACAGAGCAACAA CAAGTACGCGGCC AGCAGCTACCTGAG CCTGACGCCCCGAGC AGTGGAAGTCCAC AGAAGCTACAGCT GCCAGGTCACGCAT GAAGGGAGCACCG TGAGAAGACAGT GGCCCTACAGAAT GTTCA (SEQ ID NO: 563)	TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGAAAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACTCCTGG GGGACCGTCAGTCTTCTCTTCCCCCAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTCAAGCG TCCTCACCGTCTGCACCAAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACATAAGACCACGCCTCCCGTGCTGGACTCC GACGGTCTCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCAGATGCAGGGCGTCGCAAGCATTTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGGAAGTGCCCG AAACTTCTGATCAAATACGCATCACAAAGTTTGAGCGGTGT GCCGTGCGGCTTCTCCGGTTCCGGAAGCGGAACGGAGTTCA CGCTTACAATCTCCTCACTGCAGCCCGAGGATTTCCGCGACCT ATTACTGTCACCAGTCATCCAGACTCCCGTTTACTTTTGGCT GTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 586)
iPS:386719	SEQ ID NO: 563	CAGGTGCAGCTGGTGGAACTCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAAATG

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGATAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAGCCCTCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACCTACAAGACCACGCCTCCCGTGCTGGACTCC GACGGTCTCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCACATGCAGGGCGTCGCAAGCAATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGAAAGTGGCCG AACTTCTGATCAAATACGCATCACAAAGTTTGAGCGGTGT GCCGTGCGCTTCTCCGGTTCCGGAAGCGGAACGGAGTTCA CGCTTACAATCTCCTCACTGCAGCCCGAGGATTTGCGACCT ATTACTGTCACCAGTCATCCAGACTCCCGTTTACTTTTGGCT GTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 587)
iPS:386713	SEQ ID NO: 563	CAGGTGCAGCTGGTGGAACTCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		GAGAGATCGGCTCAATTACTATGAAAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCCGAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTACGCG TCCTCACCGTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAGGCCCTCCAGCCCCCAT CGAGAAAACCATCTCCAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACCTACAAGACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCACATGCAGGGCGTCGAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGGAAGGCCCCG AACTTCTGATCAAATACGCATCACAAAGTTTGAGCGGTGT GCCGTGCGCCTTCTCCGGTTCCGGAAGCGGAACGGAGTTCA CGTTACAATCTCCTCACTGCAGCCCGAGGATTTGCGGACCT ATTACTGTCACCAGTCATCCAGACTCCCGTTTACTTTTGCC CTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 588)
iPS:386709	SEQ ID NO: 563	CAGGTGCAGCTGGTGGAACTCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGATAGTAGTGGTTATTATCA

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTGACGG TCCTCACCGTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAGGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTACAGCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACCTACAAGACCACGCCTCCCGTGCTGGACTCC GACGGTCTCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTTAAGGGTCGGGTAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCACATGCAGGGCGTCGAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGGAAGGCCCGG AAACCTCTGATCAAATACGCATCACAAAGTTTGAGCGGTGT GCCGTCGCGCTTCTCCGGTTCCGGAAGCGGAACGAGGTTCA CGCTTACAATCTCCTCACTGCAGCCCGAGGATTTCCGCACT ATTACTGTCACCAGTCATCCAGACTCCCGTTTACTTTTGCC CTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 589)
iPS:386727	SEQ ID NO: 563	CAGGTGCAGCTGGTGAATCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGATAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTGTCAGCG TCCTCACCGTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCAT CGAGAAAACCATCTCCAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGAGGAGATGACC AAGAACCAGGTACAGCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACCTACAAGACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC GATATCCAGCTCACTCAATCGCCATCATTTCTCTCCGCTTCG GTAGGCGACCGGGTCACGATCACATGCAGGGCGTCGAAAG CATTGGGAGGTGCTTGCATTGGTATCAGCAGAAACCCGAA AGGCCCCGAAACTTCTGATCAAATACGCATCACAAAGTTTG AGCGGTGTGCCGTGCGGCTTCTCCGTTCCGGAAGCGGAAC GGAGTTCACGTTACAATCTCCTCACTGCAGCCCAGGATTT CGCGACCTATTACTGTCAACAGTCATCCAGACTCCCGTTTAC TTTTGGCCCTGGGACCAAGGTGGACATTAAGCGTGGAGGCG GAGGATCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCCAA GTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCCAGG AGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTACGTT TAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCGGTCA GGGGTGGAGTGGATGGGAGTTATTAGCTATGACGGGGGCA ATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCACAATG ACACGGGACACCTCAACCAGTACACTCTATATGGAAGTGTCT AGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCGCTAG GGGGTACGATGTATTGACGGGTTATCCTGATTACTGGGGGC AGGGGACACTCGTAACCGTGTCTTCA (SEQ ID NO: 590)
iPS:386721	CAGTCTGTGTTGAC GCAGCCGCCCTCAG TGTCTGCGGCCCA GGACAGAAGGTCA CCATCTCCTGCTCT GGAAGCAGCTCCA ACATTGGGAATAAT TATGTATCCTGGTA CCAGCAGCTCCAG GAACAGCCCCCAA	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGATAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
	ACTCCTCATTTATG ACAATAATAAGCG ACCCTCAGGGATTC CTGACCGATTCTCT GGCTCCAAGTCTGG CACGTCAGCCACCC TGGCCATCACCGGA CTCCAGACTGGGGA CGAGGCCGATTATT ACTGCGGAACATG GGATAGCCGCCTGA GTGCTGTGGTTTTC GGCGGAGGGACCA AGCTGACCGTCCTA GGTCAGCCCAAGG CCAACCCCACTGTC ACTCTGTTCCCGCC TCCTCTGAGGAGC TCCAAGCCAACAA GGCCACACTAGTGT GTCTGATCAGTGAC TTCTACCCGGGAGC TGTGACAGTGGCCT GGAAGGCAGATGG CAGCCCCGTCAAGG CGGGAGTGGAGAC CACCAAACCCTCCA AACAGAGCAACAA CAAGTACGCGGCC AGCAGCTACCTGAG CCTGACGCCCAGC AGTGGAAGTCCAC AGAAGCTACAGCT GCCAGGTCACGCAT GAAGGGAGCACCG TGGAGAAGACAGT GGCCCTACAGAAT GTTCA (SEQ ID NO: 564)	TCCCCCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGAACTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTGACCG TCCTCACCGTCTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCATCCCCGGGAGGAGATGACC AAGAACCAGGTACGCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACCTACAAGACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCACATGCAGGGCGTCGAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGGAAAGTGCCCG AAACCTCTGATCAAATACGCATCACAAAGTTTGAGCGGTGT GCCGTGCGCTTCTCCGGTTCCGGAAGCGGAACGGAGTTCA CGCTTACAATCTCCTCACTGCAGCCCCGAGGATTTCCGCAGCT ATTACTGTCACCACTCATCCAGACTCCCGTTACTTTTGGCT GTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 591)
iPS:386711	SEQ ID NO: 564	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTCAAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTTGATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGATAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCACAG

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTGGAACCTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTCAGCG TCCTCACCGTCTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGACGC CGGAGAACAACTACAAGACCACGCCTCCCGTGTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCC AGGAGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTCA CGTTTAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCG GTCAGGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGG GGCAATAAGTACTACGCCGAGTCTGTAAAGGGTCGGGTAC AATGACACGGGACACCTCAACCAGTACACTCTATATGGAAC TGTCTAGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCG CTAGGGGGTACGATGTATTGACGGGTATCCTGATTACTGGG GGCAGGGGACACTCGTAACCGTCTCCTCAGGAGGCGGAGGA TCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCGATATCCA GCTCACTCAATCGCCATCATTCTCTCCGCTTCGGTAGGCGA CCGGGTCACGATCACATGCAGGGCGTCGAAAGCATTGGGA GGTCGTTGCATTGGTATCAGCAGAAACCCGAAAGGCCCGG AAATTCTGATCAAATACGCATCACAAAGTTTGAGCGGTGT GCCGTGCGGCTTCTCCGTTCCGGAAGCGGAACGGAGTTCA CGTTACAATCTCCTCACTGCAGCCCCGAGGATTTGCGGACCT ATTACTGTCACCAGTATCCAGACTCCCGTTACTTTTGCC CTGGGACCAAGGTGGACATTAAGCGT (SEQ ID NO: 592)
iPS:386733	SEQ ID NO: 564	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCCTGTGCAGCCTCTGGATTAC CTTCAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTGTATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGAAAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		GTGACGGTGTCTGTTGAACTCAGGCGCCCTGACCAGCGGCGT GCACACCTTCCCGGCTGTCTACAGTCCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCCACCGTGCCCGAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTCAGCG TCCTCACCGTCTGTCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTACGCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGACG CGGAGAACAACTACAAGACCACGCCTCCCGTGCCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCCTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC GATATCCAGCTCACTCAATCGCCATCATTCTCTCCGCTTCG GTAGGCGACCGGGTCACGATCACATGCAGGGCGTCGAAAG CATTGGGAGGTGCTTGCATTGGTATCAGCAGAAACCCGAA AGGCCCCGAACTTCTGATCAAATACGCATCACAAGTTTG AGCGGTGTGCCGTCGCGCTTCTCCGTTCCGGAAGCGGAAC GGAGTTCACGCTTACAATCTCCTCACTGCAGCCCCGAGGATT CGCGACCTATTACTGTCACCAGTCATCCAGACTCCCGTTTAC TTTTGGCCCTGGGACCAAGGTGGACATTAAGCGTGGAGGCG GAGGATCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCCAA GTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCCAGG AGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTACGTT TAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCGGTCA GGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGGGGCA ATAAGTACTACGCCGAGTCTGTAAAGGGTGGGTCACAATG ACACGGGACACCTCAACCAGTACACTCTATATGGAAGTGTCT AGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCGCTAG GGGGTACGATGTATTGACGGGTTATCTGATTACTGGGGGC AGGGGACACTCGTAACCGTGTCTTCA (SEQ ID NO: 593)
iPS:386729	SEQ ID NO: 564	CAGGTGCAGCTGGTGGAACTCTGGGGGAGGCGTGGTCCAGCC TGGGAGGTCCCTGAGACTCTCTGTGCAGCCTCTGGATTAC CTTAGTAGCTTTGGCATGCACTGGGTCCGCCAGGCTCCAGG CAAGGGGCTGGAGTGGGTGGCAGTTATATCATTGTATGGAA GTATTAAGTATTCTGTAGACTCCGTGAAGGGCCGATTACCA TCTCCAGAGACAATTCAAAGAACACGCTGTTTCTGCAATG AACAGCCTGCGAGCCGAGGACACGGCTGTGTATTACTGTGC GAGAGATCGGCTCAATTACTATGATAGTAGTGGTTATTATCA CTACAAATACTACGGTATGGCCGTCTGGGGCCAAGGGACAA CAGTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCGGTCT TCCCCCTGGCACCCCTCCTCCAAGAGCACCTCTGGGGGCACAG CGGCCCTGGGCTGCCTGGTCAAGGACTACTTCCCCGAACCG GTGACGGTGTCTGTTGAACTCAGGCGCCCTGACCAGCGGCGT

IgG-scFv Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence
		GCACACCTTCCCGGCTGTCCTACAGTCCTCAGGACTCTACTC CCTCAGCAGCGTGGTGACCGTGCCCTCCAGCAGCTTGGGCA CCCAGACCTACATCTGCAACGTGAATCACAAGCCCAGCAAC ACCAAGGTGGACAAGAAAGTTGAGCCCAAATCTTGTGACAA AACTCACACATGCCACCGTGCCAGCACCTGAACTCCTGG GGGGACCGTCAGTCTTCTCTTCCCCCAAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGCGTGGTGG TGGACGTGAGCCACGAAGACCCTGAGGTCAAGTTCAACTGG TACGTGGACGGCGTGGAGGTGCATAATGCCAAGACAAAGCC GTGTGAGGAGCAGTACGGCAGCACGTACCGTTGTGTCAGCG TCCTCACCGTCTGCACCAGGACTGGCTGAATGGCAAGGAG TACAAGTGCAAGGTCTCCAACAAAGCCCTCCCAGCCCCCAT CGAGAAAACCATCTCCAAAGCCAAAGGGCAGCCCCGAGAAC CACAGGTGTACACCTGCCCCCATCCCGGGAGGAGATGACC AAGAACCAGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAATGGGCAGC CGGAGAACAACACTACAAGACCACGCCTCCCGTGCTGGACTCC GACGGCTCCTTCTTCTCTATAGCAAGCTCACCGTGGACAAG AGCAGGTGGCAGCAGGGGAACGTCTTCTCATGCTCCGTGAT GCATGAGGCTCTGCACAACCACTACACGCAGAAGAGCCTAA GCTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGGATCC GATATCCAGCTCACTCAATCGCCATCATTTCTCTCCGCTTCG GTAGGCGACCGGGTCACGATCACATGCAGGGCGTCGAAAG CATTGGGAGGTCGTTGCATTGGTATCAGCAGAAACCCGGAA AGGCCCCGAACTTCTGATCAAATACGCATCACAAGTTTG AGCGGTGTGCCGTCGCGCTTCTCCGTTCCGGAAGCGGAAC GGAGTTCACGCTTACAATCTCCTCACTGCAGCCCCGAGGATTT CGCGACCTATTACTGTCACCAGTCATCCAGACTCCCGTTTAC TTTTGGCCCTGGGACCAAGGTGGACATTAAGCGTGGAGGCG GAGGATCTGGTGGCGGTGGTTCTGGCGGCGGAGGCTCCCAA GTTTCAGTTGGTGGAGTCTGGAGCCGAAGTAGTAAAGCCAGG AGCTTCAGTGAAAGTCTCTTGTAAGCAAGTGGATTACGTT TAGCCGCTTTGCCATGCATTGGGTGCGGCAAGCTCCCGGTCA GGGGTTGGAGTGGATGGGAGTTATTAGCTATGACGGGGGCA ATAAGTACTACGCCGAGTCTGTAAAGGGTTCGGGTCACAATG ACACGGGACACCTCAACCAGTACACTCTATATGGAAGTGTCT AGCCTGAGATCCGAGGACACCGCTGTGTATTATTGCGCTAG GGGTACGATGTATTGACGGGTTATCTGATTACTGGGGGC AGGGGACACTCGTAACCGTGTCTTCA (SEQ ID NO: 594)

[0168] Nucleic acid sequences encoding the three components (e.g., light chains, modified heavy chains, and second polypeptides comprising the other half of the carboxyl-terminal Fab domains) of exemplary bispecific antigen binding proteins of the invention in the IgG-Fab format are listed in Table 14. In such embodiments, the isolated nucleic acid encoding the light chain of the IgG-Fab molecules may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the light chain nucleotide sequences listed in Table 14. For instance, in some embodiments, the isolated nucleic acid

encoding the light chain of the IgG-Fab molecules comprises a sequence selected from SEQ ID NOs: 225, 287, 595, and 596. In related embodiments, the isolated nucleic acid encoding the modified heavy chain of the IgG-Fab molecules may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the modified heavy chain nucleotide sequences listed in Table 14. In certain embodiments, the isolated nucleic acid encoding the modified heavy chain of the IgG-Fab molecules comprises a sequence selected from SEQ ID NOs: 597 to 620. In these and other embodiments, the isolated nucleic acid encoding the second polypeptide of the IgG-Fab molecules, which comprises the other half of the carboxyl-terminal Fab domain (e.g. a Fd fragment or second light chain), may comprise a nucleotide sequence that is at least 80% identical, at least 90% identical, at least 95% identical, or at least 98% identical to any of the second polypeptide nucleotide sequences listed in Table 14. In some embodiments, the isolated nucleic acid encoding the second polypeptide of the IgG-Fab molecules comprises a sequence selected from SEQ ID NOs: 621 to 632.

Table 14. Nucleic Acid Sequences of Exemplary Bispecific Antigen Binding Proteins in the IgG-Fab Format

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
<i>Anti-PAC1 Receptor IgG x Anti-CGRP Receptor Fab</i>			
iPS:392513	GATATCCAG CTCACTCAA TCGCCATCA TTTCTCTCCG CTTCGGTAG GCGACCGGG TCACGATCA CATGCAGGG CGTCGCAAA GCATTGGGA GGTCGTTGC ATTGGTATC AGCAGAAAC CCGGAAGG CCCCGAAAC TTCTGATCA AATACGCAT CACAAAGCT TGAGCGGTG TGCCGTCGC GCTTCTCCG GTTCCGGAA	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGATTACAGTTTAGCCGCTTTGCCATGC ATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTGCG TGGAAGTCAAGCGCCCTGACCAGCGGCGTGCACA CCTTCCCGGCTGTCTACAGTCTCAGGACTCTAC TCCCTCAAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGACACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACTCACACA TGCCACCGTGCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAACCCAAG	CAGGTGCAGCTG GTGGAATCTGGG GGAGGCGTGGTC CAGCCTGGGAGG TCCCTGAGACTCT CCTGTGCAGCCTC TGGATTCACCTTC AGTAGCTTTGGC ATGCACTGGGTC CGCCAGGCTCCA GGCAAGGGGCTG GAGTGGGTGGCA GTTATATCATTTG ATGGAAGTATTA AGTATTCTGTAGA CTCCGTGAAGGG CCGATTACCATC TCCAGAGACAAT TCAAAGAACAACG CTGTTTCTGCAAA TGAACAGCCTGC GAGCCGAGGACA

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
	GCGGAACGG AATTCACGC TTACAATCT CCTCACTGC AGCCCGAGG ATTCGCGA CCTATTACT GTCACCAGT CATCCAGAC TCCCGTTTAC TTTTGGCCCT GGGACCAAG GTGGACATT AAGCGTACG GTGGCTGCA CCATCTGTCT TCATCTTCCC GCCATCTGA TGAGCAGTT GAAATCTGG AACTGCCTC TGTTGTGTG CCTGCTGAA TAACTTCTAT CCCAGAGAG GCCAAAGTA CAGTGGAAG GTGGATAAC GCCCTCCAA TCGGGTAAC TCCCAGGAG AGTGTCA GAGCAGGAC AGCAAGGAC AGCACCTAC AGCCTCGAG AGCACCTG ACGCTGAGC AAAGCAGAC TACGAGAAA CACAAAGTC TACGCCTGC GAAGTCACC CATCAGGGC CTGAGCTCG CCCGTCACA AAGAGCTTC AACAGGGGA GAGTGT (SEQ ID NO: 225)	GACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGTTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTCACCGTCCTGCACCAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCCAGCCCCCATCGAGAAAACCATCTCCAAAGC CAAAGGGCAGCCCCGAGAACACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTACAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACAACTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAGACAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGCAGCTCCCAGGAA CAGCCCCCAAACCTCCTCATTTATGACAATAATAA GCGACCCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCAGTCAACCAACCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGC TAGTACAAAGGGCCCCCTCCGTCTTTCCACTCGCAC CCAGTTCAAAGTCCACTTCTGGAGGCACTGCGGC CTTGGGCTGTTTGGTGAAAGACTACTTCCCAGAG CCAGTGACAGTCTCTTGAATAGCGGAGCACTGA CCAGCGGTGTGCATACCTTTCCAGCTGTGCTGCAG AGCAGCGGCCTCTACTACTGAAGAGTGTCTGTC CCGTTCCTCTTCCAGCCTCGGCACTCAAACCTTAC ATCTGCAACGTGAATCATAAGCCATCTAACACCA AGGTAGACAAGAAAGTC (SEQ ID NO: 597)	CGGCTGTGTATTA CTGTGCGAGAGA TCGGCTCAATTAC TATGATAGTAGT GGTTATTATCACT ACAAATACTACG GTATGGCCGTCTG GGGCCAAGGAAC AACAGTTACCGT CTCTAGTGGTCAG CCCAAGGCCAAC CCCACTGTCACTC TGTTCCCGCCCTC CTCTGAGGAGCT CCAAGCCAACA GGCCACACTAGT GTGTCTGATCAGT GACTTCTACCCGG GAGCTGTGACAG TGGCCTGGAAGG CAGATGGCAGCC CCGTCAAGGCGG GAGTGGAGACCA CCAAACCCTCCA AACAGAGCAACA ACAAGTACGCGG CCGAAAGCTACC TGAGCCTGACGC CCGAGCAGTGGA AGTCCCACAGAA GCTACAGCTGCC AGGTCACGCATG AAGGGAGCACCG TGGAGAAGACAG TGGCCCCTACAG AATGTTCA (SEQ ID NO: 621)
iPS:392514	SEQ ID NO: 225	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA	CAGGTGCAGCTG GTGGAATCTGGG

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		AGCAAGTGGATTACGTTTACGCCGCTTTGCCATGC ATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCTG TGGAAGTCAAGCGCCCTGACCAGCGGCGTGCACA CCTTCCCGGCTGTCTACAGTCTCAGGACTCTAC TCCCTCAAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACCTACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTCACCGTCTGACACCAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCCAGCCCCCATCGAGAAAACCATCTCCAAAGC CAAAGGGCAGCCCCGAGAACACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTACAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACAACTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGAAGCTCCCAGGAA CAGCCCCCAAACCTCCTCATTTATGACAATAATAA GCGACCCCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGC TAGTACAAAGGGCCCCTCCGTCTTCCACTCGCAC CCAGTTCAAAGTCCACTTCTGGAGGCACTGCGGC CTTGGGCTGTTTGGTGAAAGACTACTTCCCAGAG CCAGTGACAGTCTCTTGGAATAGCGGAGCACTGA CCAGCGGTGTGCATACCTTCCAGCTGTGCTGCAG	GGAGGCGTGGTC CAGCCTGGGAGG TCCCTGAGACTCT CCTGTGCAGCCTC TGGATTACCTTC AGTAGCTTTGGC ATGCACTGGGTC CGCGAGGCTCCA GGCAAGGGGCTG GAGTGGGTGGCA GTTATATCATTTG ATGGAAGTATTA AGTATTCTGTAGA CTCCGTGAAGGG CCGATTACCATC TCCAGAGACAAT TCAAAGAACACG CTGTTTCTGCAAA TGAACAGCCTGC GAGCCGAGGACA CGGCTGTGTATTA CTGTGCGAGAGA TCGGCTCAATTAC TATGATAGTAGT GGTTATTATCACT ACAAATACTACG GTATGGCCGTCTG GGGCCAAGGAAC AACAGTTACCGT CTCTAGTGGTCAG CCCAAGGCCAAC CCCCTGTCACTC TGTTCCCGCCCTC CTCTGAGGAGCT CCAAGCCAACAA GGCCACACTAGT GTGTCTGATCAGT GACTTCTACCCGG GAGCTGTGACAG TGGCCTGGAAGG CAGATGGCAGCC CCGTCAAGGCGG GAGTGGAGACCA CCAAACCCTCCA AACAGAGCAACA ACAAGTACGCGG CCGAAAGCTACC TGAGCCTGACGC CCGAGCAGTGGA AGTCCCACAGAA GCTACAGCTGCC AGGTCACGCATG AAGGGAGCACCG

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		AGCAGCGGCCTCTACTCACTGAAGAGTGTCGTCA CCGTTCCCTCTTCCAGCCTCGGCACTCAAACCTTAC ATCTGCAACGTGAATCATAAGCCATCTAACACCA AGGTAGACAAGAAAGTC (SEQ ID NO: 598)	TGGAGAAGACAG TGGCCCCTACAG AATGTTCA (SEQ ID NO: 622)
iPS:392475	SEQ ID NO: 225	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGATTACAGTTTAGCCGCTTTGCCATGC ATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTGCG TGGAAGTCAAGGCGCCCTGACCAGCGGCGTGCACA CCTTCCCCGGCTGTCCTACAGTCTCAGGACTCTAC TCCCTCAAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACCTCACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTCACCGTCTGACCAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCCAGCCCCCATCGAGAAAACCATCTCCAAGC CAAAGGGCAGCCCCGAGAACCACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTCAAGCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACAACTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGCAGCTCCAGGAA CAGCCCCCAAACCTCATTATGACAATAATAA GCGACCCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCTGAGTGCTGTGG	CAGGTGCAGCTG GTGGAATCTGGG GGAGGCGTGGTC CAGCCTGGGAGG TCCCTGAGACTCT CCTGTGCAGCCTC TGGATTACCTTC AGTAGCTTTGGC ATGCACTGGGTC CGCCAGGCTCCA GGCAAGGGGCTG GAGTGGGTGGCA GTTATATCATTTG ATGGAAGTATTA AGTATTCTGTAGA CTCCGTGAAGGG CCGATTACCATC TCCAGAGACAAT TCAAAGAACACG CTGTTTCTGCAA TGAACAGCCTGC GAGCCGAGGACA CGGCTGTGTATTA CTGTGCGAGAGA TCGGCTCAATTAC TATGAAAGTAGT GGTATTATCACT ACAAATACTACG GTATGGCCGTCTG GGGCCAAGGAAC AACAGTTACCGT CTCTAGTGGTCAG CCCAAGGCCAAC CCCACTGTCACTC TGTTCCCGCCCTC CTCTGAGGAGCT CCAAGCCAACAA GGCCACACTAGT GTGTCTGATCAGT GACTTCTACCCGG GAGCTGTGACAG TGGCCTGGAAGG CAGATGGCAGCC CCGTCAAGGCGG GAGTGGAGACCA CCAAACCCTCCA AACAGAGCAACA ACAAGTACGCGG CCGAAAGCTACC

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGC TAGTACAAAGGGCCCCTCCGTCTTTCCACTCGCAC CCAGTTCAAAGTCCACTTCTGGAGGCACTGCGGC CTTGGGCTGTTTGGTGAAAGACTACTTCCCAGAG CCAGTGACAGTCTCTTGGAATAGCGGAGCACTGA CCAGCGGTGTGCATACCTTTCCAGCTGTGCTGCAG AGCAGCGGCCTCTACTACTGAAGAGTGTCGTCA CCGTTCCCTCTTCCAGCCTCGGCACTCAAACCTTAC ATCTGCAACGTGAATCATAAGCCATCTAACACCA AGGTAGACAAGAAAGTC (SEQ ID NO: 599)	TGAGCCTGACGC CCGAGCAGTGGA AGTCCCACAGAA GCTACAGCTGCC AGGTCACGCATG AAGGGAGCACCG TGGAGAAGACAG TGGCCCCCTACAG AATGTTCA (SEQ ID NO: 623)
iPS:392519	SEQ ID NO: 225	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGAATTCACGTTTAGCCGCTTTGCCATGC ATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCTG TGGAAGTCAAGCGCCCTGACCAGCGGCGTGCACA CCTTCCCGGCTGTCCTACAGTCTCAGGACTCTAC TCCCTCAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGAGACAAAACCTCACACA TGCCACCGTGCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTACGCGT CCTCACCGTCTGACACAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAGCCC TCCCAGCCCCATCGAGAAAACCATCTCCAAAGC CAAAGGGCAGCCCCGAGAACACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTACAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGAGAAACAATAACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGAGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT	CAGGTGCAGCTG GTGGAATCTGGG GGAGGCGTGGTC CAGCCTGGGAGG TCCCTGAGACTCT CCTGTGCAGCCTC TGGATTCACCTC AGTAGCTTTGGC ATGCACTGGGTC CGCGAGGCTCCA GGCAAGGGGCTG GAGTGGGTGGCA GTTATATCATTTG ATGGAAGTATTA AGTATTCTGTAGA CTCCGTGAAGGG CCGATTACCATC TCCAGAGACAAT TCAAAGAACACG CTGTTTCTGCAAA TGAACAGCCTGC GAGCCGAGGACA CGGCTGTGTATTA CTGTGCGAGAGA TCGGCTCAATTAC TATGAAAGTAGT GGTATTATCACT ACAAATACTACG GTATGGCCGTCTG GGCCAAGGAAC AACAGTTACCGT CTCTAGTGGTCAG CCCAAGGCCAAC CCCACTGTCACTC TGTTCCCGCCCTC CTCTGAGGAGCT CCAAGCCAACAA GGCCACACTAGT GTGTCTGATCAGT GACTTCTACCCG GAGCTGTGACAG TGGCCTGGAAGG CAGATGGCAGCC

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		AATTATGTATCCTGGTACCAGAAGCTCCCAGGAA CAGCCCCCAAACCTCCTCATTTATGACAATAATAA GCGACCCCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGC TAGTACAAAGGGCCCCCTCCGTCTTTCCACTCGCAC CCAGTTCAAAGTCCACTTCTGGAGGCACTGCGGC CTTGGGCTGTTTGGTGAAAGACTACTTCCCAGAG CCAGTGACAGTCTCTTGAATAGCGGAGCACTGA CCAGCGGTGTGCATACCTTTCCAGCTGTGCTGCAG AGCAGCGGCCTCTACTACTGAAGAGTGTCTGTC CCGTTCCCTCTTCCAGCCTCGGCACTCAAACCTTAC ATCTGCAACGTGAATCATAAGCCATCTAACACCA AGGTAGACAAGAAAGTC (SEQ ID NO: 600)	CCGTCAAGGCGG GAGTGGAGACCA CCAAACCCTCCA AACAGAGCAACA ACAAGTACGCGG CCGAAAGCTACC TGAGCCTGACGC CCGAGCAGTGGA AGTCCCACAGAA GCTACAGCTGCC AGGTCACGCATG AAGGGAGCACCG TGGAGAAGACAG TGGCCCCTACAG AATGTTCA (SEQ ID NO: 624)
iPS:392515	SEQ ID NO: 225	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGATTACGTTTAGCCGCTTTGCCATGC ATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCG TGGAAGTCAAGGCGCCCTGACCAGCGGCGTGCACA CCTTCCCCGGCTGTCTACAGTCTCAGGACTCTAC TCCCTCAAAAGCGTGTTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACCTCACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGTTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTCACCGTCTTGACACCAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCCAGCCCCCATCGAGAAAACCATCTCCAAGC CAAAGGGCAGCCCCGAGAACCACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTACAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACAACTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG	CAGGTGCAGCTG GTGGAATCTGGG GGAGGCGTGGTC CAGCCTGGGAGG TCCCTGAGACTCT CCTGTGCAGCCTC TGGATTACCTTC AGTAGCTTTGGC ATGCACTGGGTC CGCCAGGCTCCA GGCAAGGGGCTG GAGTGGGTGGCA GTTATATCATTTG ATGGAAGTATTA AGTATTCTGTAGA CTCCGTGAAGGG CCGATTACCATC TCCAGAGACAAT TCAAAGAACACG CTGTTTCTGCAAA TGAACAGCCTGC GAGCCGAGGACA CGGCTGTGTATTA CTGTGCGAGAGA TCGGTCAATTAC TATGATAGTAGT GGTTATTATCACT ACAAATACTACG GTATGGCCGTCTG GGGCCAAGGAAC AACAGTTACCGT CTCTAGTGCCTCC ACCAAGGGCCCA TCGGTCTTCCCCC TGGCACCCCTCCTC CAAGAGCACCTC TGGGGGCACAGC

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGCAGCTCCCAGGAA CAGCCCCCAAACCTCCTCATTTATGACAATAATAA GCGACCTCAGGGATTTCCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGG TCAGCCCCAAGGCCAACCCCACTGTCACTCTGTTCC CGCCCTCCTCTGAGGAGCTCCAAGCCAACAAGGC CACACTAGTGTGTCTGTATCAGTGACTTCTACCCGG GAGCTGTGACAGTGGCCTGGAAGGCAGATGGCAG CCCCCGTCAAGGCGGGAGTGGAGACCACCAACCC TCCAAACAGAGCAACAACAAGTACGCGGCCAAG AGCTACCTGAGCCTGACGCCCCGAGCAGTGGAAGT CCCACAGAAGCTACAGCTGCCAGGTCACGCATGA AGGGAGCACCGTGGAGAAGACAGTGGCCCCCTAC AGAATGTTCA (SEQ ID NO: 601)	GGCCCTGGGCTG CCTGGTCAAGGA CTACTTCCCCGAA CCGGTGACGGTG TCGTGGAACCTCA GCGGCCCTGACC AGCGGCGTGCAC ACCTTCCCGGCTG TCCTACAGTCTC AGGACTCTACTCC CTCGAAAGCGTG GTGACCGTGCCT CCAGCAGCTTGG GCACCCAGACCT ACATCTGCAACG TGAATCACAAGC CCAGCAACACCA AGGTGGACAAGA AAGTT (SEQ ID NO: 625)
iPS:392516	SEQ ID NO: 225	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGATTACGTTTTAGCCGCTTTGCCATGC ATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAACGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCTG TGGAACCTCAGGCGCCCTGACCAGCGGCGTGCACA CCTTCCCGGCTGTCTTACAGTCTCAGGACTCTAC TCCCTCAAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACCTCACACA TGCCACCGTGCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTACCGTCTTGCACCAAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAGCCC TCCAGCCCCCATCGAGAAAACCATCTCCAAGC	CAGGTGCAGCTG GTGGAATCTGGG GGAGGCGTGGTC CAGCCTGGGAGG TCCCTGAGACTCT CCTGTGCAGCCTC TGGATTACCTTC AGTAGCTTTGGC ATGCACTGGGTC CGCGAGGCTCCA GGCAAGGGGCTG GAGTGGGTGGCA GTTATATCATTTG ATGGAAGTATTA AGTATTCTGTAGA CTCCGTGAAGGG CCGATTACCATC TCCAGAGACAAT TCAAAGAACACG CTGTTTCTGCAAA TGAACAGCCTGC GAGCCGAGGACA CGGCTGTGTATTA CTGTGCGAGAGA TCGGCTCAATTAC TATGATAGTAGT GGTATTATCACT ACAAATACTACG GTATGGCCGTCTG GGGCCAAGGAAC

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		CAAAGGGCAGCCCCGAGAACCACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACAACACTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGAAGCTCCCAGGAA CAGCCCCCAAACCTCCTCATTTATGACAATAATA GCGACCCTCAGGGATTCTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGG TCAGCCCAAGGCCAACCCCACTGTCACTCTGTTCC CGCCCTCCTCTGAGGAGCTCCAAGCCAACAAGGC CACACTAGTGTGTCTGATCAGTGACTTCTACCCGG GAGCTGTGACAGTGGCCTGGAAGGCAGATGGCAG CCCCCTCAAGGCGGGAGTGGAGACCACCAAACCC TCCAAACAGAGCAACAACAAGTACGCGGCCAAG AGCTACCTGAGCCTGACGCCCCGAGCAGTGGAAGT CCCACAGAAGCTACAGCTGCCAGGTCACGCATGA AGGGAGCACCGTGGAGAAGACAGTGCCCCCTAC AGAATGTTC (SEQ ID NO: 602)	AACAGTTACCGT CTCTAGTGCCTCC ACCAAGGGCCCA TCGGTCTTCCCCC TGGCACCTCCTC CAAGAGCACCTC TGGGGGCACAGC GGCCCTGGGCTG CCTGGTCAAGGA CTACTTCCCCGAA CCGGTGACGGTG TCGTGGAAGTCA GGCGCCCTGACC AGCGGCGTGCAC ACCTTCCCGGCTG CCTACAGTCCTC AGGACTCTACTCC CTCGAAAGCGTG GTGACCGTGCCCT CCAGCAGCTTGG GCACCCAGACCT ACATCTGCAACG TGAATCACAAGC CCAGCAACACCA AGGTGGACAAGA AAGTT (SEQ ID NO: 626)
iPS:392521	SEQ ID NO: 225	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGATTACGTTTAGCCGCTTTGCCATGC ATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTATCTCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTGCG TGGAAGTCAAGGCGCCCTGACCAGCGGCGTGACACA CCTTCCCGGCTGTCCTACAGTCTCAGGACTCTAC TCCCTCAAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACCTCACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAACCCAAAG GACACCTCATGATCTCCCGGACCCCTGAGGTCA	CAGGTGCAGCTG GTGGAATCTGGG GGAGGCGTGGTC CAGCCTGGGAGG TCCCTGAGACTCT CCTGTGCAGCCTC TGGATTACCTTC AGTAGCTTTGGC ATGCACTGGGTC CGCAGGGTCCA GGCAAGGGCTG GAGTGGGTGGCA GTTATATCATTTG ATGGAAGTATTA AGTATTCTGTAGA CTCCGTGAAGGG CCGATTACCATC TCCAGAGACAAT TCAAAGAACACG CTGTTTCTGCAA TGAACAGCCTGC GAGCCGAGGACA CGGCTGTGTATTA

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTCACCGTCCTGCACCAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCCAGCCCCATCGAGAAAACCATCTCCAAAGC CAAAGGGCAGCCCCGAGAACCACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTACAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGAAGCTCCCAGGAA CAGCCCCAACTCCTCATTTATGACAATAATAA GCGACCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGG TCAGCCCCAAGGCCAACCCCACTGTCACTCTGTTCC CGCCCTCCTCTGAGGAGCTCCAAGCCAACAAGGC CACACTAGTGTGTCTGATCAGTGACTTCTACCCGG GAGCTGTGACAGTGGCCTGGAAGGCAGATGGCAG CCCCCTCAAGGCGGGAGTGGAGACCACCAAAACC TCCAAACAGAGCAACAACAAGTACGCGGCCAAG AGCTACCTGAGCCTGACGCCCGAGCAGTGGAAGT CCCACAGAAGCTACAGCTGCCAGGTCACGCATGA AGGGAGCACCGTGGAGAAGACAGTGGCCCCCTAC AGAATGTTCA (SEQ ID NO: 603)	CTGTGCGAGAGA TCGGCTCAATTAC TATGAAAGTAGT GGTATTATCACT ACAAATACTACG GTATGGCCGTCTG GGGCCAAGGAAC AACAGTTACCGT CTCTAGTGCCTCC ACCAAGGGCCCA TCGGTCTTCCCCC TGGCACCTCCTC CAAGAGCACCTC TGGGGGCACAGC GGCCCTGGGCTG CCTGGTCAAGGA CTACTTCCCCGAA CCGGTGACGGTG TCGTGGAACCTCA GGCGCCCTGACC AGCGGCGTGCAC ACCTTCCCGGCTG TCCTACAGTCTC AGGACTCTACTCC CTCGAAAGCGTG GTGACCGTGCCCT CCAGCAGCTTGG GCACCCAGACCT ACATCTGCAACG TGAATCACAAGC CCAGCAACACCA AGGTGGACAAGA AAGTT (SEQ ID NO: 627)
iPS:392520	SEQ ID NO: 225	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGATTACGTTTAGCCGCTTTGCCATGC ATTGGGTGCGGCAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCTG TGGAAGTCAAGGCGCCCTGACCAGCGGCGTGCACA CCTTCCCGGCTGTCTACAGTCTCAGGACTCTAC	CAGGTGCAGCTG GTGGAATCTGGG GGAGGCGTGGTC CAGCCTGGGAGG TCCCTGAGACTCT CCTGTGCAGCCTC TGGATTACCTTC AGTAGCTTTGGC ATGCACTGGGTC CGCCAGGCTCCA GGCAAGGGGCTG GAGTGGGTGGCA GTTATATCATTTG ATGGAAGTATTA AGTATTCTGTAGA CTCCGTGAAGGG

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		TCCCTCAAAAGCGTGTTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACCTCACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGTTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTCACCGTCTTGCACCAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCCAGCCCCCATCGAGAAAACCATCTCCAAGC CAAAGGCGAGCCCCGAGAACACAGGTGTACACC CTGCCCCCATCCCGGGGAGGAGATGACCAAGAACC AGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAAACAACCTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGCAGCTCCAGGAA CAGCCCCCAAACCTCCTCATTTATGACAATAATAA GCGACCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGG TCAGCCCCAAGGCAACCCCACTGTCACTCTGTTCC CGCCCTCCTCTGAGGAGCTCCAAGCCAACAAGGC CACACTAGTGTGTCTGATCAGTGACTTCTACCCGG GAGCTGTGACAGTGGCCTGGAAGGCAGATGGCAG CCCCGTCAAGGCGGGAGTGGAGACCACCAAAACC TCCAAACAGAGCAACAACAAGTACGCGGCCAAG AGCTACCTGAGCCTGACGCCCCGAGCAGTGGAAGT CCCACAGAAGCTACAGCTGCCAGGTCACGCATGA AGGGAGCACCGTGGAGAAGACAGTGGCCCCCTAC AGAATGTTCA (SEQ ID NO: 604)	CCGATTACCATC TCCAGAGACAAT TCAAAGAACACG CTGTTTCTGCAAA TGAACAGCCTGC GAGCCGAGGACA CGGCTGTGTATTA CTGTGCGAGAGA TCGGCTCAATTAC TATGAAAGTAGT GGTTATTATCACT ACAAATACTACG GTATGGCCGTCTG GGGCAAGGAAC AACAGTTACCGT CTCTAGTGCCTCC ACCAAGGGCCCA TCGGTCTTCCCCC TGGCACCCCTCTC CAAGAGCACCTC TGGGGGCACAGC GGCCCTGGGCTG CCTGGTCAAGGA CTACTTCCCCGAA CCGGTGACGGTG TCGTGGAAGTCA GGCGCCCTGACC AGCGGCGTGCAC ACCTTCCCGGCTG TCCTACAGTCTC AGGACTCTACTCC CTCGAAAGCGTG GTGACCGTGCCCT CCAGCAGCTTGG GCACCCAGACCT ACATCTGCAACG TGAATCACAAGC CCAGCAACACCA AGGTGGACAAGA AAGTT (SEQ ID NO: 628)
iPS:392517	GATATCCAG CTCACTCAA TCGCCATCA TTTCTCTCCG CTTCGGTAG GCGACCGGG TCACGATCA CATGCAGGG CGTCGCAAA	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGATTACGTTTAGCCGCTTTGCCATGC ATTGGGTGCGGAAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT	SEQ ID NO: 625

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
	GCATTGGGA GGTCGTTGC ATTGGTATC AGGAGAAAC CCGGAAAGG CCCCGAAAC TTCTGATCA AATACGCAT CACAAAGTT TGAGCGGTG TGCCGTCGC GCTTCTCCG GTTCCGGAA GCGGAACGG AGTTCACGC TTACAATCT CCTCACTGC AGCCCGAGG ATTCGCGA CCTATTACT GTCACCAGT CATCCAGAC TCCCGTTTAC TTTTGGCCCT GGGACCAAG GTGGACATT AAGCGTACG GTGGCTGCA CCATCTGTCT TCATCTTCCC GCCATCTGA TGAGCAGTT GAAATCTGG AACTGCCTC TGTTGTGTG CCTGCTGAA TAACTTCTAT CCCAGAGAG GCCAAAGTA CAGTGGAAAG GTGGATAAC GCCCTCCAA TCGGGTAAC TCCCAGGAG AGTGTCA GAGCAGGAC AGCAAGGAC AGCACCTAC AGCCTCGAA AGCACCCCTG ACGCTGAGC AAAGCAGAC TACGAGAAA	GACGGGTTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCTG TGGAACTCAGGCGCCCTGACCAGCGGCGTGCACA CCTTCCCCGGCTGTCTACAGTCTCAGGACTCTAC TCCCTCAAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACCTCACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTCACCGTCTCTGCACCAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCCAGCCCCCATCGAGAAAACCATCTCCAAAGC CAAAGGGCAGCCCCGAGAACCACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTCAAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACAACACTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGCAGCTCCCAGGAA CAGCCCCCAAACTCCTCATTTATGACAATAATAA GCGACCCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGG TCAGCCCCAAGGCCAACCCCACTGTCACTCTGTTCC CGCCCTCCTCTGAGGAGCTCCAAGCCAACAAGGC CACACTAGTGTGTCTGATCAGTGACTTCTACCCGG GAGCTGTGACAGTGGCCTGGAAGGCAGATGGCAG CCCCGTCAAGGCGGGAGTGGAGACCACCAAACCC TCCAAACAGAGCAACAACAAGTACGCGGCCAAG AGCTACCTGAGCCTGACGCCCCGAGCAGTGGAAGT CCCACAGAAGCTACAGCTGCCAGGTACGCATGA AGGGAGCACCGTGGAGAAGACAGTGGCCCCCTAC AGAATGTTCA (SEQ ID NO: 605)	

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
	CACAAAGTC TACGCCTGC GAAGTCACC CATCAGGGC CTGAGCTCG CCCGTCACA AAGAGCTTC AACAGGGGA GAGTGT (SEQ ID NO: 595)		
iPS:392518	SEQ ID NO: 595	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGATTACGTTTAGCCGCTTTGCCATGC ATTGGGTGCGGAAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCTG TGGAAGTCAAGGCGCCCTGACCAGCGGCGTGCACA CCTTCCCGGCTGTCTACAGTCCTCAGGACTCTAC TCCCTCAAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACCTCACACA TGCCACCGTGCCAGCACCTGAACCTCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCAAG GACACCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTACCGTCTGACACGAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCAGCCCCATCGAGAAAACCATCTCCAAAGC CAAAGGGCAGCCCCGAGAACCACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTACGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACAACATAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT	SEQ ID NO: 626

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		GCGGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGAAGCTCCCAGGAA CAGCCCCCAAACCTCCTCATTTATGACAATAATAA GCGACCCCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGTCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGG TCAGCCCAAGGCCAACCCCACTGTCACTCTGTTCC CGCCCTCCTCTGAGGAGCTCCAAGCCAACAAGGC CACACTAGTGTGTCTGATCAGTGACTTCTACCCGG GAGCTGTGACAGTGGCCTGGAAGGCAGATGGCAG CCCCCTCAAGGCGGGAGTGGAGACCACCAAACCC TCCAAACAGAGCAACAACAAGTACGCGGCCAAG AGCTACCTGAGCCTGACGCCCCGAGCAGTGGAAGT CCCACAGAAGCTACAGCTGCCAGGTCACGCATGA AGGGAGCACCGTGGAGAAGACAGTGGCCCCCTAC AGAATGTTCA (SEQ ID NO: 606)	
iPS:392522	SEQ ID NO: 595	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGATTACGTTTACCGCTTTGCCATGC ATTGGGTGCGGAAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTGCG TGGAAGTCAAGCGCCCTGACCAGCGGCGTGCACA CCTTCCCGGCTGTCTACAGTCCTCAGGACTCTAC TCCCTCAAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCCAAATCTTGTGACAAAACCTCACACA TGCCCAACCGTGCCAGCACCTGAACCTCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCCCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTACCGTCTCTGACCAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCCAGCCCCCATCGAGAAAACCATCTCCAAGC CAAAGGGCAGCCCCGAGAACCACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTCAGCCTGACCTGCCTGGTCAAAGGCTTCTA	SEQ ID NO: 628

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACAACACTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCCTCTAT AGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCACCAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGCAGCTCCCAGGAA CAGCCCCAACTCCTCATTATGACAATAATAA GCGACCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCGGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGG TCAGCCCCAAGGCCAACCCTACTGTACTCTGTTCC CGCCCTCCTCTGAGGAGCTCCAAGCCAACAAGGC CACACTAGTGTGTCTGATCAGTGACTTCTACCCGG GAGCTGTGACAGTGGCCTGGAAGGCAGATGGCAG CCCCGTCAAGGCGGGAGTGGAGACCACCAAACCC TCCAAACAGAGCAACAACAAGTACGCGGCCAAG AGCTACCTGAGCCTGACGCCCAGCAGTGGAAGT CCCACAGAAGCTACAGCTGCCAGGTCACGCATGA AGGGAGCACCGTGGAGAAGACAGTGGCCCCCTAC AGAATGTTCA (SEQ ID NO: 607)	
iPS:392523	SEQ ID NO: 595	CAAGTTCAGTTGGTGGAGTCTGGAGCCGAAGTAG TAAAGCCAGGAGCTTCAGTGAAAGTCTCTTGTA AGCAAGTGGATTACGTTTAGCCGCTTTGCCATGC ATTGGGTGCGGAAAGCTCCCGGTCAGGGGTTGGA GTGGATGGGAGTTATTAGCTATGACGGGGGCAAT AAGTACTACGCCGAGTCTGTAAAGGTCGGGTCA CAATGACACGGGACACCTCAACCAGTACACTCTA TATGGAAGTGTCTAGCCTGAGATCCGAGGACACC GCTGTGTATTATTGCGCTAGGGGGTACGATGTATT GACGGGTTATCCTGATTACTGGGGGCAGGGGACA CTCGTAACCGTCTCTAGTGCCTCCACCAAGGGCCC ATCGGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCA CCTCTGGGGGCACAGCGGCCCTGGGCTGCCTGGT CAAGGACTACTTCCCCGAACCGGTGACGGTGTCTG TGGAAGTCAAGGCGCCCTGACCAGCGGCGTGACA CCTTCCCCGGCTGTCCTACAGTCCTCAGGACTCTAC TCCCTCAAAAGCGTGGTGACCGTGCCCTCCAGCA GCTTGGGCACCCAGACCTACATCTGCAACGTGAA TCACAAGCCCAGCAACACCAAGGTGGACAAGAA AGTTGAGCCCAAATCTTGTGACAAAACCTCACACA TGCCCACCGTGCCCAGCACCTGAACTCCTGGGGG GACCGTCAGTCTTCTCTTCCCCCAAAACCCAAG GACACCTCATGATCTCCCGGACCCCTGAGGTCA CATGCGTGGTGGTGGACGTGAGCCACGAAGACCC TGAGGTCAAGTTCAACTGGTACGTGGACGGCGTG GAGGTGCATAATGCCAAGACAAAGCCGTGTGAGG	SEQ ID NO: 627

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		AGCAGTACGGCAGCACGTACCGTTGTGTCAGCGT CCTCACCGTCCTGCACCAGGACTGGCTGAATGGC AAGGAGTACAAGTGCAAGGTCTCCAACAAAGCCC TCCCAGCCCCCATCGAGAAAACCATCTCCAAAGC CAAAGGGCAGCCCCGAGAACCACAGGTGTACACC CTGCCCCCATCCCGGGAGGAGATGACCAAGAACC AGGTACAGCCTGACCTGCCTGGTCAAAGGCTTCTA TCCCAGCGACATCGCCGTGGAGTGGGAGAGCAAT GGGCAGCCGGAGAACAACTACAAGACCACGCCTC CCGTGCTGGACTCCGACGGCTCCTTCTTCTCTAT AGCAAGCTCACCGTGGACAAGAGCAGGTGGCAG CAGGGGAACGTCTTCTCATGCTCCGTGATGCATG AGGCTCTGCACAACCACTACACGCAGAAGAGCCT AAGCTTGTCTCCGGGTGGTGGCGGATCGGGAGGT GGCGGATCCCAGTCTGTGTTGACGCAGCCGCCCT CAGTGTCTGCGGCCCCAGGACAGAAGGTCAACAT CTCCTGCTCTGGAAGCAGCTCCAACATTGGGAAT AATTATGTATCCTGGTACCAGAAGCTCCCAGGAA CAGCCCCCAAATCCTCATTATGACAATAATAA GCGACCTCAGGGATTCTGACCGATTCTCTGGCT CCAAGTCTGGCACGTCAACCACCCTGGGCATCAC CGGACTCCAGACTGGGGACGAGGCCGATTATTAC TGCAGAACATGGGATAGCCGCCTGAGTGCTGTGG TTTTCGGCGGAGGGACCAAGCTGACCGTCCTAGG TCAGCCCCAAGGCAACCCCACTGTCACTCTGTTCC CGCCCTCCTCTGAGGAGCTCCAAGCCAACAAGGC CACACTAGTGTGTCTGATCAGTGACTTCTACCCGG GAGCTGTGACAGTGGCCTGGAAGGCAGATGGCAG CCCCCTCAAGGCGGGAGTGGAGACCACCAAACCC TCCAAACAGAGCAACAACAAGTACGCGGCCAAG AGCTACCTGAGCCTGACGCCCCGAGCAGTGGAAGT CCCACAGAAGCTACAGCTGCCAGGTCACGCATGA AGGGAGCACCGTGGAGAAGACAGTGGCCCCCTAC AGAATGTTCA (SEQ ID NO: 608)	
<i>Anti-CGRP Receptor IgG x Anti-PAC1 Receptor Fab</i>			
iPS:392524	CAGTCTGTG TTGACGCAG CCGCCCTCA GTGTCTGCG GCCCCAGGA CAGAAGGTC ACCATCTCC TGCTCTGGA AGCAGCTCC AACATTGGG AATAATTAT GTATCCTGG TACCAGCAG CTCCCAGGA ACAGCCCCC AAATCCTC ATTTATGAC AATAATAAG	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGGACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCTC TGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTCTGTGA ACTCAGGCGCCCTGACCAGCGGCGTGCACACCTT CCCGGCTGTCTACAGTCTCAGGACTCTACTCCC TCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCTT	CAAGTTCAGTTG GTGGAGTCTGGA GCCGAAGTAGTA AAGCCAGGAGCT TCAGTGAAAGTC TCTTGTAAGCA AGTGGATTACAG TTTAGCCGCTTTG CCATGCATTGGGT GCGGCAAGCTCC CGGTCAGGGGTT GGAGTGGATGGG AGTTATTAGCTAT GACGGGGGCAAT AAGTACTACGCC GAGTCTGTAAAG GGTGCGGTCACA ATGACACGGGAC

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
	CGACCTCA GGGATTCT GACCGATTC TCTGGCTCC AAGTCTGGC ACGTCAACC ACCCTGGGC ATCACCGGA CTCCAGACT GGGGACGAG GCCGATTAT TACTGCGGA ACATGGGAT AGCCGCCTG AGTGCTGTG GTTTTCGGC GGAGGGACC AAGCTGACC GTCCTAGGT CAGCCCAAG GCCAACCCC ACTGTCACT CTGTTCCCG CCCTCCTCTG AGGAGCTCC AAGCCAACA AGGCCACAC TAGTGTGTC TGATCAGTG ACTTCTACC CGGGAGCTG TGACAGTGG CCTGGAAGG CAGATGGCA GCCCCGTCA AGGCGGGAG TGGAGACCA CCAAACCTT CCAAACAGA GCAACAACA AGTACGCGG CCAAGAGCT ACCTGAGCC TGACGCCCC AGCAGTGGA AGTCCCACA GAAGCTACA GCTGCCAGG TCACGCATG AAGGGAGCA CCGTGGAGA AGACAGTGG CCCCTACAG	GGGCACCCAGACCTACATCTGCAACGTGAATCAC AAGCCCAGCAACACCAAGGTGGACAAGAAAGTT GAGCCCAAATCTTGTGACAAAACCTCACACATGCC CACCGTGCCCAGCACCTGAACCTCTGGGGGGACC GTCAGTCTTCTCTTCCCCCCTGAGGTCACATGC CCCTCATGATCTCCCGGACCCCTGAGGTCACATGC GTGGTGGTGGACGTGAGCCACGAAGACCCTGAGG TCAAGTTCAACTGGTACGTGGACGGCGTGGAGGT GCATAATGCCAAGACAAAGCCGTGTGAGGAGCA GTACGGCAGCACGTACCGTTGTGTGTCAGCGTCCTC ACCGTCTGCACCAGGACTGGCTGAATGGCAAGG AGTACAAGTGCAAGGTCTCCAACAAAGCCCTCCC AGCCCCATCGAGAAAACCATCTCCAAAGCCAAA GGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCCGGGAGGAGATGACCAAGAACCAGGT CAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCA GCGACATCGCCGTGGAGTGGGAGAGCAATGGGC AGCCGGAGAACAACCTACAAGACCACGCCTCCCGT GCTGGACTCCGACGGCTCCTTCTTCTCTATAGCA AGCTCACCGTGGACAAGAGCAGGTGGCAGCAGG GGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTAAGCT TGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGG ATCCGATATCCAGCTCACTCAATCGCCATCATTTT TCTCCGCTTCGGTAGGCGACCGGGTCACGATCAC ATGCAGGGCGTCGCAAAGCATTGGGAGGTGCTTG CATTGGTATCAGCAGAAACCCGAAAGGCCCCGA AACTTCTGATCAAATACGCATCACAAAGTTTGAG CGGTGTGCCGTGCGCTTCTCCGGTTCGGGAAGC GGAACGGAGTTCACGCTTACAATCTCCTCACTGC AGCCCGAGGATTTTCGCGACCTATTACTGTCACCA GTCATCCAGACTCCCGTTTACTTTTGGCCCTGGGA CCAAGGTGGACATTAAGCGTGCTAGTACAAAGGG CCCCTCCGTCTTTCCACTCGCACCCAGTTCAAAGT CCACTTCTGGAGGCACTGCGGCCTTGGGCTGTTTG GTGAAAGACTACTTCCAGAGCCAGTGACAGTCT CTTGGAATAGCGGAGCACTGACCAGCGGTGTGCA TACCTTTCCAGCTGTGCTGCAGAGCAGCGGCCTCT ACTCACTGGAGAGTGTGCTCACCGTTCCCTCTTCC AGCCTCGGCACTCAAACCTTACATCTGCAACGTGA ATCATAAGCCATCTAACACCAAGGTAGACAAGAA AGTC (SEQ ID NO: 609)	ACCTCAACCAGT ACACTCTATATGG AACTGTCTAGCCT GAGATCCGAGGA CACCGCTGTGTAT TATTGCGCTAGG GGGTACGATGTA TTGACGGGTTATC CTGATTACTGGG GGCAGGGGACAC TCGTAACCGTCTC TAGTACGGTGGC TGCACCATCTGTC TTCATCTTCCCGC CATCTGATGAGC AGTTGAAATCTG GAACTGCCTCTGT TGTGTGCCTGCTG AATAACTTCTATC CCAGAGAGGCCA AAGTACAGTGGA AGGTGGATAACG CCCTCCAATCGG GTAACCTCCAGG AGAGTGTACAG AGCAGGACAGCA AGGACAGCACCT ACAGCCTCAAGA GCACCCTGACGC TGAGCAAAGCAG ACTACGAGAAAC ACAAAGTCTACG CCTGCGAAGTCA CCCATCAGGGCC TGAGCTCGCCCGT CACAAAGAGCTT CAACAGGGGAGA GTGT (SEQ ID NO: 629)

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
	AATGTTCA (SEQ ID NO: 287)		
iPS:392525	SEQ ID NO: 287	CAGGTGCAGCTGGTGAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGGACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCTC TGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTCTGTGA ACTCAGGCGCCCTGACCAGCGGCGTGCACACCTT CCCGGCTGTCTACAGTCCTCAGGACTCTACTCCC TCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCTT GGGCACCCAGACCTACATCTGCAACGTGAATCAC AAGCCCAGCAACACCAAGGTGGACAAGAAAGTT GAGCCCAAATCTTGTGACAAAACCTCACACATGCC CACCGTGCCAGCACCTGAACTCCTGGGGGGACC GTCAGTCTTCTCTTCCCCCCCCAAACCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGC GTGGTGGTGGACGTGAGCCACGAAGACCCTGAGG TCAAGTTCAACTGGTACGTGGACGGCGTGGAGGT GCATAATGCCAAGACAAAGCCGTGTGAGGAGCA GTACGGCAGCACGTACCGTTGTGTGTCAGCGTCCTC ACCGTCCTGCACCAGGACTGGCTGAATGGCAAGG AGTACAAGTGCAAGGTCTCCAACAAAGCCCTCCC AGCCCCATCGAGAAAACCATCTCCAAAGCCAAA GGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCGGGAGGAGATGACCAAGAACCAGGT CAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCA GCGACATCGCCGTGGAGTGGGAGAGCAATGGGC AGCCGGAGAACAACCTACAAGACCACGCCTCCCGT GCTGGACTCCGACGGCTCCTTCTTCTCTATAGCA AGCTCACCGTGGACAAGAGCAGGTGGCAGCAGG GGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTAAGCT TGCTCCGGGTGGTGGCGGATCGGGAGGTGGCGG ATCCGATATCCAGCTCACTCAATCGCCATCATTTC TCTCCGCTTCGGTAGGCGACCGGGTCACGATCAC ATGCAGGGCGTCGCAAAGCATTGGGAGGTCTGTTG CATTGGTATCAGGAGAAACCCGAAAGGCCCCGA AACTTCTGATCAAATACGCATCACAAAGTTTGAG CGGTGTGCCGTCGCGCTTCTCCGGTTCGGAAGC GGAACGGAGTTCACGCTTACAATCTCCTCACTGC AGCCCGAGGATTTTCGCGACCTATTACTGTCACCA GTCATCCAGACTCCCGTTACTTTTGGCCCTGGGA	CAAGTTCAGTTG GTGGAGTCTGGA GCCGAAGTAGTA AAGCCAGGAGCT TCAGTGAAAGTC TCTTGTAAGCA AGTGGATTACG TTTAGCCGCTTTG CCATGCATTGGGT GCGGAAAGCTCC CGGTCAGGGGTT GGAGTGGATGGG AGTTATTAGTAT GACGGGGGCAAT AAGTACTACGCC GAGTCTGTAAAG GGTCGGGTCACA ATGACACGGGAC ACCTCAACCAGT ACACTCTATATGG AACTGTCTAGCCT GAGATCCGAGGA CACCGCTGTGTAT TATTGCGCTAGG GGGTACGATGTA TTGACGGGTTATC CTGATTACTGGG GGCAGGGGACAC TCGTAACCGTCTC TAGTACGGTGGC TGCACCATCTGTC TTCATCTTCCCGC CATCTGATGAGC AGTTGAAATCTG GAACTGCCTCTGT TGTGTGCCTGCTG AATAACTTCTATC CCAGAGAGGCCA AAGTACAGTGGA AGGTGGATAACG CCCTCCAATCGG GTAACCTCCAGG AGAGTGTACAG AGCAGGACAGCA AGGACAGCACCT ACAGCCTCAAGA GCACCCTGACGC TGAGCAAAGCAG ACTACGAGAAAC ACAAAGTCTACG

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		CCAAGGTGGACATTAAGCGTGCTAGTACAAAGGG CCCCTCCGTCTTTCCACTCGCACCCAGTTCAAAGT CCACTTCTGGAGGCACTGCGGCCTTGGGCTGTTTG GTGAAAGACTACTTCCCAGAGCCAGTGACAGTCT CTTGAATAGCGGAGCACTGACCAGCGGTGTGCA TACCTTTCCAGCTGTGCTGCAGAGCAGCGGCCTCT ACTCACTGGAGAGTGTGCTCACCGTTCCCTCTTCC AGCCTCGGCACTCAAACCTTACATCTGCAACGTGA ATCATAAGCCATCTAACACCAAGGTAGACAAGAA AGTC (SEQ ID NO: 610)	CCTGCGAAGTCA CCCATCAGGGCC TGAGCTCGCCCGT CACAAAGAGCTT CAACAGGGGAGA GTGT (SEQ ID NO: 630)
iPS:392526	SEQ ID NO: 287	CAGGTGCAGCTGGTGGGAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGAAAGTAGTGTTATTATCACTACAAATA CTACGGTATGGCCGTCTGGGGCCAAGGGACAACA GTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATC GGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCT CTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAA GGACTACTTCCCCGAACCGGTGACGGTGTGCTGG AACTCAGGCGCCCTGACCAGCGGCGTGACACCT TCCCGGCTGTCTACAGTCCTCAGGACTCTACTCC CTCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCT TGGGCACCCAGACCTACATCTGCAACGTGAATCA CAAGCCCAGCAACACCAAGGTGGACAAGAAAGT TGAGCCCCAATCTTGTGACAAAACCTCACACATGC CCACCGTGCCAGCACCTGAACTCCTGGGGGGAC CGTCAGTCTTCCTCTTCCCCCAAAACCCAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTCACAT GCGTGGTGGTGGACGTGAGCCACGAAGACCCTGA GGTCAAGTTCAACTGGTACGTGGACGGCGTGGAG GTGCATAATGCCAAGACAAAGCCGTGTGAGGAGC AGTACGGCAGCACGTACCGTTGTGTGTCAGCGTCCT CACCGTCCTGCACCAGGACTGGCTGAATGGCAAG GAGTACAAGTGCAAGGTCTCCAACAAAGCCCTCC CAGCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTG CCCCATCCCGGGAGGAGATGACCAAGAACCAGG TCAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCC AGCGACATCGCCGTGGAGTGGGAGAGCAATGGG CAGCCGGAGAACAACACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGC AAGCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGG CTCTGCACAACCACTACACGCAGAAGAGCCTAAG CTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGC GGATCCGATATCCAGCTCACTCAATCGCCATCATT TCTCTCCGCTTCGGTAGGCGACCGGGTCACGATC	SEQ ID NO: 629

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		ACATGCAGGGCGTCGCAAAGCATTGGGAGGTCGT TGCATTGGTATCAGCAGAAACCCGGAAAGGCCCC GAAACTTCTGATCAAATACGCATCACAAAGTTTG AGCGGTGTGCCGTCGCGCTTCTCCGGTTCCGGAA GCGGAACGGAGTTCACGCTTACAATCTCCTCACT GCAGCCCGAGGATTTCGCGACCTATTACTGTCAC CAGTCATCCAGACTCCCGTTTACTTTTGGCCCTGG GACCAAGGTGGACATTAAGCGTGCTAGTACAAAG GGCCCCCTCCGTCTTTCCACTCGCACCCAGTTCAAA GTCCACTTCTGGAGGCACTGCGGCCTTGGGCTGTT TGGTGAAGACTACTTCCCAGAGCCAGTGACAGT CTCTTGGAATAGCGGAGCACTGACCAGCGGTGTG CATACCTTTCCAGCTGTGCTGCAGAGCAGCGGCC TCTACTACTGGAGAGTGTGCTACCGTTCCCTCT TCCAGCCTCGGCACTCAAACCTTACATCTGCAACGT GAATCATAAGCCATCTAACACCAAGGTAGACAAG AAAGTC (SEQ ID NO: 611)	
iPS:392527	SEQ ID NO: 287	CAGGTGCAGCTGGTGGAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGAAAGTAGTGGTTATTATCACTACAAATA CTACGGTATGGCCGTCTGGGGCCAAGGGACAACA GTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATC GGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCT CTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAA GGACTACTTCCCCGAACCGGTGACGGTGTGCTGG AACTCAGGCGCCCTGACCAGCGGCGTGACACCT TCCCGGTGTGCTACAGTCCTCAGGACTCTACTCC CTCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCT TGGGCACCCAGACCTACATCTGCAACGTGAATCA CAAGCCCAGCAACACCAAGGTGGACAAGAAAGT TGAGCCCCAAATCTTGTGACAAAACCTCACACATGC CCACCGTGCCAGCACCTGAACTCCTGGGGGGAC CGTCAGTCTTCTCTTCCCCCAGAACCCAAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTCACAT GCGTGGTGGTGGACGTGAGCCACGAAGACCCTGA GGTCAAGTTCAACTGGTACGTGGACGGCGTGGAG GTGCATAATGCCAAGACAAAGCCGTGTGAGGAGC AGTACGGCAGCACGTACCGTTGTGTACGCTCCT CACCGTCTGACACAGGACTGGCTGAATGGCAAG GAGTACAAGTGCAAGGTCTCCAACAAAGCCCTCC CAGCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTG CCCCCATCCCGGGAGGAGATGACCAAGAACCAGG TCAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCC AGCGACATCGCCGTGGAGTGGGAGAGCAATGGG CAGCCGGAGAACAACCTACAAGACCACGCCTCCCG	SEQ ID NO: 630

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGC AAGCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGG CTCTGCACAACCACTACACGCAGAAGAGCCTAAG CTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGC GGATCCGATATCCAGCTCACTCAATCGCCATCATT TCTCTCCGCTTCGGTAGGCGACCGGGTCACGATC ACATGCAGGGCGTCGCAAAGCATTGGGAGGTCTGT TGCATTGGTATCAGGAGAAACCCGAAAGGCCCC GAAACTTCTGATCAAATACGCATCACAAAGTTTG AGCGGTGTGCCGTCGCGCTTCTCCGGTTCCGGAA GCGGAACGGAGTTCACGCTTACAATCTCCTCACT GCAGCCCGAGGATTTCCGCGACCTATTACTGTCAC CAGTCATCCAGACTCCCGTTTACTTTTGGCCCTGG GACCAAGGTGGACATTAAGCGTGCTAGTACAAAG GGCCCCTCCGTCTTTCCACTCGCACCCAGTTCAAA GTCCACTTCTGGAGGCACTGCGGCCTTGGGCTGTT TGGTGAAAGACTACTTCCCAGAGCCAGTGACAGT CTCTTGGAATAGCGGAGCACTGACCAGCGGTGTG CATACTTTCCAGCTGTGCTGCAGAGCAGCGGCC TCTACTCACTGGAGAGTGTCTGTCACCGTTCCCTCT TCCAGCCTCGGCACTCAAACCTTACATCTGCAACGT GAATCATAAGCCATCTAACACCAAGGTAGACAAG AAAGTC (SEQ ID NO: 612)	
iPS:392528	SEQ ID NO: 287	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGGACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCTC TGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTCTGTGA ACTCAGGCGCCCTGACCAGCGGCGTGACACACCTT CCCGGCTGTCCTACAGTCTCAGGACTCTACTCCC TCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCTT GGGCACCCAGACCTACATCTGCAACGTGAATCAC AAGCCAGCAACACCAAGGTGGACAAGAAAGTT GAGCCCAAATCTTGTGACAAAACCTCACACATGCC CACCGTGCCAGCACCTGAACTCCTGGGGGGACC GTCAGTCTTCTCTTCCCCCAAAACCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGC GTGGTGGTGGACGTGAGCCACGAAGACCCTGAGG TCAAGTTCAACTGGTACGTGGACGGCGTGAGGTT GCATAATGCCAAGACAAAGCCGTGTGAGGAGCA GTACGGCAGCACGTACCGTTGTGTGACGCTCCTC ACCGTCTGCACCAGGACTGGCTGAATGGCAAGG	CAAGTTCAGTTG GTGGAGTCTGGA GCCGAAGTAGTA AAGCCAGGAGCT TCAGTGAAAGTC TCTTGTAAGCA AGTGGATTACG TTTAGCCGCTTTG CCATGCATTGGGT GCGGCAAGCTCC CGGTCAGGGGTT GGAGTGGATGGG AGTTATTAGCTAT GACGGGGGCAAT AAGTACTACGCC GAGTCTGTTAAG GGTCGGGTCA ATGACACGGGAC ACCTCAACCAGT ACACTCTATATGG AACTGTCTAGCCT GAGATCCGAGGA CACCGCTGTGTAT TATTGCGCTAGG GGGTACGATGTA TTGACGGGTTATC CTGATTACTGGG GGCAGGGGACAC TCGTAACCGTCTC

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		AGTACAAGTGCAAGGTCTCCAACAAAGCCCTCCC AGCCCCCATCGAGAAAACCATCTCCAAAGCCAAA GGGCAGCCCCGAGAACACAGGTGTACACCCTGC CCCCATCCCCGGGAGGAGATGACCAAGAACCAGGT CAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCA GCGACATCGCCGTGGAGTGGGAGAGCAATGGGC AGCCGGAGAACAACTACAAGACCACGCCTCCCGT GCTGGACTCCGACGGCTCCTTCTTCTCTATAGCA AGCTCACCGTGGACAAGAGCAGGTGGCAGCAGG GGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTAAGCT TGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGG ATCCGATATCCAGCTCACTCAATCGCCATCATTTC TCTCCGCTTCGGTAGGCGACCGGGTCACGATCAC ATGCAGGGCGTCGCAAAGCATTGGGAGGTGCTTG CATTTGGTATCAGCAGAAACCCGAAAGGCCCGA AACTTCTGATCAAATACGCATCACAAAGTTTGAG CGGTGTGCCGTGCGCTTCTCCGGTTCGGAAGC GGAACGGAGTTCACGCTTACAATCTCCTCACTGC AGCCCGAGGATTTGCGGACCTATTACTGTCACCA GTCATCCAGACTCCCGTTTACTTTTGGCCCTGGGA CCAAGGTGGACATTAAGCGTACGGTGGCTGCACC ATCTGTCTTCATCTTCCCGCCATCTGATGAGCAGT TGAAATCTGGAAGTGCCTCTGTTGTGTGCCTGCTG AATAACTTCTATCCAGAGAGGCCAAAGTACAGT GGAAGGTGGATAACGCCCTCCAATCGGGTAACTC CCAGGAGAGTGTACAGAGCAGGACAGCAAGGA CAGCACCTACAGCCTCGAAAGCACCTGACGCTG AGCAAAGCAGACTACGAGAAACACAAAGTCTAC GCCTGCGAAGTACCCATCAGGGCCTGAGCTCGC CCGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 613)	TAGTGCCTCCACC AAGGGCCCATCG GTCTTCCCCCTGG CACCCTCCTCCAA GAGCACCTCTGG GGGCACAGCGGC CCTGGGCTGCCTG GTCAAGGACTAC TTCCCCGAACCG GTGACGGTGTGC TGGAAGTACAGGC GCCCTGACCAGC GCGGTGCACACC TTCCCGGTGTCC TACAGTCTCAG GACTCTACTCCCT CAAGAGCGTGGT GACCGTGCCCTCC AGCAGCTTGGGC ACCCAGACCTAC ATCTGCAACGTG AATCACAAGCCC AGCAACACCAAG GTGGACAAGAAA GTT (SEQ ID NO: 631)
iPS:392529	SEQ ID NO: 287	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGGACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCACCTCCTCCAAGAGCACCTC TGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTCTGTGA ACTCAGGCGCCCTGACCAGCGGCGTGCACACCTT CCCGGCTGTCTACAGTCCTCAGGACTCTACTCCC TCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCTT GGGCACCCAGACCTACATCTGCAACGTGAATCAC AAGCCCAGCAACACCAAGGTGGACAAGAAAGTT GAGCCCAAATCTTGTGACAAAACCTCACACATGCC	CAAGTTCAGTTG GTGGAGTCTGGA GCCGAAGTAGTA AAGCCAGGAGCT TCAGTGAAAGTC TCTTGTAAGCA AGTGGATTACG TTTAGCCGCTTTG CCATGCATTGGT GCGGAAAGCTCC CGGTCAGGGGTT GGAGTGGATGGG AGTTATTAGCTAT GACGGGGGCAAT AAGTACTACGCC GAGTCTGTAAAG GGTGCGGTGACA ATGACACGGGAC ACCTCAACCAAGT AACTCTATATGG AACTGTCTAGCCT

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		CACCGTGCCCAGCACCTGAACTCCTGGGGGGGACC GTCAGTCTTCCTCTTCCCCC AAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGC GTGGTGGTGGACGTGAGCCACGAAGACCCTGAGG TCAAGTTCAACTGGTACGTGGACGGCGTGAGGTT GCATAATGCCAAGACAAAGCCGTGTGAGGAGCA GTACGGCAGCACGTACCGTTGTGTGTCAGCGTCCTC ACCGTCTGCACCAGGACTGGCTGAATGGCAAGG AGTACAAGTGCAAGGTCTCCAACAAAGCCCTCCC AGCCCCATCGAGAAAACCATCTCCAAAGCCAAA GGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCGGGAGGAGATGACCAAGAACCAGGT CAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCA GCGACATCGCCGTGGAGTGGGAGAGCAATGGGC AGCCGGAGAACAACATAAGACCACGCCTCCCGT GCTGGACTCCGACGGCTCCTTCTTCTCTATAGCA AGCTCACCGTGGACAAGAGCAGGTGGCAGCAGG GGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTAAGCT TGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGG ATCCGATATCCAGCTCACTCAATCGCCATCATTTC TCTCCGCTTCGGTAGGCGACCGGGTCACGATCAC ATGCAGGGCGTCGCAAAGCATTGGGAGGTGCTTG CATTGGTATCAGGAGAAACCCGGAAGGCCCGGA AACTTCTGATCAAATACGCATCACAAAGTTTGAG CGGTGTGCCGTCGCGCTTCTCCGGTTCGGAAGC GGAACGGAGTTCACGCTTACAATCTCCTCACTGC AGCCCGAGGATTTTCGCGACCTATTACTGTCACCA GTCATCCAGACTCCCGTTTACTTTTGGCCCTGGGA CCAAGGTGGACATTAAGCGTACGGTGGCTGCACC ATCTGTCTTCATCTTCCCGCCATCTGATGAGCAGT TGAAATCTGGAAGTGCCTCTGTTGTGTGCCTGCTG AATAACTTCTATCCAGAGAGGCCAAAGTACAGT GGAAGGTGGATAACGCCCTCCAATCGGGTAACCTC CCAGGAGAGTGTACAGAGCAGGACAGCAAGGA CAGCACCTACAGCCTCGAAAGCACCTGACGCTG AGCAAAGCAGACTACGAGAAACACAAAGTCTAC GCCTGCGAAGTCACCCATCAGGGCCTGAGCTCGC CCGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 614)	GAGATCCGAGGA CACCGCTGTGTAT TATTGCGCTAGG GGGTACGATGTA TTGACGGGTATC CTGATTACTGGG GGCAGGGGACAC TCGTAACCGTCTC TAGTGCCTCCACC AAGGGCCCATCG GTCTTCCCCCTGG CACCCTCCTCAA GAGCACCTCTGG GGGCACAGCGGC CCTGGGCTGCCTG GTCAAGGACTAC TTCCCCGAACCG GTGACGGTGTGCG TGGAACCTCAGGC GCCCTGACCAGC GCGGTGCACACC TTCCCGGCTGTCC TACAGTCCTCAG GACTCTACTCCCT CAAGAGCGTGGT GACCGTGCCCTCC AGCAGCTTGGGC ACCCAGACCTAC ATCTGCAACGTG AATCACAAGCCC AGCAACACCAAG GTGGACAAGAAA GTT (SEQ ID NO: 632)
iPS:392532	SEQ ID NO: 287	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGAAAGTAGTGGTTATTATCACTACAAATA CTACGGTATGGCCGTCTGGGGCCAAGGGACAACA GTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATC GGTCTTCCCCCTGGCACCTCCTCCAAGAGCACCT	SEQ ID NO: 631

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		CTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAA GGACTACTTCCCCGAACCGGTGACGGTGTCTGG AACTCAGGCGCCCTGACCAGCGGCGTGACACCT TCCCGGTGTCTTACAGTCCTCAGGACTCTACTCC CTCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCT TGGGCACCCAGACCTACATCTGCAACGTGAATCA CAAGCCCAGCAACACCAAGGTGGACAAGAAAGT TGAGCCCAAATCTTGTGACAAAACCTCACACATGC CCACCGTGCCCGAGCACCTGAACTCCTGGGGGGAC CGTCAGTCTTCTCTTCCCCCAAAACCCAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTCACAT GCGTGGTGGTGGACGTGAGCCACGAAGACCCTGA GGTCAAGTTCAACTGGTACGTGGACGGCGTGGAG GTGCATAATGCCAAGACAAAGCCGTGTGAGGAGC AGTACGGCAGCACGTACCGTTGTGTGACGCGTCT CACCGTCTGCACCAGGACTGGCTGAATGGCAAG GAGTACAAGTGCAAGGTCTCCAACAAAGCCCTCC CAGCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTG CCCCCATCCCGGGAGGAGATGACCAAGAACCAGG TCAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCC AGCGACATCGCCGTGGAGTGGGAGAGCAATGGG CAGCCGGAGAACAACACTACAAGACCACGCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGC AAGCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGG CTCTGCACAACCACTACACGCAGAAGAGCCTAAG CTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGC GGATCCGATATCCAGCTCACTCAATCGCCATCATT TCTCTCCGCTTCGGTAGGCGACCGGGTCACGATC ACATGCAGGGCGTCGCAAAGCATTGGGAGGTCTGT TGCATTGGTATCAGCAGAAACCCGAAAGGCCCC GAAACTTCTGATCAAAATACGCATCACAAAGTTTG AGCGGTGTGCCGTGCGCTTCTCCGGTTCCGGAA GCGGAACGGAGTTCACGCTTACAATCTCCTCACT GCAGCCCGAGGATTTCCGCGACCTATTACTGTCAC CAGTCATCCAGACTCCCGTTTACTTTTGGCCCTGG GACCAAGGTGGACATTAAGCGTACGGTGGCTGCA CCATCTGTCTTCATCTTCCCGCCATCTGATGAGCA GTTGAAATCTGGAACTGCCTCTGTTGTGTGCCTGC TGAATAACTTCTATCCCAGAGAGGCCAAAGTACA GTGGAAGGTGGATAACGCCCTCCAATCGGGTAAC TCCCAGGAGAGTGTACAGAGCAGGACAGCAAG GACAGCACCTACAGCCTCGAAAGCACCCCTGACGC TGAGCAAAGCAGACTACGAGAAACACAAAGTCT ACGCCTGCGAAGTCACCCATCAGGGCCTGAGCTC GCCCGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 615)	
iPS:392533	SEQ ID NO: 287	CAGGTGCAGCTGGTGAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCCAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT	SEQ ID NO: 632

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGAAAGTAGTGGTTATTATCACTACAAATA CTACGGTATGGCCGTCTGGGGCCAAGGGACAACA GTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATC GGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCT CTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAA GGACTACTTCCCCGAACCGGTGACGGTGTCTGTGG AACTCAGGCGCCCTGACCAGCGGCGTGCACACCT TCCCGGCTGTCTACAGTCCTCAGGACTCTACTCC CTCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCT TGGGCACCCAGACCTACATCTGCAACGTGAATCA CAAGCCCAGCAACACCAAGGTGGACAAGAAAGT TGAGCCCCAAATCTTGTGACAAAACCTCACACATGC CCACCGTGCCAGCACCTGAACTCCTGGGGGGAC CGTCAGTCTTCCTCTTCCCCCAAACCCAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTCACAT GCGTGGTGGTGGACGTGAGCCACGAAGACCCCTGA GGTCAAGTTCAACTGGTACGTGGACGGCGTGGAG GTGCATAATGCCAAGACAAAGCCGTGTGAGGAGC AGTACGGCAGCACGTACCGTTGTGTACGCGTCCT CACCGTCCTGCACCAGGACTGGCTGAATGGCAAG GAGTACAAGTGCAAGGTCTCCAACAAAGCCCTCC CAGCCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTG CCCCCATCCCGGGAGGAGATGACCAAGAACCAGG TCAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCC AGCGACATCGCCGTGGAGTGGGAGAGCAATGGG CAGCCGGAGAACAACCTACAAGACCACGCCTCCCCG TGCTGGACTCCGACGGCTCCTTCTTCTCTATAGC AAGCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGG CTCTGCACAACCACTACACGCAGAAGAGCCTAAG CTTGCTCCGGGTGGTGGCGGATCGGGAGGTGGC GGATCCGATATCCAGCTCACTCAATCGCCATCATT TCTCTCCGCTTCGGTAGGCGACCGGGTCACGATC ACATGCAGGGCGTCGCAAAGCATTGGGAGGTCGT TGCATTGGTATCAGGAGAAACCCGAAAGGCCCC GAAACTTCTGATCAAATACGCATCACAAAGTTTG AGCGGTGTGCCGTGCGCTTCTCCGGTTCCGGAA GCGGAACGGAGTTCACGCTTACAATCTCCTCACT GCAGCCCGAGGATTTCCGCGACCTATTACTGTCAC CAGTCATCCAGACTCCCGTTTACTTTTGGCCCTGG GACCAAGGTGGACATTAAGCGTACGGTGGCTGCA CCATCTGTCTTCATCTTCCCGCCATCTGATGAGCA GTTGAAATCTGGAACTGCCTCTGTTGTGTGCCTGC TGAATAACTTCTATCCCAGAGAGGCCAAAGTACA GTGGAAGGTGGATAACGCCCTCCAATCGGGTAAC TCCAGGAGAGTGTACAGAGCAGGACAGCAAG GACAGCACCTACAGCCTCGAAAGCACCTGACGC TGAGCAAAGCAGACTACGAGAAACACAAAGTCT	

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		ACGCCTGCGAAGTCACCCATCAGGGCCTGAGCTC GCCCCGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 616)	
iPS:392530	CAGTCTGTG TTGACGCAG CCGCCCTCA GTGTCTGCG GCCCCAGGA CAGAAGGTC ACCATCTCC TGCTCTGGA AGCAGCTCC AACATTGGG AATAATTAT GTATCCTGG TACCAGAAG TCCCCAGGA ACAGCCCCC AAACTCCTC ATTTATGAC AATAATAAG CGACCTCA GGGATTCTC GACCGATTC TCTGGCTCC AAGTCTGGC ACGTCAACC ACCCTGGGC ATCACCGGA CTCCAGACT GGGGACGAG GCCGATTAT TACTGCGGA ACATGGGAT AGCCGCCTG AGTGCTGTG GTTTTCGGC GGAGGGACC AAGCTGACC GTCCTAGGT CAGCCCAAG GCCAACCCC ACTGTCACT CTGTTCCCG CCCTCCTCTG AGGAGCTCC AAGCCAACA AGGCCACAC TAGTGTGTC TGATCAGTG ACTTCTACC CGGGAGCTG TGACAGTGG	CAGGTGCAGCTGGTGAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCGAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGGACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCTC TGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTCTGTGGA ACTCAGGCGCCCTGACCAGCGGCGTGCACACCTT CCCGGCTGTCTTACAGTCCCTCAGGACTCTACTCCC TCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCTT GGGCACCCAGACCTACATCTGCAACGTGAATCAC AAGCCCAGCAACACCAAGGTGGACAAGAAAGTT GAGCCCAAATCTTGTGACAAAACCTCACACATGCC CACCGTGCCCAGCACCTGAACTCCTGGGGGGACC GTCAGTCTTCTCTTCCCCCCTTCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGC GTGGTGGTGGACGTGAGCCACGAAGACCCTGAGG TCAAGTTCAACTGGTACGTGGACGGCGTGGAGGT GCATAATGCCAAGACAAAGCCGTGTGAGGAGCA GTACGGCAGCACGTACCGTTGTGTGTCAGCGTCCCTC ACCGTCTGCAACCAGGACTGGCTGAATGGCAAGG AGTACAAGTGCAAGGTCTCCAACAAAGCCCTCCC AGCCCCATCGAGAAAACCATCTCCAAAGCCAAA GGGCAGCCCCGAGAACACAGGTGTACACCCTGC CCCCATCCCGGGAGGAGATGACCAAGAACCAGGT CAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCA GCGACATCGCCGTGGAGTGGGAGAGCAATGGGC AGCCGGAGAACAACCTACAAGACCACGCCTCCCGT GCTGGACTCCGACGGCTCCTTCTTCTCTATAGCA AGCTCACCGTGGACAAGAGCAGGTGGCAGCAGG GGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGAGAAAGAGCCTAAGCT TGCTCCGGGTGGTGGCGGATCGGGAGGTGGCGG ATCCGATATCCAGCTCACTCAATCGCCATCATTTC TCTCCGCTTCGGTAGGCGACCGGGTCACGATCAC ATGCAGGGCGTCGCAAAGCATTGGGAGGTCTGTTG CATTGGTATCAGCAGAAACCCGAAAGGCCCCGA AACTTCTGATCAAATACGCATCACAAAGTTTGAG CGGTGTGCCGTGCGCTTCTCCGGTTCGGAAGC GGAACGGAGTTCACGCTTACAATCTCCTCACTGC AGCCCGAGGATTTTCGCGACCTATTACTGTCACCA GTCATCCAGACTCCCGTTACTTTTGGCCCTGGGA	SEQ ID NO: 631

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
	CCTGGAAGG CAGATGGCA GCCCCGTCA AGGCGGGAG TGGAGACCA CCAAACCCT CCAAACAGA GCAACAACA AGTACGCGG CCAAGAGCT ACCTGAGCC TGACGCCCC AGCAGTGGA AGTCCCACA GAAGCTACA GCTGCCAGG TCACGCATG AAGGGAGCA CCGTGGAGA AGACAGTGG CCCCTACAG AATGTTCA (SEQ ID NO: 596)	CCAAGGTGGACATTAAGCGTACGGTGGCTGCACC ATCTGTCTTCATCTTCCC GCCATCTGATGAGCAGT TGAAATCTGGAAGTGCCTCTGTTGTGTGCCTGCTG AATAACTTCTATCCCAGAGAGGCCAAAGTACAGT GGAAGGTGGATAACGCCCTCCAATCGGGTAACTC CCAGGAGAGTGTACAGAGCAGGACAGCAAGGA CAGCACCTACAGCCTCGAAAGCACCTGACGCTG AGCAAAGCAGACTACGAGAAACACAAAGTCTAC GCCTGCGAAGTCACCCATCAGGGCCTGAGCTCGC CCGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 617)	
iPS:392531	SEQ ID NO: 596	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCGAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGATAGTAGTGGTTATTATCACTACAAATAC TACGGTATGGCCGTCTGGGGCCAAGGGACAACAG TTACCGTCTCTAGTGCCTCCACCAAGGGCCCATCG GTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCTC TGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAAG GACTACTTCCCCGAACCGGTGACGGTGTCTGTGA ACTCAGGCGCCCTGACCAGCGGCGTGCACACCTT CCCGGCTGTCTACAGTCCTCAGGACTCTACTCCC TCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCTT GGGCACCCAGACCTACATCTGCAACGTGAATCAC AAGCCCAGCAACACCAAGGTGGACAAGAAAGTT GAGCCCAAATCTTGTGACAAAACCTCACACATGCC CACCGTGCCAGCACCTGAACTCCTGGGGGGACC GTCAGTCTTCTCTTCCCCC AAAACCCAAGGACA CCCTCATGATCTCCCGGACCCCTGAGGTCACATGC GTGGTGGTGGACGTGAGCCACGAAGACCCTGAGG TCAAGTTCAACTGGTACGTGGACGGCGTGGAGGT GCATAATGCCAAGACAAAGCCGTGTGAGGAGCA	SEQ ID NO: 632

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		GTACGGCAGCACGTACCGTTGTGTGTCAGCGTCCTC ACCGTCTCTGCACCAGGACTGGCTGAATGGCAAGG AGTACAAGTGCAAGGTCTCCAACAAAGCCCTCCC AGCCCCCATCGAGAAAACCATCTCCAAAGCCAAA GGGCAGCCCCGAGAACCACAGGTGTACACCCTGC CCCCATCCCCGGGAGGAGATGACCAAGAACCAGGT CAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCCA GCGACATCGCCGTGGAGTGGGAGAGCAATGGGC AGCCGGAGAACAACCTACAAGACCACGCCTCCCGT GCTGGACTCCGACGGCTCCTTCTTCTCTATAGCA AGCTACCGTGGACAAGAGCAGGTGGCAGCAGG GGAACGTCTTCTCATGCTCCGTGATGCATGAGGCT CTGCACAACCACTACACGCAGAAGAGCCTAAGCT TGTCTCCGGGTGGTGGCGGATCGGGAGGTGGCGG ATCCGATATCCAGCTCACTCAATCGCCATCATTTC TCTCCGCTTCGGTAGGCGACCGGGTCACGATCAC ATGCAGGGCGTCGCAAAGCATTGGGAGGTCTGTG CATTGGTATCAGGAGAAACCCGAAAGGCCCGGA AACTTCTGATCAAATACGCATCACAAAGTTTGAG CGGTGTGCCGTCGCGCTTCTCCGGTTCGGAAGC GGAACGGAGTTCACGCTTACAATCTCCTCACTGC AGCCCGAGGATTTTCGCGACCTATTACTGTCACCA GTCATCCAGACTCCCGTTTACTTTTGGCCCTGGGA CCAAGGTGGACATTAAGCGTACGGTGGCTGCACC ATCTGTCTTCATCTTCCCGCCATCTGATGAGCAGT TGAAATCTGGAAGTGCCTCTGTTGTGTGCCTGCTG AATAACTTCTATCCCAGAGAGGCCAAAGTACAGT GGAAGGTGGATAACGCCCTCCAATCGGGTAACTC CCAGGAGAGTGTACAGAGCAGGACAGCAAGGA CAGCACCTACAGCCTCGAAAGCACCTGACGCTG AGCAAAGCAGACTACGAGAAACACAAAGTCTAC GCCTGCGAAGTACCCATCAGGGCCTGAGCTCGC CCGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 618)	
iPS:392534	SEQ ID NO: 596	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCGAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTGTGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGAAAGTAGTGTTATTATCACTACAAATA CTACGGTATGGCCGTCTGGGGCCAAGGGACAACA GTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATC GGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCT CTGGGGGCACAGCGGCCCTGGGCTGCCTGGTCAA GGACTACTTCCCCGAACCGGTGACGGTGTCTGTGG AACTCAGGCGCCCTGACCAGCGGCGTGCACACCT TCCCGGTGTCTACAGTCCTCAGGACTCTACTCC CTCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCT TGGGCACCCAGACCTACATCTGCAACGTGAATCA	SEQ ID NO: 631

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		CAAGCCCAGCAACACCAAGGTGGACAAGAAAGT TGAGCCCCAAATCTTGTGACAAAACCTCACACATGC CCACCGTGCCCAGCACCTGAACTCCTGGGGGGAC CGTCAGTCTTCCTCTTCCCCC AAAACCCAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTCACAT GCGTGGTGGTGGACGTGAGCCACGAAGACCCTGA GGTCAAGTTCAACTGGTACGTGGACGGCGTGGAG GTGCATAATGCCAAGACAAAGCCGTGTGAGGAGC AGTACGGCAGCACGTACCGTTGTGTGACGCTCCT CACCGTCCTGCACCAGGACTGGCTGAATGGCAAG GAGTACAAGTGCAAGGTCTCCAACAAAGCCCTCC CAGCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTG CCCCATCCCGGGAGGAGATGACCAAGAACCAGG TCAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCC AGCGACATCGCCGTGGAGTGGGAGAGCAATGGG CAGCCGGAGAACAACACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTTCCTCTATAGC AAGCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGG CTCTGCACAACCACTACACGCAGAAGAGCCTAAG CTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGC GGATCCGATATCCAGCTCACTCAATCGCCATCATT TCTCTCCGCTTCGGTAGGCGACCGGGTCACGATC ACATGCAGGGCGTCGCAAAGCATTGGGAGGTCGT TGCATTGGTATCAGCAGAAACCCGAAAGGCCCC GAAACTTCTGATCAAATACGCATCACAAAGTTTG AGCGGTGTGCCGTGCGCTTCTCCGGTTCCGGAA GCGGAACGGAGTTCACGCTTACAATCTCCTCACT GCAGCCCGAGGATTTCGCGACCTATTACTGTCAC CAGTCATCCAGACTCCCGTTTACTTTTGGCCCTGG GACCAAGGTGGACATTAAGCGTACGGTGGCTGCA CCATCTGTCTTCATCTTCCCGCCATCTGATGAGCA GTTGAAATCTGGAAGTGCCTCTGTTGTGTGCCTGC TGAATAACTTCTATCCAGAGAGGCCAAAGTACA GTGGAAGGTGGATAACGCCCTCCAATCGGGTAAC TCCCAGGAGAGTGTACAGAGCAGGACAGCAAG GACAGCACCTACAGCCTCGAAAGCACCCCTGACGC TGAGCAAAGCAGACTACGAGAAACACAAAGTCT ACGCCTGCGAAGTCACCCATCAGGGCCTGAGCTC GCCCGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 619)	
iPS:392535	SEQ ID NO: 596	CAGGTGCAGCTGGTGGAAATCTGGGGGAGGCGTGG TCCAGCCTGGGAGGTCCCTGAGACTCTCCTGTGC AGCCTCTGGATTACCTTCAGTAGCTTTGGCATGC ACTGGGTCCGCGAGGCTCCAGGCAAGGGGCTGGA GTGGGTGGCAGTTATATCATTTGATGGAAGTATT AAGTATTCTGTAGACTCCGTGAAGGGCCGATTCA CCATCTCCAGAGACAATTCAAAGAACACGCTGTT TCTGCAAATGAACAGCCTGCGAGCCGAGGACACG GCTGTGTATTACTGTGCGAGAGATCGGCTCAATT ACTATGAAAGTAGTGGTTATTATCACTACAAATA CTACGGTATGGCCGTCTGGGGCCAAGGGACAACA	SEQ ID NO: 632

IgG-Fab Molecule Designation	Light Chain Nucleic Acid Sequence	Modified Heavy Chain Nucleic Acid Sequence	Second Polypeptide Nucleic Acid Sequence
		GTTACCGTCTCTAGTGCCTCCACCAAGGGCCCATC GGTCTTCCCCCTGGCACCCCTCCTCCAAGAGCACCT CTGGGGGACACAGCGGCCCTGGGCTGCCTGGTCAA GGACTACTTCCCCGAACCGGTGACGGTGTCTGG AACTCAGGCGCCCTGACCAGCGGCGTGACACCT TCCCGGTGTCTACAGTCCTCAGGACTCTACTCC CTCGAAAGCGTGGTGACCGTGCCCTCCAGCAGCT TGGGCACCCAGACCTACATCTGCAACGTGAATCA CAAGCCCAGCAACACCAAGGTGGACAAGAAAGT TGAGCCCAAATCTTGTGACAAAACCTCACACATGC CCACCGTGCCAGCACCTGAACTCCTGGGGGGAC CGTCAGTCTTCTCTTCCCCCAAAACCCAAGGAC ACCCTCATGATCTCCCGGACCCCTGAGGTCACAT GCGTGGTGGTGGACGTGAGCCACGAAGACCCTGA GGTCAAGTTCAACTGGTACGTGGACGGCGTGGAG GTGCATAATGCCAAGACAAAAGCCGTGTGAGGAGC AGTACGGCAGCACGTACCGTTGTGTACGCGTCT CACCGTCTGCACCAGGACTGGCTGAATGGCAAG GAGTACAAGTGCAAGGTCTCCAACAAAGCCCTCC CAGCCCCATCGAGAAAACCATCTCCAAAGCCAA AGGGCAGCCCCGAGAACCACAGGTGTACACCCTG CCCCATCCCGGGAGGAGATGACCAAGAACCAGG TCAGCCTGACCTGCCTGGTCAAAGGCTTCTATCCC AGCGACATCGCCGTGGAGTGGGAGAGCAATGGG CAGCCGAGAACAACTACAAGACCACGCCTCCCG TGCTGGACTCCGACGGCTCCTTCTCCTCTATAGC AAGCTCACCGTGGACAAGAGCAGGTGGCAGCAG GGGAACGTCTTCTCATGCTCCGTGATGCATGAGG CTCTGCACAACCACTACACGCAGAAGAGCCTAAG CTTGTCTCCGGGTGGTGGCGGATCGGGAGGTGGC GGATCCGATATCCAGCTCACTCAATCGCCATCATT TCTCTCCGCTTCGGTAGGCGACCGGGTCACGATC ACATGCAGGGCGTCGCAAAGCATTGGGAGGTCTGT TGCATTGGTATCAGGAGAAACCCGAAAGGCCCC GAAACTTCTGATCAAATACGCATCACAAAGTTTG AGCGGTGTGCCGTGCGCTTCTCCGGTTCCGGAA GCGGAACGGAGTTCACGCTTACAATCTCCTCACT GCAGCCCCGAGGATTTTCGCGACCTATTACTGTCAC CAGTCATCCAGACTCCCGTTTACTTTTGGCCCTGG GACCAAGGTGGACATTAAGCGTACGGTGGCTGCA CCATCTGTCTTCATCTTCCCGCCATCTGATGAGCA GTTGAAATCTGGAACCTGCCTCTGTTGTGTGCCTGC TGAATAACTTCTATCCCAGAGAGGCCAAAGTACA GTGGAAGGTGGATAACGCCCTCCAATCGGGTAAC TCCCAGGAGAGTGTACAGAGCAGGACAGCAAG GACAGCACCTACAGCCTCGAAAGCACCCCTGACGC TGAGCAAAGCAGACTACGAGAAACACAAAGTCT ACGCCTGCGAAGTCACCCATCAGGGCCTGAGCTC GCCCGTCACAAAGAGCTTCAACAGGGGAGAGTGT (SEQ ID NO: 620)	

[0169] The nucleic acid sequences provided in Tables 6A, 6B, 7A, 7B, and 11-14 are exemplary only. As will be appreciated by those in the art, due to the degeneracy of the genetic code, an extremely large number of nucleic acids may be made, all of which encode the CDRs (and heavy and light chains or other components of the antigen binding proteins described herein) of the invention. Thus, having identified a particular amino acid sequence, those skilled in the art could make any number of different nucleic acids, by simply modifying the sequence of one or more codons in a way which does not change the amino acid sequence of the encoded protein.

[0170] The present invention also includes vectors comprising one or more nucleic acids encoding one or more components of the bispecific antigen binding proteins of the invention (e.g. variable regions, light chains, heavy chains, modified heavy chains, and Fd fragments). The term “vector” refers to any molecule or entity (e.g., nucleic acid, plasmid, bacteriophage or virus) used to transfer protein coding information into a host cell. Examples of vectors include, but are not limited to, plasmids, viral vectors, non-episomal mammalian vectors and expression vectors, for example, recombinant expression vectors. The term “expression vector” or “expression construct” as used herein refers to a recombinant DNA molecule containing a desired coding sequence and appropriate nucleic acid control sequences necessary for the expression of the operably linked coding sequence in a particular host cell. An expression vector can include, but is not limited to, sequences that affect or control transcription, translation, and, if introns are present, affect RNA splicing of a coding region operably linked thereto. Nucleic acid sequences necessary for expression in prokaryotes include a promoter, optionally an operator sequence, a ribosome binding site and possibly other sequences. Eukaryotic cells are known to utilize promoters, enhancers, and termination and polyadenylation signals. A secretory signal peptide sequence can also, optionally, be encoded by the expression vector, operably linked to the coding sequence of interest, so that the expressed polypeptide can be secreted by the recombinant host cell, for more facile isolation of the polypeptide of interest from the cell, if desired. For instance, in some embodiments, signal peptide sequences may be appended/fused to the amino terminus of any of the polypeptides sequences listed in Tables 6A, 6B, 7A, 7B, 9 and 10. In certain embodiments, a signal peptide having the amino acid sequence of MDMRVPAQLLGLLLLWLRGARC (SEQ ID NO: 633) is fused to the amino terminus of any of the polypeptide sequences in Tables 6A, 6B, 7A, 7B, 9 and 10. In other embodiments, a signal peptide having the amino acid sequence of MAWALLLTLLTQGTGSWA (SEQ ID NO:

634) is fused to the amino terminus of any of the polypeptide sequences in Tables 6A, 6B, 7A, 7B, 9 and 10. In still other embodiments, a signal peptide having the amino acid sequence of MTCSPLLLTLIHCTGSWA (SEQ ID NO: 635) is fused to the amino terminus of any of the polypeptide sequences in Tables 6A, 6B, 7A, 7B, 9 and 10. Other suitable signal peptide sequences that can be fused to the amino terminus of the polypeptide sequences described herein include: MEAPAQLLFLLLLWLPDTTG (SEQ ID NO: 636), MEWTWRVFLVAAATGAHS (SEQ ID NO: 637), METPAQLLFLLLLWLPDTTG (SEQ ID NO: 638), METPAQLLFLLLLWLPDTTG (SEQ ID NO: 639), MKHLWFFLLLVAAPRWVLS (SEQ ID NO: 640), and MEWSWVFLFFLSVTTGVHS (SEQ ID NO: 641). Other signal peptides are known to those of skill in the art and may be fused to any of the polypeptide chains listed in Tables 6A, 6B, 7A, 7B, 9 and 10, for example, to facilitate or optimize expression in particular host cells.

[0171] Typically, expression vectors used in the host cells to produce the bispecific antigen proteins of the invention will contain sequences for plasmid maintenance and for cloning and expression of exogenous nucleotide sequences encoding the components of the bispecific antigen binding proteins. Such sequences, collectively referred to as “flanking sequences,” in certain embodiments will typically include one or more of the following nucleotide sequences: a promoter, one or more enhancer sequences, an origin of replication, a transcriptional termination sequence, a complete intron sequence containing a donor and acceptor splice site, a sequence encoding a leader sequence for polypeptide secretion, a ribosome binding site, a polyadenylation sequence, a polylinker region for inserting the nucleic acid encoding the polypeptide to be expressed, and a selectable marker element. Each of these sequences is discussed below.

[0172] Optionally, the vector may contain a “tag”-encoding sequence, i.e., an oligonucleotide molecule located at the 5' or 3' end of the polypeptide coding sequence; the oligonucleotide tag sequence encodes polyHis (such as hexaHis), FLAG, HA (hemagglutinin influenza virus), myc, or another “tag” molecule for which commercially available antibodies exist. This tag is typically fused to the polypeptide upon expression of the polypeptide, and can serve as a means for affinity purification or detection of the polypeptide from the host cell. Affinity purification can be accomplished, for example, by column chromatography using antibodies against the tag as an affinity matrix. Optionally, the tag can subsequently be removed from the purified polypeptide by various means such as using certain peptidases for cleavage.

[0173] Flanking sequences may be homologous (i.e., from the same species and/or strain as the host cell), heterologous (i.e., from a species other than the host cell species or strain), hybrid (i.e., a combination of flanking sequences from more than one source), synthetic or native. As such, the source of a flanking sequence may be any prokaryotic or eukaryotic organism, any vertebrate or invertebrate organism, or any plant, provided that the flanking sequence is functional in, and can be activated by, the host cell machinery.

[0174] Flanking sequences useful in the vectors of this invention may be obtained by any of several methods well known in the art. Typically, flanking sequences useful herein will have been previously identified by mapping and/or by restriction endonuclease digestion and can thus be isolated from the proper tissue source using the appropriate restriction endonucleases. In some cases, the full nucleotide sequence of a flanking sequence may be known. Here, the flanking sequence may be synthesized using routine methods for nucleic acid synthesis or cloning.

[0175] Whether all or only a portion of the flanking sequence is known, it may be obtained using polymerase chain reaction (PCR) and/or by screening a genomic library with a suitable probe such as an oligonucleotide and/or flanking sequence fragment from the same or another species. Where the flanking sequence is not known, a fragment of DNA containing a flanking sequence may be isolated from a larger piece of DNA that may contain, for example, a coding sequence or even another gene or genes. Isolation may be accomplished by restriction endonuclease digestion to produce the proper DNA fragment followed by isolation using agarose gel purification, Qiagen® column chromatography (Chatsworth, CA), or other methods known to the skilled artisan. The selection of suitable enzymes to accomplish this purpose will be readily apparent to one of ordinary skill in the art.

[0176] An origin of replication is typically a part of those prokaryotic expression vectors purchased commercially, and the origin aids in the amplification of the vector in a host cell. If the vector of choice does not contain an origin of replication site, one may be chemically synthesized based on a known sequence, and ligated into the vector. For example, the origin of replication from the plasmid pBR322 (New England Biolabs, Beverly, MA) is suitable for most gram-negative bacteria, and various viral origins (e.g., SV40, polyoma, adenovirus, vesicular stomatitis virus (VSV), or papillomaviruses such as HPV or BPV) are useful for cloning vectors in mammalian cells. Generally, the origin of replication component is not needed for mammalian

expression vectors (for example, the SV40 origin is often used only because it also contains the virus early promoter).

[0177] A transcription termination sequence is typically located 3' to the end of a polypeptide coding region and serves to terminate transcription. Usually, a transcription termination sequence in prokaryotic cells is a G-C rich fragment followed by a poly-T sequence. While the sequence is easily cloned from a library or even purchased commercially as part of a vector, it can also be readily synthesized using known methods for nucleic acid synthesis.

[0178] A selectable marker gene encodes a protein necessary for the survival and growth of a host cell grown in a selective culture medium. Typical selection marker genes encode proteins that (a) confer resistance to antibiotics or other toxins, e.g., ampicillin, tetracycline, or kanamycin for prokaryotic host cells; (b) complement auxotrophic deficiencies of the cell; or (c) supply critical nutrients not available from complex or defined media. Specific selectable markers are the kanamycin resistance gene, the ampicillin resistance gene, and the tetracycline resistance gene. Advantageously, a neomycin resistance gene may also be used for selection in both prokaryotic and eukaryotic host cells.

[0179] Other selectable genes may be used to amplify the gene that will be expressed.

Amplification is the process wherein genes that are required for production of a protein critical for growth or cell survival are reiterated in tandem within the chromosomes of successive generations of recombinant cells. Examples of suitable selectable markers for mammalian cells include dihydrofolate reductase (DHFR) and promoterless thymidine kinase genes. Mammalian cell transformants are placed under selection pressure wherein only the transformants are uniquely adapted to survive by virtue of the selectable gene present in the vector. Selection pressure is imposed by culturing the transformed cells under conditions in which the concentration of selection agent in the medium is successively increased, thereby leading to the amplification of both the selectable gene and the DNA that encodes another gene, such as one or more components of the bispecific antigen binding proteins described herein. As a result, increased quantities of a polypeptide are synthesized from the amplified DNA.

[0180] A ribosome-binding site is usually necessary for translation initiation of mRNA and is characterized by a Shine-Dalgarno sequence (prokaryotes) or a Kozak sequence (eukaryotes). The element is typically located 3' to the promoter and 5' to the coding sequence of the polypeptide to be expressed. In certain embodiments, one or more coding regions may be

operably linked to an internal ribosome binding site (IRES), allowing translation of two open reading frames from a single RNA transcript.

[0181] In some cases, such as where glycosylation is desired in a eukaryotic host cell expression system, one may manipulate the various pre- or prosequences to improve glycosylation or yield. For example, one may alter the peptidase cleavage site of a particular signal peptide, or add prosequences, which also may affect glycosylation. The final protein product may have, in the -1 position (relative to the first amino acid of the mature protein) one or more additional amino acids incident to expression, which may not have been totally removed. For example, the final protein product may have one or two amino acid residues found in the peptidase cleavage site, attached to the amino-terminus. Alternatively, use of some enzyme cleavage sites may result in a slightly truncated form of the desired polypeptide, if the enzyme cuts at such area within the mature polypeptide.

[0182] Expression and cloning vectors of the invention will typically contain a promoter that is recognized by the host organism and operably linked to the molecule encoding the polypeptide. The term “operably linked” as used herein refers to the linkage of two or more nucleic acid sequences in such a manner that a nucleic acid molecule capable of directing the transcription of a given gene and/or the synthesis of a desired protein molecule is produced. For example, a control sequence in a vector that is “operably linked” to a protein coding sequence is ligated thereto so that expression of the protein coding sequence is achieved under conditions compatible with the transcriptional activity of the control sequences. More specifically, a promoter and/or enhancer sequence, including any combination of cis-acting transcriptional control elements is operably linked to a coding sequence if it stimulates or modulates the transcription of the coding sequence in an appropriate host cell or other expression system.

[0183] Promoters are untranscribed sequences located upstream (i.e., 5') to the start codon of a structural gene (generally within about 100 to 1000 bp) that control transcription of the structural gene. Promoters are conventionally grouped into one of two classes: inducible promoters and constitutive promoters. Inducible promoters initiate increased levels of transcription from DNA under their control in response to some change in culture conditions, such as the presence or absence of a nutrient or a change in temperature. Constitutive promoters, on the other hand, uniformly transcribe a gene to which they are operably linked, that is, with little or no control over gene expression. A large number of promoters, recognized by a variety of potential host

cells, are well known. A suitable promoter is operably linked to the DNA encoding e.g., heavy chain, light chain, modified heavy chain, or other component of the bispecific antigen binding proteins of the invention, by removing the promoter from the source DNA by restriction enzyme digestion and inserting the desired promoter sequence into the vector.

[0184] Suitable promoters for use with yeast hosts are also well known in the art. Yeast enhancers are advantageously used with yeast promoters. Suitable promoters for use with mammalian host cells are well known and include, but are not limited to, those obtained from the genomes of viruses such as polyoma virus, fowlpox virus, adenovirus (such as Adenovirus 2), bovine papilloma virus, avian sarcoma virus, cytomegalovirus, retroviruses, hepatitis-B virus and most preferably Simian Virus 40 (SV40). Other suitable mammalian promoters include heterologous mammalian promoters, for example, heat-shock promoters and the actin promoter.

[0185] Additional promoters which may be of interest include, but are not limited to: SV40 early promoter (Benoist and Chambon, 1981, *Nature* 290:304-310); CMV promoter (Thorsen et al., 1984, *Proc. Natl. Acad. U.S.A.* 81:659-663); the promoter contained in the 3' long terminal repeat of Rous sarcoma virus (Yamamoto et al., 1980, *Cell* 22:787-797); herpes thymidine kinase promoter (Wagner et al., 1981, *Proc. Natl. Acad. Sci. U.S.A.* 78: 1444-1445); promoter and regulatory sequences from the metallothionein gene Prinster et al., 1982, *Nature* 296:39-42); and prokaryotic promoters such as the beta-lactamase promoter (Villa-Kamaroff et al., 1978, *Proc. Natl. Acad. Sci. U.S.A.* 75:3727-3731); or the tac promoter (DeBoer et al., 1983, *Proc. Natl. Acad. Sci. U.S.A.* 80:21-25). Also of interest are the following animal transcriptional control regions, which exhibit tissue specificity and have been utilized in transgenic animals: the elastase I gene control region that is active in pancreatic acinar cells (Swift et al., 1984, *Cell* 38:639-646; Ornitz et al., 1986, *Cold Spring Harbor Symp. Quant. Biol.* 50:399-409; MacDonald, 1987, *Hepatology* 7:425-515); the insulin gene control region that is active in pancreatic beta cells (Hanahan, 1985, *Nature* 315: 115-122); the immunoglobulin gene control region that is active in lymphoid cells (Grosschedl et al., 1984, *Cell* 38:647-658; Adames et al., 1985, *Nature* 318:533-538; Alexander et al., 1987, *Mol. Cell. Biol.* 7: 1436-1444); the mouse mammary tumor virus control region that is active in testicular, breast, lymphoid and mast cells (Leder et al., 1986, *Cell* 45:485-495); the albumin gene control region that is active in liver (Pinkert et al., 1987, *Genes and Devel.* 1 :268-276); the alpha-feto-protein gene control region that is active in liver (Krumlauf et al., 1985, *Mol. Cell. Biol.* 5: 1639-1648; Hammer et al., 1987, *Science* 253:53-58);

the alpha 1-antitrypsin gene control region that is active in liver (Kelsey et al., 1987, *Genes and Devel.* 1: 161-171); the beta-globin gene control region that is active in myeloid cells (Mogam et al, 1985, *Nature* 315:338-340; Kollias et al, 1986, *Cell* 46:89-94); the myelin basic protein gene control region that is active in oligodendrocyte cells in the brain (Readhead et al., 1987, *Cell* 48:703-712); the myosin light chain-2 gene control region that is active in skeletal muscle (Sani, 1985, *Nature* 314:283-286); and the gonadotropic releasing hormone gene control region that is active in the hypothalamus (Mason et al., 1986, *Science* 234: 1372-1378).

[0186] An enhancer sequence may be inserted into the vector to increase transcription of DNA encoding a component of the bispecific antigen binding proteins (e.g., light chain, heavy chain, modified heavy chain, Fd fragment) by higher eukaryotes. Enhancers are cis-acting elements of DNA, usually about 10-300 bp in length, that act on the promoter to increase transcription. Enhancers are relatively orientation and position independent, having been found at positions both 5' and 3' to the transcription unit. Several enhancer sequences available from mammalian genes are known (e.g., globin, elastase, albumin, alpha-feto-protein and insulin). Typically, however, an enhancer from a virus is used. The SV40 enhancer, the cytomegalovirus early promoter enhancer, the polyoma enhancer, and adenovirus enhancers known in the art are exemplary enhancing elements for the activation of eukaryotic promoters. While an enhancer may be positioned in the vector either 5' or 3' to a coding sequence, it is typically located at a site 5' from the promoter. A sequence encoding an appropriate native or heterologous signal sequence (leader sequence or signal peptide) can be incorporated into an expression vector, to promote extracellular secretion of the antibody. The choice of signal peptide or leader depends on the type of host cells in which the antibody is to be produced, and a heterologous signal sequence can replace the native signal sequence. Examples of signal peptides are described above. Other signal peptides that are functional in mammalian host cells include the signal sequence for interleukin-7 (IL-7) described in US Patent No. 4,965,195; the signal sequence for interleukin-2 receptor described in Cosman et al., 1984, *Nature* 312:768; the interleukin-4 receptor signal peptide described in EP Patent No. 0367 566; the type I interleukin-1 receptor signal peptide described in U.S. Patent No. 4,968,607; the type II interleukin-1 receptor signal peptide described in EP Patent No. 0 460 846.

[0187] The expression vectors that are provided may be constructed from a starting vector such as a commercially available vector. Such vectors may or may not contain all of the desired

flanking sequences. Where one or more of the flanking sequences described herein are not already present in the vector, they may be individually obtained and ligated into the vector. Methods used for obtaining each of the flanking sequences are well known to one skilled in the art. The expression vectors can be introduced into host cells to thereby produce proteins, including fusion proteins, encoded by nucleic acids as described herein.

[0188] In certain embodiments, nucleic acids encoding the different components of the bispecific antigen binding proteins of the invention may be inserted into the same expression vector. For instance, the nucleic acid encoding an anti-PAC1 receptor light chain can be cloned into the same vector as the nucleic acid encoding an anti-PAC1 receptor heavy chain. In such embodiments, the two nucleic acids may be separated by an internal ribosome entry site (IRES) and under the control of a single promoter such that the light chain and heavy chain are expressed from the same mRNA transcript. Alternatively, the two nucleic acids may be under the control of two separate promoters such that the light chain and heavy chain are expressed from two separate mRNA transcripts. In some embodiments, nucleic acids encoding the anti-PAC1 receptor light chain and heavy chain are cloned into one expression vector and the nucleic acids encoding the anti-CGRP receptor light chain and heavy chain are cloned into a second expression vector.

[0189] Similarly, for IgG-scFv bispecific antigen binding proteins, the nucleic acid encoding the light chain may be cloned into the same expression vector as the nucleic acid encoding the modified heavy chain (fusion protein comprising the heavy chain and scFv) where the two nucleic acids are under the control of a single promoter and separated by an IRES or where the two nucleic acids are under the control of two separate promoters. For IgG-Fab bispecific antigen binding proteins, nucleic acids encoding each of the three components may be cloned into the same expression vector. In some embodiments, the nucleic acid encoding the light chain of the IgG-Fab molecule and the nucleic acid encoding the second polypeptide (which comprises the other half of the C-terminal Fab domain) are cloned into one expression vector, whereas the nucleic acid encoding the modified heavy chain (fusion protein comprising a heavy chain and half of a Fab domain) is cloned into a second expression vector. In certain embodiments, all components of the bispecific antigen binding proteins described herein are expressed from the same host cell population. For example, even if one or more components is cloned into a

separate expression vector, the host cell is co-transfected with both expression vectors such that one cell produces all components of the bispecific antigen binding proteins.

[0190] After the vector has been constructed and the one or more nucleic acid molecules encoding the components of the bispecific antigen binding proteins described herein has been inserted into the proper site(s) of the vector or vectors, the completed vector(s) may be inserted into a suitable host cell for amplification and/or polypeptide expression. Thus, the present invention encompasses an isolated host cell comprising one or more expression vectors encoding the components of the bispecific antigen binding proteins. The term “host cell” as used herein refers to a cell that has been transformed, or is capable of being transformed, with a nucleic acid and thereby expresses a gene of interest. The term includes the progeny of the parent cell, whether or not the progeny is identical in morphology or in genetic make-up to the original parent cell, so long as the gene of interest is present. A host cell that comprises an isolated nucleic acid of the invention, preferably operably linked to at least one expression control sequence (e.g. promoter or enhancer), is a “recombinant host cell.”

[0191] The transformation of an expression vector for an antigen binding protein into a selected host cell may be accomplished by well-known methods including transfection, infection, calcium phosphate co-precipitation, electroporation, microinjection, lipofection, DEAE-dextran mediated transfection, or other known techniques. The method selected will in part be a function of the type of host cell to be used. These methods and other suitable methods are well known to the skilled artisan, and are set forth, for example, in Sambrook et al., 2001, *supra*.

[0192] A host cell, when cultured under appropriate conditions, synthesizes an antigen binding protein that can subsequently be collected from the culture medium (if the host cell secretes it into the medium) or directly from the host cell producing it (if it is not secreted). The selection of an appropriate host cell will depend upon various factors, such as desired expression levels, polypeptide modifications that are desirable or necessary for activity (such as glycosylation or phosphorylation) and ease of folding into a biologically active molecule.

[0193] Exemplary host cells include prokaryote, yeast, or higher eukaryote cells. Prokaryotic host cells include eubacteria, such as Gram-negative or Gram-positive organisms, for example, *Enterobacteriaceae* such as *Escherichia*, e.g., *E. coli*, *Enterobacter*, *Erwinia*, *Klebsiella*, *Proteus*, *Salmonella*, e.g., *Salmonella typhimurium*, *Serratia*, e.g., *Serratia marcescans*, and *Shigella*, as well as *Bacillus*, such as *B. subtilis* and *B. licheniformis*, *Pseudomonas*, and

Streptomyces. Eukaryotic microbes such as filamentous fungi or yeast are suitable cloning or expression hosts for recombinant polypeptides. *Saccharomyces cerevisiae*, or common baker's yeast, is the most commonly used among lower eukaryotic host microorganisms. However, a number of other genera, species, and strains are commonly available and useful herein, such as *Pichia*, e.g. *P. pastoris*, *Schizosaccharomyces pombe*; *Kluyveromyces*, *Yarrowia*; *Candida*; *Trichoderma reesia*; *Neurospora crassa*; *Schwanniomyces*, such as *Schwanniomyces occidentalis*; and filamentous fungi, such as, e.g., *Neurospora*, *Penicillium*, *Tolypocladium*, and *Aspergillus* hosts such as *A. nidulans* and *A. niger*.

[0194] Host cells for the expression of glycosylated antigen binding proteins can be derived from multicellular organisms. Examples of invertebrate cells include plant and insect cells. Numerous baculoviral strains and variants and corresponding permissive insect host cells from hosts such as *Spodoptera frugiperda* (caterpillar), *Aedes aegypti* (mosquito), *Aedes albopictus* (mosquito), *Drosophila melanogaster* (fruitfly), and *Bombyx mori* have been identified. A variety of viral strains for transfection of such cells are publicly available, e.g., the L-1 variant of *Autographa californica* NPV and the Bm-5 strain of *Bombyx mori* NPV.

[0195] Vertebrate host cells are also suitable hosts, and recombinant production of antigen binding proteins from such cells has become routine procedure. Mammalian cell lines available as hosts for expression are well known in the art and include, but are not limited to, immortalized cell lines available from the American Type Culture Collection (ATCC), including but not limited to Chinese hamster ovary (CHO) cells, including CHOK1 cells (ATCC CCL61), DXB-11, DG-44, and Chinese hamster ovary cells/-DHFR (CHO, Urlaub *et al.*, Proc. Natl. Acad. Sci. USA 77: 4216, 1980); monkey kidney CV1 line transformed by SV40 (COS-7, ATCC CRL 1651); human embryonic kidney line (293 or 293 cells subcloned for growth in suspension culture, (Graham *et al.*, J. Gen Virol. 36: 59, 1977); baby hamster kidney cells (BHK, ATCC CCL 10); mouse sertoli cells (TM4, Mather, Biol. Reprod. 23: 243-251, 1980); monkey kidney cells (CV1 ATCC CCL 70); African green monkey kidney cells (VERO-76, ATCC CRL-1587); human cervical carcinoma cells (HELA, ATCC CCL 2); canine kidney cells (MDCK, ATCC CCL 34); buffalo rat liver cells (BRL 3A, ATCC CRL 1442); human lung cells (W138, ATCC CCL 75); human hepatoma cells (Hep G2, HB 8065); mouse mammary tumor (MMT 060562, ATCC CCL51); TRI cells (Mather *et al.*, Annals N.Y Acad. Sci. 383: 44-68, 1982); MRC 5 cells or FS4 cells; mammalian myeloma cells, and a number of other cell lines. In certain

embodiments, cell lines may be selected through determining which cell lines have high expression levels and constitutively produce bispecific antigen binding proteins with CGRP receptor and PAC1 receptor binding properties. In another embodiment, a cell line from the B cell lineage that does not make its own antibody but has a capacity to make and secrete a heterologous antibody can be selected. CHO cells are preferred host cells in some embodiments for expressing the bispecific antigen binding proteins of the invention.

[0196] Host cells are transformed or transfected with the above-described nucleic acids or vectors for production of bispecific antigen binding proteins and are cultured in conventional nutrient media modified as appropriate for inducing promoters, selecting transformants, or amplifying the genes encoding the desired sequences. In addition, novel vectors and transfected cell lines with multiple copies of transcription units separated by a selective marker are particularly useful for the expression of antigen binding proteins. Thus, the present invention also provides a method for preparing a bispecific antigen binding protein described herein comprising culturing a host cell comprising one or more expression vectors described herein in a culture medium under conditions permitting expression of the bispecific antigen binding protein encoded by the one or more expression vectors; and recovering the bispecific antigen binding protein from the culture medium.

[0197] The host cells used to produce the antigen binding proteins of the invention may be cultured in a variety of media. Commercially available media such as Ham's F10 (Sigma), Minimal Essential Medium ((MEM), (Sigma), RPMI-1640 (Sigma), and Dulbecco's Modified Eagle's Medium ((DMEM), Sigma) are suitable for culturing the host cells. In addition, any of the media described in Ham *et al.*, Meth. Enz. 58: 44, 1979; Barnes *et al.*, Anal. Biochem. 102: 255, 1980; U.S. Patent Nos. 4,767,704; 4,657,866; 4,927,762; 4,560,655; or 5,122,469; WO90103430; WO 87/00195; or U.S. Patent Re. No. 30,985 may be used as culture media for the host cells. Any of these media may be supplemented as necessary with hormones and/or other growth factors (such as insulin, transferrin, or epidermal growth factor), salts (such as sodium chloride, calcium, magnesium, and phosphate), buffers (such as HEPES), nucleotides (such as adenosine and thymidine), antibiotics (such as Gentamycin™ drug), trace elements (defined as inorganic compounds usually present at final concentrations in the micromolar range), and glucose or an equivalent energy source. Any other necessary supplements may also be included at appropriate concentrations that would be known to those skilled in the art. The

culture conditions, such as temperature, pH, and the like, are those previously used with the host cell selected for expression, and will be apparent to the ordinarily skilled artisan.

[0198] Upon culturing the host cells, the bispecific antigen binding protein can be produced intracellularly, in the periplasmic space, or directly secreted into the medium. If the antigen binding protein is produced intracellularly, as a first step, the particulate debris, either host cells or lysed fragments, is removed, for example, by centrifugation or ultrafiltration. The bispecific antigen binding protein can be purified using, for example, hydroxyapatite chromatography, cation or anion exchange chromatography, or preferably affinity chromatography, using the antigen(s) of interest or protein A or protein G as an affinity ligand. Protein A can be used to purify proteins that include polypeptides that are based on human $\gamma 1$, $\gamma 2$, or $\gamma 4$ heavy chains (Lindmark *et al.*, J. Immunol. Meth. 62: 1-13, 1983). Protein G is recommended for all mouse isotypes and for human $\gamma 3$ (Guss *et al.*, EMBO J. 5: 15671575, 1986). The matrix to which the affinity ligand is attached is most often agarose, but other matrices are available. Mechanically stable matrices such as controlled pore glass or poly(styrenedivinyl)benzene allow for faster flow rates and shorter processing times than can be achieved with agarose. Where the protein comprises a CH3 domain, the Bakerbond ABX™ resin (J. T. Baker, Phillipsburg, N.J.) is useful for purification. Other techniques for protein purification such as ethanol precipitation, Reverse Phase HPLC, chromatofocusing, SDS-PAGE, and ammonium sulfate precipitation are also possible depending on the particular bispecific antigen binding protein to be recovered.

[0199] In some embodiments, the invention provides a pharmaceutical composition comprising one or a plurality of the bispecific antigen binding proteins of the invention together with pharmaceutically acceptable diluents, carriers, excipients, solubilizers, emulsifiers, preservatives, and/or adjuvants. Pharmaceutical compositions of the invention include, but are not limited to, liquid, frozen, and lyophilized compositions. "Pharmaceutically-acceptable" refers to molecules, compounds, and compositions that are non-toxic to human recipients at the dosages and concentrations employed and/or do not produce allergic or adverse reactions when administered to humans. In certain embodiments, the pharmaceutical composition may contain formulation materials for modifying, maintaining or preserving, for example, the pH, osmolarity, viscosity, clarity, color, isotonicity, odor, sterility, stability, rate of dissolution or release, adsorption or penetration of the composition. In such embodiments, suitable formulation materials include, but are not limited to, amino acids (such as glycine, glutamine, asparagine, arginine or lysine);

antimicrobials; antioxidants (such as ascorbic acid, sodium sulfite or sodium hydrogen-sulfite); buffers (such as borate, bicarbonate, Tris-HCl, citrates, phosphates or other organic acids); bulking agents (such as mannitol or glycine); chelating agents (such as ethylenediamine tetraacetic acid (EDTA)); complexing agents (such as caffeine, polyvinylpyrrolidone, beta-cyclodextrin or hydroxypropyl-beta-cyclodextrin); fillers; monosaccharides; disaccharides; and other carbohydrates (such as glucose, mannose or dextrans); proteins (such as serum albumin, gelatin or immunoglobulins); coloring, flavoring and diluting agents; emulsifying agents; hydrophilic polymers (such as polyvinylpyrrolidone); low molecular weight polypeptides; salt-forming counterions (such as sodium); preservatives (such as benzalkonium chloride, benzoic acid, salicylic acid, thimerosal, phenethyl alcohol, methylparaben, propylparaben, chlorhexidine, sorbic acid or hydrogen peroxide); solvents (such as glycerin, propylene glycol or polyethylene glycol); sugar alcohols (such as mannitol or sorbitol); suspending agents; surfactants or wetting agents (such as pluronics, PEG, sorbitan esters, polysorbates such as polysorbate 20, polysorbate 80, triton, tromethamine, lecithin, cholesterol, tyloxapal); stability enhancing agents (such as sucrose or sorbitol); tonicity enhancing agents (such as alkali metal halides, preferably sodium or potassium chloride, mannitol sorbitol); delivery vehicles; diluents; excipients and/or pharmaceutical adjuvants. Methods and suitable materials for formulating molecules for therapeutic use are known in the pharmaceutical arts, and are described, for example, in REMINGTON'S PHARMACEUTICAL SCIENCES, 18th Edition, (A.R. Genrmo, ed.), 1990, Mack Publishing Company.

[0200] In some embodiments, the pharmaceutical composition of the invention comprises a standard pharmaceutical carrier, such as a sterile phosphate buffered saline solution, bacteriostatic water, and the like. A variety of aqueous carriers may be used, e.g., water, buffered water, 0.4% saline, 0.3% glycine and the like, and may include other proteins for enhanced stability, such as albumin, lipoprotein, globulin, etc., subjected to mild chemical modifications or the like.

[0201] Exemplary concentrations of the bispecific antigen binding proteins in the formulation may range from about 0.1 mg/ml to about 180 mg/ml or from about 0.1 mg/mL to about 50 mg/mL, or from about 0.5 mg/mL to about 25 mg/mL, or alternatively from about 2 mg/mL to about 10 mg/mL. An aqueous formulation of the antigen binding protein may be prepared in a pH-buffered solution, for example, at pH ranging from about 4.5 to about 6.5, or from about 4.8

to about 5.5, or alternatively about 5.0. Examples of buffers that are suitable for a pH within this range include acetate (e.g. sodium acetate), succinate (such as sodium succinate), gluconate, histidine, citrate and other organic acid buffers. The buffer concentration can be from about 1 mM to about 200 mM, or from about 10 mM to about 60 mM, depending, for example, on the buffer and the desired isotonicity of the formulation.

[0202] A tonicity agent, which may also stabilize the antigen binding protein, may be included in the formulation. Exemplary tonicity agents include polyols, such as mannitol, sucrose or trehalose. Preferably the aqueous formulation is isotonic, although hypertonic or hypotonic solutions may be suitable. Exemplary concentrations of the polyol in the formulation may range from about 1% to about 15% w/v.

[0203] A surfactant may also be added to the antigen binding protein formulation to reduce aggregation of the formulated antigen binding protein and/or minimize the formation of particulates in the formulation and/or reduce adsorption. Exemplary surfactants include nonionic surfactants such as polysorbates (e.g. polysorbate 20 or polysorbate 80) or poloxamers (e.g. poloxamer 188). Exemplary concentrations of surfactant may range from about 0.001% to about 0.5%, or from about 0.005% to about 0.2%, or alternatively from about 0.004% to about 0.01% w/v.

[0204] In one embodiment, the formulation contains the above-identified agents (i.e. antigen binding protein, buffer, polyol and surfactant) and is essentially free of one or more preservatives, such as benzyl alcohol, phenol, m-cresol, chlorobutanol and benzethonium chloride. In another embodiment, a preservative may be included in the formulation, e.g., at concentrations ranging from about 0.1% to about 2%, or alternatively from about 0.5% to about 1%. One or more other pharmaceutically acceptable carriers, excipients or stabilizers such as those described in Remington's Pharmaceutical Sciences 16th edition, Osol, A. Ed. (1980) may be included in the formulation provided that they do not adversely affect the desired characteristics of the formulation.

[0205] Therapeutic formulations of the bispecific antigen binding protein are prepared for storage by mixing the bispecific antigen binding protein having the desired degree of purity with optional physiologically acceptable carriers, excipients or stabilizers (Remington's Pharmaceutical Sciences 16th edition, Osol, A. Ed. (1980)), in the form of lyophilized formulations or aqueous solutions. Acceptable carriers, excipients, or stabilizers are nontoxic to

recipients at the dosages and concentrations employed, and include buffers such as phosphate, citrate, and other organic acids; antioxidants including ascorbic acid and methionine; preservatives (such as octadecyldimethylbenzyl ammonium chloride; hexamethonium chloride; benzalkonium chloride, benzethonium chloride; phenol, butyl or benzyl alcohol; alkyl parabens such as methyl or propyl paraben; catechol; resorcinol; cyclohexanol; 3-pentanol; and m-cresol); low molecular weight (less than about 10 residues) polypeptides; proteins, such as serum albumin, gelatin, or immunoglobulins; hydrophilic polymers such as polyvinylpyrrolidone; amino acids such as glycine, glutamine, asparagine, histidine, arginine, or lysine; monosaccharides, disaccharides, and other carbohydrates including glucose, mannose, maltose, or dextrans; chelating agents such as EDTA; sugars such as sucrose, mannitol, trehalose or sorbitol; salt-forming counter-ions such as sodium; metal complexes (e.g., Zn-protein complexes); and/or non-ionic surfactants such as TWEEN™, PLURONICS™ or polyethylene glycol (PEG).

[0206] In one embodiment, a suitable formulation of the claimed invention contains an isotonic buffer such as a phosphate, acetate, or TRIS buffer in combination with a tonicity agent, such as a polyol, sorbitol, sucrose or sodium chloride, which tonicifies and stabilizes. One example of such a tonicity agent is 5% sorbitol or sucrose. In addition, the formulation could optionally include a surfactant at 0.01% to 0.02% wt/vol, for example, to prevent aggregation or improve stability. The pH of the formulation may range from 4.5-6.5 or 4.5 to 5.5. Other exemplary descriptions of pharmaceutical formulations for antigen binding proteins may be found in US 2003/0113316 and US patent no. 6,171,586, each incorporated herein by reference in its entirety.

[0207] The formulation herein may also contain more than one active compound as necessary for the particular indication being treated, preferably those with complementary activities that do not adversely affect each other. For example, it may be desirable to further provide an immunosuppressive agent. Such molecules are suitably present in combination in amounts that are effective for the purpose intended.

[0208] The active ingredients may also be entrapped in microcapsule prepared, for example, by coacervation techniques or by interfacial polymerization, for example, hydroxymethylcellulose or gelatin-microcapsule and poly-(methylmethacrylate) microcapsule, respectively, in colloidal drug delivery systems (for example, liposomes, albumin microspheres, microemulsions, nano-

particles and nanocapsules) or in macroemulsions. Such techniques are disclosed in Remington's Pharmaceutical Sciences 16th edition, Osol, A. Ed. (1980).

[0209] Suspensions and crystal forms of antigen binding proteins are also contemplated.

Methods to make suspensions and crystal forms are known to one of skill in the art.

[0210] The formulations to be used for *in vivo* administration must be sterile. The compositions of the invention may be sterilized by conventional, well known sterilization techniques. For example, sterilization is readily accomplished by filtration through sterile filtration membranes. The resulting solutions may be packaged for use or filtered under aseptic conditions and lyophilized, the lyophilized preparation being combined with a sterile solution prior to administration.

[0211] The process of freeze-drying is often employed to stabilize polypeptides for long-term storage, particularly when the polypeptide is relatively unstable in liquid compositions. A lyophilization cycle is usually composed of three steps: freezing, primary drying, and secondary drying (*see* Williams and Polli, Journal of Parenteral Science and Technology, Volume 38, Number 2, pages 48-59, 1984). In the freezing step, the solution is cooled until it is adequately frozen. Bulk water in the solution forms ice at this stage. The ice sublimates in the primary drying stage, which is conducted by reducing chamber pressure below the vapor pressure of the ice, using a vacuum. Finally, sorbed or bound water is removed at the secondary drying stage under reduced chamber pressure and an elevated shelf temperature. The process produces a material known as a lyophilized cake. Thereafter the cake can be reconstituted prior to use.

[0212] The standard reconstitution practice for lyophilized material is to add back a volume of pure water (typically equivalent to the volume removed during lyophilization), although dilute solutions of antibacterial agents are sometimes used in the production of pharmaceuticals for parenteral administration (*see* Chen, Drug Development and Industrial Pharmacy, Volume 18: 1311-1354, 1992).

[0213] Excipients have been noted in some cases to act as stabilizers for freeze-dried products (*see* Carpenter *et al.*, Volume 74: 225-239, 1991). For example, known excipients include polyols (including mannitol, sorbitol and glycerol); sugars (including glucose and sucrose); and amino acids (including alanine, glycine and glutamic acid).

[0214] In addition, polyols and sugars are also often used to protect polypeptides from freezing and drying-induced damage and to enhance the stability during storage in the dried state. In

general, sugars, in particular disaccharides, are effective in both the freeze-drying process and during storage. Other classes of molecules, including mono- and di-saccharides and polymers such as PVP, have also been reported as stabilizers of lyophilized products.

[0215] For injection, the pharmaceutical formulation and/or medicament may be a powder suitable for reconstitution with an appropriate solution as described above. Examples of these include, but are not limited to, freeze dried, rotary dried or spray dried powders, amorphous powders, granules, precipitates, or particulates. For injection, the formulations may optionally contain stabilizers, pH modifiers, surfactants, bioavailability modifiers and combinations of these.

[0216] Sustained-release preparations may be prepared. Suitable examples of sustained-release preparations include semipermeable matrices of solid hydrophobic polymers containing the bispecific antigen binding protein, which matrices are in the form of shaped articles, e.g., films, or microcapsule. Examples of sustained-release matrices include polyesters, hydrogels (for example, poly(2-hydroxyethyl-methacrylate), or poly(vinylalcohol)), polylactides (U.S. Patent No. 3,773,919), copolymers of L-glutamic acid and γ ethyl-L-glutamate, non-degradable ethylene-vinyl acetate, degradable lactic acid-glycolic acid copolymers such as the Lupron Depot™ (injectable microspheres composed of lactic acid-glycolic acid copolymer and leuprolide acetate), and poly-D-(-)-3-hydroxybutyric acid. While polymers such as ethylene-vinyl acetate and lactic acid-glycolic acid enable release of molecules for over 100 days, certain hydrogels release proteins for shorter time periods. When encapsulated polypeptides remain in the body for a long time, they may denature or aggregate as a result of exposure to moisture at 37°C, resulting in a loss of biological activity and possible changes in immunogenicity. Rational strategies can be devised for stabilization depending on the mechanism involved. For example, if the aggregation mechanism is discovered to be intermolecular S--S bond formation through thio-disulfide interchange, stabilization may be achieved by modifying sulfhydryl residues, lyophilizing from acidic solutions, controlling moisture content, using appropriate additives, and developing specific polymer matrix compositions.

[0217] The formulations of the invention may be designed to be short-acting, fast-releasing, long-acting, or sustained-releasing as described herein. Thus, the pharmaceutical formulations may also be formulated for controlled release or for slow release.

[0218] Specific dosages may be adjusted depending on conditions of disease, the age, body weight, general health conditions, sex, and diet of the subject, dose intervals, administration routes, excretion rate, and combinations of drugs. Any of the above dosage forms containing effective amounts are well within the bounds of routine experimentation and therefore, well within the scope of the instant invention.

[0219] The bispecific antigen binding protein is administered by any suitable means, including parenteral, subcutaneous, intraperitoneal, intrapulmonary, and intranasal, and, if desired for local treatment, intralesional administration. Parenteral infusions include intravenous, intraarterial, intraperitoneal, intramuscular, intradermal or subcutaneous administration. In addition, the bispecific antigen binding protein is suitably administered by pulse infusion, particularly with declining doses of the antigen binding protein. Preferably the dosing is given by injections, most preferably intravenous or subcutaneous injections, depending in part on whether the administration is brief or chronic. Other administration methods are contemplated, including topical, particularly transdermal, transmucosal, rectal, oral or local administration e.g. through a catheter placed close to the desired site. Most preferably, the antigen binding protein of the invention is administered intravenously in a physiological solution at a dose ranging between 0.01 mg/kg to 100 mg/kg at a frequency ranging from daily to weekly to monthly (e.g. every day, every other day, every third day, or 2, 3, 4, 5, or 6 times per week), preferably a dose ranging from 0.1 to 45 mg/kg, 0.1 to 15 mg/kg or 0.1 to 10 mg/kg at a frequency of once per week, once every two weeks, or once a month.

[0220] The bispecific antigen binding proteins described herein are useful for treating or ameliorating a condition associated with CGRP receptor and/or PAC1 receptor in a patient in need thereof. As used herein, the term “treating” or “treatment” is an intervention performed with the intention of preventing the development or altering the pathology of a disorder. Accordingly, “treatment” refers to both therapeutic treatment and prophylactic or preventative measures. Those in need of treatment include those already diagnosed with or suffering from the disorder or condition as well as those in which the disorder or condition is to be prevented. “Treatment” includes any indicia of success in the amelioration of an injury, pathology or condition, including any objective or subjective parameter such as abatement, remission, diminishing of symptoms, or making the injury, pathology or condition more tolerable to the patient, slowing in the rate of degeneration or decline, making the final point of degeneration less

debilitating, or improving a patient's physical or mental well-being. The treatment or amelioration of symptoms can be based on objective or subjective parameters, including the results of a physical examination, self-reporting by a patient, neuropsychiatric exams, and/or a psychiatric evaluation.

[0221] Accordingly, in some embodiments, the present invention provides a method for treating or preventing a condition associated with CGRP receptor and/or PAC1 receptor in a patient in need thereof, comprising administering to the patient an effective amount of a bispecific antigen binding protein described herein. The term "patient" includes human patients. An "effective amount" is generally an amount sufficient to reduce the severity and/or frequency of symptoms, eliminate the symptoms and/or underlying cause, prevent the occurrence of symptoms and/or their underlying cause, and/or improve or remediate the damage that results from or is associated with a particular condition (e.g. chronic pain, headache or migraine). In some embodiments, the effective amount is a therapeutically effective amount or a prophylactically effective amount. A "therapeutically effective amount" is an amount sufficient to remedy a disease state (e.g., a headache, migraine, or chronic pain) or symptom(s), particularly a state or symptom(s) associated with the disease state, or otherwise prevent, hinder, retard or reverse the progression of the disease state or any other undesirable symptom associated with the disease in any way whatsoever (i.e. that provides "therapeutic efficacy"). A "prophylactically effective amount" is an amount of a pharmaceutical composition that, when administered to a subject, will have the intended prophylactic effect, e.g., preventing or delaying the onset (or reoccurrence) of the condition (e.g. headache or migraine), or reducing the likelihood of the onset (or reoccurrence) of the condition (e.g. headache, migraine, or headache symptoms). The full therapeutic or prophylactic effect does not necessarily occur by administration of one dose, and may occur only after administration of a series of doses. Thus, a therapeutically or prophylactically effective amount may be administered in one or more administrations.

[0222] In certain embodiments, the present invention provides a method for treating or ameliorating headache, particularly migraine headache, in a patient in need thereof comprising administering to the patient an effective amount of a bispecific antigen binding protein described herein. Migraine headaches are recurrent headaches lasting about 4 to about 72 hours that are characterized by unilateral, pulsating, and/or moderate to severe pain and/or pain that is exacerbated by physical activity. Migraine headaches are often accompanied by nausea,

vomiting, and/or sensitivity to light (photophobia), sound (phonophobia), or smell. In some patients, an aura precedes the onset of the migraine headache. The aura is typically a visual, sensory, language, or motor disturbance that signals the headache will soon occur. The methods described herein prevent, treat, or ameliorate one or more symptoms of migraine headaches with and without aura in human patients.

[0223] Activation of the CGRP receptor and PAC1 receptor by their respective ligands induce vasodilation, particularly vasodilation of the dura vasculature. Both receptor signaling cascades have been implicated in migraine pathophysiology, and are believed to contribute to the induction of migraine through different, but related mechanisms. CGRP released as a result of activation of the trigeminovascular system not only induces vasodilation of the cranial vessels, but also contributes to the induction of neurogenic inflammation, which is a form of inflammation secondary to sensory nerve activation. *See, e.g., Bigal et al., Headache, Vol. 53(8):1230-44, 2013, which is hereby incorporated by reference.* CGRP also acts as a neurotransmitter to transmit pain signals from the brainstem to the thalamus. While CGRP acts through the sensory system, the PAC1 receptor and its PACAP ligand operate through the parasympathetic division of the autonomic nervous system. Immunohistochemistry studies in cynomolgus monkey mapped PACAP and PAC1 localization to the parasympathetic pathway through the sphenopalatine ganglion (SPG; also known as pterygopalatine ganglion), which also innervates the dura vasculature (data not shown). The parasympathetic pathway is independent and parallel to the sensory pathway that also controls the dura vasculature tone. Infusion of the PAC1 receptor agonist PACAP causes migraine-like headache in migraine patients, suggesting that blocking PAC1 may be useful for treating migraine (Schytz *et al.*, *Brain* 132:16-25, 2009). Additional experiments performed in support of the present invention showed that a selective PAC1 antibody blocked electrically stimulated trigeminal cervical complex (TCC) activation, an electrophysiology model that has been reported to correlate with clinical migraine efficacy (data not shown). In some embodiments, the bispecific antigen binding proteins described herein have an additive or synergistic effect in treating migraine headache (e.g. reducing the frequency, duration, or severity of migraine headache) as compared to the treatment effect obtained with either an anti-CGRP receptor antagonist or an anti-PAC1 receptor antagonist alone. Without being bound by theory, it is believed that inhibiting both the CGRP receptor and the PAC1

receptor with the bispecific antigen binding proteins of the invention will provide greater efficacy in treating migraine headache than antagonizing either target alone.

[0224] In some embodiments, the patients to be treated according to the methods of the invention have, suffer from, or are diagnosed with episodic migraine. Episodic migraine is diagnosed when patients with a history of migraine (e.g. at least five lifetime attacks of migraine headache) have 14 or fewer migraine headache days per month. A “migraine headache day” includes any calendar day during which a patient experiences the onset, continuation, or recurrence of a “migraine headache” with or without aura lasting greater than 30 minutes. A “migraine headache” is a headache associated with nausea or vomiting or sensitivity to light or sound and/or a headache characterized by at least two of the following pain features: unilateral pain, throbbing pain, moderate to severe pain intensity, or pain exacerbated by physical activity. In certain embodiments, patients having, suffering from, or diagnosed with episodic migraine have at least four, but less than 15 migraine headache days per month on average. In related embodiments, patients having, suffering from, or diagnosed with episodic migraine have fewer than 15 headache days per month on average. As used herein, a “headache day” is any calendar day in which the patient experiences a migraine headache as defined herein or any headache that lasts greater than 30 minutes or requires acute headache treatment.

[0225] In certain embodiments, the patients to be treated according to the methods of the invention have, suffer from, or are diagnosed with chronic migraine. Chronic migraine is diagnosed when migraine patients (i.e. patients with at least five lifetime attacks of migraine headache) have 15 or more headache days per month and at least 8 of the headache days are migraine headache days. In some embodiments, patients having, suffering from, or diagnosed with chronic migraine have 15 or more migraine headache days per month on average. In certain embodiments of the methods described herein, administration of a bispecific antigen binding protein of the invention prevents, reduces, or delays the progression of episodic migraine in the patient to chronic migraine.

[0226] In other embodiments, the present invention provides a method for treating or ameliorating cluster headache in a patient in need thereof comprising administering to the patient an effective amount of a bispecific antigen binding protein described herein. Cluster headache is a condition that involves, as its most prominent feature, recurrent, severe headaches on one side of the head, typically around the eye (*see Nesbitt et al.*, BMJ, Vol. 344:e2407, 2012). Some

doctors and scientists have described the pain resulting from cluster headaches as the most intense pain a human can endure — worse than giving birth, burns or broken bones. Cluster headaches often occur periodically: spontaneous remissions interrupt active periods of pain. Cluster headaches are often accompanied by cranial autonomic symptoms, such as tearing, nasal congestion, ptosis, pupil constriction, facial blushing, sweating, and swelling around the eye, often confined to the side of the head with the pain. The average age of onset of cluster headache is ~30-50 years. It is more prevalent in males with a male to female ratio of about 2.5:1 to about 3.5:1. Sphenopalatine ganglion (SPG) stimulation has been used for the treatment of cluster headache. A neurostimulation system, which delivers low-level (but high frequency, physiologic-blocking) electrical stimulation to the SPG, has demonstrated efficacy in relieving the acute debilitating pain of cluster headache in a recent clinical trial (*see* Schoenen J, *et al.*, *Cephalalgia*, Vol. 33(10):816-30, 2013). In view of this evidence and because PACAP is one of the major neurotransmitters in SPG, inhibition of PAC1 receptor signaling with a bispecific antigen binding protein described herein is expected to have efficacy in treating cluster headache in humans.

[0227] Other conditions associated with CGRP receptor and/or PAC1 receptor signaling that may be treated according to the methods of the invention include, but are not limited to, chronic pain syndromes, such as arthritic pain (e.g. osteoarthritis and rheumatoid arthritis), neurogenic inflammation, tension-type headaches, hemiplegic migraine, retinal migraine, and vasomotor symptoms (e.g. hot flashes, facial flushing, sweating, and night sweats), such as those associated with menopause. In one embodiment, the condition is chronic pain. CGRP may be involved in chronic pain syndromes other than migraine. In rodents, intrathecally-delivered CGRP induces severe pain, and CGRP levels are enhanced in a number of pain models. In addition, CGRP antagonists partially block nociception in acute pancreatitis in rodents (*see* Wick *et al.* *Surgery*, Volume 139: 197-201, 2006). In any of the methods described herein, the treatment can comprise prophylactic treatment. Prophylactic treatment refers to treatment designed to be taken before the onset of a condition or an attack (e.g. before a migraine attack or onset of a cluster headache episode) to reduce the frequency, severity, and/or length of the symptoms (e.g. migraine or cluster headaches) in the patient.

[0228] The bispecific antigen binding proteins of the invention are useful for detecting CGRP receptor and/or PAC1 receptor in biological samples and identification of cells or tissues that

express the CGRP receptor and/or PAC1 receptor. For instance, the bispecific antigen binding proteins can be used in diagnostic assays, *e.g.*, binding assays to detect and/or quantify CGRP receptor and/or PAC1 receptor expressed in a tissue or cell. In addition, the bispecific antigen binding proteins described herein can be used to inhibit CGRP receptor from forming a complex with its ligand CGRP, thereby modulating the biological activity of CGRP receptor in a cell or tissue. Likewise, the bispecific antigen binding proteins described herein can be used to inhibit PAC1 receptor from forming a complex with its ligand PACAP, thereby modulating the biological activity of PAC1 receptor in a cell or tissue. Examples of activities that can be modulated include, but are not limited to, inhibiting vasodilation and/or reducing neurogenic inflammation.

[0229] The bispecific antigen binding proteins described herein can be used for diagnostic purposes to detect, diagnose, or monitor diseases and/or conditions associated with the CGRP receptor and/or the PAC1 receptor. Also provided are methods for the detection of the presence of CGRP receptor or PAC1 receptor in a sample using classical immunohistological methods known to those of skill in the art (*e.g.*, Tijssen, 1993, Practice and Theory of Enzyme Immunoassays, Vol 15 (Eds R.H. Burdon and P.H. van Knippenberg, Elsevier, Amsterdam); Zola, 1987, Monoclonal Antibodies: A Manual of Techniques, pp. 147-158 (CRC Press, Inc.); Jalkanen et al., 1985, J. Cell. Biol. 101:976-985; Jalkanen et al., 1987, J. Cell Biol. 105:3087-3096). The detection of either receptor (CGRP receptor or PAC1 receptor) can be performed *in vivo* or *in vitro*.

[0230] Diagnostic applications provided herein include use of the antigen binding proteins to detect expression of CGRP receptor and/or PAC1 receptor and binding of the ligands to either receptor. Examples of methods useful in the detection of the presence of the receptor include immunoassays, such as the enzyme linked immunosorbent assay (ELISA) and the radioimmunoassay (RIA).

[0231] For diagnostic applications, the antigen binding protein typically will be labeled with a detectable labeling group. Suitable labeling groups include, but are not limited to, the following: radioisotopes or radionuclides (*e.g.*, ^3H , ^{14}C , ^{15}N , ^{35}S , ^{90}Y , ^{99}Tc , ^{111}In , ^{125}I , ^{131}I), fluorescent groups (*e.g.*, FITC, rhodamine, lanthanide phosphors), enzymatic groups (*e.g.*, horseradish peroxidase, β -galactosidase, luciferase, alkaline phosphatase), chemiluminescent groups, biotinyl groups, or predetermined polypeptide epitopes recognized by a secondary reporter (*e.g.*, leucine

zipper pair sequences, binding sites for secondary antibodies, metal binding domains, epitope tags). In some embodiments, the labeling group is coupled to the antigen binding protein via spacer arms of various lengths to reduce potential steric hindrance. Various methods for labeling proteins are known in the art and may be used.

[0232] In another embodiment, the bispecific antigen binding protein described herein can be used to identify a cell or cells that express CGRP receptor and/or PAC1 receptor. In a specific embodiment, the antigen binding protein is labeled with a labeling group and the binding of the labeled antigen binding protein to CGRP receptor and/or PAC1 receptor is detected. In a further specific embodiment, the binding of the antigen binding protein to CGRP receptor and/or PAC1 receptor is detected *in vivo*. In a further specific embodiment, the bispecific antigen binding protein is isolated and measured using techniques known in the art. *See*, for example, Harlow and Lane, 1988, *Antibodies: A Laboratory Manual*, New York: Cold Spring Harbor (ed. 1991 and periodic supplements); John E. Coligan, ed., 1993, *Current Protocols In Immunology* New York: John Wiley & Sons.

[0233] Another aspect provides for detecting the presence of a test molecule that competes for binding to CGRP receptor and/or PAC1 receptor with the antigen binding proteins described herein. An example of one such assay would involve detecting the amount of free antigen binding protein in a solution containing an amount of CGRP receptor and/or PAC1 receptor in the presence or absence of the test molecule. An increase in the amount of free antigen binding protein (i.e., the antigen binding protein not bound to CGRP receptor and/or PAC1 receptor) would indicate that the test molecule is capable of competing for CGRP receptor and/or PAC1 receptor binding with the bispecific antigen binding protein. In one embodiment, the antigen binding protein is labeled with a labeling group. Alternatively, the test molecule is labeled and the amount of free test molecule is monitored in the presence and absence of the antigen binding protein.

[0234] The following are additional embodiments of the invention for exemplary purposes, and are not intended to be limiting in any way:

[0235] Embodiment 1: A bispecific antigen binding protein that specifically binds to human CGRP receptor and human PAC1.

[0236] Embodiment 2: The bispecific antigen binding protein of Embodiment 1, wherein the antigen binding protein is an antibody or an antibody fragment.

[0237] Embodiment 3: The bispecific antigen binding protein of Embodiments 1-2, wherein the antigen binding protein is an antibody, or antibody fragment, comprising all four of the variable domains found in an antibody selected from the antibodies designated iPS:326417, iPS:326626, iPS:326628, iPS:326631, iPS:326634, iPS:327870, iPS:327871, iPS:326645, iPS:326648, iPS:326651, iPS:326654, iPS:328000, iPS:328001, iPS:326661, iPS:326663, iPS:326666, iPS:326669, iPS:327017, iPS:327018, iPS:327019, iPS:327023, iPS:327024, iPS:327025, iPS:327026, iPS:327091, iPS:327092, iPS:327093, iPS:327094, iPS:326414, iPS:327102, iPS:327103, iPS:327104, iPS:327105, iPS:327106, iPS:327107, iPS:327108, iPS:327109, iPS:327110, iPS:327111, iPS:327112, iPS:327267, iPS:327268, iPS:327269, iPS:327270, iPS:327272, iPS:327273, iPS:327274, iPS:327275, iPS:327276, iPS:327277, iPS:327278, iPS:327279, iPS:327280, iPS:327281, iPS:327282, iPS:327283, iPS:327284, iPS:327285, iPS:327286, iPS:327287, iPS:327288, iPS:327289, iPS:327290, iPS:327291, iPS:327677, iPS:327678, iPS:327679, iPS:327680, iPS:327681, iPS:327682, iPS:327683, iPS:327684, iPS:327685, iPS:327686, iPS:327687, iPS:327688, iPS:327689, iPS:327690, iPS:327691, iPS:327693, iPS:327694, iPS:327696, iPS:327697, iPS:327698, iPS:327699, iPS:327700, iPS:327701, iPS:327702, iPS:327703, iPS:327704, iPS:327705, iPS:327706, iPS:327707, iPS:327708, iPS:327709, iPS:327710, iPS:327711, iPS:327712, iPS:327713, iPS:327714, iPS:327717, iPS:327718, iPS:327719, iPS:327721, iPS:327722, iPS:327724, iPS:327725, iPS:327726, iPS:327727, iPS:327728, iPS:327729, iPS:327730, iPS:327731, iPS:327732, iPS:327733, iPS:327734, iPS:327735, iPS:327736, iPS:327737, iPS:327738, iPS:327739, iPS:327740, iPS:327741, iPS:327742, iPS:327872, iPS:327874, iPS:327875, iPS:327876, iPS:327877, iPS:327878, iPS:327879, iPS:327880, iPS:327881, iPS:327882, iPS:327883, iPS:327884, iPS:327885, iPS:327886, iPS:327887, iPS:327888, iPS:327889, iPS:327890, iPS:327891, iPS:327892, iPS:327893, iPS:327894, iPS:327895, iPS:327896, iPS:327897, iPS:328031, iPS:328033, iPS:328034, iPS:328035, iPS:328036, iPS:328037, iPS:328038, iPS:328039, iPS:328040, iPS:328041, iPS:328042, iPS:328043, iPS:328044, iPS:328045, iPS:328046, iPS:328047, iPS:328048, iPS:328049, iPS:328050, and iPS:328051, as set forth herein.

[0238] Embodiment 4: The bispecific antigen binding protein of Embodiments 1-3, wherein the antigen binding protein is an antibody: (a) selected from the antibodies designated iPS:326417, iPS:326626, iPS:326628, iPS:326631, iPS:326634, iPS:327870, iPS:327871, iPS:326645,

iPS:326648, iPS:326651, iPS:326654, iPS:328000, iPS:328001, iPS:326661, iPS:326663, iPS:326666, iPS:326669, iPS:327017, iPS:327018, iPS:327019, iPS:327023, iPS:327024, iPS:327025, iPS:327026, iPS:327091, iPS:327092, iPS:327093, iPS:327094, iPS:326414, iPS:327102, iPS:327103, iPS:327104, iPS:327105, iPS:327106, iPS:327107, iPS:327108, iPS:327109, iPS:327110, iPS:327111, iPS:327112, iPS:327267, iPS:327268, iPS:327269, iPS:327270, iPS:327272, iPS:327273, iPS:327274, iPS:327275, iPS:327276, iPS:327277, iPS:327278, iPS:327279, iPS:327280, iPS:327281, iPS:327282, iPS:327283, iPS:327284, iPS:327285, iPS:327286, iPS:327287, iPS:327288, iPS:327289, iPS:327290, iPS:327291, iPS:327677, iPS:327678, iPS:327679, iPS:327680, iPS:327681, iPS:327682, iPS:327683, iPS:327684, iPS:327685, iPS:327686, iPS:327687, iPS:327688, iPS:327689, iPS:327690, iPS:327691, iPS:327693, iPS:327694, iPS:327696, iPS:327697, iPS:327698, iPS:327699, iPS:327700, iPS:327701, iPS:327702, iPS:327703, iPS:327704, iPS:327705, iPS:327706, iPS:327707, iPS:327708, iPS:327709, iPS:327710, iPS:327711, iPS:327712, iPS:327713, iPS:327714, iPS:327717, iPS:327718, iPS:327719, iPS:327721, iPS:327722, iPS:327724, iPS:327725, iPS:327726, iPS:327727, iPS:327728, iPS:327729, iPS:327730, iPS:327731, iPS:327732, iPS:327733, iPS:327734, iPS:327735, iPS:327736, iPS:327737, iPS:327738, iPS:327739, iPS:327740, iPS:327741, iPS:327742, iPS:327872, iPS:327874, iPS:327875, iPS:327876, iPS:327877, iPS:327878, iPS:327879, iPS:327880, iPS:327881, iPS:327882, iPS:327883, iPS:327884, iPS:327885, iPS:327886, iPS:327887, iPS:327888, iPS:327889, iPS:327890, iPS:327891, iPS:327892, iPS:327893, iPS:327894, iPS:327895, iPS:327896, iPS:327897, iPS:328031, iPS:328033, iPS:328034, iPS:328035, iPS:328036, iPS:328037, iPS:328038, iPS:328039, iPS:328040, iPS:328041, iPS:328042, iPS:328043, iPS:328044, iPS:328045, iPS:328046, iPS:328047, iPS:328048, iPS:328049, iPS:328050, and iPS:328051, as set forth herein, or (b) an antibody from (a) comprising an immunoglobulin light chain or immunoglobulin heavy chain from which one, two, three, four or five amino acid residues are lacking from the N-terminal or C-terminal of said light chain or heavy chain, or both.

[0239] Embodiment 5: The bispecific antigen binding protein of Embodiments 1-4, wherein the antigen binding protein is an antibody fragment selected from a Fab, a Fab', a F(ab')₂, a Fv, a Fd, a domain antibody (dAb), a complementarity determining region (CDR) fragment, a single-chain antibody (scFv), a single chain antibody fragment, a maxibody, a diabody, a triabody, a tetrabody, a minibody, a linear antibody, a chelating recombinant antibody, an intrabody, a

nanobody, a small modular immunopharmaceutical (SMIP), an antigen-binding-domain immunoglobulin fusion protein, and a camelized antibody.

[0240] Embodiment 6: The bispecific antigen binding protein of Embodiments 1-5, comprising constant regions of the IgG1, IgG2, IgG3, or IgG4 immunoglobulin isotype.

[0241] Embodiment 7: The bispecific antigen binding protein of Embodiments 1-6, comprising all twelve complementarity determining regions (CDRs) of an antibody selected from the antibodies designated iPS:326417, iPS:326626, iPS:326628, iPS:326631, iPS:326634, iPS:327870, iPS:327871, iPS:326645, iPS:326648, iPS:326651, iPS:326654, iPS:328000, iPS:328001, iPS:326661, iPS:326663, iPS:326666, iPS:326669, iPS:327017, iPS:327018, iPS:327019, iPS:327023, iPS:327024, iPS:327025, iPS:327026, iPS:327091, iPS:327092, iPS:327093, iPS:327094, iPS:326414, iPS:327102, iPS:327103, iPS:327104, iPS:327105, iPS:327106, iPS:327107, iPS:327108, iPS:327109, iPS:327110, iPS:327111, iPS:327112, iPS:327267, iPS:327268, iPS:327269, iPS:327270, iPS:327272, iPS:327273, iPS:327274, iPS:327275, iPS:327276, iPS:327277, iPS:327278, iPS:327279, iPS:327280, iPS:327281, iPS:327282, iPS:327283, iPS:327284, iPS:327285, iPS:327286, iPS:327287, iPS:327288, iPS:327289, iPS:327290, iPS:327291, iPS:327677, iPS:327678, iPS:327679, iPS:327680, iPS:327681, iPS:327682, iPS:327683, iPS:327684, iPS:327685, iPS:327686, iPS:327687, iPS:327688, iPS:327689, iPS:327690, iPS:327691, iPS:327693, iPS:327694, iPS:327696, iPS:327697, iPS:327698, iPS:327699, iPS:327700, iPS:327701, iPS:327702, iPS:327703, iPS:327704, iPS:327705, iPS:327706, iPS:327707, iPS:327708, iPS:327709, iPS:327710, iPS:327711, iPS:327712, iPS:327713, iPS:327714, iPS:327717, iPS:327718, iPS:327719, iPS:327721, iPS:327722, iPS:327724, iPS:327725, iPS:327726, iPS:327727, iPS:327728, iPS:327729, iPS:327730, iPS:327731, iPS:327732, iPS:327733, iPS:327734, iPS:327735, iPS:327736, iPS:327737, iPS:327738, iPS:327739, iPS:327740, iPS:327741, iPS:327742, iPS:327872, iPS:327874, iPS:327875, iPS:327876, iPS:327877, iPS:327878, iPS:327879, iPS:327880, iPS:327881, iPS:327882, iPS:327883, iPS:327884, iPS:327885, iPS:327886, iPS:327887, iPS:327888, iPS:327889, iPS:327890, iPS:327891, iPS:327892, iPS:327893, iPS:327894, iPS:327895, iPS:327896, iPS:327897, iPS:328031, iPS:328033, iPS:328034, iPS:328035, iPS:328036, iPS:328037, iPS:328038, iPS:328039, iPS:328040, iPS:328041, iPS:328042, iPS:328043, iPS:328044, iPS:328045, iPS:328046, iPS:328047, iPS:328048, iPS:328049, iPS:328050, and iPS:328051, as set forth herein.

[0242] Embodiment 8: The bispecific antigen binding protein of Embodiments 1-6, comprising:

(a) all six complementarity determining regions (CDRs) that specifically bind CGRP receptor of an antibody selected from the antibodies designated iPS:326417, iPS:326626, iPS:326628, iPS:326631, iPS:326634, iPS:327870, iPS:327871, iPS:326645, iPS:326648, iPS:326651, iPS:326654, iPS:328000, iPS:328001, iPS:326661, iPS:326663, iPS:326666, iPS:326669, iPS:327017, iPS:327018, iPS:327019, iPS:327023, iPS:327024, iPS:327025, iPS:327026, iPS:327091, iPS:327092, iPS:327093, iPS:327094, iPS:326414, iPS:327102, iPS:327103, iPS:327104, iPS:327105, iPS:327106, iPS:327107, iPS:327108, iPS:327109, iPS:327110, iPS:327111, iPS:327112, iPS:327267, iPS:327268, iPS:327269, iPS:327270, iPS:327272, iPS:327273, iPS:327274, iPS:327275, iPS:327276, iPS:327277, iPS:327278, iPS:327279, iPS:327280, iPS:327281, iPS:327282, iPS:327283, iPS:327284, iPS:327285, iPS:327286, iPS:327287, iPS:327288, iPS:327289, iPS:327290, iPS:327291, iPS:327677, iPS:327678, iPS:327679, iPS:327680, iPS:327681, iPS:327682, iPS:327683, iPS:327684, iPS:327685, iPS:327686, iPS:327687, iPS:327688, iPS:327689, iPS:327690, iPS:327691, iPS:327693, iPS:327694, iPS:327696, iPS:327697, iPS:327698, iPS:327699, iPS:327700, iPS:327701, iPS:327702, iPS:327703, iPS:327704, iPS:327705, iPS:327706, iPS:327707, iPS:327708, iPS:327709, iPS:327710, iPS:327711, iPS:327712, iPS:327713, iPS:327714, iPS:327717, iPS:327718, iPS:327719, iPS:327721, iPS:327722, iPS:327724, iPS:327725, iPS:327726, iPS:327727, iPS:327728, iPS:327729, iPS:327730, iPS:327731, iPS:327732, iPS:327733, iPS:327734, iPS:327735, iPS:327736, iPS:327737, iPS:327738, iPS:327739, iPS:327740, iPS:327741, iPS:327742, iPS:327872, iPS:327874, iPS:327875, iPS:327876, iPS:327877, iPS:327878, iPS:327879, iPS:327880, iPS:327881, iPS:327882, iPS:327883, iPS:327884, iPS:327885, iPS:327886, iPS:327887, iPS:327888, iPS:327889, iPS:327890, iPS:327891, iPS:327892, iPS:327893, iPS:327894, iPS:327895, iPS:327896, iPS:327897, iPS:328031, iPS:328033, iPS:328034, iPS:328035, iPS:328036, iPS:328037, iPS:328038, iPS:328039, iPS:328040, iPS:328041, iPS:328042, iPS:328043, iPS:328044, iPS:328045, iPS:328046, iPS:328047, iPS:328048, iPS:328049, iPS:328050, and iPS:328051, as set forth herein; and

(b) all six CDRs that specifically bind PAC1 from a different antibody selected from the antibodies designated iPS:326417, iPS:326626, iPS:326628, iPS:326631, iPS:326634, iPS:327870, iPS:327871, iPS:326645, iPS:326648, iPS:326651, iPS:326654, iPS:328000, iPS:328001, iPS:326661, iPS:326663, iPS:326666, iPS:326669, iPS:327017, iPS:327018,

iPS:327019, iPS:327023, iPS:327024, iPS:327025, iPS:327026, iPS:327091, iPS:327092, iPS:327093, iPS:327094, iPS:326414, iPS:327102, iPS:327103, iPS:327104, iPS:327105, iPS:327106, iPS:327107, iPS:327108, iPS:327109, iPS:327110, iPS:327111, iPS:327112, iPS:327267, iPS:327268, iPS:327269, iPS:327270, iPS:327272, iPS:327273, iPS:327274, iPS:327275, iPS:327276, iPS:327277, iPS:327278, iPS:327279, iPS:327280, iPS:327281, iPS:327282, iPS:327283, iPS:327284, iPS:327285, iPS:327286, iPS:327287, iPS:327288, iPS:327289, iPS:327290, iPS:327291, iPS:327677, iPS:327678, iPS:327679, iPS:327680, iPS:327681, iPS:327682, iPS:327683, iPS:327684, iPS:327685, iPS:327686, iPS:327687, iPS:327688, iPS:327689, iPS:327690, iPS:327691, iPS:327693, iPS:327694, iPS:327696, iPS:327697, iPS:327698, iPS:327699, iPS:327700, iPS:327701, iPS:327702, iPS:327703, iPS:327704, iPS:327705, iPS:327706, iPS:327707, iPS:327708, iPS:327709, iPS:327710, iPS:327711, iPS:327712, iPS:327713, iPS:327714, iPS:327717, iPS:327718, iPS:327719, iPS:327721, iPS:327722, iPS:327724, iPS:327725, iPS:327726, iPS:327727, iPS:327728, iPS:327729, iPS:327730, iPS:327731, iPS:327732, iPS:327733, iPS:327734, iPS:327735, iPS:327736, iPS:327737, iPS:327738, iPS:327739, iPS:327740, iPS:327741, iPS:327742, iPS:327872, iPS:327874, iPS:327875, iPS:327876, iPS:327877, iPS:327878, iPS:327879, iPS:327880, iPS:327881, iPS:327882, iPS:327883, iPS:327884, iPS:327885, iPS:327886, iPS:327887, iPS:327888, iPS:327889, iPS:327890, iPS:327891, iPS:327892, iPS:327893, iPS:327894, iPS:327895, iPS:327896, iPS:327897, iPS:328031, iPS:328033, iPS:328034, iPS:328035, iPS:328036, iPS:328037, iPS:328038, iPS:328039, iPS:328040, iPS:328041, iPS:328042, iPS:328043, iPS:328044, iPS:328045, iPS:328046, iPS:328047, iPS:328048, iPS:328049, iPS:328050, and iPS:328051, as set forth herein.

[0243] Embodiment 9: The bispecific antigen binding protein of Embodiments 7-8, wherein one or more of the CDRs of the antigen binding protein contains a conservative amino acid substitution.

[0244] Embodiment 10: The bispecific antigen binding protein of Embodiments 1-9, comprising a modification that reduces or eliminates effector function.

[0245] Embodiment 11: A pharmaceutical composition comprising the antigen binding protein of any of Embodiments 1-10, and a pharmaceutically acceptable diluent, excipient or carrier.

[0246] Embodiment 12: A recombinant host cell that expresses the bispecific antigen binding protein of any of Embodiments 1-10.

[0247] Embodiment 13: The recombinant host cell of Embodiment 12, wherein the cell is a CHO cell.

[0248] Embodiment 14: A method for treating a condition associated with CGRP receptor or PAC1, or both, in a patient, comprising administering to a patient an effective amount of the bispecific antigen binding protein of any of Embodiments 1-10.

[0249] Embodiment 15: The method of Embodiment 14, wherein the condition is headache.

[0250] Embodiment 16: The method of Embodiment 15, wherein the condition is a cluster headache.

[0251] Embodiment 17: The method of Embodiment 15, wherein the condition is migraine.

[0252] Embodiment 18: The method of Embodiment 17, wherein the migraine is episodic migraine.

[0253] Embodiment 19: The method of Embodiment 17, wherein the migraine is chronic migraine.

[0254] Embodiment 20: The method of Embodiment 14, wherein the condition is chronic pain.

[0255] Embodiment 21: The method of any of Embodiments 14-20, wherein the method comprises prophylactic treatment.

[0256] The following examples, including the experiments conducted and the results achieved, are provided for illustrative purposes only and are not to be construed as limiting the scope of the appended claims.

EXAMPLES

Example 1. Engineering of CGRP receptor and PAC1 receptor antibodies to improve stability, biophysical properties, and expression, and eliminate chemical hotspots

Starting Antibodies

[0257] ***Generation and screening of anti-CGRP receptor antibodies.*** Monoclonal anti-human CGRP receptor antibodies were generated and sequenced as described in Examples 1-3 of WO2010/075238 (Human CGRP Receptor Binding Proteins), which is hereby incorporated by reference in its entirety. Briefly, human CRLR cDNA (GenBank Accession No. U17473) and RAMP1 cDNA (GenBank Accession No. AJ001014) were cloned into the mammalian cell expression vectors pcDNA3.1-Zeo and pcDNA3.1-Hyg (Invitrogen, Carlsbad, CA), respectively,

for transfections of HEK 293EBNA cells (Invitrogen). The hCRLR cDNA and hRAMP1 cDNA were also cloned into the pDSR α 24 vector (Kim, H. Y. et al. J. Inv. Derm. Symp. Proc. (2007) 12: 48-49) for transfections of AM-1 CHO cells (U.S. Patent Number 6,210,924). Stable transfectants expressing CGRPR were identified.

[0258] XENOMOUSE® animals were immunized with purified soluble CGRP receptor protein and purified CGRP receptor membranes prepared from AM-1 CHO cells stably expressing CGRP receptor, using doses of 10 μ g/mouse and 150 μ g/mouse, respectively. Subsequent boosts were administered at doses of 10 μ g/mouse of soluble CGRP receptor or 75 μ g of purified CGRP receptor membranes. XENOMOUSE® animals were also immunized with CGRP receptor-expressing cells using doses of 3.4×10^6 CGRP receptor-transfected cells per mouse and subsequent boosts were of 1.7×10^6 CGRP receptor-transfected cells per mouse. Injection sites used were combinations of subcutaneous, base-of-tail, and intraperitoneal. Immunizations were performed in accordance with methods disclosed in U.S. Patent Number 7,064,244, the disclosure of which is hereby incorporated by reference. Adjuvants TiterMax Gold (Sigma; cat. # T2684), Alum (E.M. Sargent Pulp and Chemical Co., Clifton, NJ, cat. # 1452-250) were prepared according to manufacturers' instructions and mixed in a 1:1 ratio of adjuvant emulsion to antigen solution. Sera were collected 4 - 6 weeks after the first injection and specific titers were determined by FACs staining of recombinant CGRP receptor-expressing 293EBNA cells. Mice were immunized with either cells or membranes from cells expressing full length CGRP receptor, or soluble CGRP receptor extracellular domain, with a range of 11 - 17 immunizations over a period of approximately one to three and one-half months. Mice with the highest sera titer were identified and prepared for hybridoma generation. The immunizations were performed in groups of multiple mice, typically ten. Popliteal and inguinal lymph nodes and spleen tissues were typically pooled from each group for generating hybridomas. Hybridoma supernatants were screened for CGRP receptor-specific monoclonal antibodies by Fluorometric Microvolume Assay Technology (FMAT) (Applied Biosystems, Foster City, CA). The supernatants were screened against either the AM-1 CHO huCGRP receptor cells or recombinant HEK 293 cells that were transfected with human CGRP receptor and counter-screened against parental HEK293 cells. Anti-CGRP receptor antibodies were sequenced using standard RT-PCR methods, as described in Examples 2-3 of WO2010/075238 (Human CGRP Receptor Binding Proteins).

[0259] **Generation and screening of anti-PAC1 receptor antibodies.** Monoclonal anti-human PAC1 receptor antibodies were generated and sequenced as described in WO2014/144632 (Human PAC1 Antibodies), which is hereby incorporated by reference in its entirety. Briefly, antibodies were generated through immunization of XENOMOUSE® animals with the PAC1 extracellular domain protein (DNA tagged with a T-cell epitope tag), L1.2 cells expressing full-length human PAC1, or other human PAC1 antigens using standard methods, e.g., such as those detailed in US Patent Publication No. 2010/0172895. Hybridoma supernatants were screened for binding to PAC1 receptor as well as for functional antagonist activity in an assay detecting their ability to block generation of cAMP by activation of PAC1 with either PACAP (e.g., PACAP-27 or PACAP-38) or a selective, exogenous peptide ligand (Maxadilan), and then counter-screened against the related receptors VPAC1 and VPAC2. Those supernatants with desirable function and selectivity were sequenced and cloned, expressed recombinantly, purified, and tested again for function and selectivity using standard methods. Selected human PAC1 receptor antibodies were screened in an *in vitro* PAC1-mediated cAMP assay to determine intrinsic potency. The assay employed cell lines expressing human PAC1 (SH-SY-5Y, a human neuroblastoma cell line endogenously expressing PAC1), cynomolgus PAC1, rat PAC1, human VPAC1 and human VPAC2. The LANCE cAMP assay kit (PerkinElmer, Boston, MA) was used in the screening. The assays were performed in white 96-well plates in a total volume of 60 μ L. Briefly, on the day of the assay, the frozen cells were thawed at 37°C, cells were washed once with assay buffer and 12 μ L of cell suspension containing 10,000 cells mixed with Alexa-labeled anti-cAMP antibody was added into 96 half-area white plates. After adding 12 μ L PAC1 antibody, the mixture was incubated for 30 min at room temperature. Then 12 μ L PAC1 agonist PACAP-38 (1 nM final concentration) was added and further incubated for 15 min at room temperature. After agonist stimulation, 24 μ L of detection mix was added and incubated for 60 minutes at room temperature and the plates were read on EnVision instrument (PerkinElmer, Boston, MA) at an emission wavelength of 665nm. Data were processed and analyzed by Prism (GraphPad Software Inc.) or ActivityBase (IDBS).

Engineering to improve biophysical properties

[0260] Of the monoclonal antibodies generated and screened as described above, a subset of the anti-CGRP receptor antibodies and anti-human PAC1 receptor antibodies were identified for bispecific antibody generation and for engineering to improve biophysical properties.

[0261] Two antibodies were selected for optimization during the PAC1 antibody engineering. These antibodies resulted from the novel CDR grafting exercise to improve sequence diversity, stability, and expression. However, the other PAC1 receptor antibodies and all of the CGRP receptor antibodies did not go through the optimization engineering process. However, these antibodies were analyzed for potential chemical hotspots and covariance violations. It has been shown in numerous projects that fixing the covariance violations improves the thermal stability, expression and biophysical properties of the antibodies. *See, e.g.*, WO2012/125495. Co-variance analysis was conducted of the selected anti-CGRP receptor and anti-PAC1 receptor antibodies according to the methods described in WO2012/125495.

Example 2. Generation of CGRP Receptor/PAC1 Receptor Hetero Immunoglobulins

[0262] Generation of a bispecific antibody through co-expression of two different antibodies leads to contaminants. The preferred bispecific, heterotetramer molecule with two different heavy chains associated with correctly paired light chains is only a minority of the total amount of combinations expressed. The contaminants occur mainly due to two different reasons. The first reason is that the heavy chain that comes together at the Fc region of the antibody can homodimerize, leading to conventional monospecific antibody, or heterodimerize, leading to bispecific antibody. The second reason is that light chain is promiscuous and can pair with either of the heavy chains, leading to mispaired light-heavy chain Fab assembly that may not retain the activity and binding to the desired target. Hence, the bispecific engineering is a two-step process. The first goal is to prevent the homodimerization of the heavy chains and encourage heterodimerization. This can be achieved through engineering the Fc region of the antibodies, using, for example, the knobs-into-holes or charge pair mutations strategies. The second goal is to engineer the light-heavy chain interface in such a way that the light chain is specifically associated only with its cognate heavy chain.

[0263] The “Hetero-Ig” platform technology (*see, e.g.*, WO2009089004 and WO2014081955, both of which are hereby incorporated by reference in their entireties) takes advantage of the

electrostatic steering mechanism to overcome the two problems mentioned above. Specifically, charged residues are introduced or exploited to drive heavy chain heterodimerization and light-heavy chain association. The charge pair mutations (CPMs) in the CH3 domain of the Fc region drive the heterodimerization of the two different heavy chains through opposite charges that cause electrostatic attraction (*see, e.g.*, WO2009089004 and U.S. Patent No. 8,592,562); the two identical heavy chain combinations have identical charges and are therefore repelled. The correct heavy chain-light chain pairing is facilitated by CPMs at the CH1/CL binding interface (*see Figure 1*; “v1” & “v4”) or between the VH/VL and CH1/CL binding interfaces (*see Figure 1*; “v3”). The correct heavy chain-light chain combinations will have opposite charges and therefore be attracted to each other, whereas the incorrect heavy chain-light chain combinations will have the same charges and be repelled. As a result, the correctly assembled hetero-Ig will have either three (“v1”) or four CPMs (“v3” and “v4”) that drive the assembly of the preferred heterotetramer comprising two different heavy chains and two different light chains so that the heterotetramer will be the majority component generated by the expression system.

[0264] Because the CGRP receptor and PAC1 receptor targets are expressed on cell surfaces, there is a risk of *in vivo* platelet depletion by antagonizing either target. Thus, the effector functionless IgG1 scaffold (*see, e.g.*, U.S. Patent Publication No. 2014/0343252, which is hereby incorporated by reference in its entirety) was chosen as the framework for the generation of the bispecific hetero Ig molecules. The effector functionless scaffold includes an IgG1 variant with a N297G mutation to knock out the glycosylation in the CH2 domain and an engineered disulfide bond introduced in the CH2 domain to improve the stability in the absence of glycosylation. The lack of glycosylation in the CH2 domain resulting from the N297G mutation leads to significantly reduced binding to Fc gamma receptors, which helps address the platelet depletion issue. *See, e.g.*, Example 5 of WO2014/144632.

[0265] Six anti-PAC1 receptor antibodies (antibodies 01 to 06 as described herein) and nine anti-CGRP receptor engineered antibodies (antibodies 50 to 58 as described herein), with their co-variance violations corrected, were utilized to generate 169 distinct bispecific hetero Ig molecules using high throughput cloning, expression and purification. Each of the bispecific hetero Ig molecules had one of the three formats shown in **Figure 1** using the IgG1 effector functionless scaffold or an IgG2 scaffold. The sequences of each of the 169 bispecific hetero immunoglobulins are set forth in **Table 8**.

Example 3. Functional Activity of Bispecific Hetero Immunoglobulin Molecules

[0266] The bispecific hetero Ig molecules generated as described in Example 2 were tested for their ability to inhibit ligand-induced activation of the human CGRP receptor and the human PAC1 receptor using *in vitro* cAMP assays as described in detail below.

[0267] **CGRP receptor activity assay.** The assay employed a human neuroblastoma-derived cell line (SK-N-MC; Spengler, *et al.*, (1973) *In Vitro* 8: 410) obtained from ATCC (ATCC Number HTB-10; “HTB-10 cells”). HTB-10 cells express human CRLR and human RAMP1, which form the human CGRP receptor (McLatchie *et al.*, (1998) *Nature*, 393:333-339).

[0268] The LANCE Ultra cAMP assay kit (PerkinElmer, Boston, MA) was used. The assays were performed in white 96-well plates in a total volume of 40 μ L. Briefly, on the day of the assay, the frozen HTB-10 cells were thawed at 37°C and were washed once with assay buffer. 10 μ L of cell suspension containing 1000 cells was added into 96 half-area white plates. After adding 5 μ L of the bispecific hetero IgG (single point or 10 points dose response curve: final concentration ranges from 1 μ M to 0.5 fM), the mixture was incubated for 30 min at room temperature. Then, 5 μ L CGRP receptor agonist human α -CGRP (3nM final concentration) was added and further incubated for 15 min at room temperature. After human α -CGRP stimulation, 20 μ L of detection mix was added and incubated for 45 minutes at room temperature and the plates were read on EnVision instrument (PerkinElmer, Boston, MA) at an emission wavelength of 665 nm. Data were processed and analyzed by Prism (GraphPad Software Inc.).

[0269] **PAC1 receptor activity assay.** The assay employed a human neuroblastoma-derived cell line (SH-SH5Y; Biedler JL, *et al.*, *Cancer Res.* 38: 3751-3757, 1978) obtained from ATCC (ATCC Number CRL-2266; “CRL-2266 cells”). CRL-2266 cells express human PAC1 receptor (Monaghan *et al.*, *J Neurochem.* 104(1): 74–88, 2008).

[0270] The LANCE Ultra cAMP assay kit (PerkinElmer, Boston, MA) was used. The assays were performed in white 96-well plates in a total volume of 40 μ L. Briefly, on the day of the assay, the frozen CRL-2266 cells were thawed at 37°C and were washed once with assay buffer. 10 μ L of cell suspension containing 2000 cells was added into 96 half-area white plates. After adding 5 μ L of the bispecific hetero IgG (single point or 10 point dose response curve: concentration ranges from 1 μ M to 0.5 fM), the mixture was incubated for 30 min at room temperature. Then, 5 μ L PAC1 receptor agonist human PACAP38 (10 pM final concentration) was added and the mixture was further incubated for 15 min at room temperature. After human

PACAP38 stimulation, 20 μ L of detection mix was added and incubated for 45 minutes at room temperature and the plates were read on EnVision instrument (PerkinElmer, Boston, MA) at emission wavelength 665 nm. Data were processed and analyzed by Prizm (GraphPad Software Inc.).

[0271] Percentage inhibition of CGRP receptor and PAC1 receptor activities for each of the 169 bispecific hetero IgGs are shown in **Table 15** below. IC₅₀ values were calculated for a subset of the bispecific hetero IgGs based on a 10 point dose response curve. These IC₅₀ values are shown below in **Table 16**.

Table 15. Percentage inhibition of human CGRP receptor and human PAC1 receptor activity by bispecific hetero IgGs (n = 1)

Bispecific Hetero IgG Designation	% inhibition of human CGRPR	% inhibition of human PAC1	Bispecific Hetero IgG Designation	% inhibition of human CGRPR	% inhibition of human PAC1
iPS:326417	66	48	iPS:326651	66	23
iPS:326626	96	86	iPS:326654	79	99
iPS:326628	84	61	iPS:328000	75	63
iPS:326631	89	79	iPS:328001	65	95
iPS:326634	66	43	iPS:326661	77	72
iPS:327870	67	86	iPS:326663	64	62
iPS:327871	65	68	iPS:326666	74	15
iPS:326645	67	59	iPS:326669	74	85
iPS:326648	73	92	iPS:327017	67	27
iPS:327018	68	17	iPS:327026	81	78
iPS:327019	65	79	iPS:327091	65	67
iPS:327023	74	32	iPS:327092	73	52
iPS:327024	75	7	iPS:327093	70	68
iPS:327025	76	21	iPS:327094	73	91
iPS:326414	70	58	iPS:327106	71	6
iPS:327102	74	47	iPS:327107	76	22
iPS:327103	82	21	iPS:327108	66	74
iPS:327104	81	95	iPS:327109	73	82
iPS:327105	81	63	iPS:327110	80	71
iPS:327111	88	65	iPS:327270	71	82
iPS:327112	84	104	iPS:327272	81	62
iPS:327267	75	29	iPS:327273	81	10
iPS:327268	79	38	iPS:327274	87	22
iPS:327269	79	8	iPS:327275	85	86
iPS:327276	80	87	iPS:327282	87	58
iPS:327277	83	56	iPS:327283	85	99
iPS:327278	85	47	iPS:327284	77	25
iPS:327279	73	95	iPS:327285	84	9
iPS:327280	80	83	iPS:327286	85	23
iPS:327281	82	50	iPS:327287	86	71
iPS:327288	67	88	iPS:327679	86	23
iPS:327289	72	75	iPS:327680	88	92
iPS:327290	70	60	iPS:327681	72	73

Bispecific Hetero IgG Designation	% inhibition of human CGRPR	% inhibition of human PAC1	Bispecific Hetero IgG Designation	% inhibition of human CGRPR	% inhibition of human PAC1
iPS:327291	70	89	iPS:327682	75	12
iPS:327677	81	43	iPS:327683	70	30
iPS:327678	84	43	iPS:327684	71	74
iPS:327685	86	85	iPS:327689	78	86
iPS:327686	87	69	iPS:327690	80	50
iPS:327687	91	62	iPS:327691	73	25
iPS:327688	89	103	iPS:327693	76	82
iPS:327694	87	75	iPS:327705	88	56
iPS:327696	87	10	iPS:327706	87	103
iPS:327697	88	39	iPS:327707	73	72
iPS:327698	90	96	iPS:327708	79	18
iPS:327699	72	92	iPS:327709	82	29
iPS:327700	77	72	iPS:327710	82	61
iPS:327701	73	41	iPS:327711	87	97
iPS:327702	79	86	iPS:327712	89	81
iPS:327703	83	87	iPS:327713	89	85
iPS:327704	82	71	iPS:327714	94	104
iPS:327717	92	94	iPS:327729	84	85
iPS:327718	78	70	iPS:327730	87	101
iPS:327719	85	59	iPS:327731	74	74
iPS:327721	81	99	iPS:327732	69	56
iPS:327722	82	38	iPS:327733	84	66
iPS:327724	80	33	iPS:327734	82	99
iPS:327725	86	39	iPS:327735	81	68
iPS:327726	91	77	iPS:327736	88	20
iPS:327727	93	93	iPS:327737	82	54
iPS:327728	80	79	iPS:327738	85	93
iPS:327739	79	76	iPS:327875	83	10
iPS:327740	74	58	iPS:327876	77	11
iPS:327741	83	70	iPS:327877	72	22
iPS:327742	84	96	iPS:327878	75	42
iPS:327872	80	40	iPS:327879	81	19
iPS:327874	95	5	iPS:327880	87	15
iPS:327881	76	16	iPS:327891	80	78
iPS:327882	83	13	iPS:327892	88	33
iPS:327883	77	27	iPS:327893	74	56
iPS:327884	78	8	iPS:327894	80	12
iPS:327885	73	7	iPS:327895	80	15
iPS:327886	72	65	iPS:327896	87	28
iPS:327887	87	35	iPS:327897	80	12
iPS:327888	83	56	iPS:328031	75	27
iPS:327889	83	9	iPS:328033	82	20
iPS:327890	94	15	iPS:328034	86	9
iPS:328035	73	10	iPS:328041	82	17
iPS:328036	79	21	iPS:328042	85	20
iPS:328037	71	25	iPS:328043	75	8
iPS:328038	69	6	iPS:328044	77	5
iPS:328039	74	9	iPS:328045	67	29
iPS:328040	74	70	iPS:328046	73	3
iPS:328047	78	33	iPS:328050	80	11

Bispecific Hetero IgG Designation	% inhibition of human CGRPR	% inhibition of human PAC1	Bispecific Hetero IgG Designation	% inhibition of human CGRPR	% inhibition of human PAC1
iPS:328048	69	9	iPS:328051	77	21
iPS:328049	92	13			

Table 16. Inhibitory activity of bispecific hetero IgGs against the human CGRP receptor and human PAC1 receptor (n = 5, except where noted)

Bispecific Hetero IgG Designation	Human CGRP Receptor IC ₅₀ (nM) ± SD	Human PAC1 Receptor IC ₅₀ (nM) ± SD
iPS:326648	2.6 ± 0.8	2.7 ± 0.8
iPS:327026	5.5 (n=1)	5.4 (n=1)
iPS:327111	2.2 ± 0.8	19.4 ± 5.0
iPS:327112	10.1 (n=1)	13.6 (n=1)
iPS:327270	1.9 ± 0.55	16.2 ± 4.2
iPS:327272	1.2 ± 0.7	48.7 ± 14.2
iPS:327283	12.9 (n=1)	2.1 (n=1)
iPS:327680	2.0 ± 0.6	11.6 ± 4.3
iPS:327688	8.2 (n=1)	7.1 (n=1)
iPS:327689	1.0 ± 0.5	13.6 ± 4.2
iPS:327698	1.6 ± 0.7	14.5 ± 2.0
iPS:327702	1.4 ± 0.48	6.7 ± 0.2
iPS:327714	9.1 (n=1)	2.6 (n=1)
iPS:327717	1.8 ± 0.76	20.2 ± 5.3
iPS:327730	2.6 ± 1.3	12.2 ± 2.9
iPS:327741	1.9 ± 0.8	107.5 ± 30.5
iPS:327742	1.4 ± 0.6	11.1 ± 3.5
iPS:328001	2.5 ± 1.1	2.8 ± 1.0

Example 4. Synthesis and Activity of CGRP Receptor/PAC1 Receptor IgG-scFv Bispecific Antigen Binding Proteins

[0272] A subset of the anti-CGRP receptor and anti-PAC1 receptor antibodies described in Example 1 were used to design bispecific antigen binding proteins having an IgG-scFv format. In this format, a single-chain variable fragment (scFv) containing heavy and light chain variable domains from a first antibody is fused through a peptide linker to the carboxyl-terminus of the heavy chain of a second antibody to form a modified heavy chain (*see Figure 2*). The light chain

from the second antibody is expressed with the modified heavy chain. Assembly of the full molecule creates a tetravalent binding protein having two antigen binding domains against a first target located on the amino terminal side of a dimerized immunoglobulin Fc region and two antigen binding domains against a second target located on the carboxyl terminal side of the dimerized Fc region.

[0273] The CGRPR/PAC1 IgG-scFv contains two antigen binding domains, one directed against CGRP receptor and the other against PAC1 receptor. The DNA molecules encoding CGRPR-PAC1 IgG-scFv molecules contain fragments coding for an anti-CGRPR (or anti-PAC1 receptor) antibody heavy chain (HC) in which the C-terminus is fused to an anti-PAC1 receptor (or anti-CGRP receptor) single chain variable fragment (scFv) with or without cysteine clamp, and an anti-CGRP receptor (or anti-PAC1 receptor) antibody light chain (LC). In order to introduce the cysteine clamp, which can improve stability, position 44 (Kabat numbering) in the VH region and position 100 (Kabat numbering) in the VL region were mutated to cysteine. The DNA molecules were generated by synthesized gBlocks and cloned into a pTT5.1 vector. These expression vectors were used to transfect and express the CGRPR/PAC1 bispecific molecules in human 293-6E cells. Thirty different IgG-scFv bispecific molecules were generated. The full sequences for each molecule are set forth in **Table 9**.

[0274] The IgG-scFv molecules were tested for their ability to inhibit ligand-induced activation of the human CGRP receptor and the human PAC1 receptor using *in vitro* cAMP assays as described in Example 3. IC₅₀ values for each of the molecules for each target receptor are shown in **Table 17** below.

Table 17. Inhibitory activity of bispecific IgG-scFv molecules against the human CGRP receptor and human PAC1 receptor

Bispecific IgG-scFv Designation	Human CGRP Receptor IC₅₀ (nM)	Human PAC1 Receptor IC₅₀ (nM)
iPS:386705	0.43	605.28
iPS:386707	0.47	739.75
iPS:386709	0.47	431.70
iPS:386711	0.53	1211.80
iPS:386713	0.37	603.02
iPS:386725	0.42	548.93

Bispecific IgG-scFv Designation	Human CGRP Receptor IC50 (nM)	Human PAC1 Receptor IC50 (nM)
iPS:386727	0.72	371.35
iPS:386729	0.47	565.33
iPS:386731	0.40	346.93
iPS:386733	0.34	74.33
iPS:386736	0.90	5.43
iPS:386738	0.74	5.09
iPS:386740	0.56	4.40
iPS:386742	0.61	6.39
iPS:386744	0.61	3.63
iPS:386746	0.79	3.28
iPS:386748	0.63	2.85
iPS:386750	0.58	4.54
iPS:386752	0.62	6.08
iPS:386754	0.54	5.74
iPS:386756	1.88	7.29
iPS:386758	2.32	4.11
iPS:386760	2.11	4.67
iPS:386762	2.80	3.55
iPS:386764	2.61	11.88
iPS:386715	0.43	688.60
iPS:386717	0.33	580.08
iPS:386719	0.41	940.48
iPS:386721	0.22	197.13
iPS:386723	0.27	248.18

[0275] All bispecific IgG-scFv molecules tested exhibited inhibitory activity against both human CGRP receptor and human PAC1 receptor. Interestingly, the molecules that were the more potent inhibitors of the PAC1 receptor (e.g., iPS:386736, iPS:386738, iPS:386740, iPS:386742, iPS:386744, iPS:386746, iPS:386748, iPS:386750, iPS:386752, iPS:386754, iPS:386756, iPS:386758, iPS:386760, iPS:386762, and iPS:386764) were those in which the PAC1 receptor binding domain was located at the amino terminus of the Fc region. Generally, in this format, the CGRP receptor binding domain could be located on either side of the Fc region without substantially affecting inhibitory potency.

Example 5. Synthesis and Activity of CGRP Receptor/PAC1 Receptor IgG-Fab Bispecific Antigen Binding Proteins

[0276] Additional bispecific antigen binding proteins were prepared with a subset of the anti-CGRP receptor and anti-PAC1 receptor antibodies described in Example 1 using a third format. In some embodiments of this IgG-Fab format, a polypeptide comprising either VL-CL domains or VH-CH1 domains from a first antibody is fused through a peptide linker to the carboxyl-terminus of the heavy chain of a second antibody to form a modified heavy chain (*see Figure 3*). A second polypeptide comprising the remaining domains of the Fab fragment from the first antibody (i.e. VH-CH1 domains or VL-CL domains) is co-expressed with the light chain of the second antibody and the modified heavy chain to produce the complete molecule. Similar to the IgG-scFv format, assembly of the full molecule creates a tetravalent binding protein having two antigen binding domains against a first target located on the amino terminal side of a dimerized immunoglobulin Fc region and two antigen binding domains against a second target located on the carboxyl terminal side of the dimerized Fc region.

[0277] The CGRPR/PAC1 IgG-Fab consists of two antigen binding domains, one directed against the CGRP receptor and the other against the PAC1 receptor. The DNA molecules encoding CGRPR-PAC1 IgG-Fab molecules contain fragments encoding an anti-CGRP receptor (or anti-PAC1 receptor) antibody light chain, an anti-CGRP receptor (or anti-PAC1 receptor) antibody heavy chain in which the C-terminus is fused to (i) an anti-PAC1 receptor (or anti-CGRP receptor) antibody light chain or (ii) an anti-PAC1 receptor (or anti-CGRP receptor) Fd (VH-CH1), and a third polypeptide comprising the other half of the Fab fragment to complete the carboxy-terminal binding domain (e.g. (i) an anti-PAC1 receptor (or anti-CGRP receptor) Fd or (ii) an anti-PAC1 receptor (or anti-CGRP receptor) antibody light chain. The IgG-Fab bispecific molecules contain charge pair mutations introduced into CH1 and CL domains of each Fab region (Fab 1 and Fab 2 as illustrated in Figure 3). The charge pairs are designed to allow preferential assembly of anti-CGRPR light chain/VHCH1(Fd) pair and anti-PAC1 light chain/VHCH1 (Fd) pair. As an additional approach to promote correct pairing of the light chain/VHCH1 (Fd) pair, for a subset of the IgG-Fab molecules generated, the CL and CH1 regions in the carboxyl-terminal Fab (i.e. Fab 2) were swapped such that the polypeptide fused to the carboxyl-terminal region of the heavy chain of the second antibody comprised VL and CH1 regions from the first antibody and the second polypeptide comprised VH and CL regions from

the first antibody. See molecules designated iPS:392513, iPS:392514, iPS:392475, iPS: 392519, iPS:392524, iPS:392525, iPS:392526, and iPS: 392527 in Table 10. The DNA molecules were generated by synthesized gBlocks and cloned into the pTT5.1 vector. These expression vectors were used to transfect and express the CGRPR/PAC1 bispecific molecules in human 293 6E cells. Twenty four different IgG-Fab bispecific molecules were generated. The full sequences for each molecule are set forth in **Table 10**.

[0278] The IgG-Fab molecules were tested for their ability to inhibit ligand-induced activation of the human CGRP receptor and the human PAC1 receptor using *in vitro* cAMP assays as described in Example 3. IC₅₀ values for each of the molecules for each target receptor are shown in **Table 18** below.

Table 18. Inhibitory activity of bispecific IgG-Fab molecules against the human CGRP receptor and human PAC1 receptor

Bispecific IgG-Fab Designation	Human CGRP Receptor IC ₅₀ (nM)	Human PAC1 Receptor IC ₅₀ (nM)
iPS:392475	20.44	4.78
iPS:392513	60.16	2.70
iPS:392514	53.95	4.69
iPS:392515	12.90	2.66
iPS:392516	27.85	9.30
iPS:392517 – lot #1	10.89	2.48
iPS:392517 – lot #2	11.48	7.75
iPS:392518	17.75	3.40
iPS:392519	81.28	6.87
iPS:392520	10.50	6.28
iPS:392521	18.76	6.88
iPS:392522 – lot #1	8.80	9.32
iPS:392522 – lot #2	7.58	3.29
iPS:392523	20.38	5.03
iPS:392524	0.86	81.20
iPS:392525	1.22	37.14
iPS:392526	0.71	115.58
iPS:392527	0.42	16.40
iPS:392528	0.55	>1000
iPS:392529	0.56	>1000
iPS:392530	0.38	>1000

Bispecific IgG-Fab Designation	Human CGRP Receptor IC₅₀ (nM)	Human PAC1 Receptor IC₅₀ (nM)
iPS:392531	0.42	>1000
iPS:392532	0.51	352.50
iPS:392533	0.59	205.80
iPS:392534	0.37	349.20
iPS:392535	0.41	365.03

[0279] All but four of the bispecific IgG-Fab molecules tested exhibited inhibitory activity against both receptors.

[0280] All publications, patents, and patent applications discussed and cited herein are hereby incorporated by reference in their entireties. It is understood that the disclosed invention is not limited to the particular methodology, protocols and materials described as these can vary. It is also understood that the terminology used herein is for the purposes of describing particular embodiments only and is not intended to limit the scope of the appended claims.

[0281] Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents to the specific embodiments of the invention described herein. Such equivalents are intended to be encompassed by the following claims.

CLAIMS

What is claimed:

1. A bispecific antigen binding protein comprising a first binding domain that specifically binds to human CGRP receptor and a second binding domain that specifically binds to human PAC1 receptor.
2. The bispecific antigen binding protein of claim 1, wherein the first binding domain comprises a first light chain immunoglobulin variable region (VL1) and a first heavy chain immunoglobulin variable region (VH1), and the second binding domain comprises a second light chain immunoglobulin variable region (VL2) and a second heavy chain immunoglobulin variable region (VH2).
3. The bispecific antigen binding protein of claim 2, wherein the first binding domain and/or the second binding domain comprise humanized or human immunoglobulin variable regions.
4. The bispecific antigen binding protein of claim 2 or 3, wherein VL1 comprises (i) a CDRL1 selected from SEQ ID NOs: 109 to 119, (ii) a CDRL2 selected from SEQ ID NOs: 14, 17, 18, and 120 to 126, and (iii) a CDRL3 selected from SEQ ID NOs: 127 to 135.
5. The bispecific antigen binding protein of any one of claims 2 to 4, wherein VH1 comprises (i) a CDRH1 selected from SEQ ID NOs: 159 to 166, (ii) a CDRH2 selected from SEQ ID NOs: 167 to 178, and (iii) a CDRH3 selected from SEQ ID NOs: 179 to 189.
6. The bispecific antigen binding protein of any one of claims 2 to 5, wherein VL1 comprises a CDRL1, a CDRL2, and a CDRL3, and VH1 comprises a CDRH1, a CDRH2, and a CDRH3, and wherein:
 - (a) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 109, 120 and 127, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 167 and 179, respectively;

(b) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 109, 120 and 127, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 159, 168 and 179, respectively;

(c) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 110, 121 and 128, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 180, respectively;

(d) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 110, 121 and 128, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 160, 169 and 181, respectively;

(e) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 111, 17 and 129, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 170 and 182, respectively; or

(f) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 111, 17 and 129, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 161, 171 and 182, respectively.

7. The bispecific antigen binding protein of any one of claims 2 to 5, wherein VL1 comprises a sequence that is at least 90% identical to an amino acid sequence selected from SEQ ID NOs: 136 to 158.

8. The bispecific antigen binding protein of any one of claims 2 to 5, wherein VH1 comprises a sequence that is at least 90% identical to an amino acid sequence selected from SEQ ID NOs: 190 to 210.

9. The bispecific antigen binding protein of any one of claims 2 to 8, wherein:

(a) VL1 comprises the sequence of SEQ ID NO: 136 and VH1 comprises the sequence of SEQ ID NO: 190;

(b) VL1 comprises the sequence of SEQ ID NO: 138 and VH1 comprises the sequence of SEQ ID NO: 192;

(c) VL1 comprises the sequence of SEQ ID NO: 140 and VH1 comprises the sequence of SEQ ID NO: 194;

(d) VL1 comprises the sequence of SEQ ID NO: 140 and VH1 comprises the sequence of SEQ ID NO: 196;

(e) VL1 comprises the sequence of SEQ ID NO: 142 and VH1 comprises the sequence of SEQ ID NO: 194;

(f) VL1 comprises the sequence of SEQ ID NO: 142 and VH1 comprises the sequence of SEQ ID NO: 196;

(g) VL1 comprises the sequence of SEQ ID NO: 144 and VH1 comprises the sequence of SEQ ID NO: 194;

(h) VL1 comprises the sequence of SEQ ID NO: 146 and VH1 comprises the sequence of SEQ ID NO: 198; or

(i) VL1 comprises the sequence of SEQ ID NO: 146 and VH1 comprises the sequence of SEQ ID NO: 200.

10. The bispecific antigen binding protein of any one of claims 2 to 9, wherein VL2 comprises (i) a CDRL1 selected from SEQ ID NOs: 1 to 13, (ii) a CDRL2 selected from SEQ ID NOs: 14 to 19, and (iii) a CDRL3 selected from SEQ ID NOs: 20 to 27.

11. The bispecific antigen binding protein of any one of claims 2 to 10, wherein VH2 comprises (i) a CDRH1 selected from SEQ ID NOs: 55 to 65, (ii) a CDRH2 selected from SEQ ID NOs: 66 to 73, and (iii) a CDRH3 selected from SEQ ID NOs: 74 to 82.

12. The bispecific antigen binding protein of any one of claims 2 to 11, wherein VL2 comprises a CDRL1, a CDRL2, and a CDRL3, and VH2 comprises a CDRH1, a CDRH2, and a CDRH3, and wherein:

(a) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 1, 14 and 20, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 55, 66 and 74, respectively;

(b) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 2, 15 and 21, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 56, 67 and 75, respectively;

(c) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 3, 15 and 21, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 56, 67 and 75, respectively; or

(d) CDRL1, CDRL2, and CDRL3 have the sequence of SEQ ID NOs: 4, 16 and 22, respectively, and CDRH1, CDRH2, and CDRH3 have the sequence of SEQ ID NOs: 57, 68 and 76, respectively.

13. The bispecific antigen binding protein of any one of claims 2 to 11, wherein VL2 comprises a sequence that is at least 90% identical to an amino acid sequence selected from SEQ ID NOs: 28 to 54.

14. The bispecific antigen binding protein of any one of claims 2 to 11, wherein VH2 comprises a sequence that is at least 90% identical to an amino acid sequence selected from SEQ ID NOs: 83 to 108.

15. The bispecific antigen binding protein of any one of claims 2 to 14, wherein:

(a) VL2 comprises the sequence of SEQ ID NO: 28 and VH2 comprises the sequence of SEQ ID NO: 83;

(b) VL2 comprises the sequence of SEQ ID NO: 30 and VH2 comprises the sequence of SEQ ID NO: 83;

(c) VL2 comprises the sequence of SEQ ID NO: 31 and VH2 comprises the sequence of SEQ ID NO: 85;

(d) VL2 comprises the sequence of SEQ ID NO: 33 and VH2 comprises the sequence of SEQ ID NO: 87;

(e) VL2 comprises the sequence of SEQ ID NO: 35 and VH2 comprises the sequence of SEQ ID NO: 89; or

(f) VL2 comprises the sequence of SEQ ID NO: 37 and VH2 comprises the sequence of SEQ ID NO: 91.

16. The bispecific antigen binding protein of any one of claims 1 to 15, wherein the first binding domain and/or the second binding domain comprise a Fab, a Fab', a F(ab')₂, a Fv, a single-chain variable fragment (scFv), or a nanobody.
17. The bispecific antigen binding protein of any one of claims 1 to 16, wherein the binding protein comprises a constant region from an IgG1, IgG2, IgG3, or IgG4 immunoglobulin.
18. The bispecific antigen binding protein of claim 17, wherein the constant region comprises human IgG1 or IgG2 immunoglobulin CH2 and CH3 domains.
19. The bispecific antigen binding protein of claim 17 or 18, wherein the constant region comprises one or more amino acid substitutions to reduce glycosylation and/or effector function as compared to the binding protein without the one or more substitutions.
20. The bispecific antigen binding protein of claim 19, wherein at least one of the substitutions is N297G.
21. The bispecific antigen binding protein of any one of claims 1 to 20, wherein the binding protein is an antibody.
22. The bispecific antigen binding protein of claim 21, wherein the antibody comprises a first light chain (LC1) and a first heavy chain (HC1) from a first antibody that specifically binds to human CGRP receptor and a second light chain (LC2) and second heavy chain (HC2) from a second antibody that specifically binds to human PAC1 receptor.
23. The bispecific antigen binding protein of claim 22, wherein LC1 comprises a sequence that is at least 90% identical to a sequence selected from SEQ ID NOs: 271 to 282.
24. The bispecific antigen binding protein of claim 22 or 23, wherein HC1 comprises a sequence that is at least 90% identical to a sequence selected from SEQ ID NOs: 295 to 316.

25. The bispecific antigen binding protein of any one of claims 22 to 24, wherein:

(a) LC1 comprises the sequence of SEQ ID NO: 271 and HC1 comprises the sequence of SEQ ID NO: 295;

(b) LC1 comprises the sequence of SEQ ID NO: 272 and HC1 comprises the sequence of SEQ ID NO: 296;

(c) LC1 comprises the sequence of SEQ ID NO: 271 and HC1 comprises the sequence of SEQ ID NO: 297;

(d) LC1 comprises the sequence of SEQ ID NO: 271 and HC1 comprises the sequence of SEQ ID NO: 298;

(e) LC1 comprises the sequence of SEQ ID NO: 273 and HC1 comprises the sequence of SEQ ID NO: 299;

(f) LC1 comprises the sequence of SEQ ID NO: 274 and HC1 comprises the sequence of SEQ ID NO: 300;

(g) LC1 comprises the sequence of SEQ ID NO: 273 and HC1 comprises the sequence of SEQ ID NO: 301;

(h) LC1 comprises the sequence of SEQ ID NO: 273 and HC1 comprises the sequence of SEQ ID NO: 302;

(i) LC1 comprises the sequence of SEQ ID NO: 275 and HC1 comprises the sequence of SEQ ID NO: 303;

(j) LC1 comprises the sequence of SEQ ID NO: 276 and HC1 comprises the sequence of SEQ ID NO: 304;

(k) LC1 comprises the sequence of SEQ ID NO: 275 and HC1 comprises the sequence of SEQ ID NO: 305;

(l) LC1 comprises the sequence of SEQ ID NO: 275 and HC1 comprises the sequence of SEQ ID NO: 306;

(m) LC1 comprises the sequence of SEQ ID NO: 275 and HC1 comprises the sequence of SEQ ID NO: 307;

(n) LC1 comprises the sequence of SEQ ID NO: 276 and HC1 comprises the sequence of SEQ ID NO: 308;

(o) LC1 comprises the sequence of SEQ ID NO: 275 and HC1 comprises the sequence of SEQ ID NO: 309;

(p) LC1 comprises the sequence of SEQ ID NO: 277 and HC1 comprises the sequence of SEQ ID NO: 303;

(q) LC1 comprises the sequence of SEQ ID NO: 278 and HC1 comprises the sequence of SEQ ID NO: 304;

(r) LC1 comprises the sequence of SEQ ID NO: 277 and HC1 comprises the sequence of SEQ ID NO: 305;

(s) LC1 comprises the sequence of SEQ ID NO: 279 and HC1 comprises the sequence of SEQ ID NO: 303;

(t) LC1 comprises the sequence of SEQ ID NO: 280 and HC1 comprises the sequence of SEQ ID NO: 304;

(u) LC1 comprises the sequence of SEQ ID NO: 279 and HC1 comprises the sequence of SEQ ID NO: 305;

(v) LC1 comprises the sequence of SEQ ID NO: 277 and HC1 comprises the sequence of SEQ ID NO: 307;

(w) LC1 comprises the sequence of SEQ ID NO: 278 and HC1 comprises the sequence of SEQ ID NO: 308;

(x) LC1 comprises the sequence of SEQ ID NO: 277 and HC1 comprises the sequence of SEQ ID NO: 309;

(y) LC1 comprises the sequence of SEQ ID NO: 281 and HC1 comprises the sequence of SEQ ID NO: 310;

(z) LC1 comprises the sequence of SEQ ID NO: 282 and HC1 comprises the sequence of SEQ ID NO: 311;

(aa) LC1 comprises the sequence of SEQ ID NO: 281 and HC1 comprises the sequence of SEQ ID NO: 312;

(ab) LC1 comprises the sequence of SEQ ID NO: 281 and HC1 comprises the sequence of SEQ ID NO: 313;

(ac) LC1 comprises the sequence of SEQ ID NO: 281 and HC1 comprises the sequence of SEQ ID NO: 314;

(ad) LC1 comprises the sequence of SEQ ID NO: 282 and HC1 comprises the sequence of SEQ ID NO: 315; or

(ae) LC1 comprises the sequence of SEQ ID NO: 281 and HC1 comprises the sequence of SEQ ID NO: 316.

26. The bispecific antigen binding protein of any one of claims 22 to 25, wherein LC2 comprises a sequence that is at least 90% identical to a sequence selected from SEQ ID NOs: 211 to 221.

27. The bispecific antigen binding protein of any one of claims 22 to 26, wherein HC2 comprises a sequence that is at least 90% identical to a sequence selected from SEQ ID NOs: 233 to 251.

28. The bispecific antigen binding protein of any one of claims 22 to 27, wherein:

(a) LC2 comprises the sequence of SEQ ID NO: 211 and HC2 comprises the sequence of SEQ ID NO: 233;

(b) LC2 comprises the sequence of SEQ ID NO: 212 and HC2 comprises the sequence of SEQ ID NO: 234;

(c) LC2 comprises the sequence of SEQ ID NO: 211 and HC2 comprises the sequence of SEQ ID NO: 235;

(d) LC2 comprises the sequence of SEQ ID NO: 211 and HC2 comprises the sequence of SEQ ID NO: 236;

(e) LC2 comprises the sequence of SEQ ID NO: 213 and HC2 comprises the sequence of SEQ ID NO: 233;

(f) LC2 comprises the sequence of SEQ ID NO: 213 and HC2 comprises the sequence of SEQ ID NO: 235;

(g) LC2 comprises the sequence of SEQ ID NO: 214 and HC2 comprises the sequence of SEQ ID NO: 237;

(h) LC2 comprises the sequence of SEQ ID NO: 215 and HC2 comprises the sequence of SEQ ID NO: 238;

(i) LC2 comprises the sequence of SEQ ID NO: 214 and HC2 comprises the sequence of SEQ ID NO: 239;

(j) LC2 comprises the sequence of SEQ ID NO: 214 and HC2 comprises the sequence of SEQ ID NO: 240;

(k) LC2 comprises the sequence of SEQ ID NO: 216 and HC2 comprises the sequence of SEQ ID NO: 241;

(l) LC2 comprises the sequence of SEQ ID NO: 217 and HC2 comprises the sequence of SEQ ID NO: 242;

(m) LC2 comprises the sequence of SEQ ID NO: 216 and HC2 comprises the sequence of SEQ ID NO: 243;

(n) LC2 comprises the sequence of SEQ ID NO: 216 and HC2 comprises the sequence of SEQ ID NO: 244;

(o) LC2 comprises the sequence of SEQ ID NO: 218 and HC2 comprises the sequence of SEQ ID NO: 245;

(p) LC2 comprises the sequence of SEQ ID NO: 219 and HC2 comprises the sequence of SEQ ID NO: 246;

(q) LC2 comprises the sequence of SEQ ID NO: 218 and HC2 comprises the sequence of SEQ ID NO: 247;

(r) LC2 comprises the sequence of SEQ ID NO: 218 and HC2 comprises the sequence of SEQ ID NO: 248;

(s) LC2 comprises the sequence of SEQ ID NO: 220 and HC2 comprises the sequence of SEQ ID NO: 249;

(t) LC2 comprises the sequence of SEQ ID NO: 221 and HC2 comprises the sequence of SEQ ID NO: 250; or

(u) LC2 comprises the sequence of SEQ ID NO: 220 and HC2 comprises the sequence of SEQ ID NO: 251.

29. The bispecific antigen binding protein of any one of claims 22 to 28, wherein HC1 or HC2 comprises at least one amino acid substitution to replace a positively-charged amino acid with a negatively-charged amino acid.

30. The bispecific antigen binding protein of claim 29, wherein the substitution replaces a lysine at position 370, 392, and/or 409 with a negatively-charged amino acid.

31. The bispecific antigen binding protein of any one of claims 22 to 28, wherein HC1 or HC2 comprises at least one amino acid substitution to replace a negatively-charged amino acid with a positively-charged amino acid.

32. The bispecific antigen binding protein of claim 31, wherein the substitution replaces an aspartic acid at position 356 and/or 399 with a positively-charged amino acid.

33. The bispecific antigen binding protein of claim 31, wherein the substitution replaces a glutamic acid at position 356 and/or 357 with a positively-charged amino acid.

34. The bispecific antigen binding protein of any one of claims 22 to 33, wherein HC1 comprises at least one amino acid substitution to introduce a charged amino acid and LC1 comprises at least one amino acid substitution to introduce a charged amino acid, wherein the charged amino acid introduced into HC1 has the opposite charge of the amino acid introduced into LC1.

35. The bispecific antigen binding protein of claim 34, wherein the amino acid substitution in HC1 is at position 44 and/or 183, and the amino acid substitution in LC1 is at position 100 and/or 176.

36. The bispecific antigen binding protein of claim 35, wherein the amino acid substitution in HC1 is G44E and/or S183E, and the amino acid substitution in LC1 is G100K and/or S176K.

37. The bispecific antigen binding protein of any one of claims 22 to 36, wherein HC2 comprises at least one amino acid substitution to introduce a charged amino acid and LC2 comprises at least one amino acid substitution to introduce a charged amino acid, wherein the charged amino acid introduced into HC2 has the opposite charge of the amino acid introduced into LC2.

38. The bispecific antigen binding protein of claim 37, wherein the amino acid substitution in HC2 is at position 44 and/or 183, and the amino acid substitution in LC2 is at position 100 and/or 176.

39. The bispecific antigen binding protein of claim 38, wherein the amino acid substitution in HC2 is G44K and/or S183K, and the amino acid substitution in LC1 is G100E and/or S176E.

40. The bispecific antigen binding protein of any one of claims 21 to 39, wherein the antibody is selected from the antibodies designated as iPS:326417, iPS:326626, iPS:326628, iPS:326631, iPS:326634, iPS:327870, iPS:327871, iPS:326645, iPS:326648, iPS:326651, iPS:326654, iPS:328000, iPS:328001, iPS:326661, iPS:326663, iPS:326666, iPS:326669, iPS:327017, iPS:327018, iPS:327019, iPS:327023, iPS:327024, iPS:327025, iPS:327026, iPS:327091, iPS:327092, iPS:327093, iPS:327094, iPS:326414, iPS:327102, iPS:327103, iPS:327104, iPS:327105, iPS:327106, iPS:327107, iPS:327108, iPS:327109, iPS:327110, iPS:327111, iPS:327112, iPS:327267, iPS:327268, iPS:327269, iPS:327270, iPS:327272, iPS:327273, iPS:327274, iPS:327275, iPS:327276, iPS:327277, iPS:327278, iPS:327279, iPS:327280, iPS:327281, iPS:327282, iPS:327283, iPS:327284, iPS:327285, iPS:327286, iPS:327287, iPS:327288, iPS:327289, iPS:327290, iPS:327291, iPS:327677, iPS:327678, iPS:327679, iPS:327680, iPS:327681, iPS:327682, iPS:327683, iPS:327684, iPS:327685, iPS:327686, iPS:327687, iPS:327688, iPS:327689, iPS:327690, iPS:327691, iPS:327693, iPS:327694, iPS:327696, iPS:327697, iPS:327698, iPS:327699, iPS:327700, iPS:327701, iPS:327702, iPS:327703, iPS:327704, iPS:327705, iPS:327706, iPS:327707, iPS:327708, iPS:327709, iPS:327710, iPS:327711, iPS:327712, iPS:327713, iPS:327714, iPS:327717, iPS:327718, iPS:327719, iPS:327721, iPS:327722, iPS:327724, iPS:327725, iPS:327726, iPS:327727, iPS:327728, iPS:327729, iPS:327730, iPS:327731, iPS:327732, iPS:327733, iPS:327734, iPS:327735, iPS:327736, iPS:327737, iPS:327738, iPS:327739, iPS:327740, iPS:327741, iPS:327742, iPS:327872, iPS:327874, iPS:327875, iPS:327876, iPS:327877, iPS:327878, iPS:327879, iPS:327880, iPS:327881, iPS:327882, iPS:327883, iPS:327884, iPS:327885, iPS:327886, iPS:327887, iPS:327888, iPS:327889, iPS:327890, iPS:327891, iPS:327892, iPS:327893, iPS:327894, iPS:327895, iPS:327896, iPS:327897, iPS:328031, iPS:328033, iPS:328034, iPS:328035, iPS:328036, iPS:328037, iPS:328038, iPS:328039,

iPS:328040, iPS:328041, iPS:328042, iPS:328043, iPS:328044, iPS:328045, iPS:328046, iPS:328047, iPS:328048, iPS:328049, iPS:328050, or iPS:328051 as set forth in Table 8.

41. The bispecific antigen binding protein of claim 40, wherein the antibody is selected from the antibodies designated as iPS:327730, iPS:327680, iPS: 328001, iPS:327741, iPS:326648, iPS:327689, iPS:327111, iPS:327742, iPS:327698, iPS:327272, iPS:327717, iPS:327702, or iPS:327270 as set forth in Table 8.

42. The bispecific antigen binding protein of any one of claims 1 to 20, wherein the binding protein comprises:

(i) a first binding domain that specifically binds to human CGRP receptor comprising a first light chain immunoglobulin variable region (VL1) and a first heavy chain immunoglobulin variable region (VH1);

(ii) a second binding domain that specifically binds to human PAC1 receptor comprising a second light chain immunoglobulin variable region (VL2) and a second heavy chain immunoglobulin variable region (VH2); and

(iii) a human immunoglobulin Fc region, wherein one of the binding domains is positioned at the amino terminus of the Fc region and the other binding domain is positioned at the carboxyl terminus of the Fc region.

43. The bispecific antigen binding protein of claim 42, wherein the carboxyl-terminal binding domain is a scFv and is fused at its amino terminus to the carboxyl terminus of the Fc region through a peptide linker.

44. The bispecific antigen binding protein of claim 43, wherein the variable regions are positioned in the scFv in a VH-VL or VL-VH orientation.

45. The bispecific antigen binding protein of claim 43 or 44, wherein the peptide linker comprises the sequence of SEQ ID NO: 368.

46. The bispecific antigen binding protein of claim 42, wherein the carboxyl-terminal binding domain is a Fab and is fused through a peptide linker to the carboxyl terminus of the Fc region.
47. The bispecific antigen binding protein of claim 46, wherein the Fab is fused to the Fc region through the amino terminus of the VL region of the Fab.
48. The bispecific antigen binding protein of claim 46, wherein the Fab is fused to the Fc region through the amino terminus of the VH region of the Fab.
49. The bispecific antigen binding protein of any one of claims 46 to 48, wherein the peptide linker comprises the sequence of SEQ ID NO: 368.
50. The bispecific antigen binding protein of any one of claims 42 to 49, wherein the amino-terminal binding domain is a Fab and is fused to the amino terminus of the Fc region through an immunoglobulin hinge region.
51. The bispecific antigen binding protein of claim 50, wherein the amino-terminal Fab is fused to the Fc region through the carboxyl terminus of the CH1 region of the Fab.
52. The bispecific antigen binding protein of any one of claims 42 to 49, wherein the amino-terminal binding domain specifically binds to human CGRP receptor and the carboxyl-terminal binding domain specifically binds to human PAC1 receptor.
53. The bispecific antigen binding protein of any one of claims 42 to 49, wherein the amino-terminal binding domain specifically binds to human PAC1 receptor and the carboxyl-terminal binding domain specifically binds to human CGRP receptor.
54. A bispecific, multivalent antigen binding protein comprising:
- (i) a light chain and a heavy chain from a first antibody; and
 - (ii) a scFv comprising a light chain immunoglobulin variable region (VL) and a heavy chain immunoglobulin variable region (VH) from a second antibody, wherein the scFv is fused

at its amino terminus to the carboxyl terminus of the heavy chain through a peptide linker to form a modified heavy chain; and

wherein the first or second antibody specifically binds to human CGRP receptor and the other antibody specifically binds to human PAC1 receptor.

55. The bispecific, multivalent antigen binding protein of claim 54, wherein the variable regions are positioned in the scFv in a VH-VL or VL-VH orientation.

56. The bispecific, multivalent antigen binding protein of claims 54 or 55, wherein the first antibody specifically binds to human CGRP receptor and the second antibody specifically binds to human PAC1 receptor.

57. The bispecific, multivalent antigen binding protein of claim 56, wherein:

(a) the modified heavy chain comprises a sequence selected from SEQ ID NOs: 411 to 416 and the light chain comprises the sequence of SEQ ID NO: 393;

(b) the modified heavy chain comprises a sequence selected from SEQ ID NOs: 417 to 421 and the light chain comprises the sequence of SEQ ID NO: 394; or

(c) the modified heavy chain comprises a sequence selected from SEQ ID NOs: 422 to 425 and the light chain comprises the sequence of SEQ ID NO: 395.

58. The bispecific, multivalent antigen binding protein of claim 57, wherein the binding protein is selected from the binding proteins designated as iPS:386731, iPS:386725, iPS:386717, iPS:386715, iPS:386707, iPS:386705, iPS:386723, iPS:386719, iPS:386713, iPS:386709, iPS:386727, iPS:386721, iPS:386711, iPS:386733, or iPS:386729 as set forth in Table 9.

59. The bispecific, multivalent antigen binding protein of claims 54 or 55, wherein the first antibody specifically binds to human PAC1 receptor and the second antibody specifically binds to human CGRP receptor.

60. The bispecific, multivalent antigen binding protein of claim 59, wherein the modified heavy chain comprises a sequence selected from SEQ ID NOs: 396 to 410 and the light chain comprises the sequence of SEQ ID NO: 392.

61. The bispecific, multivalent antigen binding protein of claim 60, wherein the binding protein is selected from the binding proteins designated as iPS:386738, iPS:386764, iPS:386762, iPS:386760, iPS:386758, iPS:386756, iPS:386754, iPS:386752, iPS:386750, iPS:386748, iPS:386746, iPS:386744, iPS:386742, iPS:386740, or iPS:386736 as set forth in Table 9.

62. A bispecific, multivalent antigen binding protein comprising:

- (i) a light chain from a first antibody;
 - (ii) a heavy chain from the first antibody, wherein the heavy chain is fused at its carboxyl terminus through a peptide linker to a first polypeptide comprising VL-CL domains or VH-CH1 domains of a second antibody to form a modified heavy chain; and
 - (iii) a second polypeptide comprising VH-CH1 domains or VL-CL domains of the second antibody; and
- wherein the first or second antibody specifically binds to human CGRP receptor and the other antibody specifically binds to human PAC1 receptor.

63. The bispecific, multivalent antigen binding protein of claim 62, wherein the first polypeptide comprises VL-CL domains of the second antibody and the second polypeptide comprises VH-CH1 domains of the second antibody.

64. The bispecific, multivalent antigen binding protein of claim 62, wherein the first polypeptide comprises VH-CH1 domains of the second antibody and the second polypeptide comprises VL-CL domains of the second antibody.

65. The bispecific, multivalent antigen binding protein of any one of claims 62 to 64, wherein the first antibody specifically binds to human CGRP receptor and the second antibody specifically binds to human PAC1 receptor.

66. The bispecific, multivalent antigen binding protein of claim 65, wherein the light chain comprises the sequence of SEQ ID NO: 275 or SEQ ID NO: 427, the modified heavy chain comprises a sequence selected from SEQ ID NOs: 440 to 451, and the second polypeptide comprises a sequence selected from SEQ ID NOs: 460 to 463.

67. The bispecific, multivalent antigen binding protein of claim 66, wherein the binding protein is selected from the binding proteins designated as iPS:392524, iPS:392525, iPS:392526, iPS:392527, iPS:392532, iPS:392533, iPS:392534, or iPS:392535 as set forth in Table 10.

68. The bispecific, multivalent antigen binding protein of any one of claims 62 to 64, wherein the first antibody specifically binds to human PAC1 receptor and the second antibody specifically binds to human CGRP receptor.

69. The bispecific, multivalent antigen binding protein of claim 68, wherein the light chain comprises the sequence of SEQ ID NO: 214 or SEQ ID NO: 426, the modified heavy chain comprises a sequence selected from SEQ ID NOs: 428 to 439, and the second polypeptide comprises a sequence selected from SEQ ID NOs: 452 to 459.

70. The bispecific, multivalent antigen binding protein of claim 69, wherein the binding protein is selected from the binding proteins designated as iPS:392513, iPS:392514, iPS:392475, iPS:392519, iPS:392515, iPS:392516, iPS:392521, iPS:392520, iPS:392517, iPS:392518, iPS:392522, or iPS:392523 as set forth in Table 10.

71. The bispecific, multivalent antigen binding protein of any one of claims 54 to 70, wherein the first antibody and/or the second antibody is a human IgG1 or human IgG2 antibody.

72. The bispecific, multivalent antigen binding protein of claim 71, wherein the first antibody is a human IgG1 antibody with a N297G mutation in the heavy chain.

73. The bispecific, multivalent antigen binding protein of claim 71 or 72, wherein the first antibody is a human IgG1 antibody with mutations R292C and V302C in the heavy chain.

74. One or more isolated nucleic acids encoding the bispecific antigen binding protein of any one of claims 1 to 73.
75. An expression vector comprising the one or more isolated nucleic acids of claim 74.
76. A host cell comprising the vector of claim 75.
77. A method for the preparation of a bispecific antigen binding protein, comprising: culturing the host cell of claim 76 under conditions that allow expression of the antigen binding protein; and recovering the antigen binding protein from the culture.
78. A pharmaceutical composition comprising the bispecific antigen binding protein of any one of claims 1 to 73, and a pharmaceutically acceptable diluent, excipient or carrier.
79. A method for treating a condition associated with CGRP receptor and/or PAC1 receptor in a patient in need thereof, comprising administering to the patient an effective amount of the bispecific antigen binding protein of any one of claims 1 to 73.
80. The method of claim 79, wherein the condition is headache.
81. The method of claim 80, wherein the headache is cluster headache.
82. The method of claim 80, wherein the headache is migraine headache.
83. The method of claim 82, wherein the migraine is episodic migraine.
84. The method of claim 82, wherein the migraine is chronic migraine.
85. The method of claim 79, wherein the condition is chronic pain.

86. The method of any of any one of claims 79 to 85, wherein the treating comprises prophylactic treatment.

87. Use of the bispecific antigen binding protein of any one of claims 1 to 73 in the preparation of a medicament for treating a condition associated with CGRP receptor and/or PAC1 receptor in a patient in need thereof.

88. The use of claim 87, wherein the condition is headache.

89. The use of claim 88, wherein the headache is cluster headache.

90. The use of claim 88, wherein the headache is migraine headache.

91. The use of claim 90, wherein the migraine is episodic migraine.

92. The use of claim 90, wherein the migraine is chronic migraine.

93. The use of claim 87, wherein the condition is chronic pain.

94. The use of any of any one of claims 87 to 93, wherein the treating comprises prophylactic treatment.

95. The bispecific antigen binding protein of any one of claims 1 to 73 for use in a method for treating a condition associated with CGRP receptor and/or PAC1 receptor in a patient in need thereof.

96. The bispecific antigen binding protein of claim 95, wherein the condition is headache.

97. The bispecific antigen binding protein of claim 96, wherein the headache is cluster headache.

98. The bispecific antigen binding protein of claim 96, wherein the headache is migraine headache.
99. The bispecific antigen binding protein of claim 98, wherein the migraine is episodic migraine.
100. The bispecific antigen binding protein of claim 98, wherein the migraine is chronic migraine.
101. The bispecific antigen binding protein of claim 95, wherein the condition is chronic pain.
102. The bispecific antigen binding protein of any of any one of claims 95 to 101, wherein the treating comprises prophylactic treatment.

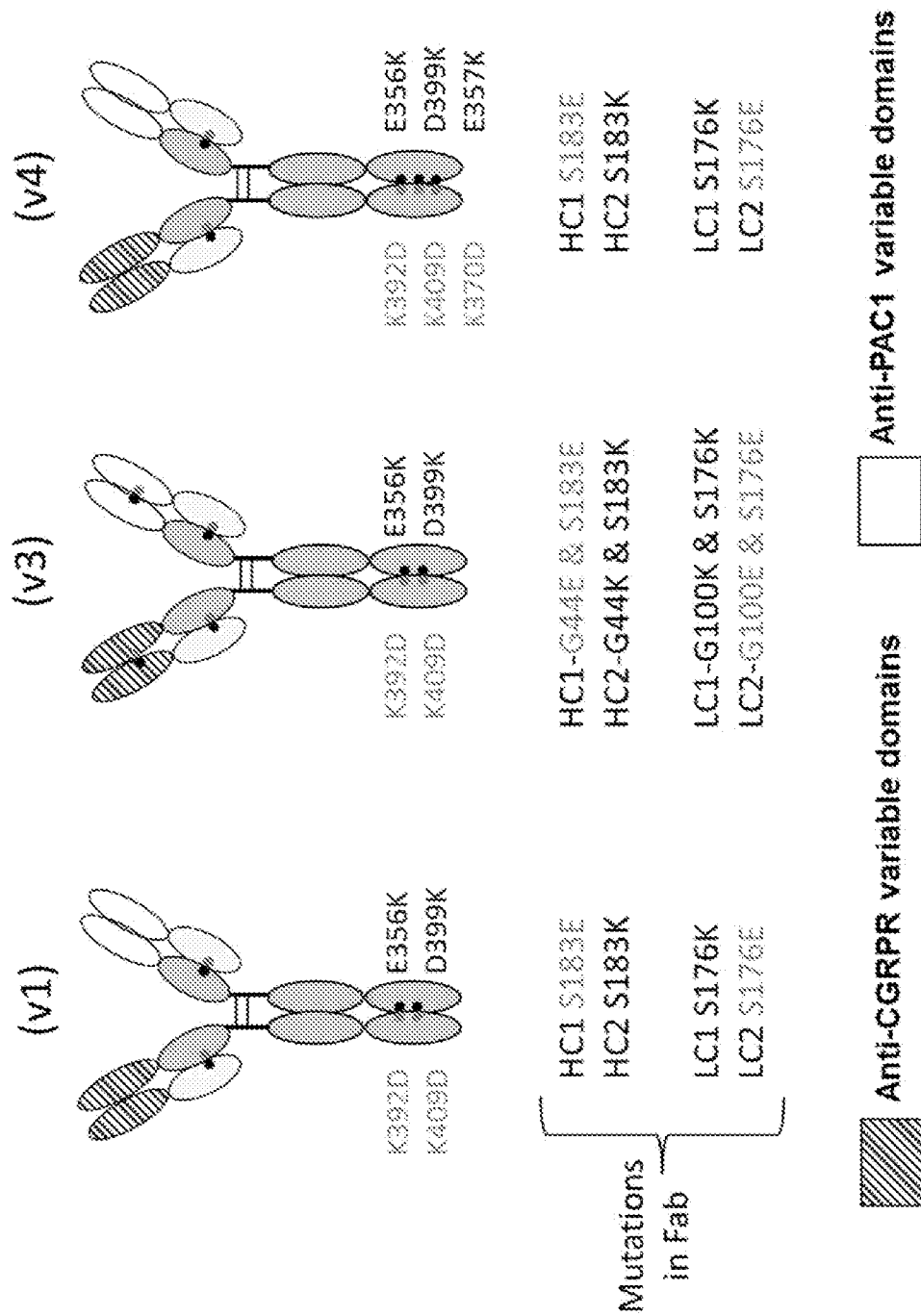


FIG. 1

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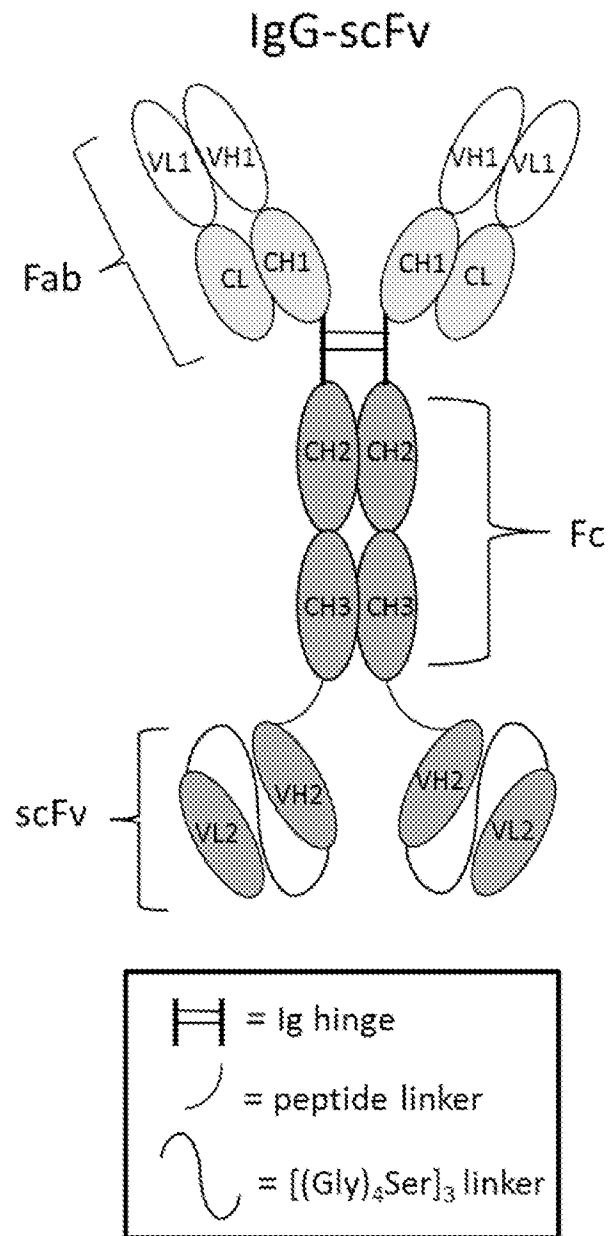


FIG. 2

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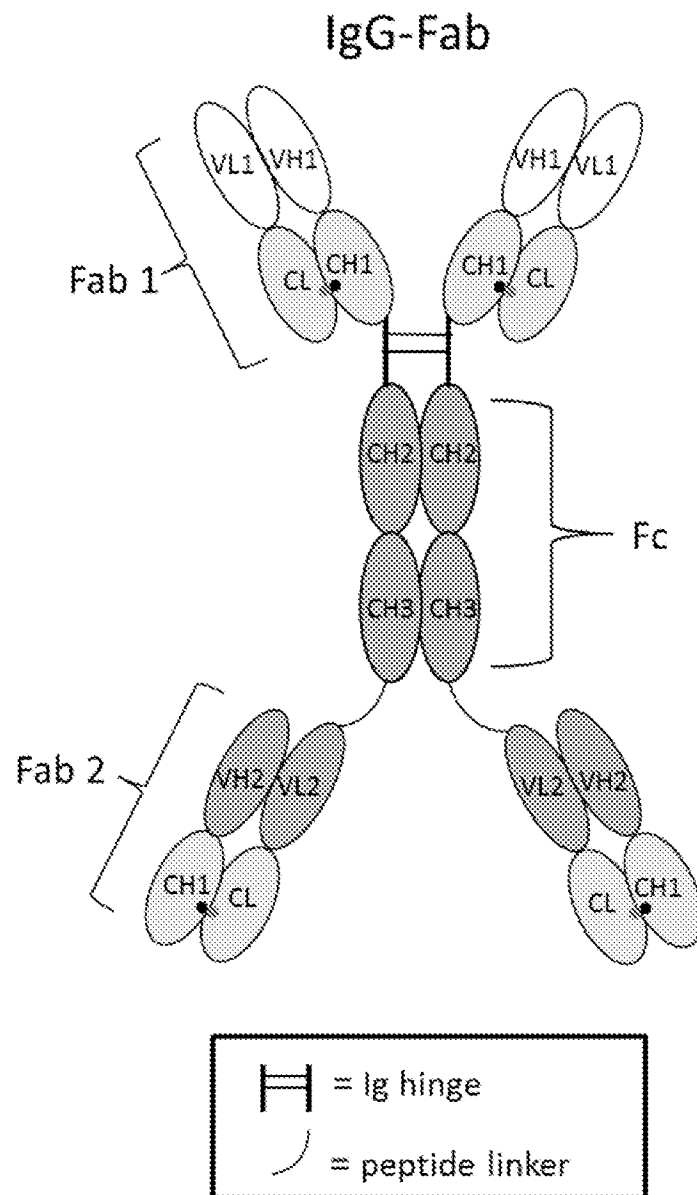


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/050115

A. CLASSIFICATION OF SUBJECT MATTER

INV. C07K16/18 C07K16/28
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C07K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SCHYTZ H W ET AL: "The PACAP Receptor: A Novel Target for Migraine Treatment", NEUROTHERAPEUTICS, ELSEVIER INC, US, vol. 7, no. 2, 1 April 2010 (2010-04-01), pages 191-196, XP027030857, ISSN: 1933-7213 [retrieved on 2010-04-27] page 194 - page 195 -----	1-102
A	JES OLESEN ET AL: "Emerging migraine treatments and drug targets", TRENDS IN PHARMACOLOGICAL SCIENCES, vol. 32, no. 6, 1 June 2011 (2011-06-01), pages 352-359, XP028222805, ISSN: 0165-6147, DOI: 10.1016/J.TIPS.2011.02.016 [retrieved on 2011-03-02] page 353 - page 355 ----- -/--	1-102



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

11 January 2016

Date of mailing of the international search report

21/01/2016

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Fellows, Edward

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/050115

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Ginger S Johnson ET AL: "Migraine Prophylaxis: The Race is On g p y Vice President Vice President Defined Health", 13 June 2014 (2014-06-13), XP055239718, Retrieved from the Internet: URL:http://knowledgebase.definedhealth.net/wp-content/uploads/2014/06/migraine/Migraine webinar 061314.pdf [retrieved on 2016-01-08] the whole document -----	1-102
A	WO 2010/075238 A1 (AMGEN INC [US]; BOONE THOMAS C [US]; BRANKOW DAVID W [US]; GEGG JR COL) 1 July 2010 (2010-07-01) the whole document -----	1-102
A	WO 2007/054809 A2 (RINAT NEUROSCIENCE CORP [US]; ZELLER JOERG [US]; POULSEN KRISTIAN TODD) 18 May 2007 (2007-05-18) the whole document -----	1-102
A	WO 2007/076336 A1 (LILLY CO ELI [US]; BENSCHOP ROBERT JAN [US]; GEHLERT DONALD RICHARD [U]) 5 July 2007 (2007-07-05) the whole document -----	1-102
A	US 2012/294802 A1 (RUSSO ANDREW F [US] ET AL) 22 November 2012 (2012-11-22) the whole document -----	1-102
A	S D SILBERSTEIN: "Emerging Target-Based Paradigms to Prevent and Treat Migraine", CLINICAL PHARMACOLOGY AND THERAPEUTICS, vol. 93, no. 1, 5 December 2012 (2012-12-05), pages 78-85, XP055227794, US ISSN: 0009-9236, DOI: 10.1038/clpt.2012.198 the whole document -----	1-102

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2015/050115

Patent document cited in search report		Publication date	Patent family member(s)		Publication date			
WO 2010075238	A1	01-07-2010	AR	074857 A1	16-02-2011			
			AU	2009330175 A1	23-06-2011			
			CA	2746858 A1	01-07-2010			
			CN	102348722 A	08-02-2012			
			CO	6400232 A2	15-03-2012			
			CR	20110400 A	12-10-2011			
			EA	201100892 A1	30-01-2012			
			EP	2379594 A1	26-10-2011			
			JP	5761805 B2	12-08-2015			
			JP	2012513214 A	14-06-2012			
			JP	2014210815 A	13-11-2014			
			KR	20110106409 A	28-09-2011			
			MA	32982 B1	02-01-2012			
			PE	04272012 A1	13-05-2012			
			SG	172307 A1	28-07-2011			
			SG	10201401879T A	27-06-2014			
			TN	2011000283 A1	17-12-2012			
			TW	201032823 A	16-09-2010			
			US	2010172895 A1	08-07-2010			
			US	2013071410 A1	21-03-2013			
			US	2015376286 A1	31-12-2015			
			WO	2010075238 A1	01-07-2010			

			WO 2007054809	A2	18-05-2007	AU	2006313434 A1	18-05-2007
						BR	PI0618705 A2	06-09-2011
						CA	2626120 A1	18-05-2007
						CN	101309704 A	19-11-2008
						CN	103421114 A	04-12-2013
CR	9975 A	02-06-2008						
CU	200800088 A7	21-06-2012						
DK	1957106 T3	04-11-2013						
EA	200801094 A1	30-10-2008						
EC	SP088451 A	30-07-2008						
EP	1957106 A2	20-08-2008						
EP	2380592 A2	26-10-2011						
ES	2433251 T3	10-12-2013						
HK	1125837 A1	19-07-2013						
IL	190876 A	28-06-2012						
JP	5123197 B2	16-01-2013						
JP	2009515942 A	16-04-2009						
KR	20080068062 A	22-07-2008						
KR	20110114705 A	19-10-2011						
MA	30136 B1	02-01-2009						
MY	153249 A	29-01-2015						
NZ	568237 A	25-11-2011						
PT	1957106 E	26-12-2013						
RS	20080200 A	15-07-2009						
SI	1957106 T1	28-02-2014						
SV	2008002905 A	05-07-2011						
UA	94244 C2	26-04-2011						
US	8734802 B1	27-05-2014						
US	2009220489 A1	03-09-2009						
US	2012009192 A1	12-01-2012						
US	2013216535 A1	22-08-2013						
US	2015050267 A1	19-02-2015						
US	2015291690 A1	15-10-2015						
US	2015361171 A1	17-12-2015						
US	2015361172 A1	17-12-2015						

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2015/050115

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 2015361173 A1	17-12-2015
		WO 2007054809 A2	18-05-2007
		ZA 200803484 A	25-03-2009

WO 2007076336	A1	05-07-2007	NONE

US 2012294802	A1	22-11-2012	CA 2836800 A1
			CN 103702685 A
			EA 201301293 A1
			EP 2709663 A2
			JP 2014515375 A
			KR 20140048136 A
			SG 194973 A1
			US 2012294802 A1
			WO 2012162257 A2
