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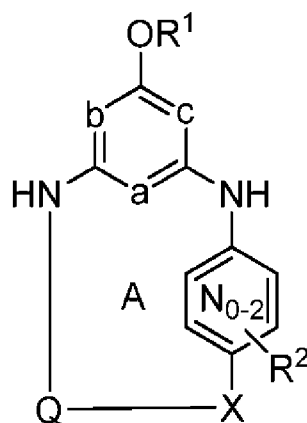
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(54) Title: MACROCYCLIC COMPOUNDS AS HCV ENTRY INHIBITORS

(57) Abstract: Compounds of Formula I, including pharma-
ceutically acceptable salts thereof, are set forth, in addition to
compositions and methods of using these compounds. The
compounds have activity against hepatitis C virus (HCV) and
may be useful in treating those infected with HCV.



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MACROCYCLIC COMPOUNDS AS HCV ENTRY INHIBITORS

CROSS REFERENCE TO RELATED APPLICATION

5 This application claims the priority of U.S. provisional application serial no. 61/761,868 filed February 7, 2013 which is herein incorporated by reference.

FIELD OF THE INVENTION

10 The invention relates to novel compounds of Formula I , including pharmaceutically acceptable salts thereof, which have activity against hepatitis C virus (HCV), and are useful in treating those infected with HCV. The invention also relates to compositions and methods of using these compounds.

15 BACKGROUND OF THE INVENTION

Hepatitis C virus (HCV) chronically infects an estimated 170 million people worldwide, with 3 to 4 million infected individuals in the United States alone (Boyer, N. and Marcellin, P. *J. Hepatology*. **2000**, 32:98-112; Alter, M. J., et al. *Engl. J. Med.* **1999**, 341:556-562). Prior to the mid 1990s, transfusion with infected blood products was the main route of HCV transmission. Following the introduction of blood screening methods, transmission via injection drug use became the primary risk factor. Chronic infection often leads to the development of severe liver complications, including fibrosis, cirrhosis, and hepatocellular carcinoma. HCV infection is also the leading cause of orthotopic liver transplantation in the United States. The degree to which disease progression is related to viral and cellular factors is not completely understood.

Considerable heterogeneity is found within the nucleotide and encoded amino acid sequence of the HCV genome (Simmonds, P. *J. Gen. Virology*. **2004**, 85:3173-3188).

30 Based on this sequence diversity, six major genotypes and multiple associated subtypes have been described. The genotypes of HCV differ in their worldwide distribution, and the clinical significance of the genetic heterogeneity of HCV remains elusive despite numerous studies of the possible effect of genotypes on pathogenesis and therapy.

Medical treatment for HCV is limited by the lack of a vaccine or approved therapies that specifically target the virus. Currently, patients undergo treatment with a combination of parenterally administered pegylated alpha-interferon and oral ribavirin.

- 5 Genotype 1 HCV is the most difficult to treat and elimination of the virus (sustained virologic response) is achieved for only approximately 50% of patients (Fried, M. W. et al. *N. Engl. J. Med.* **2002**, 347:975-982; Zeumzem, S. *Nature Clinical Practice.* **2008**, 5:610-622). This poor treatment response, combined with often severe side effects induced by therapy, highlight a need for improved antiviral drugs with better efficacy and
10 safety profiles.

HCV is a member of the Flaviviridae family of viruses with a single-stranded positive-sense RNA genome. Following infection of host cells, the 9.6 Kb genome is translated into a polyprotein precursor of approximately 3,000 amino acids (reviewed in
15 Lindenbach, B. D. and Rice, C. M. *Nature.* **2005**, 436:933-938; Moradpour, D, Penin, F., and Rice, C. M. *Nature Reviews.* **2007**, 5:453-463). Post-translational processing by both cellular and viral proteases results in the generation of at least 10 separate viral proteins. The structural proteins (which by definition are found in mature virions) include core, E1, E2, and possibly p7, and originate from the amino-terminal region of the polyprotein.

- 20 The core protein assembles into the viral nucleocapsid. The E1 and E2 glycoproteins form heterodimers that are found within the lipid envelope surrounding the viral particles, and mediate host cell receptor binding and entry of the virus into cells. It is unclear if p7 is a structural protein, and its role in replication has yet to be defined. However p7 is believed to form an ion channel in cellular membranes, preventing acidification of
25 intracellular compartments in which virions are assembled, and it has been shown to be essential for viral replication and assembly. The nonstructural proteins NS2, NS3, NS4A, NS4B, NS5A, and NS5B are produced through maturational cleavages of the carboxy-terminal region of the polyprotein. NS2 along with the amino terminus of NS3 form the NS2-3 metalloprotease which cleaves at the NS2-NS3 junction. Additionally, NS2 is
30 involved in assembly and egress of nascent virions. The NS3 protein contains both a serine protease in its amino-terminal region, and a nucleotide-dependent RNA helicase in its carboxy-terminal region. NS3 forms a heterodimer with the NS4A protein, constituting the active protease which mediates cleavages of the polyprotein downstream

of NS3, both in cis, at the NS3-NS4A cleavage site, and in trans, for the remaining NS4A-NS4B, NS4B-NS5A, NS5A-NS5B sites. The complex formation of the NS3 protein with NS4A seems necessary to the processing events, enhancing the proteolytic efficiency at all of the sites. The NS3 protein also exhibits nucleoside triphosphatase and RNA helicase activities. The NS4B protein has been shown to be important for localization of HCV proteins into replication complexes in altered membranous structures within the cell. NS5B encodes an RNA-dependent RNA polymerase that is involved in the replication of HCV.

Subgenomic HCV replicons, containing the untranslated regions 5' and 3' to the coding sequence fused to the nonstructural proteins or the full-length polyprotein, are competent for translation, viral protein expression, and replication within cultured cells (Lohmann, V. et al. *Science*. **1999**, 285:110-113; Moradpour, D, Penin, F., and Rice, C. M. *Nature Reviews*. **2007**, 5:453-463). The replicon system has proven valuable for the identification of inhibitors targeting the nonstructural proteins associated with these functions. However, only limited subsets of HCV genotypes have been used to generate functional replicons.

Other systems have been used to study the biology of the HCV structural proteins that mediate the entry into host cells. For example, virus-like-particles made in recombinant baculovirus-infected cells with the HCV core, E1 and E2 proteins have also been used to study the function of the HCV E1 and E2 proteins (Barth, H., et al. *J. Biol. Chem.* **2003**, 278:41003-41012). In addition, pseudotyping systems where the E1 and E2 glycoproteins are used to functionally replace the glycoproteins of retroviruses have been developed (Bartosch, B., Dubuisson, J. and Cosset, F.-L. *J. Exp. Med.* **2003**, 197:633-642; Hsu, M. et al. *Proc. Natl. Acad. Sci. USA*. **2003**, 100:7271-7276). These systems yield HCV pseudoparticles that bind to and enter host cells in a manner which is believed to be analogous to the natural virus, thus making them a convenient tool to study the viral entry steps as well as to identify inhibitors block this process.

Recently, a full-length genotype 2a HCV clone, JFH1, was isolated and demonstrated the ability to replicate *in vitro*. Through repeated passage and adaptation in cell culture increased titers of infectious virus were produced (Lindenbach, B. D., et al.

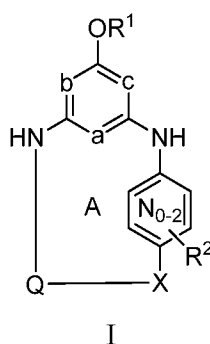
Science. **2005**, 309:623-626; Wakita, T. et al. *Nature Med.* **2005**, 11:791-796). In contrast to the HCV replicon or pseudotyping systems, the infectious virus is useful for studying the complete HCV replication cycle, including identifying inhibitors of not only the replication proteins, but those involved in early steps in virus infection (entry and
 5 uncoating) and production of progeny viruses (genome packaging, nucleocapsid assembly, virion envelopment and egress).

Triazines have been disclosed. See WO 2009/091388 and US 2009/0286778.

10 The invention provides technical advantages, for example, the compounds are novel and are effective against hepatitis C. Additionally, the compounds provide advantages for pharmaceutical uses, for example, with regard to one or more of their mechanism of action, binding, inhibition efficacy, target selectivity, solubility, safety profiles, or bioavailability.

15 SUMMARY OF THE INVENTION

One aspect of the invention is a compound of Formula I, including pharmaceutically acceptable salts thereof:



wherein

25 a, b and c are each nitrogen;

or a and b are nitrogen, while c is -CH;

or b and c are nitrogen, while a is -CH;

or a and c are nitrogen, while b is -CH;

- 5 Q is an alkylene or alkenylene chain containing 1-2 groups selected from oxetane, azetidine, homopiperazindiy, fused bicyclic diamine, spiro bicyclic diamine, bridged bicyclic diamine, lactam, 1,5,9-triazacyclododecane, and COCO, and from 0-6 groups selected from O, NR³, S, S(O), S(O₂), C(O)O, C(O)NR⁴, OC(O)NR⁴, NR⁴C(O)NR⁴, and Z, provided that any O or S atom does not directly bond to another O or S atom, such that
- 10 ring A is 13-32 membered; and wherein the alkylene or alkenylene chain is further substituted with 0-6 substituents selected from the group of alkyl, hydroxy, alkoxy, R⁶, (R⁶)alkyl, and phenyl, wherein the phenyl substituent is further substituted with 0-4 cyano, halo, alkyl, haloalkyl, alkoxy, or haloalkoxy substituents;
- 15 R¹ is selected from the group of alkyl, hydroxyalkyl, alkoxyalkyl, haloalkyl, cycloalkyl, hydroxycycloalkyl, alkoxycycloalkyl, halocycloalkyl, cycloalkenyl, indanyl, alkylcarbonyl, or benzyl wherein the benzyl moiety is substituted with 0-3 substituents selected from halo, alkyl, haloalkyl, cycloalkyl, alkoxy, haloalkoxy, alkenyl, alkynyl, hydroxy, and cyano;
- 20 R² is selected from the group of cyano, hydrogen, halo, alkyl, haloalkyl, alkoxy, haloalkoxy and Ar;
- R³ is selected from the group of hydrogen, CN, alkyl, aryl, heteroaryl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, (amino)alkyl, (alkylamino)alkyl, (dialkylamino)alkyl
- 25 ((alkylcarbonyl)amino)alkyl, ((haloalkylcarbonyl)amino)alkyl, ((alkoxycarbonyl)amino)alkyl, ((benzyloxycarbonyl)amino)alkyl, alkylcarbonyl, arylcarbonyl, alkoxy carbonyl, aryloxy carbonyl, benzyloxy carbonyl, aminocarbonyl, alkylaminocarbonyl, and dialkylaminocarbonyl; and wherein said aryl, heteroaryl, alkyl
- 30 and cycloalkyl can be substituted with 0-3 substituents selected from the group of alkyl, 1,3-dioxol-2-one, Ar, COOH, OH, NO₂, amino, amido, alkoxy, and alkyloxycarbonylamino;

R⁴ is selected from the group of hydrogen, CN, alkyl, aryl, heteroaryl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, (amino)alkyl, (alkylamino)alkyl, and (dialkylamino)alkyl; and wherein said aryl, heteroaryl, alkyl and cycloalkyl can be substituted with 0-3 substituents selected from the group of alkyl, 1,3-dioxol-2-one, Ar, COOH, OH, amino, amido,
5 alkoxy, and alkyloxycarbonylamino;

R⁵ is selected from the group of hydrogen, CN, alkyl, aryl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, (amino)alkyl, (alkylamino)alkyl, and (dialkylamino)alkyl; and wherein said aryl, alkyl and cycloalkyl can be substituted with 0-3 substituents selected
10 from the group of alkyl, 1,3-dioxol-2-one, Ar, COOH, OH, amino, amido, alkoxy, and alkyloxycarbonylamino;

R⁶ is pyrrolidinyl, piperidinyl, or piperazinyl and is substituted with 0-3 substituents selected from the group of alkyl, alkylcarbonyl, alkoxy carbonyl, and benzyloxycarbonyl;
15

Ar is selected from the group of phenyl, five-membered heterocyclic, six-membered heterocyclic, naphthalyl, and bicyclic heterocyclic;

X is selected from the group of O, CH₂, CO, CO₂, and C(O)NR⁵; and
20

Z is selected from the group of C₃₋₇ cycloalkylene, oxetane, azetidine, phenylene, pyrrolidindiy, piperidindiy, piperazindiy, homopiperazindiy, fused bicyclic diamine, spiro bicyclic diamine, bridged bicyclic diamine, lactam, and 1,5,9-triazacyclododecane.

25 The invention also relates to pharmaceutical compositions comprising a compound of Formula 1, including a pharmaceutically acceptable salt thereof, and a pharmaceutically acceptable carrier.

30 In addition, the invention provides one or more methods of treating hepatitis C infection comprising administering a therapeutically effective amount of a compound of Formula I to a patient.

Also provided as part of the invention are one or more methods for making the compounds of Formula I.

The present invention is directed to these, as well as other important ends,
5 hereinafter described.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Unless otherwise specifically set forth elsewhere in the application, the following
10 terms shall have the following meanings. "H" refers to hydrogen, including its isotopes, such as deuterium. "Halo" means fluoro, chloro, bromo, or iodo. "Alkyl" means a straight or branched alkyl group composed of 1 to 6 carbons. "Alkenyl" means a straight or branched alkyl group composed of 2 to 6 carbons with at least one double bond. "Cycloalkyl" means a monocyclic ring system composed of 3 to 8 carbons. "Alkylene"
15 means a straight or branched divalent alkyl group. "Alkenylene" means a straight or branched divalent alkyl group with at least one double bond. "Cycloalkylene" means a divalent cycloalkane moiety composed of 3 to 7 carbons and includes gem-divalency (for example 1,1-cyclopropanediyl) as well as non-gem-divalency (for example, 1,4-cyclohexanediyl). "Alkylidiny" means a divalent alkene substituent where the divalency
20 occurs on the same carbon of the alkene. "Hydroxyalkyl," "alkoxy" and other terms with a substituted alkyl moiety include straight and branched isomers composed of 1 to 6 carbon atoms for the alkyl moiety. "Haloalkyl" and "haloalkoxy" include all halogenated isomers from monohalo substituted alkyl to perhalo substituted alkyl. "Aryl" includes carbocyclic and heterocyclic aromatic substituents. Phenylene is a divalent benzene ring.
25 "1,4-Phenylene" means 1,4-benzenediyl with respect to regiochemistry for the divalent moiety. Parenthetical and multiparenthetical terms are intended to clarify bonding relationships to those skilled in the art. For example, a term such as ((R)alkyl) means an alkyl substituent further substituted with the substituent R.

30 The substituents described above may be attached at any suitable point of attachment unless otherwise specified. However, it is understood that the compounds encompassed by the present invention are those that are chemically stable as understood

by those skilled in the art. Additionally, the compounds encompassed by the present disclosure are those that are suitably stable for use as a pharmaceutical agent.

The invention includes all pharmaceutically acceptable salt forms of the compounds. Pharmaceutically acceptable salts are those in which the counter ions do not contribute significantly to the physiological activity or toxicity of the compounds and as such function as pharmacological equivalents. These salts can be made according to common organic techniques employing commercially available reagents. Some anionic salt forms include acetate, acistrate, besylate, bromide, camsylate, chloride, citrate, fumarate, glucuronate, hydrobromide, hydrochloride, hydroiodide, iodide, lactate, maleate, mesylate, nitrate, pamoate, phosphate, succinate, sulfate, tartrate, tosylate, and xinofoate. Some cationic salt forms include ammonium, aluminum, benzathine, bismuth, calcium, choline, diethylamine, diethanolamine, lithium, magnesium, meglumine, 4-phenylcyclohexylamine, piperazine, potassium, sodium, tromethamine, and zinc.

15

Some of the compounds of the invention possess asymmetric carbon atoms (see, for example, the structures below). The invention includes all stereoisomeric forms, including enantiomers and diastereomers as well as mixtures of stereoisomers such as racemates. Some stereoisomers can be made using methods known in the art.

Stereoisomeric mixtures of the compounds and related intermediates can be separated into individual isomers according to methods commonly known in the art. The use of wedges or hashes in the depictions of molecular structures in the following schemes and tables is intended only to indicate relative stereochemistry, and should not be interpreted as implying absolute stereochemical assignments.

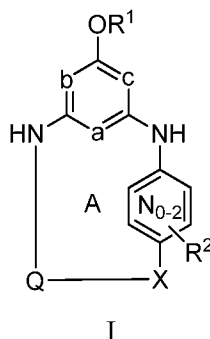
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The invention is intended to include all isotopes of atoms occurring in the present compounds. Isotopes include those atoms having the same atomic number but different mass numbers. By way of general example and without limitation, isotopes of hydrogen include deuterium and tritium. Isotopes of carbon include ^{13}C and ^{14}C . Isotopically-labeled compounds of the invention can generally be prepared by conventional techniques known to those skilled in the art or by processes analogous to those described herein, using an appropriate isotopically-labeled reagent in place of the non-labeled reagent otherwise employed. Such compounds may have a variety of potential uses, for example

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as standards and reagents in determining biological activity. In the case of stable isotopes, such compounds may have the potential to favorably modify biological, pharmacological, or pharmacokinetic properties.

- 5 As set forth above, the invention is directed to compounds of Formula I, including pharmaceutically acceptable salts thereof:



wherein

10

a, b and c are each nitrogen;

or a and b are nitrogen, while c is -CH;

- 15 or b and c are nitrogen, while a is -CH;

or a and c are nitrogen, while b is -CH;

- Q is an alkylene or alkenylene chain containing 1-2 groups selected from oxetane, azetidine, homopiperazindiyl, fused bicyclic diamine, spiro bicyclic diamine, bridged bicyclic diamine, lactam, 1,5,9-triazacyclododecane, and COCO, and from 0-6 groups selected from O, NR³, S, S(O), S(O₂), C(O)O, C(O)NR⁴, OC(O)NR⁴, NR⁴C(O)NR⁴, and Z, provided that any O or S atom does not directly bond to another O or S atom, such that ring A is 13-32 membered; and wherein the alkylene or alkenylene chain is further substituted with 0-6 substituents selected from the group of alkyl, hydroxy, alkoxy, R⁶, (R⁶)alkyl, and phenyl, wherein the phenyl substituent is further substituted with 0-4 cyano, halo, alkyl, haloalkyl, alkoxy, or haloalkoxy substituents;
- 20
- 25

- R^1 is selected from the group of alkyl, hydroxyalkyl, alkoxyalkyl, haloalkyl, cycloalkyl, hydroxycycloalkyl, alkoxycycloalkyl, halocycloalkyl, cycloalkenyl, indanyl, alkylcarbonyl, or benzyl wherein the benzyl moiety is substituted with 0-3 substituents selected from halo, alkyl, haloalkyl, cycloalkyl, alkoxy, haloalkoxy, alkenyl, alkynyl, hydroxy, and cyano;
- R^2 is selected from the group of cyano, hydrogen, halo, alkyl, haloalkyl, alkoxy, haloalkoxy and Ar;
- R^3 is selected from the group of hydrogen, CN, alkyl, aryl, heteroaryl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, (amino)alkyl, (alkylamino)alkyl, (dialkylamino)alkyl, ((alkylcarbonyl)amino)alkyl, ((haloalkylcarbonyl)amino)alkyl, ((alkoxycarbonyl)amino)alkyl, ((benzyloxycarbonyl)amino)alkyl, alkylcarbonyl, arylcarbonyl, alkoxy carbonyl, aryloxy carbonyl, benzyloxy carbonyl, aminocarbonyl, alkylaminocarbonyl, and dialkylaminocarbonyl; and wherein said aryl, heteroaryl, alkyl and cycloalkyl can be substituted with 0-3 substituents selected from the group of alkyl, 1,3-dioxol-2-one, Ar, COOH, OH, NO₂, amino, amido, alkoxy, and alkyloxycarbonylamino;
- R^4 is selected from the group of hydrogen, CN, alkyl, aryl, heteroaryl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, (amino)alkyl, (alkylamino)alkyl, and (dialkylamino)alkyl; and wherein said aryl, heteroaryl, alkyl and cycloalkyl can be substituted with 0-3 substituents selected from the group of alkyl, 1,3-dioxol-2-one, Ar, COOH, OH, amino, amido, alkoxy, and alkyloxycarbonylamino;
- R^5 is selected from the group of hydrogen, CN, alkyl, aryl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, (amino)alkyl, (alkylamino)alkyl, and (dialkylamino)alkyl; and wherein said aryl, alkyl and cycloalkyl can be substituted with 0-3 substituents selected from the group of alkyl, 1,3-dioxol-2-one, Ar, COOH, OH, amino, amido, alkoxy, and alkyloxycarbonylamino;
- R^6 is pyrrolidinyl, piperidinyl, or piperazinyl and is substituted with 0-3 substituents selected from the group of alkyl, alkylcarbonyl, alkoxy carbonyl, and benzyloxy carbonyl;

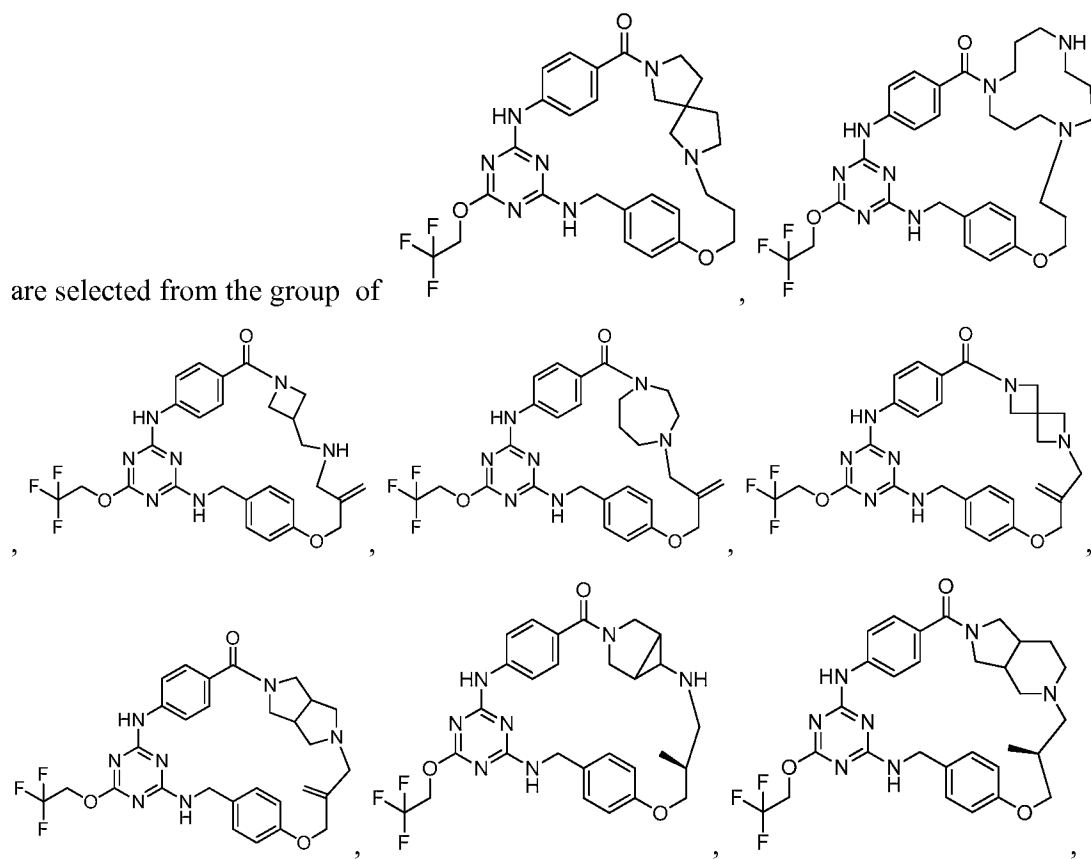
Ar is selected from the group of phenyl, five-membered heterocyclic, six-membered heterocyclic, naphthalyl, and bicyclic heterocyclic;

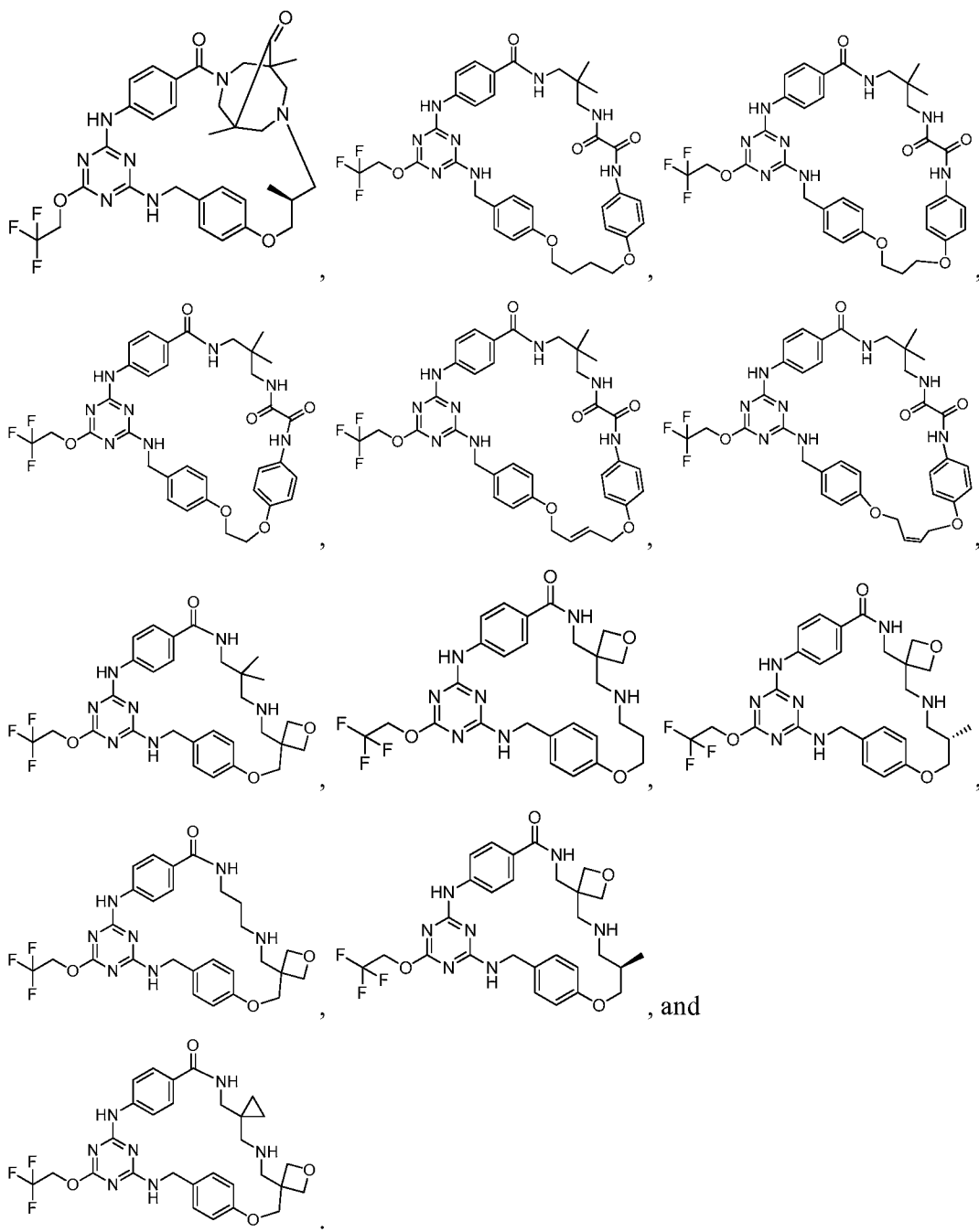
- 5 X is selected from the group of O, CH₂, CO, CO₂, and C(O)NR⁵; and

Z is selected from the group of C₃₋₇ cycloalkylene, oxetane, azetidine, phenylene, pyrrolidindiy, piperidindiy, piperazindiy, homopiperazindiy, fused bicyclic diamine, spiro bicyclic diamine, bridged bicyclic diamine, lactam, and 1,5,9-triazacyclododecane.

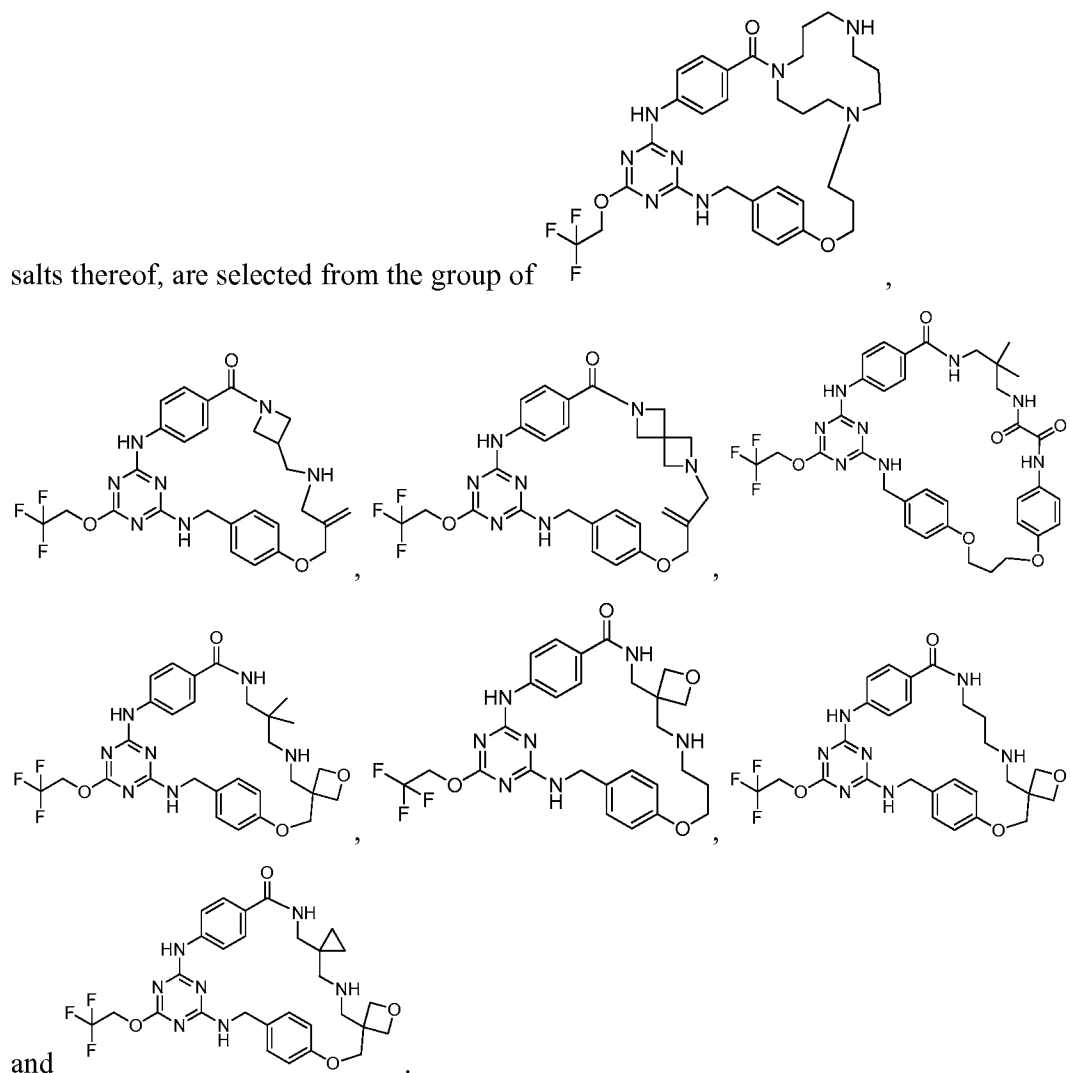
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More preferred compounds, including pharmaceutically acceptable salts thereof,





In addition, other preferred compounds, including pharmaceutically acceptable



Pharmaceutical Compositions and Methods of Treatment

The compounds demonstrate activity against HCV NS5B and can be useful in
 10 treating HCV and HCV infection. Therefore, another aspect of the invention is a
 composition comprising a compound, or a pharmaceutically acceptable salt thereof, and a
 pharmaceutically acceptable carrier.

Another aspect of the invention is a composition further comprising a compound
 15 having anti-HCV activity.

Another aspect of the invention is a composition where the compound having anti-HCV activity is an interferon or a ribavirin. Another aspect of the invention is where the interferon is selected from interferon alpha 2B, pegylated interferon alpha, consensus interferon, interferon alpha 2A, interferon lambda, and lymphoblastoid interferon tau.

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Another aspect of the invention is a composition where the compound having anti-HCV activity is a cyclosporin. Another aspect of the invention is where the cyclosporin is cyclosporin A.

10

Another aspect of the invention is a composition where the compound having anti-HCV activity is selected from the group of interleukin 2, interleukin 6, interleukin 12, a compound that enhances the development of a type 1 helper T cell response, interfering RNA, anti-sense RNA, Imiquimod, ribavirin, an inosine 5'-monophosphate dehydrogenase inhibitor, amantadine, and rimantadine.

15

Another aspect of the invention is a composition where the compound having anti-HCV activity is effective to inhibit the function of a target selected from HCV metalloprotease, HCV serine protease, HCV polymerase, HCV helicase, HCV NS4B protein, HCV entry, HCV assembly, HCV egress, HCV NS5A protein, IMPDH, and a nucleoside analog for the treatment of an HCV infection.

20

Another aspect of the invention is a composition comprising a compound, or a pharmaceutically acceptable salt thereof, a pharmaceutically acceptable carrier, an interferon and ribavirin.

25

Another aspect of the invention is a method of inhibiting the function of the HCV replicon comprising contacting the HCV replicon with a compound or a pharmaceutically acceptable salt thereof.

30

Another aspect of the invention is a method of inhibiting the function of the HCV NS5B protein comprising contacting the HCV NS5B protein with a compound or a pharmaceutically acceptable salt thereof.

Another aspect of the invention is a method of treating an HCV infection in a patient comprising administering to the patient a therapeutically effective amount of a compound or a pharmaceutically acceptable salt thereof. In another embodiment the compound is effective to inhibit the function of the HCV replicon. In another
5 embodiment the compound is effective to inhibit the function of the HCV NS5B protein.

Another aspect of the invention is a method of treating an HCV infection in a patient comprising administering to the patient a therapeutically effective amount of a compound, or a pharmaceutically acceptable salt thereof, in conjunction with (prior to,
10 after, or concurrently) another compound having anti-HCV activity.

Another aspect of the invention is the method where the other compound having anti-HCV activity is an interferon or a ribavirin.

15 Another aspect of the invention is the method where the interferon is selected from interferon alpha 2B, pegylated interferon alpha, consensus interferon, interferon alpha 2A, interferon lambda, and lymphoblastoid interferon tau.

Another aspect of the invention is the method where the other compound having anti-HCV activity is a cyclosporin.

20 Another aspect of the invention is the method where the cyclosporin is cyclosporin A.

Another aspect of the invention is the method where the other compound having
25 anti-HCV activity is selected from interleukin 2, interleukin 6, interleukin 12, a compound that enhances the development of a type 1 helper T cell response, interfering RNA, anti-sense RNA, Imiquimod, ribavirin, an inosine 5'-monophosphate dehydrogenase inhibitor, amantadine, and rimantadine.

30 Another aspect of the invention is the method where the other compound having anti-HCV activity is effective to inhibit the function of a target selected from the group of HCV metalloprotease, HCV serine protease, HCV polymerase, HCV helicase, HCV NS4B protein, HCV entry, HCV assembly, HCV egress, HCV NS5A protein, IMPDH, and a nucleoside analog for the treatment of an HCV infection.

Another aspect of the invention is the method where the other compound having anti-HCV activity is effective to inhibit the function of target in the HCV life cycle other than the HCV NS5B protein.

5

“Therapeutically effective” means the amount of agent required to provide a meaningful patient benefit as understood by practitioners in the field of hepatitis and HCV infection.

10 “Patient” means a person infected with the HCV virus and suitable for therapy as understood by practitioners in the field of hepatitis and HCV infection.

“Treatment,” “therapy,” “regimen,” “HCV infection,” and related terms are used as understood by practitioners in the field of hepatitis and HCV infection.

15

The compounds of this invention are generally given as pharmaceutical compositions comprised of a therapeutically effective amount of a compound or its pharmaceutically acceptable salt and a pharmaceutically acceptable carrier and may contain conventional excipients. Pharmaceutically acceptable carriers are those
20 conventionally known carriers having acceptable safety profiles. Compositions encompass all common solid and liquid forms including for example capsules, tablets, lozenges, and powders as well as liquid suspensions, syrups, elixers, and solutions. Compositions are made using common formulation techniques, and conventional excipients (such as binding and wetting agents) and vehicles (such as water and alcohols)
25 are generally used for compositions. See, for example, *Remington's Pharmaceutical Sciences*, Mack Publishing Company, Easton, PA, 17th edition, 1985.

Solid compositions are normally formulated in dosage units and compositions providing from about 1 to 1000 mg of the active ingredient per dose are preferred. Some
30 examples of dosages are 1 mg, 10 mg, 100 mg, 250 mg, 500 mg, and 1000 mg. Generally, other agents will be present in a unit range similar to agents of that class used clinically. Typically, this is 0.25-1000 mg/unit.

Liquid compositions are usually in dosage unit ranges. Generally, the liquid composition will be in a unit dosage range of 1-100 mg/mL. Some examples of dosages are 1 mg/mL, 10 mg/mL, 25 mg/mL, 50 mg/mL, and 100 mg/mL. Generally, other agents will be present in a unit range similar to agents of that class used clinically.

5 Typically, this is 1-100 mg/mL.

The invention encompasses all conventional modes of administration; oral and parenteral methods are preferred. Generally, the dosing regimen will be similar to other agents used clinically. Typically, the daily dose will be 1-100 mg/kg body weight daily.

10 Generally, more compound is required orally and less parenterally. The specific dosing regimen, however, will be determined by a physician using sound medical judgment.

The invention also encompasses methods where the compound is given in combination therapy. That is, the compound can be used in conjunction with, but

15 separately from, other agents useful in treating hepatitis and HCV infection. In these combination methods, the compound will generally be given in a daily dose of 1-100 mg/kg body weight daily in conjunction with other agents. The other agents generally will be given in the amounts used therapeutically. The specific dosing regimen, however, will be determined by a physician using sound medical judgment.

20

Some examples of compounds suitable for compositions and methods are listed in Table 1.

Table 1.

<i>Brand Name</i>	<i>Physiological Class</i>	<i>Type of Inhibitor or Target</i>	<i>Source Company</i>
NIM811		Cyclophilin Inhibitor	Novartis
Zadaxin		Immuno-modulator	Sciclone
Suvus		Methylene blue	Bioenvision
Actilon (CPG10101)		TLR9 agonist	Coley
Batabulin (T67)	Anticancer	β -tubulin inhibitor	Tularik Inc., South San Francisco, CA
ISIS 14803	Antiviral	antisense	ISIS Pharmaceuticals Inc, Carlsbad, CA/Elan Pharmaceuticals Inc., New York, NY

<i>Brand Name</i>	<i>Physiological Class</i>	<i>Type of Inhibitor or Target</i>	<i>Source Company</i>
Summetrel	Antiviral	antiviral	Endo Pharmaceuticals Holdings Inc., Chadds Ford, PA
GS-9132 (ACH-806)	Antiviral	HCV Inhibitor	Achillion / Gilead
Pyrazolopyrimidine compounds and salts From WO-2005047288 26 May 2005	Antiviral	HCV Inhibitors	Arrow Therapeutics Ltd.
Levovirin	Antiviral	IMPDH inhibitor	Ribapharm Inc., Costa Mesa, CA
Merimepodib (VX-497)	Antiviral	IMPDH inhibitor	Vertex Pharmaceuticals Inc., Cambridge, MA
XTL-6865 (XTL-002)	Antiviral	monoclonal antibody	XTL Biopharmaceuticals Ltd., Rehovot, Israel
Telaprevir (VX-950, LY-570310)	Antiviral	NS3 serine protease inhibitor	Vertex Pharmaceuticals Inc., Cambridge, MA/ Eli Lilly and Co. Inc., Indianapolis, IN
HCV-796	Antiviral	NS5B Replicase Inhibitor	Wyeth / Viropharma
NM-283	Antiviral	NS5B Replicase Inhibitor	Idenix / Novartis
GL-59728	Antiviral	NS5B Replicase Inhibitor	Gene Labs / Novartis
GL-60667	Antiviral	NS5B Replicase Inhibitor	Gene Labs / Novartis
2'C MeA	Antiviral	NS5B Replicase Inhibitor	Gilead
PSI 6130	Antiviral	NS5B Replicase Inhibitor	Roche
R1626	Antiviral	NS5B Replicase Inhibitor	Roche
2'C Methyl adenosine	Antiviral	NS5B Replicase Inhibitor	Merck
JTK-003	Antiviral	RdRp inhibitor	Japan Tobacco Inc., Tokyo, Japan
Levovirin	Antiviral	ribavirin	ICN Pharmaceuticals, Costa Mesa, CA

<i>Brand Name</i>	<i>Physiological Class</i>	<i>Type of Inhibitor or Target</i>	<i>Source Company</i>
Ribavirin	Antiviral	ribavirin	Schering-Plough Corporation, Kenilworth, NJ
Viramidine	Antiviral	Ribavirin Prodrug	Ribapharm Inc., Costa Mesa, CA
Heptazyme	Antiviral	ribozyme	Ribozyme Pharmaceuticals Inc., Boulder, CO
BILN-2061	Antiviral	serine protease inhibitor	Boehringer Ingelheim Pharma KG, Ingelheim, Germany
SCH 503034	Antiviral	serine protease inhibitor	Schering Plough
Zadazim	Immune modulator	Immune modulator	SciClone Pharmaceuticals Inc., San Mateo, CA
Ceplene	Immunomodulator	immune modulator	Maxim Pharmaceuticals Inc., San Diego, CA
CellCept	Immunosuppressant	HCV IgG immuno-suppressant	F. Hoffmann-La Roche LTD, Basel, Switzerland
Civacir	Immunosuppressant	HCV IgG immuno-suppressant	Nabi Biopharmaceuticals Inc., Boca Raton, FL
Albuferon - α	Interferon	albumin IFN- α 2b	Human Genome Sciences Inc., Rockville, MD
Infergen A	Interferon	IFN alfacon-1	InterMune Pharmaceuticals Inc., Brisbane, CA
Omega IFN	Interferon	IFN- ω	Intarcia Therapeutics
IFN- β and EMZ701	Interferon	IFN- β and EMZ701	Transition Therapeutics Inc., Ontario, Canada
Rebif	Interferon	IFN- β 1a	Serono, Geneva, Switzerland
Roferon A	Interferon	IFN- α 2a	F. Hoffmann-La Roche LTD, Basel, Switzerland
Intron A	Interferon	IFN- α 2b	Schering-Plough Corporation, Kenilworth, NJ
Intron A and Zadaxin	Interferon	IFN- α 2b/ α 1-thymosin	RegeneRx Biopharma. Inc., Bethesda, MD/ SciClone Pharmaceuticals Inc, San Mateo, CA

<i>Brand Name</i>	<i>Physiological Class</i>	<i>Type of Inhibitor or Target</i>	<i>Source Company</i>
Rebetron	Interferon	IFN- α 2b/ribavirin	Schering-Plough Corporation, Kenilworth, NJ
Actimmune	Interferon	INF- γ	InterMune Inc., Brisbane, CA
Interferon- β	Interferon	Interferon- β -1a	Serono
Multiferon	Interferon	Long lasting IFN	Viragen/ Valentis
Wellferon	Interferon	Lympho-blastoid IFN- α 1	GlaxoSmithKline plc, Uxbridge, UK
Omniferon	Interferon	natural IFN- α	Viragen Inc., Plantation, FL
Pegasys	Interferon	PEGylated IFN- α 2a	F. Hoffmann-La Roche LTD, Basel, Switzerland
Pegasys and Ceplene	Interferon	PEGylated IFN- α 2a/ immune modulator	Maxim Pharmaceuticals Inc., San Diego, CA
Pegasys and Ribavirin	Interferon	PEGylated IFN- α 2a/ribavirin	F. Hoffmann-La Roche LTD, Basel, Switzerland
PEG-Intron	Interferon	PEGylated IFN- α 2b	Schering-Plough Corporation, Kenilworth, NJ
PEG-Intron / Ribavirin	Interferon	PEGylated IFN- α 2b/ribavirin	Schering-Plough Corporation, Kenilworth, NJ
IP-501	Liver protection	antifibrotic	Indevus Pharmaceuticals Inc., Lexington, MA
IDN-6556	Liver protection	caspase inhibitor	Idun Pharmaceuticals Inc., San Diego, CA
ITMN-191 (R-7227)	Antiviral	serine protease inhibitor	InterMune Pharmaceuticals Inc., Brisbane, CA
GL-59728	Antiviral	NS5B Replicase Inhibitor	Genelabs
ANA-971	Antiviral	TLR-7 agonist	Anadys
Boceprevir	Antiviral	serine protease inhibitor	Schering Plough
TMS-435	Antiviral	serine protease inhibitor	Tibotec BVBA, Mechelen, Belgium
BI-201335	Antiviral	serine protease inhibitor	Boehringer Ingelheim Pharma KG, Ingelheim, Germany
MK-7009	Antiviral	serine protease inhibitor	Merck
PF-00868554	Antiviral	replicase inhibitor	Pfizer

<i>Brand Name</i>	<i>Physiological Class</i>	<i>Type of Inhibitor or Target</i>	<i>Source Company</i>
ANA598	Antiviral	Non-Nucleoside NS5B Polymerase Inhibitor	Anadys Pharmaceuticals, Inc., San Diego, CA, USA
IDX375	Antiviral	Non-Nucleoside Replicase Inhibitor	Idenix Pharmaceuticals, Cambridge, MA, USA
BILB 1941	Antiviral	NS5B Polymerase Inhibitor	Boehringer Ingelheim Canada Ltd R&D, Laval, QC, Canada
PSI-7851	Antiviral	Nucleoside Polymerase Inhibitor	Pharmasset, Princeton, NJ, USA
PSI-7977	Antiviral	Nucleotide NS5B Polymerase Inhibitor	Pharmasset, Princeton, NJ, USA
VCH-759	Antiviral	NS5B Polymerase Inhibitor	ViroChem Pharma
VCH-916	Antiviral	NS5B Polymerase Inhibitor	ViroChem Pharma
GS-9190	Antiviral	NS5B Polymerase Inhibitor	Gilead
Peg-interferon lambda	Antiviral	Interferon	ZymoGenetics/Bristol-Myers Squibb

Synthetic Methods

The compounds may be made by methods available in the art, as well as those described below and including variations within the skill of the art. Some reagents and intermediates are known in the art. Other reagents and intermediates can be made by methods known in the art using readily available materials. The variables (e.g. numbered “R” substituents) used to describe the synthesis of the compounds are intended only to illustrate how to make the compounds and are not to be confused with variables used in the claims or in other sections of the specification. The following methods are for illustrative purposes and are not intended to limit the scope of the invention.

Abbreviations used in the schemes generally follow conventions used in the art. Chemical abbreviations used in the specification and examples are defined as follows:

“NaHMDS” for sodium bis(trimethylsilyl)amide; “DMF” for N,N-dimethylformamide; “MeOH” for methanol; “NBS” for N-bromosuccinimide; “Ar” for aryl; “TFA” for trifluoroacetic acid; “LAH” for lithium aluminum hydride; “BOC”, “DMSO” for

dimethylsulfoxide; "h" for hours; "rt" for room temperature or retention time (context will dictate); "min" for minutes; "EtOAc" for ethyl acetate; "THF" for tetrahydrofuran; "EDTA" for ethylenediaminetetraacetic acid; "Et₂O" for diethyl ether; "DMAP" for 4-dimethylaminopyridine; "DCE" for 1,2-dichloroethane; "ACN" for acetonitrile; "DME" for 1,2-dimethoxyethane; "HOBT" for 1-hydroxybenzotriazole hydrate; "DIEA" for diisopropylethylamine, "Nf" for CF₃(CF₂)₃SO₂-; and "TMOF" for trimethylorthoformate.

Abbreviations are defined as follows: "1 x" for once, "2 x" for twice, "3 x" for thrice, "°C" for degrees Celsius, "eq" for equivalent or equivalents, "g" for gram or grams, "mg" for milligram or milligrams, "L" for liter or liters, "mL" for milliliter or milliliters, "μL" for microliter or microliters, "N" for normal, "M" for molar, "mmol" for millimole or millimoles, "min" for minute or minutes, "h" for hour or hours, "rt" for room temperature, "RT" for retention time, "atm" for atmosphere, "psi" for pounds per square inch, "conc." for concentrate, "sat" or "sat'd" for saturated, "MW" for molecular weight, "mp" for melting point, "ee" for enantiomeric excess, "MS" or "Mass Spec" for mass spectrometry, "ESI" for electrospray ionization mass spectroscopy, "HR" for high resolution, "HRMS" for high resolution mass spectrometry, "LCMS" for liquid chromatography mass spectrometry, "HPLC" for high pressure liquid chromatography, "RP HPLC" for reverse phase HPLC, "TLC" or "tlc" for thin layer chromatography, "NMR" for nuclear magnetic resonance spectroscopy, "¹H" for proton, "δ" for delta, "s" for singlet, "d" for doublet, "t" for triplet, "q" for quartet, "m" for multiplet, "br" for broad, "Hz" for hertz, and "α", "β", "R", "S", "E", and "Z" are stereochemical designations familiar to one skilled in the art.

25

Chemistry Experimental

The compounds may be made by methods known in the art including those described below and including variations within the skill of the art. Some reagents and intermediates are known in the art. Other reagents and intermediates can be made by methods known in the art using readily available materials. The variables (e.g. numbered "R" substituents) used to describe the synthesis of the compounds are intended only to illustrate how to make the compounds and are not to be confused with variables used in

the claims or in other sections of the specification. The following methods are for illustrative purposes and are not intended to limit the scope of the invention.

Abbreviations used in the schemes generally follow conventions used in the art.

- 5 Chemical abbreviations used in the specification and examples are defined as follows:
“NaHMDS” for sodium bis(trimethylsilyl)amide; “DMF” for N,N-dimethylformamide;
“MeOH” for methanol; “NBS” for N-bromosuccinimide; “Ar” for aryl; “TFA” for
trifluoroacetic acid; “LAH” for lithium aluminum hydride; “BOC”, “DMSO” for
dimethylsulfoxide; “h” for hours; “rt” for room temperature or retention time (context
10 will dictate); “min” for minutes; “EtOAc” for ethyl acetate; “THF” for tetrahydrofuran;
“EDTA” for ethylenediaminetetraacetic acid; “Et₂O” for diethyl ether; “DMAP” for 4-
dimethylaminopyridine; “DCE” for 1,2-dichloroethane; “ACN” for acetonitrile; “DME”
for 1,2-dimethoxyethane; “HOBt” for 1-hydroxybenzotriazole hydrate; “DIEA” for
diisopropylethylamine, “Nf” for CF₃(CF₂)₃SO₂-; and “TMOF” for trimethylorthoformate.

15

- Abbreviations are defined as follows: “1 x” for once, “2 x” for twice, “3 x” for
thrice, “°C” for degrees Celsius, “eq” for equivalent or equivalents, “g” for gram or
grams, “mg” for milligram or milligrams, “L” for liter or liters, “mL” for milliliter or
milliliters, “μL” for microliter or microliters, “N” for normal, “M” for molar, “mmol” for
20 millimole or millimoles, “min” for minute or minutes, “h” for hour or hours, “rt” for room
temperature, “RT” for retention time, “atm” for atmosphere, “psi” for pounds per square
inch, “conc.” for concentrate, “sat” or “sat’d” for saturated, “MW” for molecular weight,
“mp” for melting point, “ee” for enantiomeric excess, “MS” or “Mass Spec” for mass
spectrometry, “ESI” for electrospray ionization mass spectroscopy, “HR” for high
25 resolution, “HRMS” for high resolution mass spectrometry, “LCMS” for liquid
chromatography mass spectrometry, “HPLC” for high pressure liquid chromatography,
“RP HPLC” for reverse phase HPLC, “TLC” or “tlc” for thin layer chromatography,
“NMR” for nuclear magnetic resonance spectroscopy, “¹H” for proton, “δ” for delta, “s”
for singlet, “d” for doublet, “t” for triplet, “q” for quartet, “m” for multiplet, “br” for
30 broad, “Hz” for hertz, and “α”, “β”, “R”, “S”, “E”, and “Z” are stereochemical
designations familiar to one skilled in the art.

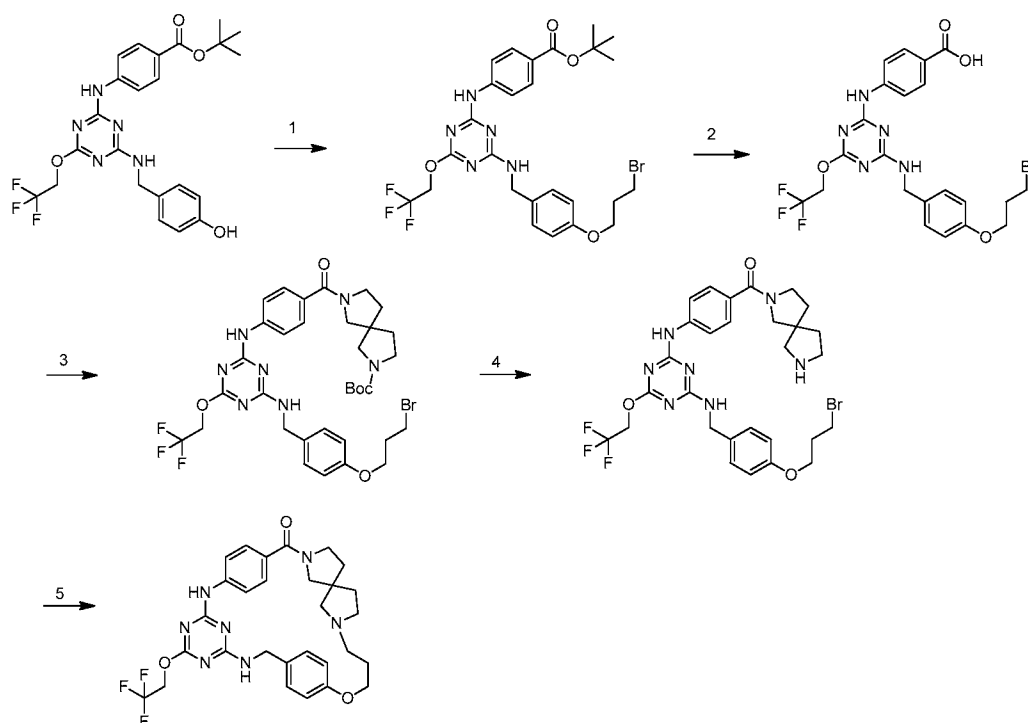
For the section of compounds in the 0000 series all Liquid Chromatography (LC) data were recorded on a Shimadzu LC-10AS or LC-20AS liquid chromatograph using a SPD-10AV or SPD-20A UV-Vis detector and Mass Spectrometry (MS) data were determined with a Micromass Platform for LC in electrospray mode.

5

HPLC Method (i.e., compound isolation). Compounds purified by preparative HPLC were diluted in methanol (1.2 mL) and purified using a Shimadzu LC-8A or LC-10A or Dionex APS-3000 or Waters Acquity™ automated preparative HPLC system.

10

Preparation of 1001:



- 15 Step 1: A suspension of tert-butyl 4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate (1.2 g), 1,3-dibromopropane (0.739 g) and K_2CO_3 (0.675 g) in acetone (20 mL) was heated at 85 °C for 16 hours. The mixture was diluted with water and extracted with EtOAc (3 x 150 mL). The organic layers were combined, washed with water, brine, dried over $MgSO_4$ and concentrated under vacuum.

The residue was purified by silica gel column (hexanes : EtOAc = 3 : 1) to give tert-butyl 4-((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate (0.35 g).

tert-butyl 4-((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate	
MS (M+H) ⁺ Calcd.	612.1
MS (M+H) ⁺ Observ.	612.1
Retention Time	2.31 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

5

Step 2: To a mixture of tert-butyl 4-((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate (350 mg) in CH₂Cl₂ (4 mL) was added TFA (0.5 mL). The mixture was stirred at room temperature for 6 hours, before solvents were removed under vacuum. The residue was used as was in next step reaction without

10 further purification.

4-((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoic acid	
MS (M+H) ⁺ Calcd.	556.1
MS (M+H) ⁺ Observ.	556.0
Retention Time	1.87 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

- Step 3: To a solution of 4-((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoic acid (60 mg) in DMF (1 mL), O-
- 5 benzotriazol-1-yl-N,N,N',N'-tetramethyluronium tetrafluoroborate (35 mg), tert-butyl 2,7-diazaspiro[4.4]nonane-2-carboxylate (24 mg) and iPr₂NEt (28 mg) were added. The reaction was stirred at room temperature for 2 hours, before being quenched by water. Solvents were removed under vacuum and the residue was purified by preparative HPLC to give tert-butyl 7-(4-((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-
- 10 1,3,5-triazin-2-yl)amino)benzoyl)-2,7-diazaspiro[4.4]nonane-2-carboxylate.

tert-butyl 7-(4-((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoyl)-2,7-diazaspiro[4.4]nonane-2-carboxylate	
MS (M+H) ⁺ Calcd.	764.2
MS (M+H) ⁺ Observ.	764.4
Retention Time	3.67 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Solvent Pair	ACN: Water: Ammonium Actetate
Column	Phenomenex LUNA C18, 50x2, 3u

Step 4: TFA (0.106 mL) was added into a solution of tert-butyl 7-(4-((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoyl)-2,7-diazaspiro[4.4]nonane-2-carboxylate (70 mg) in CH₂Cl₂ (7 mL).

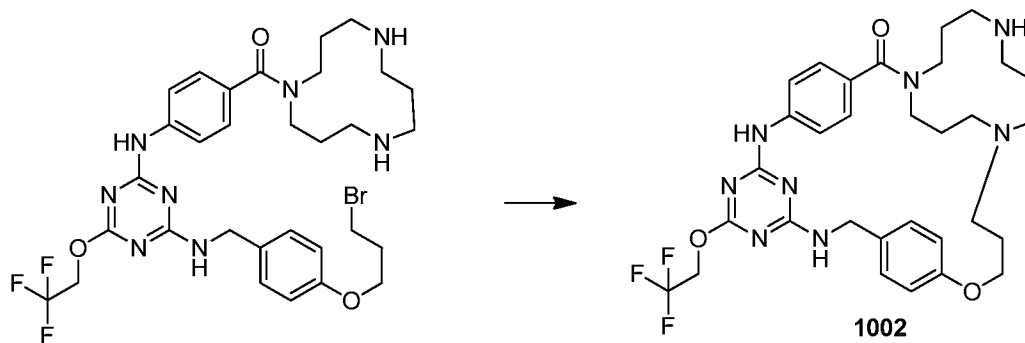
- The reaction was stirred at room temperature for 16 hours. Solvents were removed under vacuum and the residue was purified by preparative HPLC to give (4-((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)phenyl)(2,7-diazaspiro[4.4]nonan-2-yl)methanone.

(4-(((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)phenyl)(2,7-diazaspiro[4.4]nonan-2-yl)methanone	
MS (M+H) ⁺ Calcd.	664.2
MS (M+H) ⁺ Observ.	664.2
Retention Time	2.01 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

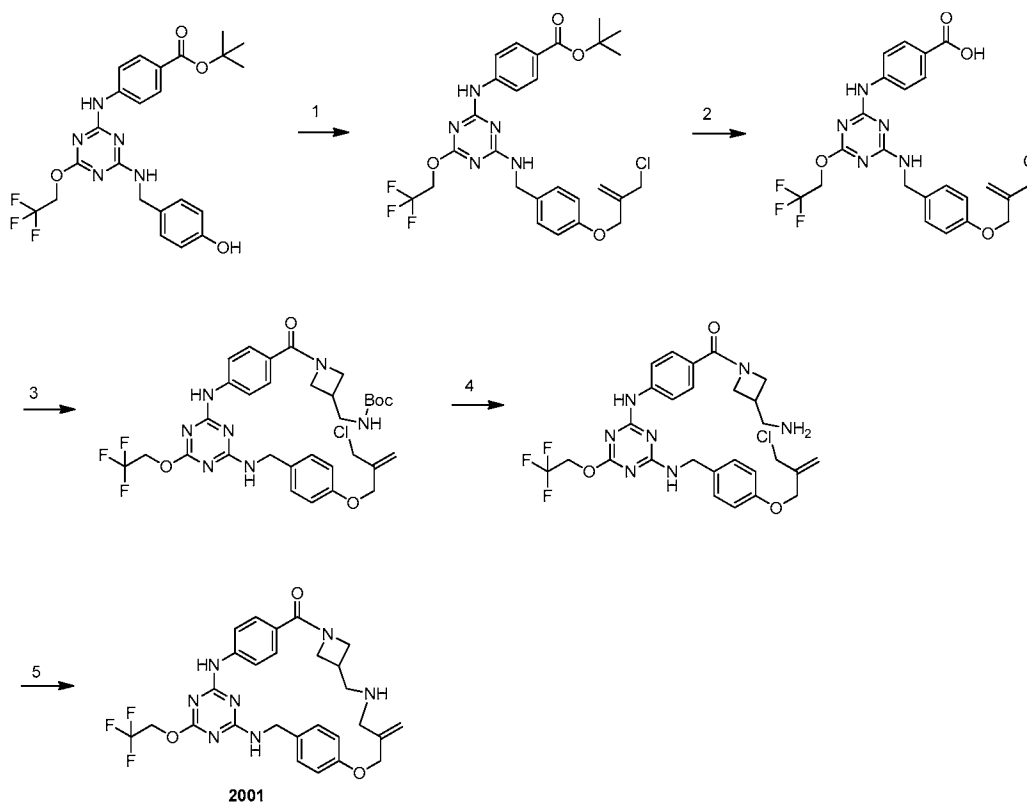
- Step 5 : A mixture of (4-(((4-((4-(3-bromopropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)phenyl)(2,7-diazaspiro[4.4]nonan-2-yl)methanone (40 mg) and K₂CO₃ (25 mg) in acetonitrile (4 mL) In a sealed tube was
- 5 heated at 115°C for 16 hours. Solvents were removed under vacuum and the residue was purified by preparative HPLC to give compound **1001**.

1001	
MS (M+H) ⁺ Calcd.	584.3
MS (M+H) ⁺ Observ.	584.4
Retention Time	2.35 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Solvent Pair	ACN: Water: Ammonium Actetate
Column	Phenomenex LUNA C18, 50x2, 3u

Preparation of 1002: From Step 1 to Step 3, compound **1002** was prepared following the same procedure of synthesizing compound **1001**, using 1,5,9-triazacyclododecane instead of tert-butyl 2,7-diazaspiro[4.4]nonane-2-carboxylate as starting material in Step 3. The final step toward **1002** is shown in below, which followed the same procedure of Step 5 in making **1001**.



1002	
MS (M+H) ⁺ Calcd.	629.3
MS (M+H) ⁺ Observ.	629.3
Retention Time	1.51 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

Preparation of 2001:

Step 1: A suspension of tert-butyl 4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate (0.6 g), 3-chloro-2-(chloromethyl)prop-1-ene (0.23 g) and K₂CO₃ (0.34 g) in acetone (15 mL) was heated to reflux for 16 hours. Solvents were removed under vacuum and the residue was purified by silica gel column (hexanes : EtOAc = 6 : 1 to 3 : 1) to give tert-butyl 4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate (280 mg).

tert-butyl 4-((4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate	
MS (M+H) ⁺ Calcd.	580.2
MS (M+H) ⁺ Observ.	580.2
Retention Time	2.28 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

10

Step 2: A solution of tert-butyl 4-((4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate (580 mg) in CH₂Cl₂ (3 mL) and TFA (2 mL) was stirred at room temperature for 16 hours. All solvents were removed under vacuum and the residue was used in next step reaction without further purification.

15

4-(((4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoic acid	
MS (M+H) ⁺ Calcd.	524.1
MS (M+H) ⁺ Observ.	524.1
Retention Time	1.84 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

- Step 3: To a solution of 4-(((4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoic acid (62 mg) and TBTU (41.8 mg) in DMF (2 mL) was added tert-butyl (azetidin-3-ylmethyl)carbamate (22.04 mg) and
- 5 iPr₂NEt (0.124 mL). After stirring at room temperature for 2 hours, the mixture was purified by preparative HPLC to give tert-butyl ((1-(4-(((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoyl)azetidin-3-yl)methyl)carbamate (30 mg).

tert-butyl ((1-(4-((4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoyl)azetidin-3-yl)methyl)carbamate	
MS (M+H) ⁺ Calcd.	692.3
MS (M+H) ⁺ Observ.	692.3
Retention Time	1.99 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

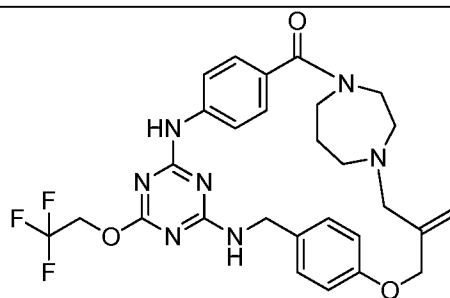
Step 4: To a solution of tert-butyl ((1-(4-((4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoyl)azetidin-3-yl)methyl)carbamate (30 mg) in CH₂Cl₂ (5 mL) was added TFA (1 mL). The mixture was stirred at room temperature for 3 hours. Solvents were removed under vacuum and the residue was diluted with EtOAc (50 mL), washed with 10% NaHCO₃ (20 mL), brine (30 mL), dried over MgSO₄ and concentrated to give (3-(aminomethyl)azetidin-1-yl)(4-((4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)phenyl)methanone (22 mg).

(3-(aminomethyl)azetidin-1-yl)(4-((4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)phenyl)methanone	
MS (M+H) ⁺ Calcd.	592.2
MS (M+H) ⁺ Observ.	592.2
Retention Time	1.29 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

- Step 5: To a solution of (3-(aminomethyl)azetidin-1-yl)(4-((4-((4-((2-(chloromethyl)allyl)oxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)phenyl)methanone (30 mg) in acetonitrile (5 mL) was added NaHCO₃ (8.51 mg). The mixture was stirred at 115 °C for 16 hours, before solvents were removed under vacuum. The residue was purified by preparative HPLC to give **2001** (12.3 mg).

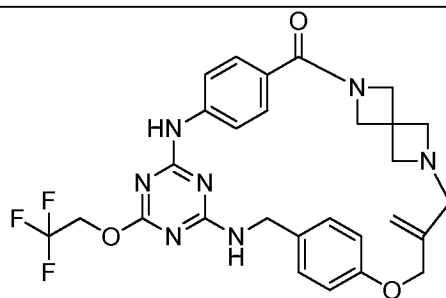
2001	
MS (M+H) ⁺ Calcd.	556.2
MS (M+H) ⁺ Observ.	556.3
Retention Time	1.28 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

Preparation of 2002: Compound **2002** was prepared following the same procedure of synthesizing compound **2001**, using tert-butyl 1,4-diazepane-1-carboxylate instead of tert-butyl (azetidin-3-ylmethyl)carbamate as starting material in Step 3.

**2002**

MS (M+H) ⁺ Calcd.	570.2
MS (M+H) ⁺ Observ.	570.3
Retention Time	1.18 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

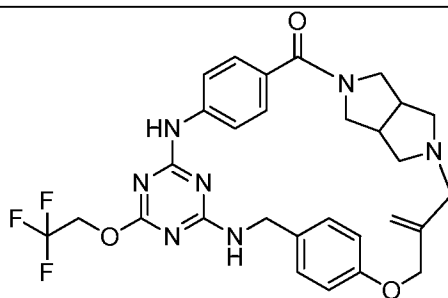
Preparation of 2003: Compound **2003** was prepared following the same procedure of synthesizing compound **2001**, using tert-butyl 2,6-diazaspiro[3.3]heptane-2-carboxylate instead of tert-butyl (azetidin-3-ylmethyl)carbamate as starting material in Step 3.

**2003**

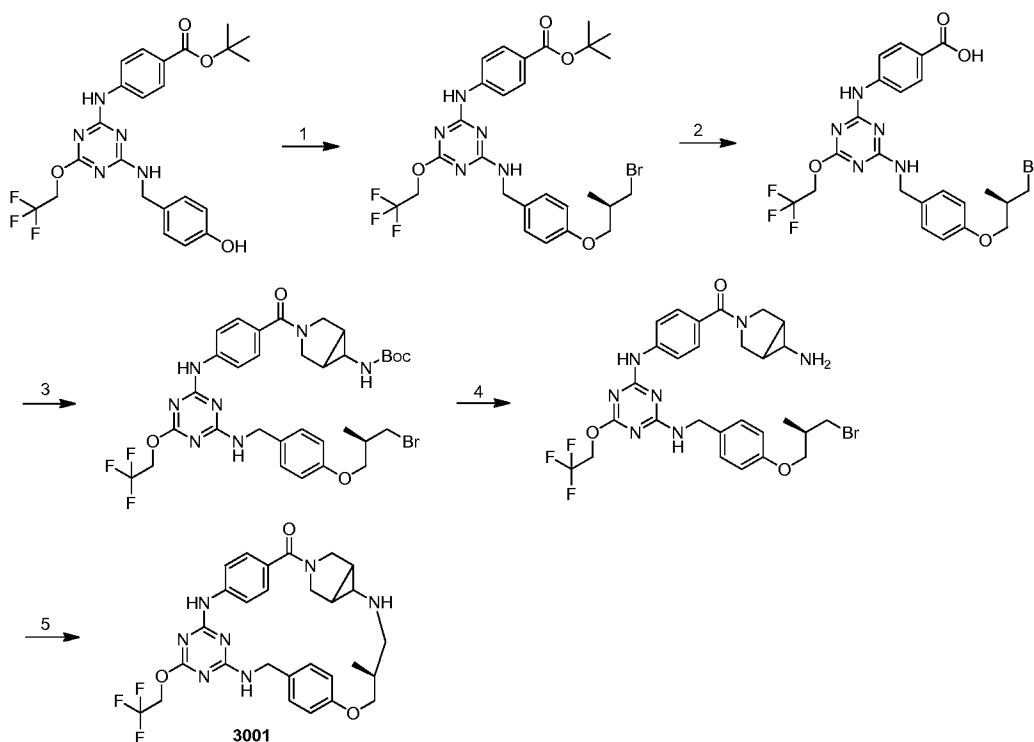
MS (M+H) ⁺ Calcd.	568.2
MS (M+H) ⁺ Observ.	568.3
Retention Time	1.28 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

Preparation of 2003: Compound **2003** was prepared following the same procedure of synthesizing compound **2001**, using tert-butyl hexahydropyrrolo[3,4-c]pyrrole-2(1H)-carboxylate instead of tert-butyl (azetidin-3-ylmethyl)carbamate as starting material in

5 Step 3.

**2004**

MS (M+H) ⁺ Calcd.	582.2
MS (M+H) ⁺ Observ.	582.3
Retention Time	1.21 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

Preparation of 3001:

- 5 Step 1: To a solution of tert-butyl 4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate (1.0 g), (R)-3-bromo-2-methylpropan-1-ol (0.311 g) and Ph_3P (0.534 g) in THF (5 mL), diisopropyl azodicarboxylate (0.411 g) was added at 0°C . The reaction was stirred at room temperature for 16 hours. Solvents were removed under vacuum and the residue was purified by silica gel column (hexanes :
- 10 EtOAc = 9 : 1 to 4 : 1) to give (R)-tert-butyl 4-((4-((4-(3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate.

(R)-tert-butyl 4-((4-((4-(3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate	
MS (M+H) ⁺ Calcd.	626.2
MS (M+H) ⁺ Observ.	626.1
Retention Time	2.57 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

- Step 2: TFA (0.46 mL) was added into a solution of (R)-tert-butyl 4-((4-((4-(3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate (0.25 g) in CH₂Cl₂ (2 mL). The reaction was stirred at room temperature for 16 hours. All solvents were removed under vacuum and the residue was used in next step reaction without further purification.

(R)-4-((4-((4-(3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoic acid	
MS (M+H) ⁺ Calcd.	570.1
MS (M+H) ⁺ Observ.	570.1
Retention Time	2.37 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

Step 3: O-Benzotriazol-1-yl-N,N,N',N'-tetramethyluronium tetrafluoroborate (34 mg), tert-butyl 3-azabicyclo[3.1.0]hexan-6-ylcarbamate (21 mg) and iPr₂NEt (27 mg) were added into a solution of (R)-4-((4-((4-(3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoic acid (60 mg) in DMF (1 mL).
 5 The reaction was stirred at room temperature for 2 hours. Solvents were removed under vacuum and the residue was purified by preparative HPLC to give tert-butyl (3-(4-((4-((R)-3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoyl)-3-azabicyclo[3.1.0]hexan-6-yl)carbamate.

10

tert-butyl (3-(4-(((4-(((R)-3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoyl)-3-azabicyclo[3.1.0]hexan-6-yl)carbamate	
MS (M+H) ⁺ Calcd.	750.2
MS (M+H) ⁺ Observ.	750.2
Retention Time	2.43 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

- Step 4: TFA (0.08 mL) was added into a solution of tert-butyl (3-(4-(((4-(((R)-3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoyl)-3-azabicyclo[3.1.0]hexan-6-yl)carbamate (50 mg, 0.067 mmol) in
- 5 CH₂Cl₂ (1 mL). The reaction was stirred at room temperature for 16 hours. Solvents were removed under vacuum and the residue was purified by preparative HPLC to give (6-amino-3-azabicyclo[3.1.0]hexan-3-yl)(4-(((4-(((R)-3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)phenyl)methanone.

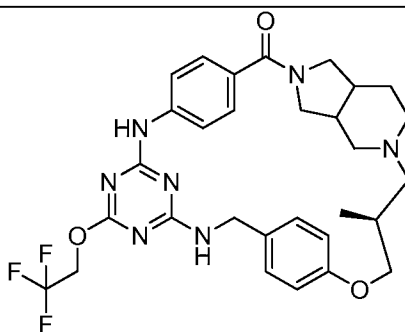
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(6-amino-3-azabicyclo[3.1.0]hexan-3-yl)(4-((4-((4-((R)-3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)phenyl)methanone	
MS (M+H) ⁺ Calcd.	650.2
MS (M+H) ⁺ Observ.	650.2
Retention Time	3.94 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	0
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 50mm 3um

- Step 5: A mixture of (6-amino-3-azabicyclo[3.1.0]hexan-3-yl)(4-((4-((4-((R)-3-bromo-2-methylpropoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)phenyl)methanone (25 mg) and K₂CO₃ (5.31 mg) in acetonitrile (4 mL) in a sealed tube was heated at 115°C for 16 hours. Solvents were removed under vacuum and the residue was purified by preparative HPLC to give compound **3001**.

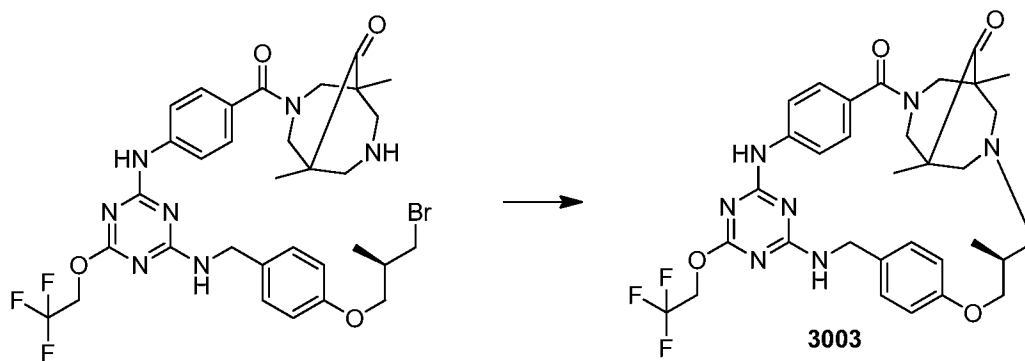
3001	
MS (M+H) ⁺ Calcd.	570.2
MS (M+H) ⁺ Observ.	570.3
Retention Time	3.05 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	0
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 50mm 3um

Preparation of 3002: Compound **3002** was prepared following the same procedure of synthesizing compound **3001**, using tert-butyl hexahydro-1H-pyrrolo[3,4-c]pyridine-5(6H)-carboxylate instead of tert-butyl 3-azabicyclo[3.1.0]hexan-6-ylcarbamate as starting material in Step 3.

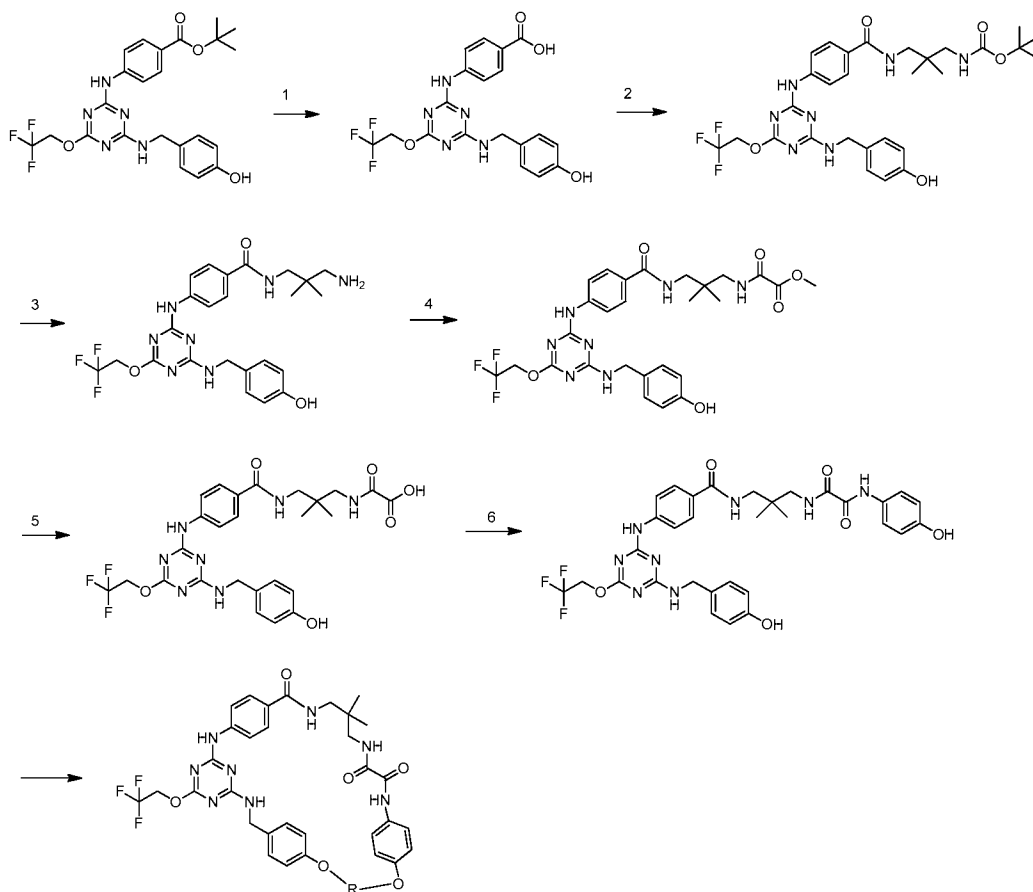
**3002**

MS (M+H) ⁺ Calcd.	598.3
MS (M+H) ⁺ Observ.	598.3
Retention Time	3.05 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	0
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 50mm 3um

- Preparation of 3003:** From Step 1 to Step 3, compound **3003** was prepared following the same procedure of synthesizing compound **3001**, using 1,5-dimethyl-3,7-diazabicyclo[3.3.1]nonan-9-one instead of tert-butyl 3-azabicyclo[3.1.0]hexan-6-ylcarbamate as starting material in Step 3. The final step toward **3003** is shown in below, which followed the same procedure of Step 5 in making **3001**.



3003	
MS (M+H) ⁺ Calcd.	640.3
MS (M+H) ⁺ Observ.	640.3
Retention Time	4.30 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	0
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 50mm 3um

Preparation of 4001, 4002, 4003, 4004 and 4005:

- 5 Step 1: To a solution of tert-butyl 4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoate (1 g) in CH_2Cl_2 (5 mL), TFA (3 mL) was added. The mixture was stirred at room temperature for 16 hours. Solvents were removed under vacuum to give 4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoic acid (0.8 g).

4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoic acid	
MS (M+H) ⁺ Calcd.	436.1
MS (M+H) ⁺ Observ.	436.1
Retention Time	1.20 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

Step 2: To a solution of 4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzoic acid (2.7 g) and TBTU (2.190 g) in NMP (20 mL), tert-butyl (3-amino-2,2-dimethylpropyl)carbamate (1.51 g) and iPr₂NEt (4.33 mL) were added.

- 5 After stirring at room temperature for 2 hours, the mixture was diluted with 100 mL of water and extracted with EtOAc (2 x 150 mL). The organic layer were combined, washed with brine (100 mL), dried over MgSO₄ and concentrated. The residue was purified by silica gel column to give tert-butyl (3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-
- 10 dimethylpropyl)carbamate (2.5 g).

(3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)carbamate	
MS (M+H) ⁺ Calcd.	620.3
MS (M+H) ⁺ Observ.	620.3
Retention Time	1.82 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

- Step 3: TFA (2 mL) was added into a solution of tert-butyl (3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)carbamate (0.6 g) in CH₂Cl₂ (10 mL). The mixture was stirred at room temperature for 4 hours. Solvents were removed under vacuum to give N-(3-amino-2,2-dimethylpropyl)-4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamide (0.5 g).

N-(3-amino-2,2-dimethylpropyl)-4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamide	
MS (M+H) ⁺ Calcd.	520.2
MS (M+H) ⁺ Observ.	520.3
Retention Time	0.68 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

- Step 4: Methyl 2-chloro-2-oxoacetate (0.13 g) was added dropwise at room temperature into a solution of N-(3-amino-2,2-dimethylpropyl)-4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamide (0.5 g) in THF (15 mL),
- 5 followed by iPr₂NEt (0.67 mL). The mixture was stirred at room temperature for 4 hours, before being diluted with EtOAc (200 mL), washed with water (50 mL), brine (50 mL), dried over MgSO₄ and concentrated. The residue was purified by silica gel column (hexanes : EtOAc = 1 : 1 to 1 : 3) to give methyl 2-((3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-
- 10 dimethylpropyl)amino)-2-oxoacetate (0.6 g).

methyl 2-((3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)amino)-2-oxoacetate	
MS (M+H) ⁺ Calcd.	606.2
MS (M+H) ⁺ Observ.	606.3
Retention Time	1.75 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

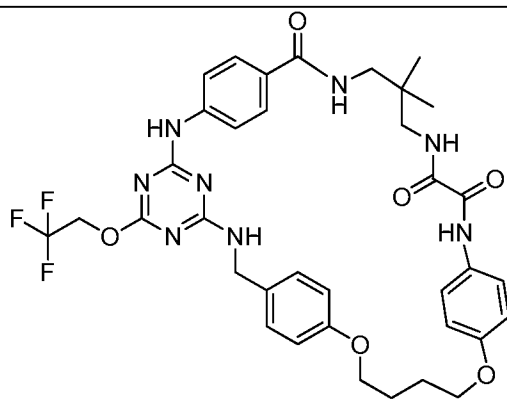
- Step 5: K₂CO₃ (0.502 g) in water (5 mL) was added into a solution of methyl 2-((3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)amino)-2-oxoacetate (0.55 g) in acetone (10 mL). The mixture was stirred at room temperature for 16 hours, before being acidified with 1N HCl to pH ~ 3. The acetone was removed under vacuum and the mixture was diluted with EtOAc (100 mL), washed with water (30 mL), brine (30 mL), dried over MgSO₄ and concentrated to give 2-((3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)amino)-2-oxoacetic acid (480 mg) which was used as was.

2-((3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)amino)-2-oxoacetic acid	
MS (M+H) ⁺ Calcd.	592.2
MS (M+H) ⁺ Observ.	592.3
Retention Time	1.70 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

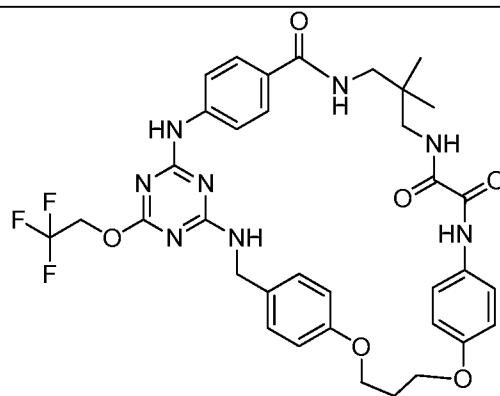
- Step 6: 4-Aminophenol (97 mg) and iPr₂NEt (0.57 mL) were added into a solution of 2-((3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)amino)-2-oxoacetic acid (480 mg) and TBTU (287 mg) in DMF (8 mL). The mixture was stirred at room temperature for 3 hours, before being diluted with EtOAc (200 mL), washed with water (30 mL), brine (30 mL), dried over MgSO₄ and concentrated. The residue was purified by silica gel column (hexanes : EtOAc = 2 : 1 to 1 : 1) to give N1-(3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)-N2-(4-hydroxyphenyl)oxalamide (300 mg).

N1-(3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)-N2-(4-hydroxyphenyl)oxalamide	
MS (M+H) ⁺ Calcd.	683.3
MS (M+H) ⁺ Observ.	683.3
Retention Time	1.85 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

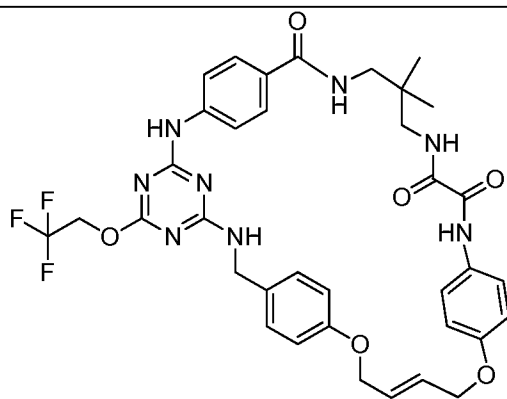
- Step 7: K₂CO₃ (2 eq.) was added into a solution of N1-(3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)-N2-(4-hydroxyphenyl)oxalamide (1 eq) and di-electrophile (0.5 eq.)
- 5 in acetone. The mixture was heated at 80 °C in a sealed tube for 16 hours. Solvents were removed under vacuum and the residue was purified by preparative HPLC to give compound of Formula I.

**4001**

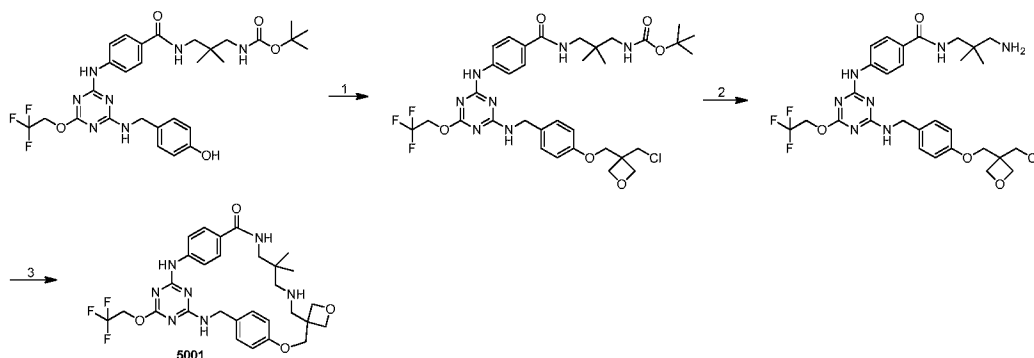
Di-electrophile Used	
MS (M+H) ⁺ Calcd.	737.3
MS (M+H) ⁺ Observ.	737.3
Retention Time	2.20 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

**4002**

Di-electrophile Used	Br-CH ₂ -CH ₂ -CH ₂ -Br
MS (M+H) ⁺ Calcd.	723.3
MS (M+H) ⁺ Observ.	723.3
Retention Time	2.08 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

**4004**

Di-electrophile Used	
MS (M+H) ⁺ Calcd.	735.3
MS (M+H) ⁺ Observ.	735.4
Retention Time	2.03 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	50
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

Preparation of 5001:

- 5 Step 1: A suspension of tert-butyl (3-(4-((4-((4-hydroxybenzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)carbamate (150 mg), 3,3-bis(chloromethyl)oxetane (113 mg) and K_2CO_3 (134 mg) in acetone (5 mL) was heated at 85 °C for 16 hours. Solvents were removed under vacuum and the residue was purified by silica gel column (hexanes : EtOAc = 5 : 1 to 2 : 1) to give tert-butyl (3-(4-((4-((3-(chloromethyl)oxetan-3-yl)methoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)carbamate (44 mg).
- 10

tert-butyl (3-(4-((4-((3-(chloromethyl)oxetan-3-yl)methoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)carbamate	
MS (M+H) ⁺ Calcd.	738.3
MS (M+H) ⁺ Observ.	738.3
Retention Time	2.26 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

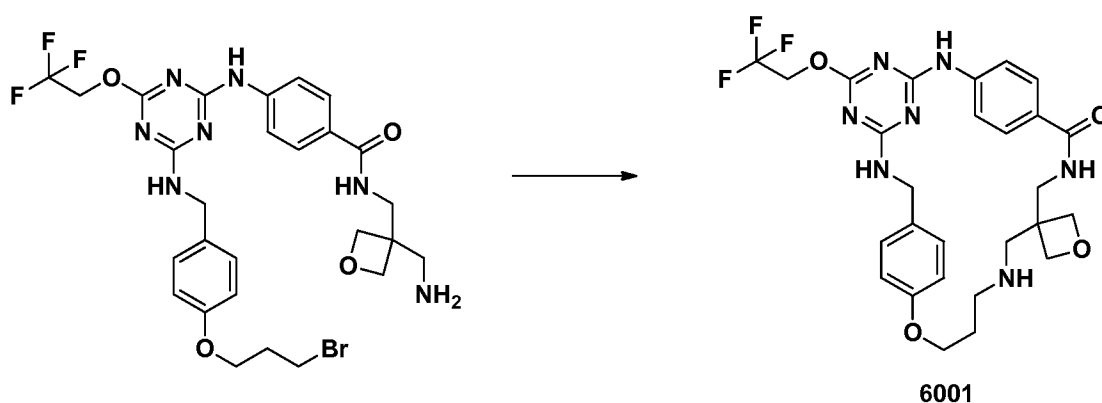
- Step 2: To a solution of tert-butyl (3-(4-((4-((3-(chloromethyl)oxetan-3-yl)methoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamido)-2,2-dimethylpropyl)carbamate (44 mg) in CH₂Cl₂ (2 mL), TFA (0.5 mL) was added. The mixture was stirred at room temperature for 2 hours, before solvents were removed under vacuum. The residue was diluted with EtOAc (50 mL) and washed with 10% of NaHCO₃ (20 mL), brine (20 mL) and dried over MgSO₄ and concentrated, which was used as was.

N-(3-amino-2,2-dimethylpropyl)-4-((4-((4-((3-(chloromethyl)oxetan-3-yl)methoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamide	
MS (M+H) ⁺ Calcd.	638.2
MS (M+H) ⁺ Observ.	638.3
Retention Time	1.68 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

- Step 3: A solution of N-(3-amino-2,2-dimethylpropyl)-4-((4-((4-((3-(chloromethyl)oxetan-3-yl)methoxy)benzyl)amino)-6-(2,2,2-trifluoroethoxy)-1,3,5-triazin-2-yl)amino)benzamide (30 mg) in acetonitrile (5 mL) was heated to reflux for 3 days. The solvent was removed under vacuum. The residue was purified by preparative HPLC to give **5001** (3.3 mg).

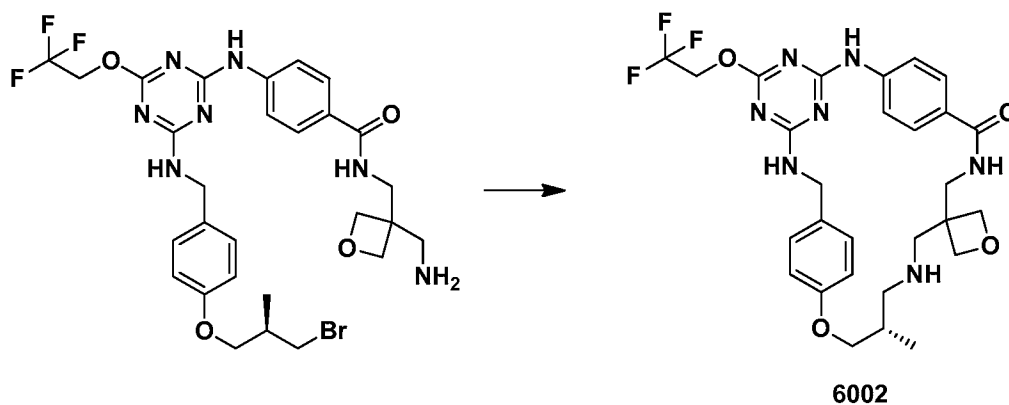
5001	
MS (M+H) ⁺ Calcd.	602.3
MS (M+H) ⁺ Observ.	602.3
Retention Time	1.47 min
LC Condition	
Solvent A	90% Water -10% Methanol-0.1% TFA
Solvent B	10% Water -90% Methanol-0.1% TFA
Start % B	30
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Methanol- TFA
Column	PHENOMENEX-LUNA 2.0 X 30mm 3um

- Preparation of 6001:** From Step 1 to Step 3, compound **6001** was prepared following the same procedure of synthesizing compound **1001**, using tert-butyl ((3-(aminomethyl)oxetan-3-yl)methyl)carbamate instead of tert-butyl 2,7-diazaspiro[4.4]nonane-2-carboxylate as starting material in Step 3. The final step toward **6001** is shown in below, which followed the same procedure of Step 5 in making **1001**.



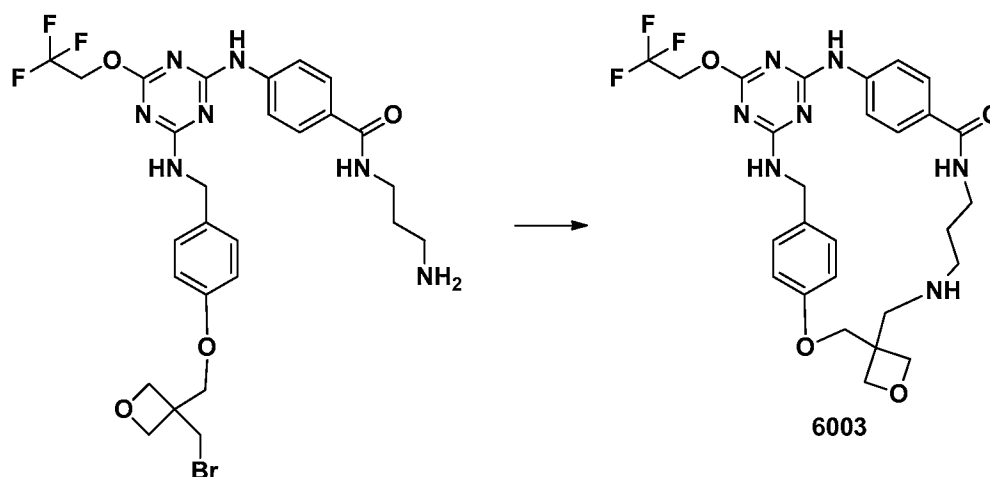
6001	
MS (M+H) ⁺ Calcd.	574.2
MS (M+H) ⁺ Observ.	574.3
Retention Time	2.04 min
LC Condition	
Solvent A	5:95 Acetonitrile:Water - 10 mM ammonium acetate
Solvent B	95:5 acetonitrile:water -10 mM ammonium acetate
Start % B	0
Final % B	100
Gradient Time	4 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Acetonitrile- Ammonium acetate
Column	Waters BEH C18, 2.0 x 50 mm, 1.7-μm

Preparation of 6002: From Step 1 to Step 3, compound **6002** was prepared following the same procedure of synthesizing compound **3001**, using tert-butyl ((3-(aminomethyl)oxetan-3-yl)methyl)carbamate instead of tert-butyl 3-azabicyclo[3.1.0]hexan-6-ylcarbamate as starting material in Step 3. The final step toward **6002** is shown in below, which followed the same procedure of Step 5 in making **3001**.



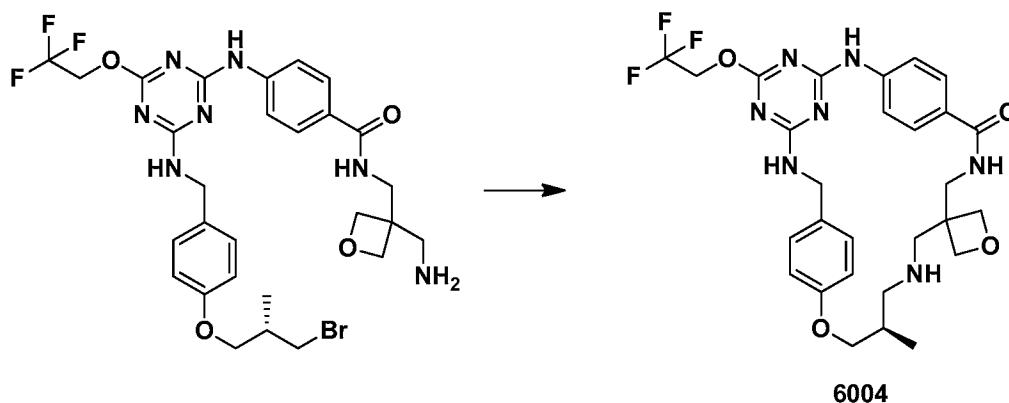
6002	
MS (M+H) ⁺ Calcd.	588.3
MS (M+H) ⁺ Observ.	588.3
Retention Time	2.12 min
LC Condition	
Solvent A	5:95 Acetonitrile:Water - 10 mM ammonium acetate
Solvent B	95:5 acetonitrile:water -10 mM ammonium acetate
Start % B	0
Final % B	100
Gradient Time	4 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Acetonitrile- Ammonium acetate
Column	Waters BEH C18, 2.0 x 50 mm, 1.7-μm

Preparation of 6003: Compound **6003** was prepared following the same procedure of synthesizing compound **1001**, using 3,3-bis(bromomethyl)oxetane instead of 1,3-dibromopropane in Step 1 and tert-butyl (3-aminopropyl)carbamate instead of tert-butyl 2,7-diazaspiro[4.4]nonane-2-carboxylate as starting material in Step 3. The final step toward **6003** is shown in below, which followed the same procedure of Step 5 in making **1001**.



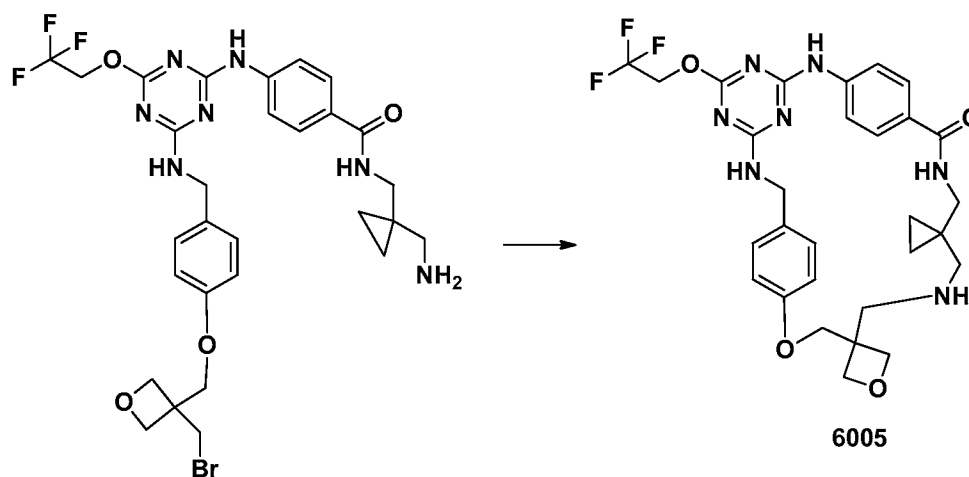
6003	
MS (M+H) ⁺ Calcd.	574.2
MS (M+H) ⁺ Observ.	574.3
Retention Time	0.85 min
LC Condition	
Solvent A	100% Water: 0.05% TFA
Solvent B	100% ACN: 0.05% TFA
Start % B	2
Final % B	98
Gradient Time	2.2 min
Flow Rate	0.8 mL/min
Wavelength	220
Solvent Pair	ACN: Water: TFA
Column	Acquity UPLC BEH C18 1.7 μm

Preparation of 6004: Compound **6004** was prepared following the same procedure of synthesizing compound 3001 except that (S)-3-bromo-2-methylpropan-1-ol was used as starting material instead of (R)-3-bromo-2-methylpropan-1-ol in Step 1 and tert-butyl ((3-(aminomethyl)oxetan-3-yl)methyl)carbamate was used as starting material in Step 3 instead of tert-butyl 3-azabicyclo[3.1.0]hexan-6-ylcarbamate. The final step toward **6004** is shown in below, which followed the same procedure of Step 5 in making **3001**.



6004	
MS (M+H) ⁺ Calcd.	588.3
MS (M+H) ⁺ Observ.	588.3
Retention Time	2.12 min
LC Condition	
Solvent A	5:95 Acetonitrile:Water - 10 mM ammonium acetate
Solvent B	95:5 acetonitrile:water -10 mM ammonium acetate
Start % B	0
Final % B	100
Gradient Time	4 min
Flow Rate	1 mL/min
Wavelength	220
Solvent Pair	Water - Acetonitrile- Ammonium acetate
Column	Waters BEH C18, 2.0 x 50 mm, 1.7-μm

- Preparation of 6005:** Compound **6005** was prepared following the same procedure of synthesizing compound **1001**, using 3,3-bis(bromomethyl)oxetane instead of 1,3-dibromopropane in Step 1 and tert-butyl ((1-(aminomethyl)cyclopropyl)methyl)carbamate instead of tert-butyl 2,7-diazaspiro[4.4]nonane-2-carboxylate as starting material in Step 3. The final step toward **6005** is shown in below, which followed the same procedure of Step 5 in making **1001**.



6005	
MS (M+H) ⁺ Calcd.	600.3
MS (M+H) ⁺ Observ.	600.3
Retention Time	0.90 min
LC Condition	
Solvent A	100% Water: 0.05% TFA
Solvent B	100% ACN: 0.05% TFA
Start % B	2
Final % B	98
Gradient Time	2.2 min
Flow Rate	0.8 mL/min
Wavelength	220
Solvent Pair	ACN: Water: TFA
Column	Acquity UPLC BEH C18 1.7 μm

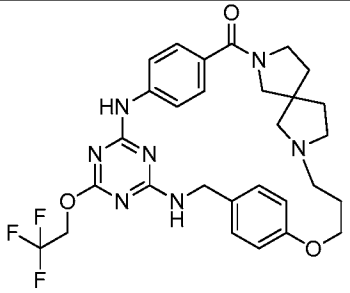
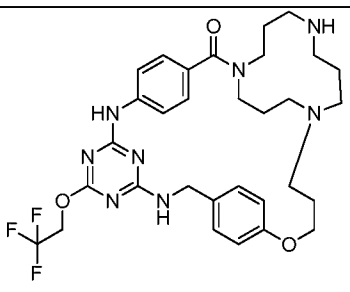
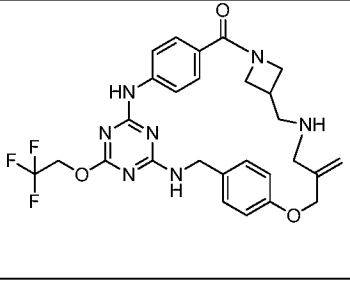
Biological Methods

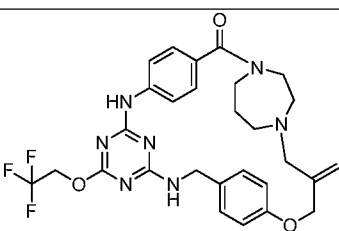
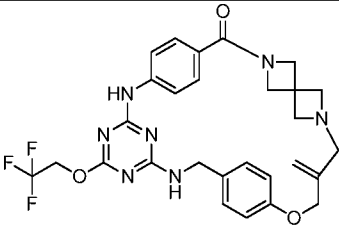
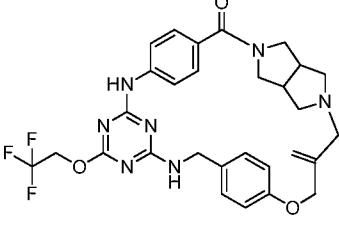
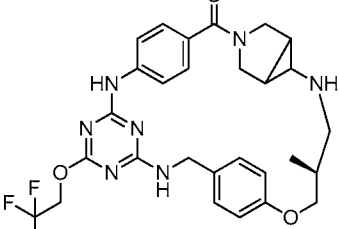
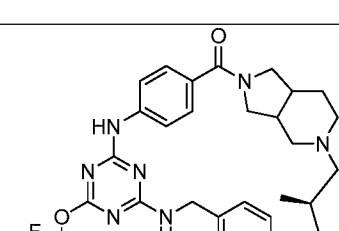
Infection assays. HCV pseudoparticles, produced using standardized methodology (Bartosch, B., Dubuisson, J. and Cosset, F.-L. *J. Exp. Med.* **2003**, 197:633-642) were made via a liposome-based transfection procedure of 293T cells with plasmids expressing the murine leukemia virus capsid and polymerase proteins, an MLV genome encoding the luciferase reporter gene, and envelope glycoproteins from either HCV or vesicular stomatitis virus (VSV). The genotype 1a HCV E1 and E2 envelope coding sequences were derived from the H77C isolate (GenBank accession number AF009606). Media containing pseudoparticles was collected 3 days following transfection, filtered, and stored at -20°C as a viral stock. Infections were performed in 384-well plates by mixing pseudovirus with 1 x 10⁴ Huh7 cells/well in the presence or absence of test inhibitors, followed by incubation at 37°C. Luciferase activity, reflecting the degree of entry of the pseudoparticles into host cells, was measured 2 days after infection. The specificity of the compounds for inhibiting HCV was determined by evaluating inhibition of VSV pseudoparticle infection.

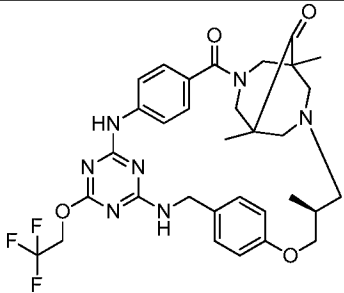
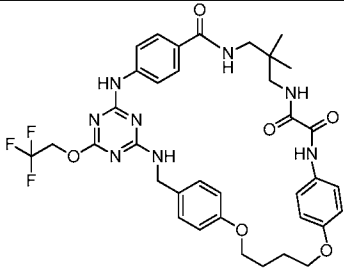
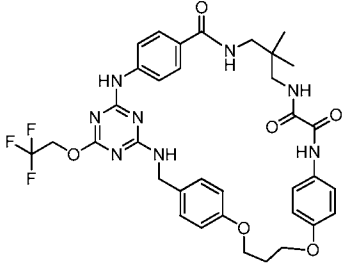
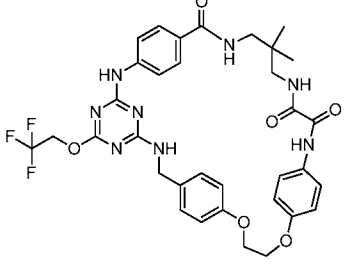
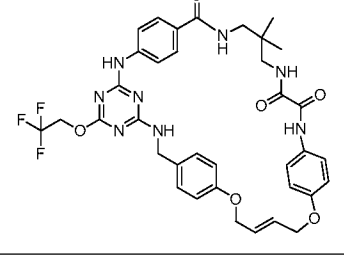
Compounds and data analysis. Test compounds were serially diluted 3-fold in dimethyl sulfoxide (DMSO) to give a final concentration range in the assay of 50.0 μ M to 0.04 pM. Maximum activity (100% of control) and background were derived from control wells containing DMSO but no inhibitor or from uninfected wells, respectively.

- 5 The individual signals in each of the compound test wells were then divided by the averaged control values after background subtraction and multiplied by 100% to determine percent activity. Assays were performed in duplicate and average EC₅₀ values (reflecting the concentration at which 50% inhibition of virus replication was achieved) were calculated. Compound EC₅₀ data is expressed as A = 0.01≤10 nM; B = 10-1000
10 nM. Representative data for compounds are reported in Table 2.

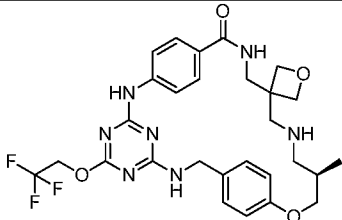
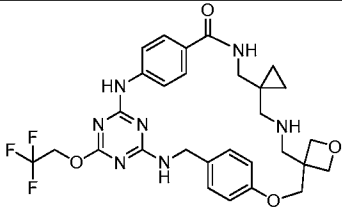
Table 2

Example		EC ₅₀ (nM) 1a (H77C)	EC ₅₀ (nM) 1a (H77C)
1001		159.900	B
1002		5.319	A
2001			A

Example		EC ₅₀ (nM) 1a (H77C)	EC ₅₀ (nM) 1a (H77C)
2002			B
2003		3.083	A
2004			B
3001			B
3002		116.000	B

Example		EC ₅₀ (nM) 1a (H77C)	EC ₅₀ (nM) 1a (H77C)
3003		34.280	B
4001			B
4002			A
4003		23.580	B
4004			B

Example		EC ₅₀ (nM) 1a (H77C)	EC ₅₀ (nM) 1a (H77C)
4005			B
5001		0.796	A
6001			A
6002			B
6003			A

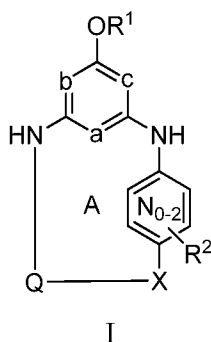
Example		EC ₅₀ (nM) 1a (H77C)	EC ₅₀ (nM) 1a (H77C)
6004			B
6005			A

It will be evident to one skilled in the art that the present disclosure is not limited to the foregoing illustrative examples, and that it can be embodied in other specific forms without departing from the essential attributes thereof. It is therefore desired that the examples be considered in all respects as illustrative and not restrictive, reference being made to the appended claims, rather than to the foregoing examples, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

CLAIMS

What is claimed is:

1. A compound of Formula I, including pharmaceutically acceptable salts thereof:



wherein

a, b and c are each nitrogen;

or a and b are nitrogen, while c is -CH;

or b and c are nitrogen, while a is -CH;

or a and c are nitrogen, while b is -CH;

Q is an alkylene or alkenylene chain containing 1-2 groups selected from oxetane, azetidine, homopiperazindiyl, fused bicyclic diamine, spiro bicyclic diamine, bridged bicyclic diamine, lactam, 1,5,9-triazacyclododecane, and COCO, and from 0-6 groups selected from O, NR³, S, S(O), S(O)₂, C(O)O, C(O)NR⁴, OC(O)NR⁴, NR⁴C(O)NR⁴, and Z, provided that any O or S atom does not directly bond to another O or S atom, such that ring A is 13-32 membered; and wherein the alkylene or alkenylene chain is further substituted with 0-6 substituents selected from the group of alkyl, hydroxy, alkoxy, R⁶, (R⁶)alkyl, and phenyl, wherein the phenyl substituent

is further substituted with 0-4 cyano, halo, alkyl, haloalkyl, alkoxy, or haloalkoxy substituents;

R¹ is selected from the group of alkyl, hydroxyalkyl, alkoxyalkyl, haloalkyl, cycloalkyl, hydroxycycloalkyl, alkoxycycloalkyl, halocycloalkyl, cycloalkenyl, indanyl, alkylcarbonyl, or benzyl wherein the benzyl moiety is substituted with 0-3 substituents selected from halo, alkyl, haloalkyl, cycloalkyl, alkoxy, haloalkoxy, alkenyl, alkynyl, hydroxy, and cyano;

R² is selected from the group of cyano, hydrogen, halo, alkyl, haloalkyl, alkoxy, haloalkoxy and Ar;

R³ is selected from the group of hydrogen, CN, alkyl, aryl, heteroaryl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, (amino)alkyl, (alkylamino)alkyl, (dialkylamino)alkyl ((alkylcarbonyl)amino)alkyl, ((haloalkylcarbonyl)amino)alkyl, ((alkoxycarbonyl)amino)alkyl, ((benzyloxycarbonyl)amino)alkyl, alkylcarbonyl, arylcarbonyl, alkoxy carbonyl, aryloxycarbonyl, benzyloxycarbonyl, aminocarbonyl, alkylaminocarbonyl, and dialkylaminocarbonyl; and wherein said aryl, heteroaryl, alkyl and cycloalkyl can be substituted with 0-3 substituents selected from the group of alkyl, 1,3-dioxol-2-one, Ar, COOH, OH, NO₂, amino, amido, alkoxy, and alkyloxycarbonylamino;

R⁴ is selected from the group of hydrogen, CN, alkyl, aryl, heteroaryl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, (amino)alkyl, (alkylamino)alkyl, and (dialkylamino)alkyl; and wherein said aryl, heteroaryl, alkyl and cycloalkyl can be substituted with 0-3 substituents selected from the group of alkyl, 1,3-dioxol-2-one, Ar, COOH, OH, amino, amido, alkoxy, and alkyloxycarbonylamino;

R⁵ is selected from the group of hydrogen, CN, alkyl, aryl, cycloalkyl, alkenyl, cycloalkenyl, alkynyl, (amino)alkyl, (alkylamino)alkyl, and (dialkylamino)alkyl; and wherein said aryl, alkyl and cycloalkyl can be substituted with 0-3 substituents selected from the group of alkyl, 1,3-dioxol-2-one, Ar, COOH, OH, amino, amido, alkoxy, and alkyloxycarbonylamino;

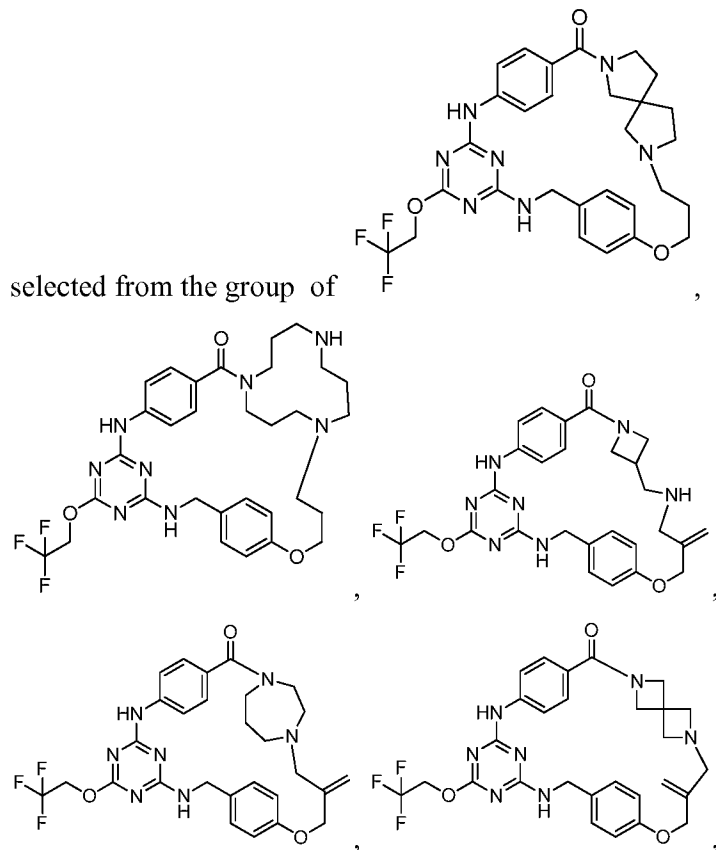
R^6 is pyrrolidinyl, piperidinyl, or piperazinyl and is substituted with 0-3 substituents selected from the group of alkyl, alkylcarbonyl, alkoxy carbonyl, and benzyloxycarbonyl;

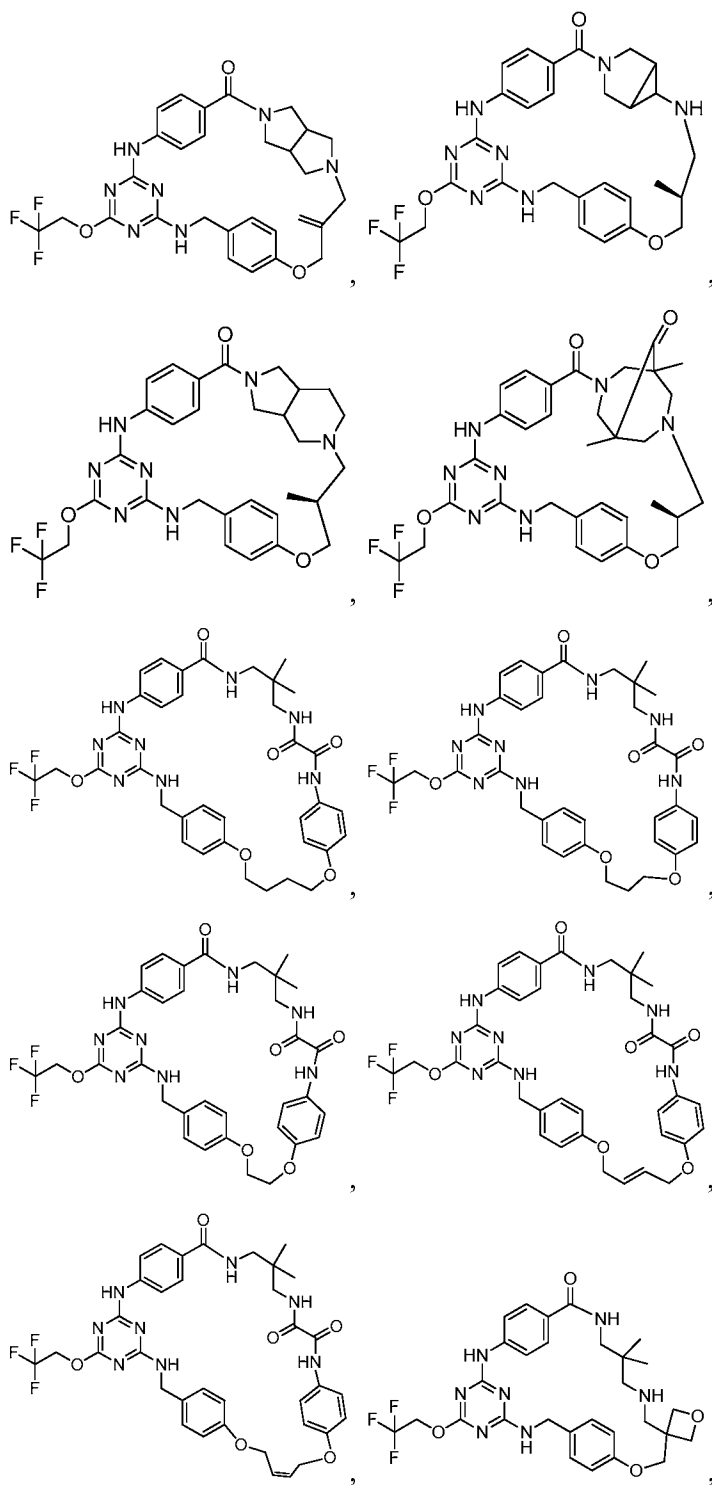
Ar is selected from the group of phenyl, five-membered heterocyclic, six-membered heterocyclic, naphthalyl, and bicyclic heterocyclic;

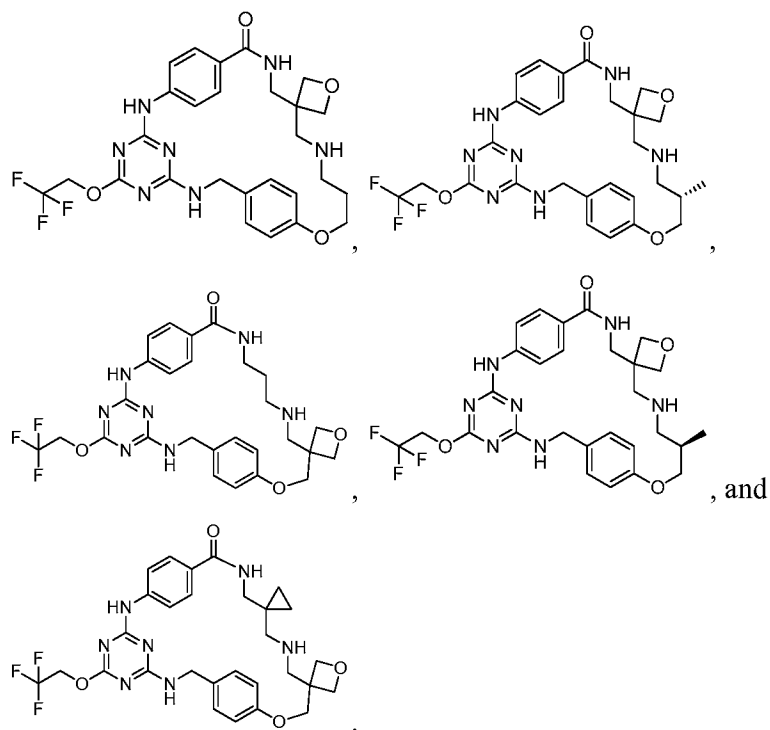
X is selected from the group of O, CH_2 , CO, CO_2 , and $C(O)NR^5$; and

Z is selected from the group of C_{3-7} cycloalkylene, oxetane, azetidine, phenylene, pyrrolidindiyl, piperidindiyl, piperazindiyl, homopiperazindiyl, fused bicyclic diamine, spiro bicyclic diamine, bridged bicyclic diamine, lactam, and 1,5,9-triazacyclododecane.

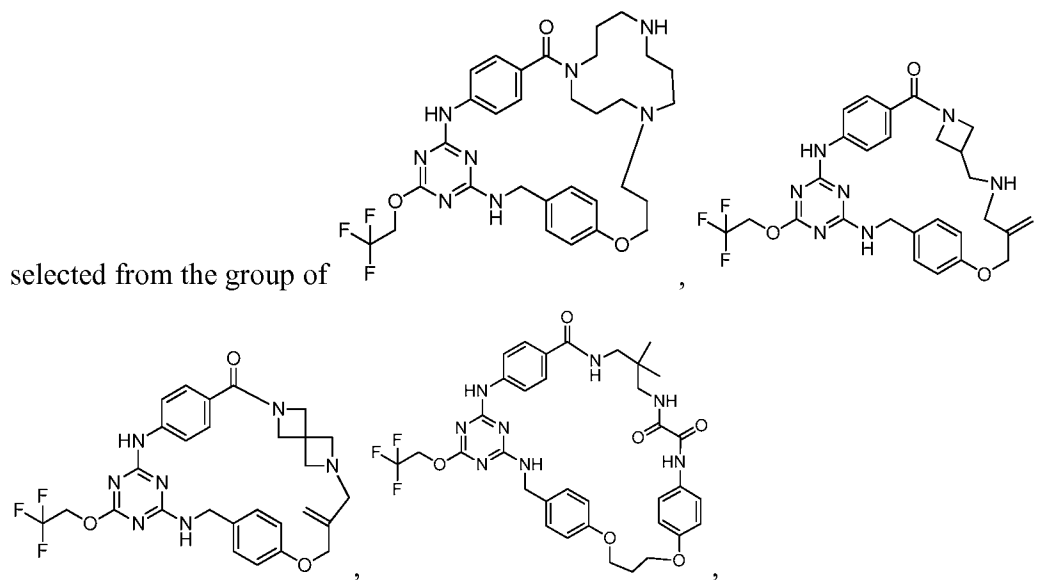
2. A compound, including pharmaceutically acceptable salts thereof, which is

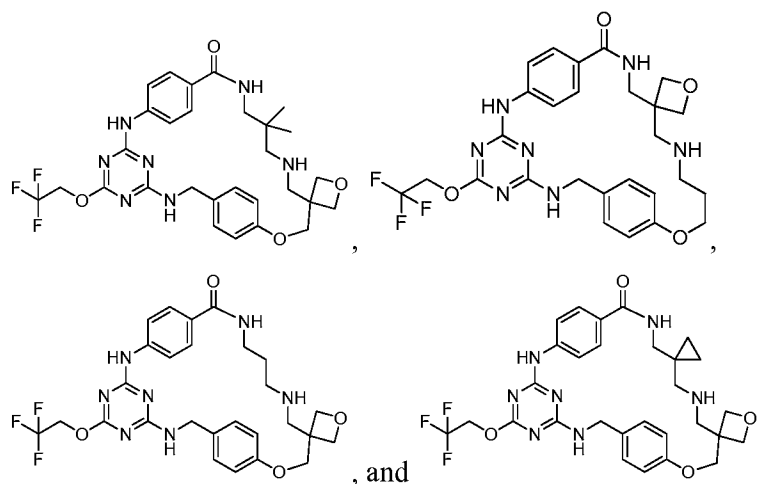






3. A compound, including pharmaceutically acceptable salts thereof, which is





4. A composition comprising a compound of claim 1, and a pharmaceutically acceptable carrier.
5. A composition comprising a compound of claim 2, and a pharmaceutically acceptable carrier.
6. A composition comprising a compound of claim 3, and a pharmaceutically acceptable carrier.
7. The composition of claim 4 further comprising at least one additional compound having therapeutic benefits for HCV wherein the compound is selected from the group of interferons, cyclosporins, interleukins, HCV metalloprotease inhibitors, HCV serine protease inhibitors, HCV polymerase inhibitors, HCV helicase inhibitors, HCV NS4B protein inhibitors, HCV entry inhibitors, HCV assembly inhibitors, HCV egress inhibitors, HCV NS5A protein inhibitors, HCV NS5B protein inhibitors, and HCV replicon inhibitors.
8. A method of treating hepatitis C infection comprising administering a therapeutically effective amount of a compound of claim 1 to a patient.
9. The method of claim 8 further comprising administering at least one additional compound having therapeutic benefits for HCV wherein the compound is

selected from the group of interferons, cyclosporins, interleukins, HCV metalloprotease inhibitors, HCV serine protease inhibitors, HCV polymerase inhibitors, HCV helicase inhibitors, HCV NS4B protein inhibitors, HCV entry inhibitors, HCV assembly inhibitors, HCV egress inhibitors, HCV NS5A protein inhibitors, HCV NS5B protein inhibitors, and HCV replicon inhibitors.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/014654

A. CLASSIFICATION OF SUBJECT MATTER

INV. C07D498/08 C07D498/18 C07D498/22 A61K31/53 A61P31/12
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)

C07D A61K A61P

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.
Y	WO 2011/047119 A1 (SQUIBB BRISTOL MYERS CO [US]; WANG TAO [US]; PENDRI ANNAPURNA [US]; ZH) 21 April 2011 (2011-04-21) page 71; example 39 claims	1-9
Y	WO 2012/141704 A1 (SQUIBB BRISTOL MYERS CO [US]; WANG TAO [US]; PENDRI ANNAPURNA [US]; ZH) 18 October 2012 (2012-10-18) examples claims	1-9

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/014654

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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WO 2012141704 A1	18-10-2012	EP 2697230 A1 WO 2012141704 A1	19-02-2014 18-10-2012