

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
16 September 2004 (16.09.2004)

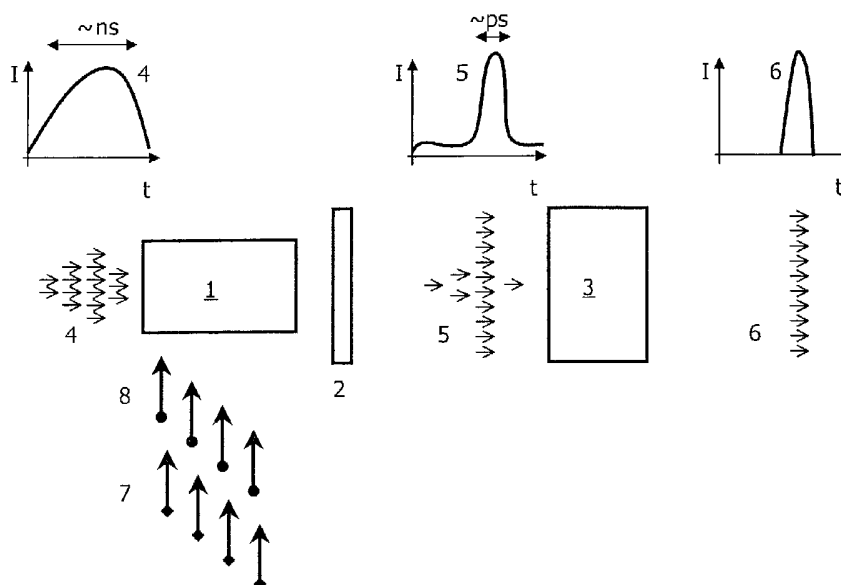
PCT

(10) International Publication Number
WO 2004/079444 A3

- (51) International Patent Classification⁷: **G02F 1/35**, H01S 3/00, G01N 21/47, A61B 5/00
- (21) International Application Number: PCT/IB2004/000555
- (22) International Filing Date: 3 March 2004 (03.03.2004)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
03100569.7 7 March 2003 (07.03.2003) EP
- (71) Applicant (for DE only): **PHILIPS INTELLECTUAL PROPERTY & STANDARDS GMBH** [DE/DE]; Stein-
damm 94, D-20099 Hamburg (DE).
- (71) Applicant (for all designated States except DE, US):
KONINKLIJKE PHILIPS ELECTRONICS N.V.
[NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).
- (72) Inventors; and
(75) Inventors/Applicants (for US only): **NIELSEN, Tim** [DE/DE]; c/o Philips Intellectual Property & Standards Gmbh, Weisshausstr. 2, D-52066 Aachen (DE).
KRÜGER, Sascha [DE/DE]; c/o Philips Intellectual Property & Standards Gmbh, Weisshausstr. 2, D-52066 Aachen (DE).
- (74) Agent: **MEYER, Michael**; Philips Intellectual Property & Standards Gmbh, Weisshausstr. 2, D-52066 Aachen (DE).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

[Continued on next page]

(54) Title: METHOD AND DEVICE FOR TIME-GATED AMPLIFICATION OF PHOTONS



(57) Abstract: The invention relates to a method for the selective amplification of signal photons of a signal pulse (4) in a desired time window. For this purpose, the signal photons (4) are passed through an activated amplification medium (1), where amplification takes place by induced emissions. The amplification is terminated at a desired point in time by the irradiation of a quench pulse (8). Optionally, the start of amplification can be determined by an irradiated pump pulse (8). Emissions that are not correlated with the signal pulse (4) can be suppressed by means of a spectral filter (2). Furthermore, an intensity filter such as a saturable absorber (3) can suppress unamplified fractions of the emission (5) leaving the amplification medium (1). Applications of the method include medical optical imaging and tomography by transillumination with time-gated detection of ballistic photons.

WO 2004/079444 A3



GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:

11 November 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2004/000555

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 G02F1/35 H01S3/00 G01N21/47 A61B5/00

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)

IPC 7 G02F H01S G01N A61B

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 practical, search terms used)

EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX, BIOSIS, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MINOSHIMA K ET AL: "THREE-DIMENSIONAL IMAGING USING A FEMTOSECOND AMPLIFYING OPTICAL KERR GATE" OPTICAL ENGINEERING, SOC. OF PHOTO-OPTICAL INSTRUMENTATION ENGINEERS. BELLINGHAM, US, vol. 38, no. 10, October 1999 (1999-10), pages 1758-1762, XP000859865 ISSN: 0091-3286 the whole document ----- -/--	1-11, 14-17

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

Z document member of the same patent family

Date of the actual completion of the international search

9 July 2004

Date of mailing of the international search report

21 09. 2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Frank, W

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2004/000555

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	LANDEN O L ET AL: "ULTRAFAST GAIN QUENCHING IN LASER AMPLIFIERS" OPTICS LETTERS, OPTICAL SOCIETY OF AMERICA, vol. 16, no. 8, 15 April 1991 (1991-04-15), pages 590-592, XP000202040 WASHINGTON, US ISSN: 0146-9592 the whole document	1-3,5-9
X	EP 0 926 783 A (PIRELLI CAVI E SISTEMI SPA) 30 June 1999 (1999-06-30) paragraphs '0035! - '0038!, '0040!, '0043!; figure 3	1,3,5-7,9
A	MARENGO S ET AL: "TIME-GATED TRANSILLUMINATION OF OBJECTS IN HIGHLY SCATTERING MEDIA USING A SUBPICOSECOND OPTICAL AMPLIFIER" IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS, IEEE SERVICE CENTER, US, vol. 5, no. 4, July 1999 (1999-07), pages 895-900, XP000893452 ISSN: 1077-260X sections I, II	1,4-7,9,10,14-17
A	HEBDEN J C ET AL: "OPTICAL IMAGING IN MEDICINE: I. EXPERIMENTAL TECHNIQUES" PHYSICS IN MEDICINE AND BIOLOGY, TAYLOR AND FRANCIS LTD. LONDON, GB, vol. 42, no. 5, 1 May 1997 (1997-05-01), pages 825-840, XP000690608 ISSN: 0031-9155 section 2.4	10,11,14-17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2004/000555

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-11, 14-17

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-11,14-17

A method and a device for time-gated amplification of photons, using an optical pulse for deactivating the amplification medium.

2. claims: 12-13

A catheter comprising a number of light guides each having at least one light scattering section.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IB2004/000555

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
EP 0926783	A	30-06-1999	EP	0926783 A1		30-06-1999
			AU	9811998 A		15-07-1999
			BR	9805807 A		13-03-2001
			CA	2256873 A1		23-06-1999
			JP	11266048 A		28-09-1999
			NZ	333525 A		28-05-1999
			US	6483629 B1		19-11-2002
