

# CURRICULUM VITAE

**Nikolay Sergeevich Makarov**

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**Date and Place of Birth:** 01 January 1980, Saint-Petersburg, Russia

**Citizenship:** Russian

## **Education:**

- |                  |  |        |             |
|------------------|--|--------|-------------|
| • Ph.D. Physics  | Montana State University   | (2010) | GPA: 3.93/4 |
| • MS Physics     | Montana State University   | (2006) | GPA: 3.89/4 |
| • MS Mathematics | Saint-Petersburg State University of<br>Information Technologies, Mechanics and<br>Optics (SPbSU ITMO) | (2003) | GPA: 5/5    |

## **Honors and Awards:**

- 2000
  - Soros student
- 2001
  - Soros student
  - CRDF travel grant
  - Russian Federation's President grant
  - Diploma of Ministry of Education of Russian Federation for the best scientific student work in natural, technical and humanitarian sciences
- 2002
  - Soros student
  - Russian Foundation for Basic Research travel grants
  - Grant of Saint-Petersburg administration for students, graduate students and young specialists
  - Medal of Russian Academy of Sciences for the best student work in general physics and astronomy
- 2003
  - Soros student
  - SPIE Scholarship grant
  - Diploma for the best university graduating student
  - Dynasty foundation grant
  - Medal of Ministry of Education of Russian Federation for the best scientific student work in natural, technical, and humanitarian sciences
- 2004
  - Grant of Saint-Petersburg administration for students, graduate students, and young specialists
- 2006
  - SPIE Scholarship grant
- 2007
  - BACUS Photomask Scholarship
- 2008
  - D.J. Lovell SPIE Scholarship
- 2009
  - Photonic Devices + Applications Best Student Paper Award (Runner Up)
  - OSA Incubic/Milton Chang Travel Grant

## **Membership in Professional Societies and Leadership Experience:**

- Rozhdestvensky Optical Society 2001-2004
- OSA 2001, 2004
- IEEE 2003
- Member of organizing committee of conferences:
  - "Optics-2002",
  - "Basic problems of Optics-2002",

- “Optics-2003”,
- "Basic problems of Optics-2004".
- SPIE 2001, 2003-2011
  - Vice-President of the SPIE Student Chapter of SPbSU ITMO 2004
  - President of SPIE Student Chapter of Montana State University 2006-2007
  - Vice-President of the SPIE Student Chapter of Montana State University 2007-2008
  - IT/Web master of the SPIE Student Chapter of Montana State University 2008-2010
- APS 2010-2011

**Ph.D. Thesis: “Ultrafast two-photon absorption in organic molecules: quantitative spectroscopy and applications”, Advised by Prof. Aleksander K. Rebane**

The thesis is devoted to fundamental understanding and experimental measurements of two-photon absorption (2PA) in organic molecules as well as to the applications of 2PA in 3D optical memory, optical power limiting, photodynamic therapy and fluorescent microscopy.

- 2PA spectra (in absolute numbers) of a number of commercially available fluorescing dyes were carefully measured to establish a reliable set of 2PA standards for further use in our and other laboratories.
- For a broad class of dipolar molecules it was shown that the quantum-mechanical expression for 2PA cross section agrees with the experimental measurements within the experimental errors.
- Nonlinear spectroscopy is used to establish validity of a few-level model for the *gerade-gerade* transitions in tetrapyrroles. Quasi-symmetric distribution of  $\pi$ -electron conjugation pathway is shown for the tribenzotetraazachlorines.
- Several limitations of the development and implementation of 3D optical memory were considered using computer simulations. The allowed range of photophysical and photochemical parameters was found and it was shown experimentally that the 2PA properties of few organic molecules fall within this range.
- A novel method (two-photon analogue of standard multispectral imaging) was suggested for non-targeted cancer imaging and diagnostics, based on the difference in the ratios of two-photon excited fluorescence signals, obtained with two different excitation wavelengths.

**Research and Work Experience:**

***Postdoctoral Fellow, School of Chemistry and Biochemistry, Georgia Institute of Technology, 2010 - Present***

- Development of two-photon absorption measurement system, 2010-Present.
  - Design of the hardware and software for high accuracy low noise reliable double channel relative fluorescence-based measurements of two-photon absorption

***Graduate Research Assistant, Physics Department, Montana State University, 2004 - 2010***

- Study of two-photon 3D optical memory, 2004-2006.
  - Computer simulations of the Signal-to-Noise and Signal-to-Background ratios in 3D optical memory devices
  - Experimental demonstration of efficient materials satisfying the requirements for high speed high density memory

Makarov N.S., Rebane A., Drobizhev M., Wolleb H., Spahni H., “Optimizing two-photon absorption for volumetric optical data storage”, *J. Opt. Soc. Am. B*, **24**, (2007), 1874-1885.

- Characterization of molecules for efficient optical power limiting, 2004-2010.
  - Experimental demonstration of the validity of perturbation theory for description of two-photon cross sections

Rebane A., Makarov N.S., Drobizhev M., Spangler B., Tarter E.S., Reeves B.D., Spangler C.W., Meng F., Suo Z., “Quantitative prediction of two-photon absorption cross section based on linear spectroscopic properties”, *J. Phys. Chem. C*, **112**, (2008), 7997-8004.

- Development of a set of reference standards for precise two-photon absorption spectral measurements. This includes accurate characterization of absolute intrinsic 2PA cross sections of 15 commercial dyes in a wide spectral range which can now be widely used for characterization of any new chromophore

Makarov N.S., Drobizhev M., Rebane A., “Two-photon absorption standards in the 550-1600 nm excitation wavelength range”, *Opt. Expr.*, **16**, (2008), 4029-4047.

- Characterization of new fluorescent proteins (FP) for two-photon microscopy, 2007-2010.
    - Development of new all-optical approach for characterization of linear absorption properties of FPs
- Drobizhev M., Tillo S., Makarov N.S., Hughes T.E., Rebane A., “Absolute Two-Photon Absorption Spectra and Two-Photon

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Brightness of Orange and Red Fluorescent Proteins”, *J. Phys. Chem. B*, **113**, (2009), 855-859.

- Measurements of two-photon absorption spectra and cross sections of various FP mutants  
Drobizhev M.A., Makarov N.S., Tillo S.E., Hughes T., Rebane A., “Two-photon absorption properties of fluorescent proteins”, *Nature Methods*, vol. 8, 2011, 393-399.
- Development of a high precision near-infrared femtosecond pump-probe setup, 2008-2010.
  - Design and realization of the computer-controlled experimental setup and controlling software
  - Experimental demonstration of the validity of a few-essential-level model for description of two-photon cross sections
- Development and application of a near-infrared imaging system for sensitive cancer detection, 2008-2010.
  - Design of an imaging system which uses near-IR two-photon excited fluorescence
  - Demonstration of non-targeted cancer imaging and diagnostics
  - Analysis of biochemical mechanisms of dye sensitivity to cancer cells
 Makarov N.S., Beuerman E., Drobizhev M., Starkey J., Rebane A., “Environment-sensitive two-photon dye”, *Proc. SPIE*, vol. 7049, 2008, p. 70490Y.

**Junior Researcher, Saint-Petersburg State University of Information Technologies, Mechanics and Optics, 1999-2004**

- Study of a quasi-phase matched stimulated Raman scattering, 1999-2004.
  - Development of several consequent versions of software for computer simulations of quasi-phase matching conditions for stimulated Raman scattering in various layered nonlinear media
 Makarov N.S., Bespalov V.G., “Effective method of anti-Stokes generation by quasi-phase-matched stimulated Raman scattering”, *J. Opt. Soc. Am. B*, **22**, (2005), 835-843.

### **Technical Background:**

**Software:** Mathematica, Visual Studio, LabView, Microsoft Office, Adobe Photoshop

### **Skills:**

- Programming (C, C++, Pascal, Mathematica, LabView)
- Operating and maintaining femtosecond laser systems (Ti:Sa oscillator, amplifier, OPA)
- Optical design of (microscopic) imaging system
- Nonlinear optical methods (2PA with registration of fluorescence, femtosecond pump-probe)
- Fluorescence lifetime measurements with ps-ns resolution using Streak-camera
- Linear spectroscopy methods

### **Hobby:**

Landscape and wildlife photography

### **References:**

Rebane Aleksander, Professor,  
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Publications:**- Papers in journals:**

- 1) Makarov N.S., Bespalov V.G., "SRS generation of anti-Stokes radiation under phase quasi-matching conditions", *Opt. & Spectr.*, vol. 90, № 6, 2001, pp. 938-941.
- 2) Makarov N.S., Bespalov V.G., "Combined Stokes-anti-Stokes Raman amplification in fiber", *izv. RAS, ser. fiz.* vol. 66, № 3, 2002, pp. 350-352.
- 3) Makarov N.S., Bespalov V.G., "Quasi-phase matching generation of blue coherent radiation at stimulated Raman scattering", *Optics Communications* 203 (3-6)(2002) pp. 413-420.
- 4) Makarov N.S., Bespalov V.G., "Multiwave Stimulated Raman Scattering under Quasi-Phase-Matching Conditions", *Opt. & Spectr.*, vol. 95, № 3, 2003, pp. 474-479.
- 5) Makarov N.S., Bespalov V.G., "Multiwave quasi-phase-matched anti-Stokes stimulated Raman scattering", *J. Opt. A: Pure Appl. Opt.*, 5, 2003, S250-S255.
- 6) Makarov N.S., Bespalov V.G., "Effective method of anti-Stokes generation by quasi-phase-matched stimulated Raman scattering", *J. Opt. Soc. Am. B*, vol. 22, № 4, 2005, pp. 835-843.
- 7) Drobizhev M., Makarov N.S., Stepanenko Y., Rebane A., "Near-infrared two photon absorption in phthalocyanines: Enhancement of lowest gerade-gerade transition by symmetrical electron-accepting substitution", *J. Chem. Phys.*, vol. 124, 2006, 224701.
- 8) Makarov N.S., Rebane A., Drobizhev M., Wolleb H., Spahni H., "Optimizing two-photon absorption for volumetric optical data storage", *J. Opt. Soc. Am. B*, vol. 24, № 8, 2007, pp. 1874-1885.
- 9) Rogers J.E., Slagle J.E., Krein D.M., Burke A.R., Hall B.C., Fratini A., McLean D.G., Fleitz P.A., Cooper T.M., Drobizhev M., Makarov N.S., Rebane A., Kim K.-Y., Farley R., Schanze K.S., "Platinum acetylide two-photon chromophores", *Inorganic Chem.*, vol. 46, 2007, pp. 6483-6494.
- 10) Drobizhev M., Makarov N.S., Rebane A., Wolleb H., Spahni H., "Very efficient two-photon induced photo-tautomerization in non-symmetrical phthalocyanines", *J. Luminescence*, vol. 128, 2008, 217-222.
- 11) Drobizhev M., Makarov N.S., Rebane A., de la Torre G., Torres T., "Strong two-photon absorption in push-pull phthalocyanines: role of resonance enhancement and permanent dipole moment change upon excitation", *J. Phys. Chem. C*, vol. 112, 2008, 848-859.
- 12) Drobizhev M., Makarov N.S., Hughes T., Rebane A., "Resonance Enhancement of Two-Photon Absorption in Fluorescent Proteins", *J. Phys. Chem. B*, vol. 111, 2007, 14051-14054.
- 13) Makarov N.S., Drobizhev M., Rebane A., "Two-photon absorption standards in the 550-1600 nm excitation wavelength range", *Opt. Expr.*, vol. 16, 2008, 4029-4047.
- 14) Rebane A., Makarov N.S., Drobizhev M., Spangler B., Tarter E.S., Reeves B.D., Spangler C.W., Meng F., Suo Z., "Quantitative prediction of two-photon absorption cross section based on linear spectroscopic properties", *J. Phys. Chem. C*, vol. 112, 2008, 7997-8004.
- 15) Rebane A., Drobizhev M., Makarov N.S., Koszarna B., Tasior M., Gryko D.T., "Two-photon absorption properties of meso-substituted A3-corroles", *Chem. Phys. Lett.*, vol. 462, 2008, 246-250.
- 16) Drobizhev M., Tillo S., Makarov N.S., Hughes T.E., Rebane A., "Absolute Two-Photon Absorption Spectra and Two-Photon Brightness of Orange and Red Fluorescent Proteins", *J. Phys. Chem. B*, vol. 113, 2009, 855-859.
- 17) Drobizhev M., Tillo S., Makarov N.S., Hughes T.E., Rebane A., "Color hues in red fluorescent proteins are due to internal quadratic Stark effect", *J. Phys. Chem. B*, vol. 113, 2009, 12860-12864.
- 18) Kuimova M.K., Collins H.A., Balaz M., Dahlstedt E., Levitt J.A., Sargent N., Suhling K., Drobizhev M., Makarov N.S., Rebane A., Anderson H.L., Phillips D., "Photophysical properties and intracellular imaging of water-soluble porphyrin dimers for two-photon excited photodynamic therapy", *Org. Biomol. Chem.*, vol. 7, 2009, 889-896.
- 19) Tillo S.E., Hughes T.E., Makarov N.S., Rebane A., Drobizhev M., "A new approach to dual-color two-photon microscopy with fluorescent proteins", *BMC Biotech.*, vol. 10:6, 2010, <http://www.biomedcentral.com/1472-6750/10/6>.
- 20) Rebane A., Drobizhev M.A., Makarov N.S., Beuerman E., Nacke C., Pahapill J., "Modeling non-Lorentzian two-photon absorption line shape in dipolar chromophores", *J. Luminescence*, vol. 130, 2010, 1055-1059.
- 21) Rebane A., Drobizhev M.A., Makarov N.S., Beuerman E., Tillo S., Hughes T., "New all-optical method for measuring molecular permanent dipole moment difference using two-photon absorption spectroscopy", *J.*

- Luminescence, vol. 130, 2010, 1619-1623.
- 22) Kim K.-Y., Shelton A.H., Drobizhev M., Makarov N., Rebane A., Schanze K.S., "Optimizing simultaneous two-photon absorption and transient triplet-triplet absorption in platinum acetylide chromophores", *J. Phys. Chem. A*, vol. 114, 2010, 7003-7013.
  - 23) Ji Z., Li Y., Pritchett T.M., Makarov N.S., Haley J.E., Li Z., Drobizhev M., Rebane A., Sun W., "One-photon photophysics and two-photon absorption of 4-[9,9-Di-(2-ethylhexyl)-7-diphenylaminofluoren-2-yl]-2,2':6',2''-terpyridine and their platinum chloride complexes", *Chem. Eur. J.*, vol. 17, 2011, 2479-2491.
  - 24) Butko M.T., Drobizhev M., Makarov N.S., Rebane A., Brinkman B.C., Gleeson J.G., "Simultaneous multiple-excitation multiphoton microscopy yields increased imaging sensitivity and specificity", *BMC Biotechnol.*, vol. 11, 2011, 20.
  - 25) Drobizhev M.A., Makarov N.S., Tillo S.E., Hughes T., Rebane A., "Two-photon absorption properties of fluorescent proteins", *Nature Methods*, vol. 8, 2011, 393-399.

**- SPIE proceedings:**

- 1) Makarov N.S., Bepalov V.G., "Quasi-phase matching anti-Stokes SRS generation", *Proc. SPIE*, vol. 4268, 2001, pp. 109-116.
- 2) Makarov N.S., Bepalov V.G., "Transient quasi-phase matching SRS generation", *Proc. SPIE*, vol. 4751, 2001, pp. 126-130.
- 3) Makarov N.S., Bepalov V.G., "Combined Stokes-anti-Stokes Raman amplification in fiber", *Proc. SPIE*, vol. 4605, 2001, pp. 280-285.
- 4) Makarov N.S., Bepalov V.G., "Simultaneously Stokes and anti-Stokes Raman amplification in silica fiber", *Proc. SPIE*, vol. 4638, 2002, pp 30-40.
- 5) Makarov N.S., Bepalov V.G., "Multiwave stimulated Raman scattering with quasi-phase matching", *Proc. SPIE*, vol. 5036, 2002, pp. 565-569.
- 6) Makarov N.S., Bepalov V.G., "Multiwave quasi-phase matched stimulated Raman scattering", *Proc. SPIE*, vol. 4829, 2002, pp. 375-376.
- 7) Makarov N.S., Bepalov V.G., "Backward and forward quasi-phase matched multiwave SRS in nonlinear periodical structures", *Proc. SPIE*, vol. 5506, 2003, p. 87-94.
- 8) Makarov N.S., Bepalov V.G., "The efficient generation of anti-Stokes radiation at multiwave forward and backward stimulated Raman scattering", *Proc. SPIE*, vol. 5402, 2003, pp. 284-290.
- 9) Makarov N.S., Bepalov V.G., "Anti-Stokes stimulated Raman scattering in photonic crystals", *Proc. SPIE*, vol. 5710, 2005, pp. 149-158.
- 10) Makarov N.S., Rebane A., Drobizhev M., Peone D., Wolleb H., Spahni H., "Experimental characterization of two-photon materials for fast rewritable optical data storage", *Proc. SPIE*, vol. 6330, 2006, p. 63300K.
- 11) Drobizhev M., Makarov N.S., Rebane A., Wolleb H., Spahni H., "Phthalocyanine molecules with extremely strong two-photon absorption for 3D rewritable optical information storage", *Proc. SPIE*, vol. 6308, 2006, p. 630803.
- 12) Makarov N.S., Rebane A., Drobizhev M., Wolleb H., Spahni H., "Resonance enhancement of two-photon cross section for optical storage in the presence of hot band absorption", *Proc. SPIE*, vol. 6470, 2007, p. 64700R.
- 13) Rebane A., Makarov N.S., Drobizhev M., Spangler C.W., Gong A., Meng. F., "Broad bandwidth near-IR two-photon absorption in conjugated porphyrins core dendrimers", *Proc. SPIE*, vol. 6653, 2007, p. 665307.
- 14) Makarov N.S., Drobizhev M., Rebane A., "Two-photon absorption standards in the 550-1600 nm excitation range: establishing a correction curve for accurate cross section calibration", *Proc. SPIE*, vol. 6891, 2008, p. 689105.
- 15) Rebane A., Drobizhev M., Makarov N.S., "Narrowing of the homogeneous two-photon absorption line width in two-level dipolar system", *Proc. SPIE*, vol. 6903, 2008, p. 69035.
- 16) Makarov N.S., Beuerman E., Drobizhev M., Starkey J., Rebane A., "Environment-sensitive two-photon dye", *Proc. SPIE*, vol. 7049, 2008, p. 70490Y.
- 17) Rebane A., Makarov N.S., Drobizhev M., "Quantitative description of two-photon - absorption with few essential states models", *Proc. SPIE*, vol. 7049, 2008, p. 704904.
- 18) Makarov N.S., Starkey J., Drobizhev M., Rebane A., "Hyperspectral two-photon near-infrared cancer imaging *in*

- vitro* and *in vivo*", Proc. SPIE, vol. 7413, 2009, p. 74130Q.
- 19) Makarov N.S., Starkey J., Drobizhev M., Rebane A., "Hyperspectral two-photon near-infrared cancer imaging at depth", Proc. SPIE, vol. 7380, 2009, p. 738048.
  - 20) Drobizhev M.A., Tillo S., Makarov N., Hughes T.E., Rebane A.K., "Searching for the two-photon brightest red fluorescent protein and its optimum excitation wavelength", Proc. SPIE, vol. 7191, 2009, p. 719104.
  - 21) Rebane A.K., Drobizhev M.A., Makarov N., Koszarna B., Tasior M., Gryko D.T., "Two-photon absorption spectroscopy of corroles", Proc. SPIE, vol. 7213, 2009, p. 72130Q.
  - 22) Rebane A., Drobizhev M.A., Makarov N.S., Beuerman E., Nacke C., Pahapill J., "Numerical modeling of non-Lorentzian two-photon absorption line shape in dipolar chromophore", Proc. SPIE, vol. 7599, 2010, p. 759919.
  - 23) Rebane A.K., Drobizhev M.A., Makarov N.S., Beuerman E., Zhao Y., Spangler C.W., "Maximizing two-photon absorption cross section within few essential state models", Proc. SPIE, vol. 7599, 2010, p. 75990W.
  - 24) Beuerman E., Makarov N.S., Drobizhev M.A., Rebane A.K., "Justification of two-level approximation for description of two-photon absorption in Oxazine dyes", Proc. SPIE, vol. 7599, 2010, p. 75990X.

#### **- Papers in books:**

- 1) Makarov N.S. "Generation of anti-Stokes SRS radiation in conditions of quasi-phase matching", in book "Problems of coherent and nonlinear optics", SPb, 2000, pp. 180-190.
- 2) Makarov N.S. "Analytical solution of quasi-phase matching anti-Stokes SRS amplification in silica fiber", in book "Modern technologies", SPb, 2001, pp. 166-175.
- 3) Makarov N.S. "Quasi-phase matched multiwave transient stimulated Raman scattering", in book "Problems of coherent and nonlinear optics", SPb, 2002, pp. 204-210.
- 4) Makarov N.S. "The equations of forward and backward multiwave stimulated Raman scattering", in book "Modern technologies", SPb, 2003, pp. 168-176.
- 5) Makarov N.S. "Quasi-phase matched anti-Stokes SRS generation in photonic crystals", in book "Problems of coherent and nonlinear optics", SPb, 2004, pp. 237-242.

#### **Conferences:**

- 1) Bespalov V.G., Lobanov S.A., Makarov N.S., Pyajt A.L., "Systems of nonlinear differential equations for nonlinear optical phenomena describing", Preprints of International Conference "Nonlinear sciences on the border of millenniums", June 22-24, 1999, p. 123. (in Russian)
- 2) Makarov N.S., "Quasi-phase matching SRS generation of anti-Stokes radiation", Proc. of International Conference "Optics-99", October 19-21, 1999, p. 82. (in Russian)
- 3) Kovelonov N.U., Makarov N.S., "Using of test programs in education", Preprints of Scientific - Methodical Conference of Mechanical-Machine-Engineering Department of St. Petersburg State Technical University "Perfection of bachelors, engineers and masters education", January 24, 2000. (in Russian)
- 4) Bespalov V.G., Lobanov S.A., Makarov N.S., "New methods of generation and amplification of light at Stimulated Raman Scattering: quasi-phase matching and photonic crystals", Preprints of Russian Scientific - Practical Conference "Optics and scientific instrument-making-2000", March 29-30, 2000, p. 47-48. (in Russian)
- 5) Bespalov V.G., Makarov N.S., "Quasi-phase matching SRS generation", Papers of First International Conference on Laser Optics for Young Scientists, June 26-30, 2000, p. 131.
- 6) Makarov N.S., "Transient quasi-phase matching anti-Stokes SRS generation in gases and crystal media", Preprints of Scientific Youth School "Optics-2000", October 16-20, 2000, pp. 101-102. (in Russian)
- 7) Bespalov V.G., Makarov N.S., "Quasi-phase matching anti-Stokes SRS generation", Photonics West 2001 (LASE 2001), 20-26 January 2001.
- 8) Bespalov V.G., Makarov N.S., "Combined Stokes-anti-Stokes Raman amplification in fiber", Photon Echo and Coherent Spectroscopy 2001 (PECS-2001), 19-24 June 2001.
- 9) Bespalov V.G., Makarov N.S., "Transient quasi-phase matching SRS generation", International Conference on Coherent and Nonlinear Optics 2001 (ICONO-2001), 26 June – 1 July 2001, p. 153.
- 10) Makarov N.S., "Stokes-anti-Stokes SRS amplification of informational signals in silica fiber", Proc. of International Conference "Optics-2001", October 16-19, 2001, p. 193. (in Russian)
- 11) Bespalov V.G., Makarov N.S., "Quasi-phase matching at Raman interaction of coherent waves", Scientific Youth

- School "Coherent Optics and Optical Spectroscopy", 25-27 October 2001, pp. 83-88. (in Russian)
- 12) Bepalov V.G., Makarov N.S., "Simultaneously Stokes and anti-Stokes Raman amplification in silica fiber", Photonics West 2002 (LASE 2002), 19-25 January 2002, p. 64.
  - 13) Makarov N.S., "Optical fiber amplifiers of information signals", 31-Science-Technical Conference of Teachers and Professors, 5-7 February 2002, p. 191-199.
  - 14) Makarov N.S., "Quasi-phase matched SRS", Young Scientist School "Nonlinear waves-2002", 2-9 March 2002.
  - 15) Makarov N.S., Bepalov V.G., "Multiwave stimulated Raman scattering with quasi-phase matching", Photonics Prague 2002, 26-29 May 2002, p. 43.
  - 16) Makarov N.S., Bepalov V.G., "Multiwave quasi-phase matching stimulated Raman scattering with dispersion of Raman gain", International Quantum Electronics Conference (IQEC-2002), 22-28 June 2002, p. 152.
  - 17) Makarov N.S., Bepalov V.G., "Multiwave quasi-phase matched stimulated Raman scattering", 19<sup>th</sup> Congress on the International Commission for Optics (ICO19), 25-30 August 2002.
  - 18) Makarov N.S., "Multiwave diffractive SRS in conditions of quasi-phase matching", Preprints of Scientific Youth School "Optics-2002", October 14-17, 2002, pp. 91-92. (in Russian)
  - 19) Makarov N.S., Bepalov V.G., "Multiwave SRS in conditions of quasi-phase matching: steady-state, transient and diffractive interactions", Scientific Youth School "Coherent Optics and Optical Spectroscopy", 31 October – 2 November, 2002, pp. 63-68. (in Russian)
  - 20) Makarov N.S., "Generation and amplification of anti-Stokes radiation at quasi-phase matching stimulated Raman scattering", Final seminar on grants of Saint-Petersburg's administration, 3 April 2003.
  - 21) Makarov N.S., Bepalov V.G., "The influence of backward Stokes on quasi-phase matched multiwave SRS in nonlinear periodical structures", CLEO Europe EQEC-2003, 22-27 June 2003.
  - 22) Makarov N.S., Bepalov V.G., "Backward and forward quasi-phase matched multiwave SRS in nonlinear periodical structures", International Symposium "Intensive Laser Actions and its Applications", 30 June – 2 July 2003, pp. 44-45.
  - 23) Makarov N.S., Bepalov V.G., "Backward and forward multiwave stimulated Raman scattering", Laser Optics-2003, 30 June – 4 July 2003.
  - 24) Makarov N.S., Bepalov V.G., "The efficient generation of anti-Stokes radiation at multiwave forward and backward stimulated Raman scattering", International Readings on Quantum Optics-2003, 12-17 October 2003.
  - 25) Makarov N.S., Bepalov V.G., "Analysis of the generation processes of anti-Stokes radiation at forward and backward SRS", Proc. of International Conference "Optics-2003", 20-23 October 2003, pp. 70-71. (in Russian)
  - 26) Lobanov S.A., Makarov N.S., Vasilev V.N., Kozlov S.A., Andreeva O.V., Bepalov V.G., Denisyuk Yu.N., "Research and educational internet site "Optoinformatics"", Proc. of International Conference "Optics-2003", 20-23 October 2003, pp. 298-299. (in Russian)
  - 27) Makarov N.S., Bepalov V.G., "Forward and backward multiwave SRS in compressed hydrogen: theory and experiment", Scientific Youth School "Coherent Optics and Optical Spectroscopy", 30 October – 1 November, 2003, pp. 257-262. (in Russian)
  - 28) Makarov N.S., "Simultaneously SRS-amplification of informational signals in E and C channels of fiber-optical lines", Young Scientists Internet-Conference "Promise and Development", 1 September 2003 - 15 February, 2004. (in Russian)
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