

## CURRICULUM VITAE

### *SERGEY B. MIROV*

**INSTITUTION**           The University of Alabama at Birmingham, Department of Physics

**TITLE**                   **Professor, Physics**  
**Associate Director, Laser & Photonics Research Center**

**ADDRESS**               UAB, Department of Physics, 1300 University Blvd.,  
Birmingham, AL 35294 -1170, (205) 934-8088; Fax (205) 934-8042;  
[mirov@uab.edu](mailto:mirov@uab.edu); <http://www.phy.uab.edu/~mirov/>

### **EDUCATION**

1983                   Ph. D. degree in Physics and Mathematics at P.N.Lebedev Physical Institute USSR Academy of Sciences for the work "Room temperature stable color center lasers tunable in the near IR region." (Adviser Prof. T.T.Basiev)

1972-1978            Master degree (with honors) in Electronic Engineering, Moscow Power Engineering Institute - Technical University; Direction - Semiconductors and Insulators; Specialization: Materials for Quantum Electronics. Thesis: "Laser Spectroscopy of Nd-ions in disordered crystals".

### **PROFESSIONAL RECORD**

1999 - pr. time      Professor of Physics, UAB  
1997 - pr. time      Associate Director, Laser & Photonics Research Center, UAB  
1994 - 1999          Associate Professor of Physics; Secondary appointment - Associate Professor of Biomedical Engineering  
1993 - 1994          Visiting Associate, The University of Alabama at Birmingham, Biomedical Engineering & Physics Departments  
1988 - 1992          Principal Research Scientist and Group Leader at Solid State Physics Department, General Physics Institute Russian Academy of Sciences, Moscow. 2 Master and 4 Ph.D. Degree Recipients Supervised  
1983-1988           Senior Staff Research Physicist and Group Leader at the Department of Solid State Physics, Laboratory of Laser Spectroscopy of Solids  
1978-1983           Staff Research Physicist, P.N. Lebedev Physical Institute of the USSR Academy of Sciences  
1990 (2 mon.)        Visiting Professor, University of San Paulo, Brazil

**PROFESSIONAL ORGANIZATIONS**   Optical Society of America, International Society for Optical Engineering, American Physical Society

### **AWARDS AND HONORS**

**Soviet Union Young Scientist's First Prize Winner (Lenin Komsomol Laureate 1982)**  
General Physics Institute Prize Winner for Scientific Research (1985, 1989)

P.N.Lebedev Physical Institute Research Award (1980)  
Ministry of People's Education Medal for Academic Achievements (1977)  
Who is Who in Science and Engineering, Marquis Who's Who, 4<sup>th</sup> edition (1997)  
International Who's Who of Professionals for the year 2000.

**RESEARCH INTERESTS:**

Long-term research is directed toward the development and investigation of novel vibronic active media for tunable lasers, passive Q-switches, and mode lockers. Recent work includes room temperature stable color center crystals and tunable color center lasers development and application. Research in the physics of color centers formation under ionizing irradiation, color center's photo chemistry, laser spectroscopy of solids led to the development of the first room temperature operable commercial color center lasers, passive Q-switches and nonlinear filters for various types of neodymium lasers from mini lasers to powerful laser glass systems. Other research interests include multiline lasers for DWDM applications, the development of laser based techniques for environmental monitoring and medical diagnostics on the micro- and macroscopic levels, as well as Raman characterization of protein crystals, and developing of time-resolved laser induced fluorescence and Raman spectroscopy of normal and malignant tissues.

**PUBLICATIONS:** 231 research publications in physics: 1 book, 78 peer-reviewed publications in refereed articles, 58 papers published in conference proceedings, book chapters and preprints, 94 not peer-reviewed publications - extended conference abstracts.

**PATENTS:** 12 patents, including 4 U.S.

**RESEARCH FUNDING AT UAB (1994-2003): \$2,692,972** (Amount funded only lists the funds available to Sergey Mirov's research program. This does not include the total project costs, UAB and commercial matching. The amount funded includes indirect costs.)

**EDUCATIONAL CONTRIBUTIONS: (scored 3.67 out of 4 in students evaluations)**

Developed and currently teach a three part Undergraduate/Graduate Laser Physics/Laser Spectroscopy curricula. Laser Physics I & II courses include basic physics and engineering of lasers of all kinds as well as various issues of relevance to lasers and electrooptics including application of nonlinear optics harmonic generation and parametric processes. The Laser Spectroscopy course embraces basic concepts and instrumentation of laser spectroscopy as well as applications of laser spectroscopy in physics, chemistry, biology and medicine.

Developed and taught Advanced Solid State Physics Graduate course illustrating properties of defects in crystals, defects classification, specific defect's models, their thermodynamics, mechanism's of defects formation, optical properties of defects in crystals, localized energy levels, configuration coordinate diagrams, and application of defects to practical devices.

Taught three quarter College Physics curricula numerous times. The first course covers kinematics, dynamics, energy, momentum, and rotational motion. The second course covers harmonic motion, waves, fluid dynamic, heat and thermodynamics, and optics. The third course covers electricity and magnetism, circuits, and modern physics.

Directed eleven undergraduate research projects at the UAB (ten in the frame of NSF program Research Experience for Undergraduates) and supervised two undergraduate students.

Currently supervise five graduate students and one post-doctoral Research Associate. Previously supervised at the UAB three post-doctoral Research Associates, four physics M.S. degree graduates, three Ph.D. degree graduates (1-physics, 1-material science, 1-biomedical engineering), and four Ph.D. degree graduates and 2 M.S. while at the General Physics Institute of Russian Academy of Sciences.

**Undegraduate Research Projects Directed at UAB:**

Student	Institution	Period	Project
Chris Wehrenberg	Denison University	Summer 02	Electrolytic Colouration of ZnSe and ZnS with Cr <sup>2+</sup>
Chris Plumlee	Arizona State University	Summer 02	Deep ultraviolet generation in an all-solid-state laser system based on a K <sub>2</sub> Al <sub>2</sub> B <sub>2</sub> O <sub>7</sub> crystal
April Holmes	Southern University	Summer 01	Spectroscopic studies of ZnS:Cr <sup>2+</sup> crystals
Ogundiran Soumonni	Talladega College	Summer 01	XRD characterization of ZnS:Cr <sup>2+</sup> crystals
Michael Ashenafi	Southern University	Summer 00	Spectroscopic Studies and spectral hole burning in LiF:F <sub>2</sub> <sup>-</sup> crystals
Jeremy Randolph	UAB	Summer 99	Laser Induced Breakdown Spectroscopy of Heavy Metals in Liquid Samples
Bern'Nadette Knight	Talladega College	Summer 99	Thermal Stability of F <sub>2</sub> <sup>-</sup> Centers in LiF Crystals
Claire Chisolm Anthony Capers*	Hoover High School UAB	Summer 99 1996-1998	Spectroscopy of F <sub>3</sub> <sup>-</sup> centers in LiF Detection of singlet oxygen by means of laser induced fluorescence and EPR methods. B.S. with honors in physics
Andrew Gallian <sup>♠</sup>	University of the South	Summer 98	Middle-IR tunable difference frequency generation based on LiIO <sub>3</sub> and LiNbO <sub>3</sub> nonlinear crystals.
Christy Poon <sup>♣</sup>	Alabama State	Summer 98	Single and Two-Photon

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\* Admitted to MD/PhD program at Albert Einstein College of Medicine

<sup>♠</sup> Admitted to PhD program in Electrical Engineering at Washington University, Missouri

<sup>♣</sup> Admitted to PhD program in Civil and Environmental Engineering at the UAB

	University		Fluorescence Excitation of Sulphuric Acid Solution containing Pyromellitic Acid as a Method of Detection of Absorbed Doses of Ionizing Irradiation.
Jeremy Randolph	UAB	Summer 97	Investigation of Atomic Fluorescence of Heavy Metals Under Laser Plasma Generation in an Argon Jet.
James Arnold, Jr. ♦	Talladega College	Summer 97	Luminescence Properties of CaF <sub>2</sub> :Sc <sup>2+</sup> crystals under UV Laser Excitation.
Anthony Capers	UAB	Summer 97	Singlet Oxygen Spectroscopy.
Eloi-Alain Kyimba	University of North Carolina-Asheville	Summer 96	Birefringent Filter For LiF:F <sub>2</sub> <sup>***</sup> Tunable Laser.

**Master & Ph.D. Graduate Students Theses Directed at the UAB:**

Student	Thesis Title	Status
Dan Crouthamel ♣ Physics, UAB	M.S. under plan II	Completed in June 1998
Candace Clary, Biomedical Engineering, UAB	Ph.D. Raman spectroscopy for in situ evaluation of malignant gliomas.	Graduated in December 1999.
Neil Jenkins, Physics, UAB	Solid state white light laser based on LiF:F <sub>2</sub> <sup>***</sup> crystals.	Graduated in June 2000.
Wonwoo Lee, Physics, UAB	M.S. under plan II. Topic: Laser Atomic Fluorescence Spectroscopy of Heavy Metals in Water Samples.	Completed in December 1999.
Keith Graham, Physics, UAB	Studies of Cr <sup>2+</sup> doped crystals as active media for Mid-IR lasers.	Performing research. Ph.D. program.
Xie Liang, Physics, UAB	Electron-phonon coupling mechanism of F <sub>2</sub> <sup>-</sup> centers in LiF (Franck-Condon or Herzberg	Graduated in June 2001.

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♦ Enrolled in medical school at UCLA

♣ Enrolled in Medical Physics program at Univ. of Wisconsin - Madison, WI

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Igor Moskalev, Physics, UAB	Superbroadband and multiline diode lasers	Performing research, Passed Ph.D. qualifiers.
Dmitri Martyshkine, Physics, UAB	MicroRaman Spectroscopy of biological cells	Imaging Performing research. Ph.D. program.

**Graduate Thesis Committees** (excluding those mentioned above)

M. Abracham (Ph.D. Biomedical Engineering); M. McCracken (Ph.D. Biomedical Engineering); C. Clary (Ph.D. Biomedical Engineering); H. Zeng (Ph.D. Materials and Biomedical Engineering); H. Hua (Ph.D. Physics); M. Robinson (Ph.D. Physics), D. Gore (Ph.D. Physics), C. Byeon (Ph.D. Physics), Blake Martin (Ph.D. Biomedical Engineering)

**PUBLICATIONS**

**231** research publications in physics: **1** book, **78** peer-reviewed publications in refereed articles, **58** papers published in conference proceedings, book chapters and preprints, **94** not peer-reviewed publications - extended conference abstracts.

**Books (1)**

1. "Room temperature tunable color center lasers", T.T.Basiev, S.B.Mirov, *Laser Science & Technology book Ser.*, **16**, 1-160, V.S.Letokhov, C.V.Shank, Y.R.Shen, H.Walter, Eds., Gordon and Breach Science Publ./Harwood Acad. Publ. (1994).

**Papers Published in Refereed Journals (75):**

2. T.T.Basiev, S.B.Mirov, and A.M.Prokhorov (academician, Nobel Prize Laureate), "Pulsed period tunable LiF:F<sub>2</sub><sup>+</sup> laser pumped by the second harmonic of YAG:Nd laser", *Dokl. Acad. Nauk SSSR*, vol. 246, pp. 72-74, 1979.
3. T.T.Basiev, Yu.K.Voron'ko, S.B.Mirov, V.V.Osiko, and A.M.Prokhorov, "Kinetics of accumulation and oscillation of F<sub>2</sub><sup>+</sup> color centers in LiF crystals", *Pis'ma v JETP*, vol. 30, pp. 661-665, 1979; *Sov. JETP Lett.*, vol. 30, pp. 626-629, 1979.
4. T.T.Basiev, Yu.K.Voron'ko, S.B.Mirov, and A.M.Prokhorov, "Frequency selection of Nd ions in glass, excited by monochromatic laser radiation at the resonant transition  $^4I_{9/2} \Rightarrow ^4F_{3/2}$ ", *Pis'ma v JETP*, vol. 29, pp. 696-700, 1979; *Sov. JETP Lett.*, vol. 29, pp. 639- 642, 1980.
5. T.T.Basiev, Yu.K.Voron'ko, S.B.Mirov, V.V.Osiko, A.M.Prokhorov, "New laser spectroscopic method of investigation of solid state media with nonhomogenous broadened spectra", *Pis'ma v JETP*, vol. 29, pp. 142-147, 1979.
6. T.T.Basiev, N.S.Vorob'ev, S.B.Mirov, V.V.Osiko, P.P.Pashinin, V.E.Postovalov, and A.M.Prokhorov, "Investigation of picosecond oscillation of F<sub>2</sub><sup>+</sup> color centers in LiF crystals with tunable frequency", *Pis'ma v JETP*, vol. 31, pp. 291-294, 1980.
7. T.T.Basiev, Yu.K.Voron'ko, E.O.Kirpichenkova, S.B.Mirov, V.V.Osiko, M.S.Soskin, and V.B.Taranenko, "Tunable laser on LiF:F<sub>2</sub><sup>+</sup> color centers with a holographic selector", *Kvant. Electron.*, vol. 8, pp. 419-421, 1981; *Sov. J. Quantum Electron*, vol. 11, pp. 255- 256, 1981.

8. T.T.Basiev, Yu.K.Voron'ko, S.B.Mirov, V.V.Osiko, and A.M.Prokhorov, "Efficient passive LiF:F<sub>2</sub><sup>-</sup> Q-switches in neodymium lasers", *Kvant. Elektron.*, vol. 9, pp. 837-839, 1982; *Sov. J. Quantum Electron.*, vol. 12, pp. 530-531, 1982.
9. T.T.Basiev, Yu.K.Voron'ko, S.B.Mirov, V.V.Osiko, A.M.Prokhorov, M.S.Soskin, and V.B.Taranenko, "Efficient tunable LiF:F<sub>2</sub><sup>-</sup> lasers", *Kvant. Elektron.*, vol. 9, pp. 1741-1743, 1982; *Sov. J. Quantum Electron.*, vol. 12, pp. 1125-1126, 1982.
10. T.T.Basiev, B.I.Denker, N.N.Il'ichev, A.A.Malyutin, S.B.Mirov, V.V.Osiko, and P.P.Pashinin, "Laser on high-concentrated Li-Nd-La - phosphate glass with passive Q-switch", *Kvant Elektron.*, vol. 9, pp. 1536-1542, 1982; *Sov. J. Quantum Electron.*, vol. 12, pp. 984- 988, 1982.
11. T.T.Basiev, Yu.K.Voron'ko, E.O.Kirpichenkova, S.B.Mirov, and V.V.Osiko, "Transformation of color centers in LiF crystals under laser irradiation", *Kratkie Soobcheniya po fizike*, vol. 3, pp. 3-9, 1982; *Sov. Phys. Lebedev Inst., Rep.*, No 3, pp. 1-8, 1982.
12. T.T.Basiev, E.M.Dianov, A.Ya.Karasik, A.V.Luchnikov, S.B.Mirov, and A.M.Prokhorov, "Stimulated Mandel'shtam-Brillouin scattering in a multimode glass fiber light guide", *Pis'ma v JETP*, vol. 26, pp. 85-87, 1982; *Sov. JETP Lett.*, vol. 36, pp. 104-107, 1982.
13. T.T.Basiev, Yu.K.Voron'ko, P.G.Zverev, S.B.Mirov, and A.M.Prokhorov, "Four wave phase conjugation in LiF crystals with F<sub>2</sub>, F<sub>2</sub><sup>+</sup> and F<sub>2</sub><sup>-</sup> CC", *Pis'ma v JETP*, vol. 8, pp. 1532-1535, 1982.
14. T.T.Basiev, Yu.K.Voron'ko, S.B.Mirov, V.V.Osiko, and A.M.Prokhorov, "Solid state tunable lasers on color centers in ionic crystals", *Izv. AN SSSR, Ser. Phys.*, vol. 46, pp. 1600-1610, 1982; *Bull Acad. Sci. USSR, Phys. Ser.*, vol. 49, pp. 145-154, 1982.
15. T.T.Basiev, E.M.Dianov, E.A.Zakhidov, A.Ya.Karasik, S.B.Mirov, and A.M.Prokhorov, "Selective nonlinear spectroscopy of non uniformly broadened phonon resonances in a disordered medium", *Pis'ma v JETP*, vol. 37, pp. 192-195, 1983; *Sov. JETP Lett.*, vol. 37, pp. 229-233, 1983.
16. T.T.Basiev, I.Ya.Itskhoki, B.G.Lysoy, S.B.Mirov, and O.B.Cherednichenko, "Pulsed YAG:Nd-laser with LiF:F<sub>2</sub><sup>-</sup> Q-switch", *Kvant. Elektron.*, vol. 10, pp. 619-621, 1983; *Sov. J. Quantum Electron* vol. 13, pp. 370-372, 1983.
17. T.T.Basiev, V.S.Burakov, F.V.Karpushko, D.V.Kovalev, S.B.Mirov, V.P.Morozov, A.M.Prokhorov, G.V.Sinitsyn, and A.P.Shkadarevich, "Output characteristics of strongly excited LiF:F<sub>2</sub><sup>-</sup> crystal lasers", *Kvant. Elektron.*, vol. 10, pp. 1919-1922; *Sov. J. Quantum Electron.*, vol. 16, pp. 1276-1278, 1983.
18. T.T.Basiev, S.A.Boldyrev, B.I.Denker, N.N.Il'ichev, G.S.Leonov, A.A.Malyutin, S.B.Mirov, and P.P.Pashinin, "Optimization of the parameters of active elements in miniature lasers utilizing concentrated Li-Nd-La phosphate glass", *Kvant. Elektron.*, vol. 11, pp. 1671-1674, 1984; *Sov. J. Quantum Electron.*, vol. 16, pp. 1125- 1130, 1986.
19. T.T.Basiev, Yu.K.Voron'ko, B.V.Ershov, S.B.Kravtsov, S.B.Mirov, V.V.Osiko, A.M.Prokhorov, V.A.Spiridonov, and V.B.Fedorov, "Application of large-aperture passive shutters from crystals LiF:F<sub>2</sub><sup>-</sup> for the generation of sub microsecond single pulses in neodymium-glass lasers with large-scale active elements", *Kratkie Soobshcheniya po Fizike* No 2, pp. 36-40, 1984, *Sov. Phys. Lebedev Inst. Rep.*, No 2, pp. 34-38, 1985.
20. Yu.M.Aleksandrov, K.V.Glagolev, V.N.Mahov, S.B.Mirov, T.I.Syreishikova, M.N.Yakimenko, "Optical properties in vacuum UV region and mechanisms of color centers formation in LiF", *Zhurnal prikladnoi spektroskopiyi*, vol. XL, No 2, pp. 244-249, 1984; *Sov. J. Appl. Spectroscopy*.
21. T.T.Basiev, B.V.Ershov, S.B.Kravtsov, S.B.Mirov, V.A.Spiridonov, V.B.Fedorov, "Lithium fluoride color center laser with an output energy of 100 J", *Kvant. Electron.*, vol. 12, pp. 1125-1126, 1985; *Sov. J. Quantum Electron.*, vol. 15 (6), pp. 745-746, 1985.
22. T.T.Basiev, S.B.Mirov, A.N.Stepanov, A.M.Shirokov, "N-absorption band increasing in  $\gamma$ -irradiated LiF crystals under plastic deformation and it's polarization properties", *Zhurnal Prikladnoy Spektroskopii*, vol. 45, pp. 508-509, 1986; *Sov. J. Appl. Spectroscopy*.

23. G.L.Muscalu, S.T.Gaceff, G.Nemes, A.Stratan, C.Fenic, R.Dabu, I.Lancranjan, T.T.Basiev, S.B.Mirov, "Optical coatings for multiwavelength solid state laser and laser beam testing experiments", *Rev. Rom. Phys.*, vol. 31, pp. 937-944, Bucharest, 1986.
24. T.T.Basiev, F.A.Vakhidov, Yu.K.Voron'ko, and S.B.Mirov, "Tunable laser utilizing LiF crystal with  $F_2^-$  color centers with an improved service life", *Kvant. Elektron.*, vol. 13, pp. 422-425, 1986; *Sov. J. Quantum Electron.*, vol. 16, pp. 277-279, 1986.
25. A.V.Babushkin, T.T.Basiev, N.S.Vorob'ev, S.B.Mirov, A.M.Prokhorov, Yu.N.Serdyuchenko, and M.Ya.Shechelev, "Generation and detection of continuously tunable subpicosecond radiation in a lithium fluoride crystal laser with  $F_2^-$  color centers", *Kvant. Elektron.*, vol. 13, pp. 2262-2266, 1986; *Sov. J. Quantum Electron.*, vol. 16, pp. 1492-1494, 1986.
26. S.A.Abrosimov, T.T.Basiev, M.E.Brodov, A.V.Ivanov, S.B.Mirov, P.P.Pashinin, R.V.Serov, and E.V.Shashkov, "Shaping of the laser pulse time profile by saturable filters", *Kvant Elektron.*, vol. 13, pp. 1718-1720, 1986; *Sov. J. Quantum Electron.*, vol. 16, pp. 1129- 1130, 1986.
27. T.T.Basiev, E.V.Zharikov, S.B.Mirov, S.Yu.Natarov, V.V.Osiko, P.P.Pashinin, A.M.Prokhorov, E.I.Shklovsky, and I.A.Shcherbakov, "Two-pass compact laser amplifier made of a gadolinium scandium galuim garnet crystal doped with Cr nd Nd ", *Kvant. Elektron.*, vol. 13, pp. 412-414, 1986; *Sov. J. Quantum Electron.*, vol. 16, pp. 269-270, 1986.
28. T.T.Basiev, A.Yu. Dergachev, P.G.Zverev, V.A.Konyushkin, B.G.Lysoi, S.B.Mirov, and V.V.Osiko, "Passive Q-switching with LiF:F $_2^-$  crystals in a continuous- wave YAG:Nd laser", *Izv. AN SSSR, ser. Phys.*, vol. 51, pp. 1440-1446, 1987, *Bull. Acad. Sci. USSR, Phys. Ser.*, vol. 51, pp. 166-170, 1987.
29. T.T.Basiev, F.V.Karpushko, S.M.Kulaschik, S.B.Mirov, V.P.Morozov, V.S.Motkin, N.A.Saskevich, and G.V.Sinitsin, "Automated tunable MALSAN-201 laser", *Kvant. Elektron.*, vol. 14, pp. 1726-1727, 1987; *Sov. J. Quantum Electron.*, vol. 17, pp. 1102-1103, 1987.
30. T.T.Basiev, F.V.Karpushko, S.M.Kulaschik, S.B.Mirov, V.P.Morozov, N.A.Saskevich, and G.V.Sinitsin, "Automated tunable MALSAN-201 laser", *Zhurnal Prikladnoy Spectroscopii*, vol. 47, pp. 682-687, 1987, *Sov. J. Appl. Spectroscopy*, 1987.
31. T.T.Basiev, N.Voitsekhovskiy, P.G.Zverev, F.V.Karpushko, A.V.Lyubimov, S.B.Mirov, V.P.Morozov, I.V.Mochalov, A.A.Pavlyuk, G.V.Sinitsin, and V.E.Yakobson, "Conversion of tunable radiation from a laser utilizing an LiF crystal containing  $F_2^-$  color centers by stimulated Raman scattering in Ba(NO $_3$ ) $_2$  and KGd(WO $_4$ ) $_2$  crystals", *Kvant. Elektron.*, vol. 12, pp. 2452-2454, 1987; *Sov. J. Quantum Electron.*, vol. 17, pp. 1560-1561, 1987.
32. T.T.Basiev, F.A.Vakhidov, and S.B.Mirov, "Radiational transformations in a new LiYF $_4$  laser crystal with color centers", *Kratkie Soobshcheniya po Fizike*, No 7, pp. 3-5, 1988; *Sov. Phys. Lebedev Inst. Rep.*, pp. 1-5, 1988.
33. T.T.Basiev, A.A.Gusev, S.V.Kruzhalov, S.B.Mirov, and V.Yu.Petrun'kin, "Continuous-wave ring LiF:F $_2^-$  - laser", *Kvant. Elektron.*, vol. 15, pp. 499-500, 1988; *Sov. J. Quantum Electron.*, vol. 18, pp. 315 - 316, 1988.
34. T.T.Basiev, F.A.Vakhidov, P.G.Zverev, N.A.Ivanov, D.F.Inshakov, F.V.Karpushko, V.A.Konyushkin, S.B.Mirov, V.G.Pak, A.G.Papashvili, and V.M.Khulugurov, "1,1-1,34 micron tunable generation in NaF crystals with color centers in a MALSAN-201 laser system", *Kratkie Soobshcheniya po Fizike*, No 1, pp. 18-20, 1988; *Sov. Phys. Lebedev Inst. Rep.* No 1, 20-24, 1988.
35. T.T.Basiev, S.B.Mirov, V.V.Osiko, "Room-temperature color center lasers", *IEEE J. of Quantum Electronics*, vol. 24, pp. 1052-1069, 1988.
36. T.T.Basiev, S.V.Dolzhenko, B.V.Ershov, S.B.Kravtsov, S.B.Mirov, V.A.Spiridonov, and V.B.Fedorov, "LiF:F $_2^-$  laser parameter optimization for Nd laser pumping", *Izv. Akademii Nauk SSSR, Ser. Fiz.*, vol. 52, pp. 400-402, 1988; *Bull. Acad. Sci. USSR, Phys. Ser.*, pp. 164-166, 1988.

37. T.T.Basiev, Yu.K.Voron'ko, S.B.Mirov, A.V.Osiko, S.A.Sychev, "Spectroscopic parameters of the new passive Q-switcher based on  $\text{MeF}_2:\text{Nd}^{2+}$ ", *Kratkie Soobscheniya po Physike* No 1, pp. 20-22, 1989; *Sov. Phys. Lebedev Inst. Rep.*, 1989.
38. T.T.Basiev, R.Dabu, C.Fenic, I.Lancranjan, G.Nemes, A.Stratan, B.Carstocea, T.T.Basiev, S.B.Mirov, "A passively Q-switched Nd:YAG laser for ophthalmology", *Laser and Optoelectronic*, 21 (6), pp. 67-69, 1989.
39. S.B.Mirov, P.P.Pashinin, V.S.Sidorin, E.I.Shklovsky, "Developing of ultimately high  $\text{LiF:F}_2$  color center concentration with a help of soft x-ray laser plasma source", *Kvant.Elektron.*, vol. 16, pp. 1646-1648, 1989; *Sov. J. Quantum Electron* 1989.
40. K.A.Gippius, Yu.N.Danileiko, P.V.Ionov, S.B.Mirov, A.G.Musatov, V.V.Osiko, A.V.Sidorin, T.V.Tulaikova, "Excitation of metals by the radiations of two YAG:Nd lasers", *Dokl. Acad. Nauk SSSR*, vol. 308, pp. 1122-1127, 1989.
41. T.T.Basiev, P.G.Zverev, F.V.Karpushko, V.A.Konyushkin, S.M.Kulashchik, S.B.Mirov, V.P.Morozov, V.S.Motkin, A.G.Papashvili, N.A.Saskevich, G.V.Sinitsyn, V.V.Fedorov, "Oscillation characteristics of the tunable color center lasers of "MALSAN" series", *Izv. Acad. Nauk SSSR, Ser. Fiz.*, vol. 54, pp. 1450-1455, 1990; *Bull. Acad. Sci. USSR, Phys. Ser.* 1990.
42. T.T.Basiev, S.B.Mirov, "Color center lasers", *Physical Encyclopedia* (USSR in Russian), A.M.Prokhorov Ed., part 2, pp. 566 - 567, 1990.
43. T.T.Basiev, A.N.Kravets, S.B.Mirov, V.A.Konyushkin, " $\text{LiF:F}_2^-$  passive Q-switching of technological YAG:Nd laser", *Kvant. Electron.*, **18**, 223-225 (1991); *Sov. J. Quantum Electron*.
44. T.T.Basiev, A.N.Kravets, S.B.Mirov, A.V.Fedin, "Technological YAG-Nd laser with a passive  $\text{LiF:F}_2^-$  Q-switch, *Pis'ma v JTP*, **17**, 16-22 (1991), *Sov. JTP Lett.*, 1991.
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46. "Solid State White Light Laser", N. Jenkins\*, S.B.Mirov, A. Okorogu, 1998 OSA annual Meeting, Baltimore, October 10, 1998.
47. "Raman Study of the Ordering of Internal Water in Thaumatin and Lysozyme Crystals", A.B.Kudryavtsev, S.B.Mirov\*, C.D.Smith, G.Christopher, and L.J.DeLucas, contributed talk presented to the 8<sup>th</sup> *International Conference on the Crystallization of Biological Macromolecules*, Sandestin, Florida (USA), May 14-19, 2000.
48. "Low Frequency Raman Spectroscopy of Lysozyme in Crystal and Solution", A.B.Kudryavtsev\*, S.B.Mirov, L.J.DeLucas (May 2000), contributed talk presented to the 8<sup>th</sup> *International Conference on the Crystallization of Biological Macromolecules*, Sandestin, Florida (USA), May 14-19, 2000.
49. "Spectroscopic properties and mechanisms of superbroadband lasing from F<sub>2</sub><sup>+</sup>-like color centers in LiF" N.W. Jenkins\*, S.B. Mirov, contributed talk presented to Optical Society of America Annual Meeting, San Jose, CA, September 1999.
50. "Middle infrared tunable system based on alexandrite laser", S.B.Mirov\*, contributed talk presented to Optical Society of America Annual Meeting, San Jose, CA, September 1999.
51. "Spectroscopic properties and mechanisms of superbroadband lasing from F<sub>2</sub><sup>\*\*\*</sup> and F<sub>2</sub><sup>\*\*\*</sup>-like color centers in LiF", N.W. Jenkins\*, S.B. Mirov, Naval Research Labs, Washington, DC, for National Research Council Associateship application, September 1999
52. "A Novel laser Breakdown Spectrometer for Environmental Monitoring", S.B.Mirov\*, R.E. Pitt, A. Dergachev, W. Lee, D.V. Martyshkin, O.D. Mirov, J.J.Randolph, L.DeLucas, C.G.Brouillette, T.T.Basiev, Y.V.Orlovskii, O.K.Alimov, I.N.Vorob'ev, contributed talk presented to Photonics East Conference, Boston, MA, September 1999.
53. "Spectroscopic properties and mechanisms of superbroadband lasing from F<sub>2</sub><sup>\*\*\*</sup> and F<sub>2</sub><sup>\*\*\*</sup>-like color centers in LiF", N.W. Jenkins\*, S.B. Mirov, Air Force Research Labs, Wright-Patterson, AFB, for National Research Council Associateship application, August 1999
54. "Peculiarities of education system in Russia" S.Mirov\* contributed talk presented to New Horizon's Program, Marshall Conference Center, UAB, Birmingham, April 12, 2000.
55. "Applications of Lasers in Medicine and Technology", S Mirov\*, four different presentations were performed for High School Students visiting UAB in 1999-2000.
56. "Progress Toward a Solid-State White Light Laser ", N.W. Jenkins\*, S.B. Mirov, University of Louisville, Department of Physics Seminar, Invited Speaker, October 1, 1999.
57. "Powerful ultrabroadly tunable LiF:F<sub>2</sub><sup>\*\*\*</sup> laser", N.W Jenkins\*, S.B. Mirov, contributed talk presented to the SPIE Photonics West Conference, San Jose, CA, January 2000.
58. "Solid State White-Light Laser Using LiF:F<sub>2</sub><sup>\*\*\*</sup> Color Center Laser" N.W.Jenkins, S.B.Mirov\*, contributed talk presented to the *Advanced Solid State Lasers Conference*, Davos, Switzerland, February 13-18, 2000.

59. Detection of Singlet Oxygen by Means of Laser and ESR Spectroscopy, A.Capers, S.Mirov\*, T.Tohver, contr. talk presented to the *OSA Annual Meeting 2000*, Providence, RI, Oct. 22-26, 2000.
60. "Alexandrite Laser Pump LiF:F<sub>2</sub><sup>-</sup> Laser", L.Xie, S.Mirov\*, contributed talk presented to the *OSA Annual Meeting 2000*, Providence, Rhode Island, October 22-26, 2000.
61. "A Laser Breakdown Spectrometer for Environmental Analysis of Metals", D.Martyshkin\*, S.Mirov, W.Lee, R. Pitt, contributed talk presented to the *67<sup>th</sup> Annual Southeastern Section Meeting of American Physical Society*, Starkville, Mississippi, November 2-4, 2000.
62. "Laser Characteristics of Cr<sup>2+</sup> doped ZnS", K.Graham\*, S.Mirov, V.Fedorov, M.E.Zvanut, A.Avanesov, V.Badikov, B.Ignat'ev, V.Panutin, G.Shevirnyaeva, contributed talk presented to the *67<sup>th</sup> Annual Southeastern Section Meeting of American Physical Society*, Starkville, Mississippi, November 2-4, 2000.
63. "External Cavity Multiwavelength or Superbroadband Diode Laser for Wavelength Division Multiplexing Applications", I.Moskalev\*, S.Mirov, V.Fedorov, T.Basiev, G.Grimes, E.Berman, contributed talk presented to the *67<sup>th</sup> Annual Southeastern Section Meeting of American Physical Society*, Starkville, Mississippi, November 2-4, 2000.
64. "Spectroscopic Analysis and Persistent Photon Gated Spectral hole Burning in LiF Crystals with F<sub>2</sub><sup>-</sup> Color Centers", M.Ashenafi, V.Fedorov, S.Mirov, L.Xie, contributed talk presented to the *67<sup>th</sup> Annual Southeastern Section Meeting of American Physical Society*, Starkville, Mississippi, November 2-4, 2000.
65. "Narrowband Tunable, Multiline, and Superbroadband Lasers for Spectroscopic and Telecommunication Applications", S.B.Mirov\*, (November 22, 2000) **invited lecture** presented at *Kitami Institute of Technology*, Kitami, Japan, November 2000.
66. Multiline, and Superbroadband Lasers for Telecommunication Applications", S.B.Mirov\*, (November 25, 2000), **invited lecture** presented at *Ibaraki University*, Hitachi, Japan, November 2000.
67. "Laser performance of Cr<sup>2+</sup> doped ZnS", K.Graham\*, S.Mirov, V.Fedorov, M.E.Zvanut, A.Avanesov, V.Badikov, B.Ignat'ev, V.Panutin, G.Shevirnyaeva, contributed talk presented to the *SPIE Photonics West Conference*, San Jose, CA, January 2001.
68. "External cavity multiline semiconductor laser for WDM applications" I.Moskalev\*, S.Mirov, V.Fedorov, T.Basiev, G.Grimes, E.Berman, (January 2001) contributed talk presented to the *SPIE Photonics West Conference*, San Jose, CA, January 2001.
69. "External cavity multiline semiconductor laser for WDM applications", S.B.Mirov\*, (January 2001), **invited lecture** presented at *Lightwave Microelectronics, Inc.* San Jose, CA, January 2001.
70. "Spectroscopic characterization and laser performance of diffusion doped Cr<sup>2+</sup>:ZnS", K. Graham\*, S.B. Mirov, V.V. Fedorov, M.E. Zvanut, A.Avanesov, V. Badikov, B. Ignat'ev, V. Panutin, G. Shevirnyaeva, (January 31, 2001) contributed talk presented to the *Advanced Solid State Lasers Conference*, Seattle, WA, USA, January 28-31, 2001.
71. "Laser Performance and Technology of Preparation of Cr<sup>2+</sup>:ZnS", S.B. Mirov\*, (April 2, 2001) contributed talk presented to the *Infrared Materials Workshop*, Fisk University, West End Courtyard by Marriott, Nashville, TN, April 1-3, 2001.
72. "CdGa<sub>2</sub>S<sub>4</sub>:Cr Absorption and EPR studies", M.Johnson\*, S.B.Mirov, M.E.Zvanut, (April 2, 2001) contributed talk presented to the *Infrared Materials Workshop*, Fisk University, West End Courtyard by Marriott, Nashville, TN, April 1-3, 2001.
73. "Spectroscopic characterization and laser performance of diffusion doped Cr<sup>2+</sup>:ZnS", K. Graham\*, S.B. Mirov, V.V. Fedorov, M.E. Zvanut, (April 2, 2001) contributed talk presented to the *Infrared Materials Workshop*, Fisk University, West End Courtyard by Marriott, Nashville, TN, April 1-3, 2001.

74. "Persistent Photon-Gated Spectral Hole Burning in  $\text{LiF:F}_2^-$  Color Center Crystal", V.V.Fedorov\*, S.B.Mirov, M.Ashenafi, L.Xie (May 10, 2001), **PostDeadline** contributed talk presented to the *Quantum Electronics and Laser Science Conference, QELS 2001*, Baltimore, MD, May 2001.
75. "Multiphonon Relaxation of Mid-IR Transitions of Rare-Earth Ions in Laser Crystals", S.B.Mirov\* (August 17, 2001) contributed talk presented to the *NSF-ECS/EPSCoR National Grantees Conference on Electronics, Photonics and Device Technologies*, Fayetteville, Arkansas, August 2001.
76. "Er fiber laser pumped CW  $\text{Cr}^{2+}:\text{ZnS}$  and  $\text{ZnSe}$  lasers" S.B.Mirov\* (September 15) **invited lecture** presented at IPG Photonics, Inc. Starbridge, MA, September 15, 2001.
77. "Mid-IR CW  $\text{Cr}^{2+}:\text{ZnS}$  and  $\text{ZnSe}$  Microchip Lasers," S.B. Mirov\*, V.V. Fedorov, K. Graham, I.Moskalev, V. Badikov, V. Panutin, (February 6, 2002) contributed talk presented to the *Advanced Solid State Lasers Conference*, Quebec City, Canada, February 3-6, 2002.
78. "Tunable continuous-wave room-temperature  $\text{Cr}^{2+}:\text{ZnS}$  laser," I.T. Sorokina\*, E. Sorokin, V. Fedorov, S. Mirov, A. Di Lieto, M. Tonelli, (February 6, 2002) contributed talk presented to the *Advanced Solid State Lasers Conference*, Quebec City, Canada, February 3-6, 2002.
79. "Er fiber laser pumped CW and pulsed  $\text{Cr}^{2+}:\text{ZnS}$  and  $\text{ZnSe}$  microchip lasers" S.B.Mirov\* (February 20) **invited lecture** presented at IPG Photonics, Inc. Oxford, MA, February 20, 2002
80. "In situ Monitoring of Crystal-Solution Interface During Lysozyme Crystal Growth via micro-Raman Spectral Imaging", A.B.Kudryavtsev\*, S.B.Mirov, L.J.DeLucas (March 25), contributed talk presented to the 9<sup>th</sup> International Conference on the Crystallization of Biological Molecules, Jena, Germany, March 23-28, 2002 .
81. "Novel All Solid State UV-Mid IR Tunable Laser Sources. Narrowband, Ultrabroadband, "White Light", and Multiline Modifications", S.Mirov\* (April 12), **invited lecture** presented at Eglin AFB, FL, April 2002."Multiphonon Relaxation of Mid IR Transitions of Rare- Earth Ions in Laser Crystals," Yu.V.Orlovskii\*, T.T.Basiev, V.V.Osiko, N.P. Barnes, S.B.Mirov (May 20), contributed talk presented to the *Conference on Lasers and Electro-Optics*, Long Beach, CA May 19-24, 2002.
83. "CW and pulsed  $\text{Cr}^{2+}:\text{ZnS}$  and  $\text{ZnSe}$  microchip lasers," S.B. Mirov\*, V.V. Fedorov, K. Graham, I. S. Moskalev, V.V. Badikov, V. Panutin (May 20), contributed talk presented to the *Conference on Lasers and Electro-Optics*, Long Beach, CA May 19-24, 2002.
84. "Broadly Tunable Continuous-Wave  $\text{Cr}^{2+}:\text{ZnS}$  Laser," I.T. Sorokina\*, E. Sorokin, S. Mirov, V. Fedorov, V.V. Badikov, V. Panutin (May 20), contributed talk presented to the *Conference on Lasers and Electro-Optics*, Long Beach, CA May 19-24, 2002.
85. "Efficient, Broadly Tunable Deep UV And Mid-IR Solid-State Laser Source," S.B.Mirov, V.V.Fedorov\*, B. Boczar, R. Frost, N. Kramer, B. Pryor, T.Thevar, J.C.Walling (May 21), contributed talk presented to the *Conference on Lasers and Electro-Optics*, Long Beach, CA May 19-24, 2002.
86. "External cavity multiwavelength semiconductor laser,"I. S. Moskalev\*, S. B. Mirov, V. V. Fedorov, G. J. Grimes, T. T. Basiev, E. Berman, J. Abeles, (May 22), contributed talk presented to the *Conference on Lasers and Electro-Optics*, Long Beach, CA May 19-24, 2002.
87. "Efficient, Broadly Tunable Deep UV and Mid-IR Solid State Laser Sources" S.B.Mirov\* (June 5) presentation for REU Physics Students, UAB, June 2002
88. " $\text{Cr}^{2+}:\text{ZnS}$  mid-IR external cavity and microchip lasers" S.B.Mirov\*, (July 6) invited lecture at the Oregon State University, Corvallis, Oregon, July 6, 2002.
89. "Transformation of spatial domain of the pumping beam into spectral domain of the output oscillation," I.S. Moskalev, S.B. Mirov\*, V.V.Fedorov, T.T.Basiev, P.G.Zverev, (July 11), contributed talk presented to the SPIE 's 47<sup>th</sup> annual meeting, Seattle, WA July 7-11, 2002.
90. "Diode, fiber, and potentially electrically pumped  $\text{Cr}^{2+}:\text{ZnS}$  mid-IR external cavity and microchip lasers", S.B. Mirov\*, V.V. Fedorov, K. Graham, I. S. Moskalev, I.T. Sorokina and E. Sorokin, V Gapontsev, D. Gapontsev, V.V. Badikov, V. Panyutin, (September 11), contributed talk presented to

- the 5<sup>th</sup> International Conference on Mid-Infrared Optoelectronic Materials and Devices, Annapolis, MA, September 8-11, 2002.
91. “Detection of Zn deficient SOD by means of laser spectroscopy and surface enhanced laser spectroscopy (SERS)”, D.V. Martyshkin\*, S.B.Mirov, J.Crow, Y.Zhuang, J.Beckman, V.Ermilov, (September 30 ) contributed talk presented to the *OSA Annual meeting/18<sup>th</sup> Laser Science Conference*, Orlando, Florida September 29-October 3, 2002.
  92. “External cavity multiwavelength semiconductor laser”, I.S. Moskalev\*, S.B.Mirov, V.V.Fedorov, G.J.Grimes, T.T.Basiev, E.berman, J.Abeles, (October 1) contributed talk presented to the *OSA Annual meeting/18<sup>th</sup> Laser Science Conference*, Orlando, Florida September 29-October 3, 2002.
  93. “CW and gain-switched Cr<sup>2+</sup>:ZnS and ZnSe mid-IR microchip lasers”S.B.Mirov\*, V.V.Fedorov, K.Graham, I.S.Moskalev, V.V.Badikov, V.Panyutin, (October 2) contributed talk presented to the *OSA Annual meeting/18<sup>th</sup> Laser Science Conference*, Orlando, Florida September 29-October 3, 2002.
  94. “All solid state system based on alexandrite-LiF:F<sub>2</sub><sup>+++</sup> laser for deep UV (196 nm) and mid-IR (4000nm) spectral ranges”, S.B.Mirov\*, V.V.Fedorov, B.Boczar, R.Frost, B.Pryor, A.Yu. Dergachev, (October 2) contributed talk presented to the *OSA Annual meeting/18<sup>th</sup> Laser Science Conference*, Orlando, Florida September 29-October 3, 2002.
  95. “Diode, fiber, and potentially electrically pumped Cr<sup>2+</sup>:ZnS mid-IR external cavity and microchip lasers”, S.Mirov\*, (October 17), Presentation for BTG International, Inc., Birmingham, UAB, October 17, 2002.
  96. “Spatial-to-frequency Fourier-transform external cavity lasers”, I.S.Moskalev\*, S.B.Mirov, V.V.Fedorov, T.T.Basiev, P.G.Zverev, (October 24), contributed talk presented to the *Optics in the Southeast 2002 Conference*, Huntsville, Alabama October 24-25, 2002.
  97. “Detection of Zn deficient SOD by means of laser spectroscopy and surface enhanced laser spectroscopy (SERS)”, D.V. Martyshkin\*, S.B.Mirov, J.Crow, Y.Zhuang, J.Beckman, V.Ermilov, (October 24) contributed talk presented to the *Optics in the Southeast 2002 Conference*, Huntsville, Alabama October 24-25, 2002.
  98. “Deep ultraviolet generation in an all-solid-state laser system based on a K<sub>2</sub>Al<sub>2</sub>B<sub>2</sub>O<sub>7</sub> crystal”, C.E.Wehrenberg\*, S.B.Mirov, V.V.Fedorov, (October 24) contributed talk presented to the *Optics in the Southeast 2002 Conference*, Huntsville, Alabama October 24-25, 2002.
  99. “Er Fiber Laser Pumped Microchip and External cavity Cr<sup>2+</sup>-doped ZnS and ZnSe mid-IR Lasers”, S.Mirov\*, (May 5), invited talk presented at the IPG Photonics Corporation, Oxford, MA, May 5, 2003.

## RESEARCH GRANTS OF SERGEY MIROV

### UAB Research Proposals Written and Funded<sup>3</sup>

1. Co-PI (Chris Lawson is PI, David Shealy is Co-PI), "Alabama Laser Research Initiative", 7/94-7/96, NSF/EPSCoR grant OSR-9450570 for \$ 199,869 (with \$451,285 of UAB and commercial matching money, the total program value is \$651,196). Of the NSF funds **\$104,279** were available to Sergey Mirov's research program.
2. Co-PI (Chris Lawson is PI), "Acquisition of Alexandrite Laser for NLO Materials Research" 7/94-7/96, NSF Grant DMR-9404712 for \$ **169,167** (with \$95,000 of matching money, the total program value is \$264,167).
3. Co-PI, (Ken Pruitt, UAB is PI of the overall grant with numerous other co-PI's) "An Integrated Approach to Edit Value Reclamation of Solid Waste" 6/95-6/99 NSF/EPSCoR grant OSR-9550480 for \$4,500,000. UAB portion of the grant is \$281,060, or \$574,860 with UAB and industrial matching. Of the UAB funds **\$212,767** (\$484,967 with UAB and industrial matching) is for a task (Laser Atomic Fluorescence Spectroscopy of Heavy Metals in Water Samples) led by S. Mirov, and \$68,293 (\$89,893 with UAB matching) is for task led by Robert Pitt from Civil & Environmental Engineering.
4. Co-PI (Thomas Wdowiak is PI, David Agresti is Co-PI) "A Laser Raman Spectrometer System Suitable for Incorporation into Lander Spacecraft," 6/96-5/99, NASA/PIDDP grant for \$312,000. Of these funds **\$42,229** available to Sergey Mirov's research.
5. Task PI\*\*, "Raman Characterization of the Quality of Protein Crystals" Task, \$ **147,827**, 9/95-8/96 Center for Macromolecular Crystallography UAB, Agreement 06.16.95.
6. Task leader for "Raman Spectroscopy of Protein Crystals" task for **\$331,471**, 11/96-10/97, part of \$5,633,848 NAGW-813 (Supplemental Space Station Grant), Larry DeLucas is PI of the overall grant and led the proposal (to which Dr. Mirov contributed).
7. Task leader "All Solid State Laser System Continuously Tunable Over 0.2-10 Micron Spectral Range" task for **\$20,000**, 5/97-8/98, part of \$60,000 SBIR/DoD/BMDO Phase I Grant # DASG60-97-M-0110, W-B.Yan (Light Age, Inc.) is PI of the overall grant (to which Dr. Mirov significantly contributed).
8. PI, "All Solid State Laser System Continuously Tunable Over 1.7-10 Micron Spectral Range", 4/97-9/97, Alabama Space Grant Consortium SUB90-204 for **\$10,000** (with \$22,909 of UAB and industrial matching money, the total program value is \$32,909).

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<sup>3</sup> Amount funded only lists the funds available to Sergey Mirov's research program. This does not include the total project costs, UAB and commercial matching. The amount funded includes indirect costs.

\*\* The following programs are funded research tasks initiated and performed by Dr. Mirov under a large umbrella grant or contract. In each case Dr. Mirov wrote the task proposal (and directed the task research and expenditures) but did not initiate or contribute to the original proposal for the umbrella grant.

9. PI, "Multiline or Superbroadband Semiconductor Transmitter for Optical Communication", 4/97-9/97, Laser & Photonics Research Center, UAB Grant for **\$8,000**.
10. PI, "Tunable Middle IR Laser Source Based on GaSe Crystal", 10/01/97-09/30/98, Faculty Development Grant, UAB for **\$10,000**.
11. Co-PI and task leader for "MicroRaman Imaging Spectroscopy of Protein Crystals" task for **\$117,048**, 11/25/97-10/31/98, part of \$6,894,141 Center for Macromolecular Crystallography NASA Grant, Larry DeLucas is PI of the overall grant and led the proposal (to which Dr. Mirov contributed).
14. PI, Multiline or Superbroadband Semiconductor Transmitter for Optical Communication", 4/01/98-03/31/99, Laser & Photonics Research Center, UAB, **\$15,000**.
15. PI, "Raman Spectroscopy of Malignant Tumors", 04/01/98-05/30/99, Alabama Space Grant Consortium for **\$10,000** (with \$24,812 of UAB and industrial matching money, the total program value is \$34,812).
16. PI, "UAB-General Physics Institute Cooperation in Comprehensive Study of the Fast Relaxation Processes in Laser Materials" 05/01/98-04/30/01, NSF Grant ECS-9710428 for **\$40,000**.
17. PI, "Spectroscopic Study of I-III-VI<sub>2</sub> and II-III-VI<sub>2</sub> Chalcopyrite Crystals. Search for Potential Laser Materials for the 2-5  $\mu\text{m}$  Spectral Range" 09/01/99-08/30/00, LPRC for **\$15,000**.
18. Co-PI, "Development of High Affinity Sensors for Biological Pathogenes" L.DeLucas (PI), S.Mirov (Co-PI), 10/01/99-09/30/01, NASA for **\$1,325,336**, Physics portion **\$244,528**
19. PI, "All Solid State Laser for Generating Deep Ultraviolet and Middle Infrared Coherent Light", 03/15/00-03/14/02, DoD/Light Age, Inc. for **\$228,322**.
20. PI, "Multiline Diode Transmitter for Telecommunication Applications", 09/01/00-08/30/02, Atlantic Vision, Inc. **\$513,963**.
21. Co-PI, "Development of a Multi-Purpose Laser Deposition Facility for Research and Education in Nanostructured Materials" R.Camata (PI) 09/01/01-18/30/03, NSF \$ **146,642**
22. PI, "Er fiber laser pumped microchip and external cavity Cr<sup>2+</sup> doped ZnS and ZnSe mid-IR lasers", 05/01/02 – 04/30/03, **IPG Photonics – UABRF \$169,240**
23. PI, "Characterization of LB4 crystals" 03/19/02-07/31/02, **Mitsubishi Materials/ Q-Peak \$11,680**
24. PI, "Mid-IR laser transitions in crystals with short phonon spectra" 09/01/02-08/30/03. **NATO, \$9,000**
25. PI, "International cooperative study of multiphonon relaxation of mid-IR transitions in laser crystals with short phonon spectra", 09/01/02-08/30/05, NSF/ECI **\$84,808**.

**26. PI, "EPR-Optical Characterization of LB4 crystals", 05/01/03-10/30/03 Mitsubishi Materials/Q-Peak \$32,000.**

**RESEARCH FUNDING AT UAB (1994-2003)**

**\$2,692,972**