（No.４　２００２年１月１５日号目次）

特集：レーザー技術関連研究開発機関

今号では、ロシアのレーザー技術関連の研究開発機関をご紹介いたします。

ロシアのレーザー技術は世界トップレベルにあり、各研究開発機関および企業ではレーザー工学のＲ＆Ｄで多くの成果を上げています。

１．ロシア・レーザー産業の概観

レーザーは科学技術の幅広い分野に多大な影響を及ぼし、今や最先端産業の一つとして、応用範囲の広さと多様性ではコンピューターに勝るとも劣らない。

レーザー技術は､ロシアが他の先進工業国と競争可能な､数少ない分野の一つであり､ロシアの研究機関や企業は、レーザー工学の多様な領域において目覚ましい成功を収めてきたと言えよう。

現在ロシアでは､レーザー分野の研究開発が数多く行われている｡その目的は幅広く､レーザーシステムの信頼性の向上、発光能力の向上と特性改善、金属疲労の回復、応用範囲の拡大、稼動効率と安全性の向上、サービスの迅速化等である。

1995 年から 2000 年にかけて、CIS 諸国とバルト諸国において国内市場におけるレーザー機器の販売とサービスおよび専門家養成も含めたレーザー技術の研究開発に携わった組織（研究所、企業体、工場、会社、小企業等）の数は約 1000 である（うち 80%がロシア)｡レーザー市場への主な参入企業の数は基礎設計を行う企業と機器製造の企業会わせて約 100 社である。

現在､CIS 諸国では上記の部門で約３万 5,000 人の専門家が働いている（1990 年～91 年には約５万人)。1993 年から 99 年にかけてレーザー技術に関して 421 の博士号が取得されたという事実も、ロシアにおいてレーザー技術研究が盛んであることの裏付けとなる（年間取得数約 70)。
年間に刊行されるレーザー関連の出版物（ロシア語版）は約 1,500 点である。

【ロシアのレーザー研究所】

組織の種類	数
ロシア科学アカデミー傘下の研究所・設計事務所	111
研究機関を含む高等教育機関	186
分野別研究所、設計事務所、企業体	127
工場・企業	31
医療高等教育機関を含む医療用レーザー研究所	238
小企業	221

【ロシアのレーザー機器製造】

1996 年から 2000 年までに製造されたレーザー機器総数	約 2500
うち、レーザー発光体	1700
レーザー医療施設	400
レーザーによる材料加工プラント	140
レーザー分析用計器(含環境モニタリング用)	160
レーザー機器製造企業の総数	約 300

しかしこの 10 年間で、ロシアのレーザー産業は大きく衰退している。経済危機の影響、国内市場におけるレーザー技術の応用範囲の狭さ、有望な研究開発に対する財政支援不足等が原因として考えられる。

ロシアでは事実上あらゆる種類のレーザー機器を製造しているが、国際規格準拠のものはそのうち 5～10%に過ぎず、試作品の段階に留まっているものが多い。

ロシアはレーザー国際会議（CLEO／Europe-EQEC）に参加し、最近まで（1996 年）、レーザー研究開発の規模において欧州第２位であった。しかし 2000 年には独仏英に遅れをとり、レーザー物理学や量子エレクトロニクスの分野における国立レーザー研究所の成果は芳しくない状況である。特に旧ソ連がアメリカと僅差で世界２位だった 1970 年代から 80 年代と比較すると大幅に弱体化している。

ロシアのレーザー産業の発展を妨げる要因の一つに、国家支援体制の未整備がある。

ロシアには、レーザーやレーザー技術に関して政策に影響力を及ぼす中心機関（省、部局、委員会、企業等）が存在しない。レーザー技術の開発のための予算が多方面から分配されるが、その活用方法が確立されていない。またレーザー機器の需要に関して、科学的根拠に基づいた見通しも立っていない。

ロシアはレーザーの研究開発予算として年間何百万ドルも計上しているが（ロシア科学アカデミー、ロシア連邦科学技術省、ロシア連邦教育省の計画に基づいた個々の研究への資金提供、国立研究機関や軍産複合体への援助、開発基金による援助金、国際プロジェクトのレーザー研究への参加および共同援助、地域予算からの融資等）、研究開発の成果使用権については管理が行われていない。

したがって、ロシア科学アカデミー傘下の研究所、その他の研究機関、小企業などがレーザー分野の科学技術成果を外国に不当に安く売却してしまったり、あるいは知的所有権を喪失してしまうことも珍しくない。

「ロシアのレーザー技術」議会公聴会は、21 世紀のレーザー産業に対する国家支援について以下の動向を承認して、閉会した。

- 国家管理の統一機関として、レーザー産業および技術の発展を目的とする政府委員会の設置
- レーザー産業発展のための連邦プロジェクトの進行、レーザー機器製造および計測施設新設プロジェクトへの参加促進
- 外国企業の国内市場参入を防ぎ、レーザーに関する国家プロジェクトに携わる者に多様な特権を付与する等、レーザー機器製造者への支援
- レーザー産業における積極的な人事政策
- レーザー産業発展を目的とする法的支援

ロシアのレーザー関連技術は、２～３年の準備期間を経て、すべての国内需要を満たすのみならず、世界市場においてレーザー機器および技術の年間売上 10～20 億ドルを達成するポテンシャルを持っている。

(社)ロシア東欧貿易会
モスクワ事務所長
池田　正弘

２．レーザー技術関連研究開発機関

①レーザー物理学研究所（サンクト・ペテルブルグ市）

State Research Centre of The Russian Federation
All-Russian Research Center "S.I. Vavilov State Optical Institute"
Research Institute for Laser Physics

I. Name of the Institute (Organization)

In Russian:
Научно-исследовательский институт Лазерной Физики
In Russian abbreviation: НИИ ЛФ
In English: Research Institute for Laser Physics
In English abbreviation: ILP

II. Location

Official address: 12, Birzhevaya line, St.Petersburg, 199034, Russia
Mail address: 12, Birzhevaya line, St.Petersburg, 199034, Russia
Phone: Phone: +7 (812) 328-5734, 328-4460
Fax: +7 (812) 328-5891
E-mail: mak@ilph.spb.su
Access (transportation, necessary time):
St.Petersburg International airport Pulkovo, then one hour driving by car

III. History

In 1960, Academician A. A. Lebedev and Professor M. P. Vanyukov initiated the laser physics research at the S.I. Vavilov State Optical Institute. On June 2, 1961, Senior researcher L.D. Khazov with a group of colleagues built the USSR's first (ruby) laser. In 1971, the laser laboratory expanded to become the laser department in the S.I. Vavilov State Optical Institute. In 1993, this department formed the core for the formation of the Institute for Laser Physics.

A distinctive feature of the research carried out at the ILP is the wedding of fundamental physical studies with applied work relating to the use of lasers in various areas of engineering, technology, and medicine.

Besides investigating the processes occurring in lasers (radiation dynamics, spatial characteristics, nonlinear and coherent phenomena), the scientists of the Institute have developed a number of unique lasers (for fusion research, with diffraction-limited angular divergence or ultrashort pulsed operation etc.).

The scientists of the Institute have contributed markedly in launching the mass production of a substantial number of different laser types and laser systems in our country.

The research performed at the Institute has been awarded many Government prizes, Lenin and State Prizes of the USSR, awards of the RF government, and medals of Scientific societies.

The scientists of the Institute for Laser Physics form one of the most dynamically developing centers of laser physics research and engineering in Russia and in the world.

The Institute enters the XXI Century full of new original ideas and concepts in the field of laser physics and technologies.

IV. Management

Kind of organization: State Research Center of Russia
Ownership: State property of RF
Responsible Ministry: Minystry of scince&technology, Ministry for Defense, Russian Space Agency

V. Executives

Director of ILP: Professor Artur Afanas'evich MAK

Structure of the Institute:

- Theoretical department, consisting of two laboratories (headed by Prof. N.N. Rozanov);
- Solid-state laser department, consisting of four laboratories (headed by Prof. V.A. Serebryakov);
- Laser optics department, consisting of three laboratories (headed by Cand. (Phys.-Math.) V.E. Sherstobitov);
- Gas laser department, consisting of four laboratories (headed by Prof. O.B. Danilov);
- Solid-state laser-physics laboratory (headed by Prof. A.A. Mak);
- Computer technology laboratory (headed by S.N. Leonov);
- Scientific Council (scientific secretary: Prof. I.M. Belousova).

VI. Current major activities

Research and Development fields:

- Solid-state lasers (diode-pumped, high-stability and low-noise, high-power and short-pulsed lasers);
- Gas lasers (CO_2, chemical, and iodine lasers);
- Dynamic correction of aberrations in lasers and optical systems;
- Problems associated with laser radiation delivery (angular divergence, high-precision pointing, propagation in the atmosphere);
- Interaction of laser radiation with matter;
- Theory of bistable systems;

- Application of lasers in medicine, technology, communications etc.

The most significant achievements obtained in the recent years can be summed up as follows:

- Theoretical study of high-temperature relativistic laser plasmas. Generation of light fields with powers of up to 30 TW capable of producing radiation power densities of up to 10^{19} W/cm^2. Building of an x-ray source with an intensity of up to 10^{15} W/cm^2 for use in research, medicine, and technology;
- Development of the concept of, and key components for, laser-assisted power transport over large distances using new methods of laser beam control. The results achieved here hold promise for powering spacecraft, delivery of power, including that originally produced by solar power, over large distances for launching mini-satellites in space etc.;
- Development of the principles underlying the construction of observation systems which use nonlinear optical techniques to correct for aberrations in large telescope mirrors, which are capable of considerably reducing the weight of a system. The results obtained could be applied to astronomy, space-borne and environmental monitoring, and coherent direction-finding systems;
- Development of methods and relevant technologies for the construction of high-power solid-state diode-pumped lasers with diffraction-limited beam divergence, as well as of key components for rapid high-precision laser beam control;
- Development of compact, CW and repetitively pulsed, RF pumped slab CO_2 lasers producing beams with an average power in excess of 200 W and with close to diffraction-limited divergence;
- Development of nonlinear optical devices based on fullerenes, liquid crystals, and vanadium oxides for the protection of optical systems, radiation detectors, and eyes from intense light fluxes in the 0.4—12 mm range;
- Development of a method of 'Averaged Photon Trajectories' for the description of light propagation through a strongly scattering medium. This allows the problem of three-dimensional tomography of complicated biological objects to be solved in real time.

Theoretical studies:

- Theory and computer simulation of lasers and laser systems, including CW and repetitively pulsed gas and solid-state lasers, «master-oscillator—amplifier» systems, adaptive optical systems, and nonlinear phase conjugation arrangements;
- Theory and computer simulation of laser beam propagation in nonlinear and inhomogeneous media (large- and small-scale self-focusing of high-power laser radiation, propagation of high power radiation in turbulent and nonlinear atmospheres, vacuum nonlinearity mechanisms in superstrong fields and nonparaxial nonlinear optics);
- Theory of laser beam interaction with matter (ultrastrong fields, ultrashort laser pulses, interaction with plasmas);

Theory of optical bistability, instabilities and soliton-like optical structures, including dissipative optical space- and space-time-domain solitons, three-dimensional optical solitons, and ultranarrow optical solitons («optical needles»).

VII. International and domestic relations

Scientists from the Institute cooperate with a number of leading Universities in the USA, Belgium, France, and Japan.

Work in all the above-mentioned areas is carried out in cooperation with many domestic enterprises, as well as foreign laboratories and companies (Germany, France, Japan, Great Britain, USA, China).

The Institute for Laser Physics organises the International «Laser Optics» conference series, which invariably attract a large number of specialists, both from our country and from abroad.

VIII. Number of employee

Total Number of Regular Staff - 133

- 110 researchers and engineers, including 11 Doctors (Sc.D.) and 54 Candidates of Sciences, (Ph.D.)
- 12 technicians,
- 11 administrators.

The average age of scientists is 45 years. The personnel includes 27 young scientists (below 35 y.) and 15 postgraduates and 19 undergraduate students working on projects.

IX. Major facilities

The Institute for Laser Physics has experimental facilities with high-power solid-state and gas lasers equipped with modern diagnostics and computer systems, which provide a solid basis for wide ranging research in the field of laser physics.

Main experimental equipment in the Institute:

- Facility for uniting and testing of diode pumped solid-state lasers.
- Solid-state laser facility (power ~ 1 TW) for investigations on radiation interaction with matter.
- CO_2 –laser facility (energy level 200 W).
- High-power CO_2- laser facility with correction for laser and optical system distortions correction using phase conjugation.
- Facility for investigations of laser beam divergence and direction control (precise addressing) using "write in - read out" algorithm.
- Facility for testing of devices for beam energy and power limitation, using fullerenes, liquid crystal systems and vanadium oxides.
- Facility for correction for imaging optics distortions by means of nonlinear optics

X. Commercial proposal

ILP welcomes the inquiries on development of lasers, optical systems, and software meeting special customer demands

Solid-state lasers with lamp and diode pumping
CW and QCW lasers in the UV, visible, and IR ranges, for various applications, including:

- Green lasers for pointing, laser displays, ophthalmology;
- Highly coherent lasers for interferometry and holography;
- Eye-safe lasers (1.5 - 3 micron) for rangefinders and medicine;
- Ultrashort pulse (pico- and femtosecond) lasers of a compact design;
- High average output power lasers (of up to 1 kW) for material processing;
- Lasers with fast beam steering and precise addressing for micromachinery

Gas lasers
CO_2 lasers, including:
- CW and QCW slab lasers for material processing with average output power of up to 2.5 kW;
- TEA lasers for different applications with pulse energy of up to 500 J (at low repetition rate)

Laser components
Various optical components and units, including:
- Laser optics;
- Laser beam limiters;
- Q-switchers;
- Nonlinear frequency conversion units (SHG, OPO)

Optical devices and systems with dynamic correction for distortions
- Phase conjugate mirrors for lasers and optical systems (visible, near IR, middle IR);
- Resonators of a special design for lasers with low beam divergence;
- Low-weight low-cost imaging systems with diffraction limited resolution;
- Large-aperture low-cost collimators for laser systems and for characterization of astronomical optics (diameter of 5 -10 m and more)

Software
- Systems for adaptive guidance of laser radiation through the turbulent atmosphere;
- Laser systems for remote sensing of the sea body through the waved sea surface;
- Vision systems looking through the waved sea surface;
- Systems for optical information processing using spatio-temporal solitons.

To promote the commercialization of developments in optics and, primarily, in laser physics, two small companies were founded at the Institute in the early 1990s, «Laser Physics» and «Lasers and Optical Systems». Due to their close ties and well-established cooperation with the ILP, these companies develop and manufacture a wide variety of lasers and laser systems, supply mechanical and optical components of lasers and specialized software.

The products manufactured by the companies find a market both in Russia and CIS countries and in a number of foreign countries, for instance, Austria, Switzerland, USA, Germany, China, Korean Republic, and India.

②ポリュスＲ＆Ｄ研究所（モスクワ市）

POLYUS Research & Development Institute

I. Name of the Institute (Organization)

In Russian:
Федеральное государственное унитарное предприятие НИИ "Полюс" им.М.Ф.Стельмаха
In Russian abbreviation: НИИ "Полюс"
In English: POLYUS Research & Development Institute
In English abbreviation: POLUS RDI

II. Location

Official address: 3, Vvedensky St., Moscow, 117343, Russia
Mail address: 3, Vvedensky St., Moscow, 117343, Russia
Phone:+7 (095) 3330389
Fax:+7 (095) 3330256
E-mail: mail@polyus.msk.ru
Access (transportation, necessary time):
Moscow International airport Sheremetjevo-2, then one hour driving by car

III. History

POLYUS Research & Development Institute is the largest laser center in Russia. The Institute was founded in 1962.

The development and production of devices based on solid-state and semiconductor lasers have been carried out at POLYUS RDI for more than two decades.

In recent years the development work at the Institute has concentrated on creation of functionally complete devices and components having concrete users. The restructuring of the scientific staff proceeds in the same direction. As a consequence, the volume of orders in the internal market of Russia grows, and the export part is steadily half the volumes of orders of POLYUS RDI.

In 1999 POLYUS RDI received the status of Federal State Unitary Enterprise.

POLYUS's products are manufactured at 5 Russian plants.

The combination of high technologies available at POLYUS RDI the powerful scientific school for lasers and laser technologies, the experience of many years in scientific research and development work allow the Institute to be among the world leaders in this field.

IV. Management

Kind of organization: Research & Development Institute
Ownership: State Enterprise of RF
Responsible Ministry: Minystry of Scince&Technology

V. Executives

Director of POLYUS R&DI: Alexander Kazakov

- Deputy Director of POLYUS R&DI: Georgy Zverev
- Director of POLYUS Foreign Trade Firm: Yunona Diyakova
- Head of Semiconductor Division:Vladimir Simakov
- Head of Laser Gyro Division: Vladimir Kuryatov
- Head of Department: Yuri Golyaev
- Head of Laser Crystal Department: Alexander Shestakov

VI. Current major activities

The main lines of activities of the Institute are development and production of solid-state lasers and devices on their basis, semiconductor lasers of various types and transmitting-receiving modules for FOCs, laser gyros, laser medical and industrial systems, components of laser systems.

Owing to the multistructure orientation, POLYUS RDI has retained its leading positions among high-tech enterprises during the market reforms in Russia.

Today POLUS RDI offer for export more than 150 models of various types of lasers and more than 50 types of devices and equipment for different applications on their basis.The

POLYUS RDI is able to offer a wide range of applied scientific research, development work and engineering services to the users.

A number of models of Nd:YAG laser rangefinders has been developed. The recently developed rangefinders use eye-safe lasers at 1.54 mm. Based on pulsed semiconductor lasers, velocimeters/rangefinders providing an accuracy of several centimeters it a range up to 1 km have been developed and are produced serially.

More than 50 models of pulsed solid-state lasers (with a pulse energy up to 1 J or a pulse repetition rate up to 400 Hz at an energy of 40 mJ) and CW solid-state lasers (with an output power up to 2 kW) are produced for such applications as metrology, location, industrial systems for welding, cutting, marking.

Based on solid-state lasers, systems for manufacturing souvenirs (making a pattern in the bulk glass), laser medical systems for surgery, ophthalmology, cosmetology (laser epilators) have been developed. The main trends in the field of laser equipment are creation of compact multifunctional systems and development of new technologies. To develop solid-state lasers, the production of rods and nonlinear elements for solid-state lasers has been organized at POLYUS RDI.

The production processes for growth, thermal treatment, optical treatment and deposition of dielectric and current-conducting coatings necessary for making modem laser rods, nonlinear elements electrooptic and passive Q-switches have been developed and introduced into production.

As a result of combined research, the range of lasers has been broadened and their lasing performance has been improved. Besides Nd:YAG and Nd:YAP crystals, the production of Er, Ho, Tu, Cr:GSGG, ISGG, YAG and YAP, crystals operating within an eye-safe range of 1.5...2.1 mm has been organized. Of great interest are Cr4+ :YAG laser rods that allow tunable generation within 1.4... 1.6 mm. Another active material developed at POLYUS R&DI to produce tunable generation and mode-locked generation is Ti:sapphire.

For diode-pumped solid-state lasers, microlaser elements have been developed that combine active and passive property (microchip lasers). New passive Q-switches based on transparent glassceramics doped with Co+2 ions have been developed for eye-safe solid-state Er+3: glass laser at 1.5 mm.

The KTP crystals developed at POLYUS RDI provide a frequency-doubling efficiency more than 50% and about the same slope efficiency in parametric generation.

The photoreceiving devices being developed at POLYUS RDI are the most important part of the devices and systems where laser radiation serves as a main information carrier (rangefinders, locators, gyros, communication systems, etc.).

One of the recent development works in this field was development of a highly sensitive photoreceiving device for the eye-safe rangefinder at l.54 mm. One of the leading lines in the POLYUS RDI activities is development and production of semiconductor lasers. More than 40 models of semiconductor lasers have been developed and are produced. In this area POLYUS RDI is also the leading scientific center in Russia. The use of quantum-well structures has allowed broadening of the spectral range of semiconductor lasers from 0.8 to 1.6 mm. A conventional feature of such diodes is a high degree of polarization of generated radiation. By now CW laser diodes up to 2W based on the quantum-well structures have been developed. The efficiency of such diodes is 35...40%. The pulsed laser diodes based on quantum-well structures provide an optical power of 20...23 W at a pulse width of 100...130 ns, a pulse repetition rate of 5...20 kHz and a pump current no more than 40A.

Now POLYUS RDI completes the development of the domestic technology for manufacturing epitaxial wafers for high-brightness red and yellow LEDs and organizes their serial production. In this case the MOCVD technology is required, which is widely used at

POLYUS RDI for production of a wide range of epitaxial structures for laser diodes including those based on AlInGaP.

The third leading line in the development work at POLYUS RDI is laser gyroscopy for civil aviation. At present the accuracy of laser gyros lies in the range from 0.01°/h (the linearly polarized KM-11-1A with the resonator made of precision prisms using high-frequency excited discharge) to 1°/h (compact circularly polarized laser gyros with magnetooptic bias using dc-excited discharge).

Laser gyros find application where their unique properties can be used most fully (the absence of moving mechanical parts, short readiness time, enhanced strength and resistance to mechanical and climatic action, higher potential accuracy and lower cost with comparable weight and overall dimensions).

Today POLYUS RDI is one of the leading Russian enterprises in the field of laser medical equipment. Many Russian clinics are equipped with the systems for surgery and ophthalmology developed at POLYUS RDI. The further work is carried out in the directions of development of laser equipment and its introduction into cardiology and physiotherapy, urology, oncology, phthisiology, surgery (more compact equipment, new wavelengths), dermatology, ophthalmology (including equipment based on semiconductor lasers).

The integrated use of the recent advances of the Institute in the field of laser engineering makes it possible to develop competitive high-tech laser medical equipment and to provide its wide introduction into medical practice.

The high scientific and technological standard of POLYUS's products and active work in the field of external economic activity allows us to export our products, the results of investigations and development work, engineering services to various countries of Europe, Asia and America.

VII. Number of employee

Total Number of Regular Staff - 1400

- 2 Academicians
- 17 Doctors of sciences
- More than 100 Candidates of sciences
- 800 Engineers

VIII. Major facilities

The production base of POLYUS RDI provides all basic technologies necessary for development and manufacturing of products of quantum electronics. These are high-temperature Czochralski growth of active and nonlinear crystals, gaseous-phase epitaxy of semiconductor structures and future technologies for development of semiconductor laser chips, advanced technologies for deposition of thin-film antireflection and beam-splitting coatings, vacuum technologies. In recent years it has been possible to introduce also such new progressive processes as ion-beam deposition of mirrors and production of structures for high-brightness LEDs.

IX. Commercial proposal

✓ **SOLID STATE LASERS**

POLYUS Research & Development Institute carries out a wide range of research and developments in the field of solid-state lasers for following main applications:

- industrial laser systems;
- medical laser systems;
- laser rangefinders;
- scientific research.

Lasers are based on Nd:YAG and Nd:YAP crystals. The recent developments also use Cr, Nd:GSGG; Cr, Tm, Ho:YAG; Er:YAG; Ti:Saphire and Cr4+:YAG crystals. Output of CW Nd:YAG and Nd:YAP lasers achieves 1 kW in CW and pulse energy up to 3J in pulse operation IR range. Harmonic generators and OPO-converters are used to expand emitting range to UV and IR range.

✓ **Laser diodes**

The division for semiconductor lasers was founded at POLYUS Research & Development Institute not longer before achieving the effect of stimulated emission generation by the p - n junction in Ga As. The main efforts are focused in following applications:

- laser pointers
- fiberoptic communications
- pumping of solid-state lasers
- laser medical therapeutic systems
- scientific research.

Today POLYUS Research & Development Institute produced over 40 models of laser diodes emitting in range of 635 to 1550 nm.

✓ **Photodiodes and receivers**

POLYUS Research & Development Institute produces a several types of photodiodes and photoreceivers for varios applications including fiberoptic communications, laser rangefinding, spectral and measurement equipment.

✓ **Laser rangefinders**

POLYUS's Laser Rangefinders have excellent technical performance to meet professional use in:

- Topography & Geodesy
- Marine Navigation
- Highway Engineering & Building Construction
- Airborne Altimeters & Locators
- Traffic Control
- Meteorology

✓ **Laser levelers & pointers**

POLYUS Research & Development Institute offers a new laser products for building works and area planning: UL-type laser levelers, ZNL-02 Direction Pointer, LPP-02 Pointer for Vertical and Horizontal Planes and OPP-01 Prism Reflector.

✓ **Laser level meters**

POLYUS Research & Development Institute offers a UDL type Laser Level Indicators for non-contact measurement of linear displacement, distance (level) to liquid and various materials with low reflectance. The indicators operate in automated technological process, they have duct and moisture protective package and can operate in aggressive environment.

✓ **Laser gyros**

POLYUS Research & Development Institute is the leading manufacturer of ring laser sensors and laser gyros in Russia. Research and developments are carried out in two main areas:
- medium accuracy systems with stability of 0.1 to 1.0 deg/h;
- high accuracy systems with stability 0.01 deg/h;

✓ **Medical Systems**

✓ **Material processing systems**

✓ **Laser communication systems**

POLYUS Research & Development Institute offers a new laser communications system for open links, which can be used for date communications with rate of 0.1 to 34 Mbps..

✓ **Laser crystals and components**

✓ **Vacuum equipment**

✓ **Spectrophotometers**

③トロイツク イノベーション熱核研究所（モスクワ州トロイツク市）

State Research Center of Russia Troitsk Institute for Innovation and Fusion Research

I. Name of the Institute (Organization)

In Russian:
Государственный научный центр Российской Федерации Троицкий институт инновационных и термоядерных исследований
In Russian abbreviation: ГНЦ РФ ТРИНИТИ
In English:
State Research Center of Russia Troitsk Institute for Innovation and Fusion Research
In English abbreviation: SRC RF TRINITI

II. Location

Official address: 142092, Troitsk, Moscow Region
Mail address: 142092, Troitsk, Moscow Region
Phone:+7 (095) 334-50-41
Fax:+7 (095) 334-57-76
E-mail: liner@triniti.ru
Access (transportation, necessary time):
Moscow International airport Sheremetjevo-2, then one hour driving by car

III. History

In 1956 on the Academician A.P.AIeksandrov's initiative the Magnetic Laboratory of the USSR Academy of Sciences was established and later incorporated by the Kurchatov Atomic Energy Institute. In 1971 the Branch of the Kurchatov Atomic Energy Institute was organized. In 1991 the Branch of the Kurchatov Institute of Atomic Energy was renamed the Troitsk Institute for Innovation and Fusion Research. In 1994 the Institute received the status of a State Research Center of the Russian Federation. In 1997 and in 1999 this status was confirmed. In 1999 the Center passed the State accreditation.

TRINITI is a large scientific center for physical research and engineering development under the programme of controlled fusion synthesis. Of special interest in this field is the creation and development of pulse systems, using laser emission for controlled fusion reaction initiation; relativity electron beams or fast percussion compression of plasma by outer magnetic field.

IV. Management

Kind of organization: State Research Center of RF
Ownership: State Enterprise of RF
Responsible Ministry: Ministry of atomic energy

V. Executives

Director of TRINITI: Vyacheslav D.Pis`menny

VI. Current major activities

Fundamental works on plasma physics, lasers and magnetohydrodynamic (MHD) generators have received priority development in TRINITI.

One of the traditional for the TRINITI scientific activity is a research into laser physics aimed at creation of promising lasers and perfection of laser system performances. The laser devices are built operating on various active media (e.g. carbon dioxide, carbon monoxide, excimer and solid-state lasers) and in various operating modes (continuous wave, single pulse and high repetition rate). The investigations are being carried out aimed at using the lasers in such areas as CTP plasma diagnostics, material processing, laser chemistry and laser isotope separation, environmental control, etc. Of special interest are mobile laser technological systems developed at the Institute. They permit to carry out a remote 50 kW laser action on various objects: in particular, to cut metallic and reinforced concrete structures for disassembly and emergency repair operations at gas and oil wells and nuclear power plants. The implication of mobile equipment proves to be effective for burning films of spreaded oil, deactivating surfaces via peeling and other purposes. The MHD facilities designed by our scientists have demonstrated their applica-bility for electric probing of the Earth's crust, search for minerals and fossils, and earthquake forecasts. Recently a conception of an MHD-generator of a repititive-short-term action has been developed which can find its application, in particular, as a powerful autonomous power supply included into the sea electrical prospecting complex designed to prospect and inspect for quality oil and gas deposits on the shelf.

The main trends in research work

- Research works related to plasma physics and plasma interaction with substances, using devices with strong magnetic fields.
- Investigations of the plasma effects on structural materials of the first wall and studies of diverter plates close to those being implemented at the thermal stage, when separation in unstable.
- The development of the LIDAR laser system for high-temperature plasma diagnostics.
- The investigation and development of pulsed plasma and quasistationary plasma accelerators with megajoule power supply sources.
- The investigation of physical and conceptual problems of the "Compact torns" system.

- The investigation of physical processes, accompanying target irradiations in a two-cascade circuit, with an effective temperature equal to 100-150 eV. Investigations of superdensity Z-pinches in a deuterium plasma at the "Angara-5" complex.
- The use of intensive ion sources and short-wave radiation.
- The development of excimer lasers with the nanosecond and femtosecond durability of radiation pulses for laser fusion-works.
- The simulation of the main fusion physical processes, the development and improvement of diagnostic methods for dense plasma.
- Laser physics studies to develop advanced types of lasers and improve characteristics of laser systems.
- The development of laser technological processes and specialized laser technological complexes for the national economy.
- Theoretical and experimental investigations in the low-temperature plasma physics area to provide the scientific basis for new plasma technologies.
- The development and application of pulsed electron power supply sources, based on MHD, compression and inductive energy converters and on up-to-date technological processes, using these converters.
- The development and manufacture of advanced computer facilities.
- Investigations of physical processes, in operating complicated experimental and commercial power plants in the design and emergency regimes, to increase their safety.

The Institute conducts investigation under agreements with a number of foreign scientific centers.

VII. International and domestic relations

The high level of scientific results obtained and the unique experimentation base provide a fruitful cooperation between the TRINITI researchers and their colleagues from major institutes and firms of the USA, Great Britain, Germany, Jtaly, Japan, France,etc.

VIII.Number of employee

Total Number of Regular Staff - 1800

- 4 Members of the Russian Academy of Sciences
- 38 Doctors of sciences
- 185 Candidates of sciences

IX. Major facilities

TRINITI maintains a highly capable experimentation base which includes a number of quite unique test facilities.

Experimental rigs, instruments stock, a variety of modern computers, available for the Institute, give the opportunity to conduct fundamental and applied research works at the world level.

X. Commercial proposal

- ✓ **Complete set of calorimetric detectors of pulsed and simulated continuous radiation**

Detectors are used in pulsed and pulsed-periodic lasers.

- ✓ **Fast acting electrodynamic gas injectors of high pressure**

Used in gas dynamics and other fields, using pulsed gas supply.

- ✓ **Controllable high-current vacuum switches**

Designed to switch current in capacitance storage devices of large energies

- ✓ **An automation system to speed up and maintain the rotational speed of an motor of a fast acting photodetector**

The system is recommended to be used in various industries to stabilize the rotational speed of electric devices.

- ✓ **A method and device for improving physical and chemical properties of solid surfaces**

The method changes both the micro- and macrostructure of the surface layer of a material. It can be used in treating metals, ceramics, composites.

- ✓ **Highly stable linear detectors of a visible and infrared range made of crystalline quartz.**

These detectors are used to control parameters of pulsed and pulsed-periodic radiation in research works, in automating laser complexes for machine building, microelectronics, biophysics, photochemistry and medicine.

④研究生産機関「アストロフィジカ」（モスクワ市）

State Research Center Of The Russian Federation
Research and Production Enterprise "ASTROPHYSICA"

I. Name of the Institute (Organization)

In Russian:
Государственный научный центр Российской Федерации Научно-Производственное объединение "Астрофизика"
In Russian abbreviation: ГНЦ НПО "Астрофизика"
In English:
State Research Center Of The Russian Federation Research and Production Enterprise "ASTROPHYSICA"
In English abbreviation: SRC R&PE “Astrophysica”

II. Location

Official address: 95, Volokolamskoye sh., Moscow, 123424, Russia
Mail address: 95, Volokolamskoye sh., Moscow, 123424, Russia
Phone:+7 (095) 491-18-57, 490-9104
Fax:+7 (095) 491-21-21
E-mail: aphysica@aha.ru
Access (transportation, necessary time):
Moscow International airport Sheremetjevo-2, then one hour driving by car

III. History

The discovery of the optical quantum generators (laser) in the beginning of 60s provided for the possibility of the development of a new scientific and technical direction - laser technology. The range of research and development efforts in the laser area expanded rapidly owing to the prominent scientists - academicians N.G.Basov, E.P.Velikhov, F.M.Prokhorov, Y.B.Hariton who have taken an active part in those efforts and with wide support from the State leaders.

The Enterprise “Luch” has been founded in 1969 with the aim of concentration scientists and constructors efforts for realization of program on designing laser systems. In 1972 the construction of the Test center has begun for stand and experimental improvement of lasers and the systems based on them. In 70s prominent scientific and technical results have been got that allowed to provide for the development of the whole number of complexes and systems. In 1978 the Research and Production Enterprise “Astrophysica” has been founded. N.D.Ustinov became its Designer General. From the end of 80s together with the works of defensive character a number of wide works in the interests of the national economy was developed. In 1994 in accordance with the decision of the Russian Federation government R&P Enterprise “Astrophysica” has got the status of the State Research Center.

Enterprise's specialists have published 45 monographs and books, more 3000 scientific articles and reports, more 5000 original technical solutions are defended by author certificates.

IV. Management

Kind of organization: State Research Center of RF
Ownership: State property of RF
Responsible Ministry: Minystry of scince&technology, Ministry for Defense

V. Executives

Director General - N.D. Belkin
Deputy Director General - Valery V. Abramov
Chief Engineer - Sergei V. Bilibin

VI. Organization chart.

The structure of the SRC R&PE "Astrophysica":
- State R&P Enterprise "Astrophysica";
- Design and Experimental office "Raduga";
- Moscow electrical and mechanical plant "Nov";
- Design and Experimental office "Ametist".

Affiliate enterprises:
- "Topaz" (Director - Viktor S.Prokofev)
- "SOLTO" (Director - Valeri A. Alekseev)
- "Crystalll" (Director - Valeri P.Barkov)
- "Lazust" (Director - Igor K. Babaev)

VII. Current major activities

Powerful (high energy) lasers and lasertechnological complexes
- solid-state lasers with ultimately small radiation diversion;
- CO_2 - lasers with high output power;
- explosive photodissociation lasers with a record pulse energy;
- free electron laser and excimer lasers;
- laser radiation interaction with substances and media.

On the basis of those lasers technological complexes are developing for cutting, welding, thermal processing of materials, marking of products. Electron-beam installation developing for speedy coating polymerization.

Laser information systems

- the means of laser location for taking coordinate and non-coordinate information about remote objects;
- moving complex for detection the aerosols in atmosphere at ranges up to 5 km;
- the systems of ecological monitoring as well as lidars of various basing for environmental control.

Optical systems. Special optics

- large dimension adaptive optical systems that compensate for wavefront distortions and sharply rising the efficiency of laser radiation;
- development of an astronomical laser with a composite primary mirror with diameter 10 m;
- metallic power mirrors for various purpose, including mirrors with a high beam durability and also light mirrors with diameter up to 1000 mm made from aluminium allows, silicon carbide and other perspective materials with a high reflection coefficient.

On the base of achievements in the fields of optics, telescope construction and in order fields at present effective works are conducting on development of helioenergetic devices for various purposes.

Medical technology

- magnetic laser therapeutic apparatus;
- laser blood flow analyzers;
- meters for measuring oxygen saturation of blood;
- installation for curing cross-eyed people and amblyopia.

The wide spectrum of laser medical devices is developing: therapeutic, surgical, diagnostic.

High Technologies:

- AMIT 01 pulse magnetotherapy unit;
- technology for metals and alloys hardening;
- technological laser complex for decontamination;
- powerful multichannel laser installation;
- powerful laser installation with phase-conjugator;
- active tunable wide-angle OPC-filter;
- diode-pumped, frequency-doubled;
- high-energy pulsed Nd-glass laser;
- multichannel Nd-glass amplifier module;
- lamp pumped Ti:sapphire laser;
- transmitter-receiver device (TRD);
- technology and devices for acousto-optical imaging

VIII. Number of employee

Total number of Center personnel more 5000, including scientific workers - 2000, doctors of science and candidates of science - more 160. Five leading scientists have been elected as Members of the various academies, three scientists have been elected as Associate Members.

IX. Major facilities

Stands with solid state lasers including:

- equipment for research of spectral re-shaping of laser radiation;
- equipment for research and lapping laser radiation steering system;
- equipment for research and lapping of autonomous pumping systems (including diode) for lasers;
- equipment for research of high-power frequency-impulse solid state lasers with reversion of a wave front.

Stands with gaseous lasers including:

- equipment for research of high-power (up to 100 kW) electroionizing CO_2 lasers with adaptation of radiation;
- equipment of electroionizing CO_2 lasers in a permanent regime (up to 30 kW) and in an impulse-periodical regime (up to 50 kW);
- equipment for research of technological processes with the use of laser radiation including laser radiation-material interaction;
- equipment for research of gaseous lasers of different types an non-linear devices for their radiation transformation.

Stand for research and lapping of methods and means of highly precision noise-defended laser location, retrieval and treatment of objects images in real time.

Complex stand for research of laser radiation-materials/structures interaction.

Stand for research and lapping of methods of optic elements fabrication by means of diamond grinding.

⑤レベジェフ物理学研究所付属量子物理学研究所（モスクワ市）

P.N. Lebedev Physical Institute
Institute of Quantum Radiophysics of LPI

I. Name of the Institute (Organization)

In Russian:
Физический институт имени П.Н.Лебедева Российской академии наук (ФИАН)
Отделение квантовой радиофизики
In Russian abbreviation: ФИАН
In English:
P.N. Lebedev Physical Institute
Institute of Quantum Radiophysics of LPI
In English abbreviation: FIAS IQR

II. Location

Official address: P.N. Lebedev Physical Institute, Russian Academy of Sciences, Quantum Radiophysics Institute, Leninsky Pr. 53, 117924, Moscow, GSP-1, Russia
Mail address: P.N. Lebedev Physical Institute, Russian Academy of Sciences, Quantum Radiophysics Institute, Leninsky Pr. 53, 117924, Moscow, GSP-1, Russia
Phone:+7 (095) 135-21-57, 135-85-50
Fax:+7 (095) 135-03-50
E-mail: borisev@sgi.lpi.msk.su
Access (transportation, necessary time):
Moscow International airport Sheremetjevo-2, then one hour driving by car

III. History

The Institute of Quantum Radiophysics was founded in December 1989. It originated from the Sector of Molecular Generators (established in 1956 and headed by Professor N.G. Basov) of the Laboratory of Oscillations of the P.N.Lebedev Physical Institute.

In January 1963, the Sector of Molecular Generators was reorganized into the Laboratory of Quantum Radiophysics. In the subsequent years, some more laboratories had been organized on its basis, They formed the Institute of Quantum Radiophysics of the P.N.Lebedev Physical Institute, and the affiliate Branch in the town of Samara (the Samara Branch of P.N.Lebedev Physical Institute, in 1980). The Institute of Quantum Radiophysics is headed by academician N.G.Basov, the Nobel, Lenin and State Prizes winner.

IV. Management

Kind of organization: Reserch Institute
Ownership: State property of RF
Responsible Ministry: Minystry of scince&technology

V. Executives

Director General - Nobel prize winner, Academician, N.G. Basov

VI. Structure of the Institute

Now the Institute of Quantum Radiophysics involves next three Departments and one Laboratory:

Department of Quantum Radiophysics
Head Prof. N. Basov

- Theoretical Physics Lab (Dynamics of nonlinear systems, Non- classical optics, X-ray optics.)
- Gas Lasers Lab (Interaction of superpower light flows with plasma and beams.)
- Laser Plasma Lab (High-power lasers with electroionization and electron-beam pumping (CO CO, N O).)
- Photochenlical Processes Lab (High-energy gas lasers with optical pumping: new mechanisms of shortwave quality.)
- Nonlinear Optical Phenomena Lab (Laser radiation conversion by the methods of nonlinear optics; high-power solid-state scattering summators and compressors.)
- Frequency Standards Lab (R&D of near IR and visible-range chemical lasers. Ultrashort pulse lasers.)
- Chemical Lasers Lab (Precision optical measurements and enhancement of the quantum frequency lasers.)
- Laser Applications Lab (Excimer and Raman lasers and their applications.)
- Laser Surgery Lab (Laser interaction with biological objects.)
- Laser Ranging of Space Objects Lab (Laser location ofgeodynamic artificial Earth satellites.)

Department of Optpelectronics
Head Prof. Yu. Popov

- Diode Lasers Lab (Development of diode heterostructure lasers: widening of the, spectral range of operation, optimal operation of multi-channel laser arrays, low-noise diode light amplifiers, diode pumping of solid-state lasers.)
- E-beam Pumped Semiconductor Lasers Lab (R & D of laser electron-beam tubes with high radiative fluxes in the TV scanning regime.)

- Optoelectronic Processors Lab (Optical data, processing by spatial time light modulators, and R & D of fast-operation high-contrast high-resolution modulators for this purpose.)
- Superfast Optoelectronics and Data Processing Lab (Integral ilillminators for processors, commutators, and display elements for optical, computers on the base of picosecond laser diodes and waveguiding holograms. Spatial time and spectral densification of optical signals for superdense data transfer systems.)

Department of Laser Thermonuclear Fusion
Head. Prof. L.Feoktistov

- Plasma Diagnostics Lab (Diagnostics of X-ray, optical, and corpuscular radiation of high-temperature plasma with spatial, temporal and spectral resolution).
- Lasers for Thermonuclear Fusion Lab (R & D and exploitation of high-power multi-channel laser systems.)
- Laser Plasma Theory Lab (Theoretical studies of laser heating and compression of the targets, conversion of X-ray radiation and improvement of target irradiation homogeneity. Physics of thermonuclear burning of prospects of thermonuclear energetics.)
- Radiation Interaction with Matter Lab (High-power laser beam interaction with plasma within a wide energy range.)

Laboratory of Molecular Photonics

VII. Current major activities

- Quantum radiophysics;
- New types of quantum generators, ultra-short-pulse lasers;
- Laser interaction with matter;
- Nonlinear optics;
- Optical frequency standards;
- Laser fusion; Optoelectronics;
- Laser applications in chemistry, biology and medicine;
- Laser technologies;
- Laser ranging of cosmic objects;

The most important achievements of scientists at the Institute of Quantum Radiophysics:

- QCW Semiconductor laser array;
- Diode-pumped solid state laser LP-LSI01-2/1;
- Development of the fundamental principles of laser physics;
- Creation of molecular generators and a hydrogen maser;
- Development of chemical lasers, high-pressure electroionization gas lasers;
- Proposal and investigation of regenerative optical quantum amplifiers, achievement of an ultimate value of the signal-noise ratio, amplification of an optical image;
- Theoretical prediction of a dynamic instability (chaos) of a quantum oscillator;

- Investigation of efficient beam combining and beam clean-up technique with SRS oscillators and SRS light amplifiers;
- Creation of the first quantum frequency standards;
- Proposal and realization of laser efficiency improvement by using a Q-switched resonator;
- Pioneering investigations and the production of semiconductor e-beam pumped and optically pumped lasers and the semiconductor injection lasers;
- Creation of the first excimer laser;
- Discovery and the development of the phase conjugation method;
- Development of the methods of optical data processing;
- Proposal of the method of intracavity laser spectroscopy;
- Development of various applications of lasers in technology, biology and medicine;
- Proposal and putting forward an idea of high-temperature plasma production with the help of a focused laser radiation (laser fusion);
- The first registration of the thermonuclear neutrons in hot laser-produced plasma;
- Formulation of the principle of multi-shell target low-entropy compression;
- Demonstration of a stable compression of high-aspect-ratio shell targets;
- Development of optical diagnostics of the plasma and the plasma turbulence under the conditions of laser fusion;
- A reproduction of spectral and temporal parameters of a broad-band exciting radiation due to stimulated light scattering (the effects of parametric interaction) - experimental observation and investigation;
- The first successful attempt of optical ranging of an angular reflector mounted on "Lunokhod-1", and the measurement of the distance between the Earth and the Moon with the accuracy of 10 cm;
- Production of the moving stations for laser ranging of the Moon and Earth satellites;
- Development of a laser cathode-ray tube for color projection TV and the laser addressing tube for optical memory;
- Proposal of an electroionization method for the initiation of chemical reactions;
- Development of a transportable optical frequency standard possessing the highest accuracy characteristics;
- Development of a "Glissada" laser system for aircraft landing.

VIII. Number of employee

Total Number of Regular Staff - 457

The staff of the Institute of Quantum Radiophysics includes 3 members of the Russian Academy of Sciences, 9 members of other Academies of Russia, 27 Doctors of sciences (professors) and 101 candidates of Sciences (PhD).

⑥物理・エネルギー研究所（カルーガ州オブニンスク市）

State Scientific Center
Institute of Physics & Power Engineering
Fisson, Fusion and Laser Studies Department

Ⅰ. Name of the Institute (Organization)

In Russian:
Государственный Научный Центр Российской Федерации Физико-энергетический институт
Отделение перспективных ядерно-лазерных и термоядерных исследований
In Russian abbreviation: ГНЦ РФ ФЭИ
In English:
State Scientific Center Institute of Physics & Power Engineering
Fisson, Fusion and Laser Studies Department
In English abbreviation: SSC IPPE (FF&LS)

Ⅱ. Location

Official address: 1, Bondarenko sq., Obninsk, Kaluga region, Russia 249020.
Mail address: 1, Bondarenko sq., Obninsk, Kaluga region, Russia 249020.
Phone: +7(084) 399-8250, 399-8914, 399-8839, +7 (08439) 98285
Fax: +7(095) 883-3112, 230-2326
E-mail: postbox@ippe.rssi.ru, kuh@ippe.obninsk.ru
Access (transportation, necessary time):
Moscow international airport Sheremetjevo-2, than 2 and harf an hour by car.

The Institute of Physics and Power Engineering (IPPE) is located in Obninsk, Kaluga region, 107 km to the South-West from Moscow on the picturesque bank of the Protva-river, of the Oka tributary.

Ⅲ. History

The Institute of Physics and Power Engineering (IPPE) was established on May 31, 1946 to solve scientific and technical problems of nuclear power development.

In 1951 the IPPE was charged with the task of construction of nuclear power plant. The world's first NPP, with the thermal power of 30 MW (5 MWe) was commissioned on June 27, 1954. After 5 year operation as a nuclear power plant, it has been in use as a research facility to test the channels generating electricity in direct thermionic rnergy conversion mode, for research of nuclear materials, production of isotopes, etc.

The Institute has become a major research and development center dealing with complex studies on the problems of reactor development for nuclear power facilities (NPFs), for various purposes. Solution of serious problems in science and technology is possible due to a high scientific potential of the IPPE. In April 1994, the IPPE was given the status of the State Research Center of Russian Federation (SRC IPPE). Its organisation structure corresponds to the main directions of its activities.

For its fifty-year existence, State Scientific Center of the Russian Federation - Institute for Physics and Power Engineering named after Acad. A.I. Leypunsky has become a major integrated research entity for comprehensive investigations of issues related to the creation of reactors for nuclear power facilities of various applications.

Ⅳ. Management

Kind of organization: State Research Center of Russia
Ownership: State property of RF
Responsible Ministry: Ministry of atomic energy

Ⅴ. Executives

Director General - Zrodnicov A.V.

Fisson, Fusion and Laser Studies Department - Prof. Petr P. Dyachenko

VI. Structure of the Fisson, Fusion and Laser Studies Department

- Laboratory of Atomic Excitations
- Experimental Physics Laboratory
- Theoretical Physics Laboratory
- Techical Physics Laboratory (Technical and Physical problems of a pulse and coupled reactors, nuclear pumped lasers. Mathematical methods and codes for simulation of the physical processes in such a systems.)
- Laboratory of Mechanics
- Laboratory of Solid Radiation Physics (Laboratory is concerned with fundamental studies and applications, experiments and calculations in the field of solid state physics, radiation damage in the materials relevant for nuclear and thermonuclear facilities)

VII. Current major activities

SSC IPPE principal activities:

Basic research and development work.

- Nuclear physics of low-and intermediate energy. Electrostatic multicharged ion accelerators.
- Fundamental plasma processes in thermionic converters and nuclear-pumped lasers.
- Fast and intermediate nuclear reactor physics, physics of radiation shielding.

- Fundamental problems of thermal physics and hydrodynamics; physical chemistry and technology of liquid metal coolants.
- Physics of radiation damage and radiation material science.

R&D works on nuclear power and high-tech problems.

- System analysis of nuclear power development; nuclear fuel cycle-related scientific and technological, economic, and ecological problems.
- Fast-neutron power reactors. Transmutation and fuel regeneration.
- Water-water and channel reactors. Investigation of severe accidents using large-scale experimental facilities.
- Nuclear safety. Nuclear material protection, control and accounting. Technology development and production of new radionuclides.
- Ex-weapons plutonium management. Radioactive waste and spent nuclear material disposition.

Nuclear technologies for national economy.

- Isotopes, medical devices, devices and facilities for industry and science.
- Methods and means of various media filtration and fine purification.
- Devices and systems for environmental monitoring.
- Non-traditional power sources.

Fisson, Fusion and Laser Studies Department

- Physics of Nuclear Fission
- Fusion Physics
- Direct Convertion of Nuclear Energy
- Nuclear Pumped Lasers
- Emerging Nuclear Energy Systems

VIII. Number of employee

where 67 Doctors, 370 Candidates of Science work, and about 4000 research workers and engineers altogether work, and up-to-date experimental and production base has been created.

IX. Major facilities within the Fisson, Fusion and Laser Studies Department

- Twin Core Fast Burst Raectors BARS-6
- Nuclear Pumped Optical Quantum Amplifier
- Special Critical Assembly UKS-1M
- Nuclear Pumped Laseers based on Proton Accelerator

- Mock-up for Subthreshold Diagnostic of Nuclear-Induced Plasmas
- Mock-up for Electrons Spectrum Studies

X. Commercial proposal

Power-generation model of optical quantum nuclear pumped amplifier (OKUYAN)

OKUYAN, a pulse reactor-pumped laser facility, is a prototype of powerful energy laser system of XXI century, to be widely used in power engineering (inertial confinement fusion), technologies (deep penetration welding, brazing, large sized object cutting), space applications (remote power supply of space crafts, laser jet propulsion), etc.
Good prospects for the development of nuclear pumped lasers are based on the unique features of the pumping source: high power intensity, autonomous operation mode, compactness, the possibility to pump large amounts of active media, high reliability.

The energy model of OKUYAN consists of the reactor and laser modules. The reactor module is a two-core pulse fast burst "BARS-6" type reactor (the number of fissions in two cores - $5x10^{17}$; the pulse duration at half-height -40µs).

Laser unit of 1.7m diameter and 2.5m length is a subcritical booster with K_{ef} close to 1 conisting of 10^3 laser-active elements, moderator and neutron reflector elements.

The principle used in optical scheme is: master generator - two-round trip amplifier; the pulse electron beam-pumped laser is used as the master oscillator.

The rated maximum power of laser radiation in transition of X_E - atom with L=1.73µm amounts to 50kJ under pulse duration of 2-10ms.

- SSC RF - Institute of Physics and Power Engineering (Obninsk)
- RFNC - All-Russian Research Instituteof Technical Physics (Chelyabinsk-70)
- General Physics Institute of Russian Academy of Sciences (Moscow)