

**SCIENCE, RESEARCH
& DEVELOPMENT**



POLYTECH

Peter the Great
St. Petersburg Polytechnic
University



Knowledge of high achievements

Peter the Great Saint-Petersburg Polytechnic University is one of the oldest leading institutions of higher education in the country. Opened at the beginning of the twentieth century with an entirely new mission in mind. In its creators' plan, it was supposed to be a unique temple of new ideas.» Throughout the history, the best traditions of polytechnic education were laid and formed and the basis has been created for the training of the best national scientific and engineering personnel. Now, at the beginning of the third millennium, the University is focused on the innovative way of development and integration into the global educational community. We solve major problems aimed at forming a new image of the University.

Today our University is named after the great reformer — Peter the Great. It sets the bar high. Today, the efforts of many thousand strong community of Polytech are aimed at the development and modernization of the Polytechnic University as a University of a new type — a leader in multidisciplinary scientific research in suprasectoral technology and knowledge-intensive world-class innovation.

Polytech has a rich educational, scientific and innovation infrastructure. Research at the University are conducted on the orders of the world giants, and it is about a hundred of international companies. Lectures are delivered by the eminent professors and a system of international educational programs has been developed. The University has everything to prepare top-notch professionals in-demand in the labor market who are capable, in the future, to make a brilliant career in science and science-intensive business. We have already done a lot on the way to the stated objec-

tive. The timely transformational changes allowed our University to win a very important victory – to become a member of the academic excellence program, by entering the list of the best Russian universities pretending to be a world-class institutions.

In the struggle for competitiveness «science» sounds as not the only dominant, but to declare oneself in full force in the world — that, nowadays, can be done mainly due to the scientific potential.

Andrey Rudskoy

Rector, Academician of Russian Academy of Sciences, Professor, DSc

For scientific and university community, it is important to always be on the frontier and to answer the challenges we receive from the global economy in a most competent way



POLYTECH CHRONICLES

GREAT HISTORY PAGES

The University, since its foundation, plays a special role in the development of new scientific fields — physics, energetics, metallurgy, mechanical engineering and economics. Polytechnicians have contributed to the history of the world of science, and many of their discoveries can be considered as a real breakthroughs.



1899
Among the founders of the University — prominent reformers and outstanding representatives of scientific community — Finance Minister Sergei Witte, Prince Alexei Gagarin, the creator of the periodic table of chemical elements Dmitri Mendeleev.



1915
Professor Nikolai Zelinsky invented and developed the design of the world's first gas mask.



1916
A theoretical physics seminar, led by Professor Abram Joffe, has started. It became the cradle of a unique world-class school of physics.



1928
The future Nobel laureate in Chemistry (1956), one of the founders of Chemical Physics, Nikolai Semyonov starts at the Polytechnic in position of Professor.



1920–1940
The «PhysMech» system developed and implemented at the Polytechnic Institute has become one of the best models of education design and determines the basis of polytechnic training system that becomes a benchmark for future generations.



1940
A graduate of the University Georgi Flerov discovers a new type of radioactive transformations — the spontaneous fission of heavy nuclei. The 114th member of the Periodic Table is named after Flerov — Flerovium.



1940–1950
Polytech becomes the cradle of the Soviet atomic project. Yuli Hariton, Igor Kurchatov, Yakov Zeldovich and other scientists have made a decisive contribution to the implementation of the nuclear project and the creation of the country's nuclear shield.



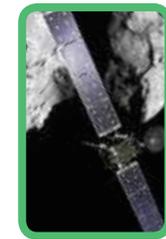
1958
The first Head of the Department of Biophysics Semen Bresler at a meeting with Dr. Francis Crick. Polytech — one of the first technical colleges in the country, began to develop biomedical direction in education, research and development.



1978
Peter Kapitsa, Polytech alumni 1919, received the Nobel Prize in Physics for his fundamental research in the field of low temperature physics.



1995–2000
The department of experimental nuclear physics is involved in various international projects carried out in the largest nuclear physics centers of the world -- CERN (Switzerland, ALICE project), the BNL (CIF, PHENIX Project).



2004
Polytechnic scientists developed the Comet Atmosphere Model to take a part in ESA Rosetta Mission



2011
110th anniversary of Anatoly Lurie — a prominent Russian scientist (mechanician), corresponding member of the Soviet Union Academy of Sciences, founder of the world-known scientific and pedagogical school



2014
Polytech restores its historic name — Peter the Great St. Petersburg Polytechnic University.



1902
Inauguration of the University, which was built on the Oxford and Cambridge principles as an autonomous complex with a sound ecosystem for professors and students.



1915
Stephen Timoshenko, a prominent scientist (mechanician) of the 20th century, was appointed to become a professor at St. Petersburg Polytechnic Institute, after having worked for ten years as a lecturer of applied and theoretical mechanics, theory of elasticity and structural mechanics.



1931
Within the walls of the Polytechnic Institute of George Gamow, who was invited from the Leningrad Physico-Technical Institute, formulated the theory of half-decay.



1939–1941
Mikhail Koshkin, a graduate of Polytech creates the first series of T-34 tank, recognized as the best medium tank of World War II.



1956
With the help of the space television equipment «Yenisei», the world's first back side of the moon shots were received.



1966
The problem of ensuring a soft spacecraft landing during return to Earth was solved under the guidance of Professor Yevgeny Yurevich.



1980
In this decade, more than 80% of the works were carried out in the interests of the defense industry.



2000
Nobel Prize in Physics for developing semiconductor heterostructures and the establishment of fast opto- and microelectronic components receives Zhores Alferov, since 1988 head of the Department of Physics and Technology.



2013 r.
The Polytechnic has been selected among the leading Russian universities to participate in a program of academic excellence.



2015
Polytech graduates have played a significant role in the creation of the modern Russian Navy. Naturally, that sets the heavy nuclear missile cruiser «Peter the Great» under Polytech patronage.

1899

1910

1920

1930

1940

1950

1960

1970

1980

1990

2000

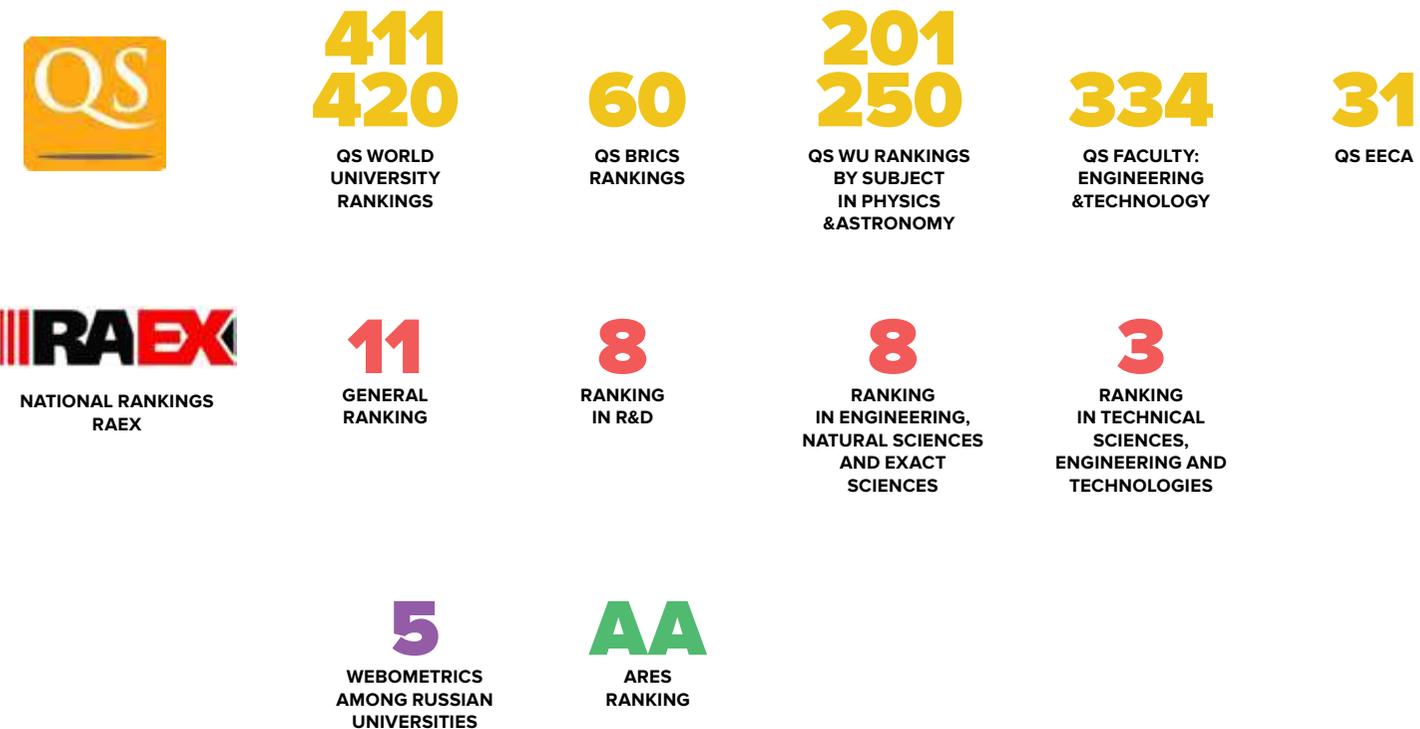
2010

2020

DYNAMICS OF CHANGES

WHERE WE ARE NOW

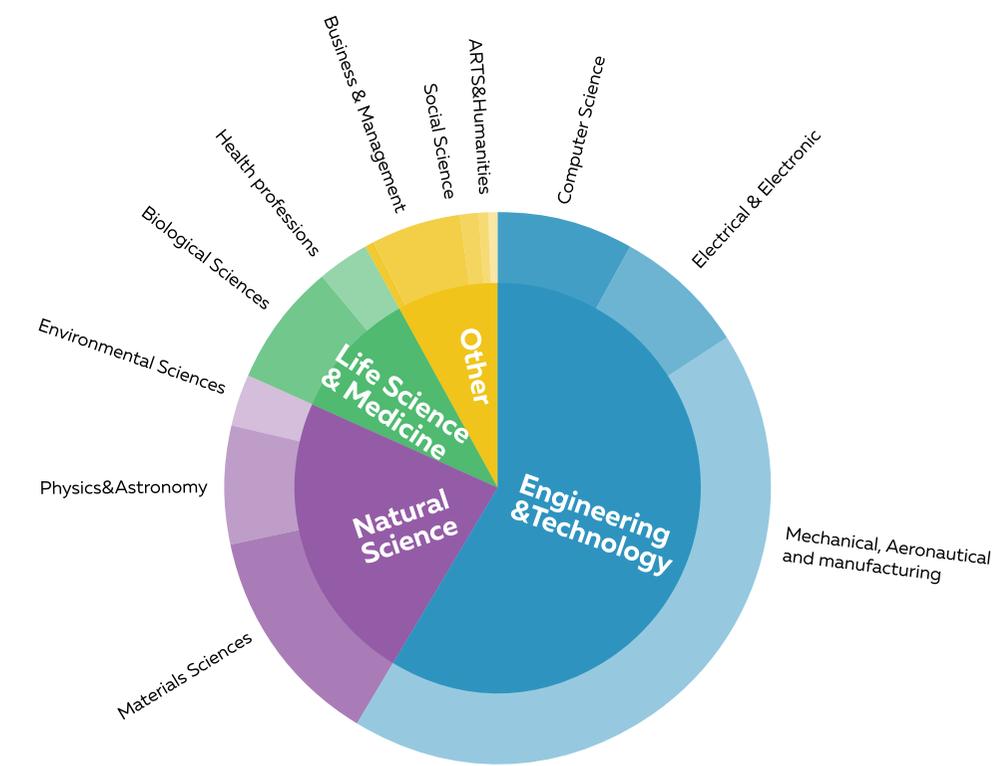
The main strategic aim of Peter the Great St. Petersburg Polytechnic University — the modernization and development of the University as a globally competitive research and education center that integrates multidisciplinary research and world-class technology and which is one of the world’s leading universities. Participation in major government projects for modernization of higher education during the last decade had a significant impact on the effectiveness of scientific research and technological development in the University. The funding of research projects during this time was greatly increased, by several times, resulting in greatly expanded range of areas to develop scientific research.



A WORLD-CLASS UNIVERSITY

Global Strategic goal of Peter the Great St. Petersburg Polytechnic University is modernization and development of university as world-level competitive scientific and educational centre, which integrates multidisciplinary scientific research and top-level technologies, one of the leading world universities.

- Institute of Civil Engineering
- Institute of Advanced Manufacturing Technologies
- Institute of Physics, Nanotechnology and Telecommunications
- Institute of Energy and Transport Systems
- Institute of Computer Science and Technology
- Institute of International Educational Programs
- Institute of Metallurgy, Mechanical Engineering and Transport
- Institute of Applied Mathematics and Mechanics
- Institute of Industrial Management, Economics and Trade
- Institute for Military Engineering and Safety Research
- Institute of Physical Education, Sport and Tourism
- Institute of Humanities

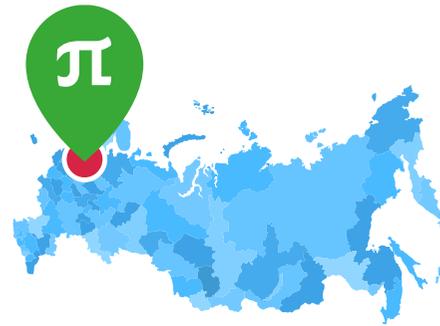


Polytech's research themes

Russia



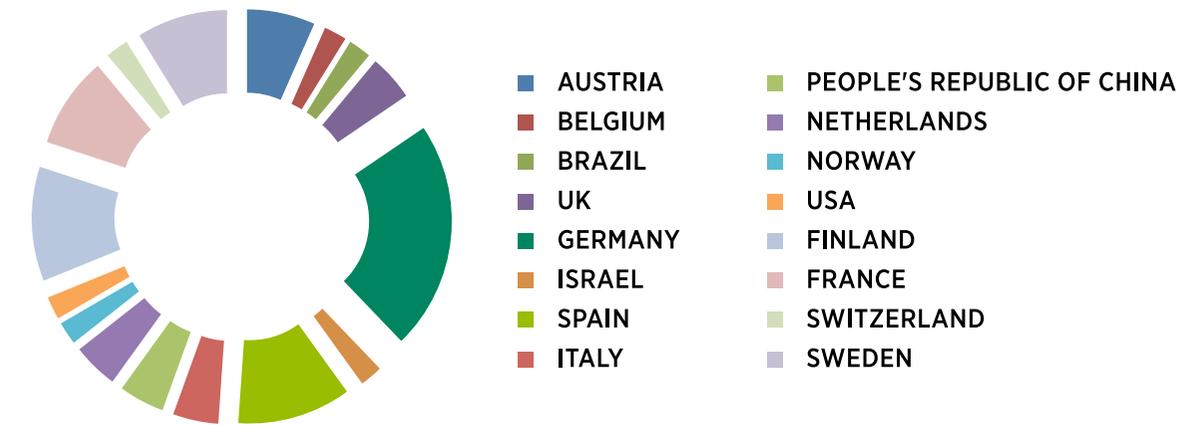
St.Petersburg



Polytech



Collaboration with leading (TOP500 of world university rankings) universities, by countries



Yuri Vasiliev

SPbPU Scientific Supervisor
Academician of Russian Academy of Sciences, Professor, DSc

We are confident in our abilities. And this confidence is based not only on strong traditions, but also on the achievements of today. Our solutions are widely used in many domestic industries. We are improving the learning process in close connection with science, keeping all the best, that has been accumulated over the years and decades in the national system of higher polytechnic education.

International perspective

120

HECTARES
CAMPUS
AREA

200

ACADEMIC
BUILDINGS

↑50

NEW
ACADEMIC
PARTNERS

Strengthening our university relations with the world's leading universities and research organizations

↑40

LEADING
SCIENTISTS

We build strong links at institutional and individual researcher level with other academics across the world

↑50

NEW LABORATORIES
AND RESEARCH
GROUPS

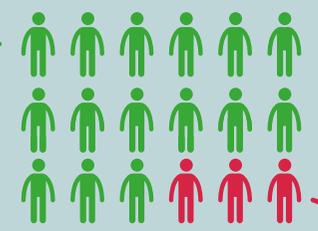
Open new labs headed by outstanding scientists and academicians

UNIQUE CAMPUS

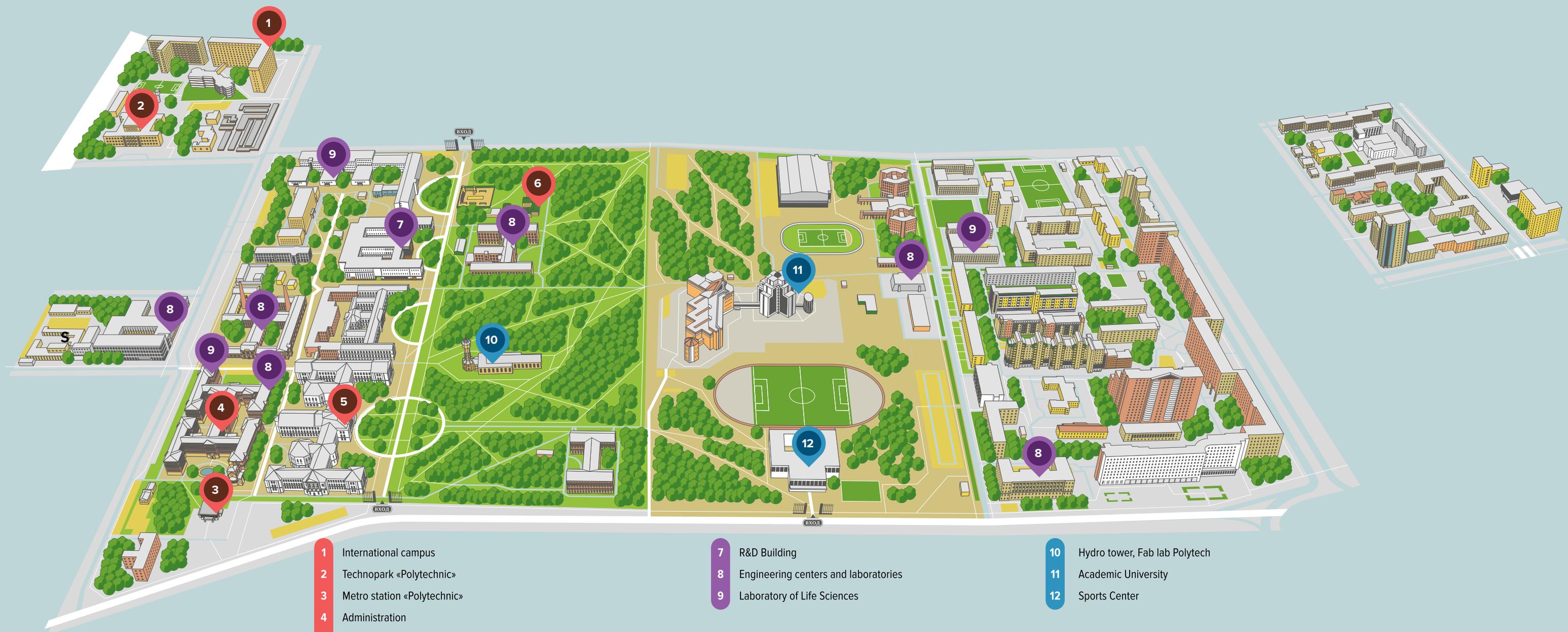
FOUNDED IN **1899**



30 000 +
TOTAL NUMBER OF STUDENTS



4 500
INTERNATIONAL STUDENTS



- 1 International campus
- 2 Technopark «Polytechnic»
- 3 Metro station «Polytechnic»
- 4 Administration
- 5 The main building, White hall, Library
- 6 House of Scientists in Lesnoye

- 7 R&D Building
- 8 Engineering centers and laboratories
- 9 Laboratory of Life Sciences

- 10 Hydro tower, Fab lab Polytech
- 11 Academic University
- 12 Sports Center

DYNAMICS OF CHANGES. WHERE WE ARE NOW



A Discussion about Breakthrough Technologies of the 21st Century



III All-Russian School for Young Scientists within the framework of the conference «NFM -2016»



Supercomputer Center «Polytechnic»



The St. Petersburg International Symposium «Systems Biology and Bioinformatics» (SBBI'2016)



The visit of Prime Minister of the Russian Federation Dmitry Medvedev to Polytechnic University



Fourth China (Shanghai) International Technology Fair



Terence Langdon, Outstanding Scientist, Became Honorary Doctor



"International Design Project", VIII International School by Fablab Polytech



Science

THE SCIENTIFIC LANDSCAPE

MEGAGRANTS

RASA

Zhores Alferov

Nobel Laureate in Physics,
Vice-President of the Russian Academy of Sciences,
Science Advisor of Institute of Physics,
Nanotechnologies and Telecommunications,
Professor, DSc

A distinguishing feature of our University is that it is an interdisciplinary complex of the most important fields of modern science and technology. The most modern physics, nanotechnology, radio electronics, medical physics — that is an interdisciplinary level of future



THE SCIENTIFIC LANDSCAPE

RESEARCH EXCELLENCE

Comprehensive analysis of the university research environment allowed us to focus on the priority research areas and identify potentially strong areas for the future. A significant focus on supporting research groups, projects and scientists — this is what lies at the heart of strategic development of science policy.



Andrey Rudskoy
Academician of Russian
Academy of Sciences,
Professor, DSc

New materials and technologies

Materials with unique properties

Conducted unprecedented research in the field of nanotechnology in metallurgy, including production of nano-powders, nanostructured materials and products, and products and preparations of nanostructured materials by methods of plastic deformation and thermomechanical processing. Key directions of scientific work is development of theoretical bases and creation of high technologies for the production of nanostructured materials with high performance and special physical and chemical properties. Interesting is the combination with additive technologies — because of the features of layer-by-layer synthesis requires less time for production and reduces the cost of production, saving of raw materials. This enables us to reach a qualitatively new level of sophisticated design products.



Mikhail Fedorov
Academician of Russian
Academy of Sciences,
Professor, DSc

Biofuel energy-efficient technologies

Technology energy-efficient recycling and use of energy potential of organic waste

Development of scientific and technical bases for the creation of energy-efficient technologies to produce high-quality biogas fuel from organic wastes for utility purposes. Given the availability of biogas sources and subjected to an effective technology for biomethane and hydrogen-containing fuel, an opportunity arises for autonomous development of hydrogen energy based on local fuel resource. This requires the development of innovative technologies to create installations on the basis of the fuel cell system — one of the priorities in modern world power. A key goal is development and implementation of methods for biogas usage installations as an additional unstable energy battery combined with wind farms, solar power plants and other renewable energy resources.



Mikhail Khodorkovsky
Associate Professor,
PhD

Nanobiotechnology

Studying the Composition and Structure of the Most Complex Biological Objects

The NIC uses modern experimental approaches to the study of complex biological objects, identifying their functions at the cellular and subcellular levels, determination of trace amounts of metabolites in human waste, the study of complex biochemical processes at the molecular level, the research on the monomolecular level of nanobiomachine dynamics:

- NMR spectroscopy of high resolution;
- a unique method for studying nanobiodynamics of biological structures on the monomolecular level.
- For these purposes, laboratories are equipped with modern equipment:
- NMR spectrometer (Varian 700, USA);
- mass spectrometer ion cyclotron resonance Fourier transform FTMS and two ionization ion source: electrospray and MALDI (Varian, USA);
- chromatography-mass spectrometer LCMS-IT-TOF (Shimadzu, Japan);
- a comprehensive system for the study of the dynamics of nanobiomachines (USU «laser tweezers»).



Yaroslav Berdnikov
Professor, DSc

Experimental nuclear physics

Particle physics and neutron research in mega science projects

Scientists are involved with the launch of two major experiments for the study of relativistic heavy nuclei interactions — PHENIX experiment at the RHIC heavy ion collider (BNL, USA) and the ALICE experiment at the Large Hadron Collider (LHC, CERN, Switzerland). They are designed for the study of phenomena in collisions of heavy ions colliding beams at different energies. With the assistance of the research team, several unique track detectors were built for central PHENIX experiment spectrometers — drift chamber and muon chambers on ALICE detector. Researchers participated in all sessions of the work during PHENIX and ALICE experiments and made an important contribution to the functionality of the detectors, experimental data collection and their physical analysis and interpretation.

Politechnicians conduct research in the field of high energy physics in proton + proton collisions, proton + core, the nucleus + nucleus at energies of the Large Hadron Collider and the Relativistic Heavy Ion Collider.



Alexey Borovkov
Associate Professor,
PhD

Computer-Aided Engineering

Multi- and Trans-Discipline, Cross-Sectoral and Computer Engineering Supercomputing

Trans-discipline and super computer-aided engineering — is a fundamental basis and breakthrough technology for urgent development of globally competitive and in-demand products in shortest time in hi-tech industries.

Priority directions in this field:

- Mechanics of deformable solids; mechanical structures, machinery, instruments, equipment, installations and structures; dynamics and durability of machines; mechanics of composites and composite structures, fracture mechanics, structural mechanics, the mechanics of plastic metal forming;
- Multidisciplinary research (deformable solid mechanics, heat transfer, thermomechanics, fluid dynamics, structural mechanics to fluid / fluid in electromagnetism, electromagnetoelastic acoustic);
- Multidisciplinary research (deformable solid mechanics, heat transfer, thermomechanics, fluid dynamics, structural mechanics to fluid / fluid in electromagnetism, electromagnetoelastic acoustic);
- Application and development of advanced science-intensive computer technologies.



Dmitry Varshalovich
Academician of Russian
Academy of Sciences,
Professor, DSc

Space Research

Astrophysics, Cosmology, Origin of the Universe

The scientific team is involved in the study of various astrophysical objects and phenomena. These are relativistic objects, such as white dwarfs, neutron stars, supermassive black holes which are a central engine of active galactic nuclei and quasars. The study of quasar spectrum allows us to obtain information about the Early Universe. Polytechnicians investigate such astrophysical topics as high energy gamma astronomy, cosmic rays, nuclear astrophysics. The theoretical activities follow several directions. Cosmology: Primordial Nucleosynthesis, Primordial Recombination, physical conditions and chemical composition of the Early Universe, problems of dark matter and dark energy. The researches participate in observational program at the largest ground-based optical telescope (6-m SAO RAS, 8-m VLT/ESO) and orbital observatory (INTEGRAL, Chandra).

THE SCIENTIFIC LANDSCAPE

LEADING GROUPS



Nanotechnology and telecommunications

Modern infocommunication systems



Sergey Makarov
Professor, DSc

Development and implementation of comprehensive programmes to improve the efficiency and competitiveness of prospective systems for collecting, transmitting and processing information, including including optical and fiber-optical sensors, micro- and nanoelectronic components and devices. Research activities related to the development and improvement of terrestrial and satellite radio communication systems, radio navigation and radar systems for various purposes, as well as modern communication systems.

New materials and additive technology

Functional materials and nanocomposites for lithium-ion batteries



Anatoly Popovich
Professor, DSc

Scientists develop promising cathode and anode materials for lithium-ion polymer batteries, and nanostructured coatings and gas-phase mechanochemical methods of synthesis, including using the installation «PICOSUN». Research of processes of mechanical alloying and sps processes- and vacuum-compression sintering. Key project is to aim at creation of advanced nanocomposite cathode material on the basis of Li₂FeSiO₄ for lithium-ion batteries.

Construction of buildings and structures

Design of building, engineering networks, systems and materials



Nikolay Vatin
Associate Professor, PhD

We have a wide range of works in the field of designing of buildings and constructions, engineering networks and systems, testing of building construction and materials. Researchers pay special attention to such fields of research as purification of air and industrial gases from dust by inertial separation. Scientific work is carried out to improve, optimize and enhance the reliability of systems of heat and gas supply, heating, ventilation and air conditioning.



Vladimir Zaborovsky
Professor, DSc

Telematics and supercomputer technologies

Automated management of cyber-physical systems

Modeling and analysis of processes, protection of information in computer networks. The focus of attention of researchers is cloud computing: technology, benefits of use, the concept of integration of cloud technologies in AIS, the introduction of such technologies and protection of information. Research is underway in the field of robotics and high performance computing. Space research require the establishment of effective systems of remote automated control of technical objects: spacecraft and robots. Improvement of the information exchange technologies and management of space and planetary robotic systems — among key scientific objectives of the group.



Nikolai Kolbasnikov
Professor, DSc

Investigation and modeling of structure and properties of metallic materials

Investigation and modeling of structure and properties of metallic materials

The laboratory of plastic metal processing technology develops steels and alloys, including high-strength automotive steel sheet, characterized by unique consumer properties — formability, weldability, dyeability, impact energy absorption during collisions. Researchers developed intelligent information technology to describe the process of thermomechanical treatment of steels and alloys with a given level of mechanical properties, optimizing chemical compositions while maintaining the level of mechanical and performance properties of the steels to optimize the energy-power parameters, taking into account changes in the chemical composition and structural state of alloys.



Alexey Filimonov
Professor, DSc

Physical electronics

Physics of Nanocomposite Materials, investigation of the nanostructure

The main tasks of the scientists are research and development of new nanomaterials for the electronics industry, as well as training professionals able to independently develop similar materials and production technologies.

Among the promising areas include the development of:

- microwave generation systems on the basis of regular arrays of Josephson junctions
- microchannel plates based on porous matrices.
- adaptive elements of nonlinear optics
- «accumulators of mechanical energy» based on nanoporous materials.



Pavel Yakutseni
Professor, DSc

Interdisciplinary Research

HPC for biological systems

Studies aimed at obtaining new fundamental knowledge about the mechanisms of the impact of high-energy photons and ions in the biological tissue and the development of nanoparticles introduced on the basis of this knowledge. This approach is fundamentally more efficient for sparing methods of treatment and diagnosis of cancer.



Renewable Energy

Renewable energy sources and technologies of independent power supply

Conducted basic research in the field of conversion and energy storage for renewable sources and applied research in the field of engineering solutions for design of renewable energy facilities.

Developed expert-information technologies to ensure the efficiency and reliability of power plants and complexes based on renewable energy.

Conducted comprehensive research into solar, biomass, wind and hydro-power plants on the basis of physical and mathematical modeling, as well as computer-aided design and mathematical modeling of hydro and water facilities.

Victor Elistratov
Professor, DSc



Data visualization in Virtual Reality in Engineering

Computer simulation technology in virtual reality systems

The field of activity of the scientific group — the creation and development of virtual engineering technologies using virtual surround systems. Competence of the research group is focused on the development of algorithms for solving extraordinary problems of science and technology in the field of the analysis of the results of predictive modeling based on virtual surround systems, the use of multiprocessor systems. One of the first Russian high school hardware and software system virtual environment based on the system of 3-sided CAVE 3D (Computer Aided Virtual Environment) was created at the department using 3 transparency screens, video cluster, optical tracking system and Display Wall based on 16 LCD Monitors NEC «46 UN.

Nikolay Shabrov
Professor, DSc



Real-time 3D graphics

3D computer graphics in real-time

Main research areas - a 3D computer graphics real-time processing and analysis of images, massive parallel computing on GPUs

- Modeling and visualization of physical processes in real time - the spread of fire and smoke in the fire simulator, the hair in the wind animation for cartoons.
- 3D reconstruction at computer tomography and US — recovery 3D models biological object by output data computer tomograph or ultrasound scanner.
- Processing and analysis of medical images - detection of pathological changes in the areas of X-ray and tomographic images, ultrasound scan pictures.
- Software development for a new generation of computer tomography, having the ability to track and compensate for movement of the heart during the scan.

Igor Shturts
Professor, DSc



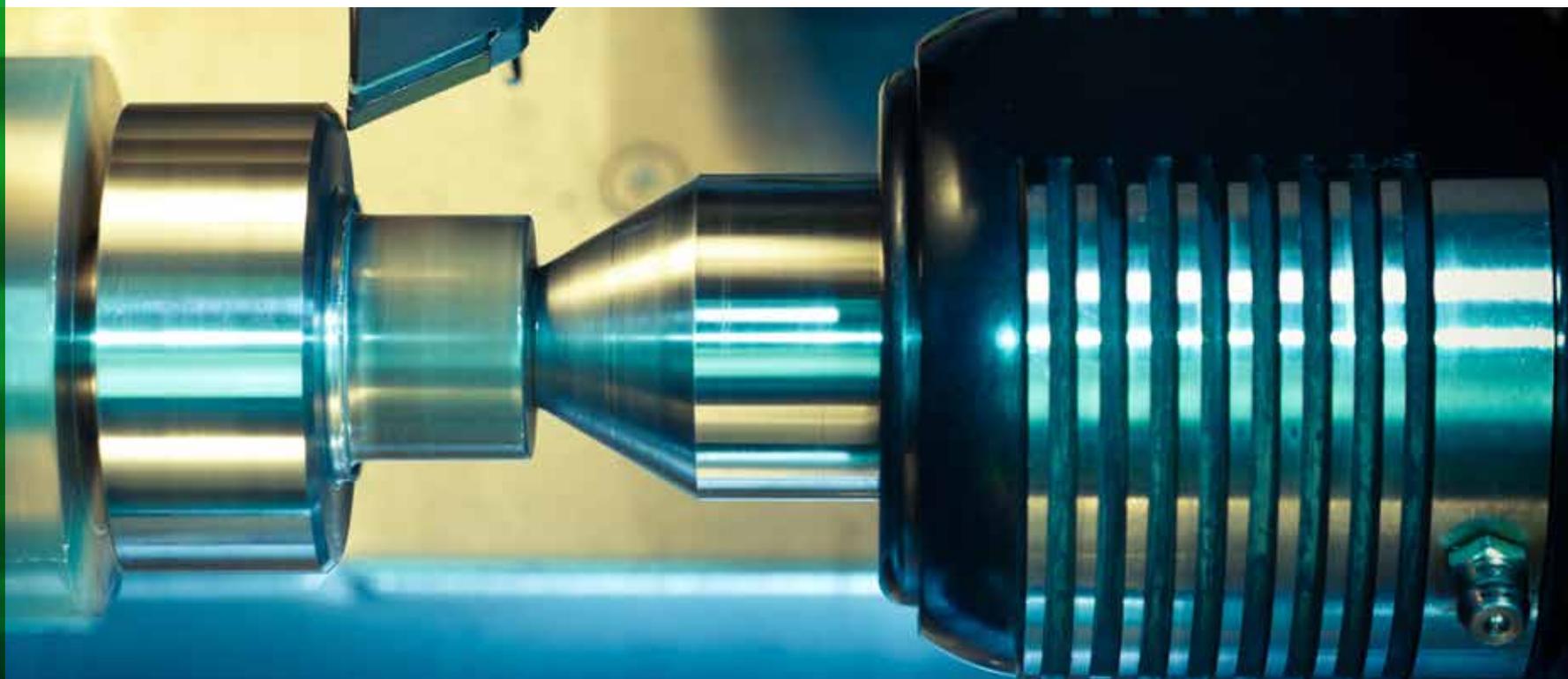
Quantum computing

New technologies for practical realization of quantum multi-bit registers

The developed technology and model samples of electronic components need to ensure the practical realization of quantum multi-bit registers, which are regarded as promising components of hybrid systems, high-performance cloud computing.

Creating scientific and technological potential for wide use of silicon nanosandwiches for qubits, promising component of hybrid systems, new generation high-performance cloud computing.

Nikolay Bagrayev
Professor, DSc



Fluid Dynamics

Solving fundamental and applied problems of fluid dynamics and heat transfer

The scientific team is focused on the development of modern computing methods and tools for the study of fundamental and applied problems of fluid dynamics and heat transfer at low and high speeds. The highly developed supercomputer computational fluid dynamics package SINF, implemented by the group for solving three-dimensional Navier-Stokes equations based on the finite volume method using a multi-block grids, is being used for the study of turbomachinery problems, thermal power, nuclear power, shipbuilding, industrial aerodynamics. RANS- and eddy-resolving approaches are used for turbulence modeling. Activities of the research group also covers the issues of interaction of flows and designs, trends in the field of mass forces, the dynamics of flows with a free surface, the conjugate heat and mass transfer in multiphase flows.

Evgeny Smirnov
Professor, DSc



Computational hydroacoustics and turbulence

Mathematical modeling of turbulent flows

The main activity — carrying out research work in the field of computational fluid dynamics and heat and mass transfer. The company has long-standing partnerships with leading aircraft and engine-building companies as well as company ANSYS, which is one of the leaders in the development of software for computational fluid dynamics.

Michael Strelets
Professor, DSc



Bioinformatics

Mathematical biology of systems, relationship of variability and stability in biological systems

Mathematical systems biology seeks to answer the main question: how the interaction of the molecules lead to the orderly and expedient behavior of cells, organs and organisms. This area of knowledge unites the efforts of mathematicians, biologists, physicists and programmers. Developed by the authors of the project, FlyEx database of gene's segmentation is one of the most popular in its field among the world scientific community.

Maria Samsonova
Professor, DSc



Systems biology

Development of vesicular transport model

Development and validation of the mathematical models of neurodegenerative diseases in humans. The work is carried out on a unique experimental material – an artificial organelles grown from precursors of nerve cells from healthy and sick patients with schizophrenia. The basis of the project of mapping genetic variability of the phenotype is the study of gene regulatory network that controls the structure of the body plan in the fruit fly *Drosophila*. Scientists create e-atlas of standardized time series of images of vesicular transport in the cells, and is developing a mathematical model of vesicular transport.

Sergey Nuzhdin
Professor, DSc



Adaptive Control Systems

Methods of adaptive control of distributed systems

Research and advancements in the area of fundamental approaches, development and application of new methods for the intelligent control of distributed systems, technological processes, android robots and cooperative behavior of robots networks based computational mathematics, computer technologies and theory of artificial intelligence. Development of new adaptive-stochastic methods in computational mathematics and mechanics.

Dmitry Arseniev
Professor, DSc



Microsystems technology

Research and development in the field of Nano- and Microsystem technology

Research laboratory has extensive experience creating devices Microsystem devices based on the developed technological base and physical methods and mathematical modeling.

Innovative projects:

- The highly sensitive strain gages;
- High temperature strain gages;
- Test Manager the medical catheter to measure pressure in the internal cavities of a patient;
- Vacuum micropropagated industrial purposes;
- Power strain gauge-type microsensors.

Eugene Pyatyshev
PhD



Molecular Virology and Oncology

Breakthrough into a Evolutionary Oncology and HIV

Areas of research covers a wide range of theoretical and practical issues, from molecular and evolutionary oncology to the prevention of infectious diseases and the development of a HIV vaccine.

Research group is studying the molecular and genetic characteristics of parenteral HIV transmission: using deep sequencing techniques will be studied thousands of virus variants for each sample. The vaccine, developed by Prof. Kozlov, has successfully passed Phase II clinical trials.

The hypothesis of the evolutionary role of tumors proposed by professor, and the prediction of expression of evolutionary new genes in tumors, allows the use of new bioinformatics approaches to search for potential tumor markers.

Andrei Kozlov
Professor, DSc



Testing technologies and programming

Improving the quality of software products

In the focus of attention of scientists is technology and tools that automate the cycle of creating a quality software product from formalization of requirements in natural language, analysis and symbolic verification to automatically generate test code and actual testing.

The peculiarity of the technology is to verify satisfaction of the requirements of semantics in the generated software product. Despite the wide range of applications the orientation of today's technology on network and distributed applications.

Vsevolod Kotlyarov
Associate Professor,
PhD



Superstrong pulsed magnetic fields

High Voltage Equipment

Research group focuses on the technological application of pulsed electric fields and discharges. However work is underway in the field of superstrong fields: proposed and developed a new concept in the field of superstrong magnetic fields, based on the use of solenoids with quasi-force-free winding. This work opens the possibility of achieving field with induction above 100 T in indestructible magnets.

Herman Shneerson
Corresponding member
of Russian Academy
of Sciences, Professor,
DSc



Materials and Technologies

Nanoparticles synthesis by different methods

Areas of scientific activity: Nanoparticles synthesis by different methods (gas phase synthesis, microwave synthesis, spray dry of solutions and suspensions, electrochemical synthesis) and its applications, composite and hybrid functional materials, materials with special properties (electric, optic, magnetic, tribological, piezoelectric).

Main scientific research and experiments carried out Magnetic nanoparticles synthesis and applications; Synthesis structure and properties of transition metals chalcogenides thin layers and nanoparticles; Synthesis structure and properties of carbon nanomaterials by CVD; Metal matrix composite materials reinforced by nanocarbons; Polymer-based composite materials.

Oleg Tolochko
Professor, DSc

THE SCIENTIFIC LANDSCAPE RESEARCHERS OF THE FUTURE



Mechanics Laboratory of new nanomaterials

Modern infocommunication systems

Scientists engaged in the development and study of the theory of plastic deformation and failure processes in new super strong materials. This will affect the production technology of materials with a unique combination of ultrahigh strength and functional plasticity.

Ilya Ovidko
Professor, DSc



Software development

Improving software quality using formal methods

The software development laboratory conducts research in the area of improving software quality using formal methods. For this purpose used deductive methods of verification the methods of complete and bounded model checking, static program analysis, automated testing and synthesis tests, automated software re-engineering, dynamic program analysis, etc.

These approaches are applied to software systems written in C, C++, Java, and software and hardware systems that are modeled using the SystemC language.

Vladimir Itsykson
Associate Professor,
PhD



Precision physics

Precision physics of simple atomic systems.

The works of chief scientific officer come in two major clusters: one associated with the specification of the fundamental constants , the other - with the study of polarization and x-rays. His work on the two-loop calculations of QED effects in atoms without an expansion in the external field received an international recognition. The work on the calculation of the anomalous magnetic moment of the bound electron , which resulted in a more accurate value of the electron mass, is widely cited.

Vladimir Erokhin
Professor, DSc



Photonics

Development of advanced photonic devices

High-speed analog to digital convertors (ADC) are vital for development of next generations of ultra high-speed mobile networks, smart sensors systems, advanced high resolution radar systems etc.

However, further progress in development of analog-to-digital convertors (ADC) for the frequencies beyond 2.5 GHz based on microelectronics is limited by fundamental physics. An alternative approach is to use light to carry high frequency signals and accomplish conversion of signal from analog to digital form on optical level.

The target of the project is to develop advanced photonics components: mode-locked lasers and photodetectors for new generation of all-optical analog-to-digital convertors.

Maxim Odnobludov
PhD



Vertical Cavity Surface Emitting Lasers

Perspective autonomous navigation systems

Researchers are working on development and studying the temperature-stable vertically emitting lasers for practical use in quantum frequency subminiature standards and miniature perspective gyroscopes based on nuclear magnetic resonance effect. Such devices are used to reduce the vulnerability of navigation systems using satellite signals, and creating interference-protected secretive communications systems.

Victor Ustinov
Corresponding member
of Russian Academy
of Sciences, Professor,
DSc



Applied Mathematics

Virtual-simulation modeling

Laboratory of virtual-simulation performs a variety of interdisciplinary projects on computational mechanics and related areas. Development of specialized software, a comprehensive analysis of engineering problems arising in industrial companies. Simulation and calculation of stress-strain state of complex mechanical systems. Modeling of composite materials. Stationary and non-stationary calculations, the study of influence of forces and vibrations. Stationary and non-stationary calculations flow of liquid and gas in areas with complex geometry. Calculations using supercomputer technologies and the world's leading CAD / CAE, FEM and CFD software systems.

Sergey Lupuleac
Associate Professor,
PhD



Integrated Circuitry Communication Systems

nano- and microelectronic component base

The field of activity of the scientific group — the creation and development of virtual engineering technologies using virtual surround systems. Competence of the research group is focused on the development of algorithms for solving extraordinary problems of science and technology in the field of the analysis of the results of predictive modeling based on virtual surround systems, the use of multiprocessor systems. One of the first Russian high school hardware and software system virtual environment based on the system of 3-sided CAVE 3D (Computer Aided Virtual Environment) was created at the department using 3 transparency screens, video cluster, optical tracking system and Display Wall based on 16 LCD Monitors NEC «46 UN.

Alexander Korotkov
Professor, DSc



Micromechanics of destruction

Modeling of the materials behavior

The main focus of the lab is to model the behavior of materials with complex internal structure at the nano, micro, meso and macro scales. The developed models and algorithms are used to describe the processes associated with strong deformation and fracture of materials, as well as the creation of new materials with unique properties.

Mark Kachanov
Professor, PhD



Metallurgical Engineering Expertise

ensuring the quality of the finished product in the production of steels and alloys

The RL is developing technical recommendations to improve the quality of finished products in the production of steel and alloys, quantitative methods of assessing the quality of steel. The laboratory is equipped with optical microscopes, image analyzers with integrated Thixomet SmartDrive for panoramic study the structure of materials, there is a complete line of machines for shlif preparation.

Alexander Kazakov
Professor, DSc



Physics and Technology of heterogeneous materials and nanoheterostructures

Reproducible synthesis of semiconductor nanostructures

The aim of the group is to develop the scientific bases and technology development for reproducible synthesis of semiconductor nanostructures, investigation of new physical effects and phenomena in them, development, simulation and experimental study of devices based on those new effects and phenomena.

Alexey Zhukov
Correspondent Member of Russian Academy of Sciences, Professor, DSc



Optics laboratory of nonequilibrium electrons

Development of physical bases of semiconductor optoelectronic devices

The main direction of scientific research is optical phenomena and optics of hot electrons in semiconductors and semiconductor nanostructures associated with intraband transitions of charge carriers; Development of physical bases of semiconductor optoelectronic devices mid-infrared and terahertz ranges. The laboratory is equipped with world-class equipment: vacuum Fourier spectrometer Bruker Vertex v80 at spectral range of 0.5-1000 microns, lattice spectrometers, photodetectors, closed cycle cryostats for temperatures 4.2-350K, measuring equipment (lock-in amplifiers and boxcar integrators).

Dmitry Firsov
Professor, DSc



Radiophysics and electronics

Conducted a series of studies of the application of spectral interferometry to measurements of the absolute optical values of the path difference with PM resolution. Similar technology can be the basis for ultra-precise optical optical temperature sensors, pressure, etc. the physical quantities.

Leonid Liokumovich
Associate Professor, DSc



New composite materials

Research of chalcogenide materials

Design and synthesis of glassy chalcogenide materials, infrared optics, diagnostics of precious minerals, nonlinear optics, chalcogenide glass-ceramic composite material.

This group of researchers specializing in the synthesis and use of low-melting chalcogenide glass and glass-ceramic composites. We have extensive experience in producing high-purity glasses and technological methods for their treatment. We have also patented the method of introducing halogens (Cl, Br, I) in the composition of chalcogenide glass.

Among the most important scientific fields groups can be identified:

Liquid and solid immersion medium with a high refractive index,

Glass-ceramic composites of chalcogenides;

Composites with nanoparticles ZnS, ZnSe, Bi, Sb, Bi₂S₃, Sb₂S₃, WS₂, WSe₂ and others.

Fiber optic materials;

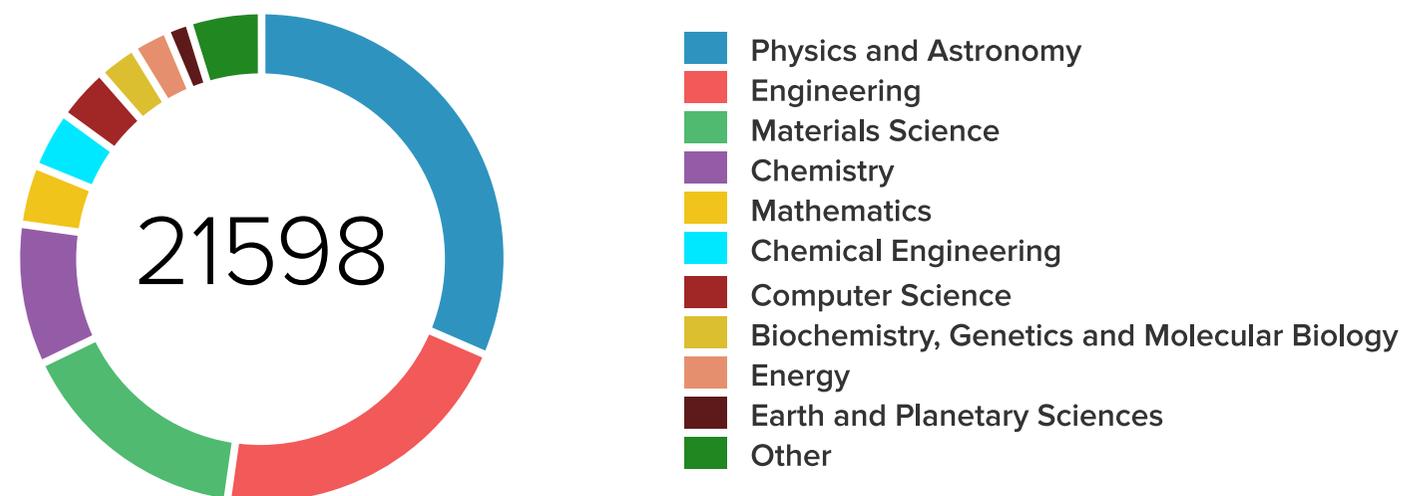
Low-melting oxy halide glass based on PbO;

High-contrast optical phase elements.



SCIENTIFIC ACTIVITY

PUBLICATIONS



Strong and superstring pulsed magnetic fields generation

Shneerson, German A. / Dolotenko, Mikhail I. / Krivosheev, Sergey I. De Gruyter, 2014

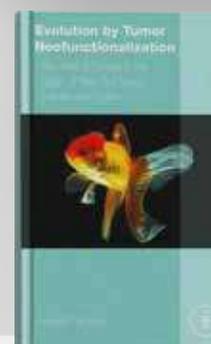
Strong pulsed magnetic fields are important for several fields in physics and engineering, such as power generation and accelerator facilities. Basic aspects of the generation of strong and superstrong pulsed magnetic fields technique are given, including the physics and hydrodynamics of the conductors interacting with the field as well as an account of the significant progress in generation of strong magnetic fields using the magnetic accumulation technique. Results of computer simulations as well as a survey of available field technology are completing the volume.



Advances in the Casimir effect

Bordag M., Klimchitskaya G.L., Mohideen U., Mostepanenko V.M. Oxford science publications, 2014.

In 2014 the Oxford University was published a revised edition of the Advances in the Casimir effect, a book co-authored by professors of the Quantum Electronics department of SPbPU. The theoretical and experimental results of a study of the Casimir force that is of quantum nature and that occurs due to zero fluctuations of vacuum and thermal photons were stated in this book for the first time. The Casimir effect has numerous applications in solid-state physics, nuclear physics, elementary particle physics and cosmology. Nowadays the applications of the Casimir effect in nanotechnology are actively studied in order to create the next generation micro- and nanoelectromechanical devices, in particular, using graphene and other carbon nanostructures.



Evolution by Tumor Neofunctionalization

Andrei P. Kozlov. The Role of Tumors in the Origin of New Cell Types, Tissues and Organs

Evolution by Tumor Neofunctionalization explores the possibility of the positive role of tumors in evolution of multicellular organisms. This unique perspective goes beyond recent publications on how evolution may influence tumors, to consider the possible role of tumors in evolution. Widespread in nature tumors represent a much broader category than malignant tumors only. The majority of tumors in humans and other animals may never undergo malignant transformation. Tumors may differentiate with the loss of malignancy, and malignant tumors may spontaneously regress. Cellular oncogenes and tumor suppressor genes play roles in normal development. Many features of tumors could be used in evolution, and there are examples of tumors that have played a role in evolution.



Origin of the Moon. New Concept

Galimov E.M., Krivtsov A.M. De Gruyter, 2012

The origin of the Moon remains an unsolved problem of the planetary science. Researchers engaged in celestial dynamics, geophysics, and geochemistry are still discussing various models of creation of our closest cosmic neighbour. The birth and development of a planet-moon system always plays a role in the formation of an entire planetary system around our Sun or around another star. All this has motivated the authors of this book to consider a new concept and to compare the currently discussed theories, analyzing their advantages and shortcomings in explaining the experimental data.

MEGAGRANTS

In order to strengthen governmental support for the development of science and innovations in tertiary education and to improve the quality of higher education, 2010, the Government of the Russian Federation instituted monetary grants that are made available on a competitive basis to support of scientific research projects implemented by the world's leading scientists at Russian institutions of higher learning.

Resolution No.220 pursues the following goals:

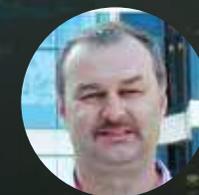
- To bring world-renowned scientists, including scientists from among Russian citizens residing abroad, to Russian institutions of higher learning;
- To create scientific research laboratories capable of competing with the world's leading laboratories;
- To ensure achievement of world-class research results;
- To create conditions required to improve the professional quality of the faculty and research specialists of Russian institutions of higher learning, as well as to create an effective and efficient system of motivation of scientific work;
- To encourage young people to pursue professional development in the fields of science, education, and high technologies;
- To help create sustainable links between Russian institutions of higher learning and the world's leading universities and science schools;
- To facilitate commercialization of the research results and new technologies developed in the course of the scientific research projects supported under the program.



KONSTANTIN SEVERINOV, PROFESSOR, DSC

Laboratory of molecular microbiology

The objective is the establishment in the Saint Petersburg Polytechnic University of a modern laboratory of molecular, ecological and applied microbiology. The laboratory faces a number of research problems to solve, covering a wide range of issues associated with bacterial metabolism.



ILYA BEZPROZVANNY, PROFESSOR, DSC

Laboratory of molecular neurodegeneration

Creation of a laboratory of a world level that would specialize in research of brain and neurodegenerative diseases, identification of the role of cytoplasmic calcium in development of neuronal pathologies, experimental verification of calcium hypothesis on cell and animal models of Alzheimer disease (AD) Huntington disease (HD) and spinocerebellar ataxia (SCA).



VESELIN MIKHAYLOV, PROFESSOR, DSC

Laboratory of light materials and structures (KMS)

The goal is to set up a leading center for development of light materials and structures, operating technology in the Russian Federation and abroad. The laboratory at the University will open up a new research area of the world level, connected with development and implementation of materials and structures with high specific strength, operating life, reliability and cost effectiveness.



GEORGY PAVLOV, PROFESSOR, DSC

Laboratory of astrophysics of objects with extreme energy generation

The goal of the project is to create a modern scientific center for fundamental interdisciplinary studies in the field of astrophysics and space research.



FRIDRICH WAGNER, PROFESSOR, DSC

Laboratory of physics of improved containment of the plasma of tokamaks (picpt)

Organization of LPICPT relies on the Executive Committee and the Scientific Committee and is focused on the long-term efforts in the field of fusion. LPICPT is involved in the research program of the Ioffe IPH for creation of the Globus-M2 device. For the purpose of education and training an accredited program of post-diploma training was developed.

RASA

RASA – Russian-speaking Academic Science Association unites Russian scientist working in leading research centres and universities practically in all countries of Europe and North America, as well as in Japan, Australia, Hong Kong, Singapore and other countries of Asia-Pacific region.



SPbPU played the core role at the initial stage of the collaboration between Russian universities and RASA. SPbPU's rector Andrey Rudskoy was invited to come to Russian Embassy in Washington D.C. to participate in round table with RASA-USA Coordination Council to discuss the possibilities of using USA experience in Russian research and educational system enhancement processes

Vyacheslav Safarov

*Head of RASA-SPbPU Centre
Professor, DSc*



BORIS CHICHKOV, PROFESSOR, DSC

Nanomanufacturing

Leibniz University Hannover



NIKOLAY VASILYEV, PROFESSOR, DSC

Medical Technology

Boston Children's Hospital



GLEB SUKHORUKOV, PROFESSOR, DSC

Controlled delivery of biologically active compounds

Queen Mary, University of London



SERGEY MIKHAILOV, PROFESSOR, DSC

Performance Coatings

University of Neuchatel



ANDREY PICHUGIN, PROFESSOR, DSC

Synthetic Biology

Institut Gustave-Roussy



DMITRY FRISHMAN, PROFESSOR, DSC

Modelling of Complex Biological Systems

Technical University of Munich

PLACE WHERE EUROPE & ASIA MEET

REPRESENTATIVE OFFICE IN SHANGHAI, CHINA

April 21, 2016, in a modern building on the territory of the High-Tech Park in the Pudong New Area, Shanghai (PRC), Peter the Great St. Petersburg Polytechnic University held the opening ceremony of its representative office. The Polytechnic University has been the first Russian University to establish a representative office in China

The mission of the University's Representative Office in Shanghai is to represent and safeguard the interests of the University in China and other countries of the Asia-Pacific region; promote international cooperation in education, research and the public sphere; promote contacts and cooperation with Chinese and international scholars, experts, academic and research institutions, industrial enterprises and companies, governmental agencies and NGOs; provide international counterparts with up-to-date information regarding the University's activities; compile and analyze information regarding cooperation opportunities with international partners and disseminate it via University communication channels; promote the University in this region as a place of innovation, creativity and international repute.



Dmitry Arseniev

Vice-Rector for International Relations

Shanghai office will help the University settle science and technology relations with both educational and business communities of PRC and other states of the Asia - Pacific Region. Presence in Shanghai - one of the largest Chinese cities, major industrial, financial and cultural center - is extremely important for our University and the prestige of the Russian higher education as a whole



Denis Borisov

Consul on Science and Technology at the Russian Consulate General in Shanghai

I am glad to participate in the occasion of opening the representative office of one of the oldest and leading Russian universities in China. The representative office is opened in the wake of the dynamic development of relations between our countries, and Shanghai today is becoming one of the world's leading innovation centers



Miao Yuan

Consul for Science and Technology of the General Consulate of the PRC in St. Petersburg

The Polytechnic University is starting to play an increasing role in the expansion of scientific technological and educational cooperation between Russia and the People's Republic of China. New promising projects, especially in the area of Hi-Tech, microelectronics, engineering and ecology are currently emerging. I hope, that SPbPU's office in Shanghai will become an important ground for the expansion of science and technology cooperation



Research

EXPLORE OUR RESEARCH

COLLABORATION AND PARTNERSHIP

MODERN SCIENTIFIC EQUIPMENT PARK

Konstantin Severinov

Professor DSc,
Head of Laboratory
of molecular microbiology

Our laboratory has excellent cutting-edge biophysical equipment, possibly unique for Russia. In addition, Polytech has many skilled professionals - physicists and engineers. This is particularly important because, rather often than not, the research requires engineering approach.



EXPLORE OUR RESEARCH PROJECTS

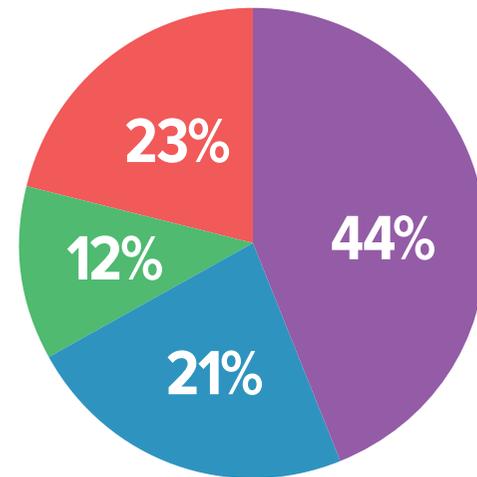
DIVERSITY OF IDEAS



Yury Simachev

Russian Science Foundation (RSF)
Deputy Director General

We are open for cooperation and we continue to think of new mechanisms for cooperation and future projects. The RSF constantly works with foreign experts. For us, the issue of international cooperation is the main question. At the end of 2014, Germany has become our strategic partner. We appreciate the efforts of Polytech in the organization of international meetings. We learned a lot about the modern grant system.



Polytech's research themes

- **Physics**
- **Material science**
- **Engineering**
- **Bio-med**



Eco-friendly Turbine Generators

The concept of using the energy of compressed natural gas for electric power generation in turbine generators for own needs of the gas transportation system. Such turbogenerators will enable to create environmentally friendly sources of generating electricity without burning additional fuel.

Nikolai Zabelin, Associate Professor, PhD



Ultrasonic theranostics

The lab of Alexander Berkovich is working on the development of new device for theranostics of varix dilatation. The device encapsulate at least two technologies – wellknown ultrasound diagnostics and therapeutic ultrasound action, due to which high energy can be concentrated inside the body without damaging the tissue.

Aleksandr Berkovich



Mobile distributed system IBS

The cooperation between Polytech and IBS company, largest Russian IT-company, became possible in the framework of Governmental program for stimulating cooperation between industry and universities. Huge experience of our partners and knowledge-intensive solutions of our university laid down as a base for the development of modern commercial software product.

Alexander Samochadin, Associate Professor, PhD



Origin of the Moon. New Concept

The origin of the Moon remains an unsolved problem of the planetary science. Researchers engaged in celestial dynamics, geophysics, and geochemistry are still discussing various models of creation of our closest cosmic neighbour. The birth and development of a planet-moon system always plays a role in the formation of an entire planetary system around our Sun or around another star. All this has motivated research team to consider a new concept and to compare the currently discussed theories, analyzing their advantages and shortcomings in explaining the experimental data.

Anton Krivtsov, Corresponding member of Russian Academy of Sciences, Professor, DSc



Polytech researchers in collaboration with European Space Agency has developed the cosmic models needed for managing of landing process.

EXPLORE OUR RESEARCH PROJECTS

CROSSING BORDERS

Polytech actively supports international grant making which helps to build direct connection with numerous academic and industrial partners from around the world. Many years of experience in implementing projects within the framework of various international programs to support collaborative research allows Polytech to act now as a credible participant in international consortia. Mechanisms of international collaborative and coordinated competitions held as a part of the FTP, RSF, RFFI and other funds make it possible to concentrate the efforts of research teams from different countries to solve a variety of challenges.



Gregor Berghorn

Head of DAAD Representative in Moscow

Despite the political tensions in the world, the scientific community is confident in maintaining professional and collegial relations. Authoritative scientific organizations and foundations have great respect for Russia's achievements and contribution into the global system of science and education. A scientist is always a man of the world, he (or she) seeks to unite people, and each discovery is a big step towards a great change and the future of all mankind. Representatives of the business community and scientific and educational organizations should understand the problem of teamwork and must have a clear understanding of mutual expectations. The basis for the mutual trust are clear intentions, and it occurs not at once, but during the development of cooperation.



The goal of the Project is to develop innovative technologies for emergency tokamak discharge quench and for the first wall maintenance by means of injection of high speed dusty jets into the plasma. Fast quenching of tokamak discharges in case of expected major disruption or other emergencies has been performed using killer pellets and intensive gas jets. Both technologies are based on injection of cold matter (hydrogen or noble gases in gas or solid state phases) with total particle content comparable or even exceeding that one of the plasma particles. It is necessary to inject the pellet or gas into plasma in a few milliseconds after the quench precursor signal, which requires km/sec or higher velocities. For killer pellets the main technological problem is complicated injection devices and substantial time spent for pellet acceleration.



ATAAC aims at improving the current turbulence modelling/simulation approaches available in CFD methods for aerodynamic flows. As Large Eddy Simulation (LES) will not be affordable for the high Reynolds numbers typical of real-life flows in the next decades, ATAAC focuses on approaches below the LES level, namely Differential Reynolds Stress Models (DRSM), advanced Unsteady Reynolds Average Navier-Stokes (RANS) models, including Scale-Adaptive Simulation (SAS), Wall-Modelled LES, and different hybrid RANS-LES coupling schemes.



The service potential of the southern and eastern Baltic Sea region is of high value for the transport and logistics sector. However, this potential is often hidden, just like amber. With the EU-project Amber Coast Logistics it shall be brought into the light of day.

The transport streams in the Amber Coast region with its natural hinterland, the Baltic States, Northwest Russia, Belarus and the Northern Ukraine have increased substantially in the past years. The number of logistics centres along the eastern and southern coast of the Baltic Sea is rising constantly. They form the basis for a supply chain that allows logistics players to better balance flows of goods and adapt more quickly to market developments.



Design of welding filler material (Flux cored wires — FCW) with created primary nano particles for higher weld seem properties. The aim of the project is to give innovative impulses for the development of new welding flux cored wires and/or solid wires containing nano-components from ceramic fractions. The synthesised powder could be used hot extruded directly as a solid electrode wire or as initial component for the filling of the FCW. The input of the high liquid temperature oxides into the weld metal causes primarily a fine grain austenite which leads after cooling to a microstructure with high mechanical properties.



The objective of the project is to increase the knowledge of Arctic climate technology for safe and sound petroleum production and transport. Joint educational activity organized for Norwegian and Russian students improve and develop relations between Norway and Russia in the Barents Sea region including Svalbard.

The cooperation within the project introduces young specialists in industrial companies working with exploration and exploitation of hydrocarbon resources of the Barents Sea region, improves relations between Norway and Russia in the Barents Sea region including Svalbard and develops common understanding of the regional problems.



Sergey Kozyrev

Head of the Center for advanced studies. Professor, DSc

«The focus of our attention — a palette of promising areas of modern science, from quantum phenomena to the human world»



PATHOSYS focuses on the development of novel and generally applicable mathematical methods and algorithms for systems biology. These methods and algorithms will be applied to study the complex interactions of hepatitis C virus, a human-pathogenic virus of high medical relevance, with its host at the systems level. Guided by biological data, PATHOSYS focuses on the design of novel algorithms and mathematical methods for systems biology. Based on developed models and using systems analysis, PATHOSYS will elucidate virus host interactions of Hepatitis C virus at an unprecedented level.

MODERN SCIENTIFIC EQUIPMENT

ENVIRONMENT FOR REVOLUTIONARY DISCOVERIES

Polytech has a fleet of modern and unique equipment. The real breakthrough was the construction of modern scientific research campus building, which fits well into the existing infrastructure — leading laboratories have new opportunities for further development.



Supercomputer Center Polytechnic

SCC — a complex and multi-faceted complex, equipped with the most modern computer systems. Peak total output during calculations is around 1.3 petaflops. This is Russia's first supercomputer cluster on the brand new Intel Xeon E5-2600 processors belonging to v3 family (1336 CPU, 18704 x86 cores). It represents the first large-scale implementation of innovative solutions in the supercomputer industry — massively parallel ultra-threading RSC PetaStream calculator built on a 60-core processor Intel Xeon Phi.



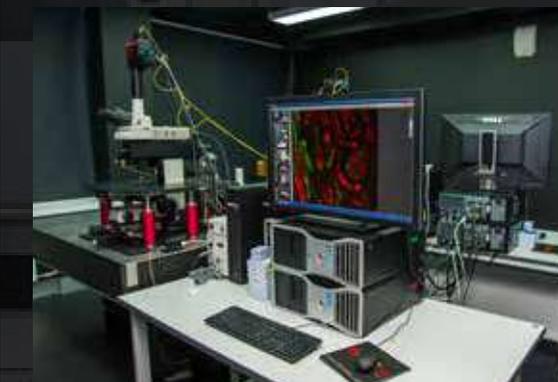
Laser tweezers

The unique integrated system for the study of the nanobiomachines dynamics has been designed for research in the field of living systems. It allows one to measure the dynamic and mechanical properties of single molecules to obtain information that is not accessible by any other means. This opens up an entirely new opportunity for direct study of mechanisms of action and the work of individual molecules in living systems.



Installation for friction stir welding

Installation, set up by the company MATEC Maschinenbau, Germany, weighs 88 tons and is designed to develop ultra-light materials and structures. This type of welding has unique characteristics — joined elements do not fall into the liquid phase, allowing the physical properties of metals to remain stable. The materials are needed in the industry since reduced weight design increases the economic feasibility of their use.



Confocal microscope

A modern two-photon confocal microscope for spatial visualization of nerve cells is used in the Laboratory of Molecular Neurodegeneration. The device allows to reach a qualitatively new level in the study of the structure and function of nerve cells.



Gleeble 3800

A specialized testing facility, Gleeble System 3800, is designed for the study of the properties of metals and alloys, and allows you to simulate the majority of metallurgical processes: continuous casting, processing semi-solid, hot rolling, forging, extrusion, welding rings, butt welding, diffusion welding, continuous annealing rolling, heat treatment, powder metallurgy, sintering and synthesis of new materials.

Development

BREAKTHROUGH PROJECTS

INNOVATIVE PROJECTS

INTERNATIONAL CENTRES

TECHNOPARK

Alexey Borovkov

Vice-Rector
for Advanced Projects
Associate Professor, PhD

We know design, technological and manufacturing processes of world leading companies from inside. In our educational programs we are going from industrial tasks-challenges, based on fundamental physical and mathematical background and modern technologies. We are sure that this is the only way to educate scientific-technological and engineering elite of the nation.



BREAKTHROUGH PROJECTS

CREATING THE IMAGE OF THE CITY



FIFA World Cup Stadium

Scientists from Polytech did their bit to the preparations for the 2018 FIFA World Cup – they

have developed a unique design withdrawable field of the new stadium, «Zenith». All components necessary for the implementation of major structural withdrawable field were produced at Russian plants while exclusive design drawings were developed with the participation of polytechnicians, specifically for this object. Stadium on Krestovsky will be the only one in Russia and one of the few stadiums in the world equipped with a roll-out field.



Machinery of a Drama

The employees of the Department of automata have participated in the decision of design and technological challenges to create the scenery in the leading theaters of Moscow and St. Petersburg. From the “Ring of the Nibelungs” to “Nutcracker” — dozens of performances gained the most complicated scenery. This work is reflected in the Russia’s only doctoral thesis on the theatrical machinery.



Restoration of the great characters

During the restoration of the Peter-and-Paul Cathedral, a need had arisen to meet the challenge of calculating load bearing characteristic of the spire and weather vane by computer simulation. The refurbished symbol of St. Petersburg — 750-pound vane Angel — took off on the spire of Peter-and-Paul Cathedral on the 300th anniversary of the city, where he continues to shine to this day.



Dam to flood guard

Polytech Scientists made valuable suggestions during the construction of the St. Petersburg dam. Modification form flaps, conducted with the help of computer simulations, allowed to provide efficient and stable operation of a navigation channel, which speeded up the completion of the dam needed to protect St. Petersburg from flooding.



Bridges: lifting equipment

Polytech scientists take on the project for all complex specialized works and services for the creation of innovative hydraulic actuators and hydraulic drive mechanism for a variety of industries. Under the guidance of Professor Ashcheulova, reconstruction of hydraulic drives movable mechanisms was carried out for the famous bridges of St. Petersburg — Nevsky, the Trinity, the Big Okhta, Volodarsky.

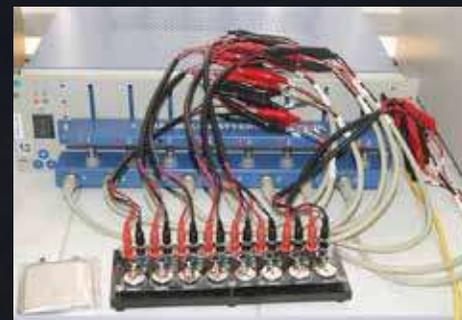
BREAKTHROUGH PROJECTS

MISSION OF CHANGES



New joint on 3D printer

Within the project the technology of designing of endoprosthesis of hip-joint was developed. Based on tomography data of hip-joint the exact 3D model is building and missing part of bone tissue is detecting. On the next stage based on this hip-joint 3D model a new 3D model of missing bone tissue part is developing and optimizing for printing. Later on the implant is produced from titanium on the SLM-installation. In particular, the joint of the patient was digitally scanned, polystyrene models were created and then metal prosthesis was built from special titanium alloy also developed by Russian scientists. Polytech was the first Russian centre, where the 3D printing of metal joint for particular patient was manufactured. The first surgery intervention was successful.



Battery for extreme conditions

In Russian-Chines laboratory the technology of producing cathode materials for polymer Li-Ion batteries was developed. The new material allowing battery work in extreme temperature conditions. As a result – the end-point technological product – will be the sample laboratory battery in a form of “tablet” with only 20mm diameter.



Wind energy for northern regions

Technologies of autonomous energy supply based on traditional and renewable sources of energy. Scientists are aimed on the development of Arctic shelf – project “The development of intelligent technologies for autonomous energy supply based on traditional and renewable sources of energy for the extreme climate conditions”. Within the project the scientists are developing the interactive map for evaluation and estimation of the resources available on different heights and different level of energy power needed.



Energy map of Ekaterinburg

Specialists of the Industrial Heat Power Engineering laboratory fulfilled the project on the design of the development program for all engineering networks of Ekaterinburg for the next 10 years.

Developed mathematical models allowed to make expert selection of most effective and economically proved variants. For the next 10 years the program includes particular action plans for each community facilities services on decreasing costs and improving quality and reliability of services. The new program will allow city to attract private and state investments for renovating networks and improving services.



Polar Economy

The laboratory of «System Dynamics» is developing a scientific and methodological principles of formation of conditions for the existence of the process of socio-economic development of the Arctic zone taking into account risk and uncertainty geo-economic strategy of Russia. Is about the theory and practice of synthesis of adequate leading model of regional policy in Russia.

BREAKTHROUGH PROJECTS FOR GLOBAL INDUSTRY

The University has created all conditions for realization of the most daring ideas, the implementation of technical and creative projects. It is no accident that the first laboratory in St. Petersburg for open digital manufacturing — the Fablab — was opened in the heart of the University campus in the famous Water Tower (Gidrobashnya).

We have an objective to develop human resource, technological, manufacturing facilities in order to take a rightful place in the currently forming global markets. It is extremely important to build up a community of engineering centers, which could effectively cooperate with the existing development institutes, state corporations and foreign partners — and a Polytechnic University has a lot to be proud of in this field.

Denis Manturov

Minister of Industry and Trade of the Russian Federation



Modelling of assembly process of wing load carrying structure for the aircraft Airbus A320

ASRP is the joint project of SPbPU and Airbus on the development, testing and implementation of specialized software for airframe assembly. During the 10 years the hundreds thousands rows of code were written, the computational core and user interface were developed. This development was certified according to NASA standards and recommended for implementations on Airbus. Joint project on assembling aircrafts A350 and A320NEO allowed to optimize the assembly technologies of main parts of the airframe.



Signal processing and image reconstruction

Fundamental research in the areas of new scintillation materials and new mathematical methods of signal processing and image reconstruction. Sustainable cooperative links with four leading European universities were established.



Breakthrough technology of oil production

More than ten years experience of cooperation in high-tech research in the field of development of unique equipment for subsea oil and gas excavation as well as in training and education of professionals for oil&gas industry. During this period more than 80 researches were trained, fulfilled more than 10 large-scale research projects, 5 applications on international patent were filed.



Technologies of testing and verification of the software systems

Creation and development of new conditions of the design for rapid growth quality of the embedded software for large and complicated systems. The aim is to fully automate the software development process: starting from the specification to the development, verification and implementation. This will significantly decrease the development circle.



Modelling of technological process and risks evaluation

The aim of the research is the study of polymer properties, thermal resistance and pyrolysis of the materials by thermal analysis, methods of hydrogen microcalorimetry and thermal gravimetric using the SPbPU's installations, as well as the development of kinetic models of the pyrolysis and flammability evaluation.



Project under realization at Polytech are part of Federal space program. Among such projects: Communication channels characteristics research for remote control of on-planet robots; Thermal regimes modelling of automated space craft; development of high-tech manufacturing of integrated functional modules for robotic space systems, as well as for civil applications.



We have a wide range of projects in the field of nuclear energy: modernization of control systems and control algorithms of NPP turbines, a comprehensive examination of the elements and systems to extend the life of nuclear power units, enhancing nuclear, technical and fire safety, as well as improving the efficiency of cooling systems, etc.



Polytechnic University was the first University partner of GC «Rostekhnologii» in St. Petersburg. There are joint integrated applied research in the promising areas of development and production of high-tech products on the basis of the analysis, forecasting and marketing to domestic and foreign markets. A particular challenge is to reduce terms of the creation of high-tech products and its cost through the introduction of advanced technologies.



Modern cooperation of the enterprise and Polytech is aimed at developing long-term engine for helicopter (MPE), which is conjuncting by JSC «Klimov» and the research institutes. A promising direction of research and production cooperation is the study of additive technologies and computational design methodologies. The results of research works have already found their application in the creation of new helicopter engine TV7-117V development of «Klimov», which will be installed in the latest Russian helicopter Mi-38.



Gazprom is one of the strategic partners in terms of integration. The corporation considers the University both as an educational and a research center and that is why we want to become not only a supporting university of Gazprom but also an intellectual-technological environment for joint developing and introducing technologies within the framework of the import substitution program. Interaction of PAO Gazprom with the Polytechnic University is a bridge between industry and science. The cooperation of the university and the corporation in introducing Russian research and development into the domestic industry already has results – employees of the Computer Engineering Center (CompMechLab®) of SPbPU have developed and produced a rotary support pin of a crane, which is required for the functioning of the ice-resistant oil platform «Prirazlomnaya» for JSC Gazprom Neft.



OJSC «Power machines» and Polytech are collaborating in the interests of the Russian power engineering industry and higher education to achieve common goals for the development of modern technologies based on last achievements of science. Among the subjects of research demanded by the world's leading industrial concern, - heat power engineering, energy and transportation engineering.

Important works on study of processes in steam and hydraulic turbines and turbine generators are performed by universities according to our orders. A significant part of orders is treated by St. Petersburg Polytechnic University, whose management is actively promoting the cooperation of university and industry

Yuri Petrenya

*Technical Director of Power Machines JSC
Professor, Corresponding member of RAS*

INTERNATIONAL CENTRES

TANDEM OF INDUSTRY AND EDUCATION

International Research and Education Centers (IREC) established in cooperation with some of the top manufacturing companies of the world are one of the key application areas for the research and education activities of the Polytechnic University. Currently, SPbPU hosts over 30 IREC operating as its organizational units. They are engaged in research projects spanning a wide range of the natural sciences: materials science, mechanics, power engineering, laser technologies, mechanical engineering, etc. The main benefit of integrating such centers into the University structure is that it ensures that the problems below are solved in a prompt manner and in close cooperation with an industry partner.



Research and Education Center «LG – Polytechnic»

Established in 2004 in cooperation LG Electronics, South Korea.

The Center conducts the following activities:

- search for and training of high-quality specialists in mobile device technologies in compliance with the profile of the LGE Russia R&D Centre
- running recruitment campaigns among final-year SPbPU students, aiming to endorse employment with LG Electronics;
- initial training of students, the further training and retraining of LGE Russia R&D Centre staff, Korean students and LG Electronics employees;
- conducting research in line with the innovation program of LG Electronics;
- performing project and design works or outsourcing as part of cooperation with the LGE Russia R&D Centre.



Research and Technology Center «Motul – Polytechnic»

The Center was established in 2013 in cooperation with «Motul Deutschland GmbH», a leader in the high-tech engine lubricants market.

«Motul Deutschland GmbH» is a world-famous producer of high-performance motor oils and industrial lubricants. The company has a strong global presence (among its international offices, there is one in Russia) and has secured an impressive foothold in the Russian market. Motul's research and development laboratories, including those located in France, are dedicated to the development of breakthrough technologies in the automotive and other industries.

The research work of «Motul – Polytechnic» is aimed at conducting joint research in the field of chemmotology, namely, promising lubricants and motor oils.

The education activities of the Center include the tailored training of students, and professional development courses for SPbPU staff and professionals fitting the company's profile.



where information lives

IREC «Polytechnic – EMC»

The Center was established in 2013 on the premises of IITM in cooperation with «EMC Corporation (EMC2)», a global leader in the area of cloud computing, big data handling, and IT protection.

Key Science Activities:

conducting joint research projects related to cutting-edge information technologies;

sharing scientific and engineering information on the research and development in the areas of the company's interests;

implementing the joint project «Research and Development of System Tools for Modeling the Features of Secure Hardware-Software Data Storage Complexes».



The International Scientific-Educational Center Embedded Microelectronics Systems (ISEC EMS)

Created in 2004 as a result of strong, long-standing partnerships between Polytechnic University, industry-leading technology companies (Xilinx Inc., Altera Inc.) and Microelectronics Support Centre, Rutherford Appleton Laboratory (UK)

- The driving force for creating ISEC EMS has been being an understanding that using of Field Programmable Gate Arrays (FPGA) and Application Specific Integrated Circuits (ASIC) will become even more wide in the nearest future, as new applications such as IoT, reconfigurable supercomputing calculations, automotive, healthcare ... require more reconfigurable and application specific Integrated Circuits (IC). As a result, the Industry will need more experienced IC designers.
- ISEC EMS is dedicated to enhance IC design, research and training capabilities of the University and stimulating the use of modern electronic design techniques and tools in academic and industry all over Russian Federation.
- ISEC EMS is the only Center in Russian Federation, which was approved as official Training Partner of Altera in Russian Federation, got a partnership agreement with Xilinx, participates in Europractice ASIC prototyping stimulation program.
- The Centre consists of a group of experienced specialists certified to provide a wide range of technical training and support services to academic and industry customers.



Weatherford

IREC «Weatherford – Polytechnic»

Activity Areas:

- developing and updating drilling and well operation equipment,
- operations research and equipment testing,
- managing specialized training for the oil and gas industry.
- The Center's training programs are a strong blend of classical university education and on-the-ground experience provided by Weatherford International.



MOTOROLA

Research and Education Laboratory «Polytechnic – Motorola»

The Laboratory was established in 1995. With support from Motorola's Saint-Petersburg Software Design Center, the Laboratory is engaged in work along the following lines:

- Java technologies;
- automotive telematics;
- remote access solutions and tools;
- telecommunications software

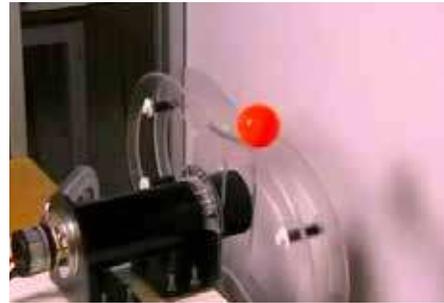
TECHNOPARK

BUSINESS-FRIENDLY UNIVERSITY



Smart implant

Implantable interface (neural-interface) to be used as sensor of remaining motion activity for the tasks of prosthesis-orthopedic devises and as test-systems of pharmacological influence on brain structure during neurodegenerative diseases treatment. Also can be used as diagnostic systems in cardiology and skeletal muscles treatments.



Robot «Butterfly»

Robot «Butterfly» is able to solve a variety of problems on calculations and stabilization of periodic motion of nonlinear mechatronic systems for robots' movement control, nondestructive capture of objects, etc. The system includes such components as electromotor, gearing, technical vision and real-time control system.



Project LeninCraft

LeninCraft company is working in the area of 3D scanning science year 2013. Started from 3D scanning of human body today the company provides the full range of services – scanning, modeling and 3D printing of objects of any kind and any complexity. Besides this services, the company offers training courses on 3D scanning and modelling.

Together we create the future of our alma-mater. Polytech is not only the source of knowledge, but also the environment for self-development, mutual source of inspiration for the active and entrepreneurial people

Olga Borscheva

Head of business incubator "Polytechnic"



Technopark
Polytechnic

Business
Incubator
Polytechnic

Development of innovative architecture and infrastructure projects contributes to form a comprehensive system of support and commercialization programs for research, development and engineering works, including programs of business incubation and acceleration of high-tech start-up projects.



The mission of Polytech Strascheg is to develop entrepreneurial culture among young people in the Northwest Region of Russia. By encouraging an entrepreneurial perspective on problem solving generally, we believe that Polytech Strascheg fosters not only business skills but also leadership qualities amongst its participants.

Youth creativity

SCIENTIFIC CREATIVITY
EVENTS



SCIENTIFIC CREATIVITY

The University has created all conditions for realization of the most daring ideas, the implementation of technical and creative projects. It is no accident that the first laboratory in St. Petersburg for open digital manufacturing — the Fablab — was opened in the heart of the University campus in the famous Water Tower (Gidrobashnya).



Center of scientific and technical creativity of youth since opening in 2013, actively involve pupils and students of St. Petersburg, Russia and Europe in its activities. Based on the University Fablab, they created broad options for creativity and self-realization, mainly due to the variety of project areas. Robotics, neuroscience, additive technologies, technologies for photo and video, art projects and souvenirs, interactives and exhibits, furniture and equipment for the smart home, vehicles — just a few trends that have developed.

Learning how to work with modern equipment, a variety of workshops and training programs, order fulfillment for private companies, aid in the implementation of ideas for all visitors — from the opening of «Polytech Fablab», it was visited by more than 10,000 people. Fablab is a means of attracting young people of all ages to the technical activities, education and self-realization tool, an interface to communicate between the schools of the city and the University. There are special programs and intensives, thematic tours and lectures, engineering competitions, implementation of projects under the supervision of students — among the participants, there are more

than 2,000 secondary school students annually. Capacities and special features of the Fablab premises allow to use it as a zone for technological co-working and conduct seminars, workshops and trainings. The ability to verify rapidly technical solutions and innovations is very attractive for developers, investment companies and venture capital funds. The Center for Scientific and Technical Creativity becomes the feed medium for a business incubator, small and medium business innovation, scientific- technological associations.



Polytech race car

Students began work on the creation of their own car — the first in the Northwest «Formula Student» prototype racing car class. Power of «Uno» is 100km / 4sec. Under the hood of the car — 80 horsepower, weight, along with a driver — 270 kg.



See the stratosphere

The team under the direction of school students managed to create a reliable and cost-effective platform for the study of the atmosphere and the stratosphere — the guys had a successful launch of the probe ball and got pictures of the planet.



Power management thought

In the project «Neurolab», they not only create the devices controlled by neurointerface, but also organize competitions on neurogaming, in parallel, creating simulators for the brain.



«Smart» regatta

The unmanned Solar trimaran — a source of pride for the participants of technical yachting section, in which students learn to yacht, win international sports and technical competitions.



Robohand

A hand printed on a 3D printer, assembled directly at the FabLab, and with the help of sensors on the glove, it duplicates operator movement. The young researchers have created a prosthesis for 13-year-old girl who uses it in her daily life.



Robofootball

The student robofootball team SPURT, led by Professor Stankevich, develops programs for the anthropomorphic robot Nao. Global objective — winning the RoboCup world championship.

MAJOR EVENTS



Week of Science / annual in december

A huge International Forum with a history of several decades is the main scientific event of the year for Polytechniciens. Nowadays Science Week includes marathon of discussions, varied formats, numerous guest speakers, rating competitions among young people. The numbers of the event are impressive: there are more than 5,000 participants annually from more than 15 countries.



Polyfest / annual in may&september

Alternative winter science week has become a summer festival of scientific creativity, initiated by FabLab-team. Polyfest is an opportunity for young people to realize their potential and observe their research in new dimension. The festival is an important event in the St.Petersburg - it transforms into a real scientific picnic on campus. The target audience not only teenagers but families.



Rise Weekend / annual in may&september

City youth forum is organized by Business Incubator "Politehnicheskyy" twice a year in three areas: "Science and innovation", "Entrepreneurship" and "Engineering creativity". It is unique opportunity for young scientists - Invited experts speak about current contests and grants, top-managers talk about the corporate programs for youth and give specific projects.



Summer school / from june to september

We offer a wide range of courses in various fields of studies: bio-physics, microelectronics, energy, engineering, architecture and design, information technologies, business and management, Russian language and culture. Students may combine 1-2 weeks modules to build own study schedule and accumulate appropriate amount of ECTS.



Week of science



Polyfest



Summer school



Rise Weekend



POLYTECH

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