

# 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 inno-

vative 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.



# Andrei Rudskoi

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.



**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.



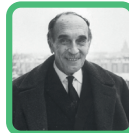
**1899**  
Among the founders of the University — prominent reformers and outstanding representatives of scientific community — Finance Minister Sergei Witte, Prince Alexei Gagarin, the creator of the periodic table of chemical elements Dmitri Mendeleev.



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



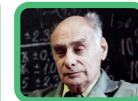
**1916**  
A theoretical physics seminar, led by Professor Abram Joffe, has started. It became the cradle of a unique world-class school of physics.



**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 Georgii 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.



**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.



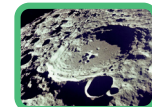
**1915**  
Stephen Timoshenko, a prominent scientist (mechanician) of the 20th century, was appointed to become a professor at St. Petersburg Polytechnic Institute, after having worked for ten years as a lecturer of applied and theoretical mechanics, theory of elasticity and structural mechanics.



**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.



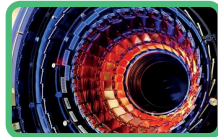
**1956**  
With the help of the space television equipment «Yenisei», the world's first back side of the moon shots were received.

**1961**  
The main event of 1961 for polytechnics was the flight of the world's first cosmonaut Yuri Gagarin. Employees of the Polytechnic University took part in the preparation of the launch. In SPbPU was organized an Experimental design Bureau, where was created equipment for processing orbital data of artificial earth satellites and developed control systems.





**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 Science, founder of the world-known scientific and pedagogical school



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



**2020**  
Technopolis

**2020**  
World-Class Research Center in Advanced Digital Technologies

1970



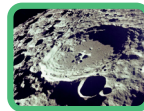
**1966**  
The problem of ensuring a soft spacecraft landing during return to Earth was solved under the guidance of Professor Yevgeny Yurevich.

1980



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

1990



**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.

2000

2010



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

2020



**2018**  
SPbPU became the winner of All-Russian Contest to organize the Centers of National Technology Initiative (NTI). NTI Center of Competencies for New Manufacturing Technology was established in Polytech.

**2016**  
SPbPU launched the Representative Office in Shanghai



# DYNAMICS OF CHANGES

## WHERE WE ARE NOW



**THE** WORLD UNIVERSITY RANKINGS  
2021 **TOP 350**

ACADEMIC RANKING OF WORLD UNIVERSITIES SINCE 2003  
**ACADEMIC RANKING OF WORLD UNIVERSITIES**  
Subjects - Physics **301-400**

**THE** WORLD UNIVERSITY RANKINGS  
2021

**TOP 101-125**

FOR PHYSICAL SCIENCES

**THE** WORLD UNIVERSITY RANKINGS  
2021

**TOP 126-150**

FOR ENGINEERING AND TECHNOLOGY

**THE** WORLD UNIVERSITY RANKINGS  
2021

**TOP 151-175**

FOR COMPUTER SCIENCES

ACADEMIC RANKING OF WORLD UNIVERSITIES SINCE 2003  
**ACADEMIC RANKING OF WORLD UNIVERSITIES**

Subjects - Instruments Science & Technology **201-300**

**THE** WORLD UNIVERSITY RANKINGS  
2021

**TOP 201-250**

FOR EDUCATION

**THE** WORLD UNIVERSITY RANKINGS  
2021

**TOP 251-300**

FOR BUSINESS AND ECONOMICS

**THE** WORLD UNIVERSITY RANKINGS  
2021

**TOP 401-500**

FOR LIFE SCIENCES



# A WORLD-CLASS UNIVERSITY

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.



## Yuri Vasiliev

SPbPU Scientific Supervisor  
Academician of Russian Academy of Science, 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.

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 Mechanical Engineering, Materials and Transport

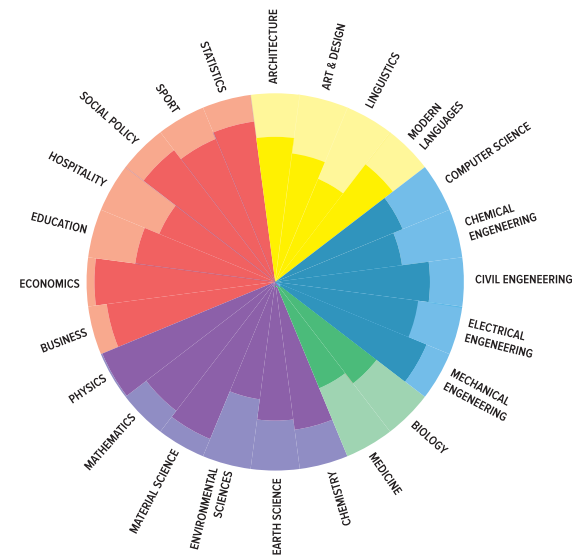
Institute of Applied Mathematics and Mechanics

Institute of Industrial Management, Economics and Trade

Institute of Physical Education, Sport and Tourism

Institute of Humanities

Institute of Biomedical Systems and Technologies



Polytech's research themes

# UNIQUE CAMPUS

FOUNDED IN  
**1899**




**33000+**  
TOTAL NUMBER  
OF STUDENTS



**8500**  
INTERNATIONAL  
STUDENTS

- 1 1st University Building. Institute of Metallurgy, Mechanical Engineering and Transport
- 2 2nd University Building. Institute of Physics, Nanotechnology and Telecommunications. Institute of Applied Mathematics and Mechanics
- 3 Main University Building. Institute of Power Engineering and Transportation. Fundamental Librass. White Concert Hall
- 4 Chemistry Building
- 5 Mechanics Building
- 6 3rd University Building. Institute of Industrial Management, Economics and Trade
- 7 Hydro Tower Building, FabLab
- 8 Sporting Complex
- 9 Research and Education Center of RAS
- 10 9th University Building. Institute of Computer Science and Technology
- 11 University Medical Complex
- 12 Institute of International Education Programs. International Education Office. Admission office for Russian Students
- 13 New Study Building. Supply Center for International Activity. International Graduate School of Management
- 14 Admission office for Russian Students
- 15 University Polytechnic College. «Radiopolytechnikum» (Engelsa pr., 23)
- 16 R&D Building

 Student's hostel

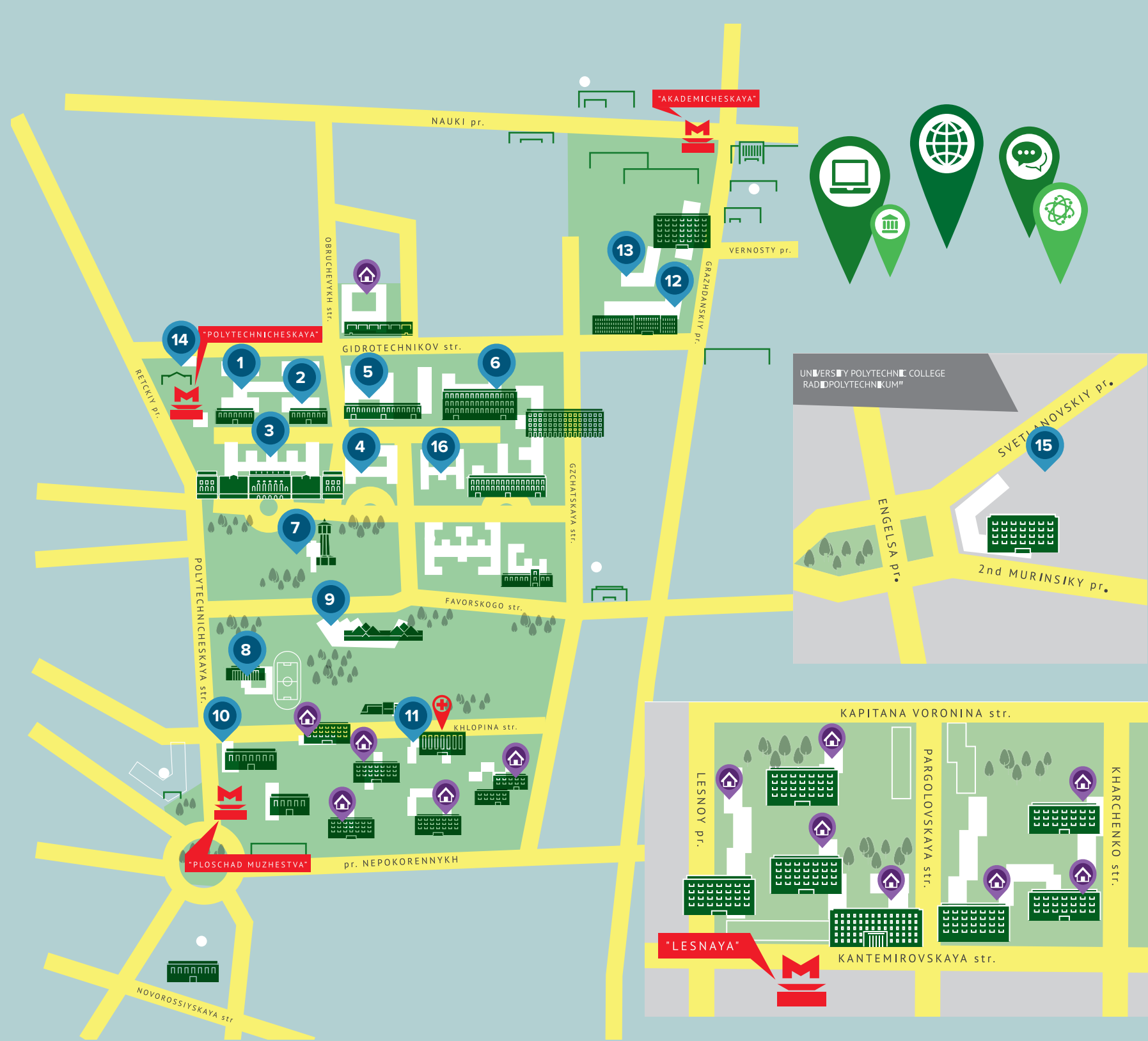
**120**

HECTARES  
CAMPUS  
AREA

**2000**

ACADEMIC  
BUILDINGS







# TECHNOPOLIS POLYTECH

## A comprehensive R&D infrastructure

Developing new approaches in the design of new technology and implementing to industry

Training specialists with world-class competencies

Retraining specialists for leading industries

Business consulting

## Structure

SPbPU NTI Center «New Manufacturing Technologies»

Computer Engineering Center SPbPU

City Design Office “Factories of the Future”

Research and educational laboratories of Russian and foreign companies

Center for Youth Technical Creativity

Small and medium-sized high-tech companies and innovative enterprises



# NEW CAMPUS AREA

2 federal land plots are granted to SPbPU on the right of operational management.

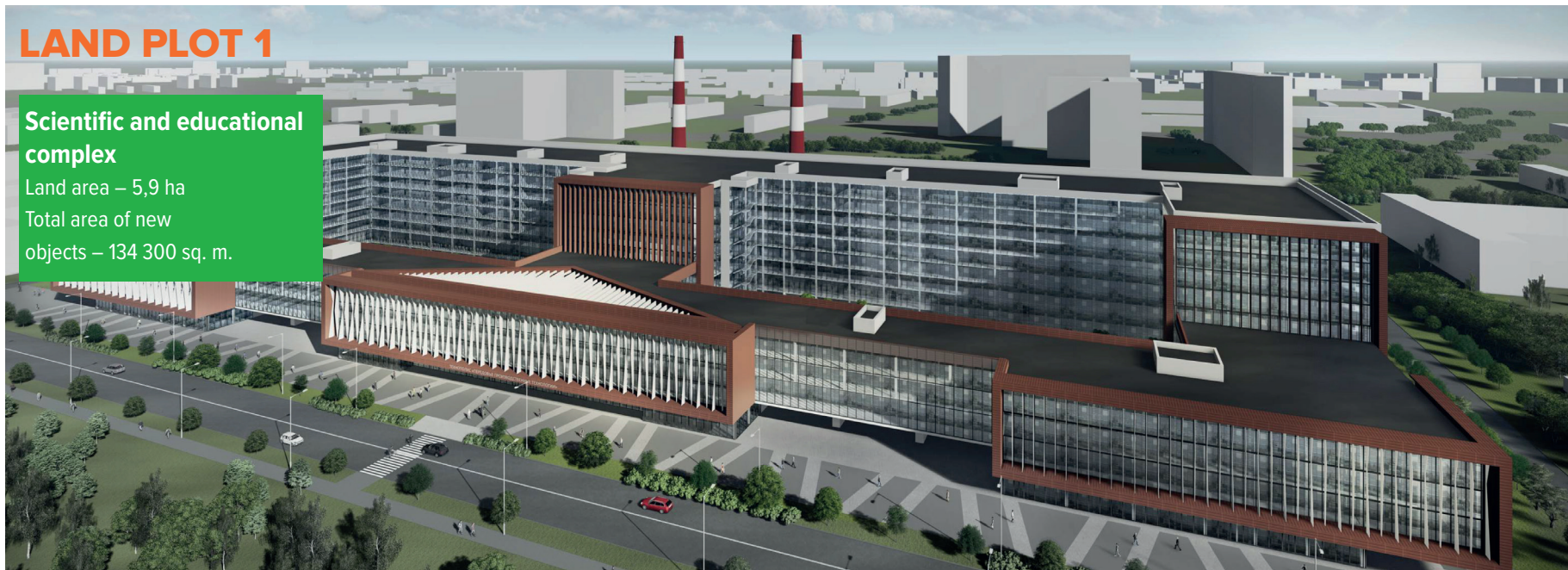
Total investment - 29,13 bln. rubles. Construction completion date – 2019–2025

## LAND PLOT 1

### Scientific and educational complex

Land area – 5,9 ha

Total area of new objects – 134 300 sq. m.



## LAND PLOT 2

### Academic and student campus

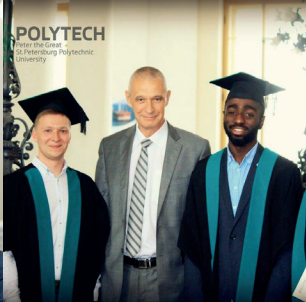
Land area – 13,3 ha

Construction area – 8 ha

Total area of new objects – 271 700 sq. m.







A Discussion about Breakthrough Technologies of the 21st Century



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



XI Congress of the Russian Union of Rectors (photo © kremlin.ru)







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



Supercomputer Center «Polytechnic»



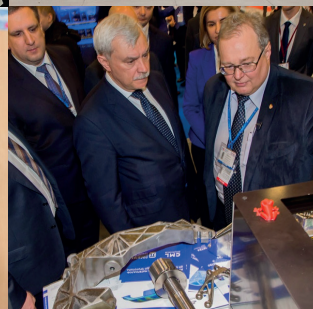
Fourth China (Shanghai) International Technology Fair



Terence Langdon, Outstanding Scientist, Became Honorary Doctor of SPbPU



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





# Science

THE SCIENTIFIC LANDSCAPE

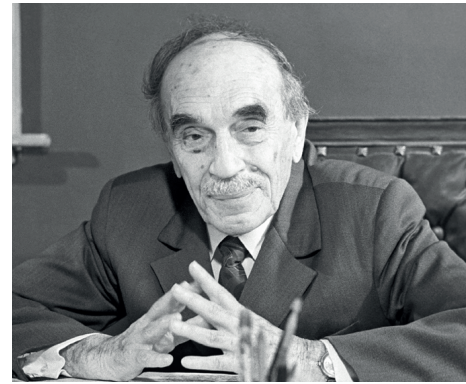
MEGAGRANTS

RASA



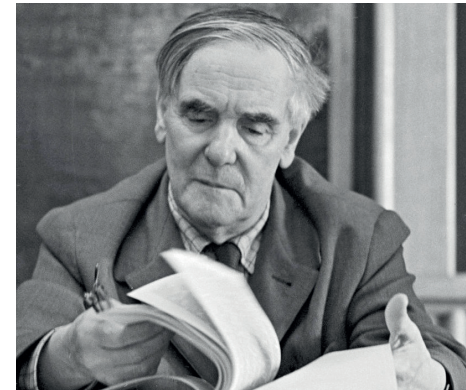
## NIKOLAY SEMENOV

Nikolai worked as a visiting professor at the Leningrad Polytechnic Institute. He introduced physical chemistry into the educational program. In 1956, he was awarded the Nobel Prize in Chemistry «for the research in the field of the mechanism of chemical reactions.»



## PETER KAPITSA

Peter studied at the Electromechanical Faculty of the St. Petersburg Polytechnic Institute. In 1978, he was awarded the Nobel Prize in Physics “for fundamental inventions and discoveries in the field of low temperature physics”.



## ZHORES ALFEROV

Zhores was the supervisor of the Institute of Physics, Nanotechnology and telecommunications and professor at the Department of Experimental Physics of the Polytech. In 2000 he was awarded the Nobel Prize in Physics «for developing semiconductor heterostructures used in highspeed-and optoelectronics».



# 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.



### New materials and technologies

*Materials with unique properties*

**Andrei Rudskoi**  
Academician of Russian  
Academy of Science,  
Professor, DSc

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.



### Biofuel energy-efficient technologies

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

**Mikhail Fedorov**  
Academician of Russian  
Academy of Science,  
Professor, DSc

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.





**Lev Utkin**  
Professor, DSc

## Artificial Intelligence

The main area of research is the development of new models of artificial intelligence and, in particular, machine learning with limited and incomplete information. The focus is on alternative approaches for deep neural networks including composition models, stacking algorithms, deep forest, combinations of neural networks and other models. We work on the problems of diagnosing oncological diseases and choosing the optimal treatment method, detecting abnormal behavior of various processes and other tasks of intellectualization of applied areas. In particular, we develop an intelligent system for the diagnosis of lung cancer using CT images and an intelligent system for analyzing patient survival and treatment choice within the framework of the concept of personalized medicine. These systems are based on completely new machine learning models that can make decisions based on limited information.



**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.

Politechnitians 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.



**Alexander Ivanchik**  
Corresponding  
Member of Russian  
Academy of Science,  
Professor, DSc

## Astrophysics, quasars spectroscopy, cosmology

Dr. Ivanchik specialize in the following areas:

- methods for determining the upper limits of possible cosmological changes of the fundamental physical constants
- studying the physical conditions and chemical composition of substances that existed in the early stages of the Universe evolution
- primary nucleosynthesis

# THE SCIENTIFIC LANDSCAPE

## LEADING GROUPS



**Anatoly Popovich**  
Professor, DSc

### New materials and additive technology

#### *Functional materials and nanocomposites for lithium-ion batteries*

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  $\text{Li}_2\text{FeSiO}_4$  for lithium-ion batteries.



**Vladimir Sorotskiy**  
Professor, DSc

### Radioelectronics and Communications Systems

Development of advanced transmitter equipment, improving energy efficiency and other technical parameters of transmitter equipment.

The main areas of research:

- distributed electricity systems
- fuel cells for hydrogen energy
- power amplifier for 5G base stations



**Andrey Vasin**  
Professor, DSc

### Virology and Biochemistry

The development of new methods for the molecular diagnosis of topical viral infections, the development of innovative drugs and vaccines, including those based on small interfering RNAs and peptides, the use of modern methods of genomics and proteomics for detecting new drug targets for viral infections treatment.





**Vladimir  
Rozhanskiy**  
Professor, DSc

## Plasma theory research

The Head of Plasma theory research group. The group has developed the code SOLPS-ITER for 2D modelling edge plasma of the tokamaks in collaboration with European colleagues. This code is used for modelling the majority of modern and future tokamaks – ASDEX Upgrade, Globus-M, JET, ITER, etc by members of the group and many other specialists. The modelling results are in good agreement with experimental data of modern tokamaks and is used for development of ITER project.



**Michael Strelets**  
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.



**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.



**Anton Krivtsov**  
Corresponding  
Member of Russian  
Academy of Science,  
Professor, DSc

## Discrete Mechanics

A mathematical and computer base has been developed for describing physical and mechanical processes in solids based on a discrete material concept. Results in fundamental and applied fields were achieved by mathematical methods and computational algorithms, for example, continuum description of discrete media of complex structure with moment interaction deformation, generalization of the Mie-Grüneisen equation for critical states of matter, analytical approach and a number of exact solutions for describing thermal processes in harmonic crystals, ambiguity of a number of mechanical properties of materials and determined boundaries of applicability of continuum mechanics at the nanoscale scale level.



**Aleksander  
Snegirev**  
Professor, DSc

## Fundamentals of Fire and Explosion, Fire Safety

The area of scientific interests includes fundamentals of fire and explosion, material flammability, combustion in microgravity, fire and suppression modelling.



**Ilya  
Bezprozvanniy**  
Professor, DSc

## Personalized medicine, high-tech healthcare and health-saving technologies

Created a world level laboratory that specializes in research of brain and neurodegenerative diseases, identification of the role of cytoplasmatic 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).



## Information Security

**Dmitry Zegzhda**  
Professor, DSc

Providing control and protection of control channels for network equipment through the implementation of gateway technologies for access control and remote control of network devices:

- local and remote management of objects and monitoring of their events;
- access control to network infrastructure facilities;
- integrity control of configurations and software composition of objects.

Due to the introduction of access control to network equipment, it is protected from computer attacks, logging operator actions, and operational signaling of violations.



**Sergey Zverev**  
Associate Professor,  
PhD

## Development of plasma installation

Development of an effective technological process for the processing of fine particles in an RFI plasmatron jet using the example of purification and spheroidization of powders of electrical periclase MgO and quartz sand SiO<sub>2</sub>. Creation of a mathematical model that adequately describes the interaction of the flow of solid particles with a plasma jet to determine the main parameters during the melting of powder raw materials in plasma, assess the quality of the products obtained in this case, and also to select the optimal technological design HF installations for processing particles of various dispersed materials.



**Maksim Frolov**  
Associate Professor,  
DSc

## Mathematical Modeling, Numerical Methods

The main area of scientific interests is the construction of reliable methods for the numerical solution of problems in mechanics, based on a posteriori accuracy control.







**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»).



**Nikolay Bagrayev**  
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.



**Evgeny Smirnov**  
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.



**Victor Elistratov**  
Professor, DSc

## 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.



**Sergey Vakhrushev**  
Professor, DSc

## Physics of Nanocomposite Materials

Major objective of the research is the investigation and development of new self-organized nanocomposite materials and artificial nanocomposite structure on the bases of dielectric matrixes for electronic industry. Major research experiments are fulfilled jointly with the leading research centers in Germany, France and Japan.



**Dmitry Rodionov**  
Professor, DSc

## Innovation Management, Innovative Digital Economy

The main fields of research include study the innovation potential of regional economics, technologies for development of the regional innovative environments, problems of infrastructural development of «Industry 4.0», econometric modelling.



**Maria Samsonova**  
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.



**Dmitry Firsov**  
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).



**Andrei Kozlov**  
Professor, DSc

## 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.



**Sergey Nuzhdin**  
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.



**Mark Kachanov**  
Professor, PhD

## 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.



**Herman Shneerson**  
Corresponding member of Russian Academy of Science, Professor, DSc

## 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.





**Dmitry Arseniev**  
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.



**Alexander Kazakov**  
Professor, DSc

## 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.



**Yury Galerkin**  
Professor, DSc

## Gas-dynamic design

Research is aimed at clarifying the specifics of work processes. This is necessary to create physical models that underlie methods of primary design, i.e. a set of rules for choosing rational shape and aspect ratio of the flow part. Mathematical models for calculating gas-dynamic characteristics are based on physical models, that creat basis of computer program complexes for optimal design. We apply CFD methods providing more extensive and detailed information than physical experiments. Physical experiments are used to test CFD methods. We carry out continuous and intensive work in the field of gas-dynamic design.



**Oleg Tolochko**  
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.



**Aleksander Chusov**  
Associate Professor,  
PhD

## Applied Ecology, Waste and Water Treatment

The main focus of research is the development of eco-friendly technologies for treatment of highly toxic liquid wastes and for producing biofuels from solid waste landfills biogas.



**Alexander Korotkov**  
Professor, DSc

## 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.

# THE SCIENTIFIC LANDSCAPE

## RESEARCHERS OF THE FUTURE



### Stir friction welding

**Anton Naumov**  
Associate Professor,  
PhD

Research and creation of new generation light materials with increased strength. Laboratory of Light materials and structures was created at SPbPU to focus on this task. It is equipped with a unique installation of pulsed friction welding with mixing. This is a new welding method in which there is a unique opportunity to weld almost all materials that cannot be welded by previously existing methods. The material is welded in a solid state without melting, which allows us to produce large complex structures with unique strength properties. So, for example, a lightweight boat with improved running characteristics was developed on the basis of SPbPU.



### New composite materials

*Research of chalcogenide materials*

**Alexander Semencha**  
Associate Professor,  
PhD

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.



### Civil Engineering and Environment

**Kseniya Strelets**  
Associate Professor,  
PhD

Resource saving in building, engineering solutions for the social housing, integrated into urban environment, energy saving building technologies in extreme conditions.





## 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



## Software engineering

– Our research areas are software engineering, computer systems development, computer science, embedded control systems, intelligent information processing systems and automation of various objects and systems.

- Scientific areas include:
  - Development of complex software and hardware systems;
  - Industrial technologies for software design;
  - Computer-aided design of embedded microelectronic systems;
  - Embedded control systems;
  - Intelligent information processing systems;
  - Information Search.

**Pavel Drobintsev**  
Associate Professor,  
PhD



## Ecology and Environment Protection

The main area of research is the treatment of industrial wastewater using phytosorbents and modified agriculture wastes.

Dr. Politaeva develops resource-saving technologies for treating chemical and petrochemical sewage with help of sorbents. Another research focus is using micro-algae for wastewater purification.

**Natalya Politaeva**  
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



## Microencapsulation and Nanotechnology

The main area of research is controlled delivery of biologically active compounds. Research group led by Gleb Sukhorukov is specialized in creating interactive controlled systems for carrying biological agents.

**Gleb Sukhorukov**  
Professor, PhD



## Self-Organising High Temperature Nanostructures

Development of new materials, modern components and integrated engineering solutions for last generation electronics, including nanostructured metal and non-metal coatings, self-heating nano-solder, sensors, MEMS etc.

**Olga Kvashenkina**  
Associate Professor,  
PhD



## 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 temperature sensors, pressure, etc. the physical quantities.

**Leonid Liokumovich**  
Associate 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.

**Vladimir Zaborovskiy**  
Professor, DSc

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.



## Nano- and micro-encapsulation

Our research activities lie in the Biomedical Science area covering disciplines of Biomaterials, Biophysics and Physical Chemistry. It comprises physics and (bio)-chemistry on submicron dimensions, design of multifunctional colloidal particles and capsules and nano-engineered biomaterials, elaboration of micron and submicron sized delivery systems with remote controlling and triggering properties including by light, magnetic field and ultrasound.

**Igor Radchenko**  
PhD



## 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 Science,  
Professor, DSc



## 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



## Intelligent Systems

Main areas of research interest are industrial systems, stream processing, software-hardware solutions. The laboratory led by Dr. Bolsunovskaya carry out research in the fields of transport, web-systems, video processing, medical information systems.

**Marina Bolsunovskaya**  
Associate Professor,  
PhD





**Andrey Belyaev**  
PhD

## Stir friction welding Autonomous power systems

Transient studies in integrated and autonomous energy systems:

- Development of technology and control system that ensures stable operation of generators at power plants connected to the electric power system and equipped with combined-cycle gas and gas turbine units.
- Improving the efficiency powerful gas piston units (from 1.5 to 18 MW) in combined and autonomous electric power systems with predominant motor and other rapidly changing loads.
- Expertise in the direction of “studying feasibility to select pilot projects for the intellectual network of the North-West OES”.



**Olga Vlasova**  
Professor, DSc

## Medical physics

Research in the field of nanobiotechnology at the intersection of two fundamental sciences: physics and biology. The research is aimed at obtaining new fundamental knowledge about the mechanism of photons and high-energy ions impact on biological tissues. The possibilities of using various types of nanostructures to improve the radio and chemotherapy of cancer are being investigated. Work is underway to develop metal nanoparticles, that are versatile carriers capable of delivering substances to the site of tumor formation.



**Dmitry Kupriyanov**  
Associate Professor,  
PhD

## Quantum Optics and Quantum Informatics

Research group led by Dr. Kupriyanov works on the problem of use of optical range and light for data transmission and has expertise in the area of theoretical atomic physics, quantum optics and quantum information science.



**Yury Lazarev**  
Professor, DSc

## Highways

Research Areas:

- production of road-building materials, products and structures;
- engineering surveys, development of design, design and survey and design estimates for construction, reconstruction, overhaul, repair and maintenance of roads;
- design, construction, reconstruction, overhaul, repair and maintenance of automobile and city roads and streets, bridges and overpasses, transport structures and other road infrastructure facilities;
- the use of machinery, equipment and technologies for the construction of reconstruction, overhaul, repair and maintenance of roads, industrial facilities, transportation facilities and other road infrastructure.



**Vladimir Itsykson**  
Associate Professor,  
PhD

## 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.



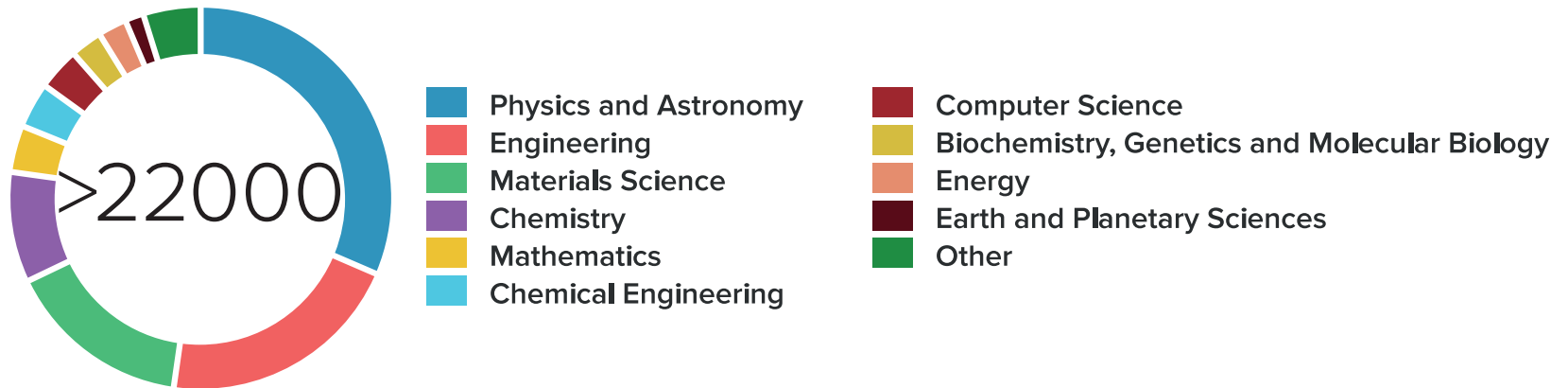
**Sergey Volvenko**  
Associate Professor,  
PhD

## Radio Navigation, Radio Communication Systems, Industrial IoT

Dr. Volvenko is a scientific leader of such projects as «Wireless sensor system of engine data collection based on ultrawideband signals», «The classifier of signals with analog modulation based on neural networks» and others.

# SCIENTIFIC ACTIVITY

## PUBLICATIONS

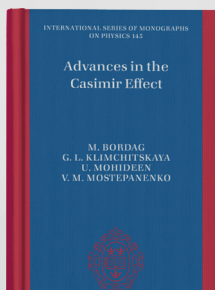


### Strong and superstring pulsed magnetic fields generation

*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.

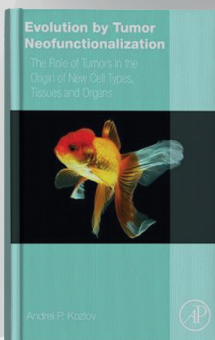




## Advances in the Casimir effect

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

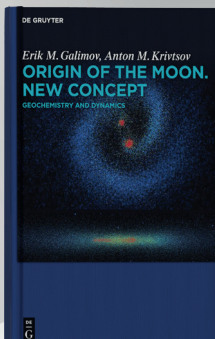
In 2014 the Oxford University was published a revised edition of the Advances in the Casimir effect, a book co-authored by professors of the Quantum Electronics department of SPbPU. The theoretical and experimental results of a study of the Casimir force that is of quantum nature and that occurs due 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**

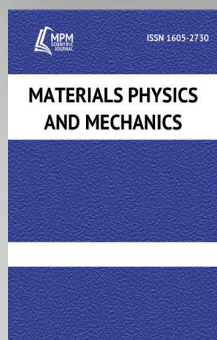
The origin of the Moon remains an unsolved problem of the planetary science. Researchers engaged in celestial dynamics, geophysics, and geochemistry are still discussing various models of creation of our closest cosmic neighbour. The birth and development of a planet-moon system always plays a role in 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.



## Civil Engineering Journal

**Chief Scientific Editor Doctor of Technical Sciences, Prof. Nikolai Vatin. Editor in Chief Yekaterina Linnik**

The journal is included in the List of Russian peer-reviewed scientific journals in which the main scientific results of dissertations for the degree of Doctor and Candidate of Science should be published (List of Higher Attestation Commission).

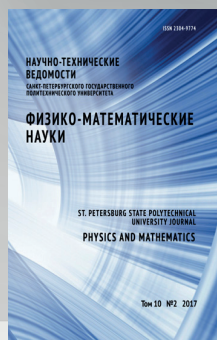


## Materials Physics and mechanics

**Editor in chief: Doctor of Technical Sciences Academician of RAS A.I.Rudskoi. CM of RAS D.A.Indeytsev**

The journal is included in the list of HAC. The journal is indexed by Web of Science (Core Collection), SCOPUS. The journal covers the following thematic areas:

- The mechanics of nanostructured materials (such as nanocrystalline materials, nanocomposites, nanoporous materials, nanotubes, nanostructured films and coatings, materials with quantum dots and wires).
- Physics of strength and ductility of nanostructured materials, physics of defects in nanostructured materials.
- The mechanics of the processes of deformation and fracture in traditional materials (solids).
- Physics of strength and ductility of traditional materials (solids).



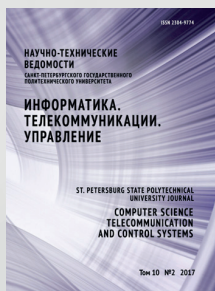
## NTV(STJ)Science and Technical Journal SPbSPU. Physics and Mathematics

**Editor in chief: Doctor of Physics and Mathematics, Prof. V.K.Ivanov**

The journal is indexed in the following databases:

Scopus, Web of Science (Core Collection), RSCI, Abstract journal and fund of scientific and technical literature AUSTIC RAS, Ulrich's Periodicals Directory, ScienceDirect (2014–2017), Google Scholar, EBSCO, Math-Net.Ru, Proquest, ROAD





## NTV SPbSPU. Computer science. Telecommunications. Control systems

*Editor in chief: Doctor of Technical Sciences, Prof. A.S.Korotkov*

The journal is indexed in the following databases:

- HAC
- RSCI
- Abstract journal and fund of scientific and technical literature AUSTIC RAS
- Ulrich's Periodicals Directory
- Google Scholar EBSCO
- Math-Net.Ru ProQuest
- Index copernicus



## NTV SPbSPU. Engineering science and technology

*Editor in chief: Academician of RAS , Dr. of Technical Sciences, Prof. Y.S.Vasiliev*

The journal is indexed in the following databases

- HAC
- RSCI
- Abstract journal and fund of scientific and technical literature AUSTIC RAS
- Ulrich's Periodicals Directory
- Google Scholar EBSCO
- Index copernicus
- Proquest
- ROA
- Russian Science Citation Index (RSCI) hosted on the WoS platform



## NTV SPbSPU. Economics

*Editor in chief: Doctor of Economics, Prof. V.V. Gluhov*

The journal is indexed in the following databases:

- HAC
- RSCI
- Abstract journal and fund of scientific and technical literature AUSTIC RAS
- Ulrich's Periodicals Directory
- Google Scholar
- EBSCO
- ProQuest
- ROAD



## NTV SPbSPU. Humanities and social sciences

*Editor in chief: Doctor of Philosophy, Prof. D.I.Kuznetsov*

The journal is indexed in the following databases:

- HAC
- RSCI
- Proquest
- Index Copernicus international

# Research

EXPLORE OUR RESEARCH  
COLLABORATION AND PARTNERSHIP  
MODERN RESEARCH FACILITIES



# Vitaly Sergeev

Vice-rector for research  
Corresponding Member  
of the Russian Academy of Sciences, DSc

The world is surging forward and our main task is to be at the forefront of the research and scientific thought. State and industry require viable developments and technologies capable of meeting market demands.





# EXPLORE OUR RESEARCH PROJECTS

## DIVERSITY OF IDEAS



### Andrei Blinov

Russian Science Foundation (RSF)  
Deputy Director General

“We are convinced that it is the talented young scientists who will determine the nature and depth of bilateral research ties on the horizon of 10-15 years, who will provide joint answers to global challenges of the future by uniting their best ideas and efforts”

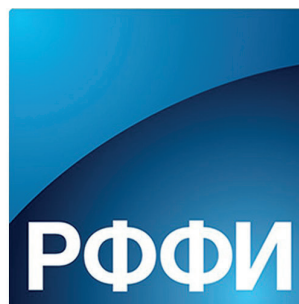
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सत्यमेव जयते  
Department of Science and Technology (DST)  
**DST**



CBC 2014-2020  
SOUTH-EAST FINLAND - RUSSIA







NATURAL SCIENCES

## «Development of physics of fast particles in the plasma of compact steady-state fusion neutron sources» (with IAEA)

The IAEA project is aimed at the derivation of new fundamental analytical results, which include the development of numerical and semi-analytical models for neutron spectra, neutron yield, plasma heating and the generation of an electric current in plasma by fast ions because of beam heating. Perspective nuclear power engineering, including nuclear fusion, ideally meets these requirements under certain conditions. A well-developed, deep fundamental basis is needed for the development and piloting of industrial applications of fusion technologies.

Pavel Goncharov, Head of Laboratory, PhD



MATERIAL SCIENCES

## Natural and artificial porous materials filled with liquid and solid dielectrics

The goal of the project is to obtain systematic information on the behavior of liquids, primarily water, aqueous solutions of salts and organic compounds playing the role of cryoprotectants and hydrocarbons, as well as solid dielectric materials in the pores and channels of regular nanoporous matrices in a wide temperature range. Special attention will be paid to the study of systems based on natural porous matrices: asbestos, porous clays and similar systems.

Sergey Vakhrushev, Professor, DSc



ENGINEERING&TECHNOLOGY

## Simulation of the improved divertor of next generation tokamak reactors

The project is aimed at studying the parameters of the wall plasma in different operating modes of the improved divertor, and developing the concept of an innovative divertor for the next generation ITER tokamak reactors (DEMO, CFETR), which are larger and more powerful than the ITER tokamak reactor.

Vladimir Rozhanskiy, Professor, DSc

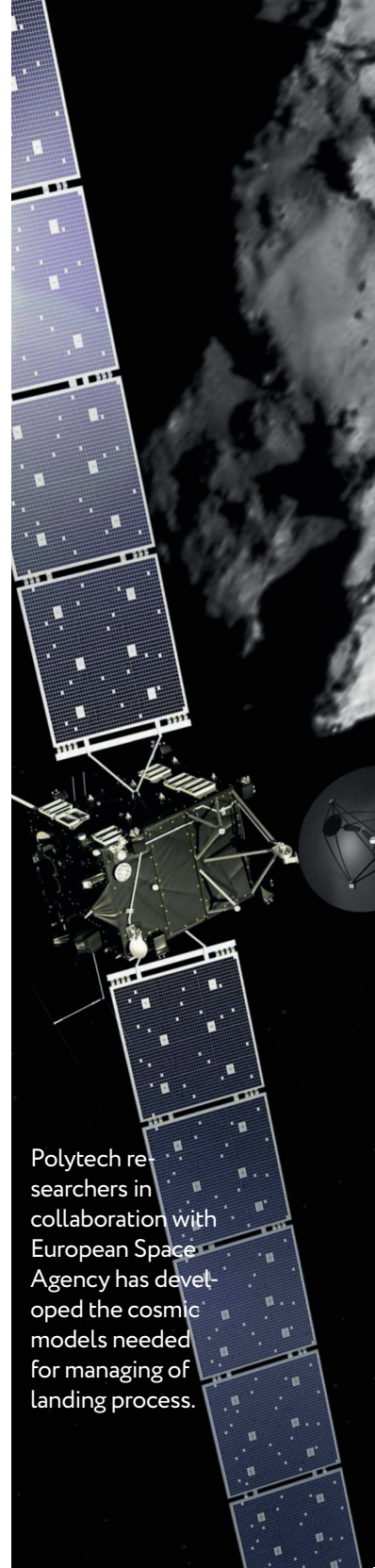


LIFE SCIENCES

## Development of a novel nanoparticle formulation for mRNA based therapeutic vaccination

Laboratory of microencapsulation and controlled delivery of biologically active compounds of the RASA-center SPbPU won a joint grant with a professor Dr. Joeri L. Aerts from Neuro-Aging & Viro-Immunotherapy laboratory in Vrije Universiteit Brussel (VUB, Belgium). The collaboration is aimed to create a therapeutic mRNA vaccine against HIV and develop a way to deliver it into target immune cells using nano- and microcapsules.

Gleb Sukhorukov, Lead Scientist, PhD



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.



### Dr. Andreas Hoeschen

German House of Science and Innovation  
DAAD  
Director

“DWIH’s mission is to support and develop cooperation in the field of science and innovation. Thus, we are a kind of showcase for the German scientific sphere, demonstrating what is interesting is offered by universities, research institutes and German enterprises that are interested in scientific cooperation between Russia and Germany.”

© Germany Online.

### POETA: Practice-oriented children’s education in the Industry 4.0 sphere on the basis of a unified open educational hardware platform

The goal of the project is to develop and certify a unique educational platform in the EU, which is based on a system of teaching materials and hardware and software resources for teaching technologies in Industry 4.0: robotics, 3D printing, the Internet of Things, and programming.

### CAMS Platform: Climate Adaptation and Mitigation Synergies in Energy Efficiency Projects

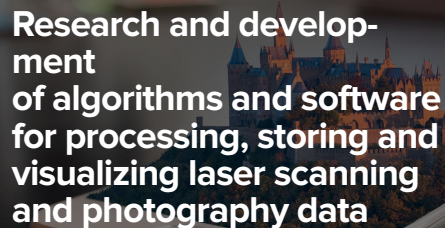
The platform provides measures to improve energy efficiency, thereby reducing the negative impact on human beings and natural ecosystems of greenhouse gases generated by energy-intensive residential and industrial sectors.





**ABiRe: Development and implementation of innovative aquatic-based bio-refinery for microalgae *Chlorella sorokiniana* and duckweed *Lemna minor***

Development and implementation of innovative biotechnologies for microalgae *Chlorella sorokiniana* and duckweed *Lemna minor* bio-refinery.



**Research and development of algorithms and software for processing, storing and visualizing laser scanning and photography data**

These algorithms will be used to create an experimental sample of a software package for a cloud service for storing and visualizing clouds of laser scanning points for natural and technical systems. The software package will be used to develop information models of natural and technical systems and subsequent computer-aided design of complex information and communication technologies.



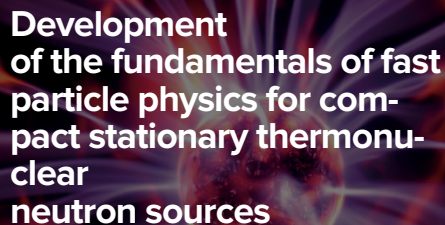
**Refinement of the SOLPS-ITER code**

Development of numerical models of transport processes in the near-wall plasma, development of software for modeling the near-wall region discharge in a tokamak.



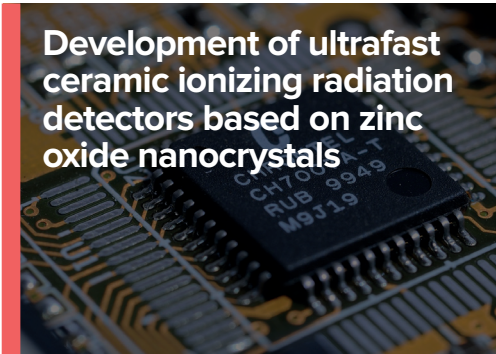
**Development and characterization of new materials for capacitor-type energy storage devices**

Creation of new dielectric materials for use in capacitor-type energy storage devices and identification of fundamental microscopic mechanisms that affect their practically significant properties at high temperatures.



**Development of the fundamentals of fast particle physics for compact stationary thermonuclear neutron sources**

Derivation of new fundamental analytical results and development of semi-analytical physical models of the behavior of fast particles in thermonuclear plasma.



**Development of ultrafast ceramic ionizing radiation detectors based on zinc oxide nanocrystals**

Such detectors can be used in various applications related to the registration of ionizing radiation: medical tomography, customs control systems, non-destructive industrial flaw detection, high energy physics. The project plans to optimize the detector for its use in the GSI beam control system.

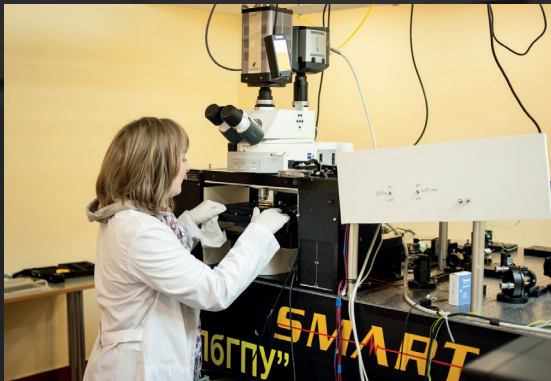
# MODERN SCIENTIFIC EQUIPMENT ENVIRONMENT FOR REVOLUTIONARY DISCOVERIES

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

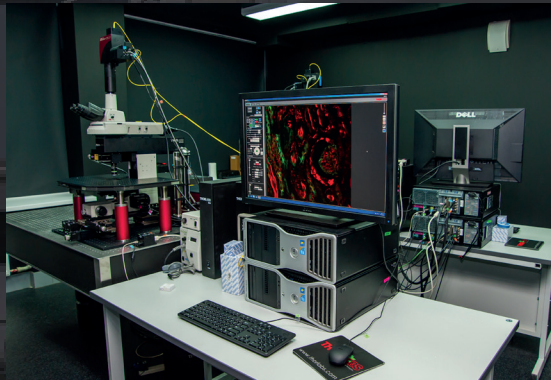
The unique integrated system for the study of the nanobiomachines dynamics has been designed for research in the field of living systems. It allows one to measure the dynamic and mechanical properties of single molecules to obtain information that is not accessible by any other means. This opens up an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





## The only in Russia Kawasaki-Polytech Science and Education Center of Kawasaki Industrial Robotics

The center includes: a demonstration platform for robots and technologies, a training center, and a laboratory. The demonstration hall features 10 robotic complexes, including robotic arc and spot welding, milling, painting, assembly, painting, sorting and stacking of products.



## 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.



## INNOVATIVE CENTER «SCIENCE - TECHNOLOGIES»

The Center "Science - Technologies" is a modern scientific and technological center for the synthesis and research of materials, furnished with equipment from leading world manufacturers with an international research team. The purpose of the center is cooperation in the field of research activities in the areas of: additive technologies, new materials and technologies, materials for batteries.

# Development

BREAKTHROUGH PROJECTS  
INNOVATIVE PROJECTS  
POLYTECH IN INDUSTRY 4.0



# Alexey Borovkov

Vice-Rector for Innovative Projects,  
Head of the SPbPU National Technology  
Initiative Excellence Center for  
Advanced Manufacturing Technologies

Digital industry is a modern high-tech industry with a fundamentally new paradigm for developing globally competitive products. The key tool and driver of this paradigm is the technology for the development and use of “digital twins” of products, and industrial and technological processes. This technology makes it possible to reasonably reduce the number of prototypes and the volume of physical and full-scale tests, significantly reduce the cost of development and production, as well as the time to bring new generation products to the market.





# POLYTECH IN INDUSTRY 4.0

## ADVANCED MANUFACTURING TECHNOLOGIES CENTER OF THE NATIONAL TECHNOLOGY INITIATIVE

NTI SPbU Competence Center is a leading Russian competence center with the largest project consortium in the field of Advanced Manufacturing Technologies created on the basis of the ecosystem of innovations of Peter the Great St. Petersburg Poly-technic University. The center is an infrastructural basis for the interaction of scientific, educational and industrial organizations in order to ensure global competitiveness of leading domestic companies in the market of NTI and high-tech industries. The key activity of the center is the development of solutions for creating world-class high-tech products using new manufacturing technologies and cross industry and multidisciplinary competencies of engineers and scientists of SPbPU and also members of the project consortium which as of February 1, 2019 has 50 members and more than 25 partner companies.

Also the NTI SPbPU center develops the competencies of the enterprises in the field of advanced manufacturing technologies (AMT), trains specialists and organizes implementation of AMT to the enterprises, transfers new manufacturing technologies into high-tech industries.

### KEY COMPETENCIES OF THE CENTER

- Digital design and modeling (CAD-CAE-HPTC-CAO-CAM-CAAM), Digital Twins, bionic design (Simulation & Optimization) - Driven Bionic/Generative Design, Smart Digital Twins, (CAD, CAE, CAO, CAM, CAAM, Simulation & Optimization) - Driven Bionic Design, PDM, PLM & Advanced Manufacturing).
- Smart-Manufacturing technologies and hybrid manufacturing technologies.
- New materials (composite materials, nanomaterials, metamaterials, metal powders for additive manufacturing).
- Additive technologies and additive manufacturing including 3D printers, technologies, approaches and ways of working with raw materials, development and production of metal powders and a set of services for 3D printing.





# WORLD-CLASS RESEARCH CENTER FOR ADVANCED DIGITAL TECHNOLOGIES

In August 2020 a consortium based on cooperation between Peter the Great St.Petersburg Polytechnic University (SPbPU), St.Petersburg State Marine Technical University, the Smorodintsev Research Institute of Influenza and Tyumen State University received the status of a World-Class Research Center in the field of advanced digital technologies. SPbPU is the supervisor of the Center.

The consortium brings together the competencies, resources and experience of four organizations, each of which has a wide partner network, including leading universities, research organizations and hi-tech companies in Russia and abroad.



## Andrei Rudskoi

SPbPU Rector,  
Academician of Russian  
Academy of Science

“Each area of the Center covers not only research, but as well training of young researchers and engineers. 57 new programs have been launched, and cooperation with the world’s leading universities is a part of the plan. Our future professionals will have the opportunity to become colleagues of the strongest experts from various countries.”





**The main goal** of the Center's program is to ensure a scientific and technological breakthrough based on world-class fundamental and applied research, to create conditions for the transition to a fundamentally new level of application of science-intensive technologies and the effectiveness of modern digital manufacturing.

The Center cooperates with leading world universities: University College London, Munich University of Applied Sciences, Berlin Technical University, Milan Polytechnic University, Shanghai Institute of Technical Physics of the Chinese Academy of Sciences and others. This cooperation involves the transfer of competencies, the exchange of experience and joint project work, which means that future specialists will have a unique opportunity to feel like students of the world's leading universities and colleagues of the strongest experts from various countries.

## KEY COMPETENCIES OF THE CENTER

- Advanced Digital Technologies
- Artificial Intelligence and Intelligent Systems
- Additive Manufacturing and New Materials
- Robotics Systems
- Digital Technologies in Physics and Mechanics
- Digital Technologies of Biomedical Systems

### Aleksey Borovkov

SPbPU Vice-Rector for Innovative Projects

“In the coming years the basis of competition will be not so much the technology itself or digital solutions, but the ecosystems of their development. The Centre is already de facto the core of the formation of a whole range of ecosystems of knowledge, competencies and technologies.”





# BREAKTHROUGH PROJECTS

## CREATING THE IMAGE OF THE CITY



### FIFA World Major Events:

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

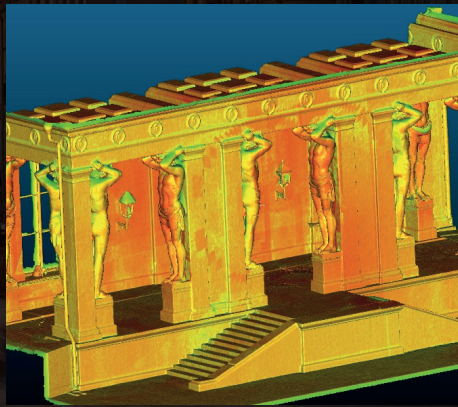
The employees of the Department of automata have participated in the decision of design and technological challenges to create the scenery in the leading theaters of Moscow and St. Petersburg. From the “Ring of the Nibelungs” to “Nutcracker” — dozens of performances gained the most complicated scenery. 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.





## Information Modeling Technologies for Cultural Heritage Buildings

SPbPU's NTI Excellence Center for Advanced Manufacturing Technologies is developing a methodology for creating information models (BIM) of engineering facilities. One of the applications of the methodology is cultural heritage information modeling. At the end of 2019, in cooperation with the State Hermitage Museum was implemented a project on digital modeling of the portico of the New Hermitage building and Atlantean sculptures to develop a monitoring system for the monument.



## 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.



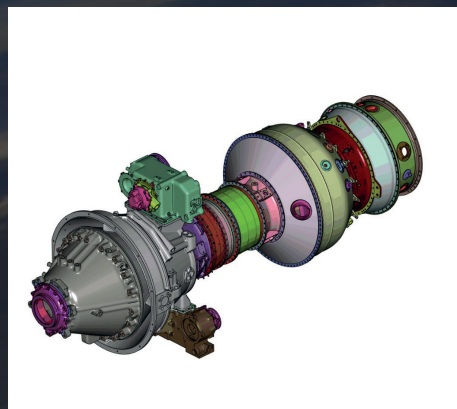
# BREAKTHROUGH PROJECTS

## MISSION OF CHANGES



### Development of an Antarctic sledges

Digital design of unique metal-composite sleds for long-distance transportation of large-sized super-heavy loads in the extreme conditions of the Arctic and Antarctic. The carrying capacity of the developed sledges reaches 60 tons (current analogues are up to 20 tons), the operating temperature is up to minus 60 degrees Celsius. A modular design has become a design feature, which makes it possible to transport sledges by rail and road without the special equipment. The performance tests of the sledges were successfully completed in February 2019 in Antarctica.



### Reducing the weight of an aircraft engine

Experts of SPbPU Engineering Center (CompMechLab®) have successfully completed a unique for the industry project aimed at reducing the weight of the aircraft engine based on the digital twin technology. Within the framework of the project, the experience in the development of engines of this class of the customer (JSC «UEC-Klimov») has been digitized. The obtained data were interpreted within the framework of a new design paradigm using the own Digital Platform CML-Bench™. Based on the results of optimization and virtual tests, the weight of individual engine parts has been reduced by up to 50%.



### 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.





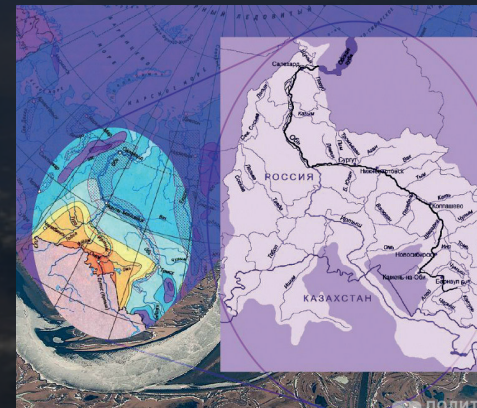
## «KAMA-1»: first Russian compact electric car

«KAMA-1» is a first Russian compact electric car, which was developed from scratch by engineers of SPbPU's Advanced Manufacturing Technologies Center of the National Technology Initiative and Engineering Center (CompMechLab®) of SPbPU using Digital Twins technology and knowledge-intensive platform solutions. «KAMA-1» has an 80 kW electric motor, which allow it to accelerate to 100 km / h in 6.7 seconds. Maximum speed - 150 km/h and the drive range without recharging is about 250 km.



## High Speed Composite Passenger Catamaran

Specialists of SPbPU Computer-Aided Engineering Centre of Excellence (CompMechLab®) have designed a carbon fiber hull for a high-speed passenger catamaran commissioned by JSC «Sredne-Neviskiy Shipbuilding Plant». The use of composite materials and vacuum infusion technologies has made it possible to significantly reduce the weight and increase the strength of the vessel. In addition, the composite body is not subject to corrosion, which significantly increases its service life.



## Federal project «Digital Ob-Irtysh Basin»

SPbPU National Technology Initiative Excellence Center for Advanced Manufacturing Technologies, as a technology coordinator and contractor, participates in the development of a federal project, which has no analogues in the world. The project is aimed at creating a system of integrated water resources management of the largest in Russia and the third largest in the world - the Ob-Irtysh river basin. The implementation is carried out based on the technology of digital twins and big data.



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*

*Credit: Minpromtorg press office*

# BREAKTHROUGH PROJECTS FOR GLOBAL INDUSTRY



## 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.



## BOSCH

Invented for life

Robert Bosch LLC supports young scientists of SPbPU who conducts their research in the spheres of applied mathematics and hydrodynamics. In addition, there is a strong cooperation in the area of student project activity.





Joint research in the sphere of plasma theory and modelling, design and engineering for ITER (International Thermonuclear Experimental Reactor), exchange of researchers and staff to train personnel.



**HUAWEI**

Cooperation between SPbPU and Huawei covers various areas of research such as new materials for electronics, wireless and 5G, software engineering and others. Students and post-graduate students of Polytech are regular members of Huawei hackathons and competitions.



Long-term cooperation with KITECH lasts for more than ten years. At present, the main area of joint activity is research of materials, alloys and mixtures properties for modeling and optimization of industrial casting processes.



### 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.





ROSCOSMOS

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.

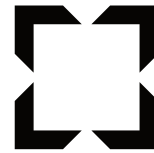


ROSATOM

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.



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.



Rostec

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.

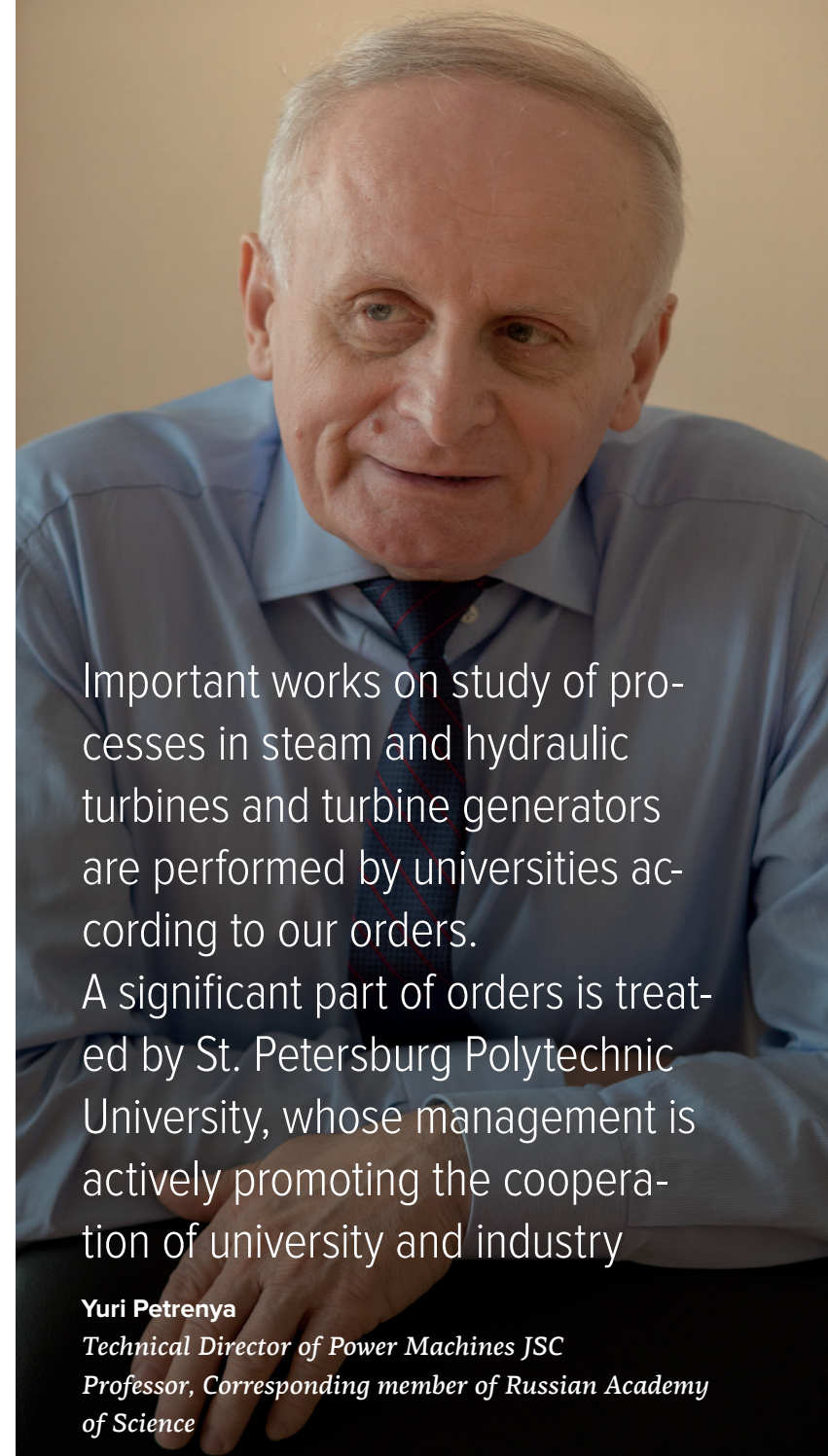




**KLIMOV**



**SIBUR**



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*

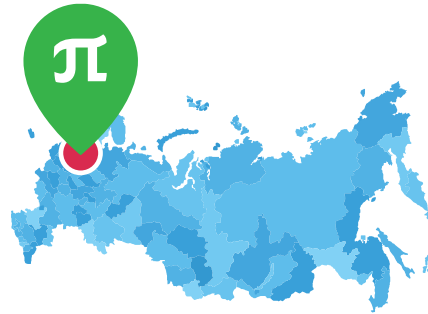
*Professor, Corresponding member of Russian Academy of Science*

## Russia



**Collaboration  
with leading uni-  
versities,  
by countries**

## St.Petersburg



## Polytech



# International perspective

**↑ 500** NEW  
ACADEMIC  
PARTNERS

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

**↑ 150** LEADING  
SCIENTISTS

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

**↑ 260+** NEW LABORATO-  
RIES AND RE-  
SEARCH GROUPS

Open new labs headed by outstanding scientists and academicians



# Dmitry Arseniev

Vice-Rector  
for International Affairs,  
Professor, DSc

World leading universities are choosing an internationalization strategy as the guarantor of the universities' sustainable development and the way to new perspectives. It connects countries and continents, unites people and helps them to reveal their talents and their potential. We have extensive experience in international collaboration and are always open to a new partnerships



# 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.

## SIEMENS

### Joint International Research and Educational Center «Polytech-Siemens»

The establishment of the Center is a strategic step in long-term cooperation between Siemens and SPbPU that lasts for more than 20 years.

The main spheres of cooperation are the following:

- collaboration in the area of basic and applied research
- training and support of undergraduate and postgraduate students, engineers and scientists
- organization of lectures, seminars and conferences including participation of invited professors and scientists
- holding competitions among students, graduate students and SPbPU employees for the best solution, invention, including hackathons for developers of software and hardware systems.

### 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».

# EMC<sup>2</sup>

where information lives





## International Research and Educational Center of Excellence «Altair - CML – Polytechnic»

The Center was established in 2016 on the basis of significant experience in the spheres of computer aided engineering and additive technology.

Main areas of cooperation:

- education programmes for master students on optimization technologies and bionic design;
- creating the model of digital manufacturing using software and equipment (3d-printers) of Altair Engineering, Inc and scaling the model to real production lines of Russian companies;
- training programmes for customers
- annual technology conference on advanced manufacturing technologies



## KAWASAKI Industrial robotics center

On the basis of the Kawasaki Polytech Center, educational programs of the university are being implemented, as well as cooperation with industrial enterprises with the aim of developing and introducing production automation technologies. The demonstration hall features 10 robotic complexes, including: robotic arc and spot welding, milling, pailing, assembly, painting, sorting and stacking of products.

- Familiarity with the capabilities of industrial robots and advanced manufacturing technologies.
- The use the material and technical base of the Center in the basic educational programs of the University.
- Consultations on automation of technological processes for enterprises.
- Personnel training in programming and maintenance of industrial robots.
- Technology testing in simulators and on real equipment in the laboratory.
- Development of technological processes and specialized software.



## SAP Academic Competence Center

The SAP Academic Competence Center was created in 2006 and operates as the interfaculty unit of the University.

Educational and research activities of the Centre includes

- teaching of the university students the basis of SAP ERP solutions, including SAP ERP modules as teaching tools into standard curriculum of engineering and economic departments,
- providing access to the SAP ERP system for university students and staff to use as a tool for their research work
- organization of presentations and seminars in the field of practical use of SAP ERP systems in industry.



**Weatherford®**

## International research center «Weatherford Polytechnik»

- Electrochemical studies, including the construction of polarization curves, determining the nature of the potential change over time, conducting research on a rotating disk electrode;
- Assessment of the corrosion properties of materials under conditions simulating operational conditions, including at elevated temperature and pressure, in aggressive gas-saturated media;
- Development of techniques and bench equipment for testing simulating non-standard conditions of material operation, close to real ones;
- Comparative studies of the erosion and corrosion-erosion properties of materials and coatings used in oilfield equipment;
- Studies of hydrogen sulfide and carbonic acid corrosion;
- Tribological testing;
- Analysis of the causes of destruction of equipment material;
- Metallographic, fractographic studies.

# REPRESENTATIVE OFFICE IN SHANGHAI, CHINA

## PLACE WHERE EUROPE & ASIA MEET

On April 21, 2016 in the Pudong New Area, Shanghai (China) a grand inauguration ceremony of the Representative Office of Peter the Great St. Petersburg Polytechnic University brought together the representatives of the leading Russian and Chinese universities and industrial companies as well as the administration of both countries. Polytech became the first Russian university with an official representation in China.

The activities of the Representative Office are aimed at organizing broad cooperation between Russian and Chinese universities, companies and organizations, as well as involving other countries of the APR in this cooperation.



### Aleksandr Shmanevskiy

Consulate General of the Russian Federation in Shanghai

Consulate General of the Russian Federation in Shanghai makes every kind of assistance for establishment of a representative office of one of the oldest Russian institutes of higher education. We believe that it will as always be a reliable stronghold of Russian - Chinese friendship and mutually beneficial cooperation in science and technology and will contribute to the development and application of high technology in our countries.

### Major Events:

- Russia-Chinese Biomedical Forums
- China International Industry Fair
- China-Russia Innovation Dialogue
- Days of Russian Language

### Associations and networks

- Belt&Road Science and Innovation Network
- Association of Sino-Russian Technical Universities
- Association of Belt&Road Universities
- The Global Energy Interconnection Development and Cooperation Organization

**2,5 +** R&D CONTRACTS  
WITH CHINESE  
PARTNERS  
mln euro

**2000 +** CHINESE STUDENTS

**40+** INDUSTRIAL  
PARTNERS

**35+** UNIVERSITIES

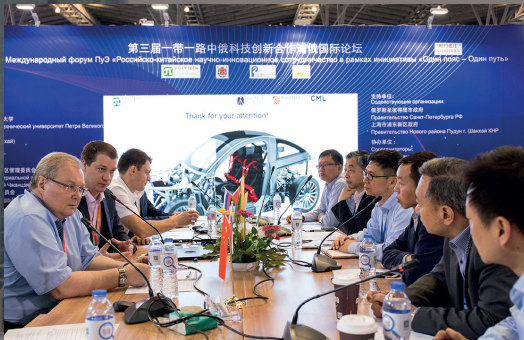




## Zhang Quan

Head of Science and Technology  
Commission of Shanghai Municipality

«Peter the Great St. Petersburg Polytechnic University is a world-renowned university, research center and talent training base. It has long-term friendly cooperation with Shanghai and other cities in China. The establishment of a Representative office in Shanghai by SPbPU (Science and Technology Center) will help carry out more pragmatic scientific research cooperation, transfer and transformation of scientific and technological achievements, deepen China-Russia scientific and technological exchanges and partnership, contribute wisdom and strengthen the bright future of China, Russia and the world»





# INFORMATION CENTER OF SPBPU IN MADRID, SPAIN

## OUTPOST OF THE RUSSIAN ACADEMIC AND RESEARCH COMMUNITY AT THE KEY

April 19, 2017, Peter the Great St. Petersburg Polytechnic University the first Russian university to open its Information Center on the territory of Spain, in the capital city - Madrid. Information Center of SPbPU in Madrid is based at the SPbPU strategic partner – Technical University of Madrid.



**Andrei Rudskoi**

Rector

We are interested in strengthening partnership in the field of education and research between Spain – as a heart of Ibero-American community, and Russia, and we are striving to mobilize the potential of higher education of both countries, both regions. We consider opening the Information Center of SPbPU in Madrid to be our major investment in the common future.

**20+** PARTNERS FROM SPAIN AND PORTUGAL

**15+** PARTNERS FROM LATIN AMERICA

**150+** STUDENTS FROM IBERO-AMERICAN COUNTRIES

**10+** JOINT INTERNATIONAL EVENTS WITH IBERO-AMERICAN PARTNERS EACH YEAR







## Guillermo Cisneros Pérez

Rector of the Universidad Politécnica de Madrid

It is very important for us to find a strategic partner in Russia. Opening of the SPbPU Information Center at the Universidad Politécnica de Madrid was a very important event for us and a big step forward in strengthening relations between our universities. Russia and Spain have very similar cultures, as well as our universities have a lot of similarities in different areas. What we have to do is to exploit our common view of life concerning research and education and to share it.



## Félix Valdés

Consul General of Spain in St. Petersburg

Attracting universities to cooperation with companies opens up new prospects for both educational and industrial spheres. Universities can offer companies new ideas and solutions, and provide talented students for internships, in order to increase future economic potential of the countries.



## Major Events:

Open your Heart to Russia (Spain)

Polytech: Science, Technology and Creativity (Spain)

Polytech: Business, Languages and Culture (Spain)

I Semana Hispano-Rusa de Lengua y Cultura (Russia)

Days of Polytech in Brazil (Brazil)

II Semana Hispano-Rusa de Lengua y Cultura (Russia, Spain)



# Youth Research & Creativity

STUDENT R&D PROJECTS

ENTREPRENEURSHIP

FAB LAB POLYTECH

BOILING POINT POLYTECH



# SOLAR CAR

FIRST RUSSIAN  
SOLAR UNIQUE  
SOLAR-POWERED  
CAR



# STUDENT R&D PROJECTS



## PROTECTIVE MASK – COVID-19 RESPONSE

Young engineers from SPbPU design, develop and manufacturing using 3D-printing the protective mask to be used by personal in hospitals and other public places.



## STUDENT TOURNAMENT OF THREE SCIENCES

Platform for the interaction of students, the business community and government authorities with the subsequent employment of talented participantsowered car



## RECTOR CUP ENGINEERING COMPETITIONS

For developing students` technical abilities, creative thinking, unleash potential, acquire teamwork skills and broaden their horizons



## FORMULA STUDENT

(Formula SAE) – race car for Formula Student racing



# STUDENT R&D PROJECTS



## SOLAR PANEL BOAT

Unmanned control solar-powered boat

## Maxim Pasholikov

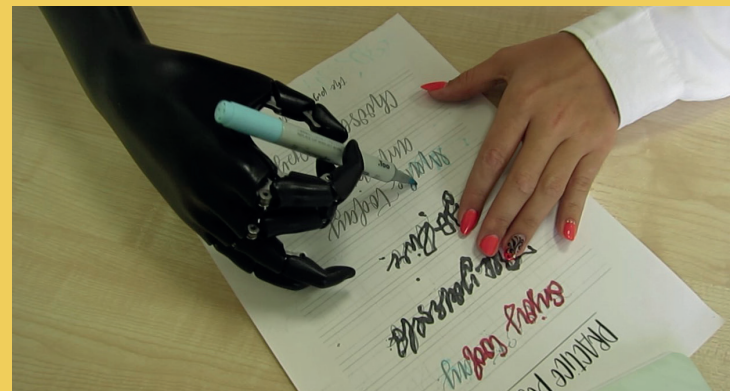
Vice-Rector for Media and Social Affairs

Our main task is to form an environment at the Polytech, where engineers and scientists could develop and implement their outstanding ideas.



## SCIENCE SLAM POLYTECH

International project to popularize science



## BIONIC HANDPROSTHETIS

A forearm prosthesis has been developed for a real patient: a girl with a congenital malformation of the forearm. The prosthesis has been successfully used for more than one year. Electromyography using an array of electrodes is used to control the prosthesis.

# ENTREPRENEURSHIP

CENTER FOR DEVELOPMENT OF TECHNOLOGICAL PROJECTS AND ENTREPRENEURSHIP



The mission of the Center is to help and assist technology entrepreneurs in turning an innovative idea into a real-life manufacturing business, creating new jobs and increasing the flow of budget revenues, creating a spirit of technological entrepreneurship in society that allows creating new breakthrough products and technologies ensuring the increase of the power of the Russian state. The Center interacts with novice entrepreneurs, startups, developers, projects and IPIs of all SPbPU universities and its partners to commercialize their developments and helps to turn business ideas into a working business.



# POLYTECH STRASCHEG



## RUSSIAN-GERMAN CENTER FOR INNOVATION AND ENTREPRENEURSHIP

The aim is to generate an economic impact in the sense of the Sustainable Development Program Goals (SDGs) in an international eco-system.

The joint activities of the partnership will be integrated in a European Resonance Space for 'European Responsible Entrepreneurship Excellence' (EREE) as a jointly developed framework with international partners and their ecosystems.

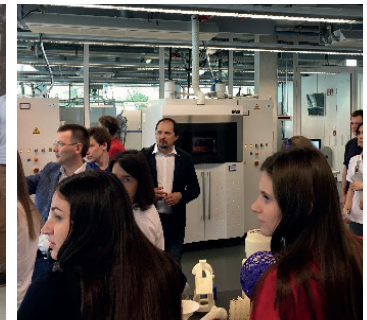
## INTERNATIONAL ACADEMIC PROJECT PARTNERS

### E-BRIDGE PARTNER

Athens University of Economics and Business  
University of Aveiro  
Technical University of Denmark  
Edinburgh Napier University  
Tampere University of Applied Sciences  
FH Campus Wien, University of Applied Sciences  
SPARK Innovation Hub  
International Burch University  
Tech7 -Negev Innovation  
California State Polytechnic University  
Peter the Great, St. Petersburg Polytechnic University  
Munich University of Applied Sciences  
Technical University Munich  
EOS Holding AG  
Roche Diagnostics GmbH  
VDMA Bayern (Association of Companies)  
And other 16 universities in Munich, Germany

### PLACE

Athens, Greece  
Aveiro, Portugal  
Lyngby, Denmark  
Edinburg, Scotland  
Tampere, Finland  
Vienna, Austria  
Mostar, BIH  
Sarajevo, BIH  
Be'er-Sheva, Israel  
Luis Obispo, USA  
St.Petersburg, Russia  
Munich, Germany  
Munich, Germany  
Krailling, Germany  
Penzberg, Germany  
Munich, Germany



344

students participated in 14 international summer schools

42

international experts on entrepreneurship participated in 2 international scientific seminars "Think Act Tank"

14

international research projects on entrepreneurship more than 300 economists, managers and engineers attended lectures by the world's leading E-ship experts

76

startup projects were selected and took part in the Polytech Strasczeg Award business ideas competition

5

seasons of Real Projects, bringing together Russian and German engineers, managers and economists

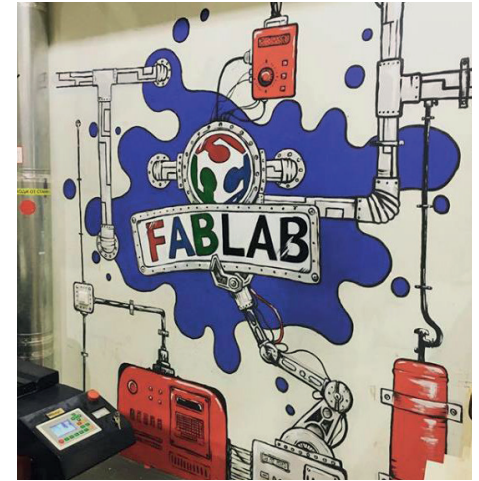
50

Innovative project pitches - about 50 pitches a year

# FABLAB POLYTECH

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).



## THE CENTER FOR SCIENTIFIC AND TECHNICAL CREATIVITY FABLAB

FabLab Polytech is part of a global network of high-tech manufacturing laboratories.

The obligatory basis of the equipment in them consists of a 3D printer, a 3D scanner,

an engraver, a laser and milling machines. The facilities of the premises make it possible to use Fablab as a zone of technological coworking and conduct research seminars, practical training, master classes and trainings. The main goal of Fablab is to provide students and schoolchildren with the opportunity to realize their technical ideas within the walls

## FABPRO DIGITAL PRODUCTION EDUCATIONAL COURSE

of SPbPU.

An educational course for students of Polytech, organized by the staff of Fablab Polytech in order to teach university students how to work with modern machines and other technological equipment. During the course, students of the Polytechnic

University receive the necessary knowledge and experience in order to independently implement their scientific and technical projects in Fablab.



# BOILING POINT POLYTECH

BOILING POINT POLYTECH IS AN OPEN NETWORK SPACE THAT WAS CREATED WITH THE SUPPORT OF THE FEDERAL PROJECT “NATIONAL TECHNOLOGY INITIATIVE” AND IS PART OF BOILING POINT NETWORK.

Boiling Point network is a growing community based on 89 spaces across Russia intended for coworking over challenges of the future, unique in its values and rules. High density of events and the involvement of leaders and talents from different social groups provide participants with the opportunity to quickly test breakthrough ideas, gather project teams or influence the development of a region.

TBoil Polytech is mainly focused in the following areas:

- Entrepreneurship
- Hi-Tech
- Soft-skills
- University Development
- Project Activities
- Modern Education



Lecture of the Honorary President of the Federal Chamber of Economics of Austria Dr. Christoph Leitl



# MAJOR EVENTS

## SPbPU INTERNATIONAL EVENTS:

SPbPU International Polytechnic week 1st Russian-Spanish Week of Language and Culture in cooperation with University of Cádiz

International Forum Student Project Marathon in cooperation with Graz University of Technology

POLYTECH DAYS in Europe and Asia

St. Petersburg German Week

Falling Walls Lab competition of young scholars in cooperation with the German Academic

Exchange Service (DAAD) and the German Centre for Research and Innovation in Moscow (DWIH)

Polytech International Culture Tours

## PARTICIPATION IN WORLD LEADING B2B EVENTS:

NAFSA (National Association for Foreign Student Affairs)

APAIE Annual Conference & Exhibition

Annual EAIE Conference & Exhibition

CEE (China Education Expo)





**Nature International Conference “Achievements and Applications of Plasma Physics”**

**International Conference Cyber-Physical Systems and Control (CPS&C’2019)**

**Scientific and Practical Conference with International Participation “SPbPU Science Week”**

**International Conference “Corrosion in the Oil and Gas Industry”**

**International Conference on Digital Technologies in Logistics and Infrastructure**

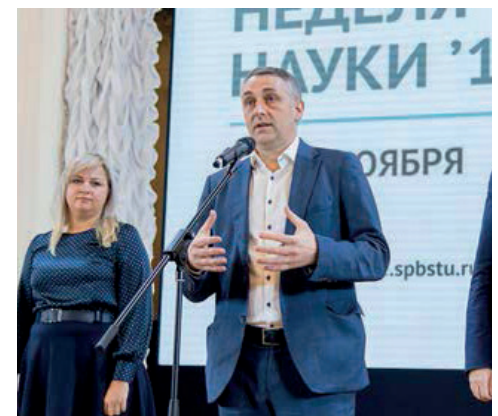
**Fifth International Scientific Conference “Technological Transformation: a New Role of People”**

**International Scientific Conference “Modern materials and advanced manufacturing technology”**

**International Scientific Conference “Mathematical Methods in Engineering and Technology – 32”**

**International Symposium “Compressors and compressor equipment «named after K.P. Seleznev”**

**International Summer School-Conference “Advanced Problems in Mechanics”**







# POLYTECH

Peter the Great  
St. Petersburg Polytechnic  
University

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