Skolkovo
Institute of Science
and Technology

Skoltech10!

Annual Report '21

2011-2021

Created to create

2021 was a milestone year for Skoltech – the year of the 10th anniversary, celebrated with outstanding achievements of scholars and engineers, students and alumni, staff and partners.

Skoltech10!

10 years that shaped one of the best young global universities

01

Being a research-intensive institute, Skoltech established 14 advanced Centers pushing the boundaries of Artificial Intelligence, Telecommunications, Life Sciences, Materials and Engineering, Energy Efficiency and ESG, Photonics, and Mathematics.

02

Skoltech academic results are globally recognized: the best computer science university in Russia (Guide2Research), # 65 in Nature Index Young universities ranking, # 35 in Physical Sciences, also named a rapidly rising university (#21).

03

Skoltech faculty and researchers established long lasting collaborations with academic peers from top world universities and research centers such as MIT, CNRS, Harvard University, University of Cambridge, University of Oxford and other top academic institutions across the globe.

04

The unique educational model attracts thousands of applicants from more than 100 countries. Quality of PhD programs is recognized with EU accreditation. More than 1300 alumni are highly demanded in R&D sector, many graduates became successful entrepreneurs.

05

True to the mission, Skoltech became a national think and act tank, hosting technology Centers in Artificial Intelligence and Communications, specializing in such areas as Next Generation of Wireless Technologies, Internet of Things, AI optimized decisions to reduce carbon footprint. 3.5 bln Rub are invested in the Centers by the state and industry.

06

Skoltech is a pioneer of cutting-edge technologies: was the first to demonstrate operation of the autonomous 5G network using own software and made the first VoNR call in Russia. Also, deployed the line for production of cathode materials for lithium-ion batteries based on oxides of nickel, manganese and cobalt with high energy density, surpassing the best world analogues; these materials serve as the basis for advanced storage batteries for transport and industrial applications. Constructed and transferred to the national aerospace industry the unique complex for production of aluminum honeycomb packs.

07

Skoltech generated 17 bln Rub of impact to the national economy in 2021. As the Institute continues to grow, the cumulative impact will exceed 100 bln Rub in 2025.

08

Skoltech with international partners developed the world's first ultrafast all-optical transistor that operates at a room temperature and has an unprecedented high gain. This is a big step towards creation of ultra-fast optical logic circuits and brings appearance of real optical computers closer.

09

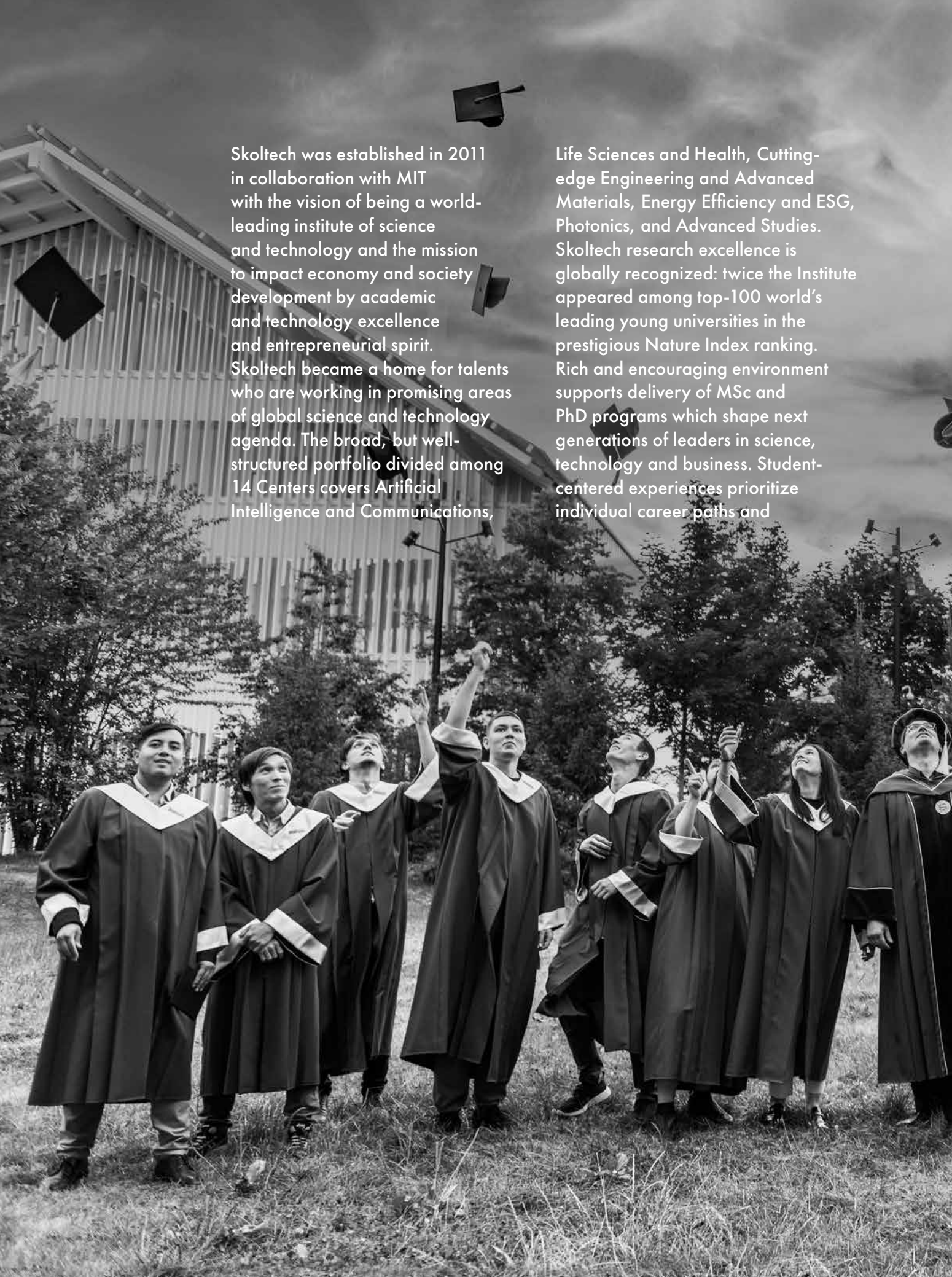
Supporting translational research, Skoltech has 150 patents and more than 100 startups of faculty, students and alumni. Joint research in genome editing (CRISPR-technologies) with Rutgers, MIT and Harvard led to cutting-edge results protected with three joint patents. The joint venture with Sber resulted in the ecosystem for development of AI in healthcare, providing hundreds of Russian hospitals with the access to a unique collection of well-structured medical data and cutting-edge data processing algorithms and tools.

10

Skoltech campus, internationally recognized with the first prize of the Prix Versailles, is a unique engineering and technical facility allowed to deploy state-of-the-art labs, design modern and spacy teaching and learning areas and community building zones.

Content

About



Skoltech was established in 2011 in collaboration with MIT with the vision of being a world-leading institute of science and technology and the mission to impact economy and society development by academic and technology excellence and entrepreneurial spirit. Skoltech became a home for talents who are working in promising areas of global science and technology agenda. The broad, but well-structured portfolio divided among 14 Centers covers Artificial Intelligence and Communications, Life Sciences and Health, Cutting-edge Engineering and Advanced Materials, Energy Efficiency and ESG, Photonics, and Advanced Studies. Skoltech research excellence is globally recognized: twice the Institute appeared among top-100 world's leading young universities in the prestigious Nature Index ranking. Rich and encouraging environment supports delivery of MSc and PhD programs which shape next generations of leaders in science, technology and business. Student-centered experiences prioritize individual career paths and

aspirations towards outstanding results. More than 1300 talented and ambitious alumni are successfully employed in high-tech sector, continue for PhD, postdoc or faculty positions, founded own startups.

Skoltech is a trusted partner for many industry players in Russia and beyond, also provides reliable expertise to governmental bodies on complex technology initiatives. The Project Centers specializing in Wireless Technologies and IoT, Artificial Intelligence, Agro Technology, Energy Transition and ESG, are driven to make the most of their potential to contribute to national technologies. Sponsored research reached the high levels securing 2.5 bln Rub by faculty and researchers for 2021.

Faculty, students and alumni founded more than 120 enterprises in Russia and abroad, 71 companies received Skolkovo residency.

Skoltech campus, marked with the prestigious Prix Versailles Award, cultivates strong and active interaction between research, teaching & learning, building community of faculty, students, and staff, which now exceeds 2200 people.

Mission and vision

Mission

Skoltech facilitates the economy and society development by academic and technology excellence and entrepreneurial spirit.

Vision

Being an international university of a new type in Russia, Skoltech is the central element of the system of the institutes for development to re-create a foundation for national high-tech industry, leveraging the boost in research and entrepreneurship in science-intensive areas. In this paradigm, Skoltech fosters research in the advanced areas of crucial importance for Russia and the world, promotes entrepreneurship while training science, technology and business leaders capable of working in a rapidly changing research and technology landscape. Skoltech looks beyond a university 3.0, integrating research, education and innovation to achieve ground-breaking advances and transfer best practices to the economy.

Key data 2021

Structure

6	Target Domains
10	Centers for Research, Education and Innovation
4	Project Centers

Global reputation

#1	University in Computer science in Russia (Guide2Research)
#65	World young universities (Nature Index ranking)
#35	Physical Sciences (Nature Index ranking)

Publication output

147	In Nature Index journals
63%	In Q1 journals[1]
59%	In international collaborations

Personnel

1230	Total staff
144	Faculty
511	Researchers engineers

Students

1063	MSc and PhD students
33%	Females
21%	Internationals from 48 countries

Alumni

1359	Alumni total
77%	In Russia
95%	Employment rate[2]

Partnerships

54	International agreements
12	Cotutelle agreements
103	Industry partners

Sponsored research

2.5	Bln Rub secured by Centers
199	R&D projects
106	Grants

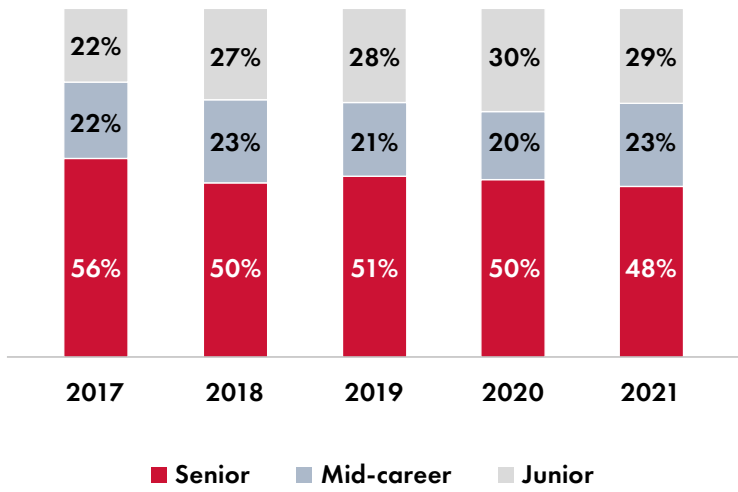
Entrepreneurship and innovation

71	Startups in Skolkovo
158	IP cumulative
>250	Mln Rub investments in startups

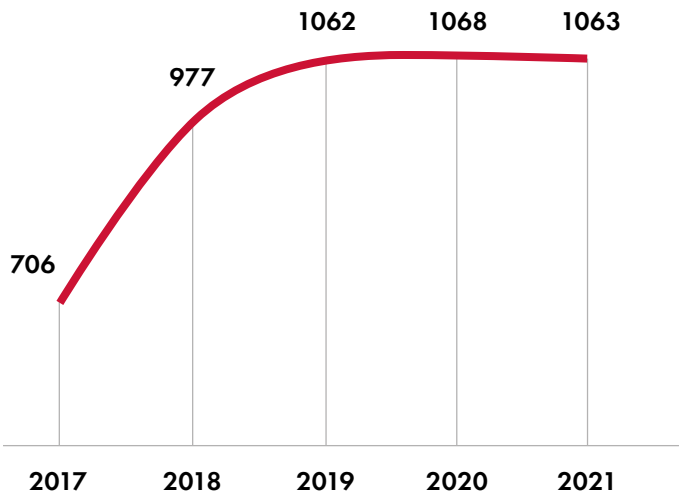
[1] From total output (Scopus)
[2] Within 4 months after graduation.

Five-year trends

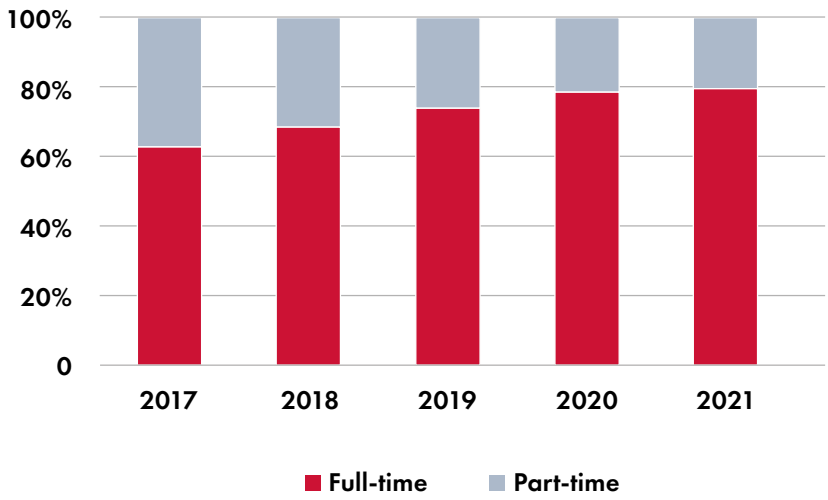
Faculty by position



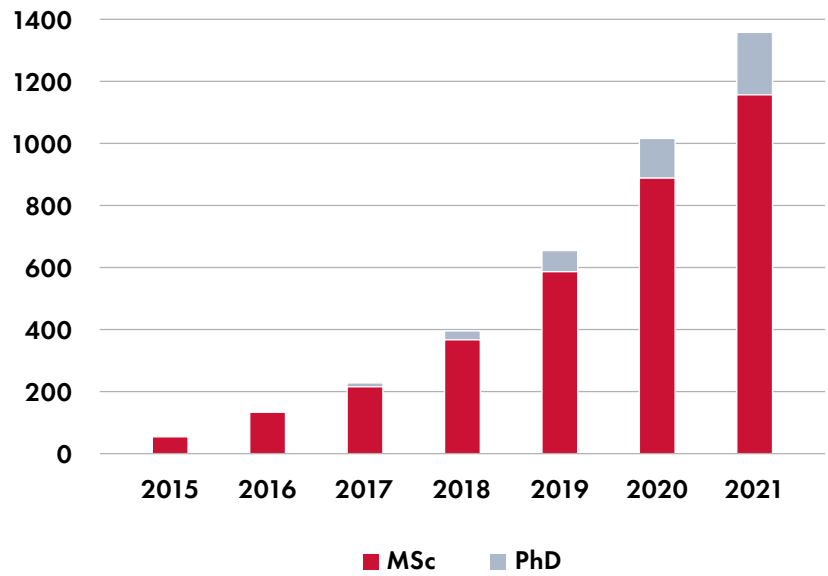
Student cohort



Faculty by contract type

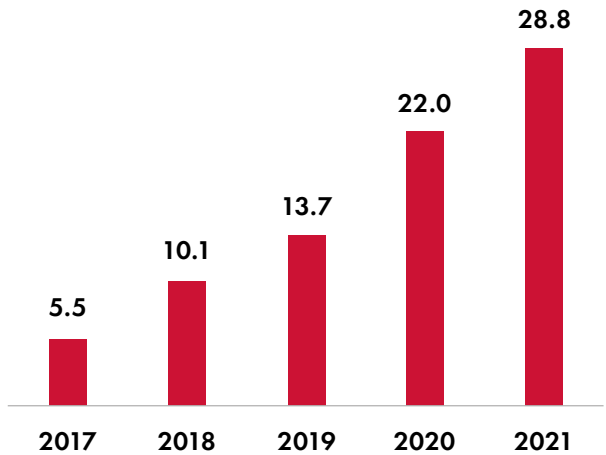


Graduates (cumulative)

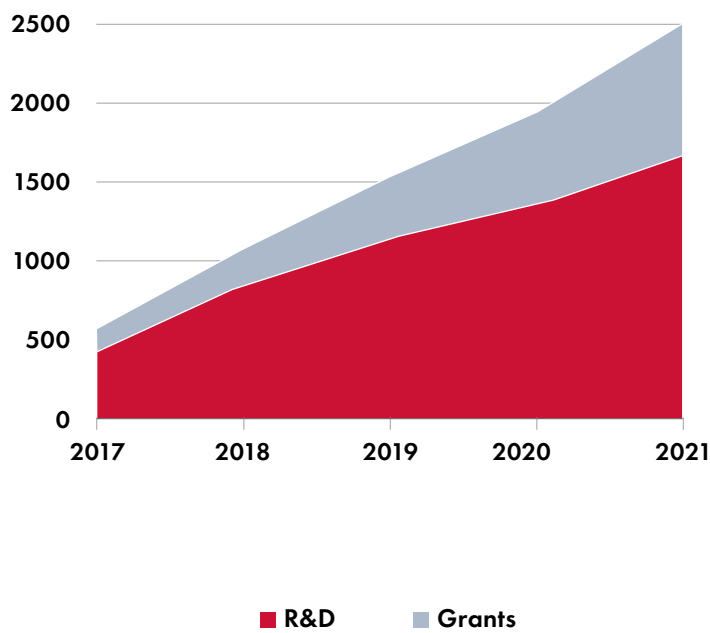


The first class graduated in 2015

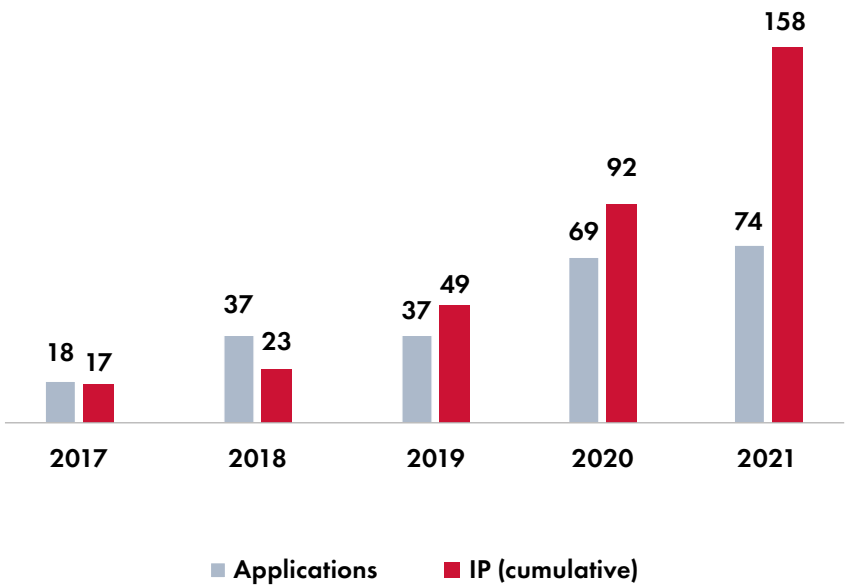
Share of Skoltech authorship in Nature Index papers



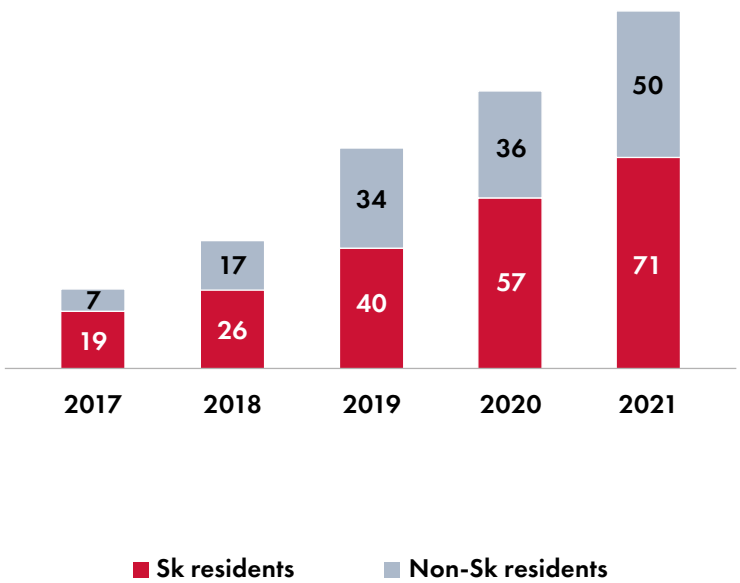
Sponsored research (mln Rub)



Patent activity



Skoltech associated startups (cumulative)



Towards 2025

The Strategy 2021 – 2025, built around Targeting Excellence today to Impact Tomorrow, prioritizes Skoltech contribution to the national economy, building the reputation of the 1st choice university for the brightest talents, serving as a national think tank and act tank in technology areas demanded in Russia. In context of these aspirations, several high level priorities were defined and big steps towards these priorities have been taken.

Strategic focus

Maintaining the reputation of a world level research and educational center, a national think tank and act tank, requires a focused and well-structured research portfolio and a critical mass of competencies in the chosen areas. To address the relatively blurred focus of research and technology agenda and "atomization" of the Centers, the institutional transformation was started to address fundamental questions:
In what areas to invest capitalizing on existing strengths and capacities?
How Skoltech will best organize itself to reach the goals of the Strategy and Centers' strategic programs?
The process built through the baseline "Target Domains – Centers – Organizational frameworks" ensured transparency and collegiality of milestone decisions, at the same time, allowed all faculty to participate in strategic planning. As a result of review of faculty proposals, strategic programs were approved by the Academic Council and the Board of Trustees, leading to a more systematic research and technology agenda (see the chart further).

Research and technology structure

To support the strategic programs, structural developments were in place to adjust institutional organizational model, historically presented with one type of the unit – Center for Research, Education and Innovation (CREI). Considering different scale and scope of the strategic programs, a new type of the unit, Project Center, was established in addition to CREI. By design, Project Center drives problem-based research to target technology solutions and economic impact from technologies implementation. Project Centers will also serve as the "frontends" for raising capacities of a national think and act tank.

Research and technology structure

Artificial Intelligence & Communications

Artificial Intelligence Technology

- Computational Intelligence
- Tensor Networks & Deep Learning
- Mobile Robotics
- Computer Vision
- Natural Language Processing
- Computational Imaging
- Intelligent Signal and Image Processing
- Multiscale Neurodynamics for Intelligent Systems
- Mathematical Foundations of AI
- Statistical Machine Learning
- AI & Supercomputing
- Medical Computer Vision
- Quantum algorithms for machine learning and optimisation
- AI for Materials Design

Next Generation Wireless and IoT

- 5G development
- 6G Research and Development
- Wireless technology perspective studies

Artificial Intelligence in direction of optimization of management decisions to reduce carbon footprint

- Data Fusion and 3D Computer Vision
- Physics-Informed ML
- Efficient DL for Green AI technologies
- ML for Industrial Predictive Analytics

Life Sciences & Health, Agro

Molecular and Cellular Biology

- Microbiology
- Metagenomics
- Functional and evolutionary virology, antiviral drugs
- Transcriptomics
- Biochemistry of nucleic acids
- Cell Biology
- Genetically encoded fluorescent probes: engineering and application in biomedical models
- Structural bioinformatics
- Immunology – Adaptive immunity
- Plant biology
- Genetics and Evolution
- Omics technologies and big data for personalized medicine and health
- Mass spectrometry molecular technologies in medicine and environmental research

Neurobiology and Brain Rehabilitation

- Brain-computer interfaces
- Neuromodulation
- Brain metabolism
- Biomaterials
- Small molecules
- Computational neurobiology
- Computational neuroimaging

Agro Technologies

- Envirotyping and Digitalization of Agriculture
- Crop improvement
- Livestock improvement

Cutting-Edge Engineering, Adv. Materials

Digital Engineering

- Product Development and Systems engineering
- Systems Modeling
- Robotics
- Space Systems

Petroleum Science and Engineering

- Enhanced Hydrocarbon Recovery (chemical, gas and thermal methods)
- Geomechanics, hydraulic fracturing
- Petrophysics and geochemistry of unconventional reservoirs
- Geocryology (gas hydrates, permafrost)
- Advanced Reservoir Modelling
- Machine learning in oil and gas industry
- Climate changes, environment protection, energy transition in oil and gas industry
- Nuclear waste disposal in geological formations

Materials Technologies

- Large-sized structures of polymer composite materials for the transport infrastructure of the Arctic zone
- Coating technology for nuclear waste management
- Additive manufacturing of implants for translation into clinical practice

Energy Efficiency & ESG

Energy Science and Technology

- Energy storage and conversion
- Energy Systems
- Laboratory of Modern Energy Systems
- Skoltech-KAMAZ laboratory for automotive batteries
- Project Laboratory on sustainable hydrogen and ammonia

Energy Transition and ESG

- Carbon Capture, Utilization and Storage
- Decarbonization of industry
- ESG Risks Assessment in Economy
- AI for ESG applications

Photonics

Photonic Science and Engineering

- Biophotonics
- Liquid Light Computing
- Nanomaterials
- Photonic Circuits and Systems

Engineering Physics

- Photonic integrated circuits and devices for applications in nano-optoelectronics, fiber sensors, and nano-biomedicine
- Quantum current standard
- Computer modeling of cerebral blood flow. Development of experimental microcirculatory model of the human brain to map out areas of specific interest and subsequent study of the hydrodynamics of a multiphase fluid in the microcirculatory system

Advanced Studies

Advanced Studies

- Algebraic and complex geometry
- Lie theory and generalizations
- Dynamical systems and differential equations
- Mathematical physics
- Probability and statistics
- Combinatorics and discrete mathematics
- Integrable Models

Center for Research, Education and Innovation

Project Center

Center

Organizational frameworks

Organizational frameworks were revised mainly to support Center's strategic programs, and also, shape enablers for the Strategy implementation.
The Policy on Centers, which is a major framework of the research and technology organizational structure, was adjusted with the concept of Project Center.
Human capital policy was bolded on the agenda to widen motivation and incentives tools, ensure attention to individual performance and team accountability, provide grounds for building transparent career ladders.

The new pay system was developed to come into force in April 2022.
Work was started on design of the performance management system to improve strategic planning through cascading the Strategy goals to all organizational levels, on the one hand, and ensure incentives and rewards for top performers, on the other. The strategic and operational planning framework was amended with the KPIs concept.
Other directions included development of the Project Activities Policy and IP Policy update, both ready to go in 2022.

om Meeting

Recording...

Strategy working group: summary report

- 22 proposals received by the Strategy working group (SWG) on time. All proposals in line with the formal requirements (e.g. initiated by faculty, templates). Review process was conducted as per Policy on strategic planning and reporting, Policy on Centers. Based on review, the SWG supported 7 CREI programs and 3 Project Centers programs. CAS program approved by the President.
- Consultations on proposals received by the SWG after the deadline, are ongoing.

CREI program

Review criteria: formal criteria to Centers*, alignment of the proposal to Skoltech strategic priorities.

Reasons for proposal rejection:
- no critical mass of faculty (e.g. 1-3 faculty, or predominantly part-time faculty)
- no capacities to deliver own MSc (PhD) program (e.g. select courses or a narrow focused track)
- focus area will require investments (e.g. hiring, lab facilities)

* Critical mass, educational program, transfer of knowledge and solutions to high-tech companies and wider communities, balance of research, education and innovation are established by the Policy on Centers (reviewed and approved by the Academic Council in May 2020).

Project center program

Review criteria: ability to design and bring to industry a scalable technology. Task force capacities, industry partner(s). Focus on national technology agenda.

Reasons for proposal rejection:
- proposal is arranged around a regular laboratory activity or a single faculty research interests
- proposal focuses on a technology service rather than a scalable technology product
- no capacities to form a task force, weak portfolio of industry partners

7

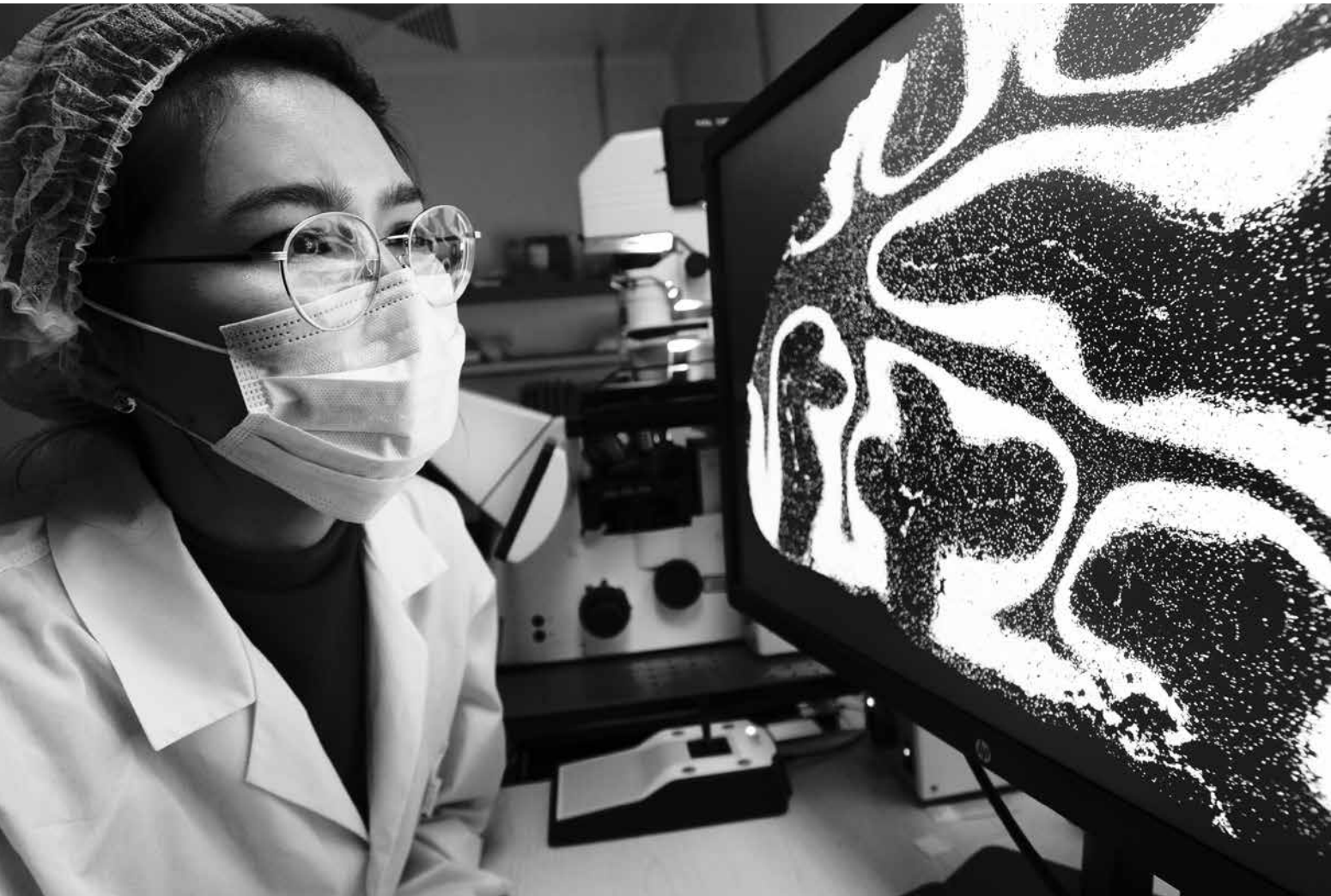
Security Participants 23 Polls Chat

Mute Stop Video

Making impact

World level research

Skoltech focuses on research which addresses major challenges facing society and the world. To support this aspiration, strong attention is paid to academic excellence and recognition of results on the global scale, maintaining academic partnerships that enrich research.



Research leadership

The year was remarkable for academic reputation and recognition of research excellence. The international rankings continued to place Skoltech among the top world universities. The Guide2-Research named Skoltech #1 university in Russia for computer science, and Prof. Cichocki and Prof. Lempitsky among the top world Computer Science scientists.
For the second time, the prestigious Nature Index ranking included Skoltech in the list of top-100 world young universities with place # 65, which is 32 placings higher compared with 2019. Remarkably, Skoltech was also named as a rising young university (#25), and received recognition for excellence in Physical Sciences (# 35).

Publication output quality

Research results were published in top reputable sources, while publication quality and impact continued to raise. The total publication output of 2021 counts more than 1200 papers, 63% of which are in top-25% journals. Almost 150 papers were published in Nature Index journals, while more than 20 papers – in A*conferences. 59% of papers are in international collaborations, among the key partners are MIT, CNRS, Aalto, Rutgers, Southampton, Oxford, Harvard, Cambridge.
Skoltech contributed to the global positioning of Moscow measured by several academic excellence indicators (source: Elsevier report on 20 Global Cities). In particular, the Centers gave Moscow 29% of the papers compound annual growth rate, and 12% of papers in prestigious journals – Cell, Nature and Science.
Research excellence was also evidenced in faculty recognition: Prof. Cichocki was named a Highly Cited Researcher 2021 (Clarivate), Prof. Oganov and Prof. Terzija appeared in the list of 2% of top-cited scientists (ELSEVIER).

Grant awards

Grant funding reached an all-time the highest level with 808 mln Rub in 2021 and 770 mln Rub for the coming years. The awards derived from various sources, while funding from national agencies kept the larger share, mainly due to "Megagrants" allocated for setting world class laboratories. Below are some examples of the largest grants:

Principal investigator	Project
Prof. Lebedev	Development of invasive and non-invasive corticospinal and peripheral interfaces, with the use of biomarker monitoring, for neurorehabilitation of motor functions and pain control 128 mln Rub, Russian Science Foundation
Prof. Bazykin	Genomic epidemiology of socially important infectious disease 24 mln Rub, Russian Science Foundation
Dr. Kononikhin	Characteristic of protein-peptide composition of urine and blood serum of patients with chronic glomerulonephritis in order to diagnose the early stages of the disease 24 mln Rub, Russian Science Foundation
Prof. Sakellaris	Spatially-selective synthesis of 2D materials 24 mln Rub, Russian Science Foundation
Dr. Zhilyaev	Nanobubbles in van der Waals heterostructures as a tool for studying the thermodynamic and structural properties of submicron portions of a substance for creating new energy technologies 24 mln Rub, Russian Science Foundation
Prof. Brilliantov	Elaboration of a forecast model of atmospheric pollution by solid phase with the use of artificial intelligence 18 mln Rub, Russian Science Foundation
Prof. Levchenko	Search for new catalysts for cheap electrochemical hydrogen production: Combined experimental, theoretical, and machine-learning approach 18 mln Rub, Russian Science Foundation
Prof. Sergeichev	Creation of a distributed facility for dynamic testing of structural polymer composites 18 mln Rub, Russian Science Foundation

Principal investigator	Project
Prof. Korsunsky	Multiscale experimental analysis of stresses in light alloys and materials for aviation 18 mln Rub, Russian Science Foundation
Dr. Bukhanov	Prediction of property changes for frozen hydrate sediments during the development of hydrocarbon deposits in the Arctic 18 mln Rub, Russian Science Foundation
Dr. Kirillova	The dynamics of the mitochondrial genome in human embryo development 18 mln Rub, Russian Science Foundation
Prof. Khrameeva	Chromatin architecture changes in mental disorders 18 mln Rub, Russian Science Foundation
Dr. Fedorov	Novel selective gas-analytical systems for mapping of chemical space 18 mln Rub, Russian Science Foundation
Dr. Rudakovskaya	Novel functional agents based on amphiphilic polymers for hybrid imaging modalities for reproductive medicine tasks 18 mln Rub, Russian Science Foundation
Dr. Sharaev	Interpretable machine learning models for the analysis of large multimodal biomedical and neuroimaging datasets based on artificial intelligence methods 18 mln Rub, Russian Science Foundation
Prof. Akhatov	Suspension droplet wall impingement and particle deposition 18 mln Rub, Russian Science Foundation

International outlook

Skoltech supported international collaborations despite closed borders due to the pandemic.
The MIT Phase III was ongoing on several directions: faculty projects within the Next Generation Program (3rd Call for Proposals), selection of new proposals within (4th Call for Proposals), a new call for MIT Principal Investigators for innovation projects that have potential to benefit Skoltech.
Partnerships with Europe were maintained within TUM Global Incentive Fund (projects in Energy and Robotics), INRIA (the project on advanced and new tactile cyberworlds and Replica Mean Fields project for networks), Karlsruhe Institute of Technology and Leibniz Institute for Solid State and Materials Research (project for development of K-ion batteries).
Academic ties with China were expanded by the Laboratory of Superconducting Quantum Technologies (joint research with University of Science and Technology of China and Tsinghua University) and Center for Molecular and Cellular Biology – the project with Zhejiang University on the role of RNA secondary structure in the regulation of alternative splicing and its drug targets will be supervised by Prof. Pervouchine.
Skoltech and the University of Sharjah established the AI for Life Joint Collaborative Grant, the joint Scientific Committee selected several projects to start in 2022.
Several multinational collaborations were in place. Prof. Bazykin participated in BRICS consortium on genomic epidemiology of SARS-CoV-2, allowing to synchronize best practices in genomic epidemiology. In particular, the involvement of India and South Africa allowed Skoltech to rapidly get the first-hand data on the SARS-CoV-2 variants that originated in these countries. The research team of Prof. Khaitovich with peers from Germany, USA and Japan investigated recent molecular evolution of our species by comparing the modern human genome to that of Neanderthals.
New agreements were signed with Ben-Gurion University of the Negev, Delhi University, National University of Singapore. Negotiations started with the Weizmann Institute of Science to launch joint research in AI, Agricultural and Biological Science, Material Science, Energy.

International conferences

Skoltech hosted or participated in visible conferences – the 10th Moscow Conference on Computational Molecular Biology MCCMB-21, Online School and International Conference "Poisson Geometry and Representation Theory", 7th International Workshop on Combinatorics of Moduli Spaces, Cluster Algebras, and Topological Recursion – MoSCATR VII, Trustworthy AI Conference: 2nd International Conference on the AI's Robustness, Transparency


THE 11TH SESSION OF THE HIGH
RUSSIA–SINGAPORE INTER-GOVER
COMMISSION
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Science and Technology


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and Sustainability, International conference "Enhanced recovery for conventional and unconventional oilfields" and others.
The International Congress of Mathematics, planned for July 2022, was in a special focus. Prof. Krichever was selected as a plenary speaker, and Prof. Feigin as an invited speaker. Prof. Okounkov, Prof. Smirnov, and the President Kuleshov represent Skoltech in the Organizing Committee.

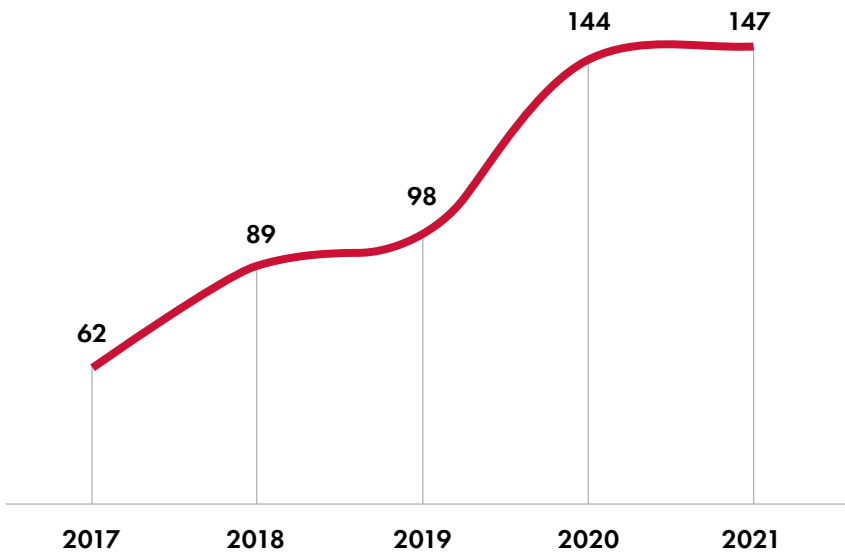
Schools for young researchers

A number of schools for young researchers were organized to share knowledge and research results.
The 2021 Young Scholar School of Neurotechnologies and Bioelectronic Medicine, organized by Prof. Lebedev, gathered more than 100 young researchers, Russian and international scientists and entrepreneurs.
Prof. Stevenson organized international schools "Battery Summer School" and "Interfacial Chemistry and Charge Transfer for Energy Storage and Conversion" at Telluride Science Research Center, Telluride, CO.

Research facilities

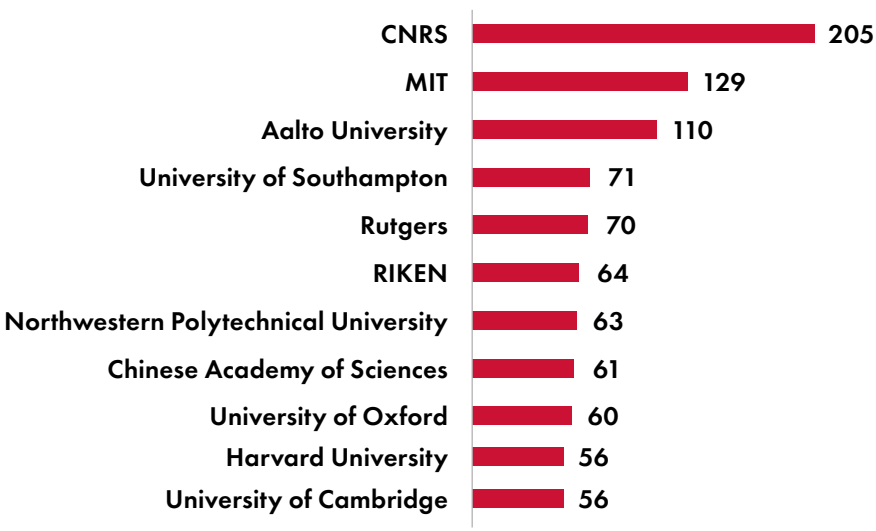
The shared facilities, mainly Genomics and Advanced Imaging, FabLab and Machine Shop, provided services for almost 100 external clients, as well as Skoltech clients - faculty, engineers, students. Micro- and Nanofabrication Cleanroom secured additional funding for 3 years. The latter is the first funded project, which is a part of a new project of Research Facilities Center aimed at building at Skoltech a high-tech infrastructure for manufacturing and testing photonic integrated circuits.
Thanks to the grant of Moscow, the Skolkovo Foundation purchased equipment for the FabLab, Advanced Imaging, Genomics and Cleanroom with a cost of more than 320 mln Rub.

Publications in Nature Index



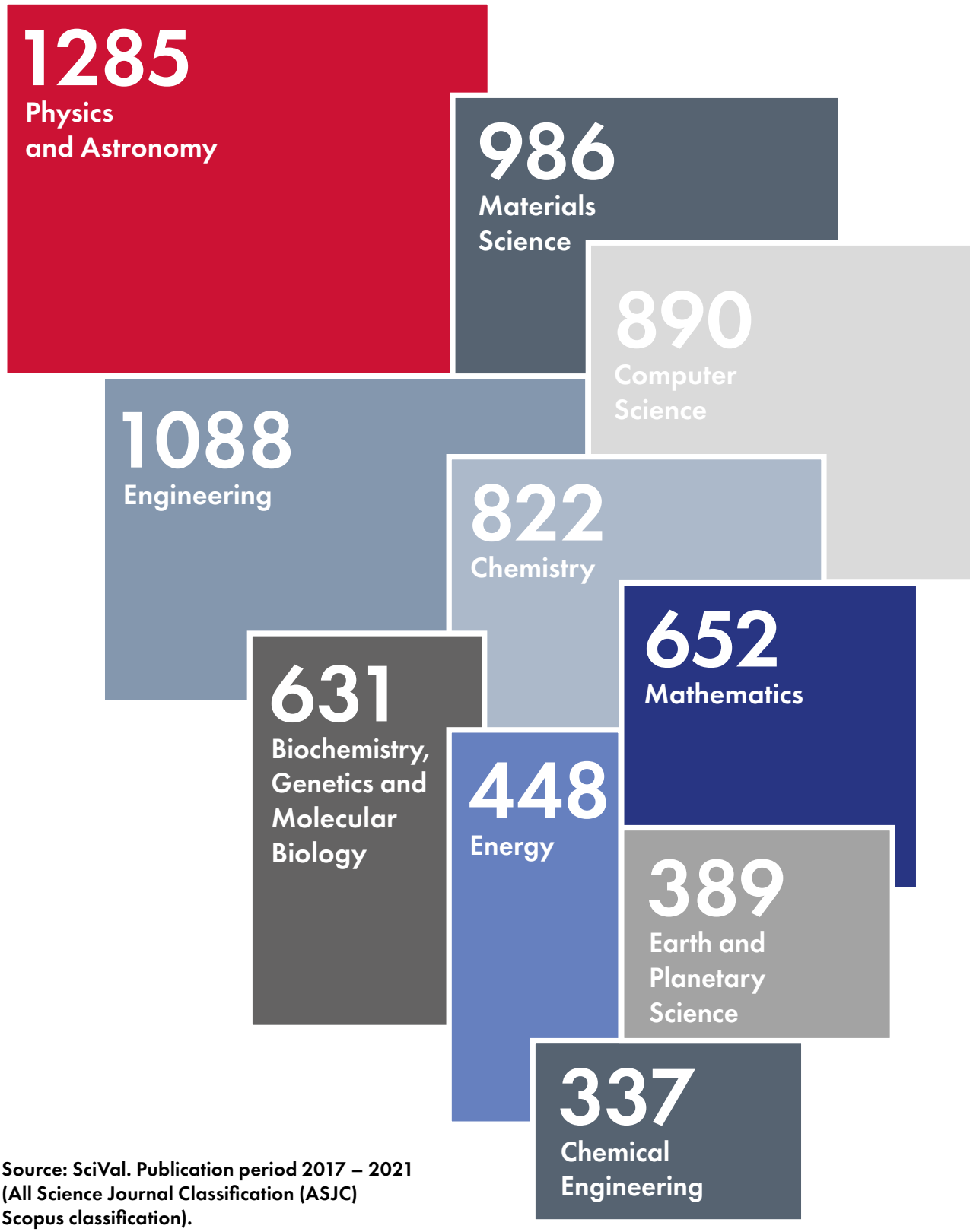
Source: SciVal.

Top international collaborators



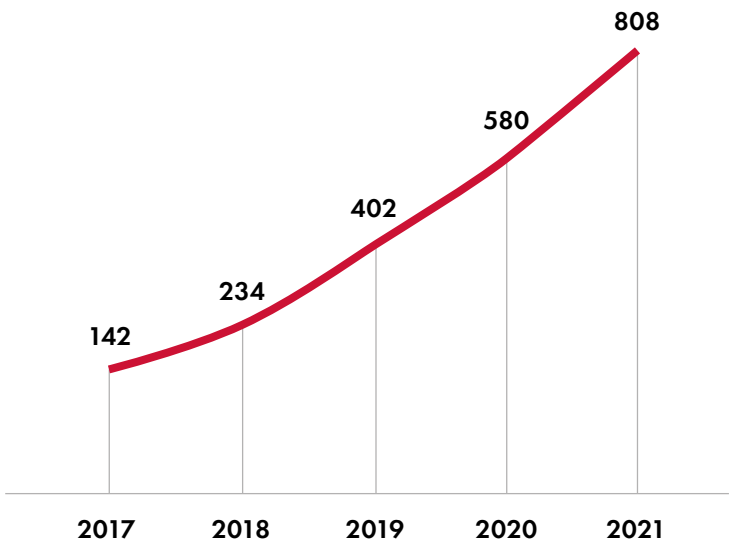
Source: SciVal. Publication period: 2017 – 2021.

Top-10 areas of publication output

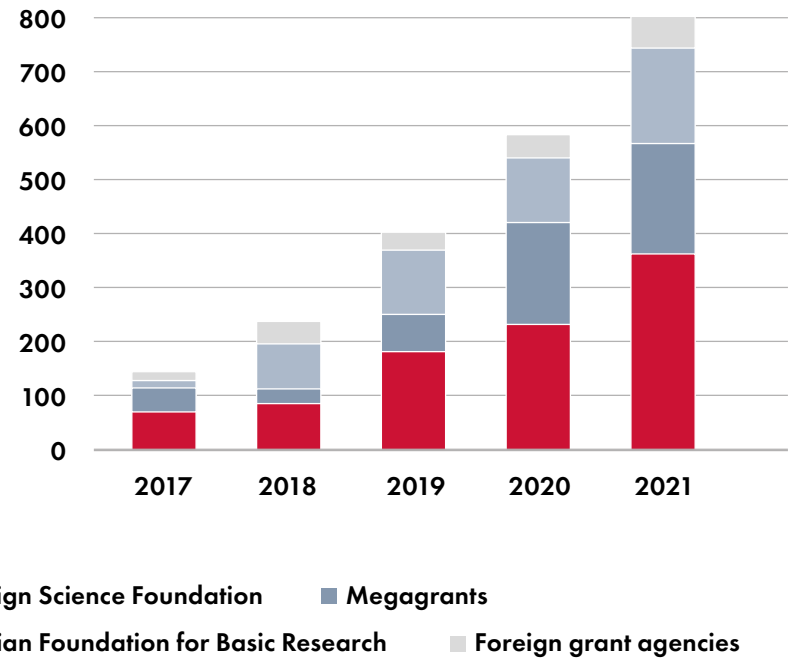


Source: SciVal. Publication period 2017 – 2021 (All Science Journal Classification (ASJC) Scopus classification).

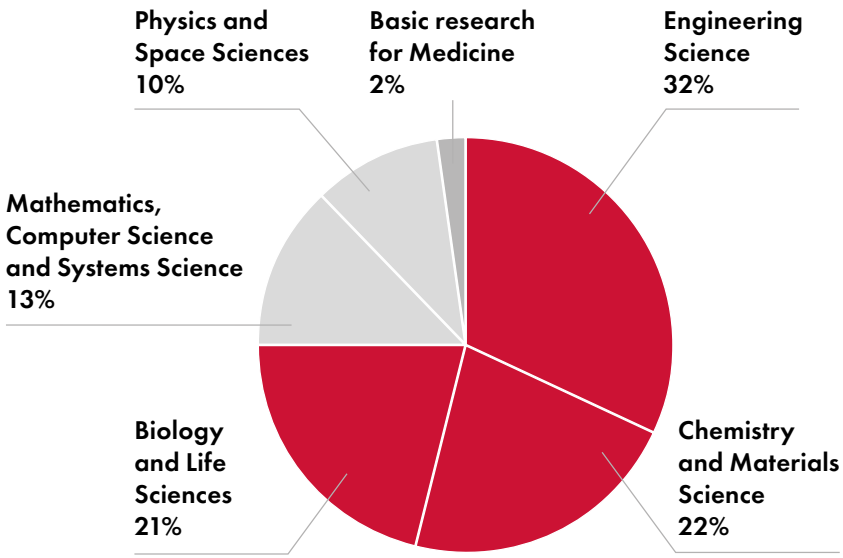
Annual grant funding (mln Rub)



Grants by source (mln Rub)

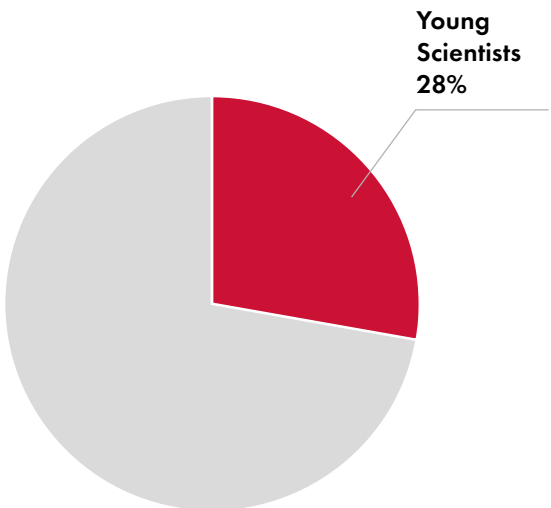


Grant funding by area



Categories shown as used by national grant agencies.
Calculation made based on funding 2021-2024.

Grant funding by Principal Investigator



The chart represents funding awarded for 2021.
Young scientists – up to 39 years old.

Select publications

Artificial Intelligence & Communications

Goncharov M., **Pisov M.**, Shevtsov A., **Shirokikh B.**, Kurmukov A., Blokhin I., Chernina V., Solovev A., Gombolevskiy V., Morozov S., **Belyaev M.**, CT-Based COVID-19 triage: Deep multitask learning improves joint identification and severity quantification. Medical Image Analysis. 2021. V. 71.

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National ‘think tank’

The strategic goal is to establish a strong position in technology intense areas, contributing to the national agenda. Skoltech serves as a national think tank through advising the governmental authorities and policy makers on complex technology initiatives, membership in trustworthiness working groups, professional training programs to key industry players.

Skoltech faculty advised on a number of the national technology roadmaps and policies as outlined below.

- **Artificial Intelligence and Communications**

The Project Center for Next Generation Wireless & Internet of Things participated in working groups for Telecommunication Technologies, Association of Organizations for Development of Open Communication Networks "Open Network Technologies", Associations of Internet of Things Market Participants. The Center also contributed to working groups of the Ministry of Digital Development, Communications and Mass Media, Ministry of Industry and Trade. Skoltech was also presented in the working group "Artificial Intelligence" of the Digital Economy program (Prof. Burnaev) to form a basis for collection and publishing data by state authorities and state-owned companies necessary to create products, solutions and services using AI technologies.

- **Electro transport**

The Center for Energy Science and Technology and the Analytical Department on Science and Technology Development contributed to the concept for development of production and usage of electro transport in Russia till 2030, advising on the market forecast and global trends and sharing expertise on production of cathode materials in Skoltech.
Materials for the governmental working group "New technological environment" were provided to develop the strategy for socio-economic development of Russia.

- **Energy efficiency, ESG**

The Center for Energy Science and Technology advised on various aspects of energy efficiency: Prof. Vorobiev, Prof. Terzija, Prof. Ibanez, and Prof. Gryazina acted as leading experts in the governmental report on technologies for electric energy transmission and distribution (National Technology Initiative), while Prof. Antipov served on the Council on priority direction of scientific and technology development "Transformation to ecologically clean and resource-efficient energy". Prof. Osiptsov advised on energy transition to the Department of Energy Efficiency and Climate (Ministry of Economic Development).

- **Life Sciences**

Prof. Bazykin served on the working group on the global genetic databases of the Presidential Administration of Russia, advised on SARS-CoV-2 epidemiology to the Head of Russia's Federal Medical Biological Agency Dr. Skvortsova, and the Head of the Central Research Institute of Epidemiology Dr. Akimkin.
Prof. Severinov developed guidelines to the Ministry of Science and Higher Education on implementation of the Federal Program of Development of Genetic Technologies. He also participated in activities of the Presidential Council of Genetic Technologies, the expert group of the National Security Council and in the biomedical think tank run by Dr. Fursenko, RF President's Scientific Advisor.
At the Congress of Young Scientists in Sochi, the President of the Russian Federation listened to Prof. Kostyukevich on issues required governmental attention, and entrusted Skoltech to lead development of the roadmap on mass spectrometry equipment in Russia.

- **Oil and gas**

The Center for Petroleum Science and Engineering delivered expertise in the Expert Group of the Commission on Technological Development of Russia's Economy (Prof. Spasennykh, Prof. Cheremisin) and participated in brainstorms on digital tech in energy organized by the Government (Prof. Koroteev).

The Analytical Department on Science and Technology provided support on a number of advising activities. Among the major results are the concept "Beacons" (part of 42 large strategic initiatives approved by the RF Government on October 6, 2021, No. 2816-r), White Paper on the Technological Development of Dairy and Beef Cattle Breeding, assessment of results of implementation of the Basic Research Program for the Accounts Chamber of the Russian Federation.
After series of expert reviews, the Head of the Department, Irina Dezhina, became a member of the Expert Board of the Accounts Chamber.

Professional programs

Professional programs were delivered to various clients in the topics demanded in the national industry – "Technology management in electro energy" and "Digital "Awareness" for energy companies, "Integration of ESG factors" for representatives of the banks and business community, "Technology leadership in aerospace industry", "Technologies for agroindustry". Machine learning programs and courses were delivered to the middle level and top management of Sber. Courses for the Moscow International Medical Cluster gathered almost 900 specialists in Molecular Oncology. Leveraging the positive feedback from participants, training activities will be expanded, also to the global pharma companies such as Roche, AstraZeneka.

Trainings and workshops for oil and gas companies were organized by the Center for Petroleum Science and Engineering on topics of thermal petrophysics, reservoir geochemistry, enhanced recovery, geomechanics.

STS Forum Russia-Japan

The STS Forum Russia-Japan was organized by Skoltech in collaboration with the Skolkovo Foundation and policy making organizations, such as Ministry of the Economic Development, Ministry of Industry and Trade, Ministry for Science and Higher Education, Japan External Trade Organization. The Forum gathered more than 200 participants representing Rostelecom, VEB.RF, KPMG, EY, Rosneft, Zarubeshneft, ITOCHU, Nissan, Yokogawa Electric Corporation, National Agriculture and Food Research Organization, Hokkaido University, leading Russian universities and others.
The agenda predominantly focused on hot topics of the technology agenda – ESG, Argo Technologies, Smart Cities. The participants addressed transformation of oil and gas companies into "energy companies", renewable energy, hydrogen generation, cross cut topics of ESG and Smart Cities with a focus on ecological goals. Special session was organized for discussing ESG in Agro Technologies.
As a result of the Forum, a set of harmonized goals in ESG agenda for the next decade was defined.

Integrator of large-scale national programs

Skoltech has strategic commitments to embed technology expertise in national technology programs. By doing so, Skoltech defines technology priorities, monitors the global agenda, organizes consortia with industry players to ensure development, implementation and scaling of technologies.

Skoltech established four Project Centers to focus on development, piloting and further scaling of technologies, contributing to the national economy.

Artificial Intelligence

One of the big successes of the year was a win of 1 bln Rub for establishing the national level Center in Artificial Intelligence. The Center, chaired by Prof. Burnaev, will focus on directions of optimization of management decisions to reduce carbon footprint. The research and technology program will be implemented with partners – Sber, Association "AI in Industry" (subsidiary of Gazprom Neft), CityAir, Izrael Institute of Global Climate and Ecology, Shirshov Institute of Oceanology, Institute of Numerical Mathematics, Space Research Institute, New Economic School, Institute of Geography. The Center will receive more than 570 mln Rub of industry co-funding until 2024. The first deliverables include the software for analysis of multimodal data for carbon balance evaluation and monitoring, software for ESG–default risks estimation (jointly with Sber), software for management decision optimization in oil production for carbon footprint and environmental risks reduction (jointly with "AI in Industry" Association), software to calculate atmospheric dynamics for air quality assessment and identification of pollution sources (jointly with CityAir).

Next Generation Wireless & IoT

The Project Center "Next Generation Wireless & IoT", operating in Digital Economy Program, continued to accumulate expertise and promote Skoltech as the intellectual and technological leader in Russian telecommunication and IT industry. The Center deployed the first version with 5G functionality (TRL 5), and made tests in MTS Lab and Skoltech pilot zone. Jointly with MTS and the Skolkovo Foundation, the Center expanded 5G coverage in Skolkovo by deploying pilot 5G communication network for the International Medical Cluster.
Leveraging the Center's expertise, Skoltech was the first in Russia to demonstrate the operation of an autonomous 5G (SA) network using domestic software and made the first VoNR call in Russia.

The Center also showcased a functioning prototype of a quantum messaging platform for mobile, intended for secure communication in organizations where it is critical – in particular, large domestic corporations. The messaging application can be used on regular smartphones that support 4G and/or 5G. Russian Railways, a major contributor to development of quantum technologies in Russia, acted as the project's key partner.
Important steps were also made in technology standardization – a series of preliminary national standards (PNST) in 5G – OpenRAN were developed.
The Center presented Russia in the international associations – O-RAN Alliance, Telecom Infra Project, Industrial Internet Consortium, 3GPP.

Energy Transition and ESG

The Project Center for Energy Transition and ESG was established under direction of Prof. Osiptsov. The Center will address decarbonization of industry (including CCUS), assessment and management of ESG risks in banking and energy transition technology (hydrogen, renewable energy).

The Center joined the CCUS consortium, where Gazprom Neft acts as the operator of a new emerging carbon capture and storage industry, as well as Sber AI lab and AI institute in the field of energy transition. First contracts were signed to start work in 2022. The Center will also collaborate with the Center in Artificial Intelligence on industrial projects.


Russia
OpenRAN
MTS


OpenRAN
MTS
STARTUP
HUB
5G

Agro

Based on the dataset of more than 330,000 genotyped animals, the Agro Technologies Center and Miratorg optimized prediction of genetic polymorphisms. This multiplies the amount of usable data by 100 times. Currently the project is ongoing on identification of genes linked to key traits in the beef cattle based on trait characteristics and the genome information of more than 15,000 animals. In this partnership, Skoltech provides algorithms, statistical and computational skills while the Miratorg provides data on genomic information and traits. Also, the Training Center of Plant Biotechnologies, funded by Bayer, was established.

R&D programs

Robust engagement with industry continued to reinforce Skoltech technology capacities. Skoltech has been proactively engaging with existing partners such as Gazprom Neft, Sber, Huawei, Bayer AG, Lukoil, Zarubezhneft, MTS, and also kicked off new partnerships with Yandex, CityAir, Russian Railways, Rosatom, Hyundai, IPG Photonics. This has generated multiple opportunities for joint research, forming commercialization capacities, projects to better prepare students for R&D careers.

Following a 10-year upward trend, Skoltech secured the highest ever amount of income from industry with a 19% growth comparing with 2020. Simultaneously, the number of research projects reached almost 200. While maintaining the leadership in oil and gas, electrochemical materials, 5G, AI, the expertise was extended in photonics, quantum communications, new materials, agro- and biotech.

Artificial Intelligence

The newly established Center for Artificial Intelligence Technology under the chair of Prof. Oseledets, reinforced the positions as one of the focal points of Skoltech long-time strategic partnerships with Huawei, Gazprom Neft, MTS and Sber.
Several new contracts were signed with Huawei, resulted not only in the increase of funding, but also longer term projects.
Jointly with Sber, the Center completed the first stage of the "Green AI" project on the topic of compression and acceleration of big neural networks training.
Among other examples are the project for 3D Slam with Samsung (Mobile Robotics Lab), R&D projects with Philips, also with opportunities for PhD advising (Computational Imaging Lab), a large-scale project in numerical simulation of quantum algorithms for ionic, atomic and photonic quantum computing systems with RQC (Laboratory for Quantum Algorithms for Machine Learning and Optimization).

Oil and gas technologies

The Center for Petroleum Science and Engineering continued applied research jointly with oil and gas industry.

Several projects were completed with Gazprom Neft.

The project on coupling a reservoir flow metamodel with a surface infrastructure model (TRL 3-4) allowed to have the prototype helping to optimize oil reservoir development while accounting for limitations coming from surface facilities. Development of a two-phase simulator for digital twins of rock samples from tight formations (TRL 3-4) was completed. The simulator brings the digital rock technology to a completely new application-level making it possible to compute properties of samples with submicron pores, such as Achimov formation samples. A unique experimental platform was created and tested to investigate the processes of filtration of reservoir fluids on microchips under reservoir conditions (TRL 3-4). Unique multiphase experiments on microfluidic chips were performed, paving the way for future technology transfer to the industrial partner.

Studies were carried out on experimental and numerical modeling of the possibility of in-situ hydrogen generation using various methods of conversion from methane and liquid hydrocarbons. The studies confirmed the possibility of hydrogen generation from methane in reservoir conditions.

Technologies for digital core models construction were developed. Several projects were completed to create digital rock models of complex carbonate and low-permeability reservoirs based on multi-scale microtomography and electron microscopy. The developed approach has the advantage of combining information on the multi-scale structure of the pore space in a single digital model.

Geochemical methods for organic matter examination were developed to improve the reliability of oil and gas prospects forecasting in sedimentary basins and individual licensed areas.

The methodology for calculation and analysis of wellbore stability based on a 3-D elastic-plastic geomechanical model (TRL 3-4) was developed. The method was verified and validated in the laboratory. The software module will be commercialized jointly with the industrial partner.

Electrochemical energy storage

Several milestones have been achieved in the field of energy storage technologies. The first-ever Russian prototype of a Na-ion battery cell was developed (TRL 3-4), demonstrating properties comparable with Li-Ion batteries (LFP type) while being cheaper and its raw materials are much more abundant. Also the technologies for NMC type cathode materials synthesis was developed, and the production line (TRL 5-6) with capacity of over 1 ton per year was set. A laboratory line to manufacture pouch-type Li- and Na-ion battery cells in half-automatic mode was built (TRL 5-6).

In line with demands for higher energy use efficiency, the Center for Energy Science and Technology demonstrated results in design of technologies for energy systems optimization.

The Electric Energy Disaggregation Project was launched. The technology comprises AI algorithms, as well as highly accurate smart meters to collect data required. The goal is to supply power grids operators with disaggregated data for better load-demand forecasting, grid development planning, estimation of Demand Response Program's potential. Moreover, AI algorithms allow for prediction of faults in appliances or electric machines at an early stage. In this case, fault prediction increases the cost-effectiveness of the operations, which is particularly critical for small and medium businesses.

The Real-time Digital Simulation Laboratory was established to create digital twins of energy systems, and for that purpose accommodating unique hardware and software instruments to test electrical energy systems, and equipment used within the systems. The first industrial partners will be oil and gas companies interested in optimizing energy consumption to reduce carbon emissions and improve cost-benefit indicators.

The Center also developed a new approach to assess the flashover probability of overhead power line insulators based on the leakage current. This approach makes it possible to define risk thresholds, quantify the likelihood of flashover and move to a risk-based approach in insulation management. The first full-scale tests of the developed technique began in April 2021 on an overhead power line of 110 kV with the MOESK (Zelenograd) utility company. For the first time, a continuous recording of leakage current oscillograms in insulation was conducted using an autonomous device, which allowed to assess the probability of insulator flashover. In addition, a software and hardware setup for insulator state diagnostics was developed.

Neurotechnologies in medicine and rehabilitation

The Vladimir Zelman Center for Neurobiology and Brain Rehabilitation made progress in development of new tools and techniques for diagnostics, prevention, and treatment of neurological and psychiatric disorders, from molecular techniques to brain-computer interfaces.
Firstly, a prototype of an invasive rehabilitation system for treatment of phantom limb pain and prosthesis sensitivity based on brain-computer interfaces (TRL 3-4) was developed with the prosthetics manufacturer Motorica LLC and the Far Eastern Federal University. It was demonstrated that stimulation of nerves by means of electrical impulses through an implant installed in the body of two Motorica's pilot users with amputated arms removes the phantom pain and allows them to feel the tips of artificial fingers.
The Center also developed a high accuracy test for mental disorders based on blood plasma lipidome alterations and tested it in a blind clinical trial at the Alekseev Psychiatric Clinical Hospital of Moscow Health Department. Timely and accurate diagnostics of health problems is a key step to efficient treatment and, potentially, disease prevention. Currently, no objective laboratory tests, which could indicate psychiatric disorder risks, exist.

SARS-CoV-2 response

Skoltech carried out applied research to tackle a novel challenge and contribute to the SARS-CoV-2 response efforts in Russia. In a project funded by the Center for Strategic Planning and Management of Biomedical Health Risks of the Russian Federal Medical Biological Agency (FMBA) Prof. Bazykin and his team assessed how the export/import dynamics of SARS-CoV-2 have been affected by governmental measures, and assessed the level to which SARS-CoV-2 testing systems designed by FMBA remain sensitive to the currently circulating viral strains. Furthermore, the team analyzed genome sequences of thousands of SARS-CoV-2 samples, monitoring virus spread in Russian regions.

Photonic Integrated Circuits

The research group of Photonic Integrated Circuits acquired competences in using standard and homemade software packages for PIC design, established contacts with Fablabs in the EU, UK, and Asia, as well as tested several runs to produce a set of main passive and active components on the chip.
With support from the National Technology Initiative, a project on tunable laser sources on chip was launched. The PICs are to be designed and produced in Russia based on a new hybrid technological approach in cooperation with industrial partners. The proposed laser technology on a chip may find applications in structural health monitoring systems, telecommunications, THz generation.
In a further initiative with support from national research funding bodies, the project on design, production and test of a fully functional prototype of the transmitter on chip for application in QKD systems (TRL 3-4) was launched.
Among the examples of technology transfer is a project with SIBUR. Skoltech researchers modified and applied the "electronic nose" technology (TRL 5-6) to identify molecule types and their smell intensity in polymer gas emissions by development of custom software and hardware. The solution solves a long-lasting problem in the polymers industry, where previously the design of new polymer types required its scent intensity to be tested by human control groups, making it a time-consuming process. This case demonstrates high commercialization potential in chemical industry, food production and healthcare.

Cyber-physical systems

The Laboratory of Cyber-Physical Systems collaborated with several Russian engineering and transport industry leaders for projects in design and systems engineering. The first stage of a large-scale project with Russian Railways in prescriptive diagnostics of train systems was completed.
With the United Aircraft Corporation, work on aircraft hydraulic system design was conducted – an initiative that paves the way for future joint projects with the company.

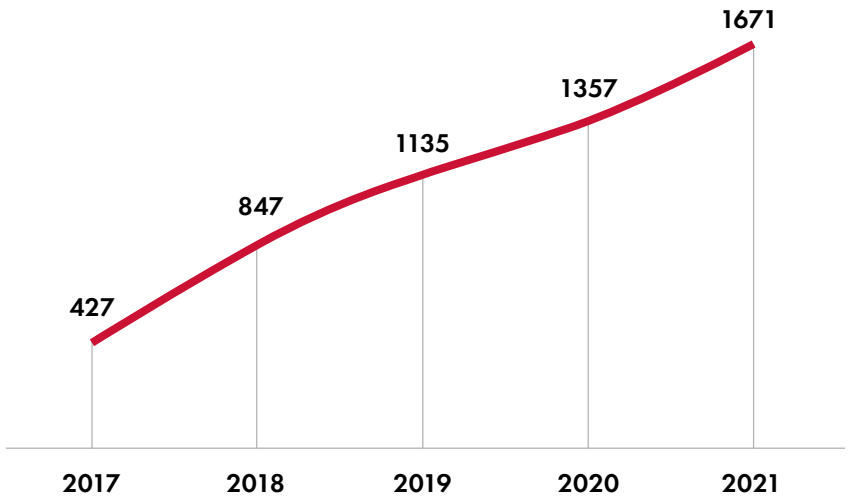
New materials

The Center for Materials Technology entered the consortium of universities and research organizations participating in development of the Center "Technologies for Modeling and Development of New Functional Materials with Set Properties" (National Technology Initiative). Demonstrating diversity in the challenges and industrial partnerships, the Laboratory for Composite Materials and Structures launched a joint project with Hyundai (South Korea) on fundamental research in the field of technologies of composite materials products manufacturing for automotive industry.

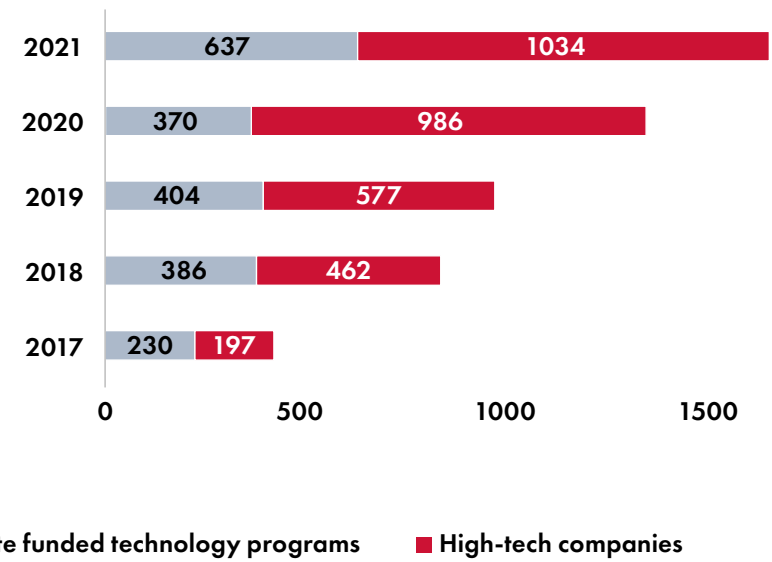
Additive manufacturing

Skoltech facilitated productive partnerships with industry in additive manufacturing.
Leveraging the successful partnership between the Additive Manufacturing Lab and Rosatom on development of the software for modeling physical processes occurring in selective laser melting (SLM), the agreement was reached to continue the joint program and to expand work to include another 3-D printing technology.
Having completed a 3 year partnership on additive manufacturing and materials with Oerlikon, the parties agreed to extend the agreement for 3 years. The lab will continue work on developing new ceramic pastes for 3-D printing, new alloys with unique mechanical properties, and creating an open-metal 3-D printer to study the 3-D printing process and validate predictive multiscale models for the printing process using various sensors and high-speed cameras.

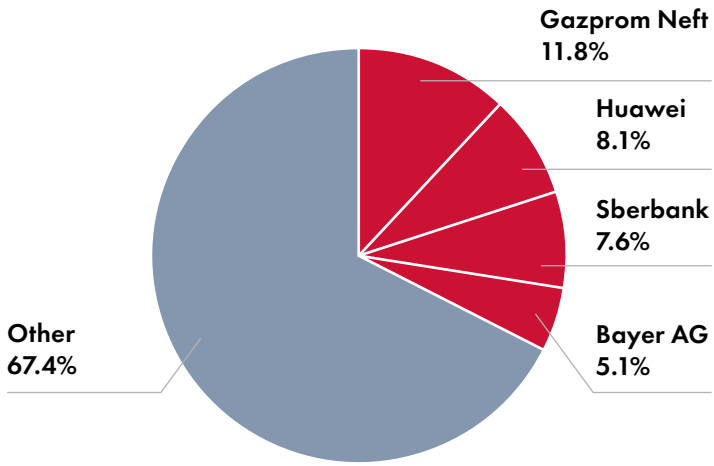
Annual R&D funding (mln Rub)



R&D funding by source (mln Rub)

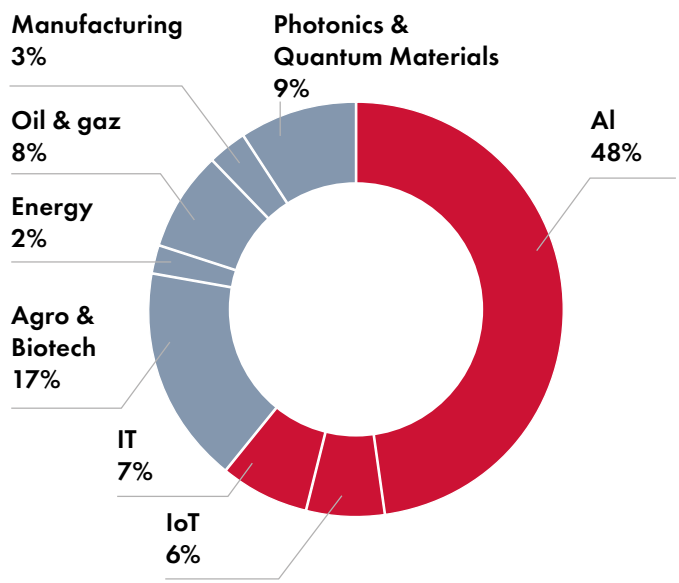


R&D funding by client



Shares are calculated for funding 2021-2024

R&D funding by area



Shares are calculated for funding 2021-2024

Cultivating entrepreneurial readiness and spirit

The Strategy targets enriching and nurturing entrepreneurial environment through E&I educational track, translational research programs, programs for identifying patentable and commercially significant results, mentoring, attracting investments for Skoltech affiliated companies.

E&I curriculum

The Startup Funnel, piloted in 2020, finally came to the full scale mode, starting from Innovation Workshop and continued with Startup Workshop and Startup Founders Workshop.
The Innovation Workshop was the largest ever, welcoming offline 350 students and resulting in visible outcomes. Apart from 95% positive feedback, 7 projects went to StartUp Workshop, several received Skolkovo residency and 2 more filed patents.
2 projects are already approved as Skolkovo residents – AR glasses UNREA and Smart AI Toy UMNYASH, 2 more projects plan to resubmit applications (AI biz-meeting summarizer FOLLOWUP an AI CV loading tool SMART-C).

The CEI delivered various courses in technology entrepreneurship, finance, marketing and commercialization, product development, innovation management, operations management and supply chain. In total, over 90% of students participated in the courses, adding more than 50 new projects to the project pipeline.
The Student Startup Club reopened doors and welcomed more than 200 students with a rich agenda: presentations, interviews, meetups, follow-up sessions and mentorship support. With introduction of Skoltech Triple Point Challenge (NGP program), the Startup Club significantly expanded the reach to Skoltech community.

Cultivating E&I environment

In 2021 the portfolio of Skoltech associated startups reached 121 enterprises. 71 companies have Skolkovo residency, 29 companies have been established by students or alumni of Skoltech. Among success stories are:

- **Spheroid Revolution** (Skoltech Startup Funnel) proposes innovative software for determining optimal characteristics of a spheroid without invasive intervention using the minimax method (maximizing the size while minimizing necrosis).

- **Cyclop** (project in the area of ultrashort pulse laser for quantum computing) and **Gheron Polymers** (project for examining degradation of polymers to increase recycling process efficiency) got initial shaping and market validation.

- **Oil Gene** project is aimed at developing a service to support marker-assisted and genomic selection in oilseed crops based on high-throughput genotyping technology using next-generation sequencing and associative mapping. The proof-of-concept studies were performed on more than 1,500 oilseed genotypes and more than 100 phenotypes.

- **Vibrant RehUp** is a rehabilitation robotic device using a brain-computer interface, AI and VR is designed to restore motor function after stroke and CNS injuries in collaboration with leading experts in the field of neuroscience. After confirmation of effectiveness in clinical trials, preparations are underway for registration of a medical device and sales of the research version have begun. The development of the project goes both in the direction of technology and market, and it is being done in close cooperation with Moscow Center for Healthcare Innovations.

The new call for Translational Research and Innovation Program received 45 applications. Coming through the review of world-class experts, 10 projects were awarded with funding for 2 years. The results of ongoing program (round 2021/2022) covered creation of IP and startups. Sustainable Development Goals Initiative and a portfolio of innovative projects were announced in Industry Day ‘21. The most interesting projects focused on cleaning remains of oilspills, water purification, energy storage. One of the successful projects turned out to be project “Illuminate” – the team designed a biogas digester that by recycling organic waste prevents the emission of methane by transforming organic waste into biogas and top-class organic fertilizer. The Illuminate successfully participated in Gazprom Neft pre-acceleration program and later established a startup.

Commercialization pathways

More than 250 mln rubles were fundraised for startups via grants, VC funds, commercial contracts.

Company	Funding source	Funding
DATADVANCE	Ministry of Industry and Trade	21.1 mln Rub
01Math	commercial contracts	40 mln Rub
Inspector Cloud	Moscow Seed Fund	14. 8 mln Rub
XReadyLab	a business angel	400k USD
CyberPhysics	Skolkovo Ventures	50 mln rubles
Komarik	business angel	4 mln rubles
IRA Labs	Department of Healthcare of Moscow	69 mln rubles
PICsTech	Fasie (Bortnik Fund)	15 mln rubles
LABADVANCE	commercial contracts	1 mln rubles

Several project teams took part in the Commercialization Reactor (Riga, EU) events for CR incubation and acceleration program to gain a balanced entrepreneurial team, pre-seed investments of up to 300k EURO, access to target customers world-wide with sales of products using technology and Skoltech IP licensed into EU startup established by Skoltech scientists.

Intellectual Property

The year brought a number of successful results in knowledge transfer and IP management, including the first license contract with a European company and the first US patent for the open dynamically harmonized trap for the ion cyclotron resonance mass spectrometer received solely by Skoltech.
The patents applications amounted to 74 applications, 20% of which were foreign and PTC applications.
The active IP portfolio has grown to 40% and represents around 140 patents and other registered IPR for technologies and inventions.
Skoltech continued to maintain relationships with licensees, despite financial burdens caused by the pandemic. All anticipated royalties were received, three new licensing agreements were signed. In parallel, the KTO initiated the IP policy update focusing on revision of remuneration schemes and priority rights for authors of inventions.

Extending partnerships

Most activities were conducted in cooperation with the Skolkovo ecosystem, academic, industrial, and financial partners.
Joint events were held with the Skolkovo Foundation and other Skolkovo participants. One of the multiple examples is Skoltech Pavilion at Startup Village 2021, offered panel discussions on public health, deeptech startups, development institutes and industrial partnerships. Among the speakers were representatives of Gazprom Neft, VEB Ventures, Skolkovo Ventures, SmartHub Venture Boutique, GETVISION, Chicago Booth Angels Network, and AngelsDeck.
The event was also supported with Skoltech startups: Robust Forest Classification, Live Printed Metal, Morphing Technologies, Tensor Fields, HeadKraken, LABADVANCE, Ecosilica, XReadyLab, Vein CV, Lean Orbit, Tag Trace Systems, FlowBat_MS.
Ties with MIT resulted in launch of Skoltech Triple Point, which is the first Russian student-led set of entrepreneurial competitions similar to MIT$100K and Tiger Launch of Princeton. The team organized lectures with MIT faculty for Skoltech students, and initiated a joint student networking event. Ties with MIT student organizations and MIT Innovation Teams Program were set.
PITCH, the first competition finals, acquired 36 project applications using

various technologies such as AI and ML, VR and AR, biotech and pharma, computer vision, robotics, energy and fuel, optics and holography. 15 projects were selected and presented during the offline event. 1 million rubles were provided as a sponsorship support from Pekka Viljakainen, a member of the Board of Trustees. The MIT Global Startup Lab bootcamp was arranged during the Independent Study Period to set interaction between Skoltech and MIT students.
In support of Moscow Center for Health Care and Innovation, the CEI hosted a visit of the Mayor of Moscow for showcasing projects having potential for Moscow healthcare infrastructure. Commercial contracts for antivirus paint, complex components of medical devices were completed.
As a result of participation in Tatarstan Oil and Gas Forum, antivirus paint was successfully tested in the Republic. Pilot tests of the anticorrosion coating were successfully carried out.
The cooperation with Grozny State Oil Technical University was kicked off with "landing" a few projects: Geonome, Labadvance and 01 Math.
Five students took part in Innovation Workshop and were among the first ones to work on ESG agenda.

Educating leaders

Teaching excellence

The Strategy is about delivering educational programs, competitive nationally and on the global scale, accounting for expectations of the stakeholders – students and employers. Skoltech is committed to continuous refresh of programs curriculum, capitalizing on expertise accumulated by the Centers.

Skoltech elite education is ensured by innovative content of internationally recognized graduate programs, curriculum flexibility, world class faculty and researchers, excellence in teaching and research advising, access to cutting-edge laboratories. These components are supported with a favorable environment, involvement of the stakeholders into programs design and delivery, wide opportunities for career development.

MSc defenses

MSc Thesis defenses usually take place in June across all MSc programs. Over 22 Defense Committees operate with more than 100 members, assessing performance results. Industry representatives typically constitute nearly 20 percent of the Committees members.

In the environment of pandemic, pre-defenses and defenses were held online showing exceptional faculty engagement, higher quality of students' presentations, seamless and professional work of the Committees.

MSc Program	MSc Graduates
Advanced Manufacturing Technologies	16
Life Sciences	33
Information Science and Technology	33
Data Science	70
Energy Systems	13
Materials Science	13
Mathematical and Theoretical Physics	13
Petroleum Engineering	13
Photonics and Quantum Materials	28
Space and Engineering Systems	29
TOTAL	261

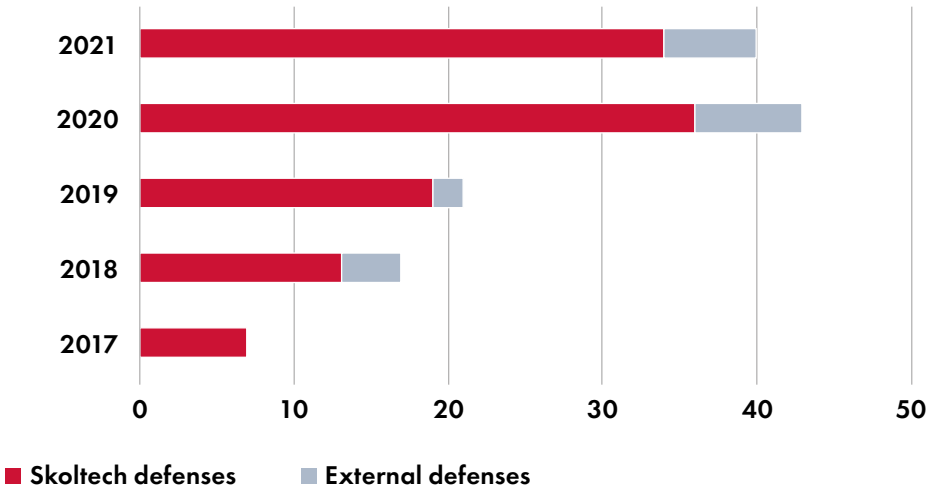
The highest appraisal received the following Theses:

Student	Thesis Title	Research Advisor
Victoria Dochkina	Predicting Permeability Based on Improved Pore-Network Modelling	Prof. Koroteev
Puskar Pathak	Development and Characterization of Cr3C2-NiCr Based Metal Matrix Composite Coatings for Wear Resistance Applications	Prof. Dzhurinskiy
Aiusha Sangadiev	Decision-Making Under Uncertainty for Large-Scale Power System Planning	Prof. Pozo
Konstantin Zamansky	Thermocycling of Resistive Sensors for Selective Discrimination of Volatile Compounds	Prof. Nasibulin
Maksim Valialshchikov	Numerical Studies of Nonlinear Compton Scattering	Prof. Rykovanov
Daniil Selihanovich	Efficient Sampling for Generative Adversarial Networks via MCMC	Prof. Panov
Aleksei Kalinov	Efficient Simulation Techniques for Problems of Mathematical Physics	Prof. Rykovanov
Basel Omran	Dynamics and Control of Multi-Tethered Tetrahedral Satellite Formations	Prof. Pritykin
Fedor Selyanin	Arnold's Problem on Monotonicity of the Newton Number	Prof. Kazarian
Vladimir Zakharov	Viscosity of a Two-Dimensional Disordered Electron System in an External Magnetic Field	Prof. Skvortsov
Andrei Vasenin	Dynamics of Multiphoton Scattering of Coherent Waves by an Artificial Superconducting Atom in a Waveguide	Prof. Astafiev
Mikhail Goncharov	Identification of Tumor Antigen-Specific T Cells in Tumor Infiltrating Lymphocytes Population Defined by Expression of Surface Markers of Exhaustion	Prof. Chudakov
Ilya Pletenev	Whole-Genome Analysis of Epigenetic Control of Human GABAergic Interneuron Differentiation	Prof. Khrameeva

The regular post-defense survey was completed by approximately 60 percent of Committees members who shared feedback on students' performance and provided recommendations on achievement of learning outcomes by the students.

PhD studies and defenses

Since 2017, 128 PhD graduates have successfully defended PhD thesis: 109 have been awarded with Skoltech Doctor of Philosophy degree, while 19 with Candidate of Science degree at the external committees (Higher School of Economics, Moscow State University, Moscow Institute of Physics and Technology, Landau Institute, etc.).



In 2021, Skoltech organized 34 PhD defenses in a hybrid mode with online presence of Jury external members, while keeping a requirement of 1/3 of on-site attendance.
Joint doctoral programs with leading international universities were continued through cotutelle agreements signed with KU Leuven, RIKEN, Aalto University, Curtin University, Ben Gurion University, Sorbonne, ETS Montreal, University of Paris, University Grenoble Alps. New agreements were signed with Karlstad University, Eindhoven University of Technology and other universities.
In a response of students to have one source of information, the PhD handbook was published, guiding on formal regulations and practical aspects of doctoral education from the very beginning till the defense.

Teaching and Learning Excellence

The Center for Teaching and Learning Excellence was opened in 2021 to support faculty and students in teaching and learning, empower favorable environment by creating new knowledge, forming networks and partnerships, celebrating progress towards success in improving student learning outcomes. The Center organized many activities, including:

- The unique professional development course "Facilitating and Accessing Learning" of Prof. Magnus Gustafsson (Chalmers, Sweden) for course instructors and teaching assistants to strengthen and broaden pedagogical skills,
- Series of workshops "Excellence in Teaching and Learning" jointly with the Teaching and Learning Center of the University of Iowa and Skoltech faculty, awarded for Teaching Excellence,
- Skoltech Learning Community of faculty and representatives of Education Department founded for joint work with the workshops "Teaching Excellence Series" (best practices by best faculty) and foundation of the new award "Innovation in Education",
- The round table with Program Directors and Coordinators of MSc Programs organized to discuss benefits and challenges of involving multiple lecturers and students' learning experience based on the feedback.


The jet quest
before
after


Valeriya
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Industry
Day 2021


Industry
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Skoltech

Enhanced educational offering

In addition to expanding curriculum, developments were undertaken in the programs.
Two MSc programs were opened in 2021: "Advanced Computational Science" and "Internet of Things and Wireless Technologies", aimed to educate next generation of STEM leaders ready to design principles and architectures as well as develop applications and services for IoT and next generation wireless technologies. The program enrolled the first cohort of 18 students from 336 applications/46 interviews.
The development of MSc program "Energy Systems" resulted in a new track "Energy Transition and ESG" for educating qualified engineers and future industry leaders capable to facilitate energy policy and develop new technologies to ensure deep decarbonization and energy transition towards a low-carbon economy (first admission in 2022).
The collaboration was set with IPG Photonics for a new educational track in Photonics and Quantum Materials to educate engineers who will be ready to become leaders and take full responsibility for technological progress at the company.
The Innovation Workshop is a 4 week full-time dive into the Skoltech vibrant ecosystem designed to foster innovators, focus on teamwork, group projects, and spark entrepreneurial instincts from the very first days in Skoltech. Together with faculty, 60 mentors from Israel, Switzerland, Germany, USA, Russia, Canada, Italy and Armenia took part in the Innovation Workshop supporting 350 students.
Another important part of MSc curriculum is the "Industrial Immersion" providing opportunities for individual or team projects in companies. 266 MSc students performed projects in 116 companies. The pool of companies included 48 Skolkovo residents (Big 3, Genetico, Haut.ai, Insilico, Motorica, New Spintronic Technologies, PrimeBioMed, Sibur PolyLab, VisionLabs and others), also Skoltech affiliated startups (Digital Petroleum, Head Kraken, Tensor Fields, Tsuru Robotics, WareVision, Ira Labs, Rustor, TetraQuant, Novaprint 3D, GeoAlert). Placements were also organized in Gazprom Neft, IBM, Huawei, Yandex, Rosneft, Sber, EVRAZ, Russian Quantum Center, Intel, IPG Photonics, Samsung, Nissan, Boeing, Generium. The Industrial Immersion and career development survey to the partner companies demonstrated excellent feedback and readiness to host students for long-term internships.
The Independent Studies Period traditionally included a variety of courses and workshops: MIT Global Startup Labs (Tim Mille, Lauryn Kortman, Ophelia Zhu, and Darren Lim, all-external students), Pilot School arranged by PhD students (Burkov Egor, Perkov Sergei, Pak Marina, Morozova Polina, and Yermakov Yakov), EQ & Negotiation Games (Prof. Kulish), Science in Contemporary Art (Prof. Shpanin, Rutgers University, and worldwide famous artists), Competition in Loan Origination (Masyutin Alexey, Managing Director, Sberbank).

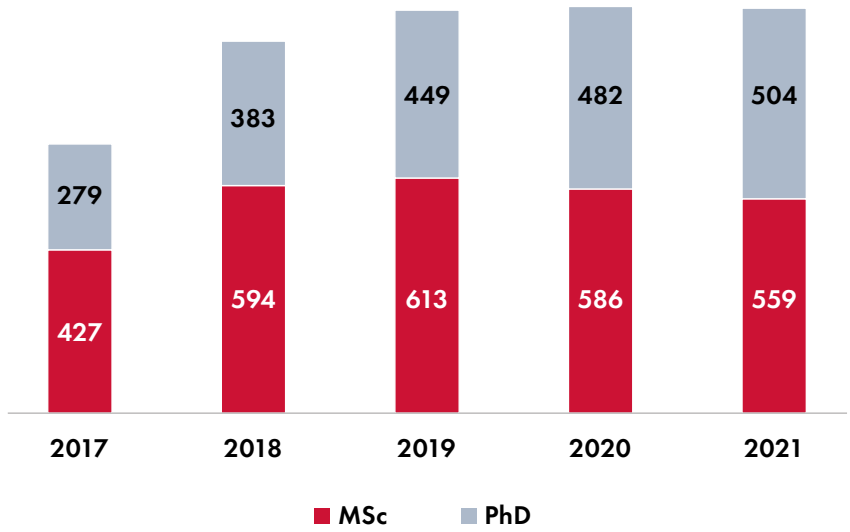
Library

The state-of the-art library opened the doors for Skoltech community in October. Also, the library extended digital database portfolio and digital infrastructure, providing access to top international databases such as Science Direct, Springer or IEEE, Scopus, Web of Science, e-books collections from Springer and Elsevier. Also, Skoltech and Moscow School of Management merged print book collections allowing to have access to more than 1000 titles on business and management.

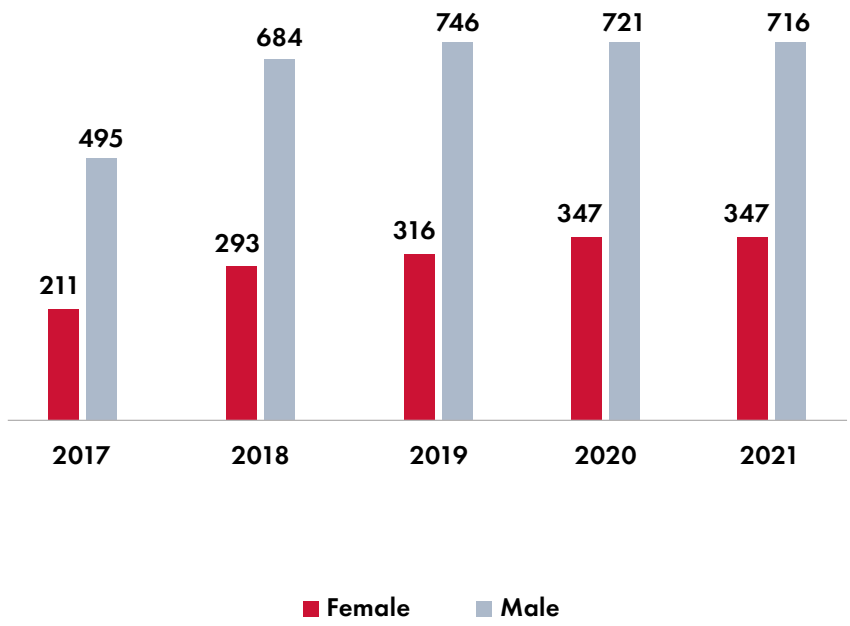
Databases	2018	2019	2020	2021
Print books collection	930	1 100	1 248	2700
Skoltech e-books*	370	420	435	469
Full-texts downloads from e-library databases	110 000	240 000	210 000	237 000

***Thanks to RFBR grant Skoltech has access to Elsevier Freedom Collection (approx. 5 000 titles) and Springer e-books (approx. 113 000 titles)**

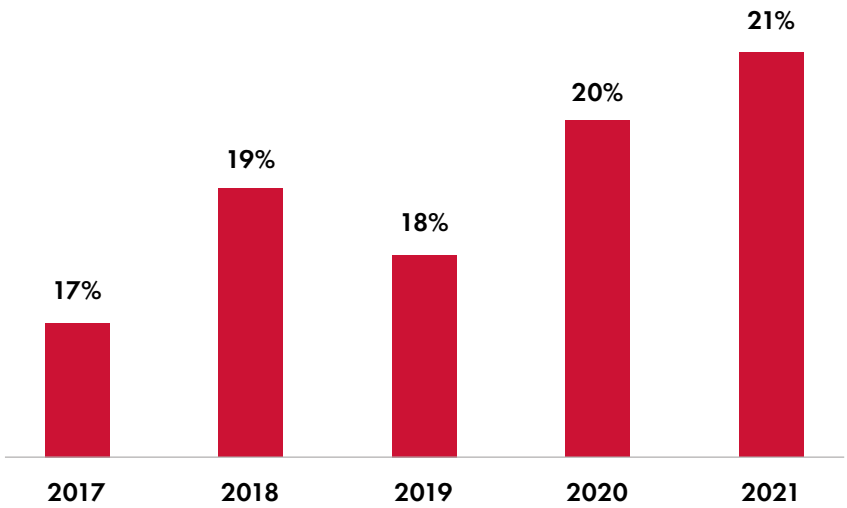
Student cohort by level of studies



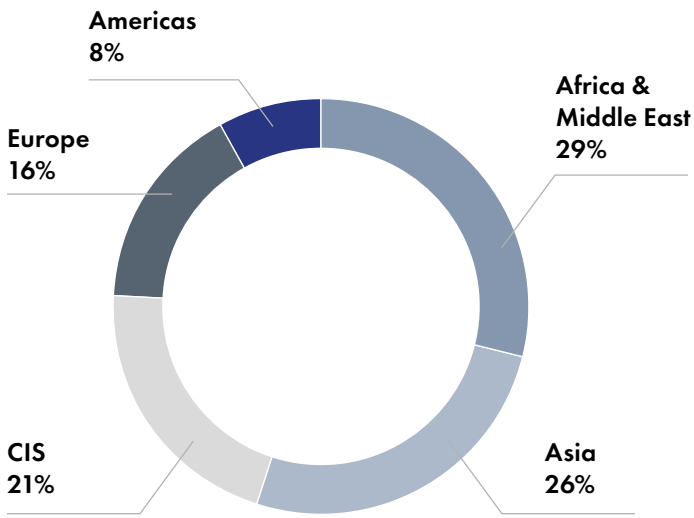
Students by gender



% of international students in cohort



International students in cohort



Student cohort

MSc Program	Students
Data Science	159
Life Sciences	82
Space and Engineering Systems	48
Photonics and Quantum Materials	45
Advanced Manufacturing Technologies	39
Petroleum Engineering	39
Materials Science	37
Information Science and Technology	36
Energy Systems	26
Internet of Things and Wireless Technologies	19
Mathematical and Theoretical Physics	18
Advanced Computational Science	11
TOTAL	559

PhD program	Students
Computational and Data Science and Engineering	139
Life Sciences	85
Materials Science and Engineering	68
Engineering Systems	59
Physics	52
Petroleum Engineering	52
Mathematics and Mechanics	49
TOTAL	504

Fostering student success

Skoltech goal is to attract and support a diverse pool of talented students, shaping rich experiences and best possible opportunities to start careers in academia, R&D and entrepreneurship, encouraging to establish lasting professional networks and friendships. Graduates' employment outcomes in the national innovation sector is the priority.

Talent recruitment

Following the strategic priorities, Skoltech continued concerted efforts to recruit the best and brightest students from Russia and the world, although it was challenging considering COVID-19 restrictions and closed borders.
The outreach team completed the mostly online recruitment campaign, composed of various appealing formats: virtual open doors, lab tours, webinars, lectures, Q&A sessions, Telegram channels. The project "Hi, Tech" made a significant contribution to attraction of more than 1700 high-quality applicants.

Promotions were mainly carried out through online advertising channels: contextual / targeted ads in Google and Yandex, social media, webinars, landing pages, email marketing. The Statistical Learning Theory track of MSc Data Science program underwent rebranding to the "Math of Machine Learning" track resulted in the sharp increase of applications (+49%) and admitted students (+56%). In total, Skoltech received more than 17000 applications from 131 countries. As a result of the multiple stage selection and admission procedures, 263 MSc and 129 PhD students joined Skoltech. 21% of enrollments are internationals from 28 countries of the world, incl. USA, India, Mexico, Kazakhstan, Nigeria, France, UK. The campaign to the target countries[3] was successful, bringing 22 % of international enrollments.

Recruitment funnel	2019	2020	2021
Applications	13881	17987	17808
Invited to pre-selection	4346	7644	8444
Invited to selection	941	888	781
Yield	416	435	391
% of enrolled	3%	2%	2%

45% of the Class 2021 are graduates of top national universities such as Moscow Institute of Physics and Technology, Moscow State University, Higher School of Economics, Bauman State Technical University. 12% of the intake are double degree students under agreements with Higher School of Economics, Moscow Institute of Physics and Technology, Tomsk State University of Control Systems and Radioelectronics, Saint Petersburg State University of Aerospace Instrumentation. 19 students were enrolled with "Zero stipends" introduced in the new Scholarship Policy.

[3] Regions of interest, approved by the Academic Council: Germany, Italy, USA, Mexico, India, China, Nigeria, and Kazakhstan.

Excellence recognition

Multiple activities provided by Skoltech to support students' success brought results evidenced in top quality papers, national and international awards and fellowships. Below are examples:

Academic excellence

Tkachev, A., Khaitovich, P. et al. Long-term fluoxetine administration causes substantial lipidome alteration of the juvenile macaque brain. (2021) International Journal of Molecular Sciences, 22 (15), art. no. 8089.

A.I. Komayko, S.V. Ryazantsev, I.A. Trussov, N.A. Arkharova, D.E. Presnov, E.E. Levin, V.A. Nikitina, The Misconception of Mg(2+) Insertion into Prussian Blue Analogue Structures from Aqueous Solution, ChemSusChem, 14, 1574-1585 (2021).

S.V. Porokhin, V.A. Nikitina, D.A. Aksyonov, D.S. Filimonov, E.M. Pazhetnov, I.V. Mikheev, A.M. Abakumov, Mixed-Cation Perovskite La0.6Ca0.4Fe0.7Ni0.3O2.9 as a Stable and Efficient Catalyst for the Oxygen Evolution Reaction, ACS Catalysis, 11, 8338-8348 (2021).

I.A. Luchnikov, D. Métivier, H. Ouerdane, and M. Chertkov. Super-relaxation of space-time-quantized ensemble of energy loads to curtail their synchronization after demand response perturbation. Applied Energy 285, 116419 (2021).

B. Mohseni-Gharyehsafa, J. Abolfazli Esfahani, K. C. Kim, and H. Ouerdane. Soft computing approach analysis of thermohydraulic enhancement using twisted tapes in a flat-plate solar collector: Sensitivity analysis and multi-objective optimization, Journal of Cleaner Production 314, 127947 (2021).

Tepliakova, M. M.; Kuznetsov, I. E.; Avilova, I. A.; Stevenson, K. J.; Akkuratov, A. V. "Impact of Synthetic Route on Photovoltaic Properties of Isoindigo-containing Conjugated Polymers," Mol. Chem. Phys. 2021, 222(15), 2100136.

E.V. Anikin, N.S. Maslova, N.A. Gippius, I.M. Sokolov, Multiphoton resonance in a driven Kerr oscillator in the presence of high-order nonlinearities, PHYSICAL REVIEW A 104(5) 053106 (2021).

N.S. Salakhova, **I.M. Fradkin**, S.A. Dyakov, N.A. Gippius, Fourier modal method for moire lattices, PHYSICAL REVIEW B 104(8) 085424 (2021)

Drobysheva AV, **Panafidina SA**, Kolesnik MV, Klimuk EI, Minakhin L, Yakunina MV, Borukhov S, Nilsson E, Holmfeldt K, Yutin N, Makarova KS, Koonin EV, Severinov KV, Leiman PG, Sokolova ML. Structure and function of virion RNA polymerase of a crAss-like phage. Nature. 2021 Jan;589(7841):306-309.

Komissarov AB, **Safina KR**, Garushyants SK, Fadeev AV, Sergeeva MV, Ivanova AA, Danilenko DM, Lioznov D, Shneider OV, Shvyrev N, Spirin V, Glyzin D, Shchur V, Bazykin GA. Genomic epidemiology of the early stages of the SARS-CoV-2 outbreak in Russia. Nat Commun. 2021; 12(1):649.

Ulianov SV, Zakharova VV, **Galitsyna AA**, Kos PI, Polovnikov KE, Flyamer IM, Mikhaleva EA, Khrameeva EE, Germini D, Logacheva MD, Gavrilov AA, Gorsky AS, Nechaev SK, Gelfand MS, Vassetzky YS, Chertovich AV, Shevelyov YY, Razin SV. Order and stochasticity in the folding of individual Drosophila genomes. Nat Commun. 2021; 12(1):41.

Mendelevich A, Vinogradova S, Gupta S, Mironov AA, Sunyaev SR, Gimelbrant AA. Replicate sequencing libraries are important for quantification of allelic imbalance. Nat Commun. 2021; 12(1):3370.

Kalmykova S, Kalinina M, Denisov S, Mironov A, Skvortsov D, Guigó R, Pervouchine D. Conserved long-range base pairings are associated with pre-mRNA processing of human genes. Nat Commun. 2021; 12(1):2300.

Gavrylenko, P., **Semenyakin, M.**, Zenkevich, Y. Solution of tetrahedron equation and cluster algebras. J. High Energ. Phys. 2021, 103 (2021). Litvinov, A., **Vilkoviskiy, I.** Integrable structure of BCD conformal field theory and boundary Bethe ansatz for affine Yangian. J. High Energ. Phys. 2021, 141 (2021).

D. Kubrak, **A. Prikhodko**, Hodge-to-de Rham Degeneration for Stacks, International Mathematics Research Notices, 2021;, rnab054

Alexander Korotin (PhD), Lingxiao Li, Justin Solomon, Evgeny Burnaev. Continuous Wasserstein-2 Barycenter Estimation without Minimax Optimization. ICLR, 2021

Alexander Korotin (PhD), **Vage Egiazarian** (PhD), Arip Asadulaev, **Alexander Safin** (PhD), Evgeny Burnaev. Wasserstein-2 Generative Networks. ICLR, 2021

Alexey Bokhovkin, **Vladislav Ishimtsev** (PhD), Emil Bogomolov, Denis Zorin, Alexey Artemov, Evgeny Burnaev, Angela Dai. Towards Part-Based Understanding of RGB-D Scans. CVPR, 2021

R Rakhimov (PhD), E Bogomolov, **A Notchenko** (PhD), F Mao, A Artemov, D Zorin, Evgeny Burnaev. Making DensePose fast and light. Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision, 1869-1877, 2021.

Nikita Kotelevskii got the 2nd place at the NeurIPS 2021 competition on Approximate Inference in Bayesian Deep Learning and 2nd author paper at ICML-2022.
Mikhail Pautov is the 1st author paper at AAAI-2022.
Daryna Dementieva became the first author of ACL SRW paper, led a team at the largest European hackathon Junction, participated as a co-author in CORE A publication at EMNLP.
Victoria Chekalina got the 1st place at the Touche CLEF-2021 competition on argument retrieval.
Alexander Belov gave the oral talk at MICCAI as first author, the top-1 conference in the field.

Fellowships

Daniil Rabinovich became a winner of the Presidential PhD Student Scholarship, awarded for the project "Limitations of variational quantum algorithms."
Valeriya Pronina and Nikita Kotelevskii were awarded with Ostrogradskii PhD fellowship for short-term research stays in France.
Rishat Zagidullin, Maksim Valialshchikov and Egor Konyagin won DAAD fellowship for short-term research stays in Helmholtz Institute Jena, Germany.
Galina Chikunova won participation in a highly competitive NASA Heliophysics Summer School and was selected as a young scientist to participate in an ISSI team workshop funded by ESA and Swiss Space Office.
PhD students E. Romadina and S. Marshenya received the Haldor Topsoe scholarship award for the projects "Design of new materials for organic redox flow batteries", and "Development of electrodes and electrolytes for all-solid-state high-voltage batteries".
The special prize in research excellence, scientific novelty, significance for the theory of catalysis, and practical impact categories was awarded to PhD student N. Luchinin.
Students supervised by Center for Advanced Studies won a number of awards: Semen Abramyan is a winner of "Young Russian Mathematics", Nikolai Bogachev – a winner of "Sirius" Contest 2021, nomination "Young Scientists".

R&D, entrepreneurship

Dmitry Artemasov became one out of three IoT Awards 2021 held by Internet of Things Association finalists in the category "IoT DIY" with the modular device for collecting and transmitting data according to the NB-IoT standard.
Yuri Katser became the winner of the hackathon "Smart Cities, Industry, Fuel and Energy Sector" (ENERGOMACH) as part of the Waico.ru team.
Alexander Korotin has been chosen as the recipient of the Ilya Segalovich Award, a prize that Yandex awards annually for outstanding achievements in computer science. Alexander Korotin receives the prize for the second time.
Gurgen Sogoyan participated in research of Prof. Lebedev group funded by Motorica LLC and successfully demonstrated stimulation of nerves by means of electrical impulses through an implant installed in the body of two Motorica's pilots with amputated arms to remove the phantom pain and allow them to feel the endings of artificial fingers. Gurgen talked on the preliminary results of that research at the Congress of Young Scientists held in Sochi.
PhD student Pavel Afanasiev created a startup "Hydrogen power" LLC.

Career support

Skoltech provides an extensive support to students, which includes not only financial support, but also opportunities to establish and extend professional network. The comprehensive series of seminars, presentations and workshops were held during the year, involving top R&D companies: Roadmap to Career Success course, overviewing R&D job market and hints to start career in companies, Soft Skills Marathon with Sber, meetings with Huawei, BostonGene, Tinkoff, P&G, Online Hackathon with Sberbank Risk Management. Meetings with employers were held on campus – Yandex Days, Meeting with Sber AI, Nvidia.

Students received monthly Career Digests, prepared involving more than 70 partner companies. The Job Board portal was launched. In autumn, together with Industrial Immersion team, the Industry Day Partners activities were held. Among formats – a round table "Career in Biotech" with BostonGene, Insilico Medicine, AIRI and Blastim, special networking zones for students with Huawei, AIRI and Accenture.
Looking forward to 2022, the student development program will be extended, also by introducing a fellowship of the Center for Entrepreneurship and Innovation for innovation achievements.

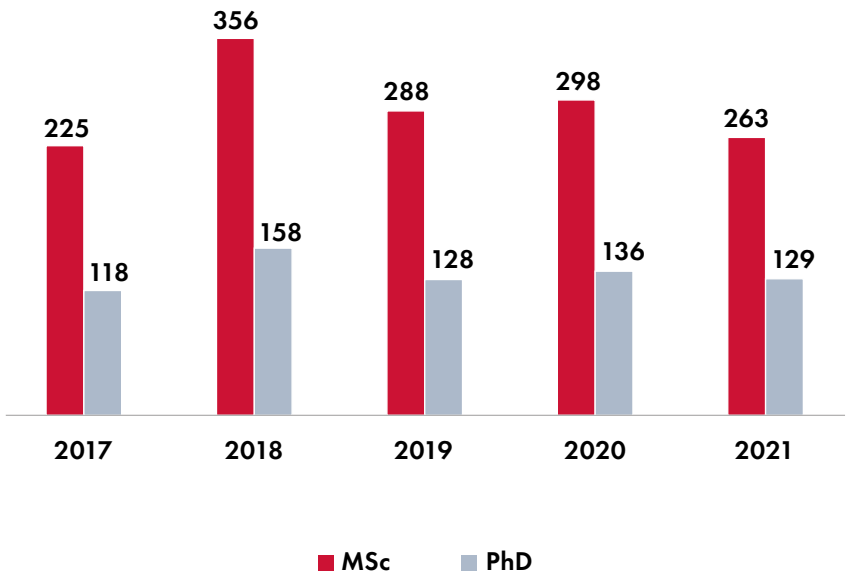
Student self-governance

The Student Council is the main body, representing interests of the student community, also facilitating student life and community building activities. In 2021, the Council addressed a number of issues related to the educational process, scholarships, extracurricular activities, student services. Also, students conducted the largest events in the online format, such as Talent Show and International Night, followed by a range of offline events. Students also had access to a wide offering of clubs in sports, languages, music, arts, dancing. Despite a lockdown, most clubs were functioning online, and by the end of 2021 successfully turned to offline mode.

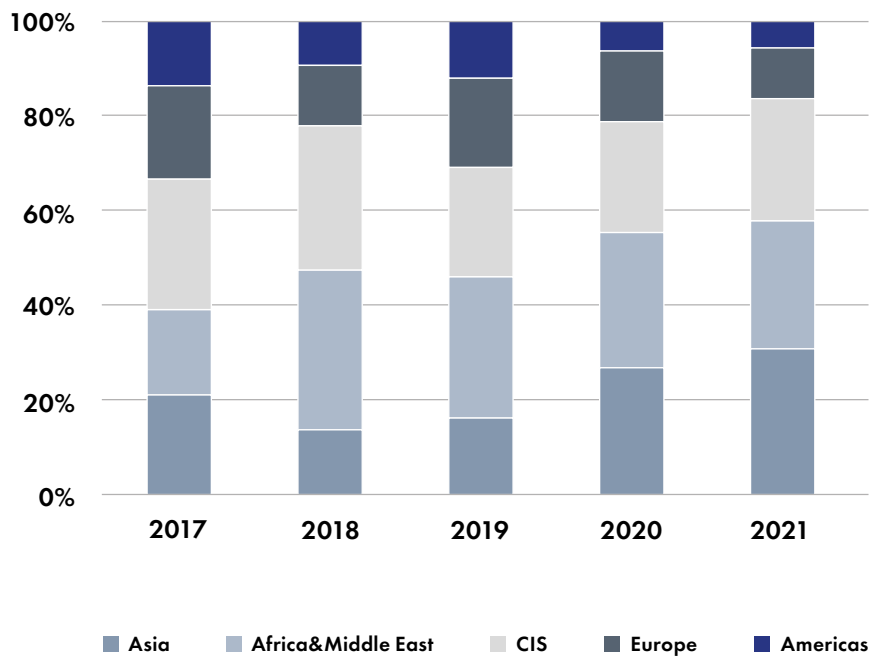
Graduates 2021 career paths

The Career Center, serving as a point of contact for all alumni, traditionally tracked the career success of the graduates 2021 by conducting an online survey.
Despite the COVID and its influence on market, the Class 2021 was successfully employed in R&D sector, continued for PhD, or became entrepreneurs. The share of "gap year and job seekers" remained on the level of 2020. The pool of top employers in R&D sector did not change – Yandex, Sber, Tinkoff, Samsung, Gazprombank. The most common positions include data scientists, product managers, analysts, software engineers.
Graduates, willing to pursue research, found positions in national research centers specializing in biology, physics, and quantum materials.
Those decided to continue for PhD outside Skoltech, were enrolled in top-national universities or went abroad, mainly to European countries (Germany, Switzerland, France).

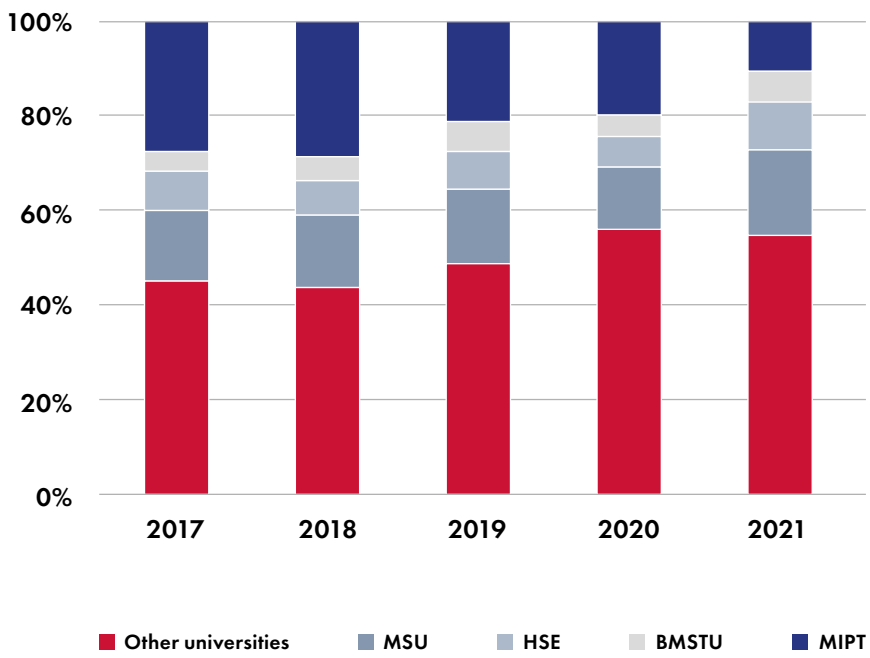
MSc and PhD intake



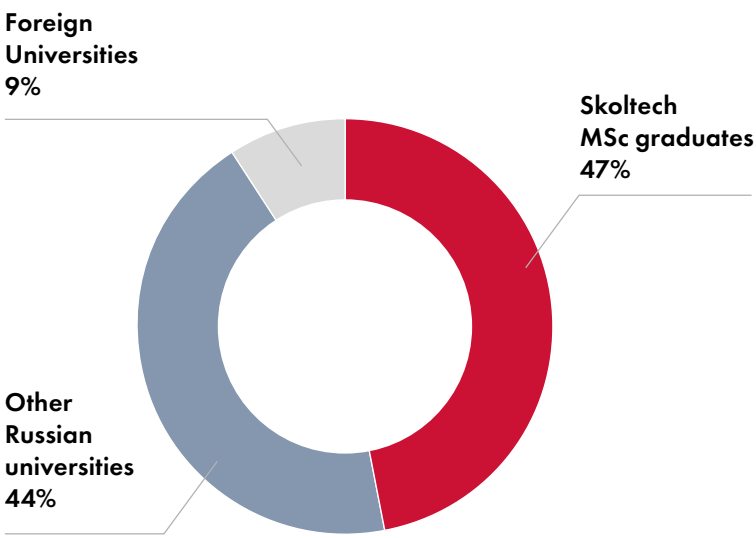
MSc and PhD annual intake: internationals



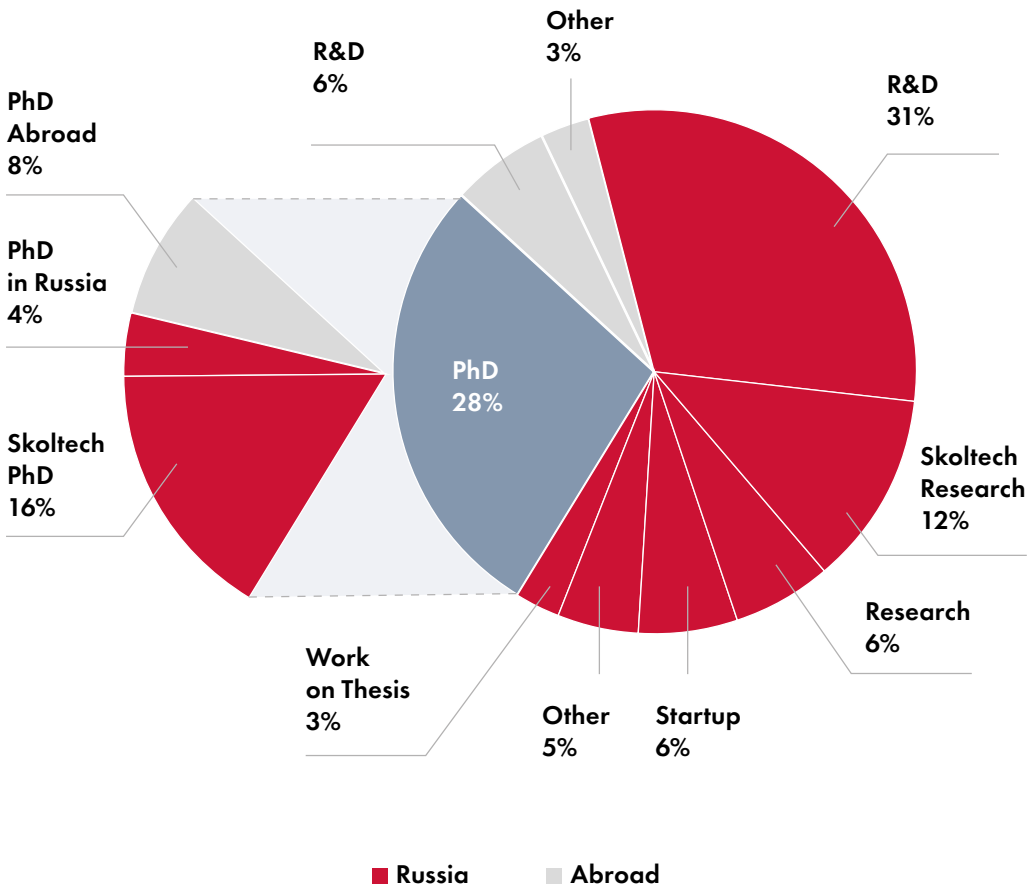
MSc and PhD intake by university



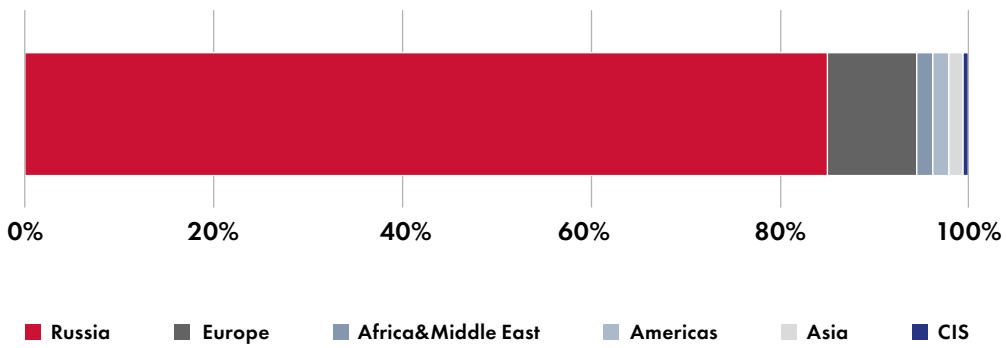
PhD intake by background



Graduates 2021 career paths



Class 2021 geography



Alumni community

Engaging with alumni is crucial for Skoltech advancement. The priority focus is on building the community of active supporters, ambassadors, promoters, and donors, contributing to Skoltech development and its positioning in Russia and the world.

The alumni community exceeded 1300 graduates, spreading across 49 countries, 77% are in Russia. The breakdown of career tracks per most common organizations where Skoltech alumni are employed or continue for PhD or research positions is presented below:

High-tech sector in Russia

Company	Number of alumni
Sber	38
Yandex	36
Huawei	25
Samsung	13
BostonGene	11
Tinkoff	10
Gazpromneft	7
Accenture	6

PhD abroad

University	Number of alumni
EPFL	12
ETH	6
TU Eindhoven	5
MIT	4
Technical University of Denmark	4
HKUST	3
Carnegie Mellon University	3

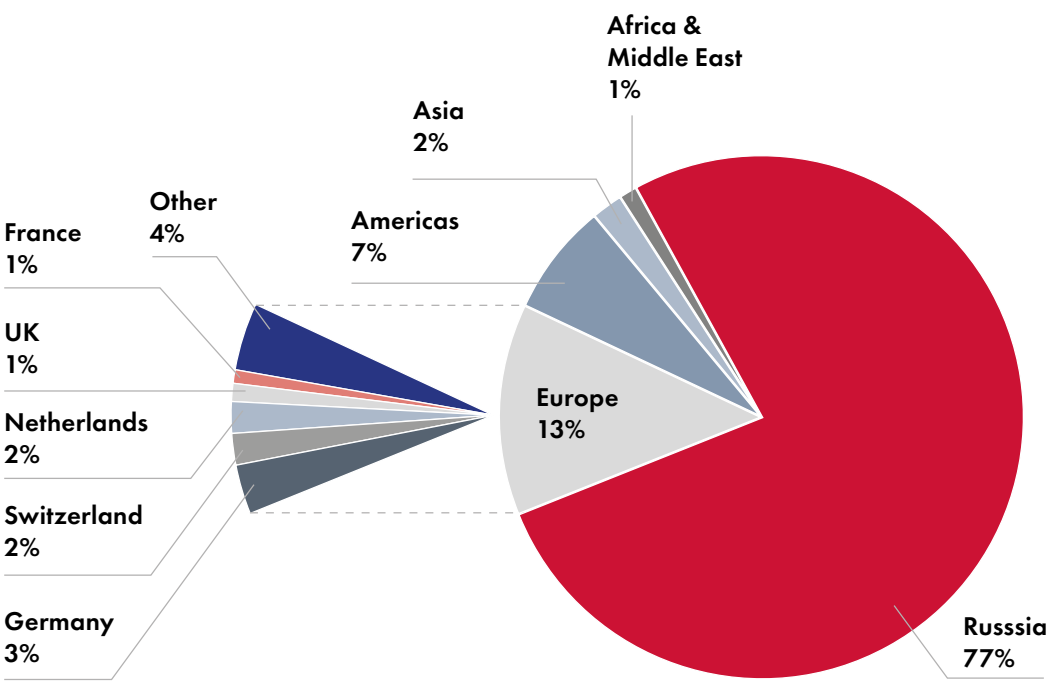
Research Russia

Institution	Number of alumni
Skoltech	162
HSE	17
MIPT	17
Institute for Information Transmission Problems	6
RQC	5
Medical-Biology Agency	4

High tech sector abroad

Company	Number of alumni
Criteo	3
Chawanich Co., Ltd.	2
Cisco	2
Microsoft	2
Snap	2
Facebook	2
Huawei	2

The alumni were involved in a range of activities during the year. The supported promotion of Skoltech brand by involvement in outreach and recruitment campaign, sharing insights of experiences in Skoltech, also through the online portal "True story". They also contributed to Sber-Skoltech Hackathon in October, meetings with employers.



Community engagement

Skoltech is committed to giving back to society. The comprehensive engagement program is built around wide outreach, projects for kids and school students, activities aimed to explain Skoltech value and impact to the public.

Science outreach programs

The portfolio of programs was expanded, mainly with Skoltech presence in events such as Technosreda Festival, All-Russian Science Festival "NAUKA0+", "N+1 Fest", Ural Biennale, FANK, and others. Simultaneously Skoltech activated activities in lecture hubs, also shaped a collaboration with Moscow Department of Education and Science and Academy of the Ministry of Education. The programs involved faculty, researchers, students and alumni, select examples are:

- Open lectures in modern molecular biology were delivered by CLS faculty and students in Ufa, Ekaterinburg, St. Petersburg, Moscow.
- Prof. Severinov developed a Youtube-based basic molecular biology course with a popular radio anchor Alexander Plyushev.
- Open Seminars involving top researchers in neurotechnology and neurobiology were organized by CNBR inviting as speakers Dr. Amol Yadav (Indiana University School of Medicine), Dr. Marcus Conrad (Helmholtz Zentrum München).
- a new educational media project "Life and other stories" featuring more than 50 interviews from 39 world leading scientific centers, including Skoltech scientists and Skolkovo ecosystem members was launched.


Маргарита
Кулько
2


Skoltech

Kids programs

Activities for schoolkids covered more than 15000 participants who joined online courses and seminars: International Research School, Skolkovo Junior Challenge Olympiad, Saturdays of Moscow schools by Moscow Department of Education and Science. Offline track was presented with courses, workshops and lectures: Letovo Summer Scholar Program, workshops for schoolkids and teachers, courses and workshops for Children's University of the Polytechnic Museum.

Select examples include:

- a course in molecular microbiology by Prof. Severinov and PhD students was delivered to Moscow high school students and biology teachers in collaboration with Moscow Outreach Education Department, with more than 500 participants.
- Prof. Stevenson designed and executed Summer Research Program for Letovo school students.
- 5G-lab tours, open lectures and quizzes were delivered in Cybersecurity and Smart agriculture in a partnership with School of New Technologies as well as IT track of the Skolkovo Junior Challenge Olympiad with the International Gymnasium "Skolkovo".
- Letovo school students were hosted in laboratories of the Center for Materials Technologies. The internships also included a course of lectures, a joint project with Harbin Technological University on production of composite profile.

Visitors

In spite of constraints imposed by the pandemic, Skoltech supported external relations, building relationships with representatives of universities, research institutions, high tech companies, governmental authorities and diplomatic missions. 163 official visits were hosted by the executive management and faculty.

Skoltech Open Day was organized on campus to showcase Skoltech results to the ecosystem and all those interested in learning more about the Institute. Executive management, stakeholders, faculty, researchers and staff delivered a comprehensive program composed of panel discussions, lab tours and activities for kids.


ПЕРЕД СНЯТИЕМ КОЖУХА
ОТКЛЮЧИТЬ ПИТАНИЕ


Skoltech warmly welcomes
Canadian
Ambassador
eClaire
the 2021 Innovation
orkshop
Skoltech
CEI
September 2021

Media coverage

This year's highlights are a BBC Reel short film and a CNN report on Evgeny Chuvilin's Siberian crater research, an episode of VICE's "Space Show" featuring Prof. Podladchikova, more time in the spotlight on national TV, special materials, and a massive increase in the coverage received from top-tier media.
Skoltech speakers continued giving expert commentaries on the scientific and societal impacts of the COVID-19 pandemic, appearing in The New York Times, BBC, Bloomberg, RT, Voice of America, RBC, Kommersant, and other media. The story about Prof. Bazykin's work showing one substrain of the coronavirus delta variant to account for 90% of infections in Russia was among Yandex's most read news.
Skoltech made headlines on a number of special occasions: an investigation of the Yamal crater, Zhores supercomputer helping Ian Nepomniachtchi to train for the World Chess Championship, extreme space weather events, an expedition to the Russian Arctic, etc., and was mentioned by top international media: The Guardian, The Telegraph, CNN, BBC, Bloomberg, Financial Times, The New York Times, VICE, AP.
The Nature journal dedicated a series of features to some achievements of Skoltech made during 10 years.
A story on the electronic nose developed at Skoltech by Prof. Nasibulin, Senior Research Scientist Fedor Fedorov, and their colleagues was featured in prime time in "Vremya" — the main evening newscast in Russia, airing on Channel One Russia.
Prof. Kulish shared his expert opinion in the first article in Nature News positively rating the Sputnik vaccine.
The Chairman of the Board of Trustees Viktor Vekselberg, President Alexander Kuleshov, Senior Vice President for Industrial Cooperation Alexey Ponomarev, Director of the AI Research Center Prof. Burnaev, Prof. Lebedev, Prof. Gabitov, Prof. Cheremisin, and Prof. Vorobev joined the Nobel Vision to discover "nexttech" on the evolutionary stage.

The PR team won the AKSON Communication Laboratory Award in the presence effect category. Since 2017, AKSON has been annually awarding the prize to the best press offices of universities and research centers.

Social media profile

The engagement with audiences continued to grow, demonstrating stronger interest to Skoltech. The major increase is evidenced in Instagram* and Youtube. The top Instagram* posts included a post on testing a refueling robot for electric vehicles by the research team of Intelligent Space Robotics Lab (92600+ views), a story of PhD student Maria Osetrova who created a brain lipid map project with a reference to Tatler magazine advising to keep track of Maria's scientific progress (1383 likes), and autumn landscapes of Skoltech campus (590 likes).
Among the most viewed Youtube videos are the open lecture of Prof. Gelfand in the Gorky park (18400 views), the New League of universities webinar on vaccination (5600 views), the commencement speech to the graduation class 2021 from Dmitry Medvedev, Deputy Chairman of the Security Council of the Russian Federation, Chairman of Advisory Board of Skolkovo Foundation (2100 views).

VK

14%
increase up to
24 600 followers

LinkedIn

20%
increase up to
8 300 followers

Youtube

45%
increase up to
4 500 followers
+145,7k views

Twitter

12%
increase up to
3 700 followers

Instagram*

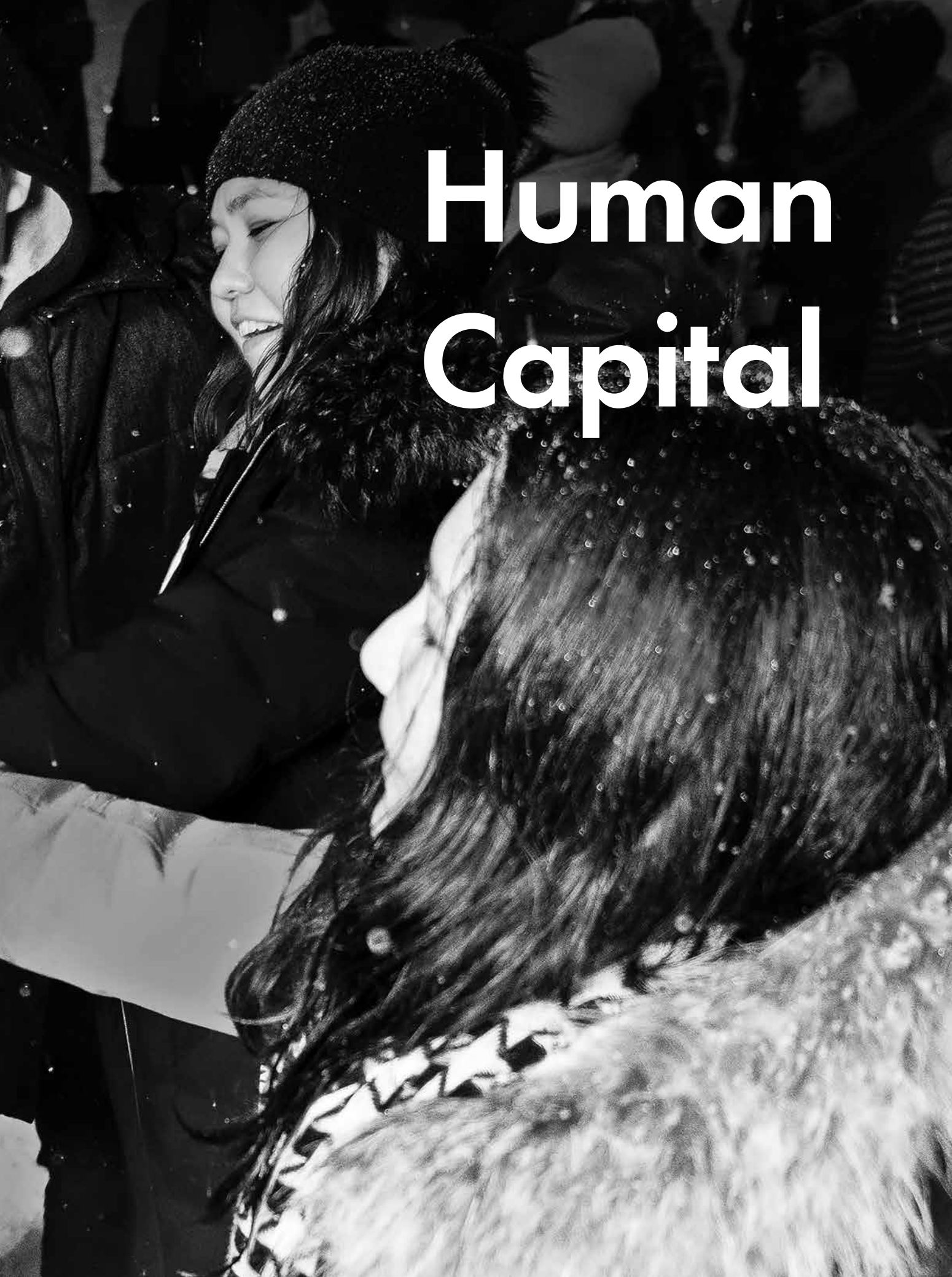
45%
increase up to
9 600 followers

Facebook*

10%
increase up to
14 600 followers

As of Dec 31, 2021.

* The following social networks are owned by Meta Platforms LLC which is not allowed to conduct activities in Russia of March 21, 2022. Starting from this date, Skoltech has suspended activities in these social networks.



Human Capital

People Awards and Achievements in 2021

International awards and recognition

L'OREAL – Unesco 2021
Prof. Khrameeva

Humboldt Research Award
Prof. Oseledets

DFG Merkator Fellowship
Prof. Panchenko

National awards and recognition

Technological Breakthrough Award 2021
Prof. Lakontsev

Moscow Government Award for Young Scientists in the chemistry and materials science
Prof. Popov

Moscow Government Award for Young Scientists in the information transmission, storage, and processing category for developing AI-based medical image analysis methods that help detect and quantify major diseases, including COVID-19
Prof. Belyaev, Dr. Shirokikh, Dr. Goncharov

Academic Fellows

Turing Fellow (Alan Turing Institute)
Prof. Bialek

Turing Fellow (Alan Turing Institute)
Prof. Berloff

Royal Microscopical Society
Prof. Korsunsky

Professor of the Year

Teaching Excellence
Prof. Dylov

Best Instructor
Prof. Ferrer

Best Research Supervisor
Prof. Nasibulin

Best Career Trainer
Prof. Kulish

Best Mentor
Prof. Oseledets

Faculty Promotions

Full Professorship
Prof. Cheremisin

Associate Professorship
Prof. Podladchikova

Full Professorship
Prof. Koroteev

Full Professorship
Prof. Osiptsov

Performance excellence award

Natalia Galochkina
Head of Admissions and Assessment Center

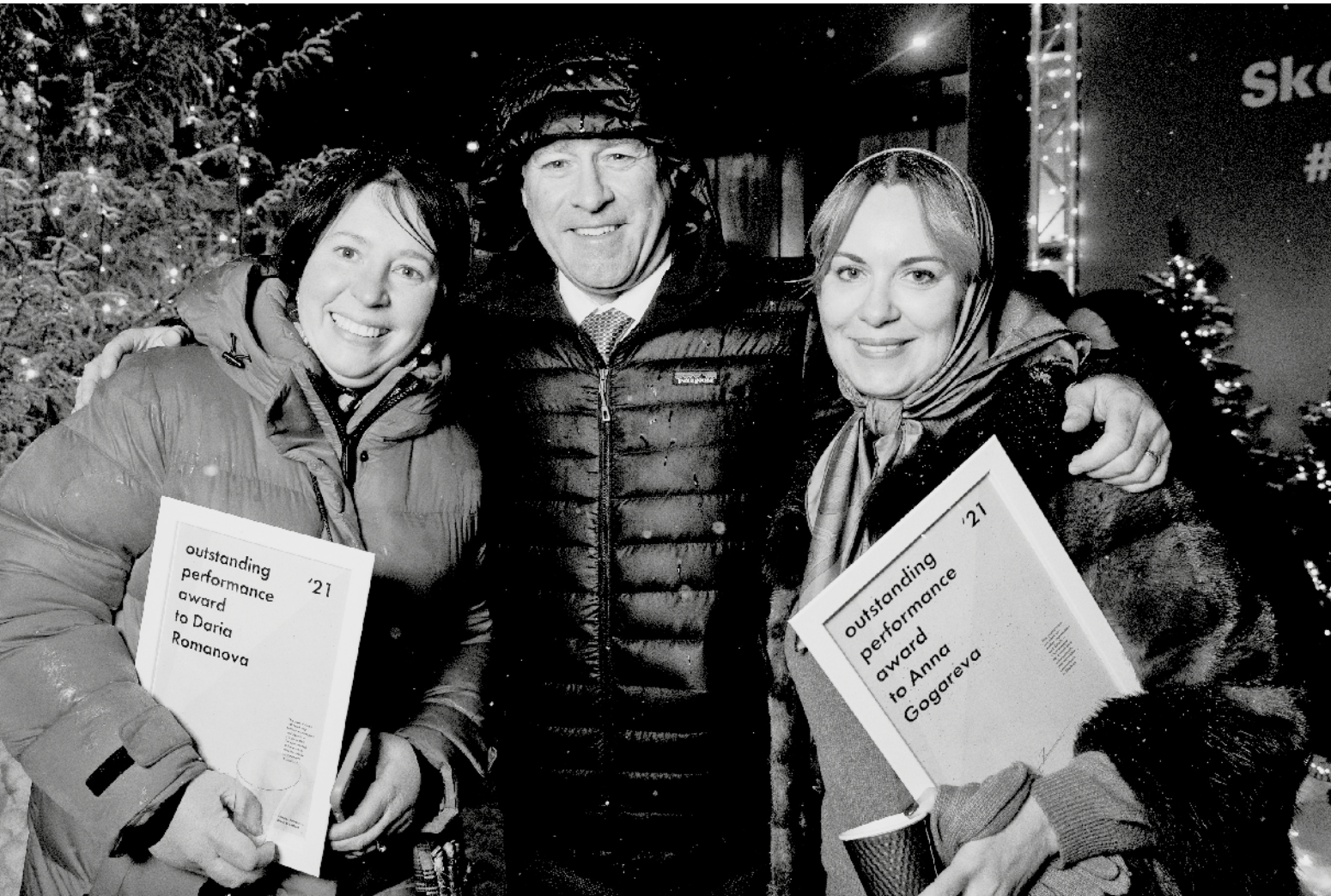
Anna Gogareva
Head of Institutional Development Department

Ekaterina Kuznetsova
Senior Compensation and Benefits Specialist

Varvara Tsygankova
Head of Events

Daria Romanova
Head of Office for Sponsored Research

Olga Ustinova
Deputy Head of PR



Angelina Prokopeva
MegaFon

MSc graduate 2021

I have finished MEPhI in plasma physics, but my thesis was related to the plasma space thruster, so I decided to go to the Space and Systems Engineering track at Skoltech as my master's degree.
I wanted to work at a private space company, and eventually, after Skoltech I found a position in a company that fits this description.
Now I work at Megafon1440, it is a private aerospace company developing the Satellite Internet Constellation (as Starlink) in Russia. I'm an analyst-developer in the team building a math model of the overall system: traffic, antennas, finance, etc. Thanks to Skoltech I met people that helped me to set my career path. Also, I had cool courses at Skoltech that became a solid introduction to the industrial challenges.

"Thanks to Skoltech I met people that helped me to set my career path. Also, I had cool courses at Skoltech that became a solid introduction to the industrial challenges"

Ilya Pletnev
Skoltech PhD Student

MSc graduate 2021

I was born in Tomsk and spent the first year of my bachelor's in Tomsk Polytechnic University (TPU) studying mechanical engineering. Then I switched to the physical faculty of Lomonosov MSU, where I suddenly got interested in biology. This interest led me to the biophysics department and later - to the "Life Sciences" program of Skoltech.

I like doing science for several reasons. First, I enjoy making sense of things. Second, I appreciate the scientific community, where most people are excited about their work, and your social status is based only on your intelligence.

My area of interest is spatial chromatin structure, i.e., the 3D conformation of DNA and proteins around it. Chromatin structure in the nucleus regulates changes that occur in cells, such as differentiation or response to signals. Therefore, most of my scientific projects involve studying changes happening in cells with time. For example, one of my projects is devoted to the differentiation of human neurons, and another one - to how amoeba D. discoideum reacts to starvation. During my master's at Skoltech, I also participated in a project devoted to the methodology of chromatin data analysis which has been published. From a practical standpoint, all this research aims to better understand how human organisms develop, why errors in development occur and how to fix them.

Skoltech plays an important role in my scientific career. It gathered outstanding scientists under one roof and allowed me to learn from them and work with them. And the Skoltech scholarship keeps me going without the need for side jobs. After my PhD, I plan to stay in science, but I haven't figured out the place and the research topic yet.

"Skoltech plays an important role in my scientific career. It gathered outstanding scientists under one roof and allowed me to learn from them and work with them"

Anastasia Stelvaga
inTouch

PhD graduate 2021

I was born in Barnaul, Altai region, Siberia. Got my BS and first MS in physics from Novosibirsk State University. The initial focus of my studies belonged to the intersection of physics and embedded systems programming. My second MS I got at Skoltech diving into Product Design as I was eager to learn how to structure and manage hardware products development. Within the course of my PhD, I have developed a framework for strategic decision-making which was tested at the Airbus CTO office for emerging technologies evaluation.

In parallel, after getting back from half a year of studies at MIT I've founded my passion - startup inTouch. My company goal is to develop wearable emotion recognition technology. This technology embedded into wearable devices would contribute to the whole mental health industry enabling better and remote services. My team has developed a hardware complex based on the in-house designed sensors to collect multimodal data labeled with human emotions. We won several startup competitions (e.g. Eureka contest at MSU, START program at Bortnik foundation), got pre-seed funding, and received the Skolkovo Foundation resident status. Currently, we are conducting negotiations with two out of the five largest electronics companies in the world discussing possible future partnerships. Several Skoltech representatives helped me along the way as mentors. I can certainly say that studying at Skoltech notably contributed to my maturation as a scientist and start-up CEO helping to develop professional skills on the top-notch international level.

"I can certainly say that studying at Skoltech notably contributed to my maturation as a scientist and start-up CEO helping to develop professional skills on the top-notch international level"

Artem Zabolotniy
Computational and Data Science and Engineering program

MSc graduate 2021

I am from Severodvinsk, I got my bachelor's degree in information security at the St. Petersburg State University of Aerospace Instrumentation (SUAI)) and after graduation decided to change the area of study. So, I got into the Skoltech master's program in Information Science and Technology.

I didn't have any significant achievements in industrial cases, so I started to participate in all possible ones to gain experience and understand my strengths and weaknesses.

I entered the industry in my second year of undergraduate studies when I started working as a web developer.

In my opinion, areas related to artificial intelligence are very promising, complex, and interesting at the same time. Doing what you love is one of the most important success factors. I joined Sber in my first year at Skoltech when I was looking for an opportunity to combine my scientific work with something important for the industry.

Continuous employee educations is the key to success in rapidly changing and dynamic areas. Almost all the knowledge I use in my work was acquired at Skoltech or the university motivated me to get it. I hope that the PhD program will be the next step in my further development.

"Almost all the knowledge I use in my work was acquired at Skoltech or the university motivated me to get it"

Arsenii Chekalov
MSc Petroleum Engineering
Class 2021

I am from Moscow, I graduated from a gymnasium with a language bias. I had been interested in economics in high school but eventually I decided to go to a technical university (Sergo Ordzhonikidze Russian State University for Geological Prospecting (MGRI)). My school interests forwarded me to startups more then to fundamental science. Petroleum engineering seemed to me as the most promising option, moreover it is the basis of the Russian economics.

The first my startup idea, which I worked on at MGRI, had not succeed. Then the new idea came to and I still working on it with my team at Skoltech. We are developing a hardware complex to improve the data transfer rate in drilling. There are a lot of sensors at the pick of drill. These sensors provide different kinds of data to operator. Due to specific of drilling of an oil well the data transmits with interference and not fast enough. Our team tries to fix that.

We had got grant foundation for the project which allowed us to develop a laboratory setup. We have got many prizes at conferences in Lomonosov MSU and other Russian universities with that setup. Now we are working on an experimental prototype that can be used on an oil well.

Skoltech is an ideal place for startup development. Firstly, the faculty is open for discussing projects with students. Most professors have major experience in the industry and can advise whom to contact with an idea. Secondly, Entrepreneurship and Innovations (E&I) courses help to improve the theoretical understanding of startups: business planning, strategy building, negotiation skills, etc. Thirdly, Skoltech has an excellent community. Graduates of the best universities study here which allows to assemble a team of like-minded people with a strong and diverse background and develop good projects.

“Skoltech is an ideal place for startups”

Kirill Tyshchuk
MSc Data Science
Class 2021

I was engaged in Olympiad mathematics since school and succeeded there. Then I decided to continue with this field and entered St. Petersburg State University. At the University I realized that I want to do something more practical and shifted my interest towards machine learning. I am attracted to advanced areas of machine learning: deep learning, Bayesian methods, reinforcement learning. I am trying to balance between fundamental and applied science. On the one hand, I can finally apply my fundamental mathematical education, on the other hand, I can implement the resulting algorithm and see how it works. Well, or it doesn't work sometimes. I was lucky to get the opportunity to study at the new joint program of Skoltech and St. Petersburg State University. This year I will spend at Skoltech, and next year I will return to my native St. Petersburg. I enjoy the courses I have taken here, and I am glad that Skoltech has a wide range of research teams and supervisors. I started my scientific work here in the group of Statistical Methods in Machine Learning under the guidance of Maxim Panov. The topic is related to Gaussian processes and was proposed in cooperation with St. Petersburg. I like the idea of doing science in a research lab like Google Deep Mind or OpenAI (keep dreaming). At Skoltech education and research in machine learning are at a high level" Scientific work provides a lot of freedom, allows you to apply your knowledge, taste the interest and joy of small discoveries. The advancement of science undoubtedly brings benefits and doing something useful is always a pleasure. The laboratories of large companies often work on important and useful tasks and have enough resources for large-scale experiments and a decent salary.

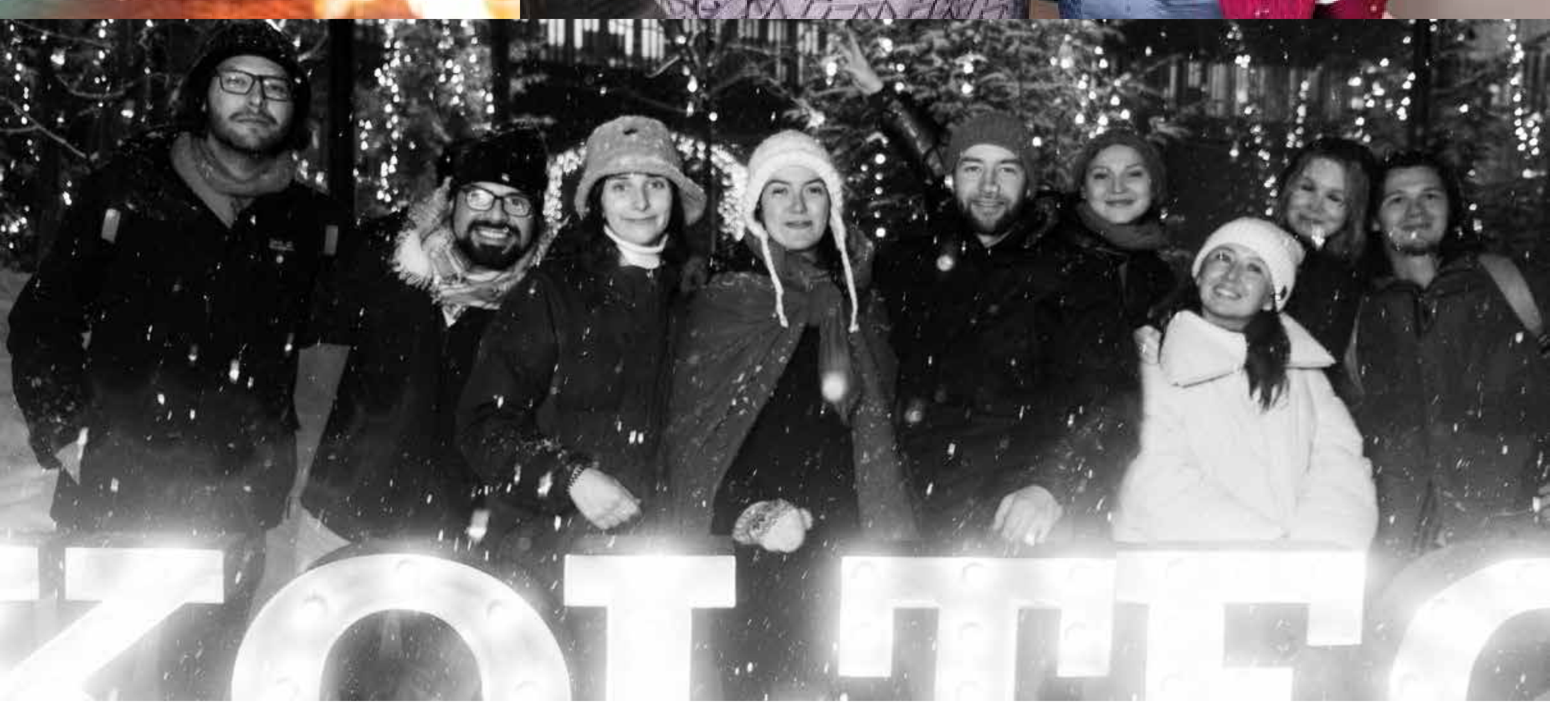
"At Skoltech education and research in machine learning are at a high level"

Melisa Basak
Space and Engineering Systems
MSc program student
Class 2021

I'm from Turkey, Izmir. I studied Aerospace Engineering at Middle East Technical University which is one of the best universities in Turkey. After graduating, I've started a master's program at the same university and department. I always wanted to work in the space field but, this program was mostly based on designing an aircraft. That's why I kept searching for other opportunities through the internet. One day, a friend of mine told me about Skoltech. When I searched, at the first glance, I was totally impressed because of the quality information which can be found on the website. After that, I've searched for current projects in the Space and Engineering Systems Department. These projects were exactly what I wanted to work on. Also, I checked professors in terms of their research fields and the ongoing projects they have. I was quite interested in this opportunity and decided to apply. After a long admission process - online tests, interviews, and documentation, I got accepted, quit my previous degree, and came to Skoltech. Right now, I'm thinking about going to work in the industry since there are lots of ongoing projects which are done in connection with different companies/startups. Also, all the courses provide us to improve our hands-on experiences as a team since we are included in different projects along with those courses. That's why I'm sure that Skoltech will prepare me to develop my skills mostly in the industrial field.

"One day, a friend of mine told me about Skoltech. When I searched, at the first glance, I was totally impressed because of the quality information which can be found on the website"

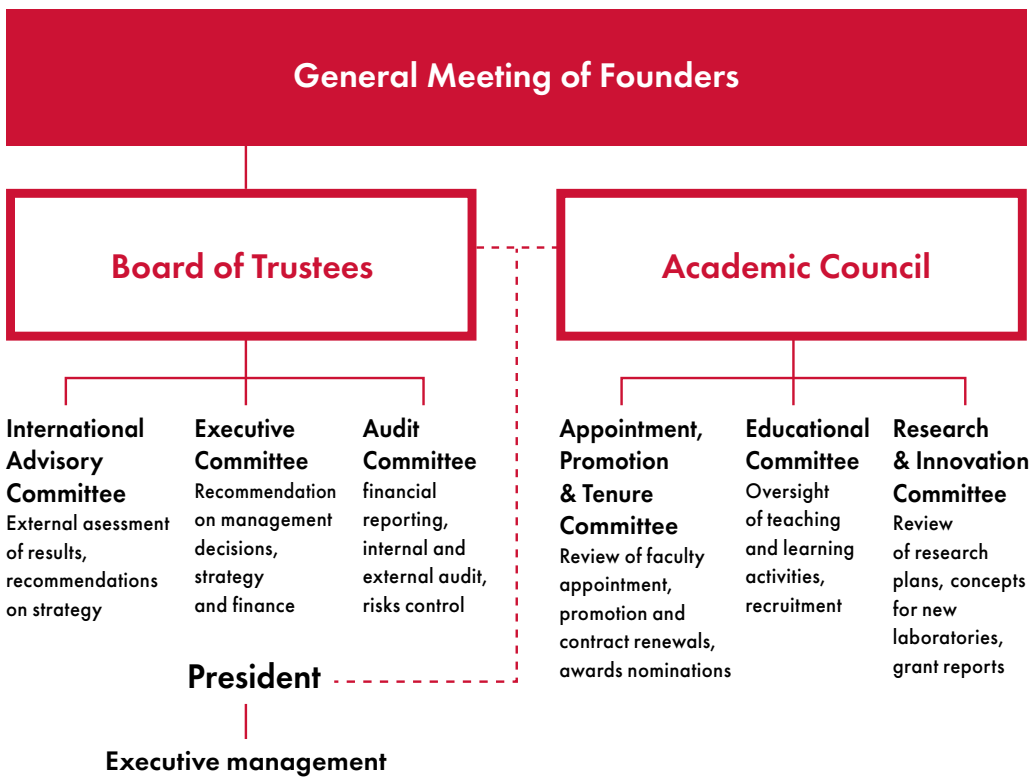

AZERBAIJAN
Photonics
#HRSkoltech with love
КАЗАКСТАН
TATARSTAN
Merry Christmas
Kashmir
HR skoltech the best
Nou Fericit
Рокош
#SKOLTECH
sleep in peace
open your
to new
pizza?
Jack

Governance & management

Governing bodies

Skoltech was established by the decision of the General meeting of Founders in 2011. Since then, the governing system was evolved coming to the comprehensive framework with clear lines of authorities. The strategic priority is to maintain the framework focused, effective, and supportive to decisions on Skoltech development and the strategy implementation.



The governance framework has a clear structure documented in Skoltech Charter. The governing bodies, each within the assigned authority, support the strategic planning, decision-making and effective management.

Charter

The Charter defines Skoltech purpose and goals, framework of the governing bodies. In 2021 the Charter was amended in support of the strategic initiatives – revisions covered the target domains, as well as provisions allowing to open bachelor programs.

General meeting of Founders

The General meeting of Founders is the highest collegial decision-making body, empowered to approve the Charter, appoint the Board of Trustees as well as approve Skoltech membership in different associations. Among resolutions made in 2021 – approval of the 6th edition of the Charter, appointment of the new membership composition of the Board of Trustees with the term of office till December 2026, approval of Skoltech membership in Association "Industrial Internet".

General meeting of Founders
Moscow Institute of Physics and Technology
Tomsk Polytechnic University
Moscow School of Management Skolkovo
New Economic School
Rusnano
Russian Venture Company (RVC)
Development Institution "VEB.RF"
Foundation for Assistance to Small Innovative Enterprises in Science and Technology
Scientific Center RAS in Chernogolovka
Sberbank Russia

Board of Trustees

The Board of Trustees is a collegial decision-making body which gives the overall strategic direction of Skoltech development and ensures that ongoing activities are properly implemented. The Board is responsible for approval of the Strategy and Financial plan, monitoring the progress against the targets, evaluating effectiveness of executive management decisions. It also provides recommendations on a variety of activities to keep focus on Skoltech standing in the context of the mission and vision.

The Board's agenda was dominated by the topics to bring the Strategy into operations – transformation of the research agenda, new strategic programs of Centers, a concept of the Project Centers. The Board also considered and approved the updates to the Strategy and new KPI system. Recommendations were provided on the strategic HR framework, the baccalaureate concept and endowment strategy. Among the regular decisions – approval of the Annual Report, Financial Report, budget 2022-2024.

Considering the planned rotation, the Board elaborated the succession approach, allowed to keep a balanced composition of national and international experts, representing governmental authorities, top world universities, business. The new members were appointed in November.

Viktor Vekselberg
Chairman of the Board of Trustees
Member of Skolkovo Foundation Board of Directors.
Chairman of the Board of Directors of Renova Group of companies

Simon Bradley
Founder & CEO of Percent-Edge. Board member since 2020

Tony F. Chan
President of King Abdullah University of Science and Technology

Edward Crawley
Skoltech Founding President

Arkady Dvorkovich
Chairman of the Skolkovo Foundation

Prof. Dr. Johann Füller
Founder and CEO of HYVE AG, Chair for Innovation and Entrepreneurship at Innsbruck University

Alexander Galitsky
Co-founder and Managing Partner of Almaz Capital

Oleg Kharkhordin
Professor, Political Science Department, Director of the Center "Res Publica", European University at St. Petersburg

Alexander Kuleshov
Skoltech President

Irina Okladnikova
Deputy Minister of Finance of the Russian Federation

Richard Lester
Japan Steel Industry Professor and Associate Provost at the Massachusetts Institute of Technology

Anastasia Rakova
Deputy Mayor of Moscow

Alexander Vedyakhin
First Deputy Chairman of the Executive Board of SberBank

Pekka Antero Viljakainen
Advisor to the Chairman of the Board of Directors, Skolkovo Foundation

Svetlana Yachevskaya
Deputy Chairperson – Member of the Board, VEB.RF

Composition of the Board of Trustees as of Dec 31, 2021

Academic Council

The Academic Council is a decision-making collegial body to give academic governance for scientific, research and development, and education activities ensuring their highest quality and integrity.
The Council is responsible for academic personnel recruitment and promotions, approval of educational programs, admission plans, review of research concepts related to new Centers and laboratories.
The year was productive as the Council and Committees addressed a wide span of issues, the major of which were brought up to the Board of Trustees' approval, such as the update of the Strategy 2021 – 2025, progress reports on the institutional transformation and reconfiguration of the Centers, a new organizational structure with regards to the Centers. Core educational policies were approved.
In the year closure meeting, the Council rotated the Committees allowing a wider representation of faculty from the new Centers.


Skolkovo
Institute of Science
and Technology
Skoltech


Skoltech
Academic
Council
report
Skoltech
'20
'21

Executive management

The executive management is responsible for organizing and managing Skoltech day-to-day operations in the respective directions. The authorities and responsibilities of the executive management are defined by the President and stated in the corresponding policy.

During the year a few changes were in place with regards to the executive management team. After several years of valued service, Prof. Fedorov resigned from position of Vice President for AI and Mathematical Modelling to take up the position of Rector in the Sirius Educational Center. Tatyana Zakharova took up the position of Senior Vice President for Finance and Operations, while authorities of Vice President for Development Alexander Safonov were extended with oversight of the institutional transformation and HR strategy. Prof. Fortin was appointed as Associate Provost, Dean of Education while Denis Stolyarov was appointed as the Dean of Students.

Collegial bodies

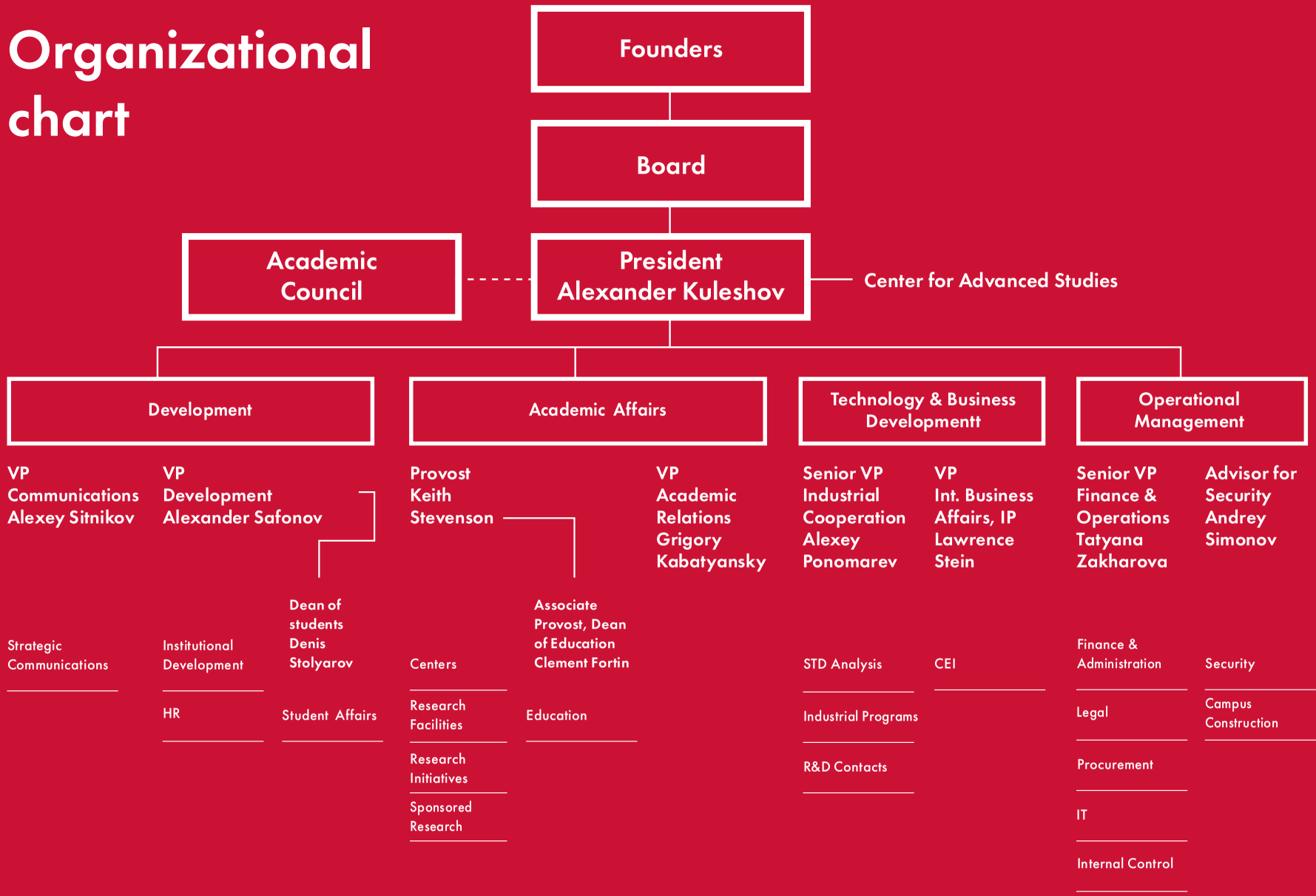
The Institute management is supported by committees and working groups operating as advisory bodies with appropriate scope of expertise.
The Strategy working group chaired by the Provost, is the principal management body, exercising authorities to facilitate the strategic report and planning cycle. During the year, the group set the approach for review and approval of the new strategic programs of the Centers, reports were delivered to the President and Academic Council.
The Personnel Committee was established in December to facilitate the HR strategy. Under the guidance of Vice President for Development, the Committee addressed the new pay system and approaches for job levelling.
The IT Committee advised on priorities of the IT landscape, considering alignment to the Strategy.
Dozens of working groups were functioning on policy making to develop balanced regulatory provisions on policies regulating Centers' operations, planning and reporting, teaching and learning, safety and operational management, financial issues.

Organisational chart

The organizational chart represents the management and administration structure as of 31 December 2021.


Skoltech

Organizational chart



KPIs and benchmarking

The composition and targets of Skoltech key indicators of development are defined by the Strategy, Grant agreement with the Skolkovo Foundation, the national program "Economic Development and Innovative Economy". Annual and interim reports on achieving the targets are reviewed by the Board of Trustees, Skolkovo Foundation, and the Ministry of Finance.

The 2021 was a year of transition to the new KPI system, focused precisely on four major components – research excellence, impact on economy, employability of graduates and contribution to Skolkovo ecosystem. The methodology on calculating Skoltech impact on the national economy and estimates were made by the New Economic School, Skoltech Founder and a long-lasting partner.

Strategy 2021 – 2025 indicators

Indicator	Unit	2020	2021	Target 2021
Impact on the national economy (bln Rub)*	Bln Rub	17	20[1]	NA
Skoltech affiliated startups in Sk ecosystem	Units (cum.)	57	71	70
Publications in Nature Index, A* conferences	Per av. faculty[5]	NA	1.0	0.7
Graduates' employment in the national innovation sector	%	70	70	70

* measured in core impact (direct effect, suppliers effect, staff spending effect, students spending effect), graduate premium, commercialization, impact produced by startups.

Supporting indicators

	2017	2018	2019	2020	2021
Publications in WoS, Scopus per faculty	5.6	5.8	6.3	6.4	6.5
MSc and PhD graduates	92	176	252	365	342
MSc and PhD graduates (cumulatively)	224	400	652	1017	1359
Patent applications per faculty	0.2	0.5	0.4	0.6	0.6
External funding (% in the budget)	20%	25%	26.5%	29.6%	34.5%

[4] Source: report of the New Economy School (2021)
[5] Average faculty – 119.4

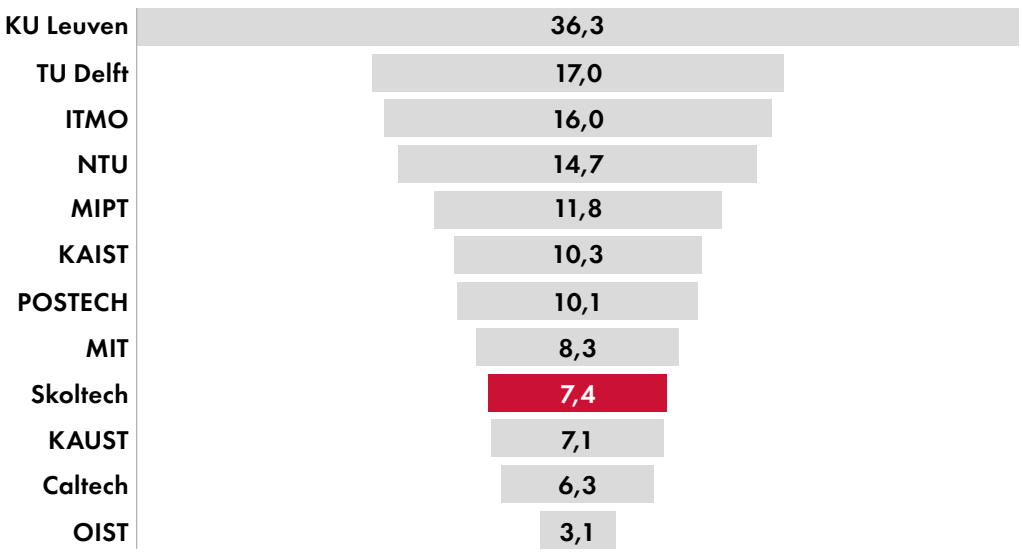
Benchmarking report

The present benchmarking report serves a purpose to overview Skolech standing against to the top world institutes, rising young universities rapidly climbing up in the international rankings, as well as national technological universities. The comparative university group includes 11 universities.

University	Short	Foundation year
Group 1. Top world leaders with science and technology focus		
California Institute of Technology	Caltech	1891
Massachusetts Institute of Technology	MIT	1861
Delft University of Technology	TU Delft	1842
KU Leuven	KU Leuven	1834
Group 2. Young research intense universities		
King Abdullah University of Science and Technology	KAUST	2009
Okinawa Institute of Science and Technology Graduate University	OIST	2011
Korea Advanced Institute of Science and Technology	KAIST	1971
Nanyang Technological University	NTU	1991
Pohang University of Science and Technology	POSTECH	1986
Group 3. National universities		
Moscow Institute of Physics and Technology	MIPT	1946
St. Petersburg National Research University of Information Technologies, Mechanics and Optics	ITMO	1994

The data was sourced from Scopus / SciVal, THE profiles of the universities, and official university webpages. As shown on the charts, Skoltech is a fast-developing international university, maintaining the position on track with similar model young universities in science and technology.

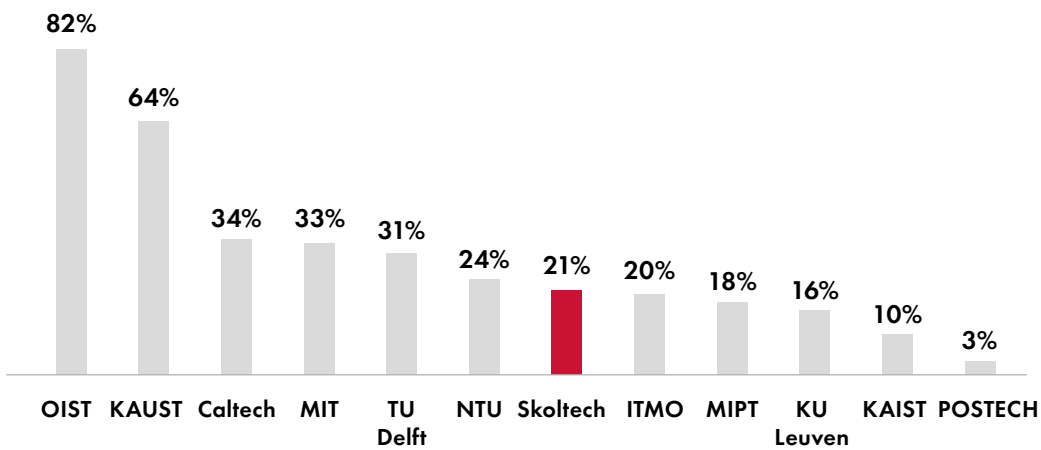
Student – faculty ratio



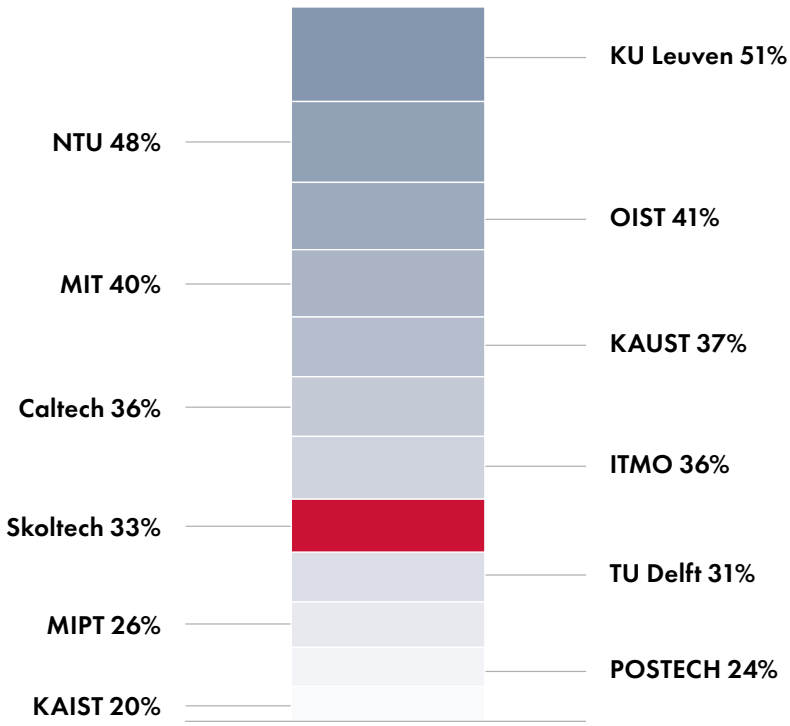
Share of international students

QS Engineering - Petroleum 101-150

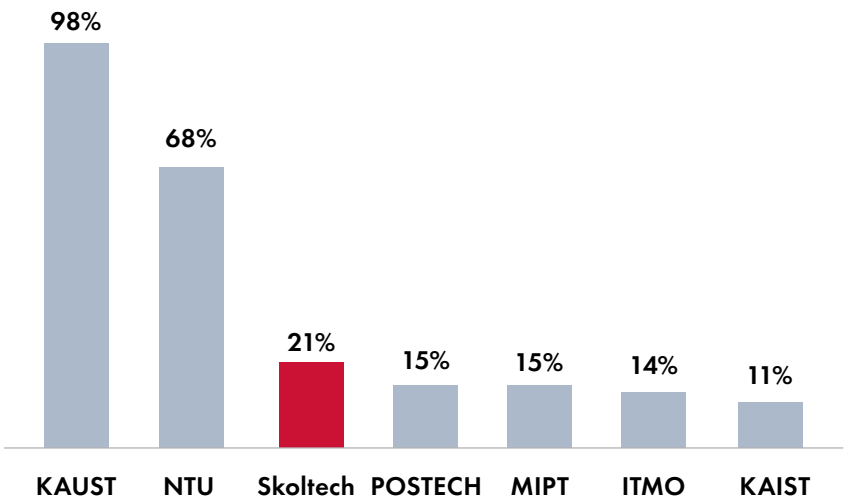
Materials Science & Engineering 301-400
Biological Sciences 301-400



Share of female students

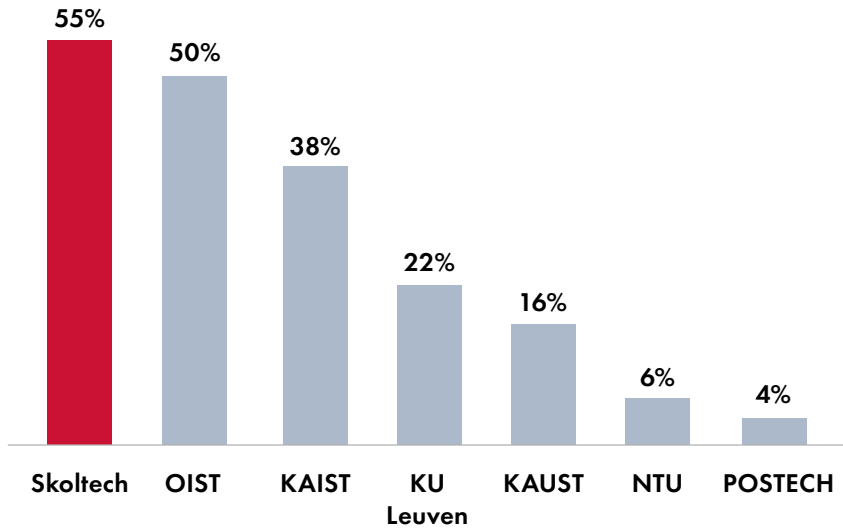


Share of International faculty



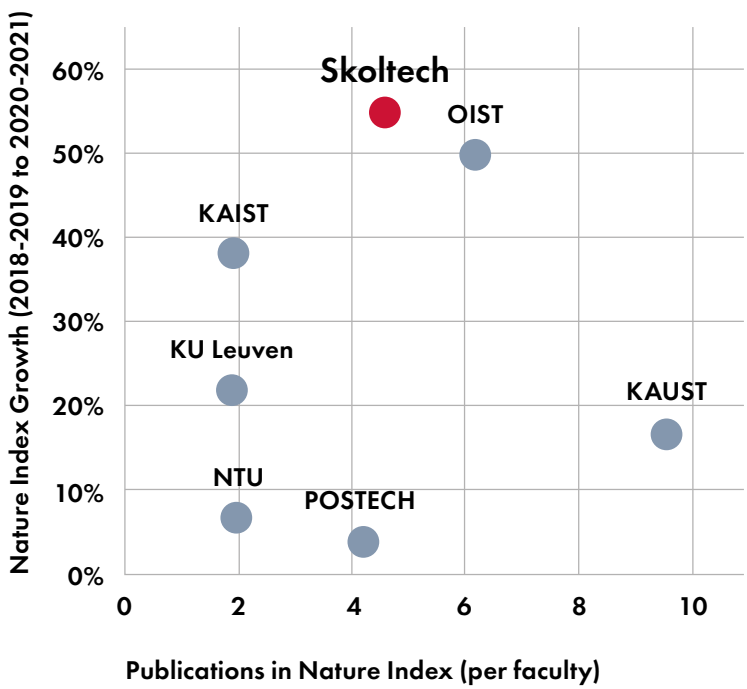
*According to QS WUR 2022

Growth of papers in Nature Index

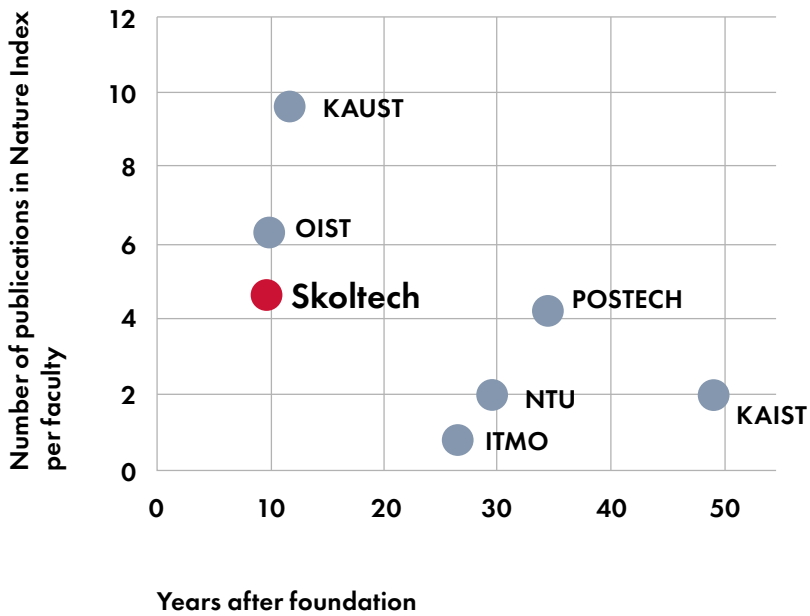


The chart shows the growth based on comparing two periods (2018-2019 and 2020-2021)

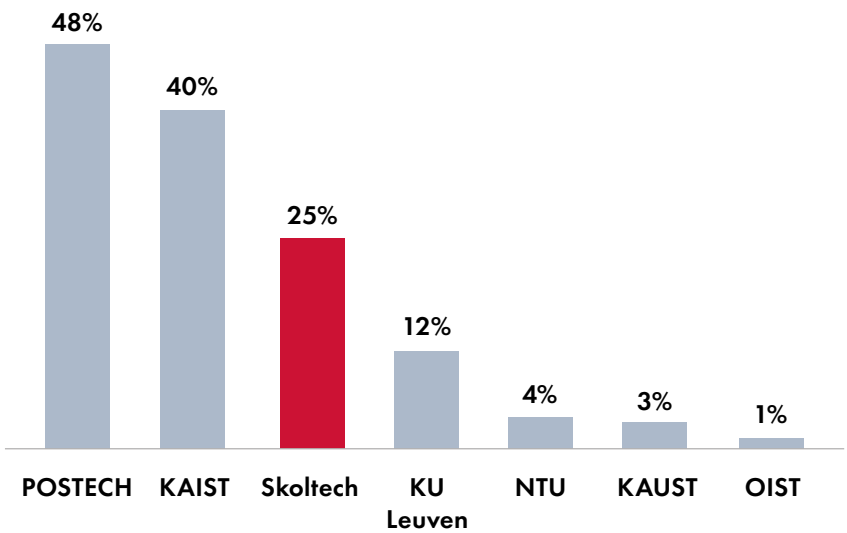
Nature Index Growth versus papers in Nature Index per faculty



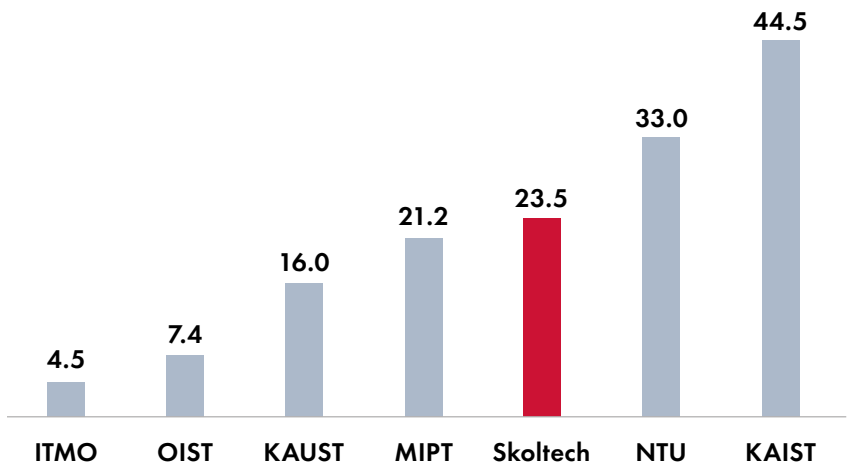
Papers in Nature Index per faculty versus university age



Publication in top 1% growth (period 2018-2019 versus 2020-2021)

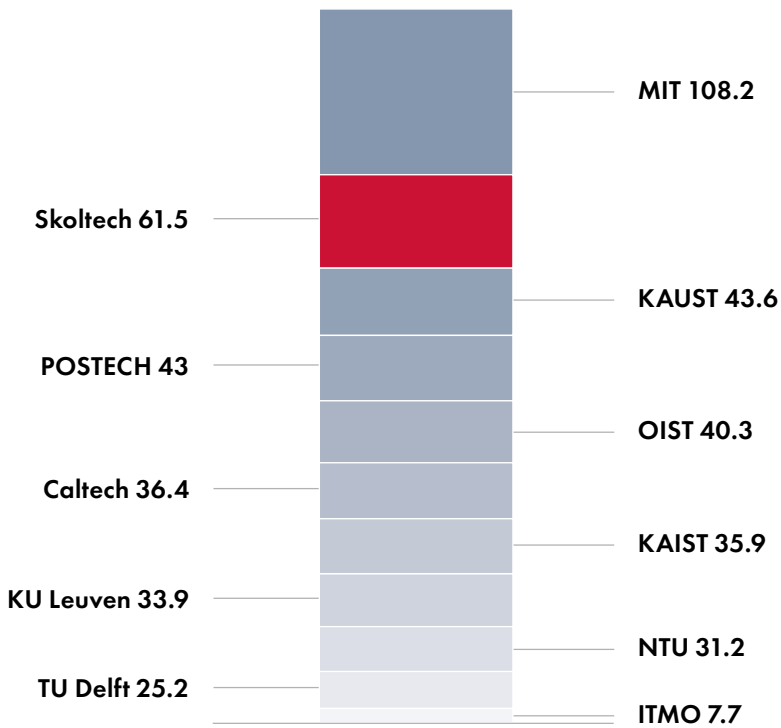


Foreign grants awarded (2017-2021) (mln,$)



Source: SciVal
Awards Volume in SciVal refers to both the count and the value of grant awards. Awards Volume considers aggregated values of awards over the award lifetime. In other words, it considers the total value awarded at the time of award and not the value (to be) spent in any particular time period.

Patent-Citations per Scholarly Output (2017-2021)



Source: SciVal.
This is the average patent-citations received per 1,000 scholarly outputs published by the entity (e.g. a university). i.e. the patent citation counts divided by the total scholarly output of the university for that period and multiplied by 1,000.

Financial performance

Financial Report for the year ended December 31, 2021

Financial Highlights

(in millions of rubles)	2016	2017	2018	2019	2020	2021
Operating Expenses	3 626	4 084	5 557	6 620	7 204	**7 499**
Capital expenses	2 215	1 794	689	800	1 083	**806**
Endowment Net Assets	4 556	4 717	4 559	4 775	4 787	**4 635**

In fiscal year 2021 Skoltech operated in the challenging pandemic environment. Thanks to the financial strategy and a reasonable and well-balanced finance framework, during 2021 Skoltech demonstrated a stable financial performance that supports the core activities and enables the strategy. Skoltech met 2021 operational budget requirements, grew income, fulfilled commitments in delivering research contracts and kept educational process going. Delivering on an ambitious agenda to complete the campus construction in 2023, in 2021 Skoltech continued construction of laboratories.

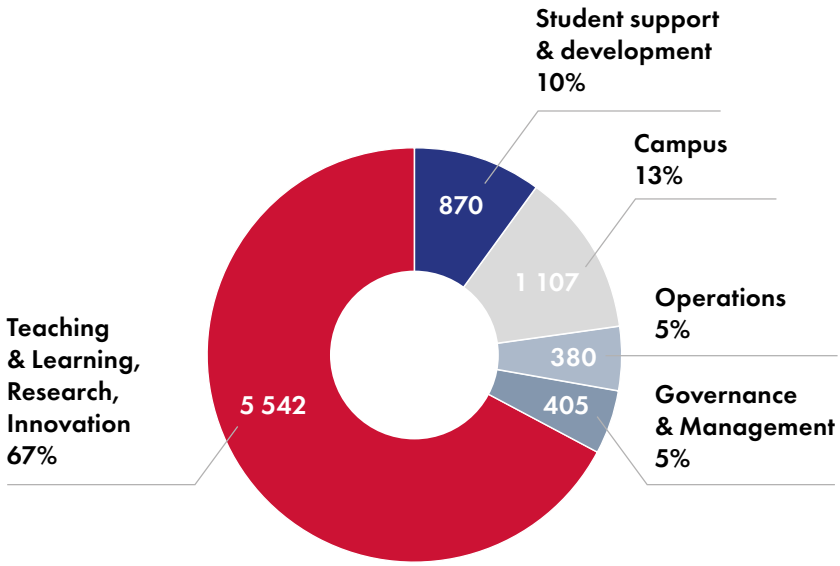
(in millions of rubles)	2020	2021	Change %
Attracted Funding incl. other revenue	**1 887**	**2 466**	**31%**
Attracted Funding	**1 840**	**2 345**	**27%**
Sponsored research contracts & professional training	1 276	1 603	26%
Grants	544	709	30%
Shared Facilities	20	34	70%
Other revenue	**48**	**121**	**154%**

Funding

As of fiscal year end 2021, Skoltech total funding from various sources was 10 224 mln Rub, a 1 239 mln increase, or 14 percent from fiscal 2020. The increase was primarily driven by the attracted funding, a 506 mln Rub increase, or 27 percent, along with a carry forward balance of 2020 unused cash of Skolkovo Foundation Grant (585 mln Rub). The increase was partially offset by a decrease of distributed income from Endowment, total distributed 396 mln Rub incl. unused cash of 2020 (79.8 mln), a 14 percent decrease from fiscal 2020, total 460 mln Rub, including unused cash of 2019 (52 mln Rub).
The 2021 structure of funding did not change significantly in comparison with the previous year. The Skolkovo Foundation Grant (total 7 361 mln Rub) remains the largest component of total funding resulting to 72 percent. Despite general implications of the pandemic, attracted funding continued to demonstrate a substantial growth, 27 percent comparing to fiscal 2020. In 2021 income from research grants and industrial contracts remain the core category of attracted funding. In the upcoming year Skoltech is going to move to the new business model. This will result in a change of Attracted funding portfolio: a slowdown of extensive growth in research contracts and grants, versus increase of share of income from commercialization of IP results and technology transfer.

Expenses

In fiscal year 2021, the expenditures totaled 8 304 mln Rub, including capital investment projects, a 45 mln Rub increase, or 0.6 percent from fiscal 2020. A slight increase of total expenses in fiscal 2021 resulted from a combination of a few factors. Operating expenses rose 322 mln Rub due to an increase of number of attracted research contracts and partial return to a normal mode of operations on Campus. The increase was offset with a 277 mln Rub decrease in Capital expenses due to the slowdown of capital construction works in fiscal 2021. As of fiscal year end 2021 Operating expenses totaled 7 499 mln Rub, Capital expenses totaled 806 Mln Rub. Structure of expenses did not change significantly comparing to fiscal 2020. Expenditure comprises the following primary activities: Teaching & Learning, Research, Innovation, Student support and development, Operations, Campus, Governance and Management.



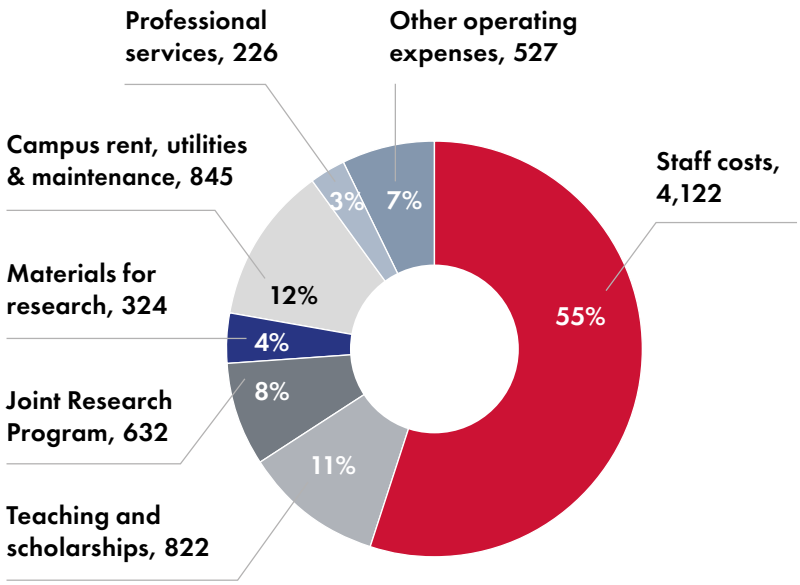
Operating Expenses

In fiscal 2021 staff expenses increased 105 mln Rub, or 3 percent comparing to 2020. The increase is naturally driven by salaries of additional staff recruited to support research contract activities and new Faculty members. These expenses include salaries, compulsory social security contributions, bonuses, medical insurance, reimbursement of accommodation and benefits in kind provided to employees. Remaining the largest category for Skoltech, staff costs represent 55 percent from total operating expenses.
Teaching and scholarship support increased 79.5 mln Rub, or 11 percent comparing to fiscal 2020 mainly due to a scholarship increase 12 percent. The increase is naturally explained by the shift in the payment schedule to the students in 2021 and due to partial release of COVID-19 restrictions in Russia, which allowed international students to return to semi-offline educational process. The cohort did not change significantly and reached 1063 students as of the year end 2021.
As in previous years, in 2021 funding of Joint research programs with world's leading universities remained in priority agenda for Skoltech. During fiscal 2021 expenses related to research initiatives increased 62 mln Rub, or 11 percent and totaled 632 mln Rub. The core expenses related to the payment of 499 mln Rub under the long-term research program with MIT, 12.5 mln Rub for NGP projects, and 61 mln Rub for Agro technology initiatives.

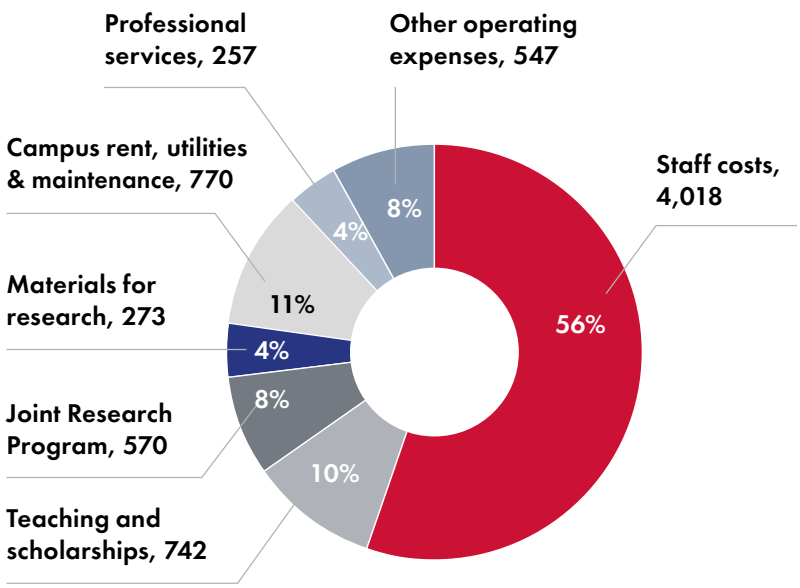
Campus rent, utilities and maintenance expenses totaled 845 mln Rub representing 12 percent from total

operating expenses and include costs for repair, maintenance of engineering systems, utilities, cleaning and security services. A 10% increase is driven by Campus utilities expenses, which were paid by Skolkovo Foundation in Jan-May 2021. Other operating costs included materials for research, business trips and events, software and IT equipment maintenance, operating rent of equipment, PR and marketing, library, taxes and charges. Expenses of this combined group totaled 1 077 mln Rub and remained at the same level as in fiscal 2020, a slight 0.1 percent change was primarily due to the same external and internal conditions, far from normal operational Campus mode: less need for travel, office supplies, services for offline conferences offset by COVID-related expenses such as cost of work safety. Apparently business trips expenses increased by 60% and materials for research by 19% comparing to 2020 due to partial release of pandemic restrictions in Russia in 2021, which was balanced by a decrease in professional services expenses.

2021

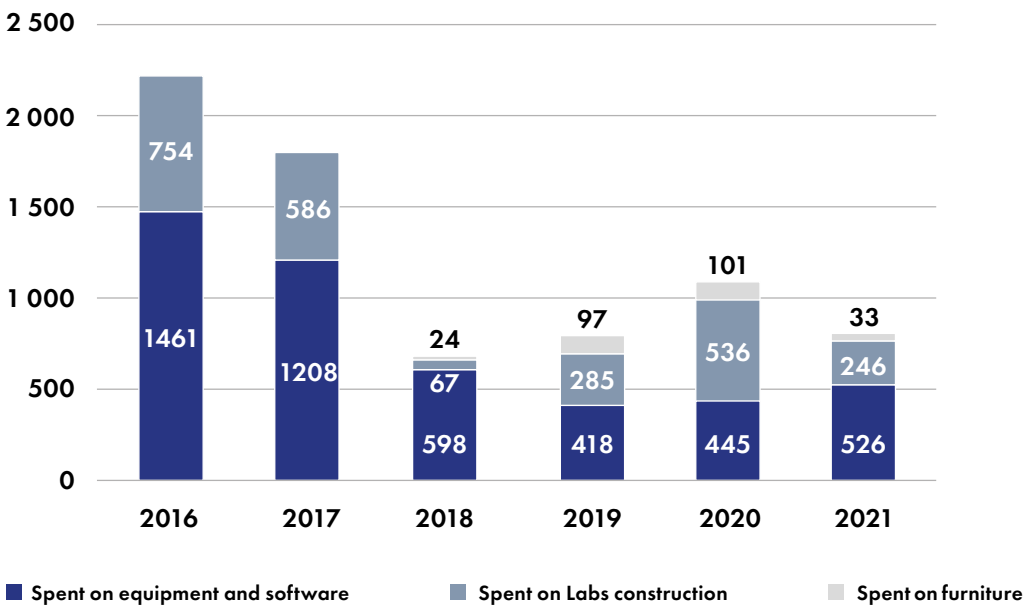

Professional services, 226
Other operating expenses, 527
Campus rent, utilities & maintenance, 845
Staff costs, 4,122
Materials for research, 324
Joint Research Program, 632
Teaching and scholarships, 822
3%
7%
12%
55%
4%
8%
11%

2020


Professional services, 257
Other operating expenses, 547
Campus rent, utilities & maintenance, 770
Staff costs, 4,018
Materials for research, 273
Joint Research Program, 570
Teaching and scholarships, 742
4%
8%
11%
56%
4%
8%
10%

Capital Expenses

Skoltech is committed to a long-term expenditure plan, implying construction of the campus. In fiscal 2021 the capital expenses totaled 806 mln Rub, including expenses on research equipment and SW totaled 526 mln Rub, 246 mln Rub on construction of Laboratories and 33 mln on furniture. In Q1 2021 the laboratory construction schedule was revised, considering the change in financing schedule from the Skolkovo Foundation, which resulted to a delay in construction works, a 54 percent decrease in Labs construction expenses comparing to 2020 and increase in operating cost.



Endowment

The Endowment Fund has a long-term investment strategy developed to enhance the Institute's financial independence and support the Strategy. The primary goal of the Endowment Fund investment policy is to ensure reliability, liquidity, yield and diversification of investments. Endowment funds are managed by professional asset management companies, including Management Company Alfa Capital and

Management Company VTB Capital Asset Management, and can be invested into the state bonds of the Russian Federation, Russian corporate bonds and in Russian Rubles in state-owned banks.
As a part of the investment strategy in 2021 Skoltech carried out an analysis of the local market of key players, in which management large endowment are located. Proposals for investment strategy were requested and received from strong Asset Management Companies, the proposed strategies of which recommended to diversify the portfolio with more risky assets and an increase in the share of investments in liquid shares of Russian companies. The attractive factors towards the new strategy are low assessment of Russian market, high dividend yield with no withdrawals from the body of the fund.
The Endowment Fund as at 31 December 2021 amounts to 4 635 mln Rub (vs 31 December 2020 amounts to 4 787 mln Rub). The following assets comprise the portfolio of the Endowment Fund as of December 31, 2021:

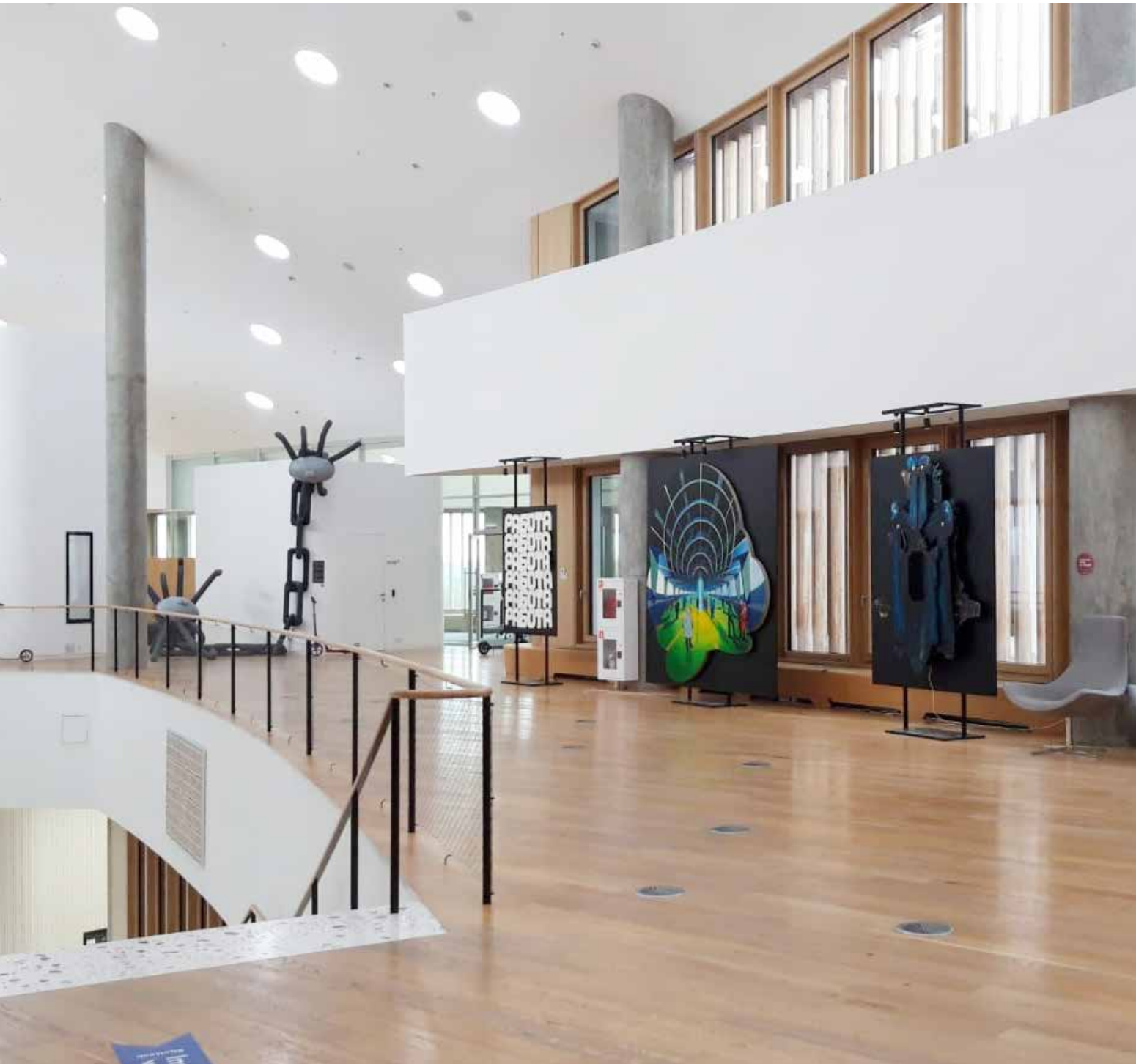
Net assets	TOTAL	
	Mln RUB	%
Russian government bonds	559	12%
Corporate bonds	4 072	88%
Cash and Cash Equivalents	2	0%
Other receivables/payables	2	0%
TOTAL	**4 635**	**100%**

Analysis of the structure of the Endowment Fund portfolio (including bonds, cash in bank) as of 31 December 2021 shows that Corporate bonds share represents 88 percent of the total portfolio comparing to 79 percent as of 31 December 2020.
Financial result from the management companies' investment activity in fiscal 2021 is 163 mln Rub comparing to 322 mln Rub in fiscal 2020. An annual return declined 3.4 percent comparing to fiscal 2020 due to the general negative situation on the market. The Year 2021 was very challenging for the Russian bond markets. Among unfavorable factors were tightening of western sanctions, acceleration in inflationary pressure up to 8.4 percent by the end of year, conservative monetary policy of the Central Bank of Russia, interest rates hike from 4.25 percent in March 21 to 8.5 percent in December 21. All these negative factors created conditions for a significant short-term volatility for the Ruble bonds and resulted the OFZ index declined 4.9 percent during the year 2021. In these conditions the Endowment Management companies focused on a conservative investment portfolio with a duration of under 1 year to mitigate credit and interest rate risks, which helped to produce a return of 3.59 percent.

	2021	2020	Change
Annual return, mln rub	163	322	-159
Annual return, %	3,59%	6,98%	-3,39%

Campus

Skoltech campus is internationally recognised for its exceptional environment and high-quality facilities for staff and students. In 2021 Skoltech continued to invest in design and arrangement of spaces, making the environment inspiring and vivid. In addition to design and construction activities, several creative projects were completed.



Library

The Library was designed around the principle of noise level gradation and designing specialized zones. Getting into the library, students go from a “noisy” entrance group, allowing to have discussions of conduct group projects, towards a “quiet” space equipped with mobile modules for individual work. Bookcrossing zones are available while valuable literature is concentrated indoors. The furniture supports the concept providing both acoustic solutions and providing opportunities of team work. The multimedia system allows to hold conferences, thematic lectures and supports students’ independent work. In the library space, a graphic project is being implemented, carried out with involvement of ESH team. Graphics provide a navigational function, which in a game format showcase publications through QR codes on the stained glass windows.

Exhibition of the Russian Museum

The campus space at the main staircase was used to present the exhibition of modern art, collected by the curator Marina Vinogradova. The collection of art was placed on the specially designed exposition equipment, which allows to place exhibits provided to Skoltech. The concept of the equipment supports the aesthetics inherent in Skoltech campus, focuses on art, dissolving into space with subtle structures. The following artists are represented at the exhibition: Alexander Dashevsky, Alexander Shishkin-Hokusai, Asya Marakulina, Egor Kraft, Ekaterina Sokolovskaya, Ivan Plyushch, Konstantin Benkovich, Liza Bobkova, Petr Dyakov, Semyon Motolyanets, Tanya Akhmetgalieva.

Exhibits of Skoltech community

The campus spaces were also used to showcase some art work produced by Skoltech community. The examples are graphic design of the campus, made by Ivan Bogdanov, deputy head of professional training programs direction, as well as art work of kids dedicated to the Holiday season.

In order to use the spaces more effectively, Skoltech leases spaces to external clients to hold events. In 2021, around 50 events were hosted, among the clients are VEB. RF, Ward Howell, MSM, Accounting Chamber of the RF, Sberbank, Otkrytie Bank, Alfa-Bank, Tochka Bank, MTS, Beeline, Yandex, KIA, Adidas, Aeroflot, Ferrero, J7, Harper's Bazaar, InStyle.

Science installations

The installation "Table of electronegativity of the chemical elements", showcases the scientific discovery of Professors A. Oganov and K. Tantardini in a visualization of the periodic table in the form of a system of chemical elements. The elements that are not hazardous are presented in flasks integrated
into the cell system. Elements that cannot be exhibited in open space are illustrated with flags representing the country that opened the element. Screens with the presentation of a scientific discovery are built into the structure.


outh
RIGF
RUSSIAN
INTERNET
GOVERNANCE
FORUM


Professor


Алмаз. Абразив и резка металлов


THE PROFESSOR IS ALWAYS RIGHT
SKOLTECH

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