UNIVERSITY OF
LATVIA

FACULTY OF
SCIENCE AND
TECHNOLOGY

Dean's Foreword

It is a pleasure to welcome you to the Faculty of Science and Technology (FST). We bring together the strengths of several faculties and research institutes to form one open and forward-looking community. Our shared goal is simple: to turn knowledge into solutions that make a difference.

At FST, research and learning go hand in hand. We encourage curiosity, collaboration, and creativity - within an inclusive culture that values diversity, respect, and balance. Our international outlook and interdisciplinary approach connect science, technology, and society in meaningful ways.

We invite you to explore, study, and collaborate with us - to be part of a faculty where ideas grow into impact and where people shape the future together.

Dr. phys. Aigars Ekers

Dean, Faculty of Science and Technology

Who We Are and Our Vision

The Faculty of Science and Technology at the University of Latvia (UL) was established in 2024 through the merger of three faculties and nine research institutes and centres. FST's research spans physics, mathematics, computer science, materials science and engineering, geography, geology, environmental science, optometry, vision science, and STEM education.

FST's vision is to become an internationally recognized hub of scientific excellence, innovation, and societal impact. To achieve this, the faculty focuses on five strategic priorities:

- Advancing research excellence
- Diversifying funding sources
- Supporting innovation and knowledge exchange
- Empowering talent development
- Strengthening global research networks

2054 *Number of students, 2024*

320 *Academic research personnel, FTE, 2024*

17,8M *Research funding, 2024*

221 *Publications in the top 10% most cited worldwide, 2019–2024*

1488 *Q1/Q2 publications in SCOPUS-indexed journals, 2021–2024*

55% *Proportion of publications available in Open Access, 2019–2024*

55% *Proportion of co-publications with foreign partners, SCOPUS, 2021–2024*

EDUCATION

The primary mission of FST is to educate competent professionals in STEM disciplines that are vital for developing a technology-driven economy. Physicists, mathematicians, and computer scientists are in high demand across Latvia's high-tech sectors, while experts in earth and environmental sciences play a vital role in large-scale infrastructure planning and regional policy development.

FST offers Bachelor's, Master's, and Doctoral programs to approximately 2,000 students (2024). In total, it provides 23 academic and professional programs across 7 fields of study. The faculty enrolls 13% of all UL students and 25% of all doctoral candidates. Most programs are interdisciplinary and unique in Latvia—particularly in geography, geology, spatial development planning, mathematics, and data science. Between 2019 and 2024, FST awarded 83 Doctoral, 651 Master's, and 1,249 Bachelor's degrees.

DEPARTMENTS

	Total Students	*International students*
Department of Optometry and Vision Science	*194*	*22*
Department of Computer Science	*1068*	*149*
Department of Physics	*199*	*21*
Department of Geography	*184*	
Department of Geology	*74*	
Department of Mathematics	*221*	
Department of Environmental Science	*170*	

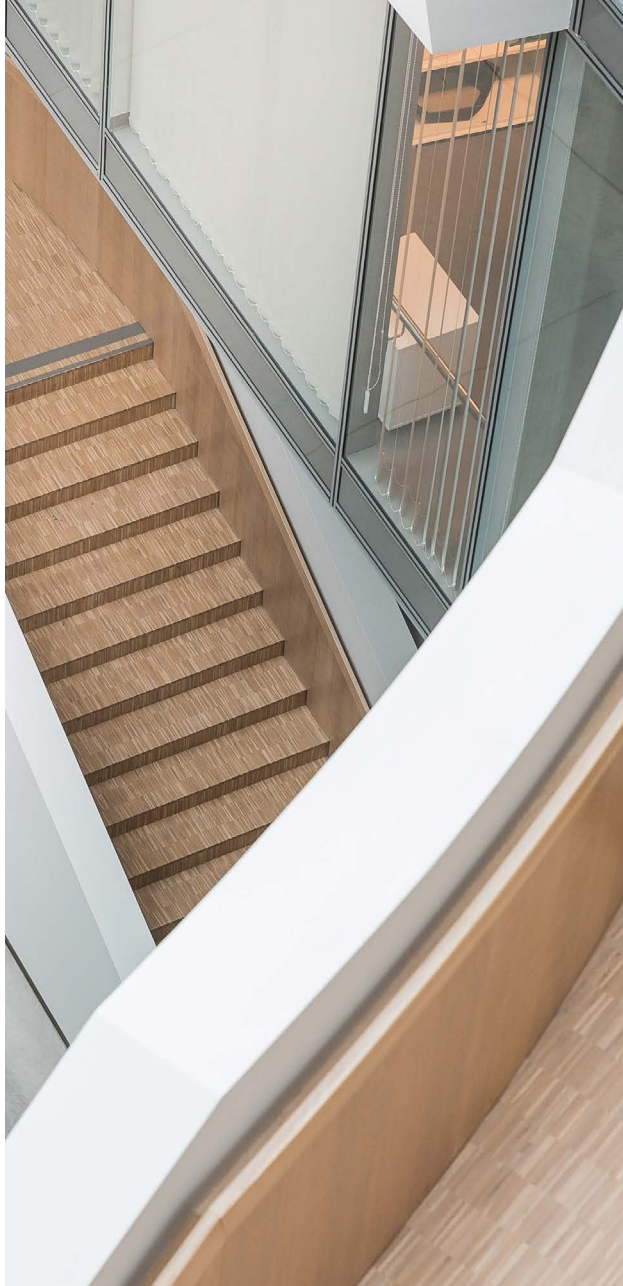
CONTRIBUTION TO SOCIETY

FST actively strengthens Latvia's scientific and technological landscape through collaboration, innovation, and public engagement.

Joint degree programs—such as the Master's in Physics and the Doctorate in Particle Physics and Accelerator Technologies, developed with universities in Latvia and abroad—connect FST to the international research community. The Bachelor's and Master's programs in Computer Science have repeatedly earned the Euro-Inf Quality Label, and for over five years, the Bachelor's program has been ranked by employers as the best in Latvia.

FST also nurtures future talent through five STEM programs for children and youth, and promotes science literacy through more than 700 annual outreach activities, including public lectures, media appearances, and events at the Baldone Observatory, which attracts around 2,000 visitors each year.

Through these efforts, FST not only educates professionals but also inspires and empowers society.



RESEARCH

Science is central to FST's mission: its institutes conduct research recognized in Latvia and internationally. Between 2019 and 2024, more than 600 projects were launched with a combined value exceeding EUR 200 Mllion. Interdisciplinary work is encouraged across biophotonics, biomaterials, environmental modelling, and related fields. Intersectoral collaboration is a growing strategic priority, reflected in industry partnerships, innovation activities, and projects aimed at commercialization.

Major research areas:

- Computer and Information Sciences: Quantum computing, spatial cognition, and visual perception
- Physical Sciences: Quantum physics, biophotonics, biomaterials, vision science, magnetohydrodynamics, and soft matter
- Materials Science and Engineering: Nanoscience, radiation chemistry, and mechanical engineering
- Mathematics: Modelling, computational dynamics, and data science
- Earth and Environmental Sciences: Geology, geography, and environmental sustainability
- Educational Sciences: STEM education research and methodology

SIGNIFICANT AND REPRESENTATIVE PROJECTS

INTERNATIONAL PROJECTS: FST IS COORDINATOR

- QuantERA ERA-NET Cofund: *Hybrid Quantum Classical Computation (HQCC)*
- QuantERA ERA-NET Cofund: *Electronic Quantum Resources (ElQuRes)*
- Horizon Europe (MSCA-SE): *Electro-conductive polymeric 3D scaffolds as novel strategies for biomedical applications (ESCULAPE)*
- Horizon Europe (MSCA-PF): *Laser for Magnesium: the influence of laser wavelength, and feedstock quality on the optical properties of Mg alloy for industrial needs*

INTERNATIONAL PROJECTS, FST IS A PARTNER

- Horizon 2020 (FET-OPEN): *The Recycling of waste heat through the application of Nanofluidic ChannelS: Advances in the conversion of thermal to electrical energy*
- Horizon 2020 (MSCA-ITN): *Spatial Thinking in STEM Learning: Increasing enrolment and gender balance in STEM learning by addressing deficits in spatial ability among children in Europe*
- Horizon Europe (RIA): *Towards sustainable land-use strategies in the context of Climate change and biodiversity challenges in Europe*

INDUSTRY CONTRACT AGREEMENT PROJECTS

- Contractor: Siltronic AG (Germany) - *Consecutive projects, e.g. Modelling and development of modelling tools for floating zone process*
- Contractor: International Fusion Energy Organization ITER (France) - *Tritium Behaviour in Thermal insulation materials and assemblies for TBSs (Test Blanket Systems)*
- Contractor: Commissariat a L`energie atomique et aux energies alternatives CEA (France) - *Advanced Sodium Technological Reactor for Industrial Demonstration (ASTRID)*
- Contractor: Accenture Oy Latvia branch, Ltd. (Latvia) - *Quantum computing case study*

Partners

Industry partners

Academic partners

Innovations

FST

drives innovation across physical, material, information, and environmental sciences, contributing to advances in various disciplines such as healthcare, transport, communications, cybersecurity, and others. Collaborations with industry have fostered progress in IT, biotechnology, nanotechnology, and data-driven decision-making. Through its research, education, and outreach, FST addresses global challenges- from AI and quantum computing to space exploration and climate change - while shaping national policy, including Latvia's Sustainable Development Strategy 2030.

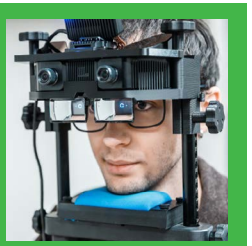
Members of Biophotonics group of IAPS, founded and now run startups Bdetect, Ltd and Vetamplify Ltd which work on developing new skin cancer diagnostic tools and photonics veterinary applications

VETAMPLIFY

Bdetect

Construction and certification of the firs Energy Plus private building in the Baltic countries

Collaboration with Lightspace Technologies Ltd. enabled the development of a comprehensive method for evaluating the impact of their novel volumetric 3D display on users



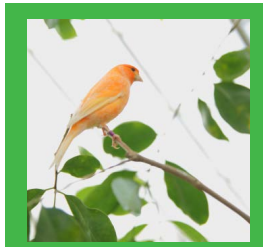
Fabrication, testing and modelling of microsphere resonators

Device for dosing, transporting and mixing liquid metals and alloys in metallurgical plants

N-type thermoelectric composite material and its production

Silica microstrip resonator based multi-wavelength light source for data transmission in fibre optic telecommunication systems

Linear motion system for a Crystal growing machine



Partnership with ornithologists and peat scientists resulted in the development of instruments for heavy metals and nanoplastics contamination

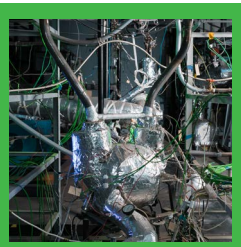
Apparatus for contactless flow excitation in electrically conductive liquids

Nanowire Extraction technique

Device for obtaining speckle-free images under scattered laser illumination

Use of a Digital Zenith Camera VESTA for mineral exploration, opening new avenues for geophysical surveying

Prototype of a Magnetohydrodynamic Generator Driven by a Thermoacoustic Engine with potential applications in deep-space missions, offering a novel energy generation solution under extreme conditions



THE DEPARTMENT OF COMPUTER SCIENCE

1068 STUDENTS

149 *INTERNATIONAL*

EDUCATION

- **8** *PROGRAMMES*
- **80** *SHORT CYCLE*
- **860** *BACHELOR'S*
- **102** *MASTER'S*
- **26** *DOCTORAL*

Find out more

The Department of Computer Science (DCS) is a diverse academic community which works on research ranging from the theoretical foundations of computation and quantum algorithms to applied innovations in human-centered computing, artificial intelligence, and software engineering.

RESEARCH AREAS

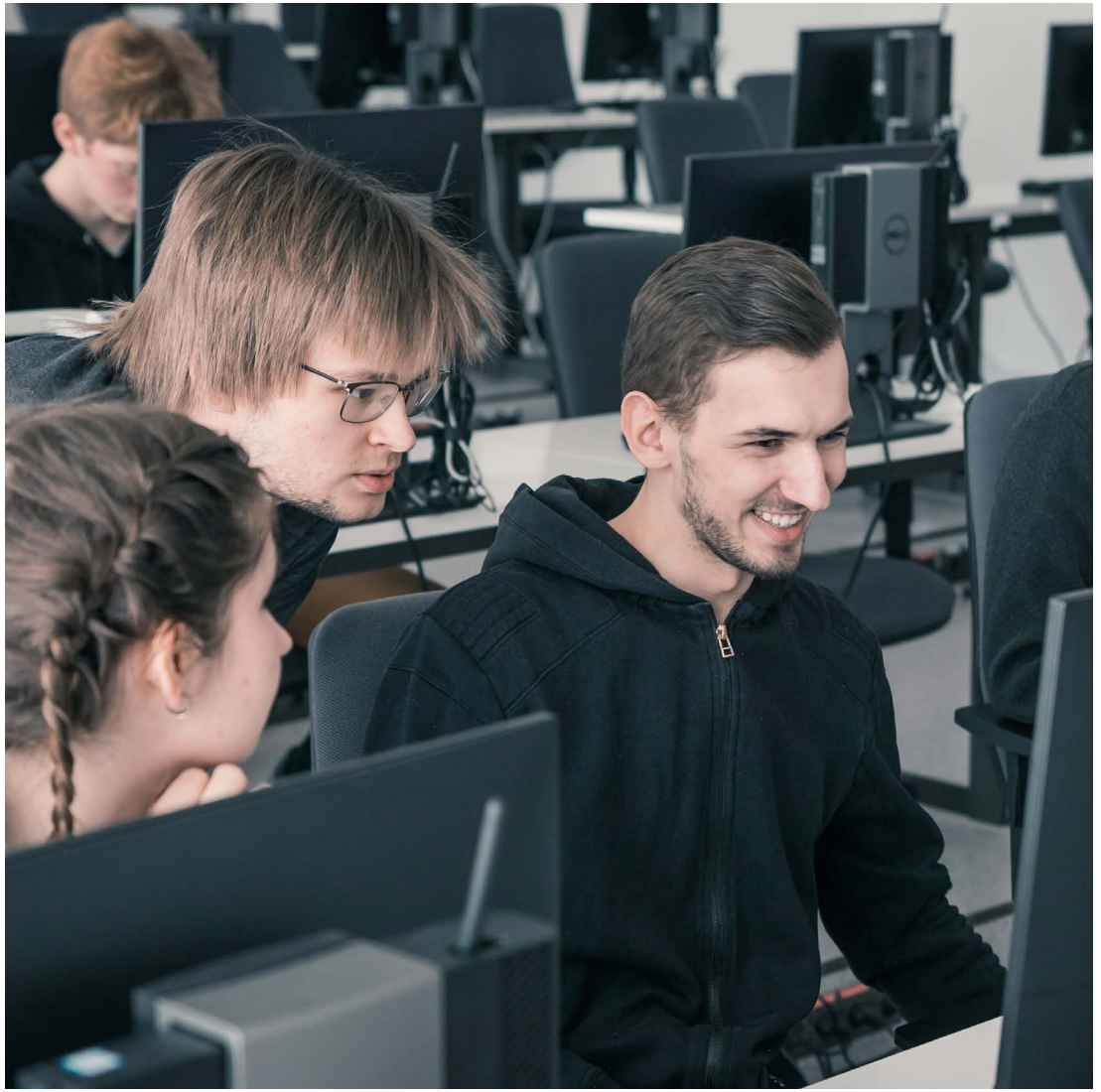
Research in DCS spans both foundational theory and applied technologies.

Core areas include theory and models of computation, with emphasis on quantum computation and the mathematics of computing.

Ongoing studies explore human-centered computing, perceptual and cognitive systems, and natural language processing within advanced computing methodologies.

Applied research focuses on computers in education, enterprise operations, life, and medicine, complemented by expertise in software engineering, including verification, validation, and system management.

Additional work addresses information systems, data management, and computer systems organization, integrating both software and hardware perspectives.



MAIN RESULTS

Main achievements include establishing the Center for Quantum Computing Science and delivering a general quantum-walk framework with quadratic speedup for search, developed with international partners and validated through a public–private case study.

The department also coordinates two European QuantERA consortia—Hybrid Quantum–Classical Computation (HQCC) and Quantum Algorithms for Optimization (QOPT) — strengthening collaboration on next-generation algorithms and applications. In human-centered computing, a Nature Human Behaviour study revealed universal action constraints in spatial communication across languages, advancing the science of spatial cognition and perception.

INNOVATIONS AND IMPACT

DCS advances research in quantum computing, artificial intelligence, and cognitive systems. Led by Professor Andris Ambainis - a world leader in quantum information, the department developed a quantum algorithm achieving quadratic speedup in collaboration with Accenture Latvia, published in STOC 2020 and Nature Communications.

Collaborations

Department of Mathematics

221 STUDENTS

EDUCATION

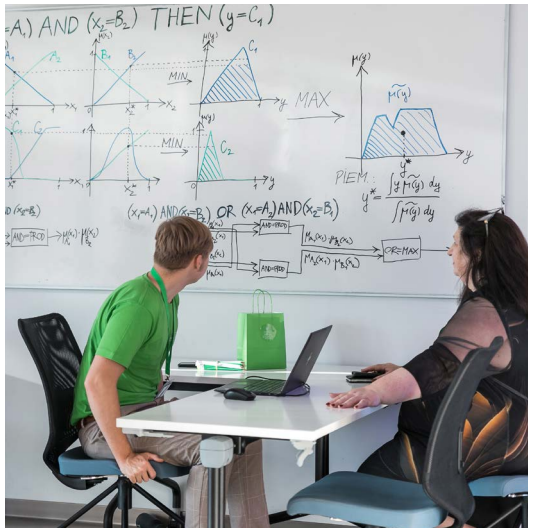
- **4** PROGRAMMES
- **167** BACHELOR'S
- **44** MASTER'S
- **10** DOCTORAL

Find out more

The Department of Mathematics (DM) offers studies that develop analytical thinking and problem-solving skills through both theoretical and applied mathematics. Research spans data-driven and fuzzy modeling, numerical simulations, discrete mathematics, analysis of differential and integral equations, mathematical statistics, and data science, using advanced mathematical methods to address challenges in science, engineering, and economics.

RESEARCH AREAS

Research in DM focuses on the development and application of advanced mathematical methods and approaches to tackle complex real-world challenges. Core areas include theoretical investigations of mathematical frameworks based on fuzzy mathematics and uncertainty modeling, data-driven modeling and analysis of complex systems, mathematical modeling applications, and structure-preserving algorithms in numerical methods and machine learning. Additional expertise includes non-parametric and robust statistical methods, data analysis, and the study of dynamical systems and boundary value problems.challenges in science, engineering, and economics.



MAIN RESULTS

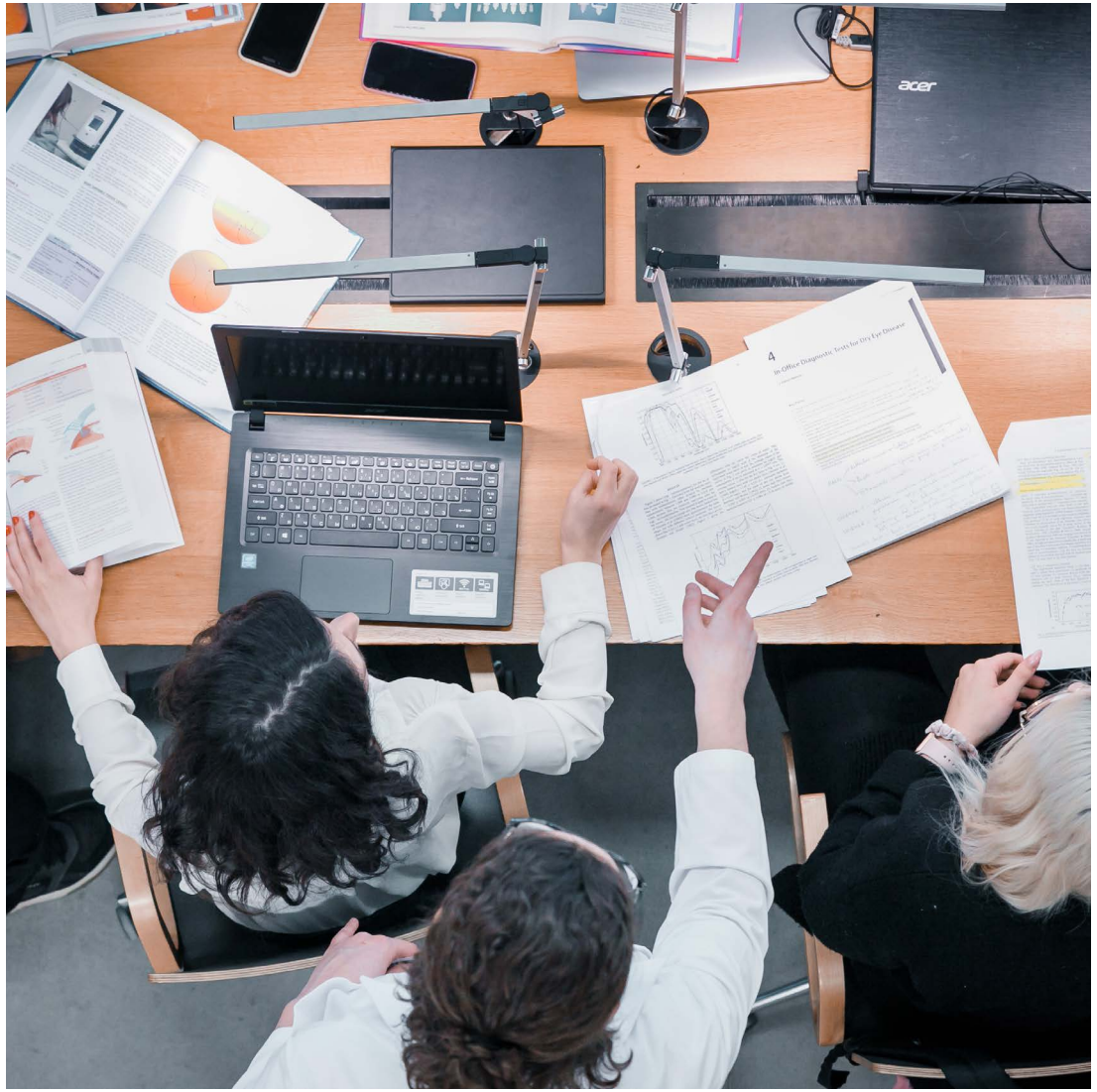
Main achievements include the gradation of fuzzy preconcept lattices and the description of (L,M)-fuzzy k-pseudo metric spaces; statistical analyses revealing a negative association between DNA damage in leukocytes and serum nitrite concentration in type 1 diabetes; characterization of the optimality and sustainability of hybrid limit cycles in pollution control problems with regime shifts; and the development of locally symplectic neural networks for learning volume-preserving dynamics. Other significant contributions include establishing methods for analyzing problems with nonlocal boundary conditions using Green's functions and fixed-point techniques, as well as investigating a family of Volterra cubic stochastic operators and identifying the parameter ranges that determine whether these systems remain regular or become non-ergodic.

INNOVATIONS AND IMPACT

Key achievements include extensive applied research collaborations with national institutions such as the Treasury of the Republic of Latvia, the Central Statistical Bureau, and the National Centre for Education, as well as joint projects with the BA School of Business and Finance and the Department of Clinical and Personalized Medicine of the University of Latvia, supporting evidence-based decision-making across finance, education, and healthcare sectors.

Collaborations

Georgetown University · Cinvestav · LSA Latvijas Statistikų asociācija · IRAFM · UIB · Universidad de Sevilla · Tartu Ülikool · Vilniaus Universitetas



Department of Physics

199 STUDENTS
21 INTERNATIONAL

EDUCATION

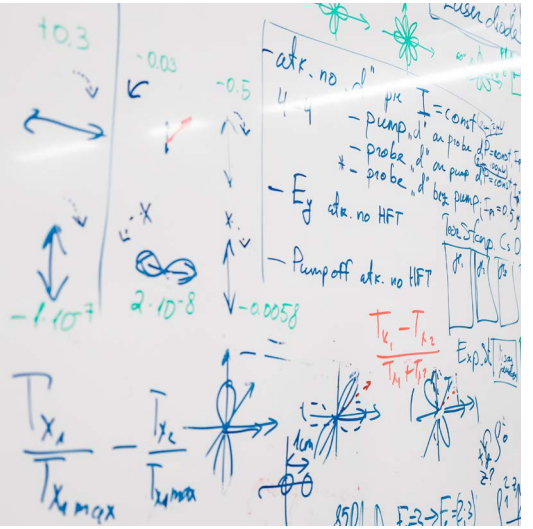
5 *PROGRAMMES*
113 *BACHELOR'S*
29 *MASTER'S*
57 *DOCTORAL*

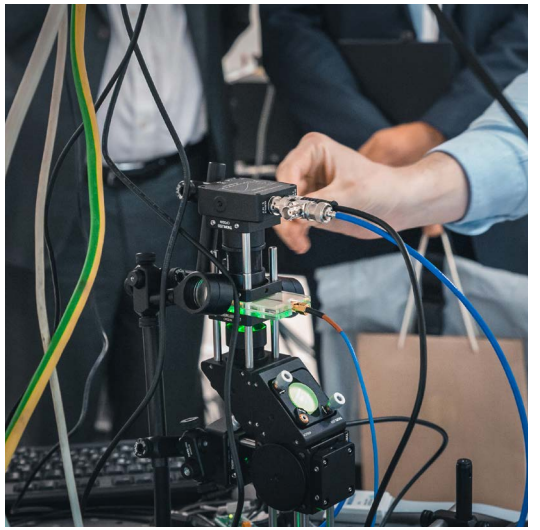
Find out more

The Department of Physics (DP) offers study programmes and hosts research covering diverse topics: magnetic soft matter, quantum electronics, physics of polymers and composite materials, computational materials science and physics education research.

RESEARCH AREAS

Six research groups at the DP work in the following areas: active media and microscopic objects such as elastic strings, gels, magnetic bacteria, and colloids; developing fundamental models for key elements of single-electron quantum technologies; high-precision computational techniques for first-principles materials studies; how environment influences polymers and composites targeting, for example, anti-icing applications; implementing research to improve physics education at school and university. for example, anti-icing applications; implementing research to improve physics education at school and university.





MAIN RESULTS

Main achievements include a contribution to fundamental electrical metrology by creating a quantum tomography protocol for ultra-short "on-demand" single-electron wave packets, a microscopic model for controlled two-electron collisions, and a statistical benchmarking methodology for single-electron circuits. Also, DP researchers discovered the first magnetotactic bacteria in Latvia. These organisms have unique properties useful for nanotechnology and medical applications, for example, biocompatible targeted drug delivery and cancer treatment. Finally, the DP coordinates large research projects such the Latvian Quantum Initiative and ERA Chair BioMagnetLink.

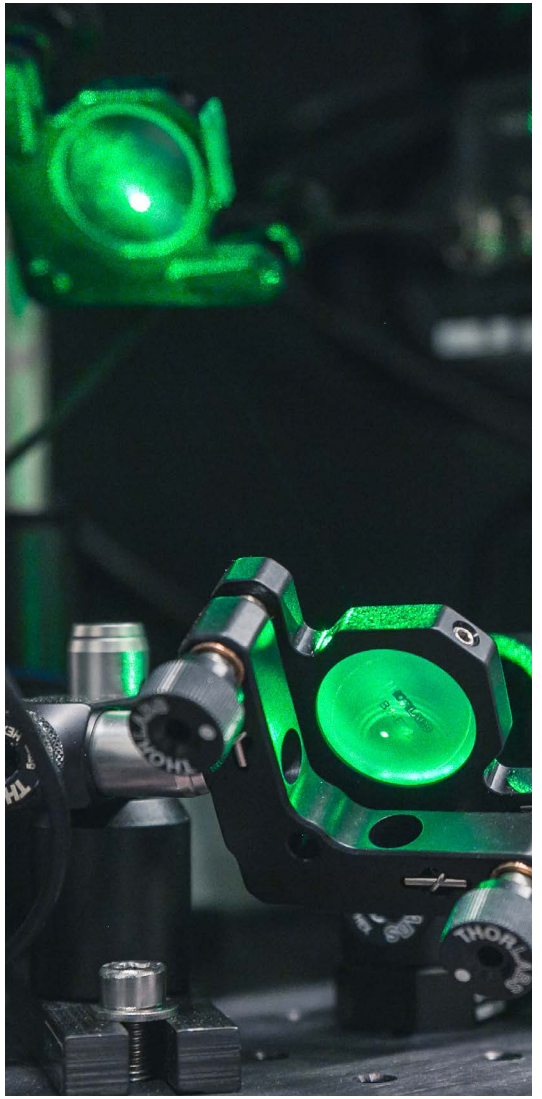
INNOVATIONS AND IMPACT

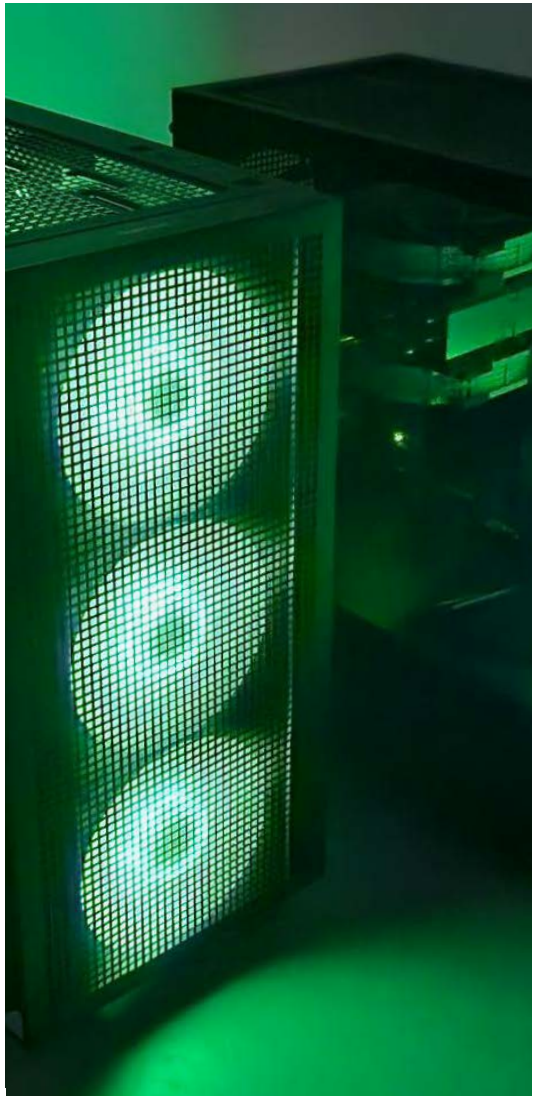
Professor Andrejs Cēbers has received the L'Ordre des Palmes Académiques award from the Republic of France in recognition of his achievements in theoretical physics and his contributions to developing and strengthening scientific collaboration between France and Latvia.

The Nanoelectronics Theory Group has achieved outstanding results, including the development of the world's first single-electron field-effect transistor and the creation of important theoretical models for two-electron collisions.

Collaborations

TAL TECH · NPL · LFSA · NATIONAL EDUCATION CENTER · DANTEC DYNAMICS · Leibniz Universität Hannover · PTB · HUMBOLDT-UNIVERSITÄT ZU BERLIN · UNIVERSITÉ DE STRASBOURG · SORBONNE UNIVERSITÉ





Department of Optometry and Vision Science

EDUCATION

194 STUDENTS
22 *INTERNATIONAL*

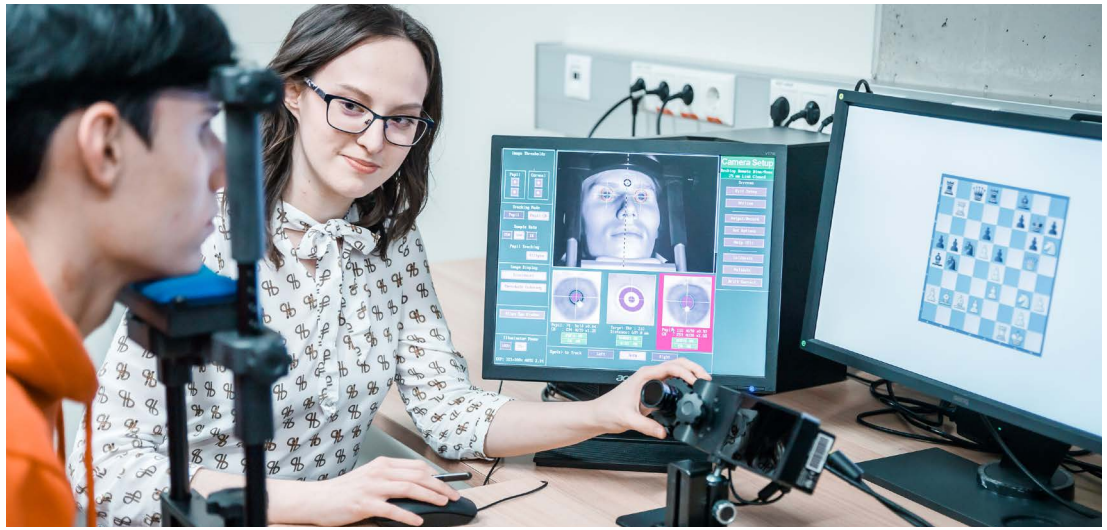
6 *PROGRAMMES*
94 *BACHELOR'S*
43 *MASTER'S*
57 *DOCTORAL*

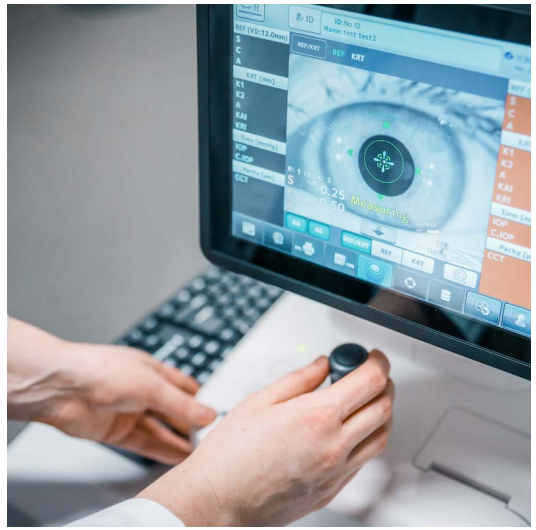
Find out more

The Department of Optometry and Vision Science (DOVS) is a leading provider of optometry education in the Baltic region. It offers study programs in both Latvian and English, delivering high-quality education aligned with the professional standards for optometrists defined across Europe. By bridging fundamental science with applied research, the Department of Optometry and Vision Science delivers evidence-based, user-centric solutions to positively impact visual health, support innovative technology development, and improve quality of life.

RESEARCH AREAS

DOVS focuses its research on three main areas: human factors and visual ergonomics, eye tracking, and clinical optometry and public health. Key areas include 3D display technology and visual system functionality, where innovative visualization systems have been developed in Latvia, visual ergonomics, studying ocular accommodation in response to different visual stimuli, and clinical optometry, in which DOVS serves as the leading national center for vision research. Additional research explores eye tracking, through interdisciplinary studies assessing the effectiveness of military camouflage and patterns of digital news consumption, as well as colour vision and perception, involving the development of innovative, digitized tools for colour vision assessment.





MAIN RESULTS

At the Department of Optometry and Vision Science, in close collaboration with the industry partner Lightspace Technologies, a tailored method was developed to assess – for the first time – the functionality of the human visual system in relation to a cutting-edge technology: a volumetric 3D display created in Latvia. This work was recognized with the Latvian Academy of Sciences Award Achievement of the Year in Applied Science (2019).

Developed and trained vision care professionals in evidence-based guidelines for upgrading eye care, based on performed large-scale vision screenings (11,000+ individuals) and detailed assessments of visual functions in school-age children, both with and without reading difficulties.

INNOVATIONS AND IMPACT

The Department of Optometry and Vision Science has developed automated technologies for visual function assessment, resulting in three patents granted by the Republic of Latvia. Through a long-term partnership with Lightspace Technologies Ltd., the department has led national and international research projects with total funding exceeding €1.5 million (University of Latvia's share). Its research contributes to the development of evidence-based, user-centered augmented reality (AR) solutions, improving visual comfort and functionality in next-generation AR technologies.

Collaborations

SiVIEW Smart innovations for View · MultiplEYE · eit Health · Children's University Hospital Latvia · VISION

Department of Geography

184 STUDENTS

EDUCATION

7 PROGRAMMES

116 BACHELOR'S

52 MASTER'S

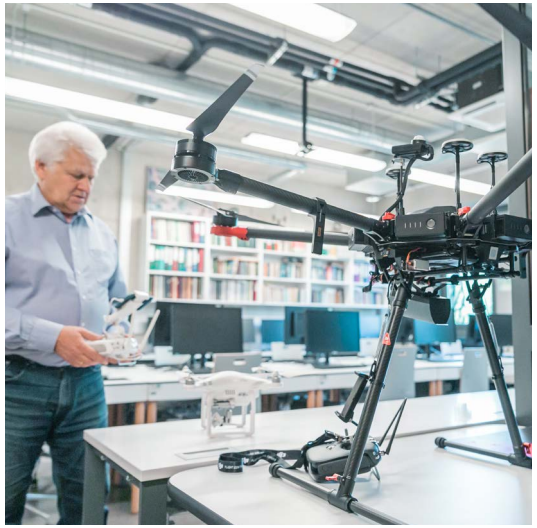
16 DOCTORAL

Find out more

The Department of Geography (DGr) offers studies that connect physical, environmental, and human geography, preparing students to address global and regional challenges. Research explores climate dynamics, environmental change, and spatial development, advancing understanding of natural systems, human activity, and sustainable land use.

RESEARCH AREAS

Research in DGr integrates Earth science, physical geography, environmental sciences, and social and economic geography to understand natural and human-driven processes shaping the planet. Key research centers include the Center for Climate Dynamics and Bioclimatology, focusing on climate variability and environmental change; the Center for Socio-Ecological Systems Research, examining interactions between society and ecosystems; and the Center for Geographic Mobility and Spatial Development Planning, addressing migration, settlement, and regional development. Additional work in Quaternary paleogeography reconstructs past landscapes and climate conditions to inform future environmental strategies.



MAIN RESULTS

Main achievements include active participation in national and international research projects, advancing both fundamental and applied environmental studies. A key milestone was the development of a new soil classification system for Latvia, harmonized with the International Soil Classification (WRB) to ensure global comparability and research integration. The team has also produced influential scholarly works, including the monographs Radioactivity and Soil Diagnostics and Classification, which together establish new standards for soil research and environmental diagnostics in Latvia.

INNOVATIONS AND IMPACT

The department co-developed a European automatic pollen monitoring network and a mobile app for personalized allergy forecasting, both now integrated into continental air quality services. Participation in major Horizon Europe projects has advanced AI-augmented Earth observation and sustainable soil management, while research in social geography has informed European policy discussions on migration, human capital, and regional development.

Collaborations

RĪGA

IGU UGI

LATVIJAS VALSTS MEŽI
KOKSNE · STĀDI · ATPŪTA

Central Statistical Bureau
Republic of Latvia

Department of Environmental Science

170 STUDENTS

EDUCATION

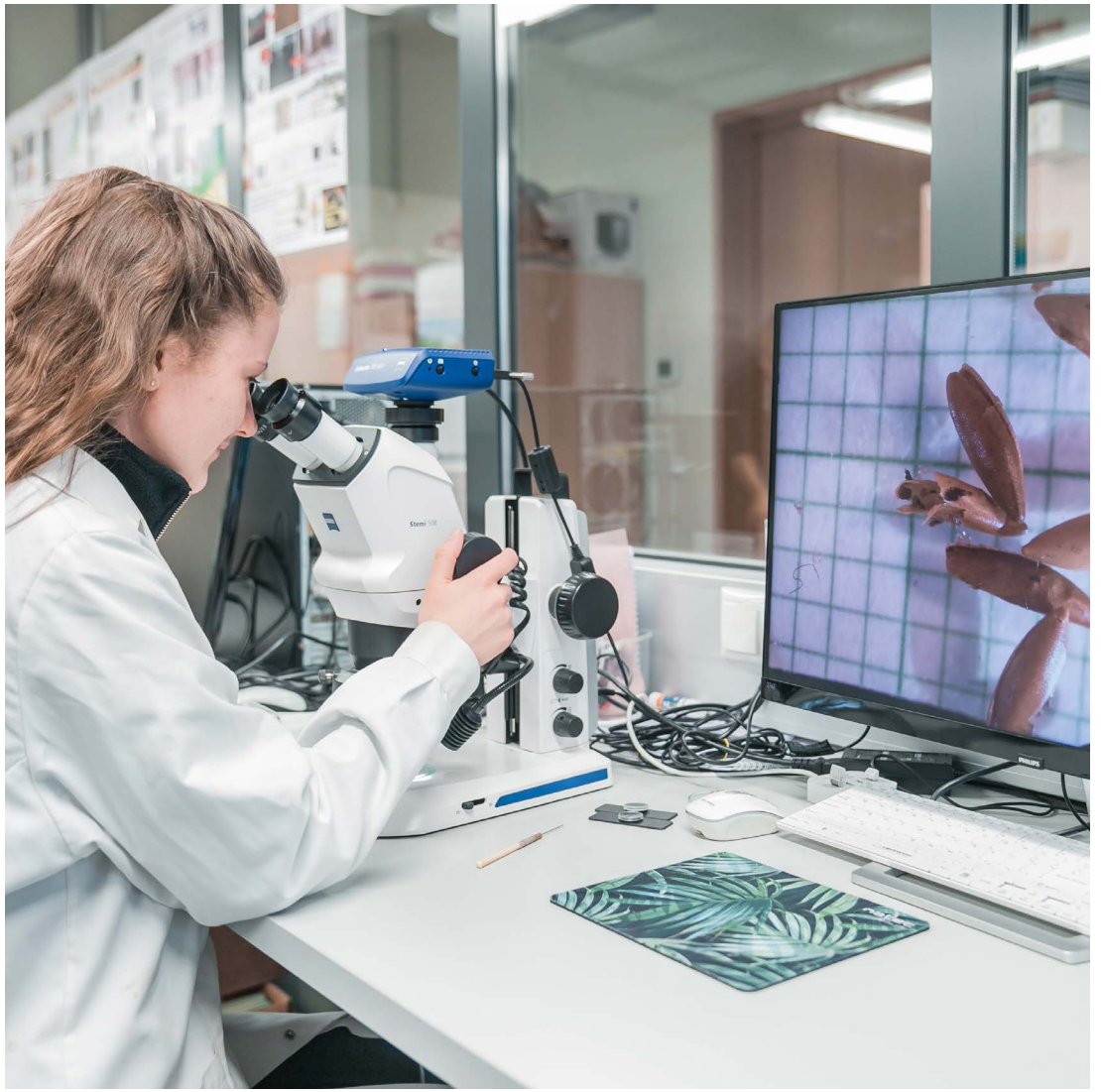
- **5** PROGRAMMES
- **116** BACHELOR'S
- **38** MASTER'S
- **16** DOCTORAL

Find out more

The Department of Environmental Science (DES) offers studies that explore the relationship between society and the environment, focusing on sustainable development, natural resource management, and soil and ecosystem research. Its research addresses environmental quality, climate change, and circular economy solutions that promote long-term ecological and climate resilience.

RESEARCH AREAS

DES conducts research on environmental quality, climate change, and the sustainable management of natural resources. Key activities include the assessment and modelling of environmental systems, the analysis of land use and climate impacts on soils and ecosystems, and the development of innovative solutions for the circular and bioeconomy. Additional research areas cover biodiversity and water studies, peatland restoration, and sustainable landscape and cultural heritage management. The department is also engaged in environmental and climate education, fostering awareness and action toward sustainable development.



MAIN RESULTS

Main achievements include the development of a new soil classification system together with DGr, and the publication of influential monographs such as Radioactivity and Soil Diagnostics and Classification. The department has also established extensive international collaborations, participating in major networks including FORTHEM (SusWaste Project), the Baltic University Programme, and the European School for Sustainability Science and Research. Cooperation extends to COST actions and Interreg projects, with long-term academic partnerships involving Hamburg University, Aalto University, Tartu University of Life Sciences, and the Finnish Institute of Natural Resources (LUKE).

INNOVATIONS AND IMPACT

Key achievements include the development of environmental biotechnology solutions for sustainable food production and the reuse of forestry waste in biopharmaceutical and industrial applications. Research on carbon sequestration using hybrid adsorbents supports Latvia's path toward climate neutrality, while active participation in national councils on landscape management, climate policy, and sustainable mobility ensures scientific input into environmental governance and strategic planning.

Collaborations

LATVIAN STATE INSTITUTE OF WOOD CHEMISTRY

Aalto University

The Baltic University Programme Since 1991

forthem.

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

UH

Luke NATURAL RESOURCES INSTITUTE FINLAND

ktu kaunas university of technology 1922

Department of Geology

74 STUDENTS

EDUCATION

- **4** PROGRAMMES
- **52** BACHELOR'S
- **15** MASTER'S
- **7** DOCTORAL

Find out more

The Department of Geology (DGI) offers studies that explore Earth's structure, history, and resources through fieldwork, laboratory analysis, and interdisciplinary research. Its work spans from Devonian palaeontology and sedimentology to geophysics, climate reconstruction, and sustainable resource management.

RESEARCH AREAS

Research in DGI encompasses a wide range of studies addressing both Earth's surface and subsurface processes. Core areas include geophysical and polar research, landform and resource studies, and soil mechanics. Ongoing work involves climate reconstruction and palaeoecological analyses of marshes, lakes, and human impacts on the environment. Additional expertise includes vertebrate palaeontology, regional geology, and Devonian palaeontological and sedimentological studies. Research also examines the composition and quality of deep-seated ore resources and conducts advanced hydrogeological investigations and modeling to support sustainable resource management.

MAIN RESULTS

Main achievements include the development of a new interdisciplinary approach to investigating the origin and evolution of tetrapods, providing novel insights into one of the most significant transitions in vertebrate history. Another major breakthrough was the world's first demonstration that microplastics are not confined to the upper layers of lake sediments, but can migrate into deeper strata, challenging previous assumptions about their environmental distribution and long-term ecological impact.

INNOVATIONS AND IMPACT

Key achievements include the development of six ISO standards in collaboration with industry partners, strengthening national and international practices in geotechnics and geophysics and enhancing the reliability of geological research and engineering applications.

Collaborations

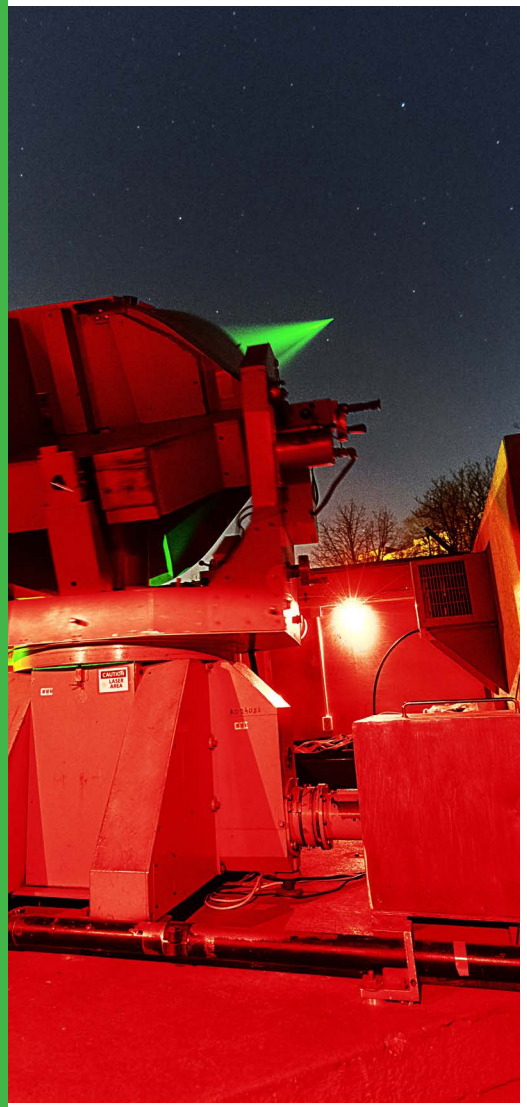
KNAUF · Geo Eko Risinājumi · Markvarta ģeotehniskais birojs · Borealis · Geolite · LVĢMC · VKB Vides Konsultāciju Birojs Laboratorija · State Construction Control Bureau of Latvia · LVS Latvijas standarts · JLCP Ceļuprojekts

Institute of Astronomy

The Institute of Astronomy conducts research in astrophysics, photonics, and space science, combining observations with advanced optical technologies. Its work spans from studying Solar System bodies and stellar phenomena to developing satellite laser ranging methods that enhance global geodetic and space surveillance networks.

RESEARCH AREAS

- Solar System minor bodies
- Carbon star research and catalogue development
- Finalization of the Schmidt Telescope analogue and digital dataset and its availability to the scientific community
- Research in satellite laser ranging (SLR) technologies and applications, including ultra-precise time-resolved measurements
- Bistatic laser ranging of cosmic debris and satellite photometry, with applications in the SSA/SST domain



Find out more

- High harmonic generation studies in gases, thin films, and plasmas
- Applications of nonlinear optics in satellite laser ranging

MAIN RESULTS

Main achievements include the publication of the General Catalog of Galactic Carbon Stars in the Strasbourg Astronomical Data Centre (CDS) by the Baldone Observatory, contributing valuable resources to the international astrophysical community. Researchers have also discovered 149 new asteroids, among them potentially Earth-threatening objects and a rare Centaur-type body. Additional accomplishments include the development and testing of the "TimeAmp" event timer, created in collaboration with the Institute of Electronics and Computer Science, and the establishment of bistatic laser ranging capability at SLR Station 1884 in Riga, enhancing Latvia's role in global space observation networks.

INNOVATIONS AND IMPACT

Key achievements include cooperation with the Latvian Geospatial Information Agency and collaboration with the Institute of Electronics and Computer Science on developing precision time interval measurement technologies. Partnerships with Eventech Ltd., Digos GmbH (Germany), and Lumi Space (UK) have advanced satellite laser ranging and space surveillance applications, contributing to the EU Space Surveillance and Tracking (SST) program and enhancing Latvia's role in international space observation networks.

INFRASTRUCTURE

- Baldone Observatory – 1m Schmidt
- Telescope with CCD camera (SBIG Aluma AC4040 16.8Mpx)
- Schmidt Telescope Archive – 20,000+ astroplates in analogue and digital formats
- Satellite laser ranging (LS-105/TPL) and GNSS receiver (Leica GR50)
- Participates in ILRS, IGS, GGOS, and EU SST network
- Ekspla PL2230 picosecond laser

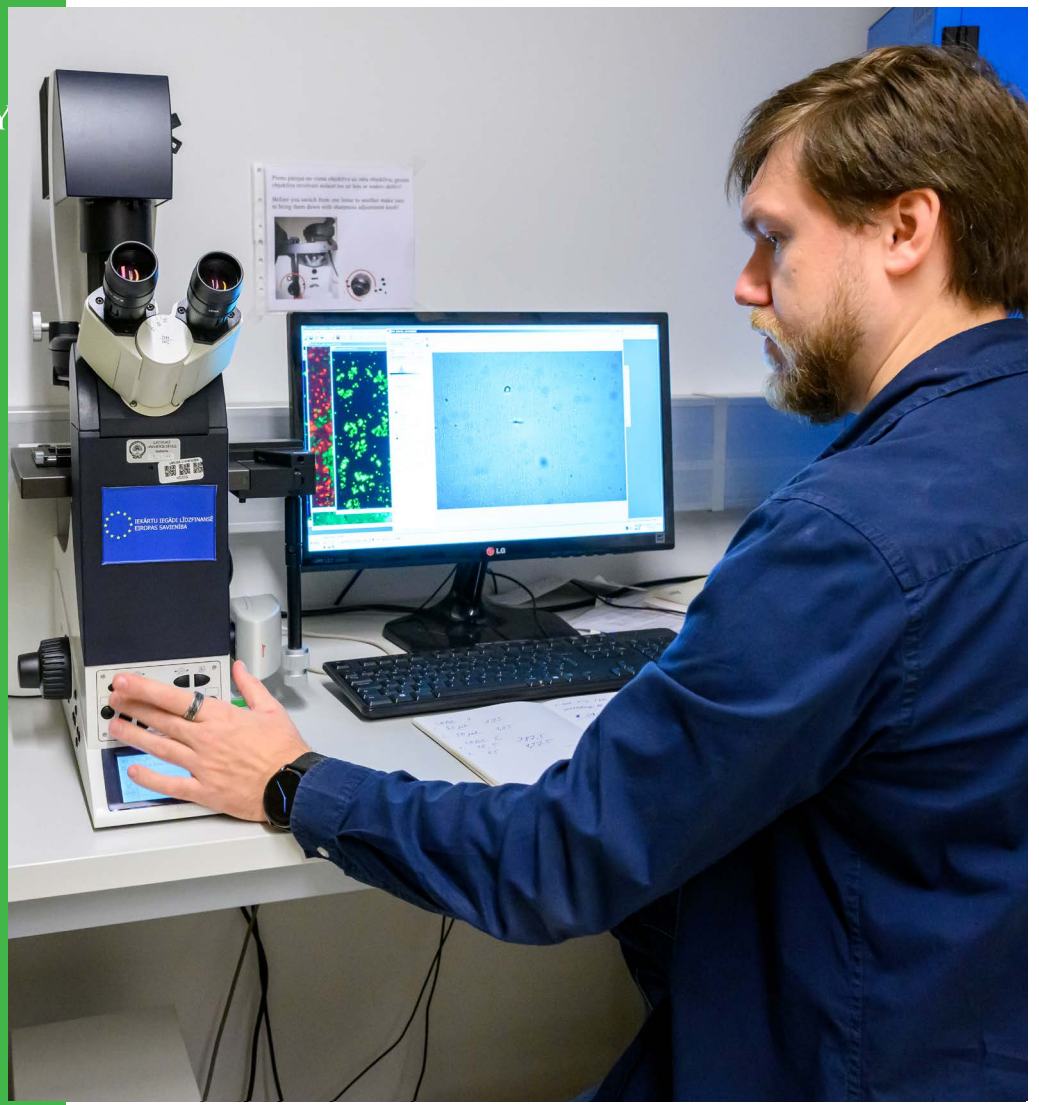
Collaborations

Institute of Atomic Physics and Spectroscopy

The Institute of Atomic Physics and Spectroscopy (IAPS) conducts internationally recognized research in atomic and quantum physics, spectroscopy, photonics, and biophotonics. It conducts interdisciplinary research between physics and medicine to develop optical diagnostic tools, while also advancing quantum optics, laser technologies, and environmental monitoring methods. The Institute has been supported by the European Commission as the Centre for Excellence in Fundamental and Applied Studies.

RESEARCH AREAS

- Optical physics, materials science, and biomedical applications.
- Non-contact optical diagnostics and imaging technologies for clinical use.
- Plasma diagnostics and high-frequency light source technologies.
- Atomic absorption spectroscopy, UV disinfection, and mercury concentration measurements.

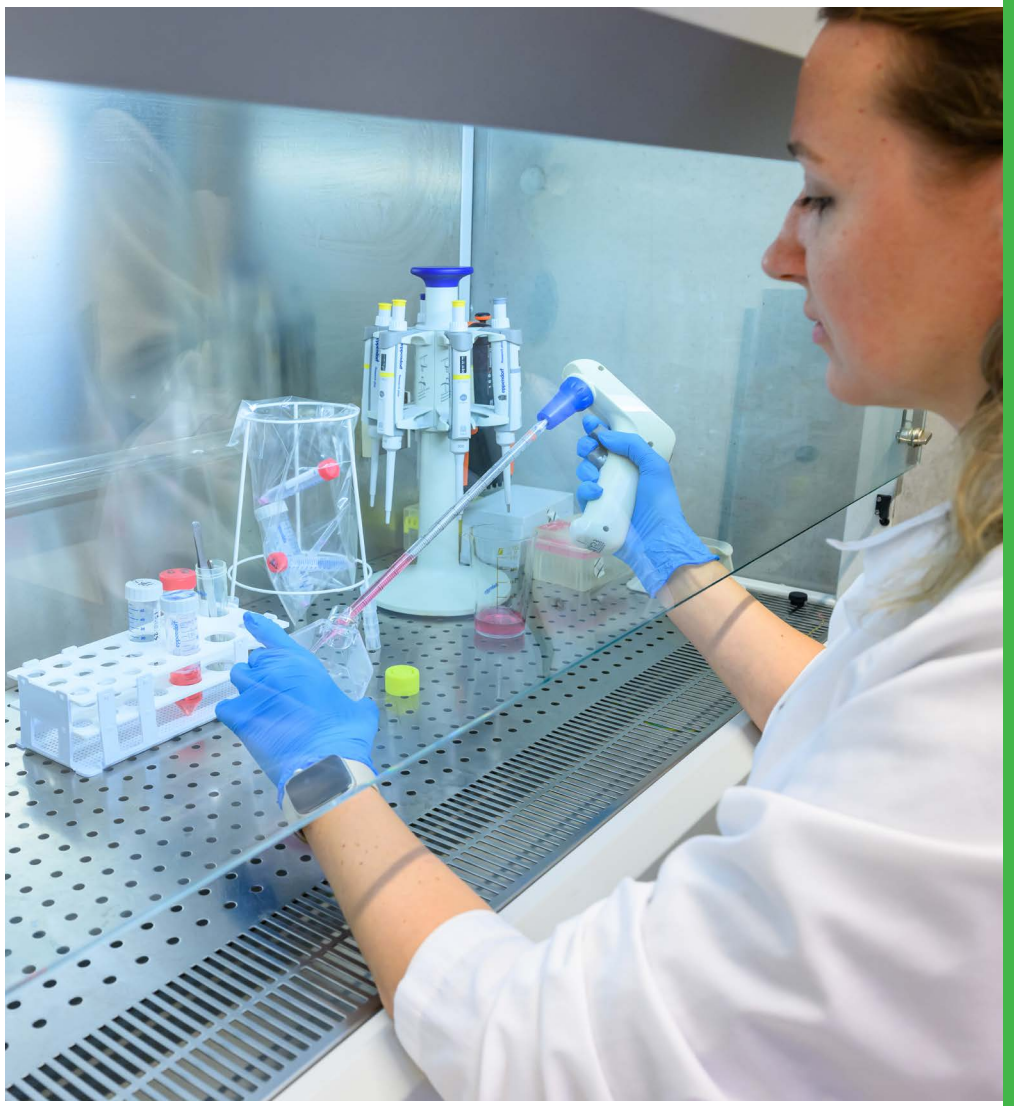


Find out more

- Tapered fiber–WGM coupling for frequency comb generation, optical chip testing, and microtoroid resonator fabrication.
- Modeling atomic interactions with electromagnetic fields, photon dynamics, and Rydberg blockade effects.
- Experimental studies on hydrodynamic stability and magnetohydrodynamic (MHD) pseudo-levitation in crystal growth.
- Biological responses of MXenes and other 2D materials for tissue engineering, antibacterial therapy, and targeted anticancer treatment.

MAIN RESULTS

Key achievements include the EU REGIOSTARS 2024–winning melanoma detection device, a prototype for full-body skin spectral imaging, and an anesthesia contactless control system now in clinical use. The institute has advanced veterinary biophotonics, plasma diagnostics, and photonic detection methods for heavy metals and VOCs, while pioneering MXenebased biomedical applications and achieving breakthroughs in quantum technologies, including a record 53 micrometer Rydberg radius. Other accomplishments include the development of optical gas sensors, nanofi bers for drug delivery, and photocatalytic nanomaterials.



INNOVATIONS AND IMPACT

Key achievements include the creation of startups Bdetect and SEPSISCAN, alongside three national patents for innovations in optical imaging and laser illumination technologies. The institute has conducted joint research on plasma-based disinfection systems with Biosan Ltd., developed instruments for detecting heavy metals and nanoplastics in collaboration with ornithologists and peat scientists, and advanced clinical nanomaterial applications through partnerships with Linari Engineering and CSD Health. Further industrial collaborations with OBF Technology, UkraVit, PhaseBreake, NaCo Technology, Eden Tech, and Riga Paint Factory demonstrate strong links between fundamental research and applied innovation.

INFRASTRUCTURE

- Jobin-Yvon 1000M High-Resolution Spectrometer with CCD detection
- Optical Frequency Comb (Menlo Systems)
- CHM Microtoroid Resonator Fusion System for micro- and nano-photonic resonator fabrication
- Raman Spectroscopy and Imaging Facility for high-sensitivity material and biological characterization
- GRIBA Ion Beam Facility
- LIBS Facility
- Plasma chamber with oil-free turbomolecular system

Collaborations

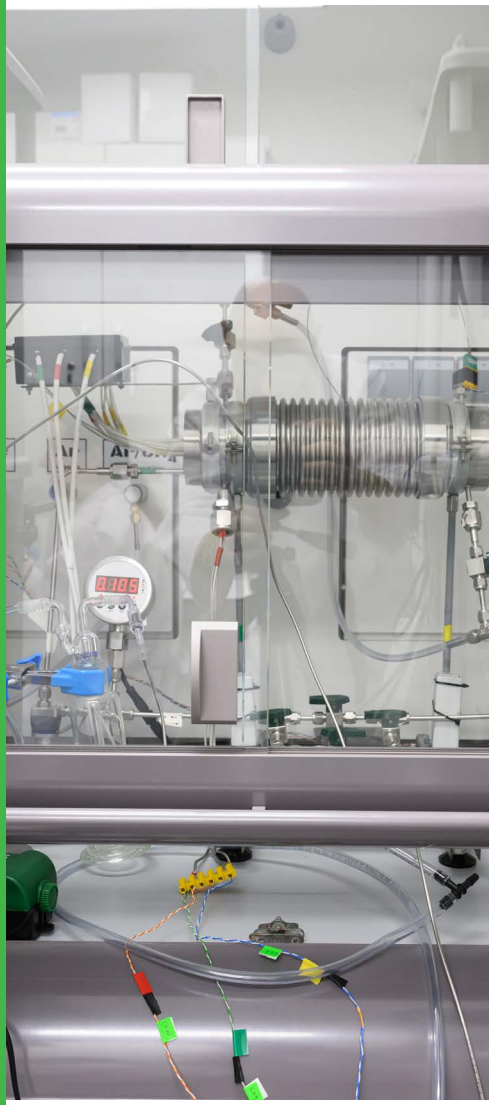
CERN
CARBON UKRAINE
Jožef Stefan Institute
Università degli Studi di Messina
RĪGAS TEHNISKĀ UNIVERSITĀTE
MXenes
ISOLDE
STEMS
Drexel University
RĪGAS STRADIŅA UNIVERSITĀTE
Latvia University of Life Sciences and Technologies
Fraunhofer IKTS

Institute of Chemical Physics

Institute of Chemical Physics (ICP) is an interdisciplinary research center uniting physics and chemistry to develop innovative materials, energy technologies, and nanodevices in collaboration with industrial partners. The institute conducts research in nanomaterials and nanotechnologies, green energy, nanoelectronics, nanooptics, radiochemistry, and radiation chemistry, fostering the transfer of scientific advances to practical applications.

RESEARCH AREAS

- Green energy
- Nanomaterials and nanotechnology
- Nanoelectronic devices and materials
- Nanooptics
- Radiation chemistry
- Radiochemistry



Find out more

MAIN RESULTS

Main achievements include the development of self-assembled nanoparticle arrays on porous anodic aluminum oxide substrates for localized surface plasmon resonance (LSPR) sensing, enabling highly sensitive optical detection technologies.

INNOVATIONS AND IMPACT

Significant progress has been made in the creation of nanoelectromechanical switches (NEMS) and a topological-insulator-based cryoswitch, demonstrating reversible low-temperature operation and advancing the field of quantum and cryogenic electronics. Additional accomplishments include the fabrication of graphene-based layered nanostructures—such as Bi_2Se_3/graphene thermoelectric composites and graphene–ZnO nanolaminates—offering enhanced thermoelectric and optoelectronic performance. The Nanoelectronic Devices and Materials Group further contributes through the synthesis of topological semimetals and 2D materials, alongside nanofabrication and quantum transport studies for next-generation electronic applications.

INFRASTRUCTURE

- Physical and chemical vapor deposition furnaces and dual-zone reactors
- Characterization tools: PPMS, SEM-EDX, AFM, solar simulators, electrochemical workstations
- TG/DTA and FTIR systems for thermal and gas analysis
- ATR-FTIR, EPR, and gamma spectroscopy facilities
- Custom electrochemical and ion-exchange systems for radionuclide separation and metal purification

Collaborations

Institute of Geodesy and Geoinformatics

The institute is Latvia's leading center for research in satellite geodesy, geoinformatics, and Earth observation. Its work covers gravity field and crustal dynamics modeling, GNSS and space weather studies, and the development of high-precision instruments such as digital zenith cameras, supporting advanced spatial analysis and Earth monitoring applications.

RESEARCH AREAS

- Measurement, modeling, and interpretation of Earth's dynamic processes
- Gravity field modeling and quasigeoid development
- Crustal dynamics studies
- Advanced GNSS research: signal accuracy, reliability, and space weather effects
- Space situational monitoring and astrogeodetic research for civilian and defense applications

Find out more

- Development of image processing and spatial analysis algorithms
- Integration of intelligent materials, engineering technologies, and ICT solutions for advanced sensing, data

MAIN RESULTS

The main achievements include the development of the digital zenith camera VESTA (VErtical by STArs)—a high-precision, automated instrument integrating optical, GNSS, and meteorological systems for measuring the Earth's gravity field components. Using custom software and star catalogues, VESTA achieves quasi-geoid surface refinement with an accuracy of approximately 0.1 arcsecond, placing it among only a few such systems worldwide. Additional accomplishments include the creation of multifunctional astrometric control and analysis software with CCD frame stacking for faint object detection, and the implementation of geodynamic monitoring across Latvia, analyzing gravity field variations, quasi-geoid deformation, and crustal movement using GNSS CORS data.

INNOVATIONS AND IMPACT

Key achievements include the development of an electronic constructor for STEAM education in collaboration with AgirVision Ltd, promoting innovation-based learning. Joint work with JSC "Latvijas Valsts Meži" resulted in an automated IT solution for wood volume assessment in forestry applications, while cooperation with BNV Systems led to the creation of digital synthesis technology for dual-band optical imaging, enhancing precision in environmental and industrial monitoring.

INFRASTRUCTURE

- BERNESE – scientific software for GNSS data processing
- Digital zenith cameras (3 pcs)
- Reconfigurable optical tracking system
- GNSS receivers and base stations (13 pcs)
- Digital leveller
- High-performance UAV
- Hardware for GNSS data processing

Nordic Geodetic Commission
NKG

EUPOS
European Position Determination System

BNV systems

agirVision

RIGA CITY COUNCIL

LATVIJAS VALSTS MEŽI
KOKSNE · STĀDI · ATPŪTA

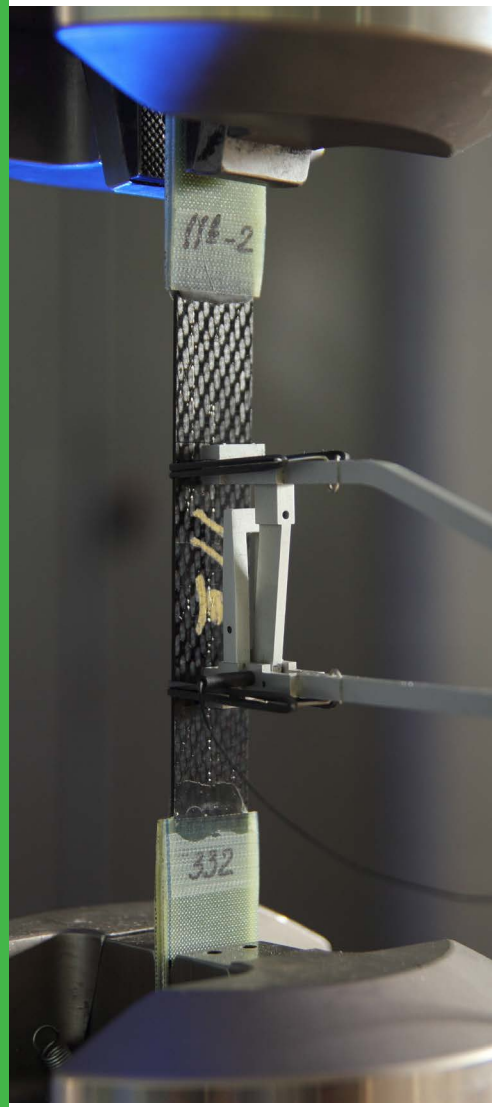
eurof

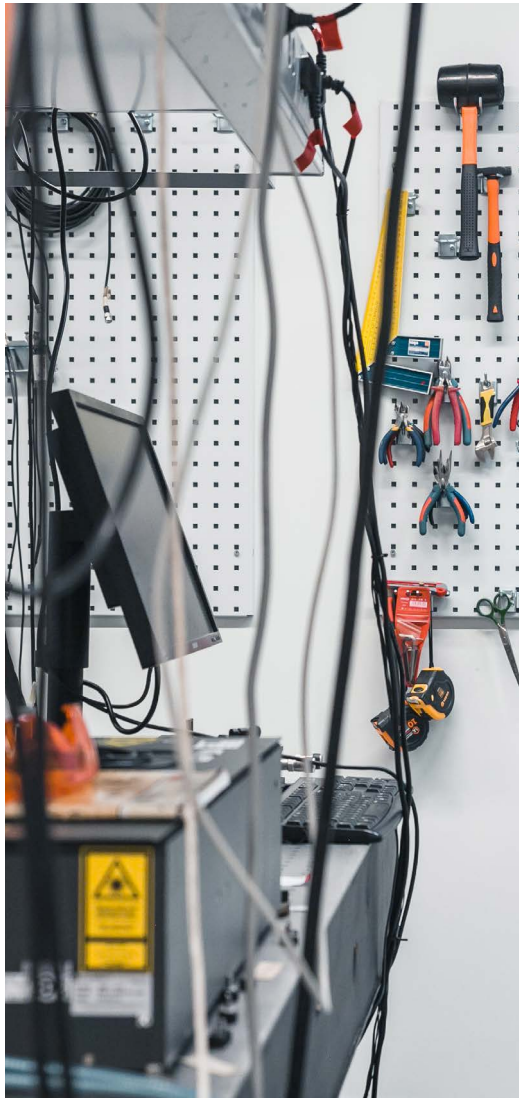
Institute for Mechanics of Materials

The Institute of Mechanics and Materials (IMM) conducts research on the mechanical behavior and durability of polymers and composite materials. Its work focuses on developing multifunctional and smart materials—such as self-healing, adaptive, and bio-based composites—supported by advanced modeling, structural analysis, and testing for sustainable engineering applications.

RESEARCH AREAS

- Deformation processes of polymer and composite materials
- Mechanical integrity of composite materials
- Structural calculations and property modeling of composites
- Multifunctional smart materials and their properties
- Environmental effects on material properties
- Physical methods for structural studies in materials mechanics



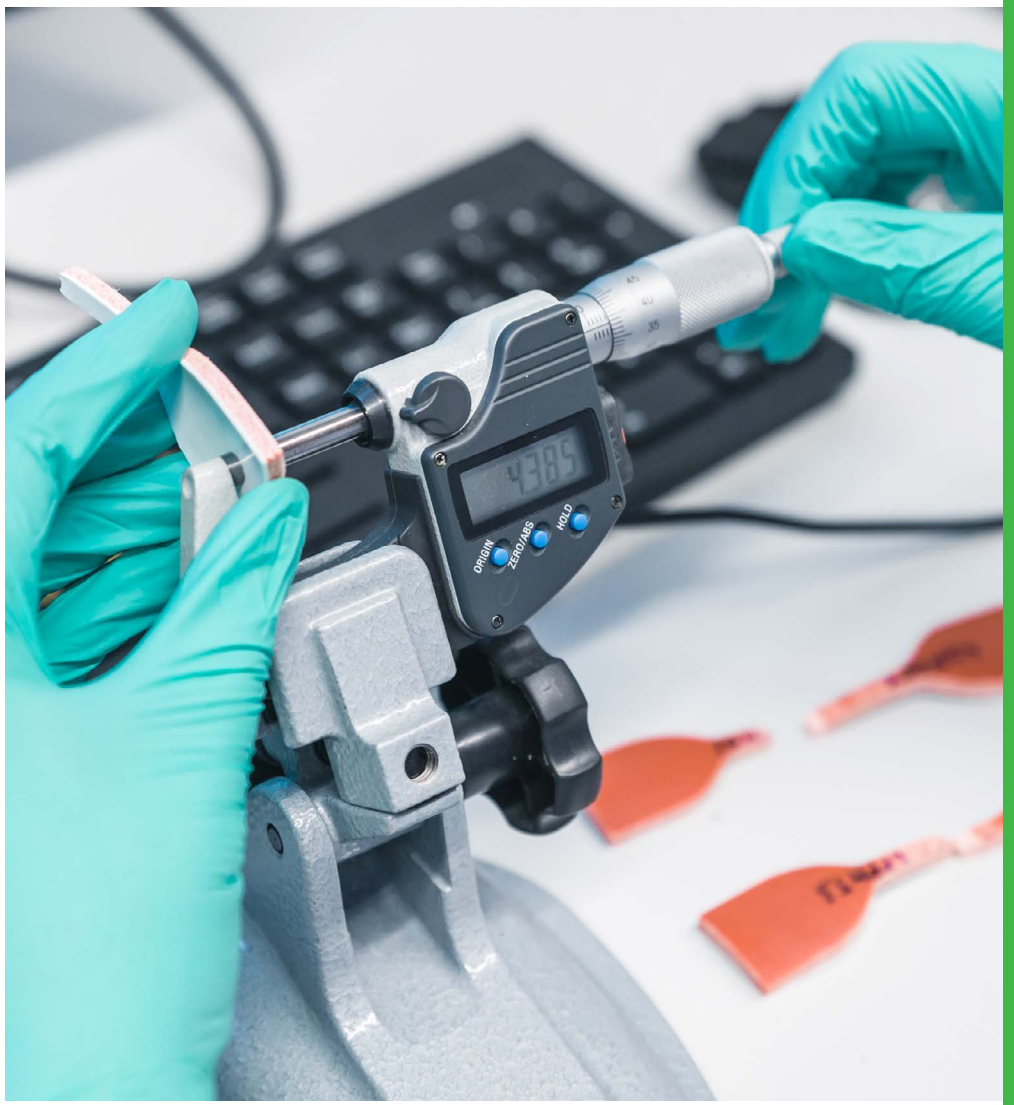


Find out more

- Non-destructive testing, structural health monitoring, and self-healing
- 3D-printed smart polymer structures
- Bio-based composite materials

MAIN RESULTS

The main achievements include the development of multifunctional polymer composites enhanced with 2D MXene nanoparticles, improving fiber-reinforced materials with strain-sensing, damage-monitoring, and Joule heating capabilities. A decision-support tool for the optimal design of 3D-printed smart polymer structures was created using fused filament fabrication technology. Researchers also engineered eco-friendly epoxy matrices on nanotechnology platforms for corrosion protection and low-flammability carbon laminates, contributing to circular economy principles. Additional innovations include bio-based polyolefin composites reinforced with natural waste fillers and antibacterial additives for small electronic applications, as well as nano-modified multilayer extrusion products offering improved performance and durability.



INNOVATIONS AND IMPACT

Key achievements include advances in multifunctional polymer composites enhanced with MXenes and graphene, as well as the development of smart corrosion-sensing coatings, flame-retardant epoxy matrices, and bio-based polymers with natural fillers. The institute has introduced new methods for structure–property characterization, modeling, and long-term behavior prediction, validating innovative material concepts in real-world environments. Active student involvement and science communication further strengthen the institute's impact by promoting public understanding of advanced materials and sustainable technologies.

INFRASTRUCTURE

- Zwick universal testing machines with temperature chambers for static, dynamic, and long-term creep tests (tension, compression, torsion)
- Thermomechanical analysis systems: Mettler Toledo DMA and TMA
- Laboratory presses, ultrasonicators, vacuum systems, and moulding equipment
- Ultimaker S5 and 2+ Connect 3D printers for prototyping and smart polymer fabrication

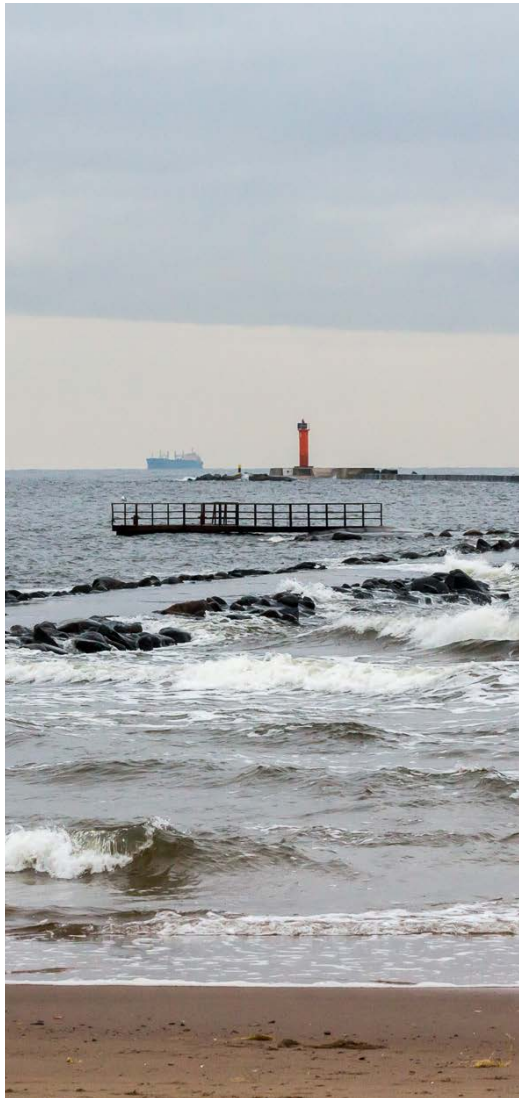
Collaborations

Institute of Numerical Modelling

The Institute of Numerical Modelling (INM) advances physics-oriented applied research in environmental and energy processes through high-performance simulations and experimental studies. Its work spans climate and ocean modelling, renewable energy research, and semiconductor crystal growth, integrating artificial intelligence and multiphysics modelling to support innovation in science and industry.

RESEARCH AREAS

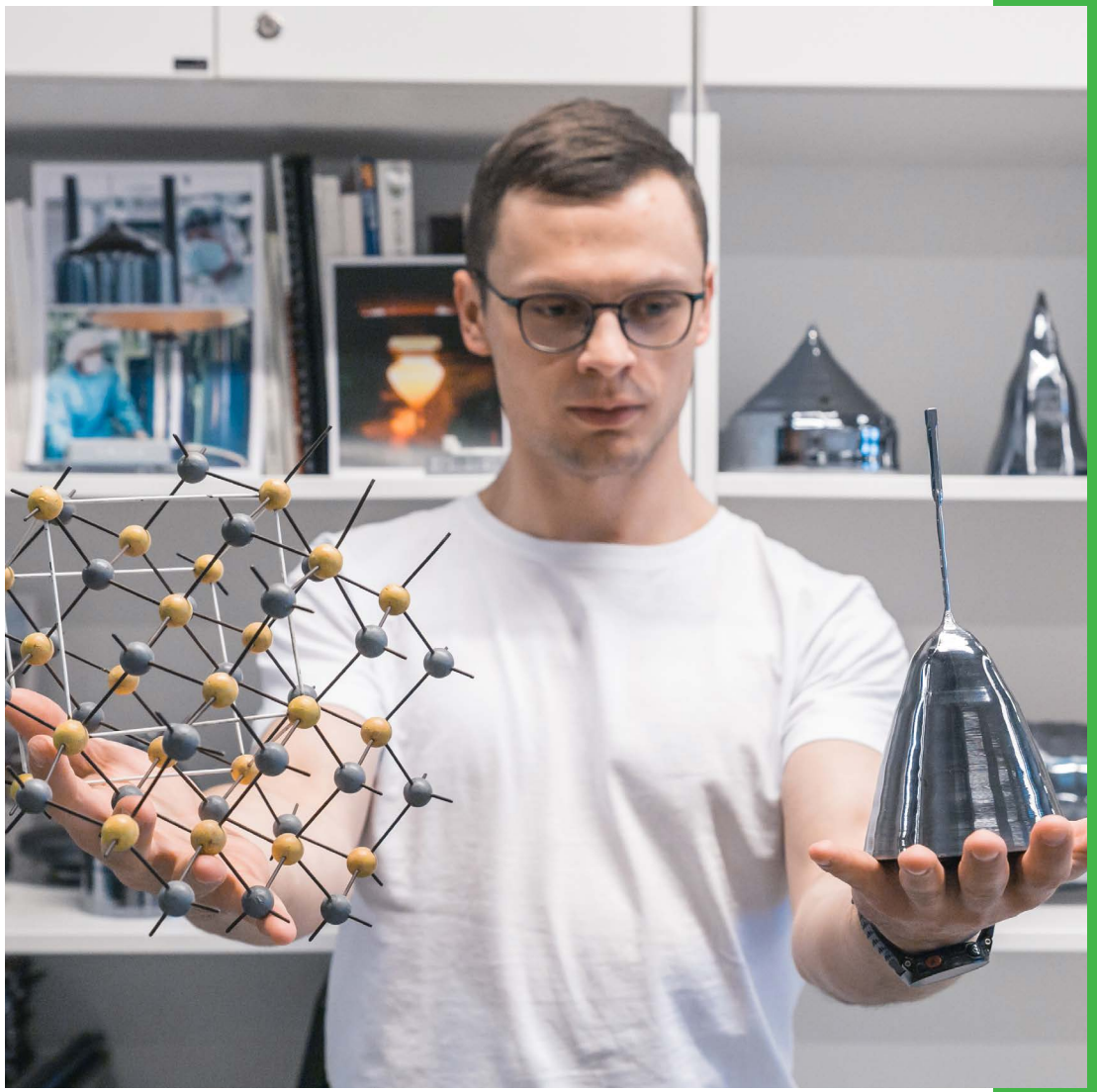
- Climate research
- Oceanography and coastal processes
- Renewable energy: wind and solar
- Semiconductor technologies and silicon crystal growth modelling
- Magnetohydrodynamics studies
- Building physics and energy efficiency analysis
- Multiphysical process modelling
- AI solutions for process control



Find out more

MAIN RESULTS

Main achievements include the development of 3D anisotropic and coupled melt-flow models for floating zone (FZ) and Czochralski (CZ) silicon growth, providing new insight into ridge formation, segregation, and thermal stress effects. Optimization algorithms for high-frequency inductors have enhanced melt stability and enabled scaling to larger crystal diameters. Additional studies on electron-beam heating identified impurity contamination pathways and proposed effective suppression methods. Experimental and numerical analyses validated thermal–flow coupling and defect modeling in crystal growth, while benchmarking of point-defect parameters established reliable baselines for large- diameter CZ silicon.



INNOVATIONS AND IMPACT

Key achievements include the construction and certification of the first Energy Plus private building in the Baltic States, demonstrating leadership in sustainable architecture and energy efficiency. The institute developed and licensed the HeatMod software for building energy certification in line with European standards and created a system for assessing viral infection risk in indoor spaces using real-time data and modeling. Additional innovations include the open-source finite element library MACPLAS for simulating thermal stresses during silicon crystal growth and co-authorship of a U.S. patent for a novel single-crystal silicon production process.

INFRASTRUCTURE

- High-performance computing (HPC) cluster: 19 compute nodes, GPU accelerators, 6 TB RAM for simulations, AI/ML, and data analysis
- Thermal performance and material testing: heat flux meters, FLIR ThermaCAM P620 and T650SC thermographic cameras
- Environmental and building monitoring systems: BACnet and KNX sensor networks
- Experimental plant with five test buildings for energy efficiency and AI research
- Crystal growth tools: Czochralski furnace and simulation software (FZone, CZTrans)

Collaborations

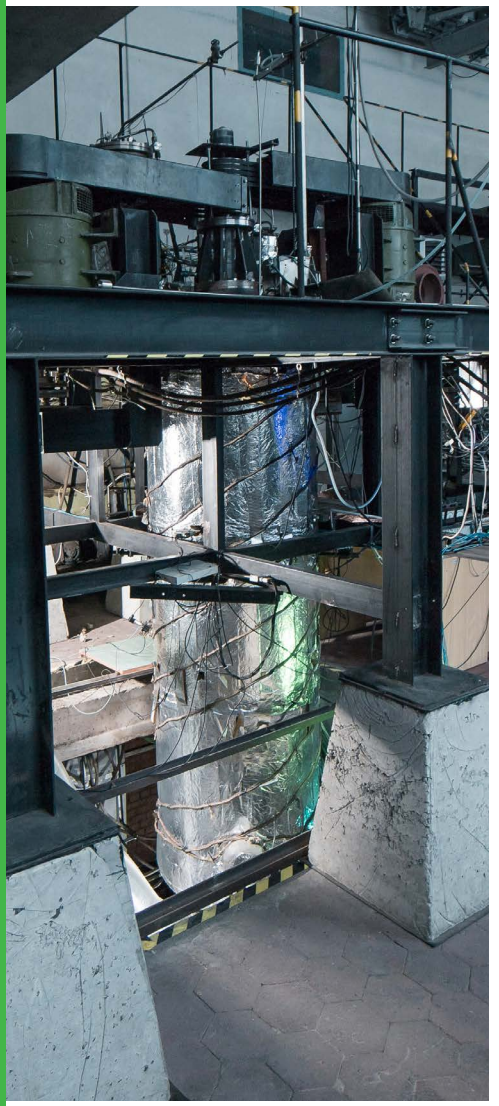
Leibniz Universität Hannover · PSI · The Institute of Electrotechnology · 1862 Rīgas Tehniskā Universitāte · HZDR Helmholtz Zentrum Dresden Rossendorf · Danmarks Meteorologiske Institut · ikz Leibniz-Institut für Kristallzüchtung · Fraunhofer IKTS · siltronic perfect silicon solutions

Institute of Physics

The Institute of Physics (IP) is one of the world's leading centres in the field of magnetohydrodynamics (MHD), with unique experimental equipment for liquid metals. Its research advances understanding of conductive fluid dynamics, energy systems, and ferrofluid technologies, with applications in nuclear power, metallurgy, and sustainable energy development.

RESEARCH AREAS

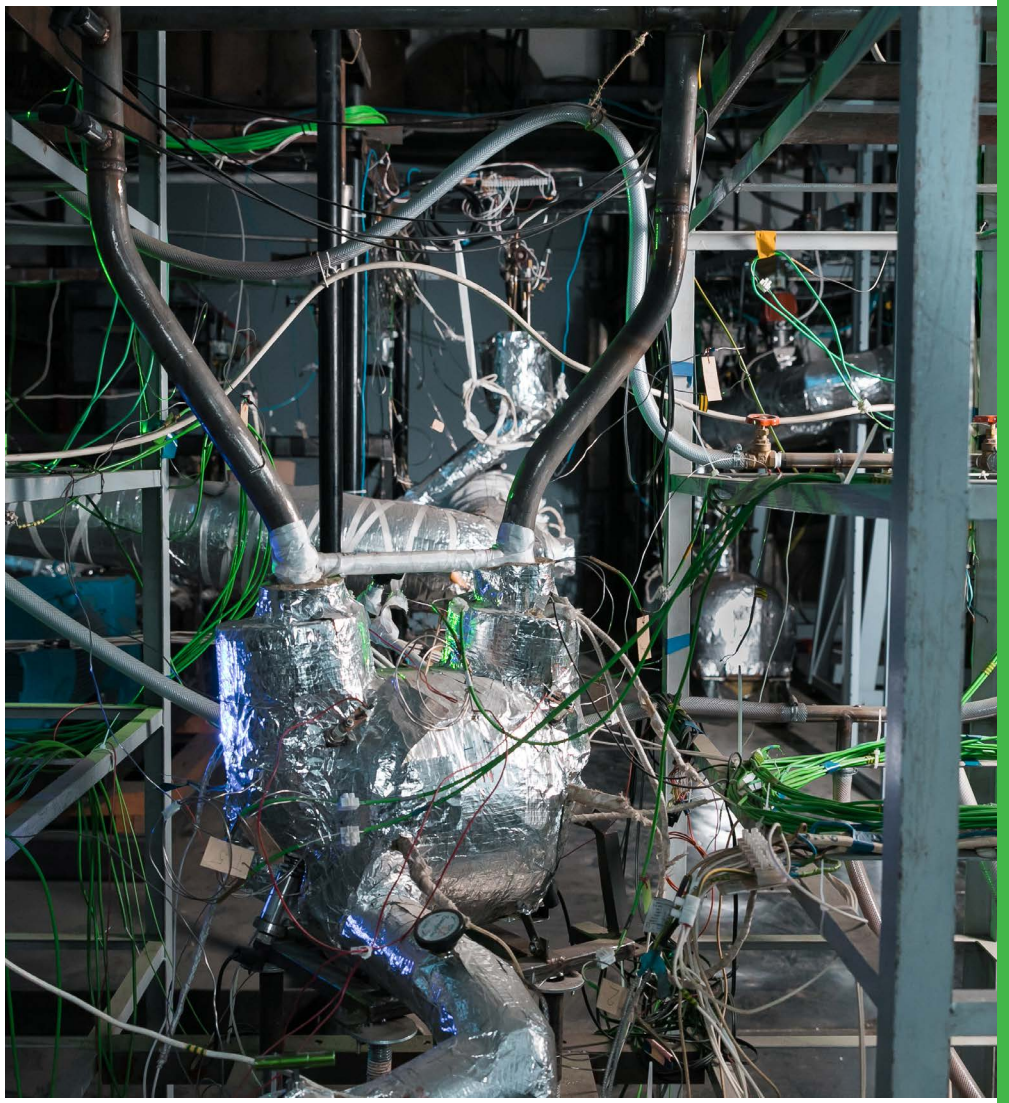
- Magnetohydrodynamics
- Liquid metal hydromechanics
- Ferrofluids
- Biomass combustion
- Electromagnetics technology for metallurgy



Find out more

MAIN RESULTS

Main achievements include the landmark MHD dynamo experiment conducted in 1999, which for the first time in the world demonstrated the self-generation of magnetic fields in a magnetohydrodynamic system, providing experimental confirmation of dynamo theory. Building on this breakthrough, researchers developed liquid metal pumps and permanent magnet devices for scientific and industrial use, enabling contactless flow control and advancing metallurgical, cooling, and energy technologies.



INNOVATIONS AND IMPACT

Key achievements include two national patents—the Apparatus for Contactless Flow Excitation in Electrically Conductive Liquids and the Electromagnetic Pump—which enable non-invasive control of liquid-metal flows through electromagnetic forces. These innovations eliminate mechanical contact, reducing contamination and wear, and have significant applications in metallurgy, cooling systems, and nuclear energy technologies. Together, they strengthen Latvia's leadership in magnetohydrodynamics and advanced energy systems, bridging fundamental research and industrial innovation.

INFRASTRUCTURE

- Eldec MFG-20 high-frequency generator (20kW, 8–20kHz)
- Custom pulsed power source (600mF, 40kA, 10pulses/s)
- MagnaPower DC supplies (1200A/16V, 600A/10V)
- Electromagnet (1.7T, 5cm gap) and permanent/rotating magnet assemblies
- Superconducting Magnet (30cm bore, 1,2 m length, 5T)
- Safe molten metal research hall with Na, Li, PbBi, PbLi
- DOP2000 Ultrasound Doppler anemometer
- 1m3 and 12m3 vacuum chambers

Collaborations

SINTEF

cea

HZDR HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF

METALLCO BERGEN

CMP SAVING ENERGY

EUROfusion

METAUX SPECIAUX

IFMIF DONES GRANADA THE KEY TO THE FUTURE

BLV

Interdisciplinary Centre for Educational Innovation

The Interdisciplinary Centre for Educational Innovation (ICEI) promotes modern, research-based teaching in natural sciences and mathematics through innovative methods, digital tools, and real-life learning. It supports teacher development, inspires student interest in science and technology, and strengthens collaboration between schools, universities, and industry.

RESEARCH AREAS

- Curriculum and methodology development (priority STEM and interdisciplinary)
- Student performance assessment (measurement)
- Data-driven development solutions in schools, municipalities, system
- Innovation creation, implementation and implementation quality
- Human resource capacity development including competency management, teacher professional development, etc.

Find out more

MAIN RESULTS

Main achievements include the development of methodological support systems for STEM education, integrating expertise across mathematics, natural, and social sciences. Extensive research-based professional development programs were implemented for teachers and school leaders, engaging over 120 training groups during 2023–2024. The publication of the collective monograph Data Science for School advanced data-driven approaches to teaching and learning. Additional accomplishments include the creation of prototype IT and blended learning models and the development of new STEM teaching methodologies for grades 1–6 within national research programs.

INNOVATIONS AND IMPACT

Key achievements include the development of innovative digital tools and support systems that enhance teaching and learning in STEM education. The centre has led major national and European projects, including the ERDF project on IT-based feedback systems for improving student performance, and two National Research Program (NRP) projects introducing blended learning solutions and personalised support systems for literacy, numeracy, and scientific literacy. These initiatives strengthen digital transformation in education and promote research-based, sustainable innovation in schools across Latvia.

Collaborations

Latvijas Koks

Sell STEM

Izglītības un zinātnes ministrija

accenture

MikroTik

AcaSTEMy

Latvijas Valsts meži
Koksne · Stādi · Atpūta

KLASE

University of Latvia Foundation

LETERA

Lielvārds

Valsts izglītības attīstības aģentūra

Erasmus+

Nordplus

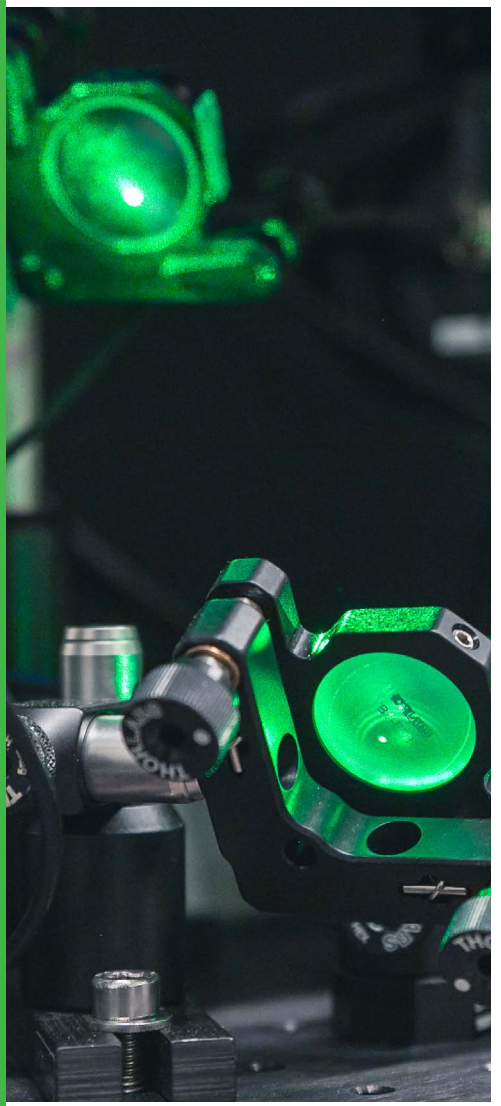
Latvijas Finieris

Laser Centre

The Laser Centre (LC) is Latvia's largest laser research facility and a key regional hub for experimental photonics. Its work explores light–atom interactions, magneto-optical effects, and high-resolution spectroscopy, advancing quantum sensing, magnetic field imaging, and laser-based technologies for scientific and space applications.

MAIN RESULTS

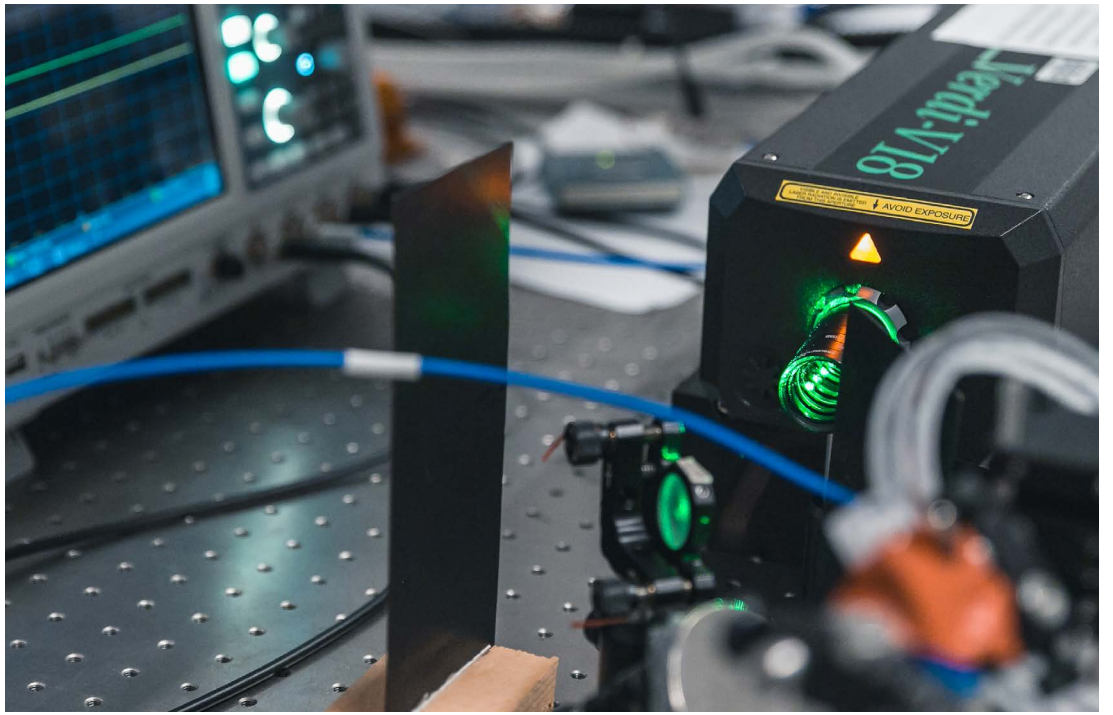
Main achievements include participation in the positronium laser erasure experiment, which advanced the understanding of matter–antimatter interactions through precision laser spectroscopy. A prototype vector magnetometer based on nitrogen-vacancy (NV) centers in diamond was developed for space applications as part of a European Space Agency concept study. Researchers also created innovative magnetometry techniques using alkali metal vapors, significantly improving sensitivity and spatial resolution in magnetic field measurements. Additionally, a magnetic field imaging system was developed, enabling real-time visualization of magnetic structures with high spatial precision.

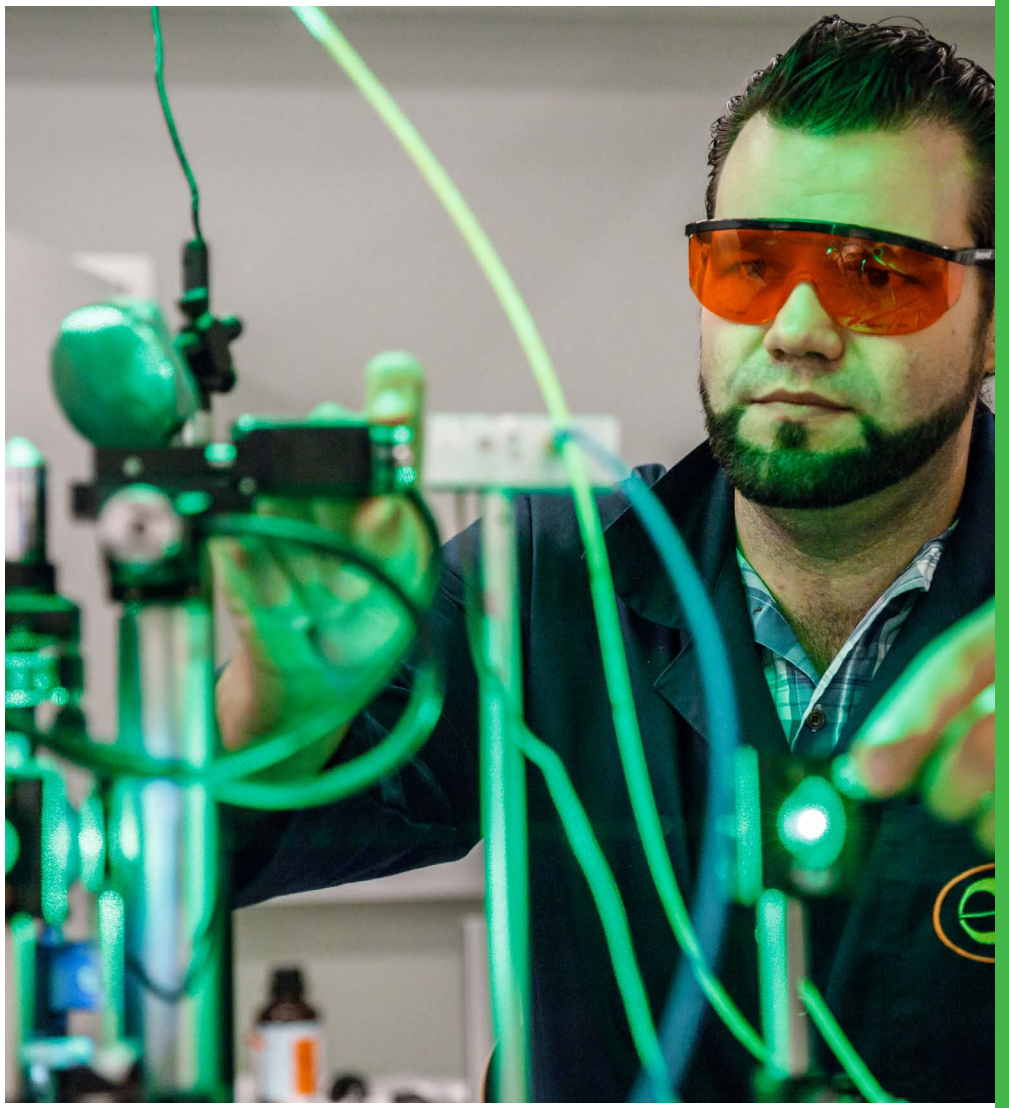


RESEARCH AREAS

- Laser physics and spectroscopy
- Atomic and molecular physics
- Astrophysics and fundamental astronomy
- Optics
- Physical methods and instruments
- Physics of magnetic phenomena

Find out more





INNOVATIONS AND IMPACT

Key achievements include participation in the positronium laser erasure experiment, advancing understanding of matter–antimatter interactions through precision spectroscopy. The centre developed a prototype vector magnetometer using nitrogen-vacancy (NV) centers in diamond for space applications under a European Space Agency concept study. Additional innovations include advanced magnetometry techniques with alkali metal vapors and a magnetic field imaging system enabling real-time visualization of magnetic structures with high spatial precision, strengthening Latvia's position in quantum sensing and photonics research.

INFRASTRUCTURE

- Ti/Sapphire laser (SolsTiS2000PSX, M Squared)
- Pumping laser and spectrum analysis (Verdi V18)
- Single-mode scanning laser (TA-SHG 110)
- Cobolt Samba 532nm laser, 1W
- High-resolution IR Fourier Transform Spectrometer
- High-speed digital imaging (CMOS Andor Camera)
- Polarimeter (PAX1000IR1, 600–1080nm)
- Magnetic field sources: Helmholtz coils, electromagnets up to 1T
- Cryostat (Oxford Instruments MicrostHe)

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