

Review 2025

Empowering innovations
with AI, supercomputers
and a quantum computer

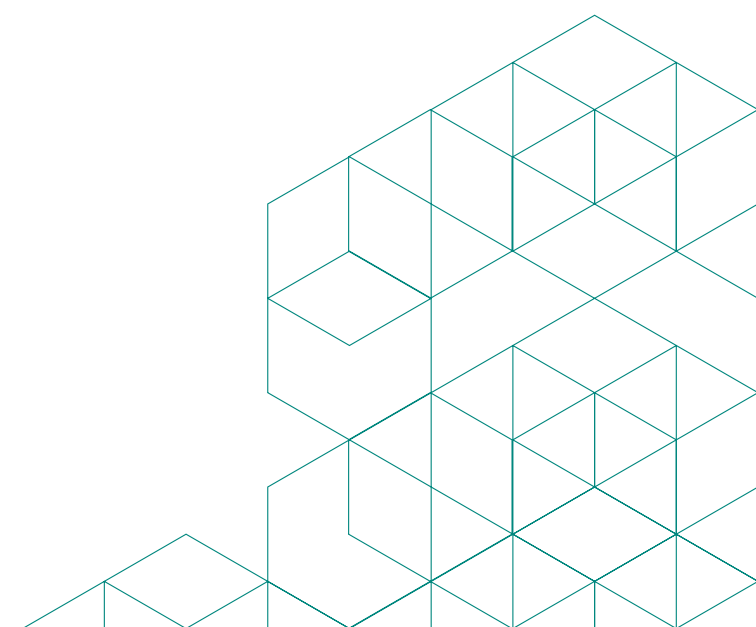


TABLE OF CONTENTS

MANAGING DIRECTOR’S INTRODUCTION	4
01 / IT4INNOVATIONS PROFILE	8
History	10
Mission, Vision, and Memberships	11
Organisational Structure IT4Innovations	12
02 / IMPORTANT EVENTS	16
03 / FINANCIAL REVIEW	20
04 / LIST OF IT4INNOVATIONS PROJECTS	24
05 / SUPERCOMPUTING SERVICES	28
Technical Specifications of the Supercomputers	30
Computational Resource Allocation	34
06 / RESEARCH AND DEVELOPMENT	40
Summary of Research and Development Results	42
Advanced Data Analysis and Simulations Lab	52
Infrastructure Research Lab	53
Parallel Algorithms Research Lab	54
Modelling for Nanotechnologies Lab	55
Quantum Computing Lab	57
07 / EDUCATIONAL AND TRAINING ACTIVITIES	58
08 / NATIONAL PROJECTS	62
Supercomputing Services Projects	62
Research and Development Projects	63
VSB-TUO Projects with IT4Innovations Participation	71
09 / INTERNATIONAL PROJECTS	74
Research and Development Projects	74
Educational Projects	85
LIST OF ABBREVIATIONS	86

IT4I

MANAGING DIRECTOR'S
INTRODUCTION

Dear colleagues, partners, and friends,

The year 2025 will be remembered in the history of IT4Innovations National Supercomputing Center as a period when long-term visions became reality. Developments we had been working intensively towards for many years took shape – from the launch of the first Czech quantum computer and the advancement of the European AI Factories to new strategic projects that will shape the future of high-performance computing, artificial intelligence, and quantum technologies in Europe.

Once again, we demonstrated that IT4Innovations is not only a provider of world-class computing infrastructure but also an active partner in building the European ecosystem for advanced computing, AI, quantum technologies, and scientific data.

Without doubt, the most significant milestone of the year was the launch of the first Czech quantum computer, named VLQ, acquired through the European LUMI-Q consortium. Following its installation in our centre, an inaugural ceremony marked the culmination of several years of intensive work by Czech and European partners. As a result, the Czech Republic joined the group of countries with their own quantum computing infrastructure integrated into the EuroHPC Joint Undertaking. At the same time, VLQ opens up new opportunities for developing hybrid applications that combine classical supercomputers and quantum technologies, which will play an increasingly important role in addressing the most demanding scientific and industrial challenges.

We also took an equally significant step in the field of artificial intelligence. We became part of the LUMI AI Factory consortium, contributing to the development of an environment, services, and tools that support AI-driven innovation, as well as to the development of the experimental LUMI-IQ quantum platform, which combines artificial intelligence with supercomputing and quantum computing. The Czech Republic was successful in the EuroHPC JU call and secured the establishment of the Czech AI Factory, coordinated by VSB – Technical University of Ostrava. IT4Innovations will therefore host a new supercomputer optimised for AI workloads and provide expert support to research organisations, the public sector, start-ups, and industrial companies. These initiatives represent a major step towards strengthening Europe's technological sovereignty and competitiveness.

We also continued to build the pan-European digital infrastructure. We are actively contributing to the development of the unique EuroHPC Federation Platform, which will unify access to all EuroHPC JU supercomputers and quantum systems, providing users with a single environment for handling computational and data resources. This initiative has also been complemented by the EUROQHPC-I project, which focuses on the coordinated integration of European quantum computers with EuroHPC supercomputers. Another confirmation of the IT4Innovations' growing position within the European research landscape was our admission to the European Quantum Industry Consortium

(QuIC), which brings together leading organisations shaping the future of European quantum technologies and research.

Energy efficiency of computing systems remains another important area of our development. In 2025, we marked ten years of research in this field, during which the MERIC software was developed to measure and optimise the energy consumption of supercomputing applications. Today, MERIC is deployed not only on our Karolina supercomputer but also on the Portuguese Deucalion system. This long-term research is now being followed by the new European SEANERYS project, which aims to develop the next generation of software tools for more energy-efficient operation of European supercomputers. As computing systems continue to improve in performance, the importance of their sustainable operation increases.

Our research activities have also expanded through a number of new European projects. We launched the DARE project, aimed at strengthening Europe's digital sovereignty by developing European processor technologies for HPC and AI based on the RISC-V architecture. The EVITA project will contribute to educating a new generation of HPC and AI specialists, while InnovAlte connects cutting-edge research with practical applications of artificial intelligence in areas such as energy, transport, cybersecurity, and insurance.

Excellent research remains one of the key pillars of IT4Innovations. Last year, we again contributed to numerous scientific results published in the world's most prestigious journals. Our research teams are advancing the new drug and materials design as well as the development of quantum algorithms and artificial intelligence methods. At the same time, we are placing increasing emphasis on ensuring that our research delivers practical impact. Examples include our collaboration with Telight to improve cell analysis using artificial intelligence and the development of 3D vascular models with University Hospital Ostrava to support the planning of colorectal cancer surgery.

Towards the end of the year, we made an important strategic decision regarding the future direction of our centre. The IT4Innovations International Scientific Panel selected five new IT4Innovations flagship research projects, which will represent our key research priorities in the years ahead. These ambitious projects combine scientific excellence with socioeconomic impact and reinforce our long-term strategy to address the challenges that will shape Europe's future.

An equally important part of our mission remains educating the next generation of experts and promoting modern technologies. We actively contributed to European educational initiatives, organised conferences, training courses and summer schools, and welcomed a record number of visitors during Researchers' Night, thanks in part to the VLQ quantum computer. We firmly believe that sharing knowledge and inspiring young people is one of the best investments in the future.

In conclusion, I would like to thank all our colleagues, partners, users of our services, and supporters who have contributed to these achievements. Thanks to their expertise, commitment, and shared vision, IT4Innovations continues to strengthen its position among Europe's leading supercomputing centres. I believe that 2025 marked another significant step forward in our journey towards new scientific discoveries, technological innovation, and international collaboration.

Sincerely,

Vít Vondrák

Managing Director



01

IT4Innovations Profile

IT4Innovations IT4Innovations National Supercomputing Center (IT4Innovations) is a university institute of VSB – Technical University of Ostrava. It is a leading research, development, and innovation centre in the field of High-Performance Computing (HPC), High-Performance Data Analysis (HPDA), Quantum Computing (QC), and Artificial Intelligence (AI), including their applications in science, industry, and society. Since 2013, IT4Innovations has been providing state-of-the-art supercomputing technologies and services and, from 2025, quantum technologies and services to both Czech and international research teams from academia and the private sector, with the goal of boosting competitiveness and fostering innovation in science and industry. Together with CESNET and CERIT-SC, IT4Innovations constitutes **e-INFRA CZ**, a strategic research infrastructure of the Czech Republic. This infrastructure is listed in the National Roadmap for Large Infrastructures for Research, Experimental Development, and Innovations, prepared by the Ministry of Education, Youth and Sports of the Czech Republic (MEYS). IT4Innovations currently operates two supercomputers. **Karolina**, installed in summer 2021, achieves a theoretical peak performance of 15.7 PFlop/s, while **Barbora**, launched in autumn 2019, offers 849 TFlop/s. The new generation of supercomputers, namely Barbora NG and Karolina NG, will be launched in 2026 and 2027, respectively.

As a member of the LUMI consortium, IT4Innovations also participates in the operation of **LUMI**, one of Europe's most powerful supercomputers, located in Kajaani, Finland. Thanks to this, the Czech research community has access to this system, which offers a theoretical peak performance of 531.5 PFlop/s.

Within its data room, IT4Innovations also operates complementary systems comprising multiple hardware platforms. These systems provide users with access to emerging, non-traditional, and highly specialised hardware architectures.

In 2025, the installation of VLQ, the first Czech quantum computer, was completed as part of the LUMI-Q consortium, which comprises 13 partners from eight European countries. **The VLQ quantum computer** is based on 24 superconducting qubits in a star-shaped topology. It is also integrated with the Karolina supercomputer, and integration with other supercomputers both within and beyond the LUMI-Q consortium is planned.

Since the beginning of 2025, IT4Innovations has been involved in implementing the **EuroHPC Federation Platform** (EFP) for the EuroHPC JU. This assignment aims to federate all EuroHPC supercomputing and quantum systems, including their integration with European data infrastructures. The objective is to unify and simplify access to all computing and data infrastructures operated by the EuroHPC JU. The backbone of the EFP computational workflow and distributed data management is formed by the LEXIS Platform components, which are being

developed right here at IT4Innovations. The pilot launch of the EFP, as well as its second version, is scheduled for 2026.

The core research topics at IT4Innovations include large-scale data processing and analysis, machine learning and AI, the development of scalable parallel algorithms and algorithms for quantum computers and simulators, solving challenging engineering problems, advanced visualisation and virtual reality, materials design, and energy efficiency of supercomputing technologies.

In 2025, the IT4Innovations International Scientific Panel selected five projects with the highest scientific and socioeconomic impact to serve as **IT4Innovations research flagships**. In the coming years, MERIC, CADENCE, LEXIS Platform, AURORA, and HPQC4F will push the boundaries of HPC, AI, and quantum technologies. In the same year, IT4Innovations became a member of the European Quantum Industry Consortium (**QuIC**), which supports the development of commercial quantum technologies and connects businesses, investors, research organisations, and academia.

IT4Innovations is a member of the **MaX, SPACE, POP3, and CLARA Centres of Excellence**. Within the CLARA Centre of Excellence, a Testbed is being established at IT4Innovations to support the scientific community researching neurodegenerative diseases using both quantum and classical supercomputing. IT4Innovations is also a partner in more than **27 international projects** under Horizon 2020, Horizon Europe, and Digital Europe programmes, and has coordinated projects such as EXA4MIND and EDIH Ostrava.

IT4Innovations actively cooperates with the industry. Experts from the **European Digital Innovation Hub Ostrava** (EDIH Ostrava) and the **National Competence Centre in HPC** are available to assist, especially SMEs and startups, by providing a wide range of services in supercomputing and in the adoption and application of digital technologies.

IT4Innovations is also actively involved in the European network of AI Factories – it is a member of the **LUMI AI Factory** and the coordinator of the **Czech AI Factory**. The primary objective of AI Factories is to foster the development of AI startups and the deployment of AI across industry, public administration, and society.

IT4Innovations has long organised and offered a wide range of specialised **training events focused on HPC, HPDA, AI, QC**, and on acquiring skills necessary for the effective use of supercomputing infrastructures. In 2025, the centre organised more than 40 educational events. It also focuses on developing digital skills. In these areas, IT4Innovations is actively involved in educating students, particularly through study programmes at VSB-TUO. IT4Innovations is a member of the **EUMaster4HPC** consortium, which implements the eponymous pan-European MSc study programme focused on high-performance computing, quantum computing, and artificial intelligence.

→ RESEARCH LABS

- Advanced Data Analysis and Simulations Lab
- Infrastructure Research Lab
- Parallel Algorithms Research Lab
- Modelling for Nanotechnologies Lab
- Quantum Computing Lab

History

- 2011

→ Foundation of IT4Innovations
→ Membership in PRACE (Partnership for Advanced Computing in Europe)
- 2013

→ Launch of the Anselm supercomputer
- 2014

→ Opening of the IT4Innovations building
- 2015

→ Launch of the Salomon supercomputer
- 2016

→ Membership in ETP4HPC (European Technology Platform for High-Performance Computing)
- 2018

→ The Czech Republic joins the EuroHPC Joint Undertaking (EuroHPC JU) with IT4Innovations playing a significant role in its activities
→ IT4Innovations becomes part of the H2020 POP2 Centre of Excellence
- 2019

→ Launch of the Barbora supercomputer and the NVIDIA DGX-2 system
→ Membership in BDVA (Big Data Value Association) and EUDAT CDI
→ Foundation of e-INFRA CZ
→ Launch of the LEXIS project, coordinated by IT4Innovations
- 2020

→ Foundation of the Digital Innovation Hub Ostrava
→ IT4Innovations becomes the National Competence Centre in HPC
- 2021

→ Launch of the Karolina supercomputer
→ Termination of operating the Anselm and Salomon supercomputers
→ Membership in the EOSC Association
- 2022

→ Foundation of the European Digital Innovation Hub Ostrava (EDIH Ostrava)
- 2023

→ IT4Innovations joins the iRODS consortium
→ Completion of the complementary system's installation
→ Start of the EXA4MIND project, coordinated by IT4Innovations
→ IT4Innovations becomes part of the MaX and SPACE Centres of Excellence
- 2024

→ Contract signed for the delivery of the VLQ quantum computer of the LUMI-Q consortium
→ IT4Innovations becomes part of the POP3 and CLARA Centres of Excellence
→ Membership in VI-HPS and WHPC
- 2025

→ Installation of the VLQ quantum computer
→ IT4Innovations becomes part of the LUMI AI Factory
→ Successful Czech AI Factory project proposal
→ Collaboration on the delivery of the EuroHPC Federation Platform
→ Membership in QuIC

Mission, Vision, and Memberships

- Mission

Our mission is to carry out excellent research in the field of high-performance and quantum computing, advanced data analysis, and artificial intelligence, and to operate the leading national supercomputing and quantum infrastructure, mediating its effective use to increase the competitiveness and innovation of Czech science and industry.
- Vision

Our vision is to become a leading supercomputing centre that provides professional services and conducts excellent research in high-performance and quantum computing, the processing of advanced data sets, and artificial intelligence, for the benefit of science, industry, and society as a whole.
- Memberships

IT4Innovations actively participates in the EuroHPC Joint Undertaking activities and is a member of critical European infrastructures, initiatives, and associations in HPC, HPDA, AI, and QC. They include the following:

→ BDVA – Big Data Value Association

→ EOSC – European Open Science Cloud

→ ETP4HPC – European Technology Platform for High-Performance Computing

→ EUDAT CDI – EUDAT Collaborative Data Infrastructure

→ iRODS – Integrated Rule-Oriented Data System

→ LUMI – Large Unified Modern Infrastructure

→ LUMI-Q – Large Unified Modern Infrastructure for Quantum Computing

→ PRACE – Partnership for Advanced Computing in Europe

→ QuIC – European Quantum Industry Consortium

→ VI-HPS – Virtual Institute – High Productivity Supercomputing

→ WHPC – Women in High Performance Computing
- Review 2025 | 11

Organisational Structure

IT4Innovations

IT4Innovations Management

Managing Director | Doc. Vít Vondrák

Scientific Director | Prof. Tomáš Kozubek

- [Advanced Data Analysis and Simulations Lab](#) | Dr Jan Martinovič
- [Infrastructure Research Lab](#) | Doc. Lubomír Říha
- [Parallel Algorithms Research Lab](#) | Dr Tomáš Karásek
- [Modelling for Nanotechnologies](#) | Prof. Michal Otyepka
- [Quantum Computing Lab](#) | Prof. Marek Lampart
- [Training and Education](#) | Karina Pešatová

Supercomputing Services Director | Dr Branislav Janský

- [HPC Operations and Administrations](#) | Radovan Pasek
- [User Support](#) | Petra Lyčková Navrátilová

- [Communications](#) | Zuzana Červenková
- [Public Procurement and Legal Service](#) | Jan Juřena
- [Finance](#) | Petr Válek
- [Security, Operations, and Facility Management](#) | Helena Starková
- [Strategic Development](#) | Martin Duda

Scientific Council of IT4Innovations

Chairman | Doc. Vít Vondrák

Internal Members

- Prof. Tomáš Kozubek
- Dr Branislav Janský
- Dr Jan Martinovič
- Doc. Lubomír Říha
- Dr Tomáš Karásek
- Prof. Michal Otyepka
- Prof. Marek Lampart

External Members

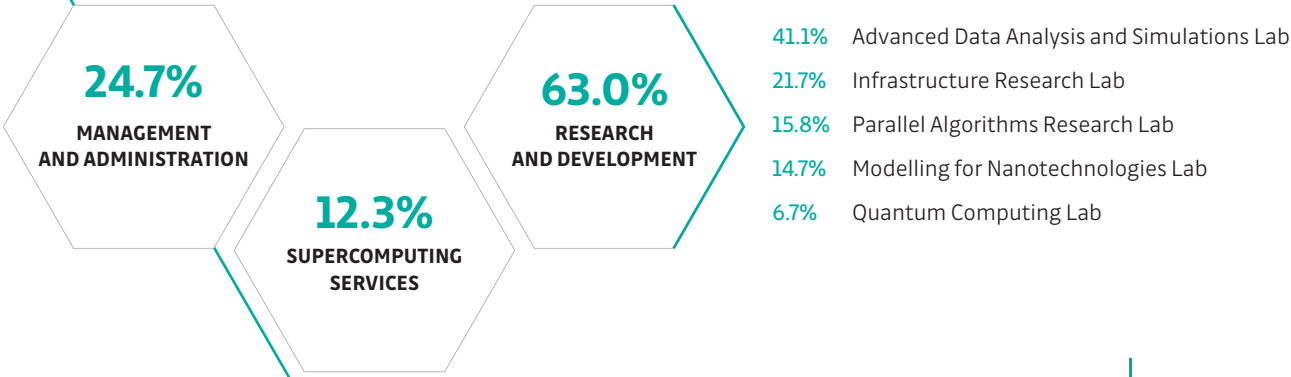
- Prof. Jiří Damborský | [Loschmidt Laboratories of Masaryk University Brno](#)
- Prof. Jiří Jaroš | [Faculty of Information Technology, Brno University of Technology](#)
- Dr Jakub Šístek | [Institute of Mathematics of the Czech Academy of Sciences](#)
- Prof. Jiří Vondrášek | [Institute of Organic Chemistry and Biochemistry of the Czech Academy of Sciences](#)
- Dr Petr Kavalíř | [University of West Bohemia in Pilsen](#)

IT4Innovations International Scientific Panel

- Prof. Claudio Pica | [University of Southern Denmark, Denmark](#)
- MSc. Maike Gilliot | [CEA, France](#)
- Prof. Pinar Karagöz | [Middle East Technical University, Turkey](#)
- Dr. Manolis Marazakis | [Foundation for Research and Technology, Greece](#)
- Dr Andreas Lintermann | [Jülich Supercomputing Centre, Germany](#)
- Prof. Leticia González | [University of Vienna, Austria](#)
- Prof. Göran Wendin | [Chalmers University, Sweden](#)

Employees of IT4Innovations

As of 31 December 2025, the total number of IT4Innoations employees expressed in full-time equivalent (FTE) was 178.47, broken down as follows:





02

IMPORTANT EVENTS

January

- IT4Innovations involved in delivering the **EuroHPC Federation Platform** for easier access and Single Sign-On to the supercomputers and quantum systems of the EuroHPC JU.
- Launch of the **TerraDT** project, with IT4Innovations being part of its consortium. The objective is to create a digital twin that will help to better understand how glaciers, sea ice, vegetation, and aerosols influence the Earth's climate.
- Research into the modelling of lipid-based drug carriers, conducted by Michal Otyepka from IT4Innovations and the TOP NANO lab, alongside scientists from CATRIN, Sanofi, and French research institutions, featured on the supplementary cover of **Molecular Pharmaceutics**.

February

- IT4Innovations launched a four-year project **titled Increasing the resilience of power grids in the context of decarbonisation, decentralisation, and sustainable socioeconomic development** (ZEUS), supported by the Programme Johannes Amos Comenius.
- The Czech **BRM AERO** company, in cooperation with Airmobis, secured a grant worth CZK 5 million from the European FFplus initiative. IT4Innovations will also participate in implementing the project.
- IT4Innovations participated in research into nitrogen-doped graphene for the efficient separation of xenon and krypton, which has potential for gas separation technologies and was also featured on the cover of the journal **Small**.
- Marek Lampart appointed by Marek Ženíšek, the Minister for Science, Research and Innovation and Chairman of the Research, Development and Innovation Council, as a **member of Expert Panel 1: Natural Sciences**, an advisory body to the Research, Development and Innovation Council (RVVI).
- Two research projects involving IT4Innovations made the cover of the journal **Nanoscale**. These studies investigate the molecular-level mechanism of carbon dot formation from citric acid and ethylenediamine, and sustainable, metal-free photocatalysts based on carbon dots.

March

- IT4Innovations became a member of the **Czech Association of Artificial Intelligence**.
- Launch of the **LUMI AI Factory Service Center**, a project that actively built and strengthened the ecosystem of environments, tools and services needed to foster innovation. It was part of the broader LUMI AI Factory ecosystem.
- Launch of the **DARE** project, which aims to strengthen Europe's digital autonomy in high-performance computing and artificial intelligence. The project will utilise the open RISC-V architecture, chiplet technology, and open-source software to develop three specialised chiplets for HPC and AI. These modules will be integrated into European supercomputers.

April

- Launch of the **EVITA** (EuroHPC Virtual Training Academy) project, which will strengthen education in HPC and AI in Europe. The aim is to create a connected community of students, educators and industry experts equipped with cutting-edge knowledge and skills.
- IT4Innovations became a member of the **QuIC** consortium (European Quantum Industry Consortium).
- Radek Halfar and Jan Martinovič from IT4Innovations, together with scientists from the Loschmidt Laboratories, introduced **Moldina**, a powerful tool designed to accelerate drug design and computational enzymology.
- Research involving IT4Innovations made the cover of the prestigious journal **ACS Applied Materials & Interfaces**. The study shows how a single amino acid substitution can fundamentally affect macrophage behaviour, offering a new approach to the design of immunomodulatory materials to control inflammation and promote tissue regeneration.
- IT4Innovations participated in the 24-hour **quantum hackathon** organised by BlueQubit in cooperation with Yale University, where it achieved an outstanding result among 1.603 participants from around the world.

May

- Scientists from the Czech Academy of Sciences, Charles University, and Thibault Derrien from IT4Innovations achieved an extraordinary breakthrough: they managed to **control the movement of electrons** in solids with extreme precision – **on the attosecond timescale**, a time shorter than a billionth of a billionth of a second. The research was published in Physical Review Letters.
- Launch of the **GBS4EO** (Gaussian Boson Sampling for Earth Observation) project, funded by the European Space Agency. The part focused on utilising quantum computing simulations for satellite data analysis is handled by IT4Innovations using the VLQ quantum computer.
- Launch of the **LUMI-IQ** project for the development of the LUMI AI Factory quantum computing platform. Together with the new LUMI-AI supercomputer, it provides researchers, industrial innovators, and developers across Europe with a unique, advanced experimental environment optimised for artificial intelligence, where quantum computing and AI converge.
- Publication of the new **Atlas of Quantum Computing Use Cases**, providing an overview of the practical uses of quantum technologies and current developments in quantum computing across disciplines.
- The **President of the Czech Republic**, Petr Pavel, visited IT4Innovations.

June

- Anum Shafiq from IT4Innovations was appointed to the **Editorial Board** for mechanical engineering at Scientific Reports, a journal published by Nature Portfolio.
- Launch of the **SEANERGY** project, aimed at developing a new generation of software for the more energy-efficient operation of EuroHPC JU supercomputers. IT4Innovations is involved in developing AI models, data visualisation, resource management, and advancing MERIC software for energy consumption measurement and CPU and GPU optimisation.
- Launch of the **InnovAlte Slovakia** project, aimed at the wide practical application of AI in sectors such as energy, (cyber)security, transport, and insurance. Within the project, IT4Innovations applies its expertise in AI, HPC, synthetic data, and the development of advanced tools for predictive control, video analysis, and algorithmic solution design.

July

- Maximilián Lamanec from IT4Innovations and the Czech Academy of Sciences was awarded the **Jean-Marie Lehn Prize** for Chemistry 2025.
- IT4Innovations is involved in the development of a tool that could significantly **simplify and improve the precision of colorectal cancer surgeries**. By combining artificial intelligence with IT4Innovations supercomputers, a detailed 3D model of the blood vessels in the abdominal cavity is being created, enabling surgeons to plan procedures more effectively and reduce the risk of complications.

August

- A team of scientists, including Michal Otyepka and David Řeha from IT4Innovations, successfully developed a **new rhodium-based catalyst** that efficiently converts waste glycerol from biodiesel production. Supported by the **REFRESH** project and IT4Innovations supercomputers, the research was published in Applied Materials Today.

September

- Inauguration ceremony for the launch of the **VLQ** quantum computer.
- IT4Innovations will push the boundaries of quantum optimisation thanks to the new **Quantum error correction codes enhanced by reinforcement learning dedicated for the Ising model-based optimization** project. Supported by the Moravian-Silesian Region under the Vouchers for Universities programme, the project focuses on developing an adaptive quantum error correction system for optimisation tasks.
- Launch of the **ARCHIVE** central storage with a capacity of over 10 PB.
- An international team of scientists, including Vladimír Ulman from IT4Innovations, presented the **MIFA** (Metadata, Incentives, Formats and Accessibility) recommendations. These recommendations are intended to accelerate the development of artificial intelligence for analysing biological images.
- IT4Innovations welcomed a record number of visitors for **Researchers' Night**, drawing nearly 1400 people.

October

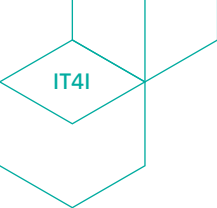
- The Czech Republic succeeded in the EuroHPC JU call and will secure its own artificial intelligence factory, the **Czech AI Factory**, which will also host a new AI supercomputer.
- Launch of the **EUROQHPC-I** project, which brings together six entities hosting quantum computers to achieve their coordinated integration with EuroHPC supercomputers. Within the project, common integration methods, applications, and benchmarks for validating these integrations will be developed, and a joint technical support forum will be established.
- Users of the **Karolina supercomputer** were honoured at the third edition of the EuroHPC User Days.
- A new study by Tomáš Hrivnák, Andrey Rogach, and Michal Otyepka from IT4Innovations, co-authored by researchers from CATRIN at Palacký University, featured on the front cover of the journal **Nanoscale**. The research demonstrates how advanced computational methods can help design sustainable, metal-free photocatalysts based on carbon dots – fascinating nanomaterials with exceptional optical properties and great potential for green technologies.

November

- Artificial intelligence and the Karolina supercomputer have enabled the **Telight** company to improve the accuracy of cell analysis. Vladimír Ulman from IT4Innovations contributed to the resulting solution.
- The **9th IT4Innovations Users' Conference** attracted nearly 90 representatives from more than 15 institutions.

December

- The IT4Innovations International Scientific Panel selected five **IT4Innovations research flagship projects** with the highest scientific and socioeconomic impact to push the boundaries of high-performance computing, AI, and quantum technologies in the coming years: MERIC, CADENCE, LEXIS Platform, AURORA, and HPQC4F.
- IT4Innovations succeeded with three proposals for standard projects from the **Czech Science Foundation**.
- Michal Otyepka from IT4Innovations co-authored a review article dedicated to the role of artificial intelligence in materials design. The study was featured on the front cover of the journal **Applied Materials Today**.
- St. Anne's University Hospital Brno, MUNI, and VSB-TUO entered into a licensing agreement with Enantis for **the use of the AggreProt software**. Jan Martinovič's team from IT4Innovations helped develop the software, co-authoring a highly accurate, machine-learning-based predictor of aggregation-prone regions, trained on labelled (non-)amyloidogenic hexapeptides.



03

FINANCIAL REVIEW

IT4Innovations Economic Balance

In 2025, IT4Innovations’ total expenditures amounted to CZK 333,893,000. Of this amount, operating (non-investment) and investment (capital) expenditures accounted for 97.7% and 2.3%, respectively.

Operating expenditures amounted to CZK 326.2 million. The largest share of these expenditures consisted of personnel costs, services (including electricity consumption costs, maintenance of operated systems and supporting infrastructure, technical and system support, etc.), and overheads. Investment expenditures amounted to CZK 7.7 million in 2025, covering, among other things, structural modifications to the data room, adjustments related to the cooling modernisation, the ARCHIVE storage, and a tracking system for the Virtual Reality and Visualisation Lab.

In 2025, a pre-tax profit of CZK 3,784,000 was achieved.

IT4Innovations Economic Balance

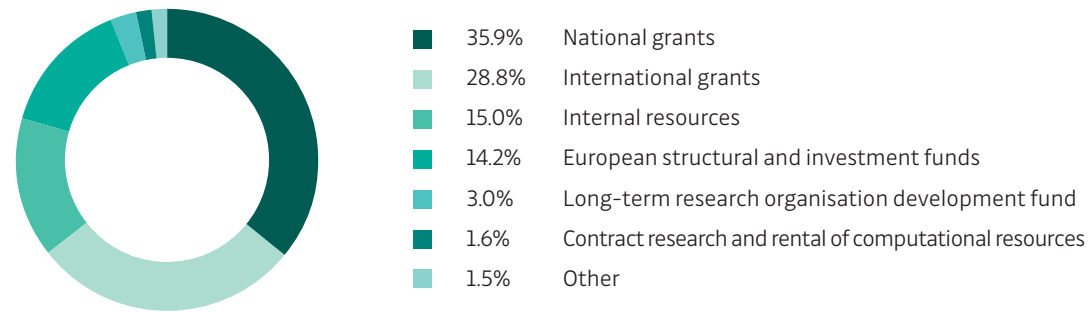
A. Operational expenditures	Personnel costs – research teams	CZK 136,261,000
	Personnel costs – management and administration	CZK 51,142,000
	Personnel costs – supercomputing services	CZK 25,828,000
	Services	CZK 58,007,000
	Overheads	CZK 36,585,000
	Domestic and international business trips	CZK 9,051,000
	Minor tangible fixed assets	CZK 2,806,000
	Consumables	CZK 2,656,000
	Fees	CZK 1,734,000
	Scholarships	CZK 1,502,000
	Other costs	CZK 655,000
	Total operational expenditures	CZK 326,227,000
B. Investment expenditures	Tangible Fixed Assets – machines and equipment	CZK 6,898,000
	Tangible Fixed Assets – buildings	CZK 768,000
	Total Investment expenditures	CZK 7,666,000
C.	Total expenditures (A. + B.)	CZK 333,893,000
D.	Total sources of funding	CZK 337,677,000
E.	Balance total (D. - C.)	CZK 3,784,000

Sources of Funding

In 2025, IT4Innovations’ overall budget was CZK 337,677,000. National grants accounted for the largest share of funding sources, followed by international grants and internal resources (operating fund and contributions to educational activities).

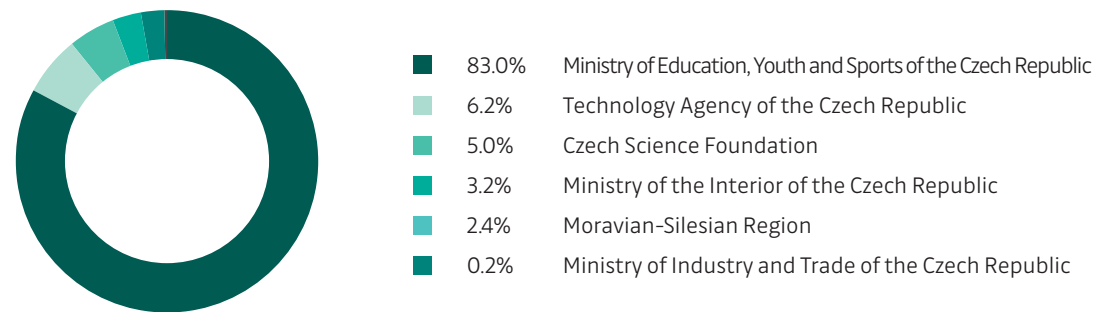
Sources of funding for the institute's costs

CZK 337,677,000 in total



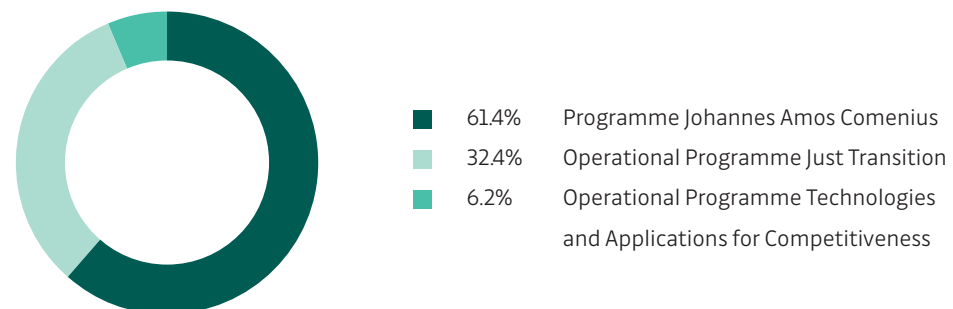
National grants

CZK 121,203,000 in total



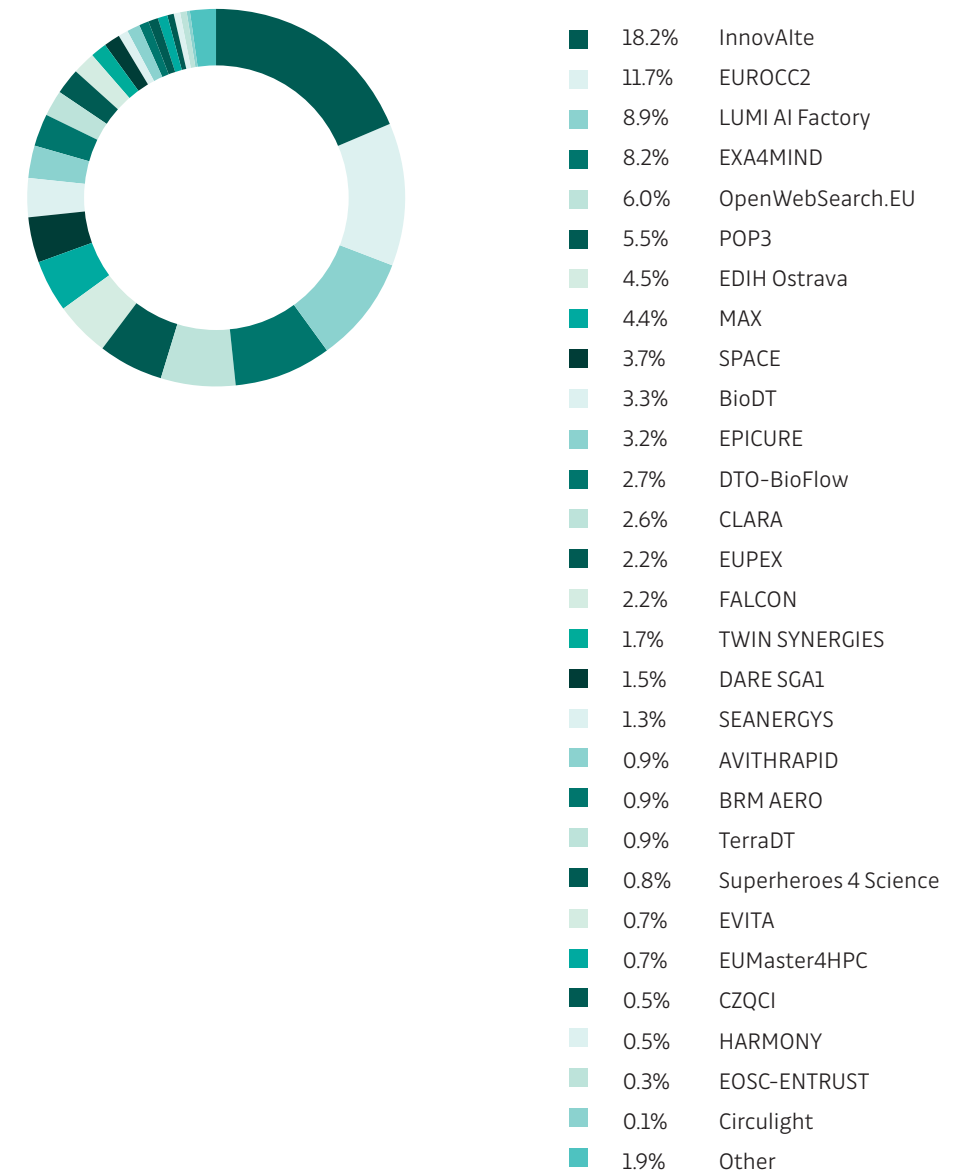
European structural and investment funds

CZK 48,137,000 in total



International grants

CZK 97,134,000 in total



04

LIST OF IT4INNOVATIONS PROJECTS

NATIONAL PROJECTS

Projects supported by the Ministry of Education, Youth and Sports

Large Infrastructure for Research, Experimental Development and Innovation Project

→ e-Infrastructure CZ

Projects of the Programme Johannes Amos Comenius

- Modernisation of e-INFRA CZ II
- Center for Artificial Intelligence and Quantum Computing in System Brain Research
- European Open Science Cloud Czech Republic
- National Repository Platform for Research Data
- Open Science II
- Increasing the resilience of power grids in the context of decarbonisation, decentralisation, and sustainable socioeconomic development

International Cooperation in Research and Development

- Influence of thermoelectrical effects on spin-orbit torques in 2D van der Waals materials

Projects supported by the Moravian-Silesian Region

Program Global Experts

- Experimental and theoretical studies of near-infrared emitting chiral carbon dot luminophores

Vouchers for Universities

- Quantum error correction codes enhanced by reinforcement learning dedicated for the Ising model-based optimisation

Projects supported by the Czech Science Foundation

International Grant Projects Evaluated on the LEAD Agency principle

- Magnetism at interfaces: from quantum to reality
- RE-free magnetoelastic materials for efficient and environmentally friendly cooling

Standard Grant Projects

- Novel thermoelectric, thermovoltaic, and piezoelectric heat conversion systems based on nitrides semiconductors

Postdoc individual fellowship – incoming

- Magnetoelasticity of non-cubic materials in spin-lattice dynamic simulations

Projects supported by the Technology Agency of the Czech Republic

M-ERA.NET Programme

- FutureMold – Flexible manufacturing approach for recyclable bio-based high-performance composite molds

TREND Programme

- Optimisation of design and production processes of vertical pumps using modern technologies
- System for real-time monitoring of aseptic production of gene therapy medicinal products

Projects supported by the Ministry of Industry and Trade

Operational Programme Technologies and Applications for Competitiveness

- EyeERP – complex ERP system for eye clinics with mobile application MojeOči for performing and AI analysis of eye tests
- Advanced medical data visualisation with AI support
- Research and development of advanced analysis and interpretation of atomic force microscopy data using artificial intelligence and machine learning

Projects supported by the Ministry of the Interior

- Research on holistic model of interconnected critical electricity and communication infrastructures

VSB-TUO Projects with IT4Innovations Participation

- REFRESH – Research Excellence For REgion Sustainability and High-tech Industries
- Validation of integrating artificial intelligence for receiving emergency calls
- Combination of holographic and digital safety protection
- National Centre for Energy II
- Proof of Concept Explorer

INTERNATIONAL PROJECTS

Projects of the 8th Framework Programme for Research and Innovation of the European Union – Horizon 2020

- EUMaster4HPC – European Master for High Performance Computing
- EUPEX – European Pilot for Exascale

Projects of the 9th Framework Programme for Research and Innovation of the European Union – Horizon Europe

- BioDT – Biodiversity Digital Twin for Advanced Modelling, Simulation and Prediction Capabilities
- OpenWebSearch.EU – Piloting a Cooperative Open Web Search Infrastructure to Support Europe's Digital Sovereignty
- EXA4MIND – EXtreme Analytics for MINing Data spaces
- SPACE – Scalable Parallel and distributed Astrophysical Codes for Exascale
- MaX – MATerials design at the eXascale
- DTO-BioFlow – Integration of biodiversity monitoring data into the Digital Twin Ocean
- FALCON – Foreseeing the next generation of Aircraft
- POP3 – Performance Optimisation and Productivity 3
- AVITHRAPID – Antiviral Therapeutics for Rapid Response Against Pandemic Infectious Diseases
- CLARA – Center for Artificial Intelligence and Quantum Computing in System Brain Research
- EOSC-ENTRUST: A European Network of TRUSTed research environments
- TWIN SYNERGIES – Empowering participation and accelerating synergies in Widening countries with a focus on Green & Digital Transition
- TerraDT – Digital Twin of Earth system for Cryosphere, Land surface and related interactions
- SEANERGYS – Software for Efficient and Energy-Aware Supercomputers
- DARE SGA1 – Digital Autonomy for RISC-V in Europe (Specific Grant Agreement 1)
- BRM Aero – Optimization of low-speed characteristics & performance of aircraft
- HARMONY – A Hybrid Generative AI-model for Resolving Molecular Structures integrating sequence and Cryo-Electron Microscopy data
- LAIF Service Center – LUMI AI Factory – Service Center
- LUMI-IQ – LUMI AI Factory – Advanced experimental AI-optimised quantum-based platform

Digital Europe Programme

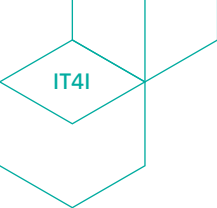
- EUROCC 2 – National Competence Centres in the Framework of EuroHPC Phase 2
- CZQCI – Czech National Quantum Communication Infrastructure
- EDIH Ostrava – European Digital Innovation Hub Ostrava
- EPICURE – High-level specialised application support service in High-Performance Computing
- EUROQHPC-I – EuroQHPC-Integration
- EVITA – EuroHPC Virtual Training Academy

Project supported by the Deputy Prime Minister's Office for the Recovery Plan and the Knowledge Economy of the Slovak Republic

- InnovAlte Slovakia: Illuminating Pathways for AI-Driven Breakthroughs

International Visegrad Fund

- Superheroes 4 Science



05

SUPERCOMPUTING SERVICES

Supercomputers

IT4Innovations operates the most powerful publicly accessible supercomputing and quantum systems in the Czech Republic, primarily serving academic institutions and research organisations. Part of the capacity is dedicated to developing collaboration between academia and industry and to providing contract partners with commercial rental. In 2025, more than 2,800 active users utilised the computing infrastructure.

In addition to operating the **Karolina** and **Barbora** supercomputers, the first Czech quantum computer, named **VLQ**, was installed at the centre. It was acquired by the LUMI-Q consortium, with half of its costs financed by the EuroHPC Joint Undertaking. VLQ features 24 qubits based on superconducting technology, and its star-shaped topology enables more efficient execution of certain quantum algorithms. Its interconnection with the Karolina supercomputer supports hybrid quantum-classical computing. At the same time, preparations were underway for the installation of the new **Barbora NG** supercomputer, which will offer 144 non-accelerated nodes with dual Intel Xeon 6925P processors.

In 2025, LUMI AI Factory Service Center was launched, developing an ecosystem of environments, tools, and industrial services aimed at supporting innovation within **LUMI AI Factory**. In the same year, IT4Innovations, together with its partners, succeeded in the EuroHPC JU call with **Czech AI Factory** (CZAI) – the largest single investment in artificial intelligence infrastructure in the Czech Republic to date. CZAI is a key instrument for implementing the National Artificial Intelligence Strategy 2030, and its core will be the specialised **KarolAlna** supercomputer, which is scheduled for installation at IT4Innovations in 2026.

In 2025, IT4Innovations operated two supercomputers — Karolina (15.7 PFlop/s) and Barbora (849 TFlop/s). The petascale **Karolina** system was fully commissioned in summer 2021. It was acquired under the EuroHPC JU, with 35% of its computing capacity having been made available to users from EuroHPC JU member states.

In 2025, the delivery of the new **Barbora NG** supercomputer, the successor to the Barbora system, commenced. The new system consists of 144 non-accelerated computing nodes, each equipped with dual Intel Xeon 6925P processors. Compared to the previous generation, it primarily delivers increased performance and memory throughput, enabling faster processing of large-scale data tasks and more efficient execution of memory-intensive simulations. Full acceptance and deployment into standard operation are planned for 2026.

IT4Innovations computational resource users with active projects can use two **cloud environments**, created from Karolina’s cloud nodes. The **e-INFRA CZ Cloud** is available to users of the e-INFRA CZ e-infrastructure, while others can access the **IT4I Cloud**.

Thanks to IT4Innovations’ membership in the LUMI consortium, composed of eleven European countries, Czech researchers can use one of the world’s most powerful and modern supercomputers – **LUMI**. Fully operational since 2023, LUMI offers a theoretical peak performance of 531.5 PFlop/s. IT4Innovations is part of its management structure, provides expert support to users through the LUST (LUMI User Support Team), participates in its operation, and develops software tools such as HyperQueue, which allows users to efficiently utilise the available computational resources of LUMI. In 2025, LUMI’s computational resources were allocated to **133 projects** through IT4Innovation’s Open Access Grant Competitions, totalling 1.25 million node hours.

IT4Innovations also operates specialised systems with various hardware platforms, allowing access to emerging and specialised architectures. It includes, for example, NVIDIA Grace CPU Superchip, featuring two processors, each with 72 Arm Neoverse V2 cores. This architecture, together with fast LPDDR5X memory, represents the current trend in HPC. The same type of processor is also used in Europe’s first exascale JUPITER supercomputer, installed in Jülich, Germany.

The IT4Innovations data room also houses a large-capacity data storage system called PROJECT, which stores and backs up data processed or generated on IT4Innovations’ supercomputers. It is available to all projects and users utilising the centre’s services. For each active project, a dedicated project directory is created, whose lifecycle strictly mirrors the project’s lifecycle. The total storage capacity is 15 PB.

In 2025, IT4Innovations launched a new central storage system dedicated to the long-term, secure preservation of scientific data. It has a capacity of 10 PB and primarily serves members of Research Programme Energy Lab 3 (EL 3): Energy Digitalisation and Transformation under the REFRESH project (Research Excellence for Region Sustainability and High-tech Industries).

**For evaluating the use of IT4Innovations computational resources, we rely on the concept of node hours, as computer clusters and individual nodes differ in architecture and performance. Each computing system has specific parameters, such as processor types, GPU accelerators, and other factors influencing its performance. Although these node hours are summed across different computer clusters for simplification purposes, they do not reflect differences in the performance of individual compute nodes.*

Technical Specifications of the Supercomputers

	BARBORA	KAROLINA	LUMI
Put into operation	Autumn 2019	Summer 2021	Winter 2023
Theoretical peak performance	849 TFlop/s	15.7 PFlop/s	531.5 PFlop/s
Operating system	RHEL 8	Rocky Linux 8.x	HPE Cray OS
Compute nodes	201	831	5,042
Types of compute nodes	192 CPU nodes 2x Intel Cascade Lake 6240, 18-core, 2.6 GHz, 192 GB RAM	756 CPU nodes 2x AMD EPYC 7h12 64-core, 2.6 GHz, 256 GB RAM	2,048 CPU nodes 2x AMD EPYC 7763 core, 2.45 GHz, 256-1,024 GB RAM
	8 GPU nodes 2x Intel Skylake 6126, 12-core, 2.6 GHz, 192 GB RAM 4x NVIDIA Tesla V100, 16 GB HBM2	72 GPU nodes 2x AMD EPYC 7763, 64-core, 2.45 GHz, 1 TB RAM, 8x NVIDIA A100, 40 GB HBM2	2,978 GPU nodes 1x AMD EPYC 7A53, 64-core, 2.45 GHz, 512 GB RAM, 4x AMD Instinct MI250X, 128 GB HBM2e
	1 SMP node 8x Intel Xeon 8153, 16-core, 2.0 GHz, 6 TB RAM	1 data analytics node 32x Intel Xeon-SC 8628, 24-core, 2.9 GHz, 24 TB RAM	8 data analytics nodes 2x AMD EPYC 7742, 64-core, 2.25 GHz, 4 TB RAM
		2 visualisation nodes 2x AMD EPYC 7452, 32-core, 2.35 GHz, 256 GB RAM 1x NVIDIA RTX 6000	8 visualisation nodes 2x AMD EPYC 7742, 64-core, 2.25 GHz, 2 TB RAM, 8x NVIDIA A40
Accelerators in total	32x NVIDIA Tesla V100	576x NVIDIA Tesla A100 2x NVIDIA RTX 6000	11,912x AMD Instinct MI250X, 8x NVIDIA A40
CPU cores in total	7,232	106,880	454,784
Storage	29 TB / home 310 TB / scratch (28 GB/s)	30 TB / home 1,275 TB / scratch (NVMe, 730 GB/s sequential write performance, 1,198 GB/s sequential read performance)	81 PB / (home + project + scratch) (240 GB/s)
Interconnection	Infiniband HDR 200 Gb/s	Infiniband HDR 200 Gb/s	Slingshot-11 200 Gb/s

KAROLINA

IT4Innovations
Data Room

BARBORANG

Computational Resource Allocation

Computing time Providing computational resources is one of the main IT4Innovations' missions. Since 2013, when the first Anselm supercomputer was commissioned, supercomputers have been continuously available to the Czech scientific community and industrial companies.

Computing time on IT4Innovations supercomputers can be acquired in the following ways:

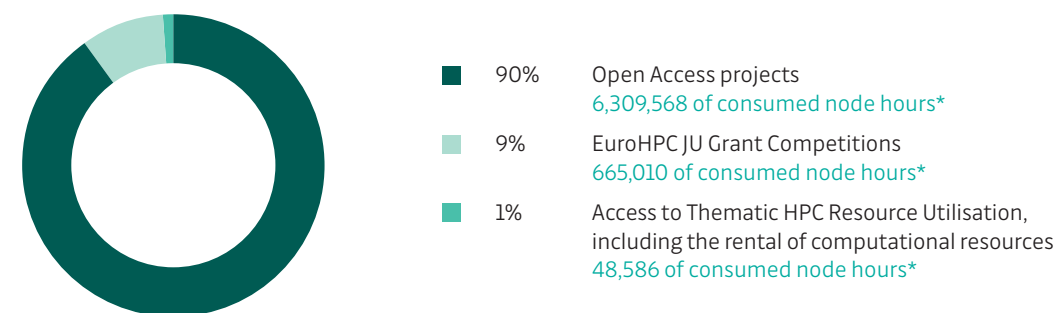
- **Open Access:** IT4Innovations computational resources are allocated to the Czech research community based on scientific excellence, computational competence, readiness, and societal and economic impact. The largest share of computing time is allocated through **Open Access Grant Competitions**, which are announced three times a year. Other options include **Institutional and Community Access**, supporting specific research, development, and innovation activities of selected research organisations, as well as **Fast Track Access**, intended for short-term tasks and application testing.
- **Access to Thematic HPC Resource Utilisation:** Computational resources are provided for socially significant projects, teaching and education, commercial use, and research on the infrastructure itself. Applications can be submitted at any time.

Within both approaches, computing time can be obtained on the Karolina and Barbora supercomputers, as well as on the Finnish LUMI supercomputer, where extensive GPU resources are available to employees of Czech research organisations.

- **EuroHPC JU Grant Calls:** The **EuroHPC Joint Undertaking** regularly announces open calls offering **35% of the capacity of petascale systems** and up to **50% of the capacity of pre-exascale systems**. This also applied to the Czech Karolina supercomputer, where **35% of the capacity** was reserved for projects submitted through these calls.

As part of EuroHPC JU grant calls, users from the Czech Republic can apply for computational resources on the Finnish LUMI supercomputer but also on other European systems such as MareNostrum 5 (Spain), Leonardo (Italy), MeluXina (Luxembourg), Discoverer (Bulgaria), Vega (Slovenia), Deucalion (Portugal), and JUPITER (Germany), the first exascale supercomputer.

Distribution of computational resources in 2025



From 2013 to the end of 2025, IT4Innovations' computational resources were used for **2,888 projects** across various scientific domains – from material and drug design, through engineering problems, to scientific data visualisation. In recent years, however, the focus has increasingly shifted towards artificial intelligence and quantum algorithm research.

In 2025, there were **717 active projects**, which together consumed more than **7 million node hours** of computing time.

*The consumed node hours provide an indication of the actual amount of computing time used in 2025. The total value here comprises all projects that actually ran in 2025 on the Karolina and Barbora supercomputers and the NVIDIA DGX-2 system at IT4Innovations. On the LUMI supercomputer, computational resources were allocated under Open Access to 133 projects, totalling 1,253,554 node hours.

Open Access / Open Access Grant Competitions

In 2025, three Open Access Grant Competitions were announced, supporting a total of **224 research projects**, including 24 multi-year projects. Specifically, these were the 33rd, 34th, and 35th calls.

According to the schedule of each call, successful applicants were granted computational resources during 2025. For standard projects, computational resources are provided for a period of 12 months, while for multi-year projects, they are granted for 24 or 36 months to support long-term research projects.

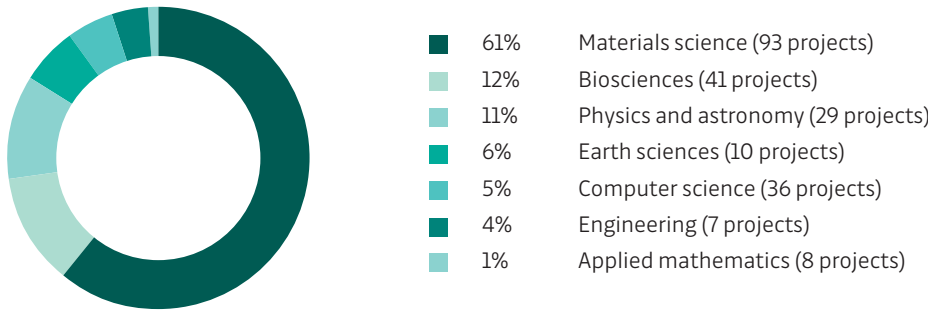
In these three Open Access Grant Competitions, applicants applied for almost 11.2 million node hours. The demand for computational resources exceeded the resources offered; therefore, the allocation committee decided to reduce the allocations for the evaluated projects. In total, **7.5 million node hours** were distributed across 224 projects within these calls on the Karolina, Barbo-ra, Barbora NG, and LUMI supercomputers as well as on the NVIDIA DGX-2 sys-tem. The NVIDIA DGX-2 system had been in operation since 2019. At the end of 2025, it was decided to decommission it from the user offering and reuse it for internal AI development.

Projects in materials science received the most computational resources. Bio-sciences projects ranked second, followed by physics and astronomy projects.

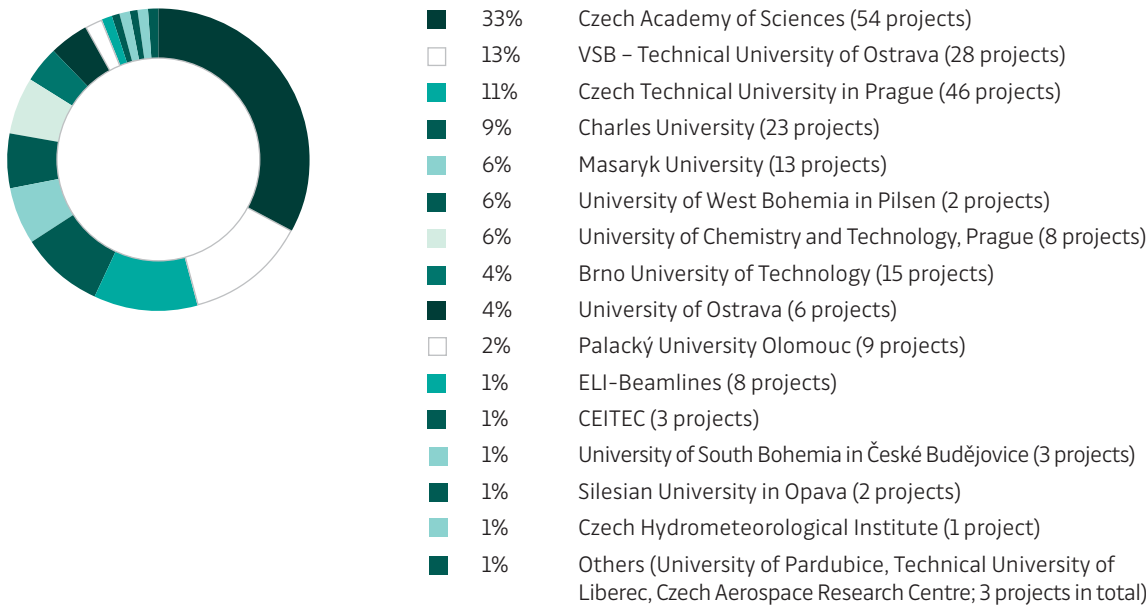
By institution, scientists from the Czech Academy of Sciences institutes re-ceived the highest allocations for their projects. These were followed by VSB – Technical University of Ostrava and the Czech Technical University in Prague. Departments at these institutions are also among the most active applicants for computational resources, with the highest number of projects submitted by researchers from the Czech Academy of Sciences.

Principal Investigators from 12 different institutes of the Czech Academy of Sciences received computational resources for a total of 54 projects. Among the institutes making the greatest use of IT4Innovations infrastructure – as in previous years – were the Institute of Organic Chemistry and Biochemistry (23 projects). Subsequent places were taken by the Institute of Plasma Physics (9 projects), the J. Heyrovsky Institute of Physical Chemistry, and the Institute of Physics (5 projects each).

Computational resources allocated within the Open Access Grant Competition in 2025 by scientific discipline



Computational resources allocated in Open Access Grant Competitions in 2025 by institutions



Computational resources consumed in 2025

Open Access

The computational resources consumed within Open Access Grant Competitions amounted to **6,233,610 node hours**. Within Fast Track Access, the primary aim of which is to prepare for grant competitions, **75,958** node hours.

Thematic Capacity Access

In 2025, **2,893** node hours were used for socially important tasks, training and educational activities, and in-house infrastructure research.

The computational resources provided through paid rental amounted to **45,693 node hours**. These were commercial projects of companies such as AIRMOBIS and DHI.

EuroHPC JU Grant Competitions

In 2025, **665,010 node hours** were provided on the Karolina supercomputer, shared among 140 projects led by Principal Investigators from 74 organisations, including 16 companies, across **25 European countries**.

Most of the projects were from Principal Investigators from KU Leuven university in Belgium, Politecnico di Milano in Italy, and French multinational Valeo company (with 9 projects).

Users of computational resources

The number of active users of the IT4Innovations computing infrastructure increased year-on-year by 8% in 2025, reaching **2,831**.

The IT4Innovations Technical Support received a total of **1,905 queries and requests** in 2025. The internal response time (first reply within 24 hours) was met in 99.31% of cases. The internal closure time (not to exceed 30 days) was met in 98.50% of the queries.

EuroHPC JU Grant Competitions



- 18 projects from Italy
- 15 projects from Germany
- 14 projects from Czech Republic
- 13 projects from France
- 11 projects from Belgium
- 9 projects from Spain
- 9 projects from Denmark
- 7 projects from Austria
- 6 projects from Hungary
- 38 projects from other countries (Turkey, Greece, Israel, Romania, Switzerland, Sweden, Portugal, Poland, Norway, United Kingdom, Slovenia, Netherlands, Iceland, Slovakia, Finland, Lithuania, Ireland)

06

RESEARCH AND DEVELOPMENT

IT4Innovations conducts excellent research primarily in high-performance computing (HPC), high-performance data analytics (HPDA), quantum computing (QC), and artificial intelligence (AI), including their applications in science and industry.

IT4Innovations is a research and development centre with strong international connections. It is involved in all activities of the EuroHPC Joint Undertaking and participates in several key international infrastructures, initiatives, and associations (PRACE, ETP4HPC, EUDAT, BDVA, EOSC, iRODS, QuIC, VI-HPS, WHPC).

In 2025, it was involved in **27 international projects** funded by the Horizon 2020, Horizon Europe, and Digital Europe programmes, coordinating the EX-A4MIND and EDIH Ostrava projects. IT4Innovations is a member of the **MaX, SPACE, POP3, and CLARA** Centres of Excellence.

Since 2020, IT4Innovations has served as the National Competence Centre in HPC within the European EuroCC project. The second phase of this project, EuroCC 2, has been running since 2023.

IT4Innovations has collaborated with the European Space Agency (ESA) since 2015. In 2025, the GBS4EO (Gaussian Boson Sampling for Earth Observation) project was launched. It focuses on using quantum computing simulations to analyse satellite data – a part of the project handled by the IT4Innovations Quantum Computing Lab on the VLQ quantum computer.

In 2025, IT4Innovations' International Scientific Panel selected five projects with the highest scientific and socio-economic impact ➡ **research flagships** that will, in the coming years, push the boundaries of high-performance computing, artificial intelligence, and quantum technologies, supporting both Czech and European science and industry. These flagships have clearly defined scientific goals and a solid implementation plan for the period 2026–2028.

The IT4Innovations' research activities are carried out across five research labs:

- ➔ Advanced Data Analysis and Simulations Lab
- ➔ Infrastructure Research Lab
- ➔ Parallel Algorithms Research Lab
- ➔ Modelling for Nanotechnologies Lab
- ➔ Quantum Computing Lab

The IT4Innovations research labs obtained computational resources for **21 research projects** within the 33rd to 35th Open Access Grant Competitions. These projects received nearly **900 thousand node hours**, representing approximately 12% of the total allocation for all supported projects. The highest number of projects (13) were submitted by researchers from the Modelling for Nanotechnologies Lab, which also received the largest share of computational resources — more than half a million node hours. An additional 250,000+ node hours were awarded to projects from the Parallel Algorithms Research Lab.

➔ IT4INNOVATIONS RESEARCH FLAGSHIPS:

- ➔ **MERIC** ➔ **MERIC Energy Aware Suite**
- ➔ **CADENCE** ➔ **Computationally Accelerated Discovery of Advanced Materials and Biomolecular Systems**
- ➔ **LEXIS Platform** ➔ **Leveraging Europe's extreme-scale Infrastructure for Science**
- ➔ **AURORA** ➔ **Artificial Intelligence for Unified Representation, Observation, Rendering and Advanced Simulation**
- ➔ **HPQC4F** ➔ **High Performance and Quantum Computing for Future**

Summary of Research and Development Results in 2025

Results classified based on the RIV 2017+ methodology

Summary of the achieved IT4Innovations research and development results in 2025

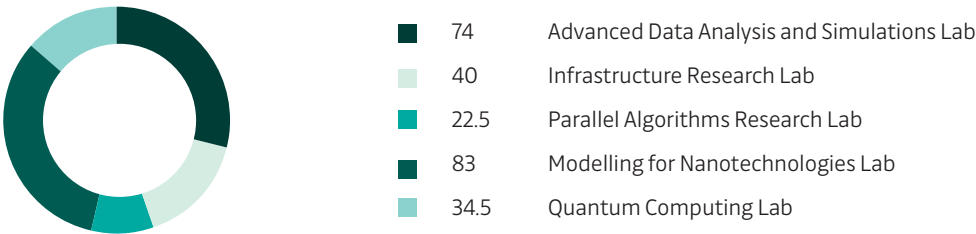
Results classified based on the RIV 2017+ Methodology	Achieved results
Jimp	234
JSC	24
Jost	0
B – reviewed publication	0
C – chapter in a reviewed publication	2
D – section in a proceeding	18
P – patent	0
F – utility model	0
Z – semi-operation, verified technology	0
G – prototype, functional sample	3
T – digital data collections	1
N – methodology, specialised map	0
R – software	11
V – research report	2

Jimp and JSC Journal Publications in 2025 by individual labs and ranking

Results by Lab and Ranking	D1	Q1/D1	Q2	Q3	Q4	Total
Advanced Data Analysis and Simulations Lab	16.5*	19.5*	34.5*	3.5*	0	74
Infrastructure Research Lab	10.5*	8.5*	18.5*	2.5*	0	40
Parallel Algorithms Research Lab	10	1.5*	8	3	0	22.5
Modelling for Nanotechnologies Lab	19	44	17	2	1	83
Quantum Computing Lab	9	10.5*	14	1	0	34.5
Research and Development	2	2	0	0	0	4
Total	67	86	92	12	1	258

* Articles shared among labs

Number of journal publications in 2025 by individual research labs



List of the Top 10 Publications of Individual Labs, Sorted by Geometric Mean

The VSB-TUO methodology accounts for a journal’s rankings across all subject categories in the Web of Science and ScimagoJR databases. Based on the relative values of these rankings, the geometric mean (GM) is used to determine the final assignment to a decile or quartile.

Advanced Data Analysis and Simulations Lab

- Dawood A., Ikram J., Riaz M. B., Alimgeer K. S., Javeed S.: Improved performance of single sided axial flux for reduction in cogging torque (IMPACT). Results in Engineering, vol. 25, issue March. DOI: 10.1016/j.rineng.2024.103778. 2025. (GM 5.8)
- Kamran T., Afzal F., Riaz M. B.: Numerical simulation of graphene Maxwell nanofluid flow with thermal radiation and slips conditions along a linearly stretched sheet. Results in Engineering, vol. 25; issue March. DOI: 10.1016/j.rineng.2025.104487. 2025. (GM 5.8)
- Zulueta-Coarasa T., Jug F., Mathur A., Moore J., Muñoz-Barrutía A., Anita L., Babalola K., Bankhead P., Gilloteaux P., Gogoberidze N., Jones Martin L., Kleywegt G., Korir P., Kreshuk A., Küpcü Yoldaş A., Marconato L., Narayan

K., Norlin N., Oezdemir B., Riesterer Jessica L., Russel C., Rzepka N., Sarkans U., Serrano-Solano B., Tischer Ch., Uhlmann V., Ulman V., Hartley M.: MIFA: Metadata, Incentives, Formats and Accessibility guidelines to improve the reuse of AI datasets for bioimage analysis. *Nature Methods*, vol. 22, issue 11; p. 2245-2252. DOI: 10.1038/s41592-025-02835-8. 2025. (GM 04)

→ Ali Ali B. M., Riaz M. B., Singh N.S., Abdelfattah W., Jawad M., Bioconvective MHD flow of Williamson nanofluid with swimming microorganisms and cross-diffusion effects induced by nonlinear stretching surface in porous media. *Results in Engineering*, vol. 27, issue September. DOI: 10.1016/j.rineng.2025.105660. 2025. (GM 5.8)

→ Riaz M. B., Tariq M.M., Kazmi S.S., Aziz-ur-Rehman M.: Exploring Nonlinear Dynamics and Stability of Embedded Carbon Nanotubes in Mechanical Engineering. *Archives of Computational Methods in Engineering*, vol. 32; 8; p.4955-4981. DOI: 10.1007/s11831-025-10289-6. 2025. (GM 2.7)

→ Riaz M. B., Al-Khaled K., Adnan A., Khan S.U., Ramesh K.: Bioconvective triple diffusion flow of micropolar nanofluid with suction effects and convective boundary conditions. *International Journal of Thermofluids*, vo. 26, issue March. DOI: 10.1016/j.rineng.2025.105660. 2025. (GM 5.8)

→ Riaz M. B., Bilal S., Saddiqa A., Sarwar L.: Significant mathematical deductions of the double-diffusive convection on the Sisko fluid dynamics model driven by peristaltic movement within ciliated channel. *International Journal of Thermofluids*, vol. 29, issue September. DOI: 10.1016/j.ijft.2025.101366. 2025. (GM 6.6)

→ Zahid F., Riaz M. B.: Computational analysis of EMHD nanofluid flow over a thermally conductive surface: Enhancing heat transfer for industrial applications. *International Journal of Thermofluids*, vol. 25, issue January. DOI: 10.1016/j.ijft.2024.100987. 2025. (GM 6.6)

→ Khan S., Asjad M.I., Aslam M.N., Riaz M. B.: Neural network study of gyrotactic microorganism dynamics in nanofluid through porous stretched surface. *Results in Engineering*, vol. 28, issue December. DOI: 10.1016/j.rineng.2025.107858. 2025.(GM 5.8)

→ Waqas M., Riaz M. B., Faisal R.S., Abd Alhassan Z. A., Taha Dakhil N.: Nanofluid induced non-Fourier thermal and non-Fickian solutal transport in visco-elastic nanomaterial with variable characteristics. *Results in Engineering*, vol.26, issue June.DOI: 10.1016/j.rineng.2025.105315. 2025. (GM 5.8)

Infrastructure Research Lab

→ Kazmi S.S., Riaz M. B., Jhangeer A.: Integrating data overlaps and nonlinear dynamics: A novel approach to the Davey-Stewartson system in optical fluid model. *Ain Shams Engineering Journal*, vol. 16, issue 7. DOI: 10.1016/j.asej.2025.103420. 2025. (GM 8.8)

→ Sethia K., Strakoš P., Jaroš M., Kubiček J., Roman J., Penhaker M., Říha L.: Advances in liver, liver lesion, hepatic vasculature, and biliary segmentation: a comprehensive review of traditional and deep learning approaches. *Artificial Intelligence Review*, vol. 58, issue 10. DOI: 10.1007/s10462-025-11310-x. 2025. (GM 1.9)

→ Tariq Kalim U., Jhangeer A., Ali M.N., Ilyas H., Tufail R. N.: Lumps, solitons, modulation instability and stability analysis for the novel generalized (2+1)-dimensional nonlinear model arising in shallow water. *Alexandria Engineering Journal*, vol. 126, issue July, p.45-52. DOI: 10.1016/j.aej.2025.03.110. 2025. (GM 8.4)

→ Arif F., Zaman F. D., Mahomed F. M., Jhangeer A.: Exploration of wave dynamics and soliton behavior in a nonlinear 3D convection-diffusion wave equation. *Results in Engineering*, vol. 28; issue December. DOI: 10.1016/j.rineng.2025.107888. 2025. (GM 5.8)

→ Murad M. A. S., Faridi W. A., Jhangeer A., Iqbal M., Arnous A. H., Tchier F.: The fractional soliton solutions and dynamical investigation for planer Hamiltonian system of Fokas model in optical fiber. *Alexandria Engineering Journal*, vol. 121, issue May, p.27-37. DOI: 10.1016/j.aej.2025.02.052. 2025. (GM 8.4)

→ Raza N., Jhangeer A., Amjad Z., Rani B., Baleanu D.: Exploring soliton dynamics and wave interactions in an extended Kadomtsev-Petviashvili-Boussinesq equation. *Ain Shams Engineering Journal*, vol. 16, issue 7. DOI: 10.1016/j.asej.2025.103395. 2025. (GM 8.8)

→ Owyed S., Jhangeer A., Fatima S., Raza N., Amjad Z., Bayram M., Muhammad T.: Modeling the co-infection dynamics between tuberculosis and lung cancer: Insights from simulations. *Alexandria Engineering Journal*, vol. 130, issue October, p.564-581. DOI: 10.1016/j.aej.2025.09.016. 2025. (GM 8.4)

→ Jhangeer A., Beenish, Říha L.: Symmetry analysis, dynamical behavior, and conservation laws of the dual-mode nonlinear fluid model. *Ain Shams Engineering Journal*, vol. 16, issue 1. DOI: 10.1016/j.asej.2024.103178. 2025. (GM 8.8)

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→ Jhangeer A., Fatima S., Raza N., Rafiq M. H., Shah N. A., Bayram M.: Numerical analysis of a novel mathematical model of measles-pneumonia co-infection with treated-vaccinated compartment. *Ain Shams Engineering Journal*, vol. 16, issue 11. DOI: 10.1016/j.asej.2025.103659. 2025. (GM 8.8)

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The IT4Innovations Visualisation and Virtual Reality Lab

Parallel Algorithms Research Lab

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→ Shafiq A., Sindhu Tabassum N., Iqbal Muhammad A.: Precision optimization of reactive squeezing flow in stratified fluids: A response surface exploration. International Journal of Thermofluids, vol. 25, issue January. DOI: 10.1016/j.ijft.2024.101027. 2025. (GM 6.6)

→ Iqbal Muhammad A., Shafiq A.: Long-term aging at 475°C: Effects on the microstructure and properties of custom 465® alloy. Results in Engineering, vol. 26, issue June. DOI: 10.1016/j.rineng.2025.104704. 2025. (GM 5.8)

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→ Shafiq A., Sindhu Tabassum N., Iqbal Muhammad A., Abushal Tahani A.: Significance of Rosseland's radiative process in magnetohydrodynamic Darcy-Forchheimer non-Newtonian fluid flow in a parabolic trough solar collector: Probable error. International Journal of Thermofluids, vol. 27, issue May. DOI: 10.1016/j.ijft.2025.101193. 2025. (GM 6.6)

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→ Yaseen M., Bartwal R., Shafiq A., Rawat S.K., Al-Mdallal Q.M., Khanduri U., Sindhu T.N.: Analysis of entropy generation in tri-hybrid nanofluid flow towards a spinning disk under the influence of hall effect and variable viscosity. International Journal of Thermofluids, vol. 27, issue May. DOI: 10.1016/j.ijft.2025.101252. 2025. (GM 6.6)

→ Životský O., Nikitin P., Skotnicová K., Alexa P., Čegan T., Shafiq A., Mareš V., Trecha V., Ziolkowski G., Čížek J., Melikhova O.: Experimental and Theoretical Investigation of Polycrystalline Hexagonal Mn2FeSn compound. Results in Engineering, vol. 28, issue December. DOI: 10.1016/j.rineng.2025.107353. 2025. (GM 5.8)

Modelling for Nanotechnologies Lab

→ Zhao Y., Qu Z., Paloncyova M., Wang Z., Weng B., Zhao Y., Liu L., Song D., Wich D., Otyepka M., Xu Q.: Spatial Conformation of Ionizable Lipids Regulates Endosomal Membrane Disruption. Journal of the American Chemical Society, vol. 147, issue 42, p.38265-38274. DOI: 10.1021/jacs.5c10908. 2025. (GM 2.9)

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→ Li Y., Hassan Md. S., Zhao X., Rogatch A.: Heterostructured Electrocatalysts: from Fundamental Microkinetic Model to Electron Configuration and Interfacial Reactive Microenvironment. Advanced Materials, vol. 37, issue 15. DOI: 10.1002/adma.202418146. 2025. (GM 1.9)

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→ Miruschenko M.D., Kosolapova K.D., Aleinik I.A., Borodina L.N., Vedernikova A.A., Sokolova A. V., Sandzhieva M.A., Mitroshin A.M., Yakimansky A.V., Koroleva A.V., Zhizhin E.V., Cherevkov S.A., Langer M., Otyepka M., Ushakova E.V., Rogatch A.: Functionalization of Hydrophilic and Amphiphilic Carbon Dots with Polyethylene Glycol for Electroluminescent Devices. Small Structures, vol. 6, issue 3. DOI: 10.1002/sstr.202400528. 2025. (GM 4.8)

Quantum Computing Lab

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- Gindl A., Suthar P., Trojánek F., Malý P., Derrien Thibault Jean-Yves, Kozák M.: Attosecond Control of Solid-State High Harmonic Generation Using w-3w Fields. Physical Review Letters, vol. 134, issue 17. DOI: 10.1103/PhysRevLett.134.176903. 2025. (GM 6.4)
- Le Si Phú, Nguyen Tan N., Le-Tien T., Trung Duy T., Nguyen Tien-Tung, Ng Derrick Wing K., Tu Lam-Thanh, Vozňák M.: On the Secrecy Performance of Reconfigurable Intelligent Surfaces-Assisted Satellite Networks under Shadow-Rician Channels. IEEE Transactions on Aerospace and Electronic Systems, vol. 64, issue 3, p.6794–6808. DOI: 10.1109/TAES.2025.3532227. 2025. (GM 13.1)
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- Mehić M., Dervisevic E., Fazio P., Vozňák M.: Virtual Quantum Key Distribution Network Ecosystem: The National Czech QKD Network. IEEE Network, vol. 39, issue 3, p.173–179. DOI: 10.1109/MNET.2025.3540705. 2025. (GM 8.1)
- Vu Thái H., Lê Anh Tú, Tu Ngo H., Nguyen Tan N., Vozňák M.: On Performance of IoT Networks with Coordinated NOMA Transmission: Covert Monitoring and Information Decoding. IEEE Internet of Things Journal, vol. 12, issue 22, p.48069–48084. DOI: 10.1109/JIOT.2025.3605276. 2025. (GM 4.4)
- Nalepova V., Lampart M.: Stabilizing energy markets: A dynamic analysis of price cap regulation in oligopolistic environments. Energy Economics, vol. 151, issue November. DOI: 10.1016/j.eneco.2025.108879. 2025. (GM 3)
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- Le Anh T., Vu Thai-Hoc, Nguyen Tan N., Minh Bui Vu, Vozňák M.: On Performance of Cooperative Satellite-AAV-Secured Reconfigurable Intelligent Surface Systems With Phase Errors. IEEE Communications Letters, vol. 29, issue 4, p.799–803. DOI: 10.1109/LCOMM.2025.3543732. 2025. (GM 6.1)
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Results of the last evaluation based on the M1 module of the RIV 2017+ Methodology rated with grades 1–3

Infrastructure Research Lab

- Vysocký O., Říha L.: MERIC-EUPEX alpha. 2023. Software. (grade 3)
- Kadlubiak K., Meca O., Brzobohatý T., Říha L.: Adaptive matrix assembler for finite element method for effective utilization of vector registers in modern processors 2023. Software. (grade 3)

Parallel Algorithms Research Lab

- Dostál Z., Kozubek T., Sadowská M., Vondrák V.: Scalable Algorithms for Contact Problems. Springer, 2023. ISBN: 978-3-031-33579-2. (grade 2)

Modelling for Nanotechnologies Lab

- Zdražil L., Badura Z., Langer M., Kalytchuk S., Panáček D., Scheibe M., Kment Š., Kmentová H., Thottappali M. A., Mohammadi E., Medved M., Bakandritsos A., Zoppellaro G., Zbořil R., Otyepka M.: Magnetic Polaron States in Photoluminescent Carbon Dots Enable Hydrogen Peroxide Photoproduction. Small, vol. 19, issue 32. DOI: 10.1002/sml.202206587. 2023. (grade 2)
- Fan Y., Chen X., Legut D., Zhang Q.: Modeling and theoretical design of next-generation lithium metal batteries. Energy Storage Materials, vol. 16. DOI: 10.1016/j.ensm.2018.05.007. 2019. (grade 3)

Advanced Data Analysis and Simulations Lab

Head of Lab: **Dr Jan Martinovič** / Number of employees: **46.25 FTE**

Significant activities:

The lab focuses on advanced data analysis, research, and development in the field of codesigning HPC, HPDA, and cloud technologies to enhance industry and society, programming models for HPDA, artificial intelligence, modelling, simulations, and application of dynamical systems.

- The lab is contributing to the development of the [EuroHPC Federation Platform](#), enabling easier access and Single Sign-On to EuroHPC JU supercomputers and quantum systems. The backbone of the EFP computing workflows and distributed data management is formed by components of the LEXIS Platform.
- Launch of the [Open Science II](#) project funded by MEYS.
- Launch of the international [TerraDT](#) project, which is creating a digital twin to help improve understanding of how glaciers, sea ice, vegetation, and aerosols influence the Earth's climate.
- Work on the [EyeERP](#) project – a comprehensive ERP system for eye ophthalmology clinics with the MojeOči mobile app for performing an AI-based analysis of eye tests, supported by the MIT CR.
- Development of the first version of [Quantum as a Service](#) (QaaS) to integrate supercomputers and quantum computers. QaaS enables workloads to be executed on the VLQ quantum computer of the LUMI-Q consortium via Python or Jupyter Notebook.
- Launch of and contribution to the implementation of the project [Increasing the resilience of power grids in the context of decarbonisation, decentralisation, and sustainable socioeconomic development](#), supported by P JAC.
- Collaboration on the development of the high-performance [Moldina](#) tool for accelerating drug discovery and computational enzymology.
- Signing of a licensing agreement with [Enantis](#) for the use of the [AggreProt](#) software, which the laboratory helped develop together with St Anne's University Hospital Brno and Masaryk University.
- Development of the [EXA4MIND Inference Service](#), providing an OpenAI API-compatible interface for models deployed on supercomputers running Slurm batch jobs.
- Development of the [BioDT Shiny App](#), bringing together eight prototype digital twins from multiple domains, including grasslands analysis, bird and forest monitoring, disease outbreaks, bee survivability, and cultural ecosystem services, as part of the international BioDT project.
- Collaboration with [Telight](#) on enhancing the accuracy of cell analysis. A customised algorithm for image normalisation was developed, and several deep learning architectures for cell segmentation were tested.
- Development of the [ADAMS4SIMS](#) platform, the core scientific outcome of the international EXA4MIND project coordinated by IT4Innovations, providing FAIR-aligned infrastructure for the management and mining of large-scale molecular dynamics data.
- Anam Zahra received the [Best Presenter](#) award at the PUT STEM Day 2025 conference.

Infrastructure Research Lab

Head of Lab: **Doc. Lubomír Říha** / Number of employees: **24.41 FTE**

Significant activities:

The lab specialises in parallel application development and acceleration, code analysis, performance and scalability optimisation, HPC energy efficiency, services for infrastructure users, medical data processing, scientific data visualisation, and virtual and augmented reality.

- Launch of two new international projects: [DARE SGA 1](#) for the development of three different chiplets based on the RISC-V architecture, and [SEANERGYS](#) for a new generation of software for the more energy-efficient operation of EuroHPC JU supercomputers.
- Launch of the [System for real-time monitoring of aseptic production of gene therapy medicinal products](#) project, supported by the TA CR TREND programme. Development of a prototype system based on advanced image analysis and 3D modelling of the manufacturing process in real time.
- Launch of cooperation with [Activair](#) and Charles University on the project Research and development of advanced analysis and interpretation of atomic force microscopy data using AI, supported by MIT CR.
- Release of a new version of the [MERIC open-source software](#), deployed on the Karolina supercomputer and other EuroHPC JU supercomputers.
- Cooperation with [Oak Ridge National Laboratory](#) within the ExaDigit project on supercomputer digital twin visualisation, and with [Argonne National Laboratory](#) on the development and deployment of Blender Rendering-as-a-Service for HPC (Braas-HPC Interactive) for interactive cinematic-quality data visualisation on the Aurora supercomputer.
- Development of scalable [simulations for fluid-structure interaction](#) (FSI) based on ESPRESO and OpenFOAM/OpenLB tools.
- Development of the [HPC Profiling Web Tool](#), a web-based tool for unified profiling and performance analysis, integrating data from Valgrind, perf, MPI trace, strace, and NVIDIA Nsight into a single interface.
- Continuation of cooperation with [EXELIZ Solutions](#) under a cooperation agreement, and the deployment of the comprehensive MERIC Energy-Efficient SW Suite – developed at IT4Innovations – for monitoring and managing the power consumption of HPC clusters on the Portuguese EuroHPC Deucalion system.
- Cooperation with the Belgian [company PUXANO](#) on the project A Hybrid Generative AI-model for Resolving Molecular Structures integrating sequence and Cryo-Electron Microscopy data (HARMONY), supported by the European FFplus initiative.
- Development of algorithms to simplify surgical planning for colorectal cancer within cooperation on the LERCO project.
- Cooperation with the [Misterine company](#) on the project Advanced medical data visualisation with AI support, supported by MIT CR.
- Participation in organising workshops at the PASC 2025 and CARLA 2025 international conferences.
- Presentation of research results in matrix assembly acceleration within the [main Technical Program of the world's largest supercomputing conference](#) (SC25).

Parallel Algorithms Research Lab

Head of Lab: **Dr Tomáš Karásek** / Number of employees: **17.82 FTE**

The lab is primarily focused on providing support to industry. The research team conducts applied research in developing scalable algorithms and HPC libraries, numerical modelling and simulation in combination with artificial intelligence, surrogate models, and digital twins in engineering applications.

Significant activities:

- Collaboration with more than **30 companies and startups** from various sectors within the services of the National Competence Centre in HPC (EuroCC 2 project). Supercomputers contributed to accelerating innovations and development in healthcare, automotive, manufacturing, energy, the rail industry, and materials design.
- Collaboration with the **BRM Aero and Airmobis** companies in designing a new type of aircraft, specifically to optimise the wing leading edge of the BRISTELL B300 aircraft under a Cooperation Agreement, and to optimise the flap system, which was supported by the European initiative FFplus.
- Launch of the international **InnovAlte Slovakia: Illuminating Pathways for AI-Driven Breakthroughs** project. The objective is to push the boundaries of current artificial intelligence applications across various industries and deliver tangible innovations that will foster economic growth, enhance sustainability, and improve quality of life.
- Launch of collaboration with the **EGU company** on spot price forecasting using artificial intelligence tools in the energy sector, under a Cooperation Agreement.
- Launch of collaboration with **University Hospital Ostrava** in the advanced evaluation of clinical data from patients with cerebrovascular diseases. The collaboration primarily focuses on assessing patients with aneurysms, using CFD methods combined with artificial intelligence tools to evaluate hemodynamic parameters. Another area of joint research is the assessment of post-stroke patients using artificial intelligence methods to support diagnostics, risk stratification, and a personalised approach to treatment.
- Long-term collaboration with **Fraunhofer ICT** and joint work on the Flexible Manufacturing Approach for Recyclable Bio-Based High-Performance Composite Molds (**FutureMold**) project.
- Continuation of the collaboration between IT4Innovations and the **G-Team company**, focusing on the assessment of the dynamic response of turbomachinery with piping systems.
- Launch of the **Increasing the resilience of power grids in the context of decarbonisation, decentralisation, and sustainable socioeconomic development** and ongoing collaboration in its implementation.
- Implementation of the **Optimisation of design and production processes of vertical pumps using modern technologies** project supported by the TA CR TREND programme. The objective is to upgrade vertical pumps in line with current market requirements.
- Anum Shafiq appointed as a **member of the Editorial Board** for mechanical engineering at Scientific Reports, a journal published by Nature Portfolio.

Modelling for Nanotechnologies Lab

Head of Lab: **Prof. Michal Otyepka** / Number of employees: **16.59 FTE**

The lab focuses on design and computer modelling in advanced nanomaterials and nanotechnology.

Significant activities:

- Maximilián Lamanec was awarded the prestigious **Jean-Marie Lehn Prize** for Chemistry 2025.
- Launch of the **RE-free magnetoelastic materials for efficient and environmentally friendly cooling** project, supported by the Czech Science Foundation.
- Completion of the **Influence of thermoelectrical effects on spin-orbit torques in 2D van der Waals materials** (MEYS) project and the projects supported by the Czech Science Foundation – **Magnetism at interfaces: from quantum to reality and Novel thermoelectric, thermovoltaic, and phonoelectric heat conversion systems based on nitrides semiconductors**.
- Publication of research in which the laboratory participated, featured on **several front and supplementary covers of scientific journals**. The research covers carbon dots, photocatalysts, immunomodulatory materials, AI in materials research, gas separation, and the modelling of drug carriers (in Nano-scale, ACS Applied Materials & Interfaces, Applied Materials Today, Small, and Molecular Pharmaceutics).
- Contribution to the **development of aluminium batteries** using Bi₂Te₃ material, which accelerates ion transport and addresses key challenges of aqueous aluminium batteries (published in Advanced Science).
- Contribution to understanding **plasmonic oxygen activation** for selective biomass oxidation (published in Nature Catalysis).
- Collaboration on the research into the thermoelectric properties of scandium nitride thin films on magnesium oxide substrates (Applied Surface Science Advances).
- Collaboration on the development of a technology combining **water treatment and energy storage** (Journal of Colloid and Interface Science).
- Co-organisation of the **international school** “Molecular Descriptions of Complex Biosystems” (COST COSY) and workshops “Advanced Technologies for Business” and “Magnetism and Phonons driven Physics in 2D and 3D systems”.
- In collaboration with the Institute of Physics of the Czech Academy of Sciences, **enhancement of the thermoelectric efficiency** of ScN-based multilayers through Nb diffusion-driven doping (Applied Surface Science Advances).
- Design of 2D material-based protective coatings via high-throughput calculations to **enhance the corrosion protection of copper** (Advanced Functional Materials).
- In collaboration with international scientists, the **mechanism of single-atom catalysis** on the surface of sulphur-functionalised MXenes elucidated (Advanced Materials).



The VLQ quantum computer

Quantum Computing Lab

Head of Lab: Prof. Marek Lampart / Number of employees: 746 FTE

Significant activities:

The lab focuses on developing new algorithms for quantum computers and simulators, including their practical application, quantum error correction, research in quantum technologies, communication, cryptography, optimisation, and machine learning.

- Launch of the international [LUMI-IQ](#) – LUMI AI Factory – Advanced experimental AI-optimised quantum-based platform project. The LUMI AI Factory quantum computing platform will be developed.
- The international [Q-NEKO](#) project approved for EU funding. A collaboration between Europe and Japan in supercomputing and quantum technologies to develop a high-performance hybrid system capable of tackling extraordinarily complex tasks faster and more efficiently than current supercomputers.
- Launch of the Gaussian Boson Sampling for Earth Observation ([GBS4EO](#)) project supported by the [European Space Agency](#). The Lab facilitates the application of quantum computing simulations for satellite data analysis.
- [Implementation of quantum algorithms](#) developed by KP Labs on IT4Innovations quantum infrastructure under a Cooperation Agreement.
- Launch of the [Quantum error correction codes enhanced by reinforcement learning dedicated for the Ising model-based optimisation](#) project, supported by the Moravian-Silesian Region from the Vouchers for Universities programme.
- Thibault Derrien co-authored the research article on [controlling the movement of electrons](#) in solids with extreme precision – [on the attosecond timescale](#), published in Physical Review Letters.
- Membership in the [European Quantum Industry Consortium](#) (QuIC).
- Marek Lampart appointed by Marek Ženíšek, the Minister for Science, Research and Innovation and Chairman of the Research, Development and Innovation Council, as a [member of Expert Panel 1](#): Natural Sciences, an advisory body to the Research, Development and Innovation Council (RVVI).
- Publication of the [Atlas of Quantum Computing Use Cases](#), providing an overview of the practical uses of quantum technologies and current developments in quantum computing across disciplines.
- Organisation of several [training events](#), including seminars focused on quantum computing as well as a training course for ČEPS as part of contract research.
- Jiří Tomčala ranked 16th among 1,603 participants of the 24-hour [quantum hackathon](#) organised by the BlueQubit company in cooperation with Yale University.

07

EDUCATIONAL
AND TRAINING ACTIVITIES

IT4Innovations has long been dedicated to developing extensive educational and training activities. Its experts participate in teaching students at VSB – Technical University of Ostrava in both Master’s and PhD study programmes, thereby linking cutting-edge research with higher education. Last year, as part of professional vocational education, IT4Innovations organised 32 training courses, seminars, and workshops focused on high-performance computing (HPC), quantum computing (QC), and artificial intelligence (AI). A total of 14 events took place under the auspices of the EOSC-CZ Training Centre, where IT4Innovations coordinates education for the wider scientific community in the Czech Republic on the key topics of open science and FAIR data principles. Concurrently, the centre organised workshops for secondary schools; a total of 14 took place over the past year in two thematic variants – AI Explorers and Quantum Revolution, contributing to the development of digital skills and fostering interest in modern technologies among the younger generation.

Educational Activities

Experts from IT4Innovations are actively involved in educational activities within PhD and MSc study programmes. In PhD study programmes guaranteed by the Faculty of Electrical Engineering and Computer Science of VSB – Technical University of Ostrava, its experts acted as supervisors for a total of 3 students in the Computational Sciences study programme and 13 students in the Informatics and Computational Sciences study programme.

In the **Computational and Applied Mathematics** MSc study programme, guaranteed by the Department of Applied Mathematics of the Faculty of Electrical Engineering and Computer Science of VSB-TUO, experts from IT4Innovations provide instruction in subjects focused on high-performance computing (HPC). Students of this and other MSc study programmes are also offered the **Introduction to Quantum Computing course**, with more than 50 students completing it in 2025.

IT4Innovations is also involved in teaching several courses within the new **Computational Technologies in Materials Science** MSc study programme at the Faculty of Materials Science and Technology of VSB-TUO, bringing expertise in advanced computational methods and their applications.

IT4Innovations is a member of an international consortium that has historically implemented the first pan-European Master’s study programme focused purely on high-performance computing – **EUMaster4HPC**. The consortium, led by the University of Luxembourg, includes universities and research and supercomputing centres across Europe. The MSc study programmes started in the 2022 winter semester. In 2025, 36 students successfully completed their studies. Graduates are finding careers in fast-growing fields such as high-performance computing, advanced data analytics, and artificial intelligence.

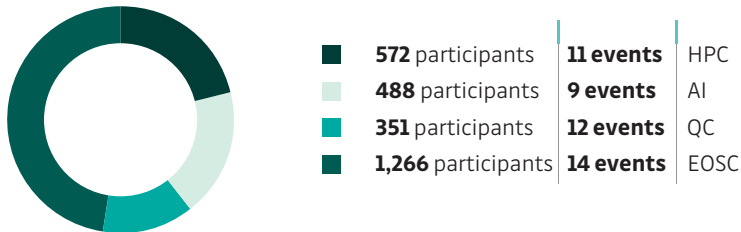
Training Activities

IT4Innovations consistently supports the Czech and international scientific community and its users by organising courses, tutorials, workshops, and other training events. The primary objective of these activities is to broadly enhance users’ competencies. IT4Innovations is committed to disseminating knowledge in high-performance computing (HPC), data analysis (HPDA), artificial intelligence (AI), and quantum computing (QC) in the Czech Republic and abroad. The training activities are aimed at a wide range of participants from the academic environment, as well as representatives of industrial and commercial entities interested in the effective use of advanced computing technologies.

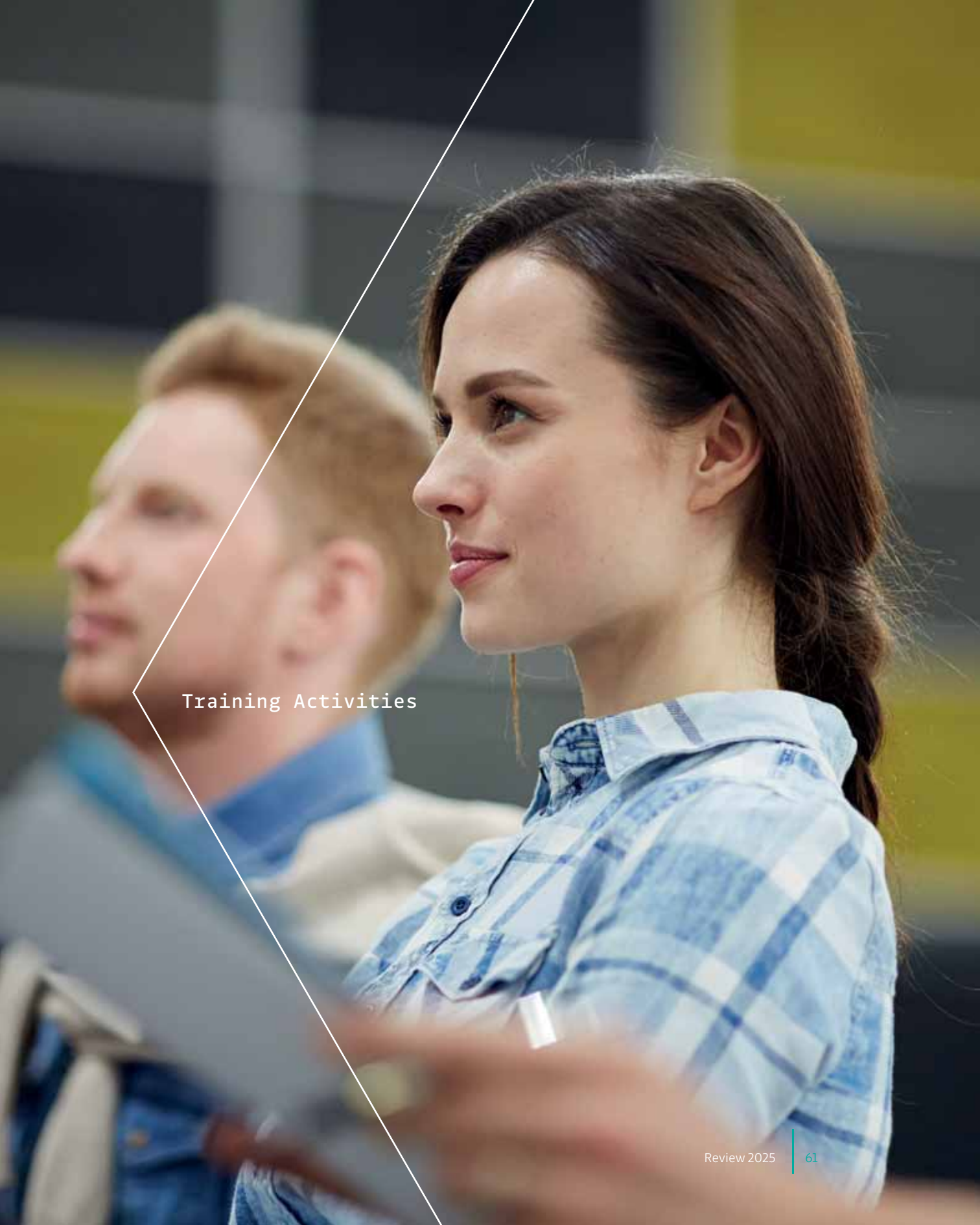
The training activities are open to the European community through international projects in which IT4Innovations is involved, such as EuroCC 2, EPICURE, SPACE, POP 3 and MaX Centres of Excellence, EDIH Ostrava, and others. Thematically, the courses offered by IT4Innovations focus on computer systems and their architecture, programming techniques and tools, libraries, and applications of computing technologies. Courses delivered by the EDIH Ostrava focus on developing digital skills for companies and enhancing their innovation potential.

In 2025, IT4Innovations held **46 educational events**, attended by **2,677 participants**, both in person and online.

Division of training courses by area



Since 2025, IT4Innovations, together with seven other partners, has been participating in the **EVITA** project, which aims to build a unified, high-quality educational ecosystem for high-performance computing across Europe. Within the consortium, IT4Innovations is involved, for instance, in developing educational content and pilot testing training modules, and leads the work package focused on the creation and quality assurance of study materials.



Training Activities

08

NATIONAL PROJECTS

Supercomputing Services Projects

→ PROJECTS SUPPORTED BY THE MINISTRY OF EDUCATION, YOUTH AND SPORTS OF THE CZECH REPUBLIC

Large Infrastructures for Research, Experimental Development, and Innovation Project

- e-Infrastructure CZ (2023–2026)**
- Project ID: LM2023054
 - Principal Investigator: Doc. Vít Vondrák
 - e-INFRA CZ is a unique e-infrastructure for research, development, and innovation in the Czech Republic. It creates a communication, information, storage, and computing platform for research, development, and innovation, both nationally in the Czech Republic and internationally, and provides an extensive and comprehensive portfolio of ICT services without which modern research, development, and innovation cannot be conducted. The main components of e-INFRA CZ include: the most powerful and advanced supercomputing systems in the Czech Republic, and high-capacity data storage.

Projects of the Programme Johannes Amos Comenius

- Modernisation of e-INFRA CZ II (2023–2026)**
- Project ID: CZ.02.01.01/00/23_016/0008329
 - Principal Investigator: Doc. Vít Vondrák
 - The aim of the project is the modernisation and upgrade of the e-INFRA CZ e-infrastructure, which is a strategic infrastructure for research, development, and innovation in the Czech Republic. The modernisation focuses on specific components – supercomputers and their facilities..
- Center for Artificial Intelligence and Quantum Computing in System Brain Research (2025–2028)**
- Project ID: CZ.02.01.01/00/23_029/0008437
 - Principal Investigator: Doc. Vít Vondrák
 - As part of the national component of the CLARA project, the CLARA project’s computing and data infrastructure will be acquired and operated, and the CLARA Testbed will be established. The CLARA Testbed is designed to create a hardware and software platform providing the computing and data facilities for research into neurodegenerative diseases, including the development of new AI models and protein simulations, as well as a connection to the quantum computing infrastructure. Specifically, the project will fund the acquisition of the HPCQC-AI computing cluster and the corresponding data storage, including their operational costs.

Research and Development Projects

→ PROJECTS SUPPORTED BY THE MINISTRY OF EDUCATION, YOUTH AND SPORTS OF THE CZECH REPUBLIC

Projects of the Programme Johannes Amos Comenius

- European Open Science Cloud Czech Republic (2023–2028)**
- Project ID: CZ.02.01.01/00/22_004/0007682
 - Principal Investigator: Dr Kateřina Slaninová
 - The European Open Science Cloud (EOSC) is a European initiative focused on developing infrastructure to support open science practices in research data management. It provides a framework for storing and making available so-called FAIR research data – findable, accessible, interoperable, and reusable. The EOSC-CZ project is the implementation of the EOSC initiative in the Czech Republic, aiming to create a national node of this European initiative and to promote best practices in research data management across scientific communities. As part of implementing the National Data Infrastructure (NDI), a common platform will be created to share, manage, and access data and computational resources for research purposes. The NDI will support both scientific and multidisciplinary research activities across a wide range of scientific fields and disciplines.
 - www.eosc.cz
- National Repository Platform for Research Data (2024–2028)**
- Project ID: CZ.02.01.01/00/23_014/0008787
 - Principal Investigator: Radovan Pasek
 - The National Repository Platform (NRP) will serve as a universal foundation for the effective handling of FAIR research data. The NRP comprises a secure system of technical and software tools that will provide sufficient capacity for storing data produced within state-supported projects and making it accessible. On top of this foundation, a system of services, tools, and methodological procedures will be available for the creation and long-term management of repositories and data stewardship in accordance with FAIR principles.

Open Science II
(2025–2028)

- Project ID: CZ.02.01.01/00/24_030/0015041
- Principal Investigator: Dr Jan Martinovič
- The project supports the development of the National Data Infrastructure (NDI) and the implementation of the EOSC initiative in the Czech Republic. It focuses on the creation and growth of disciplinary repositories, the FAIRification of data, interoperability, tool development, training, and communication. The project also engages the broader research community through an open call – so-called mini proposals – that contribute to systemic change in research data management in line with the FAIR principles. Through IT4Innovations National Supercomputing Center, and the Central Library of VSB-TUO, VSB-TUO guarantees Key Activity 4 of the Data Management thematic cluster for artificial intelligence and machine learning. The goal is to establish a repository embedded in the Czech context, taking into account both Czech and European legal frameworks, particularly regarding the use of AI on sensitive data.

Increasing the
resilience of power
grids in the context
of decarbonisation,
decentralisation,
and sustainable so-
cioeconomic devel-
opment (2025–2028)

- Project ID: CZ.02.01.01/00/23_021/0008759
- Principal Investigator: Prof. Tomáš Kozubek
- The project focuses on research and development of software tools for analysing installation efficiency and resilience of new energy sources and storage capacities for use within energy communities and research in the field of hydrogen production, transport and storage. This includes social science research to promote acceptance of these specialised technologies by the general public, development of cooperation with the application sector, project preparation, infrastructure upgrade, and compliance with RIS3.

International Cooperation in Research and Development

Influence of thermo-
electrical effects on
spin-orbit torques
in 2D van der Waals
materials
(2022–2025)

- Project ID: LUASK22099
- Principal Investigator: Dr Dominik Legut
- The project aimed at exploring and explaining the role of the proximity and temperature effects on spin-orbit torque in devices made of 2D materials forming van der Waals heterostructures. The experience and computational procedures of both partners (VSB-TUO and Pavol Jozef Šafárik University in Košice) were applied to determine the thermoelectric phenomena and the influence of interfaces for experimentally relevant 2D spin-orbit torque systems.

→ PROJECTS SUPPORTED BY THE MORAVIAN-SILESIA REGION

Global Experts Programme

Experimental and
theoretical studies
of near-infrared
emitting chiral
carbon dot lumi-
nophores project
(2023–2026)

- Project ID: 00734/2023/RRC
- Principal Investigator: Prof. Michal Otyepka
- The project brings together the expertise of carbon dot synthesis specialists, who will focus on preparing dots with high quantum emission yields, particularly in the red and near-infrared, and on chiral carbon dots for sensing applications. These efforts will be supported by state-of-the-art materials characterisation techniques to determine the composition, structural

properties, and electronic and ultrafast optical properties of carbon dots. This will be done in close collaboration with a theoretical computing group with expertise in complex structural models of a wide range of photoluminescent materials. This project serves to transfer know-how and bring the expertise of Professor Andrey Rogach’s group to VSB-TUO by importing their materials expertise and characterisation skills, and by fostering close collaboration between the teams involved.

Vouchers for Universities

Quantum error
correction codes
enhanced by rein-
forcement learning
dedicated for the
Ising model-based
optimization
(2025–2028)

- Project ID: 01906/2025/RRC
- Principal Investigator: Prof. Marek Lampart
- The aim of the project is to develop an adaptive quantum error correction system for solving optimisation tasks. It employs reinforcement learning, a cutting-edge artificial intelligence method that will enable quantum computers to independently design error-correcting codes tailored to specific tasks and noise conditions. The research focuses on the Ising model, which underpins many industrial and scientific problems. These problems can be addressed using quantum algorithms, particularly QAOA, but the results are often affected by noise. The reinforcement learning agent will generate topological quantum codes that minimise the impact of noise and adapt them to specific architectures, such as the VLQ quantum computer.

→ PROJECTS SUPPORTED BY THE CZECH SCIENCE FOUNDATION

International Grant Projects Evaluated on the LEAD Agency Principle

Magnetism at
interfaces: from
quantum to reality
(2022–2025)

- Project ID: 22-35410K
- Principal Investigator: Dr Dominik Legut
- The project aimed at studying and developing a quantitative theory of coercivity regarding the local atomic structure (grain boundary and size), and its influence on the spatial variation of the intrinsic magnetic properties and microstructure. A unique scheme of simulation procedures was developed between quantum mechanical calculations, atomic spin dynamics, and micromagnetic continuum simulations. Magnetic properties were therefore newly taken into account at the atomic scale, i.e., by including atomic interface defects and grain boundaries. This enabled the construction of a multi-scale model to determine the magnetic properties of real materials without relying on prior assumptions.

RE-free magne-
toelastic materials
for efficient and
environmentally
friendly cooling
(2025–2027)

- Project ID: 25-14529L
- Principal Investigator: Dr Dominik Legut
- The aim of the project is to search for novel materials for magnetic refrigeration based on a large magneto- and barocaloric (MCE/BCE) effects using the synergy of the theoretical ab-initio calculations and experimental materials-type studies. Special attention will be paid to studying thermal expansion to identify materials exhibiting negative thermal expansion (NTE)

and magnetoelastic phase transitions that may enhance MCE/BCE due to low thermal hysteresis and distinctive changes in magnetic order and lattice parameters. The research will be conducted within an international cooperation of experimental teams in Poland and a theoretical team from the Czech Republic.

Standard Grant Projects

- Novel thermoelectric, thermovoltaic, and phonoelectric heat conversion systems based on nitrides semiconductors (2023–2025)

→ Project ID: 23-07228S

→ Investigator: Dr Dominik Legut

→ This project, implemented in cooperation with the Institute of Physics of the Czech Academy of Sciences, focused on developing semiconductors based on doped ScN and CrN for heat transfer applications. To support and complement the experimental phase, theoretical research was conducted using state-of-the-art quantum-mechanical density functional theory calculations. Using the results obtained from the tested materials, the initial development of p–n junctions for heat conversion was carried out.

Postdoc individual fellowship – incoming

- Magnetoelasticity of non-cubic materials in spin-lattice dynamic simulations (2024–2027)

→ Project ID: 24-11388I

→ Principal Investigator: Dr Jakub Šebesta

→ The project focuses on extending spin-lattice dynamics simulations beyond cubic materials. The mentioned model represents a highly efficient scheme for describing magnetoelastic behaviour, such as magnetostriction and magnetoacoustic effects. The generalised model will enable the study and explanation of the magnetoelasticity of more complex compounds (alloys), paving the way towards materials with high application potential.

→ PROJECTS SUPPORTED BY THE TECHNOLOGY AGENCY OF THE CZECH REPUBLIC

M-ERA.NET Programme

- FutureMold – Flexible manufacturing approach for recyclable bio-based high performance composite molds (2024–2026)

→ Project ID: TQ05000004

→ Principal Investigator: Dr Tomáš Brzobohatý

→ The project focuses on the production of composite parts using a new concept of a recyclable, highly durable composite mold. The technologies developed within the project will significantly contribute to the European Green Deal programme, as its main goal is to substantially reduce CO₂ emissions in the production of composite materials.

TREND Programme

- Optimization of design and production processes of vertical pumps using modern technologies (2024–2026)

→ Project ID: FW10010202

→ Principal Investigator: Doc. Tomáš Blejchař

→ The aim of the project is to develop a modernised range of vertical pumps with improved hydraulic parameters, designed using know-how in hydraulic design (software) and new manufacturing processes (3D printing – WAAM welding technology). The project’s R&D activities will be validated on a model pump. The project focuses on a comprehensive upgrade of vertical pumps in line with current market requirements.
- System for real-time monitoring of aseptic production of gene therapy medicinal products (2025–2027)

→ Project ID: FW12010084

→ Principal Investigator: Dr Petr Strakoš

→ The aim of the BLOCK Technology a.s. and VSB-TUO project will be a prototype system based on advanced image analysis and 3D modelling of the production process in real time, which will significantly increase the safety and quality of drugs manufactured in the isolator and implement training and audit activities for the purpose of operator training. It also involves the implementation and construction of an isolator chamber equipped with durable, powerful cameras either inside or on the outer chamber of the isolator. These cameras will monitor the internal arrangement of the isolator, i.e., materials, hands in glovebox sleeves, online QR code identification, airlocks, etc. The entire system will be controlled and monitored by newly developed software, which will include the management and recording of technological procedures and will be capable of validation in accordance with applicable standards.

→ PROJECTS SUPPORTED BY THE MINISTRY OF INDUSTRY AND TRADE OF THE CZECH REPUBLIC

Operational Programme Technologies and Applications for Competitiveness

- EyeERP – complex ERP system for eye clinics with mobile application MojeOči for performing and AI analysis of eye tests (2023–2026)

→ Project ID: CZ.01.01.01/01/22_002/0000436

→ Principal Investigator: Dr Tomáš Martinovič

→ The aim of the project, supported by the Operational Programme Technologies and Applications for Competitiveness, is to create a comprehensive ERP system for eye clinics, together with a mobile application called MojeOči designed for AI-based analysis of eye tests. The project beneficiary is Apollo Data s.r.o.
- Advanced medical data visualisation with AI support (2024–2026)

→ Project ID: CZ.01.01.01/01/22_002/0001028

→ Principal Investigator: Dr Petr Strakoš

→ The project, carried out in collaboration with the Misterine company, will use artificial intelligence methods to automatically detect various structures in tissues, such as blood vessels, healthy tissue, tumours, etc. The reason is that currently available imaging methods, such as MRI or CT, only provide a basic visualisation of results, and it is up to the specialist to interpret what they see based on black-and-white images. The project also aims to develop visualisation tools for presenting the results in virtual reality.



IQM

[IQM]
VLC

Visit of the President
of the Czech Republic

TWIST Programme

Research and development of advanced analysis and interpretation of atomic force microscopy (AFM) data using artificial intelligence and machine learning (2025–2027)

- Project ID: FY01010025
- Principal Investigator: Dr Petr Strakoš
- The project, based on a partnership of Activair s.r.o., IT4Innovations, and Charles University, aims to use artificial intelligence for advanced analysis of data from material surface measurements using atomic force microscopy (AFM). The unique combination of AFM measurement data output with a high-performance computing cluster, where machine learning and AI automate data processing, will result in significant improvements and speed-ups in data analysis, leading to substantial financial savings.

→ PROJECTS SUPPORTED BY THE MINISTRY OF THE INTERIOR OF THE CZECH REPUBLIC

Research on holistic model of inter-connected critical electricity and communication infrastructures (2023–2025)

- Project ID: VK01030109
- Principal Investigator: Dr Pavel Praks
- The project brought together three research centres (CVOOZE, SIX, and IT4Innovations) and created an interdisciplinary Principal Investigator team with available expertise focused on examining the interconnections between individual critical infrastructures (control, data, and energy) to achieve resilience, robustness, and preparedness against potential risks, threats, and domino effects.

→ PROJECT SUPPORTED BY THE DEPUTY PRIME MINISTER’S OFFICE FOR THE RECOVERY PLAN AND THE KNOWLEDGE ECONOMY OF THE SLOVAK REPUBLIC

InnovAlte Slovakia: Illuminating Pathways for AI-Driven Breakthroughs (2025–2027)

- Project ID: 09I02-03-V01-00029
- Principal Investigator: Dr Tomáš Karásek
- The project aims to push the boundaries of current artificial intelligence applications across various industries, delivering tangible innovations that will drive economic growth, enhance sustainability, and improve quality of life. The project seeks to build a dynamic and sustainable innovation ecosystem in artificial intelligence, effectively linking cutting-edge research with practical applications. The project emphasises the development of AI solutions that are not only technologically advanced but also ethical, environmentally sustainable, and socially beneficial. The consortium brings together leading research centres, universities, and businesses from Slovakia, Germany, and the Czech Republic.

VSB-TUO Projects with IT4Innovations Participation

REFRESH – Research Excellence For REgion Sustainability and High-tech Industries (2022–2027)

- Project ID: CZ.10.03.01/00/22_003/0000048
- IT4Innovations Coordinator: Prof. Tomáš Kozubek
- Grant Provider: Ministry of the Environment (State Environmental Fund of the Czech Republic), Operational Programme Just Transition 2021–2027
- The REFRESH project is a key tool for implementing the SMARAGD strategy, which contributes to transforming the Moravian-Silesian Region (MSR) into a SMART And Green District. The main objective of the REFRESH project is to create a robust innovation ecosystem in the MSR in four domains of specialisation: new energy, automation and robotics in manufacturing and transport, digitalisation, novel materials, and environmental technologies, including their socio-economic dimension. These domains are part of the MSR’s smart specialisation strategy.

Validation of integrating artificial intelligence for receiving emergency calls using a voice chatbot, developed within the research project BV No. VI20192022169, with technology for receiving emergency communications 112 and 150 in the Czech Republic (TCTV 112) (2023–2025)

- Project ID: VK01020132
- VSB-TUO Principal Investigator: Ing. Petr Berglowiec (Faculty of Safety Engineering, VSB-TUO)
- Grant Provider: Ministry of Interior of the Czech Republic
- The project dealt with artificial intelligence for receiving emergency calls. It followed the results of Research Project No. VI20192022169 and its objective to integrate voice chatbot into the technologies for lines 112 and 150 in the Czech Republic (TCTV 112) with a focus on the use of geolocation to refine speech recognition and dialogue, collaborative chatbot supported by human operators in named-entity recognition, detection of topics enabling the transfer of a call to a human operator for issues outside of the chatbot’s competence, and language identification.

Combination of Holographic and Digital Safety Protection (2023–2025)

- Project ID: FW06010089
- Principal Investigator: Doc. Kamil Postava (Faculty of Materials Science and Technology, VSB-TUO)
- Grant Provider: Technology Agency of the Czech Republic, TREND Programme
- The project aimed at increasing the use of modern digital technologies in the product portfolio of Optaglio, thus increasing its competitiveness, especially in foreign markets. In essence, the aim was to prevent counterfeiting of holographic security features by linking them individually to the digital database. This linking required the development of new ways to write a completely random and non-repeatable motif, convert it into digital form using an image hashing function, read the motif quickly, preferably on a standard mobile phone, and subsequently write it and compare it with the digital (de)centralised database.



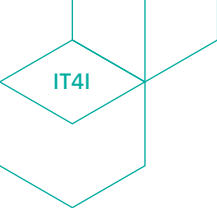
The VLQ
quantum computer

**National Centre
for Energy II
(2023–2028)**

- Project ID: TN02000025
- IT4Innovations Coordinator: Dr Pavel Praks
- Grant Provider: Technology Agency of the Czech Republic, National Centres of Competence Programme
- The mission of the National Centre for Energy II is to stimulate long-term co-operation between leading research organisations and key market players in the energy sector. Through applied research and the development of new methods, materials, and technologies, it focuses on increasing the efficiency, safety, and reliability of existing energy units, improving the reliability and security of energy networks, effectively deploying and operating decentralised energy sources, and utilising alternative fuels to ensure raw material independence and energy self-sufficiency for the Czech Republic. The goal is to create a comprehensive strategy for a modern, low-carbon, and sustainable energy sector, in line with strategic documents at both national and international levels.

**Proof of Concept
Explorer
(2024–2027)**

- Project ID: TQ11000018
- Principal Investigator: Michal Mokroš (Technology Transfer Centre, VSB-TUO)
- Grant Provider: Technology Agency of the Czech Republic, SIGMA Programme
- The aim of the project is to improve the efficiency of the established technology transfer system at VSB-TUO, which will lead to a more efficient transfer of technology and knowledge between the university and the application environment. The implementation of the project will verify the practical usability of the results of applied research and experimental development, created at the university and with high commercial potential. The project aims to build on the successful implementation of projects under the TA CR GAMA and GAMA II, which brought innovative technology solutions closer to the commercial environment.



09

INTERNATIONAL PROJECTS

Research and Development Projects

Projects of the 8 th Framework Programme for Research and Innovation of the European Union – Horizon 2020	
EUPEX – European Pilot for Exascale (2022–2026)	→ Project ID: 101033975 (H2020-JTI-EuroHPC-2020-01, RIA) → Principal Investigator: Doc. Lubomír Říha → The project consortium aims to design, build, and validate the first EU platform for High-Performance Computing (HPC), covering the end-to-end spectrum of required technologies with European assets, from the architecture, processor, system software, and development tools to applications. The EUPEX prototype will be designed to be open, scalable, and flexible, including the modular OpenSequana-compliant platform and the corresponding HPC software ecosystem for the Modular Supercomputing Architecture. Scientifically, EUPEX is a vehicle to prepare HPC, AI, and Big Data processing communities for upcoming European Exascale systems and technologies. → www.eupex.eu
Projects of the 9 th Framework Programme for Research and Innovation of the European Union– Horizon Europe	
BioDT – Biodiversity Digital Twin for Advanced Modelling, Simulation and Prediction Capabilities (2022–2025)	→ Project ID: 101057437 (HORIZON-INFRA-2021-TECH-01, RIA) → Principal Investigator: Dr Tomáš Martinovič → The project aimed to push the current boundaries of a predictive understanding of biodiversity dynamics by developing a Digital Twin that provided advanced modelling, simulation, and prediction capabilities. By exploiting existing technologies and data available across relevant research infrastructures in new ways, the project enabled accurate modelling of interactions between species and their environment. Thus, scientists used BioDT to better observe biodiversity changes, relate these changes to possible causes, and better predict their effects by considering how climate or human intervention influences these causes. → www.biodt.eu

OpenWebSearch.EU – Piloting a Cooperative Open Web Search Infrastructure to Support Europe’s Digital Sovereignty (2022–2026)	→ Project ID: 101070014 (HORIZON-CL4-2021-HUMAN-01, RIA) → Principal Investigator: Dr Jan Martinovič → The project aims at developing an open European web search infrastructure. This project will contribute to Europe’s digital sovereignty and promote an open search engine-based application market. The researchers will develop the core of the European Open Web Index as a basis for a new Internet Search in Europe. The project will also lay the foundation for an open and extensible European Open Web Search and Analysis Infrastructure based on Europe’s values, principles, legislation, and standards. → openwebsearch.eu
EXA4MIND – EXtreme Analytics for MINing Data spaces (2023–2026)	→ Project ID: 101092944 (HORIZON-CL4-2022-DATA-01, RIA) → Principal Investigator: Dr Jan Martinovič → The project will build an Extreme Data platform connecting data storage facilities and supercomputers by introducing new methods for automated data management and effective data staging. The project’s core consists of four application cases in molecular dynamics, advanced driver assistance systems, smart agriculture/viticulture, and health and social big data. The project presents innovative solutions to complex everyday data-processing problems using advanced data analytics, machine learning, and artificial intelligence to simplify using supercomputing centres in the EU for applications dealing with extreme data. → www.exa4mind.eu
SPACE – Scalable Parallel and distributed Astrophysical Codes for Exascale (2023–2026)	→ Project ID: 101093441 (HORIZON-EUROHPC-JU-2021-COE-01) → Principal Investigator: Doc. Lubomír Říha → In astrophysics and cosmology, High-Performance Computing-based numerical simulations are key tools for scientific discovery. They represent essential tools for theoretical experiments capable of understanding the physical processes behind the observed sky, for which effective exploitation of exascale computing capabilities is necessary. These systems, however, have a complicated architecture that significantly impacts simulation codes. The SPACE Centre of Excellence aims to re-engineer target codes to fully utilise new computer architectures and apply new programming methods, software solutions, and HPC libraries. → www.space-coe.eu

**MaX – MAterials de-
sign at the eXascale
(2023–2026)**

- Project ID: 101093374 (HORIZON-EUROHPC-JU-2021-COE-01)
- Principal Investigator: Doc. Lubomír Říha
- Materials simulations have become one of the most intensive and fast-growing domains for high-performance computing worldwide, with a recognised European leadership in developing and innovating the ecosystem of quantum simulation codes. The MaX Centre of Excellence will target these flagship codes to address the challenges, leverage the opportunities arising from future exascale and post-exascale architectures, and offer powerful paths to discovery and innovation serving scientific and industrial applications.
- www.max-centre.eu

**DTO-BioFlow – Inte-
gration of biodiver-
sity monitoring data
into the Digital Twin
Ocean (2023–2027)**

- Project ID: 101112823 (HORIZON-MISS-2022-OCEAN-01, IA)
- Principal Investigator: Dr Tomáš Martinovič
- The project’s primary objective is to awaken sleeping biodiversity data, enabling a smooth integration of both existing and new data into the European Digital Twin Ocean. The project will provide innovative and sustainable solutions for making previously unavailable or hard-to-access biodiversity data accessible. Additionally, it will focus on developing cost-effective and scalable technologies for monitoring species on a large scale. The project aims to improve the European biodiversity data environment by streamlining the flow of FAIR data from various sources into digital twin repositories, optimising and enhancing the functionality and societal value of the Digital Twin Ocean.
- dto-bioflow.eu

**FALCON – Foreseeing
the next generation
of Aircraft: hybrid ap-
proach using Lattice-
Boltzmann, experi-
ments and modelling
to optimize fluid/
struCture interactionS
(2024–2027)**

- Project ID: 101138305 (HORIZON-CL5-2023-D5-01-09)
- Principal Investigator: Doc. Lubomír Říha
- Aviation transport is the second biggest source of greenhouse gas emissions after road transport. One of the main levers for reducing CO₂ emissions is reducing airframe structural weight. The growing amount of air traffic means that many EU citizens are still exposed to high noise levels. FALCON’s ambition is to enhance the design capabilities of the European aircraft sector, focusing on fluid-structure interaction (FSI) phenomena to improve the aerodynamic performances of aircraft. Specifically, FALCON aims to develop high-performance, predictive, and multidisciplinary tools for FSI in aeronautics to reduce aeroacoustics and aeroelastic instabilities using multi-fidelity optimisation.
- falconproject.eu

**POP3 – Perfor-
mance Optimisation
and Productivity 3
(2024–2026)**

- Project ID: 101143931 (HORIZON-EUROHPC-JU-2023-COE-01)
- Principal Investigator: Doc. Lubomír Říha
- Performance Optimisation and Productivity Centre of Excellence (POP CoE) was established in October 2015 with the primary goal of assisting the broad community of HPC application developers and users in both scientific and industrial fields. Its aim is to help them understand performance-re-

lated issues in their applications, thereby improving their efficiency and productivity. The current project, entitled Performance Optimisation and Productivity 3 (POP3), is divided into three main pillars: services, users, and code design. The services provided within the POP project primarily focus on performance assessments, evaluating code performance and scalability, identifying the main sources of inefficiency, and providing insights and recommendations to improve performance.

→ pop-coe.eu

**AVITHRAPID – Antiviral
Therapeutics for Rapid
Response Against
Pandemic Infectious
Diseases (2024–2028)**

Project ID: 101137192 (HORIZON-HLTH-2023-DISEASE-03, RIA)
Principal Investigator: Dr Jan Martinovič

- The project aims to support the search for new broad-spectrum antiviral compounds by developing various methods. Based on an existing set of small bioactive molecules, AVITHRAPID seeks to develop preclinical candidates targeting several viruses. This will be achieved by combining relevant expertise in preclinical drug discovery, including molecular modelling, biochemical and cellular assays, X-ray crystallography, medicinal chemistry, biophysical binding studies, ADMETox profiling, in vitro and in vivo pharmacokinetics, and animal disease models.
- avithrapid.eu

**CLARA – Center for
Artificial Intelli-
gence and Quantum
Computing in Sys-
tem Brain Research
(2024–2030)**

- Project ID: 101136607
(HORIZON-WIDERA-2023-ACCESS-01-01-two-stage, CSA)
- Principal Investigator: Doc. Vít Vondrák
- The Center for Artificial Intelligence and Quantum Computing in System Brain Research (CLARA) is an interdisciplinary Centre of Excellence focused on a new generation of artificial intelligence/machine learning applications and quantum-oriented supercomputing tools that will push the boundaries of research into neurodegenerative diseases, especially Alzheimer’s disease. Within the project, a domain-specific platform for a hybrid computing and data infrastructure will be developed, based on emerging computing resources from the EuroHPC Joint Undertaking. This platform will significantly contribute to the development of the European computing and data ecosystem for systematic brain research.
- clara-center.eu

**EOSC-ENTRUST:
A European Network
of TRUSTed research
environments
(2024–2027)**

- Project ID: 101131056 (HORIZON-INFRA-2023-EOSC-01, RIA)
- Principal Investigator: Doc. Vít Vondrák
- The mission of the project is to create a European network of trusted research environments for sensitive data and to support Europe’s interoperability by establishing a common framework for federated data access and analysis. Within the project, four flagship cases were selected, focusing on genomics, clinical studies, social sciences, and public-private partnerships. These serve to compare capabilities, provide input for framework design, and demonstrate secure data analysis using federated workflows.
- www.eosc-entrust.eu

KAROLINA

The KAROLINA supercomputer

TWIN SYNERGIES – Empowering participation and accelerating synergies in Widening countries with a focus on Green & Digital Transition (2024–2026)

- Project ID: 101160135 (HORIZON-WIDERA-2023-ACCESS-04)
- Principal Investigator: Martin Duda
- The project is focused on supporting the EU’s strategic context regarding the creation of synergies at the operational and management levels and aims at so-called upstream synergies – the development of human resources and internationalisation. In this way, particular attention will be given to smart specialisation strategies, which are essential tools for creating combined effects with the smart growth strategy instruments at the EU level (especially with the Horizon Europe programme). The project will develop and implement compatible, tailored, yet transferable activities for capacity building, internalisation, human resource development, cooperation, valorisation, and technology deployment, with a focus on current developments related to the green and digital transition.

→ www.twinsynergies.net

TerraDT – Digital Twin of Earth system for Cryosphere, Land surface and related interactions (2025–2028)

- Project ID: 101187992 (HORIZON-INFRA-2024-TECH-01-03)
- Principal Investigator: Dr Jan Martinovič
- TerraDT is a groundbreaking digital twin project designed to enhance our understanding of how glaciers, sea ice, vegetation, and aerosols influence the Earth’s climate. Delivering high-resolution climate models will provide useful decision-making tools at the local level, for example, when planning optimal shipping routes, park locations, and other infrastructure. The project will leverage Europe’s most advanced supercomputers to achieve unprecedented modelling accuracy.

→ terradt.eu

SEANERGYS – Software for Efficient and Energy-Aware Supercomputers (2025–2029)

- Project ID: 101177590 (HORIZON-EUROHPC-JU-2023-ENERGY-04-01)
- Principal Investigator: Doc. Lubomír Říha
- The SEANERGYS project will develop a next-generation software solution to improve the energy-efficient operation of EuroHPC supercomputers. By enhancing the way energy is monitored, managed, and used in supercomputing, the project will help strengthen Europe’s commitment to sustainability. IT4Innovations will actively develop a set of artificial intelligence models (“model zoo”) designed to predict HPC cluster behaviour using data from data centre monitoring. IT4I will also create photorealistic visualisations of monitoring data, job schedules, and predicted future system states. In addition, IT4I will focus on dynamic resource management to improve resource utilisation and energy efficiency and will develop the MERIC software suite to measure energy consumption and optimise CPU and GPU settings.

DARE SGA1 – Digital Autonomy for RISC-V in Europe (Specific Grant Agreement 1) (2025–2028)

- Project ID: 101202459 (HORIZON-EUROHPC-JU-2024-DARE-SGA-04-01)
- Principal Investigator: Doc. Lubomír Říha
- The project aims to strengthen Europe’s digital autonomy in the fields of High-Performance Computing (HPC) and Artificial Intelligence. Its goal is to develop products for European supercomputers intended for both research and industry. It leverages the open RISC-V architecture, chiplet technology, and open-source software to design three specialised chiplets for HPC and AI. These modules will be integrated into high-performance European systems. The project includes parallel hardware and software development and will create a technical roadmap for future European post-exascale supercomputers.

→ dare-riscv.eu

HARMONY – A Hybrid Generative AI-model for Resolving Molecular Structures integrating sequence and Cryo-Electron Microscopy data (2025)

- Project ID: 101163317 (FFplus_Call-1-Type-2)
- Principal Investigator: Matej Špetko
- A novel open-source AI model was developed by incorporating cryoEM data into the OpenFold architecture. This collaboration enhanced prediction accuracy and confidence of the generated 3D protein models. Leveraging PUXANO’s experience in structural biology, it is possible to perform rapid model validation and create services around an open-source AI model for protein structure prediction.

BRM Aero – Optimization of low-speed characteristics & performance of aircraft (2025–2026)

- Project ID: 101163317 (FFplus_Call-1-Type-1)
- Principal Investigator: Dr Tomáš Karásek
- Companies specialising in custom aircraft manufacturing, BRM Aero and Airmobis, have formed a partnership with IT4Innovations to focus on the shape and configuration of aircraft flaps to achieve maximum aerodynamics. By leveraging advanced technologies such as artificial intelligence, digital modelling, neural networks, and supercomputer-accelerated simulations, they aim to develop a methodology to create an optimised aircraft design while significantly reducing development time and costs. This approach will also help reduce the aircraft’s weight and material usage, increase cruising speed, and lower fuel consumption.

LAIF Service Center – LUMI AI Factory – Service Center (2025–2028)

- Project ID: 101234208 (HORIZON-JU-EUROHPC-2025-AI-01-IBA)
- Principal Investigator: Doc. Vít Vondrák (since 2026 Dr Jan Martinovič)
- As AI technologies and methodologies continue to advance swiftly, Europe has been actively developing and strengthening the ecosystem of frameworks, environments, tools, and services required to boost innovation. This comprehensive approach aims to harmonise AI strategies across the continent, addressing the technology’s challenges and opportunities while assessing its impact on public and private sectors and society at large. The LUMI AI Factory Service Center project is a part of the broader LUMI AI Factory ecosystem leveraging the current LUMI supercomputer but gearing up for the upcoming LUMI-AI system, and the related AI-optimised quantum experimental platform LUMI-IQ.

- LUMI-IQ – LUMI AI Factory – Advanced experimental AI-optimised quantum-based platform (2025–2032)**

- Project ID: 101239031 (HORIZON-JU-EUROHPC-2025-AI-01-IBA-02)
 - Principal Investigator: Prof. Lampart Marek
 - LUMI-IQ, the quantum computing platform of the LUMI AI Factory, builds on the proven success of the LUMI supercomputer. Deployed alongside the new LUMI-AI supercomputer, LUMI-IQ will provide researchers, industry innovators, and developers across Europe with a unique, advanced, AI-optimised experimental platform where quantum computing and AI meet.

Digital Europe Programme

- EUROCC 2 – National Competence Centres in the Framework of EuroHPC Phase 2 (2023–2026)**

- Project ID: 101101903 (DIGITAL-EUROHPC-JU-2022-NCC-01)
 - Principal Investigator: Dr Tomáš Karásek
 - The mission of EuroCC 2 is to continue establishing a network of National Competence Centres in the most efficient way possible while continuing to promote an efficient way to spread High-Performance Computing (HPC) in Europe. The main objective is to support the National Competence Centres in developing their individual operational frameworks, to develop further cooperation and exchange of good practice, and to accelerate the process of competence development at the national and European level.
- www.eurocc-access.eu

- CZQCI – Czech National Quantum Communication Infrastructure (2023–2027)**

- Project ID: 101091684 (DIGITAL-2021-QCI-01, DIGITAL Simple Grants)
 - Principal Investigator: Doc. Vít Vondrák
 - The project will enable the introduction of quantum communication infrastructure (QCI) in the Czech Republic. A training programme will be designed and developed to prepare users and professionals from all sectors to use future quantum communication infrastructures. The infrastructure and expertise gained through the project will allow for testing advanced communication methods between public authorities and industrial users, testing operational requirements in terms of long distances and time, and testing QKD and network components. The highly demanding pilot testing will pave the way for the widespread deployment of QCI. The project will significantly contribute to increasing cybersecurity in Europe by promoting and implementing European quantum communication technologies.

- EDIH Ostrava – European Digital Innovation Hub (2023–2025)**

- Project ID: 101083551 (DIGITAL-2021-EDIH-01)
 - Principal Investigator: Martin Duda
 - The mission of the European Digital Innovation Hub Ostrava (EDIH Ostrava) is to support the deployment and use of advanced digital technologies in companies and society. The EDIH Ostrava offers its services under highly favourable subsidised conditions or free of charge. It was created by combining the activities of IT4Innovations and the Faculty of Electrical Engineering and Computer Science, both part of VSB-TUO, with those of the Moravian-Silesian Innovation Centre Ostrava.
- www.edihostrava.cz

- EPICURE – High-level specialised application support service in High-Performance Computing (HPC) (2024–2028)**

- Project ID: 101139786 (DIGITAL-EUROHPC-JU-2022-APPSUPPORT-01)
 - Principal Investigator: Doc. Lubomír Říha
 - The EPICURE project aims to operate an HPC application support service for European scientists and researchers using EuroHPC JU supercomputers. The Application Support Teams provide services focused primarily on application deployment, optimisation, and the correct execution of key applications, as well as organising training events and workshops within high-profile international HPC events. A single point of contact will also be established, enabling HPC users to obtain information about the systems, their architectures, access mechanisms, and available support services.
- epicure-hpc.eu

- EUROQHPC-I – EuroQHPC-Integration (2025–2029)**

- Project ID: 101159808 (DIGITAL-EUROHPC-JU-2022-HPCQC-04-01-IBA)
 - Principal Investigator: Dr Branislav Jansík
 - EuroHPC JU aims to strengthen European capacities in the field of supercomputers and quantum computers, creating a cutting-edge hybrid HPC-QC infrastructure for open research and development. The project brings together six entities that will host quantum computers, integrating them in a coordinated manner with EuroHPC supercomputers. The goal is to develop standard methods for integrating quantum computers with the HPC environment, to develop applications and test suites that verify HPC-QC integration on all systems, and to establish a joint technical support forum (TST). Global coordination between host entities will also promote the exchange of best practices in HPC-QC integration, with the aim of ultimately establishing common European standards.



Educational Projects

Projects of the 8th Framework Programme for Research and Innovation of the European Union – Horizon 2020

EUMaster4HPC – European Master for High Performance Computing (2022–2025)

- Project ID: 101051997 (H2020-JTI-EuroHPC-2020-03, CSA)
- Principal Investigator: Prof. Tomáš Kozubek
- The consortium of universities, research and supercomputing centres, industrial partners, and other cooperating institutions, which aims to launch Master’s study programmes at eight European universities. This activity is part of the broader EuroHPC JU strategy, which supports the development of critical competencies and education and training in HPC to meet the needs of European science and industry.
- eumaster4hpc.uni.lu

Digital Europe Programme

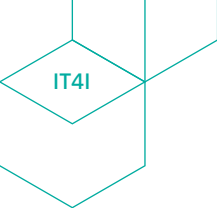
EVITA – EuroHPC Virtual Training Academy (2025–2029)

- Project ID: 101196394 (DIGITAL-EUROHPC-JU-2023-ACADEMY-02)
- Principal Investigator: Karína Pešatová
- The EVITA project will enhance education in high-performance computing and artificial intelligence in Europe. It will create a competency framework based on professional profiles and a skills tree, which will subsequently lead to the development of modules and courses. Quality training will be ensured through open calls with cascading funding, and an online educational platform will be developed with certifications and educational materials for students, as well as tools for trainers. EVITA aims to create a connected community of students, educators, and industry experts equipped with top-notch knowledge and skills in HPC.
- www.evita4hpc.eu

International Visegrad Fund

Superheroes 4 Science (2023–2025)

- Project ID: 22320170 (International Visegrad Fund)
- Principal Investigator: Karína Pešatová
- The project introduced the younger generation to High-Performance Computing (HPC), a critical technology field that uses supercomputers to solve complex problems and perform computationally intensive tasks. The project aimed to create interactive educational materials on HPC and its two related emerging fields: Artificial Intelligence and Quantum Computing.
- superheroes4science.eu

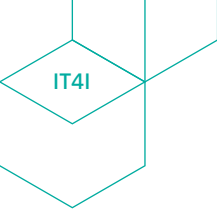


IT4I

LIST OF ABBREVIATIONS

AI	Artificial Intelligence
ARCHIVE	Data storage installed in IT4Innovations
AURORA	AI for Unified Representation, Observation, Rendering and Advanced Simulation
BDVA	Big Data Value Association
BioDT	Biodiversity Digital Twin for Advanced Modelling, Simulation and Prediction Capabilities
CADENCE	Computationally Accelerated Discovery of Advanced Materials and Biomolecular Systems
CATRIN	Czech Advanced Technology and Research Institute
CLARA	Center for Artificial Intelligence and Quantum Computing in Systematic Brain Research
CPU	Centra Processing Unit
CZAI	Czech AI Factory, part of the European network of AI Factories
DARE SGA1	Digital Autonomy for RISC-V in Europe (Specific Grant Agreement 1)
DOI	Digital Object Identifier
DTO-BioFLOW	Integration of biodiversity monitoring data into the Digital Twin Ocean
EDIH Ostrava	European Digital Innovation Hub Ostrava
e-INFRA CZ	e-Infrastructure for Research and Development in the Czech Republic
EFP	EuroHPC Federation Platform
EOSC	European Open Science Cloud
ESA	European Space Agency
ETP4HPC	European Technology Platform for High-Performance Computing
EUDAT CDI	EUDAT Collaborative Data Infrastructure
EUMaster4HPC	European Master’s Study Programme focused on High-Performance Computing
EUPEX	EUropean Pilot for EXascale
EUROCC	National Competence Centres in HPC within the EuroHPC JU network
EUROQHPC-I	EuroQHPC-Integration to interconnect European supercomputers with quantum computers
EuroHPC JU	European High-Performance Computing Joint Undertaking
EVITA	EuroHPC Virtual Training Academy
EXA4MIND	EXtreme Analytics for MINing Data spaces
FAIR data	Data managed in line with FAIR Principles (Findable, Accessible, Interoperable, Reusable)
Flop/s	Floating Point Operations per Second

FTE	Full-Time Equivalent
GBS4EO	Gaussian Boson Sampling for Earth Observation
GPU	Graphics Processing Unit
H2020	Horizon 2020
HPC	High-Performance Computing
HPQC4F	High-Performance and Quantum Computing for Future
HPDA	High-Performance Data Analytics
InnovAlte	InnovAlte Slovakia: Illuminating Pathways for AI-Driven Breakthroughs
iRODS	Integrated Rule-Oriented Data System
IQM	IQM Quantum Computers, the supplier of the first Czech quantum computer
LEXIS Platform	Leveraging Europe’s eXtreme-scale Infrastructure for Science
MaX	MAterials design at the eXascale, European Centre of Excellence
MERIC	MERIC Energy Aware Suite
MEYS	Ministry of Education, Youth and Sports of the Czech Republic
P JAC	Programme Johannes Amos Comenius
OP TAC	Operational Programme Technologies and Applications for Competitiveness
POP3	Performance Optimisation and Productivity 3, European Centre of Excellence
PRACE	Partnership for Advanced Computing in Europe
REFRESH	Research Excellence For REgion Sustainability and High-tech Industries
Q-NEKO	The Nippon-Europe Quantum Koraborëshon
QC	Quantum Computing
QKD	Quantum Key Distribution
QuIC	European Quantum Industry Consortium
SEANERGY	Software for Efficient and Energy-Aware Supercomputers
SPACE	Scalable Parallel Astrophysical Codes for Exascale, European Centre of Excellence
TA CR	Technology Agency of the Czech Republic
TerraDT	Digital Twin of Earth system for Cryosphere, Land surface and related interactions
VI-HPS	Virtual Institute – High Productivity Supercomputing
VLQ	First Czech quantum computer installed at IT4Innovations
WHPC	Women in High Performance Computing
VSB-TUO	VSB – Technical University of Ostrava



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