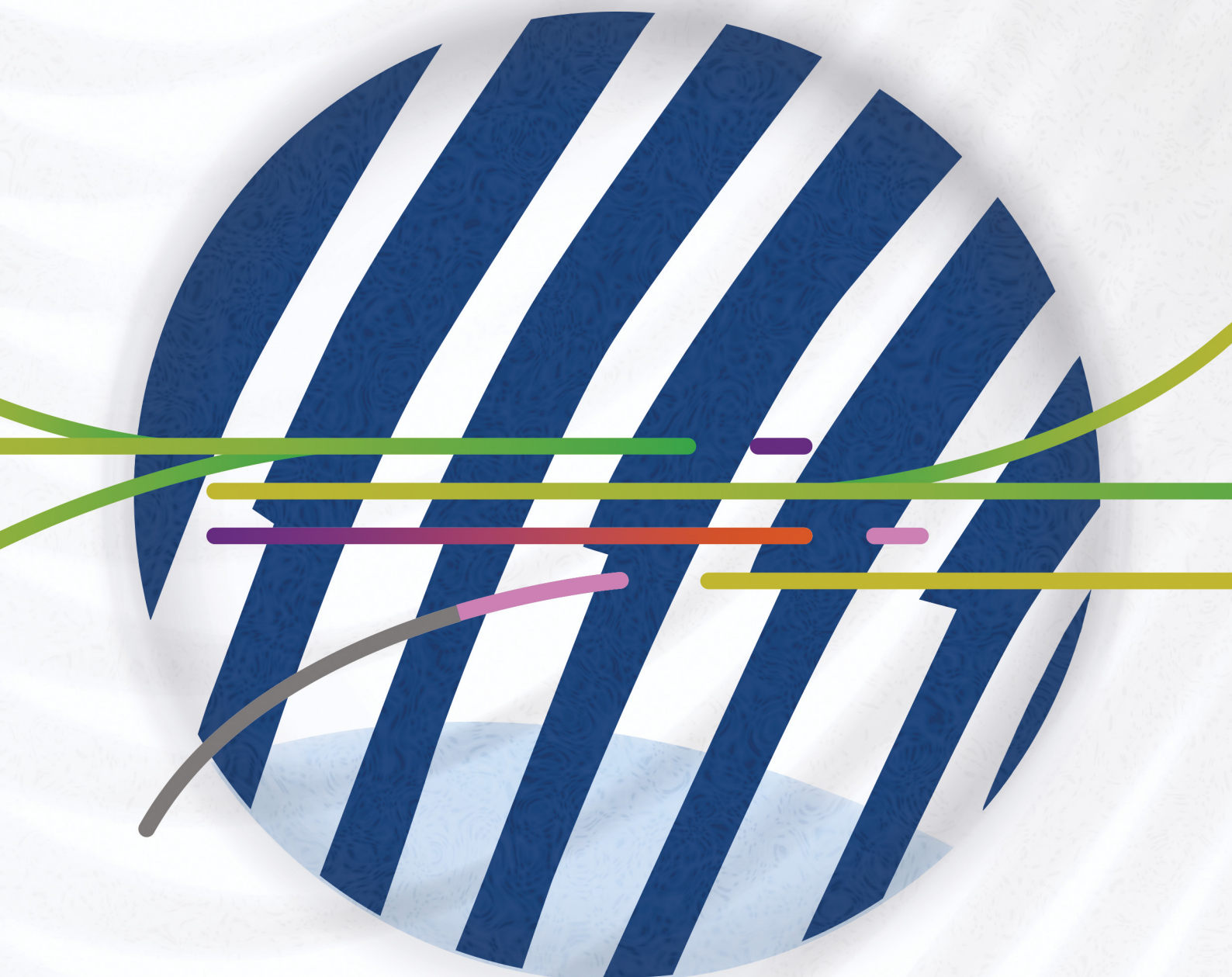
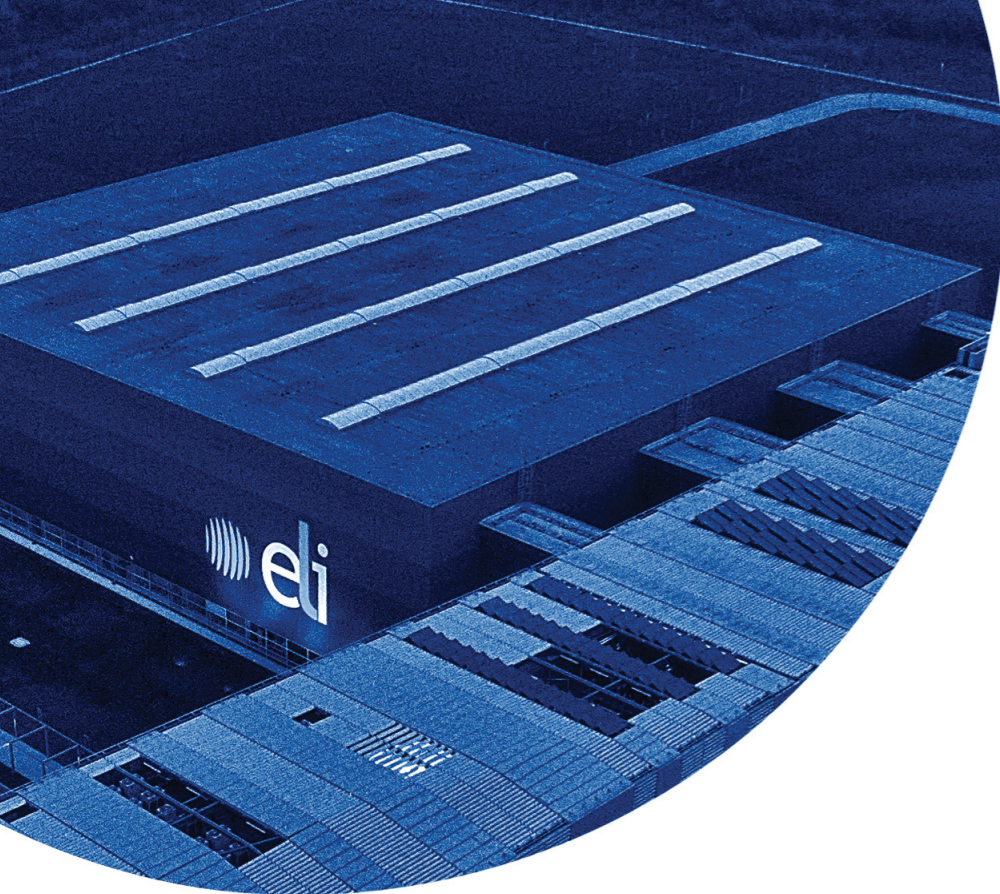




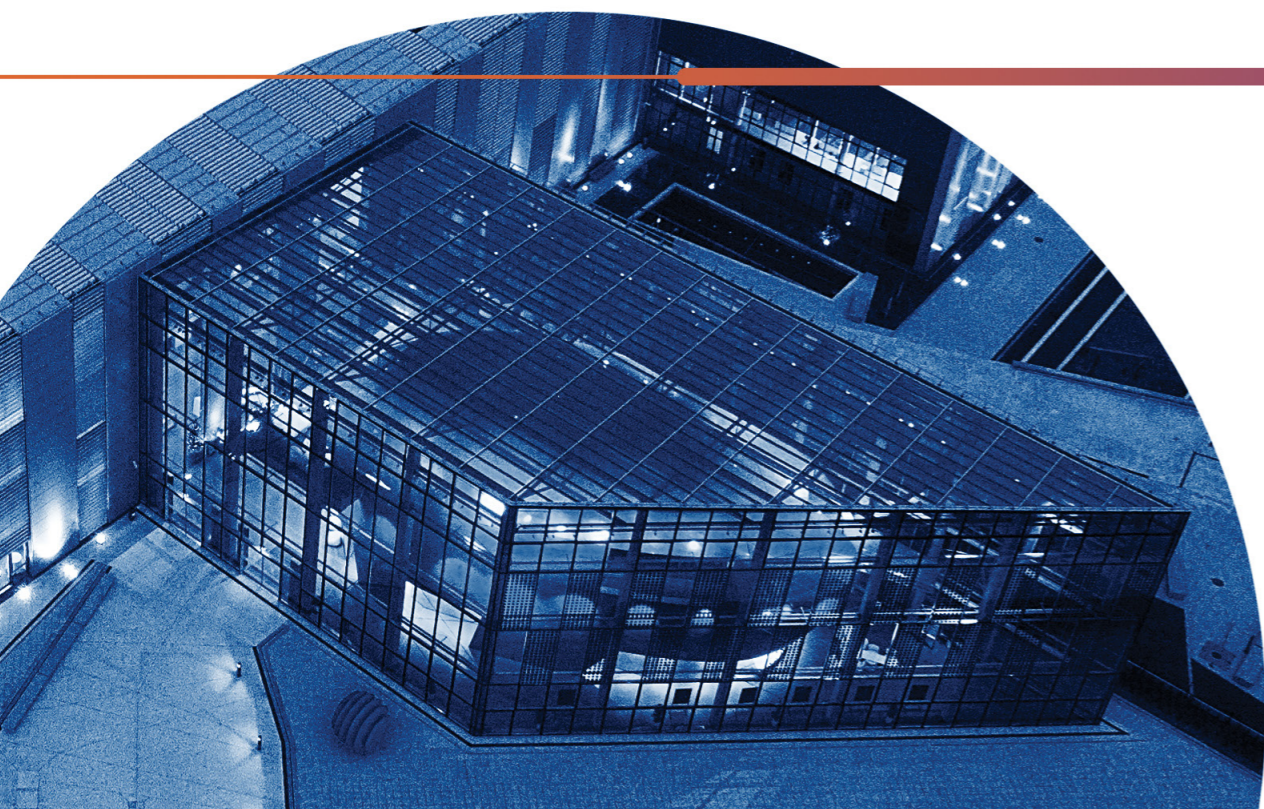
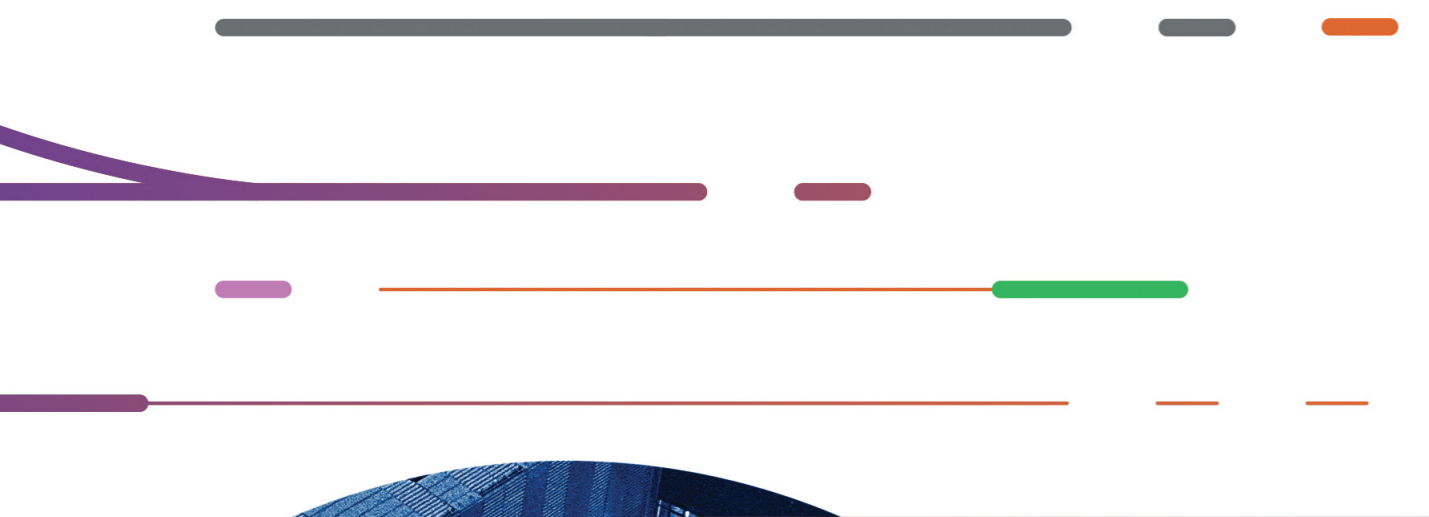
NATIONAL RESEARCH, DEVELOPMENT AND INNOVATION OFFICE
HUNGARY

TOP RESEARCH INFRASTRUCTURES in Hungary 2021





TOP RESEARCH INFRASTRUCTURES IN HUNGARY
AND THEIR EMBEDDEDNESS IN THE EUROPEAN
RESEARCH INFRASTRUCTURE LANDSCAPE



Budapest
2022

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RESEARCH INFRASTRUCTURES WILL MAKE OUR LIVES BETTER THROUGH THE GENERATION OF NEW KNOWLEDGE

Foreword by István Szabó, PhD

Vice President for Science and International Affairs
National Research, Development and Innovation Office

On the research, development and innovation (RDI) landscape of any country, research infrastructures are essential for both fundamental and exploratory research. Moreover, research infrastructures contribute to the social and economic performance of the country. Our internationally acclaimed research infrastructures (RIs), just as the network of educational and research institutions, are key throughout the continuous effort for success and excellence. As the result of this integration and the intensifying cooperation and networking with international RIs, an increasing number of our excellent research infrastructures can now be considered truly world-class.

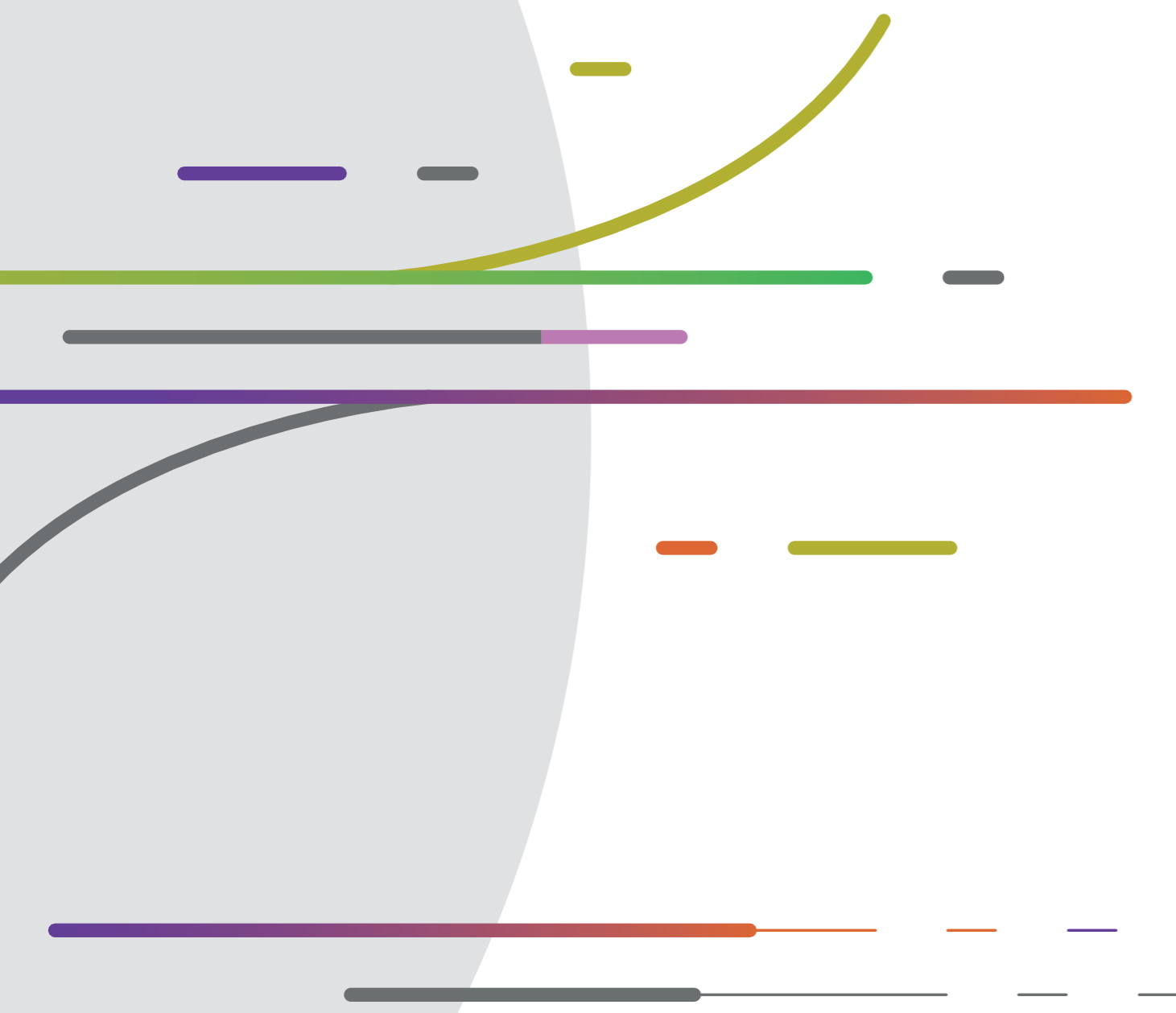
Putting Hungarian RDI on the international map and increasing the embeddedness of our research infrastructures in the research systems and networks have been among Hungary's top priorities. Similarly, research facilities and researcher groups will be recognized and make a lasting impact when their cooperation is taken further, to the international level.

The primary purpose of this publication is to showcase over fifty excellent research infrastructures located in Hungary and to present the wide spectrum of research options our RDI landscape can offer in terms of RIs. Visibility, accessibility and openness are key in enhancing cooperation and networking. These were the keywords driving us when we have selected the top research infrastructures of Hungary.

I invite and encourage every researcher, both Hungarians and from abroad, even the youngest ones at the earliest stage of their scientific career, to take a look at the various research infrastructures and their field of research featured on the following pages. Also, I encourage you to look beyond the regular paths to identify a research infrastructure in order to solve a problem, since nowadays complex problems require complex solutions and more and more intense cooperation is needed between the scientific branches. If you think you have found what you have been looking for, don't hesitate to get in touch with us. I am convinced, that Hungary's RDI scene, through the growing cooperation of researchers from around the world will make sure that research infrastructures will make our lives better through the generation of new knowledge.



01 HUNGARY'S MEMBERSHIPS IN EUROPEAN RESEARCH INFRASTRUCTURES



INTRODUCTION

Science has an important mission in the economic, social and environmental transitions but above all, science has to address the societal challenges Europe and the world are facing from time to time. Societies today demand science not to exist only in an ivory tower, but to address and help us solve a wide range of societal issues, like climate change, health and wellbeing, environmental issues and digital transition. Being at the heart of the research and innovation ecosystem, research infrastructures (RIs) are essential pillars of this mission and play a crucial role in delivering scientific breakthrough and fostering innovation. Research infrastructures constitute the backbone of national and international knowledge communities, serving as strategic tools in the development of research and innovation.

Since the first National Research Infrastructure Roadmap of Hungary was published in 2018, we have been striving to synchronize our national research infrastructure roadmapping process with the cycles of the European Strategy Forum on Research Infrastructures (ESFRI). Following the launch of the update of the ESFRI Research Infrastructure Roadmap 2018 to be completed by 2021, the National Research, Development and Innovation Office (NRDI Office) conducted a nationwide survey to learn which existing European research infrastructure Landmarks or Projects are in the focus of the Hungarian researchers' interest and we also encouraged our scientific community to join the newly forming European-scale research infrastructures.

During the national survey, the NRDI Office has received twenty one accession proposals, of which thirteen are related to RIs included on the 2018 ESFRI Roadmap, one proposal targeted an existing RI not listed on the ESFRI Roadmap, and seven proposals aimed to join newly forming RIs to be added to the 2021 ESFRI Roadmap. The proposals for joining both existing and newly forming ESFRI research infrastructures were evaluated by the National Research Infrastructure Committee (NRIC). The main aspects of the evaluation were the international excellence of the Hungarian researcher community in the given field, the existence of a critical mass including young researchers, the financial conditions and the potential of in-kind contributions. Following the recommendation of the NRIC, the representatives of the RIs aiming to join existing ESFRI research infrastructures gave an oral presentation, where the members of the Committee could clarify some additional aspects of the proposed membership.

As a result of the nationwide survey and the subsequent evaluation, Hungary participates in twenty Projects and Landmarks listed on the ESFRI Roadmap 2021. In addition, Hungary participates in several non-ESFRI related research infrastructures (e.g. CERN, EMBL, ICGEB, etc.) where our researchers can also benefit from Hungary's membership. Among the ESFRI RIs, the Extreme Light Infrastructure ERIC (ELI ERIC) project has a significant importance for Hungary, since the ELI-Attosecond Light Pulse Source (ELI-ALPS) next generation laser facility is located in the country and it is an integral part of the pan-European RI landscape.

On the following pages we will demonstrate how diversely our researchers are connected to the European research infrastructure landscape, including the European RIs Hungary has recently joined, and also the new ones which will be shaping together with the effort of the Hungarian researchers in the coming years.

TABLE 1 – HUNGARY'S MEMBERSHIP IN EUROPEAN RESEARCH INFRASTRUCTURES

RI short name	RI name	ESFRI Landmark /Project	Start of participation (year)	Brief description
ENERGY				
ITER EUROfusion	International Thermonuclear Experimental Reactor	Non ESFRI related	2007	ITER aims to demonstrate that nuclear fusion can be used on Earth for energy purposes and testing technological solutions. ITER is considered, by competent researchers indispensable in the process of creating fusion energy. Fusion related research and development is performed by EUROfusion program which integrates all member states' research projects in this field.
ENVIRONMENT				
ICOS ERIC	Integrated Carbon Observation System - European Research Infrastructure Consortium	Landmark	2022	ICOS is the main European research organisation for climate and atmosphere research. Using standardised measurement methods, ICOS aims to provide long-term studies to better understand the global carbon cycle and collect reliable data on changes in greenhouse gases through the coordinated operation of a growing network of nearly 150 atmospheric, ecological and oceanic monitoring units.
HEALTH & FOOD				
BBMRI ERIC	Biobanking and BioMolecular Resources Research Infrastructure - European Research Infrastructure Consortium	Landmark	2021	BBMRI, one of the largest research infrastructures for health research in Europe, brings together all the main players from the field of biobanking - researchers, biobankers, industry players and patients. The goal is to develop new medical applications, therapies and treatments, improve diagnostics and to give personalized medicine and the biomedical industry a boost.
ECRIN ERIC	European Clinical Research Infrastructure Network - European Research Infrastructure Consortium	Landmark	2017	The infrastructure supports the creation of a high quality, transparent, multinational system of clinical trials by mitigating the drawbacks of the fragmented clinical trial environment and poor interoperability.
ELIXIR	A distributed infrastructure for life-science information	Landmark	2016	The European initiative connects and integrates into a single infrastructure the major bioinformatics resources of national centres, hubs and service providers. It supports many fields of life sciences, including research in the field of agriculture and medicine.
EMBL	European Molecular Biology Laboratory	Non ESFRI related	2017	EMBL is a leading European laboratory in life sciences with 80 independent research institution members covering the full spectrum of molecular biology from molecules to organisms, including system biology and bioinformatics.
ERINHA	European Research Infrastructure on Highly Pathogenic Agents	Landmark	2018	ERINHA provides access to cutting-edge research facilities aiming to address the challenges posed by the emergence of highly dangerous human and animal micro-organisms infecting humans with high risks for public health, society and economy.
EuBI ERIC	European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences - European Research Infrastructure Consortium	Landmark	2016	The infrastructure provides access to a wide range of state-of-the-art technologies in biological and clinical imaging. It aims to connect the specialised, geographically fragmented national hubs to reach all European researchers in the member states.
ICGEB	International Centre for Genetic Engineering and Biotechnology	Non ESFRI related	1987	The intergovernmental organisation promotes high-quality research in molecular biology and biotechnology. ICGEB announces an open call for cooperative biotechnology research projects yearly, for PhD and Postdoctoral fellowship applications, and for proposals relating to the organisation of conferences and training courses.
PHYSICAL SCIENCES & ENGINEERING				
CERIC ERIC	Central European Research Infrastructure Consortium - European Research Infrastructure Consortium	Non ESFRI related	2017	The multidisciplinary research infrastructure integrates research projects in 7 European countries in the fields of materials science and nanotechnology at market price. The main focus of the consortium is open access (researcher exchange). Access is free of charge for commercial and industrial research projects.

TABLE 1 – HUNGARY'S MEMBERSHIP IN EUROPEAN RESEARCH INFRASTRUCTURES

RI short name	RI name	ESFRI Landmark /Project	Start of participation (year)	Brief description
PHYSICAL SCIENCES & ENGINEERING				
CERN (ALICE, CMS)	The European Organization for Nuclear Research	Non ESFRI related	1992	The European Organization for Nuclear Research is one of the most prestigious research centres in the world. Its main mission is basic research in particle physics with an aim to better understand the properties of basic interactions and the relationships of the universe. It designs, builds and operates complex particle accelerator equipment.
CERN HL-LHC	High-Luminosity Large Hadron Collider at CERN	Landmark	2014	The Large Hadron Collider (LHC) operated by CERN is going to be upgraded to increased intensity by 2026. The detectors are also being upgraded: this work has already started in 2018. Of the four large detectors of LHC, Hungary participates in the experiments of ALICE and CMS. The CMS (and Atlas) project contributed to the discovery of the Higgs boson. The ALICE project recreates the primary matter through heavy-ion collisions.
ELI ERIC	Extreme Light Infrastructure	Landmark	2013	The primary mission of the ELI Attosecond Light Pulse Source (ELI-ALPS) research infrastructure in Szeged is to provide access to a wide range of ultra-short light pulses sources for various user groups of the international scientific community. Another main element in the facility's mission is to promote the scientific and technological developments necessary for delivering lasers with high peak intensity and high average performance.
ESRF EBS	European Synchrotron Radiation Facility Extremely Brilliant Source	Landmark	2017	The infrastructure is the world's leading X-ray source. A state-of-the-art equipment enabling the atomic and nano-scale examination of matter in various fields of science: solid-state physics, medicine, pharmacy, earth sciences, environmental science and archaeology. There are many synchrotron sources across the world, but the ESRF is unique in terms of test beam parameters and the number of measurement channels.
ESS ERIC	European Spallation Source - European Research Infrastructure Consortium	Landmark	2014	ESS is the world's first so-called long-pulse spallation neutron source. Its mission is to build and operate a world leading facility for neutron research. The world's highest intensity neutron source enables the examination of systems which has never been possible due to the small size of the sample or the small intensity of the examined signal. The equipment gives a great boost to domestic research in physics, chemistry and materials science.
European XFEL	European X-Ray Free-Electron Laser Facility	Landmark	2009	This facility is unique in Europe and is used for ultra-short (27 thousands/sec) and very bright X-ray experiments. With such parameters the facility opens up entirely new opportunities for scientific and industrial research. Researchers can map viruses at the atomic level, understand the molecular structure of cells, create 3D images of the nano-world, etc.
SOCIAL & CULTURAL INNOVATION				
CESSDA ERIC	Social Science Data Archives-European Research Infrastructure Consortium	Landmark	2017	CESSDA is the only virtual research infrastructure offering a single interface and access to the social scientific databases of all EU states and associated members. CESSDA is essential for the access and use of comparative social scientific databases for administrative and scientific purposes.
CLARIN ERIC	Common Language Resources and Technology Infrastructure - European Research Infrastructure Consortium	Landmark	2016	CLARIN provides advanced digital language resources and tools, primarily for scholars and social scientists. CLARIN ERIC was created by the merger of three ESFRI language technology initiatives. One of the founding parties was the Research Institute for Linguistics of the Hungarian Academy of Sciences, which has played a leading role in the preparatory project as well.

TABLE 1 – HUNGARY'S MEMBERSHIP IN EUROPEAN RESEARCH INFRASTRUCTURES

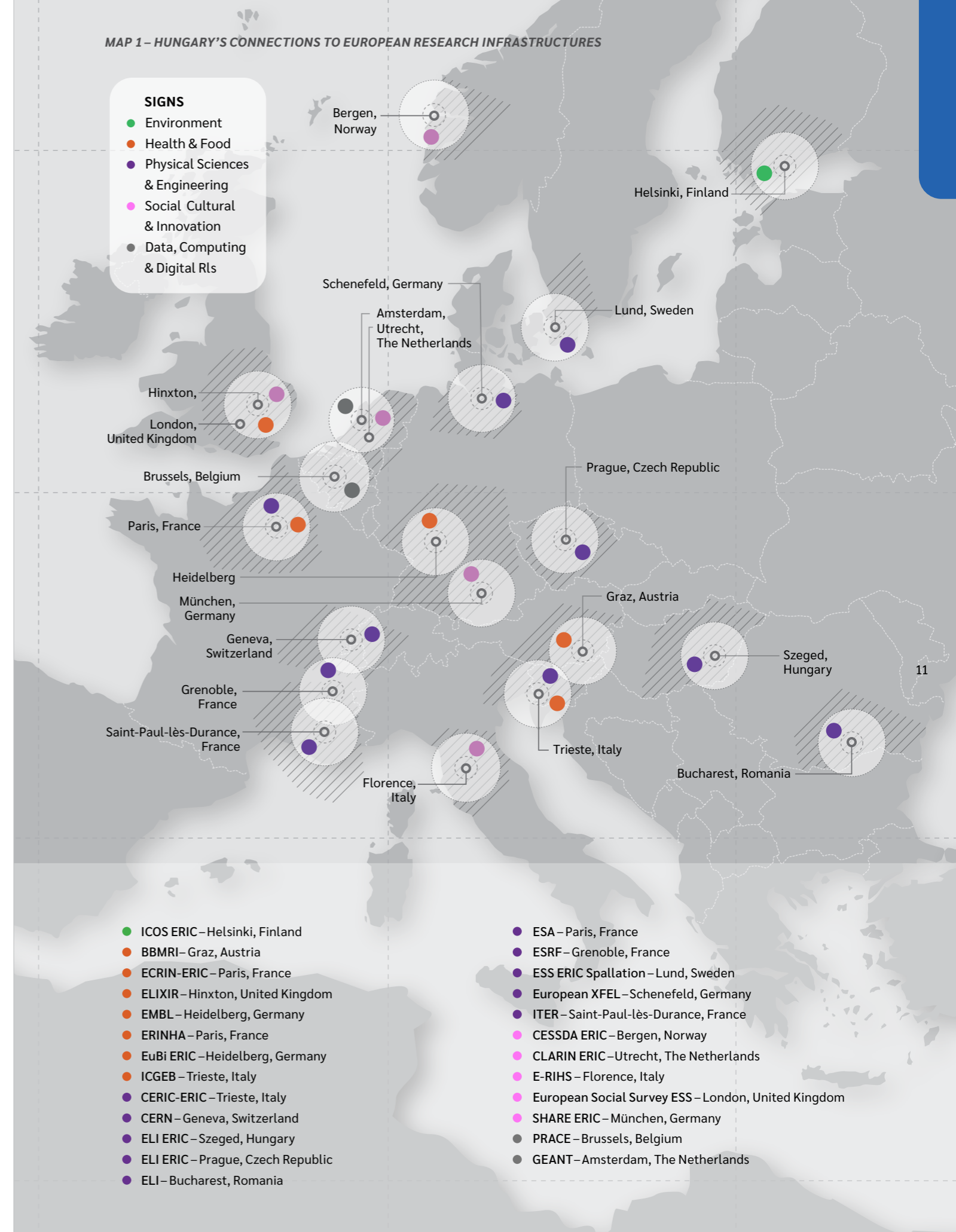
RI short name	RI name	ESFRI Landmark /Project	Start of participation (year)	Brief description
E-RIHS	European Research Infrastructure for Heritage Science	Project	2021	E-RIHS supports research on heritage interpretation, preservation, documentation and management, in order to deliver integrated access to expertise, data and technologies through a standardized approach, and to integrate world-leading European facilities into an organisation.
ESS ERIC	European Social Survey - European Research Infrastructure Consortium	Landmark	2016	ESS provides biannual comparative data about the demographic and social conditions of European societies, the changes in political and public preferences of citizens, and changes in social attitudes and action-guiding values. Data may significantly contribute to understanding changes in social behaviour taking place in Europe.
SHARE ERIC	Survey of Health, Ageing and Retirement in Europe	Landmark	2017	SHARE is a multidisciplinary panel database of information on the health, use of the healthcare system, financial status and income, socio-economic background and social and family networks of more than 30,000 individuals aged 50 or older. The aim is to build up a database that allows for high-quality, fact-based decisions on issues related to aging.
DATA, COMPUTING AND DIGITAL RESEARCH INFRASTRUCTURES				
PRACE	Partnership for Advanced Computing in Europe	Landmark	2012	PRACE is an international non-profit association. It comprises 24 member countries participating in the development of a super computer infrastructure. It provides world-class computing and data resources and services for large-scale scientific and engineering research projects.
GÉANT	Pan-European data network for the research and education community	Non ESFRI related	1993	GÉANT connects national research and education networks across Europe. It provides a high-bandwidth, high-capacity network with an ever-expanding service, which enables the strengthening of cooperation between researchers. It gives highly reliable, unlimited access to calculations, analyses, storage, applications and other resources to ensure that Europe remains at the forefront of research.

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STARTING PROJECTS WITH HUNGARIAN PARTICIPATION, ENTERING THE ESFRI ROADMAP IN 2021

PHYSICAL SCIENCES & ENGINEERING				
EuPRAXIA	European Plasma Research Accelerator with Excellence in Applications	Project	2021	EuPRAXIA is a distributed, compact and innovative accelerator facility based on plasma technology. It will be first set as an electron-beam-driven plasma accelerator in Italy, followed by a laser-driven plasma accelerator built in Europe. It will offer capabilities for research on biomolecules, viruses and microscopic processes.
SOCIAL & CULTURAL INNOVATION				
GGP	The Generations and Gender Programme	Project	2021	The Generations and Gender Programme (GGP) is a distributed RI with the aim to provide high quality and cross-nationally comparable longitudinal data to answer pressing scientific and societal challenges. The infrastructure network is based on the collection, documentation, and dissemination of data from large-scale national surveys in Europe and beyond.
GUIDE	Growing Up in Digital Europe (GUIDE): EuroCohort	Project	2021	The GUIDE will be Europe's first distributed RI to support the development of social policies that enhance the wellbeing of children, young people and their families across Europe, based on comparative cohort surveys. The collection of data will include samples of new born infants and school-age children using a common questionnaire and methodology at regular intervals until the age of 24 years.

MAP 1 – HUNGARY'S CONNECTIONS TO EUROPEAN RESEARCH INFRASTRUCTURES



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02 EXCELLENT RESEARCH INFRASTRUCTURES OF HUNGARY



RESEARCH INFRASTRUCTURES IN THE SERVICE OF RDI

Research infrastructures (RIs) at the national level have to be viewed as an integral part of a broader ecosystem, contributing to the long-term development of research and innovation, and as enablers of solving societal challenges. The bridging role of the RIs in research, development and innovation (RDI) collaborations is enhanced by the synergic planning and implementation of different funding sources. The development and networking of research infrastructures in Hungary have been supported by a number of funding schemes in the past. These have made it possible to expand and update our existing RI capacities and to improve their services for research and innovation. Through the implementation of the Smart Specialisation Strategy (S3), the research infrastructures will play a key role in the economic development of the regions and enhance cross-border and international RDI cooperation. Besides, research infrastructures will serve as tools for implementing “open laboratory” initiatives and play an important role in the promotion of our ‘open innovation’ efforts.

Our research infrastructure roadmapping process was coupled with a national call in 2021 in order to identify the top Hungarian research infrastructures. Ninety-eight proposals were received pertaining to the six scientific domains classified by the ESFRI Roadmap. The scientific excellence of the research infrastructures was measured by the uniqueness of the RI at national level, the level of international collaboration and embeddedness, the impact on researchers’ career, the influence on the education and training of next generation scientists and the open access readiness of the facility. Following the recommendation of the National Research Infrastructure Committee (NRIC), the networking of the RIs was strongly encouraged. As a result of the evaluation process, fifty research infrastructures received the “Excellent Research Infrastructure” certificate, of which ten are newly formed research infrastructure clusters. On the Hungarian research infrastructure landscape the ELI-ALPS and ZalaZone are considered and introduced here as large-scale RIs of key importance.

The following chapter intends to serve three main goals: introduce the reader to the cutting-edge Hungarian research infrastructures and their networks as excellent research sites available for the international research community; offer an insight and access to our RIs by listing their services; and showcase the embeddedness of these infrastructures in the international research landscape, which enables them to foster further pan-European scientific collaboration.

TABLE 2 – TOP RESEARCH INFRASTRUCTURES AND CLUSTERS IN HUNGARY

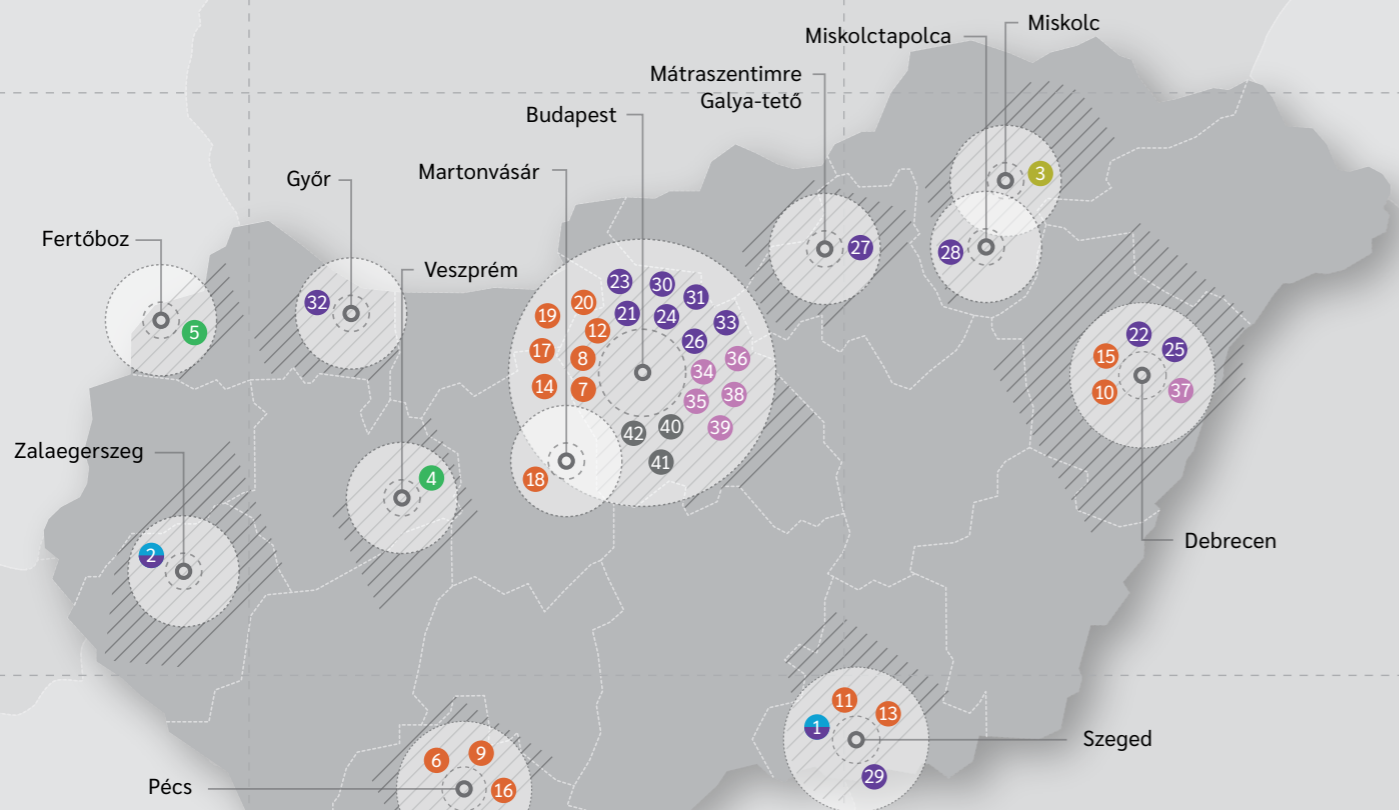
RI Name	Location
LARGE-SCALE RI PHYSICAL SCIENCES & ENGINEERING	
ELI-ALPS Extreme Light Infrastructure Attosecond Light Pulse Source	Szeged
ZalaZONE Automotive Proving Ground Ltd.	Zalaegerszeg
ENERGY	
Sustainable Natural Resource Management Research Infrastructure	Miskolc
ENVIRONMENT	
Analytical Laboratory of Biomolecular and Environmental System	Veszprém
Hertelendi Laboratory of Environmental Studies (New RI cluster)	Debrecen
Long-term Ecological Research Sites (New RI cluster)	Budapest, Vácrátót, Fülöpháza
Széchenyi István Geophysical Observatory	Fertőboz
HEALTH & FOOD	
Agricultural and Food Innovative Research Infrastructure of Debrecen University (New RI cluster)	Debrecen
BBMRI-ERIC Hungarian National Node	Budapest
Biomarker Research Laboratory	Budapest
Biosafety Level 4 Virological Laboratory and Research Center	Pécs
Cellular Imaging Hungary Euro-BioImaging Node Medical and Preclinical Imaging Hungary Euro-BioImaging Node	Debrecen
ELIXIR Hungary	Budapest
HCEMM Advanced Core Facilities (New RI cluster)	Szeged
Hungarian Centre for Genomics and Bioinformatics	Pécs
Hungarian Centre of Excellence for Molecular Medicine (New RI cluster)	Budapest
Hungarian European Clinical Research Infrastructure Network	Pécs
Microbial Gene Bank-related, Integrated Life-science and Drug Research and Development Center	Szeged
National Biosafety Laboratory	Budapest
National Cardiovascular Laboratory (New RI cluster)	Budapest
National Institute of Oncology Research Center	Budapest
Personalized Medicine Research Infrastructure	Szeged
Phytotron of the Agricultural Institute - Centre for Agricultural Research	Martonvásár
Protein Modelling Research Group - Laboratory of Structural Chemistry and Biology	Budapest
Semmelweis University - Biobank Network	Budapest
UD BMBI Proteomics Core Facility	Debrecen

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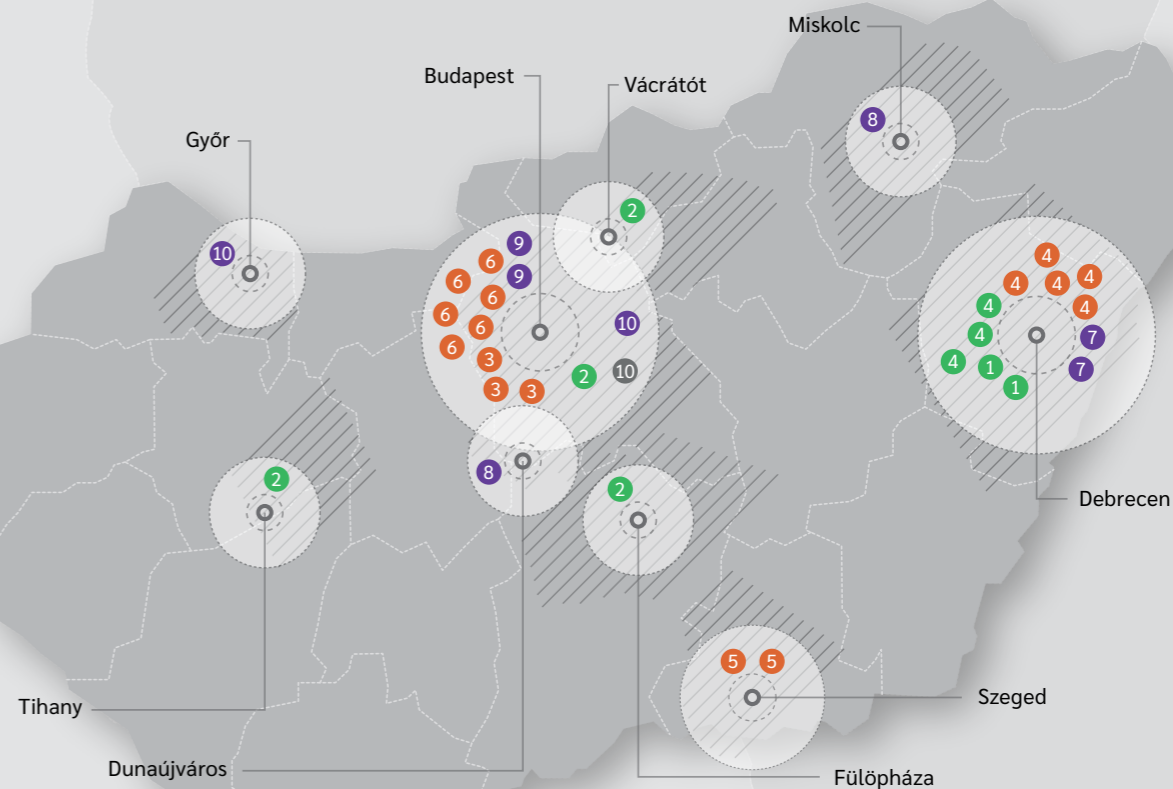
TABLE 2 – TOP RESEARCH INFRASTRUCTURES AND CLUSTERS IN HUNGARY

RI Name	Location
PHYSICAL SCIENCES & ENGINEERING	
3D Perception and Modeling Measurement System (New RI cluster)	Budapest
Aberration Corrected Transmission Electron Microscope Laboratory	Budapest
ATOMKI Accelerator Centre	Debrecen
Budapest Neutron Centre	Budapest
Department of Fluid Mechanics	Budapest
Eastern Hungarian Center of Chemical Analytics and Molecular Structural Research	Debrecen
Functional Materials Laboratory (FunMatLab)	Budapest
Industry 4.0 Research and Demonstration Infrastructure Network (New RI cluster)	Győr
Laboratory Network of Material Development and Technologies (New RI cluster)	Miskolc
Laboratory of Polymer Engineering	Budapest
Operational Safety Laboratory	Miskolctapolca
Pizskéstető Mountain Station of the Konkoly Observatory	Mátraszentimre, Galyatető
Széchenyi University Vehicle Industry Research Center	Győr
University of Debrecen - Institute for Nuclear Research - Materials Science Research Network (New RI cluster)	Debrecen
University of Szeged - Materials Science Core Facility	Szeged
Vesztergombi Laboratory for High Energy Physics (VLAB)	Budapest
Wigner Laser and Spectroscopy Centre	Budapest
SOCIAL & CULTURAL INNOVATION	
Databank of Centre for Economic and Regional Studies	Budapest
European Social Survey - European Research Infrastructure Consortium	Budapest
HunCLARIN	Budapest
Laboratory for Heritage Science, ATOMKI	Debrecen
Research Documentation Centre (RDC) - Centre for Social Sciences (CSS)	Budapest
TÁRKI Data Archive	Budapest
DATA & COMPUTING	
ELKH Cloud	Budapest
Governmental Agency for IT Development – Hungarian e-infrastructure	Budapest
WIGNER Scientific Computing Laboratory (WSCLAB)	Budapest

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- 1 Extreme Light Infrastructure Attosecond Light Pulse Source, Szeged
- 2 ZalaZONE Automotive Proving Ground Ltd, Zalaegerszeg
- 3 Sustainable Natural Resource Management Research Infrastructure, Miskolc
- 4 Analytical Laboratory of Biomolecular and Environmental Systems, Veszprém
- 5 Széchenyi István Geophysical Observatory, Fertőboz
- 6 Hungarian European Clinical Research Infrastructure Network Pécs
- 7 National Institute of Oncology Research Center, Budapest
- 8 Semmelweis University - Biobank Network, Budapest
- 9 Hungarian Centre for Genomics and Bioinformatics, Pécs
- 10 Cellular Imaging Hungary Euro-Biomedicine Node, Medical and Preclinical Imaging Hungary Euro-Biomedicine Node, Debrecen
- 11 Personalized Medicine Research Infrastructure, Szeged
- 12 Biomarker Research Laboratory, Budapest
- 13 Microbial Gene Bank Related, Integrated Life-Science and Drug Research and Development Center, Szeged
- 14 Protein Modelling Research Group, Laboratory of Structural Chemistry and Biology, Budapest
- 15 UD BMBI Proteomics Core Facility, Debrecen
- 16 Biosafety Level 4 Virological Laboratory and Research Center, Pécs
- 17 National Biosafety Laboratory, Budapest
- 18 Phytotron of the Agricultural Institute, Centre for Agricultural Research, Martonvásár
- 19 ELIXIR Hungary, Budapest
- 20 BMBRI-ERIC Hungarian National Node, Budapest
- 21 Budapest Neutron Centre, Budapest
- 22 Eastern Hungarian Center of Chemical Analytics and Molecular Structural Research, Debrecen
- 23 Functional Materials Laboratory (FunMatLab) Budapest
- 24 Wigner Laser and Spectroscopy Centre Budapest
- 25 ATOMKI Accelerator Centre, Debrecen
- 26 Laboratory of Polymer Engineering, Budapest
- 27 Piskéztető Mountain Station of the Konkoly Observatory Mátraszentimre, Galyatető
- 28 Operational Safety Laboratory, Miskolctapolca
- 29 University of Szeged - Materials Science Core Facility, Szeged
- 30 Department of Fluid Mechanics, Budapest
- 31 Aberration Corrected Transmission Electron Microscope Laboratory, Budapest
- 32 Széchenyi University Vehicle Industry Research Center, Győr
- 33 Vesztergombi Laboratory for High Energy Physics (VLAB), Budapest
- 34 European Social Survey, European Research Infrastructure Consortium (ESS ERIC), Budapest
- 35 HunCLARIN, Budapest
- 36 Databank of Centre for Economic and Regional Studies, Budapest
- 37 Laboratory for Heritage Science, ATOMKI - Debrecen
- 38 Tarki Data Archive, Budapest
- 39 Centre for Social Sciences, Research Documentation Centre Budapest
- 40 Governmental Agency for IT Development – Hungarian E-Infrastructure, Budapest
- 41 ELKH Cloud, Budapest
- 42 Wigner Scientific Computing Laboratory (WISCLAB), Budapest



- 1 **Hertelendi Laboratory of Environmental Studies, Debrecen**
 - 1. Isotope Climatology and Environmental Research Centre Debrecen, Coordinator
 - 1. Isotoptech Zrt., Debrecen, Member
- 2 **Long-Term Ecological Research Sites, Budapest, Vácrátót, Fülöpháza**
 - 2. KISKUN LTER (Long-Term Ecological Research) Budapest, Vácrátót, Fülöpháza, Coordinator
 - 2. Balaton LTER, Tihany, Member
- 3 **Hungarian Centre for Molecular Medicine, Budapest**
 - 3. In Vivo Imaging Advanced Core Facility, Budapest, Coordinator
 - 3. Kvantitativ In Vivo Molecular Imaging Group, Budapest, Member
 - 3. Optical Tweezers Combined with Laser Scanning Confocal Microscope, Budapest, Member
- 4 **Agricultural and Food Innovative Research Infrastructure of Debrecen University, Debrecen**
 - 4. University of Debrecen Faculty of Agricultural and Food Sciences and Environmental Management Food Science Institute, Debrecen, Coordinator
 - 4. Central Laboratory for Agricultural and Food Products, Debrecen, Member
 - 4. Plant Stress Condition Evaluating Research System, Debrecen, Member
 - 4. International Territorial Water Management and Climate Adaptation Instruments Centre, Debrecen, Member
 - 4. University of Debrecen, Faculty of Agriculture, Food Science and Environmental Management, Laboratory of Aquaculture and Fish Biology, Debrecen, Member
 - 4. Animal Analytical, Proteomic and Nutrigenomic Infrastructure, Debrecen, Member
 - 4. Infrastructure System for Complex Testing of Production Enhancers and Crop Conditioners, Debrecen, Member
 - 4. Evaluation of the performance and stress tolerance of horticultural crops with cultivation technology and molecular genetic methods, Debrecen, Member
- 5 **HCEMM Advanced Core Facilities, Szeged**
 - 5. Functional Cell Biology and Immunology Advanced Core Facility, Szeged, Coordinator
 - 5. Single Cell Omics Advanced Core Facility, Szeged, Member
- 6 **National Cardiovascular Laboratory, Budapest**
 - 6. SE Small Animal Experimental Laboratory, Budapest, Coordinator
 - 6. Semmelweis University Bioinformatics Core Facility, Budapest, Member
 - 6. Experimental Advanced Histopathology Corefacility, Budapest, Member
 - 6. Cardiovascular Large Animal Core Laboratory, Budapest, Member
 - 6. Cardiovascular Imaging Core Laboratory, Budapest, Member
 - 6. Cell Technology Core Facility, Budapest, Member
- 7 **University of Debrecen - Institute for Nuclear Research Materials Science Research Network, Debrecen**
 - 7. Materials Science and Nanotechnology Research Laboratory of the University of Debrecen, Debrecen, Coordinator
 - 7. ATOMKI Surface Science Laboratory, Debrecen, Member
- 8 **Laboratory Network of Material Development and Technologies, Miskolc**
 - 8. Integrated Laboratory of Material Development and Testing, Miskolc, Coordinator
 - 8. Laboratory for Materials Science and Technology, Dunaújváros, Member
- 9 **3D Perception and Modeling Measurement System, Budapest**
 - 9. LIDAR Measurement Laboratory, Budapest, Coordinator
 - 9. SZTAKI MIMO arena (SZTAKI Micro Aerial Vehicle and Motion Capture Arena), Budapest, Member
- 10 **Industry 4.0 Research and Demonstration Infrastructure Network, Győr**
 - 10. Industry 4.0 Centre of Excellence, Győr, Coordinator
 - 10. BME Industry 4.0 Technology Center, Budapest, Member
 - 10. EMI SmartFactory, Demonstration System for Cyber-Physical Production, Budapest, Member

TYPE OF THE RI

Distributed

HOST INSTITUTION

Szeged University

LOCATION OF THE RI

Szeged

STATUS

Partial operation since 2018, full operation expected in 2023

NATIONAL PARTNERS

- Institute for Nuclear Research
- Biological Research Center
- Wigner Research Center
- Eötvös Loránd University Physics Institute
- Szeged University

INTERNATIONAL COLLABORATION

- ELI-HU has participated in a number of Horizon 2020 (IMPULSE, ELITRANS, EUCALL, PanOSC)
- Danube Programme (D-STIR, RI2Integrate)
- Interreg (TRINNO), ERASMUS+(IT-ELLI)
- TéT (science and technology) projects

INTERNATIONAL CONNECTIONS

ELI-ALPS is a member of the HEPTech Network, and a founding facility of ELI ERIC

RIs AND RESEARCH ORGANIZATION

ELI-HU has signed over 15 Memorandum of Understandings with universities and research institutes abroad
25 collaborative user campaigns by November 2021.

PERSON IN CHARGE

Gábor Szabó, Managing Director

CONTACT

David Bereczkei
david.bereczkei@eli-alps.hu

WEBSITE

www.eli-alps.hu

ELI-ALPS
EXTREME LIGHT INFRASTRUCTURE
ATTOSECOND LIGHT PULSE SOURCE



Description of the research infrastructure

The Extreme light infrastructure (ELI) is the first infrastructure in the world capable of the investigation of the interactions between light and matter with the highest intensity, in the so-called ultra-relativistic range. ELI is the first civilian large-scale high-power laser research facility to be realized with trans-European cooperation and the worldwide scientific community. Hungary, the Czech Republic and in a later phase Romania, with a coordinated management and research strategy, will simultaneously implement the project through the construction of the three laser facilities with the respective mission in the attosecond, beamline and photonuclear applications. ELI ALPS and ELI Beamlines with other non-host partners have established ELI ERIC in April 2021. Located in Szeged, south-east of Hungary, ELI ALPS, the attosecond pillar of the Extreme Light Infrastructure, is focused on making the shortest, most intense laser pulses at the highest repetition rate. The combination of ground-breaking light sources and subsequent outstanding secondary sources is available for fundamental, applied and proprietary research. ELI ALPS offers more than just the use of a novel class of state-of-the-art laser systems. The unique combination of the outstanding laser pulses with the pioneering secondary sources technologies will open up new opportunities in experimental research.

Activities and Services

ELI ALPS, the Hungarian pillar of the Extreme Light Infrastructure, is dedicated to support fundamental and applied researches in physical, biological, chemical, medical and materials sciences at extreme short time scales. The ground-breaking laser systems together with the subsequent outstanding secondary sources generate the highest possible peak power at the highest possible repetition rate in a spectral range from the E-UV through visible and near infrared to THz. The facility – besides the regular scientific staff – will provide accessible research infrastructure for the international scientific community user groups from all around the world. The equipment of the Extreme Light Infrastructure - Attosecond Light Pulse Source (ELI ALPS) Research Institute, as well as its procedures and the related applications significantly surpass the opportunity to generate attosecond light pulses. The key objectives of the institute include the generation of single cycle light pulses in a broad spectral range, their application for the investigation of the dynamics of ultrafast processes in the femto- and attosecond time regime, as well as the application of extremely strong laser fields for research in plasma physics (e.g. laboratory astrophysics), for laser induced particle acceleration (e.g. for the induction of the transmutation process), as well as for the investigation of light-matter interactions at extreme intensities. The generation of ultrashort electron or proton pulses with the help of lasers, or the injection of ultrafast charge carriers into semiconductors may open up several research paths in the fields of materials science, biomedicine or nanotechnology. The continuous development of the pool of instruments and that of related technologies and techniques (e.g. measurement techniques) is intended to support a wide range of applications.

Main Research Fields and Applications

ELI ALPS will be one of the leading lights in ultrafast physical processes as well as a world-class centre for generating outstanding biological, chemical, medical and materials science results.

The main research fields and applications at ELI-ALPS

- The development and parameterisation of attosecond light sources
- Biological imaging technologies; Medical applications
- **Energy research:** from solar cells to artificial photosynthesis
- High-peak power photonics

TYPE OF THE RI

Single sited

HOST INSTITUTION

ZalaZONE Automotive Proving Ground Ltd.

LOCATION OF THE RI

Zalaegerszeg

STATUS

Fully operational, 2019

NATIONAL PARTNERS

- Budapesti University of Technology and Economics
- Széchenyi István University
- University of Pannonia
- Bay Zoltán Nonprofit Ltd. for Applied Research
- Hungarian University of Agriculture and Life Sciences
- KTI Institute for Transport Sciences Non-profit Ltd.

INTERNATIONAL COLLABORATION WITH RIs

- EU Joint Research Center
- Austrian Institute of Technology
- Linz Center of Mechatronics
- Joanneum Research
- Digital

INSTITUTIONAL PARTNERS

- Fachhochschule Campus
- TU Wien
- TU Graz
- HTW Dresden
- University Maribor

PERSON IN CHARGE

Zsolt Szalay, Head of R&I

CONTACT

Beata Bogár, R&I program coordinator
beata.bogar@zalazone.hu

WEBSITE

www.zalazone.hu

ZALAZONE AUTOMOTIVE
PROVING GROUND LTD



Description of the RI

The Zala ZONE Automotive Proving Ground is a test track built on a 260-hectare area in Zalaegerszeg in West-Hungary. It is unique in its integration of the testing of both classic vehicle dynamics and for the multiple testing requirements for autonomous vehicles and autonomous vehicle technologies, as well as validation testing for electric vehicles.

Activities and Services

Beside the conventional technical services ZalaZONE provides competitive & unique engineering service related to standardized ADAS- and individual AD function testing. The testing environment also offers laboratory and simulation facilities as well as public road-testing opportunities close to the proving ground in the city of Zalaegerszeg and in the Hungarian countryside, with the extension to international public routes.

The automotive proving ground has a key importance as a complex and integrated Research & Development facility which supports customers and experimental developments. The ZalaZONE Research and Technology Centre is located just beside the proving ground, in a very close relation with its activities. It functions as an incubator/accelerator for SMEs and start-ups as well as university-based R&D centre, for Hungarian, regional, European, and global university and industrial partners, where cooperation and collaboration between enterprises and universities are strategically key focus points. The dual training program for high school students, where students can acquire the theoretical knowledge, they have received in higher education contributes to the success of the project. Tests on the interaction of autonomous vehicles and drones may soon begin at the drone testing and development centre to be established next to ZalaZONE.

SUSTAINABLE NATURAL RESOURCE MANAGEMENT RESEARCH INFRASTRUCTURE



TYPE OF THE RI

Single sited

HOST INSTITUTION

University of Miskolc, Faculty of Earth Science and Engineering and Applied Earth Science Research Institute (AFKI)

LOCATION OF THE RI

Miskolc

STATUS

Fully operational, 2011–

NATIONAL PARTNERS

- Budapest University of Technology and Economics, Faculty of Civil Engineering
- University of Pannonia Faculty of Engineering
- University of Pécs Faculty of Engineering and Information Technology
- University of Szeged
- University of Sopron Faculty of Forestry

INTERNATIONAL COLLABORATION

- TU Bergakademie Freiberg
- Technical University of Košice
- University of Wrocław
- University of São Paulo
- Changsha University of Science and Technology
- National Metallurgical Laboratory India
- Belgrade University
- AGH University of Science and Technology
- University College London

PERSON IN CHARGE/CONTACT

Gábor Mucsi, Dean
gabor.mucsi@uni-miskolc.hu

WEBSITE

www.mfk.uni-miskolc.hu
www.afki.hu

Description of the RI

The Sustainable Natural Resource Management Research Infrastructure includes the infrastructure of the Faculty of Earth Science and Engineering at the University of Miskolc supplemented by the Infrastructure of the Applied Earth Sciences Research Institute. Also includes the Centre of Excellence for Sustainable Natural Resource Management established by the Faculty of Earth Science and Engineering, where four scientific workshops were created. Raw Material Management includes primary and secondary raw materials exploration, mining, preparation technology development, mining and industrial waste processing, metal bearing waste processing, waste management and environmental legal analysis. In the Energy Management Scientific Workshop, the main topics are biomass, geothermal energy, renewable gas, carbon-dioxide storage. The Geo-Information Processing Scientific Workshop deals with inversion methods, spectral and geoelectric methods, the development of numerical methods for geological, petrographic mineral development numerical methods, surveying and GIS methods. The main topics in the Water Resources Management and Sustainable Soil Use are innovative water management, protection of groundwater resources, hydrodynamic and transport modelling, geophysical exploration methods of water.

The Applied Earth Science Research Institute (AFKI) offers innovative procedures and services that focuses on the sustainable and efficient exploitation and protection of underground storage systems. This includes the exploitation of the thermal energy of deep geothermal reservoirs and laboratory experiments to support the design, interpretation, and related knowledge of high-efficiency geothermal systems (EGS).

The following major equipment can be found in the Research Infrastructure: air classifiers, crushers and mills, bioreactors, separators, flat die pelletizer, laser particle analyzer, zeta potential meter, shear testers, dynamic triaxial equipment, permeameter, 3000 kN telemetric 48-channel measuring equipment, geoelectric 72-channel resistance and ip measuring instrument, burst protection simulator, viscometers, microprobe equipped with WDX-EDX spectrometers, X-ray diffractometers, DTA, stereomicroscopes, XRF, porosimeter, BET specific surface area and pore size distribution testers, powder rheometer, isothermal calorimeter, scanning electron microscope.

Activities and Services

Water resources management, raw material management, waste management, biomass, geothermal energy, renewable gases, carbon dioxide storage and geoinformation, utilization of thermal of thermal energy from deep geothermal reservoirs, enhanced oil recovery (EOR). Development of waste processing technologies. Grinding. Rock mechanics tests. Mineralogy studies. Geophysical measurements. Measuring system and device development. Petrophysical measurements. Geothermal energy recovery. Carbon-dioxide storage in a geological environment (CCS). Rock core sample experiments, reservoir model building, routine, and special rock core sample analysis. Hydrodynamics and transport modelling. Soil mechanical tests. Studies related to the production and processing of renewable energy sources (biomass, biogas). Water and wastewater treatment, purification procedures and tests. Soil research.

ANALYTICAL LABORATORY OF BIOMOLECULAR AND ENVIRONMENTAL SYSTEMS



TYPE OF THE RI

Distributed

HOST INSTITUTION

University of Pannonia, Faculty of Engineering

LOCATION OF THE RI

Veszprém

STATUS

Fully operational, 2013 –

NATIONAL PARTNERS

- University of Szeged (SZTE)
- University of Pécs (PTE)
- Budapest University of Technology and Economics (BME)
- Eötvös Loránd Research Network (ELKH)
- Wigner Research Centre for Physics (Wigner FK)

INTERNATIONAL COLLABORATION

- Max-Planck Institute for Chemistry (MP)
- National Oceanic and Atmospheric Administration (NOAA)
- National Institute for Research and Development in Optoelectronics (INOE)
- Vision on Technology for a Better World (VITO)

PERSON IN CHARGE

Sándor Németh, Dean

CONTACT

Gábor Jarvas, Staff Scientist
jarvas@lendulet.uni-pannon.hu

WEBSITE

https://mk.uni-pannon.hu/

Description of the RI

The Analytical laboratory of biomolecular and environmental systems aims to study complex systems composed of organic and inorganic elements at the macroscopic and microscopic level, which is of particular importance for understanding the functioning of environmental systems. The available infrastructure is a synergistic combination of commercially available state-of-the-art equipment and custom-designed tools. The infrastructure-network available at the University of Pannonia Faculty of Engineering provides the opportunity to achieve outstanding scientific results and a significant competitive advantage for industrial clients.

Main application areas as follows

- Glycomics
- Protein engineering
- Atmospheric analysis and monitoring
- Limnology
- Environmental analytics
- Electron microscopy

The research infrastructure is operated by highly qualified staff with specialized knowledge and valuable experience within the University, while resources are also available to external parties through academic or industrial collaborations. The University's Centre for Knowledge and Technology Transfer provides the appropriate support for the rapid and efficient development of academic collaborations, joint grant applications and industrial cooperation.

Activities and services

The Analytical laboratory of biomolecular and environmental systems provides its partners with the following tools, databases and information systems to achieve its aims: Capillary electrophoresis with laser-induced fluorescence detector (Sciex PA800+), GU database and software (GUcal), LC-MS (Agilent 1290 Infinity, Shimadzu LCMS-2020, Sciex ExionLC Triple Quad 3500), CD spectrophotometer (Jasco), isothermal titration calorimeter (Malvern), scanning electron microscope (FEI), transmission electron microscope (TF Talos F200X), GC-MS (Agilent), flow cytometer (Beckman-Coulter), light microscope (Zeiss Axio Vert A1), custom-made photosynthetron and chemostat, climate chamber (Smart Pro KK-1200), gas analyzer (TESTO 350), custom-made pilot and lab scale membrane bio-reactor, and pilot optical waste sorting machine.

The main services provided by the laboratory include glycan and glycoprotein analysis, recombinant protein technology and related analytical background, comprehensive chemistry of atmospheric fine aerosols, complete algal research, environmental mineralogy, as well as solid and wastewater related analytical activities.

HERTELENDI LABORATORY OF ENVIRONMENTAL STUDIES



TYPE OF THE RI

Distributed

HOST INSTITUTION

Isotoptech Nuclear and Technology Services Ltd. (ISOTOPTECH Ltd.)

STATUS

Fully operational, 1998 –

NATIONAL PARTNERS

- ATOMKI Institute for Nuclear Research
- ELI-ALPS
- University of Debrecen Science Park

INTERNATIONAL COLLABORATION WITH RIS

- ICOS ERIC
- EUROPLANET 2020 RI

INSTITUTIONAL PARTNERS

- International Atomic Energy Agency (IAEA)
- Thermo Fisher Scientific
- EUROPLANET Society
- Institut de Radioprotection et de Sûreté Nucléaire (IRSN)
- Nuclear Physics Institute of the CAS (ASCR)

PERSON IN CHARGE/CONTACT

László Palcsu, Senior Research Fellow
palcsu.laszlo@atomki.hu

WEBSITE

<https://www.hekal.hu/>
<https://www.hekal.eu/>

Description of the RI

The Ede Hertelendi Laboratory of Environmental Studies (HEKAL) is a laboratory jointly operated by ISOTOPTECH Zrt. and the Institute for Nuclear Research (ATOMKI), which has become a leading and continuously developing isotope and elemental analytical centre in the course of more than 15 years of cooperation. The laboratory is consciously developing R&D-based sampling and measurement methods, instruments, analytical procedures and services. One of the declared aims of our cooperation is to put scientific results into practice and to transfer state-of-the-art scientific results available in research institutes and universities to economic operators. With its instrument park, unique in Central and Eastern Europe, and more than ten unique mass spectrometers, our laboratory provides a world-class research and service environment for Hungarian and international environmental, hydrological, geological, geochemical, archaeological, nuclear power and radioactive waste management communities.

Activities and Services

HEKAL's analytical instrumentation can be used to determine the isotopic ratios of many elements, as well as to precisely quantify rare isotopes that are difficult to detect. Three stable isotope ratio mass spectrometers are used to determine the isotope ratios of hydrogen, carbon, nitrogen, oxygen and sulphur for a wide range of materials (e.g., water, air, rocks, bone, tooth, plant material, etc.), while the most sensitive one is used to measure the clumped isotope ratios of carbonates. The isotopic ratios of water, methane and carbon-dioxide are measured using special laser spectrometers. The laboratory's five noble gas mass spectrometers also have a wide range of applications. The determination of helium, argon and other noble gas isotopes, whether dissolved in water, encapsulated in minerals or resulting from the decay of tritium, is carried out with special noble gas mass spectrometers. One of the main instruments in the laboratory is the Accelerator Mass Spectrometer (AMS), which allows the measurement of carbon isotopes, including radiocarbon, and has applications ranging from archaeological dating to monitoring of environmental releases from radioactive installations. In Hungary, the multicollector ICP-MS is also a unique, niche instrument which is used for the extremely precise determination of isotopic ratios of a wide range of elements (Li, Mg, Ca, Fe, Cu, Sr, Hf, Pb, Th, U, etc.).

Alpha spectrometers, gamma spectrometers and liquid scintillation counters are used for the detection of difficult-to-measure radioisotopes involved in nuclear environmental tasks. The analysis of tens of thousands of samples per year is made possible by the integrated work of several preparatory laboratories, such as a chemical, radiochemical and a cleanroom laboratory. Through its extensive international contacts, HEKAL is involved in the analysis of samples from all over the world (41 countries), providing a background for industrial, undergraduate and PhD training activities. The laboratory has become part of the European research infrastructure through its membership of EUROPLANET and ICOS ERIC. Several of our developments have reached the prototype level of technological maturity demonstrated in a real operational environment (TRL7). We continuously strive to cover the entire innovation chain with involvement of our partners, supported by our own electronics and mechanical workshop background. The main objective of HEKAL is to become a gap-filling R&D&I centre in Hungary, meeting the needs of society, environmental and economic actors, and to become an outstanding R&D&I centre at EU level.

LONG-TERM ECOLOGICAL RESEARCH SITES



TYPE OF THE RI

Distributed

HOST INSTITUTION

Centre for Ecological Research

STATUS

Under construction

NATIONAL PARTNERS

Balaton Limnological Research Institute

INTERNATIONAL COLLABORATION WITH RIS

eLTER (<https://elter-ri.eu/>)

INSTITUTIONAL PARTNERS

- Institute for Soil Sciences
- Centre For Agricultural Research

PERSON IN CHARGE

Miklós Kertész
kerteszmiklos@ecolres.hu

CONTACT

Katalin Török, Senior Research Fellow
torok.katalin@ecolres.hu

WEBSITE

<https://www.lter.hu/>

Description of the RI

The RI network carries out long-term and complex ecological and socio-ecological studies in the Kiskunság region and the Lake Balaton catchment in several sample areas through monitoring and field experiments. The network aims to understand a wide range of ecosystem processes at different spatial and temporal scales and to generate broad ecological and socio-ecological knowledge through long-term interdisciplinary research, information synthesis and theory development. The living environment is primarily shaped by humans and has an impact on the quality of human life, therefore changes in the living environment and the underlying ecological processes are studied embedded in the socio-ecological environment, in broad national and international collaborations. The RI network is part of the European eLTER infrastructure, which is in the preparatory phase, and of the International Long-term Ecological Research Network (ILTER).

In the Kiskunság region, field research is carried out at the Fejes-tanya (Fejes Farmhouse) research station of the Centre for Ecological Research in Fülöpháza, and in the case of Lake Balaton at the Balaton Limnological Research Institute. The infrastructure is partly located at the field sites, in the form of permanent sampling sites, in-site instruments and data collectors, and experimental equipment. Sample processing is partly carried out at the research station and partly at the premises of the host and partner institutions. An important element of the RI is the knowledge base maintained by the host and partner institutions, which is the result of many decades of research work at the field sites.

Activities and Services

Monitoring is carried out at permanent sample plots or sampling sites, where measurements of key ecosystem variables and monitoring of specific groups of communities are implemented. In addition, field experiments are designed and accomplished to investigate changes in ecosystem function, including the follow up and evaluation of ecological restoration success under controlled treatments.

The RI informs the wider scientific community, natural resource managers, decision-makers and the general public by providing decision support, information, recommendations, and the knowledge and skills to address complex environmental challenges. The RI contributes to the preservation of the country's natural heritage by creating well-designed and documented archives of long-term observations, experiments, and possibly samples for future generations.

SZÉCHENYI ISTVÁN GEOPHYSICAL OBSERVATORY



TYPE OF THE RI

Single sited

HOST INSTITUTION

Institute of Earth Physics and Space Science
Geodesy-Geophysics Research Unit
Space Research-Space Technology Research Unit

LOCATION OF THE RI

Fertőboz

STATUS

Fully operational, 1957–

NATIONAL PARTNERS

- National Directorate General for Disaster Management (NDGDM)
- Hungarian Meteorological Service (HMS)

INTERNATIONAL COLLABORATION WITH INSTITUTIONAL PARTNERS

- IUGG IAGA
- International Real-time Magnetic Observatory Network (INTERMAGNET)
- Global Ionospheric Radio Observatory (GIRO)

PERSON IN CHARGE/CONTACT

Viktor Wesztzergom, Director
westzergom.viktor@epss.hu

WEBSITE

<https://epss.hu/en/>
<http://nckobs.hu/>

Description of the RI

The Széchenyi István Geophysical Observatory was founded during the International Geophysical Year (in 1957-58) as a dedicated research infrastructure of the electromagnetic (EM) phenomena of the solid Earth, upper atmosphere and near-Earth space. The observatory is situated on the southern shore of lake Fertő on thick conductive sediment within the Fertő-Hanság National Park. The favorable situation shelters the observatory from most of the anthropogenic EM noises. Nowadays the spreading common use of space technologies and the increasing exposure of the surface critical infrastructures requires the continuous observation of the state and processes of the Earth's plasma environment which became known as space weather.

These, sometimes extreme changes are associated with solar activity. In addition, comprehensive observational data from several solar cycles provide an opportunity to study long-term changes in the energy coupling between the Sun and the planet. The infrastructure consists of telluric, geomagnetic, atmospheric electricity and broadband EM field measurement systems, lightning detection, ionospheric sounding and additional background measurements like meteorological observation and ground-based support of satellite Earth observation.

The uniquely long geomagnetic and telluric recordings allow us to model and reconstruct the geodynamo and the external source current systems in the ionized upper atmosphere. Furthermore, the contemporary magnetic and electric measurements serve as remote reference for the magnetotelluric deep sounding geophysical exploration method. Records related to atmospheric electricity and lightning activity enable the investigation of the variations of regional and global thunderstorm activity which are indicators of climate change. Signals from individual lightning strokes can be used to diagnose the momentary state of the plasmasphere.

Activities and Services

The observatory is a member of INTERMAGNET, a global network of the geomagnetic observatories. High time resolution (1 Hz) geomagnetic data are uploaded quasi-real time and also displayed real time on the website of the observatory. The DPS-4D digisonde automatically transfers data to the Global Ionospheric Radio Observatory (GIRO) system collecting ionosonde measurements from around the globe. These data are used to study the electron density changes and the plasma motion of the ionosphere in regional and global scales.

A station of the LINET lightning detection network is working in the observatory and contributes to the mapping of lightning strokes in Europe real-time. Data collected by the atmospheric electricity measurement systems are displayed quasi-real time on the website of the observatory. The observatory is part of the Automatic Whistler Detection and Analyzer Network (AWDANet) providing a cheap and effective way to routinely infer the cold plasma distribution of the inner magnetosphere.

AGRICULTURAL AND FOOD INNOVATIVE RESEARCH INFRASTRUCTURE OF DEBRECEN UNIVERSITY



TYPE OF THE RI

Distributed

HOST INSTITUTION

University of Debrecen, Faculty of Agriculture,
Food Science and Environmental
Management

STATUS

Fully operational

NATIONAL PARTNERS

- Institutes for Agricultural Research and Educational Farm
- Hungarian Soil Protection Laboratory Network
- Eötvös Loránd Research Network (ATOMKI)

INTERNATIONAL COLLABORATION WITH RIS

- The Global Soil Laboratory Network (GLOSOLAN)
- Global Water Partnership Central Eastern Europe
- Agriculus
- Food-Nutrition-Health Research Infrastructure

INSTITUTIONAL PARTNERS

- Université de Neuchâtel
- Slovak University of Agriculture in Nitra
- Wageningen University and Research
- BOKU-University of Natural Resources and Life Sciences
- CSIR National Institute for Interdisciplinary Science and Technology (NIIST)

PERSON IN CHARGE

László Stündl, Dean

CONTACT

Szilvia Veres, Vice Dean of Scientific Affairs
szveres@agr.unideb.hu

WEBSITE

<https://mek.unideb.hu/>

Description of the RI

The system has a uniquely complex function, which is based on the recycling of materials, following the model of a circular, bio-based economy in accordance with the principles of sustainable agriculture, increasing the added value of the products, services and implementing smart solutions. The research infrastructure (RI) system can perform the examination and analysis of the members of the entire food chain system - from raw materials to products - in a changing biotic and abiotic environment, which further increases the multidisciplinary role of the University of Debrecen in the Tisza international river basin. Its activities cover the entire vertical of precision farming: arable and horticultural crop production, animal husbandry, fish biology, soil and water management systems, food technology, digitalization and robotics. The RI allows us to evaluate the quantitative and qualitative correlations of the growing medium and the plant condition with the factors of climate change and specific treatments (biostimulator, biostimulator, pesticide, etc.) in different agrotechnological systems under controlled, half-controlled and field environment. As a living laboratory at different levels of organization, describing and evaluating a complex change in soil/plant/microorganism, it provides a comprehensive picture of the responses. Part of the RI animal analytical, proteomic and nutrigenomic infrastructure connects the food/nutrient chain, genomic expression, adaptive stress response in a translational model integrating several species. The fish biology laboratory provides a state-of-the-art educational and research background, primarily in the field of intensive fish farming and the development of aquaponic technologies. Its food technology system creates target group-oriented food development along functional, technological innovations. RI's laboratory equipment provides a complex system of material, analytical, microbiological, and molecular biology testing for both the environment and raw materials and products.

Activities and Services

Establishment of controlled, semi-controlled, field experiments, expert analysis of results. Testing and modernization of cultivation technology elements. Complex environmental investigations: soil, water, weather and plant water balance research instruments, groundwater monitoring system, dual polar high-resolution precipitation radar, precision irrigation technology research infrastructure. Soil biology complex studies. Plant condition diagnostics: enzymes, stress markers, measurement of bioactive substances, molecular genetic tests. Anatomical, morphophysiological, stress physiological, pathophysiological studies, biotechnological developments. Animal biology activities: chemical, immunocytochemical, microbial, genomic and proteomic studies of animal cells, cell cultures, metabolites, animal body and products. Husbandry and feeding technology, reproductive biology, animal health and ethology testing. Raw material and product quality tests (feed, food, soil): organoleptic, physical, analytical chemical, molecular and microbiological. Food technology: meat and milk processing, quality control dairy laboratory, mill, bakery and confectionery, dry pasta, vegetable and fruit processing units. Development of functional foods and food technologies and knowledge transfer.



BBMRI-ERIC HUNGARIAN NATIONAL NODE

TYPE OF THE RI

Distributed

HOST INSTITUTION

Semmelweis University

STATUS

Fully operational, 2021–

NATIONAL PARTNERS

- University of Szeged
- University of Pécs
- University of Debrecen
- Central Hospital of Southern Budapest
- Richter Gedeon Nyrt.

INTERNATIONAL COLLABORATION WITH RIs

- BBMRI-ERIC
- B1+MG

PERSON IN CHARGE

Mária Judit Molnár, Head of Institute
molnar.mariajudit@med.semmelweis-univ.hu

CONTACT

András Fodor, Project Manager
fodor.andras@med.semmelweis-univ.hu

WEBSITE

<https://semmelweis.hu/biobank/>

Description of the RI network

Semmelweis University has been one of the leading biomedical institutions of higher education in Hungary and Central Europe for the last 250 years. The University today is handling 2.5 million patient visits each year within nearly 40 departments. Research, development, and innovation (R&D&I) take place in the areas of living natural sciences, and social sciences. Within these, life science R&D&I activities are the most prominent. R&D&I results quickly make their way into clinical and health sciences as well as into the University's educational activities and curriculum. The synergies also manifest themselves in the various specialized networks operating at the University (e.g. nanotechnology, bio-imaging, genomics, biobank), as well as in the research university modules (diagnostics, technology, therapy, prevention) and the dynamic collaborations which have been developing within these areas. The Semmelweis Biobank Network was established in 2010 with the goal of efficiently using the synergies that occur in patient care, education, research/development and a wide spectrum of health care areas all under University premises.

Activities and Services

The Biobank Network at Semmelweis University consists of 14 (26) institutes and 15 (27) biobanks. The aggregate sample size for these institutes currently stands circa 100.000, registering over 10 000 new samples annually. Sample types vary from DNA, RNA, tumor, muscle and nerve tissue, fibroblast and clinical data. Areas covered by the Biobank Network include: cardiology, neurology, psychiatry, hematology, nephrology, rheumatology, ophthalmology, endocrinology, dermatology. The University has a Rare Disease network with a large biobank. The most recent member of the network is the ONKOBANK collecting samples from 12 departments.

Samples from the Semmelweis Biobank Network have been used in over 60 research projects during the networks existence. A main strategic goal for Semmelweis University is to elevate the role of the Biobank Network both internally and externally. A key element in achieving this goal is successfully coordinating the establishment of the Hungarian National Node of the Biobanking and BioMolecular Resources Research Infrastructure ((BBMRI- ERIC) and joining as a full member. The University is also in pursuit of offering commercialized services based on the Biobank Network, tightening the relationship with other players from the biobanking field such as industry, biobankers and other private sector parties. Initiatives set in motion are all in hope of making significant contributions to biomedical research and to the evolution of new treatment methods.

TYPE OF THE RI

Single sited

HOST INSTITUTION

Research Centre for Natural Sciences,
Institute of Enzymology

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2014–

NATIONAL PARTNERS

- Toxi-Coop Toxicological Research Center
- Kineto Lab Ltd.
- Turbine Simulated Cell Technologies Ltd.
- Gedeon Richter Plc.

INTERNATIONAL COLLABORATION WITH RIs

- ELIXIR European life-science infrastructure Node
- INSTRUCT ERIC

INSTITUTIONAL PARTNERS

- Johns Hopkins Medicine
- Medical University of Vienna
- Mobile DNA Group, Max Delbrück Center for Molecular Medicine in the Helmholtz Society
- National Institute of Child Health and Human Development, NIH
- IFOM the FIRC Institute of Molecular Oncology

PERSON IN CHARGE

László Buday, Director General

CONTACT

Katalin Monostory, Research Group leader
monostory.katalin@ttk.hu

WEBSITE

www.ttk.hu/ei/en
www.perinatalbiobank.com
www.ttk.hu/mc/ms-metabolomika-kutato-laboratorium

BIOMARKER RESEARCH LABORATORY



Description of the RI

The Biomarker Research Laboratory is an excellent platform for biomarker research projects supporting personalized medication and their application for diagnostic and therapeutic purposes. The equipment of the laboratory units (gene analytics, cell culture and stem cell laboratory, virus and FACS units, mass-spectrometry, biobank) is applied in high-throughput, multilevel research projects on nucleic acid, protein and cellular biomarkers related to public health problems.

Activities and Services

Gene Analytics laboratory: the multi-level analysis of nucleic acids for modern PCR measurements (gene expression, identification of mutations and copy number variations) facilitates specific target research and high-throughput routine studies and provides a platform for various nucleic acid based technologies.

Cell Culture laboratory: drug-resistance research with a wide repertoire of tumor models, supported by state-of-the-art cell biology instruments (i.e. Hamilton STARlet, erkinElmer Enspire, JuLI Stage; the complete NCI-60 cell-line panel as well as xenograft, allograft and genetically engineered mouse models of cancer aid the development and testing of novel anticancer compounds. Human Pluripotent Stem Cell lab: stem cell generation and differentiation (e.g. in the direction of cardiac, neuronal, endothelial and mesenchymal cell types); studying of membrane transporters as well as calcium signalling; development of induced pluripotent stem cell-based disease models and transgenic cellular reporter systems.

BSL2 biosafety Virus Laboratory: genetically modified cell lines with Adeno-, Lenti-, Sendai- and Retroviruses are created for studying diseases based on genetic differences; using DNA constructs in the laboratory, non-replicating viral particles are produced and used to "infect" target cells and express target proteins; frozen storage and subsequent use of the viruses produced. The Flow Cytometry Laboratory uses FACS devices for studying fluorescent proteins, drug transport processes and antibody labeling expressed in cells. Cells expressing specific proteins can be selected from genetically modified cell lines using a high-throughput cell sorter (FACSria III) to generate homogeneously expressing cell lines. The laboratory has the equipment needed for fluorescent labeling and the maintenance of cell lines under sterile conditions.

The Mass-spectrometry Laboratory identifies of the molecular weight, the elemental composition and the possible structure of small and large biomolecules. Furthermore the lab identifies the covalent modifications of molecules, including the position, and the sensitive quantitation of target molecules. The biobank-licensed Perinatal Biobank was designed in accordance with industry standards, equipped with an uninterruptible power supply and CO2 backup system, ultra-deep freezers with temperature monitoring and alarm system, and a 2D barcoded recording system. With the pregnancy sample collection containing tens of thousands of samples, it provides an excellent background for domestic and international collaborations to explore the molecular background of obstetrical syndromes and develop non-invasive biomarkers, facilitating early diagnosis and targeted, personalized treatments.

BIOSAFETY LEVEL 4 VIROLOGICAL LABORATORY AND RESEARCH CENTER



TYPE OF THE RI

Single sited

HOST INSTITUTION

University of Pécs, Szentágotthai Research Centre

LOCATION OF THE RI

Pécs

STATUS

Fully operational, 2012–

NATIONAL PARTNERS

- Hungarian European Clinical Research Infrastructure Network (HECRIN)
- National Laboratory of Virology
- National Laboratory of Biotechnology

INTERNATIONAL COLLABORATION WITH RIs

- European Research Infrastructure on Highly Pathogenic Agents (ERINHA)
- European Life Science Infrastructure for Biological Information (ELIXIR)

INSTITUTIONAL PARTNERS

- Boston University, National Emerging Infectious Diseases Laboratories (NEIDL), USA
- Rocky Mountain Laboratories, National Institute of Allergy and Infectious Diseases (NIAID), USA
- United States Army Medical Research Institute of Infectious (USAMRIID), USA
- University of Kent, UK
- Bernhard Nocht Institute for Tropical Medicine (BNITM), Germany

PERSON IN CHARGE/CONTACT

Ferenc Jakab, Leader of the Virological Research Center
jakab.ferenc@pte.hu

WEBSITE

https://szkk.pte.hu/en/research_groups/molecular_biology_cluster/virological_research_group_0

Description of the RI

The main profile of the Virological Research Center is the extensive research of animal-to-human viral zoonoses that pose a threat to humanity, which includes their full understanding, research into therapeutic options and active support for disease prevention measures. Humanity is being hit more and more frequently and large-scale epidemics may occur. Therefore, the results of the Center's research support the fight against epidemics along the lines of cognition, prevention and response. Due to the many side effects of global warming and the scale and change of the human habitat, the viruses carried by animals pose an increasing threat to health and epidemiology. Pathogens causing severe epidemics are appearing more and more frequently due to various global activities. For this reason, one of the aims of the Virological Research Center is to detect known and new pathogens in samples from Hungary and from international collaborations; assessment of their frequency; detailed characterization of their genetics stock; and a better understanding of the mechanism of viral infection. Their research focuses primarily on rodent and bat populations, but also places serious emphasis on mosquitoes, ticks, and other arthropod vectors. The Center has established collaborations with public, veterinary and industrial actors, one of the outcomes of which is the elaboration and development of a wide range of diagnostic options for the pathogens they study. Through their diversified activities, they are actively involved in both basic and applied research. The scientific activity of the Center is based on three closely related pillars: i) detection and identification of new pathogens, characterization of virological and molecular biology; (ii) complex testing of viruses in risk groups 3 and 4 under BSL-3 and BSL-4 laboratory conditions; iii) establishment of a national and international level education and training center.

Activities and Services

Due to its specific, high level facilities, Virological Research Center has a unique asset in Hungary. Accordingly, it is capable of conducting experiments requiring Biosafety Level 2 (BSL-2), Biosafety Level 3 (BSL-3) and as the only academically supported unit in Hungary, it is also capable of covering Biosafety Level 4 (BSL-4) standards to uniquely combat infectious diseases in the area. Virological Research Center is a distinctive research facility not only nationally, but internationally, in particular when extending its professional services to the international network regarding research, grants and R&D cooperation. Currently, the University of Pécs possesses the only virological research laboratory in Hungary that was established purely for research purposes and not for performing epidemiological tasks. Because of Virological Research Center unit is unparalleled throughout the country, the colleagues wishing to pursue research in the field of virology do not need to seek experience abroad, since the Center offer all opportunities to achieve these very same goals. In addition to research, the Centre's range of services is considerable, capable of performing high-level conventional virological and modern molecular biological technics, isolating BSL-2, BSL-3 and BSL-4 viruses, examining gene functions, determining signal transduction pathways, and performing whole genome-based studies and bioinformatics analyses.

TYPE OF THE RI

Distributed

HOST INSTITUTION

University of Debrecen

LOCATION OF THE RI

Debrecen

STATUS

Fully operational, 2009–

NATIONAL PARTNERS

- University of Debrecen
- ScanoMed Ltd.
- Institute for Nuclear Research (ATOMKI)
- Szentágotthai Research Center
- Semmelweis University
- Femtonics Ltd.
- Biology Research Center, Szeged

INTERNATIONAL COLLABORATION WITH RIs

Euro-BiolMaging ERIC (ESFRI)

INSTITUTIONAL PARTNERS

- National Institutes of Health, Helmholtz-Zentrum Dresden Rossendorf
- TU Wien
- Stanford University Stanford
- University College London
- Russian Academy of Sciences, Pavlov Institute of Physiology
- University of Toronto
- University of Siena
- Vilnius University
- Johns Hopkins University

PERSON IN CHARGE

György Vámosi, Senior Scientist
vamosig@med.unideb.hu

CONTACT

Cellular Imaging Hungary

János Szöllősi, Professor, MHASc
szollo@med.unideb.hu

Medical and Preclinical Imaging Hungary

István Hajdu, assistant professor
hajdu.istvan@med.unideb.hu

CELLULAR IMAGING HUNGARY



EURO-BIOIMAGING NODE

MEDICAL AND PRECLINICAL IMAGING HUNGARY

EURO-BIOIMAGING NODE

Description of the RI

Euro-BiolMaging (EuBI) is the European landmark distributed research infrastructure for biological (microscopy) and medical/preclinical imaging as recognised by the ESFRI. Life scientists from academia and industry can access instruments, expertise, training and data management services at 25 internationally renowned facilities (Nodes), located in 14 countries and the EMBL. **Hungary participates with 2 ratified Nodes:** Cellular Imaging Hungary, and Medical and Preclinical Imaging Hungary. The Hungarian Nodes consist of several sub-Nodes (see National Partners), which specialize in complementary methods. The importance of imaging methods in biomedical research is growing, which has been marked by 3 Nobel Prizes in the last 20 years. These methods have undergone explosive development in recent decades in terms of resolution (super-resolution techniques, single molecule microscopy), volume of data collection (e.g., high-throughput microscopy), or data processing (e.g., the application of deep learning algorithms). No laboratory can keep pace with development on its own, which requires a division of labor.

Activities and Services

Most important techniques available at the Cellular Imaging Hungary Node

- Electron Microscopy (EM)
- Correlative Light Electron Microscopy (CLEM)
- Fluorescence (cross)correlation spectroscopy (FCS, FCCS)
- Fluorescence-lifetime imaging microscopy (FLIM)
- Förster resonance energy transfer (FRET)
- Fluorescence recovery after photobleaching (FRAP)
- Laser scanning confocal microscopy (CLSM)
- High-throughput microscopy (HTM)
- Multiphoton microscopy systems (MMS)
- Spinning disc confocal microscopy systems (SDCM)
- Selective plane illumination microscopy (SPIM)
- Stimulated emission depletion microscopy (STED)
- Stochastic optical reconstruction microscopy (STORM)
- Total internal reflection fluorescence microscopy (TIRF)
- Optical tweezers
- Phosphor Imager SI for quantitative autoradiologic measurements
- LEICA CM3600 cryomicrotome for quantitative autoradiologic measurements
- Positron Emission Tomography, MiniPET for quantitative in vivo imaging
- Microtomography (microCT)
- Positron emission tomography–magnetic resonance imaging (PET-MRI)
- Integrated single photon emission computed tomography and computed tomography (SPECT/CT)
- NIKON intravital microscope with camera and image analysis software
- Magnetic Resonance Imaging (Pharmascan 4.7T MRI)
- Functional Ultrasound (FUS) – coupled to SPECT/CT
- Optical imaging (2D fluorescence)

WEB <https://www.eurobioimaging.eu/nodes/cellular-imaginghungary>

<https://www.eurobioimaging.eu/nodes/medical-and-preclinical-imaging-hungary>

ELIXIR HUNGARY



TYPE OF THE RI

Distributed

HOST INSTITUTION

Research Centre for Natural Sciences, Eötvös Loránd Research Network

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2017–

NATIONAL PARTNERS

- Eötvös Loránd University
- University of Debrecen
- Semmelweis University
- University of Pécs
- University of Veterinary Medicine Budapest
- National Institute of Oncology
- National Agricultural Research and Innovation Centre
- Centre for Ecological Research
- Alfréd Rényi Institute of Mathematics
- Centre for Agricultural Research
- Biological Research Centre
- Pázmány Péter Catholic University
- University of Szeged

INTERNATIONAL COLLABORATION WITH RIS ELIXIR

PERSON IN CHARGE

Balázs Györffy, Scientific Advisor
gyorffy.balazs@ttk.hu

CONTACT

Zsolt Csaba Kovács
kovacs.zsolt@ttk.hu

WEBSITE

www.elixir-hungary.org

Description of the RI

ELIXIR unites Europe's leading life science organisations in managing and safeguarding the increasing volume of data being generated by publicly funded research. It coordinates, integrates and sustains bioinformatics resources across its member states and enables users in academia and industry to access services that are vital for their research.

Activities and Services

Platform

It consists of five groups, created in accordance with the objectives of ELIXIR in order to carry out the tasks undertaken by ELIXIR effectively.

- Data
- Tools
- Compute
- Interoperability
- Training

Communities

Groups created by the scientific community. Their responsibilities include providing feedback on the usefulness of the services provided by the Platforms.

- 3D-BioInfo, Galaxy, Intrinsically Disordered Proteins (IDP), Marine Metagenomics, Metabolomics, Microbial Biotechnology Plant Sciences, Proteomics.

Communities in the field of human biology

Federated Human Data, Human Copy Number Variation (hCNV), Rare Diseases.

HCEMM ADVANCED CORE FACILITIES



TYPE OF THE RI

Distributed

HOST INSTITUTION

HCEMM Non-profit Kft.

LOCATION OF THE RI

Szeged

STATUS

Fully operational, 2020–

NATIONAL PARTNERS

- Biological Research Centre Szeged (SZBK)
- Semmelweis University (SE)
- University of Szeged (SZE)

INTERNATIONAL COLLABORATION WITH RIS

EMBL (European Molecular Biology Laboratory)

PERSON IN CHARGE

Zsuzsanna Darula, Core Facility Leader
zsuzsanna.darula@hceimm.eu

CONTACT

Judit Janka Ferenczi, Project Manager
janka.ferenczi@hceimm.eu

WEBSITE

https://www.hceimm.eu/teams/advanced-core-facilities

Description of the RI

The Functional Cell Biology and Immunology Advanced Core Facility (FCBI ACF) and the Single Cell Omics Advanced Core Facility (SCO ACF) are parts of the Hungarian Centre of Excellence for Molecular Medicine (HCEMM) Core Facility Network. The mission of the ACFs is to provide a range of services tailored to the requirements of HCEMM researchers, while also serving as an EU-level infrastructure, competence and training base, offering its capacities for any Hungarian and EMBL partner researcher and services to external users as well. The instrumentation of the FCBI ACF includes a state-of-the-art laser scanning confocal microscope, a STORM super-resolution microscope, a scanning electron microscope optimized for biological samples (including array tomography and correlative light and electron microscopy) and a 4-channel FACS cell sorter. The instrumentation of the SCO ACF includes two high resolution mass spectrometers (MS), several HPLC systems, a Chromium Controller microfluidic device and a well-equipped wetlab supporting sample preparation.

Activities and Services

Services offered by the SCO ACF

Proteomics services include MS-based protein identification, relative protein quantification, phosphorylation analysis, identification of protein interacting partners using co-immunoprecipitation, protein crosslinking experiments and molecular mass determination of purified single-protein samples. High-pH chromatographic fractionation for comprehensive analysis of complex biological samples is also available. We provide help in study design, perform the sample preparation and data analysis. The MS-based shotgun Lipidomics service covers comprehensive shotgun Lipidomic analysis with identification and quantification of hundreds of lipid species including principal phospholipid, sphingolipid and neutral lipid classes. The chip-based robotic delivery system ensures cross contamination-free, high throughput measurements from a wide variety of samples including cell cultures, tissues, and biofluids. The Chromium Controller microfluidic device enables sample partitioning and molecular barcoding at the single cell level using sample sizes up to a few thousand cells. Downstream sequencing and data analysis provides single cell resolution data allowing single cell gene expression, immune or epigenomic profiling of the samples.

Services offered by the FCBI ACF

Our primary objective is to support research groups with the latest imaging/cytometry techniques and software solutions. Our services range from initial advice on the selection of the most suitable equipment for a project and configuring it, to the final analysis of the imaging/cytometry data. Our static and dynamic imaging applications include standard widefield and confocal imaging of fixed samples and live cells (up to 4 wavelengths simultaneously), two-color super resolution microscopy based on STORM and PALM techniques, single particle tracking, TIRF (total internal reflection fluorescence) microscopy, array tomography with ATUMtome (semi-automated cutting and imaging of 100–2000 slices with a z-resolution of 30–50 nm and 3D rendering of the images), and correlative light and electron microscopy: a comparative dual (light and electron microscopy) analysis of the same specimen, which is essential for the analytical interpretation of high-resolution electron microscopy images at the cellular level. FACS-related applications include cell sorting and clustering from fluids and tissues, and marker identification.

TYPE OF THE RI

Single sited

HOST INSTITUTION

Szentágothai Research Centre
University of Pécs

LOCATION OF THE RI

Pécs

STATUS

Fully operational, 2018–

NATIONAL PARTNERS

- Hungarian universities
- National Health Institutes
- Biotech companies

INTERNATIONAL COLLABORATION WITH RIs

- HECRIN
- ELIXIR
- BBMRI
- EMBL
- CEITEC
- CORE FOR LIFE

INSTITUTIONAL PARTNERS

- Central European Institute of Technology at Masaryk University (CEITEC)
- Vlaams Instituut voor Biotechnologie (VIB)
- Max Planck Institute of Molecular Cell Biology and Genetics (MPICBG)
- Centre for Genomic Regulation (CRG)
- Medical University of Bialystok (MUB)

PERSON IN CHARGE

Attila Gyenesei, RI leader
gyenesei.attila@pte.hu

CONTACT

Attila Gyenesei, RI leader
gyenesei.attila@pte.hu

WEBSITE

https://szkk.pte.hu/en/core_facilities/genomics_and_bioinformatics

Description of the RI

The Hungarian Centre for Genomics and Bioinformatics RI provides an integrated, streamlined and expertly supported next generation sequencing (NGS) based services that encompass experimental design, sample preparation, sequencing, data analysis and interpretation. An expert team of laboratory scientists and bioinformaticians is available to consult and collaborate at every step of the research and diagnostic projects. They work closely together to develop optimized experimental strategies to ensure the appropriate application, technology and data analysis tools are applied to address both standard and unique questions.

The Centre provides the most cost-efficient integrated service portfolio for academic and industrial partners working on the fields of healthcare, agriculture and food safety. Currently, the RI has one of the highest sequencing and computational capacities in Hungary and Eastern Europe, including all the major sequencing platforms and high-performance computing (HPC) resources. The RI puts a strong emphasis on establishing collaborations and working together with the national nodes of European research infrastructures including ELIXIR, ECRIN and BBMRI.

Activities and Services

The Hungarian Centre for Genomics and Bioinformatics offers a broad range of NGS services on short-read sequencing Illumina platforms (NovaSeq, NextSeq, MiSeq, MiniSeq and iSeq) and long-read sequencing Oxford Nanopore technology (MinION). The application areas consist of genome, transcriptome, epigenome and metagenome sequencing. The RI's end-to-end services include advice on study design, library preparation strategies for various sample types, and the appropriate sequencing application with the suitable bioinformatics data analysis methods.

In addition to engaging in research collaborations with academic partners, the RI works together with health and agriculture biotech companies to develop and implement new innovative solutions for their needs. The Centre offers diagnostics support for clinical institutes with its 1) whole exome and genome sequencing applications for rare (inherited) diseases, 2) targeted sequencing solutions for precision oncology, and 3) pathogen (virus and bacteria) point-of-care testing.

TYPE OF THE RI

Distributed

HOST INSTITUTION

Semmelweis University

STATUS

Fully operational

NATIONAL PARTNERS

- HCEMM Nonprofit Kft.
- University of Szeged
- Semmelweis University, Basic Medical Science Center
- University of Pécs
- National Center for Public Health

INTERNATIONAL COLLABORATION WITH
INSTITUTIONAL PARTNERS

- Helmholtz-Zentrum Dresden-Rossendorf
- Institut für Radiopharmazeutische Krebsforschung

PERSON IN CHARGE

Miklós Kellermayer
kellermayer.miklos@med.semmelweis-univ.hu

CONTACT

Domokos Máthé
mathe.domokos@med.semmelweis-univ.hu

WEBSITE

<https://semmelweis.hu/molecularimaging/>
<https://www.hcemm.eu/teams/advanced-core-facilities/hcemm-su-in-vivo-imaging-advanced-core-facility/>

Description of the RI network

The headquarters being the Basic Medical Sciences Building at the Semmelweis University, 37–43 Tüzoltó utca, 1094 Budapest. The RI comprises two isotope laboratories and three imaging laboratory rooms. Permissions are in place to handle more than 80 isotopes for tracing, imaging and therapeutics and X-ray application. In addition, a local isotope-containing animal facility is also associated with the RI. We strive to include everything: from the generation of any live animal-related measurement ideas, through advice on contrast material use or metabolic imaging measurement types. Our service extends to the development of radiomic outputs and statistical analysis of data. Our constantly improving and quite comprehensive array of experience, animal model choices available, and imaging systems cover small rodents (CNS, tumour and stem cell use models) and large animals (dogs, swine) as well. Equipment for Quantitative Functional Molecular Imaging.

- **Small Animal Ultrahigh Resolution Optoacoustics and Doppler Ultrasound Imaging System:** Iconeus ONE (Iconeus, France)
- **PET/MRI system:** nanoScan PM 3T (Mediso, Hungary)
- **SPECT/CT system:** nanoScan SPECT/CT 4R (Mediso, Hungary)
- **Fast and easy MRI system:** nanoScan 1T (Mediso, Hungary)
- **Optical Imaging Systems:** FOBI (Neoscience, Korea);
- **Dedicated Clinical SPECT/PET/CT System for large animals:** AnyScan TRIO (Mediso, Hungary)

Activities and Services

High Resolution MicroCT imaging Ex Vivo

- The platform provides resolution not possible with live imaging due to the confounding effect of even minute movements in live animals
- Microscopy resolution imaging on all hard and soft tissues
- Assessment of disease progression
- Fast reconstruction of CT images
- SPECT/CT applications; Biomarker identification
- Spatial and temporal measurement of thyroid, cardiac, hepatic and kidney functions
- Bio-distribution and -availability of isotope-labeled theragnostic molecules already in clinical use or under development
- Imaging of stem cell functions; PET/MRI multimodal applications
- High spatial resolutions: 100 µm (MRI), 700 µm (PET) – Cellular, subcellular, and molecular identification
- **High sensitivity:** femtoM/mg tissue
- Anatomical localization, exact morphology of metabolic foreground
- Radiolabeling-based assessment of tissue metabolic processes
- Special focus in neurotransmitter, oncology, regeneration and immune-system studies
- Fluorescent Imaging
- Very high throughput easy-to-use phenotyping of reporter animals without the need of external luciferase injection and ATP access to tissue
- Identification of autofluorescence-related processes
- Tumor and cell tracking and time-series imaging of tumor bio-distribution or cell-based therapies
- Ultra-high-frequency and 4D ultrasound imaging applications
- A platform with portable ultrasound unit operating from 10 up to 70MHz
- Applicable for mice, rats, and other larger animals
- Focused, but not limited to, cardiovascular applications
- **FUS:** High-resolution quantitation of cerebral blood flow in mice and rats for the fast, on-the-fly analysis of blood flow changes in stroke, inflammation, intestinal microbiome and cardiovascular model mice.

TYPE OF THE RI

Distributed

HOST INSTITUTION

University of Pécs

LOCATION OF THE RI

Pécs

STATUS

Fully operational, 2014–

NATIONAL PARTNERS

See members of the HECRIN Consortium

INTERNATIONAL COLLABORATION WITH RIs

- ECRIN ERIC
- CRIGH (Clinical Research Initiative for Global Health)

INSTITUTIONAL PARTNERS

- University of Paris, Paris
- Universidade NOVA de Lisboa
- Masaryk University, Brno
- University of Cork

PERSON IN CHARGE

Gábor L. Kovács, President of the Consortium
kovacs.l.gabor@pte.hu

CONTACT

Kata Bende, European Correspondent
kata.bende@pte.hu

WEBSITE

<https://hecrin.pte.hu/>

HECRIN - HUNGARIAN EUROPEAN CLINICAL RESEARCH INFRASTRUCTURE NETWORK



Description of the RI

ECRIN ERIC, in which HECRIN is a full member, is a nonprofit organization classified as “landmark” on the ESFRI Roadmap, aims to support noncommercial, scientific, multi-center drug development research in Europe. The HECRIN Consortium supports the strengthening of the research potential and its implementation through accredited processes. The consortium promotes the continuous professional training as well as efforts to utilize the clinical data assets for research purposes.

Members of the HECRIN Consortium

- University of Pécs (Consortium Leader)
- University of Szeged
- Semmelweis University, Budapest
- University of Debrecen
- National Institute of Oncology, Budapest
- State Hospital for Cardiology, Balatonfüred
- National Institute of Rheumatology and Physiotherapy, Budapest
- National Institute of Clinical Neurosciences, Budapest
- Gottsegen György Hungarian Institute of Cardiology, Budapest
- Korányi National Institute of Pulmonology, Budapest
- Heim Pál Children’s Hospital, Budapest
- MCRN Hungary (Medicine for Children Research Network)
- Hungarian Academy of Sciences - Research Centre for Natural Sciences Brain Imaging Centre, Budapest
- HunPedNet (Hungarian Pediatric Network)
- AdWare Research Ltd., Balatonfüred
- Pharmahungary 2000 Ltd., Budapest
- National Institute of Pharmacy and Nutrition (OGYÉI), Budapest
- South Pest Central Hospital, Budapest
- DRC Drug Research Ltd., Balatonfüred
- QTICS Medical, Budapest

HECRIN supports the strengthening of research potential and its implementation through accredited processes. It promotes ongoing professional training as well as efforts to utilize clinical data assets for research purposes. The aim is to bring to the surface the potential of Hungary in innovative, high-quality clinical research.

Activities and services

The most important tasks of the Consortium are the creation of professionally established clinical trial units (CTUs) in the institutions of the consortium members, the initiation and support of high-quality Hungarian academic examinations, and the operation of the national center at the University of Pécs. Operational support for the conduct of academic, multinational clinical trials in Hungary, related management activities, provision of services (monitoring, regulatory approvals, pharmacovigilance, etc.), on the other hand, embracing Hungarian academic clinical trial initiatives. Through these services, the participation of Hungarian researchers in European multinational clinical trials will increase, the national clinical trial infrastructure will be strengthened, and research activity will increase. Hungarian researchers have access to the ECRIN certification program and data centers.

TYPE OF THE RI

Distributed

HOST INSTITUTION

University of Szeged

LOCATION OF THE RI

Szeged

STATUS

Fully operational, 2016–

NATIONAL PARTNERS

- ELI-HU Nonprofit Ltd.
- Biological Research Centre Szeged

INTERNATIONAL COLLABORATION WITH RIs

Microbial Resource Research Infrastructure (MIRRI)

INSTITUTIONAL PARTNERS

- Federation of Culture Collections
- Institute of Molecular Biology, Medical University of Innsbruck
- Department of Food and Environmental Science, University of Helsinki,
- Albert Einstein College of Medicine
- Friedrich Schiller University
- Radboud University Medical Nijmegen, Department of Medicine
- Department of Genetics and Microbiology University of Murcia,
- Vidyasagar University, Midnapur, West Bengal

PERSON IN CHARGE

Csaba Vágvölgyi, Head of Department
csaba@bio.u-szeged.hu

CONTACT

Csaba Vágvölgyi, Professor
Head of Department

WEBSITE

<http://szmc.hu/>

MICROBIAL GENE BANK-RELATED, INTEGRATED LIFE-SCIENCE AND DRUG RESEARCH AND DEVELOPMENT CENTER



Description of the RI

The RI, acting as a regional and international service providing centre, involves units operating as overlapped complex instrument clusters in the form of workstations, which participate in the systematic storage-, complex genomic and metabolomics-based characterization of microorganisms, bioactivity screening and large-scale production of their metabolites as well as pathogenicity- and virulence assay of the microorganisms with clinical relevance.

Activities and Services

Seven workstations are participating in the activity of the research infrastructure

1. The basic biobank deposit and microbial maintenance unit (MÁ-1, Department of Microbiology).
2. The workstations performing the genetic characterization of the strains (MÁ-2, Department of Biochemistry and Molecular Biology).
3. The unit characterizing the deposits of the gene bank in terms of the production of secondary metabolites (MÁ-3, Department of Microbiology).
4. The workstation for the characterization of clinical isolates (MÁ-4, Institute of Clinical Microbiology and Diagnostics).
5. The unit for the characterization of microorganisms relevant for the food industry (MÁ-5, Faculty of Engineering).
6. A workstation for the production of active substances at laboratory level (MÁ-6, Department of Biotechnology).
7. A histological workstation capable of assessing the pathogenicity of clinical isolates at tissue level (MÁ-7, Department of Physiology, Anatomy and Neuroscience).

NATIONAL BIOSAFETY LABORATORY



TYPE OF THE RI

Single sited

HOST INSTITUTION

National Public Health Center

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2018 –

NATIONAL PARTNERS

- Eötvös Loránd University (ELTE)
- Semmelweis University (SE)
- University of Pécs (PTE)
- Eötvös Loránd Research Network (ELKH)
- University of Veterinary Medicine (ÁOTE)

INTERNATIONAL COLLABORATION WITH RIs

- ERINHA (European Research Infrastructure on Highly Pathogenic Agents)
- EVD-Labnet (Emerging Viral Diseases-Expert Laboratory Network)
- EMLab (European Mobile Laboratory)

INSTITUTIONAL PARTNERS

- ERINHA
- Bernhard Nocht Institute for Tropical Medicine
- INMI Lazzaro Spallanzani Istituto Nazionale Malattie Infettive
- Robert Koch Institute
- ECDC
- WHO
- University of Tokyo

PERSON IN CHARGE

Zoltan Kis
kis.zoltan@nnk.gov.hu

CONTACT

Zoltan Kis
kis.zoltan@nnk.gov.hu

WEBSITE

<https://erinha.antsz.hu>
<https://erinha.eu>

Description of the RI

The National Biosafety Laboratory (NBL) at the National Public Health Center is the only licensed highest level biosafety laboratory (BSL) established for public health purposes in Central Europe. The NBL consists of two independently operating units: a BSL3+ laboratory with two rooms for the works with Risk Group 3 (RG3) pathogens (SARS-CoV-2, anthrax, dengue virus) and a positive pressurized suit BSL-4 laboratory with three rooms, including an animal room, for the works with RG-4 pathogens (e.g. Ebola virus, Nipah virus). NBL is also authorized to work with GMOs on BSL-3/4. NBL is the Hungarian node of the European Research Infrastructure on Highly Pathogenic Agents (ERINHA).

ERINHA is a pan-European distributed Research Infrastructure dedicated to the study of high-consequence emerging and re-emerging pathogens. It brings together leading BSL-4 and complementary (e.g. BSL3) facilities with longstanding experience of research in the field of highly infectious diseases. The over-arching goal of ERINHA is to provide capacities to conduct projects which are broad in scope, ambition and require a range of capabilities that no single facility or even country can provide on its own.

Activities and Services

NBL applies wide range of microbiological methods ranging from classical methods (virus/bacteria isolation on cell culture and animals, biochemical identification tests, antibiotic susceptibility testing, etc.), serological tests (ELISA, immunofluorescence methods and their development, neutralization methods), and molecular methods (PCR, whole genome sequencing). NBL maintains viral and bacterial cell culture collections, performs diagnostic/differential diagnostic tests, provides access to its specialized BSL-3+ and BSL-4 laboratories, gives biosecurity and biosafety advices, and offers trainings for future users at BSL-3 and BSL-4.

Services in the field of research and development of dangerous pathogens

- Whole genome sequencing (on Illumina and Oxford Nanopore platform using sequence dependent and independent methods)
- Animal experiments on mice, hamsters, rats in pre-clinical studies (Proof-of-Concept), challenge studies, immunological studies (immune-pathomechanism studies)
- Antimicrobial and disinfectant testing (in-vivo and in-vitro systems)
- Testing of new diagnostic tools

In addition to standard laboratory equipment, a wide range of equipment is available to perform these tasks: biocontainment IVC cages, ultracentrifuge, inverted fluorescence microscopy (Leica DMI8, Nikon TS2R), ELISA systems, MiSEQ and Nanopore sequencers, Luminex MagPix.

NATIONAL CARDIOVASCULAR LABORATORY



TYPE OF THE RI

Distributed

HOST INSTITUTION

Semmelweis University

STATUS

Fully operational

INTERNATIONAL COLLABORATION WITH INSTITUTIONAL PARTNERS

- University of Heidelberg
- Asklepios Klinik Hamburg

PERSON IN CHARGE

Ferdinandy Péter
tudomanyos.rektorhelyettes@semmelweis-univ.hu

CONTACT

Szigeti Gyula Péter
szigeti.gyula@med.semmelweis-univ.hu

WEBSITE

<https://semmelweis.hu/kutatas/kutatas-fejlesztési-tevekenysegy/>

Description of the RI

The National Cardiovascular Laboratory is a research infrastructure of strategic importance established within the framework of the National Heart Program, which means a network of six separate laboratories that form a professional unit.

These are the following

1. Small Animal Experiment Service Laboratory
2. Large Animal Experiment Service Laboratory
3. Cardiovascular Imaging Core Laboratory
4. Central experimental histopathology Core Lab
5. Bioinformatics core facility
6. Cell Culture Laboratory

The research results of the National Cardiovascular Laboratory will represent a decisive contribution to the development of evidence-based cardiovascular health promotion and disease prevention programs, helping to achieve the goal of a longer and healthy life for the population of the country. The interdisciplinary and translational nature of the program ensures that it successfully implements the development of evidence-based innovative disease prevention, screening, diagnostic and therapeutic procedures to reduce the incidence and mortality of cardiovascular diseases and supports their translation into medical and public health practice. The results of the program contribute to the access of international markets for innovative high economic value-added products and services, thus helping the development of the domestic pharmaceutical biotechnology industry.

Activities and Services

1. Small Animal Experiment Service Laboratory

The in-vivo laboratory allows you to track the distribution of drugs in the body and more accurately characterize drug effects.

2. Large Animal Experiment Service Laboratory

The Large Animal Experiment Service Laboratory and the infrastructure of the chronic experimental large animal husbandry being developed at an external site are unique facilities. The laboratory has adequate capacity for periprocedural accommodation of Laboratory.

3. Cardiovascular Imaging Core Laboratory

The main task of the laboratory is to perform all imaging activities related to the cardiovascular field, also at the service level.

4. Central experimental histopathology Core Lab

It is suitable for detailed molecular analysis and fluorescence-based sorting of circulating cells and extracellular vesicles, as well as for the study of spatial and single-cell gene expression processes in regional tissue areas.

5. Bioinformatics core facility

Bioinformatics core laboratory is a facilitation for the processing of large data sets obtained by omic methods and for the development of the hardware requirements of the in silico methods based on the artificial intelligence and network dynamics to be applied.

6. Cell Culture Laboratory

The main profile of the laboratory is cell and tissue culture, cell line generation, and the use of viruses in in vivo animal models for knockout studies.

TYPE OF THE RI

Single sited

HOST INSTITUTION

National Institute of Oncology

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2017–

NATIONAL PARTNERS

- Semmelweis University
- University of Debrecen
- University of Pécs
- University of Szeged
- Markusovszky University Teaching Hospital, Szombathely
- Eötvös Loránd Research Network (ELKH)

INTERNATIONAL COLLABORATION WITH RIS

- 1 million genom (1MG)
- ERN (EURACAN and ENDOERN)
- BRESO - European Breast Certification Program
- International Agency for Research on Cancer
- GEC-ESTRO

INSTITUTIONAL PARTNERS

- Karolinska Institutet and Karolinska University Hospital
- Tohoku University
- German Cancer Research Center (DKFZ)
- International Agency for Research on Cancer (IARC)
- Central-Eastern European Academy of Oncology (CEEAO)
- EMQN International accreditation for molecular diagnostics
- European Organisation for Research and Treatment of Cancer (EORTC)
- International Prevention Research Institute (IPRI)

PERSON IN CHARGE

Csaba Polgár, Director General, foig@oncol.hu

CONTACT

Péter Nagy, Scientific Director
peter.nagy@oncol.huWEBSITE <https://onkol.hu/>NATIONAL INSTITUTE OF ONCOLOGY
RESEARCH CENTER (NIO)

Description of the RI

For more than half a century, the NIO has been the patient care, organizational, methodological, research and training center of Hungarian oncology. The NIO research center is Hungary's internationally recognized oncological research infrastructure. It has 7 dedicated research departments and extensive clinical and translational research is carried out in its clinical departments. The NIO was awarded the highest level available in the accreditation structure of the Organization of European Cancer Institutes (OEI), the Comprehensive Cancer Center certification in 2008, which was renewed in 2013 and 2018, as the only institute in the Central and Eastern European region. One of the key pillars of accreditation is the research activity carried out in the given institute. The Institute has a state-of-the-art research infrastructure (large instruments) and research support departments such as the centralized biobank, the SPF animal house or the isotope laboratory.

Activities and Services

Clinical, translational, epidemiological and basic research are coordinated with significant grant support, unique infrastructure, patients and multidisciplinary expertise, which have been documented in an increasing number of prestigious multidisciplinary journals as first/last authors. The main areas of research in the NIO are: the analysis of the genetic diversity of the Hungarian population; discovering new targets for developing new therapies; exploring molecular pathways responsible for treatment resistance; identification of new molecular markers for diagnosis and response to therapy; molecular diagnostic facility to ensure the success of precision medicine; prevention and early detection of hereditary cancers (breast, colon and rectum).

Clinical research-Increase in the number of clinical trials and patients involved

- More than 100 ongoing clinical trials
- Sponsored clinical trials
- Cooperation with leading organizations (EORTC, International Breast Cancer Study Group)
- Researcher-initiated clinical trials
- Coordinating role in more and more clinical trials

Basic research - New directions in basic research

- Functional proteomics; Redox tumor biology
- Endocrine tumors; Development of novel therapies

Our priority translational research programs

- **2021- Operation of the National Tumor Biology Laboratory**
 - **Subprogram 1:** Development of the National Cancer Registry: development and clinical application of the Hungarian oncological database
 - **Subprogram 2:** Innovative approach to therapeutic development by modulating tumor cell redox systems.
 - **Subprogram 3:** Clinical research
- **2019-2020 – National Excellence Program:** “Innovative oncological treatment of breast cancer and melanoma”. The aim of the project is to develop and apply a precision treatment model for the treatment of breast cancer and melanoma by combining surgery, radiotherapy, clinical oncology, imaging, molecular diagnostics and basic research efforts.

2017–2019 National Oncogenomic Project**Epidemiological research**

NIO maintains the National Cancer Registry. Reconciliation of the databases of The National Healthcare System, the National Statistical Agency and the National Cancer Registry is currently underway. Hungary has recently joined the WHO's International Agency for Research on Cancer (IARC), with which the OOI Research Center is conducting high-level epidemiological researches.

TYPE OF THE RI

Single sited

HOST INSTITUTION

University of Szeged, Interdisciplinary Centre of Excellence

LOCATION OF THE RI

Szeged

STATUS

Fully operational, 2018–

NATIONAL PARTNERS

- HECRIN

INTERNATIONAL COLLABORATION WITH RIS

- ECRIN-ERIC
- BBMRI-ERIC
- ELI-ERIC

INSTITUTIONAL PARTNERS

- Institut National De La Sante Et De La Recherche Medicale
- Solvo Biotechnology
- REGEMAT 3D
- BRECA Health Care
- Biogelx Ltd

PERSON IN CHARGE/CONTACT

Lajos Kemény, Head of Institute
kemeny.lajos@med.u-szeged.hu

WEBSITE

www.u-szeged.huPERSONALIZED MEDICINE
RESEARCH INFRASTRUCTURE

Description of the RI

Personalized medicine RI covers the entire innovation and health value chain, from diagnosing diseases through developing new therapies to applying them at the bedside. By this RI, laboratories and infrastructures are uniquely located in a single location, providing the opportunity to implement personalized medicine for oncological, non- or difficult-to treat or rare diseases.

Activities and Services

Personalized Medicine RI includes several research laboratories and special manufacturing laboratories, accredited health research and testing facilities, and a biobank that can provide a full research lifecycle for both researchers and industrial partners, from basic research to modern diagnostics and clinical therapies. It is the only regional center of excellence with its complex infrastructure, human resources and quality management systems which is capable to develop new therapies for untreatable or rare diseases, oncology researches and personalized medicine. With regard to Research and Technological Development and Innovation, the RI covers the full spectrum of infrastructure and competence required to achieve the TLR1-TLR9 technological development levels.

RI currently isolates primary (eg. liver, skin, fat, bone marrow, umbilical cord, peripheral blood) stem and progenitor cells, tumor cells, tissues and cultures them ex vivo and in vitro, and the cells thus maintained and cultured are phenotypic, genotypic testing, viability, differentiation and tissue regeneration, biophysical properties, immunological and oncological profile. In addition to basic research methods (histology, histochemistry, immunohistochemistry), it uses state-of-the-art molecular biology, genetic sequencing and high throughput imaging technologies. In our in vitro cell studies, we can study the responses of cells to various stimuli (drugs, pro-inflammatory agents, biopolymers, etc.) in a living system, and we can create quite complex model systems by creating artificial tissues (3D tissue printing). Bioinformatic analysis of specific disease models and genetic measurement data will identify new biological pathways and drug attack points. A huge advantage of RI is its ability to work with different patient samples (collection, storage, and use in research), achieving the highest specificity in the field. To translate the research results, we conduct clinical trials at the accredited Phase I Clinical Trial site, testing new drugs, active ingredients, and therapeutic procedures. Our research and diagnostic samples are stored in a biobank.

Our services are also highly diversified. The infrastructure and instrumentation of the laboratories make it possible to perform fast and accurate analysis of industrial-scale pharmacological measurements that provide a large amount of data. Our unique experimental models and the modern high-throughput systems used in our laboratories combine current advanced therapeutic formulations with classical pharmacological studies, allowing the study of potential drugs in new, hitherto unknown fields.

Our cellular systems are suitable for diagnostic measurements, testing the effectiveness of biological therapies and vaccines, as well as quality control and monitoring of cell therapy (CTP) and advanced therapy products (ATMP). The GMP laboratory has the potential to produce drugs, genes, and cell therapy products for translational research, clinical trials, or the licensing of these products. The Phase I Clinical Trial site provides an essential service for industrial partners in the collection of patient samples, and testing of medicines.

PHYTOTRON OF THE AGRICULTURAL INSTITUTE – CENTRE FOR AGRICULTURAL RESEARCH



TYPE OF THE RI

Single sited

HOST INSTITUTION

Agricultural Institute,
Centre for Agricultural Research

LOCATION OF THE RI

Martonvásár

STATUS

Fully operational, 1972–

NATIONAL PARTNERS

- NÉBIH
- Eötvös Loránd University (ELTE)
- Hungarian University of Agriculture and Life Sciences (MATE)
- Budapest University of Technology and Economics (BME)
- University of Debrecen (DE)

INTERNATIONAL COLLABORATION

- John Innes Centre, UK
- Oregon State Univ.USA
- Department of Crop and Soil Science, University of Graz
- Structural Institute of Experimental Botany of the Czech Academy of Sciences
- University of Bari

PERSON IN CHARGE

Gyula Vida, Director General

CONTACT

Bernadette Bódi, Head of Grants Department
bernadette.bodi@atk.hu

WEBSITE

<http://www.atk.hu/en>

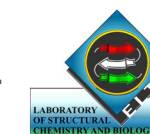
Description of the RI

The phytotron opened in the former Agricultural Research Institute of the Hungarian Academy of Sciences on November 3rd 1972 is one of the largest and most up-to-date facilities for plant experimentation in Europe. The various types of plant growth and testing units, manufactured by the Canadian company Controlled Environments Ltd. (Convion), allow plant experiments to be carried out under programmed, reproducible conditions, quite independently of the external environmental conditions. In the high quality phytotron units, the climate of any part of the world where vegetation exists can be simulated in reproducible programmes, with temperatures ranging from -25°C to +45°C. The effect of each component of the climate on plant life can be examined separately or in combination.

The phytotron provides excellent facilities for a wide range of plant research projects. In the early years the advantages of the controlled environment were mainly exploited in experiments on biotechnology, flowering biology, plant genetics and plant physiology, while nowadays an increasing amount of work is done on the probable effects of global climate changes, and on how climatic extremes influence the growth and development of plants, their abiotic and biotic resistance, and their chemical quality. Agro-ecological research and investigations on the environmental protection aspects of crop production are of increasing importance. The phytotron is also used for investigations on the biochemical and physiological processes involved in the adaptation of cereal species to abiotic stress (temperature, drought, heavy metals) and for functional genomic studies on the genes responsible for this adaptation. Since the phytotron was opened, the advantages of the controlled environment have been enjoyed not only by the staff of the Martonvásár institute, but also by other research institutes, universities and development companies, who have used it for special research and development purposes. It was understood when the funds for the phytotron were provided by the Hungarian Academy of Sciences that the growth chambers should be made available to all researchers who required controlled conditions for their work, since this was the only facility of its kind in Hungary.

More than 500 experiments carried out so far for external clients made up 15 % of the total number of experiments. Of the over 40 institutes and companies involved, special mention should be made of the National Institute for Agricultural Quality Control, for whom the frost resistance of winter wheat and barley varieties and experimental lines has been tested each year since 1976 as part of the state variety trials. Experiments have also been set up for other institutes on several dozen other plants, including chamomile, hemp, rape, periwinkle, oyster mushrooms, tomatoes, soybeans, carnations, etc. Many scientists have made use of this opportunity and numerous papers in international and Hungarian journals, dissertations and patents have arisen from the experiments carried out in the phytotron.

PROTEIN MODELLING RESEARCH GROUP LABORATORY OF STRUCTURAL CHEMISTRY AND BIOLOGY



TYPE OF THE RI

Single sited

HOST INSTITUTION

Eötvös Lorand University -Department
of Chemistry

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2002 –

NATIONAL PARTNERS

- University of Debrecen (DE)
- University of Szeged (SZTE)
- Eötvös Lorand Research Network, Research Centre for Natural Sciences (ELKH TTK)
- Budapest University of Technology and Economics (BME)

INTERNATIONAL COLLABORATION WITH RIs

- H2020 - iNext: Infrastructure for NMR, EM and X-rays for Translational Research
- Bio-NMR: NMR for structural Biology
- East NMR

INSTITUTIONAL PARTNERS

- Sanofi
- Goethe University

PERSON IN CHARGE/CONTACT

András Perczel
perczel.andras@ttk.elte.hu

WEBSITE

<https://prot.chem.elte.hu/>

Description of the RI

Using both classical organic chemistry and modern bacterial expression systems we synthesize polypeptides, foldamers and proteins of various size and biological significance. Structure elucidation and internal dynamics of biomolecules are completed by X-ray and bioNMR spectroscopy, as well as molecular modeling, applied quantum chemistry and bioinformatics.

Activities and Services

We cooperate with both Hungarian and foreign research teams on subjects ranging from organic chemistry to molecular biology. We run several ELTE-based, joint research projects, even at the national level, such as MedInProt, HunProtExc, or the SynthPlusz Excellence Programs. Recently we are synthesizing amino acids derived from carbohydrates, determining conformational properties of beta amino acids, synthesizing foldamers, expressing Exenatide-4 analogs used to treat type II Diabetes Mellitus, and conducting research for a better understanding Alzheimer's and other conformational diseases. Furthermore, we work on the structure and dynamics of kRas signaling protein, which plays an important role in tumor diseases. Devoted students, postdocs and researchers interested in modern structural chemistry and biology are always welcome.



BIOBANK NETWORK - SEMMEWEIS UNIVERSITY

TYPE OF THE RI

Distributed

HOST INSTITUTION

Semmelweis University, Institute of Genomic Medicine and Rare Disorders

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2010 –

NATIONAL PARTNERS

- Research Centre for Natural Sciences, Eötvös Loránd Research Network
- University of Pécs, Szentágotai Research Centre (PTE)

INTERNATIONAL COLLABORATION WITH RIs

- BBMRI-ERIC
- ELIXIR

INSTITUTIONAL PARTNERS

- European Reference Network
- Leiden University Medical Center Leiden,
- Thomas Jefferson University
- University of Toronto, Canada
- University of Miami
- University of Siena
- University of Helsinki, Helsinki
- University of Basel
- EMBL Heidelberg
- Medical University of Vienna

PERSON IN CHARGE/CONTACT

Mária Judit Molnár, Head of Institute
molnar.mariajudit@med.semmelweis-univ.hu

WEBSITE

<https://semmelweis.hu/biobank/>

Description of the RI

Semmelweis University has been one of the leading biomedical institutions of higher education in Hungary and Central Europe for the last 250 years. The University today is handling 2.5 million patient visits each year within nearly 40 departments. Research, development, and innovation (R&D&I) take place in the areas of living natural sciences, and social sciences. Within these, life science R&D&I activities are the most prominent. R&D&I results quickly make their way into clinical and health sciences as well as into the University's educational activities and curriculum. The synergies also manifest themselves in the various specialized networks operating at the University (e.g. nanotechnology, bio-imaging, genomics, biobank), as well as in the research university modules (diagnostics, technology, therapy, prevention) and the dynamic collaborations which have been developing within these areas. The Semmelweis Biobank Network was established in 2010 with the goal of efficiently using the synergies that occur in patient care, education, research/development and a wide spectrum of health care areas all under University premises.

Activities and Services

The Biobank Network at Semmelweis University consists of 14 (26) institutes and 15 (27) biobanks. The aggregate sample size for these institutes currently stands circa 100.000, registering over 10 000 new samples annually. Sample types vary from DNA, RNA, tumor, muscle and nerve tissue, fibroblast and clinical data. Areas covered by the Biobank Network include: cardiology, neurology, psychiatry, hematology, nephrology, rheumatology, ophthalmology, endocrinology, dermatology. The University has a Rare Disease network with a large biobank. The most recent member of the network is the ONKOBANK collecting samples from 12 departments.

Samples from the Semmelweis Biobank Network have been used in over 60 research projects during the networks existence. A main strategic goal for Semmelweis University is to elevate the role of the Biobank Network both internally and externally. A key element in achieving this goal is successfully coordinating the establishment of the Hungarian National Node of the Biobanking and BioMolecular Resources Research Infrastructure ((BBMRI- ERIC) and joining as a full member. The University is also in pursuit of offering commercialized services based on the Biobank Network, tightening the relationship with other players from the biobanking field such as industry, biobankers and other private sector parties. Initiatives set in motion are all in hope of making significant contributions to biomedical research and to the evolution of new treatment methods.

TYPE OF THE RI

Single sited

HOST INSTITUTION

University of Debrecen
Faculty of Medicine
Department of Biochemistry & Molecular Biology

LOCATION OF THE RI

Debrecen

STATUS

Fully operational, 2005 –

NATIONAL PARTNERS

- Eötvös Loránd University
- Semmelweis University
- University of Pécs
- Biological Research Center Research Centre for Natural Sciences

INTERNATIONAL COLLABORATION WITH RIs

- ELIXIR Proteomics
- ELIXIR Community Implementation Study

INSTITUTIONAL PARTNERS

- University of North Texas
- University of Arizona
- The Scripps Research Institute
- Ghent University
- Mount Saint Mary College
- Thermo Fisher Scientific

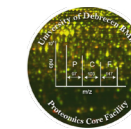
PERSON IN CHARGE/CONTACT

Éva Csósz, Associate Professor
cseva@med.unideb.hu

WEBSITE

<http://bmbi.med.unideb.hu/en/proteomics-core-facility>

UD BMBI PROTEOMICS CORE FACILITY



Description of the RI

The mission of the Proteomics Core Facility is to undertake research and to provide access to mass spectrometry-based technologies, two dimensional electrophoresis and chromatographic techniques to academic and industrial groups. The laboratory is deeply involved in proteomic and metabolomics method developments required by clinical research applications, basic-science or industry and provides state-of-the-art technologies.

Activities and Services

Examination of proteins and small molecules, application of data dependent and independent acquisition methods, targeted and shotgun analyses.

Major activities

- Protein identification using MS/MS-based sequencing
- Label-free protein quantification
- SRM or PRM-based quantification
- Examination of small molecules
- Examination of post-translational modifications
- Development and optimization of quantitative methods

TYPE OF THE RI

Distributed

HOST INSTITUTION

Institute for Computer Science and Control (SZTAKI), Machine Perception Research Laboratory (MPLab)

STATUS

Fully operational

NATIONAL PARTNERS

- National Laboratory for Autonomous Systems (NLAS)
- Hungarian Drone Coalition (HDC)

INTERNATIONAL COLLABORATION WITH INSTITUTIONAL PARTNERS

- Institut National de Recherche en Informatique et en Automatique (INRIA)
- University of Zurich (UZH)
- Czech Technical University (CTU)
- University of Konstanz (UoK)

PERSON IN CHARGE

Tamás Szirányi, Head of Research laboratory

CONTACT

András L. Majdik
Head of Robot Localization Group
majdik@sztaki.hu

WEBSITE

<https://www.sztaki.hu/tudomany/reszlegek/mplab>

Description of the RI

The network aims to research and develop new static and dynamic environmental sensing methods and tools for multi-sensor measurement environments and to demonstrate and apply these in applications addressing air and ground autonomous driving, traffic monitoring, remote sensing, smart city critical infrastructure monitoring, cultural heritage protection, ecology, earth observation, 3D urban reconstruction and medical fields.

The RI's measurement laboratory contains several different laser scanners, which enable one to scan both the static and the dynamic environment, and to detect, recognize and reconstruct various objects and events. The representation, interpretation, and visualization of the obtained 3D/4D models are cutting edge research tasks today, which can be targeted by the laboratory. Also, the RI is equipped with micro air vehicles and a motion capture system that enables the tracking of retroreflective markers with high precision and data rate. Therefore, the SZTAKI MIMO (Micro aerial vehicle and MOtion capture) arena is an ideal tool to record ground truth data to evaluate the performance of different on-board computer vision algorithms for ground and aerial mobile robots, e.g., visual odometry, 3D mapping, simultaneous localization and mapping, and tracking of objects.

The goal of the RI is the interpretation and organization of information coming from distributed multimodal sensors. Sensors can be dynamic or static imaging devices or other multimedia sources. The main challenge is to compare, evaluate, recognize, and classify spatial and temporal sequences of events by the means of machine learning, data mining, machine perception, optimization procedures and variation analysis.

Activities and Services

- 3D LiDAR and aerial survey and reconstruction, algorithmic point cloud and image processing
- Design of spatial artificial intelligence algorithms, software development, automatic interpretation of spatial data, sensor fusion, consulting
- Modeling, motion tracking and data analysis within the MIMO arena, hardware-software testing and evaluation
- Medical image segmentation, 3D organ reconstruction
- Automatic analysis of architectural and archaeological structures
- Earth observation tools to support transport and agriculture applications
- Environmental perception of autonomous driving

TYPE OF THE RI

Single sited

HOST INSTITUTION

Energy Research Centre, Institute for Technical Physics and Materials Science

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2018 –

NATIONAL PARTNERS

- WIGNER Research Centre for Physics (WIGNER)
- Budapest University of Technology and Economics (BME)
- University of Szeged (SzTE)
- Eötvös Loránd University (ELTE)

INTERNATIONAL COLLABORATION WITH INSTITUTIONAL PARTNERS

- CNR Institute for Microelectronics and Microsystems (CNR IMM)
- Jülich Forschungszentrum (FZJ)
- Linköping University (LiU)
- University of Thessaloniki

PERSON IN CHARGE/CONTACT

Béla Pécz, Institute Director
pecz.bela@ek-cer.hu

WEBSITE

<http://www.thinfilms.hu/fei/>

Description of the RI

New generation of aberration corrected electron microscope, the open laboratory of the Hungarian Materials Science. Sub-nanometer resolution in TEM imaging providing atomic arrangement and analytical (EDS) information on a few nanometer scale with the four EDS detectors built into the column. Elemental maps can be taken by EDS. Heating holder (with precise MEMS chip) and study of reactions inside the microscope. Helping the university teaching and partner in industrial development.

Activities and Services

Research of thin films exploring the growth mechanism and properties. Materials science analysis using transmission electron microscopy (TEM). Sample preparation, atomic resolution images with a resolution below 0.1 nm in TEM mode thanks to the spherical aberration corrector built in. Several detectors in Scanning Transmission Electron Microscopy mode for example giving images in which the contrast is proportional with the (square) atomic number Preparation of elemental maps taken by EDS detector based on characteristic X-Ray lines. Plan view and Cross sectional specimens, depth profiling. Determination of phases, failure analysis. Investigation of semiconductors, metals, insulators and alloys.

ATOMKI ACCELERATOR CENTRE



TYPE OF THE RI

Single sited

HOST INSTITUTION

Eötvös Loránd Research Network Institute
for Nuclear Research
Accelerator Centre

LOCATION OF THE RI

Debrecen

STATUS

Fully operational, 2009–

NATIONAL PARTNERS

- University of Debrecen, Debrecen
- Wigner Research Center, Budapest
- Eötvös Loránd University, Budapest

INTERNATIONAL COLLABORATION WITH RIs

- H2020 RADIATE
- H2020 EUROPLANET
- H2020 ChETEC-INFRA
- ISTR (International Society of Tracer and Radioisotope Applications)
- IAEA Nuclear Reaction Data Centers

INSTITUTIONAL PARTNERS

- Helmholtz-Zentrum Dresden-Rossendorf (HZDR)
- Laboratory for Underground Nuclear Astrophysics at Gran Sasso National Laboratories (LNGS/LUNA)
- University of Kent Canterbury
- International Atomic Energy Agency
- ISTR International Society of Tracer a Radioisotope Applications
- INFN (Istituto Nazionale di Fisica Nucleare)

PERSON IN CHARGE/CONTACT

Sándor Biri, Head of Unit
biri@atomki.hu

WEBSITE

<https://www.atomki.hu/>
<https://atomki.hu/en/departments/1/introduction>
<https://doi.org/10.1140/epjp/s13360-021-01219-z>

Description of the RI

The ATOMKI Accelerator Centre (Cyclotron, Tandatron, ECR ion source) is a world-class open-access research facility that provides outstanding opportunities for numerous research topics from nuclear and atomic physics through environmental and heritage science to nuclear and space technology applications. The laboratory astrophysics centre is already of European significance supported by the EU. It is the site of several IAEA and international RDI as well as research and cooperative PhD projects. Incorporated into the network of European Research Area acceleration centres, the planned developments will focus on low-energy accelerator tasks to expand irradiation capabilities and serve a wider range of users by developing beamlines, primarily to open up to space research and nuclear medicine. We continuously develop the irradiation and laboratory infrastructure in accordance with the quality assurance requirements. In addition to internal and domestic users, the Accelerator Centre is also one of several European research sites, in the form of Transnational Access (TA) type services. Our current partners are listed on the left panel (under International Collaboration), and there are several project proposals submitted and under consideration. To access ATOMKI accelerators, a beamtime application must be submitted to the local Program Advisory Committee (PAC). In the evaluation, the PAC will take into account the scientific aspects, technical and personnel conditions described in the application and will propose the projects to be supported, the level of support and the amount of beamtime.

Activities and Services

The ATOMKI Accelerator Centre, as a Research Infrastructure, offers accelerated particle beams, beamlines and end-stations for experiments. The available beams are positively charged ion beams, but fast neutron sources are also available. The particle types, energies and intensities cover a wide range, these are found on the webpages listed on the left panel. Our open access article, published in 2021, describes the technical data and ongoing research in detail with figures and tables.

BUDAPEST NEUTRON CENTRE



TYPE OF THE RI

Single sited

HOST INSTITUTION

Centre for Energy Research (EK)
Eötvös Loránd Research Network

LOCATION OF THE RI

Budapest, KFKI Campus

STATUS

Fully operational, 1993–

NATIONAL PARTNERS

- Budapest University of Technology and Economics (BME) Institute of Nuclear Techniques (NTI)
- Institute for Nuclear Research (ATOMKI)
- Wigner Research Centre for Physics (Wigner RCP)
- Research Centre for Natural Sciences, Institute of Materials and Environmental Chemistry
- Extreme Light Infrastructure (ELI)

INTERNATIONAL COLLABORATION WITH RIs

- CERIC-ERIC
- E-RIHS
- ESS
- Neutron source centres ILL, PSI, ISIS, FRM-II, NPI-Rze, FLNP-Dubna

ORGANISATIONS, INSTITUTIONS

- International Atomic Energy Agency (IAEA)
- OECD NEA
- EU JRC
- League of advanced European Neutron Sources (LENS)
- Lawrence Berkeley National Laboratory
- ETH Zürich
- Max-Planck-Institut für Festkörperphysik (Stuttgart)
- JINR-Dubna

PERSON IN CHARGE

Ákos Horváth, Director General
horvath.akos@ek-cer.hu

CONTACT

Tamás Belgya, director, deputy director-general
belgya.tamas@ek-cer.hu

WEBSITE

<https://www.bnc.hu/>

Description of the RI

Researchers at the Budapest Neutron Centre (BNC) perform basic and applied research to reveal the composition, structure, neutron activation, nuclear structure and radiation damage of a wide range of materials of our everyday life, using the neutron analytical, spectroscopic, and irradiation instrument suite installed at the Budapest Research Reactor (BRR).

The Research Infrastructure includes experimental stations that make use of the ten horizontal neutron beam-lines of the BRR, as well as the vertical irradiation channels located in the reactor core. A liquid hydrogen cold-neutron source, cooled with He, is inserted in one of the tangential channels, providing low-energy neutrons to seven measurement stations in the cold-neutron experimental hall via supermirror neutron guides. The other nine horizontal channels of BRR host six instruments, while several vertical irradiation channels are utilized for radiation damage studies and neutron activation analysis.

The measurement techniques can be classified according to the relevant spatial resolution. The macrostructure methods, e.g. the neutron/X-ray imaging, provides visual information about the structure on a 100 µm–10 cm scale. The microstructure techniques are based on neutron scattering, and relevant to a resolution scale of typically 1000–0.1 nm. Neutron diffraction, small-angle scattering, and inelastic scattering give insight into the structure and dynamics of nanostructure, macromolecular or atomic scale objects. Further, non-destructive elemental analysis can be performed by prompt-gamma and instrumental neutron activation analysis. For all methods, static and dynamic (in-situ) measurements are possible, where the time scale is limited by the intensity of the neutron beam.

Neutrons can penetrate deep into the material, this makes them adequate to determine the representative macro- and micro-structure of bulky materials, complementing the surface-targeted X-ray-based or electron microscopic techniques. Due to their 1/2 spin, neutrons provide a scarce technique to probe magnetic properties of materials. Neutrons are also indispensable in the detection of hydrogen and light elements.

Activities and Services

BNC offers free of charge, excellence-based research opportunity in multidisciplinary materials science using its neutron techniques. Scientists/users submitting outstanding research proposals relevant to priority topics of the national smart specialisation strategy, Horizon Europe, or other outstanding research fields are favoured to get beamtime, based on the assessment of an independent user selection panel. BNC provides several entry points through its user-access projects (BNC user access program, IPERON HS, ARIEL, GNeuS and CERIC-ERIC). The instrument scientists assist in the measurements, data evaluation and interpretation. BNC allocates 70% of measurement time for external measurement proposals and research projects. 30% is devoted to methodical developments, tech-transfer and training. BNC aims to conduct world-class basic and applied research and to offer R&I and quality-assurance solutions, as well as measurement services to its industrial partners (on contract/commercial basis). BNC researchers are also involved in the dissemination of research results, university education, PhD and specialisation training. They represent BNC and the Hungarian neutron community in domestic and international organizations.



TYPE OF THE RI

Single sited

HOST INSTITUTION

Budapest University of Technology and Economics

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 1934 –

NATIONAL PARTNERS

- University of Public Service
- University of Szeged
- Széchenyi István University
- University of Miskolc
- Institute for Computer Science and Control

INTERNATIONAL COLLABORATION WITH RIs

- Queen's University Belfast, Marine Research Group
- Technical University of Denmark (DTU), Department of Mechanical Engineering
- Chalmers University of Technology, Department of Mechanics and Maritime Sciences
- University of Twente, Faculty of Engineering Technology
- Trinity College Dublin, School of Engineering

INSTITUTIONAL PARTNERS

- Universidade de Lisboa, Instituto Superior Técnico
- Technische Universität Braunschweig
- Hong Kong University of Science and Technology
- Karlsruhe Institute of Technology

PERSON IN CHARGE/CONTACT

Csaba Horváth, Deputy Head of Department
horvath@ara.bme.hu

WEBSITE

www.ara.bme.hu

Description of the RI

The predecessor of the Department of Fluid Mechanics, the Institute of Aerodynamics, was established in 1934. The building of the Department was opened in 1938, and our largest wind tunnel was put into operation. The wind tunnel, which was initially used for aircraft research, still plays a major role in aerodynamic studies, pollutant dispersion and urban climate investigations, as well as many other research topics actively being pursued at the Department. Under the leadership of the former Heads of the Department, József Gruber, Tibor Szentmártony and Tamás Lajos, the Department's key areas of research have been: acoustics, aeroelasticity, atmospheric processes, environmental technology, flow control, fluid machinery, HVAC, and vehicle aerodynamics. The capacity and facilities of the Theodore von Kármán Wind Tunnel Laboratory provide unique wind tunnel and flow measurement opportunities in Hungary.

As a result of a continuous effort to further develop the Laboratory's equipment and capabilities, the members of the Department are able to actively participate in research collaborations and industrial R+D projects. Our state-of-the-art optical measurement tools, such as our LDA (Laser Doppler Anemometer) and PIV (Particle Image Velocimetry) measurement systems provide a means for carrying out accurate measurements in the case of complex fluid flow phenomena. Beside the aforementioned wind tunnel, the Laboratory is equipped with multiple smaller wind tunnels, which serve various specialized purposes, providing an easily configurable environment for fluid flow investigations. Another important state-of-the-art tool we utilize in our R+D activities is that of numerical investigations. Our Department utilizes Computational Fluid Dynamics (CFD) and Computational AeroAcoustics (CAA) tools in order to model complex phenomena.

In short, the role of the Department of Fluid Mechanics is to educate the engineers of tomorrow, carry out basic research, and to help the industry by carrying out R+D assignments with regard to gas, liquid, and vapor flow, including naturally occurring and industry-related flow phenomena and processes.

Activities and Services

As the Department has continuously grown and developed over the years, our scope of activities has also widened with regard to our research as well as industrial R+D. The staff of the Department aims to extend the capabilities of the Department even further by deepening our knowledge in other areas of fluid mechanics and numerical methods, utilizing the new knowledge in our research activities and strengthening our domestic as well as international collaborations. Some of these areas are the measurement and novel simulation of pollutant dispersion over urban areas, modeling of free surface flows in the development of wave energy converters, as well as the investigation and application of optimization techniques based on machine learning and artificial intelligence. In the case of numerical investigations, our department prefers the application of open source tools, which helps facilitate a trouble free cooperation as well as providing accessibility to our results on behalf of our partners.

As compared to other facilities in the region, the Laboratory is uniquely equipped and therefore regularly provides the needed facilities and equipment for investigating fluid flow problems and phenomena within the framework of domestic as well as international investigations.



TYPE OF THE RI

Single sited

HOST INSTITUTION

University of Debrecen
Faculty of Science and Technology

LOCATION OF THE RI

Debrecen

STATUS

Fully operational, 1981 –

NATIONAL PARTNERS

- ELTE, Budapest
- Pázmány Péter Catholic University
- Institute for Nuclear Research, Debrecen
- ELKH Biological Research Centre, Szeged
- University of Debrecen, Faculty of Medicine Department of Medical Chemistry

INTERNATIONAL COLLABORATION WITH RIs

- iNEXT (Infrastructure for NMR, EM and X-ray crystallography for translational research)
- CORBEL (Coordinated Research Infrastructures Building Enduring Life-science)
- INSTRUMENT ERIC

INSTITUTIONAL PARTNERS

- Karlsruher Institut für Technologie (KIT)
- Center for Cooperative Research in Biosciences, Division of Molecular Biology, Biocenter, Medical University of Innsbruck
- Gause Institute of New Antibiotics, Moscow
- Shanghai Institute of Materia Medica
- Ocean University of China

PERSON IN CHARGE

Katalin Kövér, Professor in Chemistry
kover@science.unideb.hu

CONTACT

Sándor Kéki, Professor in Chemistry
keki.sandor@science.unideb.hu

WEBSITE

https://debnmr.unideb.hu/
https://kemia.unideb.hu/hu/muszerpark-0

Description of the RI

The Research Infrastructure at the Institute of Chemistry, University of Debrecen is an inter- and multi-disciplinary core-center that supports research activities in diverse areas from chemistry, biology, biochemistry, medicine and material sciences to plastic industry. The state-of-the-art instruments installed in the Research Infrastructure extend the scope of academic and innovation research activities of the Institute of Chemistry and provide indispensable links between academic and industrial research. The pharmaceutical industry and R&D (e.g. TEVA, BorsodChem, GLYCOM, Richter) have established a solid and fruitful relationship with our research facility.

Activities and Services

The Bruker Avance NEO 700 MHz NMR spectrometer equipped with Prodigy TCI cryoprobe offers outstanding sensitivity and resolution, supporting research activities in diverse areas. The Research Infrastructure with the three other spectrometers (Bruker 360, 400, 500) offers a wide range of high resolution, multinuclear and multidimensional NMR measurements for structure determination and dynamics study of carbohydrates, peptides, proteins and other synthetic and natural products. The research team has special expertise in method development for sensitive and reliable measurement of important NMR parameters. The high resolution and high sensitivity mass spectrometers (Bruker maXis II ESI-QTOF-MS and Bruker Autoflex Speed MALDI-TOF-TOF MS) allow the determination of accurate molecular masses and structures of small to large (bio) molecules. The Bruker D8 Venture X-ray diffractometer allows the determination of the crystal and molecular structures of small molecules, metal complexes or even proteins.

Additional essential elements of the RI

- Infrastructure for designing, constructing and applying microfluidic chips (lab-on-a-chip systems).
- Capillary electrophoresis systems for proteomics, environmental and pharmaceutical analytic applications.
- QTOF mass spectrometer equipped with ESI, APPI, APCI, DART ion sources.
- Chromatographic systems, optical spectroscopy techniques, mechanical analyzers (DMA).



TYPE OF THE RI

Single sited

HOST INSTITUTION

Institute for Particle and Nuclear Physics,
Wigner Research Centre for Physics

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2012 –

NATIONAL PARTNERS

- Institute for Nuclear Research (ATOMKI)
- Centre for Energy Research (CER)
- Network of Hungarian Mössbauer Laboratories (NHML)
- Institute of Technical Physics and Materials Science, Centre for Energy Research (CER MFA)

INTERNATIONAL COLLABORATION WITH RIs

- EU-XFEL
- ELI-BEAMLINES
- ESRF
- SwissFEL (Switzerland's X-ray free-electron laser at the Paul Scherrer Institute)

INSTITUTIONAL PARTNERS

- Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II)
- Advanced Photon Source, Argonne National Laboratory
- SLAC National Accelerator Laboratory
- Dalian Institute of Chemical Physics, Chinese Academy of Sciences
- Technical University of Denmark (DTU)

PERSON IN CHARGE

Péter J. Lévai, Director General
wigner@wigner.hu

CONTACT

Edit Szilágyi, Head of Department
szilagyi.edit@wigner.hu

WEBSITE

wigner.hu/funmatlab

Description of the RI

Materials that know what to do

Functional materials are artificial, in most cases submicroscopic substances capable of solving certain prescribed tasks. Facilities of FunMatLab are used, in the first place, for preparing, characterizing and performing experiments with high-energy radiations (i.e., γ -photons and X-rays, neutrons and accelerated ions) on functional materials from which nanosized switching and storage units can be developed. Moreover, FunMatLab equipments are suitable for other purposes like investigating artifacts of cultural heritage, too.

FunMatLab is an open-access research infrastructure (RI) accessible to all scientists, developers and students worldwide.

Major FunMatLab facilities include

- a molecular beam epitaxy (MBE) equipment,
- a chemical technology and isotope laboratory,
- a heavy-ion implanter,
- a Van de Graaff accelerator with ion-beam analysis (IBA),
- a Mössbauer laboratory with spectrometers of various detection methods and sample environments,
- a polarized-beam neutron reflectometer (in collaboration with the CER),
- an X-ray optics development and high-resolution X-ray spectroscopy (XANES, EXAFS, and XES) laboratory,
- femtosecond-resolved pump-probe laser spectroscopy setups.

The latter facility includes transient optical absorption as well as time-resolved fluorescence and stimulated Raman scattering (fs-SRS) techniques (both under development). The X-ray and laser techniques have been developed since 2010 using an ERC grant and the national excellence programmes Momentum, VEKOP and NKP.

Most of the analytical methods are non-destructive preserving valuable samples. X-ray and Mössbauer methods have chemical sensitivity, the pump-probe techniques unveil details of ultrafast molecular dynamics, Mössbauer spectroscopy and neutron reflectometry have magnetic sensitivity, etc. Current research topics of groups recently using FunMatLab include studying ultrafast transitions in light-activated functional molecules, applying X-ray spectroscopy as probes with the final aim of developing smart materials of matching structure and function. FunMatLab facilities can be efficiently used for research related to various missions of the European Commission, most notably to Mission 4 having set the aim of building climate-neutral and smart cities.

Activities and Services

FunMatLab offers sample preparation and research services that serve as precondition of accessing numerous pan-European RIs such as ESRF, ESS and the EU-XFEL. Proposals can be submitted any time. In case of a positive outcome of the feasibility study, financial, cooperation and intellectual property conditions will be negotiated in line with public and transparent rules. FunMatLab encourages accessing the facilities in "smart-access" mode, i.e. with mail-in samples and, if possible, remote control by the user.



TYPE OF THE RI

Distributed

HOST INSTITUTION

Institute for Computer Science and Control
(SZTAKI)

STATUS

Fully operational

NATIONAL PARTNERS

BME (Budapest University of Technology and Economics)

INTERNATIONAL COLLABORATION WITH RIs

Pilot Factory of TU Wien

INSTITUTIONAL PARTNERS

Fraunhofer-Gesellschaft

PERSON IN CHARGE

József Váncza, Head of Laboratory, SZTAKI
Hassan Charaf, Head of Department, BME

CONTACT

János Nacsa, Senior Research Fellow
nacsa.janos@sztaki.hu

WEBSITE

<https://ipar40kutatas.hu/>
<http://www.ipar4.bme.hu/>

Description of the RI network

The infrastructure network consists of three research centres, two of which are operated by SZTAKI and one by BME. Locally, two are in Budapest and one in Győr. The focus and competence of the three centres complement each other synergistically. The SZTAKI's Industry 4.0 Centre of Excellence in Győr targets problems where the high-level basic research helps solving practical industry needs. Cyber-physical systems are computing structures that are intensively connected to the surrounding physical world and physical processes, and at the same time serve and utilize the data access and data processing services available on the Internet. The centre focuses primarily on robotic tasks. In 2022 it will be extended with sensor and robot technologies which on the one hand are essential to conduct research in human-robot collaboration and teamwork on the other hand, it opens the system to non-traditional robotic applications. The first example of this is the robot-supported experimental hydroponic plant fertilization system. The IoT capabilities of the pilot system are also developing to support the tracking and tracing of the objects of the production system (e.g., using advanced 5G technologies). The mission of the BME Industry 4.0 Technology Centre is to have as many modern and efficient companies using a wide range of Industry 4.0 technologies. To achieve this, it provides demonstration, education primarily to SME-s. The Centre operates more than twenty advanced solutions, on which the industrial application possibilities of several technology can be learned.

The SmartFactory is a compact, high-level but functional research and demonstration facility of SZTAKI which compresses a production site to the size of a single room and presents key physical and virtual processes of industrial manufacturing in a tangible, explorable way. In 2022 the SmartFactory will have a cyber-physical production and logistics pilot system with genuine decentralized intelligence and control. Hence, a fleet of small autonomous mobile robots will be added to the system, as well as the new version of the Manufacturing Execution System (MES) of SZTAKI which fully supports the orchestration of autonomous units. In parallel, all the developments are updated in the Digital Twin of the system.

Activities and Services

The Industry 4.0 Centre of Excellence provides essential infrastructure RDI services for collaborative and autonomous robotic applications, focusing primarily on logistics and assembly tasks. At the demonstrations of the Technology Centre, customers can learn about the possibilities of Industry4, SMEs can even test the solutions with their own data, but the equipment is also suitable for performing their own RDI tasks with the involvement of university lecturers and students.

SmartFactory, as an experimental cyber-physical manufacturing system, was created to model, demonstrate, and run industrial problems where Industry 4.0-related concepts can be tested with controlled implementation of real-world limitations and disruptions. Provision of a complex service planned primarily in the first two centres for the digitization development projects of Hungarian SMEs. As part of this, training, experimentation and testing opportunities will be provided to companies. Highlighted professional areas include industrial data collection, data processing and visualization, production scheduling and logistics, using state-of-the-art technologies such as MI, AR, VR. The internal coherence of the infrastructure network is a priority activity in 2022.

LABORATORY NETWORK OF MATERIAL DEVELOPMENT AND TECHNOLOGIES



TYPE OF THE RI

Distributed

HOST INSTITUTION

- University of Miskolc-Faculty of Mechanical Engineering and Informatics
- Faculty of Materials Science and Engineering
- Faculty of Earth Science and Engineering

STATUS

Fully operational

NATIONAL PARTNERS

University of Dunaujváros

PERSON IN CHARGE/CONTACT

Árpád Bence Palotás, Dean, Head of Institution
arpad.palotas@uni-miskolc.hu

WEBSITE

<https://www.uni-miskolc.hu>

Description of the RI network

The research infrastructure of the Laboratory Network of Material Development and Technologies is unique even at international level. The RI network unifies „state of the art” infrastructure and competences required for semi-industrial material development,- production- and examination techniques. The RI network offers possibilities to produce metallic materials starting from powders and melts. In case of powders, shaped components can be produced with 3D printing, while in the case of melts, with die or continuous casting. The upcoming shape giving can be realized with cold or hot rollings with the aid of a VonRoll roll stand, and forging. To set the required properties, heat treatments can be performed. New recipes can be established for PUR foams, final products can be manufactured using a PC controlled robot. The structure of the final products can be examined in 2 or 3 dimensions, from the macroscopic dimensions down to nanometer scale, with even nanometer resolution with the aid of a dual tube CT and scanning electron microscope. With the use of the Xe plasma beam integrated into the electron microscope, micromachinings can be realized, and the microstructure can be reconstructed in 3D through examinations of consecutive layers. The Gleeble thermo-mechanical physical simulator is a complex system that can faithfully reproduce material technologies under laboratory conditions. Besides, it creates the conditions of a real technology circumstances, the behaviour of the material or structure during operation can also be studied and the effects can be analysed together and separately. The RI network offers possibility to the physical modelling of fatigue processes of pressure vessels, and also, to reveal the explosion conditions of dusts. In addition, residual stresses can be measured in a non-destructive manner in the near surface regions of metallic components with even complex geometry, also with automated mapping and the depth profile of stresses can also be revealed.

Activities and Services

The RI actively participates in the gradual and post-gradual trainings of higher education. Within this, it supports the BSc and MSc graduations and obtaining PhD and DSc scientific degrees, strengthening the excellence of the host institute. It aids the realization of national and international scientific research projects. Through the high-quality publications connected to the conducted researches, the RI increases the international visibility of the host institute. It ensures accessibility to its competences for industrial members in the form of R&D activities or other forms. Through these, the RI produces own revenue and at the same time, it serves the scientific needs of the industrial area.

LABORATORY OF POLYMER ENGINEERING



TYPE OF THE RI

Single sited

HOST INSTITUTION

Faculty of Mechanical Engineering,
Budapest University of Technology
and Economics

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 1992 –

NATIONAL PARTNERS

- ELKH Research Centre for Natural Sciences
- ELKH Centre for Energy Research
- Furukawa Electric
- Institute of Technology Ltd.
- University of Győr, Audi Hungaria Faculty of Automotive Engineering
- Orthopedics Clinic, University of Debrecen
- Faculty of Chemical Technology and Biotechnology, Budapest University of Technology and Economics

INTERNATIONAL COLLABORATION WITH INSTITUTIONAL PARTNERS

- Imperial College London
- Ecole Polytechnique Federale de Lausanne
- University of Vienna
- Technical University of Denmark
- Katholieke Universiteit Leuven

PERSON IN CHARGE/CONTACT

Tamás Bárány, Head of Department
barany.tamas@gpk.bme.hu

WEBSITE

www.pt.bme.hu

Description of the RI

The Laboratory of Polymer Engineering is part of the Department of Polymer Engineering. For several decades, its staff has been involved in polymer engineering education, research, development, and innovation at the Faculty of Mechanical Engineering, Budapest University of Technology and Economics. They have achieved outstanding results in the processing technologies of both thermoplastic and cross-linked polymers and their composites, in the determination of rheological properties, optimization of processing parameters, simulation and modeling of technological processes, development of new materials, and design of new polymer products and molds. The Department has a well-equipped laboratory of 1500 square meters, with facilities that are outstanding even by international standards. The Department is committed to quality research and development and innovation, as evidenced by its ISO 9001:2015 and ISO 14001:2015 quality and environmental management system certification, which is unique among Hungarian university departments, and its status as a NAH-accredited testing laboratory.

The R&D and innovation activity of the Department of Polymer Engineering is reflected in the 20 national and international research projects currently in progress, as well as the 35 active PhD students. The scientific activities of the Department are also supported by two MTA research groups (MTA-BME Composite Technology Research Group, MTA-BME Lendület Lightweight Polymer Composites Research Group). The staff of the Department are authors of 40–50 scientific international journal articles per year. The Department publishes the international journal Express Polymer Letters (<http://www.expresspolymlett.com>) with an impact factor of 4.161 (2020). The Department of Polymer Technology places great emphasis on cooperation with national and international companies, as is demonstrated by the 40–50 successful expert and R&D collaboration projects with companies in the Department and its Laboratory every year.

The Department of Polymer Engineering pays special attention to the continuous development of its infrastructure, which is illustrated by the fact that several pieces of new and state-of-the-art technological and testing equipment are purchased every year, thanks in large part to grant funding. The equipment in the Laboratory of Polymer Engineering meets a wide range of small-scale expert and large-scale R&D needs in the plastics, composites and rubber industries.

Activities and Services

The Department of Polymer Engineering is involved in teaching, research, development and innovation in all aspects of polymer engineering. The Laboratory of Polymer Engineering has an outstanding range of machinery and equipment for the development, production and testing of polymers and their composites, complemented by a wide range of simulation tools. The wide range of technological equipment includes equipment for the production of raw materials (single and twin-screw extruders, internal mixers, etc.) and product manufacturing (extrusion, single and multi-component injection moulding, T-RTM, autoclave, additive manufacturing (3D printing), etc.), complemented by standard and custom-developed production molds for the equipment. The laboratory uses modern materials testing methods (static and dynamic mechanical, rheological, morphological, microscopic, metrological) to test raw materials and products. Standard tests, including those accredited by the NAH, are complemented by specific test methods developed in-house.

OPERATIONAL SAFETY LABORATORY



TYPE OF RI

Single sited

HOST INSTITUTION

Bay Zoltán Nonprofit Ltd. for Applied Research

LOCATION OF THE RI

Miskolctapolca

STATUS

Fully operational, 2004–

NATIONAL PARTNERS

- University of Miskolc (ME)
- ELKH Centre for Energy Research (ELKH EK)
- Veiki Energia+ Kft. (VEIKI)

INTERNATIONAL COLLABORATION WITH INSTITUTIONAL PARTNERS

- Joint Research Centre Petten (JRC)
- French Alternative Energies and Atomic Energy Commission (CEA)
- Montanuniversität Leoben (MU Leoben)
- VTT Research Centre (VTT)
- Framatome GmbH (Framatome)

PERSON IN CHARGE

Gyöngyvér BIRÓ, Thematic Area Director
gyongyver.biro@bayzoltan.hu

CONTACT

Szabolcs SZÁVAI, Head of Department
szabolcs.szavai@bayzoltan.hu

WEBSITE

<http://www.bayzoltan.hu/hu/laboratoriumok/mechanikai-anyagvizsgalo-laboratorium/>

<http://www.bayzoltan.hu/hu/laboratoriumok/szoftvercentrum/>

<http://www.bayzoltan.hu/hu/laboratoriumok/roncsolasmentes-vizsgalati-laboratorium/>

Description of the RI

The Operational Safety Laboratory intends to integrate testing and engineering modelling opportunities related to the operational safety of engineering structures, components and vehicles. It includes a wide range of mechanical, non-destructive, and structural testing, as well as engineering simulation and virtualisation methods. Thus the laboratory can provide special and complex services to industrial partners. In addition, we take part in international research and development projects.

The Laboratory focuses on three main research areas

The accredited Mechanical Testing Laboratory conducts standard and non-standard qualification-testing of base materials and products and other tests related to product and technology development, with a wide variety of mechanical, composition and structural testing included. In addition, the MTL develops methods and procedures for material-testing, and analyses failure processes of structural materials and complex failure cases.

The Digital Reality and Engineering Simulation Laboratory provides knowledge services which support the product- and technology development, offer expertise on the failure processes of engineering materials and operational safety issues. It integrates activities/capacities supporting by up-to-date information technologies, which leads over the whole development process in the virtual space. By means of up-to-date computer park and simulation software tools the optimisation of the production process and the product can be conducted, the differences between the real and test environment can be analysed, the realistic digital prototype can be made and the behaviour during the operation can be assessed. The Non-destructive Testing Laboratory deals with the application of different non-destructive testing methods, as well as with the development of NDT methods, analysis of the effectiveness of the testing methods by the means of modelling and elaboration of testing plans.

Activities and Services

Mechanical Testing Laboratory: tensile, compression, bending and biaxial testing–static and fatigue (specimen and component testing); biomechanical tests; fracture mechanics tests; tribological tests; impact tests; hardness tests; welding technology tests; structural, metallographic and composition tests; residual stress measurement; 3D optical strain measurement; strain measurement with strain gauges; temperature distribution measurement.

Digital Reality and Engineering Simulation Laboratory: simulation of metallic technologies (volumetric and sheet metal forming, welding, heat treatment–considering structural changes); simulation of polymer technologies (injection moulding, extrusion); product design and reliability analyses (i.e.: 2D and 3D modelling, motion simulation, elastic- and plastic deformation analysis, analysis of laminated composites and multi-phase composite materials, etc.–please see our website for a more detailed description).

Non-destructive Testing Laboratory: phase array and traditional ultrasonic test; eddy current testing; magnetic particle testing; wall thickness measurement; penetration test; simulation of UT test with CIVA software.

PISZKÉSTETŐ MOUNTAIN STATION OF THE KONKOLY OBSERVATORY



TYPE OF THE RI

Single sited

HOST INSTITUTION

Eötvös Loránd Research Network (ELKH),
Research Centre for Astronomy and Earth
Sciences, Konkoly Thege Mikós Astronomical
Institute

LOCATION OF THE RI

Mátrászentimre, Galyatető

STATUS

Fully operational, 1962–

NATIONAL PARTNERS

- ELTE Gothard Astrophysical Observatory
- SZTE Baja Observatory

INTERNATIONAL COLLABORATION WITH RIs

- European Southern Observatory (ESO)
- European Space Agency (ESA)

INSTITUTIONAL PARTNERS

- Instituto de Astrofísica de Andalucía
- Astronomical Observatory Institute, Faculty of Physics, A. Mickiewicz University
- European Space Agency
- University of Cambridge
- Gaia DPAC
- NASA/ESA-ULYSSES Consortium (approved large program for the Hubble Space Telescope)

PERSON IN CHARGE/CONTACT

Róbert Szabó, Director
szabo.robert@csfk.org

WEBSITE

<https://konkoly.hu/TAMOP/egesfold/Piszkesteto-web.pdf>

Description of the RI

The most important astronomical observatory in Hungary, hosting the largest telescopes of the country. (High-speed) photometry, and small and medium resolution spectroscopy are available. The Ritchey-Chrétien-Coudé telescope with 1m diameter main mirror was installed in 1975 and is the largest astronomical telescope of the country. Its focal length is 13.5 meters. The 10560x10560 pixel CCD-camera and the 3x3 degree field of view of the 60/90/180 cm Schmidt-camera is unique. Currently it is used to discover near-earth asteroids. A new 80 cm ASA robotic telescope was installed in 2018. Its main task is to discover and monitor astrophysical transient objects. All the telescopes can be operated remotely, while the software of the 80 cm telescope is able to automatically assemble the target list to be observe, and to update it dynamically. Our Fly's Eye system continuously monitors the whole visible sky with 19 cameras. The instruments contain a meteor camera system with a nation-wide coverage, and an ionosphere radar (located in Nagycenk).

The instruments and telescopes are operated by the astronomer on duty. Telescope time applications can be submitted three times a year. Telescope time is awarded in 1-week quanta, but certain objects requiring frequent monitoring for weeks-months, but with short individual exposures can also be accommodated (queue program).

Activities and Services

Activities: astronomical photometry, high-speed photometry, and spectroscopy. Photometry and spectroscopy of pulsating variable stars, eclipsing binaries active stars, exoplanets, and their host stars. Long-term monitoring of young stellar objects. Follow-up observations in international campaigns to aid space missions (Kepler/K2, TESS, Gaia, CHEOPS, Spitzer, etc.) Observing occultations of asteroids, discovery and monitoring of solar system objects, as well as astrophysical transients (novae, supernovae, gamma-ray bursts, etc.).

It is important to note that Piszkestető Observatory has a paramount role in training the new generations of astronomers and astrophysicists. Under the auspices of the research assistant program of the Astronomical Institute dozens of university students use the telescopes and instruments while working on a research project. We also offer hands-on laboratory courses for universities, supervision of BSc/MSc thesis programs and even practical training for high-school students who were selected to be members of the Hungarian team at the International Olympiad on Astronomy and Astrophysics.

TYPE OF THE RI

Distributed

HOST INSTITUTION

Széchenyi István University of Győr
Vehicle Industry Research Center

LOCATION OF THE RI

Győr

STATUS

Fully operational, 2012 –

NATIONAL PARTNERS

- Institute for Computer science and Control
- Budapest University of Technology and Economics
- Eötvös Loránd Research Network
- ZalaZONE Automotive Proving Ground

INTERNATIONAL COLLABORATION WITH RIs

- Massachusetts Institute of Technology (MIT)
- Motor Transport Institute (ITS)

INSTITUTIONAL PARTNERS

- Graz University of Technology (TU Graz)
- Vienna University of Technology (TU Wien)
- Technical University of Cluj-Napoca (TU Cluj Napoca)
- Brno University of Technology (TU Brno)
- Transilvania University of Brasov (UniTBv)

PERSON IN CHARGE/CONTACT

Ferenc Szauter, Head of Center
szauter@ga.sze.hu

WEBSITE

<https://jkk-web.sze.hu/>

Description of the RI

The Vehicle Industry Research Center is an independent competence center of the Széchenyi István University of Győr. Research areas cover mainly professional areas such as electromobility, self-driving vehicle control systems integrated into transport infrastructure, telecommunications, machine learning, environmental sensing, robotics, vehicle simulation, intelligent transport systems. Within the Vehicle Industry Research Center, five professional competence centers work together to achieve common research goals. In addition to research and development, the center places an outstanding emphasis on nurturing student talent, thus ensuring the continuity of researchers. As research mentors, our researchers support young talent at various national and international competitions and events.

Activities and Services

Our main research areas are the development and education issues of the autonomous transport systems and the understanding of the collaboration between people and vehicles. We expect fully automated transportation to be safe and suitable, so we are already preparing for the new technology of future by the researching of the autonomous vehicles. By the developments, we gain unique knowledge of informatics, mechatronics, robotics and artificial intelligence. We are working that the transport of future be uncompromising, safe and sustainable. The whole world is keenly interested in the alternative propulsion electric vehicles, so the e-Mobility Center of the Vehicle Industry Research Center of Széchenyi István University develop electric and other alternative propulsion systems. The Mobile-Robotics Center's researchers develop industrial, autonomous transportation, and cooperative systems. We apply the most recent scientific and technical results of our research field. We focus on developing algorithms and cyber-physical systems that are further usable in industrial digitalization, robotics, and autonomous vehicle control. Our primary research areas are IoT system integration, computer vision, machine-learning-based environment detection methods, and AI-based vehicle control. Furthermore, we also develop ground and aerial robotic and autonomous vehicle models for specific tasks. The coronavirus pandemic is a current example, that our lives, economy and health is really vulnerable, but natural or industrial disasters cause a similar situation. Moreover, the severity of the impacts of disasters is enhanced by the global-interconnection of the world. Artificial Intelligence systems, tools, algorithms are required to management and avoidment of the disasters. The research and development of artificial intelligence is a task and the solution will change our future and the Artificial Intelligence Center is working on that. The JKK-ZalaZONE Vehicle Industry Test Center includes activities related to research and development of autonomous vehicles in Zalaegerszeg. Our research engineers also have the opportunity to put the complex systems they design into practice, as the focus of the ZalaZONE Automotive Proving Ground is to provide a competitive environment for testing, validation and modern research and development.

TYPE OF THE RI

Distributed

HOST INSTITUTION

University of Debrecen
Faculty of Sciences and Technology

STATUS

Fully operational, 2005 –

NATIONAL PARTNERS

Institute for Nuclear Research (ATOMKI)

INTERNATIONAL COLLABORATION WITH RIs

HZB-BESSY (Helmholtz-Zentrum Berlin)

INSTITUTIONAL PARTNERS

- University of Stuttgart
- University of Rouen Normandy (URN)
- Ain Shams University (ASU)
- Leipzig University
- Interuniversity Microelectronics Center (IMEC)

PERSON IN CHARGE

Zoltán Erdélyi, Head of Department

CONTACT

Zoltán Erdélyi, Head of Department
zoltan.erdelyi@science.unideb.hu
Attila Csík
csik.attila@atomki.hu

WEBSITE

<https://akh.unideb.hu>

Description of the RI

The Materials Science Departments of the University of Debrecen (UD) and the Institute for Nuclear Research (ATOMKI) have a long history of cooperation spanning several decades. On these foundations, a research-industry cooperation base in materials science has been established and further developed as a research centre of excellence within the framework of a joint GINOP grant. The significant infrastructure development has resulted in the creation of a unique research facility in Eastern Hungary, with a nationally and internationally recognised infrastructure and knowledge base of unique importance, open to researchers, industrial partners and education.

The research groups working here have gained international reputations in the fabrication of thin films, multilayers, nanoparticles, membranes, shape memory alloys and other one-, two- and three-dimensional structures, in the study of their thermal properties and kinetic behaviour (stability, solid-state reactions, diffusion on the nanoscale), optical, optoelectronic, (photo)catalytic and other application-relevant properties. In addition to experimental studies, their activities extend to theoretical and computational modelling, thus completing the spectrum of scientific knowledge.

Through the activities of the partner institutions, a unique, coherent set of instruments has been created in Central-Eastern Europe that enables nanotechnology-level analysis and construction even on the atomic scale. The set of instruments provides a unique opportunity to fabricate and study (nano)structures for research and development purposes. It attracts national and international collaborators as an open access regional centre. Linked to the University of Debrecen, it provides educational functions and offers R&D support to large international companies in the region to solve manufacturing technology problems.

Activities and Services

Our laboratories offer a wide range of thin film deposition options for users, such as magnetron sputtering, thermal and plasma assisted atomic layer deposition (ALD, PE-ALD), evaporation. A range of furnaces provides the possibility to anneal samples under different atmospheres and vacuum (HV, UHV) to study the thermal stability of thin films, layer systems, atomic mobility processes or even the formation dynamics of different phases. Micro- and nanoscale sampling is performed with equipment such as scanning electron microscopes (SEM), one of which is equipped with a focused ion beam machining facility (FIB/SEM), and therefore also suitable for atomic- and nanoscale structure fabrication, a transmission electron microscope (TEM), a Raman microscope combined with an atomic force microscope, a spectroscopic ellipsometer, or a combined instrument capable of analysing samples in a common vacuum system by secondary neutral mass spectrometry (SNMS), X-ray photoelectron spectroscopy (XPS), low energy ion scattering (LEIS) and non-contact atomic force microscopy (nc-AFM). A modern thin-film X-ray facility is also available for structural analysis of samples.

UNIVERSITY OF SZEGED MATERIALS SCIENCE CORE FACILITY



TYPE OF THE RI

Single sited

HOST INSTITUTION

University of Szeged, Faculty of Science and Informatics

LOCATION OF THE RI

Szeged

STATUS

Fully operational, 2017–

NATIONAL PARTNERS

- ELKH-ATOMKI
- ELI-ALPS

INTERNATIONAL COLLABORATION WITH RIs

- ELI-ERIC
- LaserLab Europe
- Central European Institute of Technology

INSTITUTIONAL PARTNERS

- University of Notre Dame
- University of California Irvine
- Delft University of Technology
- University of Erlangen-Nürnberg
- University of California Berkeley

PERSON IN CHARGE

Dániel Sebők, Coordinator
sebokd@chem.u-szeged.hu

CONTACT

Zoltán Kónya
Vice Rector for Science and Innovation
konya@chem.u-szeged.hu

WEBSITE

<http://matsci.chem.u-szeged.hu/mtrs/>

Description of the RI

The aim of the SZTE Materials Science Core Facility is to provide a unique set of instruments that provides information from the nanoscale (e.g., electron microscopes, nano-CT) through micro-macroscale (e.g., spectroscopic and surface science methods) to practical applications (in operando procedures, catalytic and electrochemical test stations). The studied applications of the investigated materials cover a wide range of green and sustainable industrial technologies.

Most important devices

- Atomic Layer Deposition (ALD) instrument, in a cleanroom area
- 2 high-resolution scanning electron microscopes with elemental analytical detector
- 1 high-resolution transmission electron microscope (+2 more in progress) with elemental analysis detector and fast digital camera
- For electron microscopy sample preparation: Ultramicrotome with freezing pad and ion beam electron microscopy sample preparation and processing equipment
- In situ electrochemical and catalytic reaction cells for transmission electron microscopy
- X-ray and UV photoelectron spectroscopy (XPS/UPS) equipment
- NanoCT tomography equipment
- X-ray diffraction equipment
- Infrared and Raman spectroscopic microscopes with in situ catalytic and electrochemical cells
- Unit for Vibration Circular Dichroism (VCD) and Polarization Modulated Infrared Reflection (PM-IRRAS) measurements for FT-IR spectrometer
- Catalytic and electrochemical reactors connected by in-line product analysis

Activities and Services

The use of the Research is diverse. In the case of users outside SZTE, it is possible (i) within the framework of collaborative research, (ii) the user can use the equipment himself/herself after appropriate training (in the case of simpler devices), while in the case of high-complexity devices, the measurements can be performed with the help of colleagues from the Core Facility. Routine measurements are performed in the form of payroll measurements with the help of our operators.

VESZTERGOMBI LABORATORY FOR HIGH ENERGY PHYSICS (VLAB)

TYPE OF THE RI

Single sited

HOST INSTITUTION

Wigner Research Centre, Institute for Particle and Nuclear Physics

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2017–

NATIONAL PARTNERS

- University of Miskolc
- ATOMKI
- Eötvös University
- University of Debrecen

INTERNATIONAL COLLABORATION WITH RIs

- CERN, High Luminosity LHC Project
- GSI/FAIR
- INR
- EGO VIRGO
- CAS IMP

INSTITUTIONAL PARTNERS

- CERN
- University of Tokyo
- EGO

PERSON IN CHARGE

Péter J. Lévai, Director General
wigner@wigner.hu

CONTACT

Ferenc Siklér, Department Head
sikler.ferenc@wigner.hu

WEBSITE

<https://wigner.hu/vlab>

Description of the RI

The Vesztergombi High Energy Laboratory (VLAB) was created by the need for competitive participation in national and international experimental particle and nuclear physics research. It aims to provide an opportunity to develop instruments related to high-energy physics, implement innovation steps, and build specific detector elements. The VLAB cooperates with several research groups, provides the development background for H2020/Horizon Europe as well as domestically funded projects. The subunits of the laboratory are: silicon-based (semiconductor) tracking development laboratory, gas-filled tracking laboratory, data reading developments, superconducting magnet laboratory, underground laboratory (up to 30 m depth at the KFKI campus, and an external site 80 m below the surface). The infrastructure has two clean rooms (ISO6), a vacuum impregnator and winding machine for superconducting technology, the instrumentation needed for general detector development (power supplies, readout systems), and an HPGe detector is also available.

The VLAB was established in 2017 by merging the Innovative Detector Development “Momentum” research group and the semiconductor, tracking and superconducting magnet development laboratories at the Wigner Research Centre for Physics. It was named after György Vesztergombi (1943–2016), a particle physicist, the founder of Hungarian experimental research related to CERN. Today, the instrument development needs of large international collaborations in the fields of particle physics, nuclear physics, and astroparticle physics overlap to a large extent: they can be optimally served by a common research and development infrastructure. This recognition led to the creation of the VLAB, the integration of the institute laboratories that had been operating separately until then. This way, serving external partners has become more efficient and successful at the same time.

Activities and Services

The VLAB runs a broad range of activities in experimental high energy physics, including design, development, construction, calibration, signal readout and data analysis. Besides hosting groups at Wigner RCP, the infrastructure welcomes external proposals which can be completed after scientific and financial evaluation. The infrastructure offers expert personnel help as well as practical solutions, and access to services such as professional workshop and clean room facilities, DAQ systems which are compatible with most of the existing large scale laboratories, including CERN, GSI/FAIR, ESS and JINR. The VLAB activities directly contribute to CERN CMS, ALICE, NA61 and RD51 collaborations. The superconducting magnet laboratory concentrates on the design, construction and evaluation of cutting edge configurations of specific new magnet topologies. The VLAB facilities can be used efficiently for research activities related to various Horizon Europe missions, as well as other national and international research and development projects.



TYPE OF THE RI

Single sited

HOST INSTITUTION

Wigner Research Centre for Physics, Institute for Solid-State Physics and Optics

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2014–

NATIONAL PARTNERS

- ELI-HU Non-Profit Ltd.
- Centre for Energy Research, ELKH

INTERNATIONAL COLLABORATION WITH RIs

- Laserlab Europe
- ELI-ERIC

INSTITUTIONAL PARTNERS

- University of Birmingham
- Max Planck Institute for Neurobiology
- Rudjer Boskovic Institute, Zagreb
- Kassel University
- Ludwig Maximilian University
- University of Graz, Austria

PERSON IN CHARGE

Péter J. Lévai
Director general
wigner@wigner.hu

CONTACT

Péter Dombi, Deputy Director of the Institute for Solid-State Physics and Optics
dombi.peter@wigner.hu

WEBSITE

<https://wigner.hu/lasercenter/>

Description of the RI

The mission of the Wigner Laser and Spectroscopy Centre is to provide external partners with state-of-the-art femtosecond laser, ultrafast science and spectroscopy equipment in Budapest. With several infrastructural developments realized in our laboratories since 2012, we offer a unique combination of equipment for the science of light and its broad applications in physics, chemistry and biology.

Accessible instruments

- 5 fs/2.5 nJ/80 MHz Ti:sapphire oscillator with carrier-envelope phase stabilization (Venteon GmbH)
- 35 fs/7 mJ/1 kHz regenerative Ti:sapphire amplifier & OPA (350 nm–12000 nm, Newport-Spectra Physics)
- 35 fs/0.4 mJ/10 kHz/35 fs regenerative Ti:sapphire amplifier & OPA (350 nm–4000 nm, Coherent Inc.)
- 260 nJ/3.6 MHz/60 fs long-cavity Ti:sapphire oscillator (home-built)
- Time-of-flight electron spectrometers (Kaesdorf GmbH)
- Hemispheric electron spectrometer (Specs GmbH)
- Retarding field electron spectrometer (home-built)
- Ultrabroadband pulse diagnostics (FROGs and autocorrelators down to 5 fs pulses)
- Micro-Raman spectrometer with mapping resolution 100 nm, 325/532/633/785 nm excitation (Renishaw in Via)
- Femtosecond scanning stimulated Raman microscope (with Coherent Chameleon laser tunable between 750 and 1100 nm, 500 nm resolution)
- Fluorimeter with double monochromator with 250–500 nm excitation, 290–800 nm emission (Jobin Yvon Fluorolog FL322)

Activities and Services

Interaction of femtosecond laser pulse with different media enable several physics, chemistry and materials science research lines, including photoinduced chemical reactions, nanoparticle production and optical circuitry, to name a few. In addition, the micro-Raman spectrometer and the scanning stimulated Raman microscope can be used to determine composition, bonding configuration and other properties of liquid and solid (including biological) samples with sub-micrometer resolution and mapping. User services include laser beam delivery to a user-defined target, operation of lasers, auxiliary infrastructure and spectroscopic measurements on samples delivered by external partners and if necessary, SEM imaging services.



TYPE OF THE RI

Single sited

HOST INSTITUTION

Databank of Centre for Economic and Regional Studies

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2005–

NATIONAL PARTNERS

- Hungarian Central Statistical Office
- Centre for Social Sciences
- Corvinus University Budapest
- TÁRKI Zrt. Databank
- SZTAKI Institute for Computer Science and Control

INTERNATIONAL COLLABORATION WITH RIs

Global Labor Organization

INSTITUTIONAL PARTNERS

- Duke University
- University College London
- Harvard University
- KU Leuven
- British Columbia University

PERSON IN CHARGE/CONTACT

János Köllő, Head of the Databank
kollo.janos@krtk.hu

WEBSITE

<https://adatbank.krtk.mta.hu/en/>

Description of the RI

The KRTK Databank maintains the largest collection of social and economic micro data sets in Hungary, ready for analysis. Its purpose is not to serve particular research projects but to enable a research environment and data background where the most diverse researches and analysis can be carried out in accordance with international standards. Building on these data collection, there have been more than 700 publications, 107 dissertations and numerous policy impact assessments in the past fifteen years. The number of data requests is beyond one thousand and the number of sessions in the CSO-KRTK Research Room is beyond ten thousands. Access to data is regulated in the contracts agreed with primer data owners.

Activities and Services

Acquiring databases, harmonization

Researches that meet current standards are those that use longitudinal data covering long time periods. It requires the harmonization of the purchased databases; including correction for code changes and the creation of compromising code sets. The KRTK Databank provides researchers with ready-to-use databases.

Building databases

The KRTK Databank has built three large panel datasets so far, including individual, employment, educational and health data, by linking public administrative registers. The third administrative panel (Admin3) follows five million individuals on a monthly basis between 2003 and 2017. In addition to KRTK researchers, their co-authors and students, these data can be used by outside researchers as well.

CSO-KRTK Research Room

Enables researchers to use comprehensive, linkable datasets under remote control; datasets contain individual and enterprise-level data dating back to 1970.

KRTK Dataroom

Started operating in 2021; researchers can analyze data in a way that meets the requirements of leading international journals in terms of research ethics and principles of data usage

Laboratory

Established in 2018 with 40 end-points for conducting social science experiments.

Stata course and Internship

Young researchers are offered internship where they can learn how to use Stata and are given the opportunity to participate in ongoing research projects

Big Data

In 2021, the KRTK Databank has expanded with a Social Science Computing Group which uses Big Data methods for data collection and creates researchable datasets.

EUROPEAN SOCIAL SURVEY, EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM (ESS ERIC)



TYPE OF THE RI

Virtual

HOST INSTITUTION

Center for Social Sciences

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2001–

NATIONAL PARTNERS

- Eötvös Loránd University (ELTE), Social Science Faculty
- University of Pécs (PTE), Social Science Faculty
- University of Debrecen (DE), Social Science Faculty
- Semmelweis University (SE), Institute of Mental Health

INTERNATIONAL COLLABORATION WITH RIs

- European Social Survey
- SHARE ERIC
- H2020 (SUSTAIN-2)
- European Value Survey

INSTITUTIONAL PARTNERS

- City University of London (UK)
- GESIS-Leibniz Institute for the Social Sciences (Germany)
- NSD-Norwegian Centre for Research Data (Norway)
- SCP-The Netherlands Institute for Social Research (Netherlands)
- Universitat Pompeu Fabra (Spain)
- University of Essex (UK)

PERSON IN CHARGE

Bence Ságvári, National Coordinator
Vera Messing, Principal Researcher

CONTACT

messaging.vera@tk.hu
sagvari.bence@tk.hu

WEBSITE

<https://tk.hu/european-social-survey-ess>

Description of the RI

The ESS HUB is the Hungarian partner of the European Social Survey, European Research Infrastructure Consortium (ERIC). Hungary has been part of ESS since its inception in 2001 and has participated in all 10 survey rounds since then. The ESS provides a unique resource for mapping European societies, comparing countries, groups of countries or regions and studying changes over time. Insights from ESS could contribute to understanding the changes of European societies. For social scientists of the CEE region, ESS is particularly valuable as it allows comparison of the region with other regions of the EU and provides rich data for understanding social processes of transitioning.

The greatest value of ESS is its high quality: all steps of the survey, including sampling, construction and translation of questionnaires, control of fieldwork and documentation of the whole process follow the strictest quality standards. Participating countries adhere to the same methodological standards and processes, so that data collected in over thirty countries remain comparable across countries and over time. The survey includes core and rotating questionnaire modules. The core questionnaire modules are repeated every other year and provide a time-series comparison of the main socio-economic characteristics of societies, public attitudes, well-being and happiness, or basic human values. The rotating modules, on the other hand, examine more acute issues such as attitudes to climate change, the welfare state, health behavior or the timing of life - to name but a few. The ESS received several honorable recognitions in the social sciences: it was awarded the Decartes Prize in 2005 and the LPV prize by the American Political Science Association in 2020.

Activities and services

The main task of ESS is to produce comparative survey data on European societies and social attitudes in 30 countries. The ESS and its Hungarian partner are also a center for methodological innovation in Europe. It develops and tests alternative survey methods and their reliability and cross-national comparability. Currently, Hungary is involved in three innovative research projects: SUSTAIN-2 (H2020 project), alternative survey methods in the wake of the COVID -19 pandemic (Push-to-Web); cognitive interviewing of R11 rotating module questionnaires.

The data from ESS is a public good, meaning it is accessible to everyone and free of charge. More than 184 thousand people have registered to use the data worldwide, including 3100 users in Hungary. The vast majority of Hungarian users are university students (more than two thirds study at the MA and BA levels and 15% are PhD students), faculty and researchers.

An important goal of ESS HUB Hungary is to initiate academic discourse in the social sciences; it organizes annual conferences (an international conference is held every other year). With similar frequency, it initiates and edits a journal special issues. Worldwide, more than 2700 publications have used the data of ESS (more than half of them in academic journals with IF) and the contribution to international and local publications authored by Hungarian authors is also significant (over 150). Through regular lecture series the ESS HUB aims to support the information about and use of ESS data and the research infrastructure in higher education.

HUNCLARIN



TYPE OF THE RI

Distributed

HOST INSTITUTION

Hungarian Research Centre for Linguistics
Institution of Language Technology and Applied Linguistics

LOCATION OF THE RI

Budapest

STATUS

Partially operational, 2016–

NATIONAL PARTNERS

- Department of Telecommunications and Media Informatics, Budapest University of Technology and Economics
- University of Szeged
- MorphoLogic Ltd
- ELKH Research Centre for Natural Sciences
- Institute for Computer Science and Control

INTERNATIONAL COLLABORATION WITH RIs

CLARIN ERIC

INSTITUTIONAL PARTNERS

- Leibniz Institut für Deutsche Sprache (IDS)
- Jožef Stefan Institute
- University of Zagreb, Faculty of Humanities and Social Sciences
- Institutul de Cercetări pentru Inteligența Artificială
- Institute for Bulgarian Language “Prof. Lyubomir Andreychin”

PERSON IN CHARGE

Tamás Váradi, Head of Institute
varadi.tamas@nytud.hu

CONTACT

Kinga Jelencsik-Mátyus
matyus.kinga@nytud.hu

WEBSITE

<http://clarin.hu/>

Description of the RI

HunCLARIN is the research infrastructure network of the most prominent knowledge centres in the field of language and speech technology research and development in Hungary. Its aim is to support research and innovation mainly in the humanities and social sciences with providing LT resources and tools. At present the HunCLARIN consortium has 9 members (coordinator plus 8 partners), representing the leading centres of Hungarian speech- and language technology research. The coordinator of the infrastructure network is the Hungarian Research Centre for Linguistics, which was one of the founding members of the European CLARIN project, and also played a prominent role in the preparatory phase of CLARIN. Using the LT resources (eg. mono- or multilingual, as well as domain-specific corpora) and tools (eg. morphological analyzers) developed by the member organizations of HunCLARIN makes content analysis of large corpora, or automatic description of psychological layers of meaning possible.

Outstanding projects like the language-based program for monitoring psychological status of the astronauts of the European Space Agency, or the proofing tools built in the text editors show the high standard of the RIs in HunCLARIN. The aim of HunCLARIN is to support scientific research by making all digital language resources and tools easily accessible. A prerequisite for this is to create a single sign-on online environment, and its technical background, that makes all the RIs in the group, and in the whole CLARIN network, in different languages easily available and comparable. This would connect Hungarian speech and language technology to the high-level European research and development—as for several European CLARIN members, tools and resources from different centres are already interoperable.

Activities and Services

HunCLARIN Roadshows: HunCLARIN devised the concept of a Roadshow series that is based on the idea of proactively (and literally) bringing language technology to where humanities research is actually done, namely, to Hungarian universities. The other key concept behind the Roadshows is that instead of a one-sided evangelisation of language technology, the workshop should mobilise and showcase local initiatives (workshops so far: Szeged, Debrecen, Pécs).

Web-service of key Hungarian resources and tools: e-magyar (e-Hungarian). The toolchain was developed in 2016. The rationale for it was based on a clear vision of an open, modular, extendable and easy-to-use pipeline for Hungarian, which was suitable for non-specialists and developers alike.

Corpora: Multimodal HuComTech Corpus, Hungarian Webcorpus, Hungarian National Corpus, 4lang, Hungarian Generative Diachronic Syntax etc.

Language technology tools: Hunalign, Hunmorph, HunToken, MetaMorpho, Hungarian Nooj, Mazsola, magyarlanc etc.

TYPE OF THE RI

Single sited

HOST INSTITUTION

Institute for Nuclear Research (ATOMKI)

LOCATION OF THE RI

Debrecen

STATUS

Fully operational, 2019 –

NATIONAL PARTNERS

- Centre for Energy Research
- Wigner Research Centre for Physics
- Isotoptech Zrt.
- University of Debrecen

INTERNATIONAL COLLABORATION WITH RIs

- E-RIHS: European Research Infrastructure for Heritage Science

INSTITUTIONAL PARTNERS

- Consiglio Nazionale delle Ricerche (CNR)
- Centre de Recherche et de Restauration des Musées de France (C2RMF)
- IAEA
- Ancient Materials Research Platform (IPANEMA)
- ETH Zürich

PERSON IN CHARGE

Zsolt Dombrádi, Director of ATOMKI
director@atomki.hu

CONTACT

Zita Szikszai, Head of Laboratory
szikszai.zita@atomki.hu

WEBSITE

<https://hslab.atomki.hu/>

Description of the RI

The Laboratory for Heritage Science provides information on the structure, material composition and age of archaeological and museum objects over a wide range of scales, using scientific methods, dating, and equipment that allows non-destructive material analysis at microscopic level. It offers research opportunities for national museums, archaeologists, university research groups and international partners. Node of the E-RIHS European strategic infrastructure.

The Laboratory for Heritage Science consists of various analytical equipment, and it is also in close collaboration with the carbon dating facility located at ATOMKI premises. An ion beam analytical set-up, installed at one of the beamlines of the ATOMKI Tandatron accelerator, serves to determine the concentration and distribution of elements both in vacuum and in-air (for larger or sensitive artefacts) with high lateral resolution. Elemental analysis and mapping can also be carried out with a micro-XRF device. Besides more traditional techniques, a digital 3D microscope, which yields quantitative information about the structure of the objects in addition to the excellent image quality, is also available for optical imaging. A variable pressure scanning electron microscope (SEM) with analytical modalities is also at disposal. This instrumentation is fitted with a Raman microscope to identify compounds and mineral phases and is able to function as an integrated SEM-Raman microscope.

Activities and Services

All the listed techniques are non-destructive and are offered for interdisciplinary research. Projects from national partners (museums, universities, research institutions) are carried out within various frameworks, especially within the E RIHS.hu initiative. The laboratory provides trans-national access to the ion beam analytical facility within the EU H2020 IPERION HS (Integrated Platforms for the European Research Infrastructure on Heritage Science) programme and participates in joint research activities, as well. The Laboratory for Heritage Science is also active in higher education and science promotion.

TYPE OF THE RI

Single sited

HOST INSTITUTION

Centre for Social Sciences (CSS)

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2009 –

NATIONAL PARTNERS

- Hungarian National Node of the RDA (HRDA)
- Artificial Intelligence National Laboratory (MILAB)
- Centre for Linguistic Research
- Institute for Computer Science and Control (SZTAKI)
- TÁRKI Social Research Institute
- Vera és Donald Blinken Open Society Archives (OSA)

INTERNATIONAL COLLABORATION WITH RIs

- Consortium of European Social Science Data Archives (CESSDA) ERIC
- European Open Science Cloud (EOSC)
- Research Data Alliance of Europe (RDA)

INSTITUTIONAL PARTNERS

UK Data Service (UKDS)

PERSON IN CHARGE/CONTACT

Judit Gárdos, Head of Centre
gardos.judit@tk.hu

WEBSITE

<https://kdk.tk.hu>
<https://20szazadhangja.tk.hu>

REPOSITORY SITES

<https://openarchive.tk.hu>
<https://voices.tk.mta.hu>

Description of the RI

The Research Documentation Centre (RDC) at the Centre for Social Sciences (CSS), has been operating since 2013. It provides research data and other research documentation of researches conducted in the four institutes (Institute for Legal Studies, Institute for Minority Studies, Institute for Political Science, Institute for Sociology) of the CSS.

The RDC also runs the Voices of the 20th Century Archive and Research Group, which has been operating since 2009. It collects the heritage of Hungarian qualitative social research; in total, collections from all areas of Hungarian social science of the past 60 years can be researched at the RDC. In the two archives, many important 20th and 21st century collections of qualitative and quantitative Hungarian sociological research are available digitally and partly physically: thousands of documents, audio and transcribed interviews, films, photos, drawings, questionnaire surveys, etc.

Meta- and paradata on the data and documentation held in the collections are accessible to anyone, providing information on research projects and topics, research participants and other basic data. Some of our collections are available to the public without registration, while other collections and research materials require registration. Users can also find online information about our other current news, events, projects, publications presenting or using our collections, conferences and book launches, as well as links to the two social network sites of the RDC and the Voices of the 20th Century Archive (facebook.com/voicesofthe20thcentury; facebook.com/tkkdk).

Activities and Services

A number of fully public research collections are available in the RDC repository. Some collections are accessible only to researchers of the CSS, but can also be used by external researchers with registration.

Registration can be requested by e-mail: kdk@tk.hu

The Voices of the 20th Century Archive and Research Group handles a wide range of personal data, so its research collections are only accessible with user declaration. Detailed information on the activities and use of the Voices of 20th Century Archive can be found at our websites, which also provides information on the qualitative research collections available in the online repository. The sub-page “Qualitative collections” presents the careers of scholars who have regularly used qualitative methods in their social science research. The site also features three flagship projects (Children’s Drawings, RESCAPE, Fairy Tale Forest), which provide examples of how the collections can be processed - giving researchers ideas for the secondary analysis and use of the resources available.

The RDC is also one of the main Hungarian centres for social science research data management in Hungary, providing professional advice on research data management, data protection regulations, GDPR regulations, and provides advice and documents required for compliance. RDC uses Artificial Intelligence to develop its search and data visualisation services, and collaborates with the domestic research data communities on a number of other projects.

TÁRKI DATA ARCHIVE



TYPE OF THE RI

Single sited

HOST INSTITUTION

Tarki Foundation

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 1985 –

NATIONAL PARTNERS

- Databank of the Center for Economic and Regional Studies
- Centre for Social Sciences Research Documentation Centre
- Voices of the 20th Century Archive and Research Group

INTERNATIONAL COLLABORATION WITH RIs

CESSDA ERIC

INSTITUTIONAL PARTNERS

- CESSDA ERIC
- GESIS
- AUSSDA
- CSDA

PERSON IN CHARGE

Béla Janky, Chairman
TÁRKI Foundation

CONTACT

Peter Hegedűs, Head of Services
peter.hegedus@tarki.hu

WEBSITE

adatbank.tarki.hu

Description of the RI

Function of the TÁRKI Data Archive

Long-term preservation of digital research datasets from domestic and international studies; keeping pace with technological change and participation in the development of data archiving standards; providing access to data collections of empirical studies for users communities; facilitating effective data use by providing access to our own and to our partners' collections.

Activities and Services

Operated by the Tárki Foundation, the Data Archive provides free access to archived data on social sciences for national and international research communities. We strive to be up-to-date on new data archiving technologies and we moreover aim to enhance cost-effective social research by enabling secondary analyses, to develop the Hungarian research infrastructure, and to support researchers by our databank services.

Within its public interest activities, the Tárki Foundation provides free access to the databases in the Tárki Data Archive for Hungarian university students and professors and research institutions. Due to its countywide network, the Data Archive has strong connections with social science faculties in Budapest and in the countryside. Therefore, the databases help educational and research institutions all over the country.

The Data Archive collects and stores databases on empirical social science researches. Most of the data result from surveys but other type of data, such as historical statistics or census data can also be found in it. They are stored digitally, in SPSS format, but they can be requested in other formats as well. Data that contain personal information are anonymized.

The Tárki Data Archive acquires databases through international research and data exchange programs. It is a member of diverse database organizations (as the Interuniversity Consortium for Political and Social Research, ICPSR). These international data are accessible to the Hungarian users through our Data Archive. Moreover, numerous Hungarian data of international researches (as the International Social Survey Programme (ISSP); the European Social Survey (ESS)) are accessible in it as well and we offer help to access various international databanks.

ELKH CLOUD



TYPE OF THE RI

Distributed

HOST INSTITUTION

Eötvös Loránd Research Network (ELKH)
SZTAKI and Wigner FK

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2016 –

NATIONAL PARTNERS

- ELKH member institutes
- National Laboratories (MILAB, ARNL)
- Collaboration with universities

INTERNATIONAL COLLABORATION WITH RIs

- SLICES ESFRI
- EOSC
- EGI-ACE

INSTITUTIONAL PARTNERS

- EGI Foundation
- Sorbonne Université

PERSON IN CHARGE

Róbert Lovas PhD, Project Director
robert.lovas@sztaki.hu

CONTACT

Prof. Péter Kacsuk, Technical Manager
info@science-cloud.hu

WEBSITE

http://science-cloud.hu

Description of the RI

ELKH Cloud, the cloud computing system of the Eötvös Loránd Research Network (ELKH) is one of the largest general-purpose research infrastructures in Hungary. The Hungarian Academy of Sciences initiated the development of the cloud in 2016 and ELKH further developed the infrastructure in 2021. Members of the Hungarian scientific community are not only using but are also developing and operating the cloud services. Supported by ELKH, the Institute for Computer Science and Control (SZTAKI) and the Data Centre of the Wigner Research Centre for Physics (Wigner FK) provide the computing and data services to the ELKH Cloud users involved in more than 150 research projects.

The success of new scientific research is increasingly dependent on the efficient storage and processing of copious amounts of data originating from research. The ELKH Cloud facilitates research work by providing a turnkey high-capacity hardware infrastructure and special software environment necessary for data-driven research. Moreover, custom-tailored professional support is also available on demand.

The ELKH Cloud provides access to an innovative IT platform to those research teams that cannot afford the costs and efforts associated with the procurement, installation and operation of their own systems. Leveraging the applied scalability and virtualization technologies, the cloud can serve various and constantly changing user demands, resulting in significant economic savings.

Activities and Services

Research often requires complex, large-scale platforms based on the coordinated operation of multiple components. The ELKH Cloud therefore provides customisable, reliable and scalable templates, among others with the help of so-called cloud orchestration methods. In addition to operating systems and basic IaaS (Infrastructure-as-a-Service) level cloud functionalities, the most popular artificial intelligence research and data ingestion frameworks are also available at PaaS (Platform-as-a-Service) level due to the open architecture based on OpenStack.

Based on positive feedback received in recent years, as well as growing demand for artificial intelligence applications, the cloud capacity was significantly expanded in 2021 with support from ELKH. As a result, 5900 vCPU, 2060 vGPU, 28 TB RAM, 338 TB SSD storage, 1.25 PB HDD storage and 100 Gbps network capacities have become available to users. The enhanced ELKH Cloud provides a competitive research infrastructure on a European level that also welcomes projects initiated by universities and national laboratories.

ELKH aims to make the enhanced ELKH Cloud an integral part of the European Open Science Cloud and SLICES ESFRI initiatives. This will allow free flow of applications and data of Hungarian researchers in the Horizon Europe programme through the European infrastructure, providing opportunities for establishing high profile international collaborations in an ever-widening field.

TYPE OF THE RI

Virtual

HOST INSTITUTION

Governmental Agency for IT development

LOCATION OF THE RI

Operated in more than 12 sites in Hungary with the headquarter in Budapest

STATUS

Fully operational, 1986 –

NATIONAL PARTNERS

All Universities and research institutes in Hungary

KEY PARTNERS

- Wigner Research Center for Physics
- SZTAKI
- Budapest University of Technology and Economics
- ELI-ALPS

INTERNATIONAL COLLABORATION WITH RIs

- GÉANT
- PRACE
- EuroHPC
- EOSC
- RDA (Rutherford Appleton Laboratory)

INSTITUTIONAL PARTNERS

- GEANT Association
- PRACE aisbl
- EuroHPC JU
- RIPE NCC
- ISOC (Internet Society)

PERSON IN CHARGE/CONTACT

Krisztián Kongó, Vice President of KIFÜ
Intproject@kifu.hu

WEBSITE

<https://kifu.gov.hu>

HUNGARIAN E-INFRASTRUCTURE

Description of the RI

The Agency's e-infrastructure for research and education complies with European standards and demands, by featuring a complex portfolio of services, with extensive connection to the approx. 40 European NRENs (National Research and Education Network e-infrastructures), and indirect connection to an additional approx. 60 non-European NRENs. It covers all internationally accepted functions of ICT-based communication and cooperation, information processing and data storage, by providing all research areas with e-infrastructure. The e-infrastructure of the Agency, as part of the GÉANT infrastructure (the European backbone network connecting the NRENs and supporting the ICT infrastructure for research and education in Europe) and of the PRACE and EuroHPC infrastructures (the pan-European supercomputing infrastructures) and by offering capabilities of multimedia information processing, resource and service virtualisations, federated authentication, etc. provides stable and full-featured connection and cooperation possibilities. It enables access to all research institutions and researchers in Europe, including all major European research infrastructures (ESFRI, ERIC and others).

Due to its widespread domestic and international (developer, service provider and user) network, it is hard to estimate the exact number of the Agency's cooperation partners: there are more than 500 institutions in Hungary, while a couple of thousands partnerships have been established in various disciplines and regions across Europe and globally. The Hungarian research and education communities can enjoy the benefits of these communities to develop their relationships and networks. In addition to serving institutions and researchers, our Agency cooperates with key players in Hungarian research by research and development agreements in order to allow leading-edge technologies to be tested on an experimental basis on Hungary's most significant e-infrastructure.

Activities and Services

The Agency's e-infrastructure connects more than 1.7 million domestic users with a highest-speed low latency network to the international education and research network at speeds of up to 500 Gbps. The HPC operated by the Agency with more than 327 TFlops (6000 CPU cores +252 GPUs) and 2 PB disk space is complemented by the C4E cloud system, serving the Hungarian research and education community with more than 5700 cores and 17 PB storage space. HPC capacity expansion is being upgraded to more than 5PFlops. These capacities allow all disciplines to run scientific applications that require various computing capabilities on a regular and ad hoc basis and to store and manage scientific data in accordance with the Open Science and FAIR principles as part of the EOSC collaboration. In addition to the above services, our Agency is responsible for the operation and development of the educational and research identification and authorization management system in Hungary (eduroam, eduID, eduGAIN, eduTEAMS). The Agency additionally provides a comprehensive portfolio of services to support education and research with multimedia (VoIP, video conferencing, webinars, knowledge-sharing multimedia repository), to help research workflows towards open science (research notebooks, archiving repositories) and to endorse learning infrastructures (Learning Management Systems, educational repository). The Agency is actively participating in various international projects (Horizon Europe, H2020 and similar) to improve services and to strengthen collaboration among the partners.

TYPE OF THE RI

Single sited

HOST INSTITUTION

Wigner Research Centre for Physics

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2009 –

NATIONAL PARTNERS

- ELKH Research Network
- Quantuminformatics National Laboratory
- NAPLIFE National Research Laboratory
- Eötvös Loránd University, Faculty of Informatics (ELTE IK)
- Eötvös Loránd University, Faculty of Science (ELTE TTK)
- ERICSSON Research
- LOMBIQ Ltd.
- CERNTECH Ltd.

INTERNATIONAL COLLABORATION WITH RIs

- CERN WLCG
- CERN LHC Hi-Lumi (ESFRI)
- VIRGO/ET (ESFRI)
- ELI (ESFRI)
- EUPRAXIA (ESFRI)

INSTITUTIONAL PARTNERS

- CERN (Switzerland)
- EGO (Italy)
- CCNU (China)
- LBNL (USA)
- IIT Indore (India)
- ERICSSON Research (Sweden)
- KHRONOS (USA)

PERSON IN CHARGE

Péter József Lévai, Director General
wigner@wigner.hu

CONTACT

Gergely Gábor Barnaföldi
Senior Research Fellow
barnafoldi.gergely@wigner.hu

WEBSITE

<http://wigner.hu/wsclab>

Description of the RI

During recent years, applications of latest computational techniques and technologies generated breakthrough in various research fields. Traditionally, there is a strong demand for cutting-edge IT-solutions in particle, astroparticle, nuclear and theoretical physics, and related data analysis. KFKI at Csillebérc pioneered data collections in experiments and their analysis from early times. This knowledge was inherited by many research institutes of the campus including KFKI RMKI, by providing and hosting novel IT-technologies. Since 2000 large scale and high performance computing clusters were installed, and from 2009 GPU-technology and multi-platform, hybrid architectures were applied in different research fields. Today a state-of-the-art research and development direction is the application of FPGA-based computers for emulation of quantum computers, to pave the way for quantum machine learning and real quantum computer technologies of near-future.

Recently the applied-science motivated Wigner Scientific Computing Laboratory (WSCLAB) has been established, integrating the decade-old Wigner GPU Laboratory with the existing large-scale multiprocessor CPU clusters. This WSCLAB is located in the Wigner Datacenter (1 MW IT-power, 100 racks, and 10 Gb/s internet connections). The Mission of the WSCLAB is serving as a knowledge center, providing computational capacity and technology for research projects and scientists. Tutorial events and workshops have been organized: GPU Day series at 12 times, Academy-Industry Matching Event on IT-solutions since 5 years.

Wigner Scientific Computing Laboratory hosts the following units and technologies

- CERN ALICE/CMS Tier2 Cluster [4000 vCPU, 10 TB RAM, 3.6 PB storage]
- CERN ALICE Analysis Facility [3700 vCPU, 7.5 TB RAM, 2.3 PB storage]
- VIRGO/ET Tier2 Cluster [1000 vCPU, 3 TB RAM, 150 TB storage]
- GPU Units [8x Ampere A100 SXM4 and 14 x Tesla T4]
- Maxeler FPGA Unit as Quantum Computing Simulator

Activities and Services

Wigner Scientific Computing Laboratory (WSCLAB) hosts dedicated Tier2 clusters for CERN and VIRGO/ET Collaborations serving their computing requests. In parallel, knowledge transfer is offered for interested scientists, who are responsible for large scale, high-capacity clusters in other collaborations. In the ALICE AF unit research projects are optimized for effective usage of multi-core processors in large scale IT-systems to reach maximal performance of the hardware elements. In the GPU unit the users are able to test and develop their application on special architectures, containing different GPU-hardware, and they receive support on application of GPU-based languages.

In the FPGA unit a quantum computer emulator has been established on the basis of DataFlow technology. This can be used for study of different aspects of quantum programming and quantum machine learning protocols. The mission of WSCLAB is serving IT-expert researchers with novel IT-technologies, focusing on applications in research and industrial developments. The existing local background is based on two decades activity in the frontier of IT-developments and this guarantees successful cooperation and knowledge transfer. Using the resources of WSCLAB could speed up research activity of experienced users, and serve an opportunity for beginners to follow recent IT-developments in the fields of artificial intelligence, machine learning and quantum programming. Seminars and workshop helps to increase the effectivity of knowledge transfer.

03 EMERGING RESEARCH INFRASTRUCTURES IN HUNGARY



LOOKING INTO THE FUTURE

We find it important to include in the recent publication the RIs that, according to some of the evaluation criteria, cannot yet be classified as excellent research infrastructures, but have significant potential in their respective field. The National Research Infrastructure Committee has decided to select five emerging research infrastructures which are presented in this chapter and recommended for international scientific collaboration.



TABLE 3 – EMERGING RESEARCH INFRASTRUCTURES

RI Name	Name of Settlement
ENVIRONMENT	
Onfield and Virtual Agro-Environment Simulation Platform	Martonvásár
CER Mesocosms and Hungarian Pond Network	Budapest
PHYSICAL SCIENCES & ENGINEERING	
Digital Holographic Microscope Devices	Budapest
DATA & COMPUTING	
Internet of Living Things	Szeged
QULTO and DH-LAB Connected Research Infrastructures	Szeged

DESCRIPTION OF EMERGING RESEARCH INFRASTRUCTURES, THEIR ACTIVITIES AND SERVICES

ENVIRONMENT

TYPE OF THE RI
Single sited

HOST INSTITUTION
Centre for Agricultural Research, Agricultural Institute

LOCATION OF THE RI
Martonvásár

STATUS
Fully operational, 2018–

NATIONAL PARTNERS
ELTE Faculty of Science, Department of Meteorology

INTERNATIONAL COLLABORATION WITH INSTITUTIONAL PARTNERS
Agricultural Model Intercomparison and Improvement Project (AgMIP)

PERSON IN CHARGE/CONTACT
Nándor Fodor, Senior Research Fellow
fodor.nandor@atk.hu

WEBSITE
www.atk.hu/en

ONFIELD AND VIRTUAL AGRO-ENVIRONMENT SIMULATION PLATFORM



Description of the RI

The research infrastructure enables us to create environmental conditions that are projected to happen toward the end of the century. The soil-plant system is monitored with a large number of different type of sensors. A data warehouse is developed from the collected data and a process-based model is created using state-of-the-art ICT tools. Owing to the continuous improvements, the model is capable of simulating the soil-plant system more and more accurately, and supporting climate change mitigation.

Major components of the RI

1. Free Atmospheric CO2 Enrichment (FACE) experiment: in the 18 m diameter rings, using environmental sensor data, a computer controls the CO2 concentrations and maintains the elevated level (600 ppm) that is expected at the end of the century.
2. Twelve weight-lysimeter columns: 2 m height, undisturbed soil columns with environmental sensors inserted at various depths.
3. Two eddy-covariance stations, designed for the parallel measurement of (CO2, N2O, etc.) gas fluxes between the vegetation and the atmosphere as well as of micro-meteorological variables.
4. A rain shelter with retractable roof and a built-in irrigation system. 5) Data warehouse that integrates the data collected with the RI as well as data from freely accessible data sources (E-OBS, SoilGrids, HCSO, etc.).
5. Simulation agro-ecosystem model and a web-based decision support system.

Activities and Services

With the help of the FACE experiment, the impact of elevated air CO2 on the production of crops is investigated at different fertilization levels. Lysimeters are used for monitoring evapotranspiration and energy and matter flow in the soil in order to better understand the processes leading to water stress during droughts. The eddy-covariance stations are monitoring the ecosystem level energy and matter flows enabling the observation based determination of carbon sequestration of grasslands and croplands. Under the rain shelter, controlled drought stress circumstances are generated and the impact of stress length and intensity on yield quantity and quality is investigated. The continuously expanding data warehouse enables the researchers of remote scientific fields to work on reaching common goals. Using supervised and non-supervised machine learning methods computational modules are developed that describe the various processes of the agro-ecosystem. By connecting the modules, a simulation agro-ecosystem model is created. Using the advantageous features of various programming languages (JavaScript, C, R, Python, Delphi), an interface is also created to facilitate seamless data flow between the modules as well as simple communication with the users. A platform independent decision support system (DSS) is created to promote food security and food safety, the expansion of digital agriculture, the sustainable environment- and climate-smart resource management. The DSS contributes to a more competitive agricultural sector, to the mitigation of environmental pollution as well as of the negative impacts of climate change.

CER MESOCOSMS AND HUNGARIAN POND NETWORK



TYPE OF THE RI

Distributed

HOST INSTITUTION

Institute of Aquatic Ecology Centre for Ecological Research (CER) Eötvös Loránd Research Network

LOCATION OF THE RI

Vácrátót, Fülöpháza, Zánka, Balmazújváros

STATUS

Partially operational

NATIONAL PARTNERS

- Hortobágy Environmental Association (HTE)
- Herb Valley Ecological Centre, Zánka
- University of Pannonia

INTERNATIONAL COLLABORATION WITH RIs

EU network of mesocosms facilities for research on marine and freshwater ecosystems open for global collaboration

INSTITUTIONAL PARTNERS

- Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB)
- WasserCluster Lunz
- Biological Station GmbH (WCL)
- Spanish National Research Council (CSIC)
- Katholieke Universiteit Leuven (KU Leuven)
- Queen Mary University of London (QMUL)

PERSON IN CHARGE

Zsófia Horváth, Senior Researcher
horvath.zsofia@ecolres.hu

CONTACT

Zsófia Horváth, Senior Researcher
horvath.zsofia@ecolres.hu
Csaba Vad, Research Fellow
vad.csaba@ecolres.hu

WEBSITE

<http://mesocosm.org/mesocosm/cer-mesocosms/>

Description of the RI

CER mesocosms are situated on the premises of CER Institute of Ecology and Botany, operated by CER Institute of Aquatic Ecology. The facility consists of two sets of mobile mesocosms, consisting of 96 (220-litre each) and 40 (300-litre each) tanks. Both types of mesocosms can be equipped with mixing and computer-controlled heating systems. The tanks can be filled either with tap water or with water from natural ponds and shallow lakes. Mesocosms are mobile and can also be transported to the field to carry out in situ experiments in natural ponds or lakes. The Hungarian Pond Network (HPN) is being built as the extension of the existing Iberian Pond Network (IPN) as part of the H2020 project AQUACOSM-plus. Twenty-four tanks with a volume of 1000-litre each are being installed at four sites across Hungary (Vácrátót, Fülöpháza, Zánka, Balmazújváros). They will be equipped with temperature loggers and a remote-controlled heating system, enabling long-term experiments targeting the effects of climate change.

Activities and Services

Laboratories (incl. water analytical labs, molecular ecology lab, and microscopy labs) and sampling equipment are available at the CER Institute of Aquatic Ecology, Budapest. Key topics studied at the facilities are related to aquatic biodiversity, trophic relationships, metacommunity ecology, and to the role of anthropogenic stressors (e.g., climate change, invasive species, habitat fragmentation). Researchers at CER Institute of Aquatic Ecology are experts in water chemistry, aquatic biodiversity, invasion ecology, spatial ecology, and the ecology of multiple aquatic organisms (bacterio-, phyto-, and zooplankton, benthic diatoms, macrophytes, macroinvertebrates, fish etc.). International access to the infrastructure is provided via the transnational access program of the H2020 AQUACOSM-plus project for training and research. CER offers the use of guesthouses, lecture halls and libraries in Budapest, Vácrátót, and Fülöpháza.

TYPE OF THE RI

Single sited

HOST INSTITUTION

Institute for Computer Science and Control -SZTAKI

LOCATION OF THE RI

Budapest

STATUS

Fully operational, 2015 –

PERSON IN CHARGE/CONTACT

Ákos Zarándy, Laboratory Manager
zarandy@sztaki.hu

WEBSITE

<https://www.sztaki.hu/tudomany/reszlegek/analogic>

DIGITAL HOLOGRAPHIC MICROSCOPE DEVICES



Description of the RI

Digital Holographic Microscopy has two major advantages. In rare samples (e.g., drinking water), it can scan volumes up to 1000 times larger with a single snapshot than conventional microscopes. On the other hand, it is sufficient to run the sample in a transparent cell in front of the microscope, i.e. it does not require sample preparation. Thus, many tasks e.g. continuous automated monitoring of drinking water, food, industrial liquids, natural waters is possible with this device. SZTAKI currently has 3 digital holographic microscopes with different resolutions and spectral properties.

Activities and Services

Microscopes can be used in environmental and industrial applications. In the field of environmental protection, the monitoring of our natural waters and the wastewater entering them can be automated with this technology. In the industrial field, the food industry, the cosmetics industry, the chemical industry, the manufacturing industry and various biotechnologies can use the automated microscopic examinations provided by these devices.



TYPE OF THE RI

Distributed

HOST INSTITUTION

University of Szeged
Institute of Informatics

LOCATION OF THE RI

Szeged

STATUS

Fully operational, 2017–

NATIONAL PARTNERS

• ELKH- Biological Research Centre (BRC)

INTERNATIONAL COLLABORATION WITH RIs

• ELI-ALPS

INSTITUTIONAL PARTNERS

• Liverpool John Moores University
• Samsung Electronics UK Ltd.
• ARM Ltd.

PERSON IN CHARGE/CONTACT

Tibor Gyimóthy, Professor
gyimothy@inf.u-szeged.hu

WEBSITE

<https://sed.inf.u-szeged.hu/iolt>

Description of the RI

The IoT research infrastructure enables the development IoT applications by providing easy-to-use programming interfaces for ultra-low-resource devices. Its open source software allows even non-IT researchers to develop biological and medical IoT applications. Related research and development areas of the RI: JavaScript engine, software quality assurance and source code quality, IoT-Cloud infrastructure and simulators; algorithms for ensuring data safety and security.

Activities and Services

In the frame of the national GINOP IoT (Internet of Living Things) projekt, we have created a novel network of excellence integrating basic research in the IoT field with biological and medical applied research. This projekt successfully finished in 2021, its consortium was led by the University of Szeged, a prominent research university with outstanding achievements. The Biological Research Centre was the collaborating consortium member in this projekt. During the development of the IoT projekt, they created the IoT Research Infrastructure to enable and foster international research in this joint field. With the collaboration of international industrial partners they developed an open source IoT software platform that allows even non-IT researchers to develop biological, medical, and also conventional IoT applications. The platform enables researchers of any discipline to develop and execute IoT applications by providing easy-to-use programming interfaces and tool sets. The platform supports a wide range of devices in general, and ultra-low-resource, ultra-cheap IoT devices in particular. Available components and tools: JavaScript interpreter developed for heavily constrained IoT devices (JerryScript); IoT development environment for rapid application development; tools for software quality assurance including static code analysis, source code quality and vulnerability checks using AI models; device drivers, communications, IoT cloud infrastructure and simulators; algorithms for ensuring data safety and security. Development of the platform is continuous, which includes the adaptation of the core JerryScript execution environment to application-specific peripherals. The development of IoT applications is facilitated through the high-level programming of ultra-low-resource sensors for adaptive data collection and processing. Simulation tools are developed for investigating the efficient and secure management of IoT applications in fog and cloud systems. Advanced AI tools are available, e.g. for medical applications and natural language processing.

The platform enables the assessment of the impact of environmental factors determining the growth and stress reactions on individual plants. In medical practice it supports actigraphic research for identifying new ultradian and slower periodic and stochastic components in human physical activity patterns and establishing their correlation to physical conditions, activities, and certain psychiatric disorders. Devices running the platform can greatly increase the effectiveness of work on cell cultures by facilitating the testing of potential active substances. To increase the efficiency of personalised therapies, the platform can aid the analysis of microscopic images and automatic classification using machine learning methods.



TYPE OF THE RI

Distributed, virtual

HOST INSTITUTION

Eötvös Loránd University, Institute of Historical Studies, Department of Digital Humanities, Monguz Information Technology Ltd.

LOCATION OF THE RI

Hungary, CEE region

STATUS

Fully operational, 2020 –

NATIONAL PARTNERS

• The National Archives of Hungary
• Research Centre for the Humanities Institute for Literary Studies
• University of Miskolc
• Governmental Agency for IT Development
• National Széchenyi Library

INTERNATIONAL COLLABORATION

• Digital Research Infrastructure for the Arts and Humanities
• Europeana Foundation
• Sapientia Hungarian University of Transylvania
• Partium Christian University
• Protestant Theological Institute of Cluj-Napoca
• Ferenc Rákóczi II Transcarpathian Hungarian College of Higher Education

PERSON IN CHARGE/CONTACT

Gábor Palkó, Technical Director
palko.gabor@btk.elte.hu
László Kármán, CEO
laszlo.karman@qulto.eu

WEBSITE

<https://dh-lab.hu/>
<https://elte-dh.hu/en/home-2/>
<https://qulto.eu/?lang=en>

Description of the RI

QULTO and DH-LAB linked research infrastructures

A versatile research platform has been created by connecting the Qulto research infrastructures, developed with the professional assistance of the Department of Digital Humanities of ELTE BTK, with the support of the National Laboratory of Digital Heritage, and created by Monguz Information Technology Ltd. and deeply embedded in the national scientific space.

QULTO research infrastructure

The Qulto Research Infrastructure is a distributed and virtual, domain-independent research infrastructure that provides essential support for the digitization, storage, organization, retrieval, publication, reuse, and search for relevant sources and plagiarism of higher education and research content in Hungary. Some of its modules are used by 146,500 researchers and students in 98 research institutions, making 50+ million national metadata and 1.3+ million digital objects available, with 9,942,000 transactions in 2020.

DH-LAB research infrastructure

The Digital Heritage National Laboratory (DH-LAB), in close cooperation with Monguz Information Technology Ltd. and other consortium partners, has created a hardware and software infrastructure for the artificial intelligence-based processing, research, education and publication of national cultural heritage using proprietary language processing applications optimized for the Hungarian language. Special attention will also be paid to the integration of cross-border corpus and to the preservation, processing and delivery of Hungarian-language born digital content. The QULTO and DH-LAB integrated research infrastructure will provide the following activities and services.

Activities and Services

- Metadata management
- Optional digital file manager, repository and data repository (Invenio RDM, DSPACE, Eprints, OMEKA, etc.)
- Source and plagiarism finder
- Thesis manager
- Editorial system (OJS)
- Discovery/search
- Semantic knowledge base, Wikifier/HUWikifier based semantic web building based on metadata
- Digitization framework (machine learning assisted OCR, proofreading, DRM)
- TEI XML visualization (e.g. by displaying annotations and other data)
- PDF annotator
- E-learning, e-publishing
- Data visualization
- Data and content aggregator

04 FUNDING SCHEMES FOR RESEARCH COOPERATION

FUNDING SCHEMES FOR RESEARCH COOPERATION

By now, looking through the opportunities offered in our publication, we hope that you are looking for the opportunity to cooperate with Hungarian research infrastructures. Here we introduce some relevant funding schemes in order to support to make your first steps.

SUPPORTING RI-BASED S&T COOPERATION (NEMZ_KI)

<https://nkfih.gov.hu/palyazoknak/nkfi-alap/nemzetkozi-hazai-kutatasi-infrastrukturak-hasznalatanak-tamogatasa-2021-412-nemz-ki/palyazati-felhivas>

The call aims to support research infrastructure-based research and measurements, provided by international and domestic research infrastructures (RIs), in particular at those to which Hungary has joined as a full member or has scientific collaboration with. The significant national RIs, listed in this recent publication, are encouraged to host researchers from abroad.

“A” Sub-program (outgoing)

Supports the use of research and measurement opportunities provided by international research infrastructures in particular at those infrastructures to which Hungary has joined as a full member (<https://nkfih.gov.hu/english/international-cooperation/international-organisations>).

“B” Subprogram (incoming)

Supports the use of the significant domestic research infrastructures by international researchers, enhancing the integration of the national RIs into the international arena and promoting the flow of knowledge. Preference will be given to domestic research infrastructures that are linked to an international research infrastructure (e.g. Node) in which Hungary participates as a full member.

Beneficiaries: Hosting/sending Hungarian institutions (higher education institutions, research institutions, other budgetary research organizations and institutions, enterprises, non-profit research organizations).

Earmarked budget: HUF 100 million (kEUR 280)

Hosting Declaration from the institution providing the allocated beam time/measurement/etc. for the researcher at the given research infrastructure has to be submitted with the application. The application is ought to be submitted by Hungarian sending/receiving institution in all cases ('A' & 'B' sub-programs). Please contact the relevant hosting Hungarian institution.

FOREFRONT – RESEARCH EXCELLENCE PROGRAMME (KKP_21)

<https://nkfih.gov.hu/english/nrdi-fund/forefront-research-excellence-programme-kkp-21/call-for-application>

The program aims to offer opportunities for researchers, who are among the forefront of the international scientific community in the world, are in the most dynamic stage of their research career and aim to realize their research at a Hungarian research institution. The call is open exclusively to basic (fundamental) research topics with no thematic restrictions or priorities.

Earmarked budget: HUF 3 billion (kEUR 8 300)

Beneficiaries: researchers with PhD/DLA degree

Duration: 5 years

Financial support: HUF 150–300 million (kEUR 420–kEUR 840)

**TOP RESEARCH INFRASTRUCTURES IN HUNGARY
AND THEIR EMBEDDEDNESS IN THE EUROPEAN
RESEARCH INFRASTRUCTURE LANDSCAPE**

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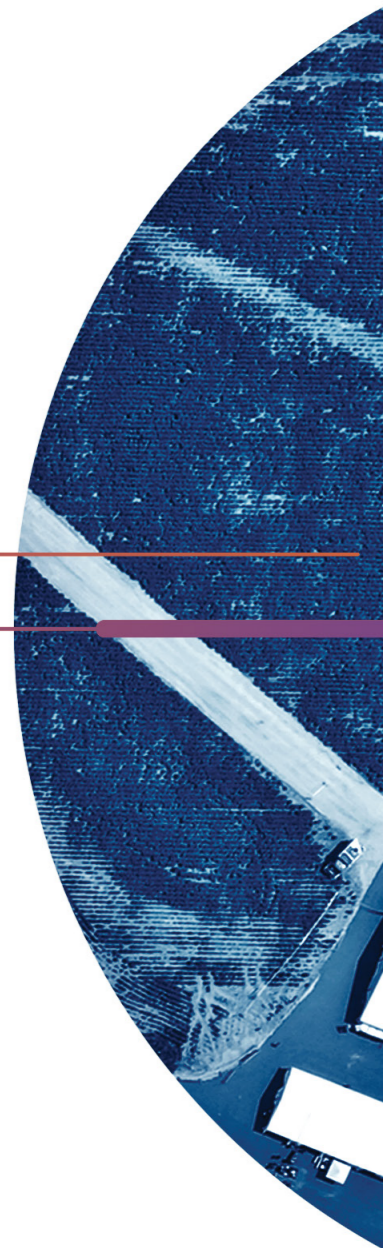
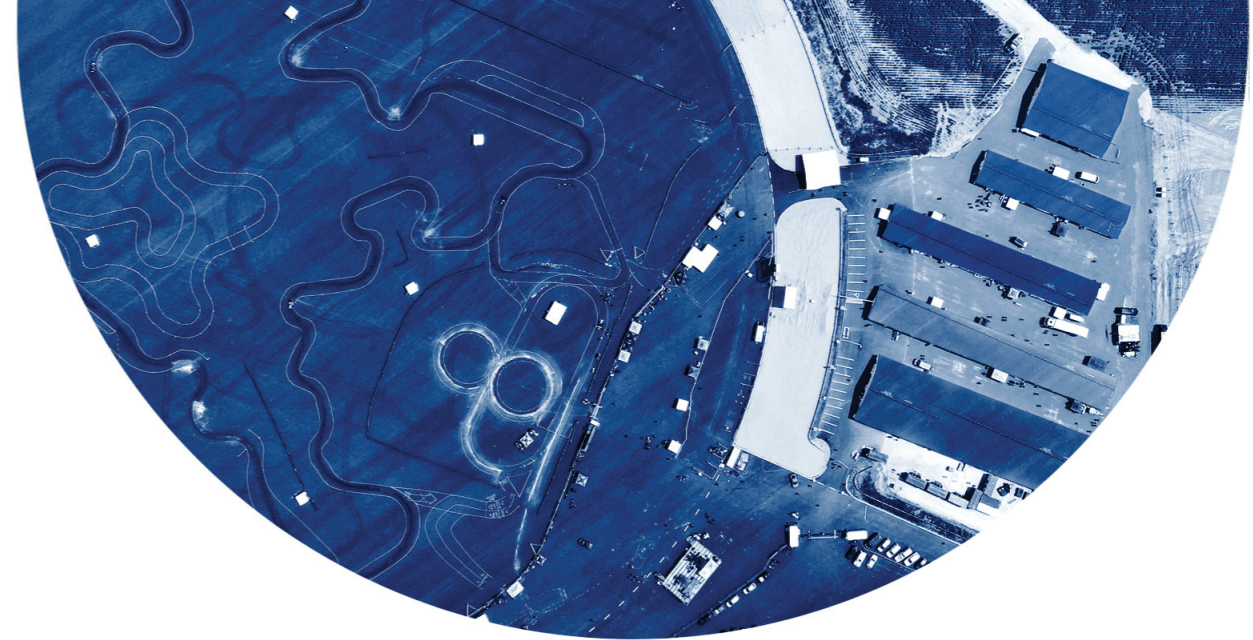
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