

Application laboratories
of the Czech Academy of Sciences

Ca

C₂H₅OH

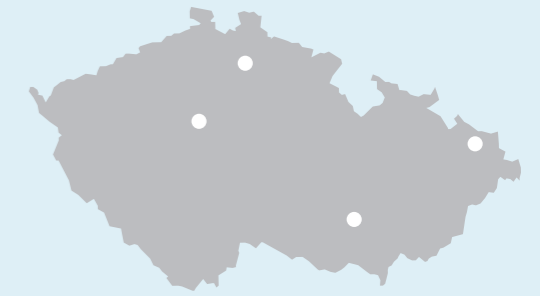
H₃

SO₂

C₂H₄



**The Czech Academy
of Sciences**



Application laboratories of the CAS

“Top research in the public interest”

“Top research in the public interest” is the motto of a new Strategy of the Academy of Sciences, which should present itself in future more distinctively as an institution the mission of which is top research focusing also on issues and challenges faced by contemporary society. The project titled Application Laboratories of the CAS, as an important part of this strategy, is a practical realisation of the abovementioned motto, and it aims to broaden direct contacts of Academy of Sciences workplaces with industrial partners and to support particular projects of cooperation between the academic and application sphere. This initiative of the Academy of Sciences will also provide a platform for the exchange of mutual experience and knowledge from the cooperation so far, which takes many forms: from contract research via collaborative research up to the transfer of technology. In the current practice, contract research is usually carried out in response to a requirement by a company partner; in the case of collaborative research it involves mostly cooperation between an enterprise and a research workplace, as a rule as part of projects supported by the Technology Agency of the CR, Ministry of Industry and Trade or by other departmental agencies. The direct transfer of technologies in the form of sale of licences or know-how is not too widely used at the workplaces of the Academy of Sciences so far. However, it is possible to assume that forming the Application laboratories of the CAS will lead to improvement in this important area as well.



Prof. Ing. Jiří Drahoš, DrSc., dr. h. c.
Chairman of the Czech Academy of Sciences

Considering the fact that contract research is often the first step for Academy of Sciences workplaces to establish cooperation with industrial partners, this publication also focused primarily on the contract research segment. Selected laboratories from a number of Academy of Sciences workplaces, not only from technical fields or from applied physics and chemistry but also from the area of life sciences and social sciences, are represented here. Individual workplaces of the Academy of Sciences present technologies that are being developed for use in research and the capacities of which they can offer for application in practice. It includes not only our own laboratories and instruments with which they are equipped but, to a much greater extent, knowledge and experience with their operation and use. The fact that they are linked to high-quality research, almost always in cooperation with renowned foreign research workplaces, guarantees that these are top-class modern technologies up to the standard of the present time.

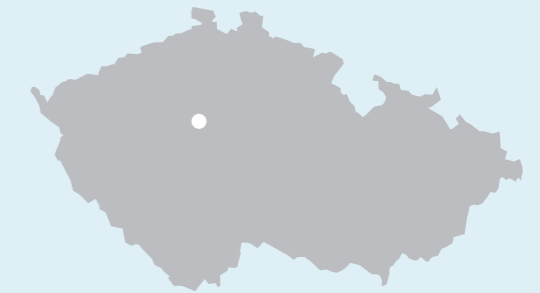
The Academy of Sciences perceives its responsibility for supporting the competitiveness of the Czech Republic. Contract research for which it offers its potential in the form of application laboratories represents a necessary initial step on the way to reach long-term partnerships with enterprises that appear to be the most efficient in terms of the direct use of new research knowledge in practice. Based on our experience, this first step is followed very frequently by more profound forms of cooperation, e.g. joint research projects. We consider cooperation with small and medium-sized enterprises to be of particular importance in this respect. And it is in this very context that it is possible to perceive the potential of the Application Laboratories of the CAS project and its significance for building such relationships between the academic and commercial spheres that will be based on mutually advantageous and long-term motivations, which, when applied, will ultimately bring continued profit and benefit mainly to the Czech Republic and its citizens. If this publication also contributes its part to that, it will realise its purpose.

Contents

HiLASE project – New lasers for industry and research	4
Regional Centre for Special Optics and Optoelectronic Systems – TOPTEC	6
Application Laboratories of Microtechnologies and Nanotechnologies (ALISI)	8
X-ray Computed Tomography Workplace	10
Water Jet Workplace	12
Laboratories of Mechanical, Magnetic and Transport Properties and Structure of Materials	14
Public Opinion Research Centre (CVVM)	16
Centre for Analysis of Functional Materials Project (SAFMAT)	18
Laboratories of Nanostructures and Nanomaterials (LNSM)	20
Laboratories of Scintillation and Luminescent Materials (SciMat)	22
SHARE project (Survey of Health, Ageing and Retirement in Europe)	24
Centre for Biorefining Research (BIORAF)	26
Laboratory of Chemistry and Physics of Aerosols	28
Centre for Accelerators and Nuclear Analytical Methods (CANAM)	30
a) Laboratory of Isochronous Cyclotron and Fast Neutrons (LC&FNG)	30
b) Laboratory of Tandetron Accelerator (LT)	32
c) Neutron Physics Laboratory (NPL)	34
Microtron Laboratory – Department of Accelerators	36
Application Dosimetry Laboratories (ADL)	38
Application laboratories and infrastructure of the Global Change Research Centre (CzechGlobe)	40
Otto Wichterle Centre of Polymer Materials and Technologies	44
Centre of Bio-Medical Polymers (CBMP)	46
Fibre Optics Laboratory	48
Station of Apple Breeding for Disease Resistance	50
Application Laboratory of Tissue Engineering	52

HiLASE project – New lasers for industry and research

Institute of Physics of the CAS, v. v. i.



Contact

Institute of Physics of the CAS, v. v. i.

Ing. Roman Švábek

Phone: +420 702 012 885

E-mail: svabek@fzu.cz

<http://www.hilase.cz/>

Specialisation

The HiLASE project deals with the development and applications of diode-pumped solid-state lasers with high pulse energy and high repetition frequency. As a result, it extends the current technology of picosecond and nanosecond lasers into a new and hitherto unexplored mode of high average power at the level of 1 kW. Lasers with such parameters are not currently available but, at the same time, they have a significant application potential. HiLASE is a response to this long-term global demand and to strengthening the strategic position of the Czech Republic in this highly promising field. HiLASE lasers are more efficient, more compact, more stable and easier to maintain than lasers based on traditional pumping from discharge tubes. The applications implemented at the



The inlet aperture of a fibre femtosecond laser oscillator

HiLASE Centre include e.g. testing of the resistance of optical materials and components with a high damage threshold, consolidation of the surface of materials with a laser-generated shock wave, compact sources of X-ray radiation for lithography, cutting and drilling of special materials for the automotive and aircraft industries and micro-/nanostructuring of surfaces.

Competences

- Feasibility studies
- Optical components and systems: visualisations, 3D models, constructions, calculations,

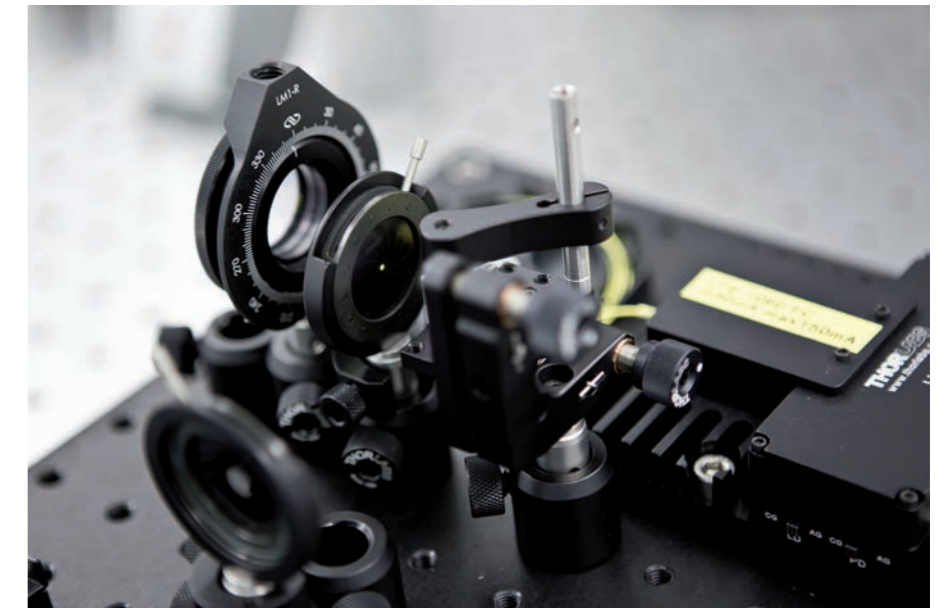
simulations, measurements and testing

- Optical layers: measurement and testing, detection of laser-induced damage thresholds
- Laser beams: measurement and testing
- Construction of laser sources and their optimisation for given applications
- Expert analyses and professional market surveys in the field of lasers, photonics and applications of laser technologies
- Direct laser applications: machining, separation of material, surface treatment, welding
- Consultations in development of

electronic components working in laser systems, and the possibility of testing them

Target groups

- Manufacturers of laser sources, optical and optomechanical components
- Companies operating in mechanical engineering, automotive and aircraft industry
- Manufacturers of electronics and microelectronics
- Biomedical engineering



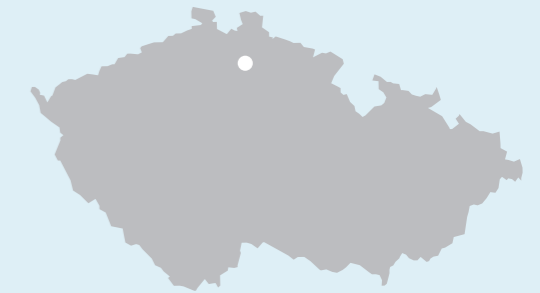
A special arrangement of optical prisms designed for the efficient excitation of lasers based on thin-disc technology

Results achieved, references and examples of cooperation

- Development and testing of optical crystals: Crytur, spol. s r. o.
- Joint development of special laser optical elements – calculations, simulations and constructions: Meopta – optika, s.r.o.
- Visualisation, construction and manufacture of optomechanical parts for experimental workplaces: Faculty of Nuclear Sciences and Physical Engineering of the Czech Technical University in Prague; TOPTEC – Regional Centre for Special Optics and Optoelectronic Systems
- Development of layers vapour-deposited onto optical elements for laser systems – mathematical draft and cooperation in construction, gauging in a laser beam: L.E.T. optomechanika Praha, spol. s r.o.; Meopta – optika, s.r.o.
- Consulting in the development of sources of high-voltage pulses: FOTON, s.r.o.
- Drilling of small openings: Technical University in Liberec
- Development of the process of laser cutting of textile materials: Staalboek s.r.o.
- Optimisation of the laser welding process: Swoboda CZ s.r.o.
- Study of the possibilities of extending a gas chromatograph: Labio a.s.
- Testing of thin films for optical components of power lasers: L.E.T. optomechanika Praha, spol. s r.o.;
- Design of a CO2 regenerative amplifier: Utsunomiya University
- Thermal depolarisation of TBB ceramic rods: NIFS
- Design of 3D models of laser heads: LAO – průmyslové systémy, s.r.o.

Regional Centre for Special Optics and Optoelectronic Systems – TOPTEC

Institute of Plasma Physics of the CAS, v. v. i.



Contact

Institute of Plasma Physics of the CAS, v. v. i. TOPTEC

Mgr. Radek Melich, Ph.D.

Phone: +420 776 783 952

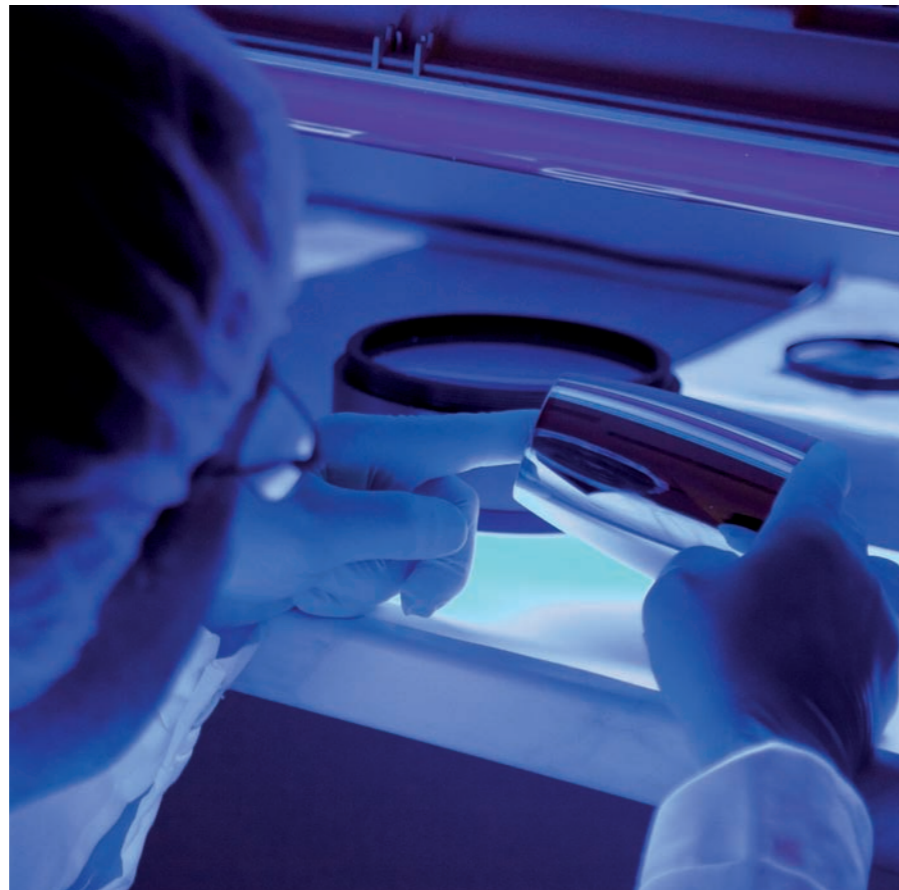
E-mail: melichr@ipp.cas.cz

<http://www.toptec.eu/cz/>

Specialisation

The main objective of the TOPTEC project is to build, run and develop a workplace with modern equipment with an excellent scientific team that specialises in the research and development of ultra-precision optics and optical systems. The workplace is able, inter alia, to ensure an efficient transfer of knowledge into industrial practice.

The Regional Centre for Special Optics and Optoelectronic Systems (Turnov OPToelectronic Centre – TOPTEC) is a direct extension to the optics workplace of the Institute of Plasma Physics of the CAS in Turnov (formerly known as the Optical Development Workshop of the CAS).



Output visual inspection of the mandrel of an X-ray objective

The specialisation of the TOPTEC is based on a 40 years' tradition of research and development of optics at the Turnov academic workplace. The main directions of research and development include working (machining) the optical surfaces of ultra-precision elements with aspheric and freeform surfaces for optical instruments including X-ray and crystal optics, researching modern optical systems for use in super-powerful lasers, developing imaging systems, developing optical systems for applications in space, developing systems for astronomic instrumentation, automotive industry and medical

purposes.

Furthermore, the TOPTEC is engaged in the development of measuring and diagnostic methods, precision mechanics and systems for the active suppression of vibrations in demanding measuring applications.

TOPTEC is currently the only research and development workplace specialising in ultra-precision and special optics in the Czech Republic. It cooperates with more than 80 companies all around the world and with a great number of scientific research institutions both in our country and in the EU.

Competences

The TOPTEC is oriented chiefly to research and development in the field of special optics and advanced optical systems. The significant asset of the Centre is its ability to offer all-services services in the above fields from identifying the partner's needs via basic design and detailed analyses to manufacturing, testing and subsequent installation or, where appropriate, certification of equipment.

Therefore, the possibilities of cooperation offered include a number of services such as design and simulation of optical systems, precise measurement of many physical, mainly optical quantities, designs of fine-mechanical structures for use in optics, structural analyses and numerical simulations or expert examinations, expert opinions and education in the field of optics.

The TOPTEC takes part in a number of national and international research and development projects; the most prestigious ones being the implementation of space research projects funded from ESA resources. The TOPTEC welcomes offers for cooperation in preparing and handling projects relating to both applied and basic research.

For more details see: www.toptec.eu

Target group of partners

The spectrum of our partners includes small enterprises as well as research and development centres, development laboratories and companies engaged in advanced technologies and

multinational firms. Our goal is always to propose a solution that suits best the partner's requirements.

Examples of results achieved

- Lighting optical systems based on the principle of facet optics for Siemens (design of system, implementation of prototype, optical tests, consulting in the start-up of series production)
- Aspherical plungers for intraocular lenses for MEDICEM Institute s.r.o. (design of the shape of optical area, design of technology of production of plungers, manufacture of plungers, optical tests)
- Germanium-, silicon-, ZnSe- and ZNS-based refractive IR systems or reflective IR systems
- Diffraction-limited optical systems for two laser wavelengths for Optometrics, USA (design and implementation of the system, optical tests)
- METIS – lightweight Zerodur mirrors for experiments on the Sun's orbit with an extreme requirement for microroughness ($R_a < 3 \text{ \AA}$) and the precision of shape for ESA (cooperation in optical design, design of bearing structure, manufacture, optical tests)
- ASPIICS (Proba 3 mission) – an optomechanical system for experiments on the Sun's orbit for ESA (design and implementation of optical and mechanical parts of the lens, optical and mechanical tests)
- Design of a telescope system for the European Solar Telescope (EST)
- Crystal optics – implementation of narrow-band filters for solar research
- Mandrels for X-ray applications with minimal microroughness ($\sim 1 \text{ \AA}$) for Rigaku
- SiSiC-based lightweight optical elements for ESA (design of bearing structure, design and implementation of optical surface, optical measurements)
- GaP machining technology for optical applications both in the visible and IR sphere as part of the EUREKA project
- An autonomous system for on-line evaluation of optical properties of thin films for PRECIOSA
- Analysis and optimisation of the electro-optical part of sensors of yarn properties for Rieter
- A system for visualisation of the welding process
- Producing a design of the optical parts of a RICH quartz detector allowing the identification of pions, kaons and protons within the range of their momentum of 1-4 GeV/c
- Implementation of an interferometer for the on-line measurement of the refractive index of gas in RICH gas detectors

Application Laboratories of Microtechnologies and Nanotechnologies (ALISI)

Institute of Scientific Instruments of the CAS, v. v. i.



Contact

Institute of Scientific Instruments of the CAS, v. v. i.

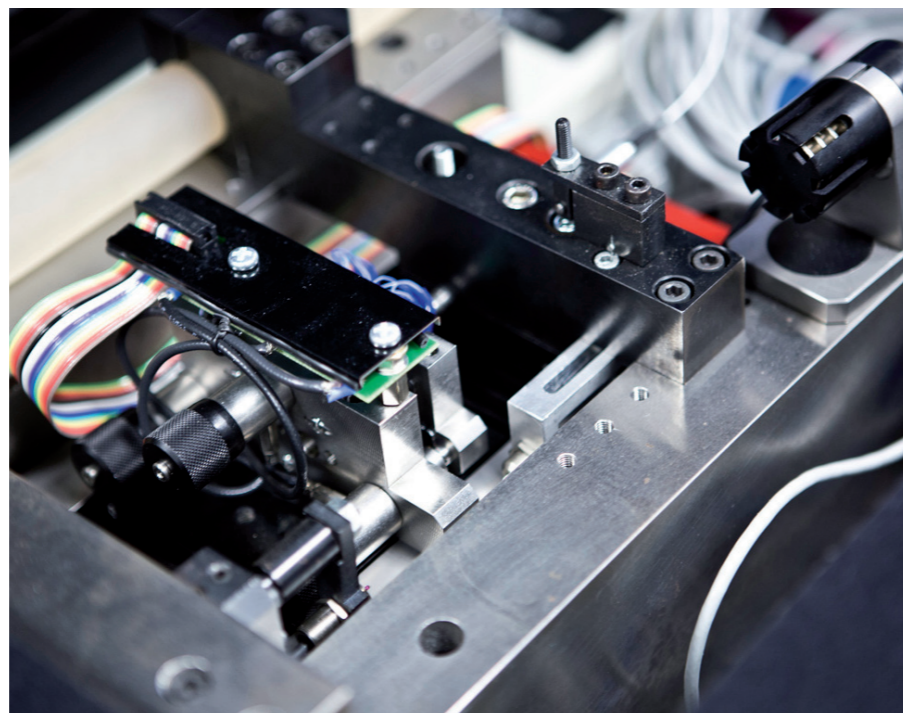
Královopolská 147
612 64 Brno

Ing. Bohdan Růžička, Ph.D., MBA

Phone: +420 541 514 111

E-mail: institute@isibrno.cz

<http://alisi.isibrno.cz/>



An interferometric system with nanometric resolution for calibrating position sensors

Specialisation

The objective of the ALISI is to build and run a regional R&D centre with modern equipment developing diagnostic methods and technologies focusing on the microworld and nanoworld. The preparation and implementation of the project is provided by the Institute of Scientific Instruments of the CAS.

The specialisation of the ALISI is based on the tradition of the Institute of Scientific Instruments of the CAS in Brno (ÚPT), which has been successfully developing diagnostic methods and technological procedures in the field of electron microscopy, nuclear magnetic resonance, biosignal processing, special technologies and metrology for more than 50 years. The results of the scientific work of the

ÚPT are utilised not only by partners operating in the region but also beyond the borders of the Czech Republic.

Competences

Application and development laboratories of advance microtechnologies and nanotechnologies are intended for the pursuit of research activities stretching into the fields of diagnostics and technologies that employ methods of magnetic resonance, laser interferometry and spectroscopy, measurement and evaluation of biosignals, electron microscopy and lithography, electron and laser beam welding, magnetron sputtering and cryogenics to construct new instruments and systems.

Our activities

- Utilisation of electron beams for displaying, diagnostics, lithography and welding
- Designing new sequences for magnetic resonance tomography and their utilisation for the detection of chemical changes in living organisms including humans
- Measurement of thermal radiation or absorption of materials under very low temperatures, designing cryogenic systems
- Technology of application of thin films
- Scanning and processing of biosignals in medicine
- Utilisation of laser beams for welding, spectroscopy, precision measurement of distances and refractive index of gases, for handling of microobjects and nanoobjects

More detailed information:
<http://alisi.isibrno.cz/upload/files/brozura-dotisk-cz.pdf>

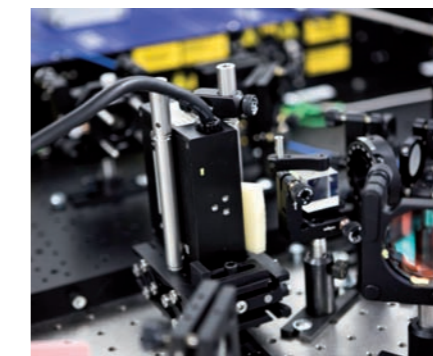
Target groups

- High tech, innovative firms
- Universities
- Research institutes

Results

- Relief structures based on the principle of diffractive optics
- Development and verification of methodology of physical realisation of optical thin films
- Analysis of the microstructure and material composition of inorganic nanoparticles
- A system for the measurement of angles on ELI handlers
- Study of dealing with measuring techniques for measuring angles with extreme resolution
- Analysis of the microstructure and chemical composition of synthetic diamond powders
- Elaboration and verification of methodology of displaying and analysing an animal model of schizophrenia by means of magnetic resonance in a field of 9.4 Tesla and gauging of a supplied sample
- Research and development of electron guns intended for electron beam welding
- Experimental determination of thermal radiation properties of surfaces of parts of instruments for operation in cosmic space
- Development of welding techniques for superalloys used in the automotive industry

- Research into detection principles and their application during the development of special detection units for electron microscopes
- Design and execution of an assembly for spectroscopy of dissociated iodine vapours
- Relief structures based on the principle of diffractive optics
- Development of heterogeneous welds of structures for special industrial fittings
- A system for defined 3D setting and monitoring of a magnetic field
- Design of a nanolithographic



An experimental assembly for generating ultra-precision optical frequencies through femtosecond pulse lasers

- system based on two-photon photopolymerisation
- A module for measuring the optical spectrum in the band of 1300-1600 nm
- A draft design and pilot experimental verification of a system for measuring the straightness of firearm barrels
- Development of welding and soldering technologies for cryogenic systems
- Elaboration and verification of methodology of physical realisation of optical thin films with the electron

- vapour-deposition method
- New soldering and welding methods for new sources of X-ray radiation
- Elaboration and verification of methodology of physical realisation of optical thin films for interferometers
- Absorptivity of thermal radiation for the development of materials by superinsulation for alternating magnetic fields
- Development of welding methods for zirconium alloys intended for creep tests
- Topography of surfaces of thin polymer films
- Development of an electron gun for welding radioactive samples in a hot chamber used for the nuclear industry
- Development of a membrane heat exchanger
- Study of the microstructure of heat-resisting steels by means of slow-electron microscopy
- Development of technologies of welding heterogeneous joints for advanced forming methods
- Expert activities in cryogenics
- Microanalysis of special steels
- Development of the reference of optical frequency for the stabilisation of laser
- Design and realisation of the reference of optical frequency in the visible spectrum area
- Development and manufacture of absorption cells for spectroscopy
- Development of a measuring station for sorting ferromagnetic materials
- Research and development of permanent joints of metal materials for instrumentation using electron welding and vacuum soldering technology

X-ray Computed Tomography Workplace

Institute of Geonics of the CAS, v. v. i.



Contact

Institute of Geonics of the CAS, v. v. i.

Studentská 1768
708 00 Ostrava-Poruba

Ing. Kamil Souček, Ph.D.;
RNDr. Lubomír Staš, CSc.

Phone: +420 596 979 111 (278; 308)

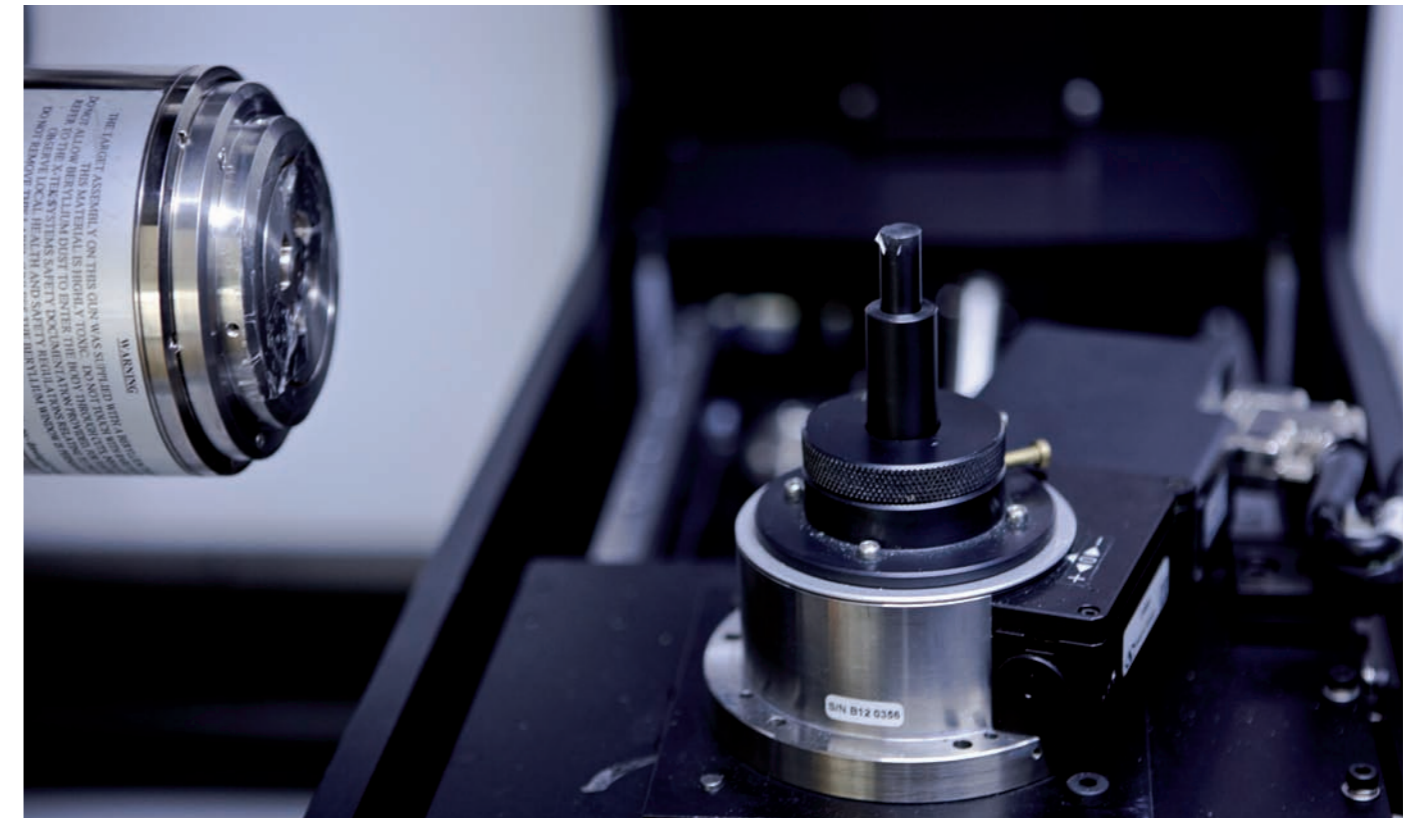
Fax: +420 596 919 452

E-mail: soucek@ugn.cas.cz;
stas@ugn.cas.cz

<http://www.ugn.cas.cz>



The XT H 225 ST X-ray CT system



The XT H 225 ST X-ray CT system, transmission X-ray source with a rotary stage for samples under analysis

Competences

The X-ray Computed Tomography Workplace was set up in 2012 as part of the formation of the Institute of Clean Technologies and Utilisation of Energy Raw Materials under an agreement between the VŠB - Technical University of Ostrava, Faculty of Mining and Geology and the Institute of Geonics of the CAS. The importance of the Workplace lies especially in the possibility of a non-destructive method of analysing and studying internal structure and space-time changes in various types of geomaterials in relation to the action of external factors. The Workplace has specialists in the field of geology, rock and building engineering, nuclear physics and other related fields

such as the extraction of mineral raw materials, geomechanics, geotechnics etc. The Workplace is equipped with two XT H 450 2D/3D and XT H 225 ST industrial micro-focus X-ray computed tomographs, reconstruction software by NIKON Metrology NV and VGStudio Max visualisation software.

Basic technical specification of equipment of the Workplace

The **XT H 450 tomograph** is a system with maximum acceleration voltage and power of an X-ray source: 450 kV/640 W, size of X-ray focus at 200 W/600 W: 80 µm/300 µm, maximum weight, diameter and height of objects

scanned: 100 kg/ca 0.6 m/0.8 m, maximum radiable thickness of analysed materials: 395 kg/m², X-ray radiation sensor (16-bit depth): area detector (200 µm per pixel, 4 million pixels) and linear detector (400 µm per pixel, 2000 pixels).

The **XT H 225 ST tomograph** with maximum acceleration voltage and power of an X-ray source (reflective mode): 225 kV/225 W, with maximum acceleration voltage and power of an X-ray source (transmission mode): 180 kV/20 W with the size of X-ray focus (reflection and transmission mode): < 3 µm/1 µm, with maximum weight, diameter and height of objects scanned: 50 kg/ca 0.35 m/0.35 m,

maximum radiable thickness of analysed materials: 237 kg/m², with an X-ray radiation sensor (16-bit depth): area detector (200 µm per pixel, 4 million pixels).

Target groups

The target group for contract research is represented by industrial enterprises, technological centres and research institutions at national and international level. Another target group may comprise, for example, project partners from the university environment, from the environment of industry and applications, institutions active in research focusing on the study of the

behaviour of geomaterials in relation to their internal structure.

Our services

The Workplace offers the following types of expert analyses:

- Research and analyses in the field of areal and spatial density nonuniformities of materials, non-destructive research into the structure and construction of rocks, geomaterials, composite, construction and structural materials
- Visualisation of the internal structure of materials
- Study of other types of materials (steel, alloys, biological materials etc)

as well as inspection of equipment and machinery or, where appropriate, components thereof

- Research into the character of disruptions, defects, formation and propagation of cracks in materials under study
- Possibility of coordinate measurement of geometric shapes of objects being analysed by means of software for the analysis of tomographic data
- Research into the pore space of rocks, the character of penetration of liquids into a porous or disrupted environment
- Radiography – taking X-ray images

Water Jet Workplace

Institute of Geonics of the CAS, v. v. i.



Contact

Institute of Geonics of the CAS, v. v. i.

Studentská 1768
708 00 Ostrava-Poruba

Ing. Josef Foldyna, CSc.

Phone: +420 596 979 111 (328)

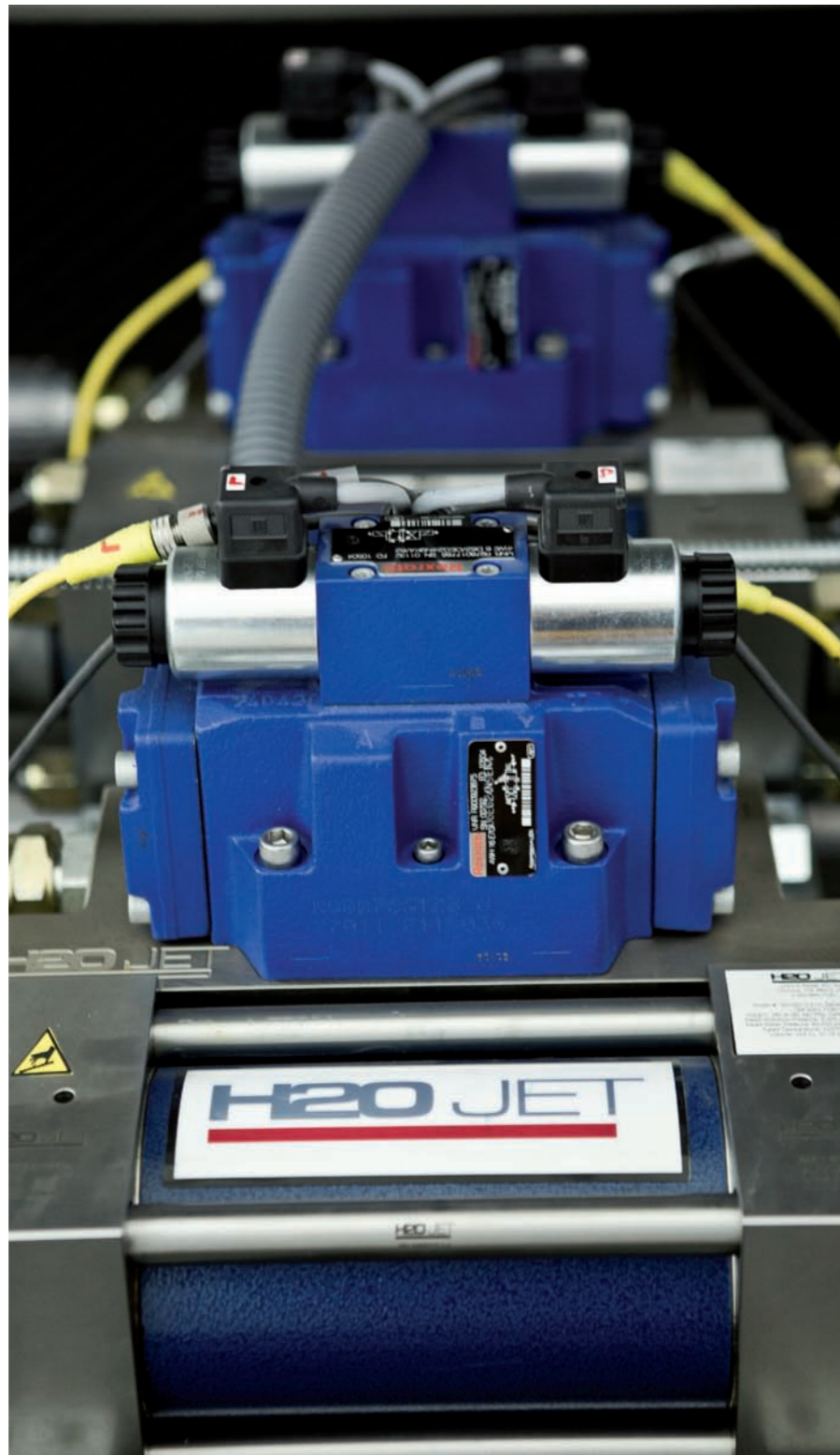
Fax: +420 596 919 452

E-mail: josef.foldyna@ugn.cas.cz

<http://www.ugn.cas.cz>

Specialisation

The Water Jet Workplace at the Institute of Geonics of the CAS has been systematically built since 1985. The important impulse for its development was a project of the Operational Programme Research and Development for Innovations – Institute of Clean Technologies of Mining and Utilisation of Energy Raw Materials dealt with in cooperation with the VŠB-Technical University of Ostrava, within the framework of which the equipment of the Workplace was supplemented by new pumps, water jet manipulators and measuring instruments. Research activities of the Workplace concentrate on intensifying the effects of high-speed water jets, on the interaction of water and abrasive jets with materials and on the development of new areas of



A PTV75-60 pump pressure multiplier

utilisation of high-speed water jets in machining, in medical applications and for ultrafine grinding and disintegration of materials.

Competences

The Workplace offers precision cutting by a water and abrasive jet, testing of surface treatments, removal of surface layers, cleaning by pulsating water jets, disintegration of particles by water jets, visualisation, measurement and evaluation of flow, numerical modelling of flow and stress calculations, analysis of the size of particles, measurement of surface characteristics, pressure tests and expert consultations with top experts including the preparation of projects and proposals for their implementation. To this end, the Workplace is equipped with a Hammelmann HDP 253 high-pressure plunger pump (maximum working pressure 160 MPa, maximum flow rate 67 l/min), PTV75-60 high-pressure pump with two pressure multipliers (working pressure 40 415 MPa, maximum flow rate 7.8 l/min at 415 MPa), ABB IRB 6640-180/2.55 Master robot for manipulating the cutting head of a water jet, X-Y PTV WJ202-2Z 1xPJ – 2D cutting table with a tilting cutting head, specially designed for water-jet cutting, a system for the visualisation and measurement of flow velocity-fields (2x PIV Imager Pro X 2M CCD camera with accessories, NL 135-15 PIV two-pulse laser with accessories and optics for the creation of a light section, High-SpeedStar 3G CMOS high-speed camera, control computer with DaVis software), a notebook-based

measuring system with a DAG National Instruments (16-bit) measuring card and LabView Full Development System software, FRT Micro Prof optical profile meter, Fritsch Analysette 22 particle size laser analyser and a computing system for flow modelling equipped with CFD ANSYS software.

Target groups

The Workplace offers cooperation both on the basis of joint projects and contract research to domestic and foreign academic and research institutions as well as industrial enterprises and firms engaged in the research, development and utilisation of high-speed water jet technology throughout the spectrum of their applications (cutting, machining, rehabilitation of structures and buildings, cleaning, removal of coatings and deposits, hydrodemolition, mining, abrasive materials, special and medical applications of water jet, high-pressure technology, safety aspects etc).

Results

As part of research oriented to intensify the effects of high-speed water jets, an original method of generating a pulsating fluid jet by means of an acoustic generator, which is patent-protected in the USA, Australia, Czech Republic and by a European patent with validation in 20 states, has been developed and it is used in the form of an exclusive licence agreement with a renowned German manufacturer of high-pressure equipment – Hammelmann GmbH.



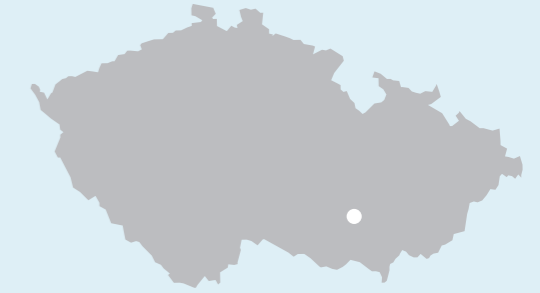
The ABB robot whilst manipulating the generator of a pulsating water jet

The Workplace has also participated, in cooperation with the Military Technical Institute of Armament and Ammunition (MTIAA) Slavičín, in the development of technology of disposal of the solid propellant of SS-23 missiles. Based on the results of laboratory and field tests, a technological procedure was worked out for cutting the charge and creating a fine ground mixture of the charge in water by means of high-speed water jets. The procedure was then applied by the MTIAA when disposing of all the SS-23 missiles that were in the arsenal of the Czech army.

Furthermore, for example, a draft was drawn up of technology of waste-free disposal of explosive charges placed in boreholes for seismic research within the built-up area of the municipality of Halenkovice, based on the use of high-speed water jets for the safe uncovering and subsequent removal or destruction of these explosive charges.

Laboratories of Mechanical, Magnetic and Transport Properties and Structure of Materials

Institute of Physics of Materials of the CAS, v. v. i.



Contact

Institute of Physics of Materials
of the CAS, v. v. i.

Žižkova 22
616 62 Brno

Secretariat:

Phone: +420 541 212 286

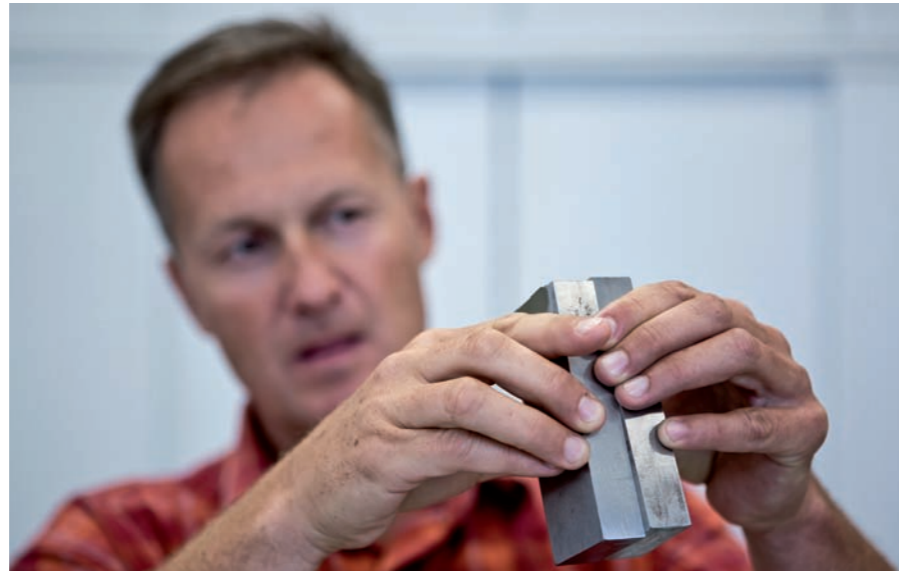
Fax: +420 541 212 301

E-mail: secretar@ipm.cz

<http://www.ipm.cz>

Specialisation

The mission of the Institute of Physics of Materials of The Czech Academy of Sciences (ÚFM) is to clarify the relation between the behaviour and properties of materials and their structural and microstructural characteristics, with research into advanced metal materials and metal-based composites in relation to their microstructure and the method of preparation being a priority. The purpose is to optimise the utility properties of materials and predict their service life. The Institute has appropriate and modern equipment for these tasks, and a part of its capacity can be used within the framework of cooperation with industry in dealing with problems concerning materials. At the



Work in a high-cycle fatigue laboratory

present time, the Institute employs more than 120 staff. Approximately one third of them possess scientific qualifications.

Competences

The Institute has a longstanding tradition in the research area that dates back all the way to 1955, when it was founded. Historically, the interest of the ÚFM has focused mainly on metal materials. Through natural development, its research portfolio has been expanded also by the study of composites or ceramic materials.

The range of expert activities of the ÚFM is broad. It includes, for example, characterisation of materials with the help of static and dynamic tests (strength and fracture characteristics of materials in a broad range of temperatures), fatigue testing of materials involving both mechanical and thermomechanical fatigue, the

determination of characteristics associated with the propagation of fatigue cracks, the determination of the creep behaviour of materials even under very high temperatures or the determination of electrical, magnetic and transport properties. The Institute has great possibilities for the characterisation of materials by means of both electron and light microscopes, the determination of the chemical composition of materials etc. It also possesses considerable experience with numerical calculations from the atomic level up to extensive analyses of disruption using the finite element method.

Target groups

The target group for services offered by our Institute comprises particularly enterprises and firms engaged in the manufacture of components that undergo great strain of materials when

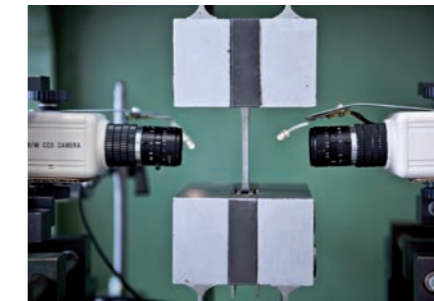
in operation. In particular, these include firms from the energy industry, firms devoted to manufacturing transport technology or components of transport machinery and equipment or firms producing medical instruments and implants. As an example of highly strained components we can state blades and rotors of combustion turbines, turboblowers, reactor vessels, highly strained parts of transport technology (axles, wheels, crankshafts, aircraft fuselage and wings etc), joint replacements. The specialist employees of the Institute have been cooperating in the long term with firms operating in the Czech Republic (Bonatrans Group a. s., GE Aviation Czech s.r.o., PBS Velká Bíteš, a. s., Medin, a.s., ABB, Honeywell...) or with foreign companies (e.g. Voestalpine).

Our services

The Institute offers expert activities in the abovementioned areas, and makes use of modern instrumentation for performing them that corresponds to the focus of the individual research groups. It includes, in particular:

- Loading machines and instrumented impact machines by Zwick or Amsler, high-speed camera and other equipment for tensile tests, determining fracture characteristics and so forth.
- The possibility of carrying out a broad range of fatigue tests from thin films with the use of a MTS Tyron device up to devices with a capacity of 100 kN. We have resonance pulsers and servo-hydraulic fatigue machines are available. The ÚFM offers the possibility to determine

fatigue characteristics during multi-axis loading (tension-pressure in combination with torsion) or in thermomechanical fatigue. There are broad possibilities for determining the characteristics of the propagation



An experimental set-up for measuring the speed of the propagation of fatigue cracks

of fatigue cracks. Most tests can be carried out in a broad range of temperatures from ca. -70°C to 900°C, on a smaller scale to 1200°C. Analyses focusing on the initiation of initial damage, assessment of the residual life or safety of structures are sought-after.

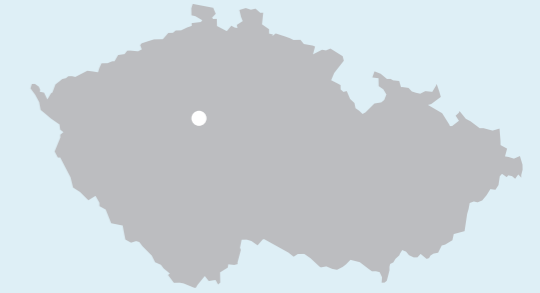
- The ÚFM has forty testing machines for measuring the creep properties of metal materials. Many of them are equipped with furnaces for the determination of creep characteristics under rather high temperatures (up to ca. 900°C). Two machines by Zwick, suitable also for very high temperatures and equipped with chambers with a possibility of testing up to 1400°C, are unique.
- The ÚFM has considerable facilities as regards the characterisation of materials. In addition to experienced staff, the Institute also has five electron microscopes (two TEMs by Jeol and Philips companies,

three SEMs by Tescan and Jeol companies). It is possible to determine the orientation of crystallographic planes by employing the EBSD method or the chemical composition of materials by energy-dispersive X-ray spectroscopy (EDS). A scanning electron microscope from Tescan is equipped with the FIB technology (focused ion beam) that makes it possible to analyse subsurface layers of material after it is dedusted by ions, or the manufacture of microscopic lamellas for precise observation in a transmission electron microscope. A well-equipped laboratory for the preparation of (metal) samples for electron microscopy or a metallographic laboratory are a matter of course.

- Also, there are vast possibilities of determining magnetic and transport properties. Devices that allow measuring and processing materials are available. For example: measurement of magnetic parameters in a magnetometer with a vibrating sample (-278-800°C), determination of the temperature dependence of electrical resistance in a temperature interval of 20-800°C, thermal treatment of small samples in a controlled atmosphere and high vacuum (20-800°C), phase and structure analysis of materials based on the measurement of X-ray diffraction and Mössbauer spectroscopy.
- Specialist employees of the Institute are able to carry out numerical analyses of the limit states of structures and estimations of residual life.

Public Opinion Research Centre (CVVM)

Institute of Sociology of the CAS, v. v. i.



Contact

Institute of Sociology of the CAS, v. v. i.

Jilská 1
110 00 Praha 1

Phone: +420 210 310 220

E-mail: cvvm@soc.cas.cz

<http://cvvm.soc.cas.cz/>

Competences

The Public Opinion Research Centre of the Institute of Sociology of the CAS inquires into both practical and theoretical issues associated with public opinion and its research, methodology of research in social sciences and analysis and interpretation of data at political, economic and social level.

As part of their specialties, individual specialist and scientific workers deal with public opinion as a social phenomenon and analyse partial problems thereof. 15 permanent workers work at CVVM, who entirely cover the needs of all-embracing sociological research and its interpretation. They have their own inquirers' network, the extent (ca. 500 inquirers) and distribution of which allow conducting both population-wide and specialised surveys. In the case of specific topics, the CVVM cooperates with experts of the Institute of Sociology



The CVVM conducts 10 regular and a number of extraordinary surveys every year

but also with specialists from the commercial, public or academic sphere.

Target groups

The CVVM draws up expert opinions, analyses and performs data collection for client from among state-administration institutions (e.g. ministries, the Occupational Safety Research Institute, the Radioactive Waste Repository Authority), commercial (e.g. Heineken ČR, Skanska, Perfect Crowd) and non-profit entities (Goethe Institute, Art for Life etc) or research organisations and universities (virtually all leading Czech universities – Charles University, Masaryk University, Palacký University

in Olomouc), including foreign ones. It is also involved in international cooperation of public-opinion research agencies of the Central European Opinion Research Group (CEORG).

Results

The key project of applied research is long-term continuous research Naše společnost (Our Society), as part of which ten surveys are conducted per year. It is a public-opinion survey on a representative sample of a Czech population above 15 years, in which at least 1,000 respondents take part at a time. The omnibus form of the questionnaire makes it possible to cover



Regular inclusion of thematic blocks of questions makes it possible to monitor social phenomena in the long term

a broad range of topics from political issues, civic participation, security issues, attitudes to the EU, NATO and to other institutions, a wide spectrum of economic issues, unemployment issues, global problems, value orientations, social politics, education system and several dozens of other topics. In most circles, the CVVM has unique timelines at its disposal, on which it carries out detailed analyses. It then publishes basic outputs in the form of press releases (ca. 100 media hits a month); CVVM analysts utilise them as bases for their comments in the media, they appear in annual reports of ministries and so forth.

In addition to this project, the CVVM implements a great number of projects of various extent and type for its clients. In 2013, it implemented the following projects, inter alia:

- Post-election study – Social media and forms of political participation. A unique post-election study on early Parliamentary elections in October 2013. Implemented, inter alia, for Konrad-Adenauer-Stiftung, Faculty of Social Sciences of the Charles University in Prague.
- The image of the Czech Statistical Office (ČSÚ) in view of the Czech public 2013. Client: ČSÚ.
- Migration relations of foreigners (and

domestic population) in the Czech Republic: concentration or diffusion processes? Large-scale data collection in a specific population of minorities in the CR. For: Charles University in Prague, Faculty of Science.

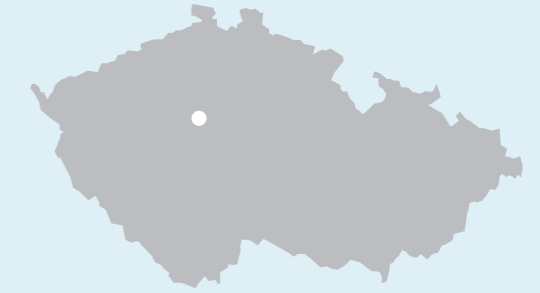
- “The elections are over... and what next?” Election surveys 2013: Evaluation and the future. Workshop of the Public Opinion Research Centre of the Institute of Sociology of the CAS and the Association of Market and Public Opinion Research Agencies (SIMAR)
- Specification of a selection plan of population research. An expert analysis and consultation of the possibilities of data collection for CZECH Consult, s.r.o.
- Beer in the Czech Republic in 2013 (20/11/2013). A round table of the Czech Beer and Malt Association and the Public Opinion Research Centre of the Institute of Sociology of the CAS
- “Going for a beer with a politician”. Data collection and analysis for Heineken Česká republika, a.s.



Research reports dating back as far as 1946 can be found in the CVVM archives.

Centre for Analysis of Functional Materials Project (SAFMAT)

Institute of Physics of the CAS, v. v. i.



Contact

Institute of Physics of the CAS, v. v. i.

Ing. Ján Lančok, Ph.D.

Phone: +420 266 052 645

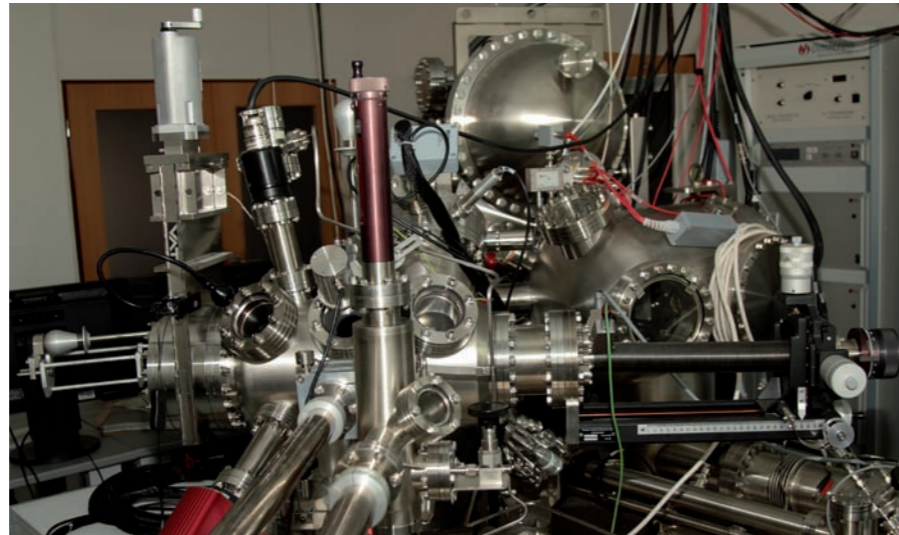
E-mail: lancok@fzu.cz

<http://www.fzu.cz/>

Specialisation

SAFMAT is an infrastructural project of the Institute of Physics (FZÚ) (funded from the Operational Programme Prague – Competitiveness), by means of which modern laboratories were built. Thanks to them, interdisciplinary research into functional materials with new, interesting physical properties for a broad spectrum of technical applications including application in medical technology and medicine can be conducted at the FZÚ. Its backbone consists of three modern experimental devices making it possible to characterise the microstructure and chemical composition of surfaces of materials at macro-, micro- as well as nanolevels (SEM-FIB TESCAN FERA3, NanoESCA, AFM Bruker) and equipment for the study of electron paramagnetic resonance (EPR).

A scanning electron microscope with



The NanoESCA instrument including a preparatory UHV chamber for analysing the chemical composition of materials in nano-dimensions



The TESCAN Fera3 scanning electron microscope with a focused ion beam for analysing the surfaces and microstructures of functional materials

a plasma focused ion beam and a wide variety of analysers allows displaying the surface of materials with electrons of various energy, including analysing its chemical composition, orientation, microstructure during the action of external influences such as increased temperature or mechanical stress.

The NanoESCA device combines electron microscopy and photoelectron spectroscopy. Therefore, using it one can study chemical composition and structural properties in a nanometric spatial resolution. This proves to be very attractive for a number of modern material applications in

which the nonuniformity of structure and of chemical composition plays a substantial role in these dimensions. The EPR laboratory is equipped with a top-class EPR spectrometer capable of analysing the dynamics and spatial distribution of paramagnetic particles at atomic level in a random type of materials. In addition to solid substances, the instrument also enables the analysis of gels, liquids and biological samples. This method is widely used for characterising defects in solid-state materials and for characterising some organic molecules. The behaviour of cells in an environment with specific physical parameters (e.g. low temperature) is studied in a new atomic force microscopy (AFM) laboratory. Other experimental equipment includes ellipsometers for measuring the optical properties of volumetric materials and thin films in a broad spectral range (from UV up to far IR). Within the infrastructure, an optical lithography laboratory was built and employs the method of direct recording into photoresist by means of UV lasers with a resolution of 0.6 micrometers.

The SAFMAT Centre offers the research community and industrial enterprises in the field of mechanical engineering, optics and fine mechanics, vacuum technology, electrical engineering and medical instruments and implants to make use of a part of the capacity of its top-class facilities by way of services.

Competences

- Analysis of paramagnetic centres in materials, e.g. optical crystals,

- semiconductors
- Analysis of the structure of organic materials
- Characterisation of surfaces of materials or thin films
- Preparation and characterisation of thin-film materials in the conditions of a ultra-clean vacuum
- Designs of special vacuum systems for PVD technologies
- Analysis and characterisation of the real structure of crystalline materials
- Analysis of new materials for biological and medical applications
- Characterisation of interfaces of biological and inorganic materials

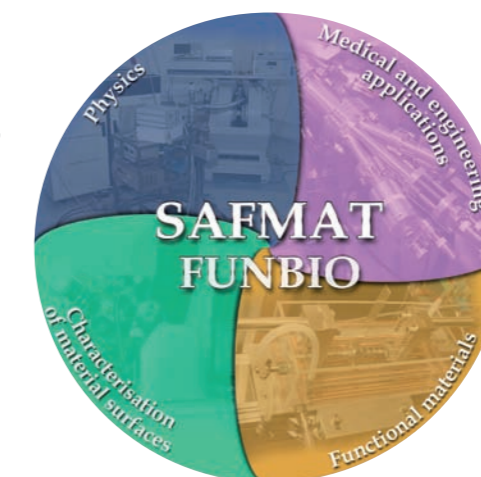
Target groups

- Manufacturers of laser and scintillation crystals
- Manufacturers of semiconductor crystals
- Companies employing thin-film technologies, e.g. graphene, hard and metal coatings, thin-film sensors
- Manufacturers of electronics and microelectronics

- Breweries for determining the quality of hops
- Engineering and metallurgical industry
- Manufacturers using actuators and super-elastic elements with shape-memory alloys
- Manufacturers of bio-implants and biomedicine

Results

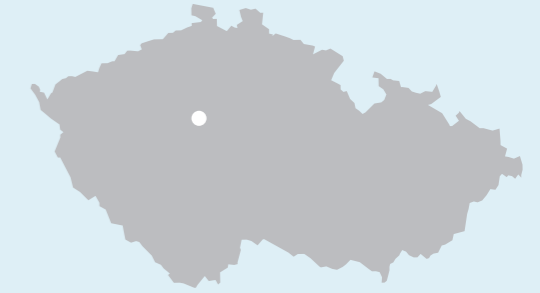
- Characterisation of defects in optical crystals – Crytur, spol. s r.o.
- Development and design of a deposition system – Institut Lumière Matière of Université Lyon 1
- Preparation and characterisation of graphene layers – University of Chemistry and Technology Prague
- Characterisation of thin-film covering of microwave components – Tesla Electrontubes, s.r.o.
- Analysis of laser welds
- Post-treatment characterisation of the surfaces of thermocouples (LINTECH/Continental)
- Design of probes for displaying magnetic particles by magnetic resonance spectrography of advanced preclinical imaging
- Drafting of methodology minimising damage during handling of haematopoietic stem and embryonic cells
- Surface layers of superelastic stents made of the NiTi alloy resistant to corrosion fatigue – ELLA-CS, s.r.o.
- Design and manufacture of springs made of the NiTi alloy for thermostatic valves – THT Polička, s.r.o.



Field specialisation of the SAFMAT project

Laboratories of Nanostructures and Nanomaterials (LNSM)

Institute of Physics of the CAS, v. v. i.



Contact

Institute of Physics of the CAS, v. v. i.

prof. Ing. Pavel Lejček, DrSc.

Phone: +420 266 052 167

E-mail: lejcekp@fzu.cz

<http://www.fzu.cz/>

Competences

The mission of the LNSM is to provide top instrumentation and know-how in the field of research and development to external entities from industry, universities, scientific and research institutions, whilst simultaneously doing qualified basic research at world level. Within the LNSM we apply ourselves to the development and utilisation of a broad spectrum of innovative and promising applications that include e.g. materials for biocompatible and bioabsorbable implants in medicine, hydrogen-storage materials in the transport industry, light construction materials, epitaxial materials for spintronic applications, silicon- or nanodiamond-based thin-film covers, nanostructures for photovoltaic solar cells, functionalised biocompatible surfaces e.g. for biosensors etc.

The competence of the LNSM



A detail of a high-resolution transmission electron microscope (HR TEM)

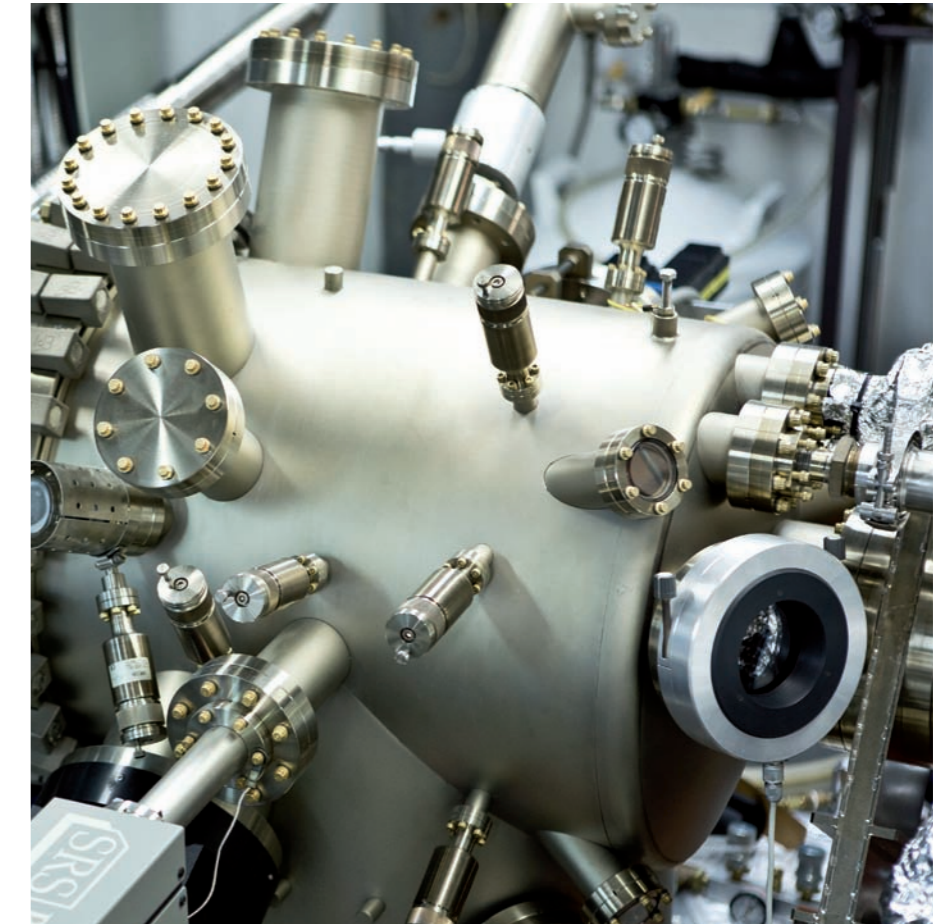
also encompasses the continuous development of human resources through vocational training of scientists and students in order that they can control complex devices, teaching at universities, holding expert meetings (workshops, seminars, summer schools etc) and popularisation of science for the general public.

Target groups

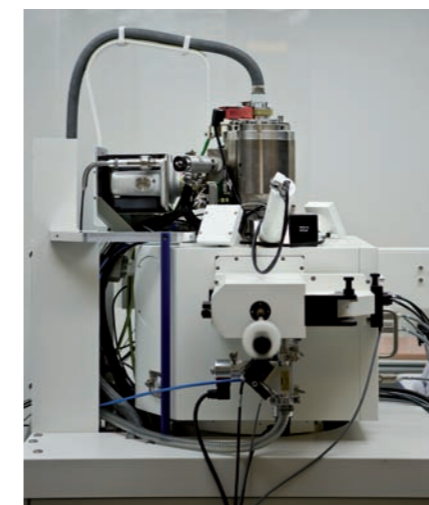
Technological start-ups, support of spin-off companies, small and medium-sized high tech enterprises that do

not have necessary experimental methods or equipment, which allows required analysis, at their disposal; multinational technological firms as part of long-term cooperations at the level of joint projects; research institutions from among universities and scientific institutes. In terms of branches, these entities cover primarily:

- Material sciences (metals, semiconductors, thin films etc)
- Physics (optics, optoelectronics, spintronics)
- Organic and inorganic chemistry, medicine and biology, power engineering



A molecular beam epitaxy (MBE) growth chamber by the Veeco company



A combined electron-beam lithograph (EBL) and a scanning electron microscope (SEM)

Our services

Doing branch and inter-disciplinary research and development by highly qualified staff using top apparatus including the provision of "added value" by way of processing measured data, interpretation of results and consultations about other possibilities of analyses in the following areas:

- Analysis of the structure of materials by means of microscopic techniques (SEM, TEM, AFM, Raman scattering microspectroscopy)
- Analysis of mechanical properties of materials from the macro- up to the

nanometric level

- Development of new alloys based on metals and nanoparticles of metal oxides
- Development of materials for spintronics based on magnetic semiconductors
- Development of silicon thin films and nanostructures
- Development of nanocrystalline diamond layers and nanostructures

If necessary, the workers are able to perform services within extremely short times.

Laboratories of Scintillation and Luminescent Materials (SciMat)

Institute of Physics of the CAS, v. v. i.



Contact

Institute of Physics of the CAS, v. v. i.

Ing. Martin Nikl, CSc.

Phone: +420 606 641 457

E-mail: nikl@fzu.cz

<http://www.fzu.cz/>

The SciMat laboratories are engaged in the research and development of new scintillation and luminescent materials, both in terms of fundamental physical and chemical process and their practical application, i.e. measurement of parameters that are of importance to application. Scintillation materials generally serve for monitoring and detecting ionising radiation with a broad range of applications, e.g. in medical imaging and radiotherapy, in high tech industrial applications and scientific instruments, safety technologies and in science proper, mainly in high-energy physics and nuclear physics.

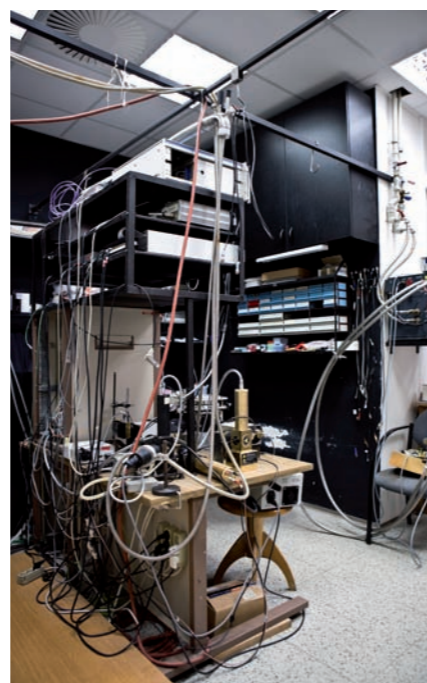
Competences

- Research studies from technical literature
- Measurement of luminescence spectra in the UV-VIS spectral



A detection unit in a McPherson VUV spectrophotometer

- band in a broad temperature range of 10-800 K
- Measurement of luminescence decay on a time scale from 100 ps up to the order of minutes
- Study of defective and trapping states affecting the scintillation and luminescence mechanism by correlated experiments of optical, luminescence and magnetic spectroscopies
- Measurement of scintillation parameters – a light yield in excitation by gamma and alpha radiators; scintillation decay in excitation by gamma radiators, radioluminescence in excitation by X-ray radiation
- Measurement of absorption spectra and induced absorption, i.e. radiation damage to optical materials



An overall view of luminescence apparatus; 5000M model, Horiba Jobin Yvon

Target groups

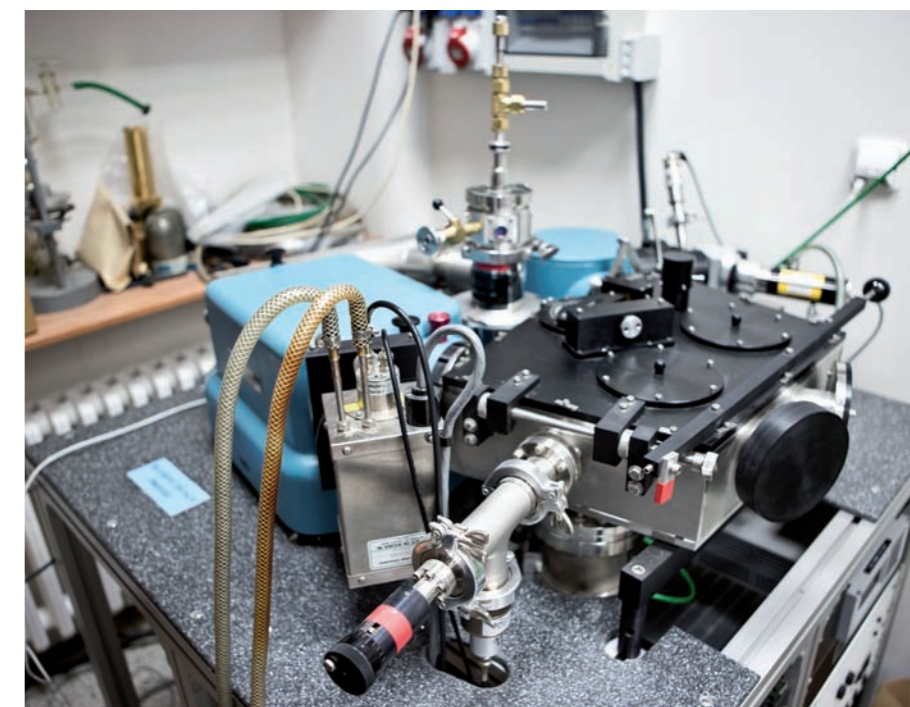
- Manufacturers of scintillation and luminescent materials
- Firms operating in the field of application of scintillators, solid-state lasers, optical sensors and lighting technology

Result

- Development and testing of scintillation monocrystals: Crytur, spol. s r. o.
- Development and testing of plastic scintillators: Envinet a.s.
- Development and testing of fluoride monocrystals for optical and scintillation applications: Tokuyama Co.



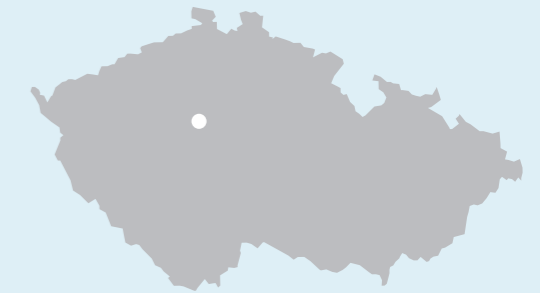
The cryostat head of a Janis closed-cycle refrigerator



An overall view of the optical part of a McPherson VUV spectrophotometer

SHARE project (Survey of Health, Ageing and Retirement in Europe)

Economics Institute of the CAS, v. v. i.



Contact

Radim Boháček, Ph.D.
koordinátor projektu SHARE
v České republice

Economics Institute of the CAS, v. v. i.

Politických vězňů 7
111 21 Praha 1

Phone: +420 224 005 123,
+420 224 005 153

E-mail: radim.bohacek@cerge-ei.cz,
radim.bohacek@gmail.com

<http://www.share-project.org>
<http://share.cerge-ei.cz>

Competences

The Economics Institute of the Czech Academy of Sciences (NHÚ), public research institution, is a participant in a joint workplace with the Centre for Economic Research and Graduate Education of the Charles University (CERGE) and closely cooperates with the Faculty of Social Sciences of the Charles University in Prague. The NHÚ pursues the scientific research into economic theory at macro- and microlevels, public finance, econometrics, economic integration, labour economics, market structure and organisation, international trade, international finance, environmental economics, health economics, experimental economics,



© MEA Max Planck Institute Mníchov

transition economy and other areas that are associated with the transition to market economy and entry into the EU. An important scientific task of the NHÚ is creating studies on the Czech economy and an active participation in the life of the Czech economic community.

The NHÚ is a coordinator of the scientific infrastructure of the SHARE (Survey of Health, Ageing and Retirement in Europe) in the Czech Republic. The SHARE project consists in the creation of an all-European longitudinal data file that includes persons aged 50+ and their families. The main topics of this multidisciplinary research on more than 100,000 respondents from 21 EU countries include: demography, family and social networking; education; health and healthcare; employment and pension;

income, consumption, property; help and finance in a family; housing; activities; life history; quality of life; the course of the last year of life in the event of death etc. The outcome comprises a unique, freely available data file providing information on the state, history and development of Czech and European societies. The SHARE is the largest international scientific project and research infrastructure of the EU in social sciences. It helps governments and research workers understand the consequences of demographic changes and prepare optimum measures for public finance, labour market, health or the pension scheme.

Target groups

The NHÚ offers help in processing and interpreting the data of the SHARE



© MEA Max Planck Institute Mníchov

project, analyses of individual topics and mediates access to the SHARE project data. Since November 2013, a new portal with simplified access to the data of the research infrastructure “easySHARE” has been available to the research public and students, and it newly allows group utilisation of the data for teaching at universities. The investigation team cooperates with researchers and pedagogues of universities in preparing courses and offers practical assistance in utilising the data in teaching.

The SHARE infrastructure makes it possible to compare the effects of various social security systems (for example, the pension scheme and healthcare system) on the quality of life, economic position, retirement, social and work participation of middle-age people and seniors etc.

Thanks to SHARE, thus, it is possible to perceive Europe as an experimental laboratory with various systems, reforms that change over the course of time. By means of the data of the SHARE infrastructure, researchers can monitor these changes, draw conclusions about the behaviour of people and recommend them for use in the formulation of optimum government policies in individual countries.

Results

The SHARE research infrastructure is currently the only long-term longitudinal survey (monitoring the same persons for many years) in the Czech Republic. In 2013, the SHARE research infrastructure successfully finished the fourth wave of data collection on a sample of more than 6,000 respondents who took part in the previous survey

waves in 2006/7, 2008/9 and 2010/11. The SHARE scientific infrastructure will welcome further persons interested in placing their own questions into the SHARE questionnaire.

The SHARE research infrastructure has been cooperating in the long term with the panel surveys on ageing Health and Retirement Study (USA), English Longitudinal Study of Ageing (UK). Panel surveys on ageing are carried out based on the SHARE research infrastructure in a number of other countries. These collaborations are essential for the further international compatibility of the SHARE research infrastructure and are of great benefit to comparing the population ageing process across countries with a different level of economic, social and institutional development.

The SHARE research infrastructure cooperates with the state administration of the Czech Republic, the Research Institute for Labour and Social Affairs, Ministry of Labour and Social Affairs, Czech Republic Government Council for Senior Citizens and Population Ageing and with a number of research institutions and universities. In addition to the academic sphere, the European Commission is the biggest user of the data of the research infrastructure: DG ECFIN uses the data of the SHARE research infrastructure for long-term projections of expenditure on pensions and healthcare, DG SANCO for health indicators, and DG EMPL for measures in the area of active ageing, inter alia, retirement and adjustment of pensions.

Centre for Biorefining Research (BIORAF)

Institute of Chemical Process Fundamentals of the CAS, v. v. i.



Contact

Institute of Chemical Process
Fundamentals of the CAS, v. v. i.

Ing. Olaga Šolcová, DSc.

Rozvojeová 1/135
165 02 Praha 6-Suchbátov

Phone: +420 220 390 111

E-mail: solcova@icpf.cas.cz

<http://www.icpf.cas.cz>

The Competence Centre for Biorefining Research (BIORAF), which was formed with the support of the Technology Agency of the Czech Republic in 2012, falls under green chemistry projects and specialises in the comprehensive utilisation of biomass using environmentally-friendly procedures. The set goal is directed at obtaining feedstuffs, food supplements, fertilisers, biopolymers and biofuels of higher generations from materials of plant and animal origin.

The BIORAF project

- It creates an interdisciplinary centre with a high innovation potential for the sustainable exploitation of renewable resources and aspires to take the leading position in the biorefining



Waste-free technology of utilising recycled water for the growth of microalgae

area in the Czech Republic in the years to come.

- It utilises biomass of animal and plant origin including algae.
- It interconnects the private sector with experts from various scientific branches (e.g. biology, analytical chemistry, enzymology, chemical, biochemical and material engineering etc).
- The principle of the BIORAF project is the interconnection of enterprises producing various biologically usable waste substances in order that waste from one production specific to a given producer can be used as a valuable raw material for another production process.

Competences

The specialisation of the Centre follows from the interconnection of

experts in various scientific areas – plant biosciences, algology, analytical chemistry, enzymology, microbiology, chemical and biochemical engineering, material engineering (biocomposites) and experts in assessing the life cycle with the private sector. All the teams composed of renowned scientists have top equipment in the above branches including the possibility to verify the technology on a magnified scale as well as analyses in accredited laboratories. The BIORAF Competence Centre is able to investigate topics concerning e.g.:

- Ensuring sustainable sources of biomass that does not compete with the use of agricultural land in the food industry
- Development of new, advanced environmentally-clean processes for biorefining biomass to obtain products of high market value, increasing market possibilities and



Chlorella vulgaris with omega-3 fatty acids for feeding purposes

- creating new job opportunities
- Verification of new, promising technologies on demonstration and pilot units in order to commercialise the products developed
- Design and verification of new technological procedures for utilising biomass of animal and plant origin including algae

Target groups

The target group includes entities from both the commercial and research sphere interested in issues concerning the following or related topics:

- Finding and identification of new, highly efficient and selective microbial strains with significant hydrolytic activity against plant and animal proteins including keratins, against animal tissues and fats, lignocellulosic materials,

- polysaccharides, starch and cell walls
- Research in the area of identification and isolation of new hydrolytic enzymes against plant and animal tissues
- Research into new types of accelerators of the growth of plants and microalgae and research into and identification of new types of microalgae with a high content of biologically active substances
- Research into new separation methods with high selectivity, in particular membrane ones for the separation of bioactive substances from microwave-based liquid media for the accelerated separation of bioactive substances from solid, very resistant matrixes and into extraction techniques for the separation of bioactive substances
- Research into new types of bioreactors for the cultivation of microorganisms

- Research into new, highly sensitive and selective methods for the identification and quantitative determination of biological substances in animal and plant material, enabling also rapid screening of new types of biologically active substances

Results

- For the first two years of existence of the BIORAF Competence Centre, two patents have been granted to members of the consortium and two more have been filed, and two prototypes and two utility designs concerning the issues specified below have been developed:
- Strains of unicellular algae capable of growing on contaminated glycerol, technology of cultivation and technology of production of algae biomass for feeding purposes from glycerol
- A photobioreactor for cultivating microalgae and an algae-based food supplement
- Inulin from Jerusalem artichoke tubers and inulin-based products
- Large-area production plantations of energy crops and certification of cultivation procedures for selected crops, extracted bioactive substances from biological materials
- Hydrolysis and fractionation of lignocellulosic materials
- An alternative fuel based on waste of plant origin
- Isolation of carbon dioxide from biogas by means of membrane separation

Laboratory of Chemistry and Physics of Aerosols

Institute of Chemical Process Fundamentals of the CAS, v. v. i.



Contact

Institute of Chemical Process Fundamentals (ICPF) of the CAS, v. v. i.

Rozvojevá 1/135
165 02 Praha 6-Suchbát

Dr. Ing. Vladimír Ždímal
Head of Laboratory

Phone: +420 220 390 246

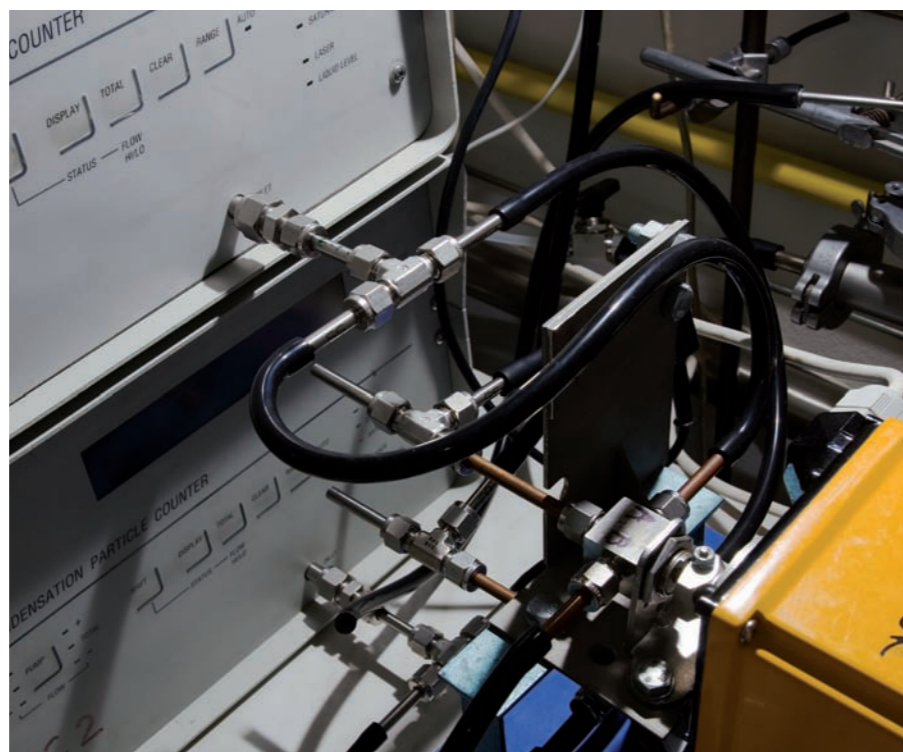
Fax: +420 220 920 661

E-mail: zdimal@icpf.cas.cz

<http://www.icpf.cas.cz/cz/user/zdimal>

Specialisation

The Laboratory of Chemistry and Physics of Aerosols is engaged in the study of chemical and physical properties of atmospheric aerosols, the behaviour of aerosols in an indoor environment, the preparation of composite nanoparticles through the aerosol process, the kinetics of the nucleation and growth of atmospheric systems and emission samplings of aerosol particles under increased temperatures and pressures. As necessary, new aerosol instrumentation is developed for solving given tasks. Considering that the Institute specialises in chemical engineering and related branches, the workers of



Aerosol particle counters – the brain of a set-up for measuring the efficiency of filters

the Laboratory are able to assess tasks being performed from a process point of view, i.e. to understand the dynamics of processes under observation and to predict the behaviour of systems being observed upon changes in conditions (e.g. during an accident).

Competences

We have been engaged on a long-term basis in the sampling of aerosol (i.e. airborne) particles from both outdoor and indoor environments including situations where there are temperatures and pressures at the sampling place that are different from atmospheric ones. We can perform samplings of these particles both online, i.e. with a very fast analysis of the samples,

and off-line (on filters or sorted by size into impactors with subsequent physical or chemical analysis) based on the customer's requirements. In samples taken we determine the concentration of particles and their size distribution. For size-distributed samples we are able to determine the composition of individual size fractions. We are equipped with a set of aerosol spectrometers and counters working on the basis of several physical principles: diffusion, electrostatic, condensation, aerodynamic and optical, which enables us to select the most suitable type of analysis for a given task. The head workers of the Laboratory have many years of experience with aerosol technologies and are constantly in close contact with the latest scientific findings in the branch.

Enumeration of key instruments

c-TOF-AMS aerosol mass spectrometer (Aerodyne, USA), which makes it possible, with a time resolution under one minute, to determine the size and basic chemical composition of aerosol particles in the size range of 50-500 nanometres.

SMPS 3936NL scanning mobility particle sizer (TSI, USA). This aerosol spectrometer determines the size distribution of aerosol particles in the size range of 3-1000 nanometres.

APS 3321 aerodynamic particle sizer (TSI, USA) is an aerosol spectrometer determining particle-size distribution in the size range of 500 nanometres up to 20 micrometres.

Diffusion battery (TSI, ICPF) measures particle-size distribution in the range of 3-300 nanometres.

OPS 3330 optical particle sizer (TSI, USA) determines particle-size distribution from 300 nanometres to 10 micrometres.

BLPI Berner low-pressure cascade impactor (Hauke, Austria) allows separating particles into 10 size classes from 25 nanometres to 10 micrometres for subsequent chemical and physical analyses.

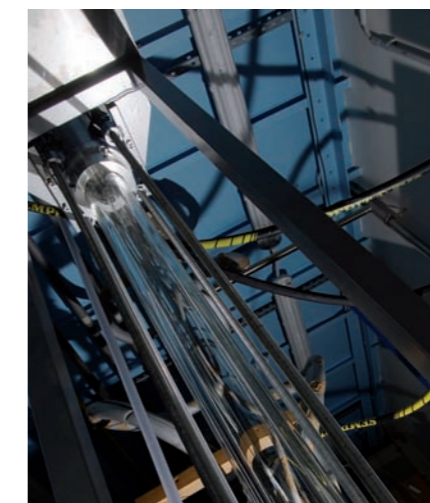
SDI small deposit area cascade impactor (FMI Finland) allows, in a similar way, separating particles into 12 size classes from 45 nanometres to 13 micrometres with an advantage for elementary analysis using the PIXE method.

Condensation particle counter (TSI, USA) – in several versions with detection and determination of the concentration of particles from 3 nanometres to 3 micrometres.

A11 particle size magnifier (Airmodus, Finland) – a two-stage condensation particle counter with a lower detection limit of 1.2 nanometres.

OC-EC Analyzer organic and elementary carbon analyser (Sunset, USA) makes it possible to determine the concentrations of several fractions of organic and elementary carbon on the basis of their various volatility.

NAS nanoparticle sampling device – (TSI) an electrostatic separator of nanoparticles for taking samples for electron microscopy.



A condensation chamber for the study of acid rain

Target groups

Firms that, for some reason, need to ascertain the presence, concentration or composition of aerosol particles in operation or to find a place of escape of particles from operating equipment. Firms that manufacture filters and personal protective equipment or that want to verify the functionality of these devices. Firms engaged in the

manufacture of nanoparticles, national organisations monitoring air quality.

Services offered

- Determination of the efficiency of aerosol filters depending on the size of particles
- Testing of the efficiency of personal protective equipment
- Operational measurement of aerosol (nano-) particles
- Measurement of the size distribution of aerosol particles in spray
- Determination of the chemical composition of aerosol particles depending on their size
- Emission and pollutant samplings of aerosol particles and analyses thereof
- Development of aerosol instrumentation
- Generation of nanoparticles using the CVD method, e.g. for inhalation experiments

References

- Czech Hydrometeorological Institute
- ČEZ a.s.
- ELMARCO s.r.o.
- Pardam s.r.o.
- Preciosa a.s., Plant 14
- PRECHEZA a.s.
- SPUR a.s.
- National Institute for Nuclear, Chemical and Biological Protection, public research institution
- National Radiation Protection Institute, public research institution
- Occupational Safety Research Institute, public research institution
- Brno University of Technology

Centre for Accelerators and Nuclear Analytical Methods (CANAM)



Nuclear Physics Institute of the CAS, v. v. i.

The mission of the large CANAM infrastructure is to make use of energetic-ion and neutron beams in physics, chemistry, biology, power engineering and other fields of science. The CANAM interconnects large experimental facilities of the Nuclear Physics Institute of the CAS in Řež (NPI): an isochronous cyclotron including fast neutron generators (Laboratory of Isochronous Cyclotron and Laboratory of Fast Neutrons), Tandetron electrostatic accelerator (Laboratory of Tandetron Accelerator) and equipment installed on the neutron irradiation channels of an LVR-15 research reactor (Laboratory of Neutron Physics).

a) Laboratory of Isochronous Cyclotron and Fast Neutrons (LC&FNG)

LC Coordinator

Ing. Jan Štursa

Phone: +420 266 173 613

E-mail: stursa@ujf.cas.cz

FNG Coordinator

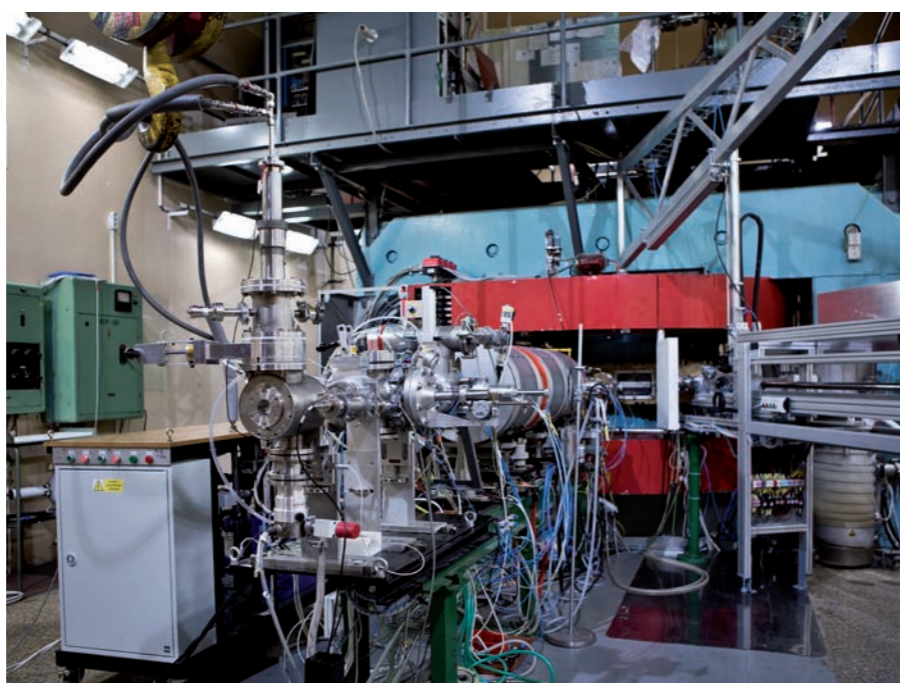
Ing. Jan Novák, Ph.D.

Phone: +420 266 172 123

E-mail: novak@ujf.cas.cz

Competences

A U-120 M isochronous cyclotron – the basic experimental device of the NIP – is operated in the Laboratory. This accelerator provides beams of accelerated ions (p, d, 3He^{2+} , 4He^{2+})



The U-120M cyclotron with the target station (Be target) for the generation of fast neutrons

with energies from 6 to 50 MeV – depending on the type of particle – and currents from units of nA up to hundreds of μA . In connection with target stations of fast neutron generators (FNG), the cyclotron is a unique intensive source of fast neutrons. Thanks to the broad range of energies and currents, the accelerated beams are used by both domestic and foreign researcher groups for a wide

range of experiments of basic as well as applied research. These include particularly astrophysical experiments (3He^{2+} beam), measurement of excitation functions and nuclear data, irradiation of biological samples, testing of radiation damage to electronic components, production of fluorescent nanodiamonds, calibration sources as well as the production of both conventional and

unconventional radionuclides for the preparation of radiopharmaceuticals. Also, components of accelerator technology, diagnostic elements of accelerated beams, target technology and systems for the irradiation of samples and materials are developed and manufactured in the Laboratory. The utilisation of a beam of accelerated particles that is in preparation for measuring the wear of components of combustion engines using the TLA (Thin Layer Activation) method appears to be very promising for the automotive industry.

Target groups

- Domestic and foreign scientific research institutes and workplaces, technological centres
- Nuclear medicine workplaces
- Radiopharmaceutical industry
- Biomedical engineering
- Manufacturers of electronic components
- Firms and institutions participating in space research

Our services

- Irradiation services including feasibility studies and design of experiments
- Designing target systems and target holders for the irradiation of samples and materials
- Calculations and designs of vacuum systems and apparatus
- Calculations and designs of ion-optical systems for the transport of accelerated particles
- Calculations and simulations of the

- movement of charged particles in combined electric (including time-variable) and magnetic fields
- Diagnostics and measurement of accelerated beams of charged particles and fast neutrons
- Production of fluorescent nanodiamonds
- Irradiation of biological samples
- Testing of radiation resistance



A deflection system for taking positive ions out of the cyclotron

- Production of commercial and non-commercial radionuclides for the preparation of radiopharmaceuticals

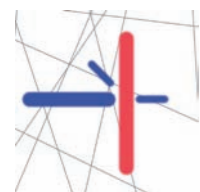
Results and references

- Astrophysical experiments – Department of Nuclear Reactions of the NIP of the CAS

- Study and measurement of excitation functions and effective cross-sections of nuclear reactions – ITU Karlsruhe, Germany, TU Dresden, Germany
- Production of fluorescent nanodiamonds – Institute of Organic Chemistry and Biochemistry of the CAS, Faculty of Biomedical Engineering of the Czech Technical University in Prague, Institute of Microbiology of the CAS, Generi Bio SME ČR, Interuniversitair Micro-Electronica Centrum vzw, Belgium, University of Stuttgart, Germany, School of Medical Science, Griffith University, Australia
- Preparation of $83\text{Rb}/83\text{mKr}$ zeolite and implanted calibration sources – KATRIN and XENON project, Karlsruhe Institute of Technology, Germany, University of Bonn, Germany
- Irradiation of biological samples – Department of Radiation Dosimetry of the NIP of the CAS
- Testing of the radiation resistance of electronic components – ALICE project, CERN, Department of Nuclear Spectroscopy of the NIP of the CAS
- Preparation of medical radionuclides for research – RadioMedic s.r.o., ÚJV Řež, a. s., Institute of Molecular Genetics of the CAS, Envinet a. s., Advanced Cyclotron Systems Inc., European Pharmacopoeia Committee
- Commercial production of radionuclides for the preparation of radiopharmaceuticals – RadioMedic s.r.o.

Centre for Accelerators and Nuclear Analytical Methods (CANAM)

Nuclear Physics Institute of the CAS, v. v. i.



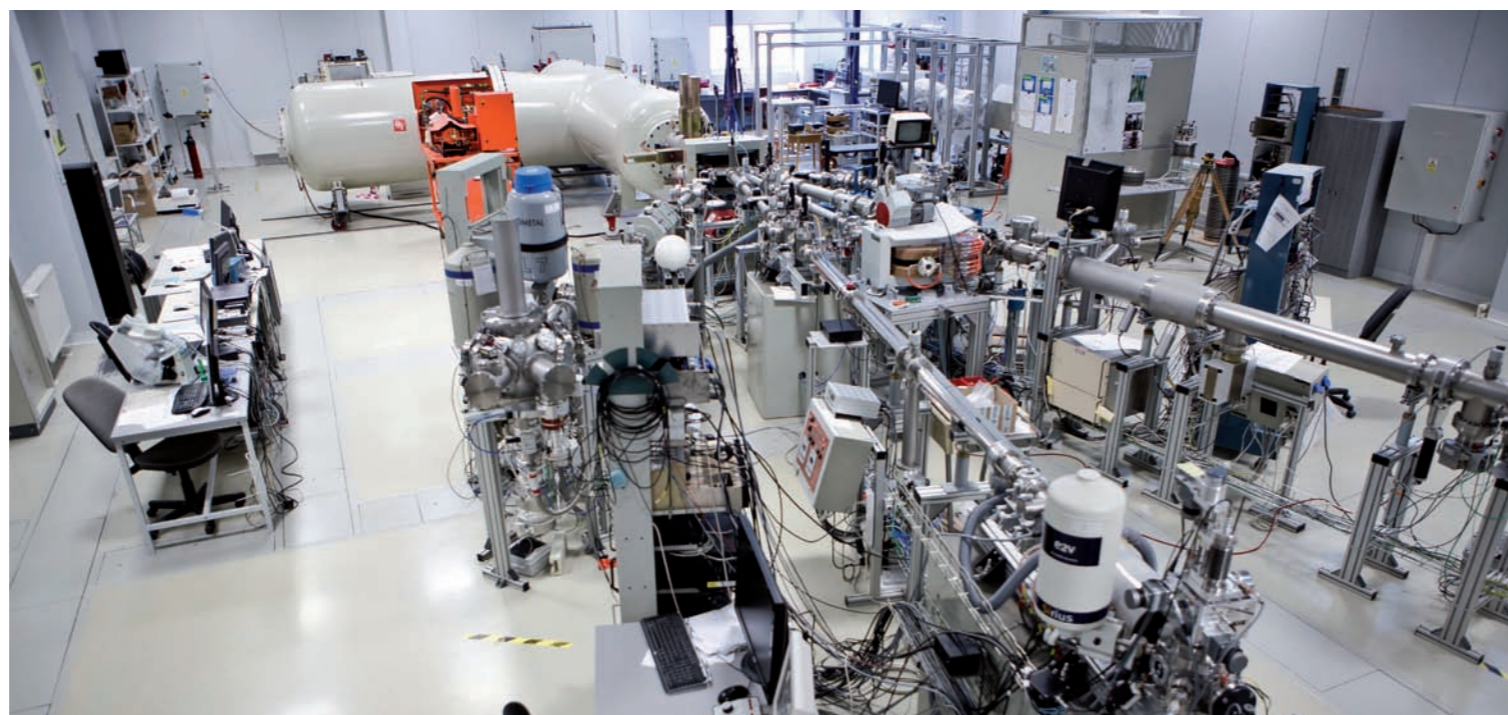
b) Laboratory of Tandetron Accelerator (LT)

LT Coordinator

RNDr. Anna Macková, Ph.D.

Phone: +420 266 172 102

E-mail: mackova@ujf.cas.cz



Laboratory of Tandetron – a view of ionic routes with end target chambers for ion analytical methods

Energetic-ion beams are used to modify surface layers of solid substances and to analyse their composition and structure. Ion analytical methods (Ion Beam Analysis – IBA) possess a number of unique properties for which they cannot be substituted by other alternative procedures in the qualitative and quantitative analysis of materials. A Tandetron 4130 MC electrostatic accelerator is used in the Laboratory of Nuclear Analytical Methods for these purposes. The accelerator provides ion beams from hydrogen to gold with ion currents up to units of mA and energies from hundreds of keV to tens of MeV. The accelerator is the only one of its kind in the Czech Republic and allows, in a substantial manner, extending analytical possibilities, introducing new ways of the modification of substances

and the synthesis of new materials and structures. Broadly conceived interdisciplinary research is done in close cooperation with specialised workplaces in the Czech Republic and abroad.

Competences

The research activities focus especially on the monitoring of processes of creation of thin films and layered structures with notable mechanical, electrical, magnetic, optical, chemical and biological properties and on the study of physical and chemical processes that take place in such structures during the passage of energy charged particles. A broad spectrum of nuclear analytical methods and their

use in interdisciplinary and application areas are developed methodically in the Laboratory. Apparatus for analyses using the proton fluorescence analysis (PIXE), charged-particle elastic scattering (RBS, RBS channelling, ERDA, ToF ERDA) methods and by various nuclear reactions (PIGE, NRA) is available. Furthermore, equipment is available for the ion implantation of samples of up to 8 cm in diameter, fluence of up to 1016 ions per cm² (possible cooling by liquid nitrogen or, where appropriate, heating of the substrate to 800°C), an external beam for the irradiation of samples that cannot be placed in a vacuum, and a microbeam making it possible to focus ions to a size of less than 1 μm.

- Ion implantation – micro- and nanostructured materials for

- microelectronics
- optics
- laser technologies, photonics
- spintronics
- biomedicine
- Use of energetic ions in the study of aerosols in the atmosphere
- Characterisation of volumetric and layered materials with notable mechanical applications
- Characterisation of materials for nuclear technologies
- Study of the element composition of archaeological artefacts
- Experiments of the study of fundamental processes during the interaction of energetic ions with solid substance
- An external beam for the predefined uniform irradiation of a sample in the air so that the sample is modified

- by the required dose of ions – applications for irradiation e.g. of living tissues for dosimetric studies
- A progressive method of preparing optical nanostructures by machining by an ion beam is a microprobe making it possible to focus the beam to a size less than 1 micrometre.
- Simulation of the passage of ions through materials, the formation of defects, structural and composition changes in the synthesis of structures by ion beams
- Deposition of layers using methods of magnetron sputtering, vapour-deposition and deposition with the use of ion beams

Target groups

- Industrial development dealing with the preparation of layered structures with notable mechanical, optical or opto-electronic properties
- Characterisation of the element composition and modification of crystalline materials for the semiconductor industry
- Characterisation of materials for nuclear power engineering – industrial development of technologies for nuclear and fusion reactors
- Preparation of nanostructures and doping of materials by ion implantation for the semiconductor industry, industrial research and development in microelectronics and optics

Results a reference

- Control of the quality and production process of roll-type capacitors,

- analyses of capacitor foils, study of the homogeneity and stoichiometry of metal layers and the content of trace elements – HYDRA a. s.
- Composition of crystalline materials, content and in-depth profile of light elements determined by the ERDA method, possibly analysis of trace elements using the RBS method, positioning of dopants using the RBS channelling method in crystals – OnSemi Conductors a.s.
- Characterisation of multi-layered systems of mechanically resistant and abrasion-resistant layers prepared in plasma reactors – HVM spol. s r. o., SHM spol. s r. o. Šumperk
- Chemical composition of zirconium layers for technology of nuclear fuel packaging material – ÚJP Praha a. s.
- Study of in-depth profiles of heavy elements I, U etc. to characterise the diffusion of fission products in granitic rocks of the Czech Massif – ÚJV Řež, a. s.



A pumping and storage vessel for the SF₆ insulation gas, whereby the acceleration part with high voltage is pressurised

Centre for Accelerators and Nuclear Analytical Methods (CANAM)

Nuclear Physics Institute of the CAS, v. v. i.



c) Neutron Physics Laboratory (NPL)

NPL Coordinator

RNDr. Pavel Strunz, CSc.

Phone: +420 266 173 553

E-mail: strunz@ujf.cas.cz

Competences

The Neutron Physics Laboratory was founded within the NPI for the purposes of neutron-physics experiments for research projects of the NPI but also for the provision of measuring time on neutron beams and of the experience of its experts to external users. Neutron channels in the LVR-15 research reactor (operated by Centrum výzkumu Řež, s.r.o. – Research Centre Řež Ltd.) are used both for material research by means of neutron diffraction and for neutron activation analysis. Analyses with the help of neutrons are carried out on a total of eight facilities and are basically divided into two circles:

- Neutron diffraction is used for studying the structure and microstructure of materials (e.g. advanced metals and ceramics but also archaeological artefacts) in diverse sizes, starting with an arrangement of atoms in a crystal lattice up to microscopic heterogeneities on a nano- and microscale. High permeability of the neutrons of most materials makes it



An SPN-100 neutron diffractometer for scanning tension in materials (left) and analytical methods for neutron in-depth profiling and prompt gamma activation analysis (right) on neutron beams in a research reactor

- possible to carry out these tests in a non-destructive manner with a large volume of materials or even in-situ under various external conditions (mechanical strain, high temperature)
- Nuclear reactions of neutrons with mass are utilised for analysing concentrations or concentration profiles of elements in substances.
- Advanced neutron and photon activation methods are used in multidisciplinary research, namely in environmental, biomedical, geo- and cosmochemical branches.

Target groups

- The target group for the services offered by the Laboratory comprises industrial enterprises, technological centres, universities and research institutions at national and international level as well as state

administration bodies.

- In the field of material characterisation users may include firms engaged in the manufacture of components where the material is strained during thermomechanical processing or during operation. These are, in particular, firms from the transport area (e.g. analysis of tension in the vicinity of welds), from the energy industry (e.g. the microstructure of materials in turbine components) or firms engaged in the manufacture of medical components (e.g. joint replacements).
- Analytical techniques can be utilised by e.g. medical firms, enterprises orientated to the environment but also food processing companies. Expert analyses can be produced for state administration bodies as well.
- Last but not least, the facilities of the Laboratory can be used by research institutions at national or international

level focusing on material sciences, geology, optics, opto-electronics and spintronics, organic and inorganic chemistry or medicine and biology. The facilities and knowledge of our experts can be used by specialised research institutions e.g. in building new scientific research capacities, too.

Our services

- Five neutron scattering devices (SPN-100 – a device for scanning internal stresses in materials, MEREDIT – a powder diffractometer, NOD – a diffractometer for testing neutron optics, MAUD – a small-angle diffractometer, TKS-400 – a high-resolution diffractometer) can be used for the following types of specialist analyses:
- Determination of crystallographic structure and phase analysis
- Determination of magnetic structure
- Development of crystallographic or magnetic structure subjected to an external influence of temperature or pressure (in situ)
- Determination of residual stresses in metals and ceramics, e.g. in the vicinity of welds, in engineering components following thermal and mechanical treatment, in functionally graded ceramics; in some cases characterisation can be carried out in an entirely non-destructive manner
- Research into microstresses and deformation mechanisms in polycrystals subjected to mechanical and thermal strain
- Characterisation (ev. non-destructive) of the microstructure of precipitates and pores in metals (e.g. high-

temperature alloys), ceramics (thermal barriers, superplastic ceramics) and glasses (e.g. from zirconium)

- Microstructure of polymers on rather large dimensional scales
 - Testing of neutron-optical components (neutron monochromators and analysers)
- Further three neutron-physics devices (T-NDP – neutron in-depth profiling, NG – prompt gamma activation analysis, NAA – neutron activation analysis) along with X-Ray fluorescence spectroscopy (XRF) can be employed for the following analytical purposes:
- Non-destructive measurement of the concentration of some light isotopes (3He, 6Li, 7Be, 10B, 14N etc) depending on the depth in areas near the surface of solid substances (to tens of μm with a resolution of $\sim 10\text{ nm}$). A 1D or 2D mode of measurement can be used.
 - Precise determination of the concentration of isotopes/elements (B, Cd, Sm, Gd, H, Cl etc) optimised for liquid or powder samples
 - Monitoring of the environment – analysis of aerosols, soil, sewage sludges, biomonitors
 - Geo- and cosmochemistry: element characterisation of rocks, minerals, tektites, meteorites
 - Geomycology: element characterisation of fungi and their substrates
 - Nutrition science: determination of basic and toxic trace elements in food and beverages
 - Biomedicine: determination of basic and toxic trace elements in human and animal tissues
 - Material science: element

characterisation of diverse materials, e.g. alloys or high tech materials that are difficult to characterise by other analytical methods

- Chemometrics: analyses for checking the accuracy of other analytical techniques, testing of homogeneity and certification analyses of reference materials that are being newly prepared
- Archaeology: analysis of metal and glass artefacts
- Analyses relating to “The Restriction of the use of certain hazardous substances in electrical and electronic equipment – RoHS (Directive 2002/95/EC)”

Contact

Nuclear Physics Institute of the CAS

Hlavní 130
250 68 Husinec-Řež

Ing. Jan Dobeš, CSc. –
CANAM Project Coordinator

Phone: +420 266 173 637

Fax: +420 220 941 130

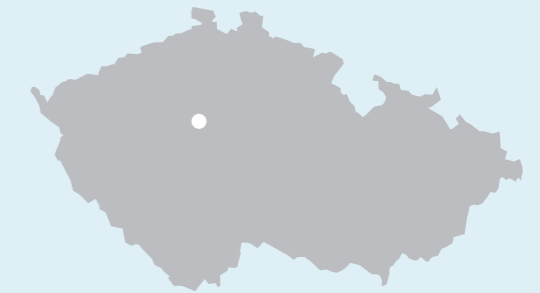
Online:

Project web site:
<http://canam.ujf.cas.cz>
User access:
<http://users.canam.ujf.cas.cz>

E-mail: useroffice@ujf.cas.cz

Microtron Laboratory – Department of Accelerators

Nuclear Physics Institute of the CAS, v. v. i.



Contact

Nuclear Physics Institute of the CAS, v. v. i.

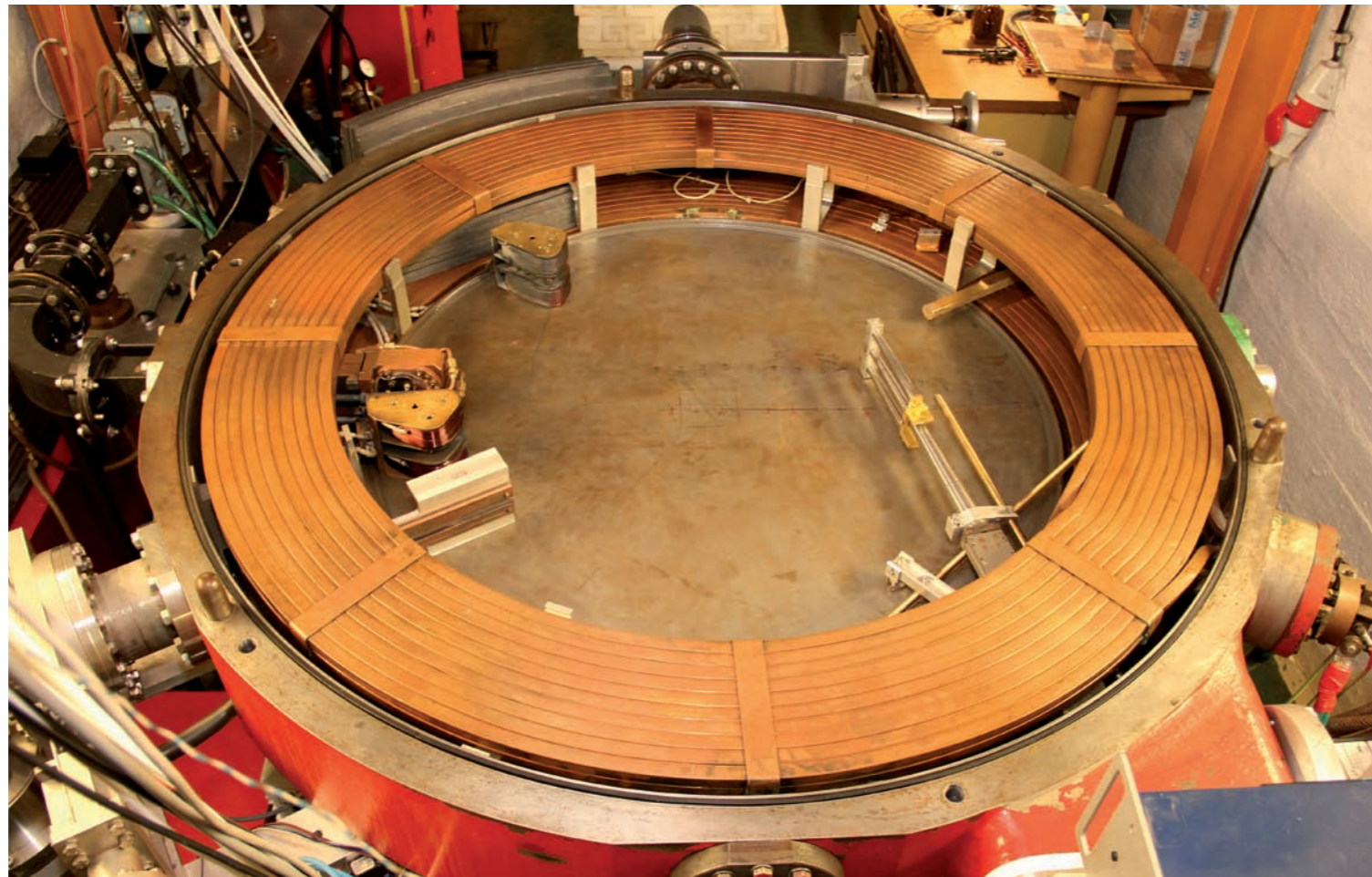
Ing. David Chvátíl

Phone: +420 222 323 657

E-mail: chvatil@ujf.cas.cz

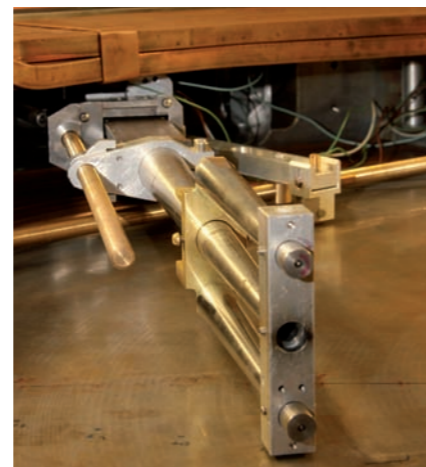
<http://accs.ujf.cas.cz/mt25>

An MT 25 microtron serves as a source of relativistic electrons (primary electron beam), secondary photon beams (braking radiation – bremsstrahlung) and neutrons from nuclear reactions. Electron beams are used for radiation cross-linking, radiation polymerisation, the irradiation of biological samples, testing of scintillation detectors and Medipix detectors and for the production of NV centres in nanodiamonds. Photon beams serve especially for the purposes of IPAA (Instrumental Photon Activation Analysis), whereby selected elements are determined in various materials, and for the irradiation of biological samples. Ionising radiation detectors are tested and electronic components, for which radiation resistance is ascertained, are tested in neutron fields. Fully automated pneumatic tube post, which



The vacuum chamber of the accelerator

provides the fast transport of samples between an irradiation place and an HPGe detector, has been built and installed in the Laboratory. This system considerably broadens the possibilities of IPAA since it allows determining isotopes with short half-lives. A method for the automatic processing of radiographic data created by means of charged particles is being developed, and an optical route for electron radiography utilisable on the microtron has been designed in the Laboratory. In cooperation with the Institute of Experimental and Applied Physics



An adjustable beam outlet from the accelerator chamber

of the Czech Technical University in Prague (ITAP), the development of a compact spectrometer of energetic charged particles, which should make it possible to determine not only the energy of the particles but also their trajectory and kind (electron, proton, alpha particles etc), is being performed.

Competences

- Feasibility studies
- Irradiation services (electron and photon beams or mixed photon

- and neutron field) including dose determination
- Instrumental photon activation analysis
- Production of radionuclides
- Testing of the radiation resistance of materials or instruments
- Testing of ionising radiation detectors and measuring systems
- Radiation sterilisation
- Radiation modification of properties of materials (through suitable irradiation it is possible to modify optical, electrical or mechanical properties)
- Radiation polymerisation and cross-linking of plastics

Target groups

- Manufacturers of ionising radiation detectors
- Manufacturers of electronics and microelectronics
- Biomedical engineering
- Chemical industry
- Geochemical laboratories
- Universities and research institutes

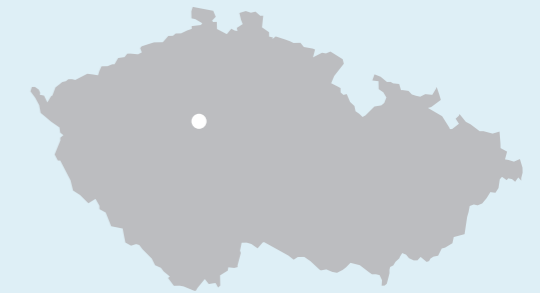
Results a spolupráce

- Testing of scintillation crystals: Technical University of Liberec
- Production of luminescent nanodiamonds: Institute of Organic Chemistry and Biochemistry of the CAS, public research institution, Faculty of Biomedical Engineering of the Czech Technical University in Prague
- Research into the effect of ionising radiation on the shelf life of fish meat: University of South Bohemia in České

- Budějovice
- Chemical composition of Ti alloys for joint replacements: UJP Praha a. s.
- Determination of the fluorine content in apatites: Institute of Rock Structure and Mechanics of the CAS, public research institution
- Radiation cross-linking of gelatines doped by hydroxylapatite intended for bone replacements: Institute of Rock Structure and Mechanics of the CAS, public research institution
- Radiation cross-linking of cryogels suitable for the subsequent cultivation of cells: Institute of Macromolecular Chemistry of the CAS, public research institution
- Preparation of radionuclides: Faculty of Nuclear Sciences and Physical Engineering of the Czech Technical University in Prague
- Testing of the response of fast-neutron detectors: Eurostandard CZ, s. r. o.
- Testing of position-sensitive pixel ionising-radiation detectors from the Medipix family: Institute of Experimental and Applied Physics of the Czech Technical University in Prague
- Radiation polymerisation and sterilisation: Food Research Institute Prague, public research institution

Application Dosimetry Laboratories (ADL)

Nuclear Physics Institute of the CAS, v. v. i.



Contact

Nuclear Physics Institute of the CAS, v. v. i.

Department of Radiation Dosimetry

Na Truhlářce 39/64
180 00 Praha 8

Phone: +420 266 177 288

E-mail: odz@ujf.cas.cz

<http://www.odz.ujf.cas.cz/>



Sampling of atmospheric $^{14}\text{CO}_2$



Transfer of C-14 to a chemical form suitable for the measurement of activity

The aim of the ADL is to provide the users with expert knowledge and experience in the field of radiation protection and ionising radiation dosimetry, to conduct research and development of ionising radiation along with associated applications of ionising radiation in medicine and industry.

The specialisation of the ADL is based on the tradition of the Department of Radiation Dosimetry, the former Institute of Radiation Dosimetry of the CAS in Prague, which has been successfully developing methods of microdosimetry and dosimetry using both active and passive radiation detectors, environmental dosimetry including new procedures for the determination of radionuclides in samples of the environment for nearly 70 years.

Competences

The research subjects concentrate especially on understanding the effects of low radiation doses, characterisation of the transfer of ionising radiation energy on a nanometric and micrometric scale, research into cosmic radiation, study of anthropogenic effects in nature, radiocarbon dating and so forth. We have unique instrumentation and laboratory premises at our disposal, in particular:

- A laboratory for low-background measurements of and work with radioactive materials
- A radiocarbon dating laboratory with the international code CRL
- A secondary calibration laboratory for gamma radiation
- A laboratory for molecular and

cellular radiobiology

- Sources of ionising radiation
- Liquid scintillation spectrometers
- A high-speed optical microscope intended for scanning and digitalisation of large areas, the only of this kind in Europe
- Active and passive radiation detectors for measurements in mixed radiation fields

Target groups

The target group for contract research is represented by industrial enterprises, university workplaces, state authorities, technological centres and research institutions at national and international level. Another target group comprises entities the workers of which may

be exposed to the effects of ionising radiation – namely healthcare facilities, nuclear power plants or air transport companies.

Results achieved, references and examples of cooperation

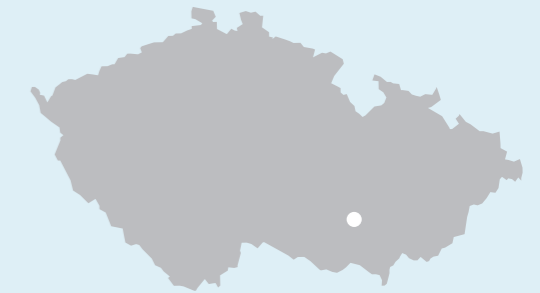
- Verification of dosimetric systems
- Irradiation of samples to a precise dose
- Studies oriented to the environmental effect of humans in the present and in past times:
 - a) occurrence of radionuclides in the environment surrounding nuclear power plants and in background reference areas,
 - b) combustion of fossil fuels and an increase in CO_2 concentration in

- c) transport of CO_2 and other chemical forms of carbon in the environment,
- d) in cooperation with institutions focusing on archaeology and geology: changes in the environment in past times and the associated man-nature relation,
- e) possibilities of employing analytical methods as part of interdisciplinary research (for example, use in ADL developed methods for monitoring radionuclides in the process sections of nuclear power plants)
- Determination of the personal dose equivalent of a flight crew
- Determination of linear energy transfer spectra in beams and fields of ionising radiation
- Determination of the content of low-

- energy beta radiators in samples of the environment (in particular, ^{14}C and, further, ^3H , ^{85}Kr , ^{90}Sr , ^{89}Sr) and development of associated analytical methods
- Sample dating in the radiocarbon dating laboratory with the international code CRL
- Determination of radiation damage by DNA methods to agarose and polyacrylamide electrophoresis
- Determination of radiation damage to cell lines

Application laboratories and infrastructure of the Global Change Research Centre (CzechGlobe)

Global Change Research Centre of the CAS, v. v. i.



Contact

Global Change Research Centre
of the CAS, v. v. i.

Bělidla 986/4a
603 00 Brno

Phone: +420 511 192 212

E-mail: centrum@czechglobe.cz

<http://www.czechglobe.cz>

CzechGlobe runs a research and development centre with top-class equipment. The activities of the CzechGlobe Centres focus on the issues of ecological sciences, specifically on the problem of global change (GC), which with its substance and possible consequences goes beyond basic thematic segments: atmosphere – ecosystem – socioeconomic system. GC has become an ecological, sociological and technical problem of the present time with global implications and, therefore, handling it requires profound expert knowledge. The infrastructure of the CzechGlobe Centre that has been built is relative costly and unique. This creates preconditions so that it is utilised in the most efficient way, whether by top foreign specialists, participating in the development of new techniques and methodologies (in the open access form), by domestic



Metabolomic profiling and target analyses of organic molecules is enabled by state-of-the-art equipment of gas and liquid chromatography, complemented by high-resolution mass spectrometers (ionisation source at an Orbitrap)

specialists from joint workplaces and other research institutions or by students of Master's and Doctoral programmes of study, for whom the GCRC carries an extended accreditation.

The specialisation of the CzechGlobe Centre is based on the tradition of the Institute of System Biology and Ecology of the CAS in Brno, focusing on the research into the flux of carbon and other substances in ecosystems, ecophysiology, photosynthesis, technologies used in the development of special scientific instruments. The results of the scientific work of the CzechGlobe Centre are utilised by

partners operating not only in the region but also beyond the borders of the Czech Republic, among others e.g. as part of the European research infrastructure consortia ESFRI, of which the Centre is a member: ICOS (research into fluxes of greenhouse gases, ANAEE (cooperation as part of multifactor experiments in various ecosystems), and EUFAR (cooperation in the utilisation of the infrastructure of Earth remote sensing).

Main elements of the Centre infrastructure offered for cooperation

1. Atmospheric station

The atmospheric station in Křešín u Pacova in the Bohemian Moravian Highlands serves as a national monitoring point for the presence and long-range transport of greenhouse gases, selected pollutants and basic meteorological characteristics. The station is composed of a 250 metres high atmospheric tower on the various height levels of which atmospheric concentrations of greenhouse gases (CO_2 , CH_4 , CO , N_2O , SF_6), pollutants (tropospheric ozone, gaseous mercury, aerosols), basic meteorological characteristics (air temperature, pressure and humidity, wind direction and speed) and the planetary boundary layer height are monitored. This facility is part of an international network of the research infrastructure ICOS. A position in the close vicinity of the Košetice Hydrometeorological Observatory and other CzechGlobe research



Impact experiments concentrating on evaluating the impacts of global change on plants take place at various levels from young plants in laboratory conditions (growth chambers) up to full-grown woody plants in field experiments (the image shows poplars grown in containers)

infrastructures makes the atmospheric station significant both on a Czech and European scale.

2. Network of ecosystem stations

The network of ecosystem stations (Bílý Kříž, Štítná, Třeboň, Křešín u Pacova, Rájec, Lanžhot Domanínek) focuses on the monitoring, quantification and evaluation of carbon fluxes in the basic types of ecosystems of the Czech Republic. The basis for such measurements consists of meteorological towers with the eddy covariance technique and with sensors for monitoring meteorological elements.

All the seven ecosystem stations are, as per the ICOS protocol, equipped with instruments for measuring fluxes of greenhouse gases (CO_2 , N_2O a CH_4), water and energy between terrestrial ecosystems and the atmosphere, basic climatic characteristics, CO_2 profile, spectral reflectance and transpiration flux of woody plants.

3. Systems of long-term impact experiments

The results of experiments allow evaluating interactions between the influence of manifestations of global climate change and independent environmental factors in terms of their

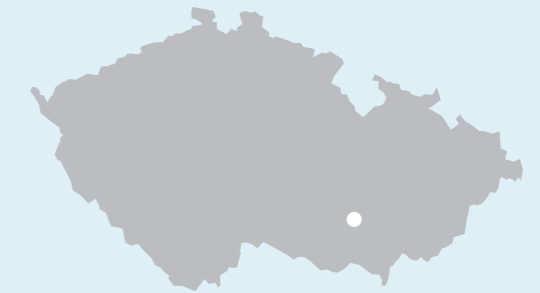
effect on plant physiology, production processes, plant metabolism and adaptation mechanisms of plants. They are carried out in the pavilion of experimental techniques in Brno, where a phytotron hall with a cluster of growth chambers (phytotrons) with the automatic control of atmospheric composition, temperature, air humidity, and intensity and spectral composition of light is available. In addition, a world-unique field system of cultivation chambers (open-top chambers) is built in Domanínek near Bystřice nad Pernštejnem, which – along with already existing cultivation lamellar mini-domes at Bílý Kříž – enable the long-term cultivation of model plant vegetation in controlled environmental conditions.

4. Aerial Earth remote sensing laboratory

A station for the collection/receipt and processing of aerial and satellite data, "FLIS" (Flying Laboratory of Imaging Systems), has been built for the process imaging of the carbon cycle. As the only research centre in the Czech Republic, the laboratory owns a Cessna Caravan aerial carrier equipped with spectroradiometers that record reflected solar radiation within the spectral range of 400-2500 nm, a thermal single-band sensor, GPS sensors, gyro-stabilisation frames, a system for controlling sensors during flight, and a ground support laboratory. Among other things, hyperspectral data are processed and analysed for partners from the private and public sectors within the aerial ERS laboratory.

Application laboratories and infrastructure of the Global Change Research Centre (CzechGlobe)

Global Change Research Centre of the CAS, v. v. i.



5. Central physiological, isotopic and metabolomic plant laboratory

A pavilion of experimental techniques including a central physiological, isotopic and metabolomic laboratory for the study of carbon assimilation processes has been built on the premises of the Czechglobe Centre in Brno. The laboratory of ecophysiological studies is equipped with a top-class set of portable instruments for ecophysiological measurements (gasometric systems, fluorometers, spectroradiometers) and stationary analytical instruments (spectrofluorometer, Raman spectrometer). The isotopic and metabolomic laboratory is equipped with a complete system of two-dimensional gas chromatography with a mass detector of volatile and easy-to-derive metabolites, high-pressure liquid chromatography with a mass detector for the determination of non-volatile metabolites, and an isotope-ratio mass spectrometer for determining the ratios of stable isotopes in both gaseous and solid-state samples of the soil-plant-atmosphere system and isotope ratios in selected metabolites. In addition, the laboratory is equipped with a thermogravimetric analyser.



Growth chambers used for experiments to evaluate the impacts of global change allow, apart from controlling basic parameters such as air temperature or humidity, also the carbon dioxide concentration or spectral composition of light to be changed

the production of third-generation biofuels or other valuable substances usable, e.g., in the pharmaceuticals or chemicals industry. These technologies are based on biological carbon sequestration, i.e., on utilising the potential of cyanobacteria and algae to transform solar energy whilst capturing CO₂ from the air or directly from combustion gases. The incubator of application outputs, which is being built in cooperation with the spin-off firm PSI in Drásov, transfers research results into industrial practice in the form of prototypes of developed or modified instruments and technological procedures. In order to achieve these goals, a laboratory photobioreactor system, cultivation chambers for maintaining cultures and basic laboratories for photoautotrophic microorganisms, large-scale photobioreactor for large-scale cultivation and a system of large-scale cell sorting by production symptoms

6. Incubator of Application Outputs

Furthermore, the application activities of the Centre are orientated towards transferring findings from basic research in the field of photosynthetic microorganisms (cyanobacteria and algae) into technologies for

are now being put into operation in the incubator.

7. Team of socioeconomic studies

This is a team dealing with the social dimension of global change that works for the needs of research into the socio-economic dimension of global climate change. As part of research and application cooperation (e.g., with public-administration bodies), statistical and econometric models are applied for the integrated assessment of the socio-economic impacts of global climate change, which include interactions between society and services of ecosystems affected by global change (e.g., ecological footprint). These assessments make it possible to predict the impacts of mitigation and adaptation measures on ecosystem services, the performance of economy and other



The isotopic laboratory is used to evaluate the natural discrimination of the stable isotopes of C, N, H, O, which is, for example, an indicator of the efficiency of utilisation of water by plants, or a type of photosynthetic metabolism

economic indicators, and to propose optimised solutions of such measures as well.

8. Experimental, teaching, information and demonstration centre

A Technical, Administrative and Training Centre is in operation at the Domanínek experimental site. It serves as a technical and laboratory facility for experiments with fast-growing woody plants for biomass production and for multifactor field experiments in the OTC and, simultaneously, as a training centre for students, company specialists, consultants, state administration and self-government employees, and members of the scientific community interested in issues concerning renewable resources.

Target groups

- High-tech innovative firms
- Universities
- Research institutes
- State administration bodies

Examples of results of cooperation in applied research that have been achieved

- Optimisation of cultivation conditions of growth of the commercially significant algae *Haematococcus*, focusing on the production of astaxanthin (a pigment with antioxidant effects)
- Research and implementation of specific large-area data collection using hyperspectral and multispectral aircraft and ERS technology of the CzechGlobe Centre
- Models of prediction of the production

- of electrical energy from photovoltaic and wind power plants based on numerical weather prediction
- Analysis of the content of organic carbon and nitrogen in agricultural soils
- Digital thematic maps of selected vegetation indexes of growths
- Study of subsidies with an adverse impact on biodiversity in terms of Strategic Objective 3 of the 2011-2020 Strategic Plan
- Analysis of the fulfilment of the Biodiversity Protection Strategy of the Czech Republic in 2005-2015
- Application of Raman spectroscopy in identifying lipid bodies in algae – beta-carotene quantification
- Calibration of hyperspectral image data
- A device for measuring gas emissions released by plant growths or soil, especially in places with a fluctuating water level
- A portable measuring instrument for the measurement of canopy reflectance
- A system of combined flexible forecasting of electrical energy production from renewable (atmospheric) resources. The system allows flexible real-time planning and revising of production plans on the basis of
 - a) currently available meteorological data and their professional evaluation by meteorologists/climatologists within an outlook of tens of minutes up to several days into the future and b) real-time feedbacks on currently measured production of photovoltaic power plants and wind power plants.

Otto Wichterle Centre of Polymer Materials and Technologies

Institute of Macromolecular Chemistry of the CAS, v. v. i.



Contact

OW Centre of Polymer Materials and Technologies

Dr. Ing. Jiří Kotek

Institute of Macromolecular Chemistry of the CAS, v. v. i.

Heyrovského nám. 2
162 06 Praha 6

Phone: +420 296 809 396

E-mail: cpmtow@imc.cas.cz

<http://www.imc.cas.cz/cpmtow>



A laboratory for the creation and processing of polymer materials



The Centre is equipped with technology for processing special materials at high temperatures up to 450°C and high-abrasiveness materials

Specialisation

The Otto Wichterle Centre of Polymer Materials and Technologies (CPMT) is the first of the "Wichterlean" innovation centres to be established by the Institute of Macromolecular Chemistry of the CAS to boost and concentrate its research capacities on key directions of its polymer research, which also evince a high innovation and application potential. The CPMT focuses on researching and developing new polymer systems with controlled structure and properties that are part of all modern trends in innovation and are applied in all advanced technologies, being quite irreplaceable in most of them at the same time. The

key activities of the Centre include primarily the development of polymer materials for use in technologies and products with a high share of added value that requires interlinking basic top research with targeted research and development. Another important activity is the transfer of new knowledge gained from basic research to the application sphere, the implementation and appreciation of own results and intellectual property. The CPMT also offers the utilisation of free capacities of advanced instrumentation for conducting contract research and expert examinations.

Competences

- Research and development of thermoplastic-based materials (including biodegradable ones and plastics from renewable resources) and the technology for processing them in a molten state, relations between the composition, mechanical, thermal and rheological properties of plants, mixtures and composites thereof
- Analysis of the supramolecular structure of solid-state polymer systems (morphology, microscopy), development of the phase structure in a molten state.
- Assessment of mechanical properties of polymer materials under various conditions by standardised tests or

- tests simulating strain on the product. Optimisation of properties through the targeted control of the structure.
- Testing of the life of plastics in conditions simulating a specific application, formulation of stabilisation systems and additives for the targeted control of lifetime. Development and optimisation of recycling procedures
- Development of polymer semiconductors and study of their opto-electronic properties

Target groups

Basic and targeted-research workplaces of the CAS and of universities; R&D sections of firms in

the field of development and processing of polymer materials, advanced technologies, organic electronics and photonics; workplaces and industrial entities needing expert examinations and testing in materials research and characterisation of materials properties, plastics recycling and processing of polymer waste.

Our services

- Consulting in the application of polymer materials
- Technical support in the optimisation of processing procedures
- Development of new polymer materials with goal-directed properties

- Development and optimisation of recycling procedures
- Testing of the life of plastics for particular applications
- Formulation of stabilisation systems and additives for targeted control of the life of plastics
- Assessment of the morphology, thermal and mechanical properties of polymer materials
- Measurement of electrical and photoelectrical properties of polymer materials
- Licences and know-how
- Expert seminars and training

Centre of Bio-Medical Polymers (CBMP)

Institute of Macromolecular Chemistry of the CAS, v. v. i.



Contact

Centre of Bio-medical Polymers

RNDr. Petr Štěpánek, DrSc.

Institute of Macromolecular Chemistry
of the CAS, v. v. i.

Heyrovského nám. 2
162 06 Praha 6

Phone: +420 296 809 211

E-mail: cbmp@imc.cas.cz

<http://www.imc.cas.cz/cbmp>



A display of cells on a confocal microscope using the FLIM method



A transmission electron microscope for cryoscopic measurements

Specialisation

The interdisciplinary Centre of Bio-medical Polymers (CBMP) is the second of the three "Wichterlean" innovation centres that have been established by the Institute of Macromolecular Chemistry of the CAS to boost and concentrate its research capacities on key directions of its polymer research, which also evince a high innovation and application potential. The CBMP focuses on researching special polymers that can be used in medicine and biotechnologies. It develops methodological approaches that are crucial for targeted biomaterials research and help overcome the barrier between the level of knowledge acquired by chemical and engineering

research and the level necessary for applying biomaterials in biology or medicine.

Competences

The CMMP comprises three laboratories with top instrumentation for specialised research work. The laboratory of bio-macromolecular analyses concentrates on describing the primary reactions of cells when in contact with polymer biomaterial or with a macromolecular system carrying biologically active substances or structures, and on using molecular-biology techniques to monitor the mechanisms of these reactions. The laboratory of polymer morphology uses

specific microscopic techniques such as confocal laser microscopy and low-vacuum electron microscopy that make it possible to observe, at submicron resolution, the morphological characteristics of polymer gels and supramolecular polymer structures in conditions in which such structures can be expected to occur in the environment of an organism. The laboratory of radionuclide polymers extends the use of highly sensitive radioisotope techniques to quantify the active components of polymer systems in biomaterials, and focuses on preparing and characterising radionuclide polymer systems and their utilisation in therapy and diagnostics.

Target groups

Apart from our own research and joint projects with basic-research workplaces of the CAS and universities, we offer qualified cooperation both in our country and abroad with industry, development laboratories and clinical workplaces.

Our services

- Methodological and analytical support in the testing of biopolymers using cellular systems
- Testing and evaluation of novel polymer materials usable in medicine, possibly in other fields
- Introduction and optimisation of

- novel approaches for monitoring the properties of biopolymers in in vitro systems
- Statistical processing of biological data

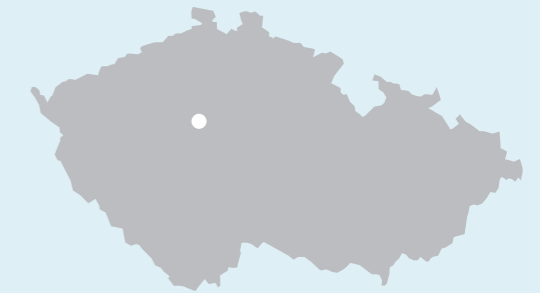


Buněčný inkubátor konfokálního mikroskopu

- Radiolabelling of low-molecular and macromolecular substances
- Employment of sensitive and selective radioanalytical methods for polymers
- Cooperation in the development of radiopharmaceuticals and their pharmaceutical forms
- Cooperation in the development of polymer materials for radionuclide technologies for health and the environment
- Study of the morphology (supramolecular) structure of polymer systems
- Determination of micromechanical properties of polymers, their mixtures and composites
- Rheometry of polymer materials and biomaterials

Fibre Optics Laboratory

Institute of Photonics and Electronics of the CAS, v. v. i.



Contact

Institute of Photonics and Electronics of the CAS, v. v. i.

Ing. Pavel Honzátko, Ph.D.

Phone: +420 266 773 431

E-mail: honzatko@ufe.cz

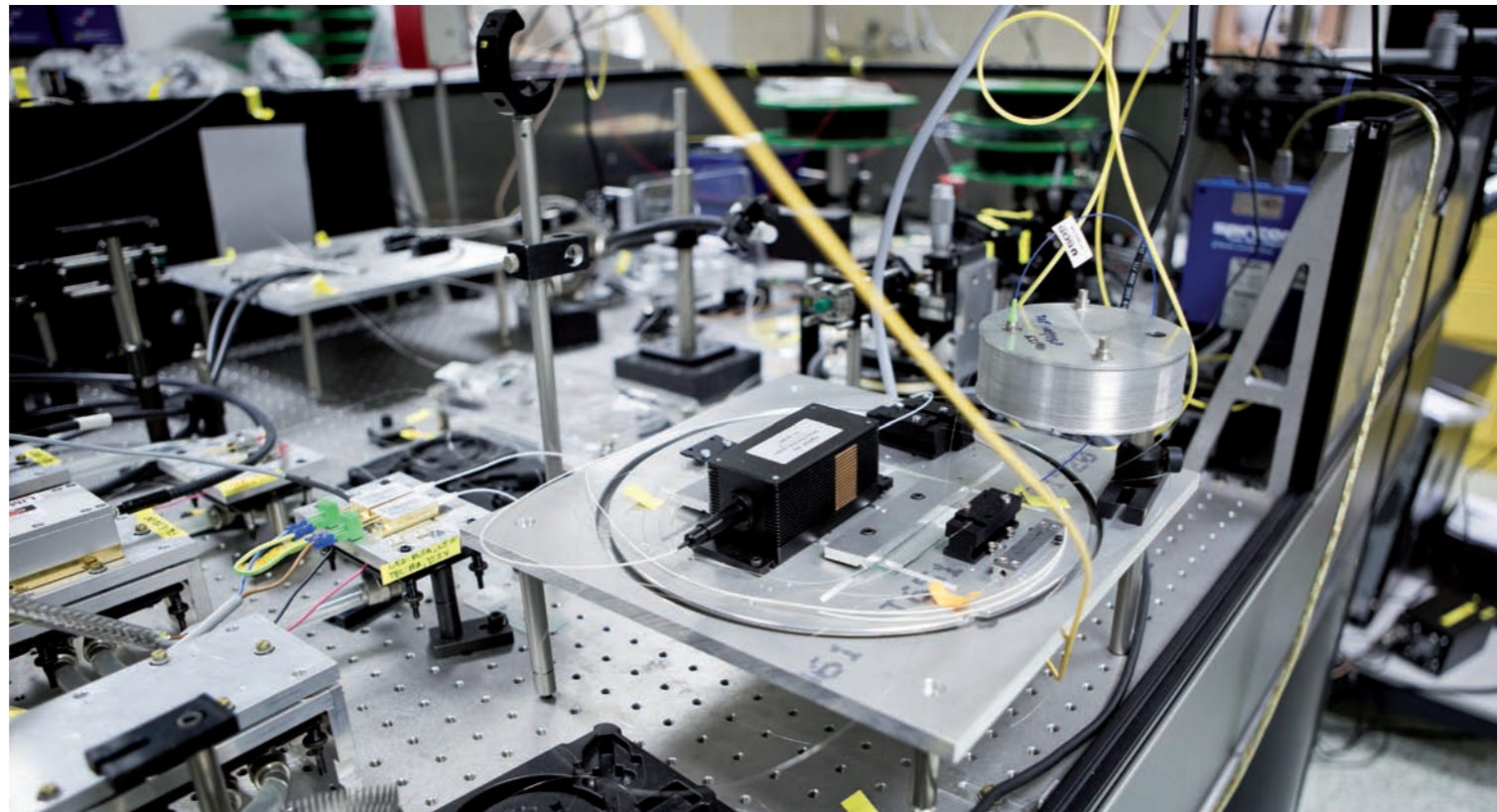
<http://www.ufe.cz>

Specialisation

The Fibre Optics Laboratory focuses on the design and development of special optical fibres, fibre lasers and amplifiers. It has technologies for the preparation of fibres doped with Yb, Er, Tm, Ho, technologies for fibre fusion splicing and forming, technology for writing long-period fibre gratings, know-how concerning the construction of fibre lasers in the midrange-power area (units up to tens of Watts) for the spectral bands of 1060, 1550, 2000 and 2100 nm and in the field of pulse femtosecond and picosecond fibre lasers.

Competences

- Design, development and manufacture of special fibres
- Characterisation of optical fibres (spectral attenuation, dispersion,

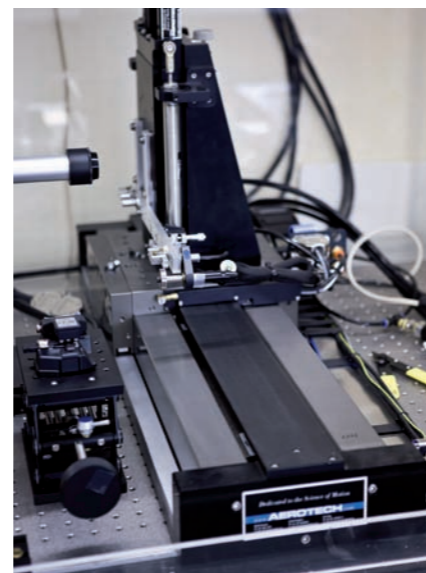


Laboratory of high-power fibre lasers

- refractive index profile, dopant concentration and so forth)
- Development of fibre-optical components
- Development of CW and G-switched, Q-switched, actively and passively mode-synchronised pulse fibre lasers
- Development of fibre amplifiers
- Measurement of laser beams
- Modelling of the propagation of light and optical pulses in optical fibres and photonic structures

Target groups

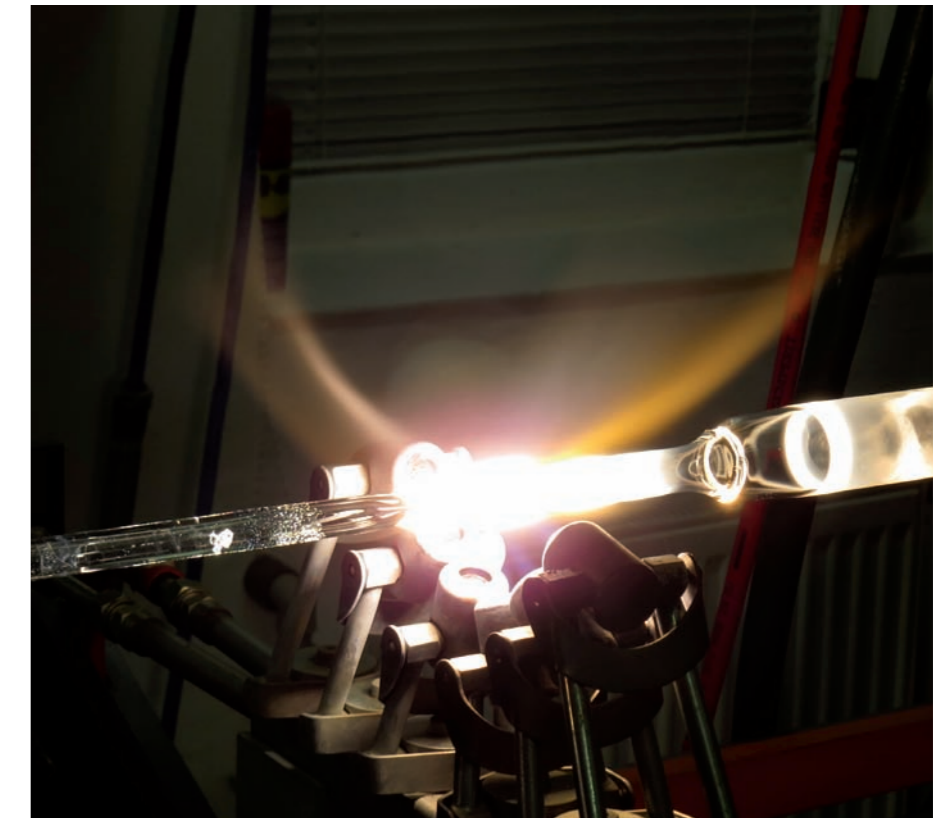
- Manufacture of fibre components
- Manufacturers of fibre lasers
- Telecommunication companies



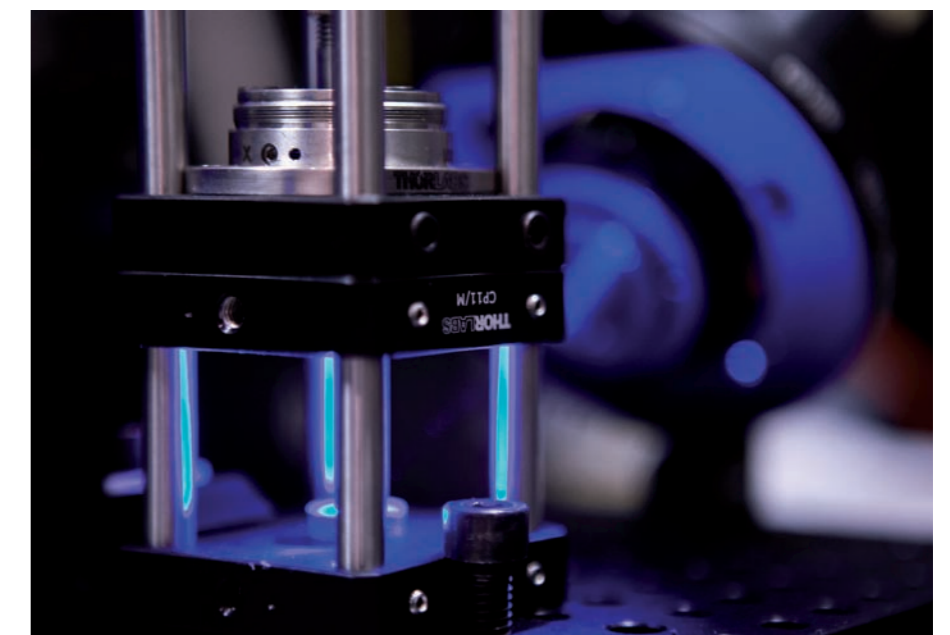
Apparatus with a CO2 laser for the preparation of special fibre components and long-period fibre gratings

Results achieved, references and examples of cooperation

- Joint development of fibre components (SQS Vláknová optika a. s.)
- Joint development of fibre amplifiers (CESNET z.s.p.o.)
- Joint development of fibre sensors and wide-spectrum sources of radiation (Safibra, s.r.o.)
- Joint development of fibre lasers and generator for the middle infrared region (Optokon, a.s.)



Preparation of a pre-form for drawing an optical fibre



Measurement of the fluorescence lifetime of thulium-doped nanoparticles

Apple Breeding Focusing on Scab Resistance

Institute of Experimental Botany of the CAS, v. v. i.



Ústav experimentální
botaniky AV ČR, v. v. i.

Contact

Institute of Experimental Botany
of the CAS, v. v. i.

Station of Apple Breeding for Disease
Resistance

Rozvojevá 313
165 02 Praha 6

Ing. Radek Černý

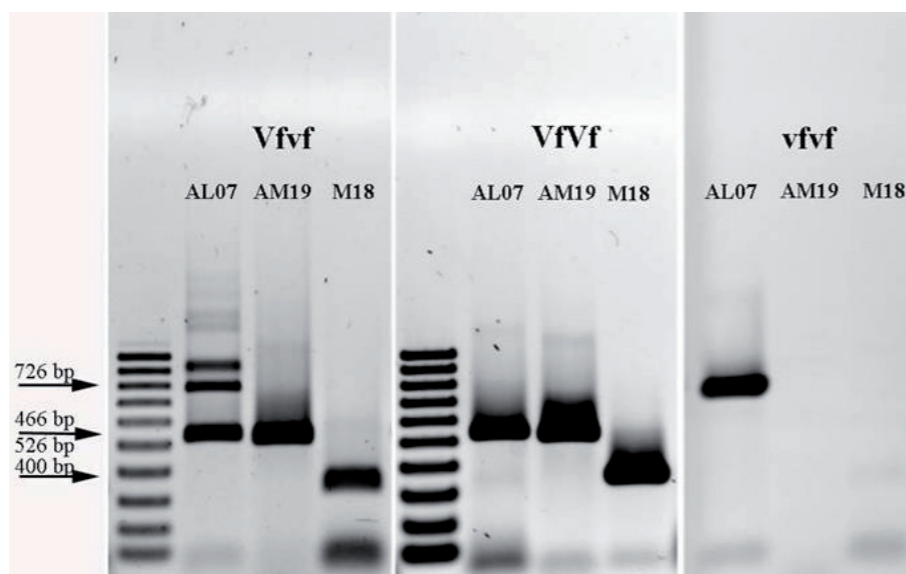
Phone: +420 225 106 492

E-mail: cerny@ueb.cas.cz

<http://www.ueb.cas.cz>

Specialisation

The programme of the Station of Apple Breeding for Disease Resistance of the IEB of the CAS focuses on resistance to scab, the most serious disease of commercially grown varieties. Protection against scab requires spraying with chemical substances several tens of times during the vegetation period, which is demanding in terms of finance and labour and may adversely affect the environment. The commercial application of new resistant varieties will significantly limit the use of chemical spraying against fungal diseases. Monogenic resistance conditional upon the Vf gene from the wild-growing species *Malus floribunda* was predominantly used for breeding resistant varieties in the past. Polygene-



Markers for the characterisation of resistance of breeding material

based sources of scab resistance are used for this purpose at the present. Experience hitherto shows that this type of resistance is more durable than Vf-type monogenic resistance, which new fungal races have already overcome in some areas of commercial apple growing.

The breeding programme is based on molecular methods of identification and analysis of the genetic bases of resistance, and makes use of markers for characterising the resistance of breeding material.

In order for new varieties to be used commercially, they must fulfil, apart from disease resistance, also strict requirements for growing qualities, especially fertility, and for the quality of fruits as regards appearance, taste, firmness and fragility of the flesh, storage life and resistance to bruising during handling. From these points of view, selected new breedings from the breeding programme of the

IEB are tested in our country and, in particular, abroad in research centres and by trading partners. Varieties with good commercial prospects from such breeding are legally protected mostly by Community plant variety rights in the European Union and by plant patents in the USA. They are grown chiefly in BIO conditions and in integrated production, and licence agreements are concluded for the propagation and sale thereof.

The Topaz variety and its Red Topaz red mutation rank amongst commercially the most successful apple-tree varieties of the IEB. In recent years, Topaz has been the best-selling European scab-resistant variety, with annual sales of nearly 400 thousand young trees.

The latest results of breeding at the IEB already include varieties with the potential of having widespread application based on a global marketing model. The implementation of such a model under the guidance of firms



The Opal[®], variety, legally protected in the EU and by plant patent in the US

in the USA and Germany for the UEB 32642 variety, known under the trademark Opal[®], which is registered in more than 40 countries around the world, is at the most advanced level. The Opal[®] variety was awarded the best mark of "excellent" in a large-scale consumer survey held by the independent company Perishables Group in the US in 2009. The output and sale of young trees develops depending on the availability of propagation material. In 2013, annual sales of young trees reached over 100 thousand in Europe and as many as 330 thousand young trees in the US and Chile. Apart from the legal protection that has been granted in the European Union and in the US, the variety has been registered for legal protection in a number of other countries (Argentina, Australia, Brazil, Chile, South Africa, Canada, Morocco, Mexico, New Zealand).



A newly bred apple variety at the IEB with prospects of being used worldwide

Competences

- Apple breeding for disease resistance and improvement in economic properties
- Testing of new breeding of the apple-tree
- Provision of background documents for legal protection
- Preparation of licence agreements, commercialisation of results

Target groups

- Research workplaces
- Nursery and horticultural enterprises
- Fruit orchards
- Marketing firms for the commercialisation of novel varieties of the IEB
- Food and sales chains
- Firms focusing on health food and bioproducts

Results

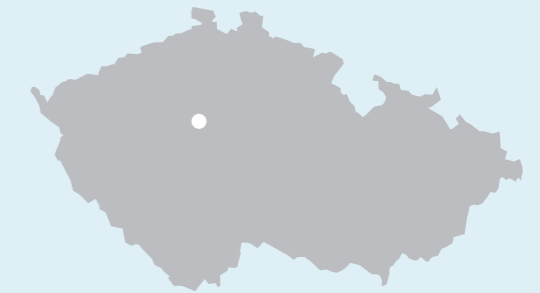
In cooperation with international trading partners, legally protected apple varieties bred at the IEB have succeeded in being commercially used. In 2013, global annual sales reached more than 1.2 million trees. The goal of the application laboratory is to make the results available to interested target groups.

Our services

- Newly bred apple varieties at the IEB
- Apple varieties of the IEB with polygenic scab resistance
- Legal protection of new apple varieties of the IEB
- Commercial utilisation of IEB apple varieties through licensed propagation
- Presentation of results at specialist conferences, seminars and trade fairs

Application Laboratory of Tissue Engineering

Institute of Experimental Medicine of the CAS, v. v. i.



Contact

Institute of Experimental Medicine of the CAS, v. v. i.

Department of Tissue Engineering

Prof. RNDr. Evžen Amler, CSc.

Phone: +420 257 296 350,
+420 296 442 387

E-mail: evzen.amler@lfmotol.cuni.cz

<http://www.iem.cas.cz/research/departments/tissue-engineering.html>



Work in sterile boxes of the laboratory of tissue cultures



Preparation of cells in class B clean rooms

Specialisation

The main specialisation of the Laboratory of Tissue Engineering lies in the development of biomaterials for applications in tissue engineering and regenerative medicine. It is orientated especially towards preparing and testing functionalised nano-fibrous layers from biocompatible materials with the controlled release of incorporated substances such as drugs, growth factors and other bioactive molecules. Other materials include polymer foams and hydrogels, from which it is possible to create composite systems of controlled drug delivery. The main applications include scaffolds for the regeneration of cartilages, bones and skin that prepared in a tailor-made fashion with the necessary length of degradation and with the controlled



Analysis of cell cultures

delivery of stimulants directly to the place of destination.

Competences

- Preparation and characterisation of nano-fibrous layers with the release of bioactive substances (drugs, growth factors and other bioactive molecules)
- Preparation of polymer foams and hydrogels
- Preparation of composite foams and hydrogels with a controlled drug delivery system
- Materials characterisation of scaffolds prepared
- Testing of the cytotoxicity of materials

- In vitro testing of materials by means of cell cultures: mesenchymal stem cells, osteoblasts, chondrocytes, keratinocytes, melanocytes, fibroblasts
- In vivo testing on a model of a rabbit, miniature pig

Target groups

- Manufacturers of materials and devices for medical applications
- Research workplaces
- Companies in the food industry, cosmetics and food supplements

Results achieved, references and examples of cooperation

The department has many years of experience in the field of tissue engineering; a number of publications in impacted magazines have originated from here. At the same time, it is the originator of several patents and utility models:

- Patent No. 302699 – A method of producing nanocapsules based on nanofibres
- Utility model No. 19818 – Hollow nanofibres enriched with liposomes
- Utility model No. 20291 – A collagen/fibrin net with nanofibres from polycaprolactone – the patent has been commercialised
- Utility design No. 20292 – A net from

polycaprolactone or polyglycolic acid or from a mixture of polylactic and polyglycolic acids with nanofibres

- Utility design No. 20293 – A nanofibre net with nanofibres with doped liposomes – the patent has been commercialised
- Utility design No. 20346 – A net enriched with nanofibres from polycaprolactone or from a mixture of polylactic and polyglycolic acids or polyvinylchloride with adhered liposomes

The Laboratory has been cooperating on a long-term basis with the cluster of Nanoprogress z.s.p.o., the companies Kertak Nanosciences s.r.o. and Student Science, s.r.o.

Notes

Notes

© 2014

The Czech Academy of Sciences

Design and production: Centre of Administration and Operations of CAS, v. v. i.