Brno Epilepsy Centre

/ First Department of Neurology
/ Faculty of Medicine / Masaryk University

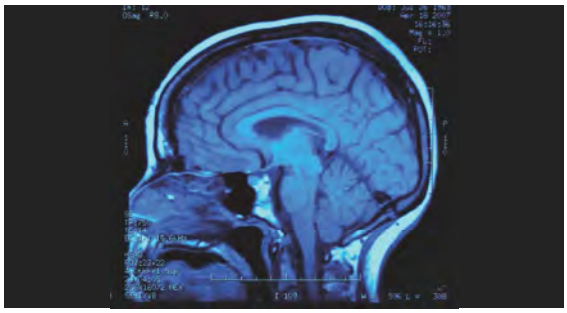
CEITEC
central european institute of technology
BRNO | CZECH REPUBLIC

RESEARCH GROUP CONTACT

Pekařská 53, 656 91 Brno, Czech Republic
http://www.epilepsiebrno.cz/

HEAD Prof. Milan Brázdil
PHONE + 420 543 182 684
E-MAIL mbrazd@med.muni.cz

HEAD Prof. Ivan Rektor
PHONE + 420 543 182 623
E-MAIL ivan.rektor@fnusa.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

Epileptology and clinical neurophysiology

EXCELLENCE

Intracerebral EEG data analysis, fMRI epilepsy research

MISSION

Top international workplace with a predominance of applied research attracting researchers and companies by force of its excellence.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

Centre provides comprehensive care for epileptic patients and performs excellent research in clinical epileptology and cognitive neuroscience.

» Conservative treatment of epilepsy: basic and advanced diagnostics, antiepileptic monotherapy and polytherapy
» Surgical treatment of epilepsy: diagnostics, full spectra of epilepsy surgery therapeutic interventions (resections, VNS, DBS, ...)
» Intracerebral EEG recordings – ERPs, high-frequency oscillations; fMRI, MRS, EEG-fMRI, SISCOM, ...

MAIN CAPABILITIES

Basic research
Study of cognitive and aective functions in the human brain

Application research + protection forms

» description of new clinical entities and diagnostic procedures, particularly in the eld of electrophysiology and neuro-imaging
» Participation in European guidelines for the surgical treatment of epilepsy

FIELDS OF RESEARCH RESULTS APPLICATION

Medical treatment – methods and substances for the treatment of epilepsy (or other neurological diseases),
Medical equipment – production of devices (and their sub-components and software) for use in medicine (for example magnetic resonance)

ALUMNI PROFILE

Specialist in comprehensive epilepsy management, incl. epilepsy surgery

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

11

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

16

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

» Specialized epilepsy service
» True Scan video-EEG system (Alien)
» New EEG systems with high sampling rate (special usage of depth electrodes) - unique in the Czech Republic

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

9 / 0.36

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

5

MAIN PROJECTS ↘

2009-2011: Novel Use of Magnetic Guidance and Catheter-Based Cerebral Venous Mapping to Treat Epilepsy and Stroke (project NS10099 financed by the Ministry of Health)

2005-2011: The Internal Organisation and Neurobiological Mechanisms of Functional CNS Systems under Normal and Pathological Conditions (institutional research plan MSM0021622404 financed by the Ministry of Education, Youth and Sports)

1999-2004: Plasticity of Regulatory Mechanisms of the Central Nervous Systems (institutional research plan MSM 141100001 financed by the Ministry of Education, Youth and Sports)

ACHIEVEMENTS

Publications in peer-reviewed and high impact journals (Epilepsia, Human Brain Mapping, NeuroImage, Epilepsy and Behavior, Seizure, Epileptic Disorder, etc.)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Theoretical Neuroscience Group, CNRS & Université de la Méditerranée (Marseille, FR)
» Institute of Scientific Instruments, Academy of Sciences of the Czech Republic (Brno, CZ)
» Laboratory for Computational Neuroscience (Gif-sur-Yvette, FR)
» Department of Biomedical Engineering, Brno University of Technology (Brno, CZ)
» Institute of Psychology, Academy of Sciences of the Czech Republic (Brno, CZ)

COLLABORATION WITH COMPANIES

» Medtronic (US)
» Cardion (CZ)
» UCB (BE)
» Janssen-Cilag (CH)
» GSK (GB)

EXPECTATIONS ↘

REQUIREMENTS

» Utilization of research results
» Development of cooperation with foreign companies

OFFERS

» Participation in randomized control trials
» Cooperation with companies
» SEEG data and advanced MRI data collection
» Opportunities for researchers from foreign research institutions

Loschmidt Laboratories

/ Department of Experimental Biology
/ Faculty of Science / Masaryk University

RESEARCH GROUP CONTACT

Kamenice 5, Bld. A13, 625 00 Brno, Czech Republic
http://loschmidt.chemi.muni.cz/peg/

HEAD Prof. Jiří Damborský
PHONE +420 549 49 3467
E-MAIL jiri@chemi.muni.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

» Enzymatic catalysis
» Engineering of enzymes for environmental, chemical, biomedical and military-defence applications

EXCELLENCE

New concepts and tools for protein engineering

MISSION

We conduct interdisciplinary research in the fields of protein engineering and synthetic biology. We wish to understand the structure-function relationships of haloalkane dehalogenase enzymes and improve their functionalities for bioremediation, biocatalysis and biosensing.

Our goal is to be recognized as one of the leading protein engineering groups in Europe. We are consistently striving to publish our findings in reputable scientific journals, develop new software tools, and apply research results to practice.

Key components of our daily activities include collaboration between experimentalists and theoreticians, solidarity among the laboratory team, and mentoring of young colleagues—all while maintaining a friendly and creative working environment to honour the name of Jan Josef Loschmidt.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

» Study of the structure-function relationships and molecular evolution of proteins
» Screening and manipulation of gene coding for enzymes with useful catalytic properties
» Study of the structure and kinetic properties of wild type and mutant enzymes
» Development of new concepts and computational tools for protein engineering

MAIN CAPABILITIES

Basic research

» Results in the area of protein tunnels and their modification - this has an influence on the catalytic rates and specificity of enzymes
» Screening and characterisation of enzymes with new functions

Applied research + protection of IP

» Yperit detoxification method (patented),
» Method of optical active substances production by enzymes isolated from microorganisms (patented)

FIELDS OF RESEARCH RESULTS APPLICATION

» Medicine – therapeutics, biopharmaceuticals, chiral building blocks
» Environmental technologies – methods for degradation of harmfull substances , biosensors for on-line monitoring of toxic compounds in the environment
» Military defence technologies – biocatalysts for decontamination and detection of warfare agents

ALUMNI PROFILE

The graduate has knowledge about structure, evolution and function of proteins.

Knowledge and skills:

1. Biology (general biology, genetics, molecular biology, anthropology, microbiology, immunology, biostatistics, physiology of organisms),
2. Biochemistry and chemistry (general biochemistry, enzymology, biochemical methods, inorganic, organic, analytical and physical chemistry)
3. Computer science (bioinformatics, molecular modelling)

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

6

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

10

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

Laboratory of Molecular Biology:

» Bioanalyzer Agilent 2100, Agilent Technologies, USA
» Biohazard Cabinet VBH-MP, Steril, Italy
» Centrifuge Mikro 120, 200, Cooled Micro 200R, Hettich, Germany
» Concentrator centrifuge DNA 120-230 SpeedVac, Thermo, USA
» Electroporator ECM 399 Generator, BTX, Canada
» Rapid Translation System ProteoMaster, Roche, France
» Spectrophotometer Boeco S30, Jenway, United Kingdom
» Thermocycler T3, Biometra, Germany

Laboratory of Microbiology:

» Innova 2100 platform shaker, New Brunswick Scientific, USA
» Labfors 3 fermentor 1.2L, 5L, Infors-HT, Switzerland
» FPLC Akta, Akta Purifier 10, Amersham Pharmacia Biotech, Sweden
» Lyophilisator Christ Alpha 1-2, Martin Christ, Germany
» Ultrasonic Desintegrator Soniprep 150, Sanyo Gallenkamp, England

Laboratory of Enzyme Kinetics:

» Isothermal Titration Calorimeter CSC 4200, Calorimetry Sciences Corp., USA
» Microplate Reader FluoStar Optima, BMG Labtech, Germany
» Microplate Reader SUNRISE, Tecan, Austria
» Rapid Quench Flow, QFM-400, Biologic, France
» Spetrophotometer Ultrospec 1000, Pharmacia Biotech, Sweden
» Spetropolarimeter JASCO J-810, Jasco, Japan
» Stopped Flow SFM-20, Biologic, France
» Thermostatic Water Bath GLS400, Grant, England

Laboratory of Gas and Liquid Chromatography:

» Advanced Compact Ion Chromatograph 861, Metrohm, Switzerland
» Fluorescence spectrophotometer FluoroMax-P, Horiba Jobin Yvon, France
» Gas Chromatograph TRACE 2000, Finnigan, USA
» Gas Chromatograph 6890N, Agilent, USA
» HPLC 1100, Agilent, USA
» Mass Spectrometer TRACE MS 2000, Finnigan, USA

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR).

13 / 0.52

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

8

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

10

MAIN PROJECTS ↘

2011-2015: International Clinical Research Centre (CZ.1.05/1.1.00/02.0123 – grant of the Ministry of Education, Youth and Sports)

2010-2014: Research Centre for Toxic Substances in the Environment (CZ.1.05/2.1.00/01.0001 – grant of the Ministry of Education, Youth and Sports)

2010-2012: Analysis and Visualization of Protein Structures (P202/10/1435 – Czech Science Foundation)

2009-2013: Evolution of Substrate Specificity in Enzymes Acting on Xenobiotic Compounds (IAA401630901 – Grant Agency of the Czech Academy of Sciences)

2008-2012: Specific Ion Effects for Proteins in Solutions and Related Biologically Relevant Systems (203/08/0114 – Czech Science Foundation)

2006-2011: Centre for Biocatalysis and Biotransformations (LC06010 – programme Research Centres; Ministry of Education, Youth and Sports)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

- Brno University of Technology (Brno, CZ)
- Institute of Microbiology (Prague, CZ)
- Institute of Molecular Pathology (Hradec Kralove, CZ)
- Institute of Organic Chemistry and Biochemistry (Prague, CZ)
- Institute of Systems Biology and Ecology (Ceske Budejovice, CZ)
- Mendel University Brno (Brno, CZ)
- Heyrovsky Institute of Physical Chemistry (Prague, CZ)
- Mayo Clinic (Rochester, US)
- Lund University (Lund, SE)
- Tohoku University (Sendai, JP)
- National Institute of Advanced Industrial Science and Technology (Tokyo, JP)
- Imperial College (London, GB)
- ETH (Zurich, CH)
- University of Alcala (Alcala, ES)
- University Groningen (Groningen, NL)

COLLABORATION WITH COMPANIES

- ANF Data – Siemens (CZ)
- Bio-Prodict (NL)
- Biovendor (CZ)
- B.R.A.I.N. (DE)
- Contipro (CZ)
- DSTL (GB)
- LentiKat´s (CZ)
- Photon Systems Instruments (CZ)
- VOP-026 Šternberk (CZ)

EXPECTATIONS ↘

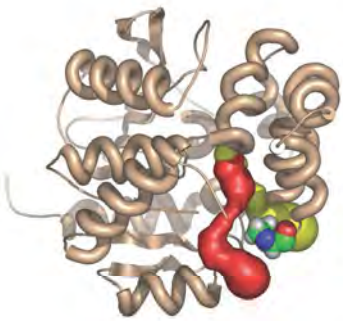
OFFERS

- Licensing of the patent for enzymatic decontamination of warfare agents
- Licensing of the patent for the production of optically pure compounds using enzymes
- Expertise in the field of protein engineering and enzyme technologies
- Specialized instrumentation for enzymological and biophysical experiments

REQUIREMENTS

- Internationalization of research team by recruitment of foreign post-docs and doctoral students

04 / 2011



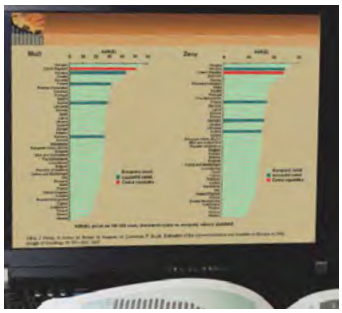
Institute of Biostatistics and Analyses

/ Faculty of Medicine and the Faculty of Science
/ Masaryk University

RESEARCH GROUP CONTACT

Kamenice 126/3, 625 00 Brno
http://www.iba.muni.cz/

HEAD Assoc. Prof. Ladislav Dušek
PHONE +420 549 49 3826
E-MAIL dusek@iba.muni.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Data analysis (clinical data, environmental and ecological data, modern data analysis)
- Information technologies (medical informatics, environmental informatics)
- Clinical trials (development, teaching and application of technologies in the field of clinical trials)

EXCELLENCE

- IBA MU is among the top institutions dealing with data analysis and ICT in medicine within Central Europe
- IBA MU excels in the field of biological and clinical data analysis, organization and management of clinical trials, medical informatics, software development and ICT applications

MISSION

The main mission of IBA, as an academic institution, is performing research in the area of:

- Data analysis – providing data analysis in research maintenance of cross-field focus on both natural science and medicine, achieving publication activities on international level, contributing to the development of modern data analysis
- ICT and software development – development of software for key environmental and clinical projects
- Medical informatics – processing medical registries, information support of nationwide health prevention programmes with reference to serious diseases, especially cancer, cooperation with international institutions
- Clinical trials – development, teaching and application of technologies in the field of clinical trials
- Environmental informatics and modelling - research, teaching and realization of projects in the field of environmental information systems, human and ecological risk assessment
- Teaching activities – application of modern information technologies and data analysis methods in biological and medical study programmes

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

Data analysis
Research is focused on modelling and application of modern information technologies in the analysis of extensive and complex data sets. In particular, we process:

a) Environmental and ecological data- analysis of biodiversity, networks analysis for biological and chemical monitoring
b) Clinical data – especially data from clinical registries, its complex data processing from descriptive statistical analysis to risk factor assessment and multidimensional prognostics models
c) Modern methods of data analysis such as multidimensional data analysis, modelling, data and knowledge mining with the application on biological and clinical data
d) Development, teaching and application of technologies in the field of clinical trials and medical devices as a specific area of medicine

Information and communication technologies
Research in the area of the design, development implementation and administration of software, especially in the medical informatics area The research activities focus on:

a) Methods of data mining in medical databases
b) Artificial intelligence methods
c) Expert systems in medicine and their development
d) Development of a multi-centric solution for data collection (registry)
e) Methods of data mining and subsequent processing of data (data storage)
f) Algorithms for digital signal and image processing.
g) Telemedicine in teaching, telehaematology, development of multimedia and electronic teaching tools

Environmental informatics and modelling
Research, teaching and realization of projects in the field of environmental information systems, human and ecological risk assessment.
These are mainly systems for the collection, aggregation, processing and visualization of data and information about the environment, and systems of environmental management and communication. The division is also concerned with modelling and prediction of environmental issues and their relation to other fields of human activity, such as industry, means of transport or health care. A significant part of the division's research work is the analysis of environmental data and modelling of processes in this area, diversity assessment of biological communities and general analysis of data from environmental biomonitoring. The division is also concerned with the application of geographic information systems in ecological risk assessment.

Clinical trials
Activities are focused on the development, teaching and application of technologies in the field of clinical trials and medical devices as a specific area of medicine Due to the cross-disciplinary nature of all clinical trials projects, the division cooperates with the best clinical centres in the Czech Republic and abroad, and with experts on the respective legislation. As the legal definition of clinical trials projects is very narrow, the division also solves projects which do not meet the legislative definition but require a similar approach (multi-centre data collection, quality assurance and quality control – QA/QC), such as the national preventive (screening) programmes and others.

MAIN CAPABILITIES

The Institute of Biostatistics and Analysis of the Masaryk University provides:

- Data analysis – collection and validation of data from other subjects and performing the role of a service partner. We create automated procedures for specific types of software, research reports and publications, graphical presentations and posters. Our staff also offer consultation services and training in the area of analysis of biological and clinical data
- Development and implementation of medical registries. IBA has developed complex systems for collection, validation and analysis of clinical data using local or web oriented technologies
- Knowledge and background in the areas of environmental modelling, simulation and evolution analysis design and development of models
- Development of information systems – specialists work within the IBA team certified for software development compliant with the methodologies SELECT Perspective, Rational Unified Process and Feature Driven Development
- Looking up information in complex data – complex services in the area of knowledge mining, which include data analysis and design of a suitable algorithm for their processing
- Support of clinical trials with the aim of covering all phases of the project with clinical assessment of treatments and health technologies. We hire a professional team for data management control and monitoring of clinical projects

FIELDS OF RESEARCH RESULTS APPLICATION

- Medicine
- Biology
- Pharmacy
- Environmentalism

ALUMNI PROFILE

All teaching activities converge on the application of medical informatics and of data analysis methods in biological and medical study programmes. Our alumni are specialized in statistical processing, analysis, and interpretation of data from clinical, biological, and environmental studies and experiments. They are also educated in the appropriate field (medicine, biology, environmental sciences) and, therefore, they are capable of full cooperation with experts in designing experiments and data interpretation.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

9

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

48

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

- 3 Screw driven testing machine (ZWICK, Instron) for loadings up to 200 kN, temperatures from -198 to +1200 °C, fixtures for tensile, three/four point bend test, compact tension, compression etc. for steels, ceramics, intermetalics and their composites, selection of different extensometers and strain gauges
- 1 hydraulic test machine for loading rates up to 6 m/s
- 3 instrumented impact pendulums with different impact energy and devices for testing different materials
- Instrumented indentation tester (including ball indentation test)
- MTS microtester for loadings from mN to 200 N
- Measuring work-station, universal test and evaluation software, both commercial and developed by laboratory
- Image analysis and digital image correlation techniques for local deformation determinations
- Confocal microscope with built-in atomic force microscope
- For details see http://www.ipm.cz/brittle-fracture-group-facilities.html

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

66 / 2.64

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

45

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

2.5

MAIN PROJECTS

2007-2013: Tatoo (the FP7 Project sharing the vision of a Single European Information Space for Environment – SISE)

2009-2012: MEFANET – Medical Faculty Network (CZ.1.07/2.4.00/12.0050 funding by ESF and SB)

2010-2012: IKTA partnership and network (CZ 1.07/2.4.00/12.0046, funding by ESF and SB)

2002- : Mamo.cz: Information background, data collection and analysis for the Czech Breast Cancer Screening Programme (Avon Cosmetics)

2009- : Kolorektum.cz (Information background, data collection and analysis Colorectal Cancer Screening Programme in the Czech Republic, Roche Ltd.)

ACHIEVEMENTS

Articles in international journals:

- Kašpárek, T., Mareček, R., Schwarz, D. Source-Based Morphometry of Gray Matter Volume in Men with First-Episode Schizophrenia. Human Brain Mapping, USA, 31, 2, 300-310, 11 p. ISSN 1065-9471. 2010.
- Mikulík, R., Dušek, L., Hill, M.D., Fulep, E., Grotta, J.C., Ribo, M., Molina, C., Alexandrov, A. Pattern of Response of National Institutes of Health Stroke Scale Components to Early Recanalization in the CLOTBUST Trial. Stroke, 41, 3, 466-470, 5 p. ISSN 0039-2499. 2010.
- Budinská, E., Gelnarová, E., Schimek, M.G. MSMAD: a computationally efficient method for the analysis of noisy array CGH data. Bioinformatics, Oxford University Press, 25, 6, 703-713, 11 p., ISSN 1367-4803. 2009.
- Kubosova K, Komprda J, Jarkovsky J, Sanka M, Hajek O, Dusek L., Holoubek I, Klanova J. Spatially Resolved Distribution Models of POP Concentrations in Soil: A Stochastic Approach Using Regression Trees . Environmental Science & Technology 43, 24, 9230-9236. 2009.
- Pavelka, K., Jarosova, K., Suchy, D., Senolt, L., Chroust, K., Dusek, L., Vencovsky, J. Increasing the infliximab dose in rheumatoid arthritis patients: a randomised, double blind study failed to confirm its efficacy. Annals of the Rheumatic Diseases, 68, 8, 1285 – 1289. ISSN: 0003-4967. 2009.

Publications – books and monographies:

- Dušek, L., et al. Czech Cancer Care in Numbers 2008–2009, Prague, Grada Publishing, a.s., 496 p., ISBN 978-80-247-3244-2. 2009.

Software:

- Schwarz, D., Šnábl, I., Komenda, M., Dusek, L. A single portal platform for sharing and offer of electronic educational content in a network of medical faculties MEFANET ver July 1st 2010. central gateway to MEFANET network

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- Charles University in Prague (CZ)
- Palacký University Olomouc (CZ)
- University of West Bohemia (CZ)
- Czech Society for Oncology (CZ)
- Czech Myeloma Group (CZ)
- Czech Society of Cardiology (CZ)
- Czech Rheumatological Society (CZ)
- Czech Hematology Society (CZ)
- University Hospital Brno (CZ)
- Czech Neurosurgical Society (CZ)
- International Society on Thrombosis and Haemostasis (US)

COLLABORATION WITH COMPANIES

- Roche (CH)
- Astra Zeneca (SE, US)
- GSK (GB)
- Novartis (CH)
- Pfizer (US)
- Novo Nordisk (DK)
- Eli Lilly (US)
- IPSEN Pharma (FR)
- Orion Diagnostica (FI)

EXPECTATIONS

REQUIREMENTS

The offer of services by external subjects conforms to the IBA's published offer, its organizational rules and the superior directives of the Masaryk University.

OFFERS

Our institution provides related services, especially in the field of biological and clinical data analysis, organization and management of clinical trials, software development and ICT applications.

Department of Biology

/ Faculty of Medicine
/ Masaryk University

INSTITUTE CONTACT

Kamenice 753/5, 625 00 Brno, Czech Republic
http://www.med.muni.cz/biology

HEAD Prof. Petr Dvořák
PHONE +420 549 493 318
E-MAIL pdvorak@med.muni.cz

HEAD Dr. David Šmajs
PHONE +420 549 497 496
E-MAIL dsmajs@med.muni.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Pluripotent stem cell research
- Molecular mechanisms of DNA damage and repair
- Functional genomics of pathogenic bacteria
- Experimental cancer biology

EXCELLENCE

We are the world leader in several aspects of stem cell biology, including molecular mechanisms of self-renewal and genomic instability.

MISSION

Advances in biomedicine depend on multidisciplinary approaches, in which knowledge and technology from diverse areas of biology and medicine intersect to inspire new ideas and discoveries. Therefore, our aim is to create a stimulating environment for high-achieving scientists and to build an internationally renowned department with several diverse groundbreaking research programmes. Currently we are particularly interested in the biology of embryonic and induced pluripotent stem cells, genome instability and DNA repair, bacterial genetics and genomics, and cancer biology.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Understanding growth factor signalling in maintaining the non differentiated state and regulating differentiation of human pluripotent stem cells
- Development and testing of new culture conditions suitable for propagation and/or the differentiation of clinical grade human stem cells involving synthetic hydrogel supports, alternative serum replacements and feeder-free culture
- High-throughput biochemical tests for nuclease, helicase and polymerase activities
- Identification of nuclease inhibitors or other biological targets
- Biochemical characterization of proteins involved in genomic instability and DNA repair
- Identification of posttranslational modification by SUMOylation and identification of conjugation sites
- Deciphering of genome differences among groups of pathogenic treponemes causing different human diseases
- Analyses of bacteriocin-encoding determinants as markers and/or factors of bacterial virulence
- Understanding the function and regulation of oncogenes Mdm2 and MdmX – key regulators of tumour suppressor p53 in normal and cancer cells
- Identification of potential targets for novel anti-cancer therapies through understanding the regulation of cellular metabolism and stress response signalling pathways in malignant melanoma

MAIN CAPABILITIES

- Development of stem cell therapies
- Biology of cancer stem cells
- Development of targeted anti-cancer therapies
- Genomic instability
- DNA repair and homologous recombination
- Evolution of bacterial genomes and identification of virulence factors
- Bacterial ecology in the human gastrointestinal system
- Development of specific diagnostic tools for treponemal diseases

Located in the Masaryk University new campus in Brno-Bohunice, the Department of Biology is ideally situated for interaction with several internationally recognized research groups in the neighbouring National Centre for Biomolecular Research, the Department of Functional Genomics and Proteomics of the Faculty of Sciences and with Brno's main hospital – the Faculty Hospital Bohunice. The Department of Biology provides state-of-the-art equipment and facilities for stem cell culture, live cell imaging, biochemistry, gene expression analysis (qRT-PCR and microarrays), flow cytometry and sequencing.

FIELDS OF RESEARCH RESULTS APPLICATION

- Pharmacology
- Biotechnology
- Diagnostic
- Therapeutic
- Medical treatment

ALUMNI PROFILE

The teaching and training curriculum of the Department has been designed to educate and train pre-gradual and Ph.D. students to become clinicians and researchers who can acquire and assimilate the increasing amount of knowledge of human health and disease-related cell biology, molecular biology, and genetics. The overall ambition is to develop an innovative and highly dynamic education programme based on the expert knowledge of group leaders and principal scientists of the Department.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

8

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

31

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

- Cell culture: O2/CO2 incubators Sanyo; Laminar flow biohazard boxes; Horizontal flow box; Automatized N2 cryostorage facility; Cs137 Gamma irradiator for cells and animals; other equipment for routine cell culture in three independent culture rooms
- Cell analysis/imaging: Confocal microscope Olympus Fluoview 5000; Inverted fluorescence microscope Olympus IX51; Inverted fluorescence microscope Olympus IX71; Upright fluorescence microscope Olympus BX51; Multipurpose zoom fluorescent microscope AZ100; Flow cytometer Cytomix XC500; Cell viability analyzer Vi-CELL XR; several other microscopes for routine observation of live cells
- General molecular biology: Real-Time PCR system LightCycler 480; Ultracentrifuge Avanti J-30I; Affymetrix GCS3000 System; standard equipment for protein analyses and recombinant DNA work
- The laboratory of Molecular mechanisms of DNA damage and repair disposes of two AKTA FPLC purifiers, French press, cryo-mill, two large-scale incubators and high-volume centrifuge, fluorescent scanner (FUJI FLA9000), two deep freezers and standard equipment for molecular biology.

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

35 / 1.4

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

20

MAIN PROJECTS ↘

2007–2013: Functional and molecular characteristics of cancer and normal stem cells – identification of targets for novel therapeutics and therapeutic strategies (Ministry of Education, Youth and Sports, No. MSM0021622430, Principal investigators: Aleš Hampl, Petr Dvořák)

2006–2011: Centre for Chemical Genetics (Ministry of Education, Youth and Sports, No. LC06077, Principal investigator: Petr Dvořák)

2006–2010: Platforms for biomedical discovery with human ES cells, acronym ESTOOLS (EU 6th FP, Integrated project No. 018739, Principal investigator: Petr Dvořák)

ACHIEVEMENTS

- Significant contribution to the discoveries of molecular mechanisms such as the regulated self renewal and pluripotency of stem cells
- Discovery of molecular mechanisms of homologous recombination regulation in eukaryotic cells
- Identification of factors causing the pathogenicity of bacteria

Research articles in prestigious scientific journals focused on biomedicine, biotechnology, stem cell and cancer research, and molecular microbiology. In the last few years, the Department has published research articles, for example in Journal of Cell Biology, Nature Biotechnology, New England Journal of Medicine, Molecular Cell, Stem Cells.

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

A. External collaboration in the Czech Republic

- Institute of Molecular Genetics, Academy of Sciences of the Czech Republic; High-throughput screening of bioactive compounds; Dr. P. Bartůněk (Prague, CZ)
- Institute of Molecular Genetics, Academy of Sciences of the Czech Republic; Molecular regulation of cell death; prof. Ladislav Anděra (Prague, CZ)
- Institute of Experimental Medicine, Academy of Sciences of the Czech Republic; Functional analysis of neural cells; prof. Eva Syková (Prague, CZ)

» Palacky University, Olomouc; Modelling cancer in stem cells and mice; Dr. Vladimir Divoký (Olomouc, CZ)
» Institute of Biophysics, Academy of Sciences of the Czech Republic; Wnt, FGF and STAT signaling; Dr. Vitězslav Bryja, Dr. Pavel Krejčí, Dr. Jiří Pacherník (Brno, CZ)
» Charles University, Prague and Institute of Physiology, Academy of Sciences of the Czech Republic; Chromatin structure; prof. Ivan Raška (Prague, CZ)
» Masaryk University, Faculty Hospital; experimental oncology; prof. Roman Hájek (Brno, CZ)

B. External collaboration outside of Czech Republic

» University of California San Diego; differentiation of embryonic stem cells; prof. Martin Marsala (US)
» University of Sheffield; self-renewal and differentiation of pluripotent stem cells; prof. Peter W. Andrews (UK)
» The Hebrew University of Jerusalem; genomic instability in pluripotent stem cells and disease modelling; prof. Nissim Benvenisty (Jerusalem, IL)
» Australian National University; synthetic biology; prof. Mathew Wilce (AU)
» European Media Laboratory; synthetic biology; Dr. Rebecca Wade (DE)
» International Institute of Molecular and Cell Biology; synthetic biology; Dr. Janusz Bujnicki (PL)
» University of Newcastle, Newcastle upon Tyne; differentiation of pluripotent stem cells and intracellular signaling; Dr. Majlinda Lako (UK)
» Universita degli studii de Milano; neural differentiation of embryonic stem cells; prof. Elena Cattaneo (Milano, IT)
» Institute of Reconstructive Neurobiology, University of Bonn; neural differentiation of embryonic stem cells; prof. Oliver Brustle (Bonn, DE)
» Rutgers University; DNA repair mechanism; prof. Steve Brill (US)
» Washington University; DNA repair mechanism; prof. Peter Burgers, prof. Tom Ellenberger (US)
» Yale University; DNA repair mechanism; prof. Patrick Sung (US)
» Beatson Institute for Cancer Research; p53 and Mdm2/X regulations; prof. Karen Vousden (Glasgow, UK)

COLLABORATION WITH COMPANIES

» Enantis; protein engineering and enzyme technologies; Dr. Zbyněk Prokop (CZ)
» LentiKat's, production of immobilized cells and enzymes; Dr. Radek Stloukal (CZ)

EXPECTATIONS ↘

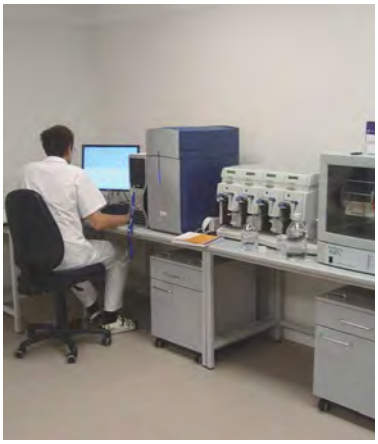
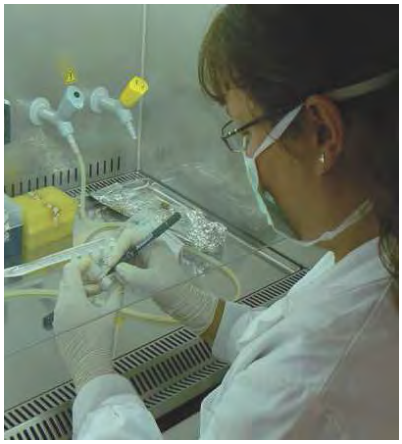
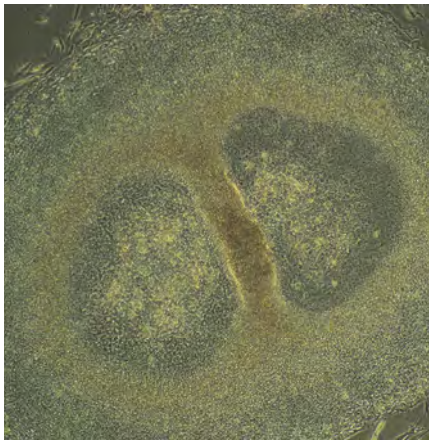
REQUIREMENTS

» New complementary technologies
» New models for stem and cancer cell research
» New tools for cell manipulation, e.g. stem cell fate, stem cell differentiation, genomic stability, and cell survival
» Biophysical or microscopic analysis on single molecule level
» Development of specific diagnostic kits to differentiate between syphilis and yaws infections
» New techniques suitable for analyses of cancer cell metabolism, growth and survival in vitro and in vivo

OFFERS

» Human pluripotent stem cell expertise
» Biochemical characterization of proteins (Protein-DNA and protein-protein interactions, Y2H, etc.)
» Knowledge on treponemal genome structure and variability including suitable genome targets for diagnostic detection
» Expertise in cancer biology – with emphasis on malignant melanoma, cancer cell metabolism, and regulation of the key tumour suppressor p53

04 / 2011

Analysis of biologically important molecular complexes

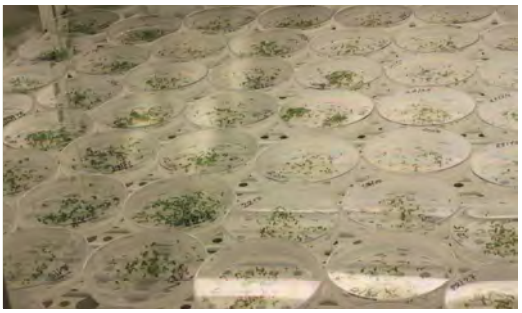
/ Department of Functional Genomics and Proteomics
/ Faculty of Science / Masaryk University

CEITEC
central european institute of technology
BRNO | CZECH REPUBLIC

RESEARCH GROUP CONTACT

Kamenice 5, building A2-ILBIT,
625 00 Brno, Czech Republic
http://www.sci.muni.cz/FGP/

HEAD Prof. Jiří Fajkus
PHONE +420 54 9494 003
E-MAIL fajkus@sci.muni.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

Structure and dynamics of chromosome domains, chromatin, epigenetics, telomere biology, genome stability

EXCELLENCE

- Plant telomere biology
- Genome stability
- Plant cytogenomics

MISSION

Performing research at the world level quality and connecting it with education of undergraduate and graduate students.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Telomere structure, function and maintenance
- Chromosome structure and evolution
- Structural proteins of eukaryotic chromosomes
- Chromosome / genome stability
- Epigenetic regulations in plant cells

MAIN CAPABILITIES

Our capabilities include construction of genetically modified plants and their use in basic and applied research or novel biotechnologies. Our team members have developed and use specific assays applied in molecular biology, such as an assay for telomerase activity in plant cells, quantitative evaluation of telomerase activity in clinical (tumour) samples, plant chromosome painting for evolutionary studies of plant karyotype, analysis of nucleosome positioning in silico. Our know-how and equipment further includes all common molecular biology, biochemical, biophysical and microscopy methods.

We are capable of collaboration on development of novel molecular diagnostic techniques based on DNA, RNA and protein analyses. We are experienced in telomere and telomerase analysis for cancer diagnostics and follow-up of treatment. These techniques can also be applied for testing novel candidate compounds for inhibition telomerase activity in cancer cells.

FIELDS OF RESEARCH RESULTS APPLICATION

- Medicine (mainly molecular diagnostic methods, new approaches and materials to treat cancer)
- Biotechnology

ALUMNI PROFILE

Alumni are experts in telomere biology, chromatin structure, DNA damage response and repair.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

10

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

22

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

» Special mass spectrometers
» Automated microscope (allows monitoring of the parallel development of a large number of samples)

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

40 / 1.6

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

2

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

5

MAIN PROJECTS ↘

2005–2011: Molecular basis of cell and tissue regulations (project MSM0021622415 financed by Ministry of Education, Youth and Sports)

2005–2009: Telomerase-independent mechanisms of telomere synthesis and loss in plants (project IAA600040505 financed by Academy of Sciences of the Czech Republic)

2005–2007: Molecular evolution and functional analysis of components of plant telomeres and telomerases (project GA521/05/0055 financed by Czech Science Foundation)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Institute of Biophysics, Academy of Sciences of the Czech Republic (Brno, CZ)
» University Hospital Brno (CZ)
» IPK in Gatersleben (DE)
» VIB Gent (BE)
» Queen Mary University of London (GB)
» Comenius University Bratislava (SK)
» Institute of Experimental Botany, Academy of Sciences of the Czech Republic (Olomouc, CZ)

COLLABORATION WITH COMPANIES

Potato Research Institute Havlíčkův Brod (CZ)

EXPECTATIONS ↘

REQUIREMENTS

We are looking for commercial partners with a concrete research goal that could be achievable with our equipment and know-how.

OFFERS

The use of equipment and know-how of the research group

Department of Biophysical Chemistry and Molecular Oncology

/ Institute of Biophysics
/ Academy of Sciences of the Czech Republic

CEITEC
central european institute of technology
BRNO | CZECH REPUBLIC

INSTITUTE CONTACT

Královopolská 135, 612 65 Brno
http://www.ibp.cz/cs/oddeleni/biofyzikalni-chemie-a-molekularni-onkologie/vyzkum

HEAD Assoc. Prof. Miroslav Fojta
PHONE +420 541 517 197, +420 733 735 240
E-MAIL fojta@ibp.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Biophysical Chemistry
- Molecular Oncology
- Bioelectrochemistry
- Bioanalysis

EXCELLENCE

Novel tools for the study of biopolymer structure and interactions. Biosensors and bioassays.

MISSION

Our mission is to maintain the position of the world-recognized bioelectrochemistry school and one of the leading laboratories in the area of electrochemical nucleic acids and protein sensing, consistently publishing our findings in respected international journals.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Electrochemistry of nucleic acids, proteins, their components, metabolites and related therapeutics
- Electrochemical biosensors and bioassays
- New methods for biopolymer labelling and detection
- Tumor suppressor proteins and their interactions in vitro and in cellular context

We perform interdisciplinary research in the field of biopolymer structure and interactions in solution and on electrically charged surfaces, combining biophysical, electrochemical, biochemical and molecular-biological approaches. Methodology development, based on introducing and application of novel techniques of biopolymer labelling and detection, oriented towards highly sensitive, selective and widely accessible biosensing techniques for molecular biology and biomedicine, represents an important part of our efforts.

MAIN CAPABILITIES

Our collaboration with numerous research and clinical laboratories creates a mutually stimulating environment and helps us to define areas of potential application of our findings. As typical examples, the following application areas can be identified:

- DNA diagnostics (SNP typing, analysis of triplet repeat expansions) by electrochemical techniques
- Studies of protein aggregation related to severe disorders such as Parkinson's
- Simple, highly sensitive and selective analysis of drugs and metabolites in clinical material
- DNA-drug interactions potentially related to drug development
- Studies of DNA damage related to genotoxicity
- Environmental monitoring

FIELDS OF RESEARCH RESULTS APPLICATION

Basic Research

- DNA structure and mechanisms of interaction of DNA with protein
- Interactions of biopolymers with electrically charged surfaces, effects of structure
- Chemical modification of nucleic acids and proteins

Areas of Application

- Electrochemical (bio)sensors and (bio)assays
- Molecular diagnostics
- Environmental monitoring

ALUMNI PROFILE

Graduates have knowledge of and practical skills in:

» Structure, interactions and chemical reactivity of nucleic acids and proteins
» Molecular mechanisms of disease such as cancer or nerodegenerative disorders
» Principles of electrochemical and other physico-chemical and biophysical experimental methods

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

11

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

16

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

» Scanning probe microscope
» Electrochemical and impedance analyzers
» Spectrofluorometer
» Biohazard box
» FPLC
» PCR cyclers
» Other standard equipment for biochemistry and molecular biology (centrifuges, concentrators, electrophoreses etc.)

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

15 / 0.6

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

1

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

7

MAIN PROJECTS ↘

2009–2013: Construction of novel functional nucleic acids for applications in chemical biology, catalysis and self assembly (project 203/09/0317, Czech Science Foundation, co-investigator: M. Fojta)

2009–2013: DNA labeling with redox markers for electrochemical sensing. Applications in analysis of nucleotide sequences and molecular diagnostic (project IAA400040901, Academy of Sciences of the Czech Republic, principal investigator: M. Fojta)

2007–2010: Interactions of wild type and mutant p53 proteins with damaged DNA and their roles in cellular response to anticancer chemotherapy (project IAA500040701, Academy of Sciences of the Czech Republic, principal investigator: M. Fojta)

2006–2010: Centre of biophysical chemistry, bioelectrochemistry and bioanalysis. New tools for genomics, proteomics and biomedicine (project LC06035, Ministry of Education, Youth and Sports, Coordinator: M. Fojta)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Institute of Organic Chemistry and Biochemistry, AS CR (Prague, CZ)
» Institute of Physical Chemistry of J. Heyrovsky, AS CR (Prague, CZ)
» Masaryk Memorial Cancer Institute (Brno, CZ)
» Faculty of Science, University of Ostrava (Ostrava, CZ)
» Department of Theoretical and Physical Chemistry, Faculty of Science, Masaryk University (Brno, CZ)
» Department of Analytical Chemistry, Faculty of Science, Charles University (Prague, CZ)
» Cancer Centre Karolinska (SE)
» Max Planck Institute for Biophysical Chemistry (Gottingen, DE)
» University of East Anglia, School of Biological Sciences (Norwich, GB)
» Univerité Libre de Bruxelles (Brussels, BE)
» Department of Analytical Chemistry, Slovak University of Technology (Bratislava, SK)
» Department of Nuclear Physics and Biophysics, Faculty of Mathematics, Physics and Informatics, Commenius University (Bratislava, SK)
» Department of Nanoengineering, University California San Diego (La Jolla, CA, US)

COLLABORATION WITH COMPANIES

» HVM PLASMA (Prague, CZ)

EXPECTATIONS ↘

REQUIREMENTS

» Cooperation with companies

OFFERS

» Adaptation of basic research products for practical applications

04 / 2011

Laboratory of Molecular Plant Physiology

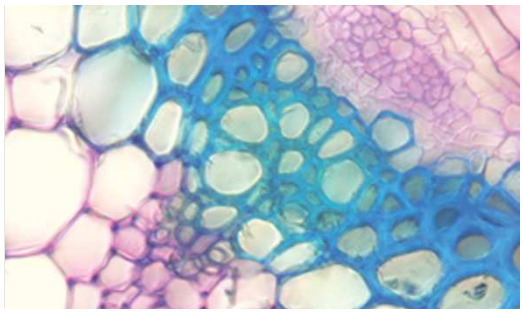
/ Department of Functional Genomics and Proteomics
/ Institute of Experimental Biology / Faculty of Science / Masaryk University

CEITEC central european institute of technology
BRNO | CZECH REPUBLIC

RESEARCH GROUP CONTACT

Kamenice 5, building A2-ILBIT,
625 00 Brno, Czech Republic
http://www.sci.muni.cz/LMFR/index.html

HEAD Dr. Jan Hejátko
PHONE +420 549 49 41 65
E-MAIL hejatko@sci.muni.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

Genetics and protein research in the plant science field

EXCELLENCE

Plant functional genomics, plant hormone signalling and action

MISSION

Our mission is to create a top-quality fundamental research workplace, which would be considered as a member of the wider world leadership in the field and the results of which are capitalized through functional technology transfer.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- The role of plant hormones cytokinins in the regulation of plant development and interaction of cytokinins with other plant growth regulators, e.g. auxin
- Identification of molecular mechanisms driving hormonal regulations of plant development. Use of this knowledge in the development of methods allowing directed regulation of the plant growth rate and improvement of economically important crop traits
- Mechanisms of plant tissue and entire plant body regeneration, deciphering of molecular mechanisms of cell division and differentiation
- Hormonal signal transduction and action
- Identification and molecular analysis of proteins regulating plant growth
- Elucidating the molecular mechanisms of interaction of two major phytohormones, auxin and cytokinins
- Identification of the roles of the sensor histidine kinases in the regulation of plant development in specific developmental processes, e.g. vascular tissue development

MAIN CAPABILITIES

- Effective regulation of plant growth, molecular plant breeding
- Production of biologically active substances with potential of their therapeutic use (e.g. monoclonal antibodies or alkaloids) by plants
- Participation in projects with potential impact in the application sphere, e.g. projects aimed at the use of hormonal regulations in the directed improvement of economically important crop traits (e.g. EPO patent "Method of regulation of biomass production in plants, DNA sequences and method of preparation thereof„)

FIELDS OF RESEARCH RESULTS APPLICATION

- Biotechnology
- Wood industry
- Paper industry
- Agriculture
- Stock Farming
- Forestry and Wood

ALUMNI PROFILE

Alumni are skilled in the use of basic bioinformatics tools, DNA manipulation, gene expression analysis including quantitative real-time PCR, preparation of both transcriptional and translational fusions of gene-specific promoters and/or gene coding sequences with the reporter genes, transgenosis, advanced histological techniques, e.g. in situ mRNA and immunolocalization, advanced microscopy techniques including confocal microscopy, transient gene expression in plant homologous systems, recombinant protein production in E.coli and protein purification, both in vitro and in vivo protein-protein interaction techniques, crystallography and protein structure analysis using X-ray diffraction.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

4

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

17

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Automated, computer controlled greenhouse
- Phytotrons and growing chambers, allowing plant cultivation under tightly regulated cultivation conditions and precise phenotype studies
- Unique microscopy systems, e.g. the system for automated microscopy (.slide), fully motorized and software-driven fluorescence and DIC microscope and horizontally-oriented confocal macroscope, allowing in vivo imaging of growing plants on Petri dishes under native conditions in a wet chamber, equipment for basic and advanced techniques of molecular biology (e.g., epMotion for automatic DNA isolation and pipetting, RealTime cycler, etc.)

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

13 / 0.52

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

0

MAIN PROJECTS

2005–2011: Molecular basis of cell and tissue regulations (Institutional research plan MSM0021622415, Ministry of Education, Youth and Sports; PI Jiří Fajkus, co-PI Jan Hejátko; 280.000 €/year)

2006–2010: Regulations of morphogenesis of plant cells and organs (project LC06034, Basic Research Centres programme, Ministry of Education, Youth and Sports; PI Eva Zažímalová, co-PI Jan Hejátko; 240.000 €/year)

ACHIEVEMENTS

- Publications in distinguished international journals with a high impact factor (e.g. Plant Cell, IF2008= 9.296; Proceedings of the National Academy of Sciences of the U.S.A., IF2008= 9.380; Development, IF2008 = 6.812; Nature Protocols, IF2008= 4.170)
- Czech national patent # 300145 "Method of regulation of biomass production in plants, DNA sequences and method of preparation thereof"

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- VIB Department of Plant Systems Biology, Ghent University (Gent, BE)
- Leibniz Institute of Plant Genetics and Crop Plant Research (Gatersleben, DE)
- University of Helsinki (Helsinki, FI)
- Pohang University of Science and Technology (Pohang, KR)

COLLABORATION WITH COMPANIES

- Oseva Research and Development (Opava, CZ)
- Crop Research Institute (Prague, CZ)

EXPECTATIONS

REQUIREMENTS

Collaboration with industrial partners in common projects dedicated to applied science. The potential industrial partner should be able to provide financial support and functional market access strategy, allowing the use of our expertise in new product development and market placement.

OFFERS

- Know-how in the field of plant molecular biology
- Highly qualified human resources and share of lab space
- Development of advanced plant biotechnology applications
- Molecular breeding, DNA analysis and manipulation services
- Teaching and educational services in the field of the molecular biology of plants

National Centre for Biomolecular Research

/ Faculty of Science / Masaryk University

CEITEC central european institute of technology
BRNO | CZECH REPUBLIC

INSTITUTE CONTACT

Kamenice 753/5, 625 00 Brno, Czech Republic
http://ncbr.chemi.muni.cz

PHONE + 420 549 496 744
FAX + 420 549 492 556
E-MAIL office@ncbr.chemi.muni.cz

HEAD Prof. Jaroslav Koča (director)
PHONE + 420 549 494 947
E-MAIL jkoca@chemi.muni.cz

HEAD Prof. Vladimír Sklenář (vice director)
PHONE + 420 549 497 022
E-MAIL sklenar@chemi.muni.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Computational chemistry and molecular modelling
- NMR spectroscopy of biomolecules
- Glycobiochemistry
- RNA/protein interactions
- RNA processing and degradation
- DNA reparation

EXCELLENCE

Research of structure-function relationships of biomolecular systems that integrates computational and experimental methods. It includes methods for structure characterization (NMR, protein crystallization), thermodynamic and kinetic measurements (ITC, SPR), and nanobiotechnology (AFM) which is complemented with a strong computational background for theoretical studies (molecular dynamics, free energy calculations, quantum chemistry, protein-ligand docking).

MISSION

We conduct research in the field of structural biology and biomolecular chemistry utilizing methods of computational chemistry, NMR spectroscopy, glycobiochemistry, protein engineering, nanobiotechnology and nucleic acid research. Theoretical and experimental research focuses on the structural characterization of biologically interesting molecules, especially proteins, nucleic acids, carbohydrates and their complexes. Top methods are employed in order to describe structural and functional properties of the molecules that may be interesting, for example, for drug design and development. Individual research projects focus on molecular recognition and host/pathogen interactions, RNA quality control, DNA repair mechanisms and cholinesterases in relation to neural diseases and chemical weapons, and other topical subjects.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

Computational Chemistry and Molecular Modelling

- Computational studies of structure, dynamics and function of catalytic RNA
- Molecular interactions in nucleic acidsComputational studies of lectin-carbohydrate interactions and in silico protein engineering
- Activation and inhibition of cyclin-dependent kinases
- Acetylcholinesterase and reactivation
- Structure and dynamics of restriction endonuclease HINC II
- Development of TRITON software for protein engineering, docking and enzymatic reactions modelling
- Development of software for conformational analysis
- Charge calculation and study of electrostatic interactions
- Methods for free energy calculations implementation and application

NMR Spectroscopy

- Ab initio calculations of NMR parameters
- Novel experimental techniques in nuclear magnetic resonance of biomolecules
- Data and structure validation
- Protein structure and dynamics
- Structure and dynamics of nucleic acids
- Studies of purine derivatives, proton transfer processes, complexations
- Structural studies of isoquinoline alkaloids

Glycobiochemistry

- Structure-functional studies of prokaryotic and eukaryotic glycosyltransferases
- Structure-functional studies on lectins from pathogenic organisms and their interactions with carbohydrates

Nanobiotechnology

- Development of a novel sensing technique based on nanomechanics for the rapid detection of bioagents
- Nanotechnological and bioanalytical detection of the DNA damage

DNA/RNA Research

» Homologoues recombination and repair of DNA DSB breaks
» Molecular basis of RNA quality control and degradation in cell nucleus
» Structural basis for poly(A) independent transcription termination and processing

FIELDS OF RESEARCH RESULTS APPLICATION

» Medicine and pharmacology – study of protein targets for the rational design of chemotherapeutic agents against M. tuberculosis, anti-tumour therapeutics, design of protein molecules for drug delivery and innovative methods for testing quality of materials for implants
» Military defence technologies – development of acetylcholinesterase reactivators for treatment of organophosphates (nerve agents and pesticides) intoxication

ALUMNI PROFILE

Graduates have knowledge of NMR techniques for the study of biomolecules, computational chemistry methods for the study of proteins, nucleic acids and carbohydrates (molecular dynamics, QM calculations, molecular docking), experimental techniques for the study of protein-ligand complexes (ITC, SPR), experimental methods for protein and nucleic acid isolation and analysis, experimental techniques for nanotechnology (AFM), bioinformatics and scientific software development.
Graduates are then applied primarily as experts in biomolecular and medical research, molecular modelling, bioinformatics, drug R&D and scientific software development.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

18

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

82

COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING ↘

COMPUTATIONAL STUDIES OF STRUCTURE, DYNAMICS AND FUNCTION OF CATALYTIC RNA

The project is focused on study of ribosomal protein-RNA complexes, and other protein-NA complexes with the aim to better characterize the catalytic centre of the ribozymes. State-of-the-art computational techniques are used, including explicit solvent molecular dynamics simulations, advanced ab initio quantum chemical methods and modern bioinformatics methods. Understanding the structure and dynamics of these complexes can be useful for development of new therapeutic agents based on blocking proteosynthesis of pathogenic microorganisms.

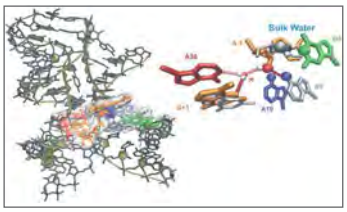


Figure 1 3D structure of Hairpin ribozyme with highlighted catalytic cavity

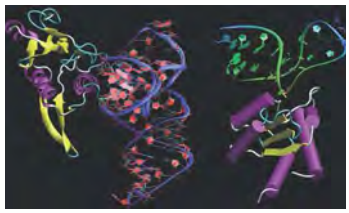


Figure 2 Detail of active site

COMPUTATIONAL STUDIES OF LECTIN-CARBOHYDRATE INTERACTIONS AND IN SILICO PROTEIN ENGINEERING

Lectin-saccharide interactions are related to the virulence of several bacteria that are capable of acting as opportunistic human pathogens or fytopathogens. The project employs methods of molecular docking and molecular dynamics to study lectin-saccharide interactions. The aim of the project is a development of a reliable in silico based method for prediction of binding affinity between ligand and lectin molecule.

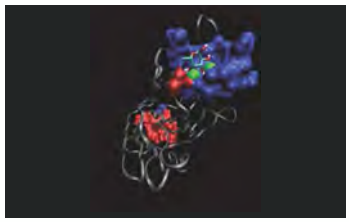


Figure 3 The structure of PA-IIL saccharide binding site

ACTIVATION AND INHIBITION OF CYCLIN-DEPENDENT KINASES

The enzymes from the Cyclin Dependent Kinases (CDK) group play an important role in controlling the eukaryotic cell division cycle. Their deregulation was proven in a series of tumours. For the synthesis of the selected inhibitors, detailed knowledge about all the interactions in the active site of the protein is important. We use the molecular dynamics method, for studying the conformational behaviour of proteins and also for studying interactions between proteins and their substrates or solvent molecules.

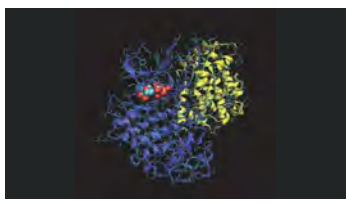


Figure 4 Complex of cyclin A (yellow) with cyclin dependent kinase 2. Molecule ATP is highlighted in the active site of the CDK2

ACETYLCHOLINESTERASE AND REACTIVATION

Acetylcholinesterase is responsible for regulation of nerve signal transmission. Organophosphates such as nerve agents and pesticides are able to inhibit this enzyme by covalent modification of serine residue in the active site. In the case of nerve agents, this inhibition is lethal. Substances called reactivators are able to attack the covalently bonded organophosphate and liberate acetylcholinesterase. This project contributes to the search for better reactivators by providing structural information. Methods used so far are molecular dynamics and protein-ligand docking.

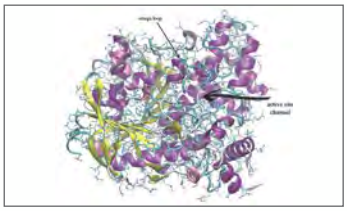


Figure 5 The structure of acetylcholinesterase enzyme.

STRUCTURE AND DYNAMICS OF RESTRICTION ENDONUCLEASE HINC II

Restriction endonuclease HincII cleaves DNA at GTPyPuAC sequence. Magnesium atom is an essential cofactor for this enzyme. Molecular dynamics is used as a tool to describe reaction partners or intermediates. We want to describe the structure of the complex to provide detailed view of the active site and relationships in it and to bring some ideas about the structure of the active site and possible role of the ions in it.

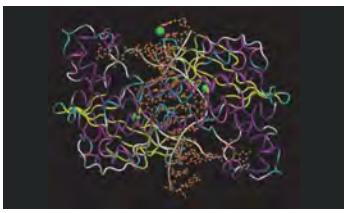


Figure 6 Dimeric biological unit of restriction endonuclease

DEVELOPMENT OF SOFTWARE FOR COMPUTATIONAL CHEMISTRY

Projects focused on software development include the program CICADA (for conformational analysis), EEM solver and ABEEM solver (charge calculation and study of electrostatic interactions), the graphical program TRITON (visualization of scientific data) and MOLE (location and characterization of channels in protein structures).

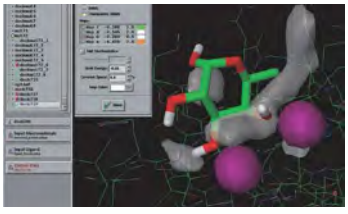


Figure 7 Graphical interface of the TRITON program

↘

NMR SPECTROSCOPY ↘

AB INITIO CALCULATIONS OF NMR PARAMETERS

Research interests focus on computing and understanding the NMR parameters of building blocks of nucleic acids by means of ab inito quantum mechanics. Isotropic chemical shielding and spin-spin coupling constants in nucleosides is studied for a series of anhydrodeoxythymidines. and genuine deoxyribonucleosides.

NOVEL EXPERIMENTAL TECHNIQUES IN NUCLEAR MAGNETIC RESONANCE OF BIOMOLECULES

A general goal of NMR studies of biomolecules is to obtain as accurate as possible data that can characterize the structure and/or dynamics of the studied system. Efficient new methods are studied to measure small changes in spin-spin couplings induced by oriented media and to obtain accurate values of chemical shifts of as many nuclei in the molecule as possible.

Photo 1 600 MHz NMR spectrometer Bruker AVANCE

PROTEIN STRUCTURE AND DYNAMICS

Mouse major urinary protein I (MUP-I) is studied using NMR techniques and molecular dynamic simulations. Results indicate that the pheromone binding does not rigidify the MUP-I structure. On the contrary, several regions of increased flexibility have been identified in the protein-pheromone complex. Other studied proteins include mammalian lectin-like receptor domains, plant lipid-transfer proteins, bacterial RNA polymerases, retroviral proteases etc. The main goal is to provide a complex description of the systems and thus help to understand their biological roles.

STRUCTURE AND DYNAMICS OF NUCLEIC ACIDS

Although the general structural features of regular DNAs and RNAs are well known, there exist a plethora of structural motifs different from the regular double helix. The structures of d(C4G4) and d(G4C4) duplexes and d(GCGAAGC) hairpin were among those solved in our laboratory. Measurement of nuclear spin relaxation by NMR spectroscopy is a powerful approach for studying intramolecular motions at atomic resolution on the nanosecond to picosecond time scale.

GLYCOBIOCHEMISTRY ↘

STRUCTURE-FUNCTIONAL STUDIES OF PROKARYOTIC AND EUKARYOTIC GLYCOSYLTRANSFERASES

The project is focused on structure-function studies of proteins, which participate on oligosaccharide synthesis (glycosyltransferases) using bioinformatic tools and molecular biology experimental methods.
Studied proteins are mycobacterial glycosyltransferases which are involved in biosynthesis of mycobacterial cell wall. They are potential and attractive targets for the rational design of novel chemotherapeutic agents against M. tuberculosis.

Photo 2 Instrumentation for ITC (isothermal titration calorimetry)

Photo 3 Instrumentation for SPR (surface plasmon resonance)

STRUCTURE-FUNCTIONAL STUDIES ON LECTINS FROM PATHOGENIC ORGANISMS AND THEIR INTERACTIONS WITH CARBOHYDRATES

Research is focused on studies of carbohydrate binding proteins (lectins) from opportunistic human pathogen Pseudomonas aeruginosa (and some other organisms) as they can play a key role in host-pathogen interactions. Advanced functional analysis methods (isothermal titration microcalorimetry, surface plasmon resonance, differential scanning microcalorimetry) are used to obtain a wide range of kinetic and thermodynamic data of protein-carbohydrate interactions. The aim is to develop methods of the rational design of carbohydrate-based drugs directed against adhesion and virulence of pathogenic bacteria and fungi.

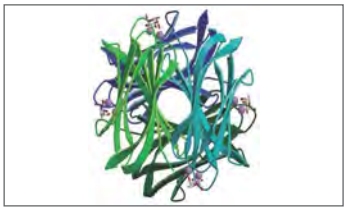


Figure 8 Structure of PA-IIL lectin complex with fucose

NANOBIOTECHNOLOGY ↘

DEVELOPMENT OF A NOVEL SENSING TECHNIQUE BASED ON NANOMECHANICS FOR THE RAPID DETECTION OF BIOAGENTS

The goal of the research is to develop a new sensing device capable of the rapid detection of bioagents in an ambient environment. The project addresses the detection of three classes of bioagent: toxins, viruses, and bacteria. For each class of bioagents, suitable bioreceptors will be used which will be immobilized on the cantilever surface.

NANOTECHNOLOGICAL AND BIOANALYTICAL DETECTION OF THE DNA DAMAGE

The aim of the project is the development of novel methods for detection of DNA damage resulting from exposure to polyaromatic hydrocarbons (PAH). The localization of DNA damage is studied using atomic force microscopy, nanoparticle-labelled antibodies serve for visualization of the point of damage. Newly developed detection methods are tested on real samples and validated with alternative approaches.

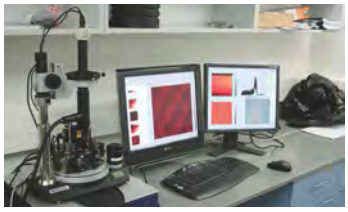


Photo 4 Atomic force microscope (AFM)

DNA/RNA RESEARCH ↘

HOMOLOGOUES RECOMBINATION AND REPAIR OF DNA DSB BREAKS

Homologous recombination plays a vital role in DNA metabolic processes and its defects can lead to pathological outcomes, including genetic diseases and cancer. Mutations in the BRCA2 gene represent the cause of a significant portion of familial breast cancers. The goal of this project is to demonstrate and characterize the recombination mediator function of BRCA2 and also to define the molecular basis for its function.
Another project is focused on the SRS2 gene product (from the yeast Saccharomyces cerevisiae) which participates on the regulation pathway of homologous recombination. The goal is to identify the role of SRS2 as a molecular switch during recombination and DNA repair.

MOLECULAR BASIS OF RNA QUALITY CONTROL AND DEGRADATION IN CELL NUCLEUS

The project aims to characterize in detail molecular mechanisms that assure that aberrant RNA species in the nucleus are efficiently recognized and destroyed. We use a combined approach of molecular biology, biochemistry, structural biology and genetics.

STRUCTURAL BASIS FOR POLY(A) INDEPENDENT TRANSCRIPTION TERMINATION AND PROCESSING

RNA Polymerase II produces not only messenger RNA but also a set of functional RNAs that are essential for the proper function of a cell. The biogenesis of these RNAs remains poorly understood and involves many dynamical processes mediated by protein-RNA and protein-protein complexes that assemble at the site of transcription. We focus on determining the structures at the atomic resolution of such complexes using Nuclear Magnetic Resonance (NMR) spectroscopy.

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

NMR spectroscopy:
600 MHz NMR spectrometer Bruker AVANCE
500 MHz NMR spectrometer Bruker AVANCE III
300 MHz NMR spectrometer Bruker AVANCE

Advanced instrumentation:
Surface plasmon resonance instrument Biacore3000
Isothermal titration microcalorimeters VP-ITC
Diferential scanning calorimeter VP-DSC
Crystallisation robot Mosquito
Optical stereoscope Leica with CCD camera
Automatic liquid handling system with vacuum manifold Tecan Evo 150
Automatic Colony picker PM-1s
AKTApurifier and several AKTAfplc chromatographs
Liquid phase AFM Ntegra
CD spectrometer Jasco J-815

Computational hardware
Computational cluster with 320 processor cores (Xeon E5620, 2.4 GHz)
Computational cluster with 72 processor cores (Opteron 8431, 2.4 GHz, 3x99GB RAM)
Computational cluster with 72 processor cores (Opteron 2218, 2,66 GHz)
3D visualization equipment
Access to Academic Supercomputer Centre (METAcenter)

Computational chemistry and molecular modelling software
Quantum chemistry programs (Gaussian, Gamess, Mopac, Spartan, deMON, CPMD)
Molecular mechanics and dynamics programs (Amber, X-PLOR, PME-MD)
Molecular visualization packages (WHAT IF, VMD, ICM, GRASP, RasMol, gOpenMol, MOLMOL, Gromacs, Spartan, Chimera, Midas Plus, MOIL-View, CCP4, Pymol, SPDB viewer, MolScript)
Docking software (AutoDock, DOCK, ICM)
Protein modelling tools (MODELLER, GRID, DelPhi, Promotif)
X-ray software and databases (CSD, O)
„In-House" software for protein engineering, potential energy (hyper) surfaces and flexibility analysis: TRITON, CICADA, EEM and ABEEM solver, MOLE, MULDER, PANIC, DRIVER, COMBINE, ANALYSE, VADER, ECSTASY, AIDA, PEGAS

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

80 / 3.2

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

25

MAIN PROJECTS ↘

2009–2013: EAST-NMR: Enhancing Access and Services to East European users towards an efficient and coordinated Pan-European pool of NMR capacities to enable global collaborative research & boost technological advancements (Contract No. RII3-026145EU-NMR, EC FP7 R&D programme, European Commission)

2009–2012: Compact Training Centre in Structural Biology and Biomolecular Chemistry (Operation programme Education for Competitiveness)

2008–2011: POSTBIOMIN: Program developing interdisciplinary research potential for the studies of biomolecular interactions (REGPOT-2007-1, EC FP7 R&D programme, European Commission)

2005–2011: Proteins in metabolism and interaction of organisms with the environment (MSM0021622413, Long term research plan, Ministry of Education, Youth and Sports)

2006–2010: Biomolecular centre (LC06030, Government programme of basic research centres, Ministry of Education, Youth and Sports)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

Bowling Green State University (Bowling Green, Ohio, US)
University of Louis Pasteur (Strasbourg, FR)
Jacobs University Bremen (Bremen, DE)
University of Utah (Salt Lake City, Utah, US)
Swiss Federal Institutes of Technology (Lausanne, CH)
University of Barcelona (Barcelona, ES)
University of Arizona (Tucson, Arizona, US)
Cermav-CNRS (Grenoble, FR)
Norwegian University of Science and Technology (Trondheim, NO)
University of Kentucky College of Pharmacy (Lexington, Kentucky, US)
IFOM (Milan, IT)
Columbia University (New York, US)
Yale University (New Haven, Connecticut, US)
University of California (US)
University of Florence (IT)
University of Frankfurt (DE)
University of Lund (SE)
Institute of Bioorganic Chemistry (Poznan, PL)
University of Warsaw (PL)
Institute of Organic Chemistry and Biochemistry (Prague, CZ)
Charles University (Prague, CZ)
Institute of Chemical Technology (Prague, CZ)
Institute of Molecular Genetics (Prague, CZ)
Institute of Scientific Instruments (Brno, CZ)
Palacky University (Olomouc, CZ)
University of Defence (Hradec Králové, CZ)

COLLABORATION WITH COMPANIES

ANF Data – Siemens (Brno, CZ)
Biovendor (Brno, CZ)
Bruker (DE)
Polymer Institute (Brno, CZ)
Contipro Group (Dolní Dobrouč, CZ)
Synthon (Blansko, CZ)
I.Q.A. (Praha, CZ)

EXPECTATIONS ↘

REQUIREMENTS

» To attract world researchers in the field, stability of funding

OFFERS

» Competitive research in a young team

04 / 2011

Cytokinetics

/ Institute of Biophysics
/ Academy of Sciences of the Czech Republic

RESEARCH GROUP CONTACT

Královopolská 135, 612 65 Brno, Czech Republic
http://www.ibp.cz/labs/DC/

HEAD Assoc. Prof. Alois Kozubík
PHONE +420 541 517 182
E-MAIL kozubik@ibp.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Cytokinetics
- Cellular Oncology
- Cancer Cell Physiology
- Cell Signalling
- Lipid Nutrition
- Cancer Therapy

EXCELLENCE

The group focuses on research in the field of cellular signalling and physiology relevant to cancer and developmental biology. High level quality results have been achieved especially in these areas: clarification of the mechanisms of the action of pharmaceuticals (NSAIDs, cytostatics), environmental pollutants (e.g. polycyclic aromatic hydrocarbons, dioxins) in cooperation with physiological regulators of cytokinetics, including tumor necrosis factor (TNF), tumor growth factor-b (TGF-b), fibroblast growth factor (FGF) and Wnt families of signalling proteins.

MISSION

The goal is to strive for greater application of knowledge based on research topics defined above, in the production programmes of pharmacological companies. To create an area proportional to the current options.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Lipid dietary compounds in regulation of cytokinetics
- Growth factors in cancer cell signalling
- Interaction of lipids and cytokines
- Effects of anticancer drugs
- Molecular and cellular mechanisms of toxicity of organic compounds

MAIN CAPABILITIES

The group offers experience in methodologies such as advanced methods of analytical cytometry (flow cytometry, cell sorting, work at both in vitro and in vivo levels) etc. The main research areas are focussed on cancer development, prevention and therapy. We have experience in cooperation with pharmaceutical companies and clinics.

FIELDS OF RESEARCH RESULTS APPLICATION

- Medicine - new medicaments, methods, products – such as new platinum complexes for effective cancer chemotherapy
- Special nutritional (lipid) supplements

ALUMNI PROFILE

Our alumni are mostly specialized in cell physiology, molecular biology and biochemistry.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

8

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

14

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

The laboratory contains top quality equipment for cell culture and detection of the cytokinetic parameters at the cellular and molecular levels:

a) Flow cytometer FACS CALIBUR Becton Dickinson (BD) with sorting option. Two lasers enable parallel detection of 8 parameters. It is possible to sort population parts of interest according to selected markers and to make further detailed analyses of these cells. CellQuest Pro and ModFit software is used to analyse the data. Together with top high resolution cytometry and confocal microscopy (equipment shared by several groups in the Institute) it creates a complex methodology not only for analyses of cell structure and morphology, but also for analyzing large cell populations especially with regard to parameters of proliferation, differentiation and cell death (including high-speed cell sorter FACS Aria II Sorp)

b) Basic facilities for handling and cultivation of cells in vitro: Laminar biohazard boxes (Jouan, Nuaire, Gelaire); CO2 incubators (Jouan, Heraeus, Nuaire); sterilizators; centrifuges (Jouan, Boeco); Water bath (Julabo); Coulter Counter (models ZM, ZF); light microscopes (Zeiss, Jena, Olympus CK40), and fluorescent microscope IX-70 (Olympus) with image analysis software Analysis D and motorised stage (Marzhauser); ELISA reader (Asys Hitech); Absorbance and fluorescence reader Fluostar Galaxy (BMG); Ultralum (Ultralum Inc.) etc.

c) Facilities for methods of molecular biology: Electroporator Biorad; Electrophoretic equipments (Biorad, Hoefer); Wet and semidry blotter (Hoefer) etc.

d) Special laboratory equipment for radioactive methods

e) Special laboratory for PCR-based and molecular cloning techniques Thermocycler (MJ Research); Biohazard box (Faster), Dry incubator (Shel Lab)

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

8 / 0.32

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

5

MAIN PROJECTS ↘

2010–2014: New mechanisms of platinum-based drug action as a tool for anticancer therapeutic strategies (Project NT11201 financed by the Ministry of Health, Czech Republic)

2007–2010: Novel anticancer platinum complexes - mechanisms of their action and innovative chemotherapy strategies (Project GA301/07/1557 financed by the Czech Science Foundation)

2005–2009: Lipid nutrition compounds - modulation of their effects and possibilities of practical application (Project 1QS500040507 financed by the Academy of Sciences of the Czech Republic)

ACHIEVEMENTS ↘

» Optimization of composition and stability of parenteral lipid nutrients in cooperation with Biomedica, Praha, s.r.o.

» Development of highly efficient cytostatics - platinum (IV) complex with adamantylamine (LA-12) overcoming resistence to cisplatin (now - the first phase of clinical trials has been finished). In cooperation with Pliva-Lachema, a.s., where this compound was originally synthesized, our group contributed in the description of mechanisms of LA-12 action, i.e. the regulation of proliferation, apoptosis and mechanisms of resistence.

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» University of Debrecen, Prof. Janos Szöllösi (Debrecen, HU)
» Johannes Gutenberg University, Dr. Cornelia Dietrich (Mainz, DE)
» Cedars Sinai Medical Center, Prof. William R. Wilcox (Los Angeles, US)
» Max-Planck Institute for Medical Genetics (Berlin, DE)
» German WNT Forschungsgruppe 1036 (Heidelberg, DE)
» University of Tübingen (Tübingen, DE)
» Pavel Jozef Šafárik University in Košice, Prof. Peter Fedoročko (Košice, SK)
» Faculty of Science, Masaryk University, Prof. Jan Šmarda (Brno, CZ)
» Veterinary Research Institute, Dr. Miroslav Machala (Brno, CZ)
» Faculty of Medicine, Palacky University Olomouc, Prof. Zdeněk Kolář (Olomouc, CZ)

COLLABORATION WITH COMPANIES

» Infusia - Hořátev (CZ)
» Pliva Lachema (CZ)
» Biomedica Praha (CZ)

EXPECTATIONS ↘

REQUIREMENTS

Serious interest and cooperation with applicants – producers (from the field of pharmacology, nutrition, dietetics, clinics etc.), preparation and realization of common projects.

OFFERS

Deep knowledge and methodology (in vitro in vivo) in the field of environmental toxicology, lipid nutrition, the effects of platinum cytostatics focused on cancer prevention and therapy.

Laboratory of Recombination and DNA Repair

/ Department of Biology / National Centre for Biomolecular Research
/ Faculty of Medicine and Faculty of Science / Masaryk University

RESEARCH GROUP CONTACT

Kamenice 5, 625 00 Brno, Czech Republic
http://ncbr.chemi.muni.cz/LORD/

HEAD Dr. Lumír Krejčí
PHONE +420 549 49 37 67
E-MAIL lkrejci@chemi.muni.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- DNA repair processes
- Mitotic and meiotic recombination
- Posttranslational modification of proteins
- Induced pluripotent cells
- Genomic instability

EXCELLENCE

- Biochemical and molecular characterization of proteins involved in DNA Repair, Recombination and Replication

MISSION

- Biochemistry of recombinant proteins and molecular dissection of their action
- Molecular characterization of processes responsible for DNA repair and genomic instability
- Targeting critical steps in these processes for therapeutical purposes
- Education and training of young scientists

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Regulation of homologous recombination
- Role of structure-specific nucleases in DNA repair
- Role of mediator proteins during recombination and repair
- Initiation of DSB formation and its processing
- Multi-functional role of Srs2 in recombination and DNA repair
- DNA repair synthesis
- Role of helicases in genomic instability
- Induced pluripotent cells

MAIN CAPABILITIES

- Biochemical and molecular characterization of biological processes
- Identification of specific genes as targets for therapeutical use
- Screening and identification of inhibitors of targeted enzymes involved in genome instability and their further optimization and characterization with an aim to specifically affect tumour cells

FIELDS OF RESEARCH RESULTS APPLICATION

- Molecular biology - understanding molecular mechanisms of processes related to genomic stability
- Biochemistry – characterization of proteins involved in DNA repair
- Medicine – potential substances for treatment of cancer and other genome instability based diseases

ALUMNI PROFILE

The graduate has knowledge about DNA repair processes, genome stability and biochemistry of proteins involved in DNA repair.

Knowledge and skills:

1. Biochemistry (protein expression and purification, basic biochemical characterization, protein-protein interactions, protein-DNA interactions, enzymology)
2. Molecular biology (cloning, mutagenesis, two-hybrid system, CHIP, Co-IP)
3. Stem cell research (cell cultures, iPS, cell differentiation)

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

6

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

10

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

Instrumentation for spectral analysis:
» Microtitration plate readers
» Spectrophotometers
» Spectrofuorometer
» Spectropolarimeter

Instrumentation for interactions studies:
» Isothermal titration calorimeter
» SPR machine

Chromatography facilities:
» 4 FPLC
» Static light scattering system

Microscopy:
» Conventional fluorescence
» Laser confocal microscope

Single molecule analysis:
» Optical tweezers
» AFM
» Microscope with TIRF objective

Additional equipment:
» 2-D electrophoresis set
» Thermocyclers
» Geldoc system
» Chemiluminiscent documentation system
» Themoblocks
» Large scale incubators
» Centrifuges
» Ultracentrifuge autoclaves
» Deep freezers

We are planning to buy a piece of equipment for the single-molecular observation of proteins and DNA.

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

7 / 0.28

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

60

MAIN PROJECTS ↘

» **2010–2012:** The role of post-translational modification in DNA repair and recombination: Meiosis, SUMOylation and Zip3 protein (project ME10048 financed by the Ministry of Education, Youth and Sports)
» **2009–2011:** Resolution of replication-recombination DNA intermediates and its role in genomic instability (project GA301/09/1917 financed by the Czech Science Foundation)

ACHIEVEMENTS ↘

» Welcome International Science Fellowship (2005)
» EMBO/HHMI Fellowship (2005)

Publications:

» Krejci, L.*, Van Komen, S., Li, Y., Villemain, J., Reddy, M. S., Klein, H., Ellenberger, T., Sung, P. (2003) DNA helicase Srs2 disrupts the Rad51 presynaptic filament. Nature 423:305-9.
» Papouli, E., Chen, S., Davies, A.A., Huttner, D., Krejci, L., Sung, P., Ulrich, H.D. (2005) Crosstalk between SUMO and Ubiquitin on PCNA is mediated by recruitment of the Helicase Srs2p. Mol. Cell 19(1): 123-33.
» Antony E, Tomko EJ, Xiao Q, Krejci L, Lohman TM, Ellenberger T. (2009) Srs2 disassembles Rad51 filaments by a protein-protein interaction triggering ATP turnover and dissociation of Rad51 from DNA. Mol Cell. 10;35(1):105-15.
» V. Altmannova, N. Eckert-Boulet, M. Arneric, P. Kolesar, R. Chaloupkova, J. Damborsky, P. Sung, X. Zhao, M. Lisby and L. Krejci * (2010) Rad52 SUMOylation affects the efficiency of the DNA repair. Nucleic Acids Res. 38 (14): 4708-21.

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Cancer Research Centre (London, GB)
» Columbia University (New York, US)
» F.I.R.C. Institute of Molecular Oncology (Milan, IT)
» Hungarian Academy of Sciences (Budapest, HU)
» IFOM (Milan, IT)
» IMP-IMBA Research Center (Vienna, AT)
» Institute of Molecular Genetics, AS CR (Prague, CZ)

- Institute of Scientific Instruments, AS CR (Brno, CZ)
- Memorial Sloan-Kettering Cancer Center (New York, US)
- New York University (New York, US)
- Technical University of Denmark (Copenhagen, DK)
- University of California (Davis, US)
- University of Copenhagen (Copenhagen, DK)
- University of Oxford (Oxford, GB)
- Washington University (St. Louis, US)
- Yale University (New Haven, US)

EXPECTATIONS ↘

REQUIREMENTS

- Structural characterization of proteins
- Single-molecule analysis (AFM, Optical or Magnetic tweezers)
- Microscopy methods (EM, SLIM, FRET)
- Microfluidics

OFFERS

- Biochemistry of proteins
- Small/medium/large scale protein production
- In vitro assays for nuclease/helicase/polymerase inhibitors

04 / 2011

Department of Free Radical Pathophysiology

/ Institute of Biophysics of the ASCR
/ Academy of Sciences of the Czech Republic

INSTITUTE CONTACT

Královopolská 135, 612 65 Brno
http://www.ibp.cz/en/departments/free-radical-pathophysiology/

HEAD Assoc. Prof. Antonín Lojek
PHONE +420 541 517 160
E-MAIL alojek@ibp.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

» Formation and reactions of free radicals in the body and the possibilities of modulating their effects with the aim of preventing selected diseases
» Antioxidative and anti-inflammatory properties of drugs and natural compounds

EXCELLENCE

» Formation of reactive oxygen and nitrogen species by phagocytes and its modulation by drugs and natural compounds

MISSION

» Production of high quality publications in reputable journals
» Collaboration with significant partners from hospitals and companies that will utilise our results

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

The aims of the department mainly involve the oxidative burst of phagocytes, interactions of phagocytes with endothelial cells, total antioxidant capacity as well as the contents of individual antioxidants in cells and body fluids, and the possibilities of oxidative injury prevention using drugs and dietary supplements.

MAIN CAPABILITIES

» Medicine and cosmetics – new medicaments, methods, products
» Nutrition – testing of antioxidative and anti-inflammatory properties of food constituents

FIELDS OF RESEARCH RESULTS APPLICATION

» Health & Nutrition
» Medical treatment

ALUMNI PROFILE

Highly qualified staff is skilled in luminometry, spectrophotometry, flow cytometry, hematology and other methods used in cellular and molecular biology.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

3

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS):

8

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

» Luminometer Orion II (BERTHOLD Detection Systems, Germany) for chemiluminescence measurements in microtitre plates or strips in a temperature controlled chamber (20 - 37 °C)
» ISO-NO Mark II potentiostat (World Precision Instruments) for the determination of nitric oxide synthesis
» HPLC Agilent 1100 with diode array and electrochemical detectors
» Flow cytometer FACS CALIBUR system (Becton Dickinson) and equipment for real time RT-PCR (Rotorgene) are shared and available at the Institute of Biophysics
» ELISA photometer Spectra-Rainbow for spectrophotometric laboratory measurements

- Multifunctional monochromator reader INFINITE M200 (TECAN) for fluorometrical analyses
- Leica TCS SP5X inverted confocal microscope system (equipped with white laser and acousto-optical beam splitter)
- High-speed sorter BD Aria II Sorp (equipped with 355, 405, 488 & 633 nm lasers)
- Coulter Counter for cell number determination
- High speed centrifuge for cell and protein separation (Jouan MR-22i).
- All other standard laboratory equipment is also available

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

6 / 0.24

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

1

MAIN PROJECTS ↘

2008–2010: Effects of polyunsaturated fatty acids and their metabolites on the physiological functions of professional phagocytes (COST – MEYS OC08058, Ministry of Education, Youth and Sports)

2009–2011: Role of myeloperoxidase in the regulation of platelets psysiology (AS CR M200040908)

2008–2012: The influence of L-arginine and its analogues on the generation of reactive oxygen and nitrogen species by professional phagocytes (GA524/08/1753, Czech Science Foundation)

ACHIEVEMENTS ↘

- Ambrozova G, Pekarova M, Lojek A. (2011): The effect of lipid peroxidation products on reactive oxygen species formation and nitric oxide production in lipopolysaccharide-stimulated RAW 264.7 macrophages. Toxicol In Vitro. Feb;25(1):145-52
- Číž M., Čížová H., Denev P., Kratchanova M., Slavov A., Lojek A. (2010): Different methods for control and comparison of the antioxidant properties of vegetables. Food Control. 21: 518-523
- Denev P, Ciz M, Lojek A, Ambrozova G, Yanakieva I, Kratchanova M (2010): Solid-phase extraction of berries' anthocyanins and evaluation of their antioxidative properties. Food Chemistry 123:1055–1061
- Klinke A, Nussbaum C, Kubala L, Friedrichs K, Rudolph TK, Rudolph V, Paust HJ, Schröder C, Benten D, Lau D, Szocs K, Furtmüller PG, Heeringa P, Sydow K, Duchstein HJ, Ehmke H, Schumacher U, Meinertz T, Sperandio M, Baldus S. (2011): Myeloperoxidase attracts neutrophils by physical forces. Blood, Jan 27;117(4):1350-8
- Králová, J., Račková L., Pekarová M., Kubala, L., Nosál R., Jančinová V., Číž M., Lojek A. (2009): The effects of H1-antihistamines on the nitric oxide production by RAW 264.7 cells with respect to their lipophilicity. International Immunopharmacology. 9(7-8):990-5
- Kubala L, Schmelzer KR, Klinke A, Kolarova H, Baldus S, Hammock BD, Eiserich JP. (2010): Modulation of arachidonic and linoleic acid metabolites in myeloperoxidase-deficient mice during acute inflammation. Free Radic Biol Med. May 15;48(10):1311-20
- Lopez D, Pavelkova M, Gallova L, Simonetti P, Gardana C, Lojek A, Loaiza R, Mitjavila MT. (2007): Dealcoholized red and white wines decrease oxidative stress associated with inflammation in rats. Br J Nutr.; 98(3): 611-9
- Pekarova M., Kralova, J., Kubala L., Ciz, M., Lojek A., Gregor C., Hrbac J.(2009): Continuous electrochemical monitoring of nitric oxide production in murine macrophage cell line RAW 264.7. Analytical and Bioanalytical Chemistry, 394(5):1497-1504
- Prachařová L, Okénková K, Lojek A, Číž M. (2010): Serotonin and its 5-HT(2) receptor agonist DOI hydrochloride inhibit the oxidative burst in total leukocytes but not in isolated neutrophils. Life Sci., 86 (13-14): 518 – 523
- Rudolph V, Rudolph TK, Kubala L, Clauberg N, Maas R, Pekarova M, Klinke A, Lau D, Szocs K, Meinertz T, Boger RH, Baldus S. (2009): A myeloperoxidase promoter polymorphism is independently associated with mortality in patients with impaired left ventricular function. Free Radical Biology and Medicine, 47:1584-1590

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

- Masaryk University (Brno, CZ)
- University of Turku (Turku, FI)
- Institute of Experimental Pharmacology and Toxicology (Bratislava, SK)
- University Hospital (Hamburg, DE)
- University of Pecs (Pecs, HU)

COLLABORATION WITH COMPANIES

- CPN, a.s. (Dolní Dobrouč, CZ) and other companies in the Nanomedic cluster

EXPECTATIONS ↘

REQUIREMENTS

We are looking for long-term collaboration in the development and testing of drugs, nutritional supplements, cosmetics and food-processing substances.

OFFERS

- Testing of functional properties of phagocytes, especially the formation of reactive oxygen/nitrogen species and expression and activation of enzymes involved in microbicidal mechanisms
- Measurement of antioxidative properties of body fluids, drugs, chemical substances and extracts from food constituents
- Participation in common research projects focused on the above described fields

Medicinal Chemistry

/ Department of Chemistry
/ Faculty of Science / Masaryk University

RESEARCH GROUP CONTACT

Kamenice 753/5, 625 00 Brno, Czech Republic
http://ustavchemie.sci.muni.cz/

HEAD Dr. Kamil Paruch
PHONE + 420 549 495 477
E-MAIL paruch@chemi.muni.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Organic synthesis
- Medicinal chemistry
- Photochemistry
- Supramolecular chemistry

EXCELLENCE

- New organic compounds with targeted biological activity

MISSION

- Internationally competitive research producing results attractive for further progression within the biotech sector

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Synthesis and development of patentable, biologically active organic compounds that can serve as leads for further (commercial) progression; focus on the area of cancer treatment

MAIN CAPABILITIES

- Design, synthesis and characterization of organic compounds and their profiling in biological assays

FIELDS OF RESEARCH RESULTS APPLICATION

Basic research

- Discovery of new activity modulators of biological targets relevant in the treatment of cancer

Application research + protection forms

- Patented biologically active compounds - within the framework of research at Schering-Plough Corp. / Merck
- Two discovered compounds currently profiled in clinical trials

ALUMNI PROFILE

Alumni are capable of synthesis, purification and characterization of organic compounds (whose complexity will depend on the academic degree obtained). In addition, they will be familiar with basic concepts and methods of biology and biochemistry and will be capable of fruitful interaction with biologists within the framework of the medicinal programmes of choice.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

1

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

6

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

- NMR (Bruker Avance 300 MHz)
- X-ray diffractometer (KM4CCD, Oxford Diffraction, Abingdon, UK)
- MS-TOF (Agilent 6224 Accurate Mass TOF)
- GC/MS (Shimadzu GC17A, Shimadzu GC2010; Shimadzu GC MS – QP 2010)
- IR (Genesis series IR ATI Mattson)
- UV/VIS (Shimadzu UV-1602)
- Polarimeter (JASCO-Autopol III)
- HPLC (Shimadzu LC-10AD with JASCO CD-1595 CD/UV detector and Shimadzu LC-10AD with Shimadzu SPD-M10A diode array detector)

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

16 / 0.64

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

80

MAIN PROJECTS ↘

2011-2015: Center for Biological and Cellular Engineering (CBCE)-research platform of FNUSA-ICRC project

2010-2013: Biologically Active Organic Compounds Interacting with Adenine-binding Proteins (project 230936 financed by FP7-PEOPLE-2009-RG Marie Curie Action)

2010-2012: Nucleoside Analogs with Targeted Biological Activity (project SRGA 771 financed by programme SoMoPro - Reintergation Grants, European Commision and South Moravian Region)

2010-2012: Molecular and supramolecular building blocks for nanostructured materials (MOSTNAMAT) (financed by Masaryk University)

ACHIEVEMENTS

- Discovery of SCH 727965 (dinaciclib) - potent and selective CDK inhibitor; currently in Phase II clinical trials
- Discovery of SCH 900776 - functionally selective inhibitor of CHK1 kinase; currently in Phase I/II clinical trials
- Schering-Plough President's Award 2004: Discovery of the cyclin-dependent kinase inhibitor SCH 727965: A comprehensive strategy for the identification of targeted cytoreductive agents

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

- CBCE/ICRC/Mayo Clinic (CZ/US)
- Columbia University (US)
- Karolinska Institutet (SE)
- Kobe-Gakuin University (JP)

COLLABORATION WITH COMPANIES

- Apigenex (Prague, CZ)

EXPECTATIONS ↘

REQUIREMENTS

Collaborating partner ideally having the ability to profile biologically active compounds in a pre-clinical (and potentially clinical) setting in proper in vitro and in vivo screenings of choice that are beyond the scope of academic institutions.

OFFERS

- Design and synthesis of organic compounds and (in the laboratories of the cooperating biologists) their profiling in screenings containing normal somatic cells, cancer cells, cancer stem cells, and human embryonic stem cells

Laboratory of Cell Differentiation

/ Institute of Experimental Biology
/ Faculty of Science / Masaryk University

RESEARCH GROUP CONTACT

Kamenice 753/5, 625 00 Brno, Czech Republic
http://www.sci.muni.cz/LCD

HEAD Prof. Jan Šmarda
PHONE +420 549 491 416
E-MAIL smarda@sci.muni.cz

HEAD Dr. Petr Beneš
PHONE +420 54949 3125
E-MAIL pbenes@sci.muni.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Behaviour of tumor cells
- Principles of proliferation, differentiation and programmed cell death in cancer cells
- Testing of anti-cancer drugs

EXCELLENCE

- Targeting gene functions using DNA manipulation and RNA interference techniques
- Testing of anti-cancer drugs

MISSION

- To increase excellence of research and teaching quality
- To be a renowned educational and research institution, able to offer an international standard of university education as its focus

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Searching for conditions suppressing proliferation and resuming differentiation and/or programmed cell death of cancer cells
- Investigating molecular mechanisms of how specific genes can promote and suppress carcinogenesis
- Investigating cytotoxicity and mechanism of action of anti-cancer drugs

MAIN CAPABILITIES

- Targeted regulation of gene expression (both „on“ and „off“)
- Gene modification and transfer among various cell types
- Monitoring of gene expression by real-time PCR and DNA microarrays
- Measuring of cell proliferation, differentiation and programmed cell death by multiple methods
- Measuring of cell motility and invasiveness in real-time

FIELDS OF RESEARCH RESULTS APPLICATION

- Drug development
- Diagnostics and therapy of cancer diseases

ALUMNI PROFILE

Alumni have excellent knowledge of methods of DNA manipulation, gene transfection, RNA interference, cell cultivation, monitoring of gene expression using real-time PCR, immunoblotting and fluorescence microscopy. They are able to design research projects as well as individual experiments independently and present their results in written and oral form.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

4

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

6

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- ELISA (Enzyme-Linked Immonosorbent Assay) (Bio-Tek) reader for detection of antibodies
- Apparatus for one- and two-dimensional gel electrophoresis (Bio-Rad) for separation of nucleic acid and proteins
- xCELLigence Real-Time Cell Analyzer (Roche) for detection of various characteristics of living cells, such as, cell motility and invasiveness
- Thermocycler for real-time PCR (Applied Biosystems) to quantitative expression of specific genes
- Device (Bio-Rad) for immunoblotting of proteins
- Deep-freeze (-80oC and-140oC) cabinets (SANYO) for safe long-term storage of cells and other samples and chemicals
- High-capacity incubators and shakers (New Brunswick) for efficient cultivation of animal and human cells, as well as bacterial cells
- Centrifuges of various types including a cytocentrifuge (Beckman, Eppendorf) for separation of various cell fractions and molecules
- UV-crosslinker (Stratagene) for immobilizing the molecules of nucleic acids on filters
- Bright field and fluorescent microscopes (Nikon) for monitoring of morphology of living cells and detection of specific cell markers in situ,
- Luminometer (Turner), spectrophotometer (Pharmacia) for measurement of luciferase activity, and optical density, respectively in liquid samples
- Nucleofector (Amaxa) for efficient transfection of cells,
- Nanophotometer (Implen) for determination of exact concentration of nucleic acids in liquids of low volume
- Casy (Roche) for determination of cell number and viability

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

5.5 / 0.22

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

0

ACHIEVMENTS

- Contribution to understanding the role of specific proteins in the process of carcinogenesis published in a series of articles in international journals
- Education of undergraduate and postgraduate students in the field of Molelucar and Cellular Biology to become valuable members in renowned laboratories in the Czech Republic and abroad (Stanford University, State University of New York at Stony Brook, University of Vienna)

MAIN PROJECTS

2009–2012: The role of c-Myb and Cox-2 proteins in colon carcinogenesis (GA301/09/1115, Czech Science Foundation)

2008–2011: Mechanism of procathepsin D effect on breast cancer cells (IAA501630801, Academy of Sciences of the Czech Republic)

2006–2008: A role of certain transcription factors in the osteoclastic differentiation pathway (GA301/06/0036, Czech Science Foundation)

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- Stanford University (prof. Lipsik, Stanford, US)
- ENS Lyon (prof. Pierre Jurdic, Lyon, FR)
- Faculty of Medicine, Masaryk University (Brno, CZ)
- Institute of Biophysics, Academy of Sciences of the Czech Republic (Brno, CZ)

EXPECTATIONS

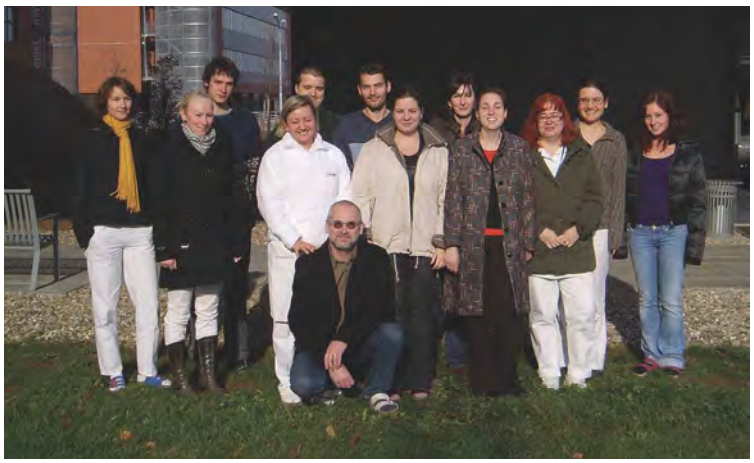
REQUIREMENTS

- Testing of gene function in animal models (metastasis in vivo, knock-out mice)
- Protein-protein interaction testing
- Live cell imaging

OFFERS

- Know-how in the field of gene targeting and cell manipulation,
- Tests of proliferation, differentiation, apoptosis, cell migration and invasivity in vitro,
- Cytotoxicity testing of various compounds in cancer cell lines,
- DNA and RNA manipulation,
- RNA and protein expression tests

04 / 2011



Cardiovascular Animal Research Centre

/ International Clinical Research Center
/ St. Anne's University Hospital

RESEARCH GROUP CONTACT

Pekařská 53, 602 00 Brno
http://www.fnusa-icrc.org

HEAD Assoc. Prof. Michal Vlašín
PHONE +420 723 816 781
E-MAIL vlasin@jaggy.cz

HEAD Prof. Miroslav Svoboda
PHONE +420 541 562 371
E-MAIL svobodam@vfu.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Animal studies
- Experimental surgery
- Cardiovascular research including interventional cardiology
- Electrophysiology
- Hematology and hemostaseology
- Intensive care medicine and research
- Animal studies for neuroscience
- Microsurgery
- Advanced diagnostic imaging
- Small animal medicine and surgery

EXCELLENCE

Experimental Laboratory for Cardiovascular and Cerebral Interventions (including magnetic catheter navigation technology); one of the world's most advanced animal facilities, with all the specialists for Animal Medicine and Pathology on-site.

MISSION

Our main task is to prepare, conduct and evaluate preclinical animal studies of new drugs, biomaterials or procedures. We offer the environment of a highly equipped animal facility with the best technology in-site. We want to be a part of the wider world leaders and cooperate with world leaders and be attractive for more institutions and companies.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Cardiovascular disease - portability to humans
- Tissue engineering
- Pre-clinical animal studies
- Veterinary clinical trials (on animal patients)

MAIN CAPABILITIES

- The use of stem-cells in cardiovascular medicine and surgery
- Rabbit arterial thrombosis model
- Pig model if hemorrhagic shock

We cooperate extensively with international companies through the background of ICRC (e.g. use of magnetic navigation and endovascular brain catheterization mapping to treat epilepsy and strokes), we invent new, more effective and more reproducible animal models, mimicking precisely real clinical situations.

FIELDS OF RESEARCH RESULTS APPLICATION

- Clinical trials for new drugs, biomedical devices and new procedures
- Biomedicine – especially cardiology and surgery
- Medical equipment - diagnostic, measurement, imaging devices

ALUMNI PROFILE

Specialists in pathophysiology, experimental surgery, animal physiology, pathology, diagnostic imaging, vascular and cardiovascular surgery.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

17

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

10

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Cardiovascular Animal Centre
- Technology for Advanced Diagnostic Imaging
- Animal pathology electrophysiology, using 1.5T MRI, NIOBE stereotactic navigation technology
- Vascular flow meter
- High tech anesthesiological equipment
- Remote telemetric monitoring

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

30 / 1.2

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

50

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

20

MAIN PROJECTS

2009–2011: Pig model of abdominal aortic aneurysm rupture. The influence of an early hyperoxygenation on parameters of systemic inflammation and reperfusion injury (grant awarded by the Czech Ministry of Health #NS10109-4/2008, Investigators: Sramek V, Suk P, Vlasin M, et al.)

2009–2011: Novel Use of Magnetic Guidance and Catheter-Based Cerebral Venous Mapping to Treat Epilepsy and Stroke (grant awarded by the Czech Ministry of Health #NS10099-4/2008, Investigators: Asirvatham SJ, Kara T, Vlasin M, et al.)

2011–2015: Studies in pig-to-primate cardiac xenotransplantation (NIH USA grant 2008 – 2010; extended 2011-2015 # AI66310-04, Investigators: McGregor CGA, Byrne GW, Vlasin M, Walker RC, Tazelaar HD, Chandrasekaran K, Oehler EA, Boilson BA, Wiseman BS and Logan JS.)

2007–2011: Ultrasonography in nanotechnology., Research Project Held by the Czech Academy of Science, project # KAN20050703, Investigators: Neužil J, Vlasin M et al.)

ACHIEVEMENTS

- Vlasin M, Dvorak M, Dvorakova M, Rauser P, Lexmaulova L, Gregor Z. Direct comparison of enoxaparin and nadroparin in a rabbit model of arterial thrombosis prevention. Thrombosis Research 126:56-60, 2010
- Meluzín J, Vlasin M, Groch L, Mayer J, Křen L, Raušer P, Tichý B, Horňáček I, Sitar J, Palša S, Klabusay M, Kořístek Z, Doubek M, Pospíšilová Š, Lexmaulová L, Dušek L. Intracoronary Delivery of Bone Marrow Cells to the Acutely Infarcted Myocardium. Cardiology 112:98-106, 2009
- Kren L, Meluzin J, Pavlovsky Z, Mayer J, Kala P, Groch L, Hornacek I, Rauser P and Vlasin M. Experimental model of myocardial infarction: Histopathology and reperfusion damage revisited. Pathol Res Pract; 206:647-650, 2010

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- International Clinical Research Centre - St. Ann's Faculty Hospital (Brno, CZ)
- Mayo Clinic (Rochester MN, US)
- University of London (GB)
- Institute of Scientific Instruments, Academy of Science of the Czech Republic (Brno, CZ)

COLLABORATION WITH COMPANIES

- BioTest (Konárovice, CZ)
- Medtronic (US)
- Biotronic (DE)
- General Electric (US)

EXPECTATIONS

REQUIREMENTS

We seek partnership in cardiovascular research, namely inventing drugs, devices and methods to be applied in medicine. We want to capitalize on our know-how from basic research.

OFFERS

We offer a high level of experience in the development of custom- made animal models and studies, including the proper interpretation of results.

BRNO UNIVERSITY OF TECHNOLOGY

Institute of Advanced Materials

/ Central European Institute of Technology of Brno University of Technology
/ Brno University of Technology

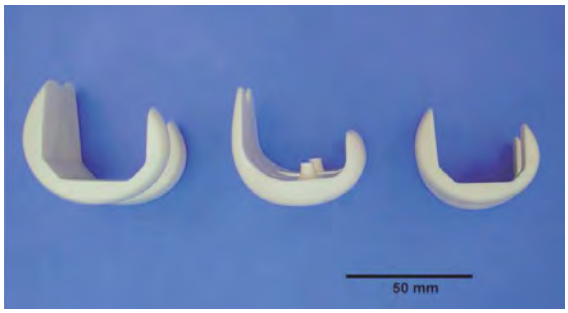
CEITEC
central european institute of technology
BRNO | CZECH REPUBLIC

RESEARCH GROUP CONTACT

Antonínská 548/1, 601 90 Brno
http://www.ceitec.cz

HEAD Prof. Jaroslav Cihlář
PHONE + 420 541 143 383
E-MAIL cihlar@fme.vutbr.cz

HEAD Prof. Josef Jančář
PHONE + 420 541 149 310
E-MAIL jancar@fch.vutbr.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Advanced ceramic, polymer materials and composites,
- Advanced metallic materials and metal based composites,
- Structure and phase analysis,
- Research and diagnostics of electrical properties of advanced materials

EXCELLENCE

- Advanced ceramic, polymer materials for bioapplications and electronic and structural applications

MISSION

- To establish equipment and personnel infrastructure further enhancing excellence in research of advanced (polymeric, ceramic, metallic and building) materials and their applications in various industrial segments, medicine and services

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

Biomaterials
development of novel composite biomaterials which can induce the growth of connective tissue on the surface of implants and therefore accelerate healing and improve the strength and biological stability of the implant-tissue connection (ceramic and metallic materials for replacement of soft and hard tissues, materials for orthopaedic devices).

Materials for energetics, communication and ecology
development of novel composite materials with a functionally graded structure for the improvement of the efficiency and lifetime of components and devices for energetics, communication and control technologies (conductive ceramic and polymer materials for electrodes, novel actuators, sensor components, control and instrumentation systems for technological processes, catalysts for the decomposition of gaseous pollutants, biopolymers and precursors from plants and plant residues).

Structural materials
development of novel polymeric, metallic and ceramic composites with excellent mechanical and thermal properties for structural applications (transparent ceramic materials; thermally and chemically resistant ceramic composite materials; impact-resistant ceramic composites; polymer multifunctional composites for high-tech engineering applications).

MAIN CAPABILITIES

Basic research
The results are published in high impal factor international journals in the mentioned fields, presented and communicated to the research and industrial community at workshops and conferences.

Application research + protection forms

- Transparent ceramics, ceramic armour, toughened engineering ceramics and composites
- New materials from easily renewable row sources (low energy materials, green materials), intelligent materials (materials with additional „smart" properties, for example – materials with high surface activity), nanomaterials.
- Innovative solutions of solar panels and diagnostics of their properties
- Application achievements in the innovation of electrode materials for NiCd batteries.
- Polymer materials: scratch-resistant materials based on nano fillers, intelligent enamels based on the application of nano fillers, soft polyurethane foams with controlled life-time

Photo 1 Bioceramics – Femoral component of knee joint

» Metallic materials for gas turbines and turbochargers (superalloys and intermetallics), metallic biomaterials for surgical implants (stainless steels, Ti-alloys, NiTi alloys) and new steels for railway traffic.
» Patent application dealing with hydrogen storage in metallic materials. This is a result of long term basic and applied research in the field of diffusion in metals

The results obtained (new materials, methodologies) create excellent conditions for expanding collaboration with hi-tech companies in the area of multilevel, multifunctional heterogeneous advanced materials.

FIELDS OF RESEARCH RESULTS APPLICATION

» Advanced materials – biomaterials, materials for energetics, communication and ecology, structural materials
» Electronic industry
» Chemical industry
» Automotive industry
» Alternative energy
» Non ferrous materials
» Plastics, polymers
» Glass, ceramics
» IT Security

Multifunctional homogeneous and heterogeneous advanced polymeric, ceramic, metallic and composite materials are expected to target a broad area of industrial segments ranging from technical sectors such as engineering, automotive industry, energetics, communication technology and medical electronics to the food industry, ecology and biomedicine. Besides traditional technical industries, the exploitation potential of multi-disciplinary scientific interactions is expected to result in novel application areas (e.g. unique mechanical characteristics of biomaterials finding applications in medicine as heart tissue substitutes in orthopaedics and dentistry, excellent mechanical and thermal properties of novel polymeric, metallic and ceramic composites exploitable in structural applications, materials originated from natural sources and environmentally compatible materials finding application in agriculture and forestry, etc.)

ALUMNI PROFILE

Doctoral graduates are on a very high technical level, provided with both the knowledge of the latest advances in the fields of materials sciences (inclusive of experimental methods for studying the structure and properties of materials) and the knowledge necessary for playing the role of a „bridge" between designers and technologists. Graduates are thus well prepared for science and research activities as members of materials science teams, for teaching activities at technical universities as well as for working in teams that, within the contemporary trend towards concurrent engineering, participate in the development of new products in manufacturing plants.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

29

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

87

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

» Multi-channel equipment Potentionstat/Galvanostat with multi-channel input /output for measuring very low frequency, voltage compliance 100V, current compliance 1nA - 10A.The measuring system is fully computerized and controlled by the programmable software.
» Multi-channel equipment for analyzing and data storage with fast sampling pulse generator (10Mvz/s) and scan rate 250kV/s. Usage of a broad range of electrochemical methods for analysing of material properties. The measuring system is fully computerized and controlled by the programmable software.
» Precision measurement system for dielectric and electrochemical impedance spectroscopy covers a frequency range from 3 μHz to 3 GHz, a temperature range - 160 ° C - 1 400 ° C and voltage range up to kV. The system consists of several frequency analyzers and potentionstats.
» Sensitive measurement system for spectroscopic measurements in the time domain for very small currents (below 1 fA).
» AC voltage module system – workplace for measurement breakdown voltage of electro insulating materials up to 200 kV
» Measuring bridges method covering both high and low voltage applications - workplace for precision measurement of capacity and dissipation factor (voltage up to 2 kV, frequency about 50 Hz)
» Set of climatic chambers – apparatus for exposing samples to different climatic condition (temperature range -70 – 200 °C, humidity range 10 – 99 %, solar and UV radiation, thermal shock chamber)
» Thermal analyser TG/DTA for thermoanalysis of ceramic particulate materials in the temp. range of 25-2000 °C and in driven atmosphere; sample mass 25 mgů mass spectrometric detection of evaluated gasses
» Device for the study of ionic permeability of ceramic high temperature membranes in the temp. range of 0-1200 °C and pressure range of 0-0.2 Mpa
» Equipment for testing of SOFC in the temperature range 0-1200 °C and pressure range of 0-0.2 Mpa
» Attrition mills for dispersion and homogenisation of fine and nanometre-sized ceramic powders, especially in liquid medium
» Heated kneading machine for mixing ceramic suspensions based on ceramic powders and liquids solvent or polymer melts
» Isostatic press with a pressure of liquid medium up to 1 GPa
» Machine for casting of ceramic green bodies of thin-wall sheets
» Milling machine for machining of complex ceramic green bodies
» Furnace for catalytic debinding of polymer binder

- Climatic chamber with temperature and humidity control
- Debinding muffle furnace for temperatures up to 1100°C with controlled gas atmosphere
- Device for mercury porosimetry of porous bodies
- Capillary rheometer for rheological evaluation of plastic materials
- Thermogravimetric analyzer with controlled gas atmosphere or with vacuum up to temperature of 1600°C and sample mass up to 100 g
- Equipment for solvothermal microwave synthesis of advanced ceramic particulate materials at max. temp. 300 °C and pressure 20 Mpa
- Device for high-temperature synthesis of ceramic particles in the temp. range of 0-1200 °C and pressure range of 0-0.2 Mpa
- Device for deposition of thick films and flat objects by means of ceramic colloidal dispersions. Maximum size of objects : 250x250 mm
- Device for deposition of thin films by means of liquid and gasseous precursors. Maximum size of objects : 50x50 mm
- Device for drying of g-l spray of ceramic particles and collection in cyclone separator. The volume of drying box is about 1 m3.
- Box for chemical experiments with reactive chemicals under intert conditions. The volume of chamber is 1,5 m3, contents of oxygen and water about 1 ppm
- Hot press used for pressing of inorganic powder materials at elevated temperature
- High-temperature dilatometer used for heating the sample and at the same time montoring its length changes
- High-temperature furnace intended for large samples
- High-temperature furnace working with vacuum or inert atmosphere
- High-temperature furnace working with pure hydrogen atmosphere
- Low-temperature furnaces with air atmosphere
- Catalytic reactor, with mass spectrometric product detection; capable of temperature programmed oxidation (TPO), temperature programmed reduction (TPR) and temperature programmed desorption (TPD) of ceramic catalytic materials
- Weather-Ometer Ci4000 + accessories
- Q-Sun Xe-1 desktop
- Weather station, type C
- HV Flame chamber HVUL2
- Melt-flow indexer
- Air-draft ageing chamber
- DMTA with low temperature chamber
- Servohydraulic tensile testing machine with temperature chamber
- High resolution SEM
- Confocal laser microscope
- Micro-rheological analyzer
- Nano CT Scan
- SAXS (small-angle X-ray scattering)
- High resolution TGA
- High temperature GPC
- Regular GPC
- Dynamic light scattering with MWD
- Modulated DSC
- Rheoviscosimeter
- FTIR microscope
- Lyophilizer
- Vacuum drying oven
- UV spectrophotometer
- GPC
- High performance dry box
- Micro twin-screw continuous reactor 15ml
- Bench top injection moulding machine
- 19 mm twin screw co-rotating split barrel extruder with accessories
- Gravimetric dosing system
- Axial-torsional servo-all-electric test system
- Multiaxial fatigue test stand
- Linear-Torsion All-Electric Test Instrument
- FEG -SEM High/Low vacuum + analytical attachments (EDS + WDS + EBSD)
- X-Ray Diffractometer + Goebble mirror for HR spectra acquisition + JCPDS database + high temperature chamber
- High resolution (sub nanometer) FEG scanning electron microscope + analytical attachments (EDS + WDS + EBSD)
- High resolution 300 keV FEG TEM/STEM with aberration correctors + analytical systems (EDS + EELS)
- Materialographic sample preparation unit - coarse (materialographic saw with equipment and materialographic press with equipment).
- Automatic grinder and polisher with equipment.
- TEM and SEM sample preparation unit (ion polisher for TEM foils, ion polisher for bulk SEM specimens and Electrolytical polisher for TEM foils).
- Oscilloscopes DSA9000 or equivalent
- Active meassurement equipment for DSA
- Meassurement stand for embedded systems and communication systems
- Pulse pattern generator
- Circuit board rapid prototyping system
- 3-ph programmable power supply 21kVA
- Oscilloscope + advanced functionality modules + probes
- Precise spatial measurement system
- Navigation unit
- Mobile calibration anechoic chamber
- PXI measurement system
- Set of acoustic sensors
- Reference vibration exciter with accessories
- Measurement and test workplace with dynamometers set

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)
40 / 1.6

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)
5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

10

MAIN PROJECTS

2007-2010: Heterogenous catalysts for oxidation of organic compounds based on composite perovskite oxides (Project OC 180 financed by the Ministry of Education, Youth and Sports)

2010-2012: Effect of nanoparticles on the chain mobility and crystallization kinetics in polyolefin nanocomposites (Project GAP205/10/2259 financed by the Czech Science Foundation)

2009-2011: Rheological behaviour of polymer melts and solutions loaded with nanoparticle fillers (project Project OC09040 financed by the Ministry of Education, Youth and Sports)

ACHIEVEMENTS

VOJTOVÁ, L.; JANČÁŘ, J.: Method of preparation of thermodegradable polyurethane foams. World Intellectual Property, Geneve, Patent no.: WO/2010/066211 (appl. no: PCT/CZ2009/000153), 2010-17-06.

TRUNEC, M., CHLUP, Z.: Higher fracture toughness through nanocrystalline structure, Scripta Materialia, 61, 2009, 56-59.

MACA, K., POUCHLY, V., ŽALUD, P.: Two-step sintering of oxide ceramics with various crystal structures, J. Eur. Ceram. Soc., 30, 2009, 583-589.

BARTONCKOVA, E., WIIK, K., MACA, K., LEIN, H. L., RUDBERG, E. A.: Synthesis and oxygen transport properties of La0.2Sr0.8Fe1-xTixO3 (x=0.2, 0.4) intented for syn-gas production, J. Eur. Ceram. Soc., 30, 2009, 605-611.

JANCAR, J., DOUGLAS, J. F., STARR, F. W., et al.: Current issues in research on structure-property relationships in polymer nanocomposites, POLYMER, 51 (15), 2010, 3321-3343

JANCAR, J., RECMAN, L.: Particle size dependence of the elastic modulus of particulate filled PMMA near its T-g, POLYMER, 51 (17), 2010, 3826-3828.

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- Arrhenius Laboratory, Stockholm University (prof. Zhiijan Shen, SE),
- Department of Materials Engineering, University of Novi Sad (prof. Vl. Srdic, RS)
- National Institute for Materials Science (Dr. Taras Kolodiazhnyi, JP)
- University Duisburg-Essen (Prof. Markus Winterer, DE)
- National Centre for Scientific Research "Demokritos" (Dr. Evagelia Moshopoulou, GR)
- Institute of Materials Research, Slovak Academy of Science (Prof. Jan Dusza, SK)
- Institute of Materials Science, University of Connecticut (Prof. R.A.Weiss, US)
- S.A. Conte Polymer Engineering Center, University of Massachussets (Prof. A. Lesser, US)
- Institut für Energietechnik, Technische Universität Dresden (Prof. Dr. Ing. Uwe Gampe, DE)
- Dipartimento di Meccanica, Politechnico di Milano (Assoc. Prof. Dr. Mauro Fillipini, IT)

COLLABORATION WITH COMPANIES

- Walter (Ing. František Denk, Prague, CZ)
- Saint-Gobain Advanced Ceramics (Ing. Vladimír Šída, Turnov, CZ)
- Lasak (Ing. Zdeněk Strnad, Prague, CZ)
- mTec (Ing. Erik Elmer, Prague, CZ)
- Synpo (Dr. J. Zelenka, Pardubice, CZ)
- Rhodia (Dr. G. Mignani, Lyon, FR)
- Volkswagen AG (Dr. W. Kramer, Wolfsburg, DE)
- Metallchemie (Vrútky, SK)
- Daneher Motion (Modřice, CZ)
- Ingersoll-Rand Czech Republic (Uničov, CZ)
- Timken Česká Republika (Bystrovany, CZ)
- BOSCH Diesel (Jihlava, CZ)
- Brisk Tabor (Tábor, CZ)
- Bochemie (Bohumín, CZ)
- Solartec (Rožnov pod Radhoštěm, CZ)
- Gumotex (Břeclav, CZ)

EXPECTATIONS

REQUIREMENTS

We are looking for both academic and industrial partners in basic and applied research in the areas of biomaterials, structural materials and materials for energetics, communication and ecology.

OFFERS

- Competitive applied research
- Specialized services on top-class instruments in the area of transmission microscopy, scanning electron microscopy, microanalysis and X-ray diffraction analysis

Photo 1 Electroceramics – Oxygen tubular membranes, material: La-Ca-Fe-Co perovskite

Department of Bioanalytical Instrumentation

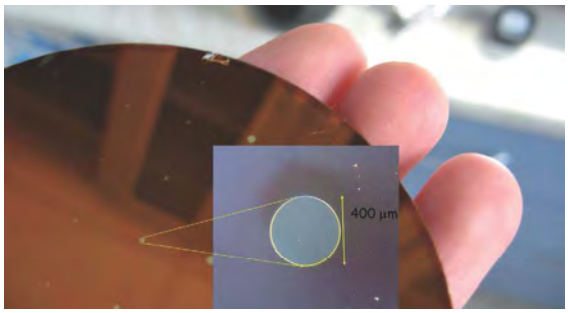
/ Institute of Analytical Chemistry
/ Academy of Sciences of the Czech Republic

CEITEC
central european institute of technology
BRNO | CZECH REPUBLIC

INSTITUTE CONTACT

Veveří 97, 602 00 Brno, Czech Republic
http://www.iach.cz/departments/ins/www/

HEAD Dr. František Foret
PHONE +420 532 290 242
E-MAIL foret@iach.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

Research of methods and their combinations and development of their applications especially for bioanalytical objects.

EXCELLENCE

Microcolumn separations – mass spectrometry coupling

MISSION

Exploring the world of Capillary Separations - Mass Spectrometry Coupling, Microfluidics and Single Cell Analysis.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Capillary separations
- Mass spectrometry coupling
- Enzymatic microreactors
- Microfabrication – Microfluidics
- Single cell analysis

MAIN CAPABILITIES

Electrospray interface for coupled column ITP system – presentment of application for patenting, others are in preparation. Capillary fraction collector, thermostat box for DNA analysis.

- International patents are granted together with Ing. Klepárník in cooperation with Barnett Institute in Boston

Miniaturized multidetector for conductivity, absorbance and fluorescence detection at a single site capillary.

- Presentment of application in Ireland in cooperation with Dublin City University (prof. Macka)

FIELDS OF RESEARCH RESULTS APPLICATION

- Biomedicine
- Biotechnology (diagnostic, medical equipment)
- Waste water treatment
- Chemical industry

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

3

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

8

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Laser lithograph
- Laser detection systems
- 3 electrospray mass
- Spectrometers
- CE and HPLC instruments

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

5 / 0.2

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

10

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

2

MAIN PROJECTS

2006-2010: Integrated bioanalytical technologies for microanalyses and diagnostics with laser induced fluorescence and mass spectrometry coupling (project LC06023 financed by the Ministry of Education, Youth and Sports)

2006-2010: Nanotechnologies for protein and gene diagnostics (project KAN400310651 financed by the Academy of Sciences of the Czech Republic)

2006-2008: Microfluidic instrumentation for analyses of biopolymers modified by structural probes (project GA203/06/1685 financed by the Czech Science Foundation)

ACHIEVEMENTS

Selected high impact publications:

- Editing of yearly special issues of Electrophoresis on Miniaturization since 2000.
- Lazar, I.M., Grym, J., Foret, F. Microfabricated devices: a new sample introduction
- approach to mass spectrometry. Mass Spectrometry Reviews, 2006, 25, 573– 594.
- Křenková, J., Foret, F. Immobilized microfluidic enzymatic reactors. Electrophoresis, 2004. 25, 3550-3563.

Patents:

- Karger, B. L., Kotler; L., Foret, F., Minarik, M., Kleparnik, K. Multichannel microscale system for high throughput preparative separation with comprehensive collection and analysis. US Patent # 7,578,915, 2009.
- Foret; F.; Karger; B. L. Parallel array of independent thermostats for column separations. U.S. Patent # 6,929,731, 2005.
- Foret; F.; Rejtar; T.; Zhang; B.; Karger; B. L. Parallel sample loading and injection device for multichannel microfluidic devices. U.S. Patent #6,939,452, 2005.
- Karger, B.L., Foret, F., Preisler, J. On-line and off-line deposition of liquid samples for matrix assisted laser desorption ionization-time of flight (MALDI-TOF) mass spectroscopy. U.S. Patent # 6,825,463, 2004.

Organization of international conferences:

- Founders and organizers of the international interdisciplinary symposium on bioanalysis CECE 2004 - 2011.
- Organization of the prestigious international conference MicroScale Bioseparations - MSB2010.

Membership in editorial boards of international journals:

- Electrophoresis
- Journal of Chromatography
- Journal of Separation Science
- Biomacromolecular Mass Spectrometry
- Current Analytical Chemistry
- The Open Proteomics Journal

MAIN COLLABORATING PARTNERS

COLLABORATIONS WITH ACADEMIC PARTNERS

- Institute of Biophysics, Academy of Sciences of the Czech Republic (Brno, CZ)
- Faculty of Science, Masaryk University (Brno, CZ)
- University Hospital (Brno, CZ)
- Masaryk Memorial Cancer Institute (Brno, CZ)
- DCU (Dublin, IE)
- CNR (Rome, IT)
- Barnett Institute (Boston, US)
- IFI CISC (Madrid, ES)
- University of Debrecen (Debrecen, HU)

COLLABORATION WITH COMPANIES

- BVT (Brno, CZ)
- Villa Labeco (SK)
- Genomac, Watrex (Prague, CZ)
- Applied Biosystems (US)
- Gyros (SE)

EXPECTATIONS

REQUIREMENT

We are looking for industrial partners in the Czech Republic as well as abroad.

OFFERS

Capacity in designing and fabrication of microdevices, preparation of surface modified quantum dots, bioanalytical method development

BRNO UNIVERSITY OF TECHNOLOGY

Polymer Group

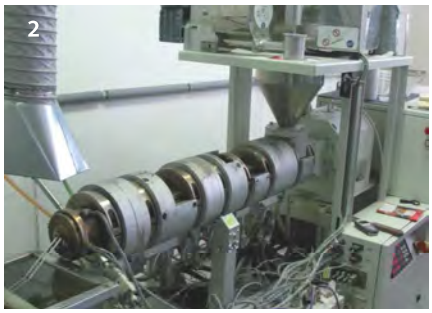
/ Institute of Materials Chemistry / Faculty of Chemistry
/ Brno University of Technology

CEITEC
central european institute of technology
BRNO | CZECH REPUBLIC

RESEARCH GROUP CONTACT

Purkyňova 118, 612 00 Brno
http://www.fch.vutbr.cz/cs/fakulta/ustav-chemie-materialu.html

HEAD Prof. Josef Jančář
PHONE + 420 541 149 310
E-MAIL jancar@fch.vutbr.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

The relationship between structure and properties of polymers, biopolymers, composites and nanocomposites and their fracture mechanics and technology of production.

EXCELLENCE

Our group has achieved world recognized results in the synthesis of amphiphile block copolymers for a wide range of biomedical applications and drug delivery, in understanding the mechanisms and kinetics of thermodynamic transitions in polymer nanocomposites and in their viscoelasticity and deformation behaviour. In addition, excellent results have been obtained in reactive compounding, polymer stability and in computer simulations of complex heterogeneous polymers and polymer composites including bio-nano-composites.

MISSION

» An excellent institute, which is one of the wider world leaders in basic and applied research

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

» Basic research in the physics of polymer nanocomposites
» Development of new polymer or composite materials for applications in electrical engineering, mechanical engineering, civil engineering and medicine
» Assessing the interaction of biological and synthetic materials with elements of the environment in terms of material life and its impact on the environment

MAIN CAPABILITIES

Basic Research:
» Fibre composite materials
» Optical microscopy
» Confocal microscopy
» Deposition and characterization of plasma polymers
» Simulation and Modelling
» Geopolymers
» MDF Composites
» Non-traditional binders and composites
» Corrosion and Protection of metallic materials
» Synthesis of organometallic compounds

Application research + protection forms
» Polymer nanocomposites
» Biomaterials for tissue engineering
» Sol-gel process

FIELDS OF RESEARCH RESULTS APPLICATION

» Advanced mechanical engineering, aerospace and automotive industries
» Biomedical technology
» Microelectronics
» Coatings, sensors

ALUMNI PROFILE

Our graduates are fluent in using a wide range of experimental devices in FTIR and UV VIS spectroscopies, SEM, OM and CLSM microscopies, thermoanalysis (DSC, TGA, DMA), mechanical testing (tensile testers, impact pendulums, rheoviscosimeters) and master a range of specific synthetic techniques (ROMP, ATRP). In addition, theoretical knowledge of the natural laws governing thermodynamic transitions in polymer based systems as well as morphology formation in polymer composites is also part of the skills acquired by our graduates in the course of their Ph.D. studies.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

25

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

47

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

- TGA 6 thermogravimetric analyzer PERKIN ELMER
- TGA Q500 thermogravimetric analyzer TA
- DSC Pyris I Differential Scanning Calorimetry PERKIN ELMER
- DMTA 2980 Dynamic mechanical thermal analyser, TA
- RSA-III dynamic mechanical analyser, TA
- AR-G2 rheoviscosimeter, TA
- DSC 2920 Differencial Scanning Calorimetr TA INSTRUMENTS
- ZWICK Z 010 Universal test equipment ZWICK – Roell
- Resil Junior, instrumented impact pendulum, CEAST
- Fractovis, biaxial instrumented impactor, CEAST
- LEXT 3000, Confocal laser scanning microscope, Olympus
- iSpeed-3, ultrafast digital camera, Olympus
- hot-stage, Linkam
- Isoperibolic 16 - digit calorimeter
- TGA + DTA SETERAM
- GPC - Gel permeation chromatography + RI detector
- Image analysis, optical microscope (Olympus BX 50 with an additional light source (Olympus TH 400-200) with a digital camera (Olympus Camedia C - 4040Zoom)
- Scanning probe microscopy Ntegra Prima (NT-MDT)
- High-shear mixer TWINROLL
- Gravimetric spectrometer HIDEN ANALYTICAL
- Chembet - 3000 (Fa Quantachrome)
- Zetasizer 3000HSA (Fa MALUERN)
- Elipsometr Jobin – Yvon UVISEL
- Chamber electric furnaces CLASIC
- Diffractometer Siemens D500

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

30 / 1.2

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

10

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

5

MAIN PROJECTS ↘

2005–2011: Multifunctional heterogeneous materials based on synthetic polymers and biopolymers (project MSM0021630501 financed by the Ministry of Education, Youth and Sports)

2010–2012: Effect of nanoparticles on the chain mobility and crystallization kinetics in polyolefin nanocomposites (project GAP205/10/2259 financed by the Czech Science Foundation),

2006-2011: Synthesis of new biomaterials and preparation of stem cell derived cells, and their applications in the treatment of diseases affecting human tissues derived from mesoderm: cartilage, bone, ligament and meniscus (Project 2B06130 financed by the Ministry of Education, Youth and Sports)

ACHIEVEMENTS ↘

- J. Jancar, J.F.Douglas, F.W. Starr, S.K. Kumar, P. Cassagnau, A.J.Lesser, S.S. Sternstein, M.J. Buehler; Current issues in research on structure–property relationships in polymer nanocomposites. Review Article, Polymer, Volume 51, Issue 15, 8 July 2010, Pages 3321-3343
- Jancar, J.; Jancarova, E.; Zidek, J.Combining Reptation Dynamics and Percolation in Modelling Viscoelastic Response of Collagen Based Nanocomposites. Journal of Computational and Theoretical Nanoscience, Volume 7, Number 7,July 2010, pp. 1257-1264
- Jancar J., Hynstova K., Pavelka V. ,Toughening of denture base resin with short deformable fibres, Composites Science and Technology, Volume 69, Issues 3-4, March 2009, Pages 457-462
- Jancar J., Recman L., Particle size dependence of the elastic modulus of particulate filled PMMA near its Tg, Polymer, Volume 51, Issue 17, 4 August 2010, Pages 3826-3828
- Kalfus, J.; Jancar, J. , Effect of Particle Size on the Thermal Stability and Flammability of Mg(OH)2/EVA Nanocomposites, Composite Interfaces, Volume 17, Numbers 5-7, 2010 , pp. 689-703(15)
- Jancar J, Interphase phenomena in polymer micro- and nanocomposites, in Nano- and Micro-mechanics of polymer blends and composites, Karger-Kocsis J, Fakirov S, Eds., Hanser, Munich 2009, Ch. 7, pp.241-267
- Jancar J, Use of reptation dynamics in modelling molecular interphase in polymer nanocomposites, in Modelling Nanomaterials and Nanosystems, Pyrz R, Rauhe JC, Eds., Springer, Heidelberg, 2009, pp.293-301
- Kalfus J., Jancar J., Theoretical Modelling and Simulation of Rubber Nanocomposites, in Thomas S., Stephen R. (Eds.), Rubber Nanocomposites: Preparation, Properties and Applications, J.Wiley, New York, 2010, ISBN: 978-0-470-82345-3

» Vojtova L, Jancar J, PCT/CZ2009/000153, Degradable polyurethane foams (granted 2011)
» Vojtova L, Jancar J, Blends for thermodegradable polyurethane foams, application CZ 2007-007, (Czech)
» Kučera F, Jancar J, Blend for preparation of ITA grafted PP, application 2007-19026 18837, awarded 28.8.2008, (Czech)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Polymer Science and Engineering Center, University of Massachusetts (US)
» Institute of Materials Science, University of Connecticut (US)
» University of Veterinary and Pharmaceutical Sciences Brno (Brno, CZ)
» Institute of Experimental Medicine, Academy of Sciences of the Czech Republic (Prague, CZ)
» Faculty of Medicine, Masaryk University (Brno, CZ)

COLLABORATION WITH COMPANIES

» Škoda (Mladá Boleslav, CZ)
» VW (Wolfsburg, DE)
» PPG Industries (Pittsburgh, US)
» Ivoclar (Schaan, LT)
» ADM (Brno, CZ)
» Gumotex (Břeclav, CZ)
» Fatra (Napajedla, CZ)
» VÚP (Brno, CZ)

EXPECTATIONS ↘

REQUIREMENTS

» Cooperation with research institutions as well as companies in the field

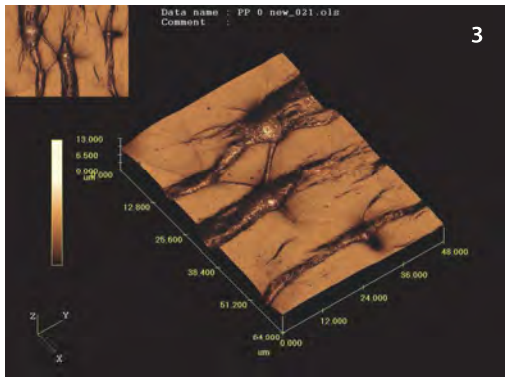
OFFERS

» Tailor made polymer based materials
» Troubleshooting

Photo 1 Polymer group leader, Professor Jancar, with Nobel Price laureate in chemistry, Professor Alan Heeger, during his visit in the Polymer Group synthetic laboratory

Photo 2 Versatile, 25mm twin-screw extruder with L/D=36 and many adds on in the Polymer Group polymer processing and modification laboratory

Photo 3 Morphology of reactor ICPP copolymer deformed in the view area of the Polymer Group Confocal Laser Scanning Microscope



BRNO UNIVERSITY OF TECHNOLOGY

Biocolloids

/ Centre for Materials Research & Institute of Physical and Applied Chemistry / Faculty of Chemistry / Brno University of Technology

RESEARCH GROUP CONTACT

Purkyňova 118, 612 00 Brno, Czech Republic
http://www.fch.vutbr.cz/ipac/index.php?fun=vyzkum&file=vyzkum

HEAD Prof. Miloslav Pekař
PHONE +420 541 14 9330
E-MAIL pekar@fch.vutbr.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

Physical chemistry of colloid and macromolecular systems

EXCELLENCE

Applied physical chemistry (3 researchers are in the world's top 10 %)

MISSION

- To look towards the European excellence in research of physical chemistry of biocolloids
- To be attractive partner for industrial R&D
- To provide a high quality educational process (for students and employees of industrial partners)

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Biocolloid transport systems for biomedical and environmental technologies, nanomedicine and other nanotechnologies
- Research on biomaterials for medical applications / applications of lignite and humic acids (e.g. sorbents)

MAIN CAPABILITIES

- Physicochemical characterization of delivery systems for (nano) medicine, cosmetics and agriculture
- Physicochemical characterization of humic substances and new humic materials for applications in agriculture and environmental technologies
- Diffusion in gels

FIELDS OF RESEARCH RESULTS APPLICATION

- Biomedicine
- Agriculture and food biotechnology
- Plastics industry
- Environmental protection technology

ALUMNI PROFILE

Alumni are specialists in applied physical and colloid chemistry in the production of specialty or consumer chemical products or for small-scale chemical and biotechnological industry in general.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

3

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

15

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Ultrasonic spectrometer (Ultrasonic Scientific, HR-US 102) - unique in the Czech Republic
- Rheometry (TA Instruments, AR G2)
- Thermal analysis (TA Instruments, DSC Q200 and TG Q5000IR)
- Tensiometry (KSV, Sigma 701 and bubble pressure BPO 800 P)
- Densitometry (Anton Paar DMA 4500)
- Fluorescence (Aminco Bowman Series 2)
- UV/VIS (Hitachi U-3900H, Varian Cary 50)

» IR spectroscopy (Nicolet Impact 400)
» Diffusion cells

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

11 / 0.44

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

0

MAIN PROJECTS

2010-2013: Centres for materials research at FCH BUT (project ED0012/01/01 financed by the Operational Programme Research and Development for Innovation, Ministry of Education, Youth and Sports)

2008-2011: Self-assembling colloids hyaluronan-surfactant, hyaluronan-amino acid for nanomedical applications (project OC08004 financed by programme OC – COST, Ministry of Education, Youth and Sports)

2005-2008: Structural effects of humic substances and some plant alkaloids on the degradation and detoxification of persistent organic pollutants in soils (project 04-82-7271 INTAS financed by the Sixth Framework Programme)

2005-2007: Progressive and efficient non-energy applications of lignite (project GA105/05/0404 financed by the Czech Science Foundation)

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

» Mendel University (Brno, CZ)
» Academy of Sciences of the Czech Republic, Institute of Biophysics - Nanomedic cluster (CZ)
» University of Poitiers (FR)
» NTNU Trondheim (NO)
» University College Dublin (IE)

COLLABORATION WITH COMPANIES

» CPN (CZ)
» Generi Biotech (Hradec Králové, CZ)
» Nanomedic (cluster) (CZ)
» Amagro (CZ)

EXPECTATIONS

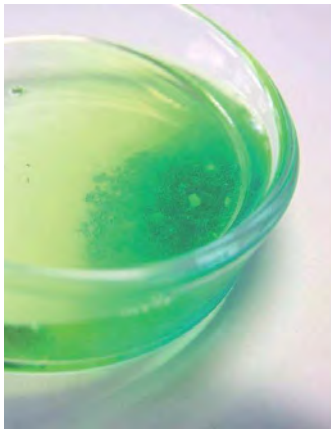
REQUIREMENTS

» Cooperation with interesting subjects and companies – cooperation with potential for further academic work
» Cooperation based on clearly defined research and development tasks from the field of colloids or nanocolloids

OFFERS

» Experience and facility in physical chemistry of colloids, including soft and macromolecular matter applicable in wide range of specific subjects or technologies
» Ideas for development of application activities

04 / 2011



BRNO UNIVERSITY OF TECHNOLOGY

Research group of smart materials for organic electronics, photonics and sensors

/ Centre for Materials Research / Faculty of Chemistry / Brno University of Technology

RESEARCH GROUP CONTACT

Purkyňova 118, 612 00 Brno
http://www.fch.vutbr.cz/en.html

HEAD Assoc. Prof. Martin Weiter
PHONE +420 541 149 484
E-MAIL weiter@fch.vutbr.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

» Organic electronics, photonics, sensors
» Small molecules, polymers and biomaterials
» Preparation of organic thin multilayered systems

EXCELLENCE

Preparation of thin organic multi-layered structures; synchronous characterization of optical and electrical properties and parameters of organic materials.

MISSION

To be excellent in Europe, be flexible in the needs of companies; development of our Centre for material research.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

» Research of advanced organic materials for organic electronics, bioelectronics, photonics and sensors
» Research of biomaterials for diagnostics / applications of biomaterials
» Deposition of multilayered thin organic systems for a broad range of applications

MAIN CAPABILITIES

The potential for application is also in the use of specific properties of organic semiconductors allowing not only expensive ones to exchange inorganic semiconductors with cheaper organic ones, but also allowing the creation of fundamentally new electronic components for molecular electronics and nanotechnology.

The successful application of research results is based on wide cooperation with many industrial partners from Europe and the Czech Republic.

FIELDS OF RESEARCH RESULTS APPLICATION

Organic electronics and photonics

Others:
Automotive industry, Textile industry, Construction - civil engineering, Construction - residential building, Measuring instruments, Chemical industry, Hazard management, Renewable energy, Energy savings, Plastics, Polymers, Diagnostic, Biotechnology, Clothing, Power supply – alternative resources

ALUMNI PROFILE

Alumni are experts in:
» Material engineering
» Physics and chemistry of advanced organic materials
» Nanotechnology
» Small-scale and special chemistry

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

12

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

25

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

» Clean room and glove boxes for the preparation of organic multilayered systems, sensors and other devices
» Complex equipment for the characterization of optical and electrical properties and parameters of organic materials

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

10 / 0.4

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

10

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

40

MAIN PROJECTS ↘

2009–2013: Multicomponent electronic systems based on organic materials (project FR-TI1/144, Ministry of Industry and Trade, CZ)

2008–2011: Development of Photovoltaic Textiles based on novel Fibres (project 7E09061, Ministry of Education, Youth and Sports, FP7 – NMT – SME, EU)

2006–2010: Molecular nanosystems and nanodevices: electric transport properties (project KAN401770651, Academy of Sciences of the Czech Republic)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Institute of Macromolecular Chemistry, Academy of Sciences of the Czech Republic (Prague, CZ)
» Institute of Physics, Academy of Science of the Czech Republic (Prague, CZ)
» Julius-Maximilians-Universität Würzburg (Würzburg, DE)

COLLABORATION WITH COMPANIES

» Generi Biotech (Hradec Králové, CZ)
» Centre of Organic Chemistry (Pardubice, CZ)
» Prefa Nanocomposites (Brno, CZ)
» Centro Ricerche Fiat S.C.p.A., (IT)
» Wetenschappelijk en technisch centrum van de Belgische textielindustrie (CENTEXBEL), (BE)
» Greatcell Solar, S.A. (CH)

EXPECTATIONS ↘

REQUIREMENTS

We appreciate a clear vision of the potential collaboration including time scales, output, IPR and other relevant circumstances.

OFFERS

We offer our substantive experience in the development of different applications based on organic advanced materials. This experience allows us to effectively utilize the Centre's up-to-date complex equipment for materials research for the preparation, characterization and application of different organic systems.

BRNO UNIVERSITY OF TECHNOLOGY

BUT Speech @ FIT

/ Department of Computer Graphics and Multimedia
/ Faculty of Information Technology / Brno University of Technology

RESEARCH GROUP CONTACT

Božetěchova 2, 612 66 Brno, Czech Republic
http://speech.fit.vutbr.cz/en

HEAD Assoc. Prof. Jan Černocký
PHONE +420 541 141 284
E-MAIL cernocky@fit.vutbr.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

Speech Processing – speaker and language identification, speech recognition and keyword spotting

EXCELLENCE

- Speaker and language identification, speech recognition, and keyword spotting
- The best phone recognition system in the world
- Feature extraction and acoustic modelling for LVCSR (posterior features, discriminative training and transforms)

MISSION

We aim to strengthen our position in the European Research Area and establish a Centre of Excellence in speech and language research at our Faculty. We wish to ensure professional development of our research staff, providing the means to the mobility of researchers and Ph.D. students. We plan to spread our excellence by organizing international workshops and conferences. We shall increase the technology transfer activities and strengthen our position in current and future EU funded projects. Management of our group will also focus on improving our relationship with our current and future industrial partners.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Robust speaker verification technology, including fast scoring
- Robust language recognition technology
- Large vocabulary continuous speech recognition (LVCSR) systems for several languages
- Keyword spotting (both acoustic and based on word/subword speech recognition)
- Indexing and search engine for spoken documents
- Lecture browser with speech indexing and search, available at http://www.superlectures.com
- Resources for speech processing (design, collection and validation of speech corpora)

MAIN CAPABILITIES

Cutting edge research, development and testing of advanced algorithms for speech recognition. The accent is on robust techniques for speech, speaker and language recognition. The group extensively investigates data-driven techniques and use of artificial neural networks for speech recognition. From the application point of view, BUT Speech@FIT is known to be close to the users (mainly from the security and defence community), and tailors its technologies to their needs. The group is also known for its open-source software development.

ACHIEVEMENTS

- Excellent results in NIST Language Recognition Evaluation 2005, 2007 and NIST Speaker Recognition Evaluation 2006, 2008 and 2010
- BUT Speech@FIT researchers are regularly invited to prestigious events, such as JHU summer workshops (already three times; Lukas Burget was the leader of JHU2008's group on speaker verification)

FIELDS OF RESEARCH RESULTS APPLICATION

- Security and defence (analysis of massive amounts of speech recording, speech analytics)
- Call-centres (seeking for individuals and keywords of interest)
- Consumer applications (dictation, personal memories, IP telephony)
- Academic and commercial research (speech recognition tools and toolkits)

ALUMNI PROFILE

Graduates of the group have an overall knowledge of state of the art in speech technologies and are specialized in one or more areas including:

» Speaker recognition
» Language recognition
» Speech transcription, keyword spotting and spoken term detection
» Machine learning (statistical models and neural networks for speech processing)
» Software development and graphical user interfaces

Thanks to participation in international conferences and research workshops, graduates are familiar with and often have strong personal relations with the world's leading academic and industrial laboratories in our field.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

8

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

8

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

» Computer Systems with more than 500 CPUs including 3 IBM-Blade centres, all running Linux
» File servers with total capacity of more than 20 Terabytes
» Speech and language databases
» Audio equipment

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

13 / 0.52

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

20

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

60

MAIN PROJECTS ↘

2009–2013: Lingea-BUT (project FR-TI1/034 – MPO financed by the Ministry of Trade and Industry of the Czech Republic)

2008–2010: MOBIO - Mobile Biometry (EU FP7 IST – 214324)

2007–2010: Overcoming the language barrier complicating investigation into financing terrorism and serious financial crimes (project VD 20072010B16 financed by the Ministry of Interior of the Czech Republic)

2006–2010: DIRAC - Detection and Identification of Rare Audio-visual Cues (EU FP6 IST – 027787)

2006–2009: AMIDA – Augmented Multi-party Interaction with Distance Access (EU-FP6-IST – 033812)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Johns Hopkins University (Baltimore, MD, US)
» Oregon Graduate Institute (Portland, US)
» McGill University, Department of ECE (Montreal, CA)
» Saarland University (DE)
» Politecnico di Torino (IT)
» Universidad de Zaragoza (ES)
» Bogazici University (TR)
» Indian Institute of Technology Madras, Department of Electrical Engineering (Chennai, IN)
» Technical University of Liberec, Speech Lab (Liberec, CZ)
» University of West Bohemia, Department of Cybernetics (Plzeň, CZ)

COLLABORATION WITH COMPANIES

» Agnitio (ES, ZA)
» CRIM – Centre de Recherche Informatique de Montreal (CA)
» Microsoft Research (Redmond, WA, US)
» Go-Vivace Inc. (Virginia, US)
» SVOX Deutschland GmbH (Münich, DE)
» IDIAP, Research Institute (Martigny, CH)
» Loquendo S.p.A., a Telecom Italia Group Company (Torino, IT)
» Lingea, s.r.o. (Brno, CZ)
» Phonexia s.ro. (Brno, CZ)
» OptimSys, s.r.o. (Olomouc, CZ)

EXPECTATIONS ↘

REQUIREMENTS

» Obtaining corporate sponsorship of core research

OFFERS

» Joint participation in EU and US-funded projects
» Custom-based research and development
» Licences of production-grade software

04 / 2011

BRNO UNIVERSITY OF TECHNOLOGY

Hardware-Software Co-design Research Group (Lissom@FIT)

/ Department of Information Systems / Faculty of Information Technology / Brno University of Technology

RESEARCH CONTACT

Božetěchova 1/2, 612 66 Brno, Czech Republic
http://www.fit.vutbr.cz/research/groups/lissom

HEAD Prof. Tomáš Hruška
PHONE +420 541 141 239
E-MAIL hruska@fit.vutbr.cz

HEAD Karel Masařík
PHONE +420 541 141 312
E-MAIL masarik@fit.vutbr.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Automation of hardware/software co-design for embedded systems and Multiprocessor System on the Chip (MPSoC)
- Support for general de-compilation techniques (for example for anti-virus companies)

EXCELLENCE

- Hardware/software co-design
- Language for description of microprocessor architectures
- Multiprocessor System on the Chip (MPSoC) design
- De-compilation techniques for various binary formats

MISSION

We hope the automation of HW/SW co-design for the embedded and multiprocessor system is a very perspective area of interest. We would like to participate in the best projects and provide our PhD students and young researchers with opportunities to cooperate with leading partners in our area of interest.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

The goal of the Lissom project is creation and especially implementation of a language for description of microprocessor architecture. For a good applicability of the language, it is necessary to create a development environment, which provides simultaneous development of both software tools and microprocessor hardware. Due to the concurrent work on hardware and software (hardware/software co-design), the total time of the development will be reduced and the developmental cycle will be shortened. The energy consumption of the processor can be also optimized. It is also possible to generate de-compilers for various microprocessor binary codes. The project is concentrated on:

- Development of a fully automated design of a hardware and software for embedded systems
- Design of Multiprocessor System on the Chip (MPSoC) technology for embedded systems
- Integrated development environments for microprocessor development
- Fundamental modification of an existing architecture description languages for the purpose of increasing their modelling skills
- New practices of formal languages and models for the purpose of model simplification
- Description of transformation of microprocessor's model between different languages
- Synthesizable hardware model of microprocessor for industrial microprocessor production

MAIN CAPABILITIES

Basic research

- Formal models of internal processor representation
- New compilation techniques
- Verification techniques
- Model equivalence checking

Application research

- Tools for automation of hardware/software co-design for embedded systems and Multiprocessor System on the Chip (MPSoC) development
- Tools for support of general de-compilation techniques development (for example for anti-virus companies)

FIELDS OF RESEARCH RESULTS APPLICATION

- Embedded systems (smart phones, tablets, game consoles, home digital systems, automotive industry)
- Applications for anti-virus companies
- Generally, all the branches which deal with microprocessor technology

ALUMNI PROFILE

Besides very good knowledge and skills in the general area of information technology, our graduates specialize in development and applications of information systems, intelligent systems, computer graphics and multimedia, computer and embedded systems, security and networks. Owing to a very good theoretical and wide, universal base of their specialization, a high adaptability in their future professional practice is ensured.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

6

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

14

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

» Integrated development environment Codasip® for Application Specific Instruction-set Processors (ASIP) and Multiprocessor System on a Chip (MPSoC) applications. Time savings are accomplished by automation of tasks that would otherwise be done manually, e.g. creation of the tool-chain or of the hardware description.

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

6 / 0.24

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

20

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

30

MAIN PROJECTS ↘

2011–2013: Improving Security of the Internet by Using System for Analyzing of Malicious Code Spreading (TA01010858, financed by the Technology Agency of the Czech Republic)

2011–2013: System for Support of Platform Independent Malware Analysis in Executable Files (TA01010667, financed by the Technology Agency of the Czech Republic)

2010–2013: SMECY-Smart Multicore Embedded SYstems (ARTEMIS JU 100230, financed by Artemis JU)

2009–2013: System for programming and realization of embedded systems (FR-TI1/038, financed by the Ministry of Industry and Trade of the Czech Republic)

ACHIEVEMENTS ↘

» **2011 Přikryl Zdeněk, Křoustek Jakub, Hruška Tomáš, Kolář Dušan, Masařík Karel, Husár Adam:** Design and Simulation of High Performance Parallel Architectures Using the ISAC Language, In: GSTF International Journal on Computing, roč. 1, č. 2, 2011, Singapur, SG, s. 97-106,ISSN 2010-2283

» **2011 Přikryl Zdeněk, Křoustek Jakub, Hruška Tomáš, Kolář Dušan:** Fast Just-In-Time Translated Simulation for ASIP Design, In: 14th IEEE International Symposium on Design and Diagnostics of Electronic Circuits and Systems, Cottbus, DE, IEEE CS, 2011, s. 279-282,ISBN 978-1-4244-9753-9

» **2010 Přikryl Zdeněk, Křoustek Jakub, Hruška Tomáš, Kolář Dušan, Masařík Karel, Husár Adam:** Design and Debugging of Parallel Architectures Using the ISAC Language, In: Proceedings ot the Annual International Conference on Advanced Distributed and Parallel Computing and Real-Time and Embedded Systems, Singapore, SG, GSTF, 2010, s. 213-221, ISBN 978-981-08-7656-2

» **2009 Přikryl Zdeněk, Masařík Karel, Hruška Tomáš, Husár Adam:** Fast Cycle-Accurate Interpreted Simulation, In: Tenth International Workshop on Microprocessor Test and Verification: Common Challenges and Solutions, Austin, US, ICSP, 2009, s. 9-14, ISBN 978-0-7695-4000-9

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Institute of Information Theory and Automation (Prague, CZ)
» Czech Technical Univesity (Prague, CZ)

COLLABORATION WITH COMPANIES

» AVG Technologies CZ (San Mateo, CA)
» ApS Brno (Brno, CZ)
» AVG Technologies CZ (Brno, CZ)
» CAMEA (Brno, CZ)
» CHIPINVEST (Brno, CZ)
» Vema (Brno, CZ)

EXPECTATIONS ↘

OFFERS

» Partnership in (mainly) international projects in the above described area
» Codasip® System applications which demand microprocessors description in co-operation with software/hardware generators capabilities
» Modelling and generation of tools for automation of hardware/software co-design for embedded systems and Multiprocessor System on the Chip (MPSoC)

REQUIREMENTS

» Partnership in (mainly) international projects in the above described area
» Research cooperation with other academic and commercial institution
» Testing of functional properties of the Codasip® System

05 / 2011

Centre for Biomedical Image Analysis

/ Faculty of Informatics / Masaryk University

RESEARCH GROUP CONTACT

Botanicka 68a, 602 00 Brno, Czech Republic
http://cbia.fi.muni.cz/

HEAD Assoc. Prof. Michal Kozubek
PHONE +420 549 494 023
E-MAIL kozubek@fi.muni.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

We focus our research and also clinical applications on 2D as well as 3D analysis of fluorescence-stained cells and/or their components observed using optical microscopy. The main aim is to contribute to the understanding of the chromatin organisation in human cell nuclei. Clinical applications are aimed at the study of mechanisms of induction, diagnostics and prevention of deleterious human diseases. We have also studied the function-structure relationship for human genome.

EXCELLENCE

IT Automation of Biomedical Image Acquisition and Analysis using Optical Microscopy

MISSION

To help researchers whose goal is to study the structure and function of cells and their components by providing suitable image acquisition and image analysis tools.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Automated acquisition of multi-dimensional image data
- Automated analysis of multi-dimensional image data
- Image segmentation and object reconstruction
- Image registration
- Correction of aberrations and artifacts in light microscopy
- Multiple view imaging using micro-axial tomography
- Optical flow in live cell imaging
- Applications in molecular/cell biology

MAIN CAPABILITIES

We have developed a special experimental equipment and software in the field of optical microscopy – automated image cytometer. We have know-how in all aspects of digital image acquisition and digital image analysis (and also teach related courses). Hence, we can offer services to academic institutions as well as companies in this area. We are specialized in applied research and we can practise it over a wide spectrum of IT and software products. They can be used for molecular biology, biophysics, biochemistry and many other applications.

FIELDS OF RESEARCH RESULTS APPLICATION

- Research in Life-Science
- Biomedicine
- Biotechnology
- Microscopy

ALUMNI PROFILE

The student gains a comprehensive overview in the field of acquisition and processing of image information starting with simple image modifications using point transforms or linear filters and ending up with sophisticated tools such as mathematical morphology or deformable models. Graduates are able to design and coordinate development of software systems for image information processing in research (e.g., research in molecular biology using microscopy imaging techniques), in medicine (e.g., ultrasound imaging, magnetic resonance, CT) as well as in industry (e.g., fingerprint or retina recognition, processing records of security or traffic cameras).

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

7

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

15

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

Automated optical microscopy equipment (so-called high-resolution cytometry instruments)

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

10 / 0.40

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

0

MAIN PROJECTS ↘

2006–2011: „Determination of markers, screening and early diagnostics of cancer diseases using highly automated processing of multidimensional biomedical images" (Grant No. 2B06052, Ministry of Education, Youth and Sports)

2005–2010: „Chromosome dynamics and structure during the cell cycle" (Grant No. LC535, Ministry of Education, Youth and Sports)

2004–2006: „High-resolution cytometry of living cells" (Grant No. 202/04/0907, Czech Science Foundation)

ACHIEVEMENTS ↘

2008: Launch of our own freely available (GNU GPL licence) image acquisition and analysis package Acquiarium (being developed and improved up to now)

2005: 1st place in the national round of the Best of Biotech competition for the best business plan in the field of innovative research in biotechnologies with the project of "High-resolution cytometer"

2001: Czech Patent No. 288693: "Way of the determination of cell properties using the method of high-resolution cytometry and equipment for its realization"

1999: Prize of the Czech Minister of Education TALENT 1998 for work in the field of fluorescence microscopy and promoting interdisciplinary research

1998 – now: Over 50 research papers in journals with an impact factor and over 500 citations (excluding self-citations) to them according to the Web of Science database

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

- Institute of Biophysics AS CR (Brno, CZ)
- Faculty of Science, Masaryk University (Brno, CZ)
- Faculty of Medicine, Masaryk University (Brno, CZ)
- Faculty of Information Technology, University of Technology (Brno, CZ)
- Czech University of Technology (Prague, CZ)
- University of Heidelberg (DE)
- University of Uppsala (SE)
- University Hospital (Brno, CZ)

COLLABORATION WITH COMPANIES

- Camea (Brno, CZ)

EXPECTATIONS ↘

REQUIREMENTS

We are looking for cooperation with research institutions as well as companies in the field.

OFFERS

We offer know-how in the areas of digital image acquisition and processing in optical microscopy.

BRNO UNIVERSITY OF TECHNOLOGY

Natural Language Processing Research Group

/ Department of Computer Graphics and Multimedia
/ Faculty of Information Technology / Brno University of Technology

RESEARCH GROUP CONTACT

Božetěchova 2, 612 66 Brno, Czech Republic
http://www.fit.vutbr.cz/research/groups/nlp

HEAD Assoc. Prof. Pavel Smrž
PHONE +420 541 141 282
E-MAIL smrz@fit.vutbr.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

Natural language processing

EXCELLENCE

- Knowledge mining from very large semi-structured data
- Cognitive ergonomics and human-machine interaction
- Multimedia semantics

MISSION

As a part of the human-machine interaction group that combines excellence in speech processing, image and video understanding and knowledge systems, we aim at strengthening our position in international research. We strive to participate in the best projects and to provide PhD students and young researchers opportunities to cooperate with leading figures in our area of interest.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Knowledge extraction components for various domains
- Social media streams analysers
- Semantic annotation technology for text and multimedia

MAIN CAPABILITIES

Research and development of context-aware knowledge-based systems that employ semantic web technologies and/or multimedia processing to overcome limits of today's solutions.

FIELDS OF RESEARCH RESULTS APPLICATION

- Knowledge management in large and medium-sized enterprises
- Technology-enhanced learning systems based on advanced content processing
- Open government and public service projects pursuing the topic of open data

ALUMNI PROFILE

In the course of their Ph.D. studies, our graduates come to know state-of-the-art natural language processing techniques as well as general machine-learning methods. They also learn from cooperating with key centres dealing with knowledge technologies, meet colleagues and establish contacts in the area.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

4

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

6

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

12 / 0.48

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

80

MAIN PROJECTS ↘

2011–2013: DECIPHER-Digital Environment for Cultural Interfaces; Promoting Heritage, Education and Research (FP7 ICT 270001, financed by the European Commission)

2010–2013: R3-COP-Robust & Safe Mobile Co-operative Autonomous Systems (ARTEMIS JU 100233, financed by the ARTEMIS Joint Undertaking)

2010–2012: TA2-Together Anywhere, Together Anytime (FP7 ICT 214793, financed by the European Commission)

2010–2012: M-Eco-Medical Ecosystem-Personalized Event-based Surveillance (FP7 ICT 247829, financed by the European Commission)

2010–2013: eSonia-Embedded Service Oriented Monitoring, Diagnostics and Control: Towards the Asset-aware and Self-Recovery Factory (ARTEMIS JU 100223, financed by the ARTEMIS Joint Undertaking)

ACHIEVEMENTS ↘

» Knowledge extraction modules used in the intranet knowledge sharing system in Sun/Oracle

» Social media analysis module which proved to provide faster epidemiology-relevant event detection than traditional indicator-based surveillance (early detection of Norovirus outbreak at Carl von Ossietzky Universität Oldenburg in Lower Saxony)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Dublin Institute of Technology (Dublin, IE)
» University of Sheffield (Sheffield, GB)
» Open University (Milton, GB)
» Salzburg Research (Salzburg, AT)
» Austrian Institute of Technology (Vienna, AT)
» Universität Koblenz-Landau (Koblenz, DE)
» Gottfried Wilhelm Leibniz Universität Hannover, L3S Research Center (Hannover, DE)
» IDIAP Research Institute (Martigny, CH)
» CWI – Centrum voor Wiskunde en Informatica (Amsterdam, NL)
» National Technical University of Athens (Athens, GR)
» Centre for Research and Technology HELLAS (Thessaloniki, GR)
» Aalborg University (Aalborg, DK)
» Tampere University of Technology (Tampere, FI)

COLLABORATION WITH COMPANIES

» British Telecom (London, GB)
» Alcatel-Lucent Bell (Antwerp, BE)
» Yahoo! (Barcelona, ES)
» Hellenic Aerospace Industry (Athens, GR)
» Vodafone (Athens, GR)
» Telefónica (Madrid, ES)
» Oracle (Prague, CZ)
» Logica (Aalborg, DK)
» Thales Italia (IT)
» Siemens (Munich, DE)
» Fraunhofer (Nürnberg, DE)
» TNO (Amsterdam, NL)
» Philips (Eindhoven, NL)
» Hermia (Tampere, FI)
» UNIS (Brno, CZ)
» Honeywell (Brno, CZ)

EXPECTATIONS ↘

OFFERS

» Partnership in European projects
» Design and development of modern knowledge-sharing platforms
» Licences of information extraction modules

REQUIREMENTS

» Industrial partners providing challenging use-cases in knowledge-based technologies
» Academic partners with a track in international research projects

BRNO UNIVERSITY OF TECHNOLOGY

Graphics and Video group: Graph@FIT

/ Department of Computer Graphics and Multimedia
/ Faculty of Information Technology / Brno University of Technology

RESEARCH GROUP CONTACT

Božetěchova 2, 612 66 Brno
http://www.fit.vutbr.cz/research/groups/graph/

HEAD Assoc. Prof. Pavel Zemčík
PHONE +420 541 141 217
E-MAIL zemcik@fit.vutbr.cz

HEAD Assoc. Prof. Adam Herout
PHONE +420 541 141 178
E-MAIL herout@fit.vutbr.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- General computer graphics algorithms
- Rendering
- Modern methods of interaction in three-dimensional space
- Image processing
- Signal processing
- Computer vision
- Feature extraction
- Machine leasing and applications

EXCELLENCE

Image processing and computer vision, object detection, realistic rendering, interaction, machine learning

MISSION

- To provide excellent education as well as research and development in the selected IT areas

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Computer graphics and image processing algorithms, algorithms of computer vision including their accelerated versions using embedded systems, DSP, FPGA, and GP-GPU
- Parallel rendering implementation of signal and image processing, vision, and graphics algorithms
- Novel methods of machine learning and their applications to the above algorithms

MAIN CAPABILITIES

Basic research:
Research and applications of algorithms, specifically video processing algorithms (scene detection, video in video search), object detection algorithms (AdaBoost/WaldBoost based), event and motion categorization.

Application research + protection forms:
The detection of faces and body parts in image or video and monitoring of motion, classification of motion, detection of key points, their evaluation and localization, 3D reconstruction, implementation of the above algorithms in mobile platforms, acceleration of the above algorithms

FIELDS OF RESEARCH RESULTS APPLICATION

- Electronics industry
- Telecommunications
- Software
- Computer hardware
- Internet
- IT Security

ALUMNI PROFILE

Graduates operate in the fields of computer graphics and multimedia, human-machine interfaces, image and sound processing and compression, application interfaces for computer graphics and multimedia, and also in other applied computer graphic disciplines, such as computer-aided design and geographic information systems.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

25

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

Standard computer equipment, computing clusters, programmable hardware and DSP boards

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

10 / 0.4

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

2

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%):

49

MAIN PROJECTS ↘

2011–2015: VideoTerror - Tools and Methods for Video and Image Processing for the Fight against Terrorism (project funded by the Ministry of Interior)

2011–2014: GenEx – System for support of evaluation of FISH (project financed by TAČR – Technology Agency of the Czech Republic)

2010–2013: SMECY – Smart Multicore Embedded Systems (funded by FP7-ARTEMIS, jointly EU and the Czech Republic)

2010–2013: RECOMP – Reduced Certification Costs for Trusted Multi-core Platforms (funded by FP7-ARTEMIS, jointly EU and the Czech Republic)

2006–2011: Centre of Computer Graphics (project financed by the Ministry of Education, Youth and Sports, Czech Republic, programme LC – Basic Research Centres)

ACHIEVEMENTS ↘

Journal papers examples:

» Hanák, I., Herout, A., Zemčík, P.: Acceleration of the Detail Driven Method for Hologram Generation, In: Optical Engineering, Vol. 2010, No. 12345, US, p. 21, ISSN 0091-3286

» Antikainen, J., Havel, J., Jošth, R., Herout, A., Zemčík, P., Hauta-Kasari, M.: Non-Negative Tensor Factorization Accelerated Using GPGPU, In: IEEE Transactions on Parallel and Distributed Systems (TPDS), Vol. 2011, No. 1111, US, p. 7, ISSN 1045-9219

» Pouli, T., Prazak M., Zemcık, P., Gutierrez, D., Reinhard, E.: Rendering fur directly into images, In: Computers and Graphics, Vol. 34, No. 5, 2010, Elmsford, NY, US, p. 612-620, ISSN 0097-8493

» Herout, A., Hradiš, M., Zemčík, P.: EnMS: Early non-Maxima Suppression, In: Pattern Analysis and Applications, Vol. 2011, No. 1111, DE, p. 10, ISSN 1433-7541

» Havel, J., Herout, A.: Yet Faster Ray-Triangle Intersection (Using SSE4), In: IEEE Transactions on Visualization and Computer Graphics, Vol. 2010, No. 3, US, p. 434-438, ISSN 1077-2626

Over 100 conference papers, 10 journal papers, and 3 book chapters in last 5 years, 3 registered utility models, industrial applications, etc.

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Faculty of Informatics, Masaryk University (Brno, CZ)
» Most Czech academic institutions

COLLABORATION WITH COMPANIES

» Honeywell (Brno, CZ)
» Camea (Brno, CZ)
» UNIS (Brno, CZ)
» BALÓNY KUBÍČEK (Brno, CZ)
» Disk/Audiffex (Boskovice, CZ)

EXPECTATIONS ↘

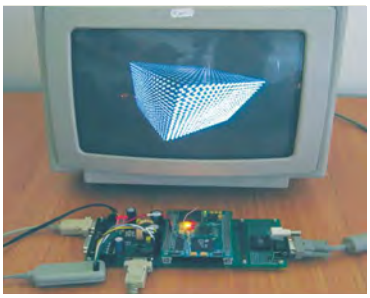
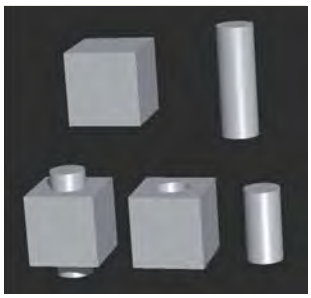
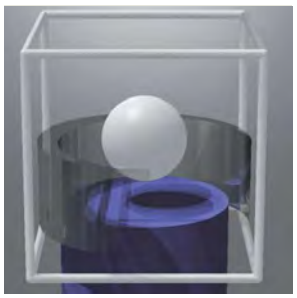
REQUIREMENTS

Customers to licence the technology, customers for application development, collaboration bodies.

OFFERS

Research and development in the above areas, application development, expertise in the above areas.

04 / 2011

Laboratory of Searching and Dialogue

/ Department of Computer Systems and Communications
/ Faculty of Informatics / Masaryk University

RESEARCH GROUP CONTACT

Botanická 554/68a, 602 00 Brno, Czech Republic
http://lsd.fi.muni.cz/tiki-index.php

HEAD Prof. Pavel Zezula
PHONE + 420 549 497 992
E-MAIL zezula@fi.muni.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

» Digital data processing, large-scale data collections, parallel processing, performance

EXCELLENCE

» New methods for extensible and scalable similarity search in digital data

MISSION

We want to be a workplace of research at international level, educating excellent IT specialists and successfully cooperating with companies.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

Similarity has been a central notion throughout our lives – it is a main concept in human perception, speech or face recognition, object classification, memory, and many others. As almost everything we see, read, hear, write or measure can now be in digital form, the group is trying to develop computer tools to manage similarity. To this objective, we assume a very universal concept of similarity that is based on the mathematical notion of metric space. In this concept, data collection is seen as objects together with a method to measure similarity between pairs of objects.

Our software tools are based on the following three development pillars:

» Extensibility – they can be used practically on data of any type – we only have to define how to measure "similarity between pairs of objects". Examples of similarity concepts that can be managed include various aspects of image visual descriptors (shapes, colours, combination of shapes & colours), similarity of video sequences, face recognition, similarity of biometric data such as fingerprints or iris scan, etc.

» Scalability – they are efficient even for very large databases. Designs offer various search structures including distributed mechanisms that are suitable for fast processing of large datasets and are mostly based on peer-to-peer principles

» Infrastructure independence – the search technologies can run on various HW infrastructures including large-scale distributed computer clouds. Migrating the search engine to different hardware can be used for performance tuning (response time and query throughput)

MAIN CAPABILITIES

Basic research
We have developed several generic search methods and published papers in the top scientific conferences and most prestigious scientific journals. We have also build prototypes and tested their performance on very large collections of data. Basic software tools are publicly available.

Application research + protection forms
Our open-source software for non-text similarity searching has been applied by Pixmac and Profimedia photo selling sites. The fastest developing application area concerns security. In general, the application areas include: - Information retrieval

» Multimedia indexing and searching (images, audio, video, etc.)

» Classification and recommender systems

» Large-scale biometric identification problems

» Biological sequence processing, etc.

FIELDS OF RESEARCH RESULTS APPLICATION

» ICT (Information and Communication Technologies) - software, internet, IT security, ecommerce

» Security (Biometric identification).

ALUMNI PROFILE

The students gain a comprehensive overview in the field of acquisition and processing of image information starting with simple image modifications using point transforms or linear filters and ending up with sophisticated tools such as mathematical morphology of deformable models. Graduates are equipped with knowledge and skills that enable them to solve challenging research and development problems in computer science and lead research teams engaged in the development and subsequent implementation of new technologies in the field of modern computer science. Graduates can work in academic and also industrial sectors, which occupy higher positions that require nontrivial management, analytical and technical skills.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

5

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

8

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

7.5 / 0.3

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

10

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

0

MAIN PROJECTS ↘

2009-2011: Searching in Large Multimedia Databases (project GA201/09/0683 financed by the Czech Science Foundation)

2006-2008: Search on Audio-visual content using Peer-to-peer Information Retrieval (project IST 045128 financed by the 6th Specific RTD Programme, European Union)

2004-2006: Network of Excellence on Digital Libraries (project IST 507618 financed by the 6th Specific RTD Programme, European Union)

ACHIEVEMENTS ↘

» Metric similarity search (M-tree, VLDB 1997), the most cited article about similarity searching;

» Springer US, 2006, Similarity Search: the Metric Space Approach - the first book on similarity searching;

» IBM Shared University Research Award 2008 on Web-scale Similarity Search in Multimedia Data

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Faculty of Mathematics and Physics, Charles University in Prague (Prague, CZ)

» Max-Planck-Institut für Informatik (Saarbrücken, DE)

» Institute of Information Science and Technologies, Italian National Research Council (Pisa, IT)

» École polytechnique fédérale de Lausanne (Lausanne, CH)

COLLABORATION WITH COMPANIES

» IBM Haifa Research Lab (Haifa, IL)

» Picsearch AB (Stockholm, SE)

» Telenor ASA (Oslo, NO)

» Javlin (Prague, CZ)

» Bull.cz (Prague, CZ)

EXPECTATIONS ↘

REQUIREMENTS

From our potential partners, we mainly expect cooperation on definition of similarity search problems and specification of effectiveness of search - which is domain (application) specific. We are interested in partners with credible business models that would lead to the development of profitable products. We are also interested in research partners to define common projects and submit proposals for grants.

OFFERS

» Software and software support for similarity search execution, as needed for numerous contemporary digital data collections, such as multimedia, biometric, biological, chemical, statistical, or other scientific data

» Cooperation on common projects which need a similarity search

» Share of know-how through consultancy

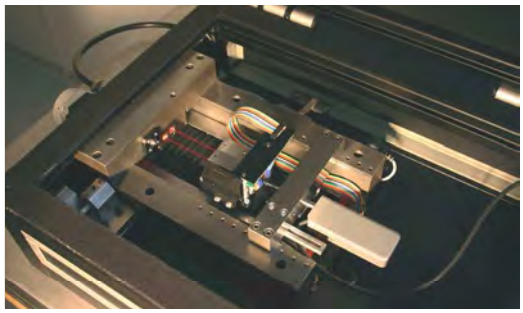
Coherent Lasers and Interferometry

/ Coherence Optics / Institute of Scientific Instruments ASCR
/ Academy of Sciences of the Czech Republic

INSTITUTE CONTACT

Královopolská 147, 612 64 Brno
http://www.isibrno.cz

HEAD Dr. Ondřej Číp
PHONE +420 541 514 254
E-MAIL ocip@isibrno.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

Lasers, laser interferometry, laser spectroscopy, optical sensing in industrial processes

EXCELLENCE

Laser interferometry, femtosecond lasers, optical sensing in industrial processes

MISSION

To stay in the wider world-top in the field of laser interferometers and optical sensing of lengths, application of the method of laser spectroscopy for contactless sensing in power engineering, medicine laser diagnostics in surgery of local necrosis of tissues.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Laser length standards
- Laser interferometers and refractometers
- Absorption gas cells for laser spectroscopy
- Frequency optical synthesis
- Special optical sensing in industrial processes

MAIN CAPABILITIES

We use the properties of light for precise measuring of length. We are now on the level of 1 nm (10 atoms), but we are working on an improvement in resolution of our methods up to 1 atom level. For this reason we have great potential for the future, new and modern applications.

The developed method for scale linearization of interference fringe leads to reducing the uncertainty of length measurements. Also our laser spectroscopy gives us the possibility of contactless measurement of the concentration of dangerous gasses in combustion processes. The method for surface diagnostics of smooth surfaces using femtosecond lasers allows fast recognition of the quality of produced components.

FIELDS OF RESEARCH RESULTS APPLICATION

- Optics
- Electric fields
- Medical Technology
- Automotive industry
- Software
- Telecommunications

ALUMNI PROFILE

Our alumni are experts in the following areas: Lasers, laser interferometry, laser spectroscopy, optical sensing in industrial processes and the construction of devices using the described technologies.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

10

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

2

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Laser interferometers made by the research team
- AFM microscopes made by the research team
- 3D positioning stage with nanometer resolution made by the research team
- Femtosecond optical frequency synthesizers (Menlosystems)
- Spectral analysers (Agilent)
- Oscilloscopes (Tektronix)
- Set of high coherence lasers working at 490 nm, 532 nm, 633 nm, 810 nm, 1064 nm (Coherent, Melles-Griot, Spectra Physics, SIOS, Continuum)

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

5 / 0.2

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

10

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

3

MAIN PROJECTS

2010–2014: Non-contact optical measuring methods and systems for precise engineering. Project FR-TI2/705 financed by the Ministry of Industry and Trade (MPO), Main contractor: Ústav přístrojové techniky AV ČR, v. v. i.

2010 –2014: Methods for generation of a length etalon by means of stabilized femtosecond mode-locked laser. Project GAP102/10/1813 financed by the Czech Science Foundation (CSF), Main contractor: Ústav přístrojové techniky AV ČR, v. v. i.

2009–2013: Components for nano-diagnostic of length fluctuations, deviation of shapes and surface faults. Project FR-TI1/241 financed by the Ministry of Industry and Trade (MPO), Main contractor: MESING, s.r.o.

2007–2009: Methods for determination of the refractive index of air with optical resonators. Project GA102/07/1179 financed by the Czech Science Foundation (CSF), Main contractor: Ústav přístrojové techniky AV ČR, v. v. i.

2006–2011: The research of methods of diagnostics of gauge blocks for precision engineering. Project 2A-1TP1/127 financed by the Ministry of Industry and Trade (MPO), Main contractor: Ústav přístrojové techniky AV ČR, v. v. i.

2006–2009: System of laser interferometers for nanometrology of lengths. Project FT-TA3/133 financed by the Ministry of Industry and Trade (MPO), Main contractor: MESING, spol. s r.o.

ACHIEVEMENTS

- The research group in cooperation with the company Mesing and the Czech Metrology Institute presented the results of the joint research – „Linear system with interferometer (Laser nano-comparator) for calibration of length sensors at the 50th International Engineering Fair in Brno (14.9. - 18.9. 2008)
- The editors of the Technický týdeník awarded its prize, choosing along with the editors of the periodical Automatizace, the joint team of researchers that performed the Laser nano-comparator at the fair. The research group firstly presented a unique method for active stabilization of the position of laser beams which improves the reproducibility of calibration processes in the nanometer levels
- Three scientists from the group have been awarded in the past ten years by the international community URSI (International Union of Radio Science), IMEKO (International Measurement Confederation) and SPIE (International Society for Optics and Photonics) for their innovative work in the field of lasers and optics

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- Czech Meteorology Institute (Brno, CZ)
- Brno University of Technology (Brno, CZ)
- Palacky University of Olomouc (Olomouc, CZ)
- BEV (Vienna, AT)

COLLABORATION WITH COMPANIES

- Mesing (Brno, CZ)
- ŽĎAS (Žďár nad Sázavou, CZ)
- I & C Energo (Třebíč, CZ)

EXPECTATIONS

REQUIREMENTS

Cooperation in joint projects where an industrial partner solves technical and technological aspects of the subject of the research and our group is oriented to the development of new methods or adapting state of the art methods for solving the topic.

OFFERS

Many quality results of basic research for application
We can offer for example:

- High-resolution laser interferometry
- Optical detection of concentration of different gasses
- Scientific instruments for real-time processing of signals in laser interferometers and length measurement

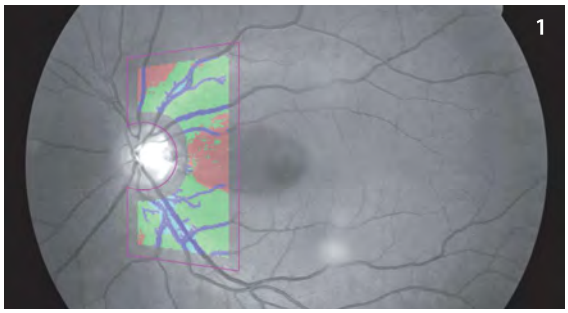
Brno group of the research centre DAR (coordinated by UTIA, Cz.Ac.Sci. Prague)

/ Department of Biomedical Engineering / Faculty of Electrical Engineering and Communication Technologies / Brno University of Technology

RESEARCH GROUP CONTACT

Kolejní 2906/4 , 612 00 Brno, Czech Republic
http://www.dbme.feec.vutbr.cz/veda-a-vyzkum

HEAD Prof. Jiří Jan
PHONE +420 54114 9540, +420 72681 9540
E-MAIL jan@feec.vutbr.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

Medical Image Reconstruction and Analysis

EXCELLENCE

- Ultrasonic computed tomography
- Retinal image analysis
- Analysis of fMRI data for neuroscientific purposes
- Fusion and analysis of multimodal medical image data

MISSION

- Internationally recognized research group in medical image processing, incl. neuroscientific applications

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

Medical Image Reconstruction and Analysis

MAIN CAPABILITIES

- Medical image processing, analysis, reconstruction and restoration
- Authorized ophthalmological software
- Authorized software for 3D CT subtractive angiography

FIELDS OF RESEARCH RESULTS APPLICATION

- Clinical and technological research (routinely usable support of diagnostics)
- Environmental analysis (various image analyses)
- Material microscopy research

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

4

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

5

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Hardware: powerful parallel computational equipment, connection to GRID resources (cooperation with Masaryk University Brno)
- Software tools for large-scale problems (up to millions of equations)

Photo 1 Human eye retina with nerve fibre layer indications for diagnosis of glaucoma, obtained by digital analysis method developed by Brno DAR group. The red colour indicates tissue damaged by the disease, the green colour indicates the existence of a healthy layer.

Photo 1 Human eye retina with bloodstream, automatically segmented by the method of Brno DAR group for the diagnosis of cardiovascular diseases.

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

1.8 / 0.072

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

12

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

12

MAIN PROJECTS ↘

2005-2011: DAR - Data, algorithms, decision-making (project 1M0572 financed by the programme 1M - The research centres, Ministry of Education, Youth and Sports)

RELATED PROJECTS OF THE CENTRE:

- Ultrasonic computed tomography (USCT): image reconstruction from measurements, simulation, calibration (cooperation with KIT Karlsruhe)
- Retinal image analysis – evaluation of structures, namely of neural layer and vessel tree, with respect to diagnostic purposes (e.g. for glaucoma) – cooperation with Erlangen University and Hospital
- Medical 3D and 4D image data mono- and multimodal registration (applications e.g. in CT subtractive angiography, in paediatric diagnostics, etc. – cooperation with Philips Nederland)
- Analysis of functional MRI image data for neurological purposes – cooperation with the Faculty Hospital Brno

ACHIEVMENTS ↘

Developed specialised software packages (http://icatb.sourceforge.net/scks/scks_download_links.htm; http://ophthalmo.ubmi.feec.vutbr.cz)

Publications:

- Jan, J.: Medical Image Processing, Reconstruction and Restoration – Concepts and Methods. CRC Taylor and Francis Inc. (USA), 2006, ISBN 0-8247-5849-8, 760 pp.
- Jan, J.: Digital Signal Filtering, Analysis and Restoration. IEE Publishing, London (UK) 2000, ISBN 0-85296-760-8 , 421 pp.
- R. Kolář, R. Laemmer, J. Jan, Ch. Y. Mardin: Segmentation of zones with increased autofluorescence in the junctional zone of parapapillary atrophy. Physiol. Measurement,. vol. 30 (2009) ,pp. 1–12 H.
- HAVLÍČEK, M.; JAN, J.; BRÁZDIL, M.; CALHOUN, V. Dynamic Granger causality based on Kalman filter for evaluation of functional network connectivity in fMRI data. NeuroImage, 2010, vol. 53, no. 1, pp. 65-77. ISSN: 1053- 8119.
- KUBEČKA, L.; JAN, J.; KOLÁŘ, R. Retrospective Illumination Correction of Retinal Images. International Journal of Biomedical Imaging, 2010, no. 5, pp. 201-223. ISSN: 1687- 4188.
- JIŘÍK, R.; PETERLÍK, I.; JAN, J.; ZAPF, M.; RUITER, N. 3D Regularized Speed- Map Reconstruction in Ultrasound Transmission Tomography. In Proceedings of 2009 IEEE Ultrasonics Symposium. Proc. IEEE Ultrasonics
- Symposium. IEEE, 2010. s. 2272-2275. ISBN: 978-1-4244-2428- 3. ISSN: 1051- 0117.

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

- Friedrich Alexander University (Erlangen, DE)
- KIT (earlier Forschungszentrum), (Karlsruhe, DE)
- Masaryk University, Faculty of Medicine (Brno, CZ)
- UTIA, Academy of Sciences of the Czech Republic (Prague, CZ)

COLLABORATIONSWITH COMPENIES

- Philips Nederland (NL)
- Ophthalmological Clinic, Zlín (CZ)

EXPECTATIONS ↘

REQUIREMENTS

- Academic partners: common scientific interests, potential for common European projects
- Industrial partners: academically formulated technological / medical problems, understanding for publication needs, material support

OFFERS

- Know-how in general and particularly medical image processing, supported by high-tech hardware and software equipment

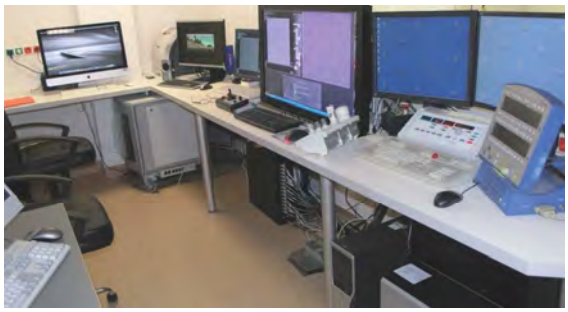
Measurement and Data Processing in Medicine

/ Magnetic Resonance and Bioinformatics
/ Institute of Scientific Instruments / Academy of Sciences of the Czech Republic

RESEARCH GROUP CONTACT

Královopolská 147, 612 64 Brno
http://www.isibrno.cz

HEAD Dr. Pavel Jurák
PHONE +420 541 514 312
E-MAIL jurak@isibrno.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

Measurement and data processing in the area of cardiology and neurology

EXCELLENCE

Analysis of repolarization dynamicity, multi-channel digital transmitter/receiver for non-invasive monitoring of hemodynamic parameters. New methods including experimental devices, protocols and mathematical tools for effective non-invasive diagnostics in cardiology and neurology.

MISSION

We want to maintain our position among the world leaders and have research themes in which we are ranked among the top in the world.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

» Cardiovascular diagnostics (the evaluation of variability of blood pressure and pulse frequency, the development of methods for non-invasive diagnostics of cardiovascular diseases with assessment of the extent of risk of acute heart incidents)
» EEG, epilepsy and Parkinson's disease (measurement and analysis of patients suffering pharmaco-resistent epilepsy and Parkinson's disease, the development of methods for analysis of event-related potentials ERP by synchronizing and de-synchronizing)
» Construction of devices and development of software for the above-mentioned topics

MAIN CAPABILITIES

Basic research

» Analysis of repolarization dynamicity (submitted international patent)
» Multi-channel digital transmitter/receiver for noninvasive monitoring of the hemodynamic parameters

Application research + protection forms

» Method of prediction of sudden cardiac death (internationally patented - US, EU)
» Method of measuring the depth of anesthesia (original non-invasive methodology)
» Whole-body impedance cardiography (submitted international patent)

FIELDS OF RESEARCH RESULTS APPLICATION

» Medicine
» Biotechnology
» Scientific instruments

ALUMNI PROFILE

Our alumni are experts in measurement and data processing of biosignals, noise and artifact elimination, coupling analysis and significant parameter definition and construction of electronic devices with high dynamic range.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

5

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

3

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

Experimental medical instruments:

- ECG monitors
- amplifiers of biological signals with high ratio signal/noise,
- acquisition systems
- software for data recording and evaluation in neurology and cardiology
- devices for non-invasive monitoring of the hemodynamic parameters
- whole body multichannel impedance cardiography

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

20 / 0.8

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

20

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

3

MAIN PROJECTS

2008–2010: Ventricular depolarization and repolarization analysis (project GA102/08/1129 financed by the Czech Science Foundation)

2005–2007: Methods of measurement and evaluation of properties in the regulation of blood circulation (project GA102/05/0402 financed by the Czech Science Foundation)

Analysis of EEG signals scanned at high frequencies from deep brain structures

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- St. Anne's University Hospital Brno, ICRC Brno (CZ)
- The University Hospital Brno (CZ)
- Department of Biomedical Engineering, Brno University of Technology (CZ)
- Faculty of Veterinary Medicine, University of Veterinary and Pharmaceutical Science Brno (CZ)
- MAYO Clinic (Rochester, MN, US)
- THEW, University of Rochester (Rochester, MN, US)

COLLABORATION WITH COMPANIES

- M&I Praha (CZ)

EXPECTATIONS

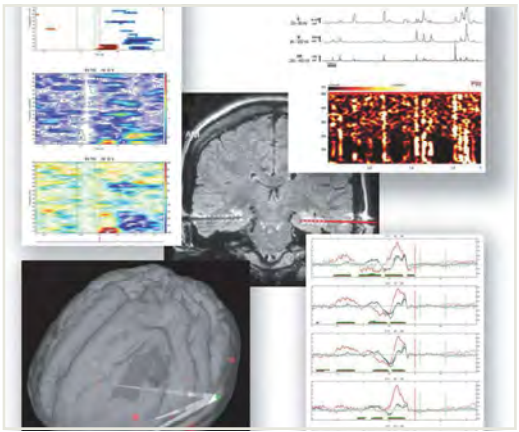
REQUIREMENTS

- Development of cooperation in the framework of established biomedical platforms (network around ICRC),
- Development of contacts with foreign firms,

OFFERS

- Experience and methodology of measurement and data analysis in cardiology and neurology
- Multichannel high dynamic range transmitter/receiver (usable for non-invasive monitoring of hemodynamic parameters)
- New, patented methodology to test the proarrhythmic influence of drugs

04 / 2011



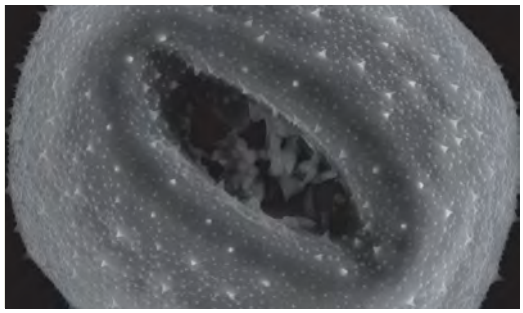
Detection Systems

/ Electron Optics / Institute of Scientific Instruments
/ Academy of Sciences of the Czech Republic

RESEARCH GROUP CONTACT

Královopolská 147, 612 64 Brno
http://www.isibrno.cz/index.php?co=/team/teamhome.php&id_celek=68&lang=_cz&id_druh_menu=2

HEAD Dr. Vilém Neděla
PHONE + 420 541 514 333
E-MAIL vilem@isibrno.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

» Scanning electron microscopy

EXCELLENCE

» BSE and SE detectors with scintillation single crystals, detection systems for VP-SEM, ESEM

MISSION

We want to maintain and further develop our position among the world's leading workplaces.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

» Physical processes of interaction mechanisms at collisions of electrons with gas molecules
» Ways of electron scatter in gaseous media
» Differential pumping as well as gas flow computation in microscopes VP-SEM and ESEM
» Problems of electron scatter in the dependence on the gas medium pressure.
» Scintillation of single crystals for detection of signal electrons in SEM, ESEM and TEM

Fig 1 Environmental scanning electron microscopy AQUAEM II

Fig 2 Detail of pollen surface structure. Ionization detector AQUASEM II microscope, a sample without any modifications

MAIN CAPABILITIES

Basic research

» Study of kinetics of single crystal scintillators
» Study of mechanisms for the creation and multiplying of signal electrons in an environment of high pressure gas and simulation of these phenomena
» Study of samples in terms of dynamic in-situ experiments

Application research + protection forms

» New types and features of the detectors for REM and EREM
» Electrochemical sensors
» Solar cells
» Stem cells and other biological samples

FIELDS OF RESEARCH RESULTS APPLICATION

Fields of research results application

» Life sciences (especially molecular biology, biochemistry)
» Material science (study of some special samples)
» Measuring instruments
» Renewable energy
» Plastics, polymers
» Glass, ceramics
» Textile industry

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

3

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

3

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

Laboratory of environmental scanning electron microscopy:

» Observation of the process of electrically non-conducting specimens without covering them with a conducting layer on the surface

If the gas pressure in the specimen chamber of EREM is higher than 200 Pa, the primary and signal electrons collide with atoms and molecules of gases in the vicinity of the specimen and thus the originating ions compensate for charging of the specimen by incident electrons. Through this process electrically non-conducting specimens can be observed and yet their surface need not be covered with a conducting layer. If the pressure of gas, or rather water vapour, in the specimen chamber is higher than 611 Pa (at 0°C), objects containing a certain amount of water do not dry up and collapse, and therefore are suitable for observation.

»

Experimental non-commercial VP-SEM AQUASEM II equipped with a moisturizing system and cooled specimen holder. The VP-SEM can be used to study:

» Details of the surface structure of conducting and non-conducting natural animated and inanimate specimens

» Wet specimens and specimens on the boundary of states (condensation, evaporation, meeting, solidification, etc.)

» Specimens in conditions of mechanical and thermal strain in the vacuum or gas of optional humidity

» Material, topographic or voltage contrast due to which imaging of electric charge accumulation and distribution e.g. on transistor gates is possible

» Reactions of various chemical substances in the specimen chamber

» Aggressive chemical substances, e.g. battery mass

» Various types of specimens in conditions closely approximate to atmospheric pressure

Unique detection systems in the world:

» Specially designed single crystal scintillation detectors using the YAG and YAP scintillator – design, development and study of physical properties of custom-built systems.

» Unique detection systems for high pressure conditions of VP-SEM or ESEM. (detection systems are based on the gas-ionisation phenomena enabling high amplification of the detected signal) Two new detection systems have been developed and patented in the last three years.

BUDGET ↘

TOTAL (MIL. CZK)

3

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

40

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

10

MAIN PROJECTS ↘

2010–2013: The study of the influence of magnetic and electric fields for amplification of secondary electron signals detected by a novel detector in VP-SEM (project GAP102/10/1410 financed by the Czech Science Foundation)

2009–2013: Application of Laser Technologies into the Process of Crystalline Silicon Solar Cells Production (project FR-TI1/305 financed by the Ministry of Industry and Trade)

2009–2013: New generation of electrochemical sensors and biosensors using thin modificated DLC layers (project FR-TI1/118 financed by the Ministry of Industry and Trade)

ACHIEVEMENTS

European patent

» Neděla, Vilém; Jirák, Josef: Ionisation detector of an environmental scanning electron microscope, Institute of Scientific Instruments, Academy of Sciences of the Czech Republic, EP 2195822 (A2), Publication date 2010-06-16.

Scientific results of the team members are regularly published in high profile scientific journals

» Jirák, J., Neděla, V., Černoch, P., Čudek, P., Runštuk, J.: Scintillation SE detector for variable pressure scanning electron microscopes. Journal of Microscopy. 239, 3 (2010), p. 233-238. ISSN 0022-2720

» Neděla, V., Weyda, F., Černoch, P.: Advantages of Study of Amber Fossils with Ionization Detector in Variable Pressure SEM. Microscopy and Microanalysis. 13, Suppl. 3 (2007), p. 250-251. ISSN 1431-9276

» Neděla, V.: Methods for Additive Hydration Allowing Observation of Fully Hydrated State of Wet Samples in Environmental SEM. Microscopy Research Technique. 70, 2 (2007), p. 95-100. ISSN 1059-910X

» Ježek, J., Čižmár, T., Neděla, V., Zemánek, P.: Formation of long and thin polymer fibre using nondiffracting beam. Optics Express. 14, 19 (2006), p. 8506-8515. ISSN 1094-4087

↘

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

- University of Cambridge (Cambridge, GB)
- Westfälische Vilhelms-Univerität (Münster, DE)
- University of Western Australia (Perth, AU)
- Institute of Scientific Instruments, Academy of Sciences of the Czech Republic (Prague, CZ)
- Faculty of Mechanical Engineering, Brno University of Technology (Brno, CZ)
- Faculty of Medicine, Masaryk University (Brno, CZ)

COLLABORATION WITH COMPANIES

- BVT Technologies (Brno, CZ)
- Solartec (Rožnov pod Radhoštěm, CZ)
- Tescan (Brno, CZ)
- Crytur (Turnov, CZ)
- Delong Instruments (Brno, CZ)
- Hitachi (JP)
- Jeol (JP)

EXPECTATIONS ↘

REQUIREMENTS

- Suitable industrial partners
- Collaboration with biologists, doctors and others
- New and high-quality postgraduates
- Motivate / initiate / help companies to arrange scholarships for graduates / postgraduates

OFFERS

- Long term experience with design and production of scintillation single crystal detectors for detection of backscattered electrons and secondary electrons for SEM and ESEM
- Long term experience in the field of environmental SEM (study of non-conductive and highly wet samples)
- Cooperation with commercial partners in the field of diagnostics of materials using scanning electron microscopy

BRNO UNIVERSITY OF TECHNOLOGY

Department of Radio Electronics

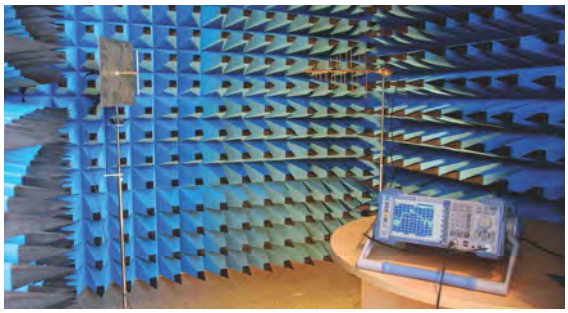
/ Faculty of Electrical Engineering and Communication
/ Brno University of Technology

INSTITUTE CONTACT

Purkyňova 118, 612 00 Brno, Czech Republic
http://www.urel.feec.vutbr.cz/

HEAD Prof. Zbyněk Raida
PHONE + 420 541 149 114
E-MAIL raida@feec.vutbr.cz

HEAD Prof. Miroslav Kasal
PHONE + 420 541 149 112
E-MAIL kasal@feec.vutbr.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

Electronic circuits and systems, application of electronic circuits in communication systems, signal processing, electromagnetic waves

MISSION

Excellent institute, which is a part of the wider world leaders in basic and applied research.

EXCELLENCE

Applied electromagnetics, satellite and mobile communication, free space optical communication, advanced analogue electronic circuits

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Theory of electronic circuits and systems
- Application of electronic circuits in communication systems, control and industrial applications
- Signal processing and its impact on speech processing and digital wireless communication
- Electromagnetic waves, antennas, microwaves, optoelectronics and electromagnetic compatibility
- Special electronic communications (mobile, satellite, optical wireless communication)

MAIN CAPABILITIES

Basic research
Our department participates in publishing the Radioengineering Journal (included in the Thomson ISI), confirming the high international level of the institute

Application research + protection forms
National patent for multi-band antenna.
In the last few years more than 10 technical arrangements and programmes have been realized. The most considerable projects are as follows:

- Atmospheric laser optical link with self-adapting control
- Contactless optoelectronic instrument for measuring dimensions with CCD elements and microprocessor control,
- Onboard low noise receiver in L band for the experimental PHASE 3D satellite of the international organization AMSAT
- SNAP – computer programme for symbolic analysis of electronic circuits
- Digital quadrature detector for SDR (software defined radio) systems
- Frequency synthesizer and detectors with post-processing DSP for the receiver of the transponder of the Phase 3E satellite of the organization AMSAT
- Testing and measuring the EDGE system for fast data transmission in GSM networks (in cooperation with T-Mobile CZ) in the mobile communications laboratory

FIELDS OF RESEARCH RESULTS APPLICATION

- Communication, control and industrial engineering

ALUMNI PROFILE

The graduate is able to develop a completely new electronic device, improve the methods for signal processing, etc. on the basis gained by deep theoretic knowledge. Graduates find their place in experimental,

research and development (R & D) centres, in academia and science institutions. Doctoral study programme graduates are also very successful abroad.

Knowledge and skills in:
Electronic analogue, pulse and digital circuits and systems, TV and video applications, HF and microwave applications, antennae and theory of electromagnetic field, signal processing, wireless communications and electromagnetic compatibility.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

10

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

30

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Fully equipped EMC chamber for measurements in the range of kHz to GHz
- Vector network analyzer for measurements up to 40 GHz
- Optoelectronic laboratory for characterizing free-space optical systems
- Mobile communication laboratory fully connected to T-Mobile network

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

50 / 2

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

4

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

20

MAIN PROJECTS

2010–2013: Agile RF transceivers and front-ends for future smart multi-standard communications applications (FP7 project; ENIAC. Coordinator: Infineon)

2008–2012: High intensity radiated fields – synthetic environment (FP7 project; COOPERATION. Coordinator: Alenia Aeronautica)

2008–2010: Antennas for Car2Car communication (research contract; Contractor: Volkswagen A.G.)

ACHIEVEMENTS

- Free space optical link for gigabit wireless communication
- Transponders for AMSAT satellites
- Measurement campaign of data transfer rate in commercial mobile networks
- Antenna system for Car2Car communication

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- Faculty of Electrical Engineering, Czech Technical University (Prague, CZ)
- Institute of Scientific Instruments, Academy of Sciences of the Czech Republic (Brno, CZ)
- Institute of Photonics and Electronics, Academy of Sciences of the Czech Republic (Prague, CZ)
- Institute of Atmospheric Physics, Academy of Sciences of the Czech Republic (Prague, CZ)

COLLABORATION WITH COMPANIES

- Barco (Uherské Hradiště, CZ)
- Ccom (Pardubice, CZ)
- Dcom (Brno, CZ)
- ERA (Pardubice, CZ)
- Evektor (Kunovice, CZ)
- Omikron (Praha, CZ)
- První brněnská strojírna (Velká Bíteš, CZ)
- Škoda Auto (Mladá Boleslav, CZ)
- T-Mobile (Prague, CZ)
- Tesla Holding (Prague, CZ)

EXPECTATIONS

REQUIREMENTS

- Foreign high-quality postdocs
- Demand after innovation

OFFERS

- Competitive applied research

Brittle Fracture Group

/ Department of Mechanical Properties / Institute of Physics of Materials
/ Academy of Sciences of the Czech Republic

RESEARCH GROUP CONTACT

Žižkova 22, 616 62 Brno
http://www.ipm.cz/brittle-fracture-group.html

HEAD Prof. Ivo Dlouhý
PHONE +420 532 290 342
E-MAIL idlouhy@ipm.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

Experimental fracture mechanics and fracture of steels, ceramics, intermetallics and composites

EXCELLENCE

Wider world-top, 3 researchers (from 6) are in the best 25 % of this field in the world

MISSION

To maintain our current position in world science and progress further to be considered among the best

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Research on initiation and fracture micromechanisms in advanced metallic materials, influence of microstructure and selected production parameters
- Investigation of the principles of experimental fracture mechanics, development of new test approaches enabling better understanding of deformation and fracture of (heterogeneous, composite) materials
- Fracture behaviour of new advanced materials (ceramic matrix composites reinforced e.g. by ceramic fibres, particles, silicon carbide nanoparticles, carbon nanotubes etc.)
- Experimental research focused on and failure analyses connected with practical and/or industrial problems including participation in Euroatom materials development and evaluation activities

MAIN CAPABILITIES

The brittle fracture group is able successfully deal with / contribute to solving the material problems generated by industrial practice, but 90 % of the team activity is focused on basic research.

The following topics may be solved in collaboration with industrial partners – development centres:
Fracture behaviour/resistance of steel - the verification and modification of knowledge for transferability of laboratory data to real components. There are good results in the field of fracture resistance prediction (for steels) applicable for commercial use which we can complete in the case of a real offer and/or support from industry.

Based on fracture toughness evaluation of about 10 different types of ceramic matrix composites, further investigation in this field including possible application of knowledge is possible. Assistance in evaluation/ quantification of ceramics and ceramic matrix composites degradation is also possible.

The knowledge obtained with TiAl intermetallics enables effective assistance in the further development of these materials; recently an attempt was made to modify microstructure through mechanicalthermal treatment of this intermetallic alloy (in collaboration with Yokohama University).

FIELDS OF RESEARCH RESULTS APPLICATION

Basic Research:

- Transferability of fracture mechanical data for steels
- Evaluation and explanation of fracture behaviour of ceramic matrix composites
- Explanation and knowledge systemisation on low temperature fracture of titanium aluminides

Applied research:

- Biomedicine / prosthetics (biocompatible highly porous glass for tissue engineering – collaboration with Imperial College London)
- Aerospace industry (glass for extreme conditions: glass ceramics reinforced by fibres, transparent armour)

» Fracture resistance of containers for spent nuclear fuel (NATO project coordinated by the group leader)
» Railway crossing points – bainitic steel and fracture resistance evaluation (DT – Vyhýbkárna a strojírna, Prostějov)

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

5

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS):

6

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

» 3 Screw driven testing machine (ZWICK, Instron) for loadings up to 200 kN, temperatures from -198 to +1200 °C, fixtures for tensile, three/four point bend test, compact tension, compression etc. for steels, ceramics, intermetallics and their composites, selection of different extensometers and strain gauges
» 1 hydraulic test machine for loading rates up 6 m/s
» 3 instrumented impact pendulums with different impact energy and devices for testing different materials
» Instrumented indentation tester (including ball indentation test)
» MTS microtester for loadings from mN to 200 N
» Measuring work-station, universal test and evaluation software, both commercial and developed by laboratory
» Image analysis and digital image correlation techniques for local deformation determinations
» Confocal microscope with built-in atomic force microscope

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

7 / 0.28

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

10

MAIN PROJECTS ↘

2010–2012: Fracture behaviour prediction based on quantification of local material response (Czech Science Foundation, GAP108/10/0466)

2010–2012: Microstructural design of high toughness materials (Czech Science Foundation, GAP107/10/0361)

2009–2012: Mechanical and fracture properties of multilayered ceramic/ceramic and ceramic/metal materials with graded layers (Czech Science Foundation, GA101/09/1821)

2009–2011: Development of new matrix types based on pyrolysed resins for composites reinforced with ceramic fibres (Czech Science Foundation, GA106/09/1101)

2008: Study of the micromechanisms of cleavage fracture of 14% Cr ODS ferritic steels (Euratom EFDA project)

2011-2014: GlaCERCo: Glass and Ceramic Composites for High Technology Applications – Initial Training Network (project 264526 financed by the 7FP EU)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Faculty of Mechanical Engineering, Brno University of Technology (NETME Centre, Brno, CZ)
» Faculty of Chemistry, Brno University of Technology (Brno, CZ)
» University of Mining - Technical University (Ostrava, CZ)
» Faculty of Mechanical Engineering, Czech Technical University (Prague, CZ)
» University of Metz (FR)
» University of Miscolc (HU)
» Imperial College London (GB)
» University of Erlangen (DE)
» Institute of Inorganic Chemistry, Slovak Academy of research (SK)

COLLABORATION WITH COMPANIES

» Schottglass Meinz (DE)
» Siemens (Brno, CZ, DE)
» DT – Výhybkárna a strojírna (Prostějov, CZ)
» KMM Vin (Virtual European Institute)
» EURATOM (EFDA, F4E)

EXPECTATIONS ↘

REQUIREMENTS

We are looking for collaboration with academic and industrial partners (Czech and foreign too) in the field of advanced materials including ceramic matrix composites.

OFFERS

» High quality research work in the field of materials fracture linked to advanced materials development and/or operational degradation analyses. Research of basic and applied type. We can mainly offer service for development centres and specialized firms
» Contacts to other laboratories (including laboratories joined in KMM-VIN Virtual European Institute
» Excellent conditions for training through research of PhD students and young scientists

04 / 2011

BRNO UNIVERSITY OF TECHNOLOGY

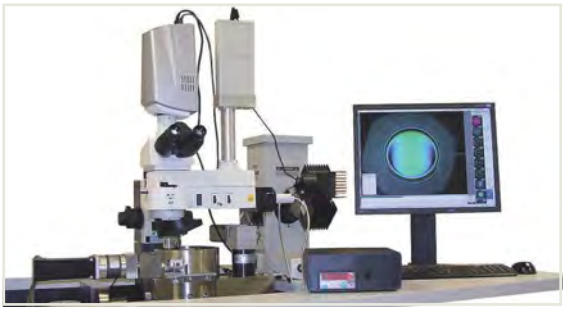
Tribology research group

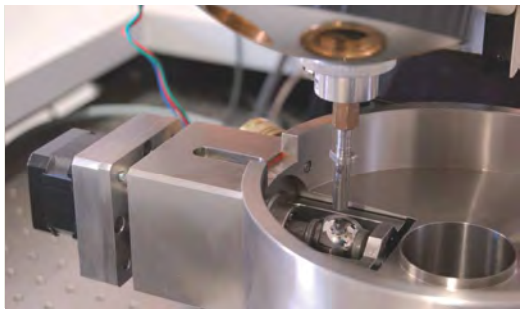
/ Institute of Machine and Industrial Design
/ Faculty of Mechanical Engineering / Brno University of Technology

RESEARCH GROUP CONTACT

Technická 2896/2, 616 69 Brno, Czech Republic
http://uk.fme.vutbr.cz/

HEAD Prof. Martin Hartl
PHONE +420 54114 2769
E-MAIL hartl@fme.vutbr.cz





THEMATIC RESEARCH FOCUS

RESEARCH AREA

» Tribology – biotribology, nanotribology, surface texturing, starved lubrication, speed and load changes in elaestohydrodynamic contact, oil degradation measurements, and transient behaviour of elastohydrodynamic contact
» Experimental study of real roughness attenuation in rolling/sliding concentrated contacts
» Mechanical Degradation of the Liquid in an Operating EHL Contact
» Effect of surface texturing on elastohydrodynamically lubricated contact under transient speed conditions

EXCELLENCE

» Tribology – very thin EHD films measurement
» Behaviour of surface roughness inside an elastohydrodynamic contact
» Transient behaviour of elastohydrodynamic contact using a very high--speed camera

MISSION

» Friction and wear reduction with respect to ecology
» Development of new measurement techniques in tribology
» The validation of theoretical models in the field of elastohydrodynamic lubrication, used for the design of highly loaded machine parts (esp. rolling bearings)

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

» Elastohydrodynamic Lubrication (EHL), Contact Mechanics
» Transient behaviour of elastohydrodynamic contacts.
» Behaviour of surface roughness inside a elastohydrodynamic contact.
» Biotribology
» Nanotribology

MAIN CAPABILITIES

The Tribology Laboratory has history of more than 12 years and is recognized as a distinguished lab in specific field. A new experimental technique for the study of thin lubricant films by means of colorimetric interferometry has been developed here. This technique is able to provide real time data for thin lubricant film shape studies.
The essential part of the lab is represented by an experimental apparatus for the study of elastohydrodynamic lubricant films based on a computer controlled dynamic Fizeau interferometer. Recently, a 3D optical profilometer based on phase shifting interferometry has been incorporated to measure in-situ initial undeformed real surface topography. Latest results published in scientific journals have proved the combination of thin film colorimetric interferometry with phase shifting interferometry to be one of the most powerful tools for the investigation of mixed lubrication of real surfaces in situ.
This laboratory enables practice verification experiments to be performed in precisely known conditions and ensure true and repeatable results. About 80 percent of machines are disabled as a result of the damage of thin surface layers caused, among other things, by the local breakdown of elastohydrodynamic lubrication films. It is in the close relation to the lubricant capability to create coherent protective film. It is mostly characterised by the film thickness dependence on operation conditions (speed, load, temperature etc.) and rubbing surfaces topography.

FIELDS OF RESEARCH RESULTS APPLICATION

All fields of engineering (in production mainly industrial design)
» Construction - civil engineering
» Electrical Engineering
» Engine construction
» Automotive industry
» Railway transport
» Energy saving

- Materials - Iron and Steel, Non ferrous materials, Plastics, Polymers
- Software
- Medical Equipment

ALUMNI PROFILE

The mission is to provide a high quality education, research and service to the industry in the field of modern machine design including integration of computer and information technology into products and processes.
Advantages of specialization are progressive technology, versatility, flexibility and a theoretical base. Graduates from this specialization can be employed mainly in design, in research and development departments or as project engineers, manufacturing, members and leaders of project teams, businessmen in the area of mechanical engineering and CAD applications.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

6

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

8

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

- Tribometer to study the behaviour of very thin lubricant films
- 3D optical profilometer
- Instruments for lubricant diagnostics

Laboratories:

- Very high-speed camera
- Digital viscosimeter
- Refractometer
- Contact fatigue
- Bearing life
- Fatigue of machine parts

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

6 / 0.24

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

40

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

10

MAIN PROJECTS ↘

2009-2011: Experimental study of elastohydrodynamic and mixed lubrication of hypoid gears (project GC101/09/J003 financed by the Czech Science Foundation)

2007-2011: Effect of surface topography modifications on lubrication films efficiency to diminish friction and wear of machine parts (project ME 905 financed by the ME – KONTAKT programme, Ministry of Education, Youth and Sports)

2005-2007: Influence of surface topography on lubricated contacts (project 1P05OC009 financed by the Ministry of Education, Youth and Sports)

ACHIEVEMENTS ↘

KŘUPKA, I.; HARTL, M.; BAIR, S.; KUMAR, P.; KHONSARI, MM. (2010) The Effect of Load (Pressure) for Quantitative EHL Film Thickness, TRIBOLOGY LETTERS, 37(3), 613 – 622.

KŘUPKA, I.; HARTL, M.; BAIR, S.; KUMAR, P.; KHONSARI, MM. (2009) An Experimental Validation of the Recently Discovered Scale Effect in Generalized Newtonian EHL. TRIBOLOGY LETTERS, 33(2): 127 – 135.

KŘUPKA, I.; HARTL, M.; SVOBODA, P. Effects of surface topography on lubrication film formation within elastohydrodynamic and mixed lubricated non-conformal contacts. PROCEEDINGS OF THE INSTITUTION OF MECHANICAL ENGINEERS PART J-JOURNAL OF ENGINEERING TRIBOLOGY. 2009. 223(6). p. 1 – 9.

KŘUPKA, I.; SVOBODA, P.; HARTL, M. Effect of surface topography on mixed lubrication film formation during start up under rolling/sliding conditions. Tribology International. 2009. 43(4). p. 1 - 9.

KŘUPKA, I.; HARTL, M. (2007) The influence of Thin Boundary Films on Real Surface Roughness in Thin Film, Mixed EHD Contact. TRIBOLOGY INTERNATIONAL, 40 (10-12): 1553-1560.

Maurice Godet Award | Leeds Lyon 2009 – award for the best presentation / paper by a young scientist.

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

- University of Munich (Munich, DE)
- University of Seoul (Seoul, KR)
- University of Shanghai (Shanghai, CN)
- Georgia Institute of Technology (Atlanta, US)
- Kyushu Institute of Technology (Kitakyushu, JP)
- Tsinghua University (Beijing, CN)
- INSA (Lyon, FR)
- Kookmin University (Seoul, KR)
- Northwestern University (Chicago, US)

COLLABORATION WITH COMPANIES

- Škoda-auto (Mladá Boleslav, CZ)
- Eaton Corp. (US)
- Koyo Bearings (JP)
- Tribotec (Brno, CZ)
- ZKL (Brno, CZ)
- Bosch Rexroth Czech Republic (Brno, CZ)
- Timken Czech Republic (Brno, CZ)
- INA Schaeffler (DE)

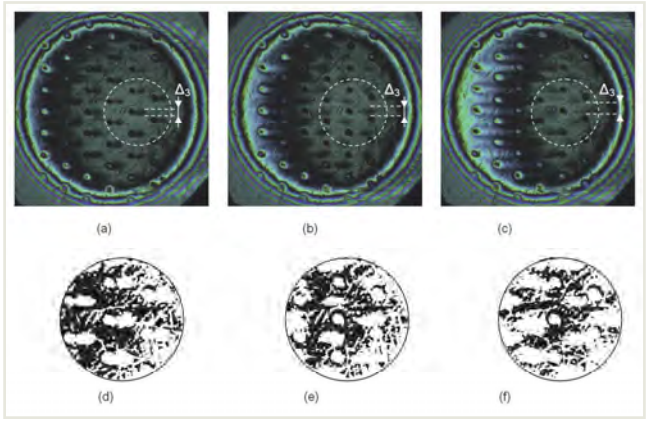
EXPECTATIONS ↘

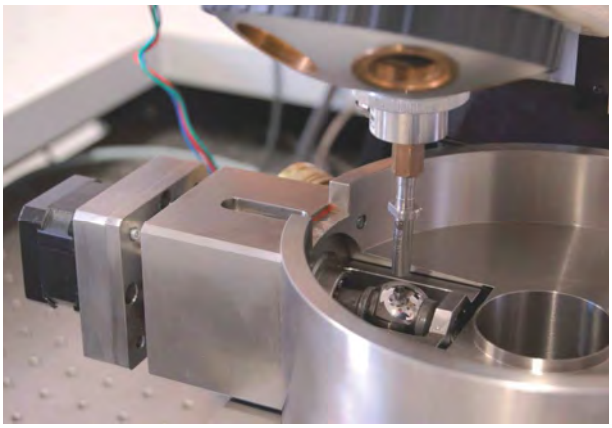
REQUIREMENTS

- Rational project plan
- Ambitious and realistic requests for scientific services – challenge for further research development
- Direct support of research for industry, focused on specific requirements of the company. Long-term projects will be preferred, short term projects are also possible

OFFERS

- Comprehensive development services for firms – in relation with NETME Centre
- Research activities include contact fatigue, bearing life, fatigue of machine parts, nanotechnology
- Machine and industrial design including 3D models
- Utilization of university capacities and acquisition of new specific equipment, operated by university staff
- Products for commercialization (we cannot be more factual because of competition)





BRNO UNIVERSITY OF TECHNOLOGY

Heat Transfer and Fluid Flow Laboratory

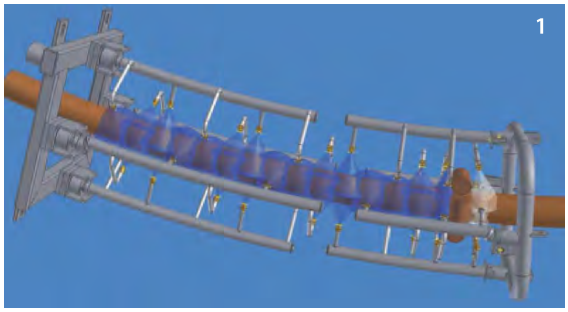
/ Faculty of Mechanical Engineering / Brno University of Technology

RESEARCH GROUP CONTACT

Technická 2896/2, 616 69 Brno
http://heatlab.fme.vutbr.cz

HEAD Assoc. Prof. Jaroslav Horský
PHONE +420 541 143 281
E-MAIL horsky@fme.vutbr.cz

HEAD Prof. Miroslav Raudenský
PHONE +420 541 143 274
E-MAIL raudensky@fme.vutbr.cz


1

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Heat transfer
- Numerical modelling of temperature and stress fields
- Experimental heat transfer
- Cooling
- Heat treatment
- Design of cooling devices
- Expertise in heat transfer and cooling in high-temperature area

EXCELLENCE

- Research and development in the area of heat transfer and high temperature applications

MISSION

- To be the top applied centre in Europe
- Have some intensive close contacts and cooperations with industry

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Interaction of flowing liquid with hot surface and inverse heat conduction problem
- Computation of the thermal boundary conditions from experimental measurements
- Numerical models – especially for continuous casting, rolling, and disposal of dross
- Calibration of thermal sensors

MAIN CAPABILITIES

- Numerical models applied in the metallurgical industry (continuous casting, rolling, descaling, optimization of cooling systems)
- Experimental work aimed at determining heat transfer boundary conditions

FIELDS OF RESEARCH RESULTS APPLICATION

- Metallurgy
- Engineering
- Saving of energy, cost reduction

ALUMNI PROFILE

The laboratory provides training only in doctoral studies, area – heat transfer, experimental research numerical modelling, design of cooling devices.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

4

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

10

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

Laboratory of thermophysical properties of materials in conditions up to 1600°C, Test benches for heat transfer measurements on moving surfaces.

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

10 / 0.4

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

63

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

81

MAIN PROJECTS

2008-2012: Advanced Method To Improve Work Roll Life Time By Coupled Oil Free Lubrication And Chilling (project CHILLUB financed by the Research Fund for Coal and Steel, European Commission)

2004-2008: Effective roll cooling (project EWRCOOL financed by the Research Fund for Coal and Steel, European Commission)

2002-2005: Experimental study of the Leidenfrost effect at the impact of water droplets on heat surface for application in metallurgy (GA106/01/0124, Czech Science Foundation)

ACHIEVMENTS

Laboratory team has documented strong scientific potential in the last five years: total of 52 published articles, 3 prototypes (special devices for on-line Measurements of temperature in the load of rolls of hot rolling process and design of cooling units for hot and cold rolling), 14 functional samples, 1 proven technology. The team has been part of the European research environment – for the last 5 years, 4 international partner projects with a total financial extent of 7.5 million Euros. The team has had a strong relationship with the private sector in the last 5 years, contract research implemented in 112 projects in the contracted amount of 37 million CZK.

MAIN COLLABORATING PARTNERS

COLLABORATIONS WITH ACADEMIC PARTNERS

- University of Technology, Faculty of Mechanical Engineering (Brno, CZ)
- University of Technology, Faculty of Electrical Engineering and Communication (Brno, CZ)
- Institute of Physics of Materials, Academy of Science of the Czech Republic (Brno, CZ)
- Geonics Institute, Academy of Science of the Czech Republic (Ostrava, CZ)
- Arizona State University (US)

COLLABORATIONS WITH COMPANIES

- Třinecké železárny, a. s. (Třinec, CZ)
- AllInvest (Břidličná, CZ)
- Vítkovice (Ostrava, CZ)
- Arcelor Mittal OV (Ostrava, CZ)
- VUHŽ (Dobrá, CZ)
- Lechler (DE)
- Alcoa (US)
- Posco (KR)
- Comalco (NZ)
- Mannesmann (DE)
- US Steel (SK)
- ArcelorMittal (Chicago, US)

EXPECTATIONS

REQUIREMENTS

We are trying to find partners for the application of our products e.g. special cooling headers and other technologies for cooling and heat treatment. Application is the basis for our activities.

- Larger space for special use
- Cooperation with companies abroad

OFFERS

Technical help, measurements, consultation, research and design work in the area of thermal processes and cooling.

Figure 1 Design secondary cooling system of billet

Photo 1 HTC measurement: Continuous casting, secondary cooling

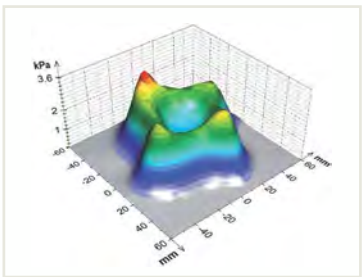


Figure 2 Impact forces measurement of nozzle jet

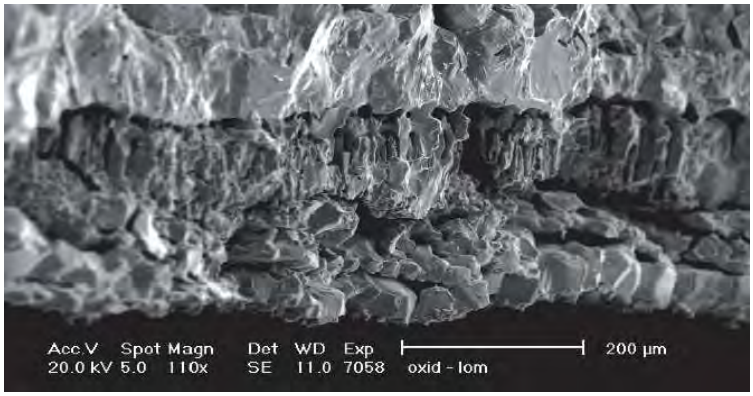


Photo 2 Structure of primary and secondary scales – electron microscope.

Electrical and Magnetic Properties Group

Department of Structure
Institute of Physics and Materials / Academy of Sciences of the Czech Republic

RESEARCH GROUP CONTACT

Žižkova 22, 616 62 Brno
http://www.ipm.cz/electrical-and-magnetic-properties-group.html

HEAD Dr. Oldřich Schneeweiss
PHONE +420 532 290 434
E-MAIL schneew@ipm.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

- Material Engineering
- Magnetic Properties
- Physics of Metals

EXCELLENCE

- Mössbauer spectroscopy
- Magnetic measurements
- Ab-initio calculations of electronic structure of materials

MISSION

- To be a part of the wider top European research of nanomaterials and metal composites

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Theoretical studies of electronic and magnetic properties of disordered alloys, epitaxial multilayers, surfaces and interfaces as well as quantum-mechanical studies of extended defects in metallic materials
- Experimental investigations of relations among structural and magnetic, transport and mechanical properties in metallic materials
- Materials for hydrogen storage

MAIN CAPABILITIES

- Patent for textiles barcode and others, which can be modified for practical application – efficient storage of hydrogen, nanocrystalline iron and guidance systems for drugs place in the body
- Cooperation with medium-sized companies concerned with medical equipment, treatment technology and environmental protection

FIELDS OF RESEARCH RESULTS APPLICATION

- Metallurgy
- Metal Processing
- Engineering
- Electrical Engineering
- Environmental Protection
- Fuel Cells
- Biomedicine – e.g. Magnetic Resonance

ALUMNI PROFILE

Basic and industrial research in materials science and engineering.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

10

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

3

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Mössbauer spectrometers (5 – 1300K)
- VSM magnetometers (5 – 1000K)
- Coercimeter Förster (80 – 1000K)
- Equipment for measurements of electrical resistivity (300 – 1000K)
- Equipment for measurements of magnetoresistance (80 – 900K, 1T)
- Quadrupole mass spectrometer
- Spark erosion system for material synthesis
- Vacuum (oil free) and gas furnaces for heat treatment of materials (up to 1300K)
- X-ray diffractometer X'PERT

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

5 / 0.2

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

10

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

0

MAIN PROJECTS

2011-2014: Theory of spin-dependent transport in magnetic solids and nanostructures (project P204/11/1228 financed by the Czech Science Foundation, Investigator: doc. RNDr. Ilja Turek, DrSc.)

2011-2014: Effects of cores and boundaries of nanograins on the structural and physical properties of ball milled and mechanically alloyed iron-based materials (project P108/11/1350 financed by the Czech Science Foundation, Investigator: Ing. Yvonna Jirásková, PhD.)

2005-2011: Research center of powdered nanomaterials (project VC 1M 0512 financed by the Ministry of Education, Youth and Sports, Investigator: Ing. Oldřich Schneeweiss, DrSc.)

ACHIEVEMENTS

- O. Schneeweiss, R. Zbořil, N. Pizúrová, M. Mašláň, E. Petrovský, J. Tuček: Novel solid-state synthesis of α-Fe and Fe3O4 nanoparticles embedded in a MgO matrix. Nanotechnology, Vol. 17 , 2006, pp. 607-616.
- B. David, O. Schneeweiss, M. Mashlan, E. Šantavá, I. Morjan: Low-temperature magnetic properties of Fe3C/iron oxide nanocomposite, J. Magn. Magn. Mater. Vol. 316, 2007, pp. 422-425.
- K. Sato, L. Bergqvist, J. Kudrnovský, P. H. Dederichs, O. Eriksson, I. Turek, B. Sanyal, G. Bouzerar, H. Katayama-Yoshida, V. A. Dinh, T. Fukushima, H. Kizaki, R. Zeller: First-principles theory of dilute magnetic semiconductors, Rev. Mod. Phys., Vol. 82, 2010, pp. 1633-1690.
- Y. Jirásková, K. Zábranský, I. Turek, J. Buršík, D. Jančík: Microstructure and physical properties of mechanically alloyed Fe-Mo powder, J. Alloys Comp. Vol. 477, 2009: pp 55– 61.

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- Faculty of Science, Masaryk University (Brno, CZ)
- Faculty of Mechanical Engineering, Brno University of Technology (Brno, CZ)
- Faculty of Science, Palacky University (Olomouc, CZ)
- Textile Testing Institute (Brno, CZ)
- Faculty of Mathematics and Physics, Charles University (Prague, CZ)
- University of Uppsala (SE)
- University of Belgrade (RS)
- National Institute for Lasers, Plasma and Radiation Physics (Bucharest, RO)
- University of Ghent (Gent, BE)

COLLABORATION WITH COMPANIES

- Aquatest (Liberec, CZ)
- Nanoiron (Rajhrad, CZ)
- Messer (DE)
- SHM (Šumperk, CZ)
- Honeywell (US)
- Delong Instruments (Brno, CZ)

EXPECTATIONS

REQUIREMENTS

Collaboration with companies - clear and exact description of the task to be solved.

OFFERS

- Measurements of magnetic and electrical properties of materials.
- Structure and phase analysis using Mössbauer spectroscopy and XRD.
- Calculation of electronic structure and related properties of selected materials

BRNO UNIVERSITY OF TECHNOLOGY

Advanced Nanotechnologies and Microtechnologies

CEITEC central european institute of technology BRNO | CZECH REPUBLIC

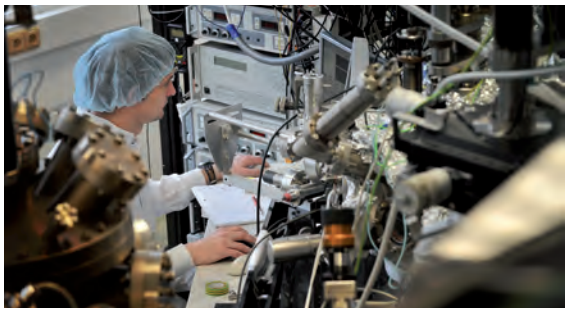
/ Central European Institute of Technology of Brno University of Technology / Brno University of Technology

INSTITUTE CONTACT

Antonínská 548/1, 601 90 Brno, Czech Republic
http://www.ceitec.vutbr.cz

HEAD Prof. Tomáš Šikola
PHONE + 420 541 149 310
E-MAIL sikola@ceitec.vutbr.cz

HEAD Prof. Josef Humlíček
PHONE +420 549 49 4505
E-MAIL humlicek@physics.muni.cz



THEMATIC RESEARCH FOCUS

RESEARCH AREA

Nanotechnologies and nanoscience covering materials and functional structures suitable for nanoelectronics and nanophotonics, generally. The research consider semiconductor nanostructures, metallic and magnetic nanostructures, nanotubes and nanowires, supramolecular structures and novel nanoelectronic circuits.

EXCELLENCE

- Preparation and analysis of nanostructures for applications in nanotechnology and biosensors
- Deposition of magnetic and nonmagnetic thin films
- Development of analytical and measurements method

MISSION

- Creation of a centre of excellence in the field of nano and microtechnology

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Fabrication of nanostructures by "bottom-up" methods
- Fabrication of nanostructures by "top-down" methods (nanolithography)
- Investigation of the functional properties of nanostructures
- The development of submicron devices and nanostructures
- The development of analytical and measurement methods

MAIN CAPABILITIES

- Acquiring the methods for the fabrication of a wide range of metallic, semiconducting and dielectric structures, including their functional combinations
- Understanding the basic principles of nanostructures, discovering their specific properties and finding their correlation with geometrical/structural parameters of nanostructures and operational parameters
- Design and realization of final products as advanced materials, nanostructures, nanodevices and systems with applications in electronics, photonics, (bio)sensing, etc.
- The development of the techniques and methods for microscopy, analysis and metrology of nanomaterials and nanostructures. The newly developed, or at least extended or upgraded methods will be, as a rule, offered to manufacturers, including domestic ones. Some parts of the research will be performed as contractual or collaborative research with manufacturers
- New diagnostic and therapeutic applications
- The development of novel small molecules. Understanding molecular mechanisms involved in RNA surveillance and gene regulation mechanisms that occur at the RNA level

FIELDS OF RESEARCH RESULTS APPLICATION

- Nanotechnology
- Nanostructure properties
- Magnetism
- Spintronics
- Plasmonics
- Coatings, sensors

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

44

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

116

KEY RESEARCH EQUIPMENT ↘

LIST OF DEVICES

Nanofabrication (Core Facility)
» E-Beam Lithography, Photolithography
» Chemical and Thermal Processing
» Deposition
» Etching
» Packaging and Testing
» Design and Simulation

Nanocharacterisation (Core Facility)
» Electrical and Magnetical Measurements
» X-ray Analysis
» Microscopy/Analysis
» Nanolithography and Nanomanipulation
» Optical Characterization
» Fabrication and in situ Characterisation I - II
» Experimental PECVD

Other Technology Units
» Confocal Microscopy
» Metrology
» NMR and Mass Spectrometry
» Micromechanical/Morphology Testing
» Tomography
» Molecular Chemistry and Bioelectrochemistry
» Electrical and Thermal Properties of Nanomaterials

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

65 / 2.6

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

5

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

10

MAIN PROJECTS ↘

2007-2011: Functional hybrid nanosystems of semiconductors and metals with organic materials (FUNS) (project KAN400100701 financed by the programme Nanotechnologies for Society, Academy of Sciences of the Czech Republic)

2006-2011: Structures for Nanophotonics and Nanoelectronics (project LC06040 financed by the Ministry of Education, Youth and Sports)

2008-2010: Multifunctional Nanomaterials Characterisation Exploiting Elipsometry and Polarimetry (project 218570 financed by the 7th Specific RTD Programme - Cooperation)

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» Institut für Angewandte Physik, Vienna University of Technology (Vienna, AT)
» Elettra Synchrotron Light Laboratory (Trieste, IT)
» Max-Planck-Institut für Eisenforschung (Düsseldorf, DE)
» University of Cologne (Cologne, DE)
» Technische Universität Wien (Vienna, AT)
» Geballe Laboratory of Advanced Materials, Stanford University (Stanford, US)
» Imperial College London, United Kingdom of Great Britain and Northern Ireland (London, GB)
» University of Fribourg, (Fribourg, CH)
» Max Planck Institute for Solid State Research (Stuttgart, DE)
» Institute of Physics, Academy of Sciences of the Czech Republic (Prague, CZ)
» Department of Macromolecular Physics, Faculty of Mathematics and Physics, Charles University in Prague (Prague, CZ)
» Centre for Nanomaterials Research, Faculty of Science, Palacky University Olomouc (Olomouc, CZ)

COLLABORATION WITH COMPANIES

» FEI Czech Republic (Brno, CZ)
» ON Semiconductor Czech Republic (Brno, CZ)
» Tescan (Brno, CZ)
» Vakuum Praha (Prague, CZ)
» DIGITAL PRO (Prague, CZ)
» BVT Technologies (Brno, CZ)

EXPECTATIONS ↘

REQUIREMENTS

» Partners for FP7 research project in the field of nanotechnology
» Company contribution in basic research and PhD. work
» Partners for utilization of nanotechnology research outputs

OFFERS

» Expertise in nanotechnology
» Surface analysis
» Preparation and analysis of nanostructures
» Equipment utilization

04 / 2011

BRNO UNIVERSITY OF TECHNOLOGY

Institute of Process and Environmental Engineering

/ Faculty of Mechanical Engineering / Brno University of Technology

INSTITUTE CONTACT

Technická 2896/2, 616 69 Brno, Czech Republic
http://www.upei.fme.vutbr.cz/

HEAD Prof. Petr Stehlík
PHONE +420 541 142 373, +420 602 566 220
E-MAIL stehlik@fme.vutbr.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

Waste/biomass to energy systems with advanced heat recovery and polluted gas cleaning subsystems - complex approach

EXCELLENCE

- Heat transfer and its application - thermal processing of waste including energy utilization (waste to energy)
- Process furnaces and heat exchangers
- Process integration
- Energy savings and emissions reduction
- Simulation calculations and optimization in the process industry
- CFD application

MISSION

Our aim is to form a Process Engineering Centre with an international reputation focusing on exploitation of waste and energy. We want to offer a high (European) standard of education, research and services for companies and penetrate the market with original and efficient solutions in the above mentioned fields. By utilizing the established NETME Centre (www.netme.cz), we aim to become one of the world's leading groups.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Thermal and non-thermal treatment of waste
- Waste to energy systems
- Heat and power systems
- Alternative fuels
- Flue gas and polluted gas cleaning
- Experimental research of combustion
- Modelling, simulation, CFD and optimization
- Equipment design
- Heat transfer systems
- Heat exchangers
- LCA and process integration

MAIN CAPABILITIES

Research and development of unique (frequently „tailor made") solutions with direct applications in industrial practice. Our R and D products are mostly concerned with thermal and non-thermal treatment of waste, waste to energy systems, equipment design and heat exchangers (see above) and include patents concerning waste gas cleaning, various software tools for data processing , simulation systems for evaluation of process and energy parameters, computational tools for evaluation of energy recovery from waste incineration and optimization in the field of alternative fuel utilization (particularly biomass) in heating plants. Functional samples cover areas of combustion related activities such as combustion air preheating in liquid fuels, equipment designed for homogenization of gaseous-liquid mixtures and atomization for the dosing of liquids fuels into the combustion chamber.

FIELDS OF RESEARCH RESULTS APPLICATION

- Waste/biomass to energy processes and systems
- Alternative fuels
- Devices for combustion, energy transfer, waste and biomass processing
- Process engineering – wide spectrum for utilization in various industrial fields
- Engine construction
- Plant and apparatus engineering
- Wide scope of industrial sectors as well as the municipal sphere

ALUMNI PROFILE

Our alumni acquire a broad scope of knowledge which may be applied in various fields of engineering practice including the power industry, all the fields of process industry (e.g. food industry, chemical industry), environmental protection, engineering administration, business, etc.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

18

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

19

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- Experimental unit for thermal and catalytic treatment of waste gases (polluted by VOC and carbon monoxide)
- Research facility for burner testing – most modern testing facility in Central Europe
- Two experimental units for flue gas cleaning by the method of filtration and/or catalytic filtration with a flowrate capacity of 1000 m3/h and 40 m3/h
- Experimental unit for flue gas cleaning by the method of two-stage absorption
- Prototype – 1MW unit for energy exploitation of various kinds of biomass (full scale reference unit in permanent operation)
- Reactors for anaerobic digestion

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

34.9 / 1.4

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

25

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

1.4

MAIN PROJECTS

2005–2011: Waste and Biomass Utilization focused on Environment Protection and Energy Generation (institutional research plan MSM0021630502 financed by the Ministry of Education, Youth and Sports)

2008–2011: Waste as raw material and energy source (project 2B08048 financed by the Ministry of Education, Youth and Sports)

2009–2013: NETME Centre (New Technologies for Mechanical Engineering) (project ED0002/01/01 financed by the EU)

ACHIEVEMENTS

- Patent Homogenization of gas-liquid mixture used in cleaning of industrial waste gases and its homogenization equipment
- W2E „Waste-to-energy" Simulation system for evaluation of process and energy parameters

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- UoM – University of Manchester Institute of Science and Technology (UK)
- University of Maryland (US)
- CERTH/CPERI - Centre for Research and Technology – Hellas (GR)
- Universität Dortmund (DE)
- Kharkov State Polytechnic University (UA)
- Polytechnic University of Bucharest (RO)
- University of Pannonia (HU)
- Brno University of Technology (FIT, FCh, FAST, CZ)
- Karlsruhe Institute of Technology (DE)

COLLABORATION WITH COMPANIES

- W. L. GORE & Assoc. (US)
- Koch-Glitsch (US)
- ABB Lummus Global (CZ)
- Procter & Gamble (US)
- PBS Industry Engineering (CZ)
- ZVVZ Enven (CZ)
- Phosphoric Fertilizers Industry s. a. (GR)
- EVECO Brno, s.r.o. (CZ)
- Kannegiesser (DE)
- Česká rafinérská, a.s. (CZ)
- Královopolská SAG, s.r.o. (CZ)
- Královopolská RIA, a.s. (CZ)
- Ústav aplikované mechaniky, s.r.o. (CZ)
- Vítkovice ÚAM, a.s. (CZ)
- Elya Solutions, s.r.o. (CZ)
- Chart Ferox, a.s. (CZ)
- Moravská energetická, a.s. (CZ)
- Vítkovice Power Engineering (CZ)

EXPECTATIONS ↘

REQUIREMENTS

- Professional and reliable collaboration
- Cooperation based on mutual profitability

OFFERS

R&D common projects and common business in the fields specified above, e.g.:

- Burner and jet testing
- Design of systems for cleaning and combustion
- Design and computing of atypical heat exchangers
- Energy and mass balance of industrial units
- Technical measurements of emissions incl. determination of dioxine concentrations
- Analyses
- Conceptual proposals of processes and devices
- Analyses and optimization of heat and power plants, incineration plants, industrial processes

04 / 2011

Department of Physical Electronics

/ Faculty of Science / Masaryk University / Kotlářská 2, 611 37 Brno

INSTITUTE CONTACT

Technická 2896/2, 616 69 Brno
http://www.physics.muni.cz/kfe

HEAD Prof. David Trunec
PHONE +420 549 49 1446
E-MAIL trunec@physics.muni.cz

HEAD Prof. Mirko Černák
PHONE +420 549 49 3445
E-MAIL cernak@physics.muni.cz

THEMATIC RESEARCH FOCUS

RESEARCH AREA

» Plasma Physics

EXCELLENCE

» Low temperature plasma physics

MISSION

» To be a leading Central-Europe educational and research institution raising high-quality professionals, and generating research results attractive for companies

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

» Research of low-temperature plasma and ionized gases
» Applications in technologies of polymer processing and thin layers (e.g. coatings of metals)
» Plasma Enhanced Chemical Vapour Deposition
» Plasma diagnostics, simulation

MAIN CAPABILITIES

» New methods for measuring the surface energy
» „Plasma Pencil" (a method of application for low-temperature plasma manufacturing technology) - USA patent
» Technology of coplanar surface discharges (a common European patent Pegas Nonwovens - a world first in that technology into practice)

Centre for Low-Cost Plasma and Nanotechnology Surface Treatment

» Research and development of new methods for plasma surface treatment for textile, glass, automotive and other traditional industries and for manufacturing of high-tech products such as solar panels and battery separators

FIELDS OF RESEARCH RESULTS APPLICATION

Basic research

» Nanotechnology

Applied research

» Plastics and chemical industry
» Electronic industry
» Construction-civil engineering
» Paper industry
» Wood industry
» Textile industry
» Chemical industry
» Automotive industry
» Air pollution treatment
» Waste treatment
» Water waste treatment
» Energy - Exploration/Production
» Materials: Iron and Steel; Plastics, Polymers; Glass, ceramics; Non ferrous materials; Building materials
» Medical Treatment
» Forestry and Wood

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

8

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

19

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- UVISEL Yobin-Ivon Ellipsometer
- Microhardness meter Fischerscope H100
- CCD spectrometers Yobin-Ivon
- FTIR spectrometer
- rf and mw generators

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

42 / 1.68

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

0

MAIN PROJECTS

2008-2011: In-line plasma-treatments and surface nano-treatments of nonwoven fabrics (project 2A-3TP1/126 financed by the Ministry of Industry and Trade)
2007-2011: Deposition of thermomechanically stable nanostructured diamond-like thin films in dual frequency capacitive discharges (project GA202/07/1669 financed by the Czech Science Foundation)
2005-2011: Study and application of plasma chemical reactions in non-isothermic low temperature plasma and its interaction with solid surface (intitutional research plan MSM0021622411 financed by the Ministry of Education, Youth and Sports)

ACHIEVEMENTS

Patents:

- M. Černák: An apparatus and method for improving felting properties of animal fibres by plasma treatment. Patent PCT/CZ2009/000123
- M. Černák: Method and apparatus for treatment of textile materials EP 1 387 90

MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS

- Institute of Plasma Physics, Academy of Sciences of the Czech Republic (Prague, CZ)
- Institute of Physics of Materials, Academy of Sciences of the Czech Republic (Brno, CZ)
- Institute of Physical Chemistry, Academy of Sciences of the Czech Republic (Prague, CZ)
- Institute of Physics, Academy of Sciences of the Czech Republic (Prague, CZ)
- Faculty of Mathematics and Physics, Charles University (Prague, CZ)
- University of Greifswald (Greifswald, DE)
- Technical University (Munich, DE)
- Faculty of Chemistry, Technical University Brno (Brno, CZ)

COLLABORATION WITH COMPANIES

- SHM (Šumperk, CZ)
- Pegas Nonwovens (Znojmo, CZ)
- Preciosa (Nový Jíčín, CZ)
- Tonak (Nový Jíčín, CZ)

EXPECTATIONS

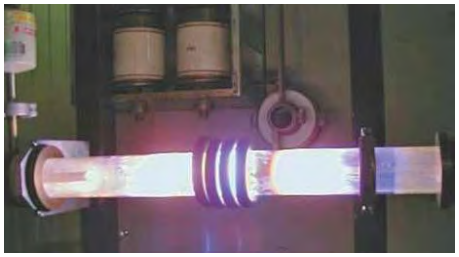
REQUIREMENTS

- Cooperation with companies – based on a clear definition of the problem to be solved (e.g. surface treatment, thin film deposition, optical and mechanical analysis of thin films)
- „Match-Making" - connecting the solution of a business requirement with the implementation of quality research and publishing high-quality results

OFFERS

- Low-cost in-line plasma surface modification of flat materials as, for example, textiles, polymer films, aluminium foils, flat glass, etc.
- Deposition of hard or protective layers
- Measurement of the properties of thin films – mechanical, optical properties, chemical composition
- Experience with cooperation on patenting and in commercial applications

04 / 2011



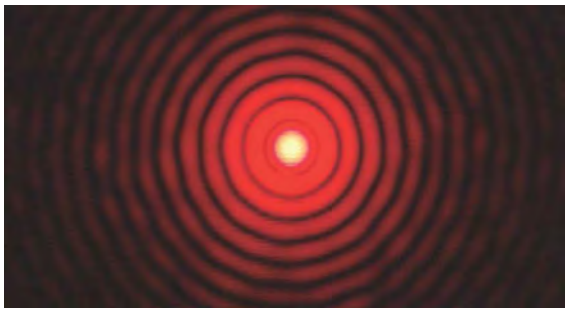
Group of Tomáš Tyc

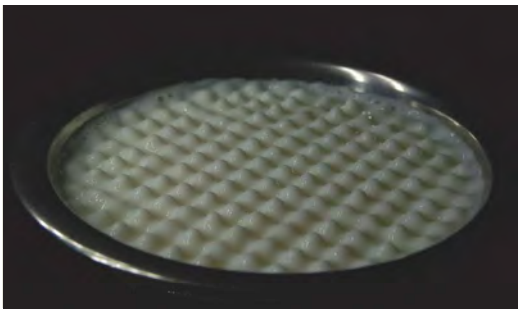
Division of Theoretical Physics / Institute of Theoretical Physics and Astrophysics
Faculty of Science / Masaryk University

RESEARCH GROUP CONTACT

Kotlářská 2, 611 37 Brno
http://theor.physics.muni.cz

HEAD Prof. Tomáš Tyc
PHONE +420 549 497 789
E-MAIL tomtyc@physics.muni.cz





THEMATIC RESEARCH FOCUS

RESEARCH AREA

Theoretical physics, mainly optics – theory of invisibility and perfect imaging, wave propagation in optical devices, applications of geometry in optics

EXCELLENCE

Top in Central Europe

MISSION

We want to make a major contribution to the understanding of perfect imaging and propagation of waves in perfect lenses. To achieve this, we plan to extend the research team.

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH

- Theory of invisibility
- Theory of perfect imaging
- Wave propagation in optical devices
- Applications of geometry in optics
- Problems in quantum theory and quantum information with continuous variables

MAIN CAPABILITIES

Basic research

- Transformation optics (article in Nature Materials)
- The draft of new type of invisible cloak (article in Science)

Application research + protection forms

- „Perfect lens" - an international patent with colleagues of the University in St. Andrews and Cornell University

FIELDS OF RESEARCH RESULTS APPLICATION

- Optics and nano-optics
- Geometry and optics
- Electronic industry

ALUMNI PROFILE

Graduates have a solid foundation in quantum mechanics, quantum optics, optics of charged particles and modern quantum theory (the string-inspired theory, quantum theory of gravitation), on which they successfully build their future work. Graduates are adequately prepared for individual scientific research in Czech or foreign institutions.

NUMBER OF RESEARCH POSITIONS ↘

SENIOR RESEARCH STAFF

1

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

3

BUDGET ↘

TOTAL (MIL. CZK/ MIL. EUR)

1.5 / 0.06

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

0

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

5

MAIN PROJECTS ↘

2005–2011: Mathematical structures and their physical applications (Institutional research plan MSM0021622409 financed by the Ministry of Education, Youth and Sports)

2000– : Interesting physics experiments with the electromagnetic field (financed by University Development Fund); for photography of interesting physics phenomena see http://zajfyz.physics.muni.cz/en

ACHIEVEMENTS ↘

» Proposal of a new type of invisibility cloak - paper published in Science - U. Leonhardt, T. Tyc, Broadband Invisibility by Non-Euclidean Cloaking, Science 323, 110 (2009)

» Invention of a method for eliminating material singularities in certain devices. This enabled the construction of an Eaton lens, which previously was just a purely theoretical proposal - T. Tyc, U. Leonhardt, Transmutation of singularities in optical instruments, New Journal of Physics 10, 115038 (2008)

» The first proposal ever of a magnifying perfect lens for imaging regions of 3D space - T. Tyc, M. Šarbort, Magnifying perfect lens with positive refraction, arxiv:1010.3178

MAIN COLLABORATING PARTNERS ↘

COLLABORATION WITH ACADEMIC PARTNERS

» University of St. Andrews (UK)

» Cornell University (US)

» Universities in Singapore and Hong Kong