



# LIFE SCIENCES

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# AEROWORKS

/ DEPARTMENT OF COMPUTER GRAPHICS AND MULTIMEDIA  
/ FACULTY OF INFORMATION TECHNOLOGY  
/ BRNO UNIVERSITY OF TECHNOLOGY

## RESEARCH GROUP CONTACT

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## THEMATIC RESEARCH FOCUS

### RESEARCH AREA

Flight Controls & Avionics— advanced graphical user interfaces, flight dynamics modelling and simulation, design of flight control algorithms, embedded avionics, numerical methods for aircraft identification.

### EXCELLENCE

The group's field of expertise spans several disciplines ranging from novel solutions in computer graphics, followed by the design, prototyping and implementation of mission critical flight control software, design of customized embedded avionics solutions supported by the hardware-in-the-loop simulation capability the team has thanks to its light aircraft flight simulator. The group has expert researchers with different scientific backgrounds that share a common goal of delivering excellent solutions that emphasise the safety and the efficiency of aircraft operations.

### MISSION

The aim is to introduce the group as an excellent research and development partner to the domestic and international industry and academia. The core of our activities is in supporting the industry with innovative solutions that will improve product's operational characteristics, technological readiness and reduce the environmental impact. Towards the inside of the group, the intentions focus on continuous professional development of the research staff, international mobility and strengthening the relationships with current and potential future partners. Management of our group will proceed in submitting project proposals to national and international agencies dealing with research and development in aviation/simulations/ embedded systems/ computer graphics.

## DEVELOPED TECHNOLOGIES

### CONTENT OF RESEARCH

- Flight dynamics modelling and simulation
- Design of embedded avionic systems (onboard computers, flight control systems)

- Design of user interfaces for onboard avionic systems
- Sensor fusion technologies
- Experimental hardware for validation and verification of software designs
- Flight software design

### MAIN CAPABILITIES

Research, development, verification and validation of light aircrafts' advanced avionics systems. The focus is directed towards innovative and robust designs in flight controls, embedded systems, user interfaces and aircraft simulation technologies. The team constantly explores creative ideas that lead to cutting edge solutions in the industry's blooming segment - the light/sport aviation. The group strives to provide tailored, direct to market solutions that meet the expectations of its project partners.

### FIELDS OF RESEARCH RESULTS APPLICATION

- Light/Sport aviation industry (avionics, safe flight control concepts)
- Simulator based training (student pilots, ground based onboard systems proficiency training, type rating)
- Intuitive user interfaces for mission critical applications (aviation, racing vehicles, robotics, medical segment)
- Academic and commercial research (software solutions, hardware platforms, toolboxes and libraries)

### ALUMNI PROFILE

Graduates have complex state of the art knowledge in avionics technologies and are specialized in one or more areas including:

- Modeling and simulation
- User interface design
- Computer graphics and multimedia
- Flight dynamics
- SW and HW design
- Flight controls

### NUMBER OF RESEARCH POSITIONS

### SENIOR RESEARCH STAFF

5

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

4

- Evektor (Kunovice, CZ)
- Outerra (Bratislava, SK)
- VRG (Praha, CZ)

**KEY RESEARCH EQUIPMENT****LIST OF DEVICES**

- SimStar – light sport aircraft simulator with hardware-in-the-loop simulation capability
- Modelling and rapid prototyping SW tools (Matlab, Simulink, etc)
- Database of aircraft dynamic models
- SW and HW rapid prototyping lab

**BUDGET****TOTAL (MIL. CZK/MIL. EUR)**

1.6/0.064

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

20

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

0

**MAIN PROJECTS**

**2011–2013:** Smart Autopilot (TA01010678, financed by the Technology Agency of the Czech Republic)

**2009–2010:** Light Aircraft Flight Simulator SimStar (financed by Brno University of Technology and Evektor)

**MAIN COLLABORATING PARTNERS****COLLABORATION WITH ACADEMIC PARTNERS**

- Institute of Flight Dynamics, Technical University Munich (Munich, DE)
- Department of Avionics and Control Systems, Rzeszow University of Technology (Rzeszów, PL)

**COLLABORATION WITH COMPANIES**

- Federal Aviation Administration (Washington DC, US)

**EXPECTATIONS****OFFERS**

- Participation in projects
- Custom based research, development and testing
- Prototyping of embedded systems

**REQUIREMENTS**

- International members for our research team – post docs and PhD students
- Industry funding of core activities



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# ANALYSIS OF BIOLOGICALLY IMPORTANT MOLECULAR COMPLEXES

/ DEPARTMENT OF EXPERIMENTAL BIOLOGY  
/ FACULTY OF SCIENCE / MASARYK UNIVERSITY



## RESEARCH GROUP CONTACT

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## 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 knowhow 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)

## 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.

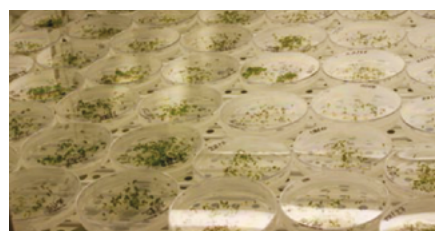
### OFFERS

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

## 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)



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# AUTOMATED ANALYSIS AND VERIFICATION RESEARCH GROUP - VERIFIT

/ DEPARTMENT OF INTELLIGENT SYSTEMS / FACULTY OF INFORMATION  
TECHNOLOGY / BRNO UNIVERSITY OF TECHNOLOGY

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## THEMATIC RESEARCH FOCUS

### RESEARCH AREA

- Research on advanced methods of automated analysis and verification of computer systems

### EXCELLENCE

- Automated formal analysis and verification of infinite-state and parameterised software as well as hardware systems
- Analysis and verification of programs with dynamic linked data structures based on pointers
- Intelligent testing, static and dynamic analysis, model checking, and self-healing of concurrent programs
- Applications of finite automata

### MISSION

We aim at developing new techniques of automated analysis and verification (be it static or dynamic analysis, model checking, or testing) towards higher efficiency, generality, and automation.

## DEVELOPED TECHNOLOGIES

### CONTENT OF RESEARCH

- Automated formal analysis and verification of infinite-state and parameterised systems using symbolic techniques based on automata and logics, often combined with automated abstraction
- Automatic formal analysis of programs with complex dynamic linked data structures based on pointers, including a support for dealing with programming techniques such as pointer arithmetic used in system software

- Static and dynamic analysis, model checking, and combinations of these approaches for analysis and verification of concurrent programs
- Intelligent search-based testing of concurrent software
- Automated self-healing of concurrent software both at development time and at run-time
- Formal verification of advanced features of hardware designs (parameters, multiple clocks, hardware-software co-design)
- Efficient techniques for dealing with (non-deterministic) finite automata applicable in verification as well as other areas

### MAIN CAPABILITIES

Basic research on new approaches to automatic analysis, testing, and verification, their prototype implementation and experimental evaluation. We primarily target basic research in the area of formalisms and algorithms used in automated analysis and verification, which should, however, be motivated by practical problems of analysis and verification. Consequently, we are interested in getting practical applications of analysis and verification too. As an extension of our basic research directions, we are interested in developing methods of automated self-healing as well.

### FIELDS OF RESEARCH RESULTS APPLICATION

- Quality assurance in software and hardware development
- Development of safety critical systems

### ALUMNI PROFILE

Graduates who collaborated with our group have a wide knowledge of the latest developments in the field of automated analysis and verification (including static and dynamic analysis, model checking, as well as testing), they have a very solid theoretical background as well as experience with writing tools for analysis and verification. Thanks to the intense international collaboration of our group and thanks to participation in renowned conferences, they are familiar with and often have strong personal links with various leading academic teams from the area.

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## NUMBER OF RESEARCH POSITIONS

### SENIOR RESEARCH STAFF

6

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

9

## KEY RESEARCH EQUIPMENT

### LIST OF DEVICES

- Multiple high performance computing servers for an experimental evaluation of newly developed techniques of automated analysis and verification

## BUDGET

### TOTAL (MIL. CZK/ MIL. EUR)

4 / 0.16

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

2

## MAIN PROJECTS

**2010–2013:** Static and Dynamic Verification of Programs with Advanced Features of Concurrency and Unboundedness (project number P103/10/0306 financed by the Czech Science Foundation)

**2009–2013:** Rich-Model Toolkit: An Infrastructure for Reliable Computer Systems (COST Action IC0901, financed by the European Commission and the Ministry of Education, Youth, and Sports of the Czech Republic)

**2008–2009:** Advanced Methods for Automatic Verification of Infinitestate Systems (a Czech-French Barrande project MEB 020840, financed on the Czech side by the Ministry of Education, Youth, and Sports of the Czech Republic)

**2007–2009:** Advanced Formal Approaches in the Design and Verification of Computer-Based Systems (project number 102/07/0322 financed by the Czech Science Foundation)

**2006–2009:** SHADOWS: A Self-Healing Approach to Designing Complex Software Systems (FP6 IST project number 035157 financed by the European Commission)

## ACHIEVEMENTS

- The group regularly publishes at renowned scientific conferences as well as in scientific journals, quite often with members of the various foreign teams it cooperates with:
- Bouajjani, A., Habermehl, P., Rogalewicz, A., Vojnar, T.: Abstract Regular Tree Model Checking of Complex Dynamic Data Structures, In: Proc. of 13th International Static Analysis Symposium – SAS'06, LNCS 4134, Springer-Verlag, 2006, pp. 52–70.
- Bouajjani, A., Habermehl, P., Vojnar, T.: Verification of Parametric Concurrent Systems with Prioritised FIFO Resource Management, In: Formal Methods in System Design, 32(2):129–172, Springer-Verlag, 2008.
- Abdulla, P.A., Chen, Y.-F., Holík, L., Mayr, R., Vojnar, T.: When Simulation Meets Antichains (On Checking Language Inclusion of NFAs), In: Proc. of 16th International Conference on Tools and Algorithms for the Construction and Analysis of Systems – TACAS'10, LNCS 6015, Springer-Verlag, 2010, pp. 158–174. The EATCS award for the best theory paper of ETAPS'10.

## MAIN COLLABORATING PARTNERS

### COLLABORATION WITH ACADEMIC PARTNERS

- LIAFA, Université Paris Diderot – Paris 7/ CNRS (Paris, FR)
- VERIMAG, Université Joseph Fourier/CNRS/ INPG (Grenoble, FR)
- Department of Information Technology, Uppsala University (Uppsala, SE)
- Institute of Information Science, Academia Sinica (Taipei, TW)
- Laboratory for Foundations of Computer Science, University of Edinburgh (Edinburgh, GB)

- Laboratory of Test and Analysis, University of Milano Bicocca (Milano, IT)
- Faculty of Informatics, University of Lugano (Lugano, CH)
- Faculty of Informatics, Masaryk University (Brno, CZ)

### COLLABORATION WITH COMPANIES

- IBM Haifa Research Laboratories (Haifa, IL)
- Red Hat Czech (Brno, CZ)

## EXPECTATIONS

### OFFERS

- Interest in common research on the current challenges of automated analysis and verification that could lead to a publication in a renowned scientific conference such as CAV, TACAS, POPL, PLDI, ISSTA, ESOP, CONCUR, SAS, etc.
- Interest in experimental applications of the latest results of our research on analysis, verification, and testing of computer systems
- Interest in applications requiring large finite automata (esp. in case they are non-deterministic) to be handled
- Interest in applying for common international research projects that would involve automated analysis and verification and that could lead to publications at renowned scientific conferences

### REQUIREMENTS

- Interest in common research, ideally, if some new challenges in analysis and verification could be identified at the beginning of the cooperation, that could lead to new fundamental results publishable at renowned scientific conferences or in scientific journals
- Interest in applying for common projects that would involve automated analysis and verification and that could lead to publications at renowned scientific conferences

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# BRNO EPILEPSY CENTRE

/ FIRST DEPARTMENT OF NEUROLOGY  
/ FACULTY OF MEDICINE / MASARYK UNIVERSITY



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## 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

### MAIN CAPABILITIES

#### Basic research

Study of cognitive and active functions in the human brain

#### Application research + protection forms

- description of new clinical entities and diagnostic procedures, particularly in the field 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 PROJECT

**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)

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**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

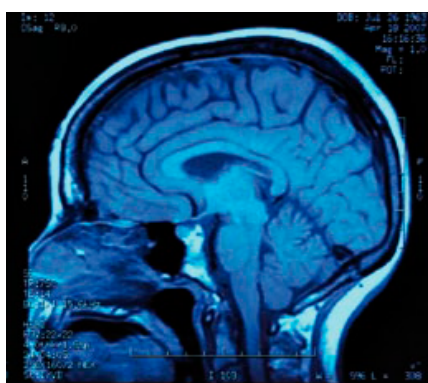
#### REQUIREMENTS

- 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



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# CARDIOVASCULAR ANIMAL RESEARCH CENTRE

/ INTERNATIONAL CLINICAL RESEARCH CENTER  
/ ST. ANNE'S UNIVERSITY HOSPITAL



## RESEARCH GROUP CONTACT

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## 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 of 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

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## 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

models and studies, including the proper interpretation of results.

## 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

04/2011

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# CYTOKINETICS

/ INSTITUTE OF BIOPHYSICS

/ ACADEMY OF SCIENCES OF THE CZECH REPUBLIC

## RESEARCH GROUP CONTACT

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## 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- $\beta$  (TGF- $\beta$ ), 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, Nuairé,

Gelaire); CO2 incubators (Jouan, Heraeus, Nuair); sterilizers; 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 resistance 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 resistance.

#### 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, Palacký University Olomouc, Prof. Zdeněk Kolář (Olomouc, CZ)

#### COLLABORATION WITH COMPANIES

- Infusia - Hořátek (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.



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## DEPARTMENT FOR HEALTH CARE SCIENCE AND BIOMEDICINE

/ FACULTY OF HEALTH AND MEDICINE

### RESEARCH GROUP CONTACT

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### THEMATIC RESEARCH FOCUS

#### RESEARCH AREA

- Extracorporeal blood purification
- Adsorption therapies for sepsis and hepatic failure
- Citrate anticoagulation
- Cell apheresis
- Tissue engineering
- Sensor development
- Water technology

#### EXCELLENCE

Development of systems for blood purification

#### MISSION

- Development of new technologies for extracorporeal blood purification for the supportive therapy of liver failure, sepsis and multi-organ failure.
- Assessment and optimization of the blood compatibility of medical devices

### DEVELOPED TECHNOLOGIES

#### CONTENT OF RESEARCH

Development of adsorbents for extracorporeal blood purification, adsorption therapies for sepsis and hepatic failure, monolithic adsorbent columns, microspheres based detoxification system, cell apheresis, advanced biomedical materials, device development: system for regional citrate-calcium anticoagulation, supportive treatment of sepsis and liver failure, cell culture models: human 3D cancer models, sepsis, wireless sensor networks, tunable microfluidic chips, fluorescence-based ion-sensitive sensors, wireless miniaturised sensors for biomedical applications

### MAIN CAPABILITIES

#### BASIC RESEARCH

- Pathophysiology of sepsis

#### APPLIED RESEARCH

- Development of combined membrane-adsorption systems for blood purification

- Citrate anticoagulation
- Cell culture models for sepsis and endothelial activation

### FIELDS OF RESEARCH RESULTS APPLICATION

- Life Sciences
- Material Science
- Medicine

### ALUMNI PROFILE

We offer training for Masters and PhD students who obtain their degrees from partner universities. These students are trained in an interdisciplinary environment in our four working groups (biochemistry, cell biology, electronics and sensor technology, process engineering) and get familiar both with basic research as well as with application-oriented research and development.

### NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF 10/30

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS) 15/30

### KEY RESEARCH EQUIPMENT

#### LIST OF DEVICES

- FACS (Coulter Cytomix FL500; Beckman Coulter)
- Particle Size Distribution Measurement (Mastersizer 2000; Malvern Instruments)
- HPLC (Waters) plus UV- and fluorescence detectors
- Mastersizer 2000 (Malvern Instruments)
- Hitachi 902 Automatic Analyzer (Roche)
- ELISA microplate readers
- Fluorescent microscope, live cell imaging
- Luminex Bead Array (Biorad) for quantification of cytokines
- Coulter Counter for quantification of blood cells

### MAIN PROJECT

- **1999-2005:** Christian Doppler Laboratory for Specific Adsorption Technology in Medicine

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- **2000 – ongoing:** Development of systems for extracorporeal blood purification (funded by Fresenius Medical Care, Federal Government of Lower Austria, Christian Doppler Society)
- **2006-2010:** Proof of principle for the enrichment of circulating tumor cells from a large blood volume (funded by EU FP6)
- **2006-ongoing:** System for regional citrate anticoagulation (funded by Federal Government of Lower Austria)
- **2009 – ongoing:** Development of a wearable artificial kidney (funded by EU FP7)
- **2007-ongoing:** Cell culture models for endothelial activation in sepsis (funded by Austrian Research Promotion Agency FFG)

#### ACHIEVEMENTS

- Patents and publications: see [\[ LINK \]](#)

- Young investigator award of the European Society for Artificial Organs (1996, 2002, 2009)
- Scientific Award of Lower Austria (2009)
- Erwin Pröll Future Award (2000)
- Emil Bücherl Silber (2011)

#### MAIN COLLABORATING PARTNERS

##### COLLABORATION WITH ACADEMIC PARTNERS

- Technische Universität Dresden (Institut für Holz- und Pflanzenchemie, Prof. Steffen Fischer)
- University of Brighton (Prof. Sergey Mikhalovsky)
- Medical University of Vienna (Transfusion Medicine)
- Institute of Biocybernetics and Bioengineering" - Polska Akademia der Wissenschaften (Warsaw/ Poland)
- Bioengineering Unit / Strathclyde University (Glasgow / UK)

##### COLLABORATION WITH COMPANIES

- Fresenius Medical Care, Bad Homburg, Germany
- Dow Chemical (Rohm&Haas), Frankfurt, Germany
- Arthro Kinetics, Krems, Austria
- Polymerics GmbH, Berlin, Germany

#### EXPECTATIONS

##### REQUIREMENTS

- Partners for research projects in the field of medical biotechnology and regenerative medicine
- Collaboration with industrial partners in common projects dedicated to applied science (keywords see above)

##### OFFERS

- Partnership in international projects



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## DEPARTMENT OF BIOLOGY

/ FACULTY OF MEDICINE  
/ MASARYK UNIVERSITY

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### 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

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- 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: 02/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) Department of Biology / Faculty of Medicine / Masaryk University
- Palacky University, Olomouc; Modelling cancer in stem cells and mice; Dr. Vladimír Divoký (Olomouc, CZ)
- Institute of Biophysics, Academy of Sciences of the Czech Republic; Wnt, FGF and STAT signaling; Dr. Vítězslav 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)
- Università degli studi 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)

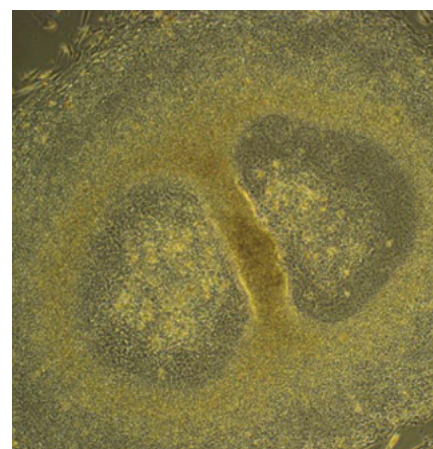
## EXPECTATIONS

### 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 proteinprotein 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



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# DEPARTMENT OF BIOPHYSICAL CHEMISTRY AND MOLECULAR ONCOLOGY

/INSTITUTE OF BIOPHYSICS  
/ACADEMY OF SCIENCES OF THE CZECH REPUBLIC



## RESEARCH GROUP CONTACT

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## 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 neurodegenerative disorders
- Principles of electrochemical and other physico-chemical and biophysical experimental methods

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## 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 (Göttingen, DE)
- University of East Anglia, School of Biological Sciences (Norwich, GB)
- Université 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, Comenius University (Bratislava, SK)
- Department of Nanoengineering, University California San Diego (La Jolla, CA, US)

### COLLABORATION WITH COMPANIES

- HVM PLASMA (Prague, CZ)

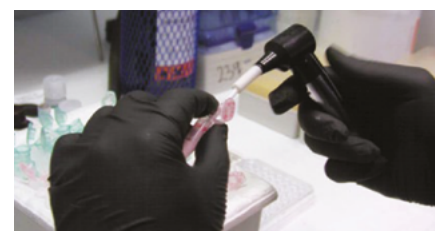
## EXPECTATIONS

### REQUIREMENTS

- Cooperation with companies

### OFFERS

- Adaptation of basic research products for practical applications



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# DEPARTMENT OF FREE RADICAL PATHOPHYSIOLOGY

/ INSTITUTE OF BIOPHYSICS OF THE ASCR  
/ ACADEMY OF SCIENCES OF THE CZECH REPUBLIC

## RESEARCH GROUP CONTACT

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### HEAD

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## 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

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

5

**PART OF THE TOTAL BUDGET FROM FOREIGN SOURCES (%)**

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 physiology (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, Furmüller 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<sub>2</sub> 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



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# INSTITUTE OF BIOSTATISTICS AND ANALYSES

/ FACULTY OF MEDICINE AND THE FACULTY OF SCIENCE  
/ MASARYK UNIVERSITY

## RESEARCH GROUP CONTACT

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## 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.

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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, intermetallics 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., Mařecek, 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

- 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**

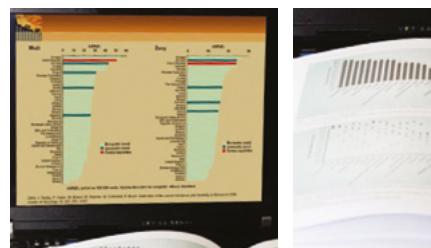
Our institution provides related services, especially in the field of biological and clinical data analysis, organization and management of clinical trials, software development and ICT applications.

**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)



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# LABORATORY OF CELL DIFFERENTIATION

/ INSTITUTE OF EXPERIMENTAL BIOLOGY  
/ FACULTY OF SCIENCE / MASARYK UNIVERSITY

## RESEARCH GROUP CONTACT

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## 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 Immunosorbent 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

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- 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

#### ACHIEVEMENTS

- 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 Molecular 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, knockout 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



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# 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

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## 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. EP0 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 realtime PCR, preparation of both transcriptional and translational fusions of gene-specific promoters and/or gene coding sequences with the reporter genes, transgenesis, 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

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**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**

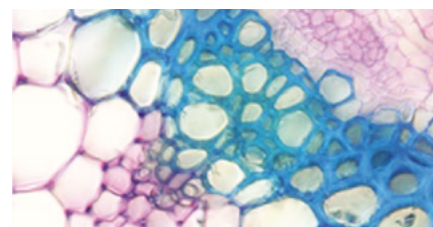
- Oseva Research and Development (Opava, CZ)
- Crop Research Institute (Prague, CZ)

**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



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# 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

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## 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. STUDENT )

10

## KEY RESEARCH EQUIPMENT

### LIST OF DEVICES

#### Instrumentation for spectral analysis:

- Microtitration plate readers
- Spectrophotometers
- Spectrofluorometer
- 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 E J, Xiao Q, Krejci L, Lohman T M, 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.

#### OFFERS

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

#### 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

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# LOSCHMIDT LABORATORIES

/ DEPARTMENT OF EXPERIMENTAL BIOLOGY  
/ FACULTY OF SCIENCE / MASARYK UNIVERSITY



## RESEARCH GROUP CONTACT

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## 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 harmful 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
- Spectrophotometer Ultrospec 1000, Pharmacia Biotech, Sweden
- Spectropolarimeter 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 Alcalá (Alcalá, ES)
- University Groningen (Groningen, NL)

## COLLABORATION WITH COMPANIES

- ANF Data – Siemens (CZ)
- Bio-Product (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 postdocs and doctoral students



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# MEDICINAL CHEMISTRY

/ DEPARTMENT OF CHEMISTRY

/ FACULTY OF SCIENCE / MASARYK UNIVERSITY



## RESEARCH GROUP CONTACT

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## 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 - Reintegration Grants, European Commission 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 cyclindependent 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



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# NATIONAL CENTRE FOR BIOMOLECULAR RESEARCH

/ FACULTY OF SCIENCE  
/ MASARYK UNIVERSITY



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## THEMATIC RESEARCH FOCUS

### RESEARCH AREA

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

### 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, glycobiology, 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 acids
- Computational 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

#### Glycobiology

- Structure-functional studies of prokaryotic and eukaryotic glycosyltransferases

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- 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

- Homologous 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, antitumour 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 proteinligand 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

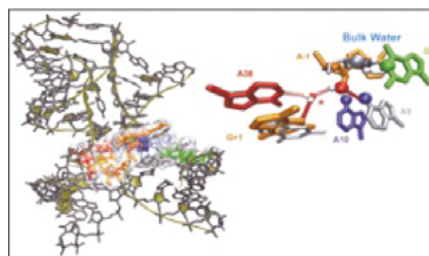
##### JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

82

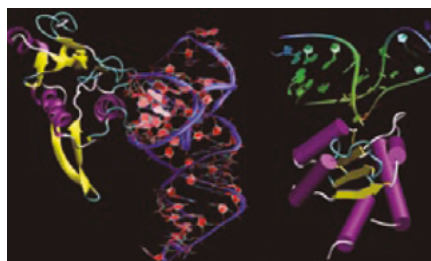
#### COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING

##### 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



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



**Figure 2** Detail of active site

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.

##### 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.



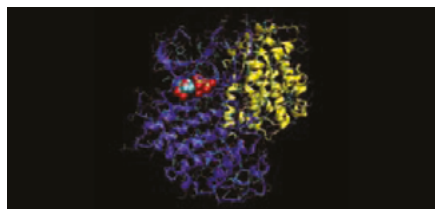
**Figure 3** The structure of PA-IIL saccharide binding site

##### 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



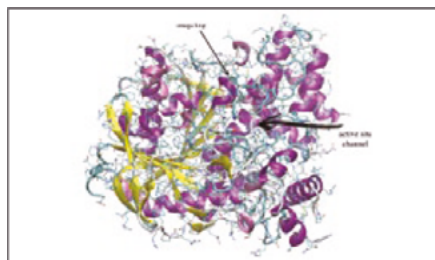
interactions between proteins and their substrates or solvent molecules.



**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.

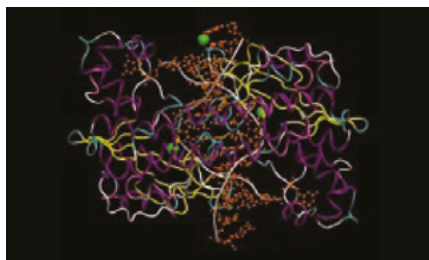


**Figure 5** The structure of acetylcholinesterase enzyme.

#### 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.

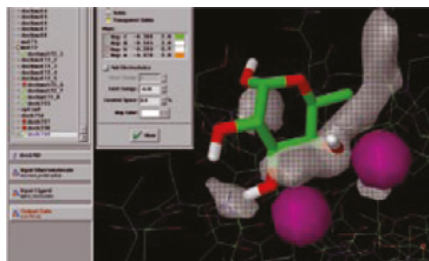
We want to describe the structure of the complex to provide detailed view of the active site and relationships in it and to bring some ideas about the structure of the active site and possible role of the ions in it.



**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 initio 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,

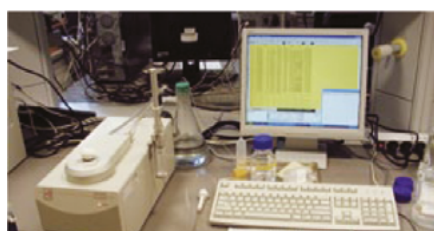
there exist a plethora of structural motifs different from the regular double helix. The structures of d(C4G4) and d(G4C4) duplexes and d(GCGAAGC) hairpin were among those solved in our laboratory. Measurement of nuclear spin relaxation by NMR spectroscopy is a powerful approach for studying intramolecular 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.

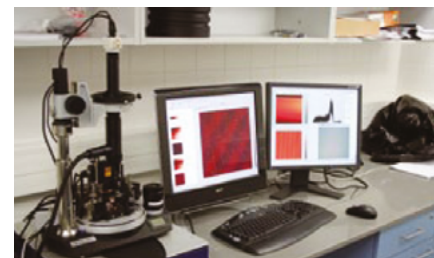


**Figure 8** Structure of PA-IIL lectin complex with fucose

### 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.



**Photo 4** Atomic force microscope (AFM)

#### 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.

### DNA/RNA RESEARCH

#### HOMOLOGUES 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
- Differential 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)
- Biovendo (Brno, CZ)
- Bruker (DE)
- Polymer Institute (Brno, CZ)
- Contipro Group (Dolní Dobruška, 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



# NEUROBIOLOGY RESEARCH GROUP

/ FACULTY OF NATURAL SCIENCES

## RESEARCH GROUP CONTACT

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[ [www.ttk.nyime.hu/neurobiology](http://www.ttk.nyime.hu/neurobiology) ]

### HEAD

ZSOLT KOVÁCS, PH.D.

### PHONE

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## THEMATIC RESEARCH FOCUS

### RESEARCH AREA

- Nucleosides in the brain
- Epilepsy research
- Absence epilepsy
- Neuroimmunology
- Neurobiology
- Pharmacology
- In vitro systems
- Neuronal signalling

### EXCELLENCE

- Nucleoside pharmacology
- Absence epilepsy research
- Pharmacology of absence epilepsy
- In vivo electrophysiology
- Development of in vitro cell-based drug screening platforms

### MISSION

Continue the development of internationally recognized research programs in the field of neurobiology, concentrating on the field of pharmacology of absence epilepsy and neuronal signalling mechanisms. Develop industrial collaborations concerning drug development and functional drug screening platforms. Create highly competitive graduate and postgraduate teaching programs in neurobiology.

## DEVELOPED TECHNOLOGIES

### CONTENT OF RESEARCH

- Clarification and characterization of function, metabolism and distribution of nucleosides in the brain.
- Pharmacological characterization of absence epileptic seizures in the WAG/Rij rat model.
- Characterization of the effects of inflammation on absence epileptic seizures.
- Development of patterned neuronal networks for drug screening applications.

## MAIN CAPABILITIES

We have built three laboratories at the University of Western Hungary and standardized several

methods for the last couple of years. Our main capability is our in vivo electrophysiology laboratory together with our breeding colony of WAG/Rij rats. We routinely record EEG from freely moving rats and perform pharmacological experiments. We also established an in vitro electrophysiological and a molecular biology laboratory. Our other important capability is our network of collaborators.

## FIELDS OF RESEARCH RESULTS APPLICATION

- Pharmaceutical industry
- Pharmaceutical
- Biotechnology

## ALUMNI PROFILE

- Neuroscience
- Electrophysiology
- Pharmacology
- Physiology
- Biotechnology
- Laboratory technology
- Molecular biology

## NUMBER OF RESEARCH POSITIONS

### SENIOR RESEARCH STAFF

3

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

1

## KEY RESEARCH EQUIPMENT

### LIST OF DEVICES

- Complete labs:
- In vivo EEG lab (multi-channel extracellular amplifiers, CED 1401 data acquisition systems, isoflurane anesthesia system, Stoelting stereotaxic apparatus, WPI microdialysis pump)
- In vitro extracellular electrophysiology lab (David Kopf electrode puller, CED 1401 data acquisition system, 3D mechanical and motorized manipulators)
- Histology (cryostat, wax embedding system, microtomes, epifluorescent microscope)



- Molecular biology (PCR, gel electrophoresis, gel imaging, cytofluor fluorescent plate reader)

#### BUDGET

##### TOTAL (MIL. CZK/ MIL. EUR)

0.1 mil. € (2010)

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

0 %

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

50 %

#### MAIN PROJECTS

- Metabolism and distribution of nucleosides in the brain.
- Pharmacological characterization of absence epileptic seizures in the WAG/Rij rat model.
- Patterned neuronal networks for drug screening applications.

#### ACHIEVEMENTS

- Kovács, Zs., Juhász, G., Palkovits, M. and Kékesi, K.A. [2011] Area, age and gender dependence of the nucleoside system in the brain: a review of current literature. *Curr. Top. Med. Chem.* 11:1012-1033.
- Kovács, Zs., Dobolyi, A., Juhász, G., Kékesi, K. A. [2010]. Nucleoside map of the human central nervous system. *Neurochem. Res.* 35:452-464.
- Kovács, Zs., Czurkó, A., Kékesi, K. A., Juhász, G. [2010]. Clomipramine increases the incidence and duration of spike-wave discharges in freely moving WAG/Rij rats. *Epilepsy Res.* 90, 167-170.
- Kovács, Zs., Kékesi, K. A., Szilágyi, N., Abrahám, I., Székács, D., Király, N., Papp, E., Császár, I., Szego, E., Barabás, K., Péterfy, H., Erdei, A., Bártfai, T., Juhász,

G. [2006]. Facilitation of spike-wave discharge activity by lipopolysaccharides in Wistar Albino Glaxo/Rijswijk rats. *Neuroscience* 140:731-742.

- Keller-Pinter A, Bottka S, Timar J, Kulka J, Katona R, Dux L, Deak F, Szilak L [2010]. Syndecan-4 promotes
- cytokinesis in a phosphorylation-dependent manner. *Cell Mol Life Sci.* 67:1881-94.
- Varghese, K., P. Molnar, M. Das, N. Bhargava, S. Lambert, M.S. Kindy and J.J. Hickman [2010] "A new target for amyloid beta toxicity validated by standard and high-throughput electrophysiology," *PLoS One* 5:1

#### MAIN COLLABORATING PARTNERS

##### COLLABORATION WITH ACADEMIC PARTNERS

- Department of Physiology and Neurobiology, Eötvös Loránd University (ELTE) (Budapest, HU)
- Proteomics Research Group, ELTE (Budapest, HU)
- Institute of Anatomy I., Semmelweis Medical University (Budapest, HU)
- Department of Neurochemistry, Research Institute of Chemistry, Hungarian Academy of Sciences, (Budapest, HU)
- Department of Neurosurgery, Markusovszky Hospital (Szombathely, HU)
- Department of Physiology, Anatomy and Neurobiology, University of Sciences (Szeged, HU)
- NanoScience Center, University of Central Florida (Orlando, US)
- Department of Biomedical Engineering Cornell University (Ithaca, US)
- Department of Informatics and Mikrosystemtechnics, University of Applied Sciences (Zweibrücken, DE)
- Biological Research Center (Szeged, HU)
- Institute of Experimental Medicine of the Hungarian Academy of Sciences (Budapest, HU)

#### EXPECTATIONS

##### REQUIREMENTS

Common research interest, complementary tools and methodology, stimulating joint research projects.

##### OFFERS

Our projects and methodologies, our experience and skills in scientific research, involvement in drug development for pharmaceutical companies.



09/2011

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