The University of Pécs as the largest higher education institution of the region has become a knowledge industry factor by today. It aims to find creative and useful solutions for current challenges and to play an initiative role in the progressive knowledge-building processes.

With the establishment of the János Szentágothai Research Centre the decade-long gap has been filled that existed in the scientific life of the South Transdanubia Region. The institute concentrates the previously fragmented research potential around the health industry and environment industry defined in the Pólus programme and it supports the sustainability of human life with research-developmental activity. It provides a region-wide unique, high-level background of instruments and knowledge and also modern laboratories.

Nevertheless we are not only talking about a building complex made with innovative technologies, or about modern instruments and laboratories, but rather about an institution integrated into the R+D+I strategy of the University that means a great opportunity for breakthrough for the next decade. Our aims are to develop innovative activity of medical-biology, natural-science and information-technology, to fit research profiles to economic and social demands, to encourage cooperation and to provide a wide-range of services.

We would like to actuate our Research Centre according to the disciplines of János Szentágothai which provides excellent conditions for constructive, thoughtful and creative people.

We are grateful to our partners and colleagues for their cooperation during the preparation and execution of this development.

Dr. József Bódis
Rector of the University of Pécs

Dr. Gábor L. Kovács
Chairman of the Research Centre
LEADER OF THE RESEARCH GROUP: Dr. Péter Balogh

FIELD(S) OF RESEARCH:
**Immunology & Developmental biology**
1. *Development of peripheral lymphoid organs*
   In our studies we investigate structural components and developmental regulators in spleen and gut which may be involved in the lymphoid neogenesis associated with chronic inflammations and the progression of lymphoid malignancies.
2. *Investigations on B-cell homeostasis*
   According to their origin, B cells responsible for antibody production can be assigned to distinct subsets, which subpopulations exert diverse roles in the immunological protection of the individual. The purpose of our studies is to identify those tissue mediators that direct the distribution and tissue survival of different B cells.

PRODUCT(S) AND SERVICE(S):
- Production and characterization of monoclonal antibodies in cellular and molecular immune assays
- Phenotypic analysis of human and mouse lymphoid cells, establishment and characterization of chimeric and transgenic animals.

SPECIAL SERVICES, LABORATORY:
- Tissue culture laboratory
- Immunoserology equipment
- Multiparameter flow cytometry
- Fluorescence microscopy
REFERENCES:
IBL rat monoclonal antibody series against mouse lymphoid antigens

SELECTED PUBLICATIONS


LEADER OF THE RESEARCH GROUP: Prof. Dr. Júlia Szekeres

FIELD(S) OF RESEARCH:
Identification of regions of the PIBF molecule which are responsible for tumour growth and maintenance of pregnancy: The Progesterone Induced Blocking Factor (PIBF) is expressed in pregnancy and following development of malignant tumours. Due to its immunological effects it contributes to the maintenance of normal pregnancy and tumour growth. A diagnostic method based on the detection of PIBF could be useful in the prognosis of early spontaneous abortion, or in monitoring the success of therapy. Substitution of PIBF could be used for prevention of early spontaneous abortion. On the other hand, neutralization of the biological function of PIBF might slow down the growth of malignant tumours.

Isolation and characterization of the PIBF receptor: We are planning to isolate and characterize the receptor. Monoclonal and polyclonal antibodies will be produced against the purified receptor. The antibodies will be used to map tissue localization of the receptor, and to detect the soluble receptors in sera of pregnant women and cancer patients. The significance of the soluble receptor is that it binds PIBF, so preventing it from binding to its membrane-bound receptor and exerting its biological function. We are also going to use the antibodies for cloning and sequencing the receptor. Knowing its sequence, we shall design PIBF antagonists.

The role of PIBF in regulation of invasion: Both trophoblasts and malignant tumours have invasive tendencies, but, while the invasion of tumours are seemingly out of control, invasion of the trophoblast is under tight spatio-temporal regulation. In the first trimester of pregnancy, the trophoblast expresses a protein, PIBF, which transmits numerous effects of progesterone. Expression level of PIBF in a tissue is inversely correlated with the invasive tendency of that tissue. Our aim is to investigate how PIBF regulates trophoblast and tumour invasion. Invasive characteristics of PIBF gene-silenced and PIBF treated trophoblast and tumour cell lines will be compared. Signalling pathways regulating invasiveness will also be investigated. We shall study whether PIBF induces proteins which can effect regulation of invasiveness in tumour and trophoblast cells.
PRODUCT(S) AND SERVICE(S):
- PIBF assay,
- cytokine assay

SPECIAL SERVICES, LABORATORY:
- Fluorescent cell sorter,
- nucleofector,
- real time PCR luminometer,
- centrifuges,
- laminar boxes,
- CO₂ incubators
LEADER OF THE RESEARCH GROUP: Prof. Dr. Judit Pongrácz

FIELD(S) OF RESEARCH:
The main interest of the research group is to investigate the role of Wnt signal transduction in ageing processes of the thymus and the lung. Wnt signaling plays an important role not only in the physiology of ageing, but also in age associated diseases, like tumors and inflammation.

PRODUCT(S) AND SERVICE(S):
Recombinant viruses, transgenic animals, cloning of full and partial gene sequences, preparation of vectors, inducible vectors, preparation of complex tissue models - thymus, lung, liver, etc. - tissue interaction studies

SPECIAL SERVICES, LABORATORY:
– PCR (traditional and quantitative)
– Nanodrop
– ELISA reader
– LAS4000 protein analyser
– Bio-Rad
REFERENCES:


The role of PARP-1 in MPK-1 expression and MAPK pathway activation in oxidative stress. Although PARP-1 is an enzyme found in the nucleus, it affects pathways originating from the cytoplasm, and mitochondria. The length of strands made up of ADP-ribose units catalyzed by PARP-1 can consist of only a few units up to 200 units, which can be disassembled quickly by poly(ADP-ribose) glycohydrolyze (PARG). ADP-ribose units are able to enter the cytoplasm and initiate mitochondrial depolarization, which induces the emission of apoptosis induction factor (AIF) as a result of oxidative stress. Studies show that nuclear PARP-1 induced ADP-riboslation and ADP-ribose units form contact with the nucleus, cytoplasm, mitochondria and cell receptors, however there is little information regarding the mechanisms behind this.

During our research we inhibited PARP-1 enzyme with specific inhibitors, with the help of PARP1 siRNA technology, which resulted in the inhibition of MAP kinase. Our results proved that PARP-1 activated by free radicals regulate the activation of JNK and p38 MAP kinase. The inhibition of JNK and p38 MAP kinase was affected by the elevated levels of cytoplasmic MKP-1, which was induced by PARP-1 inhibition as a result of oxidative stress. Further results showed that as a result of the inhibition of MPK-1, the inhibition of the protective effect of PARP-1 disappeared, which shows the importance of JNK and p38 MAP kinase in oxidative stress induced cell death, and furthermore the protective effect of the elevated levels of MPK-1 on PARP-1 inhibition. Our results suggest that through the regulation of proteins, nuclear PARP-1 can directly affect mechanisms transmitted towards the cytoplasm.

The role of poly-ADP-ribose polymerase (PARP-1) in cardiovascular regeneration. The activation of PI3K-Akt pathway has an important role in myocardial regeneration, earlier data shows that the inhibition of PARP enzyme activates PI3K-Akt pathway, and protects the cells from the induction of mitochondrial cell death, thus these processes play an important roles in regeneration.

As a model for chronic heart damage we used hypertensive rats, we examined the effect of PARP inhibitor compounds on heart function and regenerative processes.
PRODUCT(S) AND SERVICE(S):
- Patents, protocols, collaboration research
- Mass spectrometry and chromatography readings
- Proteomic methods

SPECIAL SERVICES, LABORATORY:
- HPLC, nanoLC, UHPLC, MALDI-TOF/TOF, ESI(APCI)-IT MS, ESI(Chip)-QQQ MS, NMR/μMRI
- Cell culture laboratory
- Fluorescence microscope
- Flow cytometry studies
- Proteomic studies

REFERENCES:
- Richter Gedeon zRt., mass spectrometry proteomic studies, development of protein database (2009)
- Ngene, mass spectrometry proteomic studies, protein database, conference lectures, publications
- Bionorica (Germany), LC-MS analytical studies, publications (2008)
- Polgár Bor Kft., LC-MS analytical and biochemical studies, conference lectures, publications
- Bock Kft. LC-MS analytical and biochemical studies, conference lectures, publications
LEADER OF THE RESEARCH GROUP: Dr. László Márk

FIELD(S) OF RESEARCH:
Qualitative and quantitative mass spectrometric investigation of proteins, peptides and other bioactive compounds. Imaging mass spectrometry. Pathological biomarker discovery. Analysis of neuropeptides.

PRODUCT(S) AND SERVICE(S):
Mass spectrometry and chromatography readings, bioinformatics data analysis.

SPECIAL SERVICES, LABORATORY:
**Mass spectrometry:** Bruker Autoflex II MALDI-TOF/TOF, Bruker Autoflex Speed MALDI TOF/TOF Imaging MS, Thermo AQA Single Quadrupol MS, Bruker HCT iontrap MS, Thermo Scientific Q-Exactive, Bruker Maxis 4G UHR Q-TOF, Bruker Maxis 2G ETD UHR Q-TOF, Bruker Amazon ETD Iontrap MS
ionsources: ESI, nanoESI, APPI, APCI, MALDI
**Separation techniques:** Dionex HPLC, Dionex Ultimate 3000 microHPLC, Proxeon Easy nanoLC, Waters nanoAcquity UHPLC
**Other:** Hamilton MiroStarlet robot, Eppendorf robot, Biorad 2D gelectrophoretic and DIGE systems, gelscanners

REFERENCES:
Scientific papers, cooperations with hungarian and international companies and academic institutions.
Our workgroup proved previously that pharmacological inhibition of PARP-1 enzyme influences cellular functions in many ways beyond its NAD+-sparing effect. PARP-inhibitors also have a direct mitochondrial protective effect preserving the function of respiratory chain complexes. Moreover it has been shown in a growing number of biological systems that NAD utilizing protein ADP-ribosylation processes can modulate the activity of important signaling processes. PARP inhibition could therefore influence various intracellular signaling routes beneficially, further contributing to the cardioprotective effect of these agents. PARP-1 inhibitors have beneficial effects on various signaling mechanisms that play an important role in the development of myocardial remodeling and heart failure. The pivotal role of the prosurvival PI3K/Akt-1/GSK-3β signaling pathway in the mode of action of PARP-inhibitors was demonstrated in Langendorff-perfused rat hearts. The beneficial effect of PARP inhibition on the mitogen activated protein kinases (MAPK) was also demonstrated in an in vivo myocardial infarction model. Because of these favorable effects of PARP inhibition on oxidative cell injury and on several signaling factors, we have investigated its effect on morphological and functional changes and on the activity of signaling pathways in various experimental cardiovascular remodeling and heart failure models.
**Effect of PARP-inhibitor treatment in various experimental heart failure models**
We evaluate the effect of PARP-1 inhibition on various heart failure models (post-infarction, chronic elevated afterload (hypertension) induced, toxic heart failure). In these works we examine morphological and functional changes of the heart as well as the activity of signaling molecules playing role in the pathogenesis of mal-adaptive hypertrophy (PKC-?-?, PKC-?, JNK, p38-MAPK). The activity of prosurvival signaling factors (e.g. Akt-1/GSK-3?, PKC-?, ERK1/2) will also be studied.

**Effect of PARP-inhibitor treatment on the hypertensive cardiovascular remodeling**
We evaluate the effect of PARP-1 inhibition on the chronic hypertension induced cardiovascular remodeling. The structural alterations caused by chronically elevated blood pressure (left ventricular hypertrophy, increased wall thickness of great arteries), mainly due to increased collagen accumulation, will be examined. The activity of signaling factors playing part in the development of fibrosis (MKP-1/MAPKs; TGF-?/Smad) will also be measured.

**Examination of cardiovascular effects of experimental compounds**
A novel analgesic, bradykinin B1 receptor antagonist was already studied in the chronic hypertension model. In contrast to the widely used anti-inflammatory drugs, the tested compound had a mild beneficial effect against the development of target organ damages. In this work the inhibition of TGF-? and Smad2 signaling pathway may be the potential mode of action.

**Cell culture and isolated organ perfusion experiments**
We examine the role of modulation of intracellular signaling pathways (RISK and SAFE) in a cardiomyocyte cell culture and in an isolated working heart model.

**PRODUCT(S) AND SERVICE(S):**
- Small animal ultrasound examinations
- Protocols, collaboration research

**SPECIAL SERVICES, LABORATORY:**
- Chronic in vivo animal models
- Small animal ultrasound laboratory
- Isolated working rat heart model
- Langendorff- perfusion equipment

**REFERENCES:**
- Richter Gedeon zRt. Cardiovascular evaluation of a novel analgetic compound
LEADER OF THE RESEARCH GROUP: Prof. Dr. Béla Melegh

FIELD(S) OF RESEARCH:

- Our parent department, the Department of Medical Genetics at the Medical Faculty plays central role in the research of Rare Diseases in Hungary. This disease group means a great scientific challenge as well, besides verification of mutations of already known genes, as even new genes can be annotated with the study of this unique population, or a new phenotypic variation of an already known disease can also be discovered; we included this era into our research conducted here. As part of this disease group, we are also interested about the "genomic diseases", where the pathology of the genome is involved, including non-coding sequences either, rather than a simple or complex mutation of a gene. Our array reader facility provide an excellent tool for the investigation of this topic.

- As the coordinating department of the National Biobank Network, we have recognized Biobank collection of diseases affecting large populations and ethnic groups as well. These collections supply us with useful DNA collections suitable for susceptibility gene research as well, having importance in relation with diseases affecting large populations.

- As a part of the personalized medicine paradigm (or P4 medicine) the research of pharmacogenetically relevant genes and the practical implementation of the results is one of the most important elements of drug choice based on genetic variability. Within the SB project we already involved in drug research and drug development projects, but at the same we also involved in characterization of selected major metabolizing systems. Such approaches enabled us to investigate pharmacogenetic features of Roma people as well.

- Recently, we are also involved in population genetic investigations, including research of Hungary living ethnic groups.
PRODUCT(S) AND SERVICE(S):
- Diagnostics
- DNA sequencing
- CGH array
- Carnitine-ester profile analysis

SPECIAL SERVICES, LABORATORY:
- ABIPRISM 3500 DNA Sequencer
- Agilent Microarray Scanner
- Micromass Quattro Ultima QQ mass spectrometer
- Bio-Rad Chromo4 real-time machine
- Roche Lightcycler real-time machine
- Roche 454 GS Junior

REFERENCES:


The goal of this long term program is to promote the development of non-invasive diagnostic devices for the clinic. Clinical diagnostics has entered the era of miniaturization: functional micro-laboratories have been developed on chip performing a broad range of analytical assays. Special interest is focused on devices for point-of-care analysis and life science (cell analysis), with future prospects towards personalized medicine.

Investigation of biomarkers in culture medium during in vitro fertilization

Infertility affects a relatively high percentage of the mature population leading to an increasing need to the use of assisted reproductive technologies, and in vitro fertilization (IVF). The rate of successful embryo implantations however is surprisingly low, not more then the 30% of the total number of IVF experiments. Worldwide huge efforts are made to select the possibly most viable embryos using morphological or more recently molecular markers to increase the success rate of IVF experiments. The aim of our research group is to find and quantitate such markers in the embryo culturing media to assess embryo viability prior the transfer. The discovery phase of our research involves the use of liquid chromatography coupled mass spectrometry (LC-MS) but the ultimate goal is the development of a diagnostic chip which can be routinely used in IVF centers.
FIELD(S) OF RESEARCH:
– **Angiogenesis in vitro and in vivo:** Due to the increasing aging of the western population and due to increasing survival of diabetics, the prevalence of atherosclerotic disease is increasing. A promising approach to deal with this problem is tissue engineering.

**In vitro: Tissue engineering of small-caliber blood vessels**
Specific blood vessel cells are cultured on porous biodegradable tubular structures. After in vitro formation of a blood vessel equivalent and degradation of the scaffold material, the engineered blood vessel is implanted to replace the diseased artery.

**In vivo: Autologous stem cell therapy for peripheral arterial disease**
Angiogenesis could be induced with autologous transplantation of bone-marrow cells in patients with end stage chronic limb ischemia. We hypothesize that the direct delivery of mononuclear cells in the capillary bed of the ischemic tissue itself in combination with local delivery of angiogenic proteins might improve the results.

**In vitro fertilization**
The success rate of in vitro fertilization is very low, not more than 30% despite the huge effort made worldwide to increase this ratio. Our research group in collaboration with the Department of Obstetrics and Gynaecology, the Department of Medical Biochemistry and the Department of Medical Microbiology and Immunology is working on the detection of cell culture medium biomarkers to predict the future success of fertilization. The research covers the use of immuno-assays, real-time PCR, and mass spectrometry.

PRODUCT(S) AND SERVICE(S):
Annexin V assay to measure apoptosis

SPECIAL SERVICES, LABORATORY:
– Flow cytometry,
– Liquid chromatography tandem mass spectrometry (LC/MS/MS),
– Clean-room,
– microfluidic
Popular views classify microbes either as a good or bad guys, however these phenomenon imply very complex processes in reality. It is no exaggeration to say that to understand host-microbe-environment interactions at the level of biological complexity is one of the greatest challenges in biology. Recently genomics, proteomics, high-throughput microarray and next-generation sequencing (NGS) technologies have extended our ability to provide new insight into the molecular basis of these fundamental questions.

As the problem of antimicrobial resistance becomes more widespread, the need for new anti-infective agents is more urgent than ever. As a part of these efforts, massively parallel NGS technologies provide a tremendous ability to typify microbes, not only on the basis of readily observable characteristics, but also upon their genetic (biosynthetic) potential.

In respect of the clinical needs, on the bases of our ongoing microbial whole genome shotgun sequencing (WGS) project, we designed strategy and workflow to isolate new microbial natural products (e.g. antimicrobials) and screening for potential producing microorganisms. It is important to highlight the fact that the lack of genome sequence information in non-model species often limits the downstream scientific activities, such as engineering microbial metabolic pathways. We hope that our structural genomics efforts will form a foundation for the subsequent research steps, like intelligent drug design, identification of new pathogenicity factors and target discovery etc.

State of art genomics approaches provides revolutionary tools with numerous applications, which can address different questions in almost all aspects of biological research. Nevertheless, one of the major challenges biologists are facing today is to understand and be able to interpret the functional complement (transcriptome, proteome) of the genome, which is a dynamic link between genotype and complex phenotype. Based on the assumption of one technology being able to standalone does not suffice for gaining a comprehensive understanding of any complex biological process. Therefore we intend to use complementary approaches i.e. transcriptomics (RNA-seq, microarray) and proteomics (2D PAGE) for developing molecular diagnostic methods to identify drug-, toxicant- and disease-related biomarkers.

Due to the broad range of microbial model systems formally used, and extensive research experience in the fields of traditional and molecular-microbiology, the Microbial Biotechnology Group is ready to face challenges in health, industry and agriculture sectors of biotechnology.
PRODUCT(S) AND SERVICE(S):
- Polyphasic taxonomical characterization of microbes
- Development of nucleic acid based diagnostic tools
- Improvement of microbial strains and fermentation processes for the overproduction of industrial products
- De novo whole genome shotgun sequencing
- NGS-based transcriptome profiling

SPECIAL SERVICES, LABORATORY:
- BIOSTAT Q plus new generation Fermentor-Bioreactor system
- Next-generation and capillary sequencing platforms
- epMotion 5070 automated pipetting system
- FluorChem Q system for quantitative Western blot imaging
- Two-dimensional gel electrophoresis system
- Microfluidics-based Agilent 2100 Bioanalyzer platform for sizing, quantification and quality control of DNA, RNA, proteins
- Ultra-fast endpoint, gradient and real-time PCR
- Denaturing Gradient Gel Electrophoresis (DDGE) to detect single-strand conformation polymorphism (SSCP), heteroduplex analysis (HA), and protein truncation tests (PTT)
LEADER OF THE RESEARCH GROUP: Dr. Zsuzsanna Helyes

FIELD(S) OF RESEARCH:
Investigation of inflammatory and pain mechanisms. Analysis of the pathophysiological role of capsaicin-sensitive sensory nerve terminals, the released neuropeptides and neuro-immune interactions in several complex disease models. Identification of novel anti-inflammatory and analgesic targets and testing drug candidates in the following systems:
1. Arthritis models (K/BxN immune-mediated polyarthritis, carrageenin-induced acute monoarthritis, complete Freund's adjuvant-induced chronic polyarthritis, collagen- and collagen- antibody-evoked rheumatoid arthritis, iodoacetate-evoked chronic osteoarthritis)
2. Airway inflammation models (endotoxin-evoked non-allergic and house dust mite-induced allergic lung inflammation, ovalbumin-induced asthma, cigarette smoke-induced chronic bronchitis)
3. Skin inflammation models (oxazolone-induced allergic contact dermatitis/ psoriasis, bleomycin-induced scleroderma, irritant-evoked acute inflammation).
4. Chronic colitis models (dextrane-sulfate-induced chronic colitis)
5. Migraine and neuropathy models (traumatic mononeuropathy, diabetic polineuropathy toxic polineuropathy)

PRODUCT(S) AND SERVICE(S):
Integrative investigation of pathophysiological processes involved in acute or chronic inflammation, ortho- and heterotopic tumor models, and pain mechanisms with functional, morphological, immunological and in vivo imaging. Pharmacodynamic analysis of drug candidates.
SPECIAL SERVICES, LABORATORY:

In vivo Imaging Laboratory

1. **PeriCam PSI and PIM-II blood perfusion imagers** (Perimed): They are appropriate for imaging and measuring microcirculation non-invasively on surfaces (brain, skin, joints, etc.). PeriCam is based on the Laser Speckle Contrast Analysis (LASCA) technology to visualizes tissue blood perfusion in real-time providing new means to study the microcirculation by combining dynamic response and spatial resolution.

2. **Periflux 5000** (Perimed): The modular design enables the simultaneous monitoring of (laser Doppler) blood flow / perfusion and transcutaneous oxygen (TCOM, tcpO2) and/or carbon dioxide, heat provocation and pressure control.

3. **Nikon intravital videomicroscope**: with CCD camera and analysis software: for *in vivo* or ex vivo examination of microvascular properties of tissues and investigation of cellular components in blood, using either classical colorimetric (Evans blue extravasation assay) or fluorescent (Rhodamine) techniques.

4. **Skyscan 1176 in vivo mikro CT** (Bruker): appropriate for high-resolution 3D imaging of small animals (mouse, rat) in an non-invasive manner with or without contrast agents. Also suitable for ex vivo high resolution structural imaging of organic and inorganic samples.

5. **IVIS Lumina II optical imaging system** (PerkinElmer): *In vivo* and in vitro bioluminescence (BLI) and fluorescence (FLI) imaging allow monitoring gene expression of several structural proteins, enzymes, receptors and ion channels in living organisms. BLI utilizes light emitted by luciferase enzyme or chemiluminescent sensors, and FLI uses fluorescent proteins, labelled macromolecules, etc. for evaluating expression levels. These techniques greatly help our understanding of disease mechanisms and the development of new treatments.

6. **FMT-2000 Fluorescence molecular tomograph** (PerkinElmer): to measure, monitor and quantify biological targets (receptors, enzymes), processes and pathways in vivo in animal models of pathophysiological processes. Specific molecules can be visualized with dedicated fluorescence contrast agents in 3D and can be co-registered with a subsequent micro-CT scan to be able to determine the exact anatomical location of the observed functional changes.

REFERENCES:


http://www.perkinelmer.com/catalog/category/id/in%20vivo%20imaging

http://www.perkinelmer.com/pages/020/invivo/fmtquantitativetomography.xhtml

http://www.perkinelmer.com/catalog/category/id/ivis%20lumina%20series%20iii
LEADER OF THE RESEARCH GROUP: Prof. Dr. Gábor Jakab

FIELD(S) OF RESEARCH:
The molecular background of priming in plant stress responses.
The capacity of a plant to express induced resistance depends on multiple signal transduction pathways well adapted to support a plant's struggle in very defined host-parasite/stress situations. The emerging picture today is that priming accelerates and increases a plant's ability to induce the pathway best adapted to help it cope with a defined situation. Therefore, a plant's capacity for priming is an important ecological and agronomical parameter. Efficient priming mechanisms are likely to play a role in the adaptation of natural and agronomical plant populations to rapidly changing environmental conditions.

Gene silencing techniques in plants.
The structure and function of the plant snRNAs. Similarities and differences in the mechanisms of splicing of animals and plants. Characterization of the promoter of the snRNA genes in plants and their potential application in silencing constructs.

SPECIAL SERVICES, LABORATORY:
- Plant molecular biology laboratory facility for DNA and RNA extraction,
- gel electrophoresis,
- quantitative PCR,
- generation of transgenic plants.

REFERENCES:
- Priming might prove to be of special interest for agronomy concerning protection against biotic and abiotic stresses.
- The gene silencing techniques will allow us generating disease-tolerant grapevine plants using genetic engineering technologies.
Oncolytic viruses display selective cytotoxicity toward tumor cells, they are thus promising tools to fight against cancer. One of the well-characterized oncolytic viruses is the Newcastle disease virus (NDV), a virus pathogenic in birds but harmless for humans. The mechanism of cytotoxicity of an attenuated NDV strain (MTH-68/H) is studied by our research team.

MTH-68/H kills all human and rodent tumor cell lines that have been studied in our lab, while normal fibroblasts are resistant to the virus. Using PC12 rat phaeochromocytoma cells as a model system we found that MTH-68/H (I) replicates in these cells; (II) induces apoptotic cell death; (III) virus-induced cell death does not require the involvement of p53 protein; (IV) it is accompanied by a sustained activation of stress kinase pathways (JNK and p38 MAPK); (V) endoplasmic reticulum stress may play an important role in virus-induced cell death.

Since NDV-susceptibilities of tumor cell lines studied vary in a wide range, in order to predict the efficacy of oncolytic virotherapy, the identification of signaling proteins affecting NDV-sensitivity of tumor cells would be essential. To this end, PC12 subclones resistant to MTH-68/H cytotoxicity were isolated, and different phases of NDV infection (virus adsorption and internalisation, activation of MAPK pathways, interferon secretion, endoplasmic reticulum stress, apoptosis) are being studied in our lab. Identification of NDV susceptibility proteins may be facilitated by gene expression profiling that had been performed in MTH-68/H PC12 cells. Upon virus infection hundreds of genes were induced, while the expression of many other genes were reduced. The analysis of the significance of these gene expression alterations are currently underway.
SPECIAL SERVICES, LABORATORY:
Confocal laser scanning microscope.

REFERENCES:
The group's main research field is the monitoring of viral zoonoses (diseases caused by viruses spreading from animals to humans). Numerous agents of viral zoonoses are present also in Hungary, such as the tick-borne encephalitis virus, West-Nile Fever virus, and the less-known, yet equally dangerous hantaviruses. Due to the changes in environmental factors and the widening of human territories, viruses carried by animals are posing an ever-increasing healthcare and epidemiological threat. One of our aims is the detection, molecular and phylogenetic characterization of known and newly emerging viral pathogens parallel with the estimation of their prevalence and the better understanding of the infection mechanism. Our research subjects are primarily the local rodent populations, however we also put strong efforts into the survey of other important disease vectors, i.e. mosquitoes, ticks and additional arthropod species. A further main field of interest is the application of molecular virology and recombinant DNA techniques. The latter enables us to improve serology-based diagnostic tests, and opens an opportunity to vaccine development. With the advancement and widening of our diagnostic palette, we have established a solid contact and cooperation with medical practitioners, giving us the ability to follow the course and clinical characteristics of viral infections.
PRODUCT(S) AND SERVICE(S):
Isolation and molecular characterization of dangerous viruses.

SPECIAL SERVICES, LABORATORY:
Our research group utilizes a high-safety level BSL3 laboratory. Research equipment is up-to-date with the latest scientific and technological standards. Along with the traditional virology, microbiology (cell and tissue culturing, virus isolation) and molecular biology methods (recombinant DNA techniques, protein expression), we also comprise the tools for immunological tests (ELISA, IF staining).

REFERENCES:
LEADER OF THE RESEARCH GROUP: Dr. Ákos Koller

FIELD(S) OF RESEARCH:
Most human diseases are related directly or indirectly to changes in the circulatory system. Thus investigation of the physiological and pathological mechanisms regulating the function of the heart and blood vessels is of utmost importance. Acute and chronic changes in hemodynamic forces are important determinants of the structure and function of the heart and vessels. This laboratory aims to investigate the adaptation and remodeling of the circulatory system at the biomechanical, pathophysiological, pharmacological, molecular and genetic levels.

Many researchers consider oxidative stress as a critical, early step in the development of many cardiovascular diseases, such as ischemia, hypertension, diabetes and atherosclerosis. However, the stimuli and mechanisms responsible for the increased production of reactive species, inflammatory molecules and their role in the regulation of function and structure of cardiac muscle, arterial and venous vessels are still poorly understood.

The research design and methods used in CRG and collaborating laboratories will synthesize the knowledge generated by the experimental investigations to advance our knowledge on these issues in order to develop better treatments for cardiovascular diseases.

In addition, an important aim of CRG to train and educate young researchers on the field of the function and dysfunction of the circulatory system coming both from Hungary or other countries (Marie Curie, European Training Program: SMART, SMARTER).
SPECIAL SERVICES, LABORATORY:
- Microcirculation laboratory
- Video microscopes
- DMT multi-wire myograph system
- Isotonic myograph system
- Langendorff Isolated Rat Heart System

REFERENCES:


The limbic system plays a pivotal role in the maintenance of homeostasis and regulation of motivation, emotion, learning and memory processes. Our investigations aim to unravel new limbic forebrain neuronal and neurohumoral mechanisms of the central homeostatic control in healthy and disease state conditions using multidisciplinary approaches such as in vivo microelectrophysiology, combined behavioral-neurochemical paradigms, molecular biology, transgenic technology, immunohistochemistry and single molecule imaging. In addition to elucidate new regulatory processes and so far unknown pathomechanisms, we believe that our research approach enables us to identify new molecular targets in the brain and opens new avenues in development of novel lead compounds. We place particular emphasis on investigations exploring the effect of steroid hormones in the basal forebrain in physiological and neurodegenerative processes. In these experiments, we study the neuroprotective effect of estrogen in basal forebrain cholinergic neurons in Alzheimer's disease using single molecule detection microscopy and transgenic technology.
PRODUCT(S) AND SERVICE(S):
Development of novel in vivo microelectrophysiological and neurochemical examination techniques
Development of single molecule detection microscopy systems

SPECIAL SERVICES, LABORATORY:
Olympus fiber total internal reflection fluorescence microscope for single molecule detection

REFERENCES:
The focus of our research work is twofold. We use tools of molecular biology, histology, physiology, pharmacology as well as imaging to reveal elements and neuronal contacts of the retinal hyper-circuitry especially those containing electrical synapses.

We also examine the onset and progress of retinal degenerative disorders of metabolic origin by using animal models. We ask questions of how retinal pathologies develop, what kind of metabolic processes lead to cell death and which biochemical changes underlie the processes that finally lead to blindness. These studies will open avenue to prevent retinal degenerations by blocking pathological processes or to activate defense mechanisms in nerve cells. These approaches can lead to development of pharmacological tools (test existing drugs, modify formerly described molecules or create new ones).

- Retinal information processing
- Neuron degeneration
- Neuroprotection
PRODUCT(S) AND SERVICE(S):
Histological, molecular biological, electron microscopic and electrophysiological examination of transmitters and receptors; apoptosis detection and research of its mechanisms, Ca++-imaging.

SPECIAL SERVICES, LABORATORY:
- Molecular neurobiology lab
- Histological lab
- Intracellular electrophysiology lab
- Ca++-imaging lab
- Microtomes (both for light and electron microscopy)
- Stereomicroscopes
- Digital photomicroscope
- Western-blot apparatus
- Electrophysiological setup(s) (amplifiers, electrode puller, electrode positioning devices, resonance-free tables, AD converters).

REFERENCES:
Temporal lobe epilepsy (TLE) is one of the most common neurological disorders. A significant portion of cases do not respond to drug therapy, constituting a major decrease in quality of life for patients. During seizures, certain parts of the brain produce recurrent, over-synchronized brain rhythms, and typically the more the pathological oscillation spreads throughout the brain, the more severe the symptoms are. In temporal lobe epilepsy, seizures start in a brain region that is responsible for memory and navigation. Therefore, TLE patients also suffer from memory and navigation deficits, further emphasizing the need for new treatment strategies.

While much research on genetic and cellular factors underlying epilepsy is currently underway, fewer studies have investigated how the timing of activity in certain building blocks - the neurons - of the brain change in epileptic patients, especially before and during seizures. The scope of our research will be to learn how individual neurons change their rhythmic activities in epilepsy and importantly, how their connectivity is altered compared to healthy neuronal networks. Until recently, technical limitations prevented the collection of these data without disrupting the activity of individual cells with invasive measurements. It is critical to understand both the normal oscillatory activity of these brain areas and how certain neuronal cell types may suddenly convert these normal rhythms into an uncontrollable synchronous discharge pattern.

State of the art methods will be used in the laboratory in order to interrogate the roles of diverse neuronal types in seizure generation. The outcome of our research will potentially help to develop novel epilepsy treatment paradigms which intervene in seizure generation time specifically rather continuously like an oral medication, helping to decrease long lasting effects of medication on normal brain function.
LEADER OF THE RESEARCH GROUP: Prof. Dr. András Büki

FIELD(S) OF RESEARCH:
- Experimental neurotraumatotlogy:
  Investigation of traumatic brain injury (TBI) with the utilization of the impact acceleration head injury model - described by Marmarou et al. 1994 - and the fluid percussion head injury model - described first (for rats) by Dixon et al. 1987. Quantification of the impact of the injury involve in strong collaboration with many other research groups of the Centre - histological methods (immunohistochemistry; silver staining methods), functional tests, measurement of protein biomarker levels as well as neuro-imaging (MRI, microCT) techniques.
- Clinical studies in TBI:
  Development of a serum biobank with the serum of ~5 400 TBI subjects from ~80 sites across Europe as a part of the CENTER-TBI ('Collaborative European NeuroTrauma Effectiveness Research in TBI') consortium. Protein biomarker assays associated with the study. Construction and multiple targeted statistical analysis of the 'Pécs severe head injury database' with the inclusion of the clinical and outcome data of all sTBI subjects treated by the Department of Neurosurgery from the 1st of July 2002 - more than 400 consecutive cases.

PRODUCT(S) AND SERVICE(S):
- Physiologically monitorized experimental traumatic brain injury of rats and/or mice by impact acceleration or fluid percussion head injury models.
- Protein biomarker measurement from animal/human biofluids.
- Tissue preparation for silver staining/immunohistochemistry/electron microscopic investigations.

SPECIAL SERVICES, LABORATORY:
- Impact acceleration TBI model
- Fluid percussion TBI model
- Multiplate reader
- PCR

REFERENCES:
LEADER OF THE RESEARCH GROUP: Dr. István Hernádi

FIELD(S) OF RESEARCH:

Cellularis neurophysiology:  
Recording in vivo neuronal activity with microelectrodes in the rodent brain, iontophoretic application of neurochemicals, voltammetric detection of monoamine neurotransmitters.

Small animal behavioral physiology and psychopharmacology:  
Psychopharmacology of the brain reward systems in rodents. Implementation of the delayed reward choice paradigm in computer controlled formal (operant) behavioral apparatus.

Human psychophysiology:  
Psychophysiological and cognitive behavioral assessment of higher order brain functions such as perception, anticipation, reward devaluation, decision making. Recording behavioral and neurophysiological (EEG) correlates of somatosensory, auditory and visual stimulus identification and selection.
PRODUCT(S) AND SERVICE(S):
- Development of novel testing techniques and methodology.
- Development of novel equipment for testing.
- Neurophysiological testing of bioactive environmental (chemical and electromagnetic) agents.
- Research and development and formal education within the scope of the laboratory.

SPECIAL SERVICES, LABORATORY:
In vivo cellular laboratory: extracellular unit recording, stereotaxic apparatus, biological signal conditioning (amplifiers, filters, ADCs, measurement of voltage and current), constant current generators (for microiontophoresis).
Small animal behavior laboratory: general activity, open field test, elevated plus maze test, forced swim test, food-choice tests, computer controlled operant behavioral chambers, neurotoxic brain lesions, reversible brain inactivation, central/systemic administration of bioactive agents.
Human psychophysiology laboratory: high performance 32 channel biological amplifier (EEG, EMG, ECG, EOG), computer controlled behavioral apparatus.
Current research 1) basic: neurophysiology of face perception; 2) applied: neurocognitive effects of non-ionising environmental electromagnetic fields.

REFERENCES:
http://www.neurobio.pte.hu/kutatas/index.html
1. Development of tools and equipment for microelectrophysiology (from 1995).
2. Microelectrode development and testing (from 2000)
3. Software development for electrophysiology (from 2006)
LEADER OF THE RESEARCH GROUP: Dr. Boldizsár Czéh

FIELD(S) OF RESEARCH:
The physiological stress response is essential for our daily survival and helps us to adapt to the ever changing environment. However, sustained uncontrol- lable stress can induce various dysfunctions and pathological alterations in our body. Our key interest is the structural plasticity of the brain in relation to stress.

We focus on stress-induced changes in neuronal plasticity affecting neuronal networks, adult neurogenesis as well as glial changes in the hippocampus and neocortex. We hypothesize that such stress-induced structural changes contribute to the pathophysiology of psychiatric disorders like depression or schizophrenia, but medications like antidepressant, antipsychotic treatment can also have influence.

We aim for translational research using multidisciplinary methods ranging from molecular biology to in vitro and in vivo imaging.
PRODUCT(S) AND SERVICE(S):
Post mortem neuropathology, hepcidin and prohepcidin measurements, laboratory diagnostics of clinical samples and measurement of biomarkers

SPECIAL SERVICES, LABORATORY:
– Stereoinvestigator
– Neurolucida,
– Beckman CEQ 8000 genetic analysis system
– DNA sequencer / – QIA Cube for fully automated purification of DNA, RNA, or proteins,
– Liquid chromatography tandem mass spectrometry (LC/MS/MS),
– electrophoreses/blotting

REFERENCES:
LEADER OF THE RESEARCH GROUP: Prof. Dr. István Geresdi

FIELD(S) OF RESEARCH:
Our research focuses on the precipitation formation in the clouds. Numerical models have been developed to describe this process.

– The aerosol particles not only affect the quality of the atmosphere, but they play important role of the formation both of the liquid and solid phase in clouds. Because the precipitation washes out the different type of pollution from the atmosphere, there is a strong interaction between the clouds and aerosol particle. State of art numerical model was developed to simulate how the characteristics of the aerosol particles affect the precipitation formation, and how the efficiency of the wash out occurs at different air masses. Our model allows us to simulate the regeneration of the aerosol particles as well.

– New numerical model has been developed for the simulation of the hailstone formation in the thunderstorms. Both dry and wet growth of the hailstones is involved in the model. This improvement of the numerical model allows us to make better forecast of the hail stone formation in the thunderstorms.

PRODUCT(S) AND SERVICE(S):
Improvement of the numerical models used for the weather forecast

SPECIAL SERVICES, LABORATORY:
High performance computer

REFERENCES:
More than 10 papers have been published in this field, the summarized impact factor is more than 20.
LEADER OF THE RESEARCH GROUP: Dr. Miklós Hlatki

FIELD(S) OF RESEARCH:
1. Modeling deep, fractured geothermal reservoirs  
Geological, geophysical, rock physics and well test information is integrated to characterize the fractured reservoirs for transport simulation.

2. Development of tracer simulation methodology for fractured reservoirs  
Adsorption measurements on core samples, the model developed in the above 1st task, and sophisticated parameter estimation and model setting methods are applied for tracer simulation.

3. Geoscientific modeling and engineering design for geothermal and other projects  
Geological and transport modeling, geomechanical modeling, deep drilling design, resources estimation, project development. Preparation of scientific and engineering studies.

PRODUCT(S) AND SERVICE(S):  
Applied geoscientific modeling
LEADERS OF THE RESEARCH GROUP: Prof. Dr. Ferenc Kilár and Prof. Dr. Felinger Attila

FIELD(S) OF RESEARCH:
- Liquid chromatography, gas chromatography, capillary and microchip electrophoresis, mass spectrometry, sample preparation
- Study of environmental contaminants and microorganisms interactions.
- Biosorption and biodegradation. Bioanalysis
- Study of lipopolysaccharidomics
- Ore forming processes
- Submarine volcanism and hydrothermal processes
- Geomicrobiology and biogeochemistry
- Sedimentology (siliciclastic and carbonate)

PRODUCT(S) AND SERVICE(S):
- Method development for the qualitative and quantitative analyses of biological, environmental, and pharmaceutical samples by high performance liquid chromatography, gas chromatography, capillary and microchip electrophoresis and LC-MS, GC-MS, CE-MS methods.
- Determination of urinary steroid profiles for medical diagnostic purposes from urine of outpatients or inpatients.
- Analysis of the surface properties of biosorbents
- Practice in environmental geology, expert report
- Physical characteristics of sediments and soils
- Phase analysis of solids (bulk + clay minerals)
- Cutting, sawing, thin-sectioning and polishing of geological samples
SPECIAL SERVICES, LABORATORY:
- Agilent 1290 UHPLC – Agilent 6530 Q-TOF MS: liquid chromatograph and mass spectrometer
- Agilent 1100 liquid chromatograph: autosampler, thermostat, diode array and refractive index detector
- Agilent LC/MSD Trap XCT Plus mass spectrometer
- Shimadzu Prominence liquid chromatograph: degasser, autosampler, binary pump, diode array detector
- Agilent 6890N gas chromatograph, 5975 mass spectrometer detector
- Agilent 3D capillary electrophoresis system, Agilent 2100 Bioanalyzer, Kapillarelectrophorese ZKI 02-A (ITP instrument)
- Perkin-Elmer 2380 Atomic Absorption Spectrophotometer
- Thermo Scientific Genesys 10S double beam UV/Vis spectrophotometer
- Particle-size analyzer: Malvern Mastersizer 2000 and Malvern Mastersizer 3000
- Malvern Zetasizer Nano Z – Zeta potential measurement in aqueous and non-aqueous dispersions
- Photoreactor
- Nikon Eclipse polarizing microscope
- X-ray powder diffractometer (XRD)

REFERENCES:
- examination of urinary steroid profiles: Hungarian clinics and hospitals (Pécs, Szombathely, Kaposvár, Veszprém, Debrecen, Budapest)
- statistical data evaluation: several clinics at the University of Pécs
- qualitative and quantitative analyses of pharmaceutical samples: PannonPharma Ltd., University of Pécs, Dept. of Laboratory Medicine
- Public Limited Company for Radioactive Waste Management (PURAM), MECSEKÉRC Environmental Protection Public Limited Company
The design and development of the Unit was manifested in collaboration with other related research groups in the Szentágothai Research Centre. The most important aim of the Unit is to provide modern, efficient and versatile research environment for the scientists and other corresponding investigators, so that they have excellent facilities for the engineering and preparation of biological samples of various organisation levels. Thanks to the functional multiplicity of the instrumentation available in this Unit, samples of peptides, proteins, cells and tissues can effectively be processed in the laboratory. Modern and powerful systems and applications are available for the extraction and modification, and also for the expression and purification of proteins. Fluorescent protein modifications are also possible. The conditions are provided for the use of numerous commercial preparation kits, and thus the investigation of cells and cell populations can also be manifested in this research environment. If the appropriate corresponding preliminary preparations are provided, the Unit will also provide appropriate conditions for the research with more complex biological systems, such as tissues. Based on these advances and the expected future applications the optimisation of the current set-up of the Unit is constantly in progress.

According to the current strategy the research group carries out investigations in collaboration with other groups and core facilities of the Science Building. As the optimal use of the available infrastructure assumes the application of various biophysical methods, the Bio-Imaging Center and the Spectroscopy Laboratory are considered to be the most important from these facilities.

The studies of the Biophysics Research Group are focused on the description and understanding of cellular processes essential in the function and reproduction of living cells. These processes are tightly connected to the cytoskeleton of these cells. The cytoskeleton is composed of microtubules, intermediate filaments, and actin based microfilaments. From these subsystems our research is dealing with the function and regulation of the microfilament system, and the more than 60 protein families associated to these filaments. The aim of these investigations is to characterise the molecular mechanisms underlying the function of the microfilaments, to understand the corresponding protein-protein interactions, and to describe the related changes in cell morphology.
PRODUCT(S) AND SERVICE(S):
Design, development and investigation of biological systems.

SPECIAL SERVICES, LABORATORY:
In collaboration with other groups in the Science Building the Resarch Group pro-
vides instrumentation for the preparation of peptides, proteins, cells and tissues.

REFERENCES:
Web: www.aok.pte.hu

Related publications:
1. Gabor Hild, Beata Bugyi and Miklos Nyitrai. Conformational Dynamics of Actin: 
   Effectors and Implications for Biological Function. Invited review. 2010. 
   Cytoskeleton, 67(10), 609–29.
2. Szilvia Barkó, Beáta Bugyi, Marie-France Carlier, Rita Gombos, Tamás Masurek, 
   József Mihály and Miklós Nyitrai. Characterization of the Biochemical Properties 
   and Biological Function of the Formin Homology Domains of Drosophila DAAM. 
LEADER OF THE RESEARCH GROUP: Prof. Dr. Miklós Nyitrai

FIELD(S) OF RESEARCH:
The Bioimaging Centre includes the most innovative microscopy technologies from super resolution, via single molecule microscopy to Raman microscopy. The flagship of the Bioimaging Centre is the super resolution microscopy which breaks the barrier of the diffraction limit and allows the visualization of cellular components with a space resolution less than 100 nm. Super resolution microscopy can be used in a very wide research field including cell biology, immunology, anatomy, biochemistry, biophysics, and its biotechnological applications cannot be overlooked.

The Bioimaging Centre also hosts a high end confocal microscope, which allows the production of fluorescence images with very narrow z direction resolution and also provides very fast scanning of the samples for the users, making capable the laboratory of excellent live cell imaging.

Another strategic technological direction of the Centre is the confocal Raman microscopy, which can be applied for various research project from the field of archaeology to cell biology, tissue engineering or biophysics. The power of confocal Raman microscopy is laid by the advantages of vibrational spectroscopy, which is very sensitive to any environmental change. Raman microscopy is a label free technology which due to the deep penetration of the red laser can be used for thick samples (tissues, cells, rocks)

A single molecule visualization research takes place as well in the Bioimaging Centre. With this instrumentation micro and even nano-scale objects can be visualised and the interactions of individual molecules can be tracked and described. The facilities will also allow the manipulation of these single macromolecules or cells under the microscope objectives.
PRODUCT(S) AND SERVICE(S):
- Super resolution microscopy
- Fixed and live cell imaging by the means of confocal microscopy
- Single molecule microscopy
- Confocal Raman microscopy
- Fluorescence microscopy

SPECIAL SERVICES, LABORATORY:
- 1 Super resolution microscope (< 100 nm)
- 1 High end confocal microscope
- 1 TIRF and fluorescence microscope
- 1 Confocal Raman microscope (resolution ~ 1 μm)
LEADER OF THE RESEARCH GROUP: Prof. Dr. László Kollár

FIELD(S) OF RESEARCH:

Preliminaries
The discovery of truly new synthetic reactions is mainly due to the application of the recent developments in organometallic chemistry. These syntheses are accompanied by the formation of low amount of undesired side-products (‘low waste procedures’). Similar rhodium-, platinum- and palladium-catalysed environmentally benign reactions, as well as their products have been investigated in our research group. It is worth noting that transition metal catalysts are used not only as a ‘tool’ but the elementary reactions are also studied in order to get a deeper insight to the reaction mechanism and therefore, to improve catalyst efficiency.

Topics to be investigated
1. Highly chemo-, regio- and enantioselective reactions are carried out using homogeneous catalytic methods. In order to increase efficiency of the homogeneous catalysts, the basic principles of transition metal catalysts are investigated including kinetic and coordination chemistry studies, as well as computational chemistry.
2. Environmentally benign syntheses of simple building blocks (including chiral building blocks, ‘CBBs’) and more complicated structures (steroids, dendrimers, cavitands, N-heterocycles) are carried out using the combination of high-yielding conventional reactions and homogeneous catalytic methodologies.
3. Weak molecular interactions, having significant consequences in chemistry and biochemistry, are investigated using a wide variety of host and guest compounds. The fundamental results of thermodynamics are exploited in solving problems of biochemical importance.
4. Synthesis of stable nitroxide free radicals or their precursors connected to or condensed with heterocycles under conventional and microwave assisted conditions. These new compounds will be useful building block for spin labels and paramagnetically modified biomolecules.
5. Efforts are made to develop new chemical sensors employing new sensor molecules and design. Microelectrodes are developed to solve practical problems, with special care for application as selective probe in scanning electrochemical microscopy.
PRODUCT(S) AND SERVICE(S):
- Development of carbonylation catalysts of high selectivity.
- Synthesis of carboxamides and ketocarboxamides via palladium-catalysed aminocarbonylation.
- Synthesis of dendrimers and cavitands using homogeneous catalytic reactions as key-reactions.
- Investigation of weak molecular interactions in the 'host-guest' chemistry including calixarenes, cavitands, etc. as host compounds.
- Synthesis and pharmacological application of stable nitroxide radicals.

SPECIAL SERVICES, LABORATORY:
- Laboratory devices necessary to carry out synthesis of dendrimers (inert Schlenk-technique, high-pressure autoclaves).
- Analytical methods (500 MHz NMR, FT-IR-Raman, MS, fluorimeter, electrochemical work station, low concentration gas analysis, CO2, H2S, water content).
- Microwave heating under controlled conditions (temperature, pressure).

REFERENCES:
- 230 publications (in international journals, cumulative impact factor ca. 515), 2350 independent citations (L. Kollár). Further ca. 450 papers (cumulative impact factor ca. 700) were published by the senior researchers (G. Nagy, T. Kálai, S. Kunsági-Máté) of the group.
- 9 basic patents in pharmaceutical and pesticide chemistry (announced in more than 30 countries).
LEADER OF THE RESEARCH GROUP: Prof. Dr. János Hebling, Dr. József Fülöp

FIELD(S) OF RESEARCH:
Generation and application of terahertz (THz) pulses with high pulse energy and electric field strength that is sufficient for applications in nonlinear THz spectroscopy. Searching for new application possibilities in the fields of material, medical, and life sciences.

Manipulation, acceleration, focusing, and temporal shaping of electrically charged particle bunches (electrons, protons, ions) with THz pulses having extremely large electric field strength. Conceptual study of a table-top proton accelerator enabling to use low-energy protons for hadron therapy applications. Generation of single cycle UV and X-ray radiation.

Contribution to the development of advanced THz and other types of radiation sources for Attosecond Light Pulse Source of Extreme Light Infrastructure (ELI-ALPS).

Our results so far: Generation of the highest-energy THz pulses by optical rectification. Presentation of optimal parameters for design of tilted pulse-front based THz generator scheme. It was shown that in case of using longer wavelength than the typical 800 nm in a tilted pulse-front excitation scheme semiconductors (like ZnTe, GaP) are competitive with LiNbO3 from the point of view of efficiency. It was shown, that in case of LiNbO3 the peak THz electric field strength can be increased by more than one order of magnitude using ~500 fs pump pulse length, and cryogenic temperature. With this technique it is possible to generate single cycle THz pulses with pulse energy exceeding 10 mJ, and with peak electric field strength of 100 MV/cm with central frequency about 1 THz.
PRODUCT(S) AND SERVICE(S):
Time-domain terahertz spectroscopy (TDTS), THz pump – probe measurements.

SPECIAL SERVICES, LABORATORY:
THz sources with up to 10 mW average power. Time-domain THz spectrometer with 3 THz bandwidth. Near-infrared femtosecond lasers up to 8 mJ pulse energy with characterized beam parameters. Optical equipments and diagnostic instrumentation from the visible to the THz frequency range. Clean room environment and controllable temperature conditions will be available.

REFERENCES:
THz beam source based on optical rectification – Hungarian announcement nr.: P1000514; International announcement nr.: PCT/HU2011/000081

Optical device for broadband nonlinear optical processes – Hungarian announcement nr.: P1000179; International announcement nr.: PCT/HU2011/000031

Set-up and method for manipulation of electrically charged particles – Hungarian announcement nr.: 107592–13373d

Method and device for generation of high voltage and large current fast electric pulses in plasma channel – Hungarian announcement nr.: P1000368; International announcement nr.: PCT/HU2011/000069

Undulator with short period – Hungarian announcement nr.: P1100452
LEADER OF THE RESEARCH GROUP: Dr. János Erostyák

FIELD(S) OF RESEARCH:
- Spectrofluorimetry characterization of NIR-FL materials useful in several fields of biology and biomedicine. Developing of nanoprobes of high stability and high fluorescence intensity.
- Study of: (1) NIR-FL dye molecules; (2) Luminescent quantum dots; (3) Single-wall carbon nanotubes (SWCN); (4) Lanthanide complexes capable of two-photon NIR-to-VIS conversion.
- Intra- and intermolecular energy transfer in lanthanide complexes.
- Nano- and picosecond study of protein dynamics.
- Dielectric relaxation of small fluorophores in the time range of femto- and picoseconds.
- Numerical spectral analysis and data mining in complex samples.
- Time-resolved and steady-state fluorescence spectroscopy analysis of different liquid and solid samples.
- Developing of integrating spheres for determination of real spectra and exact concentration of scattering and/or low concentration solutions.
PRODUCT(S) AND SERVICE(S):

- Determination of real spectra and exact concentration of scattering and/or low concentration solutions.
- Spectral measurements for material studies, light source checking etc. In the 200–1600 nm spectral range. Measurements of excitation, emission, synchronous excitation spectra and decay curves. Vary fast analysis of complex samples using Matrix Isopotential Synchronous Fluorimetry (MISF).
- Optical planning of indoor and outdoor displays of very high contrast and good visibility for environment of high luminosity using LED sources.

SPECIAL SERVICES, LABORATORY:

- Jobin-Yvon Nanolog spectrofluorometer. Spectral range: 200–1600 nm (UV-VIS-NIR), Time range: 50 ps – 100 ns;
- Jobin-Yvon Fluorolog Tau3 spectrofluorometer. Spectral range: 200–1000 nm. Time range: 0,1 ns – 100 ns;
- Perkin-Elmer LS50B luminescence spectrometer for steady-state and phosphorescence studies;
- Spectrophotometers for absorption and transmission measurements.

REFERENCES:


http://physics.ttk.pte.hu/erostyak/
28 years practice in research in spectroscopy and optics and in teaching optics.
Basic question of modern time is whether the mankind will be able to create and manage the built environment, our civilised world so, that provides a liveable and sustainable habitat for recent and further generations. That built environment has to be able to respond to the changes in societal needs, address the adaptation to climate change, natural disasters, while reasonable exploits all kind of resources, especially the non-renewable ones. The research aims to the issues of sustainable architecture and preservation of the built environment that include the development and management of small footprint cities, design of green-housing and public spaces, development of methodologies and information technology tools for resource-saving design and city management, resilience of built environment. Research and development areas are the following:

- Sustainable Design Development
- Development of Methodologies and IT Tools for City Management
- Resilience, Adaptation to Disasters
- Sustaining the Built Values

The research and development activities are performed and managed by subgroups.
RESEARCH GOALS:
Goal of the Subgroup is to develop and implement methodologies, software and procedures for sustainable design. The research covers the development of climate and energy concepts for residential, office and industrial buildings and sustainable smart cities. Building monitoring data validates methodologies and software. The most important and complex test object is the Science Building itself. The research tasks are:

– Energy design, experimental investigation and simulation of energy use of residential, office and industrial buildings (Kistelegdi I.)
– Small footprint habitat design (Bachmann B.)
– Optimisation of structures, optimal design methods (Csébfalvi A., Iványi P)

PRODUCT(S) AND SERVICE(S):
Development of climate concepts and design methodologies of passive, zero and positive energy residential and public buildings.
Resources-optimised building renovation and operation concepts and procedures.
Methods and techniques for analysis and design of buildings; structural design of building skin.
Civil and structural engineering analysis and computational methods addressing the optimal use of resources.
SPECIAL SERVICES, LABORATORY:
Light Technology simulation software, fluid dynamics simulation software, building ener-
getics and climate simulation software, architectural, structural modeling software.
Measuring and data acquisition system for building monitoring, thermo- and photo-tech-
nique instrumentation, thermo-camera, spectral-radiometer, weather station.
Hardware and software tools for civil and structural engineering analysis and design.

REFERENCES:
University of Pécs Szentágothai János Research Centre (near 7000 m2). Development
of energy design concept and system.
Positive energy factory and office building (RATI) in Sikonda. Aerodynamical design and
construction plan of climate concept and passive airing tower of an implemented con-
struction.
Romany Cultural Centre, Cserdi, Hungary. Low-tech wood and clay and straw mortar;
ETFE film structure, with PCM phase-changing solutions.
Y Tsompanakis, P Iványi, B H V Topping (editors) Civil and Structural Engineering
(Computational Science, Engineering and Technology Series; 32.) (ISBN:978-1-
874672-64-7)
Anikó Csébfalvi, Robust truss optimization with uncertain-but-bounded load directions,

Subgroup for Development of Methodologies
and IT Tools for City Management

Dr. Iványi Péter, Dr. Tibor Kiss, Dr. Márk Zagorácz, József Etlinger

RESEARCH GOALS:
Goal of the Subgroup is to develop and implement IT Tools and methodologies, for smart
city applications:
− Development of Building Information Modeling (BIM) applications for sustainable city
management purposes. (Zagorácz M., Iványi P., Etlinger J., Kiss T.)
− Development of intelligent building control and utility network management solutions
and planning tools. Enhancement of built infrastructure with smart technology,
monitoring and data analysis for intelligent city management. (Iványi P., Kiss T.)

PRODUCT(S) AND SERVICE(S):
Full Building Information Modeling services, e.g. model-based plan revision, trades coor-
dination, quantity extraction, schedule preparation, virtual prefabrication, facility man-
agement services, high quality visualizations.

SPECIAL SERVICES, LABORATORY:
High performance desktop computers and market leader BIM software, mobile devices
with corresponding applications.
REFERENCES:
Optimisation of the water system of the central plant of Pannon Power Ltd.
Noise level certification of the air-blowers of the air-technical system of Pécs Conference Centre.
Korányi Project, Budapest - BIM model-based quantity calculation, workflow scheduling and budget estimation for the preliminary expert's report, prior to public procurement procedures.
IT Services Hungary, site expansion in Pécs - BIM model-based construction preparation, building system coordination.

Subgroup for Development of Intelligent Control and Monitoring Systems for Infrastructure Management

Dr. Géza Várady, Dr. Ildikó Jancskár, Dr. Ádám Schiffer, Dr. Zoltán Sári

RESEARCH GOALS:
Goal of the Subgroup is to develop and implement hardware and software tools for smart infrastructure management.
- Development of autonomous quadcopter drone for indoor and outdoor applications,
- Development of Image based navigation and control system for drones and unmanned aerial vehicles,
- Distributed systems in modelling and control.
PRODUCT(S) AND SERVICE(S):
Control platform for image and sensor based drone navigation. Drones capable to roam on programmed routes and take predefined actions and manoeuvres. Fuzzy control model of rotor control, signal- and image processing competence, several types of measuring and interfering tools.
Automation signal and image processing, Matlab/Comsol simulation, LabView design and programming, thermal image processing, vision and machine vision competence.

SPECIAL SERVICES, LABORATORY:
High performance desktop computers, simulation and calculation software, imaging devices, LabView Lab and Academy, AR.Drone 2 quadcopters with HD camera.
Atom-absorption spectrometer, portable micro gas-composition and total organic carbon meter, ultraviolet-visible spectrophotometers, Differential Thermal Analysis and Differential Scanning Calorimeter, laser particle meter, digital sieve shaker machine, microwave digestion, calcining furnace, emission measuring laboratory, gas analysers, noise laboratory, flow meters, psychrometer, HVAC meters, dust separator cyclone, centrifugal washer, heat exchangers, flue gas analyser, water quality analysing and measuring system, aerobic and anaerobic reactors, decanter; LabView Lab, AR.Drone 2 quadcopters with HD camera;

REFERENCES:
Resilience refers to the ability of built environment to withstand and to recover quickly from any plausible hazards. The subgroup research aims at the subjects:

- Investigation of the hazards endangering the human settlements and strategic infrastructures.
- Analysis of response of cities and strategic infrastructure to relevant hazards, development of methodologies for analysis of response to hazards and risk assessment.
- Development of concepts for risk reduction measures for cities and strategic infrastructure.

Identification of plausible hazards for the South-West Region of Hungary, including those relevant for the Pécs city and the strategic infrastructure in the region, e.g. nuclear power plant, radioactive waste repository.
Evaluation of risk due to natural hazards.
Analysis and evaluation of the built environment (housing and infrastructure objects) to respond to the effects of hazards.
SPECIAL SERVICES, LABORATORY:
Software tools for civil and structural engineering analysis and design.
Experimental modal analysis tools and experiences.

REFERENCES:

Subgroup "Sustaining the Built Values"

Dr. Gábor Zoboki, Dr. Zoltán Orbán

RESEARCH GOALS:
Sustainability starts with preservation, refurbishment and use of existing built environment. The historical heritage has spiritual and touristic values additional to the inherent sustainability. The goal of the Subgroup is to identify the values of existing structures, develop methods for reconstruction and reuse of existing buildings and architectural heritages.

PRODUCT(S) AND SERVICE(S):
Design of reconstruction/refurbishment of architectural values
Design and utilisation of architectural values
Condition assessment of historical structures

SPECIAL SERVICES, LABORATORY:
See as above at Subgroup for Development of Methodologies and IT Tools for City Management

REFERENCES:
Integrative investigation of neuropeptide-mediated mechanisms in vascular, inflammatory and immune functions.

In this project the complex regulatory roles of neuropeptides in neuronal, vascular and immune processes are analysed in order to understand the precise molecular mechanisms and identify new pharmacological targets. Our research expertise, high standard infrastructure and integrative methods in model systems and clinical analysis, as well as extensive national and international collaborations help us to determine which neuropeptides play key pathophysiological roles in certain diseases. Besides the complex functional, biochemical, immunological and histological methods we also have sophisticated, modern imaging techniques (laser-Doppler blood perfusion scanner, micro-CT, intravital microscopy, fluorescence/luminescence functional tomography) that helps us to analyse the roles of selected target molecules.

In this project there are important collaborations to establish complex research models for common medical conditions with inflammation, circulatory changes, vascular and immune regulation disorders, pain and degenerative processes.