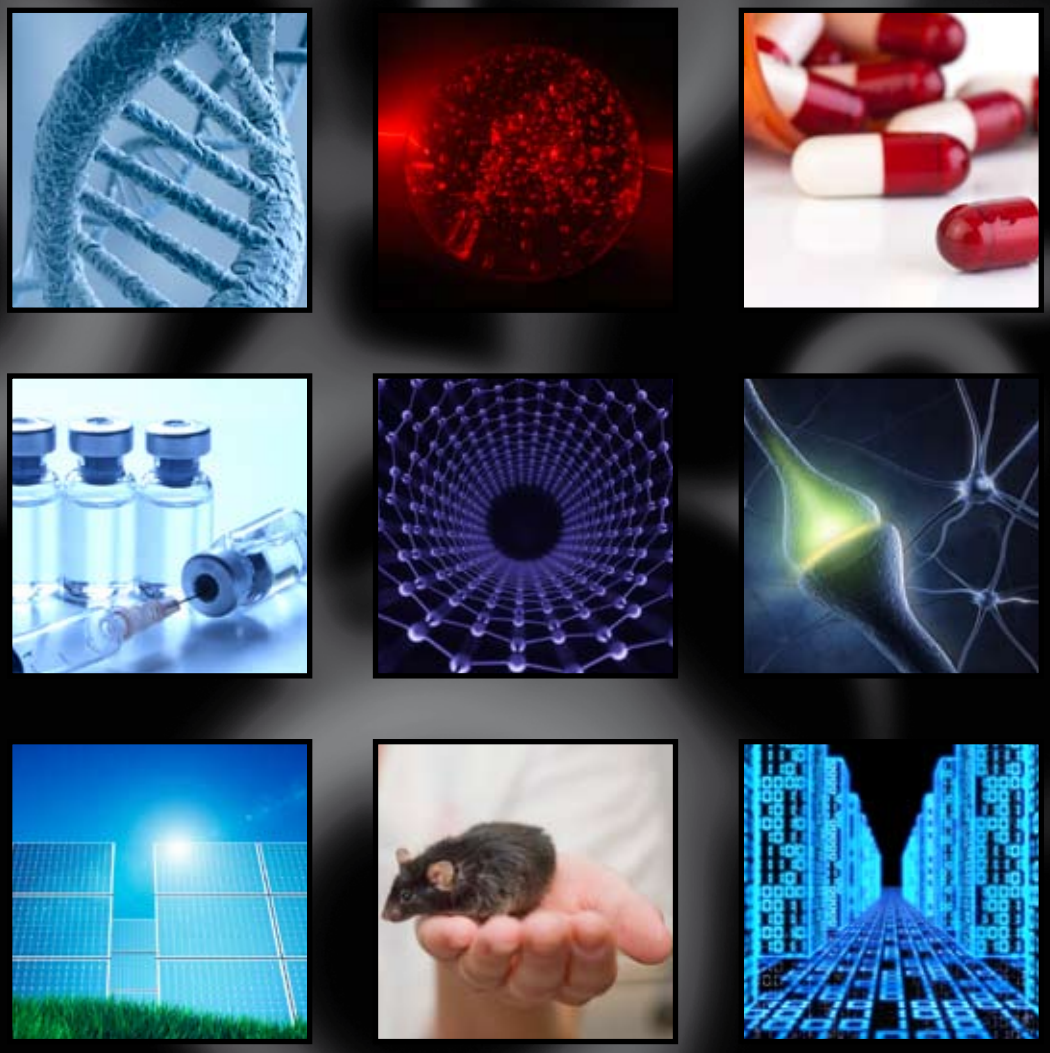

EXCELLENCE IN RESEARCH AND INNOVATION

UNIVERSITAS SCIENTIARUM SZEGEDIENSIS
UNIVERSITY OF SZEGED

NEW SZÉCHENYI PLAN

Rector's Greeting

Dear Readers,

The University of Szeged, as one of the most prestigious institutions of higher education in Hungary, was acknowledged as a research university in 2010. Thus it became a member of the very few elite universities of the country. As one of the most excellent institutions, it devotedly supports the advancement of scientific research.

The success of the University's research and development activity begins in the workshops of the scholars, where ideas are conceived. However, developing great ideas into inventions and products is the responsibility of the University; this attitude comprises the ideology that makes our institution a research university. The effectiveness of the research and development activity depends on the efficiency of business networking, the active participation in the innovation process and also the dissemination of scientific results. By accomplishing these tasks, it is possible to meet the brand new social challenge of 21st century universities, and not only to maintain high quality educational and research activity, but also to ensure the commercialization of intellectual property.

This brochure presents briefly the research and development achievements of the University of Szeged; its fields of focus were selected on the basis of scholarly, publication and key industrial cooperation activity. The achieved results in these fields prove the aptitude of our scholars. By publishing a concise summary of their work, our unconcealed aim is to draw the attention of technology transfer experts to their talent, as the greatest success of science is to leave the laboratories and become part of our everyday lives.

Hereby it is with great pleasure that we present this publication to those who would like to have an insight into the R&D activity of the University of Szeged, and to the devoted admirers of science having interest in research universities. I wish this publication to serve as an inspiration for utilizing new ideas and for the onset of new collaborations.

Dr. Gábor Szabó
Rector

R + D + I

The University of Szeged is one of the largest universities in Hungary, and the efforts of its nearly 30,000 students, 700 PhD students, and close to 7000 employees at the 12 university faculties help make the institution the regional centre of knowledge in the Southern Great Plain.

Our students can choose from 88 BA and BSc, 117 MA and MSc majors, 4 undivided degree courses, 59 postgraduate and complementary training courses. The University also offers 33 accredited post secondary vocational trainings and doctoral programs in 19 fields. The key to the high standard educational and scholarly research activity is the 291 researchers and the 2.239 instructors; 19 of them are full members of the Hungarian Academy of Sciences (HAS) and 114 are corresponding members, and 643 are Doctors of Philosophy.

Conducting research of an internationally competitive standard and preserving its research university title and nature are core missions of the University of Szeged; tasks inseparable from maintaining its high quality educational activity. Research, development and innovation activity carried out within national and international research programmes involves knowledge expanding and problem solving researches as well as product and service development. Resulting from the strong cooperation between the Hungarian Academy of Sciences and our institution, 20 joint cooperation research teams operate at 4 faculties of the University, 12 of which are financed by the HAS. In the past 5 years, scholars of our institution published nearly 50.000 studies and articles in Hungarian and international journals and in conference publications.

Researches conducted for industrial R&D commissions are of great significance: they generated more than 16,3 million USD, approximately 16.3 million USD income in the past 5 years. The patent portfolio of the University consists of nearly 40 patents, many of which have already been commercialized through license agreements and spin-off enterprises established especially for this purpose.

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I. Neurobiology

The research teams of our University have great achievements related to this field, thus contributing to the expansion of our knowledge about the anatomy of human brain and to the treatment of common problems (pain sensation, headache) and also of special injuries and diseases (traumatic brain injury, Alzheimer's disease, Parkinson's disease).

Pain Research

Investigations into the mechanisms of pain and neurogenic inflammation have a long-standing tradition in the Department of Physiology at the Faculty of Medicine. The discovery of the selective and specific neurotoxic effect of capsaicin (the pungent principle of chilli peppers) on nociceptive primary sensory neurons has paved the way for studies on pain mechanisms. Prof. Dr. Gábor Jancsó's research team developed new methods, such as neonatal capsaicin treatment, local capsaicin treatment of peripheral nerves and administration of capsaicin into the subarachnoid space, which produce selective and long-lasting functional impairments of primary sensory neurons involved in the mediation of pain. Since then, these methods have become established experimental tools in the field of pain research. Importantly, their findings have opened new perspectives in the study and treatment of pain by creating the possibility to treat the pain where it actually arises: at the level of the nociceptive primary sensory neuron.
Other recent studies they conducted provided direct morphological evidence of the chemosensitive pain sensory innervation of the pachymeninx, and through an experimental animal model of headaches they clarified the role of these nerves in the pathomechanism of migraines.

In vitro experiments proved that neuronal gangliosides play an important role in the molecular regulation of capsaicin sensitivity and also in the development of acute sensitisation, an important mechanism of hyperalgesia. Their further investigations are aimed at revealing novel types of pain killing methods.

Research of Neuro-degenerative Diseases

Prof. Dr. Botond Penke's research team at the Department of Medical Chemistry focuses on the

▼ *"...neonatal capsaicin treatment, local capsaicin treatment of peripheral nerves and administration of capsaicin into the subarachnoid space..."*

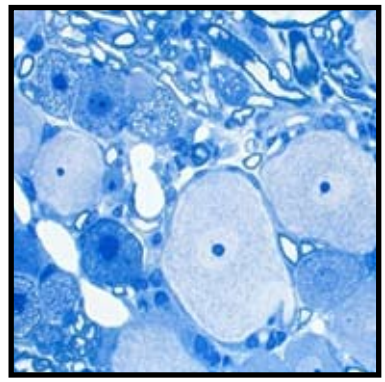
research of neurodegenerative diseases such as Alzheimer's, Parkinson's and ALS (amyotrophic lateral sclerosis). They conduct researches in interdisciplinary manner, which involve many fields from computer aided molecular design to the closure of preclinical examinations.

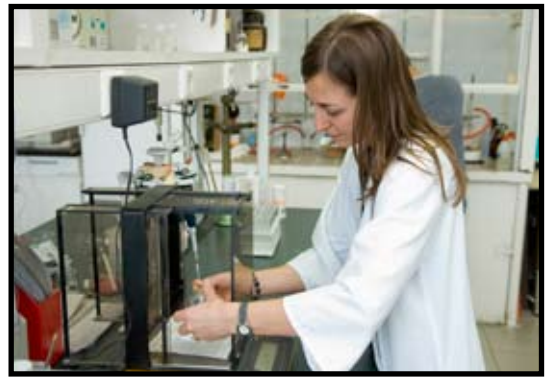
During the research of the pathomechanism of Alzheimer's disease the scientists analyse the origin of those proteins that induce degeneration: they observe whether they are produced by the central nervous system or they get into the brain from the peripheral. They examine whether β–amyloids really generate the disease, the exact function of extra- and intracellular β–amyloids, and what kind of signalization and intracellular amyloid-protein interactions trigger neurodegeneration. Their research involves examining the role of aging in inducing Alzheimer's, the changes taking place at the level of proteins at the beginning of the disease, and also the significance of steroid-hormones and gene-expression during the process.

The research team conducts different basic and applied research to examine the use of neutral neuroprotective substances as dietary supplements. They also examine drug candidate compounds which might be suitable for neutralizing β-amyloids in the brain and in the peripheral and for increasing the clearance of β-amyloids by efflux.

One of the significant results of the research team is the development of a novel, cost effective animal model for testing the potential drug

▼ *"...to treat the pain where it actually arises: at the level of the nociceptive primary sensory neuron."*





▲ *"...involve many fields from computer aided molecular design to the closure of preclinical examinations."*

▲ *"...might be suitable for neutralizing β-amyloids in the brain and in the peripheral and for increasing the clearance of β-amyloids by efflux."*

candidate compounds for Alzheimer's disease, and they have also elaborated a new principle for the treatment of Alzheimer's, which is about the neutralization of intracellular toxic protein aggregates by the means of novel drug candidate compounds.

Research of Neural Networks

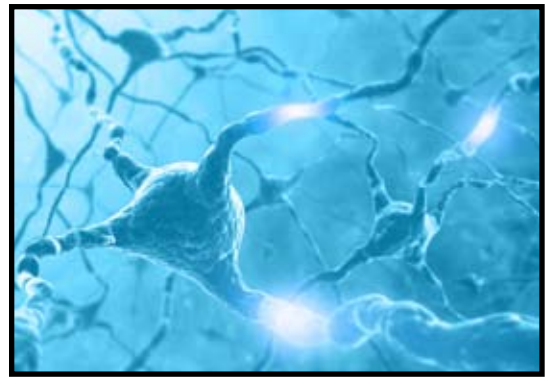
The Cortical Microcircuits Joint Cooperation Research Team of the Hungarian Academy of Sciences and the University of Szeged is led by Prof. Dr. Gábor Tamás. The research team reveals the mechanisms that connect neurons to neural networks by defining the role of neurons in the cerebral cortex. According to the key hypotheses the role of neurogliaform and axoaxonic cells is based on the extreme forms of aspecificity and specificity.

According to the hypotheses based on their research results, neurogliaform cells are likely to synchronize the metabolic needs and supply of micro-networks. The results of their research conducted in order to unveil the connections within the human cortex demonstrate that the axoaxonic cells activate cell networks that are crucial in higher-order cognitive brain activity.

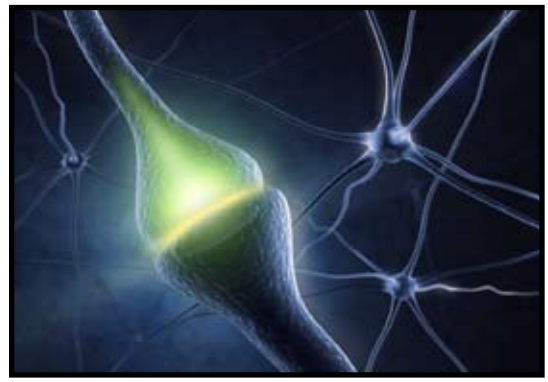
The research team's aim is to describe the interactions between neurogliaform and axoaxonic cells and cortical networks, and to modulate it on human samples with agents that are widely used in treatments. They use genomic-test-supported imaging, electrophysiological and ultrastructural high technology devices to test their hypotheses.

Research of Neuro-protective Mechanisms

Prof. Dr. József Toldi's research team at the Department of Physiology, Anatomy and Neuroscience deals with the mechanisms of the neurodegenerative and neuroprotective processes in the central nervous system, with special regard to interventions and substances of neuroprotective effect.



▲ *"They use genomic-test-supported imaging, electrophysiological and ultrastructural high technology devices."*



▲ *"…the axoaxonic cells activate cell networks that are crucial in higher-order cognitive brain activity."*

The aim of their research is to find ways to reduce secondary cytolysis connected to neurodegenerative diseases, ischemic state and traumatic brain injury. They can achieve this by reducing the level of glutamate itself, or its excitotoxic effect in the brain. The reduction of glutamate level can be attained by a rather novel method: an enzyme, or rather its co-substrate, that reduces the glutamate level of the plasma by increasing the transport of glutamate from the brain to the blood. The reduction of excitotoxic effect can be reached by using

an endogenous (present in the human body) substance, kynurenic acid, or its pre-substance, kynurenine, or different types of derivatives of kynurenic acid.
During the past years, while testing the numerous newly developed kynurenic acid derivatives (in collaboration with Professors Vécsei and Fülöp) the research team discovered a new molecule, which proved to be an effective neuroprotective substance with minimal side effects. The molecule itself and the method both are protected by patents.

▲ *"…to reduce secondary cytolysis connected to neurodegenerative diseases, ischemic state and traumatic brain injury."*

Research of Neuro-degeneration, Headache and Multiplex Sclerosis

In the laboratories of the Neurology Department, which is led by Prof. Dr. László Vécsei, research is conducted mainly in connection with neuro-degeneration, headache and multiplex sclerosis.
In their neurodegenerative programme the researchers examine pharmacological responses of patients suffering from Parkinson's syndrome and other extrapyramidal diseases. They test potential neuroprotective compounds on transgenic Huntington mouse and in MPTP models. They also examine biomarkers related to Alzheimer's disease.
The researchers observe therapeutic responses, changes of the quality of life, fatigue, genetic factors and biomarkers of patients suffering from multiplex sclerosis; and they also conduct liquordiagnostic examinations.
During their migraine programme the patients' therapeutic responses and pathochemical parameters are observed. Potential therapeutic alternatives are tested in experimental models such as trigeminal stimulation and dosing nitroglycerin.
In the stroke-programme researchers track the therapeutic response of cerebrovascular patients, and also the impact of stent, endarterectomy and thrombolysis on them. In the neuromuscularis programme, the associates make the diagnoses of the patients suffering from peripheral nerve disorders and examine their therapeutic responsibility. They also conduct functional MRI-examinations of several neurological disorders.
In their comprehensive research projects connected to the kynurenine programme *(www.u-szeged.hu/kinurenin)* the researchers cooperate with the chemists, physiologists and immunologists of the Faculty of Pharmacy and the Faculty of Science and Informatics, and other excellent professionals. Due to the kynurenine programme several patents have been registered, one of them is for producing kynurenic acid derivatives, and its application in the treatment of headache and Huntington's disease.

▲ *"Potential therapeutic alternatives are tested in experimental models such as trigeminal stimulation and dosing nitroglycerin…"*

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The globalization and urbanization processes of the past few decades significantly changed the lifestyle of the citizens of developed countries which also had negative consequences, for instance allergic and other immune disorders became common diseases. Recent processes allow us to conclude that this tendency will continue, thus immunology will become an even more significant field of research. At the University of Szeged, the operation of immune organs is examined both on a genetic and on a cellular level, immune responses and diseases of immunological background are investigated, thus our scholars considerably contribute to finding a solution for common problems from skin diseases to allergy

Research of Dermatologic Disorders

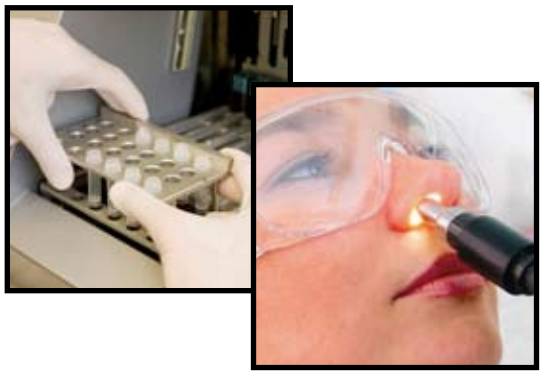
The Immunology Research Team, which is led by Prof. Dr. Lajos Kemény, operates at the Department of Dermatology and Allergology at the Faculty of Medicine. The team's professionals focus on the research of the skin as an organ of the immune system. They aim at revealing the pathomechanism and therapeutic possibilities of skin diseases of immunological origin. They were the first to prove that epidermal cells (keratinocytes) possess receptors that are capable of recognizing microbial pathogens. The team's research activity in phototherapy is important, as immunosuppressive phototherapy (the use of ultraviolet light, such as UVA, UVB light) is a significant part of the dermatological therapy. They revealed many details of the mechanisms of UV light-induced immunosuppressive effects and they developed new phototherapeutical devices for the treatment of skin diseases (excimer laser, UVB-LED therapy). The efficacy of phototherapy was tested on patients with hay fever too, based on the similarity of pathomechanism. Intranasal phototherapy proved to be effective in reducing the clinical symptoms of patients with allergic rhinitis. The team also conducts research on the immunogenetic background of inflammatory dermatologic diseases. The team also examines the modern diagnostic possibilities and the development mechanism of autoimmune bullous (blistering) skin diseases.

II. Immunology

In addition, the research group investigates the abnormal keratinocyte proliferation in psoriasis and they could identify and describe a non-coding RNA gene in psoriasis, which is overexpressed in normal, non-lesion psoriatic epidermis compared to healthy epidermis (PRINS). The research team was the first to develop a phototherapy-based method with which patients of allergic rhinitis can be successfully treated. The

intranasal Rhinolight phototherapy is suitable for the treatment of patients with allergic rhinitis independently from the inducing allergens. The therapy can be a successful treatment for patients whose allergic symptoms cannot be properly reduced by the combination of oral antihistamines and intranasal medication.

▼*„"…they could identify and describe a non-coding RNA gene in psoriasis…"*



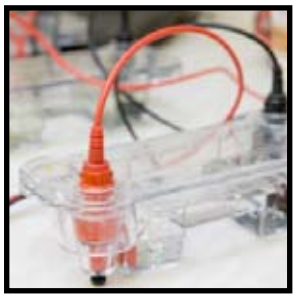
"The intranasal Rhinolight phototherapy is suitable for the treatment of patients with allergic rhinitis independently from the inducing allergens."▲

Genetic Examinations of Immunologic Processes

Immunologic research is conducted at the Department of Medical Microbiology and Immunbiology at the Faculty of Medicine. One of the main streams of research is the examination of the polymorphism of those genes that play a significant role in natural immune responses of multifactorial diseases; such examinations are supervised by Prof. Dr. Yvette Mándi. The aim of the research is the cognition of the risk factors that can influence evoking stroke, acute pancreatitis and diabetes mellitus, or can alter their severity. During their research, the associates examine the genetic polymorphisms of the previously mentioned diseases that can alter the functions, and influence the production of cytokines (pattern recognition receptors), and defensins of antimicrobial and immunomodulant effects. The cognition of the genetic risk factors can be of prognostic significance.

The examination of the immunology of Chlamydia infections is the other important field of research, during which the associates examine the immunopathologic mechanisms of chronic Chlamydia trachomatis infection, which is a common disease and induces infertility as a late complication. The research team applies DNA chip technology on in vitro tissue cultures, on in vivo mouse models, and also on organ cultures of ex vivo human fallopian tubes to observe the host-cell gene expression generated by Chlamydia trachomatis infection.

The researchers of the University of Szeged also participate in the research of the Atherosclerosis vaccine in cooperation with the Thrombosis Research Institute of London.



▲ *„"…examination of the polymorphism of those genes that play a significant role in natural immune responses of multifactorial diseases…"*

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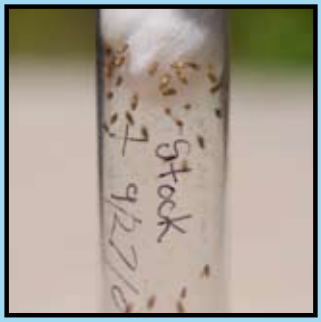
III. Genetics



▲ *"…they identified the key gene of the larval ecdysone production, mld…"*

As part of genetic research at the University of Szeged, researchers conduct genetic analysis of animals, and from these results they draw conclusions concerning specific biological features relevant for human health, especially in the field of hormone regulation. Extensive clinical genomic examinations are also carried out at the University, which aim at recognizing the genomic factors in the background of certain diseases and developing new diagnostic and therapeutic methods by using them.

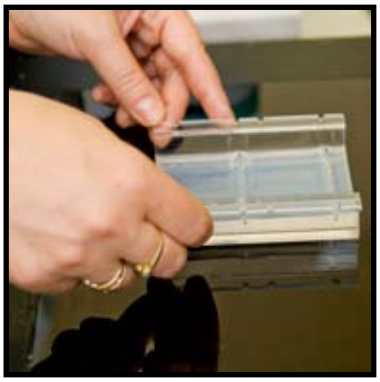
Genetic Research of Hormone Dependent Changes

The research team led by Prof. Dr. Péter Maróy operates at the Department of Genetics within the Institute of Biology at the Faculty of Science and Informatics. Their research focuses on biological events important for human health examining the model organism fruitfly (Drosophila melanogaster).

By genetic analysis of the hormone dependent development of the fruitfly, they identified the key gene of the larval ecdysone production, mld, and isolated several genetic variant of this gene. Their present research focuses on exploring the connection between this gene and the genes coding the enzymes executing the synthesis of the hormone.
One interesting observation was that the hormone deficiency caused by the lack of mld function resulted in a strong hypertrophy of the hormone producing endocrine gland. This phenomenon is similar to the symptoms of human endocrine disease, such as the hypertrophy of the thyroid gland due to the underproduction of its hormone. The results of the team revealed that the overgrowth of the fly's gland is the due to increased DNA-synthesis. Exogenous hormone treatment prevented the size increase, and this effect is mediated by the nuclear receptor of the hormone.

Clinical Genomic Examinations

Targeted clinical genomic examinations are performed at many departments and clinics of the Faculty of Medicine. These examinations aim at revealing the hidden genomic factors, and developing new diagnostic and therapeutic methods based on their results.



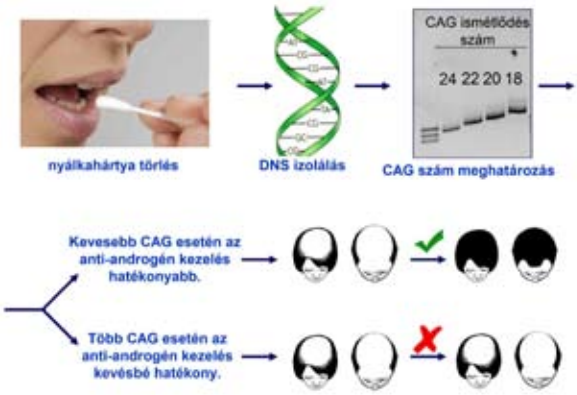
◀ *"…research of diagnostic significance is conducted for the mutation screening of patients with cardiomyopathy and their family members…"*

◀◀ *"…the overgrowth of the fly's gland is the due to increased DNA-synthesis…"*

Research focused mainly on multifactorial dermatological diseases and genomic research of genodermatoses is conducted at the Department of Dermatology and Allergology. The Dermatology Joint Cooperation Research Team of the Hungarian Academy of Sciences and the University of Szeged in collaboration with the Oto-Rhino-Laryngology and Head- Neck Surgery Department identifies genetic factors that induce susceptibility for allergic rhinitis, tracheal compression and nasal polyposis.

At the Second Department of Internal Medicine and Cardiological Centre research of diagnostic significance is conducted for the mutation screening of patients with cardiomyopathy and their family members. Clinical doctors at the Department of Haematology in collaboration with the Medical Genetic Institution carry out diagnostic examinations, which make it possible to apply personalised therapy on haematologic patients. Associates at the Neurology Department identify genetic factors that induce susceptibility for neurodegenerative diseases. A laboratory specialised in screening neonatal metabolic disorders operates at the Paediatric Department. Specialists at the First Department of Internal Medicine in cooperation with the researchers of the Department of Medical Microbiology Immunobiology strive for the comprehensive understanding of the pathogenesis of inflammatory internal medical diagnoses.

The Dermatology Joint Cooperation Research Team of the Hungarian Academy of Sciences and the University of Szeged and the specialists



▲ *"…the investigation of the CAG polymorphism responsible for the development of androgenic alopecia…"*

of the Oto-Rhino-Laryngology and Head- Neck Surgery Department registered a patent for detecting a certain polymorphism of TGFβ gene. By the examination of this polymorphism it is possible to identify those patients who are genetically more endangered by developing acquired beningus tracheal compression, which is one of the most severe complications of tracheal intubation.

At the Department of Dermatology and Allergology, research is also focused on the identification of the genetic susceptibility factors predisposing to hair loss or sparse hair. Based on their results, the investigation of the CAG polymorphism responsible for the development of androgenic alopecia is available in their laboratory. The significance of the CAG polymorphism is that it offers efficient genetic-based personal therapy for the patients.

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Drug design and synthesis

Preparative organic chemistry is the main research profile of the Institute of Pharmaceutical Chemistry led by Prof. Dr. Ferenc Fülöp. The research activity in the field of pharmaceutical chemistry involves the discovery and the deveopment of modern chemical compounds. Foldalmer chemistry, one of the Institution's basic research streams, follows the most recent trends. The Institute has been participating in long-term collaborations with various pharmaceutical companies and research institutions both from Hungary and from Europe; currently, the Institute is participating in the development projects concerning neuroprotective, cardoprotective and anti-tumour compounds.

The Institute possesses a ca. 4000-membered diverse compound library collected from the substances prepared in the Institute in the recent years. The library contains various derivatives of 1,2- and 1,3-difunctional compounds (amino acids, amino alcohols, hydroxyl acids, etc.). The structures and >95% purities of the members of the compound library are determined by NMR spectroscopy and mass spectrometry.

The Institute has 5 well-equipped laboratories for preparative organic chemical research (one of them has been established for enzymatic reactions) and an instrument centre for the structural analysis of the prepared compounds (400, 500 and 600 MHz NMR, GC-LC-HRMS, polarimeter, GC and HPLC instruments).

IV. Preclinical pharmacology

The researchers of the University of Szeged analyze herbs, aroma plants, toxic agents and new drug candidate compounds, define and prove the effects of certain molecules, specify the fields of application, thus they provide an extensive basis for clinical pharmacology.

Examination of Natural Compounds

The research team in the Institute of Pharmacognosy at the Faculty of Pharmacy, under the supervision of Prof. Dr. Judit Hohmann isolates and identifies biologically active natural compounds, especially from plant species found in the Carpathian Basin.

The significance of these researches is due to the fact that natural agents of high biological activity have the potential to provide models for the development of new drugs, to become lead molecules for drug discovery or to contribute to drug development by revealing new mechanisms of action. A research group of the Institute also deals with the structure modification of natural compounds by semisynthesis or biotransformation. The compounds isolated or produced by the Institute by means of semisynthesis, which consists a compound library of 300 components, have been tested in automatized screening systems and some of them were selected for further clinical development.

In addition, the workgroup of the Institute develops products that contain plant extracts; such as traditional medicinal products, dietary supplements, functional foods and also cosmetics. The continuously expanding market for herbal medicinal products justifies the significance of this stream of research. The Institute leads the initiative to establish the quality control of dietary supplements made in Hungary, and it is the leading Hungarian institution in the field of adulteration of dietary supplements and in the development of protocols for analyzing their quality.

The research team also examines the active compounds of medicinal and aromatic plants, accumulation of their compounds, and the dynamics of the accumulation. The research groups examine especially those members of the Lamiaceae plant family that contain volatile oils (such as Salvia, Origanum and Hyssopus). These investigations provide the chemical background of technological development of medicinal plant cultivation, and contribute to the production of medicinal plant raw materials in high quality.

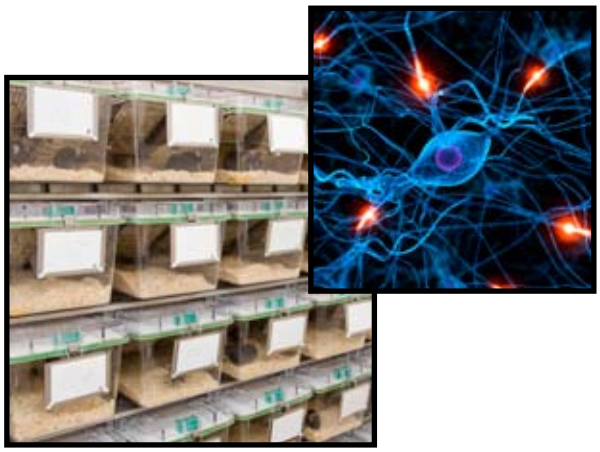
In the Institute of Pharmacodynamics and Biopharmaceutics, supervised by Dr. István Zupkó, extensive pharmacologic research is conducted. The researchers use human adherent tumour cell lines to perform in vitro examinations of the anti-tumour effect of vegetal extracts, isolated content substances and their synthetic analogues. The aim of their research is to identify new agents, describe their pharmacologic characteristics, analyse their effect mechanism, and also to select lead molecules that might raise the interest of potential partners in the pharmaceutical industry. The associates of the institute also test the effects of another natural substance, drone milk, in the treatment of infertility. Drone milk enhances male fertility, and the examinations indicate that it also improves the fertility of female animals. The fractionation and the testing of the fractions are in progress. The research group proved the effect of drone milk on reproductive organs in mouse models.

◀ *"…a compound directory of 300 components, have been tested in automatized screening examination systems…"*

▲ *"They also produce plant extracts and purified compounds for pharmacologic screening examinations…"*

◀ *"The researchers use human adherent tumour cell lines to perform in vitro examinations of the anti-tumour effect of vegetal extracts, isolated content substances and their synthetic analogues."*

"Safety Pharmacological tests focus on the electrophysiological parameters of the central and peripheral nervous system…" ▼



▲ *"Toxicologic experiments carried out in the Laboratory include the investigation of acute, repeated-dose, subchronic oral and dermal toxicity, and also neurotoxicology investigations in rodents."*

"The aim of the research team is to develop new syntheses, to create peptides that contain multiple disulfide bridges…" ▶

▲ *"…the team managed to create selective ion channel blocking analogues from scorpion toxins."*

Toxicity Examinations

The Department of Public Health at the Faculty of Medicine is led by Prof. Dr. László Nagymajtényi. Within the Department, a Safety Pharmacology and Toxicology Laboratory has been operating with a GLP certificate since 2003. The main profile of this specialized laboratory is the investigation of toxicological and safety pharmacological parameters altered by acute, subacute or subchronic exposure induced by toxic agents (drugs, biotechnological preparations, medical products, environmental xenobiotics and nanoparticles).

Toxicological experiments carried out in the Laboratory include the investigation of acute, repeated-dose, subchronic oral and dermal toxicity, and also neurotoxicology investigations in rodents.

Safety Pharmacological tests focus on the electrophysiological parameters of the central and peripheral nervous system, by the analyses of the spontaneous and evoked cortical activity, peripheral nervous activity, and cortical single unit activity. The tests are done in anaesthetized rats.

Research of Peptide and Protein Modifications

Professor Dr. Gábor Tóth's research team in the Laboratory of Peptide Chemistry in the Institute of Medical Chemistry at the Faculty of Medicine conducts research in the field of posttranslational modifications of peptides and proteins.

The posttranslational modifications of peptides and proteins on the one hand are essential in biological recognition processes, and other hand the modulation of the configuration of short bioactive peptides can led to the development of valuable lead compounds. Nowadays the synthesis of modified oligopeptides and the development of novel synthesis methods applicable for the modification of oligopeptides have become increasingly significant. The professionals in Szeged mainly deal with the synthesis of phosphorylated and glycosylated peptides, but their methods also include chemical alterations of proteins, fluorescent labelling of peptides and the synthesis and insertion of conformationally restricted structural elements into host peptides. In cooperation with researchers from another university, the researchers gained insight to

the B-cell receptor functions and the signal transduction process by applying B-cell permeable phosphopeptide derivatives.
The chemistry used to oxidize the free thiol (-SH) bonds to the corresponding disulfide (-S-S-) bond under control remains a significant challenge in spite of many advances in peptide chemistry. The primary reason for this is the difficulties involved in the formation of multiple regioselective disulphide bonds. One aims of the research team is to develop new syntheses to create peptides that contain multiple disulfide bridges, and to verify the position of the resulting disulfide bridges. In the frame of this project, in cooperation with the researchers of Debrecen University, the team managed to create selective ion channel blocking analogues from scorpion toxins, which can modulate the physiological functions of immune cells, and may open up new possibilities in the treatment of certain autoimmune diseases.

Cardiovascular Researches

The major research field of the Department of Pharmacology and Pharmacotherapy belonging to the Medical Faculty of the Szeged University represents physiological, pathophysiological and pharmacological investigations under the direction of professor Andras Varro.
They perform studies concerning the mechanisms of cardiac arrhythmias and the basic electrophysiology of the heart muscle in general, in intact large animals (dog, goat) and rodents (rat, rabbit) and in vitro tissue and cellular methods.
In addition his coworkers participate in several projects sponsored by the governement and industry which wished to develop new more effective and safer antiarrhythmic drugs than those applied presently in the therapy of both supraventricular and ventricular arrhythmias.
Since many of the available drugs – incuding cardiovascular and non-cardiovascular ones – exert serious life threatening side effects, intensive safety pharmacological research is carried out in the department to reveal these proarrhythmic mechanisms and to develop new effecive methods to prevent and predict drug induced proarrhythmic complications including sudden deaths.
The ongoing research in the department is also focused on the transmembrane ion-channel function and calcium homeostasis („electro-mechanical coupling") both having particular importance regarding cardiotonic, antiarrhythmic mechanisms and their possible pharmacological modulations.
In addtion there are ongoing experimental works to study the mechanisms of smooth muscle relaxing drugs such as coronary, systemic and penile vessel dilatators.
The Department of Pharmacology and Pharmacotherapy has so far made important contributions to the development of several drugs, such as the cardiotonic „Levosimendan" and the antarrhythmic „Dronedarone", drugs which came into the market recently and were applied successfully in the clinical practice.Also in recent years within the framework of industrial contracts, several compounds were studied regarding their possible proarrhythmic side effects.

▼ *"The ongoing research in the department is also focused on the transmembrane ion-channel function and calcium homeostasis."*

"They perform studies in intact large animals and rodents and in vitro tissue and cellular methods. ▲

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Coordination of Clinical Researches

In the field of sponsoring and organizing clinical researches, the departments of the Clinical Center providing medical attendance are in contact with numerous pharmaceutical and clinical research organising CRO companies. The Clinical Research Coordination Center, led by Prof. Dr. Lajos Kemény, has been coordinating and administering all the information of clinical researches conducted at every department of the institution since January 2007. Since 2008 the Coordination Center has been the member of the HECRIN Committee, which is the Hungarian member of the ECRIN, whose centre is in France (European Clinical Research Infrastructure Network).

V. Clinical pharmacology

Extensive clinical pharmacological research is conducted in several departments of the Albert Szent-Györgyi Clinical Center at the University of Szeged. During these researches the efficiency, effect mechanisms, side effects and the modification possibilities of side effects of new drugs and drug combinations are examined. Based on the results, novel pharmacokinetic and pharmacogenetic methods are developed. A Research Laboratory for Human Phase I Clinical-pharmacological Trials also operates at the University. Alongside with phase I. and bioequivalence tests, a great number of phase II-IV tests are conducted in the institution.

Through clinical pharmaceutical researches the professionals examine the efficiency, effect mechanism, side-effects and the side-effect alteration possibilities of new medications and combination of medications. The results of their research greatly contribute to the establishment of pharmacokinetic and pharmacogenetic methods that make the application of safer and more efficient therapies possible.

Human clinical trials of phase I-IV are conducted at the Clinical Center. Phase I. clinical trials are performed at the accredited clinical-pharmacological testing laboratory at the First Department of Internal Medicine. Phase II and III clinical trials were the most commonly conducted ones in the Clinical Center.

Pharmaceutical researches performed at the clinics of the Faculty of Medicine have contributed to the introduction of the most modern biological medications for the treatment of patients of neurological, cardiovascular, autoimmune, infectious and tumorous diseases. As a result of their

researches a number of new medications/drugs have been registered and listed; drugs for the treatment of infliximab, etanercept, adalimumab and ustekinumab autoimmune diseases (such as psoriasis, rheumatoid arithis, inflammatory bowel diseases) are among them. The researches significantly contributed to the assessment of the effectiveness of etacrolimus and pimecrolimus in atopic dermatitis and to the development of alitretinoin for the treatment of hand eczema. Examinations of oncologic indications provide new possibilities for patients with tumours to fight against their disease.

Accredited Human Phase I Clinical Trials

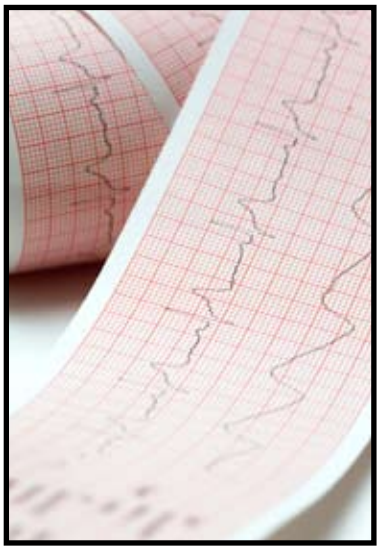
In November 2006, an accredited Research Laboratory for Human Phase I Clinical Trials started its operation at the First Department of Internal Medicine at the Faculty of Medicine. In this specialized Clinical Unit phase I type and bioequivalence examinations are performed, and the Laboratory is also responsible for the co-ordination of phase II-IV clinical trials. The database of healthy volunteers for phase I studies consists of nearly 300 people.

Due to the specialization and profiles of the department led by Prof. Dr. Tibor Wittmann, the subject of examinations is related mainly to internal medicine (nephrology, diabetology, hypertonology, gastroenterology, and endocrinology) and conducted at the institute but the Unit also performs examinations that involve partner professions (dermatology, rheumatology, oncology, and haematology).

In the Research Laboratory for Human Phase I Clinical Trials the bioequivalence examination of a cardiologic and a diabetologic substance was performed, and two examinations of biosimilars are in progress in rheumatoid arthritis and malignant lymphoma indications. Human phase I research was conducted to reveal whether a novel substance can contribute to the avoidance of leukopenia that occurs during the cytostatic treatment of malignant tumours. The Unit has also been requested to conduct tests into a novel immune therapy of psoriatic arthritis and rheumatic arthritis.

▲ *„…the professionals examine the efficiency, effect mechanism, side-effects and the side-effect alteration possibilities of new medications and combination of medications."*

▼ *"In the Research Laboratory for Human Phase I Trials the bioequivalence examination of a cardiologic and a diabetologic substance was performed…"*



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Biogas Production from Organic Waste

The Department of Biotechnology, led by Prof. Dr. Kornél L. Kovács is part of the Institute of Biology at the Faculty of Science and Informatics. The most significant research activity of the team, which has developed a collaboration with the Institute of Biophysics, the Biological Research Center and the Hungarian Academy of Sciences, is focused on hydrogen production by biological systems. Hydrogen is one of the energy carriers that will substitute fossil energy carriers in the future in order to ensure humanity's sustainable development.

Living organisms can produce hydrogen in various ways. Many of these approaches, whether on their own or in combination with others, can generate hydrogen economically from renewable sources. Prof. Kovács's team at the Department of Biotechnology is engaged in the generation of efficient and long lasting versions of the microbes that are of key importance in such processes. They are examining the extension possibilities of the technology's life span, and the methods to increase the working stability of the hydrogenase enzymes, one of the key molecular players in these systems. A range of related basic and applied development projects are studied as well.

One of their outstanding achievements is the internationally registered patent for a method that increases biogas production by 30 -50% by adding specially selected hydrogen producing mesophilic or thermophilic bacteria. Biogas production is significant as the anaerobic treatment of organic waste and biomass offers double advantage: harmful organic pollutants can be neutralized while producing a renewable energy source.

In cooperation with the BayGen Applied Research Institute, the team started to apply up-to-date metagenomic methods to examine the extremely

VI. Environmental Science

Technological developments contributing to maximal resource efficiency are essential due to the depletion of natural resources. Researches of environmental technology deal with the possibilities of using waste as raw material for producing energy, and with the more efficient utilization methods of natural resources such as solar energy. In addition to resource utilization, other important streams of environmental scientific research are environmental microbiology and the more accurate description of geographic and geologic processes and environmental reconstruction.

complex and continuously changing biogas producing microbial communities. Methods are being developed which provide the opportunity to engineer microbial communities that are able to utilise optimally the available raw materials, and are also exploitable in the daily operations of biogas facilities. This way, the efficiency and the security of biogas producing power plants can be significantly improved due to the results of an exciting new basic research project on the understanding of the relationships within microbe communities.

Researches of Environmental Microbiology and Biocontrol

At the Department of Microbiology at the Faculty of Science and Informatics research of microbiological plant protection has been conducted for decades. The demand is continuously increasing for environmentally friendly technologies due to the harmful environmental and health impacts of xenobiotics (e.g.: pesticides) used in intense agricultural practice. The researchers at the department have significant achievements in the development of bacterial and microscopic fungal biocontrol methods, which can be utilized in industrialized fungus cultivation and also for the protection of various vegetable cultures (hydroponically and outdoor grown).

In the field of environmental microbiology the associates conduct researches concerning the pesticides accumulated in the environment, and they work on developing the microbial background of bioaugmentation methods for neutralizing their hazardous decomposition product intermediers.

Innovative, microbial based products are being developed within an international cooperation project in order to contribute to safer food production and to lowering the level of pollutant compounds found in the environment.

The Department's researchers contributed to creating a number of inventions based on biocontrol methods. They developed molecular diagnostic methods that facilitate the investigation of the spread of certain vegetal pathogenic microorganisms. Other methods were developed for the effective production of bacterial depsipeptides with high practical importance. They identified strains applicable in bioaugmentation, which effectively degrade certain pesticides (e.g. carbendazim, mankozeb, diuron).

▼ *"…a method that increases biogas production by 30 -50% by adding specially selected hydrogen producing mesophilic or thermophilic bacteria."*

"…opportunity to engineer microbial communities that are able to utilise optimally the available raw materials." ▲

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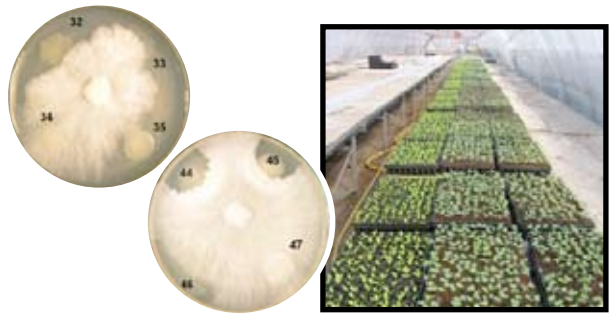

"…can be utilized in industrialized fungus cultivation and also for the protection of various vegetable cultures (hydroponically and outdoor grown)." ▲

Research of Solar Energy

The Environmental Chemistry Research Group at the Faculty of Science and Informatics is led by Prof. Dr. András Dombi. The team seeks solutions for the long-term utilization of the sunshine radiation: they examine the possibilities of converting sunlight directly to electric energy, and a related research project deals with hydrogen generation from water.

In order to achieve their goals, the associates conduct research and development projects in the field of materials science. These projects mainly focus on innovative, energy saving, closed-cycle material production technologies, but also address the issue of waste recycling as a support of environmental protection, and as partial solution of raw material matters.

During their research, they produced solar radiation utilizer photocatalyzers by which environmental pollutants can be directly degraded without using any other energy. Based on this method, a solution was found for the degradation of other toxic pollutants that are resistant to biological methods; a functioning technology is being built for this purpose.

The composite materials having been produced from photocatalyzers and carbon nanotubes have proved to be rather promising in certain water and air purification processes.

"During their research, they produced solar radiation utilizer photocatalyzers…" ▶

Geological Research

The luminescence research team at the Institute of Geography and Geology has achieved outstanding results in the field of luminescence dating, which is one of the most dynamically developing dating methods nowadays. By this technique it is possible to determine the last exposure date of loess and sand sized sediment grains to sunlight, and the firing date of potteries, terracotta artworks or bricks. The most important geological and archaeological and art historical applications of the method, among many others, include: description of the time and rate of past geographic and geologic processes, climate change research, environmental reconstruction, dating of archaeological findings and examining the authenticity of art works.

At the Department of Geology and Palaeontology, led by Prof. Dr. Pál Sümegi, the most recently developed technique of magnetic susceptibility measurements enables us to determine the concentration of ferromagnetic particles in geologic substances. Measurements are implemented along geological profiles, outcrop surfaces, soil and sediment surfaces as well as cores. The gained results allow for the stratigraphic subdivision of boreholes, and geological sequences, the identification of buried geological, archeological features. Furthermore, via the application of surface scanning, iron deposits of bacterial or mineral origin with potential successor elements can also be identified vertically as well as horizontally both in the lab and the field, enabling the correct spatial delineation of such features. These measurements may also play a significant role in aiding ammunition exemption prior to large-scale property investments and construction works; i.e. motorway, highway and railway constructions.

"…achieved outstanding results in the field of luminescence dating" "achieved outstanding results in the field of luminescence dating…" ▲

▲ *"…climate change research, environmental reconstruction, dating of archaeological findings and examining the authenticity of art works…"*

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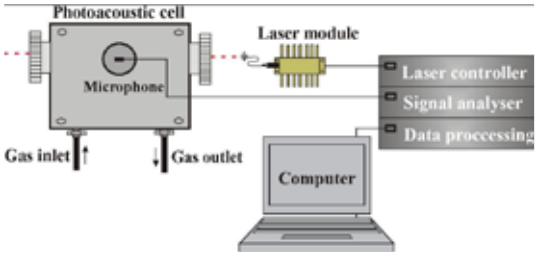
VII. Laser Physics

Laser technology researches conducted at the University of Szeged are based on deca des of scientific tradition and scholarly professionalism, and the research laboratories are equipped with internationally outstanding infrastructure. The two terawatt peak power titan-sapphire laser system (TeWaTi) which is unique in Hungary, the internationally acknowledged High Intensity Laser Laboratory (HILL), and the ELI-ALPS 'superlaser' which will be implemented in Szeged as a European Union common research infrastructure of a 200 million EUR investment altogether provide excellent technical facilities for future researches.

Laser Materials Research

The LAMILAB team is active in a number of fields within laser material processing and material research. After more than a decade of internationally acknowledged basic research, the pulse laser method of thin layer building is applied to produce the nanostructured sensory surfaces of gas sensors in order to simultaneously improve the selectivity and the sensitivity of the sensors. A Swedish-Hungarian cooperational research project is also in progress to develop a fibre-optic heart catheter that can perform in-vivo measurement of biomarker molecules by surface-enhanced Raman spectroscopy. The most recent research project of the group aims at producing nanoparticles with lasers, and at the laser assisted study of these production procedures.
The Photoacoustic Research Team, led by Prof. Dr. Gábor Szabó, also operates at the Department of Optics and Quantum Electronics at the Faculty of Science and Informatics. For the past fifteen years it has been dealing with the development of high-sensitivity laser based photoacoustic gas detection instruments for industrial and environmental measurement applications. The main application of the photoacoustic instruments developed by the Photoacoustic Research Team is to measure the concentration of the atmosphere's environmentally significant components (water vapour, aerosols, ammonia), and also to measure the water vapour and sulphur-hydrogen content of natural gas. The instruments developed by the team are marketable alternatives to the measurement tools currently being used. Another high priority research project of the group is the characterisation of the gas permeability of polymers. The research topics of the team are connected to current environmental protection and industrial measurement issues, and they are also matters of international attention.



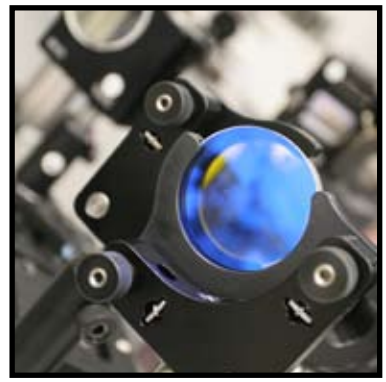
▲ *"…measure the water vapour and sulphur-hydrogen content of natural gas…"*

High Intensity (Excimer) Laser Laboratory

The High Intensity Laser Laboratory (HILL) led by Prof. Dr. Sándor Szatmári, is operated at the Department of Experimental Physics at the Faculty of Science and Informatics of the University of Szeged. As a result of its continuous development HILL became an internationally acknowledged 'user's facility' type laboratory, and joined Laserlab-Europe; the European network of laser research laboratories. The HILL lab has two femtosecond excimer laser systems, five vacuum chambers and the corresponding diagnostics.

The self-constructed KrF laser systems generate femtosecond pulses of 80mJ energy, at 248 nm wavelength, leading to 10^19 W/cm2 focused intensities. Through harmonic generation of this ultraviolet (UV) radiation high brightness radiation can be produced in the vacuum ultraviolet (VUV) range. The energy of UV lasers can also be efficiently converted to the X-ray range. A recently demonstrated X-ray generation mechanism allowing the generation of intense, coherent radiation at 2.7 A has great perspectives.

Since the Extreme Light Infrastructure (ELI) site will be located in Szeged, the experiments performed by the excimer lasers of the HILL lab become even more important. Certain problems which can be studied in this laboratory (such as interferometric multiplexing, temporal and spatial contrast improvements, etc.) could significantly contribute to the success of ELI.



▲ *"…the pulse laser method of thin layer building is applied to produce the nanostructured sensory surfaces of gas sensors…"*

▼ *"As a result of its continuous development HILL became an internationally acknowledged 'user's facility' type laboratory…"*

Researches on the Femtosecond Scale

This specialized research team was established at the end of the 1990's at the Department of Optics and Quantum Electronics at the Faculty of Science and Informatics. Its activity is based on Szeged's tradition of laser research, and it is nowadays the centre of Hungary's femtosecond scale, high intensity laser research. The main experimental device is Hungary's only titan-

sapphire laser system, the so called TeWaTi laser that produces close to 2 terawatt peak power pulses. The TeWaTi Laser and Research Group's scientific activity, which is supervised by Dr. Károly Osvay, is strongly connected to the scientific and technological development of the European research infrastructure, the ELI-ALPS (Extreme Light Infrastructure – Attosecond Light Pulse Source), which is to be built in Szeged, and also to the research to be conducted there.

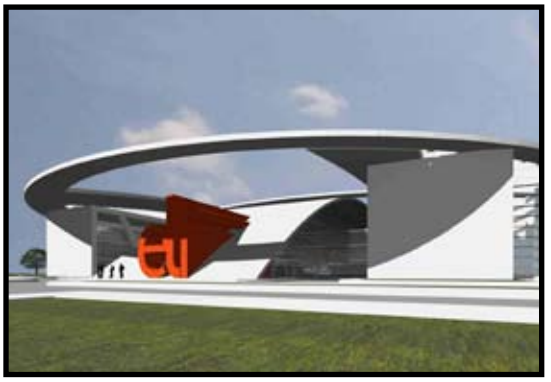
The Research Group has great achievements in the fields of measurement and diagnostics. They developed extremely accurate methods to measure material dispersion, including the measurement of the dispersion of air, neutral gases, biological materials, and optical fibres among many others. Based on their research results in the field of linear interferometry, they developed measurement methods for the temporal and spectral diagnostics of few-cycle laser pulses, including the determination of angular dispersion, and the measurement and stabilization of carrier envelope phase.

Among the planned and ongoing projects of the scholars of Szeged, it is worth mentioning the study of ultra-fast switching of proteins, which they conduct in cooperation with the Biophysics Institution of the Biologic Research Centre of Szeged; the measurement of the transient absorption of light-sensitive medicaments; and also the ultrafast, time resolved research on the of laser-light-induced ablation of the surface of materials.

Attosecond pulses can be produced by non-linear processes generated by high intensity femtosecond laser pulses. The researchers develop methods for increasing the efficiency of the generation as well as for the temporal and spectral characterization of the attosecond pulses.

During the experiments laser pulses that are different from the provided primer lasers often have to be used, so the variety of available laser pulses in the TeWaTi lab is constantly extended and their parameters are continuously developed, according to the researchers' experience in the fields of generation, amplification and frequency conversion of laser pulses.

The most outstanding results of the past five years are the new methods developed for the isochronic tuning of the carrier envelope phase of short pulses, and the two registered international patents based on them. The high-accuracy measurements of the linear refractive index of bacteriorhodopsin, and of the linear and non-linear refractive index of neutral gases are also worth mentioning. The research team's professionals have also generated femtosecond light pulses in the green spectral range, which is not possible to reach directly by laser. This result is absolutely unique in the field of light source development.



▲ *"European research infrastructure, the ELI-ALPS, which is to be built in Szeged…"*

"The main experimental device is Hungary's only titan-sapphire laser system, the so called TeWaTi laser that produces close to 2 terawatt peak power pulses." ▼

Lézeres orvos- és anyagtudományi kutatások

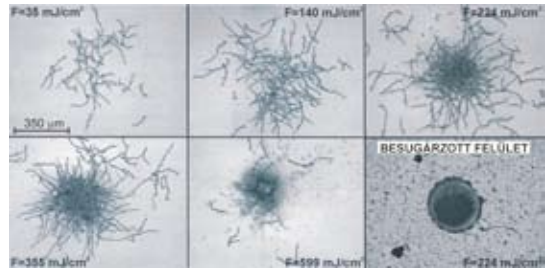
The Ablation Team within the Institute of Physics at the Faculty of Science and Informatics is led by Dr. Béla Hopp, and conducts high standard research in the field of medical and materials scientific applications of lasers. Alongside with their basic research activity, the members of the Team strive for developing practical methods based on their results.

The Ablation Team uses lasers for the segmentation, controlled transfer and deposition of biological materials which is a novel and promising field of research with great prospects. By this technology the associates could produce open heterogeneous stripes, layers and three-dimensional structures from living cells and biomaterials. The final aim of their research, among many others, is to produce new generation tissue-based sensors and living human tissues. Their novel, altered method enabled the researchers to transfer biological materials, such as spores and living cells. The transferred conidiums germinated, the cells continued to develop; they remained viable through the laser transmission.

The pulsed laser deposition of thin films (PLD) that is based on the high-intensity laser ablation of solid target objects proved to be applicable to produce thin films from a wide variety of materials. The team successfully produced thin films from polymers (Teflon), from biologically degradable plastic (polyhydroxybutyrate), from ezymes (urease, pepsin) and from human materials (tooth) as well. In the future, the associates are going to examine the medical diagnostical and maybe therapeutical application possibilities of these thin films.

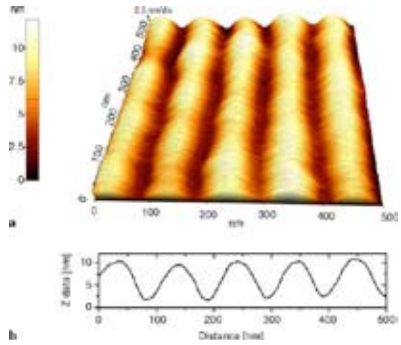
The research team also deals with the pulsed laser precision processing of transparent materials. Transparent materials processed in the micro- and nanometer ranges offer a number of micro-optical application opportunities, which fact makes their processing methods one of the frequently researched fields of physics. Among the indirect methods the most significant ones are the laser induced backside wet etching and the team's own development, the laser induced backside dry etching (LIBWE, LIBDE). By these methods the researchers produced fused silica gratings having 266 nm period, and by the LIBWE method they were even able to reach the104 nm period which is highly significant in point of the application possibilities.

In the fields of clinical practice and research, there is a gradually increasing demand for the constant monitoring of the blood supply of larger areas, for instance, during the examination of the vascularity of surgically reattached limbs, of the surface of the brain or of the fundus of the eye. Due to the research results of the team, it is possible to constantly measure the blood supply of an area as large as a hand by laser speckle (dispersal interference) contrast analysis. The researchers developed a sampling and data processing algorithm that eliminates measurement ambiguities caused by undesirable surface dispersal and reflection.



▲ *"Their novel, altered method enabled the researchers to transfer biological materials, such as spores and living cells."*

"…by the LIBWE method they were even able to reach the104 nm period…" ▼



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The main stream of materials science research involves the research of properly functionalized nanometals of controlled size and shape that can be applied widely in biological, chemical, electronic and optical systems in several fields of diagnostics, medicine and industrial production. Materials science research that may lead to the discovery of self-cleaning surfaces, the more efficient utilization of solar energy and industrial solvents is also of equal importance. The latter may play an important role in degrading pollutants and in the exploitation of raw materials.

Examination of Nanodispersions, Self-organizing Films and Biocomposite Materials

In the Colloids and Nanostructured Materials Research Group at the Department of Physical Chemistry and Materials Science, and in the Supramolecular and Nanostructured Materials Joint Cooperation Research Team of the University of Szeged and the Hungarian Academy of Sciences (HAS), the researchers led by Prof. Dr. Imre Dékány, mainly deal with colloid dispersions, self-organizing systems examined in materials science and in nanotechnological applications and the aggregation of biocolloids such as proteins.
The researchers developed complex liquids (nanoemulsions) for the Hungarian Oil and Gas Company, MOL Plc. that can enter into the smallest pores of the reservoir rocks, thus they provide the opportunity of so called tertiary (enhanced) recovery of crude oil (EOR) and natural gas in Hungarian oil and gas fields.
Under a commission of Fraunhofer Gesellschaft, the research team also produces reactive self-organizing surfaces and also deals with photo-catalysis which makes it possible to produce photocatalytic self-cleaning thin films. They developed functionalized (plasmonic) photo-catalysts that are capable of degrading pollutants as a reaction to natural light thus they can be used for both environmental protection and civil defence purposes. According to one of their most recent results, functionalized reactive surfaces reacting under solar light are also possible to apply in microbiological researches, namely, the possible methods for swiftly destroying various antibiotic-resistant bacteria have also been developed. Their

VIII. Nanotechnology and Materials Science

"…fluorescent nanoparticle powders self-organizing films and nanostructured electrode coating materials were synthesized…"

results can be utilized in healthcare and in every field that deals with bacteria and viruses that threaten human health.

The associates also developed hydrophobized intercalated nanocomposites for the fragrance industry giant, Firmenich SA. The characteristics of such nanocomposites have recently been examined during the development of products that could ensure the controlled release of drug and scent molecules.

For GE Hungary, fluorescent nanoparticle powders, self-organizing films and nanostructured electrode coating materials were synthesized, which are used for the development of novel energy efficient light sources by the industrial partner.

The synthesis of controlled size and shape noble metal (e.g.: gold and silver) nanoparticles is of high priority among the projects of the research teams. They produce nanosized gold and silver with different surface plasmonic properties, and their alloys in order to analyze the biocompatibility of the biologically active materials absorbed on their surface, and the effect of the surface modification under physiologic circumstances. They attach drug agents such as peptides to the functionalized noble metal particles. Functionalized noble metal particles are also used during the development of optical sensors exploiting the fact that their plasmonic characteristics are significantly modified by protein aggregation. They also create an optical waveguide biosensor that facilitates the quantitative analysis of the bond of drug molecules in the nanogram/cm2 range on its surface, in various biological systems.

Research of Nano-structured Materials

The research conducted at the Department of Applied and Environmental Chemistry at the Faculty of Science and Informatics is supervised by Dr. Zoltán Kónya, and focus on the extension of the production and characterization methods of materials with novel properties.

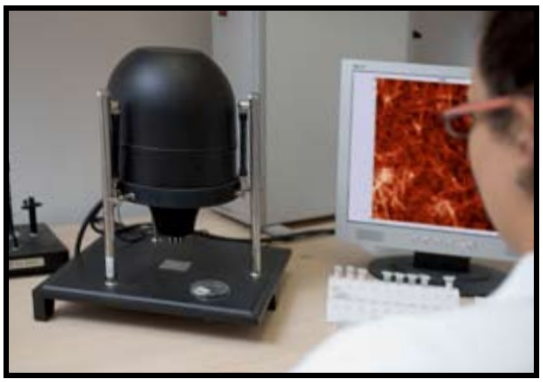
The main stream of their research is the development of nanoporous solid materials to be used as absorbents and catalyst supports, and the production of metallic and semiconductor nanoparticles for catalytic, photoelectric, sensory and healthcare purposes. The research group also deals with the development of metal, carbon and metal-oxide nanotubes and nanofibers, which can be used for composite construction and for sensory and photocatalytic applications.

Their most current results concern the production and utilization of one-dimensional nanostructures (titanate and carbon nanotubes). Carbon and other inorganic nanotubes, and

▼ *"...the possible methods for swiftly destroying various antibiotic-resistant bacteria have also been developed."*

▼ *"Carbon and other inorganic nanotubes, and the composite materials made with their proper modifications can be used for a wide variety of purposes..."*

the composite materials made with their proper modifications can be used for a wide variety of purposes, for instance to bond biologically active proteins (while conserving their activity), and to increase the efficiency of photocatalytic processes.



▲ *"Their most current results concern the production and utilization of one-dimensional nanostructures (titanate and carbon nanotubes)."*

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IX. Information Technology and Software Development

At the University of Szeged extensive research is conducted in the fields of online algorithm development and artificial intelligence with results relevant for language technology.
Software quality research that deals with the analysis of the problems present on the code level of software products helps prevent or delay software 'aging'.
Computer optimization bears ever greater economic relevance, the spectrum of research concerning this branch is continuously expanding to incorporate non-linear optimization and microsimulation.
Results of such research contribute to traffic modelling, production simulation or even the solution of various ranking problems.

Research of Artificial Intelligence

Among those researchers who deal with software development at the Department of Computer Algorithms and Artificial Intelligence in the Institution of Informatics, Prof. Dr. János Csirik and his colleagues focus their research on artificial intelligence and algorithms.
One of their main research fields is online optimization, a particular type of algorithm where the entire input is not known at the beginning, rather certain fragments of the input are received while the algorithm is already running, and it is allowed to make decisions only according to the information it has already received. Results of such research hold significant practical potential, especially in solving problems for service providers.
Development projects of softwares for annotation of natural language databases and for text processing are also conducted at our University. Among these one can find segmentation programmes, which divide the raw texts into paragraphs, sentences and words; a Hungarian morphology analyzer software that analyses the order and the type of affixes attached to the roots; part-of-speech definition programmes and also syntactic analyzer softwares. Customised softwares were made for recognizing proper nouns, medical diagnoses, gene interactions and even participants of business news. Linguistic databases, so called corpuses have been developed for years.
Hungarian, speech recognition related solutions are also crucial elements of the R&D activity. The analysis of new acoustic modelling algorithms, which make large scale vocabulary dictation possible, and the research focused on making sound-archives searchable by keyword search algorithms belong to this field.
The development of the Speech Master Software that supports the speech learning of the hearing impaired

and the teaching of reading to elementary school students is an outstanding result.
The research team also participates in the development of the econophysics forum's WEB 2.0 portal, and deals with programming wireless sensor networks. The latter is a new feature in the profile: it involves the development of energy efficient medium access protocols, time synchronizer, localizer and data forwarder algorithms and their applications.

▲ *"The development of the Speech Master Software is an outstanding result…"*

Research on Software Quality

Prof. Dr. Tibor Gyimóthy and his colleagues, who work at the Department of Software Engineering within the Institute of Informatics at the Faculty of Science and Informatics, have made major scientific achievements in a number of significant research fields.
Due to their research activities related to the different tools and technologies supporting software quality assurance, now various tools are available for source code analysis in several programming languages. In addition, the tools for software architecture reconstruction and software development enable the users to gain more information about the weaknesses of software and the problematic modules on code level. Relying on the software quality indicators, the aim of the software quality research group is to create a criteria system for providing a clear and understandable description of the quality of software.
The research group also conducts research activities in the field of M2M (Machine-to-Machine) solutions and embedded systems. M2M solutions are mainly utilized in telemedicine and agriculture. The research group has developed a reference architecture and methodology which can speed up the development process of M2M applications and reduce their total development costs. The group also have remarkable achievements in integrating telemedicine sensors into mobile phones and in transferring GSM based data

▲ *"…the analysis of new acoustic modelling algorithms, which make large scale vocabulary dictation possible…"*

"…to create a criteria system for providing a clear and understandable description of the quality of software." ▼

adjusted to M2M systems. The researchers are also involved in developing software for embedded systems: they have developed energy consumption optimization software solutions for XScale processors.

The researchers of the Department participate in developing open source systems as well. They have been working on the development and optimization of the WebKit mobile browser engine, on the optimization of gcc, one of the most widespread open-source C compilers, and on its porting to the Symbian system. Due to several successfully accomplished industrial research projects, the researchers have also gained significant experience with the Drupal content management system.

Computational Optimization Research

Professor Tibor Csendes and his colleagues at the Department of Computational Optimization conduct research mainly in the fields of optimization and reliable computer procedures.

Among optimization models, those involving non-linear functions are frequently used especially in higher dimensional spaces, when a number of variables are to be optimized. To solve such problems they develop general-purpose algorithms, which are especially efficient in finding solutions for problems with a higher computational complexity. Many of their programmes are used for both basic and applied research and also for development purposes worldwide, such as for designing optimal public lights and for scheduling automotive industry production.

The reliable numerical algorithms developed by the research team are used during the control of hazardous mechanical systems, during solving some theoretical problems with mathematical rigour, and also during the automatic validation of data uncertainty.

The industrial research project conducted with a micro-simulation method is one of the most significant achievements of the research team; they confirmed the advantageous effects of time-based tickets in terms of economic and traffic technology in the case of a middle-sized city's public transportation system. The micro-simulation method proved to be adequate for the project's purposes, and was also appropriate for the numerical expression of the economic, passenger satisfaction and performance results.

A new research direction is detecting quality within systems described by networks based on the PageRank algorithm and its further developed versions. The target fields are the evaluation of wine tasting tests on the basis of wine-tasters' votes (similar to tennis and chess rankings), and the refinement of scientometric indicators according to the directed graph constructed on the basis of references.

▲ *"The industrial research project was conducted with a micro-simulation method concerning a middle-sized city's public transportation system."*

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