



CEITEC

Central European Institute of Technology  
BRNO | CZECH REPUBLIC**NEWSLETTER**

Dear CEITEC Friends,

It has been an exciting year for CEITEC. We are starting to see the seeds that were planted during the founding of CEITEC germinate. Our scientific outputs are quite high for Czech standards, but the true measure of our discoveries will be the impact that they have in a broader context. Within the last year we have published several articles in the Nature Publishing series, for example, which we see as the beginnings to achieving greater scientific impact. Our role within the wider scientific community is invaluable in light of the launch of Horizon 2020, which places emphasis on collaboration throughout Europe. In this context, we have been active in the newly formed EU-Life initiative as the only member from emerging Europe, and we are also

engaged in the ESFRI Roadmap. We have 5 of our planned 9 open access core facilities now functioning which provide a great platform to initiate joint projects. Looking forward, 2014 will be an important year. We are scheduled to complete the new CEITEC buildings which will bring many of our scientists together and enable cross-disciplinary activities. Additionally, we will have the second international scientific evaluation of our progress in September. Within the pages of this quarterly newsletter, you will read about some of the awards our scientists have recently received, which we are proud of, as well as our events that we hosted. Thanks again for your continued support of CEITEC and our mission.

*Best wishes,*

**Markus Dettenhofer**

## CONTENT

---

### 3 GRANTS

Karel Říha receives a prestigious EMBO Installation Grant 2013

### 3 AWARDS

Prof. Alexandra Šulcová wins the Milada Paulová Award for her lifetime achievements in pharmacological science

The scientist Terezie Mandáková receives the Award of the Minister of Education

The team of Prof. Chmelík wins award for best cooperation of the year

Students from CEITEC VRI succeed in the Leica Calendar Contest

### 6 OTHER INTERESTING NEWS

Jiří Nantl becomes the Operational Director of CEITEC

Meeting of CEITEC and EMBL in Heidelberg

### 7 PAST EVENTS

CEITEC supported the prestigious international conference MSMF7

Week of Science and Technology

ELIXIR Director Dr. Niklas Blomberg delivered a lecture in Brno

### 9 UPCOMMING EVENTS

3<sup>rd</sup> International Congress on Epilepsy, Brain and Mind

Structural Biology Seminar Series

### 10 INTERVIEW WITH CEITEC SCIENTISTS

Karel Maca, Martin Trunec, David Salamon – principal investigators in the Bio-Scaffolds project

### 13 SELECTED PUBLICATIONS

Advanced Nanotechnologies and Microtechnologies

Advanced Materials

Structural Biology

Genomics and Proteomics of Plant Systems

Molecular Medicine

Brain and Mind Research

Molecular Veterinary Medicine



## GRANTS

### Karel Říha receives a prestigious EMBO Installation Grant 2013



Karel Říha

Karel Říha has received an EMBO Installation Grant and is the only Czech scientist to have done so in 2013. EMBO – the European Molecular Biology Organization gives grants once a year and this year has awarded it to six scientists from the Czech Republic, Poland, Portugal and Turkey. The EMBO Installation Grant enables the successful researchers to establish their own research group in the country of their origin.

Karel Říha graduated from genetics and molecular biology at Masaryk University in Brno, where he also received the title of PhD. He drew up the doctoral project at the Institute of Biophysics, Academy of Sciences of the Czech Republic under the leadership of Prof. Boris Vyskot. In 1999-2002 he worked as a postdoc at Texas A&M University, USA. He acts as a research group leader at Gregor Mendel Institute in Vienna Biocentre and in 2008-2011 he achieved the position of Deputy Director there. Since July 2013 he has also been working in CEITEC.

More information can be found [HERE](#)



## AWARDS

### Prof. Alexandra Šulcová wins the Milada Paulová Award for her lifetime achievements in pharmacological science



Prof. Alexandra Šulcová

© photo: Michal Ureš

On 5 December 2013 Prof. Alexandra Šulcová, the [Experimental and Applied Neuropsychopharmacology](#) research group leader at CEITEC MU, received the Milada Paulová Award, awarded to females for their lifetime achievements in science. The purpose of the award is to draw attention to and appreciate the scientific work of important Czech female researchers and through their example to inspire female scientists or students at the start of their careers. This was the fifth year that this prize has been awarded, this time in the field of pharmacology, specifically experimental and clinical pharmacology and toxicology.


Alexandra Šulcová has been involved in research in the field of experimental neuropsychopharmacology and ethopharmacology. The focus of her professional interest is the neuropsychotropic effects of substances contained in cannabis and generally research into the neurobiology of drug addiction and the effects of drugs on motoric skills,

emotionality and cognition. Professor Šulcová cooperates with many international teams in science and she is the organizer of important international conferences. For her erudition in the research fields she pursues, she has won recognition from scientists around the world as well as from renowned international professional societies where she has been, and remains, involved in their executive committees.

## The scientist Terezie Mandáková receives the Award of the Minister of Education

For her excellent results during her doctoral programme in the field of general and molecular genetics, Terezie Mandáková from CEITEC MU received the Award of the Minister of Education, Youth and Sports for excellent students and graduates in study programmes. The award ceremony took place on 21 November 2013 in the hall of the National Museum of Education of J. A. Komenský.

Terezie Mandáková works in the [Plant Cytogenomics](#) research group of Martin Lysák. The talented scientist has achieved extraordinary scientific results in the field of the evolution of plant chromosomes and genomes. She is close to being alone in the world in using the unique method of chromosome painting in plants in her studies, which enables us to compare genome structures of various species.

The scientific results of Terezie Mandáková are extraordinary on a global scale. During her doctoral studies she published a number of pieces of work in top scientific journals as the first author, e. g. in *The Plant Cell*, *New Phytologist* and others. She has also participated as an author in three articles published in one of the most prestigious scientific journals – *Nature Genetics*. 

More information can be found [HERE](#)




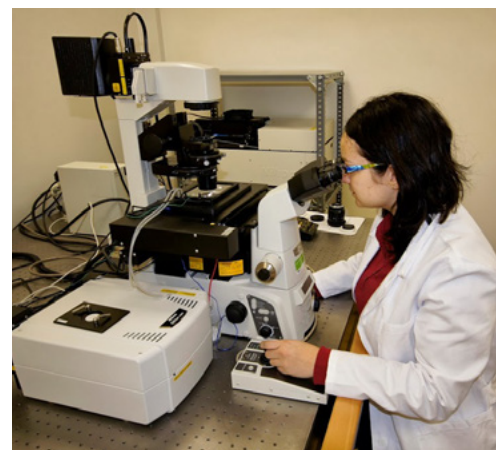
Terezie Mandáková

## The team of Prof. Chmelík wins award for best cooperation of the year

On 22 October 2013 the Association for Foreign Investment (AFI), American Chamber of Commerce in the Czech Republic (AmCham) and the Technology Agency of the Czech Republic (TAČR) awarded projects of The Cooperation of the Year between the companies and research spheres. The first place was taken by the Czech company TESCANA and the Faculty of Mechanical Engineering at BUT Brno with a holographic camera microscope using 3D technology. The co-author of the patent is the CEITEC scientist Radim Chmelík, [Experimental Biophotonics](#) research group leader.

This revolutionary prototype of a microscope based on camera recording, enables researchers to measure accurately the localization and trajectory of very quickly changing objects of research – for example cells – in 3D. This device will be found useful in biological and technical fields as well.


This is the third time that the competition in Cooperation of the Year has been held. Its aim is to increase awareness of successful examples of the application of scientific findings in corporate practice and also to stimulate such cooperation in the future. 



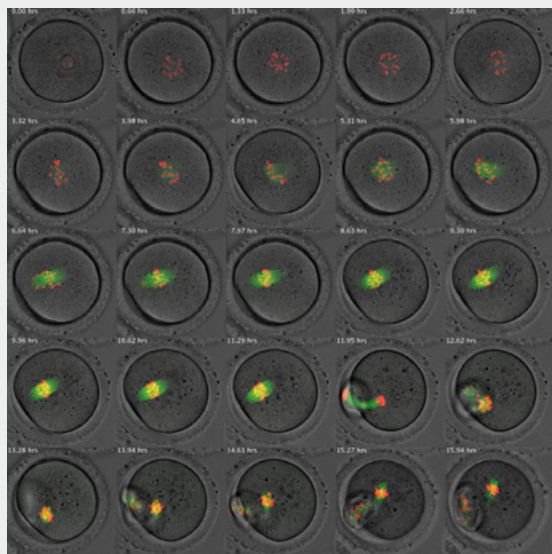
Holographic camera microscope

## Students from CEITEC VRI succeed in the Leica Calendar Contest

The company Leica, producing advanced microscope technology, opens a competition every year, where scientists enter interesting photographs created by microscopic technology. Out of these pictures a jury of experts chooses 12 photographs, which will be shown in the company calendar for the next year. Out of a huge number of competing photographs, there are also two pictures by two PhD students

– Lucie Nováková and Kristína Kovačovicová, representing CEITEC Veterinary Research Institute, which have been selected. You can see their work below and also in the [calendar 2014](#) in the months of November and December. Both students are working in [Mammalian Reproduction](#) research group headed by Martin Anger and are involved in the area of chromosome segregation errors in meiosis in mammalian oocytes. 

November

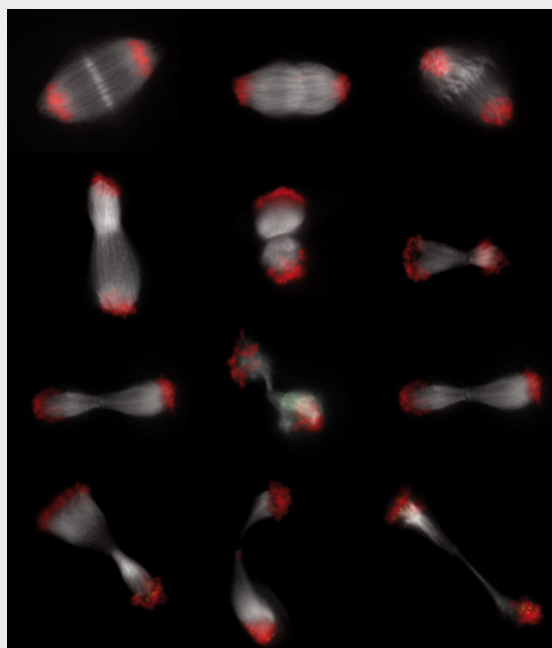


### Lucie Nováková

Her research is focused on chromosome segregation errors in female meiosis and early embryo development.

**Meiotic maturation:** The image is a montage of selected time frames from a time-lapse recording of the meiotic maturation of a mouse oocyte. The images are an overlay of fluorescence images with images acquired using transmitted light as contrasting method.

December



### Kristína Kovačovicová

In her previous work she focused on molecular prenatal diagnostics. Nowadays she is interested in spindle assembly and chromosome missegregation in the female meiosis.

**Polar body extrusion:** Montage of spindles from mouse oocytes during the polar body extrusion process.


## OTHER INTERESTING NEWS

### Jiří Nantl becomes Operational Director of CEITEC



**Jiří Nantl**, CEITEC Operational Director

On 18 November the former First Deputy Minister of Education Jiří Nantl became the new Operational Director of CEITEC. The competence of the Operational Director of CEITEC includes mainly financial and project management, quality, risk management and human resources management. This experienced manager has been appointed to this position based on an open selection procedure.

Jiří Nantl graduated in Political Science, Social Policy and Social Work at the Faculty of Social Studies MU and in the field of Law at the Faculty of Law MU. Between 2005 and 2010 he worked at Masaryk University, first as the Head of the Department of Studies of the Rector's Office, and later as the Chancellor and Director of Legal and Corporate Relations. Between 2010 and 2012 he worked at the Ministry of Education in the position of Director of the Department of Higher Education and also Deputy Minister, during the term of Petr Fiala as Minister of Education he was the First Deputy Minister. 

More information can be found [HERE](#)

### Meeting of CEITEC and EMBL in Heidelberg

A delegation from CEITEC visited their counterparts at [EMBL](#) (The European Molecular Biology Laboratory) in Heidelberg on 6 December 2013.

The cooperation with EMBL as a truly international and top-level institution is based on a number of overlaps in science as well as interesting management principles

that pursue excellence. The visit provided an opportunity for members of the administration to discuss existing good practice in the fields of international relations, event management, internal and external courses, PhD programmes and training, grants services, core facilities management and technology transfer which have proven to be successful at EMBL.




**Top row (from the left)** : Vladimír Beneš, Jana Pavlič, Jan Neuman, Nikola Kostlánová, Olga Bohuslavová, Zlatuše Novotná, Silke Schumacher, Helke Hillebrand  
**Bottom row**: Eliška Omelková, Kateřina Vágnerová, Monika Sieberová

The study visit has been organized within the [SYLICA](#) project (contract No. 286154, 7th Framework Programme) which supports the capacity-building activities and the international strategic partnership of CEITEC. A follow-up visit of CEITEC researchers is being planned for the spring semester. 

## PAST EVENTS

### CEITEC supported the prestigious international conference MSMF7

CEITEC supported the prestigious Seventh International Conference on Materials Structure & Micromechanics of Fracture (MSMF7) which was held at the Faculty of Mechanical Engineering BUT on 1–3 July. This three day scientific meeting was focused on fundamental relations between structural and mechanical characteristics of materials and attracted more than 250 participants from 32 countries. The conference chairman was Prof. Jaroslav Pokluda and the chair of the local organizing committee was Prof. Pavel ŠanĎera (both from FME and CEITEC BUT).

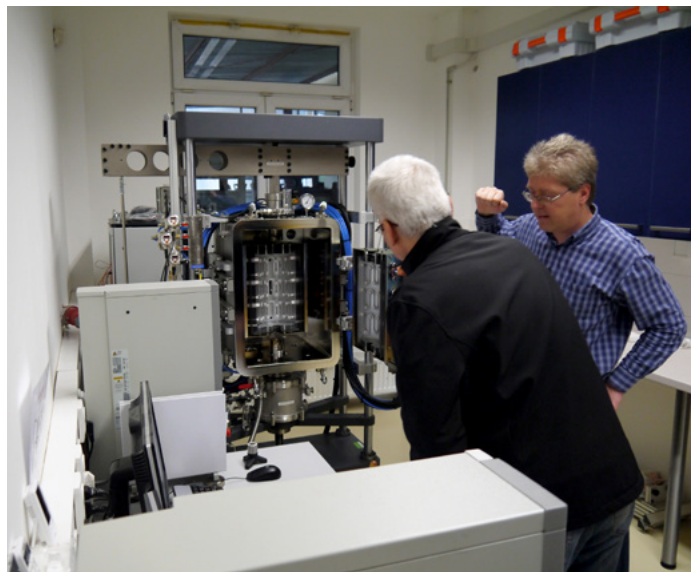
Prof. Ehrenfried Zschech, president of the Federation of European Materials Societies (FEMS), and Prof. Stefano Beretta, vice-president of the European Structural Integrity Society (ESIS), actively attended the opening ceremony as prominent guests of MSMF7. They expressed the great interest of FEMS and ESIS in the MSMF7 conference and emphasized its scientific and social significance. During the conference, world-leading experts in the field of fatigue and fracture delivered 6 plenary and 15 keynote lectures. A further 142 oral contributions and 67 posters were presented in 10 technical sections. Participants also enjoyed the rich accompanying social programme. The conference was truly successful and led to a deepening of existing cooperative relationships as well as to the establishment of new professional contacts. 



Conference photogallery can be found [HERE](#)

## ★ Week of Science and Technology

The Institute of Physics of Material AS CR, v. v. i. (IPM), the CEITEC partner institution, is annually involved in the Week of Science and Technology organized by Academy of Sciences of the Czech Republic. In this week celebrating science and technology IPM held an Open Day on November 7. Visitors could attend lectures for the general public led by CEITEC staff and become familiar with research equipment. Researchers presented unique devices of CEITEC IPM together with practical demonstrations of the equipments' use. The most interesting equipment presented to the public was a system for measuring electric, magnetic and transport properties in the range of 4-300 K, an axial-torsion fatigue test system and creep machines enabling testing in a range up to 1400 °C (in the figure). Mainly university students, secondary school students, PhD students and also visitors from technological companies and other research institutions showed interest in the Open Day. 🟩



Unique creep machine for tests up to 1400 °C

## ★ ELIXIR Director Dr. Niklas Blomberg delivered a lecture in Brno



**Dr. Niklas Blomberg**, ELIXIR Director

On November 26, Dr. Niklas Blomberg, ELIXIR Director, delivered a lecture in Brno. The goal of ELIXIR is to orchestrate the collection, quality control and archiving of large amounts of biological data produced by life science experiments. Some of these datasets are highly specialised and would previously only have been available to researchers within the country in which they were generated.

Dr. Blomberg started the block of lectures with his presentation about the ELIXIR project. This was followed by lectures aimed at Czech institutions involved in ELIXIR and their role in this project. Dr. Blomberg's visit to Brno was organized by CEITEC, CERIT-SC and UPOL. 🟩



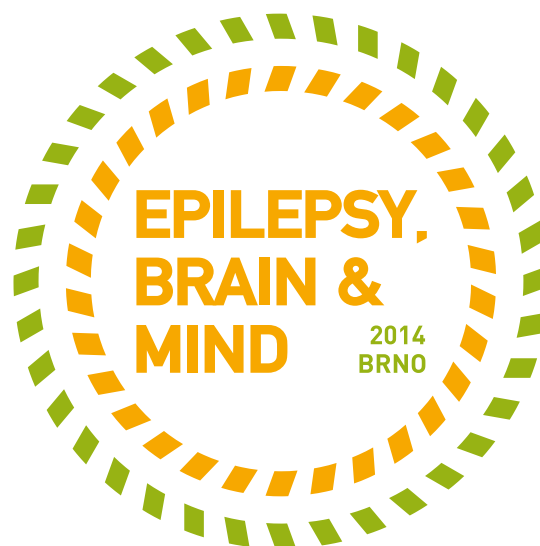
## UPCOMING EVENTS

---

### 3<sup>rd</sup> International Congress on Epilepsy, Brain and Mind

We are very pleased to announce the 3<sup>rd</sup> International Congress on Epilepsy, Brain & Mind which will take place in Brno, Czech Republic on April 3 – 5, 2014.

Epilepsy is both a disease of the brain and the mind. Brain diseases, structural and/or functional, underlie the appearance of epilepsy, but the notion of epilepsy is larger and cannot be reduced exclusively to the brain. We can therefore look at epilepsy from two angles. The first perspective is intrinsic: the etiology and pathophysiology, problems of therapy, impact on brain networks, and the “mind” aspects of brain functions – cognitive, emotional, and affective. The second perspective is extrinsic: the social interactions of the person with epilepsy, the influence of the surrounding environment, and the influence of epilepsy on society. All these aspects reaching far beyond the pure biological nature of epilepsy have been the topics of two International Congresses of Epilepsy, Brain, and Mind that were held in Prague, Czech Republic, in 2010 and 2012. Third Congress, supported by CEITEC, will be held in Brno, Czech Republic on April 3 – 5, 2014.



**WHEN:** April 3 – 5, 2014

**WHERE:** Brno, Czech Republic

More information can be found [HERE](#)

---

### Structural Biology Seminar Series

You are cordially invited to the CEITEC Structural Biology Seminar Series organized by Structural Biology research programme coordinator, Prof. Vladimír Sklenář. The lectures have been organized every month since January 2013 and will continue in 2014 as well.

More information and the programme can be found [HERE](#)

## INTERVIEW WITH CEITEC SCIENTISTS

### Prof. Karel Maca, Prof. Martin Trunec, Dr. David Salamon – principal investigators in the Bio-Scaffolds project

Research Group – **Advanced Ceramic Materials** | Research Programme – **Advanced Materials**

#### Congratulations on gaining an FP7 project, which you will use to develop a special bioactive replacement for jaw bone. Can you tell us how difficult it was to get an FP7?

Our workplace applied for the FP7 project concerning bioceramic materials in 2011 but it was not successful then. However we gained valuable experience and contacts with European workplaces in the field. Three of the members of the consortium at that time – BUT, Universidad de Extremadura (Spain), and Ortoma AB (Sweden) – have also become members of a new consortium, whose main coordinator is the University Medical Center of the Johannes Gutenberg University Mainz (Germany). Four workplaces in China are also members of the consortium within the collaboration challenge.

The long-term preparation of the project started on our initiative with a meeting of three European and one Chinese workplace in Prague. It was followed by a three-month-long period of writing the project itself and at the beginning of 2013 we received the information that, from a total of 22 projects which passed the first round of evaluation, our project had been placed among the top three projects financed.

#### How did you get involved in such a multinational project?

The project is a result of our long-term cooperation with professor Shen from Tsinghua University and also the cooperation of the University Medical Center of the Johannes

**Karel Maca** graduated in the Physics of Solid Materials at Masaryk University in Brno. Since 1988 he has worked at the Faculty of Mechanical Engineering in Brno, where he gained his doctorate in 1996, he received his habilitation title of docent in 2006 and since 2011 has been a professor in the field of Material Sciences and Engineering. Since that time he has also been a senior researcher in CEITEC BUT. He is the author of over 35 publications in renowned scientific journals, has more than 300 citations and a h-index of 12.

He is the national coordinator and a “principal investigator” in the area of analysis of microstructure of porous materials in the Bio-Scaffolds project.



The project team at the Kick-off meeting  
(2 September, 2013)

Gutenberg University Mainz with professor Wang from Tsinghua University and professor Liu from Peking University.

### What do you see as most interesting about your project?

The aim of the project is the preparation of natural inorganic polymers and smart functionalized micro-units applied in the customized rapid prototyping of bioactive scaffolds. The aim itself shows the multidisciplinary nature of the project, where material research, physiological chemistry, and image processing meet and the whole chain is concluded by clinical tests which will take place in China.

### Can you describe exactly what you are going to study within your FP7?

In general our main task is the preparation of porous ceramic structure with a defined shape and microstructure, according to a patient's individual needs. We will use mainly two basic procedures for that – the processing of micro-units with controlled porosity, and porous foam with customized outer shapes and internal porosity produced by CNC milling of gel-casted blanks. Subsequently these structures will be modified by a special bio-organic polymer (from a patented workplace in Mainz) accelerating the production of osteocytes.

### How long have you been interested in ceramic implants?

We have had experience with the preparation of bioceramic implants in our workplace since the second half of 1990s – however at that time it was bulk ceramics, for example for joint replacements. Nowadays it is the preparation of porous ceramic materials which should help the accelerated penetration and healing of bone tissue.

### How many scientists from the Advanced Ceramic Materials group are involved in the project?

There will be four researchers, two PhD students and two technicians working on the project. All employees range between 0.1 and 0.2 FTE.



*In general our main task is the preparation of porous ceramic structure with a defined shape and microstructure, according to a patient's individual needs.*

**Martin Trunec** graduated in Foundry Technology at the Faculty of Mechanical Engineering, BUT. In 1988-1990 he worked as a researcher in the National Research Institute of Materials in Brno. Since 1990 he has been working at the Faculty of Mechanical Engineering in Brno, where he gained his doctorate in 1996 and in 2006 he received his habilitation title of docent. He was also appointed professor in 2011 in the field of Material Sciences and Engineering, and since then he has been a senior researcher in CEITEC BUT. He is the author of over 25 publications in international scientific journals, has more than 270 citations and he has a h-index of 10.

He is a "principal investigator" for the area of "subtractive manufacturing" in the Bio-Scaffolds project.

**David Salamon** graduated in the Chemistry of Materials at the Faculty of Chemistry, BUT. In 2001 he started a doctoral programme in the Institute of Inorganic Chemistry, Slovak Academy of Sciences, which he completed in 2005. Subsequently he started a post-doctoral fellowship at the Faculty of Natural Sciences at Stockholm University in Sweden. After its completion he worked as a researcher at the Faculty of Natural Sciences and the Faculty of Mechanical Engineering, Twente University, the Netherlands. Since September 2011 he has been a researcher in CEITEC BUT. He is the author of over 20 publications in renowned scientific journals, has had more than 80 citations, and has a h-index of 5.

He is a "principal investigator" for the area of "micro units" in the Bio-Scaffolds project.

### Your research interests are much broader. What else are you working on?

All three principal investigators are also principal investigators for other projects in the field of technology of ceramic materials for structural and functional applications. These projects include basic (GAČR, COST) as well as applied research (TAČR).



**Dr. David Salamon** and **Prof. Karel Maca**  
© photo: Tomáš Škoda, Hospodářské noviny

### In CEITEC you work in the Advanced Ceramic Materials research group – who are you going to be cooperating with inside CEITEC? Who are you planning to work with outside CEITEC?

Currently we are already developing cooperation with other research groups within our research programme Advanced Materials and with some groups in programme Advanced Nanotechnologies and Microtechnologies. We would like to use the experience acquired with the above-mentioned bioceramic project Bio-Scaffolds in cooperation with some programmes from the life sciences fields of CEITEC.

Outside CEITEC we would like to develop our existing cooperation with significant European workplaces (Stockholm University, ETH-Zurich, IENI-CNR Genoa, IKTS Dresden,...) and of course with the members of the consortium of the Bio-Scaffolds project. We are also open to other constructive cooperation with the aim of a joint publishing activity and mainly the preparation of projects for the Horizon 2020 programme.

**Thank you for the interview!**

## SELECTED PUBLICATIONS

### ADVANCED NANOTECHNOLOGIES AND MICROTECHNOLOGIES

#### Physical Review Letters

*Interface-Induced Room-Temperature Ferromagnetism in Hydrogenated Epitaxial Graphene*

Giesbers A., Uhlířová K., **Konečný M.**, Peters E., Burkhard M., Aarts J., Flipse C.

**Research Group:** Fabrication and Characterisation of Nanostructures

**Research Programme:** Advanced Nanotechnologies and Microtechnologies

**Summary:** We show ferromagnetic properties of hydrogen-functionalized epitaxial graphene on SiC. Ferromagnetism in such a material is not directly evident as it is inherently composed of only nonmagnetic constituents. Our results nevertheless show strong ferromagnetism with a saturation of  $0.9\mu_B/\text{hexagon}$  projected area, which cannot be explained by simple magnetic impurities. The ferromagnetism is unique to hydrogenated epitaxial graphene on SiC, where interactions

with the interfacial buffer layer play a crucial role. We argue that the origin of the observed ferromagnetism is governed by electron correlation effects of the narrow Si dangling bond states in the buffer layer exchange coupled to localized states in the hydrogenated graphene layer. This forms a quasi-three-dimensional ferromagnet with a Curie temperature higher than 300 K.

#### Acta Materialia

*Stress dependence of the Peierls barrier of  $1/2 \langle 111 \rangle$  screw dislocations in bcc metals*

**Gröger R.**, Vitek V.

**Research Group:** Transport and Magnetic Properties

**Research Programme:** Advanced Nanotechnologies and Microtechnologies

**Summary:** The recently formulated constrained nudged elastic band method with atomic relaxations (NEB + r) is used to investigate the dependence of the Peierls barrier of  $1/2 \langle 111 \rangle$  screw dislocations in body-centered cubic metals on non-glide stresses. These are the shear stresses parallel to the slip direction acting in the planes of the  $\langle 111 \rangle$  zone different from the slip plane, and the shear stresses perpendicular to the slip direction. Both these shear stresses modify the structure of the dislocation core and thus alter both the Peierls barrier and the related Peierls stress. Understanding of this effect of loading is crucial for the development of

mesoscopic models of thermally activated dislocation motion via formation and propagation of pairs of kinks. The Peierls stresses and related choices of the glide planes determined from the Peierls barriers agree with the results of molecular statics calculations, which demonstrates that the NEB + r method is a reliable tool for determining the variation in the Peierls barrier with the applied stress. However, such calculations are very time consuming, and it is shown here that an approximate approach of determining the stress dependence of the Peierls barrier can be used, combined with test calculations employing the NEB + r method.

## ADVANCED MATERIALS

### Physical Review B

#### Lattice instabilities in bulk $\text{EuTiO}_3$

Bessas D., Rushchanskii K., **Kachlík M.**, Disch S., Gourdon O., Bednarčík J., **Maca K.**, Sergueev I., Kamba S., Ležaić M., Hermann R.

**Research Group:** Advanced Ceramic Materials

**Research Programme:** Advanced Materials

**Summary:** The phase purity and the lattice dynamics in bulk  $\text{EuTiO}_3$  were investigated both microscopically, using x-ray and neutron diffraction,  $^{151}\text{Eu}$ -Mössbauer spectroscopy, and  $^{151}\text{Eu}$  nuclear inelastic scattering, and macroscopically using calorimetry, resonant ultrasound spectroscopy, and magnetometry. Furthermore, our investigations were corroborated by *ab initio* theoretical studies. The perovskite symmetry,  $Pm\bar{3}m$ , is unstable at the *M*- and *R*-points of the Brillouin zone. The lattice instabilities are lifted when the structure relaxes in one of the symmetries:  $I4/mcm$ ,  $Imma$ ,  $R\bar{3}c$  with relative relaxation energy around  $-25$  meV. Intimate phase analysis confirmed phase purity of our ceramics. A prominent

peak in the Eu specific density of phonon states at 11.5 meV can be modeled in all candidate symmetries. A stiffening on heating around room temperature is indicative of a phase transition similar to the one observed in  $\text{SrTiO}_3$ , however, although previous studies reported the structural phase transition to the tetragonal  $I4/mcm$  phase our detailed sample purity analysis and thorough structural studies using complementary techniques did not confirm a direct phase transition. Instead, in the same temperature range, Eu delocalization is observed which might explain the lattice dynamical instabilities.

### Acta Materialia

#### Near-threshold propagation of mode II and mode III fatigue cracks in ferrite and austenite

**Vojtek T.**, Pippan R., Hohenwarter A., Holáň L., **Pokluda J.**

**Research Group:** Advanced Metallic Materials and Metal Based Composites

**Research Programme:** Advanced Materials

**Summary:** The near-threshold behavior of mode II and mode III long fatigue cracks in ferritic (ARMCO iron) and austenitic (X5CrNi18-10) steel were experimentally studied using various samples specially prepared to obtain the effective threshold values  $\Delta K_{\text{Ieff,th}}$  and  $\Delta K_{\text{IIIeff,th}}$ . In both investigated materials, the effective thresholds for mode III were  $\sim 1.7$  times higher than those for mode II. Three-dimensional topological data obtained by the examination of fracture surfaces using stereophotogrammetry were utilized to identify crack growth micromechanisms. In austenite, mode I branching of

both the mode II and mode III cracks started at the very onset of crack growth. On the other hand, all cracks in ferrite propagated in crystallographically assisted local mixed mode I + II + III with mode II dominance. These experimental results can be understood in terms of crack growth micromechanisms according to a deformation model in ferrite and a decohesion model in austenite. The dissimilarity of growth mechanisms in ferrite and austenite may be attributed to a different number of available slip systems in body-centered cubic and face-centered cubic metals.

## STRUCTURAL BIOLOGY

### ☐ Nature Structural & Molecular Biology

*Molecular basis of UG-rich RNA recognition by the human splicing factor TDP-43*

**Lukavsky P. J.**, Daujotyte D., Tollervey J. R., Ule J., Stuani C., Buratti E., Baralle F. E., Damberger F. F., Allain F. H-T

**Research Group:** RNA-based Regulation of Gene Expression

**Research Programme:** Structural Biology

**Summary:** TDP-43 encodes an alternative-splicing regulator with tandem RNA-recognition motifs (RRMs). The protein regulates cystic fibrosis transmembrane regulator (*CFTR*) exon 9 splicing through binding to long UG-rich RNA sequences and is found in cytoplasmic inclusions of several neurodegenerative diseases. We solved the solution structure of the TDP-43 RRM in complex with UG-rich RNA. Ten nucleotides are bound by both RRM, and six are recognized sequence specifically. Among these, a central G interacts with both RRM and stabilizes a new tandem RRM arrangement. Muta-

tions that eliminate recognition of this key nucleotide or crucial inter-RRM interactions disrupt RNA binding and TDP-43-dependent splicing regulation. In contrast, point mutations that affect base-specific recognition in either RRM have weaker effects. Our findings reveal not only how TDP-43 recognizes UG repeats but also how RNA binding-dependent inter-RRM interactions are crucial for TDP-43 function.

### ☐ RNA – A publication of the RNA society

*Mammalian DIS3L2 exoribonuclease targets the uridylylated precursors of let-7 miRNAs*

**Ustianenko D., Hrossová D., Potěšil D., Chalupníková K., Hrazdilová K.,** Pachernik J., Cetkovska K., Uldrijan S., **Zdráhal Z., Vaňáčová Š.**

**Research Groups:** RNA Quality Control & Proteomics

**Research Programmes:** Structural Biology & Genomics and Proteomics of Plant Systems

**Summary:** The mechanisms of gene expression regulation by miRNAs have been extensively studied. However, the regulation of miRNA function and decay has long remained enigmatic. Only recently, 3' uridylation via LIN28A-TUT4/7 has been recognized as an essential component controlling the biogenesis of let-7 miRNAs in stem cells. Although uridylation has been generally implicated in miRNA degradation, the nuclease

responsible has remained unknown. Here, we identify the Perlman syndrome associated protein DIS3L2 as an oligo(U)-binding and processing exoribonuclease that specifically targets uridylylated pre-let-7 in vivo. This study establishes DIS3L2 as the missing component of the LIN28-TUT4/7-DIS3L2 pathway required for the repression of let-7 in pluripotent cells.

## GENOMICS AND PROTEOMICS OF PLANT SYSTEMS

### ☐ Nucleic Acids Research

*Compromised telomere maintenance in hypomethylated Arabidopsis thaliana plants*

**Ogrocka A., Polanska P., Majerová E.,** Janeba Z., **Fajkus J., Fojtová M.**

**Research Group:** Chromatin Molecular Complexes

**Research Programme:** Genomics and Proteomics of Plant System

**Summary:** Telomeres, nucleoprotein structures at the ends of linear eukaryotic chromosomes, are important for the maintenance of genomic stability. Telomeres were considered as typical heterochromatic regions, but in light of recent results, this view should be reconsidered. Asymmetrically located cytosines in plant telomeric DNA repeats may be substrates for a DNA methyl-

transferase enzyme and indeed, it was shown that these repeats are methylated. Here, we analyse the methylation of telomeric cytosines and the length of telomeres in *Arabidopsis thaliana* methylation mutants (*met 1-3* and *ddm 1-8*), and in their wild-type siblings that were germinated in the presence of hypomethylation drugs.

### ☐ Current Biology

*Local Auxin Sources Orient the Apical-Basal Axis in Arabidopsis Embryos*

**Robert H.S.,** Grones P., Stepanova A.N., Robles L.M., Lokerse A.S., Alonso J.M., Weijers D., **Friml J.**

**Research Group:** Developmental and Cell Biology of Plants

**Research Programme:** Genomics and Proteomics of Plant Systems

**Summary:** Establishment of the embryonic axis foreshadows the main body axis of adults both in plants and in animals, but underlying mechanisms are considered distinct. Plants utilize directional, cell-to-cell transport of the growth hormone auxin to generate an asymmetric auxin response that specifies the embryonic apical-basal axis. The auxin flow directionality depends on the

polarized subcellular localization of PIN-FORMED (PIN) auxin transporters. It remains unknown which mechanisms and spatial cues guide cell polarization and axis orientation in early embryos. Herein, we provide conceptually novel insights into the formation of embryonic axis in *Arabidopsis* by identifying a crucial role of localized tryptophan-dependent auxin biosynthesis.

### ☐ The Plant Cell

*The More the Merrier: Recent Hybridization and Polyploidy in Cardamine*

**Mandáková T.,** Kovařík A., Zozomová-Lihová J., Shimizu-Inatsugid R., Shimizu K., Mummenhoff K., Marholdc K., **Lysák M. A.**

**Research Group:** Plant Cytogenomics

**Research Programme:** Genomics and Proteomics of Plant Systems

**Summary:** This article describes the use of cytogenomic and molecular approaches to explore the origin and evolution of *Cardamine schulzii*, a textbook example of a recent allopolyploid, in its ~110-year history of human-induced hybridization and allopolyploidy in the Swiss Alps. Triploids are typically viewed as bridges between

diploids and tetraploids but rarely as parental genomes of high-level hybrids and polyploids. The genome of the triploid semifertile hybrid *Cardamine* × *insueta* ( $2n=24$ , RRA) was shown to combine the parental genomes of two diploid ( $2n=2x=16$ ) species, *Cardamine amara* (AA) and *Cardamine rivularis* (RR).



## MOLECULAR MEDICINE

### ☐ Carcinogenesis

*Identification of novel sequence variations in microRNAs in chronic lymphocytic leukemia*

**Kmínková J., Mráz M., Zápražná K., Navrkalová V., Tichý B., Plevová K., Malčíková J., Černá K., Rausch T., Beneš V., Brychtová Y., Doubek M., Mayer J., Pospíšilová S.**

**Research Group:** Medical Genomics

**Research Programme:** Molecular Medicine

**Summary:** MicroRNA (miRNA) expression is deregulated in many tumors including chronic lymphocytic leukemia (CLL). Although the particular mechanism responsible for their aberrant expression is not well characterized, the presence of mutations and single nucleotide polymorphisms (SNP) in miRNA genes, possibly affecting their secondary structure and expression, has been described. In CLL, however, the impact and frequency of such variations have yet to be elucidated. Using a custom resequencing microarray, we screened sequence variations in 109 cancer related pre-miRNAs in 98 CLL patients. Additionally, the primary regions of miR-29b-2/29c were analyzed by Sanger sequencing in another cohort of 213 CLL patients. Altogether, we describe 6 novel miR-sequence variations

and the presence of SNPs (n=27), most of which changed the miR-secondary structure. Moreover, some of the identified SNPs have a significantly different frequency in CLL when compared to a control population. Additionally, we identified a novel variation in miR-16-1 that had not been previously described in CLL patients. We show that this variation affects the expression of mature miR-16-1. We also show that the expression of another miRNA with pathogenetic relevance for CLL, namely miR-29b-2, is influenced by the presence of a polymorphic insertion which is more frequent in CLL than in a control population. Altogether, these data suggest that sequence variations may occur during CLL development and/or progression.

### ☐ Nucleic Acids Research

*Quadruplex-forming sequences occupy discrete regions inside plant LTR retrotransposons*

**Lexa M., Kejnovský E., Šteflová P., Konvalinová H., Vorlíčková M., Výskot B.**

**Research Group:** Genome Dynamics

**Research Programme:** Molecular Medicine

**Summary:** Retrotransposons with long terminal repeats (LTR) form a significant proportion of eukaryotic genomes, especially in plants. They have *gag* and *pol* genes and several regulatory regions necessary for transcription and reverse transcription. We searched for potential quadruplex-forming sequences (PQSs) and potential triplex-forming sequences (PTSs) in 18 377 full-length LTR retrotransposons collected from 21 plant species. We found that PQSs were often located in LTRs, both upstream and downstream of promoters from which the whole retrotransposon is transcribed. Upstream-located guanine PQSs were dominant in the minus DNA strand, whereas downstream-located

guanine PQSs prevailed in the plus strand, indicating their role both at transcriptional and posttranscriptional levels. Our circular dichroism spectroscopy measurements confirmed that these PQSs readily adopted guanine quadruplex structures – some of them were parallel-stranded, while others were anti-parallel-stranded. The PQS often formed doublets at a mutual distance of up to 400 bp. PTSs were most abundant in 3'UTR (but were also present in 5'UTR). We discuss the potential role of quadruplexes and triplexes as the regulators of various processes participating in LTR retrotransposon life cycle and as potential recombination sites during post-insertional retrotransposon-based genome rearrangements.

## BRAIN AND MIND RESEARCH

### ☐ Neural Plasticity

*The Mechanisms of Movement Control and Time Estimation in Cervical Dystonia Patients*

Filip P., Lungu O.V., Shaw D.J., Kaspárek T., Bareš M.

**Research Group:** Behavioural and Social Neuroscience

**Research Programme:** Brain and Mind Research

**Summary:** Traditionally, the pathophysiology of cervical dystonia has been regarded mainly in relation to neurochemical abnormalities in the basal ganglia. Recently, however, substantial evidence has emerged for cerebellar involvement. While the absence of neurological „cerebellar signs“ in most dystonia patients may be considered at least provoking, there are more subtle indications of cerebellar dysfunction in complex, demanding tasks. Specifically, given the role of the cerebellum in the neural representation of time, in the millisecond range, dysfunction to this structure is considered to be of greater importance than dysfunction of the basal ganglia. In the current study, we

investigated the performance of cervical dystonia patients on a computer task known to engage the cerebellum, namely, the interception of a moving target with changing parameters (speed, acceleration, and angle) with a simple response (pushing a button). The cervical dystonia patients achieved significantly worse results than a sample of healthy controls. Our results suggest that the cervical dystonia patients are impaired at integrating incoming visual information with motor responses during the prediction of upcoming actions, an impairment we interpret as evidence of cerebellar dysfunction.

### ☐ Schizophrenia Research

*A detailed analysis of the effect of repetitive transcranial magnetic stimulation on negative symptoms of schizophrenia: A double-blind trial.*

Prikryl R., Ustohal L., Prikrylova Kucerova H., Kaspárek T., Venclikova S., Vrzalova M., Ceskova E.

**Research Group:** Applied Neuroscience

**Research Programme:** Brain and Mind Research

**Summary:**

**Objective:** The aim of the study was to assess the effect of rTMS not only on the general severity of negative schizophrenia symptoms, but also particularly on their individual domains, such as affective flattening or blunting, alogia, avolition or apathy, anhedonia, and impaired attention.

**Methods:** Forty schizophrenic male patients on stable antipsychotic medication with prominent negative symptoms were included in the study. They were divided into two groups: 23 were treated with active and 17 with placebo rTMS. Both treatments were similar, but placebo rTMS was administered using a purpose-built sham coil. Stimulation was applied to the left dorsolateral prefrontal cortex (DLPFC). The stimulation frequency was 10 Hz; stimulation intensity was 110% of the individual motor threshold intensity. Each patient received 15 rTMS sessions on 15 consecu-

tive working days (five working days „on“ and two weekend days „off“ design). Each daily session consisted of 20 applications of 10-second duration with 30-second intervals between sequences. The patients and raters were blind to condition of stimulation treatment.

**Results:** The active rTMS led to a statistically significantly higher reduction of the Scale for the Assessment of Negative Symptoms (SANS) total score and of all domains of negative symptoms of schizophrenia. After Bonferroni adjustments for multiple testing, the statistical significance disappeared in alogia only.

**Conclusion:** High-frequency rTMS stimulation over the left DLPFC at a high stimulation intensity with a sufficient number of applied stimulating pulses may represent an efficient augmentation of antipsychotics in alleviating the negative symptoms of schizophrenia.

## MOLECULAR VETERINARY MEDICINE

### ☐ Chromosome Research

*Subchromosomal karyotype evolution in Equidae*

Musilova P., Kubickova S., Vahala J., Rubes J.

**Research Group:** Animal Genomics

**Research Programme:** Molecular Veterinary Medicine

**Summary:** Equidae is a small family which comprises horses, African and Asiatic asses, and zebras. Despite equids having diverged quite recently, their karyotypes underwent rapid evolution which resulted in extensive differences among chromosome complements in respective species. Comparative mapping using whole-chromosome painting probes delineated genome-wide chromosome homologies among extant equids, enabling us to trace chromosome rearrangements that occurred during evolution. In the present study, we performed subchromosomal comparative mapping among seven Equidae species, representing the whole family. Region-specific painting and bacterial artificial chromosome probes were used to determine the orientation of evolutionarily conserved segments with respect to centromere positions. This allowed assessment of the configuration of all fusions occurring during the evolution of Equidae, as well as revealing discrepancies in centromere location caused by centromere repositioning or inversions. Our results indicate that the prevailing type of fusion in Equidae is centric fusion.

Tandem fusions of the type telomere–telomere occur almost exclusively in the karyotype of Hartmann's zebra and are characteristic of this species' evolution. We revealed inversions in segments homologous to horse chromosomes 3p/10p and 13 in zebras and confirmed inversions in segments 4/31 in African ass, 7 in horse and 8p/20 in zebras. Furthermore, our mapping results suggested that centromere repositioning events occurred in segments homologous to horse chromosomes 7, 8q, 10p and 19 in the African ass and an element homologous to horse chromosome 16 in Asiatic asses. Centromere repositioning in chromosome 1 resulted in three different chromosome types occurring in extant species. Heterozygosity of the centromere position of this chromosome was observed in the kiang. Other subtle changes in centromere position were described in several evolutionary conserved chromosomal segments, suggesting that tiny centromere repositioning or pericentric inversions are quite frequent in zebras and asses.

### ☐ PLOS One

*Preliminary Insights into the Impact of Dietary Starch on the Ciliate, Neobalantidium coli, in Captive Chimpanzees*

Schovancova K., Pomajbikova K., Prochazka D., **Modry D.**, Bolechova P., Petrzalkova K.J.

**Research Group:** Parasitology

**Research Programme:** Molecular Veterinary Medicine

**Summary:** Infections caused by the intestinal ciliate *Neobalantidium coli* are asymptomatic in most hosts. In humans and captive African great apes clinical infections occasionally occur, manifested mainly by dysentery; however, factors responsible for development of clinical balantidiasis have not been fully clarified. We studied the effect of dietary starch on the intensities of infection by *N. coli* in two groups of captive chimpanzees. Adult chimpanzees infected by *N. coli* from the Hodonin Zoo

and from the Brno Zoo, Czech Republic, were fed with a high starch diet (HSD) (average 14.7% of starch) for 14 days, followed by a five-day transition period and subsequently with a period of low starch diet (LoSD) (average 0.1% of starch) for another 14 days. We collected fecal samples during the last seven days of HSD and LoSD and fixed them in 10% formalin. We quantified trophozoites of *N. coli* using the FLOTAC method. The numbers of *N. coli* trophozoites were higher during the HSD

(mean  $\pm$  SD:  $49.0 \pm 134.7$ ) than during the LoSD ( $3.5 \pm 6.8$ ). A generalized linear mixed-effects model revealed significantly lower numbers of the *N. coli* trophozoites in the feces during the LoSD period in comparison to the HSD period (treatment contrast LoSD vs. HSD:  $2.7 \pm 0.06$  (SE),  $z=47.7$ ;  $p < 0.001$ ). We conclude that our data provide a

first indication that starch-rich diet might be responsible for high intensities of infection of *N. coli* in captive individuals and might predispose them for clinically manifested balantidiasis. We discuss the potential nutritional modifications to host diets that can be implemented in part to control *N. coli* infections.



Please send us your comments and ideas to [pavla.vyhnankova@ceitec.cz](mailto:pavla.vyhnankova@ceitec.cz)

If you would rather not receive future editions of this newsletter, please send us a reply with the subject line "DO NOT SEND".

CEITEC used its best efforts in collecting and preparing the information published herein. However, CEITEC does not assume, and hereby disclaims, any and all liability for any loss or damage caused by errors, whether such errors resulted from negligence, accident, or other causes.

CEITEC © 2013, All rights reserved.



EUROPEAN UNION  
EUROPEAN REGIONAL DEVELOPMENT FUND  
INVESTING IN YOUR FUTURE



OP Research and  
Development for Innovation

[www.ceitec.eu](http://www.ceitec.eu)