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CZECH-U.S. INTERNATIONAL COOPERATION **IN RESEARCH AND DEVELOPMENT**



KONTAKT II
PROGRAM



Thanks to all those who contributed to the survey. Because of their responses, it was possible to create this brochure and present the results of the KONTAKT II program.

Special thanks to all Czech participants who supplied papers to individual projects presented in this brochure. This brochure was created thanks to their responsible and quality cooperation.

Czech-U.S. International Cooperation in Research and Development – KONTAKT II (LH) program

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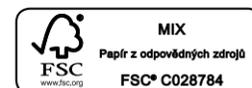
www.msmt.cz/vyzkum-a-vyvoj-2/brozury-k-vysledkum-programu-kontakt-ii



Ministry of Education, Youth and Sports

Karmelitska 529/5, 118 12 Prague 1, Czech Republic

www.msmt.cz



KONTAKT II

be in scientific
connection too



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The KONTAKT II (LH) Program – The Ministry of Education, Youth and Sports of the Czech Republic (MEYS), Provider

As far as the support of international cooperation in research and development is concerned, the KONTAKT II (LH) program has played a significant role and has contributed to increasing the quality of Czech science on the international level during the 2011 – 2017 period. Owing to this financial support from the Czech state budget, Czech scientists have been able to participate in high-quality projects throughout the scientific world and have had the opportunity to work in laboratories in the US.

This program does not only subsidize cooperation with the US, but also with other countries within all announced competitions, including Israel, India, South Korea, Japan and others.

Within the KONTAKT II program of Czech – U.S. cooperation, **450.6 million CZK** from the state budget has been spent on **202 approved projects** during the entire program period. The **average duration of a project is three years** and has on average **2.2 million CZK** available for its entire duration.

In 2016, the MEYS approved the Inter-Excellence program, which will support international cooperation in science in the upcoming years and follow the excellent practice of the KONTAKT II funding program.

THE MAIN AIMS OF THE KONTAKT II PROGRAM ARE AS FOLLOWS:

1. Support international cooperation in research and development.
2. Assistance in establishing new contacts among research institutions of the Czech Republic and of other countries.

THE GREATEST BENEFITS OF THIS SUPPORT (CZECH – U.S. SUPPORT AREA) ARE AS FOLLOWS:

- Czech scientists have become members of large international leading research teams
- They have been enabled to personally work with our American colleagues in laboratories in the U.S.
- Based on the scientific cooperation between both countries valuable research results have been obtained.

Without international cooperation, it is no longer possible to achieve significant research results.



Statistics and graphs of Czech-US cooperation in science supported by the KONTAKT II program – Provider of the Program: The Czech Republic – MEYS

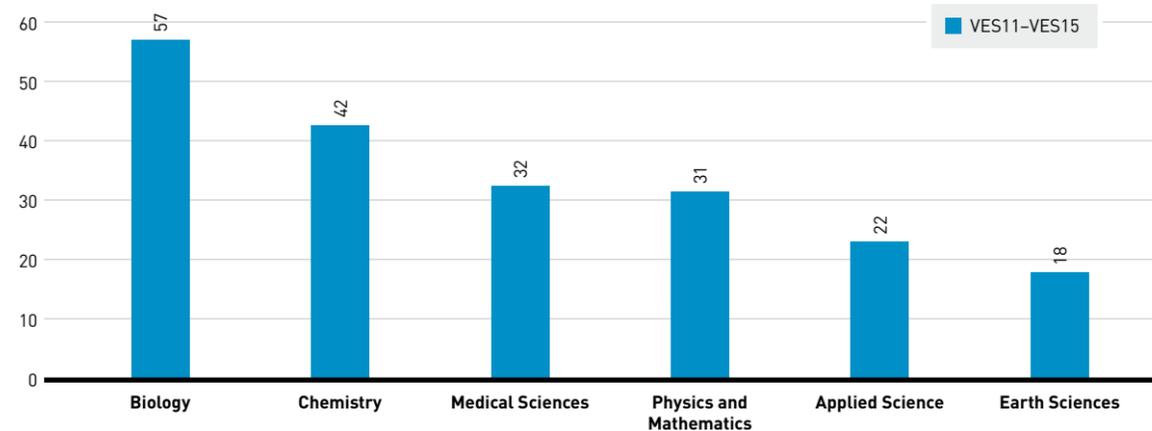
KONTAKT II PROGRAM – TOTAL ALLOCATED FUNDING FOR ALL STATES (IN THOUSANDS OF CZK)

KONTAKT II	2011	2012	2013	2014	2015	2016	2017	total VES
VES11	34 018	38 599	35 309	26 155				134 081
VES12		72 463	85 462	73 462	50 610			281 997
VES13			25 427	24 999	24 416			74 842
VES14				28 718	33 583	32 675		94 976
VES15					5 738	26 696	24 300	56 734
total	34 018	111 062	146 198	153 334	114 347	59 371	24 300	642 630

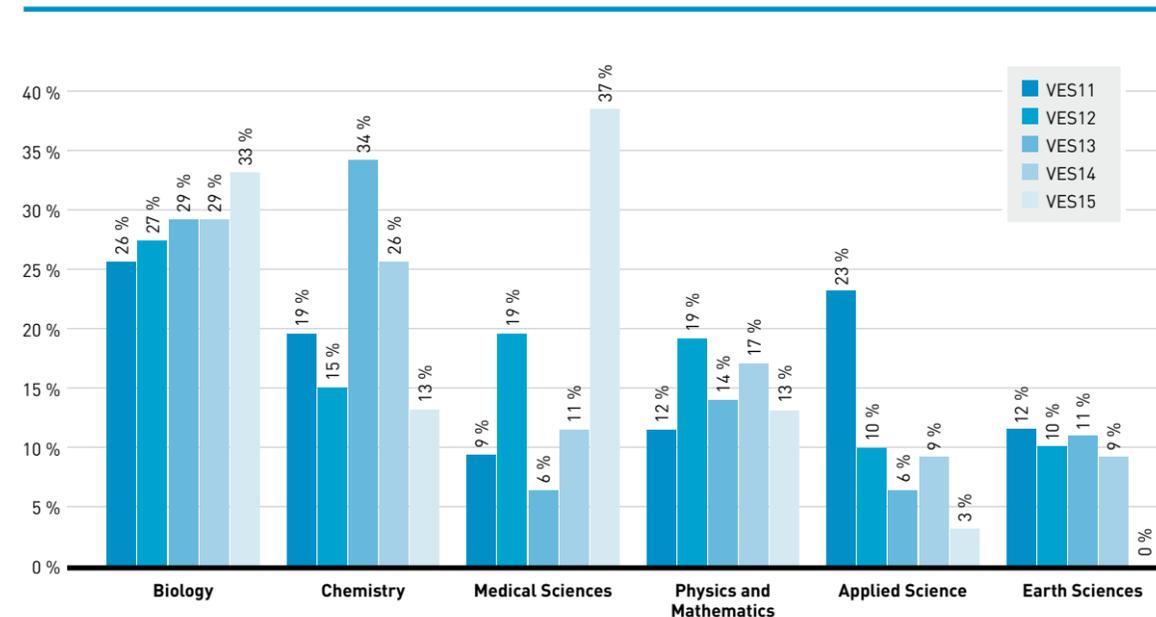
KONTAKT II PROGRAM – FUNDING FOR CZECH-U.S. COOPERATION (IN THOUSANDS OF CZK)

KONTAKT II USA	2011	2012	2013	2014	2015	2016	2017	total VES
VES11	26 278	28 681	27 566	22 007				104 532
VES12		44 153	51 648	47 103	34 122			177 026
VES13			18 324	17 614	21 375			57 313
VES14				17 775	20 256	21 263		59 294
VES15					5 217	24 823	22 388	52 428
total	26 278	72 834	97 538	104 499	80 970	46 086	22 388	450 593

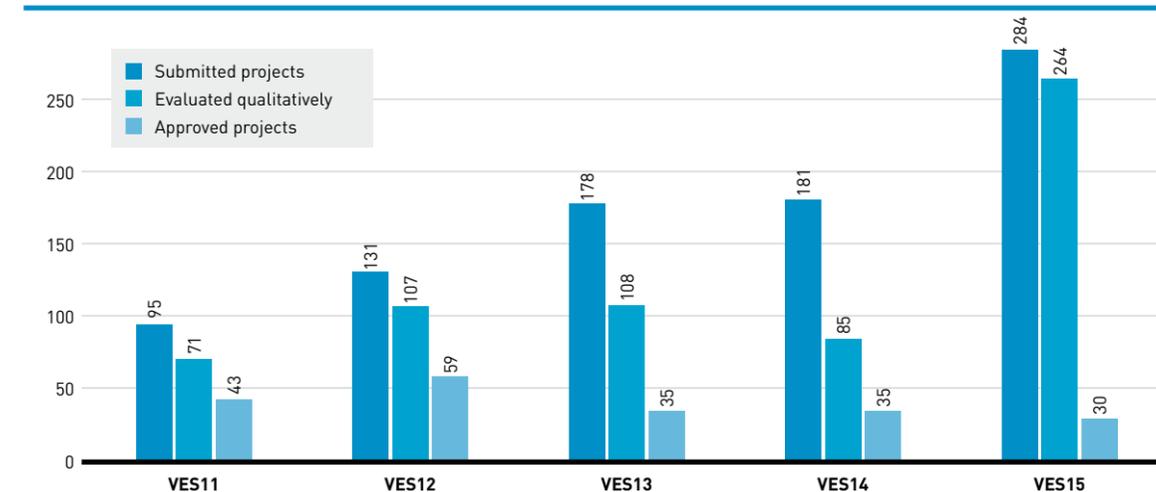
SUMMARY VALUES OF APPROVED PROJECTS ACCORDING TO THE SCIENTIFIC FIELD FOR THE VES11-VES15 PERIOD OF THE KONTAKT II PROGRAM (SUPPORT AREA CR-USA)



APPROVED PROJECTS OF THE KONTAKT II PROGRAM ACCORDING TO THE SCIENTIFIC FIELD (SUPPORT AREA CR-USA)



STATISTICS OF SUBMITTED AND APPROVED PROJECTS OF THE KONTAKT II PROGRAM – THE VES11-VES15 PROGRAM PERIOD (SUPPORT AREA CR-USA)





Examples of Significant Research Results Obtained Due to the Support of the KONTAKT II Program (LH)

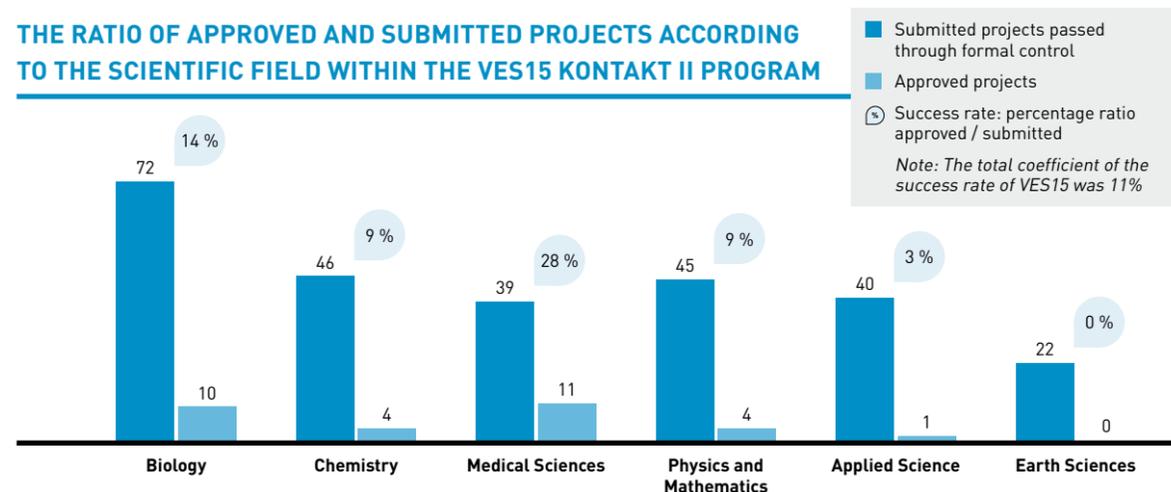
CLASSIFICATION OF PROJECTS OF THE KONTAKT II PROGRAM – SUMMARY OF PUBLIC TENDERS VES11– VES15 (SUPPORT AREA CR-USA)

	VES11	VES12	VES13	VES14	VES15	Sum
Submitted projects	95	131	178	181	284	869
Discarded due to formal reasons	24	24	70	96	20	234
Evaluated qualitatively	71	107	108	85	264	635
Approved projects	43	59	35	35	30	202
Success rate	45%	45%	20%	19%	11%	23%

SUCCESS RATE OF SUBMITTED APPLICATIONS FROM THE TOTAL KONTAKT II PROGRAM

KONTAKT II	Total KONTAKT II			AMVIA – Czech–U.S. cooperation			mil. CZK
	Submitted	Approved	Success rate	Submitted	Approved	Success rate	
VES11	135	56	41%	95	43	45%	107.2
VES12	245	98	40%	131	59	45%	176.2
VES13	294	47	16%	178	35	20%	57.3
VES14	345	57	17%	181	35	19%	59.3
VES15	301	32	11%	284	30	11%	52.4

THE RATIO OF APPROVED AND SUBMITTED PROJECTS ACCORDING TO THE SCIENTIFIC FIELD WITHIN THE VES15 KONTAKT II PROGRAM



“The level of knowledge and the ability of the Czech scientific team undoubtedly provided very important motivation for the American partner. The long-term friendly relationships among the scientists also played a large role.”

“The most important benefit is definitely the synergistic effect that is gained from combining both expertise of the Czech and the U.S. institutions where each institution has a particular overlap which is for the second workplace substantial. It is inevitable that new topics are shared between the teams, leading to their concerted development. Finally, our department benefits from the utilization of research specimens that are inaccessible in the Czech Republic. To our great satisfaction, we have also reached an agreement on subsequent cooperation on other projects.”

M.D. Pavel Vodička, Ph.D., The Institute of Experimental Medicine, The Czech Academy of Sciences, Prague, 2016

LH13061 – The Role of *Ganoderma lucidum* extracts in the regulation of interactions between NFκB signaling, DNA repair and proteasomes in colorectal carcinogenesis.

Dynamics of Norway spruce forests on selected areas in the Czech Republic and Romania using historical and dendroecological methods

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Prof. Ing.
Miroslav Svoboda, Ph.D.

INSTITUTION CZ

Czech University of Life Sciences Prague, Faculty of Forestry and Wood Sciences, www.fld.czu.cz



PRINCIPAL INVESTIGATOR USA

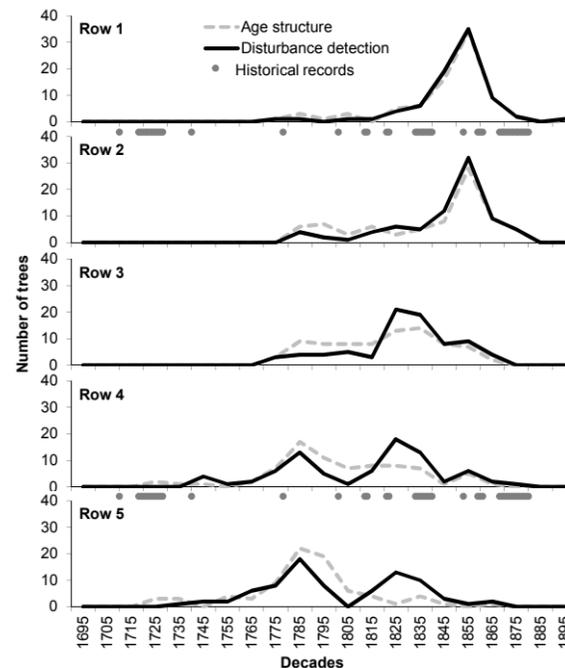
Dr. Shawn Fraver

INSTITUTION USA

University of Maine, School of Forest Resources, Orono, www.forest.umaine.edu

ANNOTATION OF THE RESEARCH RESULT

For a thorough understanding of the dynamics of forest ecosystems, it is crucial to understand the importance of natural disturbances (disturbance in the forest), what their effect is on the structure and forest development without human influence. These principles are the basis for implementing management planning in national parks, as well as for bringing important knowledge to forestry practices, where in many cases artificial processes that mimic natural processes are used. From our work, it was discovered that the spatial and temporal effects of analyzed disturbances were variable within the study area and pointed to disturbance events indirectly related to the elevation gradient. Forest stands were shaped by several large moderate to severe natural disturbances that have resulted in historically significant damage caused by wind and bark-beetle outbreaks. It seems that the interaction between wind disturbances and the dying of trees caused by bark-beetle activity has historically been a common phenomenon in mountain spruce forests in Šumava National Park.



▲ Detecting disturbances and age structure discovered on the altitudinal gradient. Source: DOI



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The American partner participated in data processing and article writing.



How did the Czech partner participate in this research result?

The Czech partner was the initiator of the study, suggested the design, gathered data, led the analysis and guided the writing of the article.

CITATION

Svoboda, M.; Janda, P.; Nagel, T. A.; Fraver, S.; Rejzek, J.; Bače, R. 2012. Disturbance history of an old-growth sub-alpine *Picea abies* stand in the Bohemian Forest, Czech Republic. *J. Veg. Sci.* 23, 86–97.

► DOI: [10.1111/j.1654-1103.2011.01329.x](https://doi.org/10.1111/j.1654-1103.2011.01329.x)



▲ A meeting during fieldwork, the team of field workers together with the main coordinator M. Svoboda (right) and S. Fraver (first row, second from the left). Source: M. Svoboda, 2012

Study of local electronic and optical characteristics of solar cells

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Prof. RNDr.
Pavel Tománek, CSc.

INSTITUTION CZ

Brno University of Technology, Faculty of Electrical Engineering and Communication
www.feec.vutbr.cz



PRINCIPAL INVESTIGATOR USA

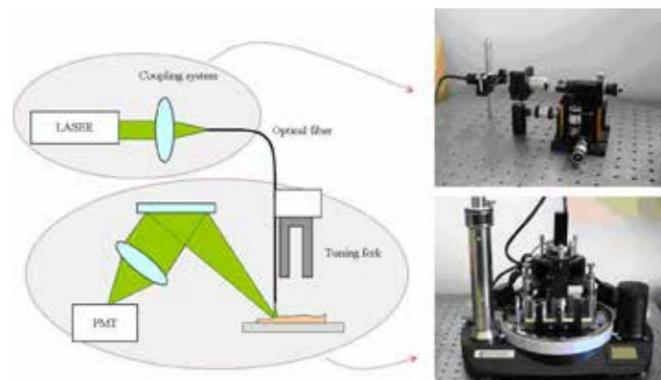
Prof. Steve J. Smith, Ph.D.

INSTITUTION USA

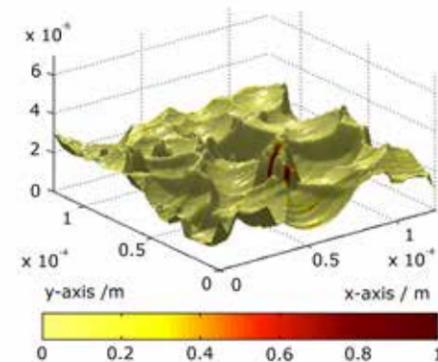
South Dakota School of Mines & Technology, Nanoscience and Nanoengineering, Rapid City
www.sdsmt.edu/NANO

ANNOTATION OF THE RESEARCH RESULT

The main objective of the common research was to improve the efficiency and reliability of monocrystalline silicon solar cells, which today cover about 90% of the world market of photovoltaics. Semiconductor crystals are of the highest quality, nevertheless they contain a variety of defects, both visible and hidden, in the surface or crystal bulk. Reviewing the different defects decreasing cell performance and their characterization is an important issue and the basis for future collaboration, both with our American partner and with others. The paper also serves as a guide on how to remove some of the defects and enhance the quality and reliability of photovoltaic sources for alternative energy for the 21st century.



▲ A schematic of the measuring device used for detecting defects in local materials, 2012. Source: DOI



▲ Localization of two microscopic defects (red) in a silicon solar cell, 2012. Source: DOI



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

During his visits to the Czech Republic, Prof. Smith was a member of the program committee of the Photonics Prague 2014 conference. He chaired a workshop on modern imaging techniques in SPM microscopy for BUT students. He also took part in the measurement of fluctuation phenomena in optoelectric devices. The specific contribution by Prof. Smith's team was about 15%.



How did the Czech partner participate in this research result?

During mutual visits, the two member teams used the measuring facilities that had the other partner. Because of that, the Czech side of the project involved five people and we estimate our market share to be 85%.

CITATION

Škvarda, P.; Tománek, P.; Koktavý, P.; Macků, R.; Šicner, J.; Vondra, M.; Dallaeva, D.; Smith, S.; Grmela, L. A variety of microstructural defects in crystalline silicon solar cells. Applied Surface Science, 2014, roč. 312, č. 312, s. 50-56. ISSN: 0169-4332. > DOI: [10.1016/j.apsusc.2014.05.064](https://doi.org/10.1016/j.apsusc.2014.05.064)



Prof. Tománek (President of the Czech and Slovak Society for Photonics – CSSF) and Dinara Dallaeva (Sobola) – 1st prize CSSF for young scientists at the 7th International Conference of Photonics Prague 2014. Source: P. Škvarda

Stochastic discrete modeling of fracture processes in heterogeneous materials

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Ing. Jan Eliáš, Ph.D.

INSTITUTION CZ

Brno University of Technology,
Faculty of Civil Engineering
www.fce.vutbr.cz



PRINCIPAL INVESTIGATOR USA

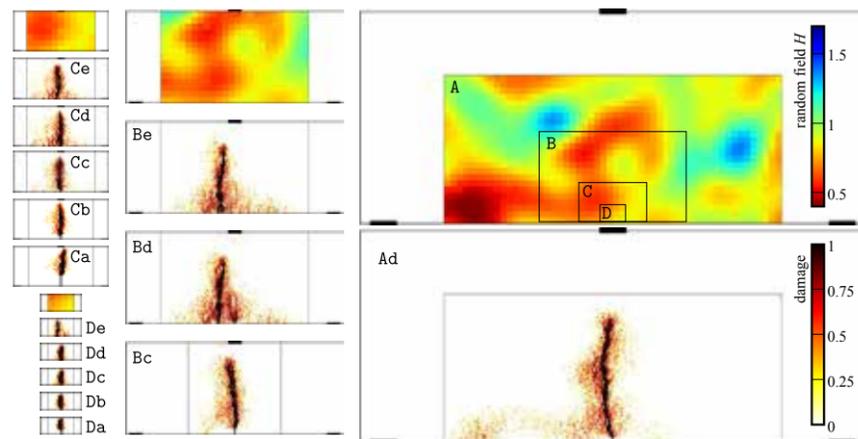
Prof. Jia-Liang Le, Ph.D.

INSTITUTION USA

University of Minnesota, Department of Civil,
Environmental, and Geo- Engineering,
Minneapolis, www.twin-cities.umn.edu

ANNOTATION OF THE RESEARCH RESULT

The main outcome of the project is the creation of a probabilistic model of concrete that is applicable for simulating the fracturing of concrete beams and structural members. The word “probabilistic” means that the material parameters are randomly fluctuating in space. The model has been verified by simulating a large experimental campaign. It is capable of predicting the statistical characteristics of the properties of concrete members, such as strength, ductility and cracking. It can be also used to roughly estimate failure probabilities. The model has been utilized to reveal several consequences of spatial variability that occur during concrete fracturing.



Random fields and corresponding damage resulting from simulations of concrete beams of different sizes and notches. Brno, 2015. Source: J. Eliáš



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

With regards to the development of the model, the American partner mainly participated in discussions and consultations. Balanced cooperation existed in the application of the model to practical issues during the simulation of the statistical size effect or when simulating fast dynamic phenomena and fragmentation. In these cases, the American partner derived the theoretical background of the studied events.

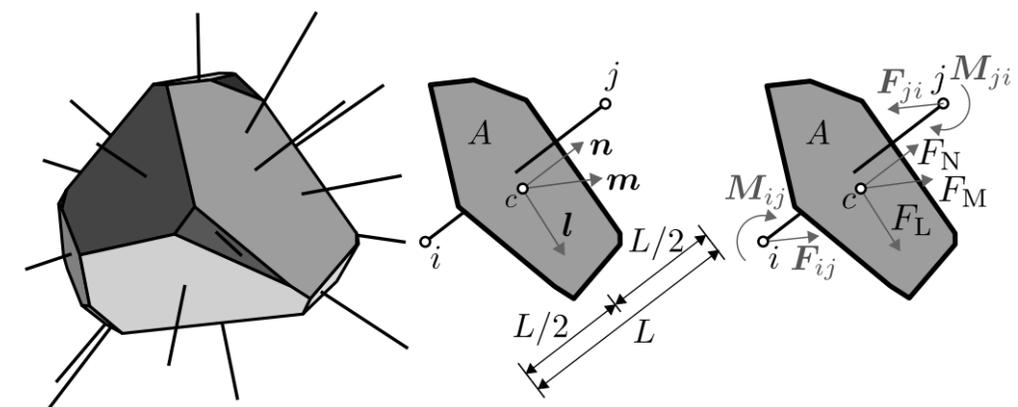


How did the Czech partner participate in this research result?

The Czech partner created the described model and wrote a large part of the computer code. Furthermore, he derived a significant simplification during the generation of the random field. When applying the model, he performed all simulations and evaluated them.

CITACE

Eliáš, J.; Vořechovský, M.; Skoček, J.; Bažant, Z. P. Stochastic discrete meso-scale simulations of concrete fracture: comparison to experimental data. *Engineering Fracture Mechanics* 135, pp. 1-16, 2015, ISSN: 0013-7944. > DOI: [10.1016/j.engfracmech.2015.01.004](https://doi.org/10.1016/j.engfracmech.2015.01.004)



One cell of the discrete model and the contact facet between the two cells. Brno, 2015. Source: J. Eliáš

The role of repetitive DNA in plant genome architecture and function

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

RNDr. Jiří Macas, Ph.D.

INSTITUTION CZ

Biology Centre of the Czech Academy of Sciences, Institute of Plant Molecular Biology, České Budějovice, www.umbr.cas.cz



PRINCIPAL INVESTIGATOR USA

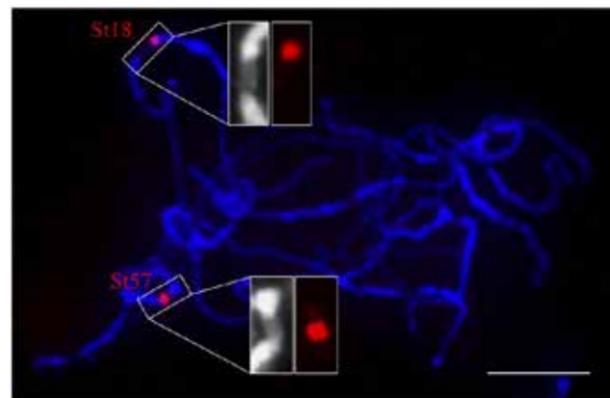
Prof. Jiming Jiang, Ph.D.

INSTITUTION USA

University of Wisconsin-Madison, Jiming Jiang's Lab, Madison www.wisc.edu

ANNOTATION OF THE RESEARCH RESULT

This work was focused on investigating the structure and function of centromeres, the chromosome regions responsible for the faithful segregation of genetic material during cell division. In most plants and animals studied to date, centromeres are composed of highly repetitive DNA sequences (termed satellite DNA), which are supposed to be important for proper centromere function. However, we found that in the plant genus *Solanaceae* (including e.g. the potato), there are species that possess centromeres that lack satellite DNA or contain chromosome-specific repeats with extremely long units. These findings have an impact on formulating hypotheses about centromere evolution as well as provide a new model to study this interesting phenomenon.



Potato chromosomes as a new model to study the evolution of centromeres. Source: DOI



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

They carried out sequencing of the studied genomes and performed all cytogenetic analyses.

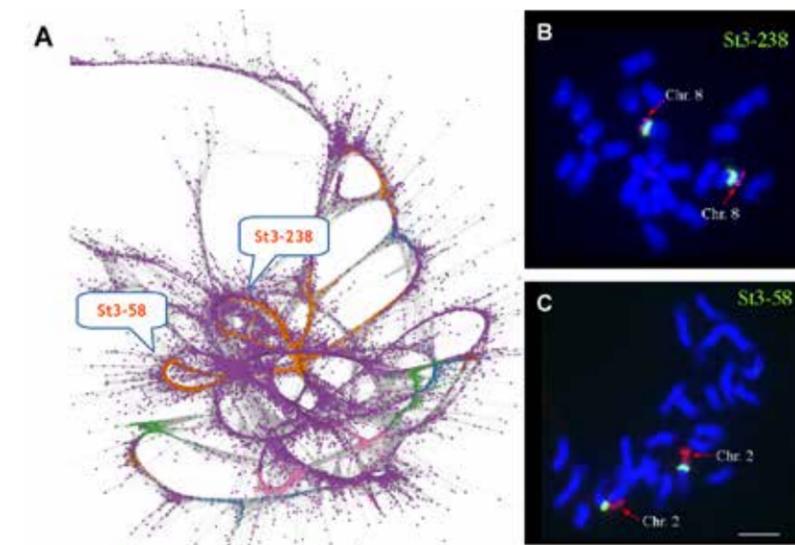


How did the Czech partner participate in this research result?

They performed bioinformatic analyses of the sequencing data which led to the characterization of repetitive DNA in the studied genomes. These analyses were performed using special programs developed at the Czech partner's workplace. Furthermore, a Czech laboratory created the design and cloning probes for cytogenetic experiments.

CITATION

Gong, Z.; Wu, Y.; Koblikova, A.; Torres, G.A.; Wang, K.; Iovene, M.; Neumann, P.; Zhang, W.; Novak, P.; Buell, R.; Macas, J.; Jiang, J. (2012) - Repeatless and repeat-based centromeres in potato: implications for centromere evolution. *Plant Cell* 24: 3559-3574. > DOI: [10.1105/tpc.112.100511](https://doi.org/10.1105/tpc.112.100511)



Potato chromosomes as a new model to study the evolution of centromeres. Source: DOI

Cyanobacterial biodiversity of tropical and subtropical biomes

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Doc. RNDr.
Jan Kaštovský, Ph.D.

INSTITUTION CZ

University of South Bohemia in České Budějovice, Faculty of Science, www.prf.jcu.cz



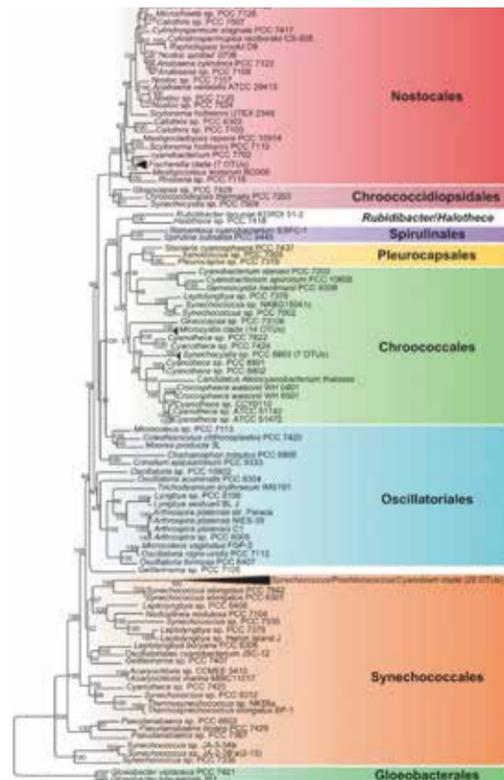
PRINCIPAL INVESTIGATOR USA

Prof. Jeffrey
R. Johansen, Ph.D.

INSTITUTION USA

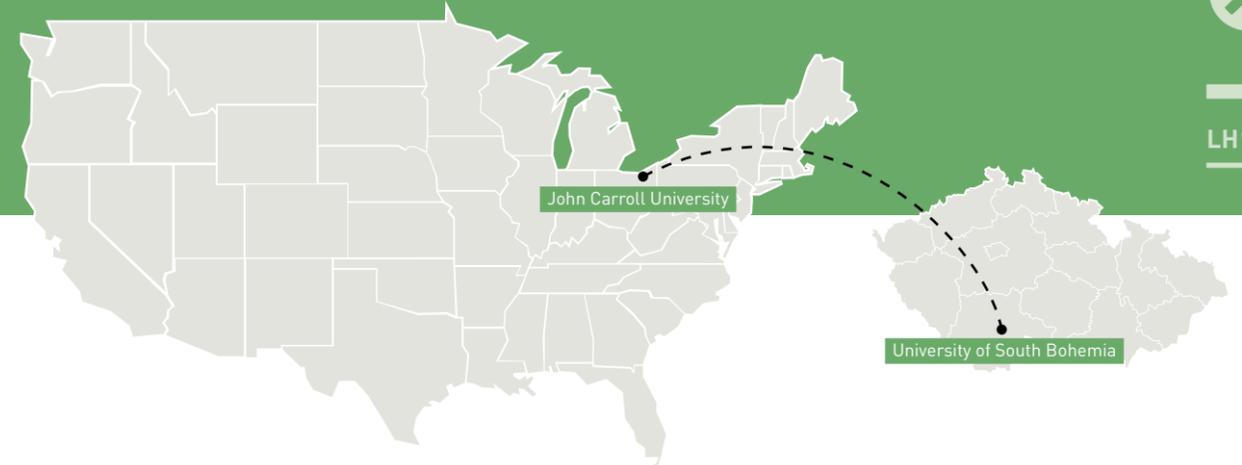
John Carroll University, Department of Biology, Ohio, www.sites.jcu.edu/biology

ANNOTATION OF THE RESEARCH RESULT



The whole classification of cyanobacteria (species, genera, families, orders) has undergone extensive restructuring and revision in recent years with the advent of phylogenetic analyses based on molecular sequence data. Several recent revisionary and monographic works have initiated a revision and it is anticipated there will be further changes in the future. However, with the completion of the monographic series on Cyanobacteria in *Süßwasserflora von Mitteleuropa*, and the recent flurry of taxonomic papers describing new genera, it seems beneficial that a summary of the modern taxonomic system for cyanobacteria be published. In this review, we present the status of all currently used families of cyanobacteria, review the results of molecular taxonomic studies, the descriptions and characteristics of new orders and new families and the elevation of a few subfamilies to the family level. All recently defined cyanobacterial genera (some still invalid) are listed in the family to which they are likely to belong and an indication is given of their taxonomic validity and level of polyphasic characterization of each genus.

◀ A phylogenetic tree of cyanobacteria arising on the basis 31 protein sequences, published in an article by Komarek et al. 2014 *Preslia* 86: 295-335. Source: J. Mareš



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The American partner worked on the project directly; he performed laboratory analyses, sampling and wrote publications. He enabled cooperation with other American scientists and provided the Czech scientists with samples they would not otherwise get.



How did the Czech partner participate in this research result?

The Czech scientists worked on solutions for problems throughout the whole range, from sampling to final publication.

CITATION

Komárek, J.; Kaštovský, J.; Mareš, J.; Johansen, J.R. (2014): Taxonomic classification of cyanoprokaryotes (cyanobacterial genera) 2014 using a polyphasic approach. *Preslia* 86(4): 295-235.
 ▶ WOS: 000348630000001



▶ The joint collection of samples in the Tamana River, Puerto Rico, from the left: Jan Kaštovský, Radka Muhlsteinová, Jeffrey R. Johansen, Jana Vesela and Jan Mareš. Source: T. Hauer



CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

**Prof. RNDr.
Boris Vyskot, DrSc.**

INSTITUTION CZ

Institute of Biophysics of the Czech Academy of Sciences, Brno
www.ibp.cz



PRINCIPAL INVESTIGATOR USA

Prof. Daniel F. Voytas, Ph.D.

INSTITUTION USA

University of Minnesota, Department of Cell Biology and Development Genetics, Saint Paul
www.cbs.umn.edu

ANNOTATION OF THE RESEARCH RESULT

Targeted genome editing represents a fast tool for improving the gene pool of agricultural crops. In this study, the genome editing tools for selected plant species were improved. Heritable targeted gene disruption and the integration of foreign DNA into a unique site in the genome were accomplished. Furthermore, the constructs and components used in this study generally work in other plant species. Hence, this study makes a breakthrough in the gene technologies of crop plants.



◀ *In vitro* regeneration of transgenic plants dioecious Silenka (*Silene latifolia*) with a target edited genome. Brno, 2016. Source: V. Hudzieczek



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

In the American partner's laboratory, the design and transfer of constructs with a nuclease to the genome of selected plant species were performed. Furthermore, editing accuracy and its transmission to future generations were checked.



How did the Czech partner participate in this research result?

In this publication, we used Czech knowledge of the test constructs for performing a targeted mutagenesis of dioecious plants. The activity of the proposed constructs was assessed using massively parallel sequencing, resulting in a more efficient and faster editing genome, which currently represents the main efforts of the scientific community mostly with respect to agricultural crops, but also for other plants as well.

CITATION

Čermák, T.; Baltés, N.J.; Čegan, R.; Zhang, Y.; Voytas, D.F. High-frequency, precise modification of the tomato genome. *Genome Biology*. 2015 Nov 6;16:232. > DOI: [10.1186/s13059-015-0796-9](https://doi.org/10.1186/s13059-015-0796-9)



◀ A photo from the work stay of our colleague Dr. Vojtech Hudzieczka (standing on the left in the picture) at the University of Minnesota with a team of Prof. Dan Voytas (in the middle of the cell). Saint Paul, 2014. Source: V. Hudzieczek

Chemical and biochemical sensors based on functionalized micro- and nanostructured optical waveguides

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Ing. Jiří Kaňka, CSc.

INSTITUTION CZ

Institute of Photonics and Electronics of the Czech Academy of Sciences, Prague
www.ufe.cz



PRINCIPAL INVESTIGATOR USA

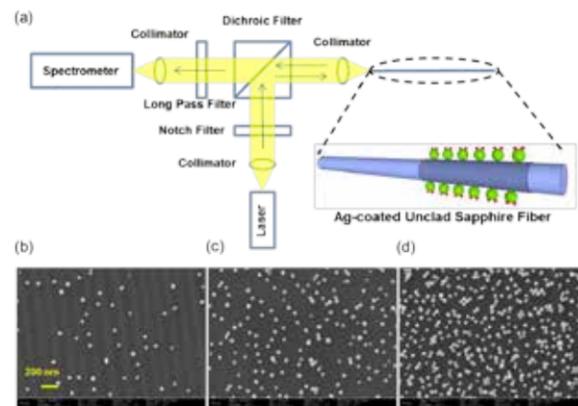
Prof. Henry Du, Ph.D.

INSTITUTION USA

Stevens Institute of Technology, Department of Chemical Engineering & Materials Science, Hoboken, www.stevens.edu

ANNOTATION OF THE RESEARCH RESULT

An unclad, multi-mode single crystal sapphire fiber was used as the platform, and immobilized colloidal Ag nanoparticles were used as an enabler, for evanescent-field fiber-optic sensing via surface-enhanced Raman scattering (SERS) of a Rhodamine 6G solution. The dependence of the measured Raman intensity on the nanoparticle coverage density as well as the coverage length were investigated. We demonstrated the utility of SERS-active sapphire fibers for sensitive measurements. We further revealed, with the aid of theoretical analysis, that a multi-mode fiber offers a significant advantage compared to its single-mode counterpart because the former allows for a two-order-of-magnitude higher particle coverage density than the latter to maximize the SERS benefit, while maintaining the dominance of Raman gain despite the competitive interplay of nanoparticle-induced absorption and scattering loss along the interaction path length.



(a) A scheme of the experimental arrangement for evanescent detection by an unclad sapphire fiber with Ag nanoparticles deposited on a 3-cm-long segment of the fiber. SEM images of Ag nanoparticles with a density coverage of **(b)** 20 **(c)** 50 **(d)** 120 nanoparticles / μm^2 on the fiber surface. Stevens Institute of Technology, Hoboken, NJ, USA, 2014. Source: H. Chen



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

Functionalization of optical fibers with long-period grating inscription, layer-by-layer deposition of polyelectrolyte monolayers and immobilization of metallic nanoparticles.

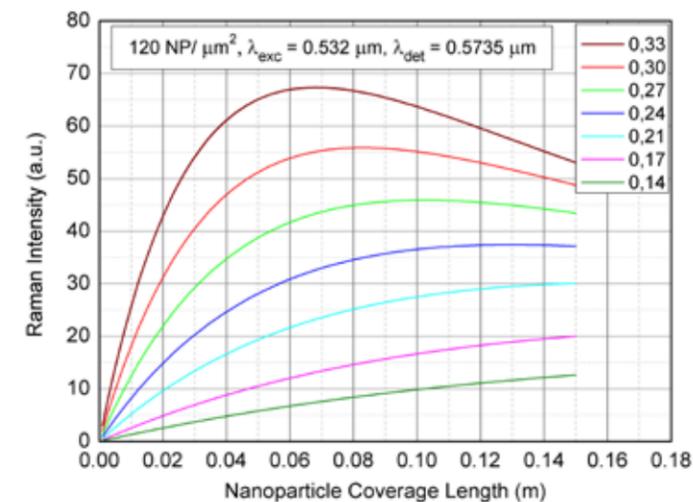


How did the Czech partner participate in this research result?

Numerical analysis and optimization of sensor fibers and interpretation of experimental results.

CITATION

Chen, H.; Tian, F.; Chi, J.; Kanka, J.; Du, H. Advantage of multi-mode sapphire optical fiber for evanescent-field SERS sensing, *Optics Letters* 39, 5822-5825 (2014). [DOI: 10.1364/OL.39.005822](https://doi.org/10.1364/OL.39.005822)



A numerical simulation of Raman intensity depending on the length of the sapphire fiber with immobilized Ag nanoparticles with a density of coverage of 120 nanoparticles / μm^2 for a range of $\text{LP}_{0,m}$ fiber modes. Institute of Photonics and Electronics ASCR, v.v.i., Prague, 2014. Source: J. Kaňka



Jiri Kanka with the team of Prof. Henry Du, Stevens Institute of Technology, Hoboken, NJ, USA, 2012. Source: J. Kaňka



Strain-induced multiferroics

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

RNDr. Stanislav Kamba, CSc.

INSTITUTION CZ

Institute of Physics of the Czech Academy of Sciences, Prague
www.fzu.cz



PRINCIPAL INVESTIGATOR USA

Prof. Darrell G. Schlom, Ph.D.

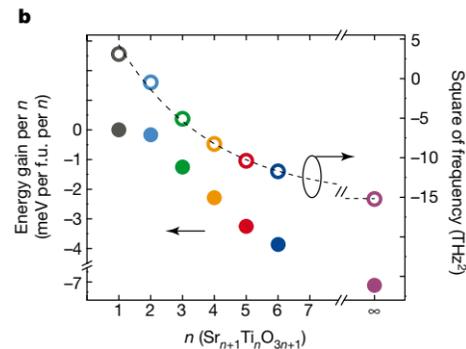
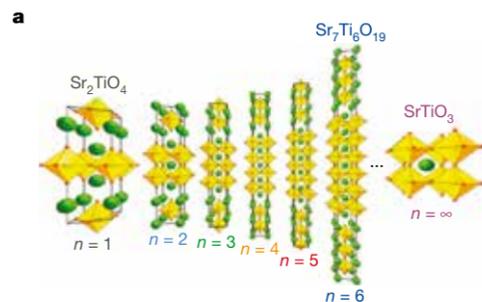
INSTITUTION USA

Cornell University, Department of Materials Science and Engineering, Ithaca
www.mse.cornell.edu

ANNOTATION OF THE RESEARCH RESULT

A new approach for preparing highly tunable microwave dielectrics

Scientists from the Institute of Physics ASCR together with their American colleagues theoretically predicted, physically prepared and experimentally characterized thin films of a layered perovskite system, $Sr_{n+1}Ti_nO_{3n+1}$ with $n=1-6$. Although this material is non-ferroelectric in bulk crystals or ceramics, their thin films become ferroelectric under tensile strain and their critical temperatures increase to room temperature with rising n . Owing to this, its permittivity and electric tunability increase. Since these films exhibit one-order-of-magnitude better microwave properties than previously-used materials, they have high potential for application in microwave electronics, e.g. in mobiles. The paper was published in *Nature*.



First-principle calculations showing how the index n of $Sr_{n+1}Ti_nO_{3n+1}$ phases strained commensurately to $DyScO_3$ substrates can be used to control local ferroelectric instability. **(a)** Diagram of the crystal structure of a unit cell of the $n=1-6$ and $n=\infty$ members of the $Sr_{n+1}Ti_nO_{3n+1}$ phases. **(b)** Square of polar soft-phonon-mode frequency (right-hand axis) and the energy gain per n (left-hand axis) of the ferroelectric state with respect to the nonpolar state, calculated from first principles. Source: DOI



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The American partner prepared a high-quality thin film and studied their structural and microwave properties. Also, he theoretically predicted the unique physical properties of thin film $Sr_{n+1}Ti_nO_{3n+1}$.

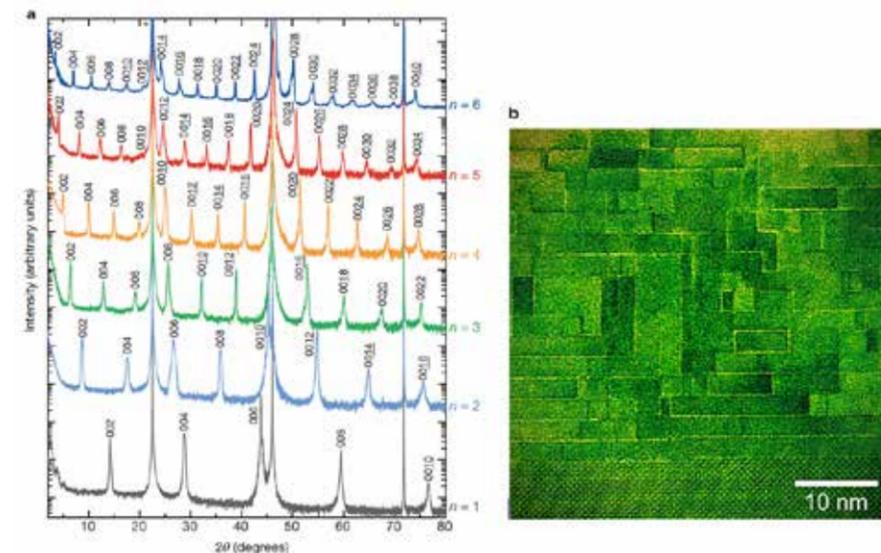


How did the Czech partner participate in this research result?

The Czech side measured the terahertz and infrared properties of thin films $Sr_{n+1}Ti_nO_{3n+1}$ and explained unique dielectric properties.

CITATION

Lee, C.-H.; Orloff, N.D.; Birol, T.; Zhu, Y.; Goian, V.; Rocas, E.; Haislmaier, R.; Vlahos, E.; Mundy, J.A.; Kourkoutis, L.F.; Nie, Y.; Biegalski, M.D.; Zhang, J.; Bernhagen, M.; Benedek, N.A.; Kim, Y.; Brock, J.D.; Uecker, R.; Xi, X.X.; Gopalan, V.; Nuzhnyy, D.; Kamba, S.; Muller, D.A.; Takeuchi, I.; Booth, J.C.; Fennie, C.J.; Schlom, D.G. Exploiting dimensionality and defect mitigation to create tunable microwave dielectrics. *Nature* (2013) 502, 532.. [DOI: 10.1038/nature12582](https://doi.org/10.1038/nature12582)



Structural characterization by X-ray diffraction and Transmission electron microscopy. **(a)** θ - 2θ scans of epitaxial $Sr_{n+1}Ti_nO_{3n+1}$ ($n=1-6$) films grown on $DyScO_3$. Substrate peaks are labelled with an asterisk, and the plots are offset for clarity. **(b)** Bright-field scanning transmission electron microscopy image of the $n=6$ film grown on $DyScO_3$. Source: DOI

Propagation of waves in the radiation belt region: analysis of measurements of the NASA Van Allen Probes mission

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Prof. RNDr.
Ondřej Santolík, Dr.

INSTITUTION CZ

Charles University, Faculty of Mathematics and Physics, Prague
www.mff.cuni.cz



PRINCIPAL INVESTIGATOR USA

Prof. Craig A. Kletzing, Ph. D.

INSTITUTION USA

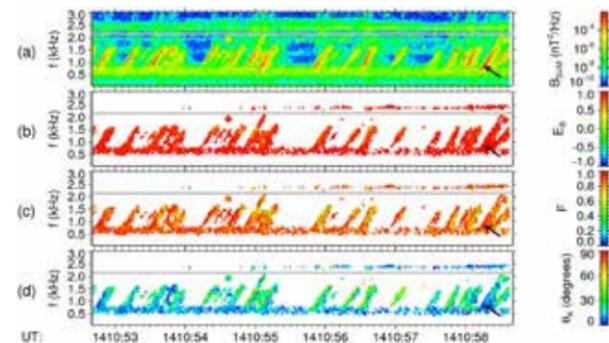
University of Iowa, Department of Physics and Astronomy, Iowa City
www.physics.uiowa.edu

ANNOTATION OF THE RESEARCH RESULT

Whistler mode chorus emissions are natural electromagnetic waves generated by unstable plasma in the Earth's magnetosphere. Their frequencies are in the audible range and when the recorded data is played through a loudspeaker, we can hear characteristic chirping sounds reminding us of a rookery of birds waking up in the morning. Chorus waves occur in the outer Van Allen radiation belt. They have been proven to accelerate relativistic electrons through wave-particle interactions with potentially devastating consequences for the safety of spacecraft in geostationary orbit. New multicomponent waveform measurements have been collected by the NASA Van Allen Probes spacecraft.

We have detected the fine structure of chorus elements with peak instantaneous amplitudes of a few hundred pT, but exceptionally reaching up to 3 nT, i.e., more than 1% of the background magnetic field. The wave vector direction turns by a few tens of degrees within a single chorus element, but also within

its subpackets. This result brings new insight into the dynamics of chorus emissions and their effects.



An analysis of the magnetic field record obtained by the EMFISIS Wave instrument onboard Van Allen Probe A on 14 November 2012. Source: O. Santolík, 2014



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The design and construction of the instruments for measuring electromagnetic waves on NASA's Van Allen Probes satellites. Planning and management of measurements. Primary data processing.



How did the Czech partner participate in this research result?

Contribution to algorithms on board the Van Allen Probes satellites. Unique analysis of the measured data. Interpretation of results.

CITATION

Santolík, O.; Kletzing, C.A.; Kurth, W.S.; Hospodarsky, G.B.; Bounds, S.R. (2014), Fine structure of large-amplitude chorus wave packets. Geophys.Res.Lett., 41, 293-299. > DOI: [10.1002/2013GL058889](https://doi.org/10.1002/2013GL058889)



From the left: J. A. Van Allen, discoverer of the radiation belts of the Earth; Ondřej Santolík; Bruce Randall. Department of Physics and Astronomy, The University of Iowa, 2001. Source: R. R. Anderson

Spectral and timing properties of cosmic black holes

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Mgr. Michal Bursa, Ph.D.

INSTITUTION CZ

Astronomical Institute of the Czech Academy of Sciences, Ondřejov, www.asu.cas.cz



PRINCIPAL INVESTIGATOR USA

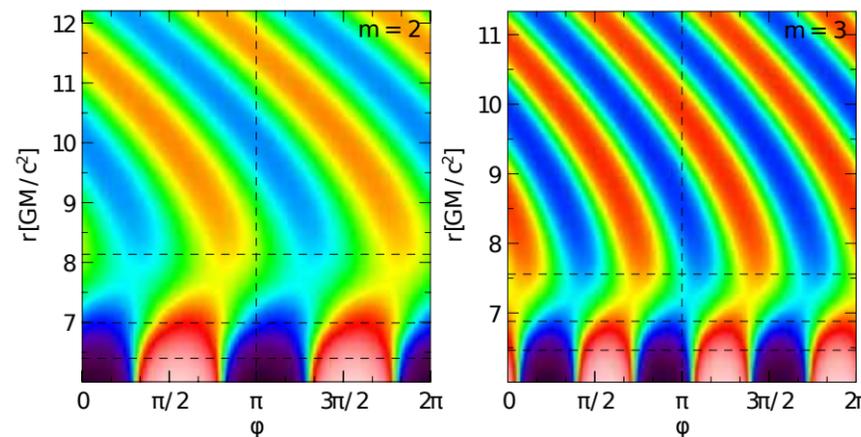
Prof. Ronald A. Remillard, Ph.D.

INSTITUTION USA

MIT Kavli Institute, Cambridge www.space.mit.edu

ANNOTATION OF THE RESEARCH RESULT

The angular momentum transport in accretion disks is traditionally attributed to the action of magneto-hydrodynamic turbulence that is qualitatively described using Shakura-Sunyaev viscosity. Our work has focused on the theoretical calculations of corrections of the oscillation mode frequencies due to this turbulence. We have derived a general formula describing the local growth rates of the density waves and excitation of the global oscillation modes in vertically integrated disks that describe changes of oscillation mode frequencies due to turbulent viscosity, as well as due to the radial motion of the fluid. Both our theoretical and numerical results agree with previous general ideas that the inner edges of black-hole accretion disks are pretty unstable and may host coherent oscillations.



Corotational instability in an accretion disk surrounding a non-rotating black hole. The color expresses the density of the disk depending on the position of the radial coordinate r and the azimuthal coordinate φ . At higher radii ($r > 7.5 r_g$), corotational instability spiral waves are generated. The image shows modes with two (the left panel) and three (the right panel) spiral arms, which could pose a high frequency quasi-periodic oscillation. Source: J. Horák



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The American partner conducted the verification of theoretical calculations and numerical simulations using the PLUTO hydrodynamic code.



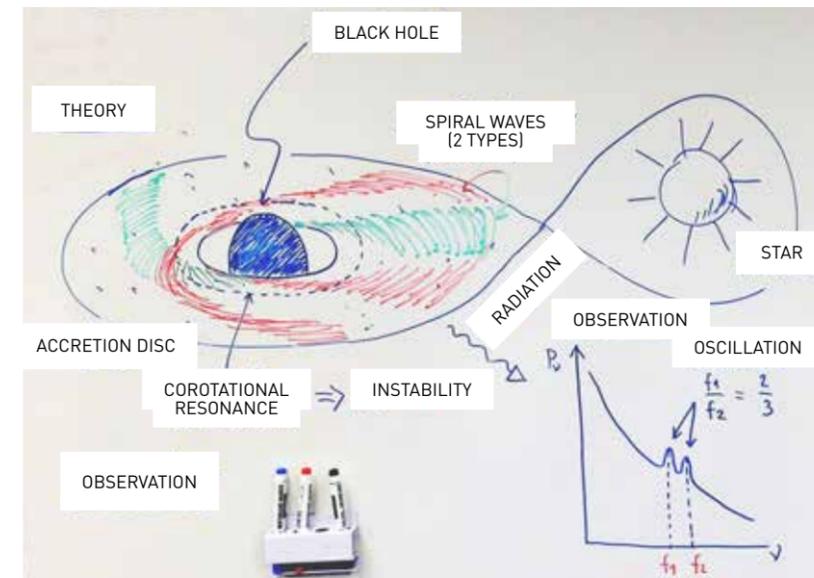
How did the Czech partner participate in this research result?

The Czech partners participated mainly in theoretical calculations using perturbation methods. They also helped with the analysis and theoretical interpretation of the numerical results.

CITATION

Miranda, R.; Horák, J.; Lai, D. 2015. *Viscous driving of global oscillations in accretion discs around black holes*. Monthly Notices of the Royal Astronomical Society 446, 240-253.

► DOI: [10.1093/mnras/stu2122](https://doi.org/10.1093/mnras/stu2122)



Depiction of the corotational instability origin in an accretion disk created from gas of a co-orbiting star around a black hole. Two types of spiral density waves with different numbers of arms meet at a certain radius in phase and lead to instability and possible generation of quasi-periodic oscillations. Source: J. Horák / M. Bursa

Metalloprotein photoactivation: Structural dynamics and electron transfer

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Prof. RNDr. Antonín Vlček, CSc.

INSTITUTION CZ

J. Heyrovský Institute of Physical Chemistry
of the CAS, Prague
www.jh-inst.cas.cz



PRINCIPAL INVESTIGATOR USA

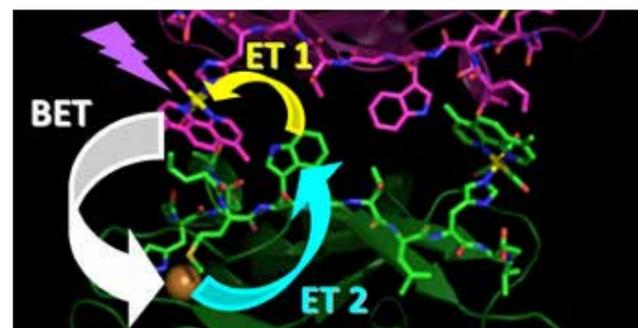
Prof. Harry B. Gray, Ph.D.

INSTITUTION USA

California Institute of Technology,
Beckman Institute, Pasadena
www.caltech.edu

ANNOTATION OF THE RESEARCH RESULT

Electron hopping is a mechanism whereby electrons can flow through biological systems over distances longer than 1.5-2.0 nanometers, by travelling ("hopping") through a series of shorter steps composed, for example, of the amino acid tryptophan. Investigating judiciously designed azurin mutants, we have established that hopping can occur very fast in protein complexes across hydrophobic protein-protein interfaces and showed that direct interaction between the photooxidant and tryptophan is a necessary prerequisite for efficient electron hopping. It also follows that the hopping mechanism rectifies the electron flow, accelerating it in one direction and not the other. These novel observations have important implications for understanding biological electron transfer and designing artificial biomimetic systems for light-energy storage, redox catalysis and bioelectronics.



◀ A photo-induced electron transfer on the interface between two proteins.
Source: DOI



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The synthesis and characterization of samples (including protein crystallography), taking part in the physical measurements (time-resolved spectroscopy in the ultraviolet and visible spectra), data exchange, ongoing consultation and research planning, preparation of joint publications.



How did the Czech partner participate in this research result?

Theoretical (quantum chemical) calculations, taking the complementary part of the physical measurements (time-resolved infrared spectroscopy), data exchange, ongoing consultation and research planning, preparation of joint publications.

CITATION

Takematsu, K.; Williamson, H.; Blanco-Rodríguez, A.M.; Sokolová, L.; Nikolovski, P.; Kaiser, J.T.; Towrie, M.; Clark, I.P.; Vlček, A., Jr.; Winkler, J.R.; Gray, H.B. Tryptophan-accelerated electron flow across a protein-protein interface. *J. Am. Chem. Soc.*, 2013, 135, 15515–15525.

► DOI: [10.1021/ja406830d](https://doi.org/10.1021/ja406830d)



◀ The Beckman Institute, which Prof. Harry Gray built and where his seat is.
Source: A. Vlček

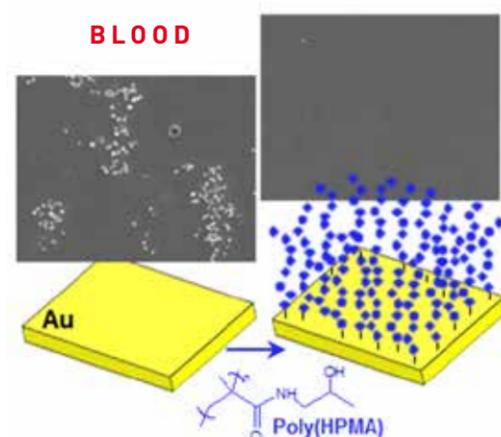
Ultra-low fouling polymers for biomedical applications synthesized by living radical polymerization

CZECH-AMERICAN SCIENTIFIC TEAM

 <p>PRINCIPAL INVESTIGATOR CZ Ing. Zdeňka Sedláková, CSc.</p> <p>INSTITUTION CZ Institute of Macromolecular Chemistry of the Czech Academy of Sciences, Prague www.imc.cas.cz</p>	 <p>PRINCIPAL INVESTIGATOR USA Prof. Virgil Percec, PhD.</p> <p>INSTITUTION USA University of Pennsylvania, Department of Chemistry, Philadelphia www.chem.upenn.edu</p>
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ANNOTATION OF THE RESEARCH RESULT

The key requirement of polymer surfaces operating in biological media is suppressing the non-specific adsorption of proteins. Our team discovered that surfaces prepared from poly[N-(2-hydroxypropyl) methacrylamide] remarkably suppress fouling from blood plasma and prevents the adhesion of platelets, erythrocytes and leukocytes. Controlling polymerization is a very important requirement for the preparation of defined polymer surfaces. Reaction conditions that enable the monitoring of the course of N-(2-hydroxypropyl) methacrylamide polymerization while using the single electron living radical polymerization method with conversion up to 90% have been discovered.



The prepared hydrophilic polymer brushes based on HPMA provide an excellent surface modification to prevent the adhesion of blood components as well as fouling from whole blood. This surface modification opens new opportunities to improve the performance of blood contacting devices. IMC, Prague 2015. Source: Z. Sedláková



PARTICULAR CONTRIBUTION TO THE COOPERATION

- How did the U.S. partner participate in this research result?**
Professor V. Percec is the inventor of controlled radical polymerization with a single electron transfer. The American partner participated in designing experiments and evaluating obtained results. Part of the experimental work and evaluation of the results was carried out jointly by Czech and American partners in the US lab, under the expert guidance of Professor Percec.
- How did the Czech partner participate in this research result?**
The Czech partner was involved in the implementation of the experimental part of the work and, together with our American partners, in evaluating the results.

CITATION

Nguyen, N.H.; Rodriguez-Emmenegger, C.; Brynda, E.; Sedlakova, Z.; Percec, V. SET-LRP of N-(2-hydroxypropyl) methacrylamide in H₂O, *Polymer Chemistry* 4(8), 2424-2427 (2013).
DOI: [10.1039/c3py00220a](https://doi.org/10.1039/c3py00220a)



Department of Controlled Polymer Synthesis: Vladimír Raus, Rafał Poreba, Štěpán Adamec, Jiří Podešva, Miroslav Janata, Lenka Poláková, Jana Šrotýřova, Tereza Klímová, Zdeňka Sedláková, Jana Rovenská, Eva Čadová, František Surman. IMC, Prague 2015. Source: D. Illnerová



CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

doc. Ing. Karel Friess, Ph.D.

INSTITUTION CZ

University of Chemistry and Technology,
Faculty of Chemical Engineering, Prague
fchi.vscht.cz



PRINCIPAL INVESTIGATOR USA

Prof. Richard D. Noble, Ph.D.

INSTITUTION USA

University of Colorado, Chemical and Biological
Engineering, Boulder
www.colorado.edu/chbe



INVESTIGATOR CZ

Ing. Pavel Izák, Ph.D., DSc.

INSTITUTION CZ

Institute of Chemical Process Fundamentals
of the Czech Academy of Science, Prague
www.icpf.cas.cz

ANNOTATION OF THE RESEARCH RESULT

The most important outcome of the CZ-US bilateral project is a forthcoming publication that summarizes all important results and findings related to the use of unique polymer supported membranes with embedded ionic liquids (in both liquid and polymerized form) for energy purposes. Raw biogas, which is produced from renewable sources such as agricultural waste, sewage treatment plants and landfills, represents an alternative and inexpensive source of pure methane from waste. The US partner was responsible for preparing unique membranes with different contents of ionic liquid. The transport properties of such samples were tested in both Czech cooperating institutions. The permeability and sorption of pure gases and mixed gases ($\text{CO}_2 / \text{CH}_4$) were determined. The influence of relative humidity in the feed gas mixture was tested as well. It was found that the presence of water vapor significantly improves separation performance.



▲ Ing. Pavel Izák, Ph.D., DSc., Eduard Hála
Laboratory of Separation Processes,
ICPF CAS. Source: P. Izák



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The contribution of the American partner in the project was crucial. Due to his knowledge and experience, unique polymer membranes with built-in ionic liquids were prepared, not only in a liquid form, but also in its polymerized form. Moreover, the prepared membranes were mechanically and thermally stable, despite the content of ionic liquid reached about 75 weight percent.



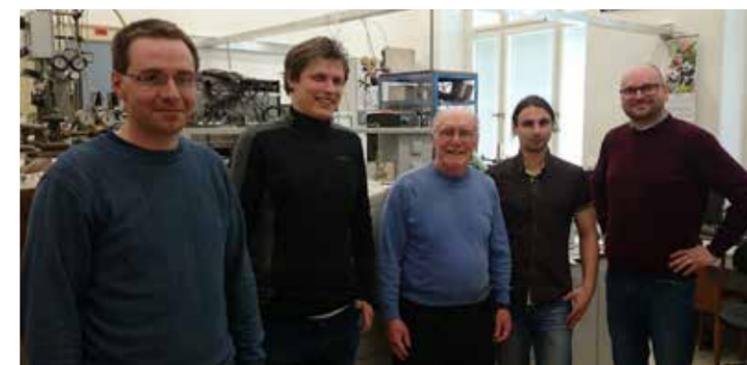
How did the Czech partner participate in this research result?

Both Czech partners in the project performed the experimental testing and characterization of prepared membranes using unique self-invented apparatuses. Besides determining the permeation and sorption properties of membrane materials for pure substances, sophisticated experiments with mixtures of gases in the presence of water vapor were also carried out. The obtained results demonstrated the ability of materials to effectively separate gas mixtures that correspond to raw biogas composition.

CITATION

Kárászová, M.; Kačírková, M.; Friess, K.; Izák, P. Progress in Separation of Gases by Permeation and Liquids by Pervaporation Using Ionic Liquids: A Review. (Eng) Sep. Purif. Technol. 132, 93-101 (2014).

► DOI: [10.1016/j.seppur.2014.05.008](https://doi.org/10.1016/j.seppur.2014.05.008)



Visiting Prof. Noble in Prague in the Membrane Separation Process Laboratory, UCT Prague, April 2015. From the left: Ing. Ondřej Vopička, Ph.D., Ing. Kryštof Pílnáček, Prof. Richard Noble, Ing. Marek Lanč, doc. Ing. Karel Friess, Ph.D. Source: K. Friess

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Ing. Marie Zikánová, Ph.D.

INSTITUTION CZ

Charles University, First Faculty of Medicine, Prague, www.lf1.cuni.cz



PRINCIPAL INVESTIGATOR USA

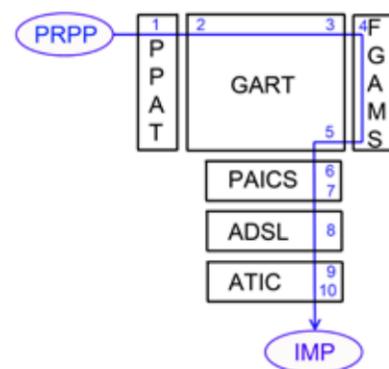
Prof. Dr. David Patterson

INSTITUTION USA

University of Denver, Eleanor Roosevelt Institute, Denver, www.du.edu

ANNOTATION OF THE RESEARCH RESULT

Purines are essential molecules for nucleic acid synthesis and are the universal carriers of chemical energy in all living organisms. The cellular pool of purines is maintained by the balance between their biosynthesis (DNPS), recycling and degradation. DNPS includes ten reactions catalyzed by six enzymes. To date, two genetically determined disorders of DNPS enzymes have been described, and the existence of other defects is highly presumable. Purinosome is a multienzyme complex that cells transiently assemble upon the depletion of purines. Using parallel immunolabeling of various DNPS enzymes and confocal fluorescent microscopy, we proved purinosome assembly in different control cells, skin fibroblasts from patients with ADSL deficiency and AICArribosiduria. Our results show that the assembly of functional purinosomes is fully dependent on the presence of structurally unaffected DNPS proteins.



← **A diagram of purinosome (Barešová et al, 2012).**

Input substrate of a *de novo* purine synthesis - phosphoribosyl pyrophosphate (PRPP) is converted by 6 enzymes (black boxes) in 10 enzymatic reactions into inosine monophosphate (IMP). The arrow indicates the expected flow of intermediates through purinosome. Source: DOI



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

Prof. D. Patterson provided the technical expertise and CHO (hamster ovarian) cell line deficient in individual steps of *de novo* purine synthesis, which served as a model system for the study of disorders of this pathway, hence purinosome.

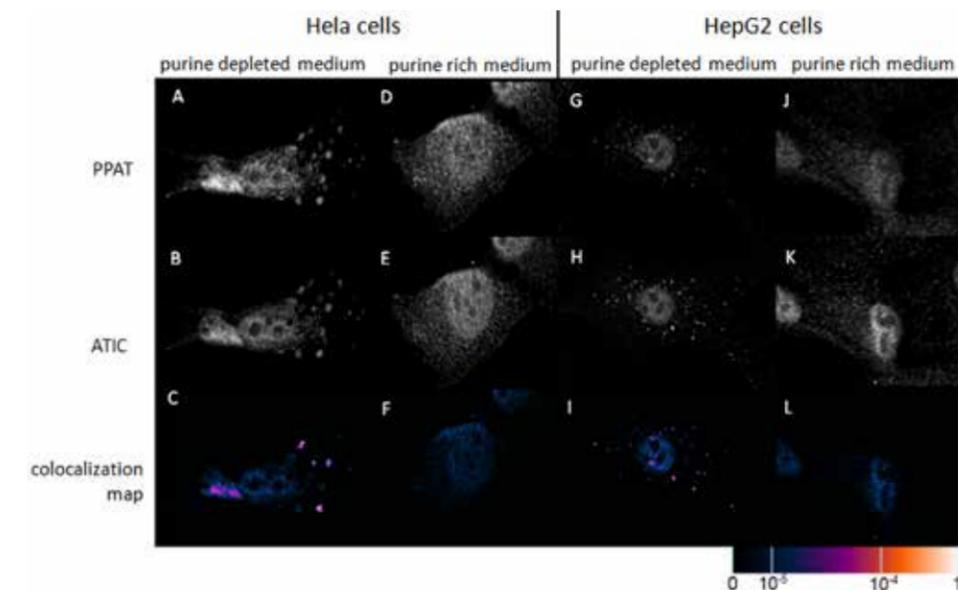


How did the Czech partner participate in this research result?

The actual work was done mainly in the workplace of the Czech partner.

CITATION

Baresova, V.; Skopova, V.; Sikora, J.; Patterson, D.; Sovova, J.; Zikanova, M.; Kmoch, S. 2012. Mutations of ATIC and ADSL affect purinosome assembly in cultured skin fibroblasts from patients with AICArribosiduria and ADSL deficiency. *Hum Mol Genet* 21(7):1534-43. > DOI: [10.1093/hmg/ddr591](https://doi.org/10.1093/hmg/ddr591)



← **The formation of purinosome in HeLa and HepG2 cell cultures (Barešová et al 2012).**

A-F: HeLa cells cultured in a medium without purines (A-C) or a medium with purines (D-F). G-L: HepG2 cells cultured in a medium without purines (G-I), or in a medium with purines (J-L). In the cells grown in a medium without purines are PPAT (A, G) and the ATIC (B, H) located in clusters and their fluorescent signals show a high degree of overlap (C, I). In the cells grown in a purine-rich medium, PPAT (D, J) and the ATIC (E, K) are diffusely distributed throughout the cytosol and their fluorescent signals do not overlap (F, L). Source: DOI

Identification and characterization of genetic factors contributing to chronic kidney disease

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Doc. Ing. Stanislav Kmoch, CSc.

INSTITUTION CZ

Charles University, First Faculty of Medicine, Prague, www.lf1.cuni.cz



PRINCIPAL INVESTIGATOR USA

Dr. Anthony J. Bleyer, M.D.

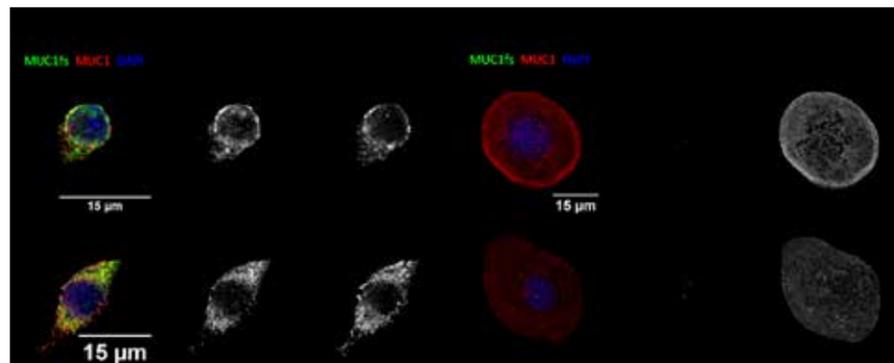
INSTITUTION USA

Wake Forest University, School of Medicine www.wakehealth.edu

ANNOTATION OF THE RESEARCH RESULT

Clarification of the genetic and molecular causes of medullary cystic kidney disease (MKD1).

We describe the illustrative case of the simple mendelian disorder medullary cystic kidney disease type 1 (MCKD1), mapped more than a decade ago to a 2-Mb region on chromosome 1. Ultimately, only by cloning, capillary sequencing and de novo assembly did we find that each of six families with MCKD1 harbors an equivalent, yet apparently independently arising mutation in a sequence markedly under-represented in massively parallel sequencing data: the insertion of a single cytosine in one copy (but a different copy in each family) of the repeat unit comprising an extremely long (~1.5–5 kb), GC-rich (>80%) coding variable-number tandem repeat (VNTR) sequence in the MUC1 gene encoding mucin 1. These results provide a cautionary tale about the challenges in identifying the genes responsible for mendelian, let alone more complex disorders through massively parallel sequencing.



← A new method of MCKD1 diagnosis based on the immunofluorescence detection of mutated cells in a urinary MUC1fs patient, which was developed within the project. Source: M. Živná, V. Barešová



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

Prof. Bleyer assembled the world's largest group of patients with an autosomal dominant form of tubulointerstitial nephropathy.



How did the Czech partner participate in this research result?

The Czech partner prepared an antibody that allows for the specific detection of a mutated protein and revealed the presence of mutated protein mucin-1 in a series of biopsy material from patients and generated cellular models. Based on these results, he further introduced a unique immunohistochemical diagnostics, which current cooperating workplaces around the world have been provided.

CITATION

Kirby, A.; Gnirke, A.; Jaffe, D.B.; Barešová, V.; Pochet, N.; Blumenstiel, B.; Ye C.; Aird, D.; Stevens, C.; Robinson, J.T.; Cabili, M.N.; Gat-Viks, I.; Kelliher, E.; Daza, R.; DeFelice, M.; Hůlková, H.; Sovová, J.; Vyletal, P.; Antignac, C.; Guttman, M.; Handsaker, R.E.; Perrin, D.; Steelman, S.; Sigurdsson, S.; Scheinman, S.J.; Sougnez, C.; Cibulskis, K.; Parkin, M.; Green, T.; Rossin, E.; Zody, M.C.; Xavier, R.J.; Pollak, M.R.; Alper, S.L.; Lindblad-Toh, K.; Gabriel, S.; Hart, P.S.; Regev, A.; Nusbaum, Ch.; Kmoch, S.; Bleyer, A.J.; Lander, ES.; Daly, M.J. Mutations causing medullary cystic kidney disease type 1 (MCKD1) lie in a large VNTR in /MUC1/ missed by massively parallel sequencing. *Nature Genetics* 2013 Mar;45(3):299-303. > DOI: [10.1038/ng.2543](https://doi.org/10.1038/ng.2543)



← Meeting of working teams and patients during a visit by Anthony Bleyer to the Czech Republic in 2016. Source: S. Kmoch

Determining the molecular aspects of spinal cord injury, regeneration, stem cell therapy and treatment with anti-inflammatory compounds

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

Doc. RNDr.
Pavla Jendelová, Ph.D.

INSTITUTION CZ

Institute of Experimental Medicine of the Czech Academy of Sciences, Prague, www.iem.cas.cz



PRINCIPAL INVESTIGATOR USA

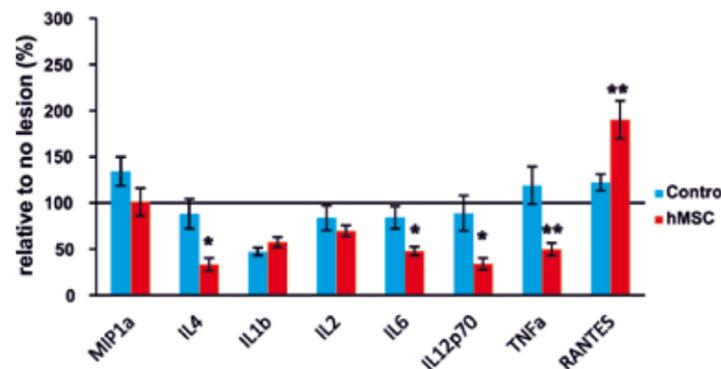
Assoc. Prof.
Meena Jhanwar-Uniyal, Ph.D.

INSTITUTION USA

New York Medical College, Valhalla
www.nymc.edu

ANNOTATION OF THE RESEARCH RESULT

The transplantation of mesenchymal stem cells (MSC) improves functional recovery in experimental models of spinal cord injury (SCI); however, the mechanisms underlying this effect are not completely understood. We investigated the effect of the intrathecal implantation of human MSC in rats with SCI. Transplanted cells did not survive at the lesion site of the spinal cord; however, functional recovery was enhanced in the MSC-treated group. Morphometric analysis showed a significantly higher amount of spared white matter. Transplantation of MSCs reduced levels of inflammatory cytokines, modulated glial scarring and provided an increased expression of genes involved in spinal cord regeneration. In conclusion, the intrathecal implantation of MSCs reduces the inflammatory reaction and apoptosis, improves functional recovery and modulates glial scar formation after SCI, regardless of cell survival. Therefore, repeated applications may prolong the beneficial effects induced by MSC application.



The decline of inflammatory cytokines in a spinal cord injury 10 days after administration of mesenchymal stem cells, the IEM, Prague, 2013. Source: P. Jendelová



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The American partner carried out the analysis of samples in the Luminex system, which were sent to the US from the Czech Republic. Also, she participated in the planning of experiments and study design.



How did the Czech partner participate in this research result?

The Czech partner undertook a study on animals, surgery, behavioral experiments, immunohistological and morphometric analysis.

CITATION

Machová Urdzíkova, L.; Růžička, J.; LaBagnara, M.; Kárová, K.; Kubinová, Š.; Jiráková, K.; Murali, R.; Syková, E.; Jhanwar-Uniyal, M.; Jendelová, P. Human mesenchymal stem cells modulate inflammatory cytokines after spinal cord injury in rat. *Int J Mol Sci.* 2014 Jun 25;15(7):11275-93.

DOI: [10.3390/ijms150711275](https://doi.org/10.3390/ijms150711275)



Mgr. Růžička prepares a surgery, IEM, Prague 2014. Source: P. Jendelová

Modulation of fatty acid reesterification in adipose tissue by lipid mediators

CZECH-AMERICAN SCIENTIFIC TEAM



PRINCIPAL INVESTIGATOR CZ

RNDr. Ondřej Kuda, Ph.D.

INSTITUTION CZ

Institute of Physiology of the Czech Academy of Sciences, Prague
www.fgu.cas.cz



PRINCIPAL INVESTIGATOR USA

Prof. Nada A. Abumrad, Ph.D.

INSTITUTION USA

Washington University School of Medicine, Department of Medicine and Cell Biology, St. Louis, www.medicine.wustl.edu

ANNOTATION OF THE RESEARCH RESULT

The anti-inflammatory effects of omega-3 PUFA are mediated by new lipid mediators from adipose tissue

Omega-3 polyunsaturated fatty acids (omega-3) of a marine origin alleviate inflammation, while having favorable metabolic effects. Omega-3 reduces the risk of the development of cardiovascular disorders that are linked to obesity and type 2 diabetes, and also improve lipid metabolism. A complex research of omega-3-related mechanisms of action in mouse models of obesity at the Institute of Physiology CAS, clinical research on obese patients with type 2 diabetes in the Institute for Clinical and Experimental Medicine, and collaboration with the Institute of Organic Chemistry and Biochemistry CAS led to the identification of the structures of novel signaling molecules of a lipid origin – esters of fatty acids and hydroxyl-fatty acids (FAHFA) – derived from docosahexaenoic acid (DHA): 13-DHAHLA, 9-DHAHLA a 14-DHAHDHA. These molecules, which are synthesized by adipose cells and exert anti-inflammatory effects, were detected in the serum and adipose tissue of both obese mice and diabetic patients following dietary intervention with omega-3. These newly discovered molecules, which can be endogenously synthesized when eating an appropriate diet, are involved in the beneficial health effects of omega-3 and have the potential for wide use in the prevention and treatment of severe diseases.



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The US partner participated in the published results indirectly, within the LH14040 project focused on the systematic exploration of the influence of lipid mediators (lipid signaling molecules) on the metabolism of adipose tissue. We managed to discover previously undescribed signaling molecules derived from fat cells. Their involvement in the metabolism of adipose and immune cells is currently being investigated in cooperation with the American partner.



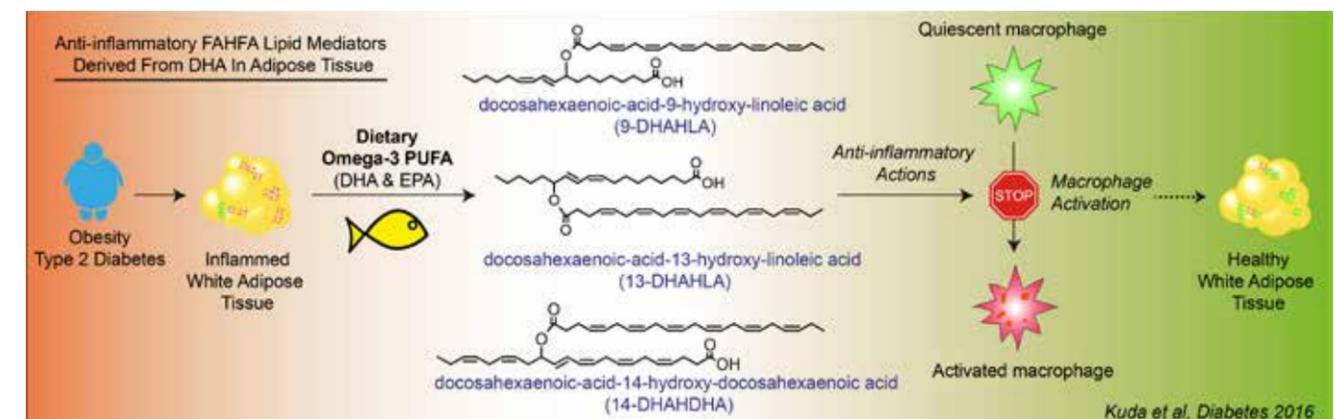
How did the Czech partner participate in this research result?

The Czech partner identified completely new lipid mediators derived from omega-3 polyunsaturated fatty acids, performed basic identification and examined the biological activities of selected compounds.

CITATION

Kuda, O.; Brezinova, M.; Rombaldova, M.; Slavikova, B.; Posta, M.; Beier, P.; Janovska, P.; Veleba, J.; Kopecky, J. Jr.; Kudova, E.; Pelikanova, T.; Kopecky, J. Docosahexaenoic Acid-Derived Fatty Acid Esters of Hydroxy Fatty Acids (FAHFAs) With Anti-inflammatory Properties. *Diabetes*. 2016 Sep; 65(9):2580-90.

► DOI: [10.2337/db16-0385](https://doi.org/10.2337/db16-0385)



▲ Graphic abstract, Prague 2016. Source: O. Kuda



Multilingual Corpus Annotation as a Support for Language Technologies



CZECH-AMERICAN SCIENTIFIC TEAM



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ANNOTATION OF THE RESEARCH RESULT

What is the nature of text? Are there general rules for the structure of text (discourse)? If so, what are the mechanisms that enable us to perceive text as an integrated, coherent whole and how do they interact? This research monograph, the fruit of eight years' work by ten authors from the Institute of Formal and Applied Linguistics (Charles University, Faculty of Mathematics and Physics), gathers the findings on several different aspects of discourse coherence: discourse relations and discourse connectives, coreference, bridging relations (associative anaphora), information structure (topic-focus articulation) and salience of the elements of the stock of shared knowledge of the speaker and the hearer. The newly established Prague Discourse Treebank 1.0 (and its enhanced version in Prague Dependency Treebank 3.0) was designed in close cooperation with the Penn Discourse Treebank research team (from the University of Pennsylvania). The PDTB team members provided theoretical background and material for making data comparisons and they offered scientific advice throughout the project.



◀ Prof. Eva Hajičová (ÚFAL MFF UK) presents a gift to Prof. Aravind Joshi (IRCS, The University of Pennsylvania) at the DepLing conference (Prague, 2013). Source: A. Nedoluzhko



▶ Awarding an Honorary Doctorate from Charles University to Prof. Aravind Joshi (IRCS, University of Pennsylvania). Karolinum, Prague, 2013. Source: www.cuni.cz



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

Penn Discourse Treebank members consulted on the course of research on the Czech side, provided a basis for comparison, and reported the results of research conducted on English and other languages.



How did the Czech partner participate in this research result?

Members of the Czech side are the authors of this monograph; they conducted the research that concerns the Czech language and considerably developed the US methodology for analyzing the construction discourse relations and enriched it with additional terms.

CITATION

Zikánová, Š.; Hajičová, E.; Hladká, B.; Jínová, P.; Mírovský, J.; Nedoluzhko, A.; Poláková, L.; Rysová, K.; Rysová, M.; Václ, J. Discourse and Coherence. From the Sentence Structure to Relations in Text. Charles University in Prague, Faculty of Mathematics and Physics, Institute of Formal and Applied Linguistics, Praha, Czechia, ISBN 978-80-904571-8-8, 274 pp., 2015.



◀ Meeting of the research teams. Institute for Research in Cognitive Science, University of Pennsylvania, Philadelphia, 2012. Source: R. Prasad

Beta diversity of plant-insect food webs along an altitudinal gradient in the tropics

ČESKO-AMERICKÝ VĚDECKÝ TÝM



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ANNOTATION OF THE RESEARCH RESULT

Ecological theory suggests that tropical forests maintain high species diversity of insects by narrow host specificity so that for instance most herbivorous species can feed on only a single plant host species. Herbivorous insects using different host plant species do not compete with one another, which facilitates their coexistence. Our study of tropical insects demonstrated that highly specialized guilds are in fact species poor, while the bulk of tropical biodiversity is represented by less specialized guilds. This result shows that high tropical biodiversity cannot be explained by ecological, niche differentiation mechanisms. We need to focus on the mechanisms and rate of speciation that generate large species pools in the tropics from which local communities are recruited.



Caterpillar *Homodes iomolybda*, caterpillar feeding on leaves of *Trichospermum pleiostigma* tropical trees, which are typically found in disturbed forest vegetation. Source: V. Novotný, 2013



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

There was close cooperation combining the expertise of the Czech ecological study of herbivorous insects (Novotný) with the taxonomic expertise (Miller) and botanical and phylogenetic expertise (Weiblen) of the American partners. The American team led the botanical analysis and participated in other aspects of the research.



How did the Czech partner participate in this research result?

The Czech team designed this research, led by field data collection and the analysis of data on communities of insects. The American team led the botanical analysis and participated in other aspects of the research. The leading (first) author of the resulting publication is from the Czech team, while the senior (last) author is from the American team.

CITATION

Novotný, V.; Miller, S.E.; Hrcék, J.; Baje, L.; Basset, Y.; Lewis, O.T.; Stewart, A.J.A.; Weiblen, G.D. 2012. Insects on plants: explaining the paradox of low diversity within specialist herbivore guilds. *American Naturalist* 179, 351–362. [DOI: 10.1086/664082](https://doi.org/10.1086/664082)



Field study of insect communities in Papua New Guinea in cooperation among Czech, American and New-Guinean researchers. Source: V. Novotný, 2013

Sea-level oscillations and changes in atmospheric CO₂ concentrations during the peak greenhouse climate (Cenomanian-Turonian, Western Interior basin)

CZECH-AMERICAN SCIENTIFIC TEAM



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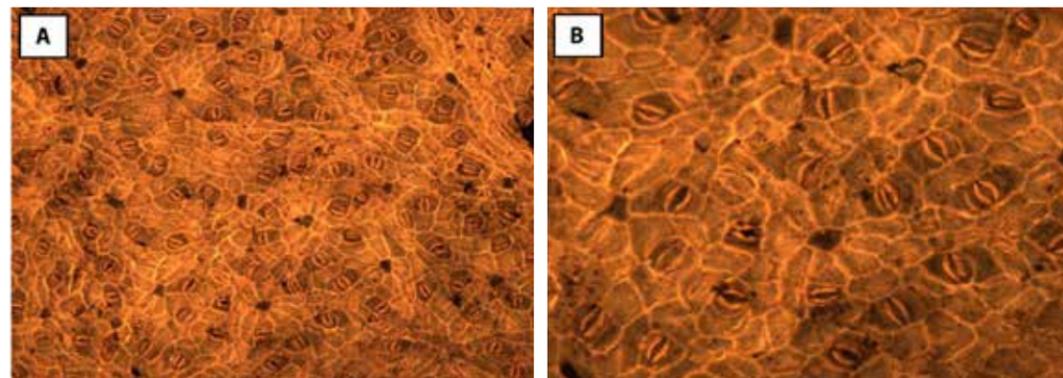
Prof. Bradley B. Sageman

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ANNOTATION OF THE RESEARCH RESULT

New data and numerical models focusing on the peak greenhouse climate (c. 80–100 million years ago) suggest a prominent and persistent role of the long-term modulation of axial obliquity in controlling the carbon cycle and concentrations of greenhouse gases in the atmosphere. The relationship is mediated by changes in the capacity of continental reservoirs at middle and high latitudes. It is restricted to the interval of peak greenhouse warmth probably due to enhanced continental weathering and nutrient fluxes. The results improve our understanding of the response of Earth's climate to changes in the intensity and seasonal distribution of solar irradiance.



▲ Microphotography of fossil cuticles, which are used to interpret the concentration of carbon dioxide in the atmosphere, (A) 100x, (B) 200x. Northwestern University, 2012. Source: R. Barclay



PARTICULAR CONTRIBUTION TO THE COOPERATION



How did the U.S. partner participate in this research result?

The American partner provided access to geological sites, isotopic analysis and laboratory processing of fossil materials.



How did the Czech partner participate in this research result?

The Czech partner performed sedimentological logging in the field, interpreted depositional environments and provided field samples for geochemical analyses. In the next stage, he carried out time series analysis, interpreted the geochemical results and created a set of numerical models to examine the isotopic mass balance of the carbon cycle.

CITATION

Laurin, J.; Meyers, S.R.; Uličný, D.; Jarvis, I.; Sageman, B.B. 2015. Axial-obliquity control on the greenhouse carbon budget through middle- to high-latitude reservoirs. *Paleoceanography*, v. 30, p. 133-149. > DOI: [10.1002/2014PA002736](https://doi.org/10.1002/2014PA002736)



▲ A team of geologists performing fieldwork (excavation of an ichthyosaurid fossil). Bigwater, Utah, 2012. Source: J. Laurin

Climate Networks: Multiple scales of dynamics and interactions in the Earth's atmosphere

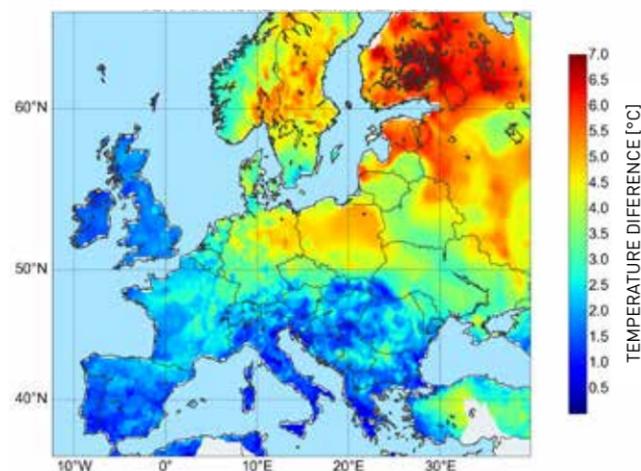
CZECH-AMERICAN SCIENTIFIC TEAM

 <p>PRINCIPAL INVESTIGATOR CZ</p> <p>RNDr. Milan Paluš, DrSc.</p> <p>INSTITUTION CZ</p> <p>Institute of Computer Science of the Czech Academy of Sciences, Prague www.ustavinformatiky.cz</p>	 <p>PRINCIPAL INVESTIGATOR USA</p> <p>Prof. Anastasios A. Tsonis, Ph.D.</p> <p>INSTITUTION USA</p> <p>University of Wisconsin-Milwaukee, Milwaukee www.uwm.edu</p>
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ANNOTATION OF THE RESEARCH RESULT

The inter-annual variability of air temperature is influenced by, in addition to global changes and random weather variability, climatic oscillation with a period of about 7–8 years. This oscillation itself is very weak; its amplitude is less than half a degree Celsius. However, due to cross-scale interactions, it causes larger changes in air temperature, mainly in winter. The difference between the winter mean temperatures in various parts of the 7–8-year cycle can exceed 4 degrees Celsius in Central Europe. Such large changes can strongly influence economy, agriculture, tourism and human life in general.

THE EFFECT ON AVERAGE WINTER TEMPERATURES



It is important to understand the physical mechanisms underlying these changes and find algorithms for their forecasting. This scientific result, obtained by the team from the Institute of Computer Science CAS, led by Dr. Paluš, in cooperation with scientists from the University of Wisconsin in Milwaukee, has been published in the prestigious journal *Geophysical Research Letters*.

◀ The effect of the phase of the 7–8-year climate oscillation on average winter temperatures in Europe. The color scale expresses temperature differences in degrees of Celsius. ICS ASCR, 2016. Source: N. Jajcay, M. Paluš

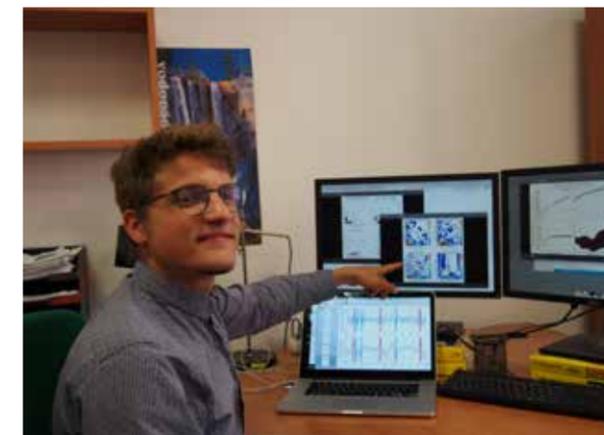


PARTICULAR CONTRIBUTION TO THE COOPERATION

-  **How did the U.S. partner participate in this research result?**
The American partner participated in discussions about the results obtained by the Czech team, their classification and interpretation in the broader context of climate science and in proposals of the possible physical mechanisms of the revealed effects.
-  **How did the Czech partner participate in this research result?**
The Czech team developed original mathematical methods and computer algorithms to detect cross-scale interactions in complex nonlinear time series, which were then applied to the analysis of long-term records of meteorological variables. The developed methods enabled us to uncover a new phenomenon of cross-scale interactions in atmospheric dynamics and to estimate its effect on air temperature variability.

CITATION

Jajcay, N.; Hlinka, J.; Kravtsov, S.; Tsonis, A.A.; Paluš, M. 2016. Time scales of the European surface air temperature variability: The role of the 7-8 year cycle. *Geophysical Research Letters* 43, 902-909.
▶ DOI: [10.1002/2015GL067325](https://doi.org/10.1002/2015GL067325)



◀ PhD student Mgr. Nikola Jajcay while working in the Institute of Computer Science of the CAS. Praha, 2016. Source: M. Paluš



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