SLOVAK ACADEMY OF SCIENCES
ANNUAL REPORT 2020

IMPRINT

The Annual Report has been compiled pursuant to the Act on the Slovak Academy of Sciences No. 133/2002 Coll. In compliance with Article 8 paragraph 7 c) thereof, the Assembly of the Slovak Academy of Sciences endorsed the Annual Report on 20th April 2021.
The Government of the Slovak Republic took note at its 13th meeting on 26th May 2021.

Compiled and edited by: PhDr. Dušan Gálik, CSc.
Mgr. Andrea Nozdrovická
Ing. Tatiana Bezáková

Translation: Mgr. Romana Korenková

Published by the Slovak Academy of Sciences
Štefánikova 49, 814 38 Bratislava, Slovak Republic

Available in electronic form at www.sav.sk

Photos and images of the best results by SAS research institutes.

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FOREWORD BY THE PRESIDENT OF THE SAS

2020 was a year different from previous years. The pandemic spread fully and the SAS organizations were initially surprised by this situation. Fortunately, this situation did not last long, and the SAS Crisis Staff, in cooperation with the directors of organizations, proposed such a regime that the activities and research at the SAS would not stop. On the one hand, field types of research have been limited, but on the other hand, those types of research that deal with virology, biomedicine, but also other areas related to the pandemic have been fully developed. The activities of scientists from the Biomedical Research Center SAS became visible and the company appreciated their specialization and expertise in the initial testing, but also in the development of new types of tests and potential medical drugs. Experimental work in institutes and centers did not stop, so the SAS report for 2020 could take a standard form.

The important thing is that the Presidium of SAS announced several programs in this non-standard year as well, which should lead to higher research excellence. One of the important projects is the **SASPRO 2** project, where the first calls for top postdoctoral students were announced in 2020. This time, the Slovak University of Technology in Bratislava and Comenius University also participate in the SASPRO2 project scheme. Another important project was the **MoRePro** program focused on recruiting top domestic and foreign researchers. Last but not least, it was the **DoktoGrant** program, which is focused on doctoral students of the SAS. The aim of this program is to support quality project proposals that can be implemented within one year. In 2020, the SAS received the significant **Human Resources Excellence in Research** award, which is awarded by the European Commission to institutions guaranteeing compliance with the principles of the European Charter for Researchers.

The overview of the most important scientific results for 2020 is varied and comprehensive and worth reading. It is also clear from this review that the pandemic did not dramatically weaken the performance of the scientific teams at the SAS. Not only the results of basic research are presented, but also the results applied in social practice and obtained in an international context.

SAS participates in the 3rd level of university studies. In 2020, 512 students studied at the SAS. The number of students has long been around 500. The interest of doctoral students in studying at the SAS is a manifestation of the high credibility of SAS organizations, which are external educational institutions. The growing number of foreign students is also positive.

The SAS is also well visible in the European Research Area. In 2020, 34 H2020 projects with a total value of almost EUR 7 million were solved. A large number of participations of scientists and scientific teams in projects within COST and ERA-NET schemes only underlines this fact.

A serious problem is still the insufficient average wage of the SAS staff, which since 2015 has exceeded the average earnings in the national economy, but is still insufficient in comparison with the average earnings of the staff of the Czech Academy of Sciences. The scissors between the average earnings of a researcher at the SAS and a university teacher are also opening dangerously. The outflow of researchers from the SAS to the university environment is a serious problem that the SAS will have to solve in the near future. Without obtaining additional external resources, solving this problem will be difficult despite the introduction of internal quality criteria for the distribution of organizations' payroll fund through performance financing.

prof. RNDr. Pavol Šajgalík, DrSc., Dr. h. c.
President of the SAS

I. SCIENCE POLICY

The new government of the Slovak Republic, which was formed following the elections in February 2020, claimed in its mission statement to support science, research and innovation, to improve funding and to introduce systemic changes in this area. A working commission was set up at the Ministry of Education, Science, Research and Sport of the Slovak Republic to prepare the reform program, in which the SAS is also represented. The commission commented on the material prepared by the Ministry with several suggestions for the reform of research funding, the reform of the grant system, the research evaluation system, but also the transformation of the SAS organizations into public research institutions (VVI). These suggestions are to be reflected in the amendments to several laws and move to the implementation phase with the support of state and private resources, as well as to the Reconstruction Fund and the European Structural and Investment Funds, which will be implemented in 2021. From 2021, the new period of the EU framework programs - Horizon Europe - also begins. In 2020, the SAS cooperated very intensively with the Ministry of Education, especially with its State Secretary, Ľudovít Paulis, in the preparation of the transformation of the SAS and related amendments to the SAS and VVI Acts. The SAS understands the transformation that should take place on January 1, 2022, not only as an opportunity to move to a new administrative and legal form that will allow better cooperation with the private sector and obtain additional resources for research, but also as an opportunity to become a top research institution with a modern infrastructure and with an emphasis on green solutions and digitization. In this sense, the SAS will submit to the Government of the Slovak Republic a transformation project in 2021 to be supported by the Reconstruction Fund.

In 2020, the SAS commented on materials for the preparation of the Reconstruction Fund as Modern and Successful Slovakia, which was published by the Ministry of Finance of the Slovak Republic as a starting material for a discussion on fundamental structural reforms in science, research and innovation. It should be emphasized that in order to successfully fulfill these efforts, it is necessary to formulate a comprehensive state science policy aimed at the comprehensive development of the research system and to determine the role of science, research and innovation in the development of society. The RIS3 smart specialization strategy, which is currently being innovated, is only a subset of this state science policy, an ex ante conditionality for drawing on EU funds, but it cannot replace science policy. The SAS, in cooperation with the management of Comenius University in Bratislava, the Slovak University of Technology in Bratislava, the Technical University in Košice and Pavol Jozef Šafárik University in Košice, supports the creation of two science centers in Slovakia capable of competing with the most important European and world partners who have already carried out this integration and concentration of education, research and development capacities. The SAS wants to participate in this process, similarly to our French research partner organization CNRS (Center national de la recherche scientifique), in which ninety percent of research institutes are associated with universities.

I.1. Support of excellent research

The SAS implements its own science policy to support excellent research through its own project schemes or by supporting other tools, which are listed in Chapter I.2. One of the most significant innovations in 2020 is the launch of the SASPRO 2 mobility and reintegration project. The duration of the entire project is five years, from October 1, 2020, to September 30, 2025. SASPRO 2 is a program of the SAS and partners of Comenius University in Bratislava and the Slovak University of Technology in Bratislava, intended for experienced scientists from abroad who are interested in working in the host organizations of the program partners. The aim of the program is to attract talented researchers from abroad (Slovak citizens and foreign researchers) and create motivating conditions for them. An important aspect of the project is to improve cooperation between the scientific and application sectors, to support multidisciplinary approaches to project solutions.

Last year, the creation of the EURAXESS point for the SAS was important to support European projects, but also to attract workers from abroad. EURAXESS point SAS helps to remove obstacles that stand in the way of a smooth process of obtaining all permits and visas associated with the stay in Slovakia. As part of the Human Resources Strategy for Researchers (HRS4R), the SAS received the *HR Excellence in Research* label.

Following the example of several European countries, the SAS has decided to prepare a completely new Impulz project scheme, which is to become a preparatory phase to improve the acquisition of the most prestigious European grants from the ERC European Research Council scheme. The Impulz project scheme aims to improve the quality of the scientific organizations of the SAS by attracting internationally recognized scientists and highly talented young researchers who come from abroad or do not go abroad. The task of this new generation of leading scientists will be to create their own research groups that will work on new research directions and current topics in accordance with world trends. The scheme will provide excellent scientists with motivating conditions for their development and will bring scientific organizations an improvement in the research environment and scientific outputs. The scheme, which will start in 2021, is intended to help increase the Academy's excellence, internationalization and competitiveness in the European Research Area and its success in obtaining prestigious grants.

In 2020, the Academy continued for the third year in a row to evaluate its scientific organizations for performance funding. The total amount earmarked for performance financing was again significantly increased compared to the previous year, by more than EUR 6.2 million. The basic rules have not changed significantly compared to the previous year. Of the total amount, 43 percent were awarded for results in comprehensive accreditation of scientific organizations, 30 percent for publishing activities, 10 percent for scientific responses, 12 percent for grants received and five percent for the number of doctoral students. To further support the quality, the Academy introduced a bonus for scientific publications in journals in the first decile according to the Scopus database.

Another tool to support the quality of scientific work at the SAS is the appreciation of top publications. Five works in the journals Nature, International Journal of Engineering Science, Energy and Environmental Science, Nature Ecology & Evolution, Drug Resistance Updates in the category Top journal works in scientific journals with the highest impact measured by the SJR index (Scimago Journal Ranking) falling into the first percentile of the SJR in the relevant scientific field were awarded. Ten works in journals registered in the Nature index database (www.natureindex.com) and two works in journals from the Norwegian Register of Scientific Journals, Series and Publishers, six

highly cited publications and six scientific monographs published by renowned publishers were awarded.

The Slovak Research and Development Agency, SRDA, remains to be the decisive tool for project research funding in Slovakia and the Slovak Academy of Sciences. Even in 2020, the Academy was the most successful organization in obtaining APVV grants.

SAS is still handicapped in the field of technology transfer due to the lack of transformation. Last year, the Office for Technology Transfer was strengthened by new staff, whose task is to help the SAS organizations with patent protection. The Presidium of the SAS approved the SAS Principles for the Application, Protection and Utilization of Industrial Property Rights of Organizations established by the Slovak Academy of Sciences, which will become a fundamental standard for this area in the Academy. SAS also began to participate in the national project for the transfer of NITT2 technologies from the EU structural funds, which is coordinated by the Slovak Centre of Scientific and Technical Information.

I.2. SAS Projects

VEGA activities in the Slovak Academy of Sciences in 2020

The Scientific Grant Agency of the Ministry of Education, Science, Research and Sport SR and the Slovak Academy of Sciences (hereinafter referred to as "VEGA") is a joint body of the Ministry of Education, Science, Research and Sport and the Slovak Academy of Sciences.

VEGA represents a system of institutional support for basic research, while through this scheme the SAS provides funds to its organizations for the solution of scientific projects from its own budget chapter.

In 2020, VEGA's activities were significantly affected by the epidemic situation associated with the COVID-19 pandemic. Several measures have been taken:

- the deadline for submitting VEGA projects in a new call with the start of the solution in 2021 has been extended to May 29, 2020,
- the deadline for solving projects the solution of which was to be completed by December 31, 2020, was extended until March 31, 2021,
- the start of activities of the new VEGA bodies has been postponed - from June 2020 to April 2021.

VEGA's main activities in 2020:

- the announcement of a new call for submitting applications for a financial contribution to scientific projects, the solution of which will begin in 2021, and the subsequent evaluation of projects,
- financing of ongoing and new VEGA projects,
- final evaluation of projects, the solution of which was completed in 2019,
- creation of new VEGA bodies for the term of office in the years 2021 - 2024

Financing of ongoing and new VEGA projects
For 2020, the Presidium of the SAS allocated EUR 4,516,769 to finance VEGA projects. A total of 566 projects were financed from the SAS organizations and 69 joint projects, in which the project leader is from a university and in which the SAS employees participate in the solution, which is a total of 635 projects.

There are 153 projects from the SAS organizations with the beginning of the solution in 2020 and 413 projects are ongoing. The average contribution per VEGA project in 2020 was EUR 7,113, i.e. at a comparable level as in 2019 when the average contribution was EUR 7,169.

In 2020, funds in the amount of EUR 1,093,569 were provided to the budget organizations of the SAS, which represents 24,2% of the allocated amount. Funds in the amount of EUR 3,423,200 were provided to the contributory organizations of the SAS, which is 75,8% of the allocated amount.

Information on the VEGA funds provided for 2020 to individual institutes and projects is published on the VEGA website at the SAS.

Allocated funds for VEGA projects in 2020 according to the scientific section of the SAS

SAS Scientific Section	Number of projects	Financial contribution (€)
1. Physical, Space, Earth, and Engineering Sciences	181	1,382,841
2. Life, Chemical, Medical, and Environmental Sciences	304	2,290,287
3. Social Sciences, Humanities, Arts, and Culture	150	843,641
Total	**635**	**4,516,769**

Final evaluation of projects, the solution of which was completed in 2019
As of December 31, 2019, a total of 523 projects were completed, of which 136 were projects from the SAS. The VEGA commissions selected a total of 70 projects that achieved very significant results, of which up to 30 were projects from the SAS workplaces.

Creation of new VEGA bodies for the term of office in the years 2021 - 2024
The proposals for the composition of the VEGA commissions were approved by the extended Presidium of VEGA on April 23, 2020, by Resolution No. 34/2020. When creating the VEGA commissions, care was taken to ensure that the commissions had a balanced representation of scientific disciplines, with the same number of members from the education and SAS departments, with the exception of institutionally unrepresented scientific disciplines in one of the departments. This exception applies only to Commission No. 11 - Humanities, where a larger number of members from the Ministry of Education is proposed, as the SAS has pedagogical sciences institutionally represented by the Institute for Research in Social Communication SAS and does not have institutionally represented sciences on sports.

On June 17, 2020, the Presidium of the SAS approved the proposal of the extended Presidency of VEGA for the composition of VEGA commissions for the SAS for the term of office in the years 2021 - 2024 by Resolution No. 1036.C. The change of members in individual VEGA commissions for the new term of office is at the level of 55% (53% from the SAS and 58% from universities).

Due to the epidemic situation caused by the COVID-19 pandemic, the appointment of new members of the VEGA bodies has been postponed until 2021.

Project financing of the SAS through the Slovak Research and Development Agency

In 2020, the SAS organizations participated in the solution of 421 projects financed by the SRDA grant agency, while the SAS organizations were the main recipient of SRDA support in the case of 221 projects. In the case of 200 projects financed by SRDA, the SAS organizations were co-beneficiaries of SRDA support.

The total volume of financial resources provided by SRDA for the solution of projects in the SAS reached the amount of EUR 9,852,703 in 2020.

A total of 153 projects were submitted from the SAS organizations to the grant schemes of SRDA - Public call for submitting applications for the solution of research and development projects in individual disciplines of science and technology with the title of the call VV 2020 and Support for research and development with a focus on coping with the coronavirus pandemic and its impacts for the period 2020 - 2021 with the title of the call PP-COVID 2020. The SAS organization with

organizations from other sectors of research and development submitted 133 projects in the position of co-researcher.

Number of submitted proposals, solved projects and funds drawn in the SAS in SRDA calls in 2020 by scientific sections

	Submitted proposals		Projects solved		Drawn funds (€)	
	A	**B**	**A**	**B**	**A**	**B**
Scientific Section 1	51	52	61	61	2,200,436	717,596
Scientific Section 2	78	63	121	115	4,475,522	1,058,707
Scientific Section 3	24	18	39	24	1,256,337	144,105
Total	153	133	221	200	7,932,295	1,920,408
Total A + B	286		421		9,852,703	

A - SAS organization is the project promoter
B - SAS organization is the contractual project solver

The above data document a significant degree of cooperation between the SAS organizations with universities, as well as with the business sector. Both of these sectors are the most important partners in solving the SAS joint projects. The solution of joint projects is implemented both at the level when the project is carried out by the SAS organization, as well as at the level when the project is carried out by the organization, or rather organizations from other sectors of research and development.

Other SAS Projects

SASPRO 2 program

The SASPRO 2 program (https://saspro2.sav.sk/) is divided into two mobility schemes: Incoming and Reintegration, and for both schemes, it is one of the conditions that the scientist does not work in Slovakia for some time before submitting the application. The program allows them to apply for a work stay of 12 to 36 months, while the field of science in which they can apply is not limited.

The project is worth EUR 9,34 million and the SAS is its coordinator. The co-financing rate from the European Commission is around 50%.

40 scientists will get the opportunity within SASPRO 2. Each of the universities will accept 10 scientists for its workplaces and the remaining 20 will work in the SAS organizations. The first call of the program was postponed from July 1, 2020, to November 1, 2020, due to the COVID-19 pandemic. The selection procedure will take place in 2021 and in the first quarter of 2022.

MoRePro program

In 2020, the selection procedure for the acquisition of the mobility and reintegration program of the SAS was completed, the aim of which is to attract top domestic and foreign scientists to the SAS workplaces. The SAS provided grant recipients with adequate and motivating conditions for their scientific work. On the other hand, the SAS expects them to improve the research environment and scientific outputs.

Of the 14 applications received, four projects were recommended and approved for funding. The total duration of projects is a maximum of four years. The first scientist joined the SAS workplace in

April 2020, the other grant recipients had to postpone the beginning of their stay due to the pandemic situation. During the release of the measures, two more grant recipients joined. The beginning of the last grant recipient's stay was scheduled for January 2021. Of the four grant recipients, two are foreign grant recipients (one from the EU, the other from the so-called third countries), the other two grant recipients are of Slovak nationality. No new call was announced in 2020.

Grant program for the SAS doctoral students

In June 2020, the 2nd call of the grant program for doctoral students of the SAS was announced, which is an activity of the Slovak Academy of Sciences with the intention to support scientific projects of full-time doctoral students implemented within SAS organizations. The aim is to financially support quality project proposals that can be implemented within one year.

By the deadline for submitting applications in August 2020, 96 applications were received - the total number of evaluated applications within the 2nd call of the grant program for doctoral students of the SAS was 95. Of the total number, 30 applications were supported, each with a grant in the amount of EUR 2,000. All projects supported by the grant in the 2nd call of the program will be implemented by grant recipients in research organizations of the SAS from January 1, 2021, to December 12, 2021.

CARLis (Career in Life Sciences)

SAS is a partner of the CARLiS project (Careers in Life Sciences), which was successful within the INTERREG SK-AT call and started on November 1, 2020. The main coordinator of the project is SAIA, n. o. In addition to the SAS, the partners of the project are Universität Wien, the Slovak University of Technology in Bratislava and Comenius University in Bratislava. The duration of the project is two years.

The project aims to contribute to increasing the quality of doctoral education, improving cooperation between the academic and private sectors and maintaining talent in the Vienna-Bratislava region. Within the project, the SAS participates in the creation of a comprehensive training program focused on the preparation of PhD. students on non-academic career paths in life sciences and biotechnology.

The total budget of the project is approximately EUR 549,000, of which the SAS will use approximately EUR 43,500 for the management of activities planned within the project.

EURAXESS Point for the SAS

EURAXESS Slovakia, centers for researchers and research organizations, is part of the European network of EURAXESS centers in 40 countries. The centers were gradually set up in 2004 at the initiative of the European Commission.

In Slovakia, the national network of EURAXESS centers consists of five SAIA workplaces (in Bratislava, Nitra, Žilina, Banská Bystrica and Košice). From September 1, 2020, they were joined by the SAS as a EURAXESS point for the SAS with the contact email address euraxess_point@savba.sk.

The EURAXESS point team for the SAS helps to remove obstacles that stand in the way of the smooth process of obtaining all permits and visas associated with the stay in Slovakia. It provides doctoral students and researchers coming to the SAS with information and services related to various aspects of mobility, including practical information on social security, tax issues, visas and residence permits, health insurance.

EURAXESS point for the SAS also provides escort of persons at the Alien Police in Bratislava. In this way, seven visits were secured in 2020. There were three persons for the Institute of Physics SAS, two persons for the Institute of Inorganic Chemistry SAS and two persons for the Institute of Informatics SAS.

The beginning of the COVID-19 pandemic in 2020 also influenced the EURAXESS point project for the SAS. Not only did the closure of borders and embassies around the world significantly reduce the mobility of scientific researchers and doctoral students, but it was also necessary to adapt and ensure the hygienic measures resulting from the regulations of the Government of the Slovak Republic. Therefore, a meeting of coordinators for the admission of doctoral students and researchers from third countries took place on August 7, 2020. An accommodation facility on Royova Street no. 10 in Bratislava was set up for a mandatory quarantine for persons coming from the so-called red countries, The Legal Department SAS has prepared a manual for doctoral students and rules for the arrival of persons from high-risk countries, which have also been translated into English.

Communication with EURAXESS point took place mainly via email communication. Not only the coordinators of the incoming doctoral students asked for information, but also foreign scientific researchers and doctoral students directly. Various questions were answered, especially concerning the process of issuing visas, temporary stay, but also the conditions of arrival in Slovakia, the current pandemic situation and accommodation in the SAS quarantine facility. Thus, in 2020 (reporting period 1. 9. 2020 – 31. 12. 2020), 50 inquiries were answered within the SAS, 1,608 inquiries within the whole of Slovakia.

Human resources strategy in research

On July 13, 2020, the Slovak Academy of Sciences successfully became the second Slovak scientific institution to receive the *HR Excellence in Research* label. This award is given by the European Commission to institutions that guarantee that they will comply with the 40 principles and rules of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers under the Human Resources Strategy for Researchers (HRS4R). The SAS is committed to incorporating the principles of the Charter and the Code into institutional policies and strategies for human resource management and, in particular, to emphasize quality working conditions, transparent recruitment based on qualifications and experience, and creating a favorable environment for career development.

Cooperation with the European Commission and other activities

Horizon Europe program missions

In 2020, a representative of the Department of Science and Research (based on the nomination of the Ministry of Education, Science, Research and Sport of the Slovak Republic) participated in the work of the Subgroup for the Mission of Climate Resilient Europe of the Horizon Europe program. The aim of this subgroup was, in cooperation with other panels, to develop and define the concept of research and innovation missions of the new Horizon Europe program, which should reflect the tasks and objectives transcending all grant schemes of the European Commission. As part of this activity, an event was organized in July 2020, where Slovak citizens discussed their views on the planned activities of the European Commission in adapting to climate change. The event was organized by the SAS in cooperation with the European Commission, the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Centre of Scientific and Technical Information. The event resulted in 20 recommendations for a climate-resilient Europe mission, which the European Commission will take into account when launching Horizon Europe calls.

Cooperation with European Academies' Science Advisory Council (EASAC)
At the December meeting of the Presidium of SAS, the SAS representative was nominated to the *EASAC Press and Communication Group*. During the COVID-19 pandemic, the European Academies' Science Advisory Council (EASAC) organizes various webinars and communication seminars for academics in order to gain as much knowledge as possible on how to present scientific findings and outputs to the public.

Cooperation with the International Network for Government Science Advice (INGSA)
In cooperation with the INGSA network (*International Network for Government Science Advice*), the SAS participated in the implementation of the COVID-19 Policy Tracker in the area of pandemic management in 2020. The aim of this tool was to monitor all government policy statements regarding the COVID-19 pandemic and to identify whether the justification for the measures was based on scientific knowledge. The result of this activity is a comparative analysis called *Tracking global evidence-to-policy pathways in the coronavirus crisis*, which is available on the INGSA website, together with further information on this initiative.

Cooperation with the European Institute of Innovation and Technology (EIT)
SAS, together with other Slovak partners, became a member of EIT Climate-KIC Hub Slovakia. The EIT Climate-KIC is a knowledge and innovation community of the European Institute of Innovation and Technology aimed at accelerating the transition to a sustainable, zero-carbon economy, as well as helping society to mitigate and adapt to climate change. Slovak consortium of partners led by Civitta Slovakia, a. s., consists, in addition to the SAS, of the Bratislava Self-Governing Region, the Green Foundation and GA Drilling, a.s.

II. SELECTED RESULTS OF SCIENTIFIC RESEARCH

2020 was a specific year not only in our lives, but also in the environment of science and research. It was full of new challenges for many scientific fields and public expectations of how we scientists can respond to a global epidemic situation unparalleled in modern history. The past year has shown, among other things, how important and mutually beneficial is internal cooperation within the SAS.

For the Physical, Space, Earth, and Engineering Sciences, it also meant limiting or even stopping field observations, research in various parts of the world, but also launched new forms of cooperation and brought a number of significant scientific achievements, either in the form of significant world-renowned publications (Nature, Earth Science) or project and program solutions (Horizon 2020), or contributions to address societal needs and innovation in areas that have not received as much attention so far.

Results and achievements can be grouped into several thematic areas. New technologies for energy and transport in the 21st century, non-traditional materials for healthcare, advanced analytical methods for health protection, research in areas related to the remediation and degradation of complex environmental burdens, as well as studies aimed at understanding the gravimetric forces of planet Earth.

Scientists from the Life, Chemical, Medical, and Environmental Sciences responded immediately to the pandemic situation caused by the SARS CoV-2 virus. The categories of applied research include their contribution to testing samples for the presence of SARS-CoV-2 virus using RT-qPCR, validation of relevant tests, isolation of SARS-CoV-2 genomic RNA virus and many other activities that have been monitored by the general public. Despite the obstacles posed by anti-epidemic measures to research, they have achieved significant results in all areas of research. These include, for example, new knowledge into the protective effect of biomolecules against diseases associated with aging, clinical validation of a new biomarker for the diagnosis and prognosis of prostate cancer. In the field of polymer chemistry, hybrid graphene oxide nanoparticles have been synthesized as active additives for new functional polymeric materials. They also paid attention to the study of biodiversity, which is becoming more and more the focus of attention of the professional and non-expert public. Among the projects that addressed the issue of biodiversity, particularly interesting results were achieved in the field of evolution and adaptive potential of fragmented and isolated populations of model species.

The COVID-19 pandemic significantly limited some aspects of research activities in the Social Sciences, Humanities, Arts, and Culture. At the same time, specific topics related to the pandemic have come to the forefront, highlighting the need for interdisciplinary cooperation. An example can be the participation of sociologists, psychologists, social anthropologists, economists and prognosticators in pandemic-related projects and expertise, coordinated by experts in epidemiology, virology and medicine, but the participation of mathematicians, IT specialists, as well as specialists in the field of social sciences was also necessary and beneficial The issue determined by the general interest focused attention on the fight against harmful and unsubstantiated information spread mainly through the Internet and social media, on the psychological aspects and social consequences of crisis situations, but also the historical experience of pandemics. A large number of institutes have also become involved in new forms of distance learning, which have spread during an emergency.

The research and publication outputs of the humanities, social sciences and culture have maintained their diversity despite the limitations or change of focus of research to a new situation. Significant results have been achieved in archeology, history, political science and oriental studies. Several

teams researched the issue of living conditions of the Roma ethnic group and other marginalized groups, and research focused on minorities, the relationship with migrants and foreigners, etc. were also active. Sociological research focused on voting behavior, the religious structure of Slovakia, the social and economic consequences of the decarbonization of industry in some regions and others. The Slovak participation in the European Social Survey project was also renewed. Remarkable are several results of linguists, especially in sociolinguistics and etymology, the continuation of international cooperation on the Slavic Linguistic Atlas, as well as publications addressing the general public. From the production of the SAS literary institutes, it is possible to mention works devoted to the study of popular literary genres, occasional poetry, sermon literature, various forms of literary representations, metaphors and others. Religious and cultural traditions have been reflected in several artistic and Slavic researches, focusing on e.g. the Marian veneration or the iconological research of the depiction of St. Alžbeta Uhorská in Central European area and others.

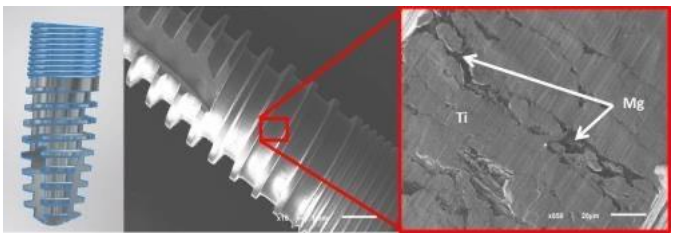
II.1 Selected results of basic research

Scientific Section 1 - Physical, Space, Earth, and Engineering Sciences

Development and study of bioactive Ti+Mg composite BIACOM® for dental implant application

Institute of Materials and Machine Mechanics SAS
Researchers: Martin Balog, Ahmed Mohamed Hassan Ibrahim, Peter Krížik

A unique partially biodegradable titanium (Ti)-based composite (BIACOM®) has been developed as a material for use in prosthodontic surgery. BIACOM® is prepared by powder metallurgy methods, where a biodegradable component - magnesium (Mg) is added to the supporting matrix Ti structure in an optimal content of 17 volume % in the form of purposefully directed and interconnected microfibers. Thanks to its specific microstructure, the bioinert permanent Ti matrix ensures the mechanical properties of the implant during its entire function in the human body. Thanks to the Mg component, BIACOM® minimizes the basic lack of current commercial Ti implants - the so-called stress-shielding effect and insufficient surface bioactivity. Mg reduces Young's modulus (E) and thus reduces the mechanical incompatibility of the implant with the bone. In addition, after insertion of the implant, the Mg component degrades selectively and in a controlled manner in reaction with human tissue and fluids, which is accompanied by the gradual formation of surface pores. This leads to a further positive reduction in E, with the degraded Mg gradually being replaced by new tissue. The presence of Mg leads to improved osseointegration and the subsequent formation of a quality mechanical bond at the interface of the implant with the bone. At the same time, BIACOM® retains sufficient mechanical and fatigue properties, which makes it suitable for applications in which the implant is exposed to intense and cyclic mechanical stress (e.g. dental implants). An *in vitro* study of the response of four cell cultures to BIACOM® samples by the indirect contact method indicated the need to stabilize the surface of the samples due to the high degree of Mg degradation in the initial stage of exposure. Two different ways of stabilizing the surface of the samples were optimized, which led to the desired viability and proliferation of the cells and to a negative cyto/genotoxic effect. In cooperation with MARTIKAN, s. r. o., BIACOM® pilot dental implants were manufactured. These were subsequently tested with a positive result for fatigue life and *in vitro* biological response according to the relevant standards for biomedical implants.



Pilot dental implant MV4,5-10 made of BIACOM® development composite (Ti+17% Mg).

HASSAN IBRAHIM, Ahmed Mohamed – BALOG, Martin – KRÍŽIK, Peter – NOVÝ, František – CETIN, Yuksel – ŠVEC, Peter, Jr. – BAJANA, Oto – DRIENOVSKÝ, Marián. Partially biodegradable Ti-based composites for biomedical applications subjected to intense and cyclic loading. In *Journal of Alloys and Compounds*. 2020, vol. 839, pp. 1 – 13. (2019: 4.650 – IF, Q1 – JCR Best Q, 1.055 – SJR, Q1 – SJR Best Q). ISSN 0925-8388.

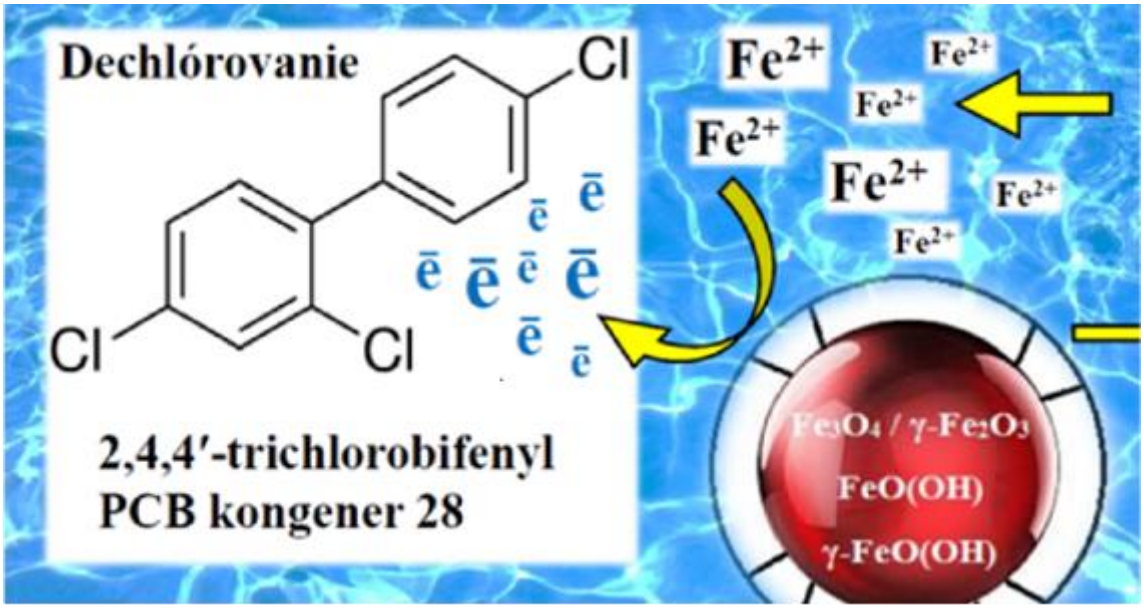
CETIN, Yuksel – HASSAN IBRAHIM, Ahmed Mohamed – GUNGOR, Aysen – YILDIZHAN, Yasemin – BALOG, Martin – KRÍŽIK, Peter. In vitro evaluation of a partially biodegradable TiMg dental

implant: The cytotoxicity, genotoxicity and oxidative stress. In *Materialia*. 2020, vol. 14, pp. 1 – 9. (2019: 0.643 – SJR, Q2 – SJR Best Q). ISSN 2589-1529.

Use of magnetoferritin nanoparticles for reducing the toxicity of PCBs in the aquatic environment

Institute of Hydrology SAS
Researchers: Lucia Balejčíková, Milan Gomboš, Andrej Tall, Branislav Kandra, Dana Pavelková
Projects: VEGA 2/0044/20

Polychlorinated biphenyls are synthetic industrial organic chemicals. These persistent pollutants cause high environmental risks and damage to the health of living organisms, including humans. Magnetoferritin, composed of the protein apoferritin, which surrounds synthetically prepared iron-based nanoparticles, appears to be a promising candidate for the elimination of polychlorinated biphenyls from organisms and the aquatic environment. The properties of magnetoferritin, such as redox activity, biocompatibility, high application possibilities and close relationship to the human body, supported *in vitro* studies of the catalytic activity of magnetoferritin in the presence of a representative 2,4,4'-trichlorobiphenyl (PCB congener 28). The basic physicochemical properties of magnetoferritin were determined by ultraviolet and visible spectrophotometry, dynamic light scattering, zeta potential measurements, SQUID magnetometry and atomic force microscopy. The remediation effect of magnetoferritin on PCB congener 28 was demonstrated by high-resolution gas chromatography in combination with infrared spectroscopy. The work opens new possibilities for the use of material not only in the field of technology/industry/medicine, but also in hydrology and environmental studies.



Schematic representation of dechlorination of PCB congener 28 by magnetoferritin, active under given conditions of an aquatic medium.

BALEJČÍKOVÁ, Lucia – TOMAŠOVIČOVÁ, Natália – ZAKUŤANSKÁ, Katarína – BAŤKOVÁ, Marianna – KOVÁČ, Jozef – KOPČANSKÝ, Peter. Dechlorination of 2,4,40-trichlorobiphenyl by magnetoferritin with different loading factors. In *Chemosphere*, 2020, vol. 260, art. no. 127629. (2019: 5.778 – IF, Q1 – JCR, 1.530 – SJR, Q1 – SJR). ISSN 0045-6535. Available at: https://doi.org/10.1016/j.chemosphere.2020.127629.

Topographic gravimetric effects in earth sciences: Review of origin, significance and implications

Earth Science Institute of the SAS
Researcher: Peter Vajda
Project: APVV-16-0482 (LITHORES)

In the review study on the origin, significance and implications of topographic effects in gravimetric applications in earth sciences, we present the spatial properties of these effects, discuss their relevance and impacts in geodesy studies and applications, geophysical structural studies (exploration and prospection) and geodynamics with a focus on volcanic geodesy.

VAJDA, Peter – FOROUGHI, Ismael – VANÍČEK, Petr – KINGDON, D. R. – SANTOS, Marcelo – SHENG, Michael – GOLI, Mehdi. Topographic gravimetric effects in earth sciences: Review of origin, significance and implications. In *Earth-Science Reviews*, 2020, vol. 211, art. no. 103428. ((019: Q1, SJR=3.750, IF=9.724, IF(5yr)=10.973, CiteScore=15.0, Elsevier). ISSN: 0012-8252.

Scientific Section 2 - Life, Chemical, Medical, and Environmental Sciences

Chemical properties of biomolecules *vs* their protective effect against age--related diseases

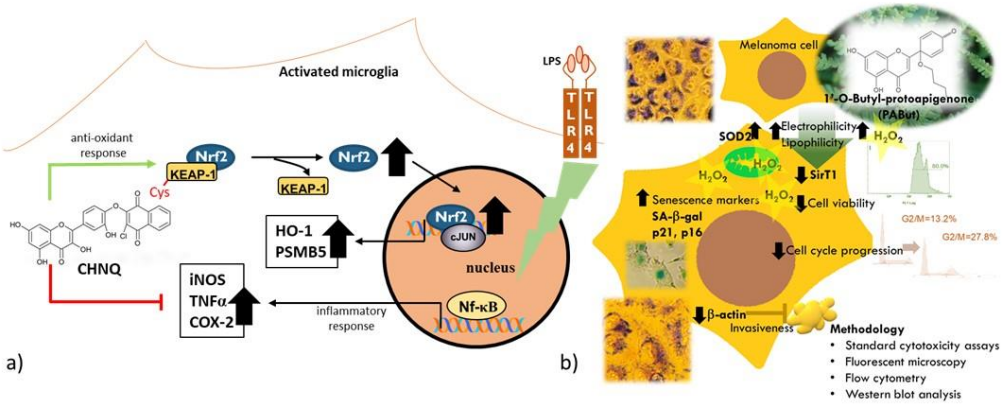
Centre of Experimental Medicine SAS
Researchers: Lucia Račková et al.
Projects: VEGA 2/0041/17, APVV-18-0336

Plant constituents with the structure of the so-called Michael acceptors represent a perspective in terms of their use in the prevention and treatment of ageing-related diseases, such as cancer or Alzheimer's disease. The lack of electrons in the molecules of these substances may determine their beneficial effect on cells and tissues. In addition, the targeted structure modification achieved by chemical synthesis can contribute to its optimization.

Our cell culture studies show that, at high concentrations, the chemically modified plant flavonoid quercetin–4'-O- (2-chloro-1,4-naphthoquinon-3-yloxy) quercetin (CHNQ)–increases oxidative stress in microglia, the immune cells of the brain. These cells contribute significantly to the development of inflammation in the brain and neurological disorders during ageing. However, low concentrations of CHNQ suppressed the microglial markers of inflammation. The molecular mechanism involves the activation of the protective signalling pathway Nrf2 / Keap-1, which is sensitive to oxidative stress induced by CHNQ (**Fig. 1a**). Precursors for the synthesis of CHNQ, quercetin and 1,4-naphthoquinone (i.e., the substances that chemically combine to give CHNQ) have shown these beneficial effects only to a limited extent.

Similarly, chemical modification of the fern flavonoid constituent, protoapigenone, has led to an improvement in its ability to induce oxidative stress and damage in melanoma tumour cells. The new compound, protoapigenone 1'-O-butyl ether (PABut), was thus able to induce senescence in melanoma cells, consequently achieving a better antitumor effect (**Fig. 1b**). Paradoxically, PABut improved detoxification mechanisms in old skin cells (fibroblasts), suggesting that this substance may protect non-malignant cells from ageing.

The biological effects of biomacromolecules are also significantly related to their chemical properties. The review summarizes the knowledge about the effects of physicochemical factors in the cell, such as pH, temperature fluctuations and reactions with products of oxidative metabolism, on the function of the proteasome as an important detoxifying enzyme involved in protection against ageing. Furthermore, the evidence for the direct interaction of the proteasome with disease protein clusters (accompanying e.g., Alzheimer’s and Parkinson’s disease) is compared with the knowledge obtained from immobilization biotechnologies.



Chemical structure and mechanism of action of **a)** 4'-O- (2-chloro-1,4-naphthoquinon-3-yloxy) quercetin (CHNQ) and **b)** protoapigenone 1'-O-butyl ether (PABut). Names of the proteins involved in the cytoprotective effects and the development of cellular ageing and inflammation: HO-1, heme oxygenase-1; PSMB5, β5 subunit of 20S proteasome; iNOS - inducible NO synthase; COX2 - cyclooxygenase 2; TNFα, cytokine tumor necrosis factor α; SOD2, superoxide dismutase 2; TLR4 - toll-like receptor 4; SirT1, sirtuin 1; SA-β-gal, senescence-associated β-galactosidase; p21, p16 - inhibitors of cyclin dependent kinases

ŠKANDÍK, Martin – MRVOVÁ, Nataša – BEZEK, Štefan – RAČKOVÁ, Lucia. Semisynthetic quercetin-quinone mitigates BV-2 microglia activation through modulation of Nrf2 pathway. *In Free Radical Biology and Medicine*, 2020, vol. 152, p. 18-32. (2019: 6.170 – IF, Q1 – JCR, 1.841 – SJR, Q1 – SJR). ISSN 0891-5849.

CSEKES, Erika – VÁGVÖLGYI, Máté – HUNYADI, Attila – RAČKOVÁ, Lucia. Protoflavones in melanoma therapy: Prooxidant and pro-senescence effect of protoapigenone and its synthetic alkyl derivative in A375 cells. In *Life Sciences*, 2020, vol. 260, art. no. 118419. (2019: 3.647 – IF, Q2 – JCR, 1.031 – SJR, Q1 – SJR). ISSN 0024-3205.

RAČKOVÁ, Lucia – CSEKES, Erika. Proteasome Biology: Chemistry and Bioengineering Insights. In *Polymers : Open Access Polymer Science Journal*, 2020, vol. 12, no. 12, art. no. 2909, [58] p. (2019: 3.426 – IF, Q1 – JCR, 0.704 – SJR, Q1 – SJR). ISSN 2073-4360.

MEČÁROVÁ, Jana – ČÍŽOVÁ, Alžbeta – RAČKOVÁ, Lucia – BYSTRICKÝ, Slavomír. Anti-staphylococcal activity of quaternized mannan from the yeast Candida Albicans. In Carbohydrate Polymers, 2020, vol. 240, art. no. 116228. (2019: 7.182 – IF, Q1 – JCR, 1.514 – SJR, Q1 – SJR). ISSN 0144-8617.

Bacterial nanotube formation as a "post mortem" manifestation of a stressed cell

Institute of Molecular Biology SAS
Researchers: Imrich Barák, Katarína Muchová

Projects: VEGA 2/0007/17, APVV-18-0104

Bacterial nanotubes were discovered ten years ago. The unique capabilities of these nanotubes have been attributed to processes such as the transfer of DNA, RNA and proteins between cells of various bacteria, as well as the "vampire-like" suck out of nutrients from a eukaryotic cell. Our results are in

stark contrast to previously published findings. We have shown that nanotubes, in principle, are formed from every cell when we use various stress factors, such as pressure, or the cells are exposed to antibiotics. The bacterial cell wall can maintain a pressure of up to twenty atmospheres inside the cell. However, if the wall is disturbed either mechanically or by the action of antibiotics, further maintenance of such a high pressure is not possible. This pressure will literally cause the cytoplasmic membrane to be "fired out" in the form of a nanotube into the environment through the holes in the cell wall. An important finding was that just as the cell "fires out" the nanotube, the cell dies. This means that the formation of nanotubes is not a controlled biological process but a "post mortem" manifestation of a stressed cell.

Scanning electron microscopy image of *Bacillus subtilis* cells that are as if interconnected by nanotubes (O. Benada, Institute of Microbiology, Czech Academy of Sciences)

POSPÍŠIL, J. – VÍTOVSKÁ, D. – KOFROŇOVÁ, Olga – MUCHOVÁ, Katarína – ŠANDEROVÁ, H. – HUBÁLEK, M. – ŠIKOVÁ, M. – MODRÁK, M. – BENADA, O. – BARÁK, Imrich – KRÁSNY, L. Bacterial nanotubes as a manifestation of cell death. In *Nature Communications*, 2020, vol. 11, no. 4963. (2019: 12.121 – IF, Q1 – JCR, 5.569 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents). ISSN 2041-1723. Available at: https://doi.org/10.1038/s41467-020-18800-2.

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GACEK-MATTHEWS, A. – CHROMÍKOVÁ, Zuzana – SULYOK, Michael – LÜCKING, G. – BARÁK, Imrich – EHLING-SCHULZ, M. Beyond toxin transport: novel role of ABC transporter for enzymatic machinery of cereulide NRPS assembly line. In *mBio*, 2020, vol. 11, no. e01577. (2019: 6.784 – IF, Q1 – JCR, 3.876 – SJR, Q1 – SJR). ISSN 2150-7511. Available at: https://doi.org/10.1128/mBio.01577-20.

SOBOLEV, E. – ZOLOTAREV, S. – GIEWEKEMEYER, K. – BIELECKI, J. – OKAMOTO, K. – BARÁK, Imrich – MAIA, Filip R.N.C.. Megahertz single-particle imaging at the European XFEL. In *Communications*

Physics, 2020, vol. 3, no. 97. (2019: 4.684 – IF, Q1 – JCR, 2.310 – SJR, Q1 – SJR, karentované – CCC). (2020 – Current Contents). ISSN 2399-3650. Available at: https://doi.org/10.1038/s42005-020-0362-y.

Evolution and adaptive potential of fragmented and isolated populations

Institute of Forest Ecology SAS
Researchers: Peter Kaňuch, Benjamín Jarčuška, Martina Dorková, Lenka Sarvašová, Anton Krištín
Projects: VEGA 2/0076/19, VEGA 2/0077/17

Due to historical as well as rapid recent changes of the environment and fragmentation of habitats, distribution area of many species is divided. These species often survive in isolated areas with limited gene flow among populations. In such conditions we studied population-genetic structures, phenotypic traits and also mechanisms which are behind adaptation of species to environmental changes, especially in bottlenecked populations. This knowledge is fundamental mainly for umbrella species, e.g. lynx or capercaillie, which are important for stability and conservation of whole ecosystems. Using a set of vertebrate and invertebrate species having different evolutionary history we have analysed the effect of different level of gene flow on phenotypic expression and interspecific relationships. We found that the morphology may relate to recent climatic conditions but also to demographic evolution in the last glacial period. On the other hand, limited gene flow can be important for climatically induced selection of specific phenotypes.

DORKOVÁ, Martina – KRIŠTÍN, Anton – JARČUŠKA, Benjamín – KAŇUCH, Peter. The mosaic distribution pattern of two sister bush-cricket species and the possible role of reproductive interference. In *Ecology and Evolution*, 2020, vol. 10, iss. 5, p. 2570-2578. (2019: 2.392 – IF, Q2 – JCR, 1.238 – SJR, Q1 – SJR). ISSN 2045-7758. Available at: https://doi.org/10.1002/ece3.6086.

KAŇUCH, Peter – KIEHL, Berrit – CASSEL-LUNDHAGEN, Anna – LAUGEN, Ane T. – LOW, Matthew – BERGGREN, Åsa. Gene flow relates to evolutionary divergence among populations at the range margin. In *PEERJ*, 2020, vol. 8, art. no. e10036. (2019: 2.379 – IF, Q2 – JCR, 0.995 – SJR, Q1 – SJR). ISSN 2167-8359. Available at: https://doi.org/10.7717/peerj.10036.

CASSEL-LUNDHAGEN, Anna – SCHMITT, Thomas – WAHLBERG, Niklaus – SARVAŠOVÁ, Lenka – KONVIČKA, M. – RYRHOLM, Nils – KAŇUCH, Peter. Wing morphology of the butterfly Coenonympha arcania in Europe: Traces of both historical isolation in glacial refugia and current adaptation. In *Journal of Zoological Systematics & Evolutionary Research*, 2020, vol. 58, iss. 4, p. 929-943. (2019: 2.159 – IF, Q1 – JCR, 0.863 – SJR, Q1 – SJR). ISSN 0947-5745. Available at: https://doi.org/10.1111/jzs.12360.

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Scientific Section 3 - Social Sciences, Humanities, Arts, and Culture

Theory of Development of Western civilization in the Ancient and Medieval World

Institute of Philosophy SAS
Researcher: Jon Stewart
Project: APVV-15-0682

The author follows several interrelated topics through more than a dozen texts that have been written over several millennia. Based on the analysis of these texts, the work presents a theory of the development of Western civilization from antiquity to the Middle Ages. The main argument line traces the various self-conceptions of the different cultures as they developed historically. These self-conceptions reflect different views of what it is to be human. It gradually emerges that we can today discern inwardness and subjectivity. As human civilization took its first tenuous steps, it had a very limited conception of the individual. Instead, the dominant principle was that of the wider group: the family, clan or people. Only in the course of history did the idea of what we know as individuality begin to emerge. It took millennia for this idea to be fully recognized and developed. The conception of human beings as having a sphere of inwardness and subjectivity subsequently had a sweeping impact on all aspects of culture, such as philosophy, religion, law, and art. Indeed, this conception largely constitutes what is today referred to as modernity. It is easy to lose sight of the fact that this modern conception of human subjectivity was not simply something given but rather the result of a long process of historical and cultural development.

STEWART, Jon. *The Emergence of Subjectivity in the Ancient and Medieval World: an interpretation of western civilization.* First Edition. New York: Oxford University Press, 2020. xiv+399 pp. ISBN 978-0-19-885435-7.

Sexuality: From Intimacy to Politics: With Focus on Slovakia in the Globalized World.

Institute for Research in Social Communication SAS
Researcher: Gabriel Bianchi
Projects: APVV-18-0303, VEGA 2/0027/17

The book presents a synthetic view of new challenges in the field of sexual subjectivity, transformation and transmutation of intimacy and the relationship between intimacy and sexuality, which are relevant in the issue of transitions in intimate relationships, as well as in the development and diversification of forms of parenthood in civil society. In particular, it is a process in which the current cultural and social trend of Western civilization is massively developing the need to satisfy particularized subjective identity in the areas of race, gender, body, language, ethnicity, nationality or age. These aspects of identity are experienced as intimate and simultaneously disclosed. In the environment of digital social media and the Internet, the needs of intimacy are met without a partnership bond. This seems to have a significant effect on the willingness to form intimate partnership bonds and their specific form. Thus, not only the form of partnerships changes, but also their essence, internal content. The book raises several questions: What was the price human sexuality has had to pay for the attention received from scientific medicine since the 19th century? Why do we need to conceptualize and analyze healthy sex and not only sexual health? What do we know about, and what can we learn from, the boundary between wanted and unwanted sex? What

new normative systems are offered for sexuality issues, and what will that be good for? Why is sexuality so important in politics and what are the risks?

BIANCHI, Gabriel. *Sexuality: From Intimacy to Politics: With Focus on Slovakia in the Globalized World*. Berlín: Peter Lang GmbH, 2020. 201 p. ISBN 978-3-631-82807-6.

The Divine Message of St. Alžbeta Uhorská in Central European Images

Art Research Centre of SAS
Researcher: Ivan Gerát
Project: VEGA 2/0075/19

The book is the result of long-term research into Central European images, which reflect the unique spiritual path of St. Alžbeta Uhorská, powered by various sources, including spontaneous inspiration. The religious leaders who went on to commission these images understood the enormous potential associated with the charitable work of the saint. They used the promotion of this radiant example of exemplary Christian for various purposes, from cultivating memory and cult through local politics to crusader propaganda and the fight against heresy. The book maps complex events in the interval between over-temporal truths and unique historical situations, so it presents the images as a testimony to the desires and needs of leaders and members of various communities - from the Teutonic Knights in Marburg through monastic communities in Český Krumlov to the inhabitants of medieval Košice that were one of the most important European centers of its cult. The book understands the images not only as the promotion of spiritual ideals and values, but also as a reflection of political and military struggles, or even purely material interests.

GERÁT, Ivan. *Iconology of Charity: Medieval Legends of Saint Elizabeth in Central Europe*. Leuven – Paris – Bristol: Peeters, 2020. 218 p. Art&Religion, 9. ISBN 978-90-429-4171-7.

II.2 Problem solving for social practice

Scientific Section 1 - Physical, Space, Earth, and Engineering Sciences

Growth of thin films of organic semiconductors for optoelectronics

Institute of Physics SAS
Researchers: Peter Šiffalovič, Naďa Mrkývková, Jakub Hagara, Peter Nádaždy, Ashin Shaji, Michal Bodík, Jurij Halahovets, Alica Brunová, Matej Jergel, Eva Majková

The alignment of organic molecules (e.g. horizontal, vertical) in organic thin films has a fundamental impact on their optoelectronic properties. The researchers, therefore, focused on the possibility of controlling the molecular alignment in thin organic films using suitable low-dimensional substrates such as graphene and two-dimensional MoS2 [1, 2], which serve as a template. They have demonstrated that graphene initiates the growth of the vertical phase of various molecules such as e.g. 5,5'-bis(naphth-2-yl)-2,2'-bithiophene (NaT2) [3]. For the incorporation of an otherwise aligned phase, such as e.g. horizontal phase, however, a template made of another material had to be used. To overcome this limitation, layers of 2D MoS2 flakes with a thickness of several monatomic planes with differently aligned crystallographic axes *c* were used. They have shown that such MoS2 layers with different c-axis alignment initiate the growth of differently aligned phases of organic films, such as e.g. 1- 5 '- (2-naphthyl) -2,2'-bithiophen-5-yl] hexan-1-one (NCOH) and diindenoperylene (DIP) [4,5]. This gives the universal possibility of controlled growth of molecular layers with crystallographically differently aligned domains on the same template. To monitor this growth in terms of crystalline phase development and to monitor the development of surface morphology in real time, they further developed the small-angle *in situ* X-ray scattering (GIWAXS) method [6].

[1] HUTÁR, Peter – SOJKOVÁ, Michaela – KUNDRATA, Ivan – VÉGSO, Karol – SHAJI, Ashin – NÁDAŽDY, Peter – PRIBUSOVÁ SLUŠNÁ, Lenka – MAJKOVÁ, Eva – ŠIFFALOVIČ, Peter – HULMAN, Martin. Correlation between the crystalline phase of molybdenum oxide and horizontal alignment in thin MoS2 films. In *Journal of Physical Chemistry C*, 2020, vol. 124, no. 35, p. 19362-19367. (2019: 4.189 – IF, Q2 – JCR, 1.477 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents). ISSN 1932-7447. Available at: https://doi.org/10.1021/acs.jpcc.0c05336.

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[5] HAGARA, Jakub – MRKÝVKOVÁ, Naďa, Tesařová – FERIANCOVÁ, Lucia – PUTALA, Martin – NÁDAŽDY, Peter – HODAS, Martin – SHAJI, Ashin – NÁDAŽDY, Vojtech – HUSS-HANSEN, M.K. – KNAAPILA, M. – HAGENLOCHER, J. – RUSSEGGER, N. – ZWADLO, M. – MERTEN, L. – SOJKOVÁ, Michaela – HULMAN, Martin – VLAD, A. – PANDIT, P. – ROTH, S. – JERGEL, Matej – MAJKOVÁ, Eva – HINDERHOFER, A. – ŠIFFALOVIČ, Peter – SCHREIBER, F. Novel highly substituted thiophene-based n-type organic semiconductor: structural study, optical anisotropy and molecular control. In *CrystEngComm*, 2020, vol. 22, no. 42, pp. 7095-7103. (2019: 3.117 – IF, Q2 – JCR, 0.814 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents). ISSN 1466-8033. Available at: https://doi.org/10.1039/d0ce01171a.

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Remediation of environmental burden in Bratislava - Vrakuňa

Institute of Geotechnics SAS
Project: Vrakunská cesta – skládka CHZJD – SK/EZ/B2/136

Pilot project for technology verification for decontamination of groundwater in the area enclosed by an underground sealing wall. Within the project solution, the waste-free groundwater treatment technology under the body of the CHZJD landfill was successfully tested. Contaminated groundwater pumped from the IG-624V hydrogeological well (former Darex area) was treated in three steps: 1. pre-treatment of water by degassing method, 2. pressure membrane filtration, 3. electrolysis. Three-stage water treatment reduced contamination to the level of groundwater remediation target values, which were set in the risk analysis for the polluted area. Water purification technology was implemented using advanced physical processes without the use of chemicals.

Methods of image analysis in the quantification of neurons and the study of dynamic properties of elastic structures

Institute of Experimental Physics SAS
Researchers: Zoltán Tomori, Jana Kubacková
Projects: APVV-15-0665, MAD SK-HU

In the case of an extensive study by a foreign partner (University of California, San Diego), the hypothesis that targeted transport of drugs to the so-called subpial layer of the CNS prevents the spread of neurodegenerative changes in ALS (amyotrophic lateral sclerosis) was proved by several methods. The researchers have developed software that enables quantifying the axons of the sciatic

nerve, both in automatic and interactive mode. This helped to demonstrate a significant therapeutic effect with possible clinical use. The result was published in a prestigious magazine.

As part of a joint grant MAD with the Institute of Biophysics of the Hungarian Academy of Sciences in Szeged, the researchers investigated the elastic properties of polymerized microstructures. Using a high-speed camera, they recorded the relaxation of a microstrip periodically stretched and released using a laser optical trap, and subsequently analyzed the video to determine the viscosity of the environment.

BRAVO-HERNANDEZ, Mariana – TADOKORO, T. – NAVARRO, M. – PLATOSHYN, Oleksandr – KOBAYASHI, Yoshiomi – MARSALA, Silvia – MIYANOHARA, A – JUHAS, Stefan – JUHASOVA, Jana – SKALNIKOVA, Helena – TOMORI, Zoltán – VANICKÝ, Ivo – STUDENOVSKA, Hana – PROKS, Vladimír – CHEN, PeiXi – GOVEA-PEREZ, Noe – DITSWORTH, Dara – CIACCI, Joseph D. – GAO, Shang – ZHU, Wenlian – AHRENS, Eric T – DRISCOLL, Shawn P – GLENN, Thomas D – MCALONIS-DOWNES, Melissa – DA CRUZ, Sandrine – PFAFF, Samuel L. – KASPER, Brian K. – CLEVELAND, Don W. – MARSALA, Martin. Spinal subpial delivery of AAV9 enables widespread gene silencing and blocks motoneuron degeneration in ALS. In *Nature medicine*, 2020, vol. 26, no. 1, p.118-130. (2019: 36.130 – IF, Q1 – JCR, 15.812 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents). ISSN 1078-8956. Available at: https://doi.org/10.1038/s41591-019-0674-1 (APVV-14-0847: Regenerácia nervových vlákien v biosyntetických vodičoch.)

KUBACKOVÁ, Jana – IVÁNYI, Gergely T. – KAŽIKOVÁ, Veronika – STREJČKOVÁ, Alena – HOVAN, Andrej – ŽOLDÁK, Gabriel – VISZNYICZAI, Gaszton – KELEMEN, Lóránd – TOMORI, Zoltán – BÁNÓ, Gregor. Bending dynamics of viscoelastic photopolymer nanowires. In *Applied Physics Letters*, 2020, vol. 117, no. 1, art. no. 013701. (2019: 3.597 – IF, Q1 – JCR, 1.343 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents, WOS, SCOPUS). ISSN 0003-6951. Available at: https://doi.org/10.1063/5.0014662.

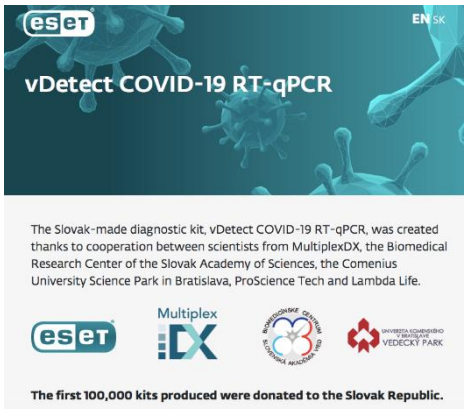
Scientific Section 2 - Life, Chemical, Medical, and Environmental Sciences

Active participation in the fight against the COVID-19 pandemic in direct response to an acute societal need

Institute of Virology BMC SAS
Researchers: Boris Klempa, Monika Sláviková, Kristína Boršová, Viktória Čabanová, Martina Ličková, Sabína Fumačová Havlíková, Ľubomíra Lukáčiková, Ivana Kajanová, Juraj Koči, Juraj Kopáček, Žofia Rádiková, Miroslav Vlček, Silvia Schmidtová, Andrea Bábelová, Michal Šelc, Jana Plavá, Viera Horváthová Kajabová, Lucia Demková, Miroslava Matúšková
Projects: activities were carried out on the basis of a mandate from the Government of the Slovak Republic, Ministry of Health of the Slovak Republic, MŠVVaŠ SR, in cooperation with the Public Health Office of the Slovak Republic, with the companies MultiplexDX, ESET and AXON Neuroscience, with the Department of Infectious Diseases and Geographical Medicine of the University Hospital Bratislava, PriF UK, FMFI UK and LF UK. Part of the results was realized within the APVV project IMPROVE PP-COVID-20-0017 and H2020 project EVA GLOBAL. These activities were implemented thanks to financial and material donations from the SLSP Foundation, managed by the Slovenská sporiteľňa, from the company MultiplexDX, from Ing. Miloš Jaroška and thanks to subsidies from the Government of the Slovak Republic and MIRRI SR.

The staff of the Department of Virus Ecology, led by Boris Klempa and with the organizational support of the scientific director of the Institute of Virology Juraj Kopáček. From the very beginning, they took the initiative in the fight against the pandemic through several activities.
These were mainly the following activities, most of which will continue in 2021:

- **Routine testing of samples for the presence of SARS-CoV-2 virus using RT-qPCR.** These required adaptation and addition of the necessary infrastructure in the BSL3 laboratory with a high degree of biological safety. Logistical and methodical managing of testing and long-term above-standard high workload of scientists which had to harmonize testing activities with their own research programs. Testing takes place in coordination with the Public Health Office of the Slovak Republic. Within the critical periods of high incidence of the disease also at the direct request of the hospitals. From the beginning in the testing process are involved researchers from the Institute of Virology of the BMC SAS and since October the staff of the Institute of Experimental Oncology of the BMC SAS has been gradually involved in the process. The quality and reliability of the testing in BMC SAV was confirmed by obtaining the ECDC Certificate.
- **Validation of a series of new Slovak RT-qPCR tests** for SARS-CoV-2 virus detection in cooperation with MultiplexDX, which has led to CE certification of tests in ŠÚKL and their implementation in practice. The development and validation of the first vDETECT test was carried out under the responsibility of ESET, in cooperation with several partners (see Figure 2.5 below).



- **Isolation of SARS-CoV-2 virus from the samples of patients in Slovakia** with COVID-19 disease, determination of their genomic sequence with subsequent input of data into the global GISAID database EpiCoV (by the end of 2020 it was 34 sequences). This activity took place in cooperation with KIGM, PriF UK and FMFI UK. At the same time, several virus isolations were performed in order to exclude infectivity in long-term hospitalized patients who showed persistent PCR positivity (in cooperation with various clinical workplaces, especially KIGM ÚNB).
- **Isolation of the genomic RNA of the SARS-CoV-2 virus**, which together with the virus isolates has been deposit into the biobank of the European virus archive EVA GLOBAL, of which the Institute of Virology BMC SAS is the founding member. Viral RNA as a positive control is also involved in the Slovak RT-qPCR tests for the detection of SARS-CoV-2. Virus and RNA have also been provided as controls to foreign companies developing vaccines against COVID-19.
- **Introduction and validation of a test for the detection of virus-neutralizing antibodies** in individuals who have recovered from COVID-19 disease, as well as for the analysis of virus-neutralizing activity of experimental antibodies in collaboration with AXON Neuroscience R&D and KIGM UNB.
- **Verification of ELISA and antigen tests** of various foreign manufacturers in cooperation with KIGM UNB.
- **Experimental use of a new sampling method for the detection of SARS-CoV-2 virus by gargling**. It is a non-invasive sampling method that does not require the presence of medical staff and allows RT-qPCR to reliably detect the virus even when multiple samples are pooled. BMC SAS experimentally uses this method of sampling for RT-qPCR testing of its employees and for testing actors and accompanying SND staff, which it helps to implement at least basic artistic activities. Sampling by swabs for comparison with sampling by gargling, or for antigen tests were performed by ÚKTV staff from the Research Clinic of the BMC SAS.
- **International validation of gargling method** in cooperation with the Vienna Institute of Molecular Pathology of the Medical University of Vienna and KIGM UNB with subsequent testing using RT-qPCR and LAMP methods with and without RNA isolation, which will continue in 2021.
- **Pilot verification of the possibility of using sampling by gargling for mass testing of schools.** The reliability of this sampling method was confirmed in the testing of two schools within the activity organized by the Ministry of Health of the Slovak Republic, MŠVVaŠ SR, KIGM UNB, BMC SAS and the contributory organization MZ SR Healthy Regions. More than 900 samples were examined in this way. In the pilot test, the samples were pooled according to school classes. In these pooled samples, infected persons were detected by RT-qPCR with even higher sensitivity than was indicated by individual antigen tests of the same participants. Examination of samples by gargling combined with RT-qPCR can reliably identify individuals with a high viral load even when samples are pooled.
- **Testing the antiviral properties of various materials.**

ALM, Erik – BROBERG, Eeva – CONNOR, Thomas – HODCROFT, Emma B. – KOMISSAROV, Andrey B. – MAURER-STROH, Sebastian – MELIDOU, Angeliki – NEHER, Richard A. – TOOLE, Aine O –

PEREYASLOV, Dmitriy – THE WHO EUROPEAN REGION SEQUENCING LABORATORIES, Investigator group – GISAID EPICOV GROUP, Investigator group – SLÁVIKOVÁ, Monika – LIČKOVÁ, Martina – KLEMPA, Boris. Geographical and temporal distribution of SARS-CoV-2 clades in the WHO European Region, January to June 2020. In *Eurosurveillance*, 2020, vol. 25, no. 32, pp. 7-14. (2019: 6.454 – IF, Q1 – JCR, 3.014 – SJR, Q1 – SJR). ISSN 1560-7917. Available at: https://doi.org/10.2807/1560-7917.ES.2020.25.32.2001410.

Glycans as reliable biomarkers for the diagnosis and prognosis of prostate cancer

Institute of Chemistry SAS
Researchers: Tomáš Bertók, Eduard Jáné, Anikó Bertóková, Lenka Lorencová, Ján Tkáč
Project: ERC PoC

Clinical validation of a new biomarker (glycan analysis) for the diagnosis and prognosis of prostate cancer (PCa) was performed using 140 blood samples. Clinical validation showed that the combination of 4 glycan biomarkers was significantly more accurate (0.821) compared to PSA (Prostate-Specific Antigen) analysis (0.517) and the other two currently used assays such as %fPSA (0.683) and the current gold standard using a PHI (Prostate Health Index) assay (0.737). Thus, our test reliably indicated 63.5% of patients who did not have to undergo a biopsy, while in the case of determining the %fPSA this figure was 17.5% and in the case of PHI test of 33.3%. In addition, our test could be used for prognosis i.e. for patients with PCa, where it was possible to distinguish more accurately patients in the early stages of the disease, when it is sufficient to actively monitor them from patients with a more aggressive form of PCa when treatment or surgery is required.

BERTÓK, Tomáš – JÁNÉ, Eduard – BERTÓKOVÁ, Anikó – LORENCOVÁ, Lenka – ZVARA, Peter – SMOLKOVÁ, Božena – KUČERA, Radek – KLOCKER, Helmut – TKÁČ, Ján. Validating fPSA glycoprofile as a prostate cancer biomarker to avoid unnecessary biopsies and re-biopsies. In *Cancers*, 2020, vol. 12, art. no. 2988 [10] p. (2019: 6.126 – IF, Q1 – JCR, 1.938 – SJR, Q1 – SJR, registered – WoS Core Collection, Scopus). ISSN 2072-6694.

First report on *Giardia duodenalis* assemblage F in children from underprivileged environmental conditions in Europe

Institute of Parasitology SAS
Researchers: Ingrid Papajová, Júlia Šmigová, Jindřich Šoltys
Projects: VEGA 2/0125/17, ITMS 26220120022

Giardia duodenalis (syn. *G. intestinalis, G. lamblia*) is unicellular parasite causing gastrointestinal disorders in wide range hosts what include wild and companion animals as well as humans. It is one of the most spread parasitic disease in man, who can be infected via fecal-oral route through contaminated water („water-borne“) and food („food-borne“), or by direct transmission from host to host. This parasitic disease is classified as neglected, and occurs more frequently in areas with poor hygiene standards, where children is the most affected population. Based on differences in genetic structure of selected genes *G. duodenalis* is divided into 8 genetic assemblages A-G, which are strictly host specific and can be found either only in animals (C, D, E, F, G) or in humans (A, B). The aim of this study was to isolate and determine *G. duodenalis* genetic asemblages, which can circulate within pediatric population living below hygienic standards in Eastern Slovakia. The sequence analysis of

genes encoding triosaphosphate isomerase (tpi) and glutamate dehydrogenase (gdh), were used to distinguish between *G. duodenalis* genotypes. Subsequent molecular analyses revealed the presence of multiple *G. duodenalis* genotypes in the studied localities. In addition to the detected assemblages A and B, which are common and typical for human disease another three isolates were classified as assemblage F, which is at first specific for cats. This is the first original discovery confirming the occurrence of this assemblage in humans not also in Slovakia, but in the Europe. We draw attention to possible zoonotic potential of assemblage F, what means that the spectrum of giardiasis causative agents in humans is wider than originally thought. This principal explanation on *G. duodenalis* transmission agents in children from socio-economically disadvantaged communities will facilitate and improve preventive measures for the eradication of *G. duodenalis* infections within pediatric population.

PIPIKOVÁ, Jana – PAPAJOVÁ, Ingrid – MAJLÁTHOVÁ, Viktória – ŠOLTYS, Jindřich – BYSTRIANSKA, Júlia – SCHUSTEROVÁ, Ingrid – VARGOVÁ, Veronika. First report on Giardia duodenalis assemblage F in Slovakian children living in poor environmental conditions. In *Journal of Microbiology*, Immunology and Infection, 2020, vol. 53, no. 1, pp. 148-156. (2019: 3.493 – IF, Q2 – JCR, 0.947 – SJR, Q1 – SJR). ISSN 1684-1182. Available at: https://doi.org/10.1016/j.jmii.2018.04.007. (VEGA 2/0125/17: Impact of anthropogenic load on the occurrence of microbial and parasitic organisms in the environment in urban and rural ecosystems. ITMS 26220120022: Centre of Exellence for Parasitology.)

Scientific Section 3 - Social Sciences, Humanities, Arts, and Culture

Bratislava (un)planned city

Institute of History SAS
Researchers: Henrieta Moravčíková, Peter Szalay, Katarína Haberlandová, Laura Krišteková, Monika Bočková
Project: APVV-16-0584

The publication is the result of comprehensive and long-term research of the architectural and urban development of Bratislava in the 20th century. In it, the author's team summarizes the history of modern planning and construction of Bratislava, reveals the relationship between urban intentions and completed construction, analyzes architectural and urban concepts and paradigms relevant to the urban structure. The authors tried to specify the characteristic urban structures, architectural forms and situations that determine the appearance of the city. They presented the development of urban plans throughout the 20th century, as well as architectural interventions that influenced their feasibility. Emphasis was placed on those features and processes that were characteristic of Bratislava and still determine its urban structure and spatial relationships. The work is also exceptional in its methodological approach, which has enabled the authors to identify, abstract and visualize key features of the urban tissue and its transformation over the past hundred years.

The book *Bratislava (un)planned city* is a unique guide not only for experts, but also for the general public who want to know the history of the planning and construction of Bratislava.

MORAVČÍKOVÁ, Henrieta – SZALAY, Peter – HABERLANDOVÁ, Katarína – KRIŠTEKOVÁ, Laura – BOČKOVÁ, Monika. *Bratislava (ne)plánované mesto. Bratislava (un)planned city.* Bratislava: SLOVART, spol. s r. o., 2020. 613 p. ISBN 978-80-556-4696-1.

Selected aspects of Roma integration for public policy makers

Institute for Research in Social Communication SAS
Institute of Ethnology and Social Anthropology SAS
Centre of Social and Psychological Sciences SAS
Researchers: Barbara Lášticová, Richard Filčák, Daniel Škobla, Dušana Dokupilová

In solving the problem of Roma integration, it is effective for public policy makers to effectively design such interventions that are supported by scientific research.
The publication *Evidence-Based Methods to Effectively Combat Antigypsyism in the Changing Political Climate of Europe* responds to the current situation of increasing discrimination, hate speech and segregation, which hamper the efforts of social inclusion in Europe. It provides evidence based on socio-psychological research as well as analyzes of current political discourse and the effectiveness of anti-discrimination interventions in five EU countries. It offers recommendations for the implementation of interventions based on examples of good practice, which will take into account the specifics of antigypsyism as a normatively acceptable form of prejudice in Europe. The manual can help policy makers to define the basic principles for implementing interventions to mitigate antigypsyism within future national strategic frameworks for Roma integration.
An equally important aspect of Roma integration is addressed by the authors of the monograph *Ensuring Access to Sanitation Infrastructure: Roma settlements and structural inequalities in Slovakia.*

The increased incidence of infectious diseases in localities with a Roma population is one of the indicators of structural inequalities in Slovakia. The core of the problem is the absence of basic infrastructure for access to drinking water and waste-water treatment. Researchers have developed a typology that works with actors and factors in municipalities with a significant Roma population, helping to identify and analyze how they individually and collectively create and influence structural problems in access to sewerage infrastructure. It provides a framework for analyzing the main common features and thus the implications for public policies. Access to water and sanitation infrastructure is and will remain a key factor in social inclusion. The authors also offer recommendations for improving access to water and sanitation and Roma integration. Sanitation infrastructure should not be a goal in itself, but rather a means of integration.

KENDE, Anna – LÁŠTICOVÁ, Barbara – MINESCU, Anca – LANTOS, Nóra Anna – O'CONNOR, Ashley. *Evidence-Based Methods to Effectively Combat Antigypsyism in the Changing Political Climate of Europe.* Bratislava: Institute for Research in Social Communication, SAS, 2020. 54 pp. ISBN 978-80-973370-5-6.

FILČÁK, Richard – ŠKOBLA, Daniel – DOKUPILOVÁ, Dušana. *Ensuring Access to Sanitation Infrastructure: Roma settlements and structural inequalities in Slovakia*. Bratislava: Centre of Social and Psychological Sciences, Slovak Academy of Sciences, 2020. 145 p. ISBN 978-80-89524-46-4.

Strategies for stimulating reading literacy

Institute for Research in Social Communication SAS
Researchers: Oľga Zápotočná, Kamila Urban, Zuzana Petrová
Projects: VEGA 2/0134/18, APVV-19-0074

In cooperation with the National Institute for Certified Educational Measurements, studies have been made, which became the basis for secondary analyzes of the results of the international measurement PISA 2018. Data were analyzed to monitor how teachers support students' reading activities and how this affects their reading literacy levels. Compared to the results of PISA 2009, positive trends were shown. In the context of the information explosion and digital technologies, the relationships between the level of reading literacy, students' experiences with digital technologies, their behavior in the online space, as well as the extent to which they encounter relevant topics in teaching, were also monitored. More experienced students achieved a significantly higher level of reading literacy. The most significant positive impact was shown for students who often read and search for information in a certain area on the Internet. Further analyzes focused on data on appropriate reading and writing strategies. The repertoire of often used helpful metacognitive strategies is relatively narrow. The selection of important information and the summarization of the text proved to be the most effective. Students who found these strategies useful in both reading and writing performed better in reading literacy, even after taking into account the impact of the family environment.

MIKLOVIČOVÁ, Júlia – VALOVIČ, Jakub – ZÁPOTOČNÁ, Oľga – PETROVÁ, Zuzana – URBAN, Kamila *Čitateľská gramotnosť: Výsledky slovenských žiakov v štúdii PISA 2018. Tematická správa*. Bratislava: NÚCEM, 2021, 106 p.

II.3 Selected results of international cooperation

Scientific Section 1 - Physical, Space, Earth, and Engineering Sciences

Advanced experimental model of superconducting motor

Institute of Electrical Engineering SAS
Researcher: Enric Pardo
Project: Horizont 2020 ASuMED

The expected global increase in the use of air transport after the end of the COVID-19 crisis inevitably leads to a renewed increase in emissions worldwide. That is why the European Union is aiming to reduce CO2 emissions by 75%, NO_x and particulate matter emissions by 90%, and noise by 65% in ACARE Flightpath 2050. Distributed electric propulsion of aircraft has the ambition to achieve these goals thanks to higher efficiency on the one hand, and more importantly, a dramatic improvement of the overall aerodynamics of aircraft on the other hand. Batteries, as well as a combustion turbogenerator, are able to supply electricity. The aim of the ASuMED project is the construction of a 1 MW fully superconducting experimental motor tested in laboratory conditions. The consortium includes academic partners as well as industry partners, including Oswald Elektromotoren GmbH (coordinator), Rolls-Royce PLC, the University of Cambridge and the Karlsruhe Institute of Technology. The mentioned superconducting motor uses stacks (parallel tapes) of high-temperature REBCO superconductors in the rotor as strong permanent magnets and efficient stator windings of REBCO superconductors. Probably the most important result in 2020 is considered to be numerical modeling of transverse demagnetization in superconducting high-temperature REBCO rotor stacks with a relevant number of tapes (100), for up to two million cycles. Such a high number is necessary because, at an assumed operating frequency of 1,000 Hz, the alternating field will reach two million cycles in just 33 minutes of flight. The researchers have also developed a strategy to reduce AC losses in the stator below 0,04% of overall performance. In addition, a measurement system was built for the experimental measurement of AC losses in one stator coil in solid nitrogen ice at 25 K using a cryocooler.

DADHICH, Anang – PARDO, Enric – KAPOLKA, Milan. Time constant of the transverse-field demagnetization of superconducting stacks of tapes. In *Superconductor Science and Technology*, 2020, vol. 33, no. 6, no. 065003. (2019: 3.067 – IF, Q2 – JCR, 0.991 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents). ISSN 0953-2048.

DADHICH, Anang – PARDO, Enric. Modeling cross-field demagnetization of superconducting stacks and bulks for up to 100 tapes and 2 million cycles. In *Scientific Reports*, 2020, vol. 10, no. 19265. (2019: 3.998 – IF, Q1 – JCR, 1.341 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents, WOS, SCOPUS). ISSN 2045-2322.

KAPOLKA, Milan – PARDO, Enric – GRILLI, F. – BASKYS, A. – CLIMENTE-ALARCON, V. – DADHICH, Anang – GLOWACKI, B.A. Cross-field demagnetization of stacks of tapes: 3D modeling and measurements. In *Superconductor Science and Technology*, 2020, vol. 33, no. 4, no. 044019. (2019: 3.067 – IF, Q2 – JCR, 0.991 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents). ISSN 0953-2048.

LI, S. – KOVÁČ, Ján – PARDO, Enric. Coupling loss at the end connections of REBCO stacks: 2D modelling and measurement. In *Superconductor Science and Technology*, 2020, vol. 33, no. 075014. (2019: 3.067 – IF, Q2 – JCR, 0.991 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents). ISSN 0953-2048.

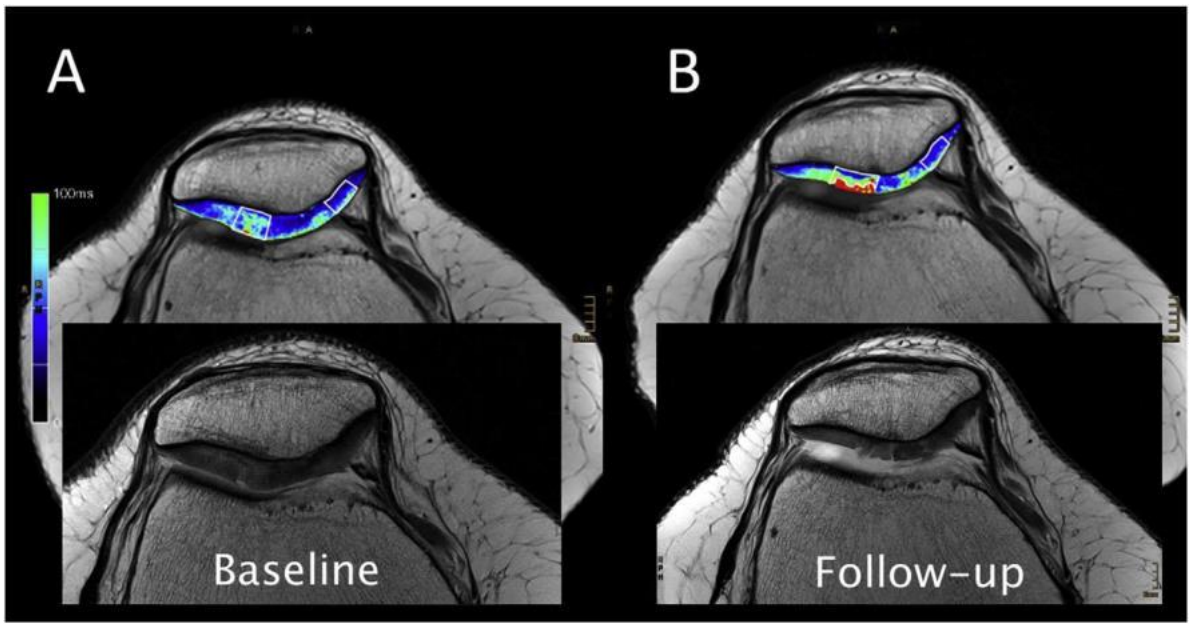
BENKEL, T. – LAO, M. – LIU, Y. – PARDO, Enric – WOLFTÄDLER, S. – REIS, T. – GRILLI, F. T–A-formulation to model electrical machines with HTS coated conductor coils. In *IEEE Transactions on Applied Superconductivity*, 2020, vol. 30, no. 5205807. (2019: 1.692 – IF, Q3 – JCR, 0.419 – SJR, Q2 – SJR, registered – CCC). (2020 – Current Contents). ISSN 1051-8223.

Application of gadolinium-based contrast agents in magnetic resonance imaging methods, prognosis for patients with untreated patellar cartilage lesions

Institute of Measurement Science SAS
Researcher: Pavol Szomolányi
Project: APVV-15-0029
Foreign partner: Univ. Prof. Dr. Siegfried Trattnig, High Field MR Center, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Austria

Many factors influence the increase in signal intensity provided by magnetic resonance imaging (MRI) contrast media. The purpose of the research was to assess the impact of different gadolinium concentrations and dilutions of three macrocyclic gadolinium-based contrast agents. The test tubes were positioned in a rack in a silicon oil bath to maintain the temperature at 37°C during the measurement The temperature of the silicone oil was kept constant using warm water, which flushed a separate chamber within the tube holder. The water flushed chamber was separated from the bath oil by a thin thermal-conductive wall.

The research was oriented to demonstration of the potential of axial T2 mapping for quantification of untreated early-stage patellar cartilage lesions over time and to assess its capability as a potential predictive marker for future progression. This mapping sequence, in combination with the unique characteristics of the patella cartilage (thick cartilage, superficial and parallel position to the body surface), might be well suited for future prospective studies to evaluate the natural course of cartilage defects and their treatment *in vivo.*



A: 34-year-old female patient with an ICRS grade 1 cartilage defect. After 3 ½ years, the morphological follow-up image showed a progression of the cartilage defect. The corresponding T2 map shows a significant increase (red area of cartilage).

B: 42-year old male patient with suspected cartilage lesion. After 4 years, morphological cartilage status seems to have improved. T2 values have decreased as well (green colored cartilage turns to blue).

SZOMOLÁNYI, Pavol – FRENZEL, T. – NOEBAUER-HUHMANN, I.M. – ROHRER, M. – TRATTNIG, S. – PIETSCH, H. – ENDRIKAT, J. Impact of concentration and dilution of three macrocyclic gadolinium-based contrast agents on MRI signal intensity at 1.5T and 3T and different pulse sequences: Results of a phantom study in human plasma. In *Acta Radiologica*, 2020, ISSN 0284-1851. (1.635-IF2019).

EDER, J. – SZOMOLÁNYI, Pavol – SCHMID-SCHWAP, M. – BRISTELA, M. –SKOLKA, A. – PITTSCHIELER, E. – PIEHSLINGER, E. – TRATTNIG, S. Early diagnosis of degenerative changes in the articular/fibrocartilaginous disc of the temporomandibular joint in patients with temporomandibular disorders using delayed gadolinium-enhanced MRI at 3 Tesla – preliminary results. In *Magnetic Resonance Imaging*, 2020, vol. 67, pp. 24-27. ISSN 0730-725X. (2.053-IF2019)

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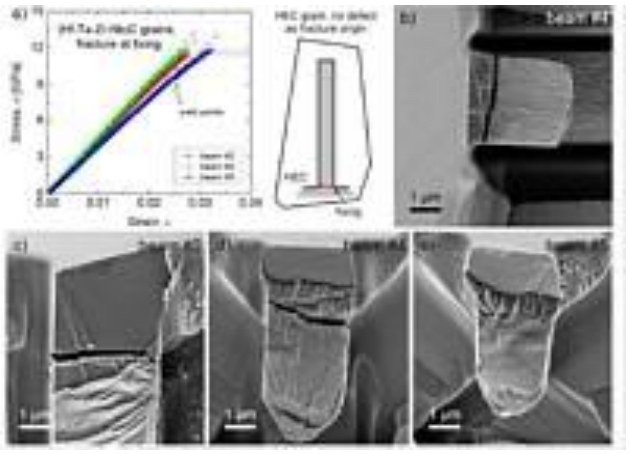
ZBÝŇ, Š. – SCHREINER, M. – JURÁŠ, Vladimír – MLYNARIK, V. – SZOMOLÁNYI, Pavol – LAURENT, D. – SCOTTI, C. – HABER, H. – DELIGIANNI, X. – BIERI, O. – NIEMINEN, M.T. – TRATTNIG, S. Assessment of low-grade focal cartilage lesions in the knee with sodium MRI at 7 T: Reproducibility and short-term, 6-month follow-up data. In Investigative Radiology, 2020, vol. 55, no. 7, pp. 430-437. ISSN 0020-9996. (5.156-IF2019). Available at: https://doi.org/10.1097/rli.0000000000000652.

Small scale fracture and strength of high-entropy carbide grains during microcantilever bending experiments

Institute of Materials Research SAS
Researchers: Ján Dusza, Tamás Csanádi
Projects: M-ERA.NET2 (DURACER), APVV-14-0385, APVV-15-0469

The work deals with the study of fracture behavior of high-entropy carbides in the system (Hf-Ta-Zr-Nb) C by the method of micromechanical experiments of microforms/microcantilevers in the bending. The fracture related properties (e.g. strength, toughness) were determined using linear beam theory. Microcantilevers were prepared by microfabricating focused ion beam (FIB) of large carbide grains with orientation {001} and {101} and subsequently subjected to micromechanical bending experiments. About half of them fractured at the fixing position at FIB-induced surface cracks, while the rest of the beams failed at small cracks located at submicron size pores or inclusions. In all cases, fracture occurred on the {001} cleavage plane. The fracture strength of beams fractured at the fixing position was 11,8 ± 0,2 GPa, while the strength of beams that failed at submicron defects was in the range of 3,8 - 8,9 GPa. The calculation of stress concentration in the vicinity of pores revealed that the local stress field exceeded the value that induced cracking in 'defect free' beams.



Fracture of (Hf-Ta-Zr-Nb) C grains in the microcantilever experiment in bending a) stress-strain dependence, b)-e) fracture surfaces.

CSANÁDI, Tamás – VOJTKO, Marek – DANKHÁZI, Zoltán – REECE, Michael J. – DUSZA, Ján. Small scale fracture and strength of high-entropy carbide grains during microcantilever bending experiments. *In Journal of the European Ceramic Society*, 2020, vol. 40, pp. 4774-4782. (2019: 4.495 – IF, Q1 – JCR, 1.164 – SJR, Q1 SJR, registered – CCC). (2020 – Current Contents). ISSN 0955-2219. Available at: https://doi.org/10.1016/j.jeurceramsoc.2020.04.023.

Scientific Section 2 - Life, Chemical, Medical, and Environmental Sciences

Microglia located in the spinal cord efficiently inhibit brain tumors

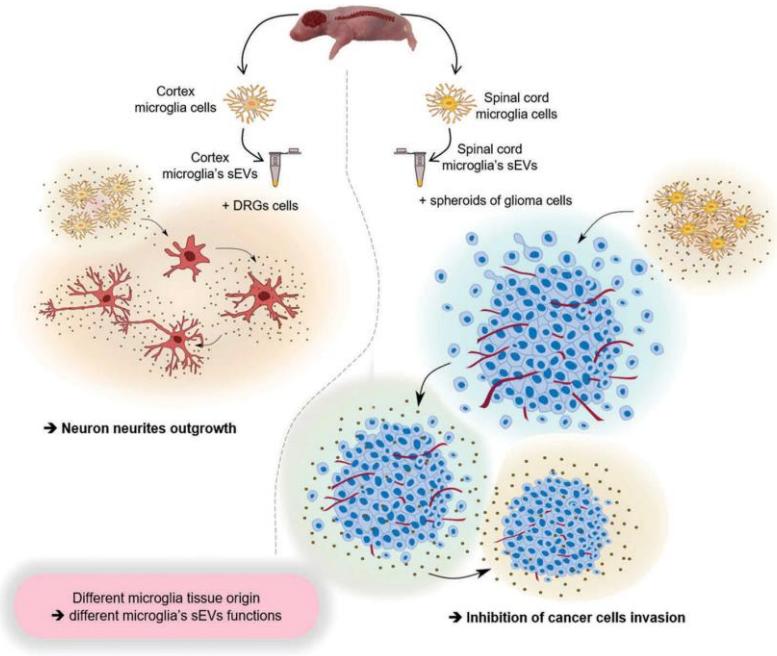
Institute of Neuroimmunology SAS
Projects: INSERM, SIRIC ONCOLille Grant z DGOS-Inserm 6041aa (IF) a University Lille (ANM), APVV 15-0613 (DC), Štefánika SK-FR-2015-0018 (DC, MS), ERANET Axon Repair (DC), VEGA 2/0167/17 (MZ)

Microglia are resident CNS immune cells that play a key role in the communication of the nervous and immune systems. They appear to be a very heterogeneous population of cells, resulting in their functional variability.

By combining proteomic techniques and systems biology approaches, we have shown that microglial cells isolated from different anatomical regions of the CNS, specifically from the brain and spinal cord of new-born rats, differ in phenotype and immunological setting. They release different amounts of small vesicles (extracellular vesicles -sEVs), which differ in protein, lipid, RNA and DNA content.

Microglia isolated from the cerebral cortex are able to suppress inflammatory processes and are involved in neurogenesis and tumorigenesis. On the other hand, microglia obtained from the spinal cord are characterized by their pro-inflammatory nature stimulating inflammatory environment. Interestingly, extracellular vesicles obtained from both types of microglia potentiate the growth of nerve processes. However, a unique ability to suppress the growth of gliomas (glial tumor cells) revealed only stimulated extracellular vesicles isolated from spinal cord microglia. This phenomenon may clarify the territorial preference for brain tumor proliferation. Although this hypothesis requires further investigation, the result of our study indicates the importance of specific therapy with respect to tumor localization (glioma) and the associated microglia phenotype.

In summary, our results showed the role of anatomical localization of microglia in the CNS, which affects their physiological / pathological function, which has a direct impact on surrounding cells through molecules contained in extracellular vesicles.



The localization of microglia in the CNS affects their physiological/pathological function.

MURGOCI, Adriana-Natalia – DUHAMEL, Marie – RAFFO-ROMERO, Antonella – MALLAH, Khalid – ABOULOUARD, Soulaimane – LEFEBRE, Christophe – KOBEISSY, Firas – FOURNIER, Isabelle – ŽILKOVÁ, Monika MÁDEROVÁ, Denisa – ČÍŽEK, Milan – ČÍŽKOVÁ, Dáša – SALZET, Michel. Location of neonatal microglia drives small extracellular vesicles content and biological functions in vitro. In *Journal of Extracellular Vesicles*, 2020, vol. 9, no. 1, art. no. 1727637. (2019: 14.976 – IF, Q7 – JCR, 5.274 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents). ISSN 2001-3078. Available at: https://doi.org/10.1080/20013078.2020.1727637.

Synthesis of hybrid graphene oxide-based nanoparticles as active fillers for novel functional polymeric materials

Polymer Institute SAS
Researchers: Markéta Ilčíková, Ana Hološ, Juraj Mosnáček
Projects: CEMEA, POLONEZ

Within the cooperation with Tomas Bata University in Zlin and Technical University in Lodz, graphene oxide nanoparticles were modified by various polymers using surface-initiated atom transfer radical polymerization. Simultaneously with the modification, also reduction of graphene oxide surface was proceeded, while the conductivity of the prepared hybrids was increased up to 8 orders of magnitude. The degree of graphene oxide reduction and thus also conductivity of the hybrid nanoparticles could be controlled by polymerization conditions. Effect of the prepared graphene oxide hybrids as fillers in elastomers and polymer blends on their properties was investigated. Various composite elastomers filled with graphene oxide hybrids showed excellent photo-actuation properties. In addition, the graphene oxide grafted with polystyrene chains was able to increase stability of miscible PMMA/SAN blends against the phase separation at high temperatures.

ILČÍKOVÁ, Markéta – GALEZIEWSKA, Monika – MRLÍK, Miroslav – OSIČKA, Josef – MASAR, Milan – ŠLOUF, Miroslav – MASLOWSKI, Marcin – KRACALIK, Milan – PIETRASIK, Robert – MOSNÁČEK, Jaroslav – PIETRASIK, Joanna. The effect of short polystyrene brushes grafted from graphene oxide on the behavior of miscible PMMA/SAN blends. *In Polymer: the International Journal for the Science and Technology of Polymers*, 2020, vol. 211, art. no. 123088, [9] p. (2019: 4.231 – IF, Q1 – JCR, 1.016 – SJR, Q1 – SJR). ISSN 0032-3861.

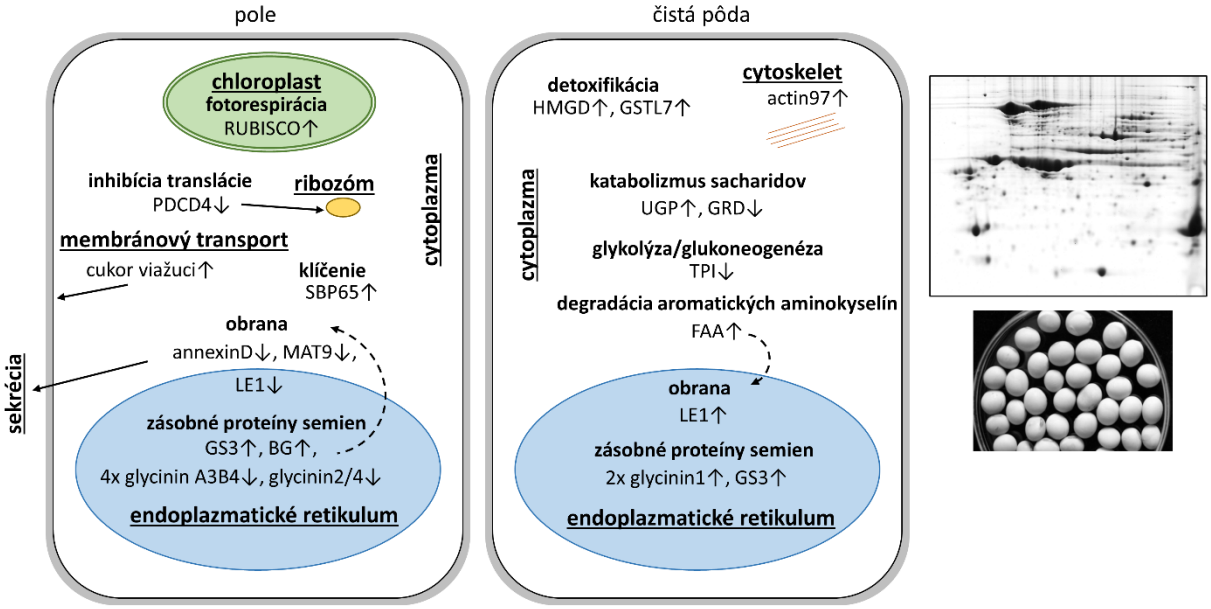
OSICKA, Josef – MRLIK, Miroslav – ILČÍKOVÁ, Markéta – KRUPA, Igor – SOBOLČIAK, Patrik – PLACHÝ, Tomáš – MOSNÁČEK, Jaroslav. Controllably coated graphene oxide particles with enhanced compatibility with poly(ethylene-co-propylene) thermoplastic elastomer for excellent photo-mechanical actuation capability. In *Reactive & Functional Polymers*, 2020, vol. 148, art. no. 104487, [8] p. (2019: 3.333 – IF, Q1 – JCR, 0.708 – SJR, Q1 – SJR). ISSN 1381-5148.

ZYGO, Monika – MRLIK, Miroslav – ILČÍKOVÁ, Markéta – HRABALIKOVA, Martina – OSICKA, Josef – CVEK, Martin – SEDLACIK, Michal – HANULIKOVA, Barbora – MUNSTER, Lukas – SKODA, David – URBÁNEK, Pavel – PIETRASIK, Joanna – MOSNÁČEK, Jaroslav. Effect of structure of polymers grafted from graphene oxide on the compatibility of particles with silicone-based environment and the stimuli-responsive capabilities of their composites. In *Nanomaterials-Base*l, 2020, vol. 10, no. 3, art.no. 591, [17] p. (2019: 4.324 – IF, Q2 – JCR, 0.858 – SJR, Q1 – SJR, registered – CCC). (2020 – Current Contents, WOS, SCOPUS). ISSN 2079-4991.

Soybean recovery from stress imposed by multigenerational growth in contaminated Chernobyl environment

Plant Science and Biodiversity Center SAS
Researchers: Miroslav Perniš, Katarína Klubicová, Maksym Danchenko
Project: FP7-PEOPLE-2013-IRSES

A comprehensive comparison of seed proteomes and photosynthetic indices of leaves between soybean (*Glycine max*) grown in a radionuclide-contaminated field, followed by a clean ground recovery season, allowed to formulate a hypothesis, explaining effects induced by chronic ionizing radiation. We suggested that low-quality seed provisioning caused a detrimental effect persisting in the offspring generation. Energy flow was restricted at least partially because of suboptimal photosynthesis on the vegetative stage. Moreover, we proposed future experiments for direct functional testing of an idea about compromised immunity against phytopathogens in the field, but perhaps even primed in the clean ground. Additionally, we envisioned a prospective study on post-translational modifications of proteins, particularly assays on oxidative stress-related carbonylation, to discover the mysterious nature of damaging factor. From a practical perspective, our data can be used to develop biotechnological applications, targeting the engineering of crops for the phytoremediation of contaminated areas.



PERNIŠ, Miroslav – ŠKULTÉTY, Ľudovít – SHEVCHENKO, Viktor – KLUBICOVÁ, Katarína – RASHYDOV, Namik M. – DANCHENKO, Maksym. Soybean recovery from stress imposed by multigenerational growth in contaminated Chernobyl environment. In *Journal of Plant Physiology*, 2020, vol. 251, art.no. 153219. (2019: 3.013 – IF, Q1 – JCR, 1.037 – SJR, Q1 – SJR). ISSN 0176-1617.

Scientific Section 3 - Social Sciences, Humanities, Arts, and Culture

Identity of music codes of medieval Hungary in the European context

Institute of Musicology SAS
Researcher: Eva Veselovská

Under the influence of economic, historical and cultural factors, many cities in Central Europe have used codes based on several patterns and liturgical traditions. They were made in various illumination and notation workshops. The identity of musical codes, complete and fragmented, as well as individual content and formal components (liturgical and musical content, scripting and notation tradition), were conditioned by several value systems. Individual manuscripts have become the bearers of the identity of a particular religious institution, city, or even personality. New findings on these identities are the result of international cooperation and have been made available in a collection of authors from four Central European countries (Slovakia, Czech Republic, Hungary, Slovenia). They were created as part of a bilateral research project between scientific institutions in Slovakia and Hungary (ÚHV SAS, Catholic University in Ružomberok, Institute of Musicology of the Research Center for the Humanities, Hungarian Academy of Sciences).

VESELOVSKÁ, Eva – CZAGÁNY, Zsuzsa (eds.). *Notated Sources from Medieval Europe and Medieval Hungary: Transregional Research and Online Database Building*. Bratislava; Budapest: Institute of Musicology of the Slovak Academy of Sciences; Institute of Musicology, Research Centre for the Humanities, 2020. 101 p. ISBN 978-80-89135-48-6.

Archaeological research of settlement site of Vráble

Institute of Archaeology SAS
Researchers: Ivan Cheben, Alena Bistáková, Jozef Bátora, Zuzana Hukeľová
Project: The Dynamics of Settlement Concentration Processes and Land-use in Early Farming Communities in the North-western Carpathian Basin

As part of a large international project, the culture settlement of the linear and iron group in Vráble (approximately 5250 to 4950 BC), which is one of the largest settlement agglomerations in Central Europe, was investigated. Together with the modern settlements in Melek, Veľká Maňa, Vlkas, Michal nad Žitavou and Úľany nad Žitavou, where dozens of floor plans of houses with palisade structures were surveyed, they form a network of settlements of the oldest farmers on the middle flow of the Žitava river. A detailed geophysical survey in Vráble proved the existence of three settlement sites, one of which is defined by a ditch with seven entrances, with more than 320 houses. The location and layout of the individual houses indicate that all three settlement sites were built according to a well-considered unified urban plan. The research made full use of scientific analyzes to evaluate archaeozoological and archaeobotanical findings, dating through the radiocarbon method, pedological samples obtained from numerous probes and profiles. The results of archaeological research in cooperation with the Institute of Archaeology SAS and the Christian-Albrechts-Universität Kiel are summarized in the first part of the publication and in other sub-studies published in highly ranked journals.

FURHOLT, Martin – CHEBEN, Ivan – MÜLLER, Johannes – BISTÁKOVÁ, Alena – WUNDERLICH, Maria – MÜLLER-SCHEESSEL, Nils. *Archaeology in the Žitava Valley I : The LBK and Želiezovce settlement site of Vráble*. 1. Aufl. Leiden: Sidestone Press, 2020. 541 p. ISBN 978-90-8890-897-2.

GILLIS, Rosalind E. – ECKELMANN, Rebekka – FILIPOVIĆ, Dragana – MÜLLER-SCHEEßEL, Nils – CHEBEN, Ivan – FURHOLT, Martin – MAKAREWICZ, Cheryl A. Stable isotopic insights into crop cultivation, animal husbandry, and land use at the Linearbandkeramik site of Vráble-Veľké Lehemby (Slovakia). In *Archaeological and Anthropological Sciences*, 2020, vol. 12, no. 256, pp. 255-269. ISSN 1866-9557.

PICKARTZ, Natalie – RABBEL, Wolfgang – RASSMANN, Knut – MUELLER-SCHEESSEL, Nils – FURHOLT, Martin – MUELLER, JOHANNES, Johannes – CHEBEN, Ivan – WILKEN, Dennis – WUNDERLICH, Tina – DREIBRODT, Stefan. What over 100 drillings tell us: a new method for determining the Koenigsberger ratio of soils from magnetic mapping and susceptibility logging. In *Archaeological Prospection*, 2020, vol. 27, no. 4, pp. 393-414. ISSN 1075-2196.

How metaphors enable and structure our thinking and acting

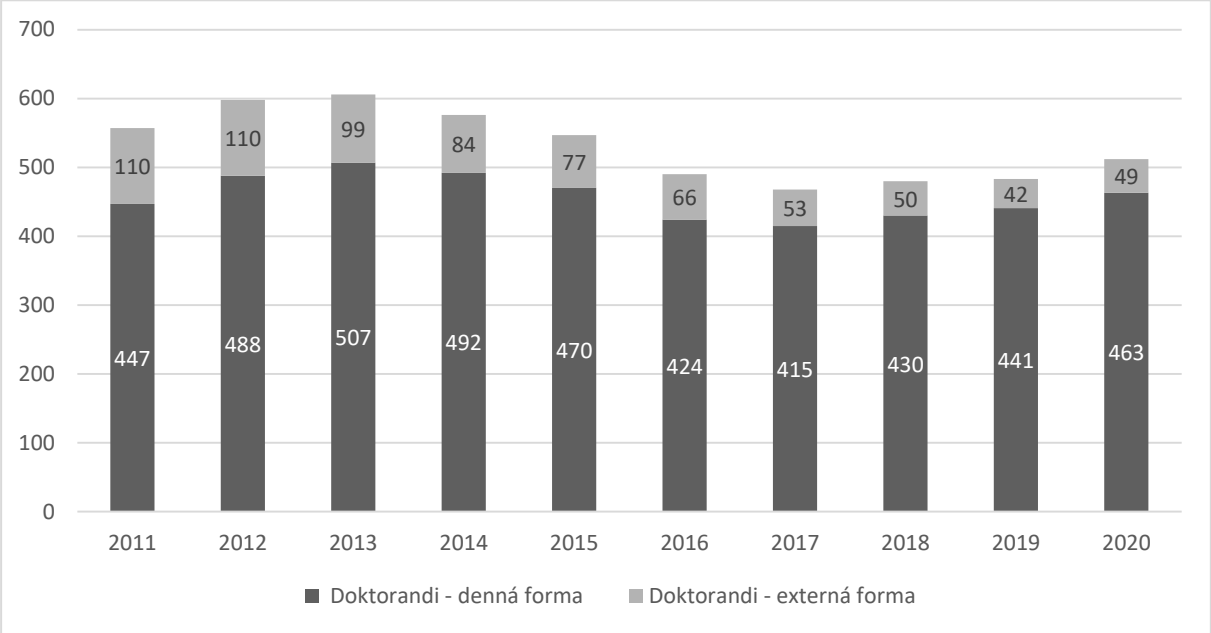
Institute of World Literature SAS
Researcher: Roman Mikuláš

The publication by an international scientific team led by Roman Mikuláš pursues the research of metaphor. It reflects the metaphor as a phenomenon that constantly accompanies us and shapes our orientation space, communication and thinking. In metaphor, our reality arises and exists. This process can be examined from several perspectives of humanities, and, depending on the given perspective, we can find specific answers to the question of the communicative-constructive nature of reality. Therefore, it makes sense to ask what metaphors mean for our thinking and acting and how they (re)structure it. The authors do not perceive the metaphor primarily as a phenomenon of the language system, but rather as a special kind of connection between cognition and communication. Such a position is also supported by the fact that the field of metaphor research is increasingly opening up to cognitive and discourse-analytical approaches. In a supremely interdisciplinary space, the authors provide unique insights into a complex of questions related to the description of the ways in which metaphors in the field between cognition and communication operate, to what extent they contribute to constituting what we can call a coherent and cohesive image of the world.

MIKULÁŠ, Roman (ed.). *Metaphernforschung in interdisziplinären und interdiskursiven Perspektiven.* Paderborn: Brill /Mentis, 2020. 457 p. ISBN 978-3-95743-190-5.

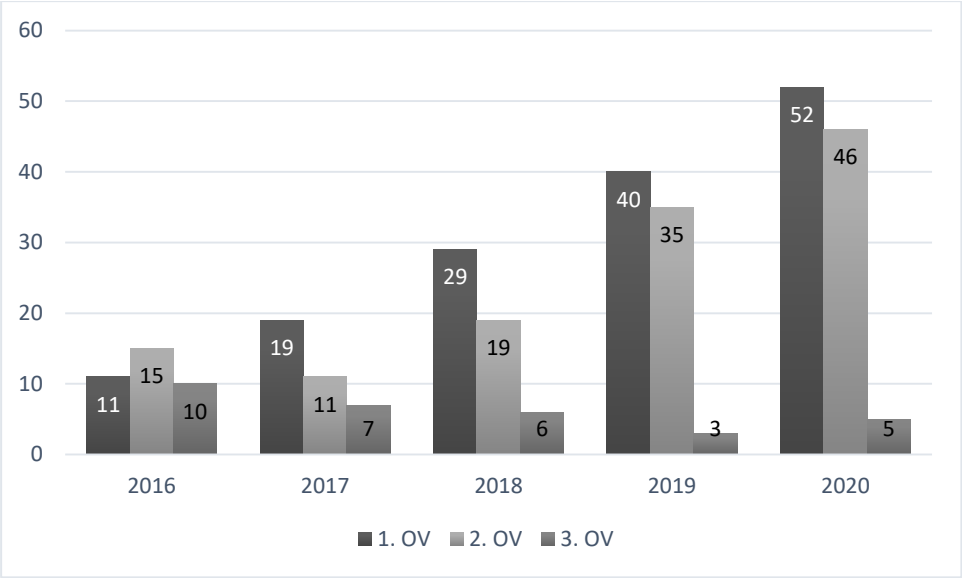
III. EDUCATIONAL ACTIVITIES

SAS organizations actively participate in third-level higher education (doctoral studies). As external educational institutions, SAS organizations participate in the implementation of doctoral study programs at 12 universities. After the entry into force of the amendment to Act No. 131/2002 Coll. on Higher Education and Act No. 269/2018 Coll. on Quality Assurance in Higher Education, the SAS has created a separate internal quality assurance system for doctoral studies. It focuses on the quality of the institutional environment, the quality of potential supervisors and, finally, the quality of the outputs of the doctoral students themselves. The SAS organizations continue in the process of concluding framework agreements on cooperation with an external educational institution by participating in the implementation of doctoral study programs in doctoral studies with the relevant universities.



Development of the number of doctoral students between the years 2011 - 2020

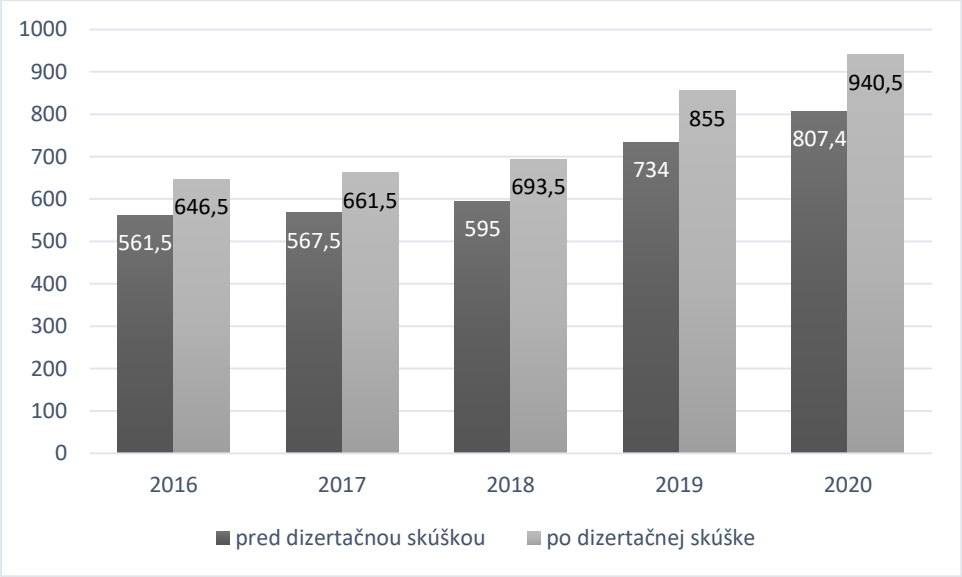
The number of doctoral students has increased compared to 2019. The SAS workplaces had a total of 512 doctoral students, of which 463 were full-time doctoral students and 49 were doctoral students in the external form of doctoral studies. There were 129 newly admitted doctoral students for internal doctoral studies with a topic assigned by the SAS. In addition, the SAS staff acted as the main supervisors for 92 doctoral students at universities, which points to the further scientific and pedagogical capacity of the SAS workplaces. The number of foreign doctoral students has increased. Their share in the total number of students is 22,2 percent. The main obstacle to the faster internationalization of doctoral studies is the lengthy and complicated processing of documents required for applicants from third countries. To facilitate the immigration process, a EURAXESS point was established at the SAS in 2020 and a staff member was employed to assist foreign students in processing the necessary documents.



Development of the number of foreign doctoral students by science department (OV) between 2016 - 2020

70 doctoral students completed their doctoral studies with the thesis defense. Of these, 48 were employed in the research (SAS, universities, abroad), five were employed outside research area in their field, five were employed outside their field and two were unemployed for some time. In ten cases, SAS organizations do not have information on the application of their doctoral graduates in practice.

The net monthly income of doctoral students after stagnation in 2014-2016 began to grow and in 2020, it reached EUR 807,50 before the dissertation exam and EUR 940,50 after its completion. This amount of scholarship is guaranteed to all students from central funds, individual organizations can increase the scholarships of their doctoral students, for example, based on a good performance. The median gross wage in Slovakia in 2019 (data for 2020 are not yet available) was EUR 1,018, which in 2020 corresponded to a net wage of EUR 783,98. After beginning the doctoral study until the completion of the professional examination, students achieve a median income in Slovakia. In addition, the SAS provides them with affordable accommodation in its accommodation facilities.



Development of the net monthly income of doctoral students before and after the dissertation examination in the years 2016 - 2020

After starting their employment at the SAS, the net monthly table income of graduates of doctoral studies will decrease - in 2020, the basic net starting salary was EUR 809,60. To compensate for this difference, the SAS created in 2020 a compensatory allowance in the amount of EUR 150 per month (EUR 75 from central sources, EUR 75 provided by the organization from its own resources), which is allocated competitively. In 2020, 19 graduates received a compensatory allowance.

The SAS also supports young researchers through the Štefan Schwarz Supporting Fund for the creation of postdoctoral positions in the SAS. Organizations, in which successful candidates work, will receive from a central source a wage fund in the amount of 100 percent of the tariff salary in grade T8 of the salary scale and grade according to the professional experience of the candidate, including fees, while grant recipients will receive a salary supplement in the amount of EUR 300 per month. Support within this program is granted for two years, with the possibility of extension for one year. In 2020, 22 postdoctoral students from 19 organizations received a grant.

The education and scientific work of doctoral and postdoctoral students at the SAS is of standard high quality, which is reflected in their success in competitions such as the Student Personality of Slovakia or the ESET Science Award. The winner of the Student Personality of Slovakia competition in the Medical Sciences category was Ing. Filip Květoň from the Institute of Chemistry SAS in Bratislava, in the Natural Sciences, Chemistry category, Mgr. Hemen Sendi from the Institute of Zoology SAS in Bratislava and in the Philosophy, Political Science, Sociology, History category, Mgr. Jana Magdaléna Májeková from the Institute of History SAS in Bratislava. MSc. Tamás Csanádi, PhD., from the Institute of Materials Research SAS in Košice, won the ESET Science Award in the category of exceptional Young Scientist under the age of 35. RNDr. Matej Baláž, PhD., from the Institute of Geotechnics SAS, received an award in the form of third place from the Falling Walls Lab Slovakia 2020 event, where young innovators from various scientific fields presented their exceptional projects.

Within the framework of cooperation with colleges and universities, the employees of the SAS most participated in the lecture activities of universities - 261 employees lectured 9,757 hours at domestic universities and 35 employees lectured 1,134 hours abroad. Exercises and seminars were led at home by 183 employees (11,566 hours) and abroad by 19 employees (741 hours). An important part of the pedagogical activity is the supervision of diploma and bachelor theses - 399 employees of the SAS supervised 879 diploma and bachelor theses, 212 employees opposed 330 dissertations and habilitation theses. The main supervisors of doctoral students were 366 supervisors, who also supervised at other institutions and together they supervised 604 doctoral students. SAS employees worked as members of commissions for PhD defenses (243), commissions for the defense of doctoral dissertations (39), as members of commissions, or rather opponents in inaugural or habilitation proceedings at universities (95). In 2020, two SAS employees received the scientific degree of DrSc and eleven SAS employees received the scientific-pedagogical degree.

As of December 31, 2020, 2,106 researchers, of which 238 are doctors of science and 1,868 are CSc and PhD worked at the SAS workplaces (permanent staff). Compared to last year, the number of researchers with a scientific-pedagogical degree has increased. There are 139 professors and 158 associate professors at the SAS. According to the qualification structure, there were 276 leading researchers and 975 independent researchers working at the SAS.

In 2020, the Academic Committee of the SAS awarded two scientific degrees of Doctor of Science. 144 proposals for awarding scientific qualifications were submitted to the SAS Commission for Assessing the Scientific Qualification of Employees, of which 82 were from the Slovak Academy of Sciences, 61 from the Ministry of Education, Science, Research and Sports of the Slovak Republic and

other ministries of the Slovak Republic and one from the private sector - business company DPP Žilina, s. r.o. The Commission discussed six proposals for awarding scientific qualification level I and 138 proposals for awarding scientific qualification level IIa. It awarded a total of 142 scientific qualifications.

IV. SAS IN THE INTERNATIONAL CONTEXT

IV.1 SAS in the European Research Area

The COVID-19 pandemic has significantly affected international scientific cooperation. Several scheduled or regular events had to be cancelled and postponed. For example, there was no regular meeting of representatives of the V4 academies, nor a regular meeting of representatives of the academies of the SAS and the ASCR. The meeting of the Presidents of the V4 academies with the European Commissioner for Research and Innovation, Mariya Gabriel, and other representatives of the European Commission, which was to take place in March in Brussels, was also postponed. The award ceremony of the International Prize of the Slovak Academy of Sciences for 2020 could not take place either. The research of many international projects was interrupted, and the exchange of scientists was significantly reduced. Many activities (meetings of the governing bodies of international associations, project management and consortia announcing and evaluating calls for proposals, monitoring and evaluation of projects, as well as international conferences) have moved to the online space. Despite these limitations, the SAS activities continued to develop international cooperation.

SAS activities in international scientific organizations

SAS actively and purposefully builds relations with international scientific institutions and associations at the governmental level, the most important of which are the EU, UNESCO, CERN, ESA, as well as at the non-governmental level, e.g. ISC, ALLEA, EASAC and others. In several of these organizations, the SAS also represents other scientific institutions from Slovakia.

ISC (International Science Council) brings together international scientific societies and member organizations at the level of national representations. The ISC was formed by merging the ICSU (International Council for Science) and the ISSC (International Social Science Council) in 2017.

As part of its activities in the ISC, the SAS provided the activities of 20 national committees, associations of scientists from various scientific disciplines, which represent the Slovak Republic in the relevant international scientific unions, which are covered by the ISC.

ALLEA (All European Academies) is a federation of all European academies. ALLEA members currently include 56 academies from 41 countries. Its goals and objectives include the development of science policy in an effort to improve the conditions for scientific work, increase excellence, and develop and adhere to high ethical standards of science in Europe. The representative of the SAS in ALLEA is Mária Omastová, who participated in the online meeting of the ALLEA Council.

EASAC (European Academies Science Advisory Council) is made up of the national academies of the EU Member States. The aim is to develop mutual cooperation between academies, to create a common platform for commenting on urgent issues of the development of science and society, as well as to provide advice on the preparation of documents in accordance with EU legislation. EASAC provides highly expert opinions on current issues, assesses European legislation, organizes seminars for European regulators and issues opinions on topics discussed in the European Commission. The representative of the SAS in EASAC is Mária Omastová, who participated in five meetings of the EASAC Council and the EASAC Environment Steering Panel. All meetings were held online.

ESA (European Space Agency) is an intergovernmental organization of 18 member states for space research founded in 1974. Research focuses on environmental monitoring, meteorology, aeronomy and geoinformatics, solar system research and navigation and safety systems. In 2010, an agreement was signed between the Slovak Republic and ESA on Slovakia's entry into the first of three stages of cooperation in research and the use of space for peaceful purposes. SAS actively participated in ESA activities mainly in the fields of space science (space biology and medicine), mapping the unused agricultural land and processing of materials, including the development of advanced alloys and material architectures suitable for use in space. In 2020, SAS organizations participated in the research of five ESA projects, one of which was financed from the SAS resources.

Bilateral scientific cooperation

The mutual exchange of scientists, information and research experience is an important part of international cooperation. Bilateral mobility cooperation is carried out based on agreements between the SAS and foreign partners. SAS currently has 41 bilateral agreements concluded on scientific cooperation with scientific institutions in 31 countries. Negotiations with other partners took place during 2020. A cooperation agreement was concluded with the Serbian Academy of Sciences and Arts and the National Academy of Sciences of the Republic of Kazakhstan. A new cooperation agreement and an implementing protocol were signed with the Bulgarian Academy of Sciences and the Academy of Sciences of the Czech Republic, a new cooperation protocol between SAS and DAAD, as well as a new implementing protocol with the National Academy of Sciences of Ukraine. Negotiations have taken place on a new cooperation agreement with the Chinese Academy of Sciences, the Chinese Academy of Social Sciences and the Hungarian Academy of Sciences. Negotiations on cooperation between SAS and Academia Sinica, Taiwan have begun.

In accordance with the concluded agreements, calls for projects were announced in 2020 under the mobility program with the Bulgarian Academy of Sciences, the Academy of Sciences of the Czech Republic and the Serbian Academy of Sciences and Arts.

As a result of the COVID-19 pandemic, the main mobility project researchers were given the opportunity to request an extension of the project research period. Following an agreement with the partners, the research of bilateral mobility projects for the period 2021 - 2022 was interrupted and postponed.

Multilateral scientific cooperation

Horizon 2020 projects

In 2020, the SAS organizations participated in the research of 34 projects within the Horizon 2020 program, the EU framework program. Teams from SAS participated in the preparation of 54 Horizon 2020 project proposals, of which 10 proposals in the position of coordinator. One ERC project (Institute of Chemistry SAS) was researched.

COST projects

The *European Cooperation in Science and Technology* (COST) program is the oldest European transversal program for scientific and technological cooperation between EU Member States and EFTA countries. Cooperation takes place through the coordination of national research projects, with projects funded at the national level. In 2020, SAS teams participated in a total of 89 COST projects.

ERA-NET projects

The ERA-NET program is a specific EU tool for coordinating national research programs through national agencies. SAS is the only Slovak organization that is actively and systematically involved in the ERA-NET program. Within Horizon 2020 program, the ERA-NET program takes place under the COFUND scheme, which means that part of the funds that the agencies spend on projects (up to 30% depending on the consortium contract) is paid from EU funds. The participation of SAS in coordination projects enables teams from SAS organizations to participate in the submission of research projects. During 2020, SAS was a member of 21 ERA-NET coordination projects; by the end of 2020, the number had dropped to 20. In 2020, SAS teams participated in the research of 29 projects (in 2019, it was 26 projects, in 2018, 19 projects).

Other projects

Other programs with the participation of SAS organizations include the International Visegrad Fund (IVF), within which five projects were researched at SAS, and UNESCO (five projects). In cooperation with UNESCO, the SAS participated in the International Hydrological Program (IHP). SAS workplaces were also represented in other important international programs, such as IAEA, NATO, IEA, INES, CERN and EMPR.

Cooperation with economically and research developed countries

Taiwan

Under the bilateral scientific cooperation agreement between SAS and

MOST Taiwan, SAS organisations run 8 research projects with Taiwanese

partners. Due to the COVID-19 pandemic, the research of two projects was interrupted. In April 2020, the 12th call for research projects submission for the years 2021 - 2023 was announced, open to all SAS organizations. Eight project proposals were submitted under the published call. After the evaluation on the Slovak and Taiwanese side, two projects were selected for funding with the beginning of the solution research in January 2021.

Turkey

SAS cooperates with Turkey based on an agreement with TÜBITAK

(The Scientific and Technological Research Council of Turkey). Under the agreement with this institution, there are 2 types of projects:

- **Mobility support projects.** Project application can be made continuously throughout the year. In 2020, the research of one project continued.
- **Joint Research Projects Program (JRP).** Four projects have been researched within this program. The start of the research of one project was postponed to 2021.

Japan

In the summer of 2020, negotiations began on the second call under the V4 program - Japan. The negotiations were successfully concluded with the signing of a new Memorandum on scientific and technical cooperation between institutions from the Visegrad Group countries (Ministry of Education, Youth and Sports of the Czech Republic, National Agency for Research and Innovation, Hungary, National Center for Research and Development, Poland, Slovak Academy of Sciences, International Visegrad Fund) and Japan (Japan Science and Technology Agency). The call launch was scheduled for January 2021.

EIG CONCERT Japan
EIG CONCERT Japan is a program of cooperation in science and technology between European partners and Japan within the European Interest Group (EIG) for Japan consortium. The consortium follows up on the successful ERA-Net CONCERT Japan project from 2011-2014.

In 2020, three projects were researched with the participation of the SAS. A renewed and revised memorandum of cooperation was signed in December 2020

Republic of Korea

The cooperation is based on a memorandum of understanding between the Republic of Korea represented by the Ministry of Science, ICT and Future Planning of the Republic of Korea, and institutions from the V4 countries (International Visegrad Fund, Ministry of Education, Youth and Sports of the Czech Republic, National Agency for Research, Hungary, the National Center for Research and Development, Poland, and the Slovak Academy of Sciences). The cooperation is based on joint research projects with the participation of teams from scientific institutions and universities in the Republic of Korea and the V4 countries. In 2020, three projects were researched with the participation of teams from the SAS from the first call announced in 2017. The research of two projects was completed during the year, one project was interrupted.

IV.3 Other activities in the development of international cooperation

V4 academies cooperation, cooperation with the Czech Academy of Sciences

The planned meeting of the representatives of the V4 academies of science, which was to take place in October 2020 in Budapest, did not take place due to the COVID-19 pandemic. The event will take place on an alternate date in 2021, when developments in the pandemic situation allow.

The planned meeting of the representatives of the SAS and the AV ČR, which was to take place in the Czech Republic, did not take place either. This meeting was also postponed to 2021.

Participation of SAS delegations in meetings abroad

In 2020, SAS delegations participated in the following negotiations and congresses abroad:

- bilateral negotiation with representatives of the AV ČR and participation in the AV ČR New Year's concert, 10. - 11. 1. 2020, Prague, Czech Republic,
- 1st Shadow Strategic Configuration of the Horizon Europe, 22.1.2020, Brussels, Belgium,
- ceremony UN 5th International Day of Women in Science Assembly, 9. -14. 2. 2020, New York, United States of America,
- conference Supporting the preparation of future European Partnerships, 9. - 10. 3. 2020, Brussels, Belgium,
- the signing of a memorandum of cooperation between Charles University in Prague and SAS, 4. 8. 2020, Prague, Czech Republic. The memorandum will support and expand the existing cooperation in the implementation of doctoral study programs.

Due to the COVID-19 pandemic, from mid-March 2020 to the end of December 2020, no further sending of SAS representatives to major negotiations and congresses took place.

Significant welcomes at SAS

- **On 26. 2. 2020, the President of the SAS, Pavol Šajgalík, welcomed the Ambassador of the Hellenic Republic, J. E. Georgios Dimitriadis**, who began his diplomatic mission in Slovakia at the end of 2019. His effort will be to establish cooperation between the SAS and the Greek universities of Athens and Thessaloniki. The diplomat praised the work of Ján Zozuľak, who is an expert in the history of Byzantine philosophy, Byzantine anthropology, ethics, patrology and the Greek language. He also expressed interest in strengthening the role of the social sciences and humanities.
- **On 2. 3. 2020, Claudio Palestini, a prominent expert on new security challenges and a member of the NATO Section for Implementation of the Science for Peace and Security (SPS) program, visited SAS.** The visit was received by the President of the SAS, Pavol Šajgalík, and other members of the SAS Presidium - Juraj Koppel and Martin Venhart. The guest was accompanied by Karol Nemoga, Director of the Mathematical Institute SAS and a member of the international team of NATO project evaluators. The main topic of the meeting was the SPS (Science for Peace and Security) program focused on the development of technologies to combat terrorism (radars, drones), as well as on finding ways to face the growing threat of cyberterrorism. In the future, the SAS plans to take steps to intensify the participation of research centers and institutes of the SAS in the NATO - SPS program.

- **On 3. 3. 2020, the President of the Slovak Academy of Sciences, Pavol Šajgalík, welcomed the Ambassador of the Republic of Korea in the Slovak Republic, J. E. Byung Hwa Chung, at the Academy.** Mária Omastová, Deputy Vice-President of the SAS for International Relations, was also present at the meeting. The two sides discussed cooperation plans for the near future. The Korean Ambassador became acquainted with the activities and structure of the SAS. He also learned from her representatives about the current joint outputs, which are a memorandum of understanding between the National Research Foundation of Korea and the SAS, as well as a memorandum with the Korean Institute of Materials Science. Multilateral scientific cooperation was also discussed, within which the SAS is currently cooperating with the Republic of Korea on five projects. The participants also discussed the preparation of a joint workshop of the SAS - NRF, which was to take place at the end of 2020. The main topics were to be: analytical chemistry, molecular biology, inorganic chemistry and high-molecular sciences.
- **On 9. 3. 2020, Vice-President of the SAS for International Relations, Dušan Gálik, welcomed a delegation from the Shota Rustaveli National Scientific Foundation (Georgia) led by Zviad Gabisonio.** The participants of the meeting informed each other about the history, structure and current activities of both institutions in the field of science and research, as well as about the participation of Slovakia and Georgia in international research programs. Dušan Gálik pointed out the yet unused potential of cooperation between the SAS and Georgia. This could start in the coming years on the basis of an exchange of doctoral students, within which those interested from Georgia would be given the opportunity to complete a doctoral stay at the SAS workplaces. Following this, it is necessary to consider the possibility of establishing direct cooperation between the SAS and the SRNSFG, which would bring the opportunity for researchers from both countries to participate in projects in selected areas of common interest.
- **On 9. 5. 2020, the President of the SAS, Pavol Šajgalík, welcomed the Ambassador of the Republic of Kazakhstan in Slovakia, J. E. Roman Vasilenko, at the SAS.** The meeting was focused on the preparation of an agreement on scientific cooperation between the Slovak Academy of Sciences and the National Academy of Sciences of the Republic of Kazakhstan. In this context, the representatives of the SAS and the Kazakh Ambassador supported the idea of organizing a joint meeting with representatives of both parties in order to name areas of common interest and define specific forms and conditions of cooperation.
- **On 22. 7. 2020, the President of the SAS, Pavol Šajgalík, welcomed the Slovenian Minister for Education, Science and Sports, Simona Kustecová, at the SAS.** The Slovenian delegation included Dragica Bacová, Director of the Minister's Office, Petra Mišičová, Head of the PR Department, and Mateja Kobavová, Ministerial Counselor from the Embassy of the Republic of Slovenia in the Slovak Republic. On behalf of the SAS, the friendly meeting was attended by the Vice-Presidents of the SAS Peter Samuely, Juraj Koppel and Karol Marhold, as well as the Deputy Vice-President of the SAS for International Relations, Mária Omastová, and the Director of the Institute of Informatics SAS, Ivana Budinská. In her short speech, the head of the Slovenian delegation, Minister Simona Kustecová, thanked for the warm reception at the SAS and emphasized that although Slovenia and Slovakia are small in terms of population, both have extensive human potential and unique natural wealth. It is an opportunity for researchers from both countries to take part in new joint projects and - like the SAS - thinks that new European project calls are directly calling for more intense participation of scientists in the social sciences and humanities. The director of the Institute of Informatics SAS, Ivana Budinská, spoke about the achievements of the institute, and mentioned in particular projects related to artificial intelligence. Finally, the representatives of both parties

expressed their goodwill and willingness to take steps to establish closer and more extensive cooperation.

- **11. 11. 2020, the President of the SAS, Pavol Šajgalík, welcomed the Ambassador of the Federal Republic of Germany, J. E. Barbara Wolf.** Dušan Gálik, Vice-resident of the SAS for International Relations, was also present at the meeting. They discussed scientific cooperation between scientific institutions in Germany, SAS and universities in Slovakia, in particular the Slovak University of Technology in Bratislava, Comenius University in Bratislava, P. J. Šafárik University in Košice, the Technical University in Košice and the University of Veterinary Medicine and Pharmacy in Košice, with which the SAS has signed memoranda of understanding. The Ambassador was interested in the brain drain from Slovakia and its causes. The Vice-President of the SAS, Dušan Gálik, briefly evaluated the mutual cooperation between the SAS and scientific institutions in Germany, emphasizing, in particular, the development of cooperation with the DAAD, where several joint projects are taking place.

V. RESEARCH FOR SOCIETY

V.1 Activities of the SAS in the fight against the COVID-19 pandemic

The year 2020 was marked by the fight against the COVID-19 pandemic and brought a significant change in social priorities, the way of work, the possibility of mutual contacts and travel.

Paradoxically, it is precisely this difficult situation that has shown the importance of having our own experts capable of bringing solutions to serious issues when foreign aid for a global problem is limited or unavailable. Therefore, the SAS has, with all responsibility, played the extraordinary role it has in society, and has taken the initiative to help the fight against the disease on several fronts. The activities were coordinated by the President of the SAS, who was a full member of the Pandemic Commission of the Government of the Slovak Republic, through the own crisis staff of the SAS. It included experts from the SAS with the corresponding competencies.

The main role was played mainly by the Institute of Virology of the Biomedical Research Center SAS, whose staff, under the leadership of RNDr. Boris Klempa, DrSc., focused on the research of the SARS-CoV-2 virus, on monitoring its spread in Slovakia, on virus isolation, on elucidating its genomic structure, immune responses to infection. The staff of the Institute participated in socially important activities in the fight against the pandemic, including routine testing, preparation of disinfection and sampling media, validation of tests, pilot studies, as well as direct assistance to clinical workplaces. These activities were also supported by the participation of several scientists in advisory groups of the Central Crisis Staff of the Slovak Republic, in public activities of the initiative Science Helps and also by an exceptionally high number of media appearances to inform the public about scientific knowledge about the virus, its spread and necessary anti-epidemic measures. BMC SAV participated in the fight against the pandemic with several activities, most of which still continue in 2021:

- Routine testing of samples for the presence of SARS-CoV-2 virus using RT-qPCR, which required adaptation and completion of the necessary infrastructure in the BSL3 laboratory with a high degree of protection, logistical and methodological refinement of the testing process, long-term high workload of scientists, who had to align testing activities with their own research programmes. The testing was performed in coordination with the Public Health Authority of the Slovak Republic and in critical periods of the high incidence of the disease also at the direct request of clinical workplaces. The quality and reliability of testing in BMC SAV was also confirmed by obtaining the ECDC Certificate.

- Validation of a series of new Slovak RT-qPCR tests for SARS-CoV-2 virus detection in cooperation with MultiplexDX, p. r. o., which led to their CE certification at the State Institute for Drug Control (ŠÚKL) and their implementation in practice. The development and validation of the first vDETECT test were carried out under the responsibility of ESET, s. r. o., in cooperation with several partners.

- Isolation of SARS-CoV-2 virus from samples of Slovak patients with COVID-19 disease, determination of their genomic sequence with subsequent input of data into the global GISAID database EpiCoV (by the end of 2020, it was 34 sequences). This activity took place in cooperation with the Department of Infectology and Geographical Medicine of the University Hospital Bratislava, the Faculty of Science of Comenius University and the Faculty of Mathematics, Physics and Informatics of Comenius University. At the same time, virus isolations were performed to exclude infectiosity in long-term hospitalized patients who

showed persistent PCR positivity (in cooperation with various clinical sites, especially the Department of Infectology and Geographical Medicine of the University Hospital Bratislava).

- Isolation of the genomic RNA of the SARS-CoV-2 virus, which, together with the virus isolates, has been entered into the biobank of the European virus archive EVA GLOBAL, of which the BMC SAV Institute of Virology is the founding partner. Viral RNA is also part of the Slovak RT-qPCR tests for the detection of the SARS-CoV-2 virus as a positive control. Virus and RNA have also been provided as controls to foreign companies developing vaccines against COVID-19.

- Introduction and validation of a test for the detection of virus-neutralizing antibodies in persons who have overcome COVID-19 infection and disease, as well as for the analysis of the virus-neutralizing activity of experimental antibodies in cooperation with the Institute of Neuroimmunology SAS, AXON Neuroscience R&D and the Department of Infectious Diseases and Geography of the University Hospital Bratislava.

- Verification of ELISA and antigen tests of various foreign manufacturers in cooperation with the Department of Infectology and Geographical Medicine of the University Hospital Bratislava.

- Experimental use of a new sampling method for the detection of SARS-CoV-2 virus by gargling. It is a non-invasive sampling method that does not require the presence of medical staff and allows RT-qPCR to reliably detect the virus even when multiple samples are combined. The Biomedical Research Center SAS experimentally uses this method of sampling for RT-qPCR testing of its employees and testing actors and accompanying staff of the Slovak National Theater, which it helps to carry out at least basic artistic activities. Samples were taken by swabbing for comparison with gargling or antigen tests by the staff of the Institute for Clinical and Translational Research of the Biomedical Research Center SAS.

- International validation of gargles in cooperation with the Vienna Research Institute of Molecular Pathology of the Vienna Medical University and the Department of Infectology and Geographical Medicine of the University Hospital Bratislava with subsequent testing using RT-qPCR and LAMP methods with and without RNA isolation, which will continue in 2021.

- Pilot verification of the possibility of using sampling by gargling for mass testing at schools. The reliability of these samples was confirmed during testing at two schools within the activity organized by the Ministry of Health, Ministry of Education, Science, Research and Sports, Department of Infectology and Geographical Medicine of the University Hospital Bratislava, Biomedical Research Center SAS and the contributory organization of the Ministry of Health of the Slovak Republic - Healthy Regions - when they examined more than 900 samples in this way. Class-pooled samples were used in the pilot testing, and even in these pooled samples, infected individuals were detected by RT-qPCR with a sensitivity higher than that shown by individual antigen tests of the same test participants. Examination of gargling samples with RT-qPCR can reliably identify individuals with a high viral load even when pooling samples.

- Testing of antiviral properties of various materials.

In addition to direct virological research in the COVID-19 pandemic, the SAS also participated in the development of several mathematical models for the spread of this disease. Under the leadership of

the Mathematical Institute SAS, a model was created to monitor the spread of epidemiological waves between different geographical regions (countries), which can help in analysing and designing the effectiveness of epidemic traffic lights. Another model is based on an agent approach and describes the spread of COVID-19 within one region (e.g. district, region, the whole territory of Slovakia). The model takes into account RT-PCR testing, infection screening, and mass testing using rapid tests (e.g. antigen tests). The model is able to reconstruct the observed daily average increase of those infected, which allows the model to be calibrated based on available information about the ongoing pandemic. In addition, the model also allows the analysis of various nationwide testing strategies. However, work on optimising the models was negatively affected by the acute lack of suitable data as well as their poor availability by the state.

The Institute of Neuroimmunology SAS, in close cooperation with AXON Neuroscience R&D, began to focus intensively on the immunology of viral infections with an emphasis on COVID-19, especially understanding the principle of viral S protein interaction with various host cell surface receptors. The development of our own Slovak vaccine has also started, which is to result in clinical trials in 2021. Another project aims to identify pathological changes in the brain of patients whose cause of death was related to COVID-19 infection.

The Polymer Institute SAS, the Institute of Molecular Biology SAS and the Institute of Geotechnics SAS focused on the detection and sterilisation of virus-contaminated surfaces and wastewater. Several institutes have begun to research suitable materials for respiratory protective equipment (Institute of Materials Research SAS, Polymer Institute SAS). Institute of Materials and Machine Mechanics SAS, in cooperation with the Biomedical Research Center SAS, produces a large-capacity aerosol purifier for viruses, which could help protect large common areas (waiting rooms, gyms, theatres, cinemas, etc.).

Institute of Social Sciences SAS also became intensively involved in the fight against the pandemic. Employees of the Institute for Sociology SAS, together with the Mathematical Institute SAS, participated in modelling pandemic spread and commented on the pandemic spread models from the Institute of Health Policy (IZP) of the Ministry of Health of the Slovak Republic within interdisciplinary cooperation in predicting and setting life tools and policies during the epidemic. They later commented on the system of automatic management of restrictions and their release during a pandemic. Institute of Sociology SAS, together with the Institute for Research in Social Communication SAS, communication agency Seesame, s. r. o., and the research company MNFORCE, s. r. o., collaborated on the continuous research of the company during the pandemic called *How are you, Slovakia?* Using questionnaire surveys, they conducted several surveys of the social behaviour of the population during a pandemic. The results of the research were also presented within the Science Helps platform and were published in twelve press releases (the first report was published on 27. 3. 2020). The research focused on current issues in six thematic areas: social trust, politics and democracy, conspiracy theories, views on vaccination, the environment and leisure. Findings from this series of research recorded a considerable response in the media and also contributed to the adjustment of state policy in the field of promotion of necessary measures, testing, or rather vaccination. An employee of the Institute of Ethnology and Social Anthropology SAS, Mgr. Andrej Belák became an expert consultant of the Permanent Crisis Staff of the Prime Minister of the Slovak Republic for resolving the SARS-CoV-2 pandemic in the environment of marginalized Roma communities and also the head of the working group of the Pandemic Commission of the Slovak Government on prevention and control of the SARS-CoV-2 pandemic in the environment of marginalized Roma communities.

V.2 Contribution of the SAS to economic growth and better governance of society and the country

The second important activity after the COVID-19 pandemic, which will soon affect the country's economic growth, was the creation of a Recovery and Resilience Plan, as well as a long-term strategy for smart RIS3 specialization at the national and regional levels. Here, too, scientists from the SAS, as members of various advisory bodies, actively participated in the preparation of these strategic materials. Representatives of the SAS were invited mainly to economic and prognostic analyzes (Institute of Economic Research SAS, Centre of Social and Psychological Sciences SAS), to environmental protection issues (Plant Science and Biodiversity Center SAS, Earth Science Institute of the SAS, Institute of Geotechnics SAS, Institute of Landscape Ecology SAS, Institute of Forest Ecology SAS, etc.), to the strategy of industrial revival, including future automation and digitization (Institute of Informatics SAS, Institute of Physics SAS, Institute of Materials and Machine Mechanics SAS, etc.).

Centre of Social and Psychological Sciences SAS has published an analysis related to the decision to end brown-coal mining in the Upper Nitra region, focusing mainly on the small and medium-sized enterprise (MSP) sector in the region to provide information for economic and social policy-making and planning future interventions. The analysis has shown that the closure of mines is an opportunity for greater ambition than just replacing one type of work with another. This can be seen as a challenge to transform the economy into a low-carbon system adapted to climate change.

Based on the assignment of the Association of Supplementary Pension Companies (ADDS), the Institute of Economic Research SAS prepared an analysis of the cost of the Slovak supplementary pension savings system. The purpose of the international comparison was to provide the most accurate comparison of the cost of pension schemes from the saver's point of view with the given possibilities.

VI. PROJECTS SUPPORTED BY THE STRUCTURAL FUNDS

Operational Program Research and Innovation

In 2014, the European Commission approved the Operational Program Research and Innovation within the programming period 2014-2020. This operational program consisted of a joint program document of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Ministry of Economy of the Slovak Republic for the provision of support from the European Structural and Investment Funds. With effect from 13. 12. 2019, the European Commission approved merging the Operational Programme Integrated Infrastructure with the Operational Programme Research and Innovation.

The Slovak Academy of Sciences signed a contract in June 2019 for the implementation of the project Establishment of the Centre for Advanced Materials Applications SAS in the amount of EUR 29,941,629. The partners in this project are seven SAS organizations. In 2020, the costs of this project were reimbursed in the amount of EUR 1,316,813.67. In addition, nine projects of SAS organizations to support research and development capacities in the amount of EUR 6,778,771 were researched. In 2020, the SAS organizations concluded contracts on the provision of a non-repayable financial contribution under the following calls:

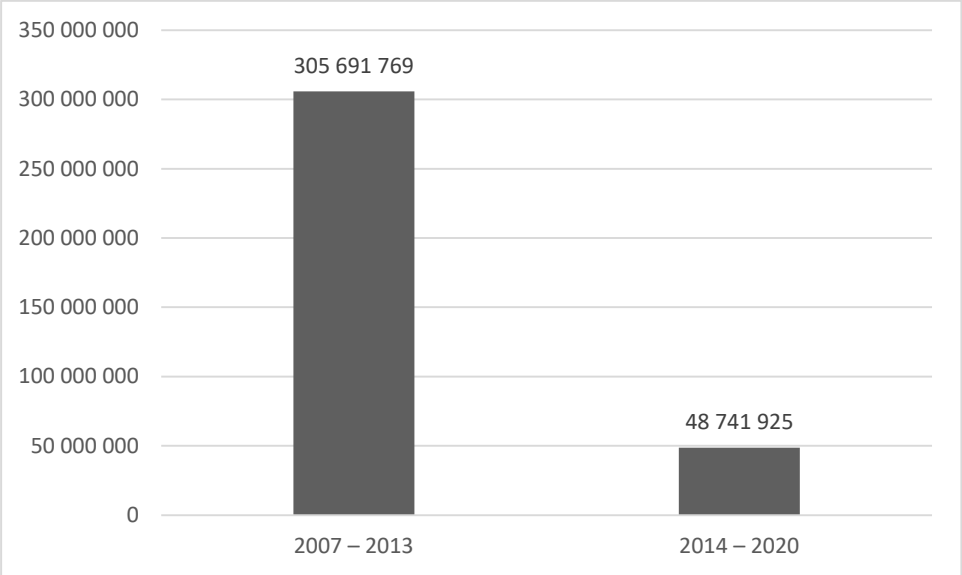
- Support for international research projects approved in the H2020 program (Institute of Experimental Physics SAS),
- Support for the mobilization of excellent research teams in the areas of RIS3 SK specialization outside the Bratislava region (Institute of Landscape Ecology SAS),
- Support for the long-term strategic research and development - Population Health and Health Technologies (Biomedical Research Center SAS).

Within the call Support for the long-term strategic research and development - Healthy Food and the Environment, the research agency has not yet decided on the applicant's appeal (Centre of Biosciences SAS) against the decision on non-approval of the NFP application, which was submitted on 7. 9. 2020.

In 2020, a procedure was held within the call for support for the long-term strategic research Industry for the 21st Century (OPVaI-VA/DP/2018/1.2.1-05). The call was cancelled on 14. 1. 2021. Projects within the call Support for the mobilization of excellent research teams in the areas of RIS3 SK specialization in the Bratislava self-governing region (Institute of Chemistry SAS) and the call Support for the participation of Slovak research institutions in international research projects aimed at combating the pandemic caused by COVID-19 (Biomedical Research Center SAS) are currently being evaluated.

In this context, it should be noted that in the operational program Research and Development in the last year of the previous programming period, the SAS and its organizations implemented 76 projects as beneficiaries with a total volume of contracted non-repayable financial contributions (NFP) in the amount of EUR 305,691,769 in 2013. In the seventh year of the 2014-2020 programming period, the Integrated Infrastructure operational program (with which the Research and Innovation operational program was merged) reached the total volume of 13 contracted projects of the SAS and its organizations as beneficiaries of non-repayable financial contributions as of 31. 12. 2020, in the

amount of EUR 34,220,598. In addition, SAS organizations are partners in 15 projects with a share in the NFP in the amount of EUR 14,521,327.



Comparison of the amount of non-repayable financial contribution that the SAS and its organizations received in the programming period 2007 - 2013 and in the programming period 2014 - 2020

SAS and its organizations perceive very negatively this significant decline in an important source of funding for the further development of modern research infrastructure, including human resources.

VII. MANAGEMENT AND EMPLOYMENT

At the end of the year, the Slovak Academy of Sciences had 22 budgetary organizations and 26 contributory organizations. Compared to 2019, there has been no change.

In accordance with § 15 Sec. 6 of Act No. 133/2002 Coll. on the Slovak Academy of Sciences, four SAS organizations (one scientific organization with a budget form of management, two scientific organizations with a contribution form of management and one specialized organization with a contribution form of management) carried out business activities.

The drawing of funds complied with the applicable legislation, the principles within the individual programs, the functional and economic classification and the binding purposefulness of their use. All organizations were involved in the budget information system of the State Treasury.

Approved revenue budget for 2020 according to Act No. 468/2019 Coll. on state budget amounted to EUR 500,000. Following the approved amendment to the State Budget Act No. 217/2020 Coll. which entered into force on 5. 8. 2020, the binding indicator approved for revenue budget for 2020 was changed to EUR 492,000. The revenue budget was as of 31. 12. 2020, increased by the expected achievement of other non-tax revenues and due to the sale of assets (buildings and land) by EUR 230,000. In fact, the budget organizations of the SAS transferred funds in the amount of EUR 797,288 to the revenue account of the state budget.

Table VII-1: Structure of budget revenue

Main category/category	Approved budget (€)	Adjusted budget (€)	Actual (€)	% to the Adjusted budget
200 - Non-tax revenues	**492,000**	**722,000**	**797,288**	**110.43**
210 - Revenue from business and property ownership	125,000	10,230	13,107	128,12
220 - Administrative fees and other fees and charges	367,000	421,360	458,394	108,79
230 – Capital revenue	0	167,846	180,846	107,75
290 - Other non-tax revenues	0	122,564	144,941	118,26

In the approved budget for 2020, the chapter had a breakdown of the total expenditure budget in the amount of EUR 85,367,494. During the year, the budget for total expenditure was adjusted based on budgetary measures to the amount of EUR 90,408,096. An increase of EUR 6, 614, 331 and a decrease of EUR 1, 573, 729 contributed to the adjustment of the expenditure budget.

The increase in expenditure was influenced by budgetary measures, which addressed, in particular, the following:

- a transfer of capital expenditure from 2019 in the amount of EUR 1, 142, 011,
- an increase in the budget of expenditures for the solution of the project financed from the EU structural funds, including co-financing from the state budget intended for the project Building of the Center for Advanced Materials SAS in the amount of EUR 1,368,768,
- an increase in the expenditure budget ensured by the commitment of expenditure in other chapters,

- an increase in expenditure due to the compensation of expenditures of the SAS chapter negatively affected by the pandemic related to the COVID-19 disease in the amount of EUR 1,005,419,
- an increase of the budget of the SAS chapter based on the request of the organization Biomedical Research Center SAS in the amount of EUR 592,658.

The decrease in the budget of expenditures resulted mainly from the budgetary measures that bound the expenditures of the SAS chapter:

- due to the commitment of funds pursuant to § 8 of the Act on budget rules of public administration.

During the year, budgetary measures were also implemented, which were of an internal nature and dealt with the reclassification of budget funds within the SAS chapter.

All expenditures of the budget chapter of the SAS were allocated in programs structured into sub-programs and elements.

Budget organizations of the SAS as of 31. 12. 2020, drew funds in the total amount of EUR 90,407,426 through expenditure accounts in the State Treasury. The structure of total expenditure by the source was as follows:

- expenditures from the state budget in the amount of EUR 88,877,646;
- expenditures for joint programs of the Slovak Republic and the EU financed from the EU structural funds, including co-financing from the state budget, adopted on the basis of budgetary measures in the amount of EUR 1,529,780.

Of the total budget expenditures, current expenditures amounted to EUR 87,292,183 (of which the founder's contribution to the operation of SAS contributory organizations was EUR 59,055,301) and capital budget expenditures amounted to EUR 3,115,243 (of which the founder's contribution to SAS contributory organizations was EUR 2,079,071).

The average registered number of employees recalculated for 2020 was 838.1 persons in budgetary organizations. The level of the average salary for 2020 was EUR 1,634, of which EUR 1,531 from the state budget (source 111) (source data report Práca 2-04).

The contributory organizations of the SAS achieved total revenues in the amount of EUR 87,439,339. Of the total revenues of contributory organizations, the contribution from the state budget through the founder amounted to EUR 61,134,372 (of which: current EUR 59,055,301 and capital EUR 2,079,071).

Own resources, which consisted mainly of revenue from the sale of goods, goods and services, revenue from the rental of buildings, premises and objects and revenue from the sale of capital assets, amounted to EUR 4,618,219 and grants from domestic non-government entities amounted to EUR 1,063,735. Other revenues of contributory organizations were contributions to project research, in particular contributions from the state budget provided by the Research and Development Agency and foreign grants, especially funds for research of international cooperation projects (Horizon 2020, multilateral projects within the EU, other multilateral projects, bilateral projects and projects within the framework of intergovernmental agreements on scientific and technological cooperation).

The total expenditure of the contributory organizations amounted to EUR 81,035,847, of which EUR 77,874,718 was current and the capital amounted to EUR 3,161,129.

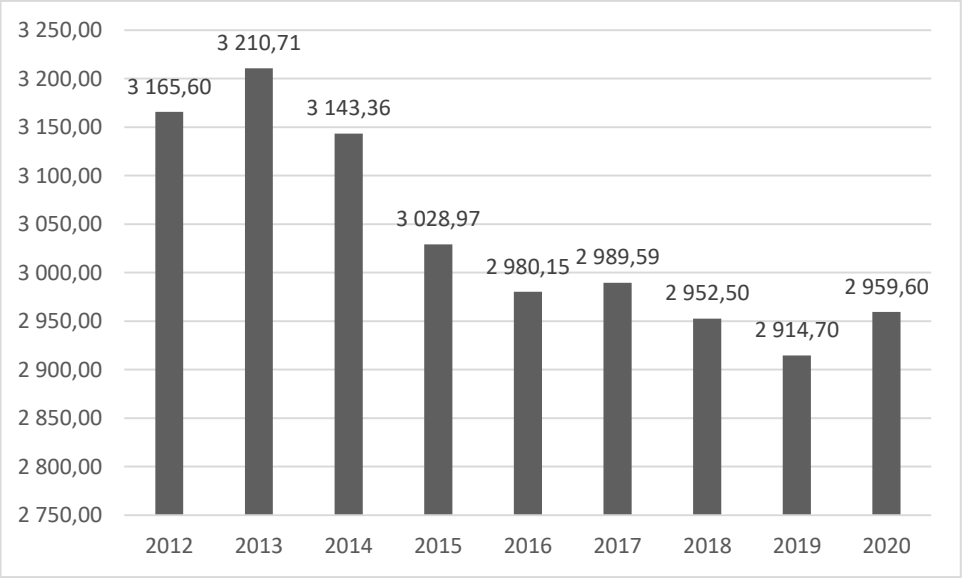
The average registered number of employees recalculated in 2020 was 2,121.5 persons in contributory organizations. The level of the average salary was EUR 1,530, of which EUR 1,304 from the state budget (source 111) (data source report Práca 2-04).

Table VII-2: Achieved level of average salary of all employees for 2020 (in EUR)

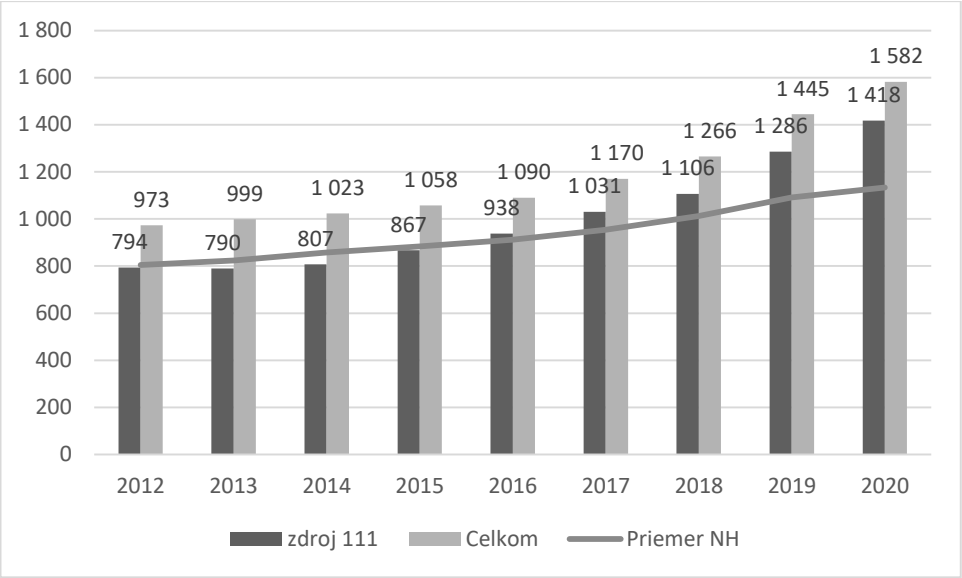
Year 2020	RO	PO	SAV
Source 111 ŠR	1,531	1,304	1,418
Other resources total	103	220	164
Average earnings total	1,634	1,530	1,582

Table VII-3: Achieved level of average salary of researchers (DrSc., PhD., CSc.) for 2020 - scientific organizations of the SAS (in EUR)

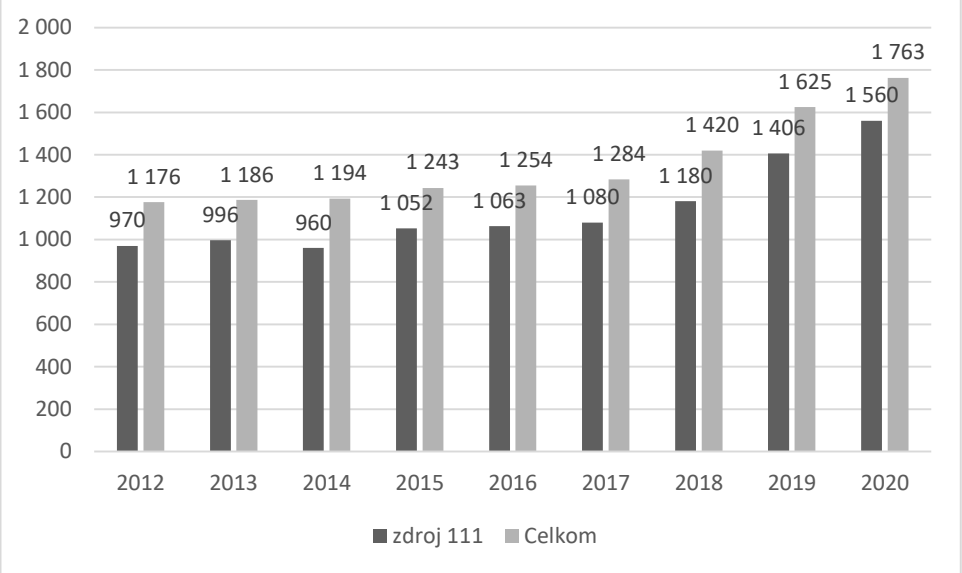
Year 2020	RO	PO	SAV
Source 111 ŠR	1,597	1,524	1,560
Other resources total	192	214	203
Average earnings total	1,789	1,738	1,763



Development of the number of employees (recalculated number) in the years 2012 - 2020



Development of average earnings in 2012 - 2020 (source 111 ŠR and total average salary of all employees) and its comparison with the development of average wage in the national economy (in EUR)



Development of average earnings of researchers in the years 2012 - 2020 (source 111 ŠR and total average salary, in EUR)

VIII. SAS ORGANIZATIONS AS OF 31 DECEMBER 2020

Section 1: Physical, Space, Earth, and Engineering Sciences

Earth and Space Sciences
SAS Institute of Astronomy
SAS Earth Science Institute
SAS Institute of Geography
SAS Institute of Hydrology

Mathematical and Physical Sciences
SAS Centre for Advanced Material Application
SAS Institute of Experimental Physics
SAS Institute of Physics
SAS Mathematical Institute

Engineering Sciences
SAS Institute of Construction and Architecture
SAS Institute of Electrical Engineering
SAS Institute of Geotechnics
SAS Institute of Informatics
SAS Institute of Materials and Machine Mechanics
SAS Institute of Materials Research
SAS Institute of Measurement Science

Section 2: Life, Chemical, Medical, and Environmental Sciences

Medical Sciences
SAS Biomedical Research Center
- Cancer Research Institute
- Institute for Clinical and Translational Research
- Institute of Experimental Endocrinology
- Institute of Neurobiology
- Institute of Virology

SAS Centre of Experimental Medicine
- Institute of Experimental Pharmacology and Toxicology
- Institute for Heart Research
- Institute of Normal and Pathological Physiology

SAS Institute of Neuroimmunology

Biological and Chemical Sciences
SAS Centre of Biosciences
- Institute of Animal Biochemistry and Genetics
- Institute of Animal Physiology
- Institute of Molecular Physiology and Genetics

SAS Institute of Chemistry
SAS Institute of Inorganic Chemistry

SAS Institute of Molecular Biology
SAS Institute of Zoology
SAS Polymer Institute

Agricultural and Veterinary Sciences
SAS Institute of Forest Ecology
SAS Institute of Landscape Ecology
SAS Institute of Parasitology
SAS Plant Science and Biodiversity Center

- Institute of Botany
- Institute of Plant Genetics and Biotechnology

Section 3: Social Sciences, Humanities, Arts, and Culture

Historical Sciences
SAS Institute of Archaeology
SAS Institute of Ethnology
SAS Institute of History

Humanities and Social Sciences
SAS Centre for Social and Psychological Sciences

- Institute of Experimental Psychology
- Institute of Social Sciences
- Institute for Forecasting

SAS Institute for Research in Social Communication
SAS Institute for Sociology
SAS Institute of Economic Research
SAS Institute of Philosophy
SAS Institute of Political Sciences
SAS Institute of State and Law

Arts and Culture
SAS Art Research Centre

- Institute of Art History
- Institute of Theatre and Film Research

SAS Institute of Musicology
SAS Institute of Oriental Studies
SAS Institute of Slovak Literature
SAS Institute of World Literature
SAS Jan Stanislav Institute of Slavistics
SAS Ludovit Stur Institute of Linguistics

Specialized and Service Units

SAS Central Library
SAS Centre of Operations

- Administration of special purpose facilities
- Central Archive of SAS

- Computing Center
- Congress Centre Academia Stará Lesná
- Congress Centre Smolenice
- Encyclopaedic Institute
- Technical and Economic Administration of Social Sciences Institutes
- Veda Publishing House