



SLOVAK ACADEMY OF SCIENCES ANNUAL REPORT 2021



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

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FOREWORD BY THE PRESIDENT OF THE SAS



The year 2021 was similar to the previous year. It started with an intensified pandemic situation that started to ebb away during summer months, only to break out again in the autumn and winter. Scientific institutes, already wised up from the experiences of the previous year, adapted their scientific program with the exception of organizing face-to-face scientific events, which is also why the gaps in research were not so striking.

The programme of **SASPRO 2** project is fully underway. With the help of a panel of experts, SAS has already selected all the candidates, and as of today, all 20 positions are filled. In 2021, the **IMPULZ** programme was launched, the task of which is to look for new leaders whose objective is to convince the international jury of evaluators that they bring excellent research touching the frontier of knowledge to SAS. The **Doktograd** programme, which is aimed at doctoral students of the SAS, also continued, and its mission is to teach students to be able to write scientific projects that can withstand high criteria of difficulty.

The overview of the most important scientific results for 2021 is very wide and comprehensive and is worth reading. It is clear from this overview that even the second year of the pandemic did not dramatically weaken the performance of scientific teams at the SAS. Not only the results of basic research are presented therein, but also the results applied in social practice and obtained in an international context.

SAS participates in the 3rd level of university studies. The number of students has been around 500 on a long-term basis, 509 students studied at the SAS this year. The interest of doctoral students in studying at the SAS is a manifestation of the high credibility of the SAS institutes, which are external educational institutions. The growing number of foreign students, which reached almost 30% in 2021, is also a positive thing. The increasing number of foreign students also has a positive effect on competition, which manifests itself mainly in the increased number of applicants for individual doctoral positions.

SAS is also highly visible in the European Research Area, 49 Horizon 2020 and Horizon Europe projects, EU framework programmes, were solved at the SAS institutes in 2021. At the same time, teams from the SAS participated in the preparation of 60 proposals for the Horizon 2020 and Horizon Europe projects, and in 11 proposals, they represented the position of coordinator. A large number of institutes' participation in projects within the COST and ERA-NET schemes only underlines this fact.

In 2021, the SAS also continued their wage reform, the goal of which was to distribute the wage fund to institutes according to a new key that takes into account the number of employees needed for research in the given field. Simultaneously, the methodology for the breakdown of wages applied as part of the wage reform is also connected with the performance component of wages, which takes into account the real performance of individual scientific teams, according to a regular evaluation monitoring the performances of the previous two years. In this way, almost a quarter of the wage fund is allocated to institutes.

After implementing the human resources strategy in research at the SAS and obtaining the HR Excellence in Research certificate (2020), the SAS Gender Equality Plan was adopted in 2021, the historically first document and programme of this kind at the academy.

Last but not least, it should be mentioned that in 2021, all the necessary steps were completed so that the transition of SAS organizations to the legal form of public research institutions as of 1. 1. 2022 could pass without unnecessary complications.

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

I. SAS SCIENCE POLICY

I.1 Support of excellent research

In 2021, the elections in the SAS Assembly resulted in a new Presidium of SAS, which will manage the Academy until 2025. When creating its program statement, the Presidium of SAS refers to the general recommendations of its International Advisory Board, the documents Initiative – Vision for a Knowledge-based Society and a Better Slovakia and the SAS Strategy 2030, adopted in previous years. We consider efforts to restore and improve the scientific ensemble of the SAS through the progressive SASPRO2 and IMPULZ programmes to be an essential element of our science policy. In this way, a new generation of leading scientific personalities will be formed, and the international character of our organizations will be strengthened. In 2021, the first two SASPRO2 calls were evaluated, and the third - the last of this programme - which is supported by the H2020 Marie Skłodowska-Curie Actions – COFUND, was announced. The third call is coordinated by the SAS and shared together with the Comenius University and the Slovak University of Technology. In 2021, three projects of the MoRePro scheme, which is a replica of SASPRO2 but fully funded by the SAS, were also implemented. The most important innovation was the launch of the IMPULZ programme aimed at creating new research teams in innovative scientific directions around new key figures. 31 applicants applied for the call, and an international panel selected three of them for funding starting in 2022. Other ongoing schemes and science support tools in the SAS are described in more detail below.

SAS was involved in the preparation of strategic activities mainly under the auspices of the Ministry of Education, Science, Research and Sport of the Slovak Republic. It involved work in commissions for the transformation of the SAS, preparation of state science policy, reform of the grant system and evaluation of the creative activity.

The SAS was also part of the initiatives related to the implementation of the Recovery and Resilience Fund, as well as the new programme period of the European Structural and Investment Funds. In Košice, the interesting association of legal entities - the Cassovia New Industry Cluster (CNIC, z. z. p. o.) - was created in 2021. It was founded by the association of the Košice universities UPJŠ, TUKE, UVLaF, the Košice Self-governing Region, the City of Košice and the company Discovery Park, and after its establishment, the SAS also joined it with its three Košice materials institutes, ÚEF, ÚMV and ÚGt, as well as the Louis Pasteur University Hospital. The CNIC project is aimed at creating an innovation cluster focused on new biomedical, industrial, digital and quantum technologies that will change the economic and social character of the region. The project is in an advanced stage of preparation. It has received considerable funding from the

Ministry of Education, Science, Research and Sport of the Slovak Republic and was presented at many forums, including the Government Office and several ministries. SAS, together with the Bratislava Self-Governing Region, the Comenius University and the Slovak University of Technology, is preparing a similar scheme for Bratislava as well. SAS is also part of the newly established Slovak National Center for Quantum Technologies, z. z. p. o. and the National Supercomputing Centre, z. z. p. o.

From 2021, a new period of EU framework programmes - Horizon Europe - also begins. SAS is preparing a Horizon Europe project support office for its researchers to improve its success rate in obtaining European projects.

In 2021, the Academy continued to evaluate its scientific organizations for the performance form of funding. The total amount designated for performance financing was EUR 5,866,799. It consisted of 10 percent of the organization's wage fund (EUR 3,666,749) and other funds from the Presidium of SAS Fund (EUR 2,200,050). 43 percent of the total amount was intended for the results in the comprehensive accreditation of scientific organizations, which took place in 2017, 30 percent for publication activity, 10 percent for a scientific response, 12 percent for received grants and 5 percent for the number of doctoral students. During the evaluation, scientific sections took into account the specifics of the scientific fields, which mainly concerned the publication activity. Since performance funding is also reflected in the ongoing wage reform, which also takes into account the performances of previous years, the total amount that research organizations receive for wages through measured performances is currently more than 25 percent of the total wage funds. We consider performance funding to be an effective tool for increasing the quality of scientific performance of scientific organizations, and therefore its share in the funding of scientific organizations will continue to grow.

Another tool for supporting the quality of scientific work is awarding top publications. In the Top works in scientific journals with the highest impact category measured by the SJR index (Scimago Journal Ranking) falling into the first percentile of SJR in the relevant scientific field, four publications in the journals Nature, Social Science&Medicine, Chemical Reviews and Earth-Science Reviews, were awarded. We also recognized nine works in journals registered in the Nature index database, six publications in journals included in the Norwegian Register (2nd level) and four publications with the highest number of citations obtained during the years 2016-2018. In the third category, three top scientific monographs published by renowned foreign publishing houses, were awarded.

The Slovak Research and Development Agency (APVV) remains the decisive tool for project funding of research in Slovakia and at the SAS. The Academy remained the most successful organization in obtaining APVV grants.

SAS was still handicapped by the lack of transformation in the field of technology transfer. Last year, we again strengthened the personnel of the Technology Transfer Office, the task of which is to help the SAS organizations with patent protection. SAS also participated in the NITT2 national project for the transfer of technologies from EU structural funds, which is coordinated by the Slovak Centre of Scientific and Technical Information.

I.2. SAS projects

I.2.1 VEGA activities

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.

Even in 2021, VEGA's activities were affected by the epidemic situation associated with the COVID-19 pandemic. All measures were aimed at minimizing the impact of this special situation on the implementation of research activities within the framework of VEGA projects.

VEGA's main activities in 2021:

- the announcement of a new call for submitting applications for a financial contribution to scientific projects, the solution of which will begin in 2022, and the subsequent evaluation of projects;
- financing of ongoing and new VEGA projects;
- final evaluation of projects, the solution of which was completed in 2020;
- creation of new VEGA bodies for the term of office in the years 2021 - 2024.

Call for submitting applications for financial contributions for scientific projects, the solution of which will start in 2022 and initial evaluation of projects

The Presidium of SAS approved the announcement of the VEGA 2022 call for applications for financial contributions to scientific projects on January 14, 2021.

A total of 918 applications were submitted in the call, of which 166 projects were from the SAS. The evaluation took place in two rounds. A total of 56 projects were rejected in the 1st round, as these projects did not meet the basic entry criteria set for individual VEGA commissions. In the

2nd round, 862 projects were evaluated. 36 projects were rejected due to failure to meet quality criteria. Almost 90% of the submitted projects were selected for financing. Through the initial evaluation, the projects were divided into individual categories A – C, which are the main indicator of project quality. This categorization within the SAS also conditions the amount of allocated financial resources for project solutions. The low proportion (11%) of projects included in category C points to the high-quality level of projects submitted by the SAS department.

Project quality category	Number of projects		Share [%]	
	VEGA in total	of which SAS	VEGA in total	of which SAS
A	289	83	35	51
B	341	61	41	38
C	196	18	24	11

Tab. I.1: Results of the initial evaluation of VEGA project proposals in 2021

The list of evaluated projects by VEGA commissions, which are ranked according to success, is available at <http://www.vega.sav.sk/index.php?p=show&id=27>.

Financing of ongoing and new VEGA projects

For 2021, the Presidium of SAS allocated EUR 4,516,769 to finance VEGA projects. The principles of the breakdown of funds for VEGA projects at the SAS in 2020 were approved by the Presidium of the SAS on January 14, 2021.

A total of 561 projects were financed from the SAS organizations and 71 joint projects (in which the project leader is from a university), with SAS employees participating in their solution – a total of 632 projects.

For projects where the main recipient of funds was the SAS organization, the average annual contribution amounted to EUR 8,000.

Information on the VEGA project funds provided for 2021 to the SAS is available at the VEGA website: <http://www.vega.sav.sk/index.php?p=show&id=16>.

SAS Scientific Section	Number of projects	Financial contribution (in EUR)
1. Physical, Space, Earth, and Engineering Sciences	186	1,387,200

2. Life, Chemical, Medical, and Environmental Sciences	294	2,251,762
3. Social Sciences, Humanities, Arts, and Culture	152	877,807
Total	632	4,516,769

Tab. I.2: Allocated funds for VEGA projects in 2021 according to the SAS Scientific Section

Final evaluation of projects, the solution of which was completed in 2020

Due to the pandemic situation, the period for solving projects that were supposed to be completed, was extended as of December 31, 2020. The completion of these projects and submission of the final report for the entire solution period was possible by March 31, 2021. The evaluation of the final reports of the projects was carried out on special dates in the months of May – June.

A total of 509 projects were completed, of which 167 were projects from the SAS. The VEGA commissions selected a total of 76 projects that achieved very significant results, of which 32 were projects from the SAS workplaces.

Creation of new VEGA bodies for the period of 2021 - 2024

In 2021, the new period of the VEGA bodies for the years 2021-2024 began. In the months of April-May, the initial meetings of the VEGA commissions took place, at which the Presidents/Vice-Presidents of the commissions were elected. Subsequently, a meeting of the Extended VEGA Presidium took place, which elected the President of VEGA, the Vice-President of VEGA and other members of the VEGA Presidium. PhDr. František Gahér, CSc. became the VEGA President for a period of two years.

The composition of the individual VEGA bodies is available at the VEGA website: <http://www.vega.sav.sk/index.php?p=show&id=8>.

I.2.2 SAS projects financed through the Slovak Research and Development Agency (APVV)

In 2021, the SAS organizations participated in the solution of 412 projects financed by the APVV grant agency, while the SAS organizations were the main recipient of APVV contribution in the

case of 221 projects. In addition, in 191 projects financed by APVV, SAS organizations were co-recipients of APVV contribution based on a Cooperation Agreement.

The total volume of financial resources provided by APVV for the solution of SAS projects reached the amount of EUR 9,923,010 in 2021.

Within the framework of cooperation in the solution of APVV projects, SAS organizations received funds in the amount of EUR 2,232,399 for the solution of projects. The given data document a significant degree of cooperation of SAS organizations with universities, as well as with the business sector. Both of these sectors are the most important partners in the solution of joint SAS projects. The solution of joint projects is carried out at the level where the project bearer is the SAS organization and where the bearer is the organization, or organizations from other research and development sectors.

A total of 151 projects from SAS organizations were submitted to the calls for all APVV support schemes in 2021. The SAS organization with organizations from other sectors of research and development submitted 133 projects in the position of co-researcher.

SAS Scientific Section	Number of submitted proposals		Number of projects solved		Drawn funds (€)	
	A	B	A	B	A	B
Scientific Section 1	68	44	65	65	2,168,777	766,935
Scientific Section 2	64	50	117	103	4,359,376	1,325,077
Scientific Section 3	19	7	39	23	1,162,458	140,387
Total	151	101	221	191	7,690,611	2,232,399
Total A + B	252		412		9,923,010	

A - SAS organization is the project promoter

B - SAS organization is the contractual project solver

Tab. I.3: Number of submitted proposals, solved projects and funds drawn at the SAS in APVV calls in 2021 by Scientific Sections

I.2.3 Projects supported by EU structural funds

Operational programme Integrated Infrastructure

In 2014, the European Commission approved the Operational Programme Research and Innovation within the programming period 2014-2020. This operational program consisted of a joint programme 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 within the programming period 2014-2020. The new Operational Programme Slovakia for the programming period 2021-2027 until the end of 2021 was only in the preparation stage.

Two projects began to be solved in the Operational Programme Integrated Infrastructure (Priority axis: 9 Support for research, development and innovation) in 2021: Biomedical Research Center SAS Development of the biotechnological research potential of the Biomedical Research Center SAS to combat the COVID-19 pandemic in synergy with the European Virus Archive of global importance supported by the H2020 programme (NFP in the amount of EUR 1,999,645) and the Centre of Experimental Medicine SAS Development of biomodels to improve the evaluation of drug effectiveness and substances that have potential in the treatment of COVID-19 (BIOVID-19) (NFP in the amount of EUR 4,196,784).

Two projects began to be solved in the Integrated Infrastructure Operational Programme (Priority axis: 10 Support for research, development and innovation in the Bratislava region) in 2021, the Institute of Chemistry SAS began to solve the project Study of structural changes of complex glycoconjugates in the process of hereditary metabolic and civilizational diseases (NFP in the amount of EUR 720,297).

In the Integrated Infrastructure Operational Programme (Priority axis: 7 Information society) the Centre of Operations SAS, since 2020, has been solving the project National Competence Center for High Performance Computing (NFP in the amount of EUR 3,199,192) and the Institute of Archaeology SAS, since 2020, has been solving the project Data Management of the Central Archaeological Archiving of the Slovak Republic (NFP in the amount of EUR 2,139,663).

In this context, it should be noted that in the Research and Development Operational Programme as of 31. 12. 2014 (a year after the end of the previous programming period), SAS and its organizations implemented 80 projects as recipients with a total volume of contracted NFP in the amount of EUR 506,483,225.

In the Integrated Infrastructure Operational Programme (Priority axis 9 and 10), one year after the end of the 2014-2020 programming period, the total volume of 16 contracted projects of SAS

and its organizations as recipients of NFP as of 31. 12. 2021, in the amount of EUR 39,829,384, and SAS organizations are partners in 34 projects with an NFP share in the amount of EUR 17,637,797. In the Integrated Infrastructure Operational Programme (Priority Axis 7), the total volume of two contracted projects of SAS organizations as recipients of the NFP as of 31. 12. 2021, in the amount of EUR 5,338,855.

From this point of view, SAS and its organizations have a long-term negative feeling of a significantly reduced important source of finance for the further development of modern research infrastructure, including human resources.

I.2.4 Mobility, reintegration and other SAS support programmes

An important part of the SAS science policy is the acquisition of talented researchers from abroad. The Department of Science and Research, the Research Support Department, tries to attract experienced researchers from abroad to SAS institutes through various mobility schemes. Top foreign researchers will enrich the scientific teams, increase the involvement of SAS in international projects. Mobility and reintegration programmes make it possible to partially reverse, or at least mitigate, the phenomenon of "brain drain" from Slovakia by motivating people to return to Slovakia and offering Slovak scientists working abroad adequate conditions for work in their home country. The Department of Science and Research has expanded its portfolio of activities related to the mobility of scientific researchers.

SASPRO 2 programme

In 2021, the second year of implementation of the SASPRO 2 mobility and reintegration programme continued (<https://saspro2.sav.sk/>), co-financed by the H2020 scheme Marie Skłodowska-Curie Actions - COFUND.

SASPRO 2 is a mobility programme of the SAS and partners, the 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 programme's partners. The portfolio of host organizations includes up to 70 institutions. An important aspect of the project is to improve cooperation between the scientific and applied sectors, and to support multidisciplinary approaches to project solutions. The program 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 programme 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%.

Three calls were announced as part of the project. 40 scientists will get the opportunity within SASPRO 2 (<https://saspro2.sav.sk/>). Each of the universities will accept 10 scientists for its workplaces and the remaining 20 will work at the SAS organizations. All projects must be completed by 30. 9. 2025.

1. The first call was announced from 2. 11. 2020 to 1. 3. 2021. A total of 71 applications were received, of which 16 applications were recommended for funding. Success ratio: 22.5%. Two applicants withdrew during negotiations on the future contract.

2. The second call was announced from 3. 5. 2021 to 31. 8. 2021. 52 applications were received, of which 17 were recommended for funding. Success ratio: 32.69%.

3. The third call was published and announced from 1. 11. 2021 and will be open until 28. 2. 2022.

MoRePro programme

In the course of 2021, three scholarship projects of the SAS mobility and reintegration programme under the name MoRePro were implemented. The programme aims to attract top domestic and foreign scientists to SAS workplaces. SAS provides the three scientists who are implementing their projects with adequate and motivating conditions for their scientific work and, on the other hand, expects scholarship holders to improve the quality of the research environment and scientific outputs. Scholarship holders are future leaders who will develop research topics competitively in an international environment. The total duration of projects is a maximum of 4 years. A new call in 2021 has not been announced. Short profiles of scholarship holders are available at: <https://www.sav.sk/?lang=sk&doc=educ-morepro>.

IMPULZ programme

In the course of 2021, the first call of the IMPULZ programme was announced and evaluated, the goal of which is to improve the scientific SAS organizations through the recruitment of internationally recognized scientists, including talented young researchers, whose task is to create and manage their own research groups at the SAS. The IMPULZ programme is intended to help increase research excellence, its internationalization and competitiveness across various scientific fields in the SAS and the European Research Area, and last but not least, to gain success in obtaining prestigious European grants. As part of the first call, 31 applications were received for the IMPULZ programme (including 10 applications from Scientific Section 1, 14 from Scientific Section 2 and 7 from Scientific Section 3). As part of the two-round evaluation process, the applications were evaluated by the IMPULZ Programme Evaluation Committee composed of independent foreign evaluators.

Based on the recommendation of the Evaluation Committee, the financing of 3 projects was approved. The ratio of applications recommended for funding to the number of applications received (success ratio) in the first year was 10%. Successful projects will receive funding ranging from EUR 60,000 to EUR 160,000 per year over the next 5 years. Successful applicants must be employed at individual SAS institutes, which will ensure the financing of the project's indirect costs. In the middle of the implementation of the projects, an interim evaluation will be carried out, based on which it will be evaluated whether the project will continue to be financed. The ongoing evaluation of the project will also take into account all the project's prospects for co-financing from other external sources - such as e.g. Horizon Europe (with special emphasis on the ERC grant scheme) or another prestigious foreign grant with comparable funding as the addressed IMPULZ project.

Detailed information about the Impulz Programme is available at: <https://impulz.sav.sk/>.

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 1. 11. 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 project lasts 26 months until 31. 12. 2022. 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.

In 2021, SAS provided the SAIA project coordinator with materials for the analysis of the situation in the labour market and job opportunities in the life sciences sector in the Bratislava region, and the "Map of career opportunities and analysis of skills for non-academic career paths in the field of life sciences and biotechnology" is already available on the project's website in the *Sector map* section. Within the project, SAS representatives are active members of working groups and participate in creating the structure of a comprehensive training programme aimed to prepare PhD students for non-academic career paths in life sciences and biotechnology.

In 2021, the "Training of Trainers" activity also successfully started, in the framework of which SAS representatives are trained, and who, even after the end of the project, will provide training for doctoral students at the SAS institutes. The total project budget is approximately EUR 549,000, of which SAS will use approximately EUR 43,500 for the management of the activities planned within the project.

More information on the CARLis project is available at: <https://carlis.saia.sk/>

Euraxess_Point for the SAS

Euraxess_Point SAS carries out information and educational activities for SAS institutes to improve cooperation between Euraxess_Point SAS and SAS institutes and streamlining the process of accepting foreign researchers. Euraxess_Point for the SAS regularly communicates with SAS institutes, and provides information and consultations.

In 2021, Euraxess_Point SAS also provided information and assistance to foreign researchers and doctoral students who come to SAS or their family members (for the purpose of family reunification). The information mainly concerns the processing of visas to the Slovak Republic and temporary stay in the Slovak Republic, social security, health insurance, tax issues, or practical questions related to life in Slovakia (e.g. health care, vaccination against COVID-19, opening a bank account, etc.) Foreign researchers and doctoral students or their coordinators at the SAS institutes request information directly, or responsible tutors of these researchers. Euraxess_Point SAS is, in some cases, contacted directly by directors of institutes or administrative staff of institutes. In 2021, 245 suggestions were answered.

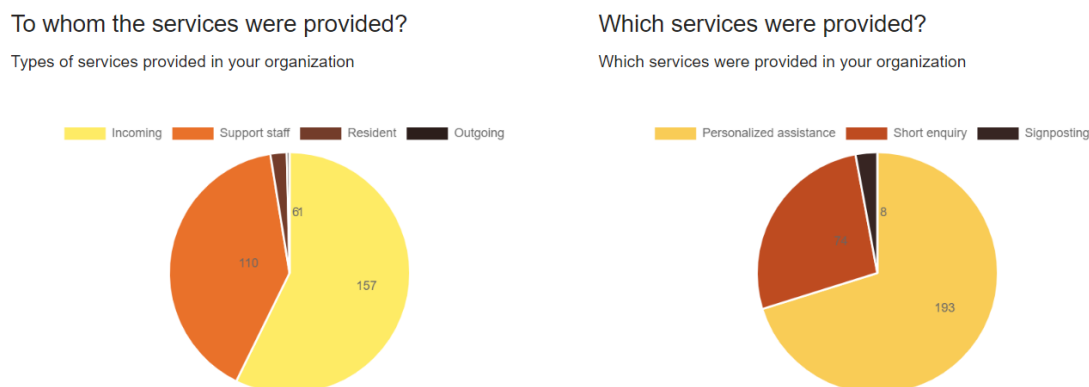
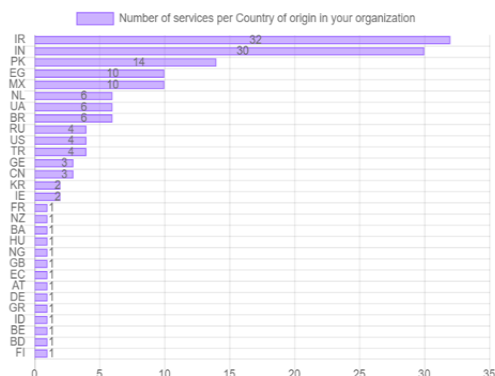


Fig. I.1: Types of services provided by Euraxess Point SAS

The most – 109 issues related to the conditions of entry to Slovakia (procurement of visas and temporary stay), 67 of them were of different focus: the possibility of vaccinating foreign researchers against COVID-19 in the Slovak Republic, questions regarding closed Slovak embassies, or the foreign police and the validity of documents, the regime at the borders upon arrival in the Slovak Republic, specific questions in concrete problematic cases that needed to be consulted with experts. There were 20 questions about health insurance and social security. There were 19 questions about the conditions for leaving the country. More practical questions mainly concerned accommodation options (11) and opening a bank account (9).

Most researchers and questions came from Iran (32), India (30), Pakistan (14). They were followed by Egypt (10) and Mexico (10) and other countries: Netherlands (6), Brazil (6), Ukraine (6), Russia (4). More male (120) researchers than female (34) researchers continued to arrive.

Country of origin



Gender

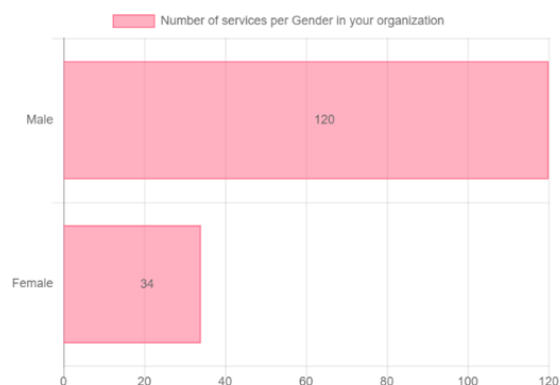


Fig. I.2 and-b: Euraxess Point SAS clients by origin and gender

As for the focus of foreign researchers, most of them came to institutes focused on chemical sciences (39), physical sciences (30) and technical sciences (15).

Research field

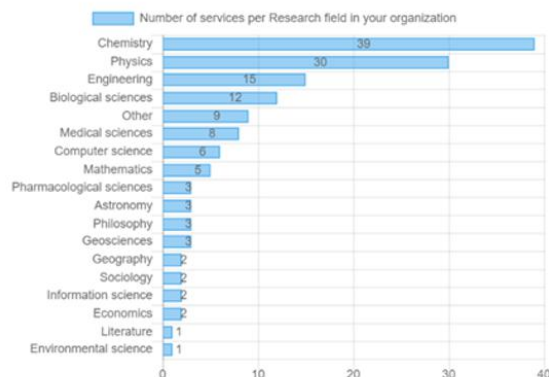


Fig. I.3: Euraxess Point SAS clients by scientific fields

Human resources strategy in research

In the course of 2021, work continued on the ongoing fulfilment of the points of the Action Plan of the Human Resources Strategy in Research (<https://www.sav.sk/?lang=sk&doc=activity-hrs4r>). In 2020, SAS became only the second scientific institution in Slovakia 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). 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 favourable environment for career development, including gender policy.

SAS Gender Equality Plan

Gender equality is one of the key values of the European Union, but the European Research Area has so far suffered a significant loss due to insufficient use of the potential of talented women. SAS, as the largest research institution in Slovakia, has the ambition to contribute to changing the long-neglected state of gender equality in science and research. In 2021, the Presidium of SAS adopted the first-ever SAS Gender Equality Plan (PRR SAV), in which the Academy critically reflects on the current state of the representation of women in its workplaces and sets the principles of gender equality. By adopting this strategic document, SAS fulfils its vision and values and ranks among modern European research institutions. In addition to the SAS Commission for Equal Opportunities, the ATHENA project's research team - Implementation of gender equality plans with the aim of supporting the research potential of research and research-funding organizations in Europe (Horizon 2020 - Institute for Research in Social Communication SAS), provided significant assistance to the Presidium of SAS in the preparation, adoption and implementation of the PRR SAV).

1.2.5 Programmes for supporting doctoral students and young researchers

Grant programme for SAS doctoral students - DoktoGrant

The Department of Science and Research of the Office of the SAS (hereinafter referred to as OVV Ú SAV), in cooperation with the member of the Presidium of SAS responsible for education and doctoral studies, prof. RNDr. Ľubica Lacinová, DrSc., ensured the implementation of the grant programme for SAS doctoral students - DoktoGrant. In June 2021, the 3rd call of the programme was announced, to support scientific projects of students of full-time doctoral studies carried out within SAS organizations. The goal of this SAS activity is to financially support high-quality project proposals that form a coherent entity within the projects solved during doctoral studies and which can be implemented within one year. At the same time, students gain valuable experience in the preparation and implementation of projects, which are necessary for their future careers and the possibility of obtaining additional grants.

By the deadline for submitting applications in August 2021, 71 applications were received - the total number of evaluated applications within the 3rd call of the SAS PhD Student Grants programme was 70 (the number of received applications by Scientific Sections: Scientific Section 1 – 15, Scientific Section 2 – 44, Scientific Section 3 – 11).

A total of 36 projects were supported in the amount of EUR 72,000 (the number of applications supported by the grant for Scientific Section 1 – 8, for Scientific Section 2 – 22, for Scientific Section 3 – 6). All projects supported by a grant in the 3rd call of the programme will be implemented by successful scholarship holders in research organizations of the SAS from 1. 1. 2022 to 31. 12. 2022.

Current calls, conditions for applicants and organizations can be found on the website of the DoktoGrant programme: <https://www.doktogrant.sav.sk/> .

SAS scholarship

The SAS Scholarship programme was created as the SAS initiative to bring to SAS workplaces excellent workers from abroad under the age of 40 who have been working abroad for a long time in the field of science and research. The effort was to strengthen SAS workplaces with people with experience from top foreign research workplaces who will contribute to the development of Slovak science in a national and international context. In August 2021, the final report of the last project under the SAS Scholarship scheme was submitted. Subsequently, in September 2021, the scholarship holder presented the results of her research at a meeting of the Presidium of SAS, which approved her final report on the project solution.

Štefan Schwarz Support Fund

OVV Ú SAV, in collaboration with a member of the P SAV responsible for doctoral studies, prof. RNDr. Ľubica Lacinová, DrSc., and the Department of Physical, Space, Earth, and Engineering Sciences ensured the implementation of the Štefan Schwarz Support fund with a new call in 2021. The SAS postdoctoral programme is intended for graduates of full-time studies from Slovakia and abroad, for whom no more than four years have passed since the defence of their dissertations. Successful applicants will receive a salary allowance for two years, with the option of extending the allowance for 1 more year.

In 2021, a new, significantly updated website of the Fund <https://schwarz.sav.sk/Shell/Home/FrontPage> and an online system was introduced, with the help of which applicants could apply from 30. 09. 2021 to 1. 10. 2021 to submit an application as part of the 2021 call. 44 applications were received by the application deadline. The number of applications evaluated for Scientific Section 1 was 12, for Scientific Section 2 - 17, for Scientific

Section 3 - 15. A total of 17 projects were supported (in the structure according to Scientific Section: 5 – 6 – 6). Successful scholarship holders will implement their project within the SAS institutes for a period of 2 years.

1.2.6 Other activities of project and support units of the Office of the SAS

In 2021, the **Institute of Strategic Analysis** continued to cooperate with international advisory and executive organizations such as the European Academies' Science Advisory Council (EASAC), the International Network for Government Science Advice (INGSA), the European Institute of Innovation & Technology (EIT), Europe's People's Forum (EPF) and others, as well as in support and advice in this area for SAS organizations.

The **Technology Transfer Office SAS** (KTT SAV) also provided complex services for SAS organizations in 2021 in the field of intellectual property protection and commercialization, transfer of research results into practice, and education and promotion of these activities. .

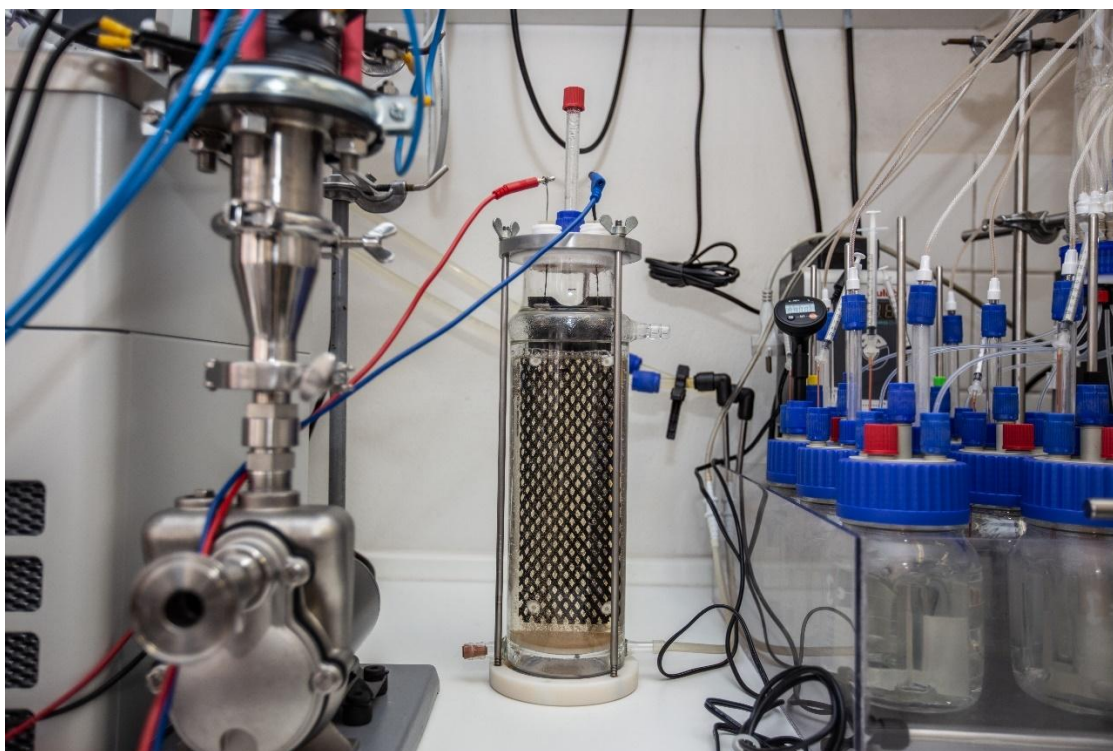
An important service provided by KTT SAV is technical and commercial evaluation in relation to the reported objects of industrial property (PPV). The technical and commercial evaluation also includes the proposal of a strategy for obtaining legal protection, market analysis, as well as other evaluation criteria. For a high-quality assessment of the fulfilment of patentability conditions, it is necessary to carry out background research on the state of technology. The background research on the state of technology is carried out by the Industrial Property Office of the Slovak Republic (UPV SR) based on a cooperation agreement between the UPV SR and SAS. In 2021, a total of 4 background research on the state of technology were developed based on this cooperation.

Within the framework of activities related to the protection of intellectual property, in 2021 the employees of KTT SAV provided cooperation in securing the services of patent attorneys, preparing national (SK) applications for protection, as well as in preparing answers to the assessments of the UPV SR, and prepared and submitted two applications on their own on the granting of a Legal Protection of Plant Varieties.

As part of activities related to the commercialization of intellectual property, KTT SAV employees approached various companies offering technologies from the SAS environment, prepared cooperation profiles and sent them to the Enterprise Europe Network database. They also covered communication with potentially interested parties, and informed about licensing opportunities through the updated KTT SAV website. The result of these activities was the preparation of drafts of two license agreements and one amendment to the concluded license agreement.

In 2021, KTT SAV staff again carried out activities related to raising awareness of technology transfer among SAS scientists in the form of professional/educational lectures (seminars/webinars), as well as activities aimed at identifying a newly created intellectual property in SAS organizations. One webinar was implemented in cooperation with the Industrial Property Office of the Slovak Republic.

Within the framework of the conceptual activities of KTT SAV, it is important to mention the provision of cooperation to members of the Presidium of SAS in connection with the preparation of the SAS Principles for the application, protection and use of industrial property rights of organizations established by the Slovak Academy of Sciences.



II. SELECTED RESULTS OF SCIENTIFIC RESEARCH

The persistent problems caused by the COVID-19 pandemic also negatively affected the conditions of scientific research in 2021, but SAS organizations, scientific teams and individuals were already better able to adapt to specific conditions and restrictions. In several cases, they even focused more on the goals resulting from the current social order related to the epidemiological situation, which naturally also activated interdisciplinary cooperation, often across the SAS Scientific Sections. These activities are also described separately in chapter no. VI of this report, some related scientific results are described in more detail in this chapter as well.

In addition to specific activities focused on the issue of COVID, the variety of research focus did not suffer either. The evidence of this is a whole series of remarkable results from the SAS institutes and scientific centres, which we present on the following pages in an arrangement according to individual Scientific Sections. A brief enumeration of more significant research in individual organizations is followed by a selection of the most significant results for 2021, with a more detailed description and the listing of publication and other outputs.

II.1 SAS in the mirror of the focus and research results of its scientific centres and institutes

The activity of the SAS scientific organizations best characterizes the focus and results of research in the given period. The following selection of results provides a certain characterization of the core SAS effort without claiming a comprehensive view.

In the area of Physical, Space, Earth, and Engineering Sciences, we can specifically mention the following results for 2021:

The **Astronomical Institute SAS** carried out photometric and spectral studies of the decay of comet C/2019 Y4 (ATLAS) in order to obtain information about the physical parameters of the cometary coma. From the obtained data, the contribution of the gaseous component to the total flow was investigated for two periods of observation.

The **Institute of Hydrology SAS** dealt with the study of historical flash floods (floods from intense summer storms) in small river-basins. A method for deriving 1000-year short-term scenario precipitation in small basins was developed. (The result is separately mentioned and described in more detail below.) As part of an international project, the Institute solved the problem of

locating unknown sources of pollution in sewage networks. The results led to the improvement of the existing model of pollution in sewage networks.

The **Centre for Advanced Materials Application SAS** studied the angular dependence of nanoscopic friction forces of atomically thin layers based on MoSe₂. The Centre also dealt with the innovative composite of titanium and magnesium as a prospective material for dental implants. The achieved results are important from the point of view of the prospective production of such implants. Within international cooperation, the relationship between the structure and physico-chemical properties of the melt electrolyte based on Na₃AlF₆-SiO₂ for the electrolytic production of Solar Grade silicon, was studied.

The problem of waste recycling using high-energy ball milling has been solved for a long time at the **Institute of Geotechnics SAS**. In 2021, the monograph Environmental Mechanochemistry was published. The text contains an overview of applications of high-energy ball milling for the processing of various types of waste. As part of the Institute's international cooperation with the Technologica company in Ukraine, the biological activity of adsorbents, biocompatibility and cytotoxicity of various materials were studied in vitro.

Amyloid diseases such as Alzheimer's or Parkinson's are currently not curable. The research team from the **Institute of Experimental Physics SAS** studied magnetic nanoparticles of various types with to determine their potential to inhibit the formation/destruction of amyloid aggregates. The Institute also conducted a series of studies focused on ferronematics – nematic liquid crystals doped with magnetic nanoparticles and their responses to external magnetic fields.

The monitoring of biological oxidation processes induced by chemical or physical stimuli is currently extremely important due to the environmental burden of various physico-chemical factors. The **Institute of Measurement Science SAS** proposed a new approach to oxidation monitoring based on biological autoluminescence. Measuring systems for automated measurement of the tilt of reactor vessels of nuclear power plants in Jaslovské Bohunice and Mochovce were further developed at the Institute and are currently in continuous operation.

The **Mathematical Institute SAS** studied the issue of spectrality in order unit spaces, which is of great importance for quantum mechanics. Important property of every mathematical model of quantum mechanics is spectrality, i.e. the existence of spectral decompositions that allow expressing effects as an integral through special elements, called projections. The Institute also proposed a new calibration model based on the linear calibration function of the comparison of two measuring devices. In cooperation with the University of Tokyo, the Institute studied the convergence of eigenvalues and eigenvectors in the block-Jacobi EVD algorithm with dynamic ordering.

The book Investigating Spoken English: A Practical Guide to Phonetics and Phonology Using Praat summarizes the long-term research of the author Štefan Beňuš from the **Institute of Informatics**

SAS in the area of investigating the acoustic and articulatory characteristics of English. These researches are oriented towards phonetic analysis using the Praat software and also apply a didactic approach with the aim of better understanding and improving English pronunciation. The Institute further implemented a study focused on global space exploration inspired by queues for system load modelling.

The properties of nickel-based composite materials can be affected by changing their microstructure, e.g. by creating a predefined porosity. The research of the **Institute of Materials and Machine Mechanics SAS** in this area dealt with a new, relatively inexpensive process for the production of Ni-Al₂O₃ composites with open porosity modified by the size of ceramic particles.

The result of the work of the group from the **Institute of Materials Research SAS** are theoretical starting points and common materials used in the preparation of fibres suitable for applications in the area of composite materials using electrospinning. The basic parameters affecting this process were characterized. The Institute further studied the properties of modified composite biocement. This could represent a simple and promising solution for patients suffering from damage to the knee joints.

The **Institute of Electrical Engineering SAS** has analyzed the applicability of high-temperature superconductors for a new particle accelerator at GSI Darmstadt, Germany. Magnetic skyrmions are topologically protected spin textures that are currently attracting considerable attention in both fundamental and applied physics. The Institute studied skyrmions created in nanodiscs produced using electron lithography and etching.

The **Institute of Physics SAS** studied the magnetic properties and structure of amorphous and nanocrystalline Fe/Co-Sn/P-B metal strips. New alloys prepared by rapid cooling of the Fe-based melt with tin content and low phosphorus substitution have good soft magnetic properties and a high value of saturation induction. As part of international cooperation, the Institute studied the influence of electronic structure and defect states on charge processes in organic polymers and perovskites.

The **Institute of Geography SAS** carried out an assessment of the impact of flood protection works on the Belá River. The Institute also mapped the development of land use in the steppe region of Russia. The project researchers identified the main causes of changes in the use of these areas since 1990. From the development trends, it can be mentioned that it was steppe grass communities that expanded in more economically backward areas and thus improved the continuity of steppe communities.

A research group from the **Earth Science Institute of the SAS** carried out the dating of boundary events and records of global environmental changes over the course of 30 million years from the end of the Cretaceous to the middle Eocene in the Western Carpathians. The Institute further studied the dependence of selected characteristics of summer atmospheric precipitation from

the ground air temperature, the position of the dew point and the thermodynamic conditions of the atmosphere before the start of rain. Knowledge of these characteristics can be used for more accurate predictions of the effects of intense precipitation in conditions of a changing climate.

The team from the **Institute of Construction and Architecture SAS** came to the important conclusion that the increase in the number of satellites, debris and the smallest particles in the Earth's orbit can contribute to the increase in the brightness of the natural background by more than 10%, which is the limit set by the International Astronomical Union for the purpose of defining conditions for an environment "infested" with light pollution. The Institute further studied the effect of flexoelectricity with a focus on the development of sensors to prevent the catastrophic destruction of special structures.

Broad-spectrum research was carried out in the scientific centres and institutes of **the Scientific Section 2**, i.e. in the field of biological, medical and chemical sciences, from which we select the following results:

The **Biomedical Research Center SAS** studied the activation of neuroprotective phenotypes at the site of a traumatic spinal cord injury, which are crucial for the spontaneous recovery of the function of paralyzed limbs. The Biomedical Research Center SAS further addressed the issue of sequencing SARS-CoV-2 variants and the related development of sensitive diagnostic tests. Several seroepidemiological studies were also carried out, one of which was monitoring the level of antibodies against the S protein of the SARS-CoV-2 virus among SAS employees.

The **Centre of Experimental Medicine SAS** looked at the process in which the SARS-CoV-2 virus infects host cells through the ACE 2 (angiotensin converting enzyme 2) receptor, thereby simultaneously blocking the physiological effects mediated by it. The study revealed a complex effect of ACE2 inhibition with several negative and partially positive effects. The results obtained in other CEM studies have significantly contributed to the understanding of the mechanisms of cardioprotection against ischemia-reperfusion damage to the heart and identified the possibilities of new cardioprotective interventions.

In international cooperation, the **Institute of Neuroimmunology SAS** has intensively addressed the issue of repeated head impacts (RHI), which are common among young athletes who engage in contact sports. Unlike concussions, they are considered blows to the head that usually do not result in acute symptoms and are, therefore, also referred to as "subconcussive" head impacts. REPIMPACT is a multicentre longitudinal study aimed at researching the effects of RHI in the category of competitive youth football players and non-contact sports control subjects aged 14 to 16 years. The study aims to characterize the consequences of RHI on behaviour (i.e. cognition and motor function), clinical consequences (i.e. psychiatric and neurological symptoms), brain

structure and function, diffusion and biochemistry, as well as biomarkers of molecular processes associated with RHI.

In the **Centre of Biosciences SAS**, among other things, they focused on the characterization of the evolutionary process leading to the splicing of mutually exclusive exons (MXE) in the 2-oxoglutarate dehydrogenase (*OGDH*) gene, which enabled the creation of a critical regulatory point of Krebs cycle activity as a driving force of central metabolic conversion in evolution of animals. They monitored the organization and structural requirements of the intron splice sites dividing MXE exons 4a and 4b in the context of competitive and cooperative interactions of poly(U) RNA-binding proteins. The results of this study provide new insight into the regulation of MXE splicing, which affects the activation of the OGDH complex and the supply of NADH and ATP in response to mitochondrial calcium.

At the **Institute of Chemistry SAS**, they studied the possibilities of using glycan analysis in the diagnosis of several cancer diseases. They summarized the advantages and disadvantages of different types of biomarkers for the diagnosis of prostate cancer, including protein glycoprofiling. In addition, PSA (prostate-specific antigen) specific glycoprofiling has been used for early diagnosis of the disease, as well as to identify patients with a certain subtype of this disease. The analysis of glycans in the sera of patients with colorectal cancer and healthy people shows that glycans can be not only an indicator of the biological age of people, but also a biomarker for the diagnosis of colorectal cancer.

Institute of Inorganic Chemistry SAS. An important group of materials based on layered silicates are hybrid inorganic-organic materials, in which various organic dyes are the functional component. Various interactions and phenomena take place between the components, which required extensive research and in-depth analysis of experimental data. It was possible to reveal the mechanisms of interactions of organic dyes with layered silicates, which helped clarify the occurrence of some phenomena, such as formation of molecular aggregates and decrease in photoactivity. Various strategies have been developed for the preparation of hybrid solids in order to preserve the photoactivity of the dyes as much as possible. By optimizing synthesis parameters, it was possible to prepare polymer composites with significant antimicrobial properties, in which the photosensitizer phloxine B appeared as an important antimicrobial component.

Excessive use of synthetic compounds with antimicrobial activity has led to the selection of resistant microorganisms. A new and significant strategy to overcome this problem could be the use of plant essential oils (EOs) with antimicrobial activity encapsulated in ecological nanosystems. In an international collaboration, the staff of the **Institute of Molecular Biology** proved that EOs of the chemotype carvacrol from *Thymus capitatus* and the chemotype thymol and carvacrol from *Origanum vulgare* encapsulated in biocompatible poly(ϵ -caprolactone) nanocapsules (NC) showed antibacterial, antifungal and antibiofilm activities against

Staphylococcus aureus, *Escherichia coli* and *Candida albicans*. EO nanosuspensions were also tested against a panel of fourteen fungal strains belonging to *Ascomycota* and *Basidiomycota* phyla.

Polymer Institute SAS. Gradient and block copolymers are effective surfactants capable of encapsulating a significant amount of water-insoluble drugs. Gradient copolymers were prepared by one-step random cationic copolymerization of 2-ethyl-2-oxazoline with different 2-(4-alkyloxyphenyl)-2-oxazolines due to different polymerization rates of the given monomers. The prepared copolymers were used for the encapsulation of hypericin, which is an effective photosensitizer for photodynamic therapy of various cancer diseases. Effective penetration of nanoparticles into cancer cells and subsequently their effective photodynamic activity was demonstrated.

Institute of Zoology SAS. Methyl farnesoate (MF) has a hormonal regulatory role in crustaceans. The epoxidized form of MF, known as juvenile hormone (JH), controls metamorphosis and stimulates insect reproduction. Thanks to international cooperation, it was shown that mosquito larvae prepared without both MF and JH died at the beginning of metamorphosis. Remarkably, however, prepared epox^{2/2} mosquito mutants that synthesized MF but not JH completed the entire life cycle. While epox^{2/2} adults were fertile, the reproductive performance of both sexes was dramatically reduced. These results suggest that although MF can compensate for the absence of JH in mosquitoes, this is at a significant fitness cost. It is thought that MF could perform most of the functions of JH, but its epoxidation to JH was the key innovation giving the insect a reproductive advantage.

Scientists from the **Plant Science and Biodiversity Center SAS**, who have been engaged in vegetation research for a long time, and mathematicians from the STU Faculty of Civil Engineering, who have many years of experience in satellite image processing, combined knowledge from mathematics, computer modelling, botany and data from the European Space Agency's Sentinel-2 satellite. agency (ESA) to create the NaturaSat software for mapping Natura 2000 habitats. The newly created software makes it possible to precisely locate and classify Natura 2000 habitats and continuously monitor their dynamics with the possibility of immediate detection of sudden changes. In Slovakia, 642 territories of European importance are included in the Natura 2000 system, and biotopes of European importance are also found outside them. NaturaSat software can replace the slow and error-prone mapping of habitats in the field with the accurate and fast work of algorithms. It supports the use of Sentinel-2 multispectral data with different vegetation databases in a user-optimized environment, for example, for vegetation scientists, field experts and conservationists.

Institute of Parasitology SAS. A comprehensive study of non-segmented tapeworms of the Caryophyllidea order, the basal group of the so-called true tapeworms (Eucestoda), covers the long-term efforts of an international team, which, based on molecular-phylogenetic and

morphological analyzes of representatives of this order (63 species belonging to 32 genera), proposed a natural classification at the level of families. For the valid genera of the newly defined families (Balanotaeniidae, Capingentidae, Caryophyllaeidae, Lytocestidae), data on their geographical distribution and host range were summarized, and a new identification key was developed.

Institute of Forest Ecology SAS. Based on international cooperation (Great Britain, the Czech Republic, the Slovak Republic, Italy, Belgium, Portugal), an electronic application (smartphone) was developed for the identification and recording of the occurrence of ladybugs with the involvement of the public (citizen science). The application will enable a better understanding of the distribution and ecology of ladybugs across Europe. The mass occurrence of the eastern ladybug (*Harmonia axyridis*) in the urban environment, where its development takes place faster, also contributed to the increase of public interest in ladybugs, which contributes to its successful colonization of the urban environment. The public can thus become more familiar with the distribution, temporal occurrence, ecology and importance of ladybugs in various ecosystems.

Institute of Landscape Ecology SAS. The concept of green infrastructure is implemented in Slovakia in the form of the concept of the Territorial System of Ecological Stability (ÚSES), which represents a spatial structure of interconnected ecosystems, their components and elements, which ensures the diversity of conditions and forms of life in the country. ÚSES consists of two basic parts: Skeleton of ÚSES (biocentres, biocorridors, interaction elements) and a set of ecostabilization measures. The Institute was the guarantor of the processing of the updated methodology of local territorial systems of ecological stability (MÚSES) and participated in the development of a tool for the automated creation of MÚSES. The newly created tool represents a comprehensive basis for an integrated solution of landscape greening, water retention in the landscape, anti-erosion, anti-accumulation and anti-flood measures, as well as spatial stabilization measures.

In 2021, the results of the institutes of **Scientific Section 3** were also fruitful, and the share of foreign language publications increased significantly. A positive shift can also be observed from the point of view of the interdisciplinarity of research - in many cases also in relation to natural science, medicine and technical disciplines.

Scientists from the **Institute of Archaeology SAS** continued their research of the rich early medieval centre of power Bojná and, using modern prospecting methods (LIDAR, aerial photography), they discovered previously unknown burial grounds. Archaeologists also managed to examine several Bronze Age burial grounds from various locations in Slovakia, which are a valuable source of information about demography, social stratification of the population,

religious ideas and rituals associated with them, but also about the craftsmanship and business contacts of the communities living in our territory.

The traditionally rich monographic production of the **Institute of History SAS** has brought modern biographies of Milan Rastislav Štefánik in Slovak and English editions, which reflect the current methodological trends of European historiography, and are readable and attractive even for ordinary readers. The author's works were also appreciated by the President of the Slovak Republic, Zuzana Čaputová. Project "From denarius to euro: phenomenon of money in the history of Slovakia, from Middle Ages up to present day" has enriched the until recently neglected area of economic history with several interesting scientific studies and monographs focused on, for example, the fate of monetary gold reserves from interwar Czechoslovakia, on the unprocessed history of trade and economic relations between Slovakia and Germany in the years 1939-1945 and more. The Department of Architecture continued to expand the Register of Modern Architecture in Slovakia. The result of the Institute's international cooperation is a monograph on the phenomenon of Czechoslovakism (see also in more detail).

From the work of the **Institute of Ethnology and Social Anthropology SAS**, we can highlight the continuation of research into various forms of religiosity, which resulted in a monograph on Marian devotion among the Roma in Slovakia, published in English by the prestigious Palgrave Macmillan publishing house. (more detailed information below). The monograph "Ethnography in Slovakia at the Service of the Third Reich" is also noteworthy, which is a contribution to the discussion of the institutional and personal forms of ideological use of ethnography and related nationalistic disciplines by Nazi Germany in its foreign policy plans.

Even with a small number of researchers, the **Institute of Oriental Studies SAS** has a relatively varied focus. In 2021, there was a strong representation of various issues with an orientation to Egypt - from contemporary Egyptian literature to detailed research of an ancient Egyptian coffin in the Slovak National Museum in Bratislava to archaeological research by an international team in Egypt itself, in which the Institute participates.

Among the most significant scientific outputs of the **Institute of Philosophy SAS** for 2021 is a new monograph on Hegel's influence on 19th-century thought (Cambridge University Press), awarded by the Association of American Publishers (AAP) as part of the prestigious international Prose Award competition as the best book of the year in the field of philosophy (more information below). The result of the Institute's international cooperation is a collective monograph analyzing the topic of the crisis of symbolic forms within the philosophical-anthropological discourse (P. Šajda et al.), as well as a special issue of the journal *Organon F* devoted to the issue of evaluative judgments in natural language.

Teams and individuals from the **Institute for Sociology SAS** addressed a wide range of social phenomena and current events: the consequences of student mobility, the living conditions of

Slovak au pairs, the suburbanization of Bratislava, conspiracy theories, "gamification" in the financial sector, etc. Special mention should be made of research focusing on society during the COVID-19 pandemic, e.g. research programme called How are you, Slovakia? (read below for more detail). The historical topic of the role of evangelicals in the construction of national identity over the last two centuries, solved from the point of view of a sociologist, or the methodological work solving the issue of creating a grounded theory in qualitative research (Grounded Theory approach) in comparison with other methodologies also deserve attention.

The **Institute for Research in Social Communication SAS** also participated in the research program "How are you, Slovakia?", primarily in the form of research into changes in the quality of life, partner relationships, the psychological state of individuals, etc. during the pandemic. Another research team from the Institute participated in the preparation of the SAS Gender Equality Plan, among other things, based on an audit from the Academy's setting. The Institute also continued research into the issue of Roma inclusion, preparation of educational programmes, especially for pre-primary level, etc.

A number of socially relevant topics can also be found among the results of the **Centre of Social and Psychological Sciences SAS**. From the field of psychology, these are, for example, the issue of the connection between the feeling of anxiety, loss of control and subjection to conspiracy theories, the issue of mental well-being and maintaining the meaning of life during the transition to retirement, emotionally demanding situations in the work of paramedics, strategies for managing a pandemic situation and more. From the field of sociology, these include, e.g. mortality, health status and perception of one's own health in Roma communities in Slovakia, investigation of populist attitudes, connections of the pandemic situation with health, especially psychological status, etc. Several works concerned the Košice Roma residential district Luník IX in Košice in an original way based on multidisciplinary research.

The topic of the pandemic also occupied the minds of experts from the **Institute of Economic Research SAS**. In their edition on the economic development of Slovakia, the topic "How the coronavirus crisis is changing the country's economy" was covered. At the Institute, however, they also dealt with issues of predicting price fluctuations of traded assets, the issue of illegitimate capital flows in European countries, the social and economic consequences of migration between Belarus, Poland, Slovakia and the Czech Republic, the connections between labour productivity and the minimum wages, etc. Experts from the Institute participated in the creation of an international database on occupations and skills, which was designed with the intention of improving the mobility conditions of professionals, but also refugees in Europe.

Monographs on the formal characteristics of law, on the legal context of professional sports, on the right to a fair trial, on constitutional law in the Slovak Republic and others dominated the outputs of the **Institute of State and Law SAS**. Commentaries on the Press Act, the Advertising Act and others were also issued.

From the works of the **Institute of Political Sciences SAS**, we can mention mainly book publications about the origin of Czechoslovakia and the process leading to its division and the creation of the independent Slovak Republic in 1993.

Experts from the **Art Research Centre of SAS** were interested in, for example, the topic of the three kings in art in Slovakia, television drama production in the early 90s, but also the past, present and perspectives of cultural and artistic transfer in the field of theatre and music within the framework of international projects.

The **Institute of Musicology SAS** has prepared a monograph for publication, which contains a set of studies and an anthology of the musical repertoire for the Epiphany holiday from the territory of Slovakia, covering the period from the Middle Ages to the 20th century. Authors from the Institute also addressed the issue of the song culture of the Slovak enclave in Serbia, forms of piety in medieval manuscript sources and other topics. In cooperation with the Institute of Chemistry SAS and the Institute of Molecular Biology SAS, the Institute succeeded in patenting a special bio-preparation that is successfully used in the restoration of wooden organ pipes (more details in the selection).

In the **Ludovít Štúr Institute of Linguistics SAS**, dictionary creation has successfully progressed, resulting in the publication of the 4th volume of the Dictionary of the Contemporary Slovak Language (read further for more details)

and the 3rd volume of the Slovak Dialect Dictionary. These works were already prepared with the wide use of modern methods of corpus linguistics and other tools of computer lexicography. The Institute has prepared for publication the 2nd volume of Fándly's work *Pilní domajší a poľní hospodár* (The Diligent Householder and Farmer), some parts of which have been preserved only in manuscript and were published for the first time.

The **Jan Stanislav Institute of Slavistics SAS** continued the tradition of publishing source editions - in 2021, it was the manuscript of Bradačová's Handbook of Church History from the end of the 18th century. Authors from the Institute also worked on a new translation of Luke's Gospel and on a monograph that examines various aspects of theocracy.

The **Institute of Slovak Literature SAS** published papers on cognitive literary science, literary representations and narratives, the depiction of the countryside in the literature of Central Europe, the transformations of Czech and Slovak literature after 1989, the critical writings of Alexander Matuška from the 1930s, literary representations of Bratislava after 1918 and also worked on a number of other topics. An interesting output is also the reconstruction of the collection of Vojtech Mihálik's work *Rose*, including a digital edition of the work.

From the scientific works of the **Institute of World Literature SAS**, we can mention the monothematic issues of the magazine *World Literature Studies* (posthuman themes, Location of

utopia, Historiography and translation, Interdiscursive construction of literature), but also a monograph on the reception of French writers Emile Zola, Gustav Flaubert, Guy de Maupassant in Slovak culture. The monograph of Dominik Tatarka's Yesterday and Today (Paris 1939 – 2019) was published in French as a result of the Institute's international cooperation.

In 2021, the expected 9th volume of Encyclopaedia Beliana was also published, which was prepared by the editorial team of the **Encyclopaedic Institute of SAS**, the printing was carried out by Veda, the SAS publishing house - both civil society organizations of Centre of Operations SAS. The encyclopaedia also has an electronic version available at: <https://beliana.sav.sk/> .



II.2 Selection of the most significant results

II.2.1 Results based on basic research

Scientific Section 1 (Physical, Space, Earth, and Engineering Sciences)

Wind mass transfer in S-type symbiotic binaries: III. Confirmation of a wind focusing in EG Andromedae from the nebular [OIII] lambda5007 line

Astronomical Institute SAS

Solvers: Natalia Shagatova, Augustín Skopal, Sergey Shugarov, Richard Komžík, Emil Kundra

Projects: VEGA 2/0008/17, APVV-15-0458

The density distribution of the stellar wind lost by the red giant affects how much of its mass is transferred to the white dwarf and thus the further development of the symbiotic binary star. The work used spectra obtained at the observatories at Skalnaté Pleso and Stará Lesná, as well as from the ARAS (Astronomical Ring for Access to Spectroscopy) database, covering five orbital cycles of the calm symbiotic star EG Andromedae. This allowed us to analyze periodic changes in the radiation flux and radial velocities of the individual components of the H-alpha and [OIII] lambda 5007 spectral lines. They showed an asymmetric distribution of matter in the region of the orbit and a less dense environment around the poles of the red giant, characterized by up to two orders of magnitude lower mass outflow than was determined in the plane of the orbit. This result independently confirms the finding that the circumstellar mass in EG Andromedae is concentrated towards the orbit of the binary components. This work was included among the "Highlight" articles in the Astronomy and Astrophysics journal (<https://www.aanda.org/2021-highlights>).

SHAGATOVA, Natalia - SKOPAL, Augustín - SHUGAROV, Sergey - KOMŽÍK, Richard - KUNDRA, Emil - TEYSSIER, Francois. Wind mass transfer in S-type symbiotic binaries : III. Confirmation of a wind focusing in EG Andromedae from the nebular [O_iii] lambda5007 line. In *Astronomy and Astrophysics*, 2021, vol. 646, article no. A116, p. 1-10. (2020: 5.802 - IF, Q1 - JCR, 2.137 - SJR, Q1 - SJR, karentované - CCC). (2021 - Current Contents, WOS, SCOPUS, NASA ADS). ISSN 0004-6361.

Study of hybrid organic-inorganic and organic layers for photovoltaics

and other optoelectronic applications

Institute of Physics SAS

Solvers: N. Mrkývková, P. Šiffalovič, K. Gmucová, V. Nádaždy, V. Held, A. Brunová, P. Nádaždy, K. Végső, E. Majková, M. Jergel

Hybrid organic-inorganic layers with a perovskite structure are intensively studied for their unique optoelectronic properties and high photoconversion efficiency. In connection with the low price and simple preparation, they are an advantageous alternative to traditional photovoltaics based on crystalline silicon. However, their properties degrade very quickly due to the formation of defects during the crystallization of the perovskite layer from the precursor solution. In order to optimize the preparation of the perovskite layer, in the first part of the proposal, we studied the kinetics of crystallization, the formation of defects and their influence on photoconversion using the in-situ GIWAXS method and real-time luminescence measurements, which were supplemented by ex-situ methods and molecular dynamics simulations. We have shown the positive effect of the underlying 2D layer, such as graphene, on the growth of a strongly textured 2D perovskite layer [1], and we achieved a similar effect with a suitable precursor admixture [2].

We detected the fundamental influence of grain boundaries as defect centres for non-radiative recombination in 3D perovskite [3]. We found a narrow time window for the pulsed laser annealing of the perovskite layer by the FIRA method [4], which opens up the possibility of continuous preparation of solar cells by the "roll-to-roll" method. In the area of organic molecular layers (the second part of the proposal), we focused on the correlation of structure and optoelectronic properties, where the orientation of molecules plays a key role. We studied the relationship between molecular and electronic structure on layers of different stereo-isomers of selected polymers using GIWAXS and ER-EIS methods and, in combination with DFT simulations, we clarified how the spatial chemical structure of the molecule affects the properties of the layer [5]. We specifically engaged in the study of orientational defects in uniformly oriented molecular layers using the SNOM method and proved that only the optical amplitude and not the phase of the scattered IR radiation provides an undistorted topography of the defects [6]. Using the methods of UV-vis spectroscopy, photoluminescence and ER-EIS supported by DFT simulations, we studied new derivatives of selected organic semiconductors in terms of their suitability for optoelectronic and photovoltaic applications [7, 8]. We summarized the influence of the arrangement of organic conjugated molecules in donor-acceptor copolymers on the functionality of the photonic element in a review article [9].

P. KOVAŘÍČEK, P. NÁDAŽDY, E. PLUHÁROVÁ, A. BRUNOVÁ, R. SUBAIR, K. VÉGSŐ, V.L.P. GUERRA, O. VOLOCHANSKYI, M. KALBAC, A. KRASNANSKY, P. PANDIT, S.V. ROTH, A. HINDERHOFER, E. MAJKOVÁ, M.

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X-ray microtomography methods in 3D imaging

Institute of Measurement Science SAS

Solver: M. Hain

Projects: VEGA 1/0228/19, COST CA 17121, COST CA 16101, VEGA 1/0191/21, APVV-14-0719

High-resolution X-ray microtomography measurement methods have been used in three-dimensional imaging in materials research, biology and palaeontology.

In the non-destructive imaging and characterization of the properties of new materials and technologies of additive manufacturing using 3D printing, microtomography was used in cooperation with FCHPT STU to research the repeatability and reliability of 3D printing in the

additive manufacturing of objects from high-density aluminium oxide ceramics. The methods enabled a non-destructive and accurate evaluation of changes in ceramic objects in the process of additive manufacturing after the application of individual technological operations – the appearance of cracks, deformations and dimensional changes. The results were published in the prestigious Additive Manufacturing journal (Q1, D1) [1].

In cooperation with EIÚ SAV, the longitudinal homogeneity of wires made of MgB₂ superconductors produced by the process of internal diffusion of magnesium was studied using microtomographic measurement methods. The results were published in the prestigious Superconductor Science and Technology journal (Q1, D1) [2].

As part of the long-term cooperation with PriF UK, x-ray microtomography methods were used in the study of palaeontological findings from the late Carboniferous period, specifically in three-dimensional imaging of the morphological structures of the skull and inner ear of the four-legged reptile *Limnoscelis dynatis*. The results were published in the prestigious *Frontiers in Ecology and Evolution* journal (Q1, D1) [3].

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[2] KOVÁČ, P. – HUŠEK, I. – HAIN, Miroslav – KOPERA, L. – MELIŠEK, T. – BEREK, D. Longitudinal uniformity of MgB₂ wires made by an internal magnesium diffusion process. In *Superconductor Science and Technology*, 2021, vol. 34, art. no. 095007. ISSN 0953-2048. (3.219 – IF2020) Q1, D1

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Scientific Section 2 (Life, Chemical, Medical, and Environmental Sciences)

Activities aimed at fighting the COVID-19 pandemic

Institute of Virology of BMC SAS

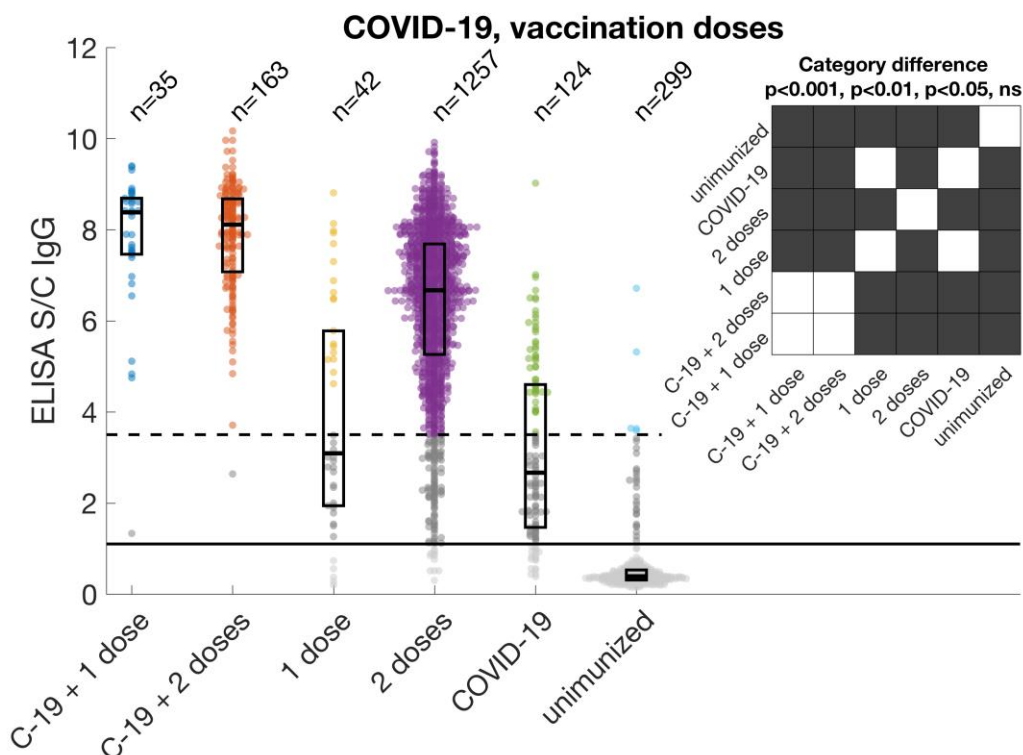
Solvers: Kristína Boršová, Veronika Vaňová, Viktória Čabanová, Monika Sláviková, Martina Ličková, Sabína Fumačová Havlíková, Boris Klempa, Ľubomíra Lukáčiková, Ivana

Kajanová, Lenka Jelenská, Katarína Grossmanová, Žofia Rádiková, Miroslav Vlček,
Juraj Kopáček, Silvia Pastoreková

Projects: APVV-PP-COVID-20-0017, APVV-PP-COVID-20-0116, H2020 EVA-GLOBAL

The sequencing of SARS-CoV-2 variants brought not only significant help in solving the ongoing COVID-19 pandemic for the government authorities involved, but also important scientific results. Our team started participating in sequencing using Oxford nanopore technology already in the summer of 2020. At the beginning of 2021, the B.1.1.7 variant became dominant in Slovakia. This variant, meanwhile named the alpha variant, has been classified as a variant of concern by the WHO due to increasing infectivity, mortality and uncertainty about the effectiveness of vaccines. Based on this, there was a request to create a sensitive diagnostic RT-qPCR test. In cooperation with MultiplexDX, a new RT-qPCR rTEST COVID-19 qPCR B.1.1.7 test kit was developed and validated. Its suitability was also tested during nationwide testing on 6,886 positive samples. Thanks to the use of this test, an 82 percent prevalence of the alpha variant was revealed. During the year, we also detected beta, delta and, most recently, omicron variants. In addition, we also continued isolation experiments to obtain new virus isolates to be placed in the virus archive, as well as in the form of infectivity tests for the needs of clinical workplaces.

During 2021, testing of the level of antibodies against the SARS-CoV-2 virus in dry capillary blood obtained by sampling from a finger was introduced at the BMC SAV Institute of Virology. This was preceded by several steps: comparison of available tests from several manufacturers, internal validation of the selected ELISA test, testing of antibody levels in serum and plasma samples, mathematical analysis of semi-quantitative results obtained and the kinetics of antibody formation after vaccination, introduction of own methodology for collection and initial processing of dry blood samples, as well as a mutual comparison of the results obtained from sera and dried blood. Since the introduction of this method, it has been successfully used in several large-scale seroepidemiological studies. The first of them was a study aimed at monitoring the level of antibodies against the S protein of the SARS-CoV-2 virus in SAS employees. More than 1,900 participants voluntarily participated in the study in two rounds, and its results were published in the Acta Virologica journal. The study clearly confirmed that the level of antibodies after overcoming the disease is demonstrably lower than after full vaccination and that vaccination, even after overcoming the disease, brings a significant benefit in the form of high levels of antibodies (see figure). Another study was conducted under the auspices of the Ministry of Health of the Slovak Republic in cooperation with several faculties of the Comenius University and the Faculty of Medicine of Pavol Jozef Šafárik in Košice. The results of the analysis of almost 4,000 samples of unvaccinated participants in the study conducted at BMC SAV helped to get an idea of the current seroepidemiological situation in individual regions in Slovakia.



Relative antibody levels in humans after overcoming COVID-19 and/or vaccination.

The participants of the study are divided according to the overcoming of the disease and the number of doses of the vaccine, regardless of the type of vaccine.

BREJOVÁ, Broňa – BORŠOVÁ, Kristína – HODOROVÁ, Viktória – ČABANOVÁ, Viktória – GAFUROV, Askar – FRIČOVÁ, Dominika – VINAŘ, Tomáš – KLEMPA, Boris – NOSEK, Jozef. Nanopore Sequencing of SARS-CoV-2: Comparison of Short and Long PCR-tiling Amplicon Protocols. In *PLoS ONE*, 2021, vol. 16, iss. 10, art. no. e0259277. (2020: 3.240 - IF, Q2 - JCR, 0.990 - SJR, Q1 - SJR). ISSN 1932-6203. Available at: <https://doi.org/10.1371/journal.pone.0259277>

BORŠOVÁ, Kristína – PAUL, D. – KOVÁČOVÁ, Viera – RADVÁNSZKA, Monika – HAJDU, Roman – ČABANOVÁ, Viktória – SLÁVIKOVÁ, Monika – LÍČKOVÁ, Martina – LUKÁČIKOVÁ, Ľubomíra – BELÁK, Andrej – ROUSSIER, Lucia – KOSTIČOVÁ, Michaela – LÍŠKOVÁ, A. – MAĎAROVÁ, L. – ŠTEFKOVIČOVÁ, Mária – REIZIGOVÁ, Lenka – NOVÁKOVÁ, Elena – SABAKA, P. – KOŠČÁLOVÁ, Alena – BREJOVÁ, Broňa – STAROŇOVÁ, Edita – MIŠÍK, Matej – VINAŘ, Tomáš – NOSEK, Jozef – ČEKAN, Pavol – KLEMPA, Boris. Surveillance of SARS-CoV-2 lineage B.1.1.7 in Slovakia using a novel, multiplexed RT-qPCR assay. In *Scientific Reports*, 2021, vol. 11, no. 1, art. no. 20494. (2020: 4.380 - IF, Q1 - JCR, 1.240 - SJR, Q1 - SJR, karentované - CCC). (2021 - Current Contents, WOS, SCOPUS). ISSN 2045-2322. Available at: <https://doi.org/10.1038/s41598-021-99661-7>

BREJOVÁ, Broňa – BORŠOVÁ, Kristína – HODOROVÁ, Viktória – ČABANOVÁ, Viktória – REIZIGOVÁ, Lenka – PAUL, D. – ČEKAN, Pavol – KLEMPA, Boris – NOSEK, Jozef – VINAŘ, Tomáš. A SARS-CoV-2 mutant from B.1.258 lineage with $\Delta H69/\Delta V70$ deletion in the Spike protein circulating in Central Europe in the fall 2020. In *Virus Genes*, 2021, vol. 57, no. 6, p. 556–560. (2020: 2.332 - IF, Q3 - JCR, 0.642 - SJR, Q2 - SJR, karentované - CCC). (2021 – Current Contents). ISSN 0920-8569. Available at: <https://doi.org/10.1007/s11262-021-01866-5>

KAJANOVÁ, Ivana – LUKÁČIKOVÁ, Ľubomíra – JELENSKÁ, Lenka – GROSSMANOVÁ, Katarína – RÁDIKOVÁ, Žofia – VLČEK, Miroslav – KLEMPA, Boris – KOLLÁR, Richard – BODOVÁ, Katarína – KOPÁČEK, Juraj – PASTOREKOVÁ, Silvia. Seroprevalence of SARS-CoV-2 IgG antibodies in the staff of the Slovak Academy of Sciences in response to COVID-19 and/or vaccination: situation in August 2021. In *Acta Virologica*, 2021, vol. 65, no. 4, p. 420-432. (2020: 1.162 - IF, Q4 - JCR, 0.412 - SJR, Q3 - SJR, karentované - CCC). (2021 – Current Contents). ISSN 0001- 723X. Available at: <https://doi.org/10.1038/s42255-021-00489-2>

Transcriptomic analysis of human brain microvascular endothelial cells exposed to laminin binding protein (adhesion lipoprotein) and *Streptococcus pneumoniae*

Institute of Neuroimmunology SAS

Solvers: Petra Majerová, Mangesh Bhide

Streptococcus pneumoniae is a neuroinvasive bacterium that causes central nervous system (CNS) infections. During neuroinvasion, various signalling pathways are triggered by human brain microvascular endothelial cells (hBMECs) affecting pathogen translocation across the blood-brain barrier (BBB). The picture of activated biological processes and signalling pathways has not yet been comprehensively mapped. As part of our study, we monitored the response of hBMECs exposed either to live pneumococci or to their surface adhesion – laminin-binding protein (Lbp). Lbp was recently identified as a potential hBMEC-interacting ligand. Transcriptomic analysis of three biological replicates of pathogen- and ligand-induced hBMECs was performed using an innovative RNA sequencing technique. We found that cells treated with *S. pneumoniae* regulated 350 differentially expressed genes (DEGs), while Lbp stimulated 443 DEGs. Of the total number of expressed genes, 231 were common to both samples. Differential gene expression of the induced cells was determined based on the gene expression profile of the negative control. The next step of the analysis was the determination of the induced biological processes. Using integrative functional analysis, we found that hBMECs activated cytokine, chemokine, and TNF signalling pathways. Processes leading to the formation of phagosomes were also stimulated. A surprising finding was that Lbp induced senescence, disruption of cell integrity, and remodelling of the extracellular matrix. The results show that the Lbp studied by us is an important adhesin with a significant role in the process of translocation and neuroinvasion of pneumococci. This study is the first of its kind to provide a complete picture of the activated signalling pathways in hBMECs after their induction by *S. pneumoniae* and Lbp.

The obtained data contribute to the expansion of knowledge about the processes of bacterial neuroinvasion and point to the significant influence of Lbp adhesin during neuropathogenesis.

Irene JIMÉNEZ-MUNGUÍA, Zuzana TOMEČKOVÁ, Evelína MOCHNÁČOVÁ, Katarína BHIDE, Petra MAJEROVÁ & Mangesh BHIDE. Transcriptomic analysis of human brain microvascular endothelial cells exposed to laminin binding protein (adhesion lipoprotein) and *Streptococcus pneumoniae*. *Sci Rep* 11, 7970 (2021). IF 4.379

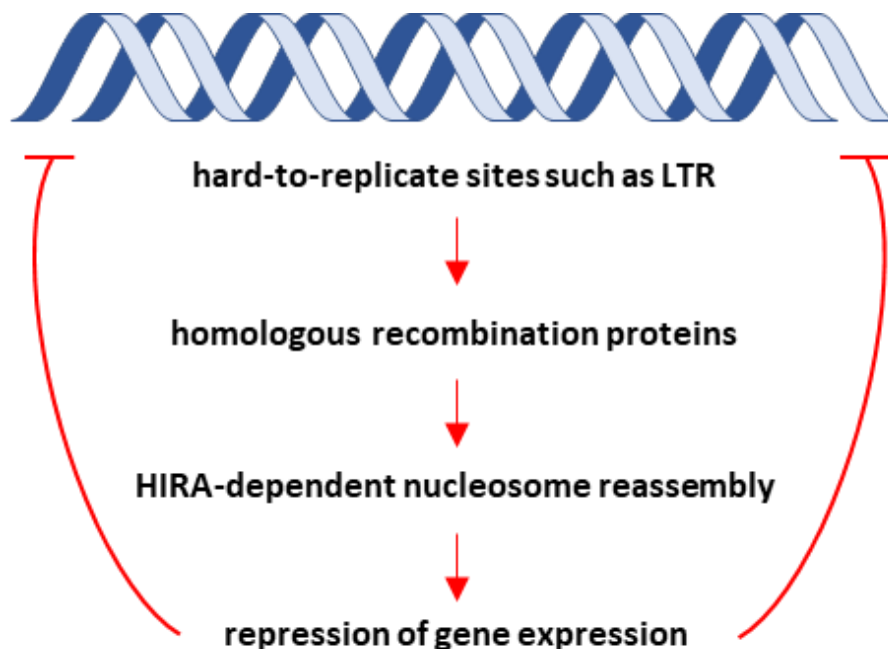
Repression of a large number of genes requires interplay between homologous recombination and HIRA

Centre of Biosciences SAS, Biomedical Research Center SAS

Solvers: Silvia Bágeľová Poláková, Alexandra Piteľová, Ivana Mišová, Karolína Pichlerová, Zsigmond Benkő (ÚBGŽ CBv SAV), Ľuboš Čipák (BMC SAV)

Projects: APVV-18-0219, APVV-17-0130, APVV-16-0120, VEGA 2/0034/19, VEGA 1/0013/20, VEGA 1/0048/16, VEGA 2/0026/18, VEGA 1/0450/18, VEGA 2/0039/19

In the course of evolution, eukaryotes have developed two pathways responsible for the repair of double-strand breaks during mitotic cell division: non-homologous end joining and homologous recombination (HR). Our latest research showed that in *S. pombe* yeast with deletion of HR genes, there is an increase in the expression of more than 500 loci, especially in the area of subtelomeres, antisense transcripts and LTR retrotransposons, which represent the so-called mobile repetitive elements. A comparison of the expression profiles showed that HR proteins repress the expression of the same genes as the histone chaperone complex HIRA. Interestingly, the absence of HR proteins can restore the correct level of expression in the centromere region, which is altered in HIRA mutants. In this publication, we provide evidence for the first time of a link between the homologous recombination pathway, gene expression, and the histone chaperone complex HIRA, which until recently was mainly associated with post-transcriptional nucleosome storage or silencing of retrotransposon activity. Our research is also important from a medical point of view. For example, the histone chaperone complex HIRA is involved in the activation of the immune response against various types of viruses, and DNA repair, as well as switching genes on and off, is closely related to the development of cancer. Therefore, understanding the connection of these mechanisms at the molecular level can help in the future in the search for new therapeutic approaches effective not only in the treatment of cancer, but also in the fight against viral infections.



A model of repression of gene expression in hard-to-replicate regions of the genome, such as LTR elements. Such regions in standard-type cells cause stalling or collapse of the replication fork during replication, which is accompanied by the formation of DNA single-stranded and double-stranded breaks. Subsequently, the HR proteins, in cooperation with the HIRA complex, restore the chromatin structure in these areas, which leads to repression of expression.

MIŠOVÁ, Ivana – PITEĽOVÁ, Alexandra – BUDIŠ, J. – GAZDARICA, Juraj – SEDLÁČKOVÁ, Tatiana – JORDÁKOVÁ, Anna – BENKŮ, Zsigmond – ŠMONDRKOVÁ, M. – MAYEROVÁ, Nina – PICHLEROVÁ, K. – STRIEŠKOVÁ, Lucia – PŘEVOROVSKÝ, Martin – GREGÁŇ, Juraj – ČIPÁK, Ľuboš – SZEMES, Tomáš – BÁGEĽOVÁ POLÁKOVÁ, Silvia. Repression of a large number of genes requires interplay between homologous recombination and HIRA. In *Nucleic acids research*, 2021, vol. 49, no. 4, p. 1914-1934. (2020: 16.971 - IF, Q1 - JCR, 9.008 - SJR, Q1 - SJR). ISSN 0305-1048.

Available at: <https://doi.org/10.1093/nar/gkab027>

Silicon as an effective tool on alleviation of nickel toxicity in plants

Plant Science and Biodiversity Center SAS

Solvers: Marek Vaculík, Ján Kováč, Ivana Fialová, Roderik Fiala, Katarína Jašková, Miroslava Luxová

Project: VEGA 2/0018/17

The positive effect of the beneficial element silicon (Si) in suppressing the negative manifestations of various, especially toxic metals and semi-metals, such as cadmium (Cd), lead (Pb), antimony (Sb) or arsenic (As), is relatively well known today. However, until now, no information was available on its effect on toxicity caused by high amounts of nickel (Ni), which is a vital element. Therefore, a team of scientists from the Plant Science and Biodiversity Center SAS monitored the effect of high concentrations of Ni in young maize roots. Nickel acted on the roots for different lengths of time (24, 48 and 72 hours). It was found out that the excessive concentration of Ni has a negative effect on their growth and development. There was an increase and stimulation of the formation of barriers in the roots, which fulfil the function of controlling the intake of elements into the above-ground parts. The addition of Si changed the anatomical structures of the root, thereby alleviating the negative effect of Ni on the plant. The likely mechanisms by which Si helps overcome the adverse effects of excess Ni on maize plants have been proved to be: 1. increased integrity of cell membranes and 2. lower production of some reactive oxygen forms, which is related to a decrease in the leaching of electrolytes from the cells, as well as stimulation of the ascorbate-based antioxidant system. The results of the experiments contributed to the clarification and understanding of the mysterious role of silicon in overcoming abiotic stress in plants.

Intensive research on the action of silicon to alleviate the consequences of some abiotic stresses, such as drought or salinity, has in recent years led to the application of various preparations based on silicon, which positively affected the cultivation of some crops such as rice, bamboo or sugar cane. The increasing level of environmental contamination forces us to study the mechanisms of the potential use of silicon in alleviating the consequences of an excessive amount of toxic metals in the environment, and we also try to contribute to this effort of scientists all over the world.

VACULÍK, Marek – KOVÁČ, Ján – FIALOVÁ, Ivana – FIALA, RODERIK – JAŠKOVÁ, Katarína – LUXOVÁ, Miroslava. Multiple effects of silicon on alleviation of nickel toxicity in young maize roots. In *Journal of Hazardous Materials*, 2021, 415: 125570 (2020: 10,6 – IF, Q1- JCR, 2.03 – SJR, Q1 – SJR). ISSN 0304-3894.

Scientific Section 3 (Social Sciences, Humanities, Arts, and Culture)

On profound influence of Hegel's philosophy on the 19th century

Institute of Philosophy SAS

Solver: Jon Stewart

Project: VEGA 2/0025/20

Jon Stewart's scholarly monograph on Hegel's profound influence on the 19th century reveals how that century contributed to the wider history of philosophy. It shows how Hegel's concepts of alienation and recognition became central to the thinking of the time and how they were transferred into other areas such as religion, politics, literature and drama. This created a rich cultural phenomenon that can be called "Hegel's century". The publication received the PROSE Award Winner for the best philosophical book of 2021. The award is presented by the Association of American Publishers (AAP).

STEWART, Jon. *Hegel's Century: alienation and recognition in a time of revolution*. Cambridge: Cambridge University Press, 2021. xi + 338 p.

Marian Devotion Among the Roma in Slovakia

Institute of Ethnology and Social Anthropology SAS

Solver: Tatiana Zachar Podolinská

Project: VEGA 2/0060/19

Based on several years of research on religiosity in several locations in Slovakia, the author presents a plastic image of the Marian devotion among the Roma in Slovakia. Against the background of the overall image of Marian devotion in the modern and postmodern world, it presents the Virgin Mary as a spokesperson and fighter for the rights of overlooked and oppressed people, living on the real or symbolic periphery of majority societies - while pointing to her inculturated and ethnicized, i.e. forms ethnically "colored" and translated by ethnic groups and nations. The author reveals how the post-modern reverence for the Virgin Mary represents, on the one hand, the continuation of the traditional Christian reverence for the Mother of God (in

all its basic elements), but, on the other hand, it is constantly creatively rewritten and embodied in a completely new language of the modern world and postmodern religiosity and spirituality. According to the author, the Virgin Mary essentially colonized the world in the 20th century, thereby fundamentally contributing to its Christianization.

ZACHAR PODOLINSKÁ, Tatiana. *Marian Devotion Among the Roma in Slovakia: A Post-Modern Religious Response to Marginality*. London, New York: Palgrave Macmillan, 2021. 166 s. ISBN 978-3-030-56363-9

Dictionary of the Contemporary Slovak Language O – Pn

Ludovít Štur Institute of Linguistics SAS

Solvers: Miroslava Avramovová, Ľubica Balážová, Jana Hasanová, Bronislava Chocholová, Nicol Janočková, Alexandra Jarošová, Jana Končalová, Lenka Ocetová, Adriana Oravcová, Magdaléna Petrufová, Emília Porubská, Anna Šebestová, Alexandra Šufliarska, Daša Zvončeková

The Dictionary of the Contemporary Slovak Language O – Pn is an important result of the basic research of the Ludovít Štur Institute of Linguistics SAS. The composite of female authors approaches the formulation of a unique academic dictionary with the knowledge that the vocabulary of a language is an image of the culture of each nation. The fourth volume, which comes out five years after the publication of the third one, is a representative, information-saturated and user-friendly work providing a picture of the vocabulary of the contemporary Slovak language, including a new, lexicographically unprocessed lexicon.

In this dictionary volume, too, the authors follow the concept developed and published in the introductory part of the first volume of the Dictionary of the Contemporary Slovak Language A – G (2006), but, at the same time, it is more precisely supplemented by the issue of such lexical-grammatical phenomena as brought by the lexis of entries beginning with the letters O to Pn. Users will find information on 15,329 entries on 1,128 pages. The interpretation of their meaning is based on a complex of knowledge about the marked extra-linguistic reality, as well as a complex of evaluations, attitudes and connotations in the consciousness of an ordinary member of the language community. The dictionary contains a stylish and prescriptive assessment of keywords, their synonyms, antonyms and usage examples drawn from rich and authentic language sources. The cognitive value of the dictionary is also increased by the detailed grammatical characteristics.

In accordance with the requirements of users of the 21st century, the dictionary captures basic terminology from approximately 100 scientific fields, while 64 experts from various fields collaborated in the development of terminological entries.

Phraseology is represented in the fourth volume in the form of 3,083 idiomatic fixed expressions. Part of the dictionary is an appendix with the names of municipalities in Slovakia and their location, as well as resident names and adjectives derived from them.

The tools and methods of computer lexicography, a set of text corpora consisting of the Slovak National Corpus, specialized and web corpora with a range of 4.95 billion text words were used to create the dictionary. The Sketch Engine tool from Lexical Computing CZ, s.r.o. was used for the analysis of corpus resources, for which a specialized collocation grammar was developed, taking into account the specific needs of lexicographic work.

AVRAMOVOVÁ, Miroslava - BALÁŽOVÁ, Ľubica - HAŠANOVÁ, Jana - CHOCHOLOVÁ, Bronislava - JANOČKOVÁ, Nicol - JAROŠOVÁ, Alexandra - KONČALOVÁ, Jana - OCETOVÁ, Lenka - ORAVCOVÁ, Adriana - PETRUFOVÁ, Magdaléna - PORUBSKÁ, Emília - ŠEBESTOVÁ, Anna - ŠUFLIARSKA, Alexandra - ZVONČEKOVÁ, Dáša. *Slovník súčasného slovenského jazyka (O - Pn)* = Dictionary of Contemporary Slovak (O - Pn). 4. zv. Ed. Alexandra Jarošová, rec. Ľubor Králik, Jozef Mlacek. 1. vyd. Bratislava: Veda, 2021. 1128 s. ISBN 978-80-224-1901-7.

II.2.2 Application-type results

Scientific Section 1 (Physical, Space, Earth, and Engineering Sciences)

Integrated technology for water treatment from mixed contaminants

Institute of Geotechnics SAS

Solver/Author: MVDr. Daniel Kupka,

Co-authors: Ing. Miroslava Václavíková, PhD, Mgr. Gergő Bodnár, PhD.

On 30. On 11. 2021, an industrial property application entitled "Integrated technology for water treatment from mixed contaminants" was submitted.

Technology Transfer Office of SAS (KTT SAV) – Department of Office of the SAS.

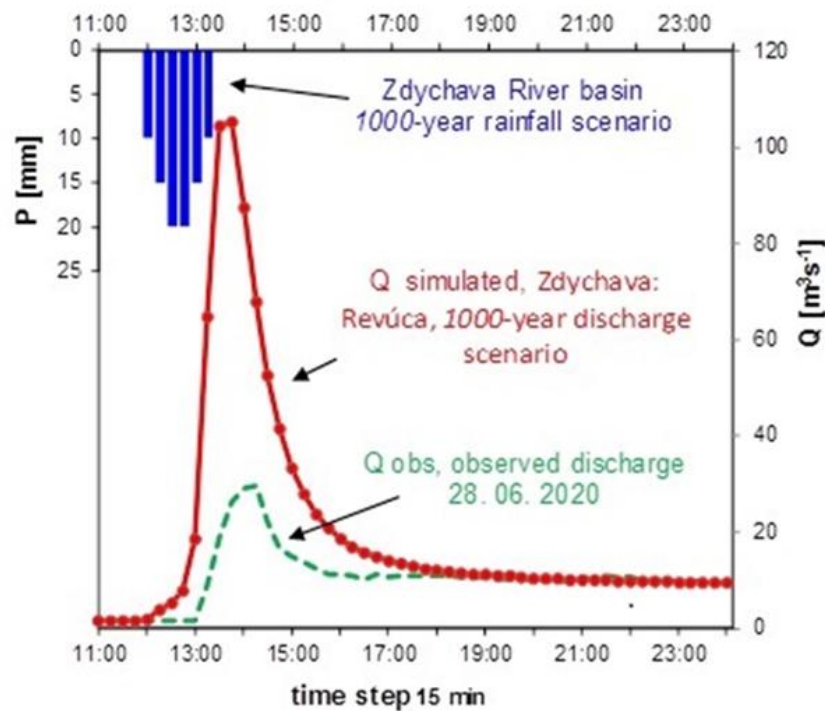
A catastrophic 1000-year flash summer flood scenario

Institute of Hydrology SAS

Solvers: P. Pekárová, J. Mészáros, P. Miklánek, J. Pekár, C. Siman, J. Podolinská

Project: VEGA 2/0004/19

From the study of historical flash floods (floods from intense summer storms) in small river basins, it follows that the cause of these catastrophic phenomena is to a decisive degree the causative precipitation and the initial distribution of moisture in the basin's soils, and not the influence of the vegetation cover, as is sometimes emphasized recently. This is evidenced by several flash floods from recent years (e.g. 1998 - M. Svinka, 2011 - Gidra and Parná, 2014 - Vrátnanka, 2020 - Muráň), which occurred in forested basins with over 80% forest cover. The causal precipitation in these basins exceeded 60 mm per 1 hour. As part of the VEGA project, a method for deriving 1,000-year short-term scenario precipitation in small basins was developed. This was applied to the Zdychavy to the Revúca basin. The derivation scenario represented torrential rainfall of 90 mm per 1.5 hours on a basin area of 59,324 km². A 1000-year flash flood in this basin was subsequently simulated on the Zdychava River in Revúca by a calibrated NLC rainfall-runoff model on the flood wave from 28.06.2020. In such an extreme precipitation scenario, the peak flow would reach 105.15 m³s⁻¹, i.e. specific runoff of 1.78 m³s⁻¹km⁻². The total runoff in 18 hours would be 1.119 million m³, which represents 21.11% of the precipitation (5.301 million m³).



The authors' results point to, among other things, the huge volumes of water during extreme storms and the corresponding huge volumes of runoff. Such volumes of water cannot be effectively retained by the natural environment of our watersheds – soil and vegetation cover. Such volumes must either be created artificially, or each part of the river network must be modified so that it is able to handle the inflow from these precipitations without erosion.

PEKÁROVÁ, Pavla - MÉSZÁROS, Jakub - MIKLÁNEK, Pavol - PEKÁR, Ján - SIMAN, Cyril - PODOLINSKÁ, Jana. Post-flood field investigation of the June 2020 flash flood in the upper Muráň River basin and the catastrophic flash flood scenario. In *Journal of Hydrology and Hydromechanics*, 2021, vol. 69, no. 3, p. 288-299. (2020: 2.512 - IF, Q3 - JCR, 0.784 - SJR, Q1 - SJR, karentované - CCC). (2021 - Current Contents, WOS, CCC, SCOPUS). ISSN 1338-4333. Available at: <https://doi.org/10.2478/johh-2021-0015>

Magnetic nanoparticles for the detection of tumour cells

Institute of Experimental Physics SAS

Solvers: I. Antal, I. Khmara, M. Koneracká, M. Kubovčíková, V. Závíšová

Projects: VEGA 2/0033/19, APVV-14-0120, APVV-SK-SRB-18-0055, APVV-DS-FR-19-0052

Since almost all solid tumours are hypoxic, have an increased metastatic potential, and many are additionally resistant to chemo/radiotherapy, the key task in the cited work was the synthesis of magnetic nanocultures, functionalization of their surface and immobilization of a specific monoclonal antibody, thanks to which a bioconjugate was prepared not only specifically bound to human tumour cells, but its internalization into tumour cells has also been proven. We also tested the conjugated antibody on 3D models of tumour cells, which more closely describe the tumour microenvironment, and not only the specific binding between the conjugated antibody and tumour cells, but also the internalization of the bioconjugate into the 3D spheroid was confirmed for this type of cells. The research results provide promising evidence for targeting tumour cells with broad potential for visualization and future treatment of tumours.

ANTAL, Iryna - KONERACKÁ, Martina - KUBOVČÍKOVÁ, Martina - ZÁVIŠOVÁ, Vlasta - JURÍKOVÁ, Alena - KHMARA, Iryna - OMASTOVÁ, Mária - MIČUŠÍK, Matej - BARÁTHOVÁ, Monika - JELENSKÁ, Lenka - KAJANOVÁ, Ivana - ZAŤOVIČOVÁ, Miriam - PASTOREKOVÁ, Silvia. Targeting of carbonic anhydrase IX-positive cancer cells by glycine-coated superparamagnetic nanoparticles. In *Colloids and Surfaces B - Biointerfaces*, 2021, vol. 205, art.no. 111893, [10] p. (2020: 5.268 - IF, Q1 - JCR, 0.939 - SJR, Q1 - SJR, karentované - CCC). (2021 - Current Contents, WOS, SCOPUS). ISSN 0927-7765. Available at: <https://doi.org/10.1016/j.colsurfb.2021.111893>

Scientific Section 2 (Life, Chemical, Medical, and Environmental Sciences)

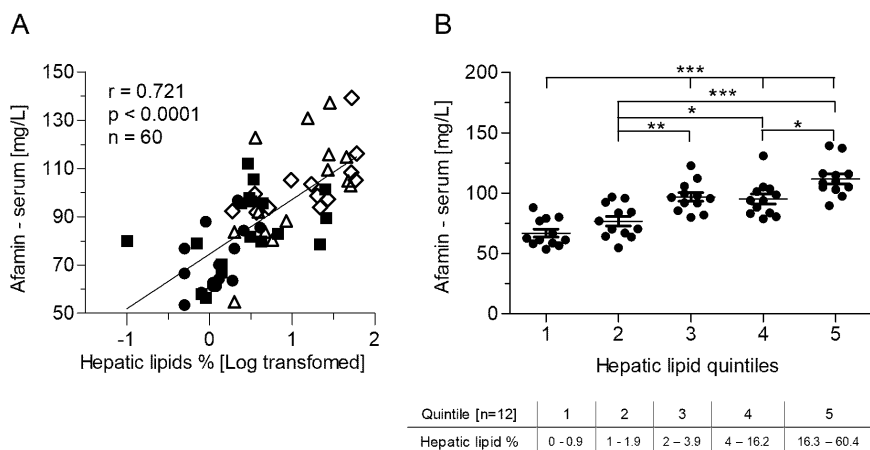
Serum afamin a novel marker of increased hepatic lipid content in liver

Institute of Experimental Endocrinology of BMC SAS

Solvers: Tímea Kurdiová, Miroslav Baláž, Zuzana Kovaničová, Daniela Gašperíková, Barbara Ukropcová, Jozef Ukropec

Projects: VEGA 2/0107/18, VEGA 2/0164/20, ITMS: 313011V344

Afamin is a glycoprotein that is formed in the liver and released into the blood in relatively high concentrations. Although its role in the body is still unclear, previous work has suggested that its increase in the blood is associated with an increased risk of metabolic diseases in humans. In our work, we focused on the regulation of systemic afamin levels in association with obesity, insulin resistance, impaired glucose tolerance and newly diagnosed diabetes type 2. At the same time, we looked at the regulation of afamin after a three-month training intervention in patients with obesity and prediabetes. In contrast to obesity, the presence of prediabetes and diabetes has been shown to be associated with elevated afamin levels, which are also positively correlated with several parameters of adiposity (percentage of body fat, adipocyte size), insulin resistance (HOMA-IR, insulinemia, C-peptide) and negative with insulin sensitivity (EHZ lock). The most important finding was that elevated serum afamin levels are associated with increased lipid accumulation in the liver (measured by ¹H-MRS, Fig. A-B), as well as increased liver damage markers (ALT, AST, GMT) and fatty liver index (FLI), suggesting that afamin could be a clinically relevant marker of increased lipid accumulation in the liver. Although the three-month training intervention did not change serum afamin levels, post-exercise improvements in glucose metabolism parameters were positively correlated with changes in afamin concentrations.



A. Serum levels of afamin correlate positively with the number of lipids in the liver.

B. Comparison of afamin in individual quintiles – studied population divided according to the number of lipids in the liver.

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; ● *lean-healthy*; ■ *obese*; △ *obese-prediabetics*; ◇ *obese-type 2 diabetics*

KURDIOVÁ, Tímea – BALÁŽ, Miroslav – KOVANIČOVÁ, Zuzana – ZEMKOVÁ, Erika – KUZMA, Martin – BELAN, V. – PAYER, Juraj – GAŠPERÍKOVÁ, Daniela – DIEPLINGER, Hans – UKROPCOVÁ, Barbara – UKROPEC, Jozef. Serum Afamin a Novel Marker of Increased Hepatic Lipid Content. In *Frontiers in Endocrinology*, 2021, vol. 12, sept., art. No. 670425. (2020: 5.555 - IF, Q1 - JCR, 1.518 - SJR, Q1 - SJR). ISSN 1664-2392. Available at: <https://doi.org/10.3389/fendo.2021.670425>

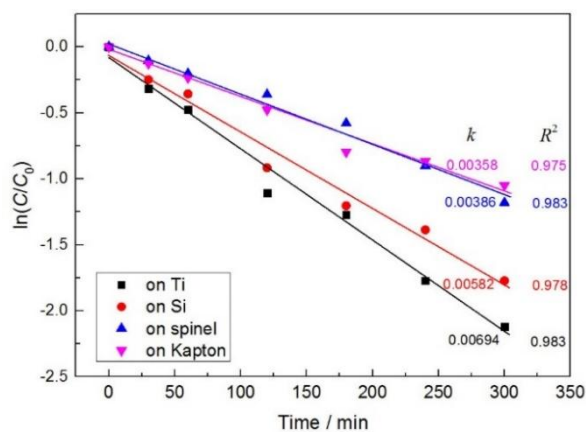
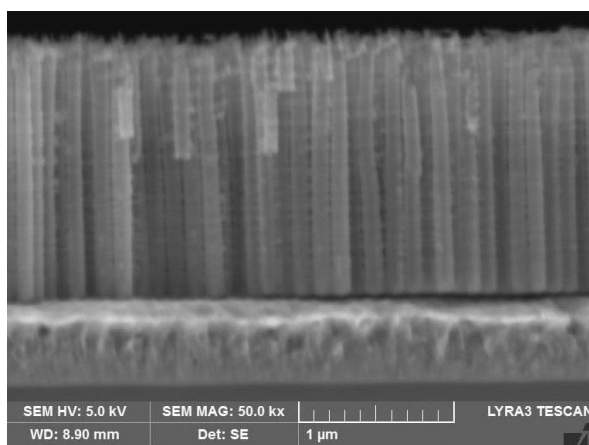
Preparation and photocatalytic activity of TiO₂ nanotubes synthesized on a transparent spinel substrate

Institute of Inorganic Chemistry SAS

Solvers: Patrícia Petrisková, Zoltán Lenčéš

Over the past two decades, more and more attention has been paid to treatment of waste water and air using TiO₂ photocatalyst. TiO₂ is also used for hydrogen production, in solar cells, for antibacterial applications, etc. For this reason, the research was focused on the preparation of TiO₂ nanotubes (TNTs) on a transparent ceramic material (spinel – MgAl₂O₄) using anodic

oxidation of the Ti layer deposited by magnetron deposition. The properties of TNTs were compared with nanotubes prepared on three different substrates: a monocrystalline Si substrate, a Kapton polymer foil, and a metallic Ti foil. Using the photocatalytic degradation of two model pollutants rhodamine B (RhB) and bisphenol A (BPA), we proved that, depending on the substrate used, the efficiency of photocatalytic degradation of TNTs increases in the following order: Kapton < spinel < Si < Ti. Nanotubes grown on Ti foil have the best photocatalytic activity reaching 88% RhB degradation and 36% BPA degradation. The kinetic model for the degradation of RhB is best described by a pseudo-first-order reaction, while the degradation of BPA is better described by a fractal pseudo-first-order reaction. The results of calculating the residual stress and deformation at the substrate-TNTs interface showed that the spinel-TNTs material shows the lowest values of stress and deformation, they have a stable structure and only minimal exfoliation of TNTs occurs. For this reason, a chemically and thermally stable transparent ceramic material (spinel) can be considered a suitable substrate for TNTs and their application in the aforementioned environmental and energy applications.



TiO₂ nanotubes prepared on a spinel substrate. Degradation rate of RhB on TiO₂ nanotubes.

PETRISKOVÁ, Patrícia – MONFORT, Olivier – SATRAPINSKY, Leonid – DOBROČKA, Edmund – PLECENIK, Tomáš – PLESCH, Gustav – PAPŠIK, Roman – BERMEJO, Raúl – LENČEŠ, Zoltán: Preparation and photocatalytic properties of TiO₂ nanotube arrays prepared on transparent spinel. *Ceramics International*, 47 (2021) 12970-12980. (2020: 4.527 - IF, Q1 - JCR, 0.936 - SJR, Q1 - SJR, karentované - CCC). (2021 - Current Contents, WOS, SCOPUS). ISSN 0272-8842.

Available at: <https://doi.org/10.1016/j.ceramint.2021.01.160>

Evaluation of the environmental load of the aquatic ecosystem by PCB substances using fish and their parasites

Institute of Parasitology SAS

Solvers: Tímea BRÁZOVÁ, Mikuláš OROS, Daniel BARČÁK, Dana MIKLISOVÁ, Martina OROSOVÁ, Dalibor UHROVIČ

Projects: APVV 18-0467; VEGA 2/0126/20

The Zemplín region belongs to the areas most long-term contaminated with polychlorinated biphenyls (PCBs) on a long-term basis, not only in Slovakia, but also on a global scale. An important reservoir of these dangerous lipophilic compounds is the Zemplínska Širava water reservoir, where PCBs are bound to sediments, from where they are released and subsequently deposited in the bodies of aquatic organisms, especially fish. Long-term consumption of contaminated fish meat poses a significant risk to human health, therefore, their constant monitoring is essential. In the model parasite-host system intestinal parasite (tapeworm *Caryophyllaeus laticeps*) - fish (freshwater bream *Abramis brama*), high levels of PCBs were measured in the intestine, hepatopancreas (liver) and muscle of the fish, which points to the continued inappropriateness of consuming fish from this location. In addition, the ability of tapeworms to accumulate significantly higher amounts of PCBs compared to fish organs was detected for the first time. Due to the fact that tapeworms were more sensitive to the presence of pollutants in the aquatic environment compared to fish organs, they could be used as sensitive bioindicators even at lower levels of pollution, e.g. when checking the effectiveness of recovery measures. From a medical point of view, early detection of contaminants in the environment is extremely important, therefore, the current discovery could help prevent negative consequences for human health as well.

BRÁZOVÁ, Tímea – MIKLISOVÁ, Dana – BARČÁK, Daniel – UHROVIČ, Dalibor – ŠALAMÚN, Peter – OROSOVÁ, Martina – OROS, Mikuláš. Hazardous pollutants in the environment: Fish host-parasite interactions and bioaccumulation of polychlorinated biphenyls. In *Environmental Pollution*, 2021, vol. 291, art. no. 118175. (2020: 8.071 - IF, Q1 - JCR, 2.136 - SJR, Q1 - SJR). ISSN 0269-7491.

BRÁZOVÁ, Tímea – OROS, Mikuláš. Hodnoty polychlórovaných bifenylov v rybách a ich parazitoch z vodnej nádrže Zemplínska Širava = Values of polychlorinated biphenyls in fish and their parasites from the Zemplínska širava water reservoir. In *Situácia v ekologicky zaťažených regiónoch Slovenska a strednej Európy : Zborník z XXX. vedeckého sympózia s medzinárodnou účasťou, Hrádok 21. – 22. október 2021* Hrádok. Ed.: Hredzák, S. Košice : Slovenská banícka spoločnosť ZSVTS, Základná organizácia pri Ústave geotechniky SAV (v. v. i.), Košice, 2021, p. 40-43. ISBN 978-80-89883-12-7.

Scientific Section 3 (Social Sciences, Humanities, Arts, and Culture)

Hate speech in the online environment

Centre of Social and Psychological Sciences SAS

Solvers: Jana Papcunová, Marcel Martončík, Denisa Fedáková, Michal Kentoš, Miroslava Bozogánová, Ivan Srba, Robert Moro, Matúš Pikuliak, Marián Šimko, Matúš Adamkovič

Hate speech in online spaces represents a complex phenomenon that can have different meanings for different people. There is still no uniform definition of hate speech. Within the Institute of Social Sciences of CSPV SAV, with the help of experts in the field of human rights, media, social work, the non-profit sector, or representatives of minorities in Slovakia, we propose an empirical definition of hate speech by providing a list of 10 indicators – specific, observable and measurable characteristics of hate speech. The promotion of violent behaviour and the denial of human rights dominated as the main aspects of hate speech in online spaces, focusing on comments related to migrants. In the study, we discuss, together with experts in the field of artificial intelligence at the Kempelen Institute of Intelligent Technologies, the practical uses of the proposed indicators, using the latest methods of natural language processing (NLP) and machine learning. A set of quantifiable indicators could benefit researchers, human rights activists, pedagogues and analysts by providing a pragmatic approach to assessing and detecting hate speech.

PAPCUNOVÁ, Jana - MARTONČIK, Marcel - FEDÁKOVÁ, Denisa - KENTOŠ, Michal - BOZOGÁŇOVÁ, Miroslava - SRBA, Ivan - MORO, Robert - PIKULIAK, Matúš - ŠIMKO, Marián - ADAMKOVIČ, Matúš. *Hate speech operationalization: a preliminary examination of hate speech indicators and their structure*. In *Complex & Intelligent Systems*, 2021, vol., no., p. (2020: 4.927 - IF, Q2 - JCR). ISSN 2199-4536.

Research series on human society during a pandemic: How are you, Slovakia?

Institute for Sociology SAS, Institute for Research in Social Communication SAS

Solvers: Miloslav Bahna, Róbert Klobucký, Jana Lindbloom and teams of research institutes

In 2021, the Institute for Sociology SAS continued to cooperate on the continuous research of society during the pandemic called "How are you, Slovakia?" The partners of this cooperation were the Institute for Research in Social Communication SAS, Seesame communication agency

and the research company MNFORCE. Several employees of the Institute participated in the creation of the questionnaire and collaborated on the release of 22 press releases from the six waves of research carried out in 2021, which are available on the Institute's website. The findings from this series of research received considerable media attention and contributed to the recognition of the Institute as a centre of social science expertise in relation to the pandemic. Data files from these researches are gradually made available in the Slovak Archive of Social Data.

Based on the knowledge gained in a series of these researches, several employees of SÚ SAS provided consultations and expertise:

With questions inserted in the October and December wave, Jana Lindbloom pointed out the validity of the theses she emphasized regarding the social, interpretive and situational aspects of vaccination and compliance with anti-epidemic measures, as well as with quantitative data. The results were used in the discussions of the Science Helps initiative, in expert consultations for the Government of the Slovak Republic and the Ministry of Health of the Slovak Republic, and in explaining the social context of the pandemic to the public in the media.

Miloslav Bahna participated as an expert in the activities of the working group of the Public Health Authority of the Slovak Republic, where, based on findings from several waves of research - How are you, Slovakia? - he presented recommendations regarding anti-epidemic measures.

Robert Klobucký helped with consultations in setting up research on the effectiveness of the vaccination lottery Value for Money Organization (Ministry of Finance of the Slovak Republic).

Bioprepurate from *Exiguobacterium undae* – joint patent of three SAS institutes

Institute of Musicology SAS, Institute of Chemistry SAS, Institute of Molecular Biology SAS

Solvers: Štefan Nagy, Andrej Štatura and others

The patent entitled "Bioprepurate from *Exiguobacterium undae*" (No. 288915) is the result of transdisciplinary cooperation, whereas it was at three SAS institutes from Scientific Sections 2 and 3 (Institute of Chemistry SAS, Institute of Molecular Biology SAS, Institute of Musicology SAS) and one university workplace (Technical University in Zvolen). For the Institute of Musicology SAS, a technical laboratory employee (Ing. Štefan Nagy, ArtD.) and a former employee of the Institute from the Department of Systematic Musicology (Mgr. Art. Andrej Štatura, PhD.), collaborated on the patent. The bioprepurate has good degrading effects on glue and glue adhesives and is also suitable, for example, for use in the restoration work of wooden organ pipes.

II.2.3 Results based on international cooperation

Scientific Section 1 (Physical, Space, Earth, and Engineering Sciences)

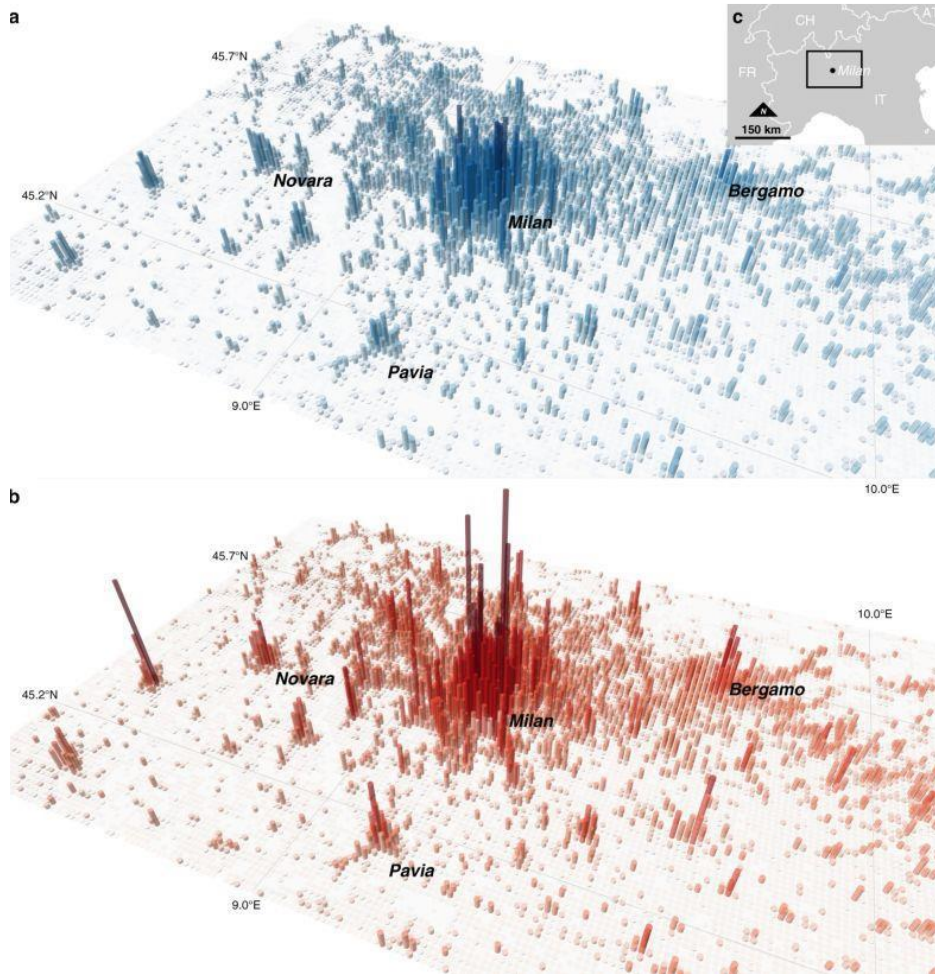
Analysis of temporal changes in population density in Europe

Institute of Geography SAS

Solvers: Collective of authors (Konštantín Rosina for GgÚ SAS)

Data on population distribution are usually available based on territorial-administrative units. However, these data are quite unsuitable for detailed spatial analyses, in which it is necessary to combine demographic variables with data describing, e.g. physical environment (areas exposed to noise, flood zones, catchment areas of infrastructure and other). In the recent period, population data at the level of regular and sufficiently small units are slowly starting to be used, but, like before, they only capture the residential (night) status of the population. However, this is inadequate for many problems, e.g. in spatial planning or crisis management, it represents a gross simplification of reality. Thanks to the ENACT project, the distribution of the population of the entire EU was mapped for the first time on a detailed scale (1 km²), taking into account its daily and seasonal mobility. The main method was the fusion of statistical and geographic data, including innovative sources of spatial data (e.g. OpenStreetMap or data from mobile operators in validation, etc.). The result is 24 freely available data layers representing the state of the population during the day and at night for each month of the year, taking into account attendance at work, schools, and tourism. E.g. typification of European metropolises according to the course of population density in the direction from the centre to the periphery was processed. One of the specific findings is that the daily population in the centres of large European cities with over 1 million inhabitants is 1.9 times higher on average than at night.

BATISTA E SILVA, F., FREIRE, S., SCHIAVINA, M., ROSINA, K., MARÍN-HERRERA, M. A., ZIEMBA, L., CRAGLIA, M., KOOMEN, E., LAVALLE, C.: Uncovering temporal changes in Europe's population density patterns using a data fusion approach. *Nature Communications*, 2020, vol. 11, art. no. 4631. (2019: 12.121 - IF, Q1 - JCR, 5.569 - SJR, Q1 - SJR, karentované - CCC). (2020 - Current Contents). ISSN 2041-1723.
doi: 10.1038/s41467-020-18344-5



Population density - average daytime and night-time population around Milan (in an area of 150×100 km with a spatial resolution of 1×1 km).

Safety of air transport infrastructure in Europe

Institute of Informatics SAS

Solvers: The collective of researchers, from ÚI SAV Rusko, M., Trnka, M., Darjaa, S., Guoth, I., Sabo, R., Ritomský, M.

Projects: Horizon 2020, grant agreement ID: 832969, Call H2020-SU-INFRA-2018

The project deals with the security of air transport infrastructure in Europe. A block for voice verification of persons during radio communication between aircraft pilots at the airport and the tower was designed, developed and implemented into the airport tower and control simulator system. A new speaker recognition module based on deep learning was developed for the SATIE project. For the purposes of the project, a database of speech under stress called "StressDat" voiced over by professional actors was created, which contains more than 10,000 sentences spoken by professional actors at three different levels of stress. A new system for stress identification in the voice based on deep learning and prediction of the level of emotional activation and the level of softness of the emotion, was designed, developed and implemented. The created database "StressDat" was used to train the models.

TRNKA, Marián - DARJAA, Sakhia - RITOMSKÝ, Marian - SABO, Róbert - RUSKO, Milan - SCHAPER, Meilin - STELKENS-KOBSCHE, Tim. Mapping discrete emotions in the dimensional space: an acoustic approach. In *Electronics*, 2021, vol. 10, no. 23, art. no. 2950. (2020: 2.397 - IF, Q3 - JCR, 0.360 - SJR, Q2 - SJR, karentované - CCC). (2021 - Current Contents). ISSN 2079-9292.

Available at: <https://doi.org/10.3390/electronics10232950>

SABO, Róbert – BEŇUŠ, Štefan – TRNKA, Marian – RITOMSKÝ, Mario – RUSKO, Milan – SCHAPER, Meilin – SZABO, Jakub. StressDat – Database of Speech under Stress in Slovak. *Journal of Linguistics (Scientific Journal for the Theory of Languages)*, 2021, vol. 72, No 2, pp. 579-590, (Q3 - SJR, 2019 - Scopus) ISSN 0021-5597 (print ver.), ISSN 1338-4287 (online ver.) DOI 10.2478/jazcas-2021-0030

TRNKA, Marián - DARJAA, Sakhia - RUSKO, Milan - SCHAPER, Meilin - STELKENS-KOBSCHE, Tim. Speaker authorization for air traffic control security. In *Lecture Notes in Computer Science: Speech and Computer*. - Heidelberg: Springer, 2021, vol. 12997, p. 716-726. (2020: 0.249 - SJR, Q3 - SJR). ISBN 978-3-030-87801-6. ISSN 0302-9743. Available at: https://doi.org/10.1007/978-3-030-87802-3_64

SCHAPER, Meilin - GLUCHSHENKO, Olga - MUTH, Kathleen - TYBURZY, Lukas - TRNKA, Marián - RUSKO, Milan. The traffic management intrusion and compliance system as security situation assessment system at an air traffic controller's working position. In *Proceedings of the 31st European Safety and Reliability Conference: ESREL 2021*. - Singapore: Research Publishing, 2021, p. 2825-2831. ISBN 978-981-18-2016-8. (ESREL 2021: 31st European Safety and Reliability Conference)

Improving the understanding of the geological development of the Alps and surrounding mountains

Earth Science Institute of the SAS

Solvers: Collective of authors, Pavol ZAHOREC, Miroslav BIELIK, Ema NOGOVÁ for ÚVZ SAV

The European AlpArray initiative, aimed at improving our understanding of the geological evolution of the Alps and surrounding mountains, is a prime example of broad international cooperation. The gravitational field of the Earth is also an integral part of the investigation of the deeper structure of the Earth's crust. A team of Slovak scientists became a leader in the creation of a common gravimetric database of ten European countries in this region. The result is the first unified gravimetric map of this scale, which will serve for subsequent interpretations of the geological structure of the entire Alps and adjacent territories.

ZAHOREC, Pavol - PAPČO, Juraj - PAŠTEKA, Roman - BIELIK, Miroslav - BONVALOT, Sylvain - BRAITENBERG, Carla - EBBING, Jörg - GABRIEL, Gerald - GOSAR, Andrej - GRAND, Adam - GÖTZE, Hans-Jürgen - HETÉNYI, György - HOLZRICHTER, Nils - KISSLING, Edi - MARTI, Urs - MEURERS, Bruno - MRLINA, Jan - NOGOVÁ, Ema - PASTORUTTI, Alberto - SALAUN, Corinne - SCARPONI, Matteo - SEBERA, Josef - SEOANE, Lucia - SKYBA, Peter - SZŰCS, Eszter - VARGA, Matej. The first pan-Alpine surface-gravity database, a modern compilation that crosses frontiers. In *Earth System Science Data*, 2021, vol. 13, no. 5, p. 2165-2209. (2020: 11.333 - IF, Q1 - JCR, 4.066 - SJR, Q1 - SJR, karentované - CCC). (2021 - Current Contents). ISSN 1866-3508.

Scientific Section 2 (Life, Chemical, Medical, and Environmental Sciences)

Mircofluidic in vitro platform for (nano)safety and (nano)drug efficiency screening.

Cancer Research Institute of BMC SAV

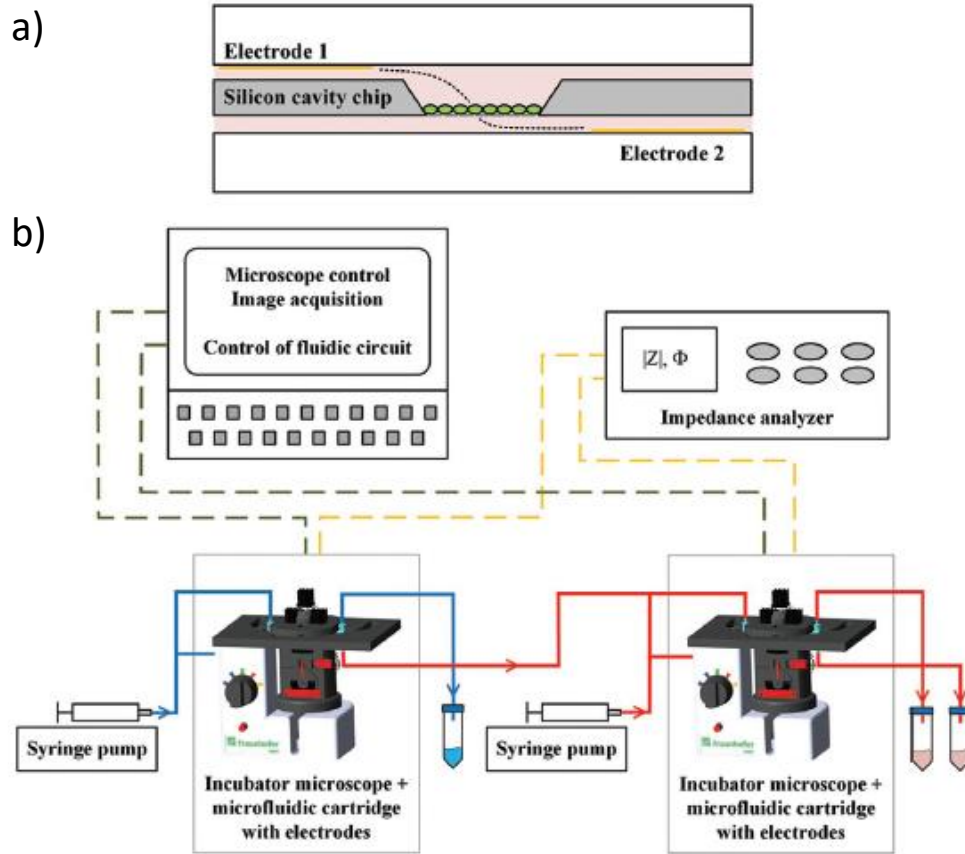
Solvers: Kristina Kopecká, Alena Gábelová

Projects: H2020-MNP HISENTS, H2020 -Twinning VISION, ERA-NET EuroNanoMed II INNOCENT

Microfluidic technology is a valuable tool for developing relevant *in vitro* models to monitor the response of organs and tissues to exposure. The use of these technologies (microchips) in

assessing the biological safety of new drugs and compounds will contribute to limiting experiments on laboratory animals. The microfluidic cell culture device is fully automated, flexible and enables a powerful screening not only of chemical compounds but also nanomaterials. The requirement for rapid preclinical testing of the potential toxicity of drugs and chemicals under development is constantly growing (Registration, Evaluation, Authorization and Restriction of Chemical Substances, REACH). The miniaturization of this device reduces material (solutions, chemicals) as well as economic costs related to their use. The work describes a microfluidic platform for *in vitro* cell cultivation. This device is designed to mimic the conditions in a living organism (e.g. continuous flow of culture medium). The platform is made up of individual modules; each consisting of a microcavity containing a silicon chip in the form of a cell culture plate and integrated electrodes (see fig.). A miniaturized microscope is built into each module to monitor cell morphology and proliferation. Integrated electrodes allow for non-invasive monitoring of the integrity of seeded cells and direct assessment of the cytotoxic effect of the test substance (impedance). Each module (representing one organ/tissue) can be used independently or can be flexibly connected to another module. Interconnection of different modules allows simulating the exposure of the entire organism and monitoring the responses of individual tissues/organs. The microfluidic platform can contribute to the replacement/reduction of animal testing in accordance with the 3R's principle – replace, reduce and refine animal suffering. The suitability of the microfluidic platform was investigated in various human cell models that represented individual organs/tissues.

KOHL, Yvonne – BIEHL, Margit – SPRING, Sarah – HESLER, Michelle – OGOURTSOV, Vladimir – TODOROVIC, Miomir – OWEN, Joshua – ELJE, Elisabeth – KOPECKÁ, Kristína [SAVBIOMED] – MORIONES, Oscar Hernando – BASTUS, Neus G. – SIMON, Peter – DUBAJ, Tibor – RUNDÉN-PRAN, Elise – PUNTES, Victor – WILLIAM, Nicola – BRIESEN, Hagen von – WAGNER, Sylvia – KAPUR, Nikil – MARIUSSEN, Espen – NELSON, Andrew – GÁBELOVÁ, Alena [SAVEXONK] – DUŠINSKÁ, Mária – VELTEN, Thomas – KNOLL, Thorsten. Microfluidic *in vitro* platform for (nano)safety and (nano)drug efficiency screening. In *Small*, 2021, vol. 17, no. 15, art. no. 2006012. (2020: 13.281 - IF, Q1 - JCR, 3.785 - SJR, Q1 - SJR, karentované - CCC). (2021 - Current Contents). ISSN 1613-6810. Available at: <https://doi.org/10.1002/sml.202006012>



Microfluidic platform.

- a) Schematic representation of the microfluidic cassette. Electrodes (yellow) are placed in two microfluidic channels. An electric current flows between the electrodes through the pores in the membrane (dashed line).
- b) Scheme of the experimental setup with two modules for parallel or series operation

Surface-initiated polymerizations as a tool for the preparation of materials with functional surfaces in order to achieve targeted properties

Polymer Institute SAS

Solvers: Markéta Ilčíková, Gamal Zain, Katarína Mosnáčková, Ana Hološ, Alena Opálková Šišková, Jozef Kollár, Jaroslav Mosnáček

Projects: CEMEA, POLONEZ, APVV-19-0338, SAIA

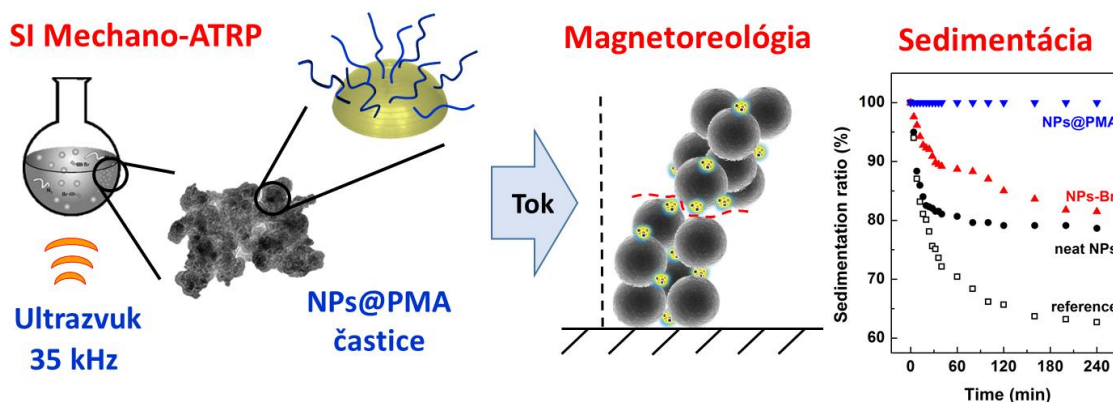
As part of cooperation with foreign research groups, modern polymerization techniques developed at ÚPo SAV were used to modify the surfaces of various nanomaterials to achieve the required properties:

a) The recently developed ultrasound-assisted radical polymerization was used for the first time to modify the surfaces (SI Mechano-ATRP) of magnetic iron oxide nanoparticles, achieving a significant increase in the stability of a magnetorheological suspension with increased tensile strength after application of a magnetic field;

b) ATRP was also used for the simultaneous modification and reduction of graphene oxides, while an electrically conductive composite material was prepared in one step;

c) By modifying the surface of carbon nanotubes by a combination of polymerization techniques, a material composed purely of nanoparticles capable of photoactuation was prepared for the first time;

d) Photochemical polymerization (photoATRP), developed at ÚPo SAV, was used to prepare cotton textiles with an antibacterial surface.



Ultrasound-assisted polymerization from the surface of magnetic particles used for the

preparation of a stable magnetorheological suspension with an increased tensile strength after the application of a magnetic field

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What genetic analysis reveals about pine pathogens

Institute of Forest Ecology SAS

Solvers: Zuzana Jánošíková, Katarína Adamčíková, Emília Ondrušková

Projects: APVV SK-FR-2017-0025, COST FP1102 DIAROD, VEGA 2/0077/18

Dothistroma septosporum is the primary pathogen of red powdery mildew of pines, the world's most significant foliar disease of pines. The results of the genetic diversity and population structure of Slovak populations of the pathogen indicate that it is a long-term occurring pathogen in Slovakia with an existing asexual and sexual mode of reproduction, spreading both naturally and artificially. Genetic analysis and modelling of historical and evolutionary scenarios revealed that the Northeastern European population of *D. septosporum* is ancestral to all other European populations and also to the North American population.

Diplodia sapinea has been a cosmopolitan endophyte and opportunistic pathogen of conifers in Europe for at least 200 years, but its incidence has increased in recent decades. In this work, we studied the genetic structure of European and West Asian populations of *D. sapinea* from 15 countries. Slovakia was represented in the study by 92 isolates of the fungus from 11 locations and seven species of pine. Populations were characterized by high uniformity and low genetic distance between them. Most of the Slovak isolates belonged to the group that dominated the European population.

The results of analyses of the genetic structure of pathogens offer insight into the way and direction of their spread, the extent of variability that may be related to their virulence and developmental potential, such as the ability to adapt to changing environmental conditions.

This knowledge can be used to develop a suitable strategy for the management and protection of overgrowth, or it can be used to determine the intensity of the risk of damage to the host.

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Available at: <https://doi.org/10.3390/jof7080634>

Scientific Section 3 (Social Sciences, Humanities, Arts, and Culture)

How do people in different countries perceive the appropriateness of responses to violations of social norms?

Centre of Social and Psychological Sciences SAS, Institute of Experimental Psychology SAS

Solvers: Kimmo Eriksson, Pontus Strimling, Peter Halama, Paul van Lange

Within the framework of the international network of researchers called International study of meta-norms, which is coordinated by Stockholm University in Sweden, cross-cultural research on the perception of what appropriate responses can be used in response to violations of social norms was carried out. The findings of the 57-country study pointed to both cultural universals and cultural variations. A universal negative relationship was identified between ratings of the appropriateness of norm violations and ratings of the appropriateness of responses in the form of confrontation, social ostracism, and defamation. Differences were found within the various sanctions. In countries where the use of physical confrontation and social ostracism is considered less appropriate, defamation is considered more appropriate. The preference of different reactions was also related to the socio-economic-psychological characteristics of the countries, e.g. physical aggression was perceived as more appropriate in countries with lower incomes, low gender equality, higher presence of infectious diseases, etc.

ERIKSSON, Kimmo - STRIMLING, Pontus - ... - HALAMA, Peter ... - VAN LANGE., Paul. Perceptions of the appropriate response to norm violation in 57 societies. In *Nature Communications*, 2021, vol. 12, no. 1, p. 1-11. (2020: 14.919 - IF, Q1 - JCR, 5.559 - SJR, Q1 - SJR, karentovaná - CCC). (2021 - Current Contents). ISSN 2041-1723.

Modelling the network of illegitimate capital flows in European countries

Institute of Economic Research SAS

Solvers: Mária Širaňová, Menbere Workie Tiruneh, Boris Fišera

Project: APVV-15-0666

Current empirical literature dealing with the issue of illegitimate capital flows often considers this problem a negative "privilege" of developing countries. However, a series of scandals linked to

leaked documents related to activities in offshore centres (Panama Papers, Paradise Papers) have shown that this assumption may not always be justified. The aim of the contribution of the author and authors from the Institute of Economic Research SAS is to model the network of illegitimate capital flows in European countries and analyse the potential fundamental factors affecting the structure of such a financial network. The article used information from the Errors and mistakes item reported in the balances of payments of individual countries as proxy variables for capturing the volume of illegitimate capital flows. The connections in the thus created network were estimated using Granger causality using shifting time windows. In the next step, the impact of selected economic determinants on the creation of connections in the network of illegitimate capital flows was analyzed using a two-stage probabilistic Cragg tobit estimate. The results of the analysis show that while the probability of a connection between two countries in the network of illegitimate capital flows depends primarily on the differential of long-term interest rates, the frequency of the occurrence of such connections reflects the strength of bilateral economic relations between countries, whether measured through the volume of foreign trade or amounts of direct foreign investments. An equally important factor is the level of quality of institutions and the difference in tax rates between business partners.

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History of the phenomenon of Czechoslovakism

Institute of History SAS

Solvers: Adam Hudek, Michal Kopeček, Jan Mervart

The result of the continuing international cooperation of the HÚ SAV with the Institute of Contemporary History (ÚSD) of the Czech Academy of Sciences was the preparation of a publication on the history of Czechoslovakism for the English publishing house Routledge as part of the *Histories of Central and Eastern Europe* series. The work took place within the framework of solving several projects of both partner organizations related to the given issue. The book was published in autumn 2021 as a significantly revised and supplemented version of the publication published in 2019 by the Czech publishing house Lidové noviny. For the first time, the work presents to an international audience a clear history of the phenomenon of Czechoslovakism from the middle of the 19th century to the end of the 20th century in the broader context of the history of nationalism and intellectual history. Scientists from HÚ SAV, Institute of Political Sciences SAS,

Comenius University, ÚSD AV ČR, Masaryk Institute AV ČR, Institute of Philosophy AV ČR, Charles University in Prague and the University of Oslo collaborated on the book. The publication has the potential to become a standard work on the issue of the development of nationalism in Central and Eastern Europe. Its editors will present it in April 2022 as part of the British Association for Soviet, Slavonic and East European Studies congress at the University of Cambridge.

HUDEK, Adam – KOPEČEK, Michal – MERVART, Jan. *Czechoslovakism*. Abingdon; New York: Routledge, 2022. 490 s.



III. EDUCATIONAL ACTIVITIES AND SCIENTIFIC QUALIFICATION OF EMPLOYEES

SAS organizations actively participate in third-level higher education (doctoral studies) as external educational institutions based on framework agreements concluded with individual universities and their faculties. 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” with the relevant universities. Currently, SAS institutes have concluded 132 agreements on doctoral studies with the faculties of universities in the Slovak Republic. The most important partners of SAS institutes in doctoral studies are the Comenius University (65 agreements) and the Slovak University of Technology (26 agreements), which are ranked best in international rankings. A total of 119 agreements (90%) are concluded with universities belonging to the Association of Research and Technical Universities of the Slovak Republic. An overview of the number of agreements with universities and their faculties is in table no. III.1.

Table no. III.1 (Part 1)

The number of framework agreements with an external educational institution for participating in the implementation of doctoral study programs concluded as of 31. 12. 2021

University/College	Faculty	Number of agreements
Comenius University in Bratislava	Faculty of Natural Sciences	34
	Faculty of Medicine	3
	Jessenius Faculty of Medicine	1
	Faculty of Mathematics, Physics and Informatics	7
	Faculty of Arts	14
	Faculty of Social and Economic Sciences	5

	Faculty of Law	1
	UK total	65

Table no. III.1 (Part 2 - continued from the previous page)

The number of framework agreements with an external educational institution for participating in the implementation of doctoral study programs concluded as of 31. 12. 2021

Slovak University of Technology in Bratislava	Faculty of Electrical Engineering and Information Technology	5
	Faculty of Chemical and Food Technology	15
	Faculty of Informatics and Information Technologies	1
	Faculty of Materials Science and Technology in Trnava	1
	Faculty of Mechanical Engineering	2
	Faculty of Civil Engineering	2
STUBA total		26
Pavol Jozef Šafárik University in Košice	Faculty of Science	10
	Faculty of Arts	4
UPJŠ total		14
University of Veterinary Medicine and Pharmacy in Košice	UVLF total	6
Technical University of Košice	Faculty of Materials, Metallurgy and Recycling	3
	Faculty of Mechanical Engineering	1
	Faculty of Electrical Engineering and Informatics	2
TUCE total		6
Constantine the Philosopher University in Nitra	Faculty of Arts	3
	Faculty of Natural Sciences and Informatics	1
UKF total		4
Technical university in Zvolen	Faculty of Ecology and Environmental Sciences	1
	Faculty of Forestry	1
TUZVO total		2
Slovak University of Agriculture in Nitra	Faculty of Biotechnology and Food Sciences	1
	Faculty of Horticulture and Landscape Engineering	1
SPU total		2
Alexander Dubček University of Trenčín	TNUNI total	1

University of Trnava	Faculty of Education	1
	Faculty of Philosophy and Art	3
TRUNI total		4
University of Economics in Bratislava	Faculty of National Economy	2
EUBA total		2
SAS as a whole		132

SAS scientific organizations cooperate with several universities and colleges throughout Slovakia in solving domestic and foreign projects (VEGA, APVV, Horizon 2020 programmes, etc.). In 2021, SAS institutes were partners of colleges in 173 VEGA projects and 81 APVV projects (Fig. III.1).

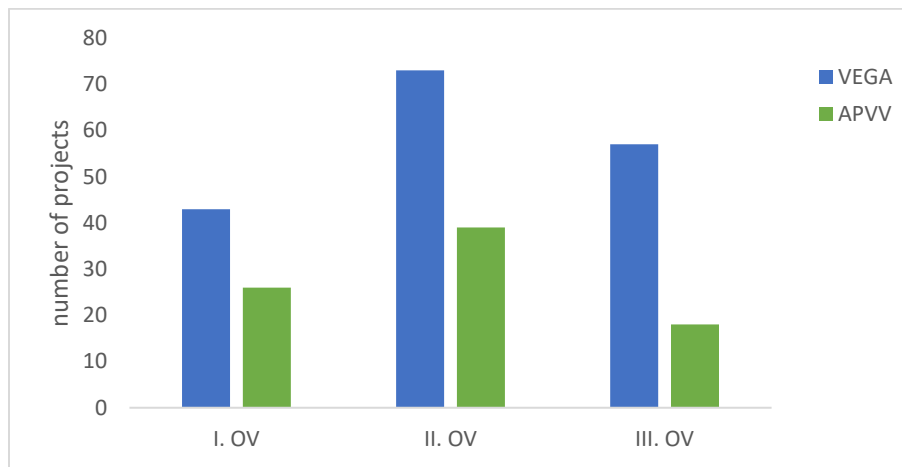


Fig. III.1 Number of solved VEGA (blue columns) and APVV (green columns) projects in which SAS institutes were partners of colleges in individual Scientific Sections (OV). The distribution between Scientific Sections corresponds to the ratio of their sizes.

Development of the number of researchers and doctoral students

The number of SAS researchers has a very slight growing trend. The number of doctoral students has stabilized in the last five years (Fig. III.2).

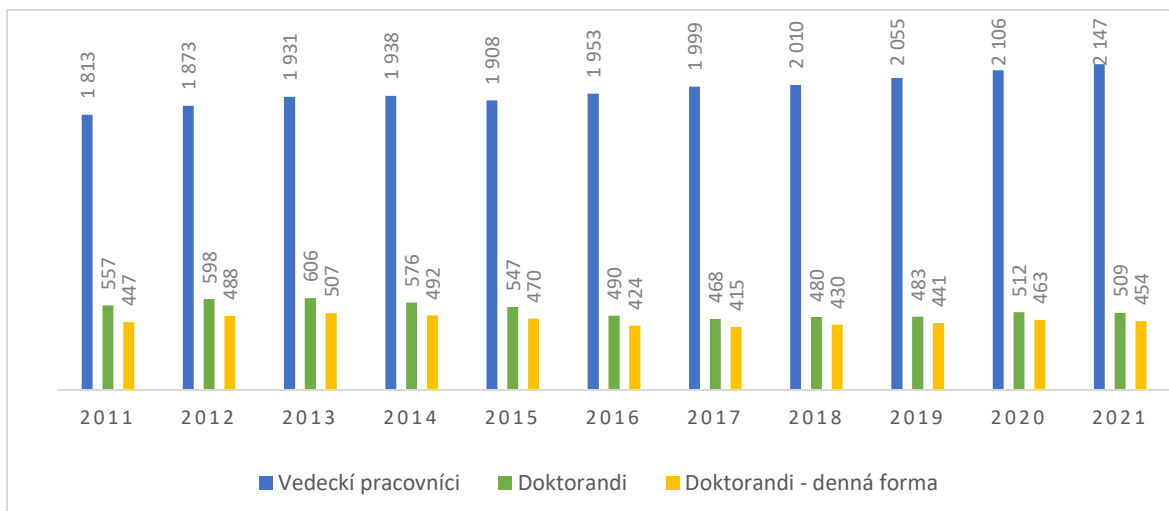


Fig. III.2 Development of the number of researchers and doctoral students from 2011-2021

SAS workplaces had a total of 509 doctoral students, of which 454 full-time doctoral students and 55 part-time doctoral students. There were 112 newly admitted doctoral students for internal doctoral studies with a topic assigned by the SAS. In addition, SAS employees worked as main supervisors for 66 doctoral students at universities, which points to further scientific and pedagogical capacity of SAS workplaces. The number of foreign doctoral students slightly decreased. Their share in the total number of students is 19.5% (Fig. III.3). The main obstacle to the faster internationalization of doctoral studies is the lengthy and complicated processing of the necessary documents by applicants from third countries. Last year, several admitted PhD students from third countries did not start their studies after all, because they did not manage to get an entry visa even after several months and gave preference to other countries. In order to facilitate the immigration process, a Euraxess point was established at the SAS in 2020. Currently, two female employees participate in its activities, helping foreign students with the preparation of the necessary documents.

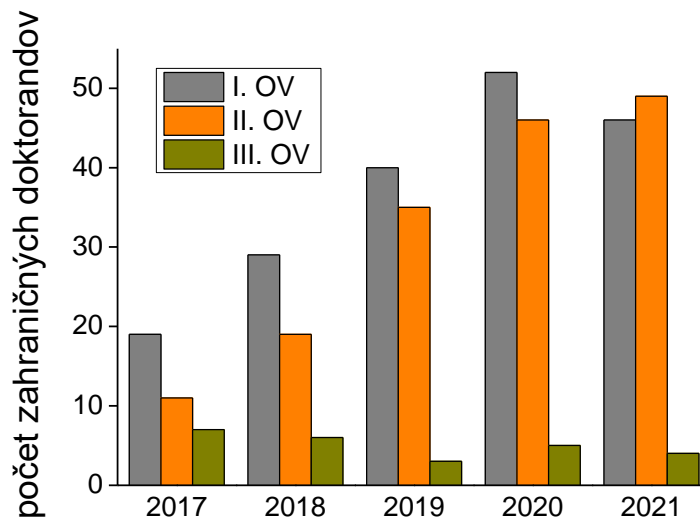


Fig. III.3 Development of the number of foreign doctoral students by Scientific Sections (OV) in the years 2017-2021.

89 doctoral students completed their doctoral studies with a habilitation. Of them, 53 were employed in research (SAS, universities, abroad), 15 were employed outside research in their field, 2 were employed outside their field, and 2 were unemployed for some time. In 17 cases, SAS organizations do not have information about the practical application of their doctoral graduates.

In 2021, there were approximately 50% more female students than doctoral students in the entire SAS (Fig. III.4).

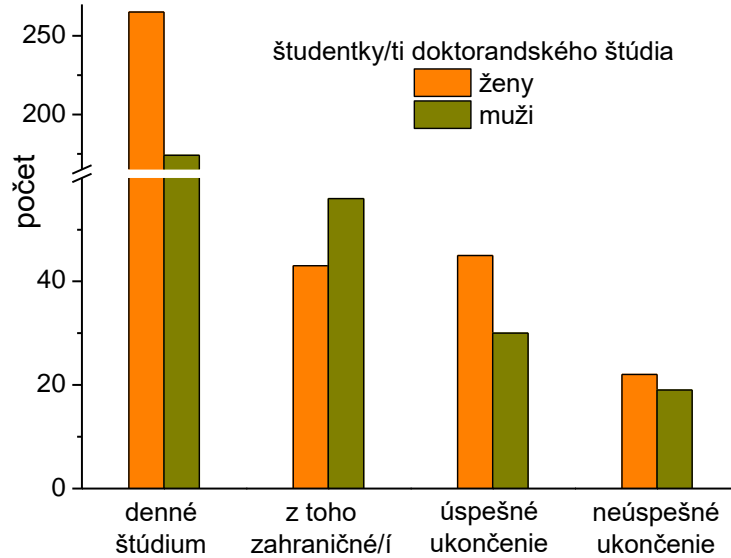


Fig. III.4 Gender composition of PhD students at the SAS in 2021

In the case of foreign students, on the other hand, men slightly predominate. The number of successful graduates copies the overall composition, in the case of unsuccessful or early terminations, the gender ratio is balanced.

After stagnation in 2014-2016, the net monthly income of doctoral students began to grow, and in 2020, it reached €807.50 before and €940.50 after the dissertation exam (Fig. III.5). Such a scholarship amount was guaranteed to all students from central funds in 2021, individual institutes can, e.g. based on good performances, increase scholarships for specific doctoral students. The median gross salary in Slovakia in 2020 (data for 2021 is not yet available) was €1,081, which corresponds to a net salary of €829.72 in 2021. After starting their doctoral studies, students reach the median income in Slovakia until they take the professional exam. SAS provides cost-effective accommodation in its accommodation facilities (see the chapter on management activities). In connection with the Covid-19 pandemic, one smaller accommodation facility was assigned for quarantine accommodation of workers arriving from countries for which mandatory quarantine was ordered.

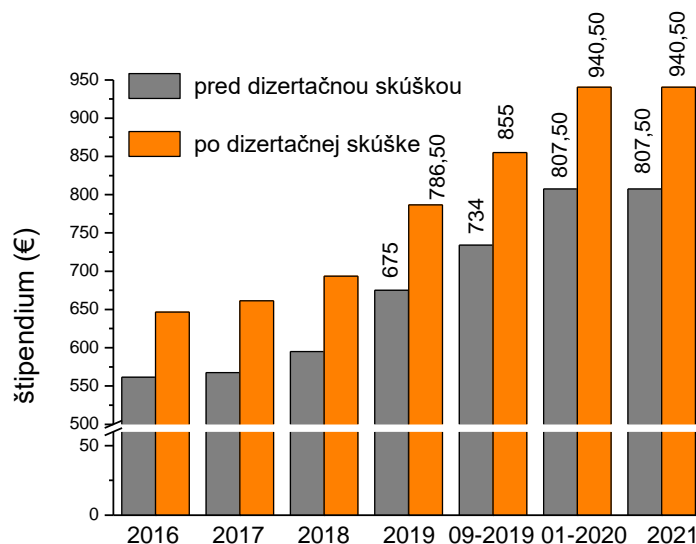


Fig. III.5 Development of the net monthly income of doctoral students before and after passing the dissertation exam in 2016-2021.

The net monthly tabular income of a recent graduate of doctoral studies after starting a job at SAS will drop - in 2021, the basic starting net salary was €792.90 (in salary class T8 of the salary scale and salary level 2 according to Annex No. 5 of the Decree of the Government of the Slovak Republic No. 338/2019 Coll.) For this reason, SAS offered in 2021 a competitive compensation allowance in the amount of €150/month to balance the difference between the scholarship and the net monthly income of a young researcher after starting a job. Presidium of SAS increased the wage fund of the organization by €75, and €75 was provided by the organization from its own funds. In 2021, 21 graduates received a compensation allowance.

SAS also supports young researchers through the Štefan Schwarz Support Fund. Institutes in which successful applicants work will receive from central sources a salary fund in the amount of 100% of the tariff salary in salary class T8 of the salary scale and salary level 4, including levies, and the scholarship holders will receive an additional payment from the organization for two years (with the possibility of extension by one year) to the salary of at least €300 per month. In 2021, 17 postdoctoral students received a grant from 15 organizations.

The education and scientific work of PhD students and post-doctoral students at SAS is of a standard high quality, which is reflected by their success in competitions such as Student Personality of Slovakia or the ESET Science Award. Ladislav Valkovič, who works at the Institute of Measurement Science SAS and the Oxford Centre for Clinical Magnetic Resonance Research at the University of Oxford, became the laureate of the ESET Science Award in the Exceptional Young Scientist category. As part of the ESET Science Award event, in addition to the main categories, there was also a competition for the best essay on the topic Is science the solution to

everything? The winner was chosen by the Nobel Prize laureate and chairman of the ESET Science Award committee – Kip Thorne. The award for the best essay went to Roman Burič, who works as a doctoral student at the Centre of Social and Psychological Sciences SAS at the Institute of Experimental Psychology. The significant Danubius Young Scientist Award 2021 was won by a young scientist nominated by the Slovak Academy of Sciences, Veronika Szeghy-Gayer, PhD., from the Centre of Social and Psychological Sciences SAS, Institute of Social Sciences. Ing. Lucia Pažitná from the Institute of Chemistry became the XIII winner of the Preveda Interactive Conference of Young Scientists 2021.

Within the framework of cooperation with colleges and universities, SAS employees participated the most in the lecturing activities of universities - 263 employees gave 9,663 hours of lectures at home, and 35 employees gave 1,236 hours of lectures abroad, exercises and seminars were led by 188 employees at home (10,785 hours) and 14 employees (489 hours) abroad. An important part of the pedagogical activity is the management of diploma and bachelor's theses: 369 SAS employees supervised 785 diploma and bachelor theses, 237 employees opposed 356 dissertation and habilitation theses. 350 supervisors, who also supervised for other institutions, acted as the main supervisors of doctoral students, supervising a total of 575 doctoral students. SAS employees worked as members of committees for PhD defences (249), committees for the defence of doctoral dissertations (50), as members of committees, or opponents in inaugural or habilitation proceedings at universities (106).

Qualification structure of SAS employees

As of 31. 12. 2021, 2,147 researchers worked at SAS workplaces, of which 233 were doctors of science and 1,914 CSc. and PhD. (permanent staff). In 2021, 6 SAS employees received the scientific title of DrSc., and 13 SAS employees of SAS obtained scientific-pedagogical titles. Compared to last year, the number of researchers with scientific-pedagogical titles increased. There are 132 professors and 161 Associate Professors working at SAS. According to the qualification structure, there were 269 leading researchers and 1,013 independent researchers working at the SAS.

121 proposals for awarding scientific qualifications were submitted to the SAS Commission for Assessing the Scientific Qualification of Employees, of which 53 were from the Slovak Academy of Sciences, 68 from the Ministry of Education, Science, Research and Sports of the Slovak Republic. The Commission discussed 5 proposals for awarding scientific qualification level I and 116 proposals for awarding scientific qualification level IIa. It awarded a total of 117 scientific qualifications.

IV. SAS IN THE INTERNATIONAL CONTEXT

IV.1 SAS in the European Research Area

From the point of view of international cooperation, the year 2021 was significant for the Slovak Academy of Sciences on several levels. SAS used its potential, for example, in the co-organization of the Innovation Day with the participation of forty-four ambassadors accredited in the Slovak Republic together with the Ministry of Foreign and European Affairs of the Slovak Republic. On the grounds of the Institute of Virology of the Biomedical Research Center SAS, in addition to the representatives of the Slovak Republic and diplomatic representatives, there were also State Secretary of the Ministry of Foreign and European Affairs of the Slovak Republic Ingrid Brocková and State Secretary of the Ministry of Education, Science, Research and Sport of the Slovak Republic Ľudovít Paulis. Activities in the fight against the pandemic and international activities such as the European Virus Archive Global project were presented to the diplomatic corps. It institutionalized its cooperation with the SAS Department of Diplomacy by signing a Memorandum of Cooperation. Both parties thus confirmed that they are aware of the importance of science and research as one of the effective tools for developing international cooperation. Both parties are interested in jointly advocating for the enlightenment of "professional" public opinion based on scientific knowledge, professional presentations and opinions to prevent the spread of hoaxes in society. In 2021, SAS presented the International SAS Award to Antoine Marès, emeritus professor of history at the Sorbonne University in Paris. In 2021, the SAS was also active on a bilateral level, e.g. It actively participated in negotiations with partners from France (CNRS, CEFRES), from Taiwan (during expert scientific negotiations with representatives of the Taiwanese delegation in the Slovak Republic in October 2021) and from other countries. Another pillar of SAS activity in the field of international relations is cooperation with international scientific organizations, such as ALLEA (All European Academies), EASAC (European Academies Science Advisory Council) and ISC (International Science Council). It is through cooperation with these institutions that it tries to promote enlightenment in the form of public opinion based on scientific knowledge. SAS also develops cooperation within UNESCO, CERN, ESA and other groups. In several of these organizations, SAS represents other scientific institutions from Slovakia. International cooperation within the SAS is managed by the Vice-President for foreign relations and her representatives. They ensured the participation of the SAS in various programmes such as ERA-NET, European Partnerships, SAS Joint Research Projects, the bilateral Mobility programme, etc. They supported excellent research and increased the possibility of SAS scientists to succeed in ERC challenges through the Seal of Excellence or SAS-UPJŠ ERC Visiting Fellowship Grants programmes. Many activities in the field of international cooperation, such as

meetings of governing bodies of international associations, project management and consortia announcing and evaluating calls for project submissions, project monitoring and evaluation, as well as international conferences, have moved to the online space.

ISC (International Science Council) brings together international scientific societies and member organizations at the level of national representations. 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. Dušan Gálik was the SAS representative in the ISC until June 2021, he was then replaced by Zuzana Panczová, who participated in several ISC meetings, including the ISC General Assembly in October 2021.

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. She was replaced by Michal Kšiňan.

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. Mária Omastová was the representative of the SAS in EASAC until June 2021. She was replaced by Karol Marhold, who attended two meetings of the EASAC Council.

ESA (European Space Agency) is an intergovernmental organization of 22 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. Also in 2021, cooperation within the ESA project was financially supported by 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, which are concluded in accordance with the principles of the Mobility programme from 2020. SAS signed bilateral agreements within the framework of this programme with partner organizations in Bulgaria, the Czech Republic, Serbia and Italy.

During 2021, negotiations were held with other partners such as South Korea, China, Taiwan, Israel, Norway, Greece, Spain and Great Britain. A new cooperation protocol with DAAD and a new cooperation agreement and implementation protocol with the Romanian Academy were signed. Similar agreements are also being prepared with other long-term partners from the V4 countries – Hungary and Poland, and negotiations are held to establish closer cooperation with the CEFRES institute (French Research Center in Humanities and Social Sciences based in Prague). In accordance with the concluded agreements, calls for projects were announced in 2021 under the Mobility programme with the Romanian Academy of Sciences. In 2021, a Memorandum of Cooperation was also signed with Academia Sinica in Taiwan. SAS is also negotiating the conclusion of other Memorandums of Cooperation with institutions in this country. In 2022, it is planned to announce calls for submission of projects with the mentioned partner countries for the period of 2023-2024, as well as a new call for submission of Open Mobility projects.

In cooperation with the Computing Centre of SAS, a new website of the Department of International Cooperation of the SAS was created, on which, starting in 2022, all current calls for submitting projects under the Mobility programme with individual partner countries and the Open Mobility programme will be published.

Multilateral scientific cooperation

Horizon 2020 and Horizon Europe projects

In 2021, the SAS organizations participated in the research of 49 projects within the Horizon 2020 and Horizon Europe programmes, the EU framework programmes. Teams from SAS participated in the preparation of 60 Horizon 2020 and Horizon Europe project proposals, of which 11 proposals in the position of coordinator.

COST projects

The European Cooperation in Science and Technology (COST) programme 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 2021, SAS teams participated in a total of 100 COST projects.

ERA-NET and European Partnership projects

The ERA-NET (Horizon 2020) and European Partnerships (Horizon Europe) are specific EU tools for coordinating national research programmes through national agencies. The ERA-NET and Co-funded European Partnerships programmes are carried out in the COFUND scheme, which means that part of the funds that the agencies spend on solving projects (up to 30% depending on the consortium agreement) 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 2021, SAS was a member of 23 ERA-NET coordination projects and 1 in a Co-funded European Partnership project. In 2021, SAS teams participated in the research of 28 research projects (in 2020, it was 29 projects, in 2019, 26 projects).

Other projects

Other programmes with the participation of SAS organizations include the International Visegrad Fund (IVF), within which 11 projects were solved at SAS, and UNESCO (5 projects). In cooperation with UNESCO, the SAS participated in the International Hydrological Program (IHP). SAS workplaces were also represented in other important international programmes, such as IAEA, NATO, IEA, INES, CERN and EMPR.

IV.2 Cooperation with economically and research developed countries

Taiwan

Under the bilateral scientific cooperation agreement between SAS and MOST Taiwan, SAS organisations solved 7 research projects with Taiwanese partners in 2021. Due to the COVID-19 pandemic, the research of 2 projects was interrupted. In February 2021, the 13th call for research projects submission for the years 2022 - 2024 without topic restriction, was announced, open to all SAS organizations. Nine 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 research solution in January 2022.

Turkey

SAS cooperates with Turkey based on an agreement with TÜBİTAK (The Scientific and Technological Research Council of Turkey). The Joint Research Projects (JRP) programme is carried out as part of the agreement. In 2021, 6 joint bilateral projects were solved.

Japan

Cooperation with Japan is carried out through two types of project programmes:

- V4-Japan. In 2021, active cooperation between the V4 countries and Japan was renewed in the JRP (Joint Research Projects) format aimed at supporting joint research projects and intensifying scientific and technical cooperation in the field of materials research. Based on the evaluation of the results of the 2nd joint call, the financing of five projects co-financed by the participating parties was approved. Three of them started to be solved at the end of 2021, the start of the remaining projects is expected in 2022.
- EIG CONCERT Japan is a programme 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 2021, three projects were solved with the participation of the SAS from the 6th joint call (2019) Smart Water Management for Sustainable Society. In 2021, SAS also collaborated on the organization of the 8th joint call on Sustainable Hydrogen Technology as Affordable and Clean Energy.

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. The last call was organized in 2017, and in 2021, one project was solved with the participation of the SAS institute. In 2021, the SAS cooperated with the Ministry of Education, Science, Research and Sport of the Slovak Republic on commenting on the forthcoming new memorandum on cooperation between the V4 countries and the Republic of Korea.

IV.3 Other activities in the development of international cooperation

V4 academies cooperation and a cooperation with the Czech Academy of Sciences

The meeting of the representatives of the V4 academies of science scheduled for an alternative date on November 25 – 26, 2021, in Budapest had to be postponed again to a later date due to the COVID-19 pandemic. The event will take place on a second alternative date in the first half of 2022 when the development of the pandemic situation allows it. Likewise, the planned meeting

of the representatives of the SAS and the Czech Academy of Sciences, which was supposed to take place in the Czech Republic, did not take place. This meeting was also postponed to 2022.

Participation of SAS delegations in meetings abroad:

- discussion on the activity strategy of the Centre of Operations SAS with representatives of the Czech Academy of Sciences; September 13, 2021, Prague (Czech Republic)
- "Czech Head" award ceremony; October 26, 2021, Brno (Czech Republic)
- the first meeting of the Working Group for Economic Cooperation of the SAS - Taiwan and the signing of the Memorandum of Understanding between the SAS and Academia Sinica; December 4 - 11, 2021, Taipei (Taiwan)
- the third part of the conference on the future of Europe with regard to European democratic rights, values and security; December 9 - 12, 2021 Florence (Italy)
- the "Space Week" event organized as part of the world exhibition EXPO 2020 DUBAI; October 17 – 23, 2021 Dubai (United Arab Emirates)
- negotiations with representatives of the Czech Academy of Sciences and participation in the Round Table International focused on the safety of research in international scientific cooperation; October 4 – 5, 2021 Prague (Czech Republic)

Due to the COVID-19 pandemic in 2021, no further sending of SAS representatives to major negotiations and congresses took place.

Significant receptions at SAS

- **On March 16, 2021, the President of the SAS, Pavol Šajgalík, welcomed the Ambassador of the Hellenic Republic, J. E. Georgios Dimitriadis.**
SAS representatives agreed with the Greek Ambassador to develop proposals for possible future cooperation, who will interpret them to the relevant institutions of the Hellenic Republic.
- **On May 17, 2021, the President of the SAS, Pavol Šajgalík, welcomed the Ambassador of the Federative Republic of Brazil, H.E. Eduardo Gradilone, at the Academy.**
The topic of the meeting was mutual cooperation in the field of science and research. Based on the results of this survey, a professional seminar with the participation of researchers from the SAS and Brazil, with the aim of establishing cooperation with a specific partner institution in Brazil based on joint projects is planned to be organized.
- **On May 19, 2021, the President of the SAS welcomed the Austrian Ambassador, J.E. Margit Bruck-Friedrich.**
The main topic of the visit was an overview of cooperation in the field of science and

research between Austria and the Slovak Academy of Sciences and the possibilities for its further development.

- **Innovation day with ambassadors**

On July 1, 2021, the Slovak Academy of Sciences co-organized the so-called Innovation day with foreign ambassadors at the Biomedical Research Center SAS.

- **Meeting of the Slovak-Korean committee**

The meeting of the Slovak-Korean committee was held on June 29, 2021, at the Slovak Centre of Scientific and Technical Information. The Korean delegation was led by the Director General of the International Cooperation of the Ministry of Science and ICT (MSIT KR) with the participation of representatives of the National Research Foundation of Korea (NRF) and the Korea Research Institute of Bioscience and Biotechnology (KRIBB). The meeting evaluated the mutual cooperation between the SAS, the Ministry of Education, Science, Research and Sport of the Slovak Republic and the NRF. At its conclusion, a Memorandum of Cooperation was signed between the Institute of Chemistry SAS and KRIBB.

- **Reception of the Italian Ambassador by the SAS President**

On the occasion of taking office on July 29, 2021, the President of the SAS, prof. Pavol Šajgalík, welcomed the Ambassador of the Italian Republic, J.E. Catherine Flumiani. The topic of the meeting was mainly getting to know the previous scientific cooperation between the SAS and Italian research institutions and the prospects for further joint projects.

- **Reception of the head of the Taipei representative office**

On September 17, 2021, the head of the Taipei representative office in Bratislava, David Lee, visited the SAS. He was accompanied by Claudette Li-Chin LIN, Deputy of the Policy Department and Zoya Wang, who is responsible for Education and Scholarships. The aim of the meeting was to discuss the planned visit of members of the government of Taiwan to Slovakia in October 2021. Another reception of the head of the Taipei representative office was held at the President of the SAS on December 20, 2021.

- **Meeting of representatives of the SAS with representatives of the Taiwanese delegation in Slovakia**

The Taiwanese delegation visited the Slovak Republic on October 21 – 23, 2021. The delegation was led by Mr. Tsung-Tsong Wu - Minister of Science and Technology, and Mr. Ming-Hsin Kung – head of the National Development Council. The meeting of SAS representatives with some members of the delegation took place at the premises of the

SAS Small Congress Centre of the VEDA publishing house on October 21, 2021. Its goal was to discuss new possibilities for mutual scientific cooperation.

- **Cooperation with France**

In 2021, several meetings of SAS representatives took place with representatives of the French Cultural Institute and the CNRS. SAS organizations were offered the opportunity to participate in the call for cooperation with French institutions, and a webinar focused on the topic of creating joint teams between research workplaces and universities also offered important information.

- **Reception of designated ambassadors of the Slovak Republic to the Kingdom of Norway, the Italian Republic and Sweden**

In the course of 2021, President of the SAS, prof. Pavol Šajgalík received the designated ambassadors of the Kingdom of Norway, the Italian Republic and Sweden in order to discuss the possibilities of further development of scientific cooperation with scientific institutions in the mentioned countries.

V. MANAGEMENT AND EMPLOYMENT

By the end of 2021, the Slovak Academy of Sciences had 22 budgetary organizations and 26 contributory organizations. Compared to 2020, there has been no change.

In accordance with § 15 Sec. 6 of Act No. 133/2002 Coll. on the Slovak Academy of Sciences, 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 at SAS in 2021.

When drawing funds, valid legislation, principles within the framework of individual programmes, functional and economic classification, and binding expediency of their use were observed. All organizations were involved in the budget information system of the State Treasury.

The approved revenue budget for 2021 amounted to EUR 1,000,000. In fact, the budget organizations of the SAS transferred funds in the amount of EUR 1,870,988 to the revenue account of the state budget.

Table V.1: Structure of budget revenue

Hlavná kategória/kategória	Schválený rozpočet	Upravený rozpočet	Skutočnosť	% k upravenému rozpočtu
200-Nedaňové príjmy	1 000 000	1 000 000	1 870 998	187,10
210-Príjmy u podnikania a vlastníctva majetku	125 000	18 634	14 081	75,56
220-Administratívne a iné poplatky	375 000	389 930	394 601	101,20
230-Kapitálové príjmy	500 000	430 651	1 300 423	301,97
290-Iné nedaňové príjmy	0	160 785	161 894	100,69

In the approved budget for 2021, the chapter had a breakdown of the total expenditure budget in the amount of EUR 83,600,429. During the year, the budget for total expenditure was adjusted based on budgetary measures to the amount of EUR 89,459,789. An increase of EUR 8,917,451 and a decrease of EUR 3,058,088 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 2020 in the amount of EUR 1,573,729,
- 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 1,163,250,
- an increase in the expenditure budget ensured by the commitment of expenditure in other chapters,

- an increase in expenditure due to the loss of income of contributory organizations in connection with the COVID-19 disease in 2021 in the amount of EUR 875,240,
- an increase in expenditure intended for the fulfilment of amendments no. 1 to collective agreements of a higher level for the year 2021 in the amount of EUR 1,427,415,
- an increase in expenditure for the Institute of Neuroimmunology SAS, to support the instrument infrastructure aimed at analyzing COVID-19 and for the SAS to implement a system program for complex cognition and critical thinking in the form of experiential education in the amount of EUR 580,000.

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 programmes structured into sub-programmes and elements.

Budget organizations of the SAS as of 31. 12. 2021, drew funds in the total amount of EUR 89,441,576 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 87,944,412,
- expenditures for joint programmes 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 1,497,164.

Of the total budget expenditures, current expenditures amounted to EUR 86,245,923 (of which the founder's contribution to the operation of SAS contributory organizations was EUR 58,131,94, a contribution to the CEMEA project in the amount of EUR 983,662 and travel reimbursement in the amount of EUR 6,306) and capital budget expenditures amounted to EUR 3,195,653 (of which the founder's contribution to SAS contributory organizations was EUR 1,974,978).

The average registered number of employees recalculated for 2021 was 847 persons in budgetary organizations. The level of the average salary for 2021 was EUR 1,634, of which EUR 1,507 from the state budget (data source report Práca 2-04, FIN 1-12).

The contributory organizations of the SAS achieved total revenues in the amount of EUR 85,121,185. Of the total revenues of contributory organizations, the contribution from the state

budget through the founder amounted to EUR 60,106,920 (of which: current EUR 58,131,942 and capital EUR 1,974,978).

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 4,969,880 and grants from domestic non-government entities amounted to EUR 330,706. 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 84,062,523, of which EUR 81,423,408 was current and the capital amounted to EUR 2,639,115.

The average registered number of employees recalculated in 2021 was 2,183.4 persons in contributory organizations. The level of the average salary was EUR 1,539, of which (source 111) EUR 1,247 from the state budget (data source report Práca 2-04, FIN 1-12).

The average registered number of employees recalculated in 2021 was 3,030,4 persons at the SAS. The level of the average salary was EUR 1,566, of which (source 111) EUR 1,320 from the state budget (data source report Práca 2-04, FIN 1-12).

Table V.2 Achieved level of average salary of researchers for 2021 in euros (DrSc., PhD., CSc.) – scientific organizations of the SAS

Year 2021	RO	PO
Source 111 ŠR	1,565.40	1,392.95
Other resources total	149.52	281.15
Average earnings total	1,714.93	1,674.10

Table V.3 Average salary according to the remuneration tables (Act No.553/2003 Coll.) for the year 2021 (data source report Práca 2-04).

Salary table	RO	PO
College and university teachers and research and development employees - Annex 5 of the Act	1,782	1,772

Basic table - Annex 3 of the Act	1,375	1,145
SAS total	1,634	1,539

VI. RESEARCH FOR SOCIETY

VI.1 SAS activities in the fight against the COVID-19 pandemic

The COVID-19 pandemic had a significant impact on SAS activities in 2021 as well. The complex situation showed 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, SAS took full responsibility for the extraordinary role it has in society and took the initiative in several areas to help in the fight against the disease. The activities were coordinated by the President of the SAS, who is also a regular member of the state's pandemic commission, through his own SAS crisis staff. It included experts from the SAS with corresponding competencies. These activities were also supported by the participation of several researchers in the advisory groups of the Crisis Staff of the Slovak Republic, in the public activities of the Science Helps initiative, and also an exceptionally high number of media appearances to inform the public about scientific knowledge about the virus, its spread and the necessary anti-epidemic measures.

The main role was again 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, virus isolation, elucidating its genomic structure, immune responses to infection, and 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. The main scientific results of these activities are described in more detail in Chapter 2 of this report.

Other SAS organizations also intensively participated in the fight against the pandemic within their capabilities and competences:

- The **Institute of Neuroimmunology SAS**, in cooperation with the biotechnology company AXON Neuroscience, participated in the development of original therapeutic antibodies against COVID-19 and, at the same time, in a large-scale study aimed at monitoring the immune response of patients who have overcome COVID-19 or individuals who have been vaccinated against this disease.
- The **Polymer Institute SAS**, the **Institute of Molecular Biology SAS** and the **Institute of Geotechnics SAS** focused on the detection and sterilization of virus-contaminated surfaces, or rather, of waste water, several institutes engaged in the research of suitable materials for respiratory protective devices (**Institute of Materials Research SAS, Polymer Institute SAS**).

- The **Institute of Materials and Machine Mechanics SAS** and the **Institute of Virology of the Biomedical Research Center SAS** developed an original large-capacity air purifier that can effectively remove pathogens in dispersed aerosols without the need to interrupt operations in the clean room. Although the primary goal of the project was to develop a device intended for the decontamination of premises from human coronaviruses, such as SARS-CoV-2, the new purifier will have much wider use, because the high temperature can eliminate practically all dangerous airborne microorganisms. In addition, hot air is able to destroy airborne bacteria. The purifier can help protect larger common spaces (waiting rooms, gyms, theatres, cinemas, etc.) or closed production spaces with a lot of staff movement or means of transport. The principle of the purifier has also been applied for patent protection.
- In 2021, the **Institute for Research in Social Communication SAS** and the **Institute for Sociology SAS**, in cooperation with the research agency MNFORCE and the communication agency Seesame, conducted six waves of a representative survey called *How are you in Slovakia?* in which they mapped feelings of threat, attitudes towards government measures and the behaviour of people in Slovakia during the COVID-19 pandemic. Survey studies helped the decision-making sphere in the optimization of the measures taken.
- The **Institute of Ethnology and Social Anthropology SAS** and the **Centre of Social and Psychological Sciences SAS** have created an original and practical tool for monitoring the SARS-CoV-2 pandemic in the environment of marginalized Roma communities in Slovak Republic for the needs of the Ministry of Health of the Slovak Republic.

VI.2 SAS activities for improving living conditions and better governance of society and the country

With its frankness, expertise, broad, almost universal focus and, last but not least, personnel background, SAS is predetermined to express itself on various issues of country management. SAS experts can respond impartially and with principled consistency to current problems resonating in public and responsibly influence the development of the state and society.

Providing systematic expert or consulting activities for the state sector, public administration, and self-government, as well as for the public in the entire spectrum of scientific fields, is already a

matter of course for several SAS employees. SAS researchers are proactively involved in the preparation and reminder of strategic documents, solving societal challenges and campaigns.

In 2021, SAS experts participated, e.g. in the preparation of the Water Plan of the Slovak Republic, the guarantor of which is the Ministry of the Environment of the Slovak Republic. The participation of the SAS was also active in the preparation of the so-called Green Agreement as the basic framework for the transition of EU countries to so-called carbon neutrality. Several SAS employees worked in professional groups of the Ministry of the Environment of the Slovak Republic (but also of other ministries and outside the field of environmental protection).

Towards the end of 2021, SAS and the circular economy platform Circular Slovakia signed a memorandum of cooperation. With this act, both parties declared the need to support synergies between scientific research and the private sector in order to find joint solutions to the challenges of the current unsustainable linear economy. The Circular Slovakia platform now unites 50 members from the public, private and non-governmental sectors, whose goal is to help Slovakia with the transformation to a circular economy. The founding members of the platform include the Ministry of the Environment of the Slovak Republic, the Institute for Circular Economy and the Slovak Environment Agency, the Embassy of the Kingdom of the Netherlands and the Netherlands Chamber of Commerce. Thanks to the involvement of the SAS, the platform was expanded to include a partner from the scientific and research community. The nearest output of the platform in the context of supporting cooperation with the scientific and research community is the prepared brochure on scientific and research and expert capacities in the circular economy, which also highlights the expertise of selected SAS researchers.

Since 2020, SAS has become a founding member of the Hydrogen Technology Research Centre (CVVT), which deals with research and development in the field of hydrogen technologies, as well as the use of hydrogen propulsion in the field of transport. CVVT has the ambition to integrate the entire scientific and research potential within the hydrogen chain in Slovakia. It is about ensuring production, transportation, storage and applications in various industries of the Slovak Republic. Within the department of the Ministry of Economy, the Academy was actively involved in the preparation of the National Hydrogen Strategy for the Slovak Republic, as well as the preparation of a stable Action Plan for the implementation and introduction of hydrogen technologies into life.

In the area of the Ministry of Education, Science, Research and Sport of the Slovak Republic, we participated in the preparation and setting of the rules for the participation of the Slovak Republic in international research infrastructures within the ESFRI framework. With regard to the ongoing epidemiological situation caused by the SARS-CoV2 virus in 2021, we continued to work on modelling tools for research on the spread of infectious respiratory diseases and the application of various epidemiological measures in Slovakia. In this area, we can also mention the modelling of protein structures of the virus, which would help in the treatment and prevention of the COVID-

19 disease. Several SAS institutes and centres actively participated in determining the level and activity of antibodies in the human body and, in this context, provided not only laboratory tests, but also pilot local sampling in Bratislava and other cities in Slovakia.

SAS participated in the preparation of the Partnership Agreement and the Slovak Operational Programme for the years 2021-2027. SAS experts were involved in the working group activities for the preparation of the RIS3 Smart Specialization Platform. The task of the RIS3 programme document is to define the vision, goals and measures based on the complex analytical part and the established priorities of the specialization of the economy in the field of research and development in Slovakia. SAS was also involved in the creation and updating of the National Vocational System in connection with innovations, digitization, new technologies and global challenges in the "Sector-driven innovations towards an efficient labour market in the Slovak Republic" project.

SAS provided documents for the new Medium-term Strategy for Development Cooperation of the Slovak Republic for the Ministry of Foreign and European Affairs of the Slovak Republic, specifically on the relations of the Slovak Republic with the Central European countries.

SAS prepared a manual entitled "Identifying evidence-based methods to effectively combat discrimination of the Roma in the changing political climate of Europe" for the Office of the Plenipotentiary of the Government of the Slovak Republic for Roma Communities and collaborated with the Office in the preparation of the Strategy for Equality, Inclusion and Participation of Roma by 2030.

Even in 2021, the SAS workers' research results found application in the decisions of the Slovak courts when solving legal problems that arose in the proceedings conducted by them. Decisions of the Constitutional Court and the Supreme Court are also based on knowledge formulated in SAS publications.

The Department of Architecture of the Institute of History SAS is continuously working on expanding the Register of Modern Architecture in Slovakia to include new architectural and urban works and urban structures. The Register is a relevant source of information for the state administration and municipalities: In 2021, the SAS provided searches from the works of the Register for applications for funds for the restoration of valuable architectural works from the Restoration Fund, and the Register also serves as a basis for the upcoming project of the Ministry of Transport and Construction of the Slovak Republic focused on the solution of energy efficiency in the framework of the historic restoration of the architecture of the 20th century.

SAS contributed to the verification of the State Educational Programme for pre-primary education in kindergartens. The concept of early literacy development should be based on a literacy-stimulating environment. Children's early literacy was examined in relation to socio-culturally sensitive predictors of reading and writing: text comprehension, meta-comprehension, meta-

cognitive monitoring and narrative production. Several SAS experts participated in the preparation of study materials and aids for distance learning during the pandemic. Some SAS programmes are also aimed at cooperation with primary and secondary schools and bring playful, entertaining forms of education to the soil of these institutions with the undisguised intent of awakening interest in science and scientific research in young talents. The cooperation of SAS organizations with universities and colleges is extensive, not only within the framework of doctoral studies (Chapter III.), but also through lecturing, conducting seminars, and bachelor's and master's theses.

VI.3 Professional SAS activities as a service for the country and society

Even in 2021, SAS organizations carried out several activities that are of service to the country and various spheres of society's life. SAS Experts have traditionally, and for a long time, ensured these activities thanks to their professional preparation, personnel background and technical infrastructure. In addition to traditional activities, new challenges also arise, within the framework of which SAS provides its expertise and professional activities for economic growth and better management of society and the country.

Scientific Section 1

- **Astronomical Institute SAS** carries out expert activities in assessing the findings of "meteorites", special phenomena and bodies in the atmosphere and provides the calculation of sunrise and sunset times for Slovak airports. In cooperation with the Astronomical Institute of the Czech Academy of Sciences in Ondřejov, they operate four stations of the European Fireball Network in Slovakia.
- The **Institute of Hydrology SAS** concluded an agreement on the implementation of joint research with the Slovak Museum of Nature Conservation and Caves in Liptovský Mikuláš. Together with the Slovak Hydrometeorological Institute, it cooperates in the field of surface water research. In a joint project with the Faculty of Civil Engineering STU, they propose a solution to crises situations in water supply due to climate change.
- The **Earth Science Institute SAS** is the only Slovak workplace that analyzes the seismic risk in the entire territory of Slovakia and prepares seismic assessments at nationally important localities. It monitors the seismic activity in Slovak's territory using the National Network of Seismic Stations. The Institute performs magnetic declination measurements for air traffic for the Ministry of Defence of the Slovak Republic. Within the framework of contractual cooperation, it carries out expert work for linear constructions (railways, highways, tunnels) and investment construction, and cooperates with mining companies on research into raw materials and energy resources.
- The **Institute of Geotechnics SAS** has been cooperating for a long time on the rehabilitation of the environmental burden Bratislava Vrakuňa – Vrakuňská cesta-dump site CHZJD with the Environcentrum, s.r.o. company. Based on this cooperation, project documentation was prepared for a permanent treatment plant for groundwater purification in the area of a chemical waste dump isolated by an underground sealing wall. The project documentation, including the budget, was submitted to Geotest, a. s. company, which is the contractor of the geological task.

- The **Mathematical Institute SAS** has long been involved in research into the issue of information protection for the state sphere of the Slovak Republic.
- The **Institute of Experimental Physics SAS** is one of the most important centres of physics research in Slovakia. It regularly participates in various space missions with its supplies, operates a low-temperature physics centre, deals with nuclear research, research of magnetic materials, nanoparticles, and in 2021, it made a significant contribution to the construction of the SEVAN detector for the Cosmic Ray Observatory at Lomnický štít.
- The **Institute of Informatics SAS** strategically focuses on research activities related to the use of high-performance computing and cloud sharing of large data sets.
- The **Institute of Materials and Machine Mechanics SAS** focuses on research in the field of lightweight structural materials, aimed primarily on structural applications in the automotive industry, biocompatible materials, including implants, materials for the production, conversion and storage of energy, as well as materials needed for nuclear energy. In Žiar nad Hronom, it operates the innovation centre INOVAL, which helps the innovative activities of local enterprises in the field of processing aluminium alloys. At the Enermat research centre in Trnava, it evaluates the residual service life of energy equipment components and proposes measures to safely extend their operation.
- The **Institute of Materials Research SAS**, together with the Technical University of Košice, works in the newly founded laboratory for research and innovation of batteries - VIB on research and development in the field of new types of batteries with high density of stored energy and electrode materials, liquid and solid electrolytes, smart monitoring and lifetime predictions of battery systems. By developing metal hydrides, it actively participates in the research of hydrogen technologies. The Institute cooperates with industrial partners in the framework of expert activities in determining the basic properties of materials, chemical composition, microstructure, breakage, fractographic analyses and heat treatment of materials, etc.
- The **Institute of Measurement Science SAS** has been cooperating for a long time in medical research on the use of nuclear magnetic resonance using the SISCO NMR spectrometer. The Institute also provides calibration, service and maintenance of the tilt measurement system of the nuclear reactor objects of the Mochovce and Jaslovské Bohunice atomic power plants.
- The **Institute of Construction and Architecture SAS** deals with the issue of production, concrete testing and fabrication of concrete structures, as well as monitoring the health of structures, which is important for large special structures. It performs expertise and standardization-technical activities for the Slovak Office of Standards, Metrology and Testing.

Scientific Section 2

- The **Biomedical Research Center SAS** develops and prepares diagnostic preparations enabling a wide range of serological examinations at a top level. As part of the DIABGENE laboratory, which closely cooperates with clinical workplaces throughout Slovakia, it provides analyses of genes responsible for monogenic diabetes, hereditary hearing disorders and other rare diseases that had an impact on clinical decisions about patient treatment. In cooperation with the National Oncology Institute, it analyses tumour tissue samples from oncology patients while creating realistic simulation models of the course of the metastatic process, which significantly improve patient treatment. Based on the results of research into the health effects of physical activity, practical physical exercises for seniors and other volunteers are implemented in the Centre for Physical Activity BMC SAS. The staff of BMC SAV also carry out some unique examinations of biological samples for the presence of infectious pathogens or antibodies induced by them, based on the request of general practitioners. A very beneficial activity for the public is the analysis of ticks, which determines the causative agents of Lyme disease and other tick-borne pathogens, such as tick-borne encephalitis virus. Preparations for the diagnosis of rickettsial infections from the typhus origin group of diseases are also being developed for the needs of the practice. The development/production of diagnostic preparations for the diagnosis of chlamydial infections is of particular importance due to their abundant occurrence in our country and the world. The BMC SAV laboratory provides free samples of diagnostic preparations, consulting and technical assistance.
- The **Centre of Experimental Medicine SAS**, in cooperation with II. neurological clinic of the Faculty of Medicine UK and UNB, is dedicated to research in the field of neurophysiological mechanisms of posture and motor control and their disturbances in patients with neurological diseases. The Institute cooperates with the Faculty of Pharmacy of the Comenius University in the field of pharmacological and toxicological research. Researchers working at the centre are looking for new ways to protect the heart from radiation in the treatment of oncological diseases with radiotherapy. The original result is an invention in the field of prevention or eventual treatment of cancer that originates in chronic inflammation (colon, lung, breast, liver, prostate, pancreas, endometrial and cervical cancer).
- The **Centre of Biosciences SAS** carries out expert work for the State Veterinary and Food Administration of the Slovak Republic. As part of the cooperation, researchers of the animal microbiology laboratory help in the production of probiotic products and the

testing of substances for farm animals.

- Through its detached workplace Centrum Memory, n. o., the **Institute of Neuroimmunology SAS** helps people with memory disorders and patients suffering from Alzheimer's disease. It investigates neurodegenerative and neurodevelopmental diseases of the brain, regularly monitors the latest results and gradually introduces them into everyday life. Centrum Memory also provides services for those interested in maintaining good memory and vitality at any age, family members or loved ones who live with the sick in the household or take care of them daily, and health and social workers.
- The **Institute of Molecular Biology SAS** deals with the issue of biodegradation of objects of cultural heritage. It also investigates the effectiveness of the biological degradation of pharmaceuticals in wastewater. It operates a "honey laboratory" in which it provides free consultations for beekeepers and, in cooperation with the Slovak Beekeepers Association, examines and evaluates the quality parameters of honey.
- The **Polymer Institute SAS** has long been engaged in the preparation of biodegradable polymer mixtures based on thermoplastic starch, the development of polymer microcapsules for the immune protection of transplanted cells, the treatment of diabetes, the testing of materials intended as carriers of biocidal elements for application in the food industry as packaging materials, and in medicine. As part of the Nano-Art project, the Institute cooperates in the use of modern technologies in the design of objects of applied art and the field of jewellery and clothing. This cooperation results not only in designer pieces exhibited at national but also international exhibitions, as well as a material intended for wider practical applications.
- The **Plant Science and Biodiversity Center SAS** deals with complex research of ecosystems at different geographical scales. It provides consulting activities on the problem of the occurrence and identification of invasive plants, as well as the application of chemical substances in their removal.
- The **Institute of Parasitology SAS** systematically deals with the diagnosis of human parasitic diseases, verification and confirmation of the diagnosis, e.g. echinococcosis, trichinellosis, toxocarosis and other parasitoses in humans, using classical examination methods, as well as methods that other diagnostic laboratories in Slovakia do not provide for these diseases (Western Blot, molecular methods). At the Institute, researchers verify a positive result for the presence of antibodies against *Trichinella* spp. and *Echinococcus* spp. In cooperation with the State Veterinary and Food Administration of the Slovak Republic, Veterinary and Food Institutes, public health authorities and the Department of Epidemiology of the UPJŠ Faculty of Medicine, chapters were prepared regarding the current situation of the spread of helminthic zoonoses in the Slovak Republic.

- The **Institute of Forest Ecology SAS** has been carrying out expert work for a long time in the framework of evaluating the stability of woody plants using the method of acoustic tomography. It participates in the creation of programmes related to a sustainable environment within the Žilina self-governing region, with an emphasis on the Liptov region. It assesses the impact of human activities on the population conditions of the western capercaillie in the mountains of Slovakia and proposes measures to improve the environment and the continued survival of this bird species.

Scientific Section 3

- The **Institute of Archaeology SAS** is systematically dedicated to the restoration, making accessible and use of historical architecture and objects for the needs of cultural tourism and the popularization of our history. The Institute also provides a range of professional activities in the planning and preparation of constructions of national importance, issues assessments and expertise on archaeological objects. Cooperation with the National Council of the Slovak Republic in the research and presentation of archaeological monuments at Bratislava Castle is intensive. The Institute has been cooperating for a long time in the creation of permanent archaeological expositions and carries out archaeological research of domestic and foreign sites. Some of the researchers also work as forensic experts in the field of cultural heritage.
- The **Institute of History SAS** prepares assessments for educational materials intended for teaching at primary and secondary schools and continuously works on expanding the Register of Modern Architecture in Slovakia to include new architectural and urban works and urban structures. For a long time, it has been providing expert advice on historical film productions and texts. The Institute is also a strategic partner of the Ministry for Foreign and European Affairs and Slovak embassies in the promotion of Slovak history abroad.
- The **Centre of Social and Psychological Sciences SAS** carries out research in the fields of history, sociology, economics, demography and psychology through its institutes. It solves the methodological and conceptual problems of forecasting the development of Slovak society in the national and global context. In cooperation with the city of Košice, it opened an educational laboratory for the empowerment of members of the Roma community at Luník IX to bridge the existing gap between Roma and non-Roma residents of the region in the information, digital and functional literacy areas. The Centre has created an electronic platform that includes popularization activities, communication in international forums, identification of topics in the field of developing skills and adult learning, as well as networking with experts and organizations active in areas that are content-relevant for improving adult participation in learning in Slovakia.

- **The Institute for Sociology SAS** ensures the operation of the Slovak Archive of Social Data for a long time. It works with public opinion polling agencies and, upon agreement, incorporates the data into archival funds and uses it for analytical purposes. The Institute carried out a series of research on the society during the pandemic and provided consultations and expertise based on the knowledge thus obtained. Several employees are members of the interdisciplinary initiative Science helps COVID-19, where they monitored the development of the epidemic in Slovakia on a daily basis, regularly commenting on strategies, documents and measures of the Slovak government and individual ministries. The employees of the Institute provided many expert consultations, formulated their own proposals for managing the coronavirus pandemic in Slovakia and published public statements on current epidemic issues.
- The **Institute for Research in Social Communication SAS** provides psychological counselling and training in the area of ethical code, monitors the implementation of the new state programme in the educational field *Language and communication in the practice of kindergartens*. It regularly organizes workshops in the field of sexual and reproductive health aimed at training health assistants for work in the field of prevention and promotion of sexual and reproductive rights and health in marginalized Roma communities.
- The **Ludovit Stur Institute of Linguistics SAS** provides a dictionary portal, makes available a number of scientific and professional publications in their entirety, and provides the professional and lay public with the opportunity to obtain information about the use of language from older and more recent explanatory dictionaries and manuals. It provides language consulting services to the public by telephone and in writing, as well as through personal consultations. The Institute created a multilingual seven-language (Slovak, Polish, Hungarian, Croatian, Bulgarian, Slovenian, Romanian) comparable corpus of legal regulations in the given languages for lawyers, experts from various fields and the general public.
- The **Institute of Slovak Literature SAS** has been cooperating for a long time on the continuous education of teaching staff in the field of Slovak language and literature. It cooperates with the Centre for Information on Literature and the civic association Ars litera, which organizes the literary Anasoft litera award, and the civic association Platform for Literature and Research, which is the publisher of the professional internet periodical plav.sk.
- The **Institute of Economic Research SAS** provides expert consultations in the field of international economic policy, macroeconomic forecasting and consultations regarding the efficient labour market in the Slovak Republic. Scientists have prepared a monograph focusing on research and analysis of economic development in Slovakia in 2020 in the

context of the consequences of the new coronavirus pandemic.

As part of the DISKOW project, a database of knowledge about occupations and skills was created by analyzing web data to improve the mobility of European professionals and refugees.

In addition to the above, SAS carries out a number of activities focused on specific problems and tasks within the framework of bilateral agreements with various organizations from economic and social practice (for more details, see Appendix 7.1).

VII. COMMUNICATION WITH THE PUBLIC AND PROMOTION OF SAS RESULTS

The year 2021 was again marked by the COVID-19 pandemic, which complicated the implementation of traditional popularization activities. They increasingly moved to the online space, to which the popularization actions of SAS also adapted, in which many scientists from its institutes and centres were actively involved.

In response to the social order, popularizers focused primarily on current issues related to the pandemic and vaccination. In the first quarter, the SAS Department of Communication and Media (RKM) published a successful series of short popularization videos entitled 3 questions about the coronavirus, in which SAS scientists from various scientific fields answered various questions in relation to the pandemic. The videos achieved a high number of views and were also shared on social networks by renowned institutions (e.g. The Ministry of Health of the Slovak Republic, State Institute for Drug Control) or the media.

In a representative survey on the credibility of institutions, which was carried out by the FOCUS agency at the beginning of June 2021, SAS ranked first among the fifteen compared institutions in Slovakia for the fourth time in a row. According to the results of the survey, 74 percent of respondents completely or more likely trust SAS. Thanks to the informal cooperation with TV JOJ, scientists were regularly invited to the News at 12:00.

VII.1. Popularization activities in 2021

The pandemic still did not make it possible to implement several traditional SAS popularization activities in full (Roadshow of young scientists, Science Slam, Weekend with SAS, ...), others were carried out, as far as possible, in online or hybrid form.

SAS Open Doors Week online event (12.-16. 4. 2021) presented the students of universities with current topics of doctoral studies at SAS. The participating institutes presented their doctoral topics with video presentations. The website achieved interesting traffic - from the beginning of April to 1. 6. 2021, it was 4591 views.

SAvinci cafe

The ongoing pandemic situation has caused the SAVinci science cafe to be broadcast six times exclusively online via Facebook. One lecture with live audience participation under the name Summer SAVinci at Tyršák took place as part of the Summer at Tyršák event.

Super school in Petržalka

Likewise, due to the pandemic situation, lectures and events within the Super school in Petržalka project were not held. During June, only two lectures were held via the YouTube channel.

Science in the theatre

In the last year, 5 editions of the discussion Science in the Theatre were held, of which one edition was held as an online lecture via ZOOM, the other discussions were carried out with the personal participation of discussants and hosts on the stage of the theatre, without audience participation. All episodes are available on the Studio12 theatre's YouTube channel.

Science Den

A popular activity for children in Košice – Science Den has also adapted to the pandemic situation. In addition to several online lectures in June, symbolically for Children's Day, a new podcast, Science Evenings, in which SAS scientists answer children's curious questions., was launched.

Videos about SAS institutes

In 2021, in addition to the successful series of videos entitled 3 questions about the coronavirus, the SAS Department for communication and media (RKM) produced 10 promotional videos about SAS institutes, which it published on social networks. Thanks to the purchase of new audiovisual equipment and the use of new graphics, the videos have become more attractive. Moreover, RKM, in cooperation with Adam Hudek from the Institute of History SAS, created a short documentary film entitled The History of the SAS, which presents key events from the SAS history in an attractive way. The film was screened internally, and it will be presented to the public on the occasion of the 70th anniversary of the establishment of the SAS by law. All videos produced by RKM have English subtitles, which expands their availability to foreign audiences.

Science for 2 minutes

In 2021, cooperation with Funrádio continued successfully. The section Science for 2 minutes, in which SAS scientists answer practical questions from listeners' lives, has become an established part of the morning broadcast - the Morning Show with Junior and Marcel. The section is broadcast live every Tuesday and Thursday at 7:50 a.m. According to representatives of Funrádio, this popularization activity is popular with listeners, and the radio station itself values it immensely.

Academy Journal/SAS News

In 2021, SAS published six issues of the Academy Journal (SAS News) under the guidance of Martin Podstupka. The journal continued to systematically present the work of SAS institutes, their teams and projects. It presented outstanding personalities from various Scientific Sections and their scientific work, bringing profiles of award-winning scientists of various age categories with special emphasis on the upcoming generation. The Academy/SAS News also paid attention to the popularization actions of SAS institutes and individuals.

Open Academy

In 2021, the Open Academy programme financed several popularization activities of individual SAS institutes (Extrapolations, publication of scientific popularization periodicals). In 2021, the publication of two popularization brochures on the topics of Climate Change I and Obesity, was being prepared. In addition to the already published brochures, the Open Academy programme will finance the creation of short popularization videos that will be promoted on social networks. As part of the Open Academy programme, a call for writing popularization brochures was launched with the aim of publishing two to three brochures a year regularly.

VII.2 SAS on the Internet

Website sav.sk

In 2021, the SAS website was a source of information for the public, media and SAS employees. The Academy promoted its own research and projects on the web, webinars and seminars during the easing of measures, conferences and all events in which it participated. As in the previous pandemic year, in 2021, materials related to the COVID-19 disease and related topics achieved the highest number of views. Astronomy topics also had a significant number of views. Compared to 2020, 81 more articles (544) were published on the SAS website in 2021.

The most read Slovak text was the article from July 14, 2021: *Facts that are good to know about the Delta variant of SARS-CoV-2*, which was read by 24,180 readers. The second most-read article from March 16, 2021, entitled *The project smell and COVID-19 brings remote examination of the sense of smell* (12,477 times), which was the most read article in the English version (12,476 times), was also related to the coronavirus. The third most-read article from June 2, 2021 - *Partial solar eclipse to be observed on June 10* (viewed 11,830 times) also had over ten thousand views and was the second most-read article in the English version with the same number of views (11,830 times). The third most-read article in the English language was the *Opinion of the Slovak Academy of Sciences on Vaccination Against COVID-19* from January 13, 2021 (9,610 times).

SAS science podcast

In 2021, the pandemic did not interrupt a popular popularization format *SAS science podcast*, which found its place in the offer of Slovak science podcasts. During the year, Klara Kohoutová from the Institute of Social Sciences of the Centre of Social and Psychological Sciences SAS added the tandem of hosts: Soňa G. Lutherová (ÚESA SAV) and Peter Boháč (ÚACH SAV). The SAS science podcast is available on all major podcast platforms, streaming services and apps (PodBean, Spotify, Apple Podcasts, Google Podcasts) as well as on the SAS YouTube channel. In 2021, a total of 21 episodes were released in a two-week interval (with a break in July and August), which reached a total of 15.5 thousand listeners. The average audience for one episode is 738 listeners. As of February 2022, the SAS science podcast has a total of 1,313 followers outside of Slovakia and a total of more than 20,000 listeners.

VII.3. SAS social networks

SAS Facebook

The number of followers of the SAS Facebook account has increased from approximately 10,500 to 12,600 accounts over the past year.

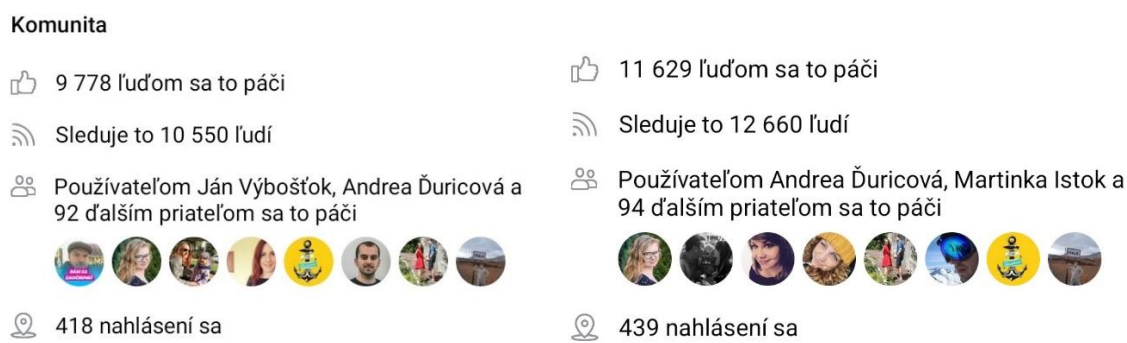


Fig. VIII.1 Number of followers of the SAS Facebook account - increase over the last year (2021)

In 2021, more than 400 posts were added to the SAS fan page pointing to news from the world of SAS and the achievements of its scientists. The most successful posts on the SAS Facebook page with the highest reach were, like on the SAS webpage, related to the coronavirus pandemic. These include mainly videos from the series entitled *3 questions about the coronavirus*. Fans also appreciated the sharing of important statements by the Slovak Academy of Sciences.

11. 2. 2021 9:33	 sk Slovensko dalo svetu nový  minerál -			266,2K 	14,5K 9,7K 
10. 3. 2021 8:00	 😬 Ktoré konšpiračné teórie o koronavíruse			73,3K 	3,9K 666 
23. 11. 2021 13:14	 Predsedníctvo SAV vydalo stanovisko k			64,4K 	5,5K 4,7K 
12. 3. 2021 8:00	 😬 Prečo niektorí ľudia odmietajú dodržiavať			59,6K 	2,7K 454 
9. 4. 2021 15:08	 👉 Biomedical Research Center of the Slovak			55,1K 	2,9K 3K 

Table VIII.1: Overview of the most successful posts of 2021
(the yellow graph indicates the number of user accounts on which the post had an impact)

In 2021, information about the discovery of the new mineral *dobšínait* was most interesting to Slovaks on the SAS Facebook page. This is the discovery of mineralogists from the Earth Science Institute SAS, in cooperation with colleagues from the Czech Republic. The post had over 1,000 shares and reached nearly 270,000 people.

SAS YouTube channel

The number of fans of the SAS YouTube account grew by more than one-third, from 600 subscribers to over 900. This can mainly be attributed to engaging and relevant content for the public. Videos from the series *3 questions about the coronavirus*, where scientists across SAS institutes were involved in spreading awareness about the coronavirus and vaccination against COVID-19, have been uploaded. In total, the videos posted on this platform had more than 43,000 views. The most successful in terms of the number of views was the video from the series *3 questions about the coronavirus* on vaccines and vaccination, which was viewed more than 6,400 times by users in 2021.

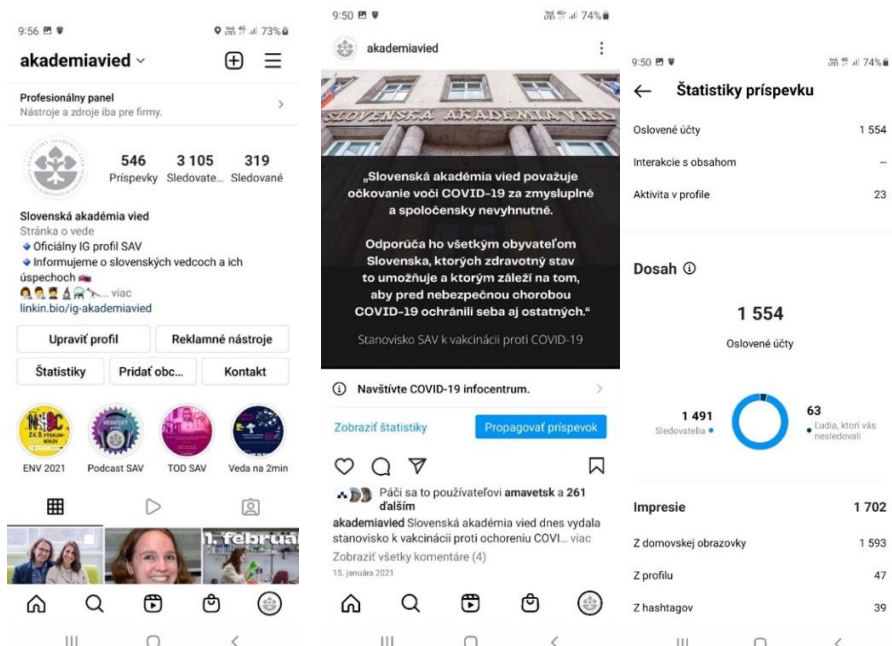


Fig. VIII.3: Samples of SAS Instagram posts and their statistics

SAS Twitter

The number of fans following the SAS Twitter has increased to 1,305. Statements such as the election of the former SAS President prof. Pavol Šajgalík, the credibility of the Slovak Academy of Sciences in the eyes of the public or the global achievements of Slovak science, resonated the most.



Fig. VIII.4: Sample of SAS Twitter account with the highest reaching posts

Mar 2021 · 31 days

TWEET HIGHLIGHTS

Top Tweet earned 729 impressions

Snem SAV do funkcie predsedu SAV opätovne zvolil Pavla Šajgalíka

sav.sk/?lang=sk&doc=s...

4 4

May 2021 · 31 days

TWEET HIGHLIGHTS

Top Tweet earned 921 impressions

Rodičia chcú pre deti radšej kariéru vedca ako poslanca

sav.sk/?lang=sk&doc=s...

3 8

LinkedIn SAS

In 2021, RKM established an official SAS account on the LinkedIn social network. The profile is followed by almost 300 fans so far, who can find out information about job opportunities at the Slovak Academy of Sciences, professional courses and grant calls. There is also regular news from the SAS environment.

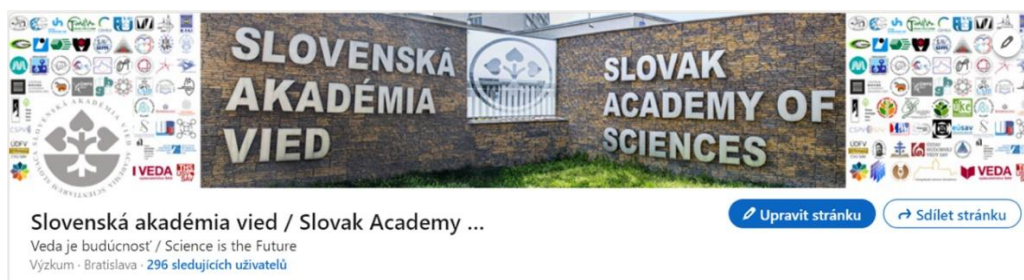


Fig. VIII.5: SAS's LinkedIn account - landing page