



**ANNUAL REPORT
2017**



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SLOVENIAN RESEARCH AGENCY

Introduction



2017 represents an important turning point, both in terms of the budgetary financing of science and the activities of the Slovenian Research Agency (ARRS). The second supplementary budget has increased the Agency's budget by an additional four and a half million euros at the end of 2017, thus strengthening the growing funding curve of science through the ARRS. This increase, with an additional budgetary increase in 2018, along with the efforts reflected in the drafting of the new science and research act, promises a definitive step away from the effects of austerity measures. The consequences of austerity were drastic and difficult to remediate, as is reflected by the disproportionate ratio of researcher outflow to inflow. Funding is not the only dimension of a good quality research environment, so in 2017, in

accordance with the Strategy for the Operation and Development of the Agency to 2020 and regardless of serious human resource constraints, the Agency was able to improve the quality of its activities and expand its reach. The annual report lists and summarizes the main activities, which show the implementation of the strategy in accord with the seven strategic orientations.

Alongside reliable operation and performance of tasks in accordance with the work programme, it is necessary to emphasize the introduction of new instruments such as the MR+ pilot scheme for young researchers, as well as successful implementation of the hosting call for ERC grantees and new bilateral activities. Special attention was paid to activities aimed at increasing the

” The Agency is committed to high standards of operation, as is reflected by the nearly 15-year funding of scientific activities. ”

efficiency of operations, including a more thorough oversight in terms of improvements and the development of a new reporting format. In 2017, the Agency published two reports that are also of importance to the general public: Analysis of the involvement of researchers in research programs, and Analysis of the post educational employment of PhDs in science for the 2012-2016 period.

Introduction of an electronic system for interaction with reviewers and information support for their work (e-Assessment) are important milestones, which were successfully tested in the evaluation of research programs and in the first phase of research project evaluations. The presentation of science to the wider public in 2017 took the form of the now

traditional series of six events within the scope of the Excellence in Science project, the reception of a new generation of young researchers by the President of the Republic and the publicized series of events and expert workshops on the communication of science for researchers and the media - Days of Science Communication (with Prof. Deborah Blum, director of the program of scientific journalism at MIT and Pulitzer Prize winner, as the main guest).

It is important to highlight the risks that the Agency has encountered during its work in 2017. The staffing profile, health-related absences, and above all the lack of scientific officers and highly competent associates in the field of information technology expose the Agency to great risks. With the additional allocation of one

post in 2017, the Agency will cover the implementation activities for a government strategy on open access to scientific publications and research data.

The Agency is committed to high standards of operation, as is reflected by the nearly 15-year funding of scientific activities. We recognize that improvements are possible and that the role of the Agency's Scientific Council and Board of Directors, as well as those of all permanent professional bodies of scientific research councils for individual sciences, is extremely important in this regard.

Prof. József Györkös,
Director

Annual report 2017

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IN THE SPOTLIGHT

Post-war transitions in gendered perspective

Prof. dr. Marta Verginella

Faculty of Arts, University of Ljubljana



Prof. Marta Verginella has received funding from the European Research Council (ERC) in the category of established researchers. In a five-year project within her research group in the field of social sciences and humanities, she shall research the role and position of women in the post-war era in the territory of Slovenia and neighboring regions.

Researchers are always pointing out that it is extremely challenging to apply for funding under the ERC. Why did you decide to apply?

In the past, I have already applied to European projects with my research group. In one of the applications, I had qualified as an applicant along with two external partners in the narrowest group of 18 projects, although the number of financed researchers was then smaller. It was precisely because of this rather positive experience, through which I was later awarded a Slovenian project, that I was inclined to a new application.

It was only necessary to find a good idea, which I was actively involved in.

It is interesting that you have succeeded in the field of humanities. Is there such a large deficit of research in the humanities, that it does not fall among the ERC projects?

There are very few humanists and social scientists among the ERC winners, which means that naturalists are in the lead in all European countries. Among recipients of the ERC Advanced Grant I have two very good colleagues who are historians. One of them received a project the year

before me, and the other a year after. Both are well-established historians who have been rewarded for good ideas and great resumes. In my case, the favorable circumstances were that the proposed topic, which was still unexplored, completely overlapped with my previous work and bibliography, both methodologically and substantively. It is therefore not just the idea that matters, but also one's curriculum vitae and prior management of research projects. A researcher who is a candidate for funding as an established researcher must provide every assurance that they will conduct the research work seriously and scientifically.

The topic of your research project is the post-war transition from the gender perspective. Can you explain this a bit more for us?

The theme I proposed concerns post-war periods in the northern Adriatic

region. The research is aimed at studying the Slovenian, Austrian, Italian and Croatian areas, and the Hungarian-Slovenian border areas, because at least three important transitions took place here after World War I and World War II, and in part of this area, during the 1990s. State borders changed three times during this period, while at the same time, political and ideological changes occurred. I am interested in what was happening with the female population during these transitions, how women experienced these post-war periods, what were their roles and what was happening to them both privately and publicly. Our research team is currently looking at what has been explored and what still needs to be explored.

What do you think the ERC project evaluators found so crucial or important that they showed interest in this project?

In general, we know that the research of the history of women is inadequate. The evaluators were also convinced by the finding of a lack of political and sociological studies that are exploring the subject of transition at the synchronized level, and a proposal for the transition to be explored from a long-term historical perspective. The marking of existent conceptual and methodological shortcomings was important, and the offer of a new approach that seeks to link historiography with social sciences.

How can transitional periods affect the change of social patterns, if at all?

The purpose of the project is to explore transitional periods at various levels. Changes occurred at the institutional level, and more slowly at the mental and cultural level. The challenge of this project will be to identify the delays between the

change of national borders and political regimes, and changes in the function and mentality of the female population.

Can you imagine how the emancipatory charge in these transitional periods and countries has changed?

It will be interesting to compare the Austrian, Italian, Slovenian and Croatian positions. For the transition after 1945, the post-World War II period, we know that the situation of women in these regions or countries was quite different. With a variety of indicators, we will attempt to define what these differences were and what was going on, not only at the declarative level but also, for example, in the labor market. The labor market during all three periods will be explored, the post-war periods of World War I and World War II, and that of the 1990s. We know that structural changes took place,

and most recently during the 1990s, when the Slovenian textile industry collapsed. At that time, part of the female workforce was employed in the private sector of neighboring countries, in particular in the border areas, as paid house workers.

Your research incorporates a transnational approach, a cross-historical manner of studying, which I think is new to us.

It is undoubtedly a novelty. So far, there has been a lot of international cooperation, but each researcher has usually dealt with their own national case. The history of multiethnic areas requires the overcoming of nation-centric histories, which can be achieved by close interactions within an internationally-formed research team. I have designed the study precisely so. My Slovenian team was joined by an Austrian researcher, an Italian researcher and a Croatian researcher. As a rule, group members are multilingual researchers who master the languages of resources and the entire area. On this basis, conditions were created for transnational treatment of research topics.

This is your core group. Will you recruit anyone else, perhaps Slovenian researchers?

Currently there are 11 of us in the project, with different job quotas. My core group comprises five researchers, and depending on how individual topics will be processed, space for a new job can be created.

This is a comprehensive study and a question arises as to how much such justifications would be comparable or at least methodologically useful in other environments.

I recently visited Paris and found that Parisian bookstores offer a novel and interesting study of the Fran-

co-German history of the First World War. Unfortunately, we do not have a similar publication to offer a transnational demonstration of the war on the Soča front. We are breaking new ground here, undoubtedly our studies will be an important contribution to the authoring of a cross-cultural history on European soil.

As can be understood, the study extends to the field of historical anthropology and social comparative history, therefore it is a highly interdisciplinary approach. How do you assess today's need for interdisciplinary research not only in historical, sociological or anthropological disciplines, but in general?

I think that interdisciplinarity is a must, and has been for decades, if not more than a century. It goes without saying that historiography should take into account the findings offered by sociology, ethnology, anthropology, political science, and so on. One would expect that historiographical insights would be taken into account in the social sciences and humanities, but this does not always happen. Sometimes historians and anthropologists deal with the same themes, but it seems as if everyone follows their own frameworks. Sometimes there is a lack of dialogue, but if we look at foreign, internationally propulsive environments, we see more interdisciplinarity.

What does 'scientist' mean to you? Is attitude to science in your opinion changing? If so, how?

To me personally, it means the possibility of exploration and discovery, the realization of the magic of discovery. Every time that I have the option, either of working in the archive or working with published sources, I feel a great deal of satisfaction. I am

not interested in the application of external discoveries and discovering the same topic in Slovenia. I am interested in an independent research path that follows a variety of external incentives and personal curiosities. What is the attitude to science in our environment? Unfortunately, very poor. Slovene science is maltreated, at least as far as funds allocated to it by politicians are concerned. Nevertheless, despite the state's input, the results seem to me to be exceptionally good. It is sometimes unfortunate to find that Slovenia has excellent scientists who do not have the adequate financial support, which one might expect from a young and small country.

For several years now, scientists have been struggling with financial shortages; on the other hand, in increasingly difficult situations, you are required to be competitive on the market, to be successful in obtaining European funds, economic resources and so on. How do you manage to meet all these requirements?

Work situations are very unfavourable, I would emphasize that this applies especially to young people or for those who are not yet in the academic environment. The fact that they are constantly on the market and that their survival is so uncertain is an exceptionally machiavellian attitude towards gifted and high-quality university educated people.

Does the ERC project give you a new impetus for research?

It surely gives me personally a new impetus. The possibility of reducing pedagogical obligations means more time for research and, above all, the possibility of better quality research, work in archives and in foreign libraries, where all the necessary literature is available.



How do you assess the attitude towards science in the environments you know and the attitude that you experience in Slovenia? With this I mean primarily the relationship between structural policies, the economy and, ultimately, the wider public.

I think that the structural problems of the Slovenian research sphere

must be very precisely defined and that it is absurd to criticize non-discriminatory ones, for example, the functioning of the ARRS and the institutional organization of research work. The precariousness of the research domain is undoubtedly the worst problem, along with insufficient financial resources, which are doled out to science. The state must

provide for the material rebuilding of laboratories, it must cease to press austere conditions, otherwise the emigration of our best people will continue. In the Great Britain and many other European countries, the situation of ERC recipients is incomparably better than in Slovenia. Conditions in Italy are also excellent, although the scientific field is in some respects less organized than in Slovenia. For ERC project holders, the best European universities offer, in addition to optimal working conditions, permanent employment as they recognize the prestige of the recipients.

How do we overcome the prevailing state of mind - that science is merely a cost - so that decision makers will perceive science as the most important factor in social development in the broadest sense? We refer to some such societies when we talk about structural changes in context of development at the state level.

The question is a very difficult one, but worth dealing with. There is weakness and an absence of a long-term vision in the background of the policy-to-science relationship. But it is not just about who enters into politics today. We need to ask ourselves who are the people who formulate scientific policy in the ministry and how individual societal actors define themselves. If an important politician declares that university teachers work only four or six hours per week, it is clear that a wider and extremely negative view of academic teaching undermines the populist atmosphere in which it becomes acceptable to degrade the work of scientists, university professors and other researchers.

Cavitation – from prevention to its practical application

Prof. dr. Matevž Dular

Faculty of Mechanical Engineering, University of Ljubljana

Prof. Matevž Dular has received approximately two million euros in funding from the European Research Council (ERC) in 2017. Within the CABUM project, he will conduct research into physics of the cavitation phenomenon.

You are only the fifth researcher in Slovenia to acquire research funding from the prestigious ERC. Is the ERC system really so demanding and competition so great?

There were eight Slovenian researchers vying for funds in this call. There are likely many reasons why there are so few of us. One needs a breakthrough idea with the prospect of new technologies and research in several areas; it is difficult to come up with such an idea. On the other hand, it is difficult to gain independence in Slovenia and be good enough to compete for such tenders. I made an initial attempt five years ago, but was refused because I was still working in my mentor's research group. Then I was able to become independent, which requires a lot of courage and poses considerable risk, though many more opportunities arise if one succeeds. Slovenia is lagging behind Western Europe because our system is not well set up for young people.

From our perspective, the funds allocated for some projects seem to be substantial. The implementation deadline is five years, but there is little emphasis on the demands of modern research, which are quite high if it is to be effective.

This is particularly true of mechanical engineering, as our research is extremely expensive. A lot of the world's research is focused on numerical simulations, which require particularly powerful computers. Already a few years ago, our group noticed that if we wanted a competitive edge over others, we would have to focus on experiments and those are extremely expensive. We have earned a global reputation precisely because we excel at experimentation. The modelers always need us to confirm the correctness of their work. Five years and two million euros seem a lot, but in reality half of these funds is allocated for the salaries of researchers, some covers

overhead costs, some is used to pay for larger equipment, and ultimately ten or twenty thousand euros per year can be spent on material costs.

The effectiveness of modern research is increasingly dependent on the performance of the group working on the project. How will you look for colleagues and what obstacles do you expect?

There are currently 12 researchers in our group. I would like to retain those whose projects will soon be concluded, so that they will be able to continue their work as part of the CABUM project. I must nevertheless ensure that they will be independent enough to register with the ERC, if they so choose, within three to five years. We will collaborate, but I should not hinder them. I shall attempt to attract researchers from abroad, especially those who were my undergraduate students but conducted their doctoral studies

elsewhere due to the previous lack of funding. Some would like to return and I hope that the ERC project is a good enough motivation for them to do so.

The ERC awards funding for basic research, and you have already studied cavitation. What is the common focus?

The ERC does not support continued research. The focus is on basic research, not necessarily its application. In mechanical or engineering sciences, however, it is assumed that there is at least a vision of application. My project is based on academic-industrial collaboration. It developed from a basic project, but when we began to work with bacteria and viruses, we collaborated with industry. We had developed a device for cleaning water systems, but at the same time noticed that the measurement results were not aligned with our understanding of the pro-



Until recently, cavitation has been considered an unwanted phenomenon. Its occurrence in turbines causes vibration, noise and erosion damage, as well as decreased efficiency. On the other hand, due to its aggressiveness, it is used in the homogenization of milk, which is the process of breaking down large fat cells. It is also used in lithotripsy - the removal of kidney stones, i.e. removal of these stones noninvasively with ultrasound, and in the production of emulsions. Prof. Matevž Dular and his research team will investigate mechanisms of cavitation bubble interactions with contaminants such as bacteria and viruses.

cess. For example, a very aggressive hydrodynamic cavitation can damage ship propellers, turbines and pumps. Measurements of its effect on bacteria have shown that the gentlest type of hydrodynamic cavitation is the least favourable for their survival. Thousands of articles have been authored on the use of cavitation for these purposes, but nobody has yet explored the underlying mechanism. That was the idea I was pursuing when I applied for the project.

You say that cavitation is not desirable, but it has proved to be very useful in some cases. You have most commonly mentioned wastewater treatment and the successful disposal of pharmaceutical waste and removal of cyanobacteria, algae and legionella bacteria. You were the first to point out the possibility of cavitating viruses.

In the group we are somewhat polarized. Some of us want to focus on understanding the phenomenon and what is occurring in terms of physics. Another group with whom we work closely promotes patenting and application. We prevent them from proceeding too quickly before we have the requisite knowledge, and they encourage us to advance the theory as much as possible. Thus, we began to test various contaminants, first with pharmaceuti-

cals, in cooperation with the Jožef Stefan Institute. There are engineers, pharmacists, biologists and physicists in the research group. The group is very heterogeneous and we cooperate very well. Nobody has yet attempted to experiment with viruses. It worked, but the workload was enormous. A post-doctoral student in biology worked on this for two years. Finally, we were able to inactivate 99.7 percent of viruses with a very small energy input. According to the regulations, we can not yet speak of disinfection, though we have approached that level. A project like this will enable us to better understand what is happening on the micro level and improve devices.

How did you arrive at the idea that you used in the ERC project? Your research will involve primarily viruses and bacteria.

The project could be expanded to include chemistry and pharmacy, but in this case it would be too large and difficult to coordinate well. We work very well with biologists, so we have decided to conduct biological work exclusively. We performed research with bacteria, hence the idea. It was mainly with legionella. We attempted to use methods that had previously worked with pharmaceuticals, but these were unsuccessful. Then we tried something completely different, a very gentle cavitation, i.e.

super cavitation. This was unfavorable for bacteria - they did not survive. We have therefore concluded that bacteria are not sensitive to aggressive hydrodynamics, but to something very subtle. If we want to create a system that will work well against legionella in the domestic water supply system, we need to change the way we think.

Viruses, on the other hand, respond better than pharmaceuticals. In this case, the following occurs: the bubble collapses, whereby, according to some predictions, temperatures of about 10,000 degrees Celsius occur. This allows the formation of radicals and the oxidation of various chemical compounds. It is possible that something similar happens with viruses. We have only very indirect evidence for this, so CABUM is supposed to address this problem more directly. For example, the idea is to place several micrometers-long bacteria and the bubble next to each other and observe what happens. Will the bacteria be inhibited by high temperature, a high-pressure wave or a stream that is directed by the bubble into the bacteria? The number of possible mechanisms is enormous, but we do not know which one is the right one.

By analogy, are you also researching the same mechanism for viruses?

For viruses, the research is more difficult because they are smaller. We cannot place a virus and a bubble together, so this will have to be studied more indirectly. Once we find out what is going on, we can make a device that will intensify the exact mechanism that is most inhibitive for a particular contaminant.

Do you predict that a special cavitation will be needed for each contaminant?

Probably also for every system. There is a difference if we are considering a plumbing system for drinking water or for waste, a treatment plant for the production of biogas or a milk homogenization machine in the dairy industry. Each system has its own peculiarities, which is no longer an ERC subject, as it is pure application. We hope, however, that in four or five years, we will have enough knowledge to cooperate with a forward thinking small or large company and invest in a device that would actually be built into a system. In this regard, the issue is to assure the user that the system is safe and reliable.

Which area do you find most problematic or where the use of your knowledge would be the most effective?

Currently, there are two areas that I think have the greatest potential. One is certainly swimming pools and reduction of chlorine use. Chlorine in swimming pools is very problematic, as it reacts with organic substances to produce carcinogenic triha-

lomethanes. Reduction of chlorine use would be a big breakthrough. Another example is legionella, which, as reported by the media, is a constant problem in large hospital buildings. If we had a system to continuously ameliorate the concentration of legionella in these systems, then expensive and dangerous thermal shocks would not be necessary, that is, the water would not have to be heated to 70 or 80 degrees Celsius.

Cavitation research is very much industry-oriented. What is your experience with these relations and to what extent is Slovenian industry open to applying research innovations?

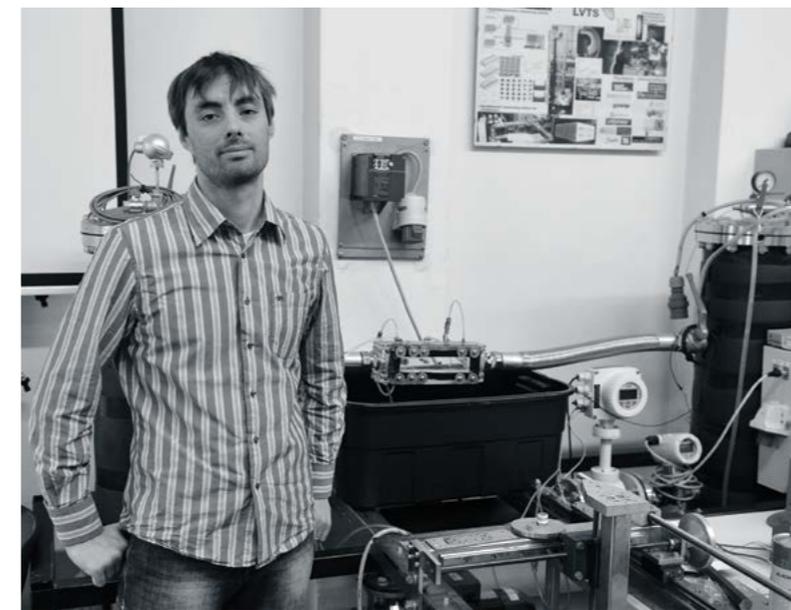
Because we are from the Faculty of Mechanical Engineering, collaboration with industry is essential. If there were none, our work would be meaningless. We collaborate with many companies and, for the most part, they know that they need us. Our knowledge makes for excellent collaboration. There are two types of industrial collaboration. One is

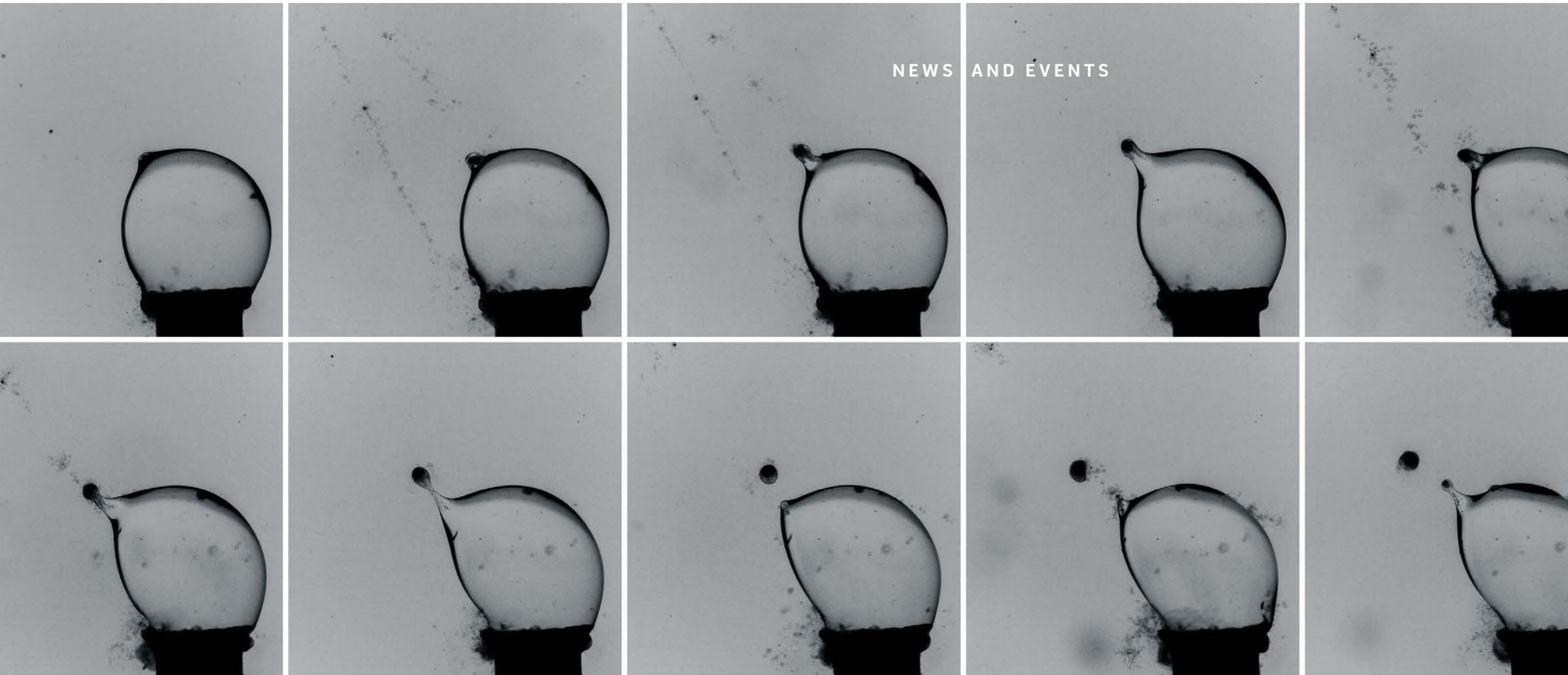
long-term, involving a long-standing cooperation with continual improvements and suggestions. The second is short-term, mostly with smaller companies, in which individual problems are solved. This work is very intense, requiring a lot of effort, but the results are very tangible. What is lacking in Slovenian industry for projects such as this is courage. It is a risky project or idea, with great prospects.

Among scientists, there is a shared opinion that science is being pushed to the margins of social and public interest. Have you ever thought about why this is happening?

Because people do not see the long-term potential of science. During protests for increased investment in science, people saw only that a group was protesting because they wanted more money to sit in cabinets and calculate. They do not see, however, that if we stop investing in science, I, for example, will not be able to provide students with the latest findings and students entering the industry will not be able to apply their knowledge in practice. We are talking about a downward spiral. The effect of a lack of science funding will be seen in five or ten years. People are not aware of this. How to convince them that science is important is beyond me. When this project was approved, a few people at the ceremony advised me to be careful of how I spend the taxpayers' money. If this idea is in the minds of most people, we have a problem. Perhaps not today, but in ten years.

Full interviews, conducted by Ina Petric, will be published on the website of Tromba Agency: www.tromba.si





NEWS AND EVENTS

Reception of the new generation of young researchers by the President of the Republic of Slovenia



Source: Office of the President of the Republic of Slovenia
Photo: Danijel Novakovič, STA
Summarized by: Press release, Office of the President of the Republic

In October 2017, the President of the Republic of Slovenia, Borut Pahor, held a reception at the Presidential Palace for the new generation of young researchers who began the four years of training toward their doctorates. More than five thousand young people have joined, who in the past 30 years have successfully completed their third-level studies in this programme.

Young researchers were addressed by President Pahor, who congratulated them on the start of their research work, which marks the beginning of an inspiring and responsible career. The Young Researchers Programme has been successfully implemented since 1985. In 2016, under the honourable patronage of the President of the Republic, 30 years of work were marked, allowing young researchers to participate in research work during post-graduate studies based on a temporary employment contract. The purpose of the mechanism is to rejuvenate research staff by promoting new ideas and approaches. The programme is a source of highly qualified and motivated employees who represent significant potential for the Slovenian economy and other socially important areas.

Days of Science Communication 2017



Photo: Bor Slana, STA

A three-day event within the Days of Science Communication project, organized by the Agency in cooperation with the US Embassy in Slovenia, was attended by more than 200 participants. The purpose of the project was to strengthen qualitative and credible reporting on scientific topics and to bring science closer to the general public.

The main guest of the event was Prof. Deborah Blum, Pulitzer Prize Winner and Director of the Science Journalism Program at MIT – Massachusetts Institute of Technology (Knight Science Journalism Program at MIT). The introductory speech with Prof. Blum was led by Ksenija Horvat, journalist at Radiotelevizija Slovenija and host of Interview. The participants were greeted by his Ex-

cellency Gautam Rana, US Ambassador to Slovenia, Dr. Tomaž Boh, State Secretary at the Ministry of Education, Science and Sport, and the Director of ARRS, Prof. József Györkös. Prof. Blum stressed that scientists should be trained to communicate with the general public, and that communication is an organic part of the research process.

Deborah Blum then led a workshop for editors and journalists on the subject of media reporting on science and a workshop for researchers on the importance of communicating science and research results. The event ended with a workshop on media skills for researchers with Igor E. Bergant, a journalist and host of the show *Odmevi* at Radiotelevizija Slovenija.

Science Europe: Prof. József Györkös appointed as member of the Management Board

Science Europe is an umbrella association of agencies that fund or carry out research activities. The association, which was established in 2011, represents the common interests of its members and co-creates the European Research Area (ERA). It has 43 members from 27 European countries, which allocate approximately 18 billion EUR annually from national budgetary funds. The national funding of research and innovation in Europe accounts for a large majority of the funds, which shows the importance of national research policies and funding for the creation

of a fully operational ERA. ARRS is one of eight founding members of the Association.

At its regular session in autumn of 2017, the General Assembly appointed the Agency's director, Prof. József Györkös, as a member of the Board of Directors. Mark Schiltz, General Manager of the Luxembourg FNR Agency, was elected Chairman of the Committee, and Ingrid Petersson, Director of the Swedish FORMAS Agency, as Vice-President. The term of office of members of the Management Board of Science Europe is two years.

Establishment of the initiative of directors and presidents of central European agencies (CE HORCs) to strengthen regional cooperation

In September 2017, the Agency hosted the first meeting of five directors and presidents of central European agencies, financiers of research activities. The directors and presidents of the ARRS (József Györkös, Slovenia), FWF (Klement Tockner, Austria), GA ČR (Alice Valkárová, Czech Republic), NCN (Zbigniew Błocki, Poland) and NKFIH (József Pálincás, Hungary) agreed that cooperation would be aimed at strengthening research connections in the region. The participants expressed their commitment to strengthening the mutual cooperation of leading research organizations and researchers, strengthening



the position of central European agencies at the European level and harmonizing evaluation procedures. In the next stages of the initiative, the expansion and integration of partner agencies from other central European countries is envisaged.

(from left to right) Zbigniew Błocki, director of NCN (Poland), Klement Tockner, president of FWF (Austria), Alice Valkárová, president of GA ČR (Czech Republic), József Pálincás, president of NKFIH (Hungary), and József Györkös, director of ARRS (Slovenia).
Photo: Marko Vitas



FINANCING STRUCTURE

Financing structure

In 2017, the budget of the Republic of Slovenia provided EUR 148.2 million through the Slovenian Research Agency (hereinafter: the Agency) for the financing of scientific research, which is 3.6 million EUR or 2.5% more than in the previous year. The Agency's budget for scientific

research activities fell from 175.9 million to EUR 148.2 million between 2011 and 2017, representing a difference of 15.7%. The first increase in funding after 2011 occurred in 2016, namely 8.6% more than the previous year.

In 2016, a total of 1.52% of the budget of the Republic of Slovenia was dedicated to the Agency for the purpose of financing scientific research activities; in 2017, it rose to 1.56%.

Agency funds for scientific research activities and their corresponding share of the budget of the Republic of Slovenia¹



A detailed overview of the financing of research activities by year is available at www.arrs.gov.si/sl/finan. More data and graphic representations about the scope and structure of the Agency's funding from the state budget are available at www.arrs.gov.si/sl/analize/obseg01/.

¹ Funds for 2018 and 2019 are shown as cash flow estimates.

Agency funds in 2017

Research programmes: long-term financing of research, which is expected to be topical and produce usable results over a longer time period.

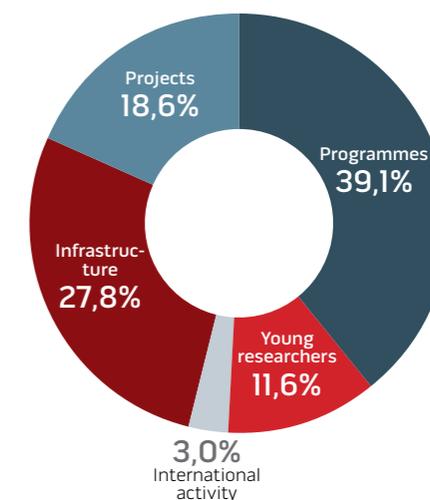
Research projects: co-financing of basic, applied and research projects, targeted research programs and those of Doctors of science in the pilot public calls framework »Employment support of young Doctors of science«.

Young researchers: financing of postgraduate studies and the training of researchers to obtain a doctorate degree.

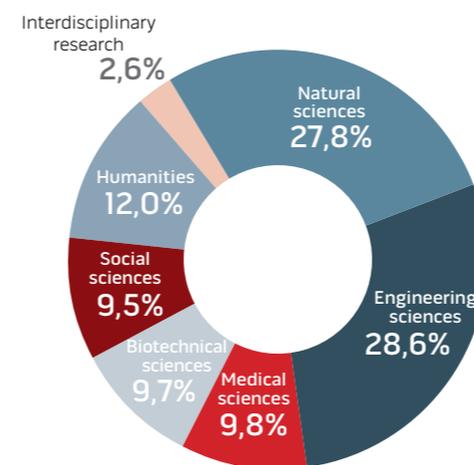
International activities: co-financing projects within the complementary scheme of the ERC and the scheme of lead agencies, visits to ERC project leaders, launching of projects based on the Marie Skłodowska-Curie seal of excellence, co-financing of international bilateral co-operation, promotion of participation of research organizations in Horizon 2020 calls, support of international congresses, promotion of Slovene science abroad and linking scientific achievements, and facilitation of participation of Slovenian researchers in COST mechanisms.

Research infrastructure: co-financing of infrastructure programmes, scientific and popular scientific periodicals and scientific monographs, founder's obligations, COBISS and other library-informatics activities and infrastructures, international periodicals and databases, and research equipment.

Agency funds per mechanism³

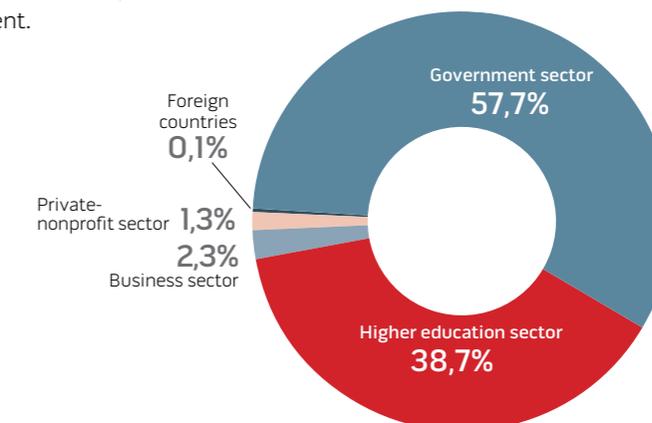


Agency funds per discipline²



² Funding for founder obligations, infrastructure programmes, international promotion of science, the operation of Slovenian congresses around the world, the promotion of applications to EU-projects, OSIC and foreign periodicals and databases cannot be classified according to discipline and are therefore not taken into account.

Agency funds per activity sector⁴



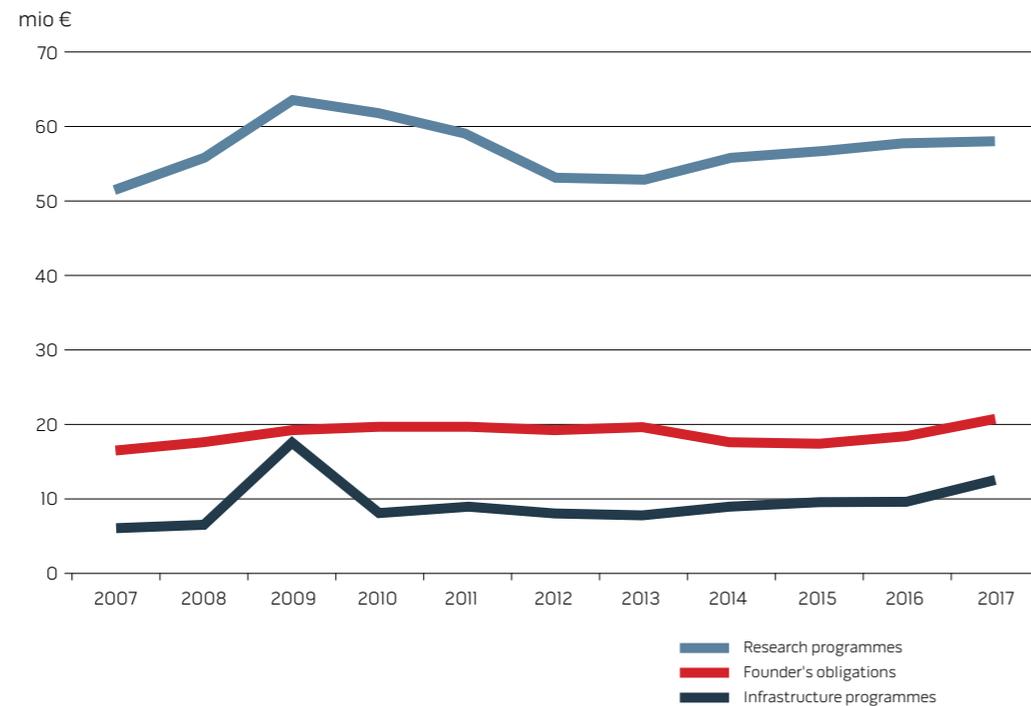
³ Rounded to two decimal places; the sum of shares is not always 100.

⁴ Government sector: public research institutes and other public institutions.

Institutional financing

Research programmes: **EUR 57.9 million**
 Founder obligations: **EUR 20.7 million**
 Infrastructure programmes: **EUR 12.4 million**

Research programmes, infrastructure programmes and founder's obligations are stable parts of the financial support for research activities. Due to austerity measures, the financing of research programmes in 2012 was reduced by 10% in comparison with the previous year. In 2014 and 2015, the Agency slightly increased its funding for research programmes to strengthen long-term stable financing and thus easing the fall in funding from 2012. The slight increase in research programmes funding continues to grow in 2016 and 2017.

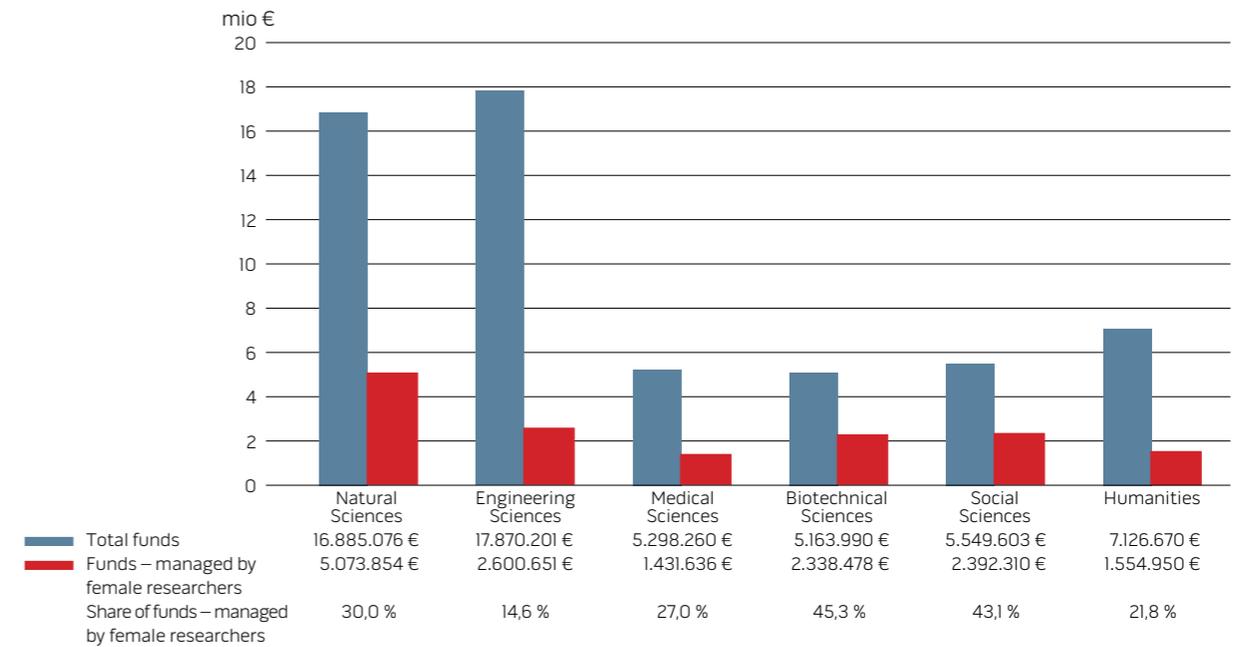


Research programmes

In 2017, the Agency paid EUR 57.9 million for the co-financing of research programmes, which represents 39.1% of the Agency's total budget. In 2017, a total of 299 research programmes were financed, of which 63 were in the field of natural sciences, 89 were in engineering, 38 in medical sciences, 20 in biotechnical sciences, 45 in the social sciences and 44 in the humanities.

Call and Tender in 2017

Based on a public call and tender, 52 research programmes for which the funding period had expired in 2017, were approved for continued financing totalling EUR 6.5 million over a period of six years. One research organization did not submit an application for a public tender to continue funding the research programme.



Funds per activity sector in €⁵

Public sector	31.251.865
Higher education sector	25.563.647
Business sector	842.857
Private non-profit sector	235.431
Total	57.893.800

Funding for research programmes increased by 0.4% in comparison with 2016.

⁵ Government sector: public research institutes and other public institutions

Infrastructure programmes and founder's obligations

Founder's obligations comprise the obligations of the founder to public research and infrastructural institutions, whereby the Agency settles fixed operating costs that are linked to basic research or infrastructure activities. EUR 20.7 million was paid for founder's obligations in 2017, which is 12.3% more than in 2016.

Funding for founder's obligations per activity sector in €

Government sector	19.731.346
Higher education sector	944.712
Total	20.676.058

Infrastructure programmes support research work. The central role of research infrastructure is to ensure a high-quality research environment. EUR 12.4 million was paid for infrastructure programmes in 2017, which is 30.8% more than in 2016.

Funding for infrastructure programmes per activity sector in €

Government sector	8.614.838
Business sector	146.035
Higher education sector	2.714.078
Private non-profit	890.882
Total	12.365.833

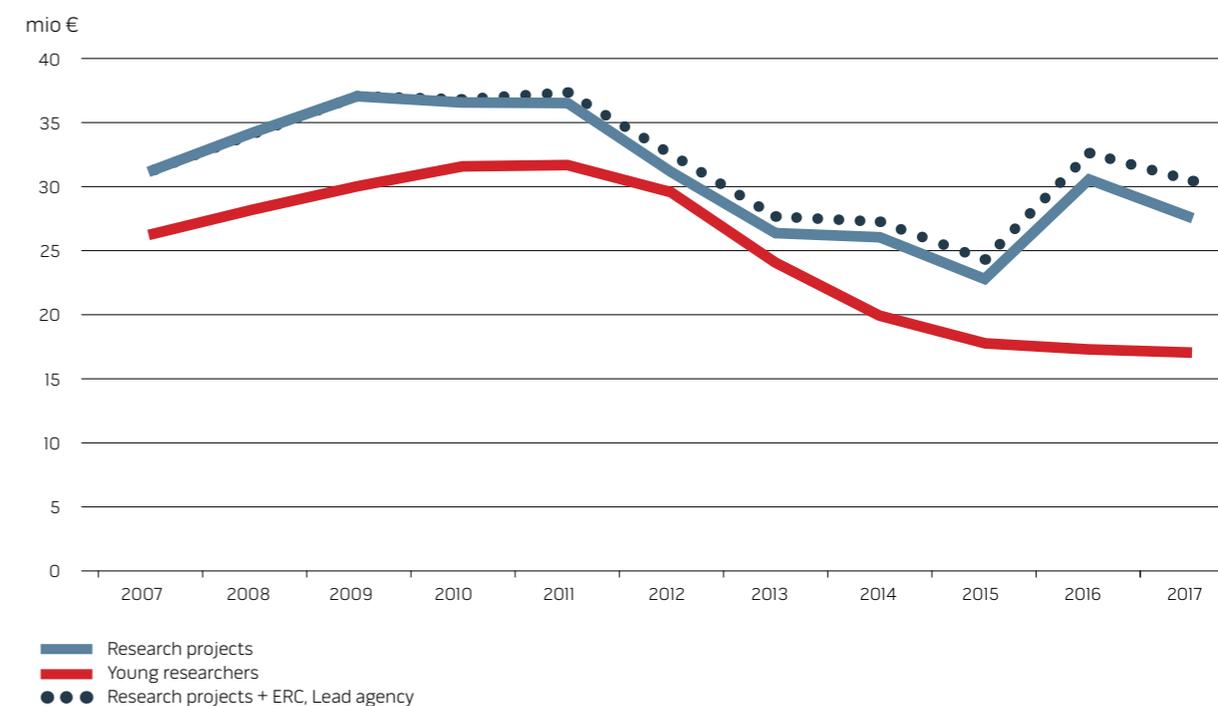
Competitive financing

Research projects: **EUR 27.5 million**
Young researchers: **EUR 17.1 million**

In 2017, funding for research projects fell by 9.5% in comparison with the previous year, but increased by 11.4% in comparison with 2015. A significant decrease in funding was recorded in 2012, when the Agency did not finance any new research projects due to austerity measures. Funding for research projects decreased by 19% between 2011 and 2017. More funding for research projects in 2016 was the result of austerity measures in previous years and the associated delays in the start of fi-

ancing, especially in 2013. Consequently, in 2016, more projects than usual were funded. Since 2010, there has been a continued trend of reduced funding for young researcher training, though the decrease in 2017 reduced from 2.8 to 0.9% in comparison with the previous year. The decrease in funding in 2017 compared to 2016 was the result of the completion of training by generations that were smaller during the period of crisis than before or after it.

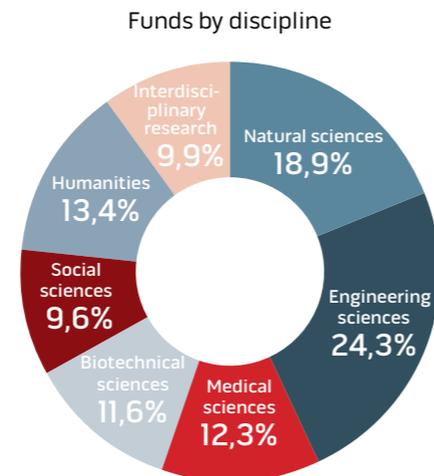
Funds for research projects and young researchers



Research projects

In 2017, the Agency paid EUR 27.5 million for the co-financing of research projects. This amount represents 18.6% of the overall budget of the Agency and is 2.5% lower than in 2016.

Basic research projects: **EUR 18.3 million**
 Applied research projects: **EUR 5.5 million**
 Postdoctoral research projects: **EUR 2.4 million**
 Targeted research programme projects: **EUR 1.1 million**
 Promoting the employment of young doctors of science: **EUR 239 thousand**



Basic and applied research projects

In 2017, with finances from the state budget, the Agency co-financed 288 basic research projects, with a total value of EUR 18.3 million. Funding decreased by 4.7% in comparison with 2016, but increased by 35.8% in comparison with 2015.

Younger researchers (up to 10 active years after defending their doctorate) conducted 103 basic projects, and received 37.1% of the funding allocated for basic research projects.

The evaluation methodology for public calls for tender dictates that the share of applied research projects must be at least 30% for engineering sciences, at least 20% for biotechnical sciences, at least 10% for medical sciences and social sciences, and at least 5% for natural sciences. The structure of (co-)financed research projects strictly follows the implementation of the specified methodology.

Discipline	Basic and applied projects in millions of €	Female researchers	Young leaders	Of those female researchers
Natural sciences	4.6	33,9 %	31,6 %	27,7 %
Engineering sciences	6.0	15,7 %	34,1 %	13,4 %
Medical sciences	2.9	41,7 %	36,2 %	48,3 %
Biotechnical sciences	2.3	33,4 %	25,3 %	55,7 %
Social sciences	2.2	45,4 %	34,7 %	43,0 %
Humanities	3.4	33,3 %	49,4 %	35,0 %
Interdisciplinary research	2.4	25,2 %	33,7 %	12,6 %
Total	23.8	30,3 %	35,2 %	30,1 %

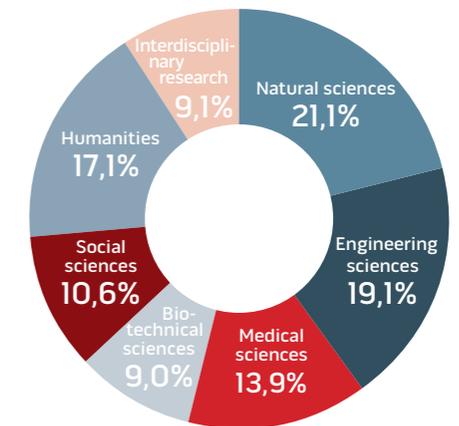
The funding for basic and applied research projects with shares of projects led by female researchers and young researchers. Funding share data for projects led by young female researchers are given in the last column.

The evaluation methodology for applications to public calls for tender dictates that at least 20% of the projects chosen must be led by young researchers (male/female researchers, not more than 10 years after defending their doctorate). This is how the Agency promotes the integration of young scientists into its research activities.

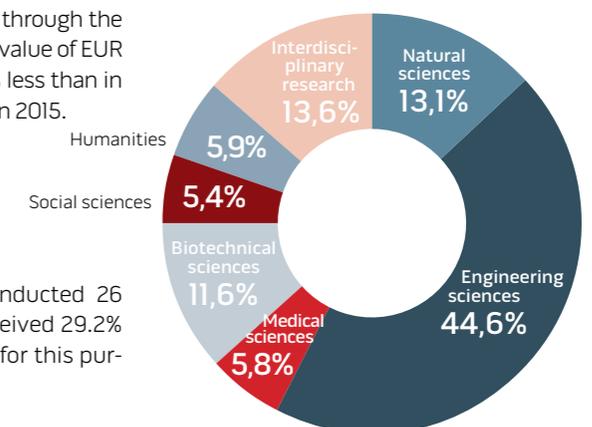
In 2017, the Agency co-financed 79 applied research projects through the state budget, with a total value of EUR 5.5 million, which is 22.1% less than in 2016 and 12.4% less than in 2015.

Younger researchers conducted 26 applied projects, and received 29.2% of the funding allocated for this purpose.

Funds for basic research projects by discipline



Funds for applied research projects by discipline



Postdoctoral projects

In 2017, the Agency financed 61 post-doctoral projects from the state budget, with a total value of EUR 2.4 million, which is 5.9% more than in 2016.

The evaluation methodology for applications to public calls for tender dictates that at least 10% of all projects within each discipline must be at post-doctoral level.

Funding for postdoctoral projects with shares of projects led by female researchers

Subject	Funding in €	Female leaders
Natural sciences	479.803	41,9 %
Engineering sciences	616.908	27,4 %
Medical sciences	370.216	50,6 %
Biotechnical sciences	274.178	46,7 %
Social sciences	155.396	100,0 %
Humanities	150.783	100,0 %
Interdisciplinary research	315.342	72,5 %
Total	2.362.626	51,6 %

Public call in 2017

The funding of research projects that were accepted into co-financing in the framework of the call for proposals for 2016 began in 2017. The funding of research projects for which the Agency published the public call in 2017 will begin in 2018.

Targeted research programme (TRP) projects

EUR 1.1 million was paid for the co-financing of TRP projects in 2017, which is 8.9% less than in 2016.

In 2017, 89 projects were financed under the TRP. The financing of TRP projects enables interested ministries and other users to gain research support for the design of strategic targets of Slovenia's development and in deciding on fundamental development tasks, which are imperative for the increase of Slovenian competitiveness, adaptability and innovation. Projects are thematically targeted based upon the proposals of ministries and other parties who are competent to act in the public interest.

In 2017, the Agency published a public call for the selection of targeted research projects within the »TRP 2017« framework.

In October 2017, the Agency published a public call for the selection of research projects of the »TRP 2017« Targeted Research Programme, in cooperation with the Ministry of Education, Science and Sport, the Office of the Government of the Republic of Slovenia for Slovenians Abroad, the Ministry of Health, the Chemicals Bureau of the Republic of Slovenia, the Ministry of Economic Development and Technology, the Ministry of Culture, the Ministry of Environment and Spatial Planning, the Surveying and Mapping Authority of the Republic of Slovenia, the Ministry of the Interior, the Public Agency of the Republic of Slovenia for Transport Safety, the Ministry of Infrastructure, the Ministry of Justice and the Ministry of Labour, Family, Social Affairs and Equal Opportunities.

The subject of the public call is decided with priority given to content in the framework of the following focal points:

- measures and activities in the field of education and research,
- Slovenes outside the Republic of Slovenia,
- strengthening and protecting health and optimizing health care,
- establishing the exposure of people and the environment to chemicals,
- regional development: linking measures to achieve sustainable development and promoting the increase in the competitiveness of Slovenian tourism,
- cultural cooperation,
- environment and space,
- effective management of violent radicalization and hostile speech, and the effective operation of a pluralistic police activity in Slovenia,
- more efficient and cheaper state,
- development and planning of energy consumption monitoring through the integration of different databases and innovative technology in railway infrastructure,
- strengthening trust in judicial institutions,
- improving the function of the labour market.

The public call was closed in 2018 with 41 projects accepted for co-financing.

Young researchers

In 2017, the Agency financed the training of 840 young researchers, with a total funding amount of EUR 17.1 million, which represents 11.6% of the Agency's total budget and is 0.4% less than in 2016. The Agency facilitates the participation of young researchers in research work during their postgraduate studies based on a temporary employment contracts.

Their salaries, social contributions, costs of material and services are financed by the Agency. The average annual cost of financing one young researcher is about 30,000 EUR. Training funds are allocated for a temporary period, which is not to exceed four years of a doctoral study programme. The purpose of the programme is to rejuvenate research

staff by promoting new ideas and approaches. The young researcher programme is a source of highly qualified and motivated employees who represent significant potential for the Slovenian economy and other socially important areas. Approximately 8,000 young researchers were trained between 1985 and 2016.

In 2017, four young researchers received rewards for the early completion of training.

Support for young mentors

The Agency's regulations stipulate that among the accepted mentors of young researchers within the research organization, at least 25% must be young mentors.

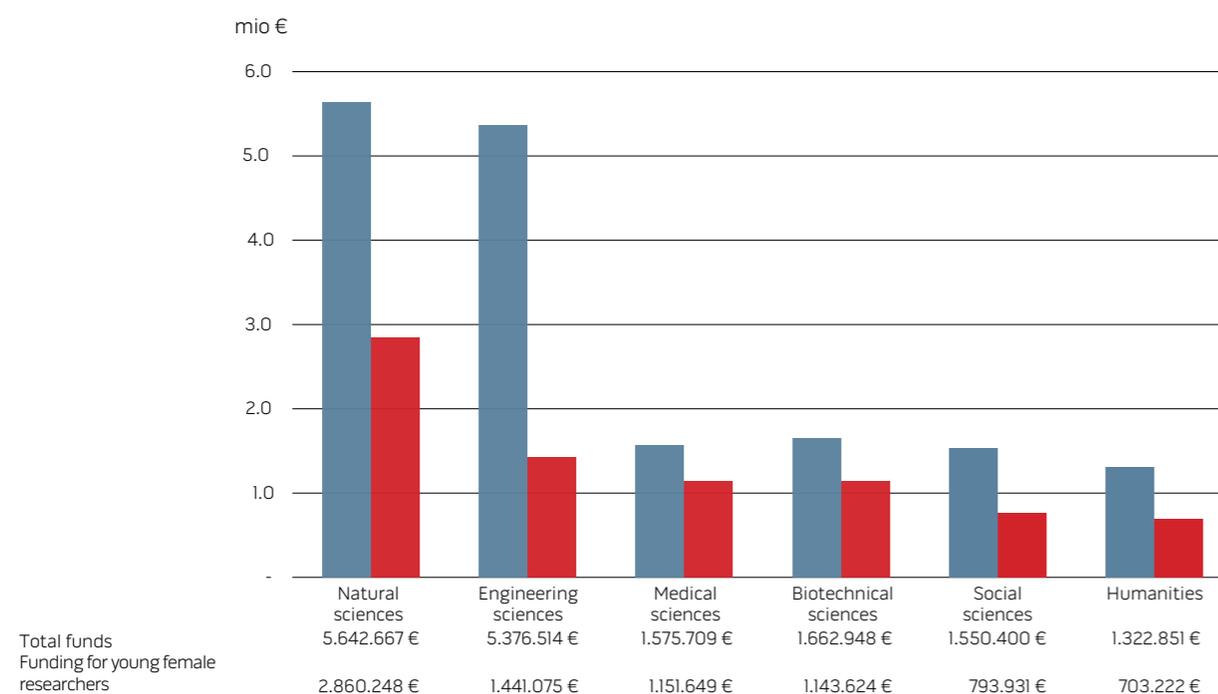
Public call in 2017

In January 2017, the Agency published a call for the allocation of mentorship positions within research programmes, which led to 177 mentorship positions being allocated among 156 research programmes: 55 in the natural sciences, 55 in engineering sciences, 18 in medical sciences, 16 in biotechnical sciences, 18 in social sciences and 15 in humanities.

MR+ Tender

In January 2018, the Agency published the MR+ pilot public tender for the selection of mentors to new young researchers for 2018. An additional 50 mentorship positions were awarded to young researchers, with a total value of EUR 1.5 million.

Funding for young researchers



Scientific literature

Scientific literature: **EUR 1.4 million**
International journals and databases: **EUR 5.4 million**

The Agency co-finances electronic access to the latest scientific databases and the purchase of international scientific literature in order to ensure the availability and accessibility of international scientific and expert information for the purposes of research, educational and development activities. The literature is publicly available in all libraries, research organizations and via the COBISS system. The Agency also co-finances popular science publications on the basis of a call for the purpose of enabling the publication of popular science publications which are important for the promotion of interest in the general public

and, especially, an interest among young people for science and technology. The Agency also co-finances the issuance of scientific monographs that are important for the development of Slovenian scientific terminology, for the presentation of scientific achievements and for domestic and international findings, to facilitate the spread of scientific culture. The co-financing of the scientific literature, including domestic scientific and popular science publications, commanded a sum of EUR 1.1 million in 2017, while EUR 0.3 million was channelled towards scientific monographs.

International activity

The ERC complementary scheme: **EUR 1.1 million**

Within the framework of the complementary scheme, applicants from Slovenian research organizations who have been positively evaluated but not selected for co-financing by the European Research Council (ERC) have the possibility to apply to the Agency with a customised project, which, based on its objectives and scope of work, takes into account the time required to customise the project as well as the amount of available funding. The Agency co-finances customised projects in accordance with a proposal from the Scientific Council and with respect to the budgetary options made available

The purpose of the complementary scheme is to act as a safety net, enabling researchers to develop their project idea in the course of funding by the Agency, to continue and again (successfully) candidate via ERC tenders. Of the six recipients of ERC projects in Slovenia, five were supported during the period between the first and second successful ERC applications in the complementary scheme of the Agency.

for the co-financing of projects conducted primarily in Slovenia. In 2017, the Agency co-financed 12 projects within the complementary scheme, of which six were in the natural sciences (51.6% of funding), three in the humanities (22.5% of funding), two in the biotechnical

sciences (16.8%) and one in the engineering sciences (9.1% of funding). Organizations in the higher education sector received 52.1% of funding, while organizations in the government sector received 47.9%. The ERC calls are aimed at individual projects focused on conducting leading pioneering research in all scientific fields and rank among some of the most competitive in the world, with a success rate of approximately 10 percent. The calls are open to all researchers, regardless of their current place of employment, on the proviso that the ERC project acquired is conducted within Europe.

The European Research Council was established in 2007. It currently operates within the Horizon 2020 programme, accounting for 17% of the budget. Since its inception, the ERC has financed over 7,000 projects from more than 65,000 applications. There are six Nobel Prize winners among the recipients of ERC funds. The ERC's total budget in 2017 was approximately 1.8 billion EUR. Over 70% of the projects evaluated by an independent study achieved breakthrough scientific discoveries or significant progress, and about 25% contributed to significant improvements..

Source: <https://erc.europa.eu/>

The six researchers who have been or will be financed by the ERC, have conducted/shall conduct their research in Slovenia.

2017, Prof. Marta Verginella received an ERC Advanced Grant which represents the first ERC project from the social sciences and humanities. Prof. Matevž Dular became the first recipient of the ERC project in 2017 for the consolidation of independent research studies (Consolidator Grant) in Slovenia. In 2018, an Advanced Grant was awarded to Prof. Roman Jerala from the Chemical Institute.

The ERC publishes an annual work programme that serves as the foundation of three calls for the current year:

- Starting Grant – enabling the start of independent research (2–7 years after the award of a doctoral degree);
- Consolidator Grant – enabling the consolidation of independent research studies (7–12 years after the award of a doctoral degree);
- Advanced Grant – for recognized researchers.

Collaborative projects are currently underway between:

- the Austrian Fund for Scientific Research – *Fonds zur Förderung der wissenschaftlichen Forschung, FWF*;
- the Flemish Research Foundation – *The Research Foundation Flanders, FWO*;
- the Hungarian National Fund for Research, Development and Innovation – *The National Research, Development and Innovation Fund, NKFIH*.

The lead agency scheme: **EUR 1.6 million**

The Agency promotes international scientific research via the lead agency scheme. Through a cooperation agreement between the agencies of various countries, researchers are able to apply collectively, as a joint project, under the auspices of one of the agencies (the lead agency), which is tasked with implementing the review process. If the peer review process for the application is successful and the lead agency proposes that the project is co-financed, then another agency takes on the co-financing of the researcher from their own country without conduct-

ing an additional review process. In 2017, the Agency co-financed 39 projects within the lead agency scheme, of which 24 were in the sciences (56.8% of funding), six in the engineering sciences (20.2% of funding), three in the medical sciences (9.7% of funding), three in the biotechnical sciences (6.3% of funding), one in the social sciences (4.9% of funding) and two in the humanities (2.2% of funding). Institutions within the higher education sector received 57.6% of the funding available, while those in government sector were allocated 42.4%.

International bilateral projects: **EUR 0.6 million**

In 2017, the international bilateral scientific cooperative took place through the coordinated efforts of the Agency and the Ministry responsible for Science.

In all, 16 countries cooperated: Argentina, Austria, Bosnia and Herzegovina, Montenegro, France, Croatia, India, Japan, China, Hungary, Germany, the Republic of Macedonia, Russia, Serbia, Turkey and the United States of America. Most funds were allocated for cooperation with the United States of America (21.8%).

The Agency cooperates with the French Commissariat for alternative and atomic energy (CEA). This cooperation is conducted via a public call for tender, the subject of which is the

co-financing of international scientific research projects lasting for a period of two years. On the basis of three public calls in 2017, a total of 19 collaborative research projects were co-financed in the fields of new energy technologies, nuclear energy, adaptation to climate change, fundamental physics, life science and global safety.

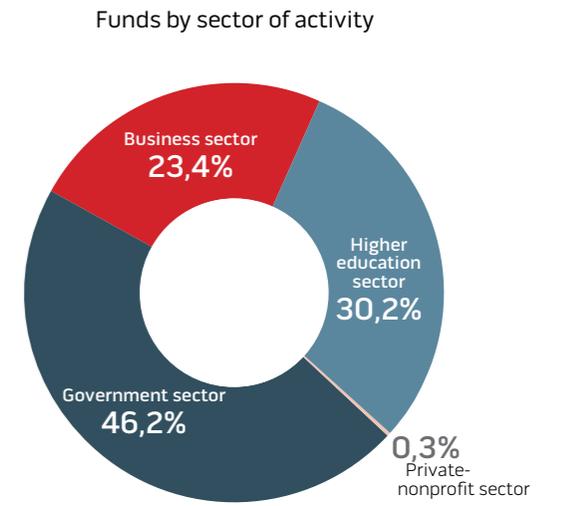
The total amount co-financed for scientific collaboration with the CEA in 2017 was EUR 472 thousand.

Horizon 2020 public call application incentive: **EUR 0.3 million**

The Agency encourages the participation of Slovenian research organizations in Horizon 2020 tenders. This allows for a continuous open public call to project applicants under the EU Horizon 2020 Programme for Research and Innovation.

Research organizations (ROs) who are, on the day of submission of the application for a public call, registered in the Register of ROs, managed by the Agency, and are project coordinators or partners are eligible for a one-time financial contribution toward the cost of the project's application to the EU Horizon 2020 Programme for Research and Innovation. EUR 2,000 is the fee to help cover the costs incurred by the

preparation and application of a project that has been coordinated and applied to the international consortium by a Slovenian organization, whereas EUR 1,000 is put toward the costs incurred by a Slovenian organization that submits a project independently to the international consortium, assuming the call was anticipated by the European Commission.



Government sector: public research institutes and other public institutions.

Support for the promotion of science abroad and membership in international associations: **EUR 0.3 million**

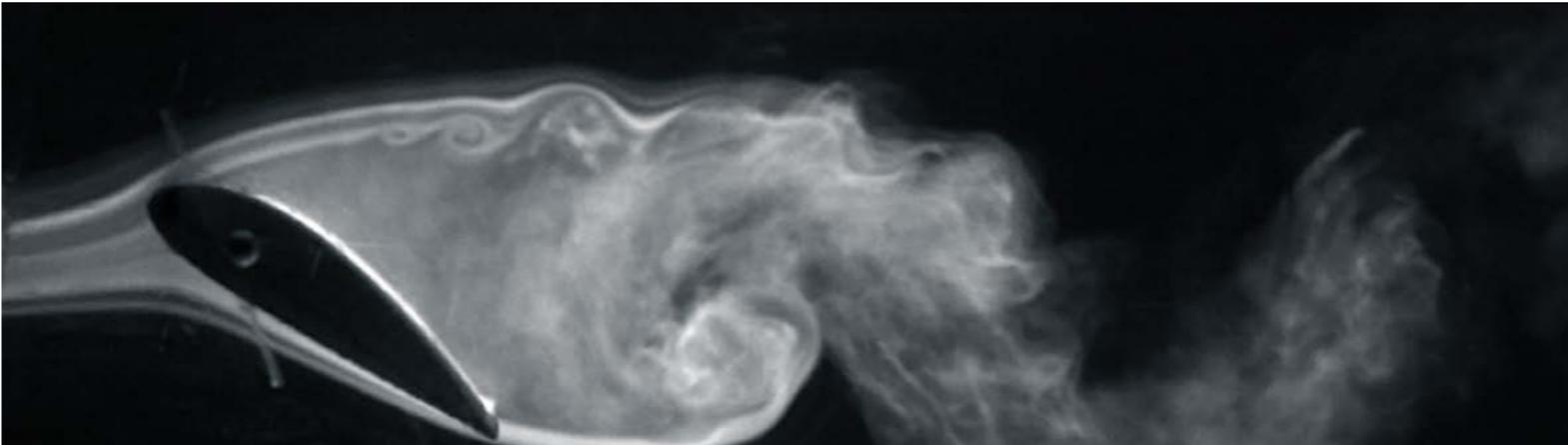
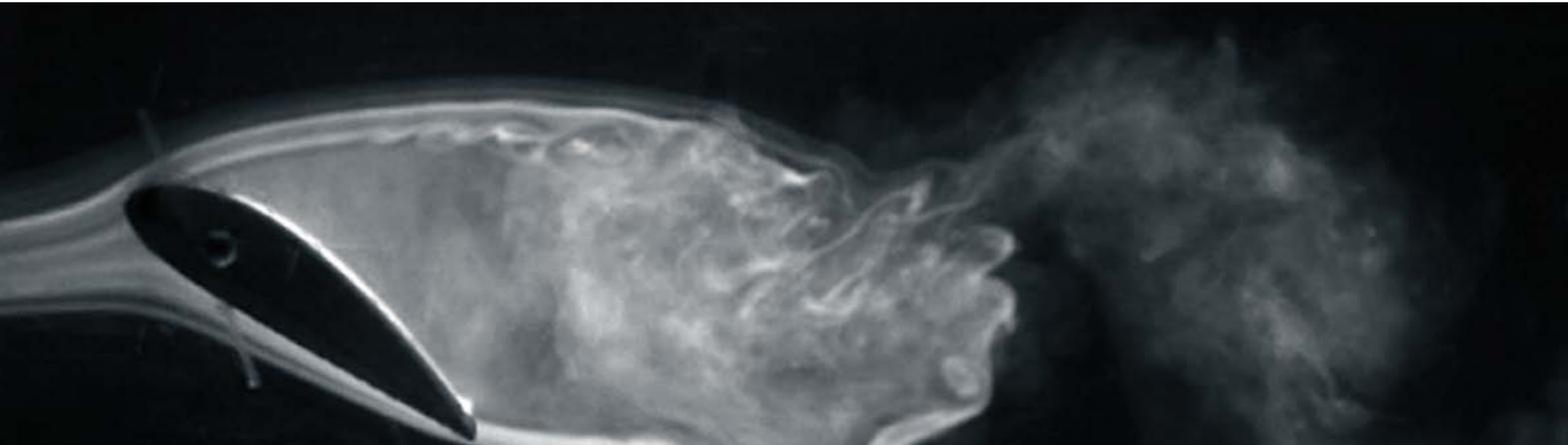
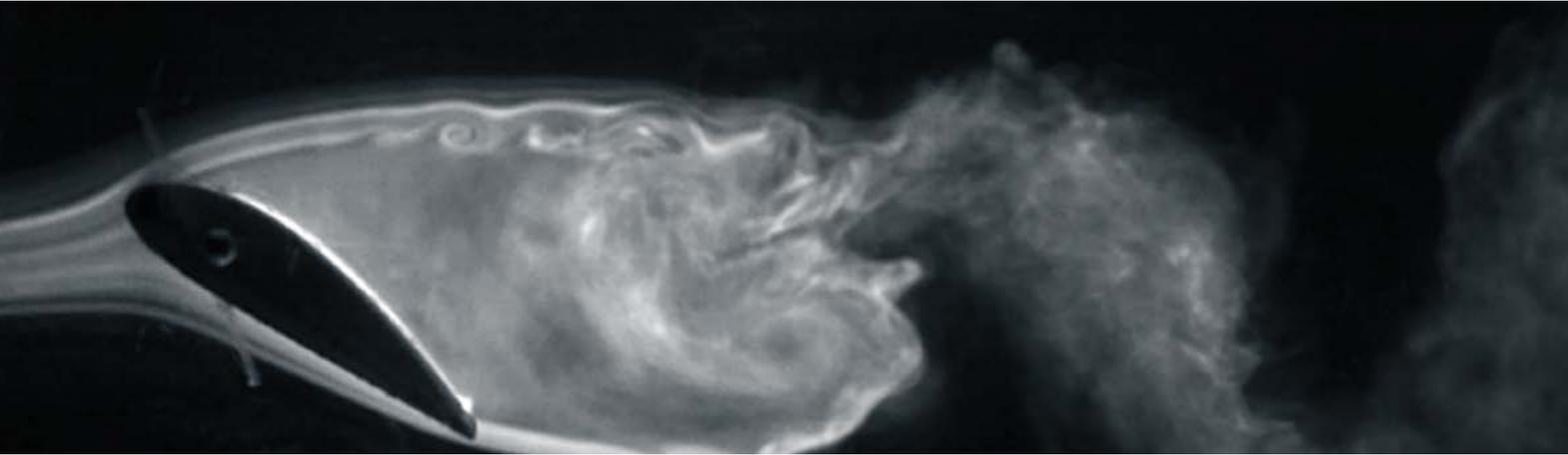
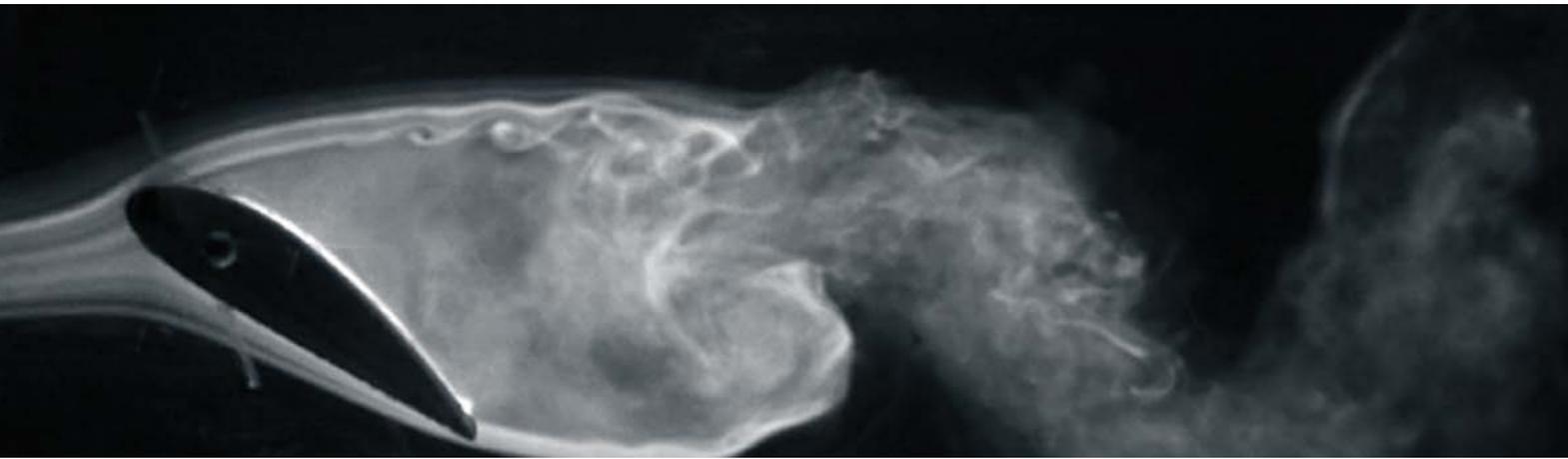
The Agency co-finances the promotion of Slovenian science and knowledge, thus providing support for active participation in events organized by recognized international associations, international organizations or the European Commission. In addition, the programme also facilitates cooperation with Slovenian research organizations and researchers from neighbouring countries, as well as cooperation with Slovenian researchers working abroad. The public call includes innovative activities for the promotion of

Slovene science abroad with the aim of supporting new, pervasive ideas in the field of promotion and communication of science. In 2017, the Agency (co-)financed the following innovative activities:

- STA Science 2.0 – Slovenian scientific achievements in global media,
- An Innovative Tool for the Promotion of Science – *Kvarkadabra*,
- Science on the street, Knowledge and Ideas on the go (*ZnC*), and
- The META scientific podcast *Meta PhODcast* and *Metamorphosis*.

The novelty in the 2017 public call is the promotion of the establishment and development of global integration platforms.

The Agency also co-finances the membership of Slovenian scientific associations in international scientific associations and the works of Slovenian scientific representatives elected to international scientific associations as presidents, vice-presidents, secretaries-general and members of management bodies.



The Agency has established a mechanism for the national financing of research projects with an MSCA seal of excellence

The Agency has established a mechanism for the national financing of research projects by researchers who receive a rating of 85% or more in the review procedure of the Marie Skłodowska-Curie Individual Fellowship and are awarded the European Commission Seal of Excellence, but are not accepted for European co-financing.

The purpose of the seal of excellence is to encourage countries to finance such projects from national funds without additional national assessment procedures, since the seal of excellence is a certificate of internationally recognized project excellence.

Recipients of the MSCA seal of excellence can apply to a public call and receive funding for a national project lasting up to two years in the annual volume of one full-time equivalent (IFTE) in price category E.

Scholarships for visits to ERC project leaders

In June 2017, results were published of the first implementation of a public call for the co-financing of visits to ERC project leaders in 2017.

The Agency is one of the first six agencies that responded to the ERC call in 2016 and, in cooperation with the Ministry of Education, Science and Sport, successfully established a national mechanism to allocate funding for visits of researchers to ERC project leaders. The main criterion for selection is scientific excellence.

The ERC Fellowship to Visit ERC Grantee mechanism is an initiative of the ERC Scientific Council working group for the extension of cooperation with the aim of overcoming the gap in the number of ERC grantees between EU Member States. Accordingly, one of the conditions of the public call is the submission of an application for an ERC call within the period of the first two ERC calls of the same type following the termination of the visit.

Seven researchers – three in the natural sciences, two in the engineering sciences, one in the social sciences and one in the humanities – received funding for three to six month visits to ERC project leaders. The visits will take place in five countries (Switzerland, Belgium, Spain, Italy and Finland).

The Agency will continue with the mechanism, announcing the second public call at the end of 2017.

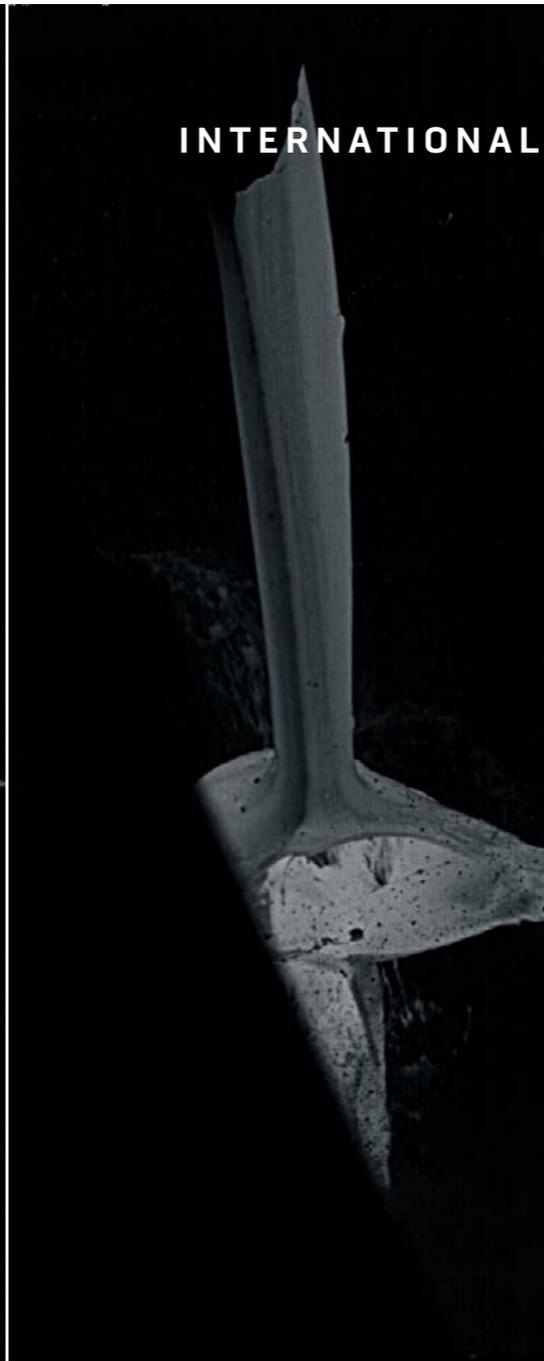
Global networking

In 2018, the Agency, under the public call for co-financing activities related to the promotion of Slovenian science abroad and integration of scientific achievements, introduced

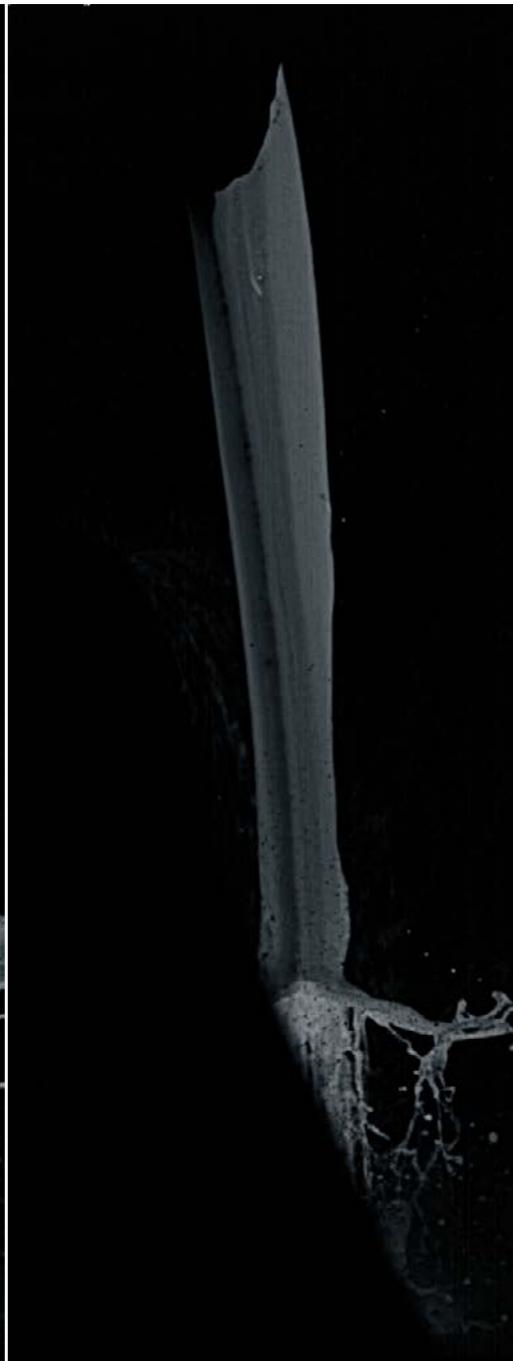
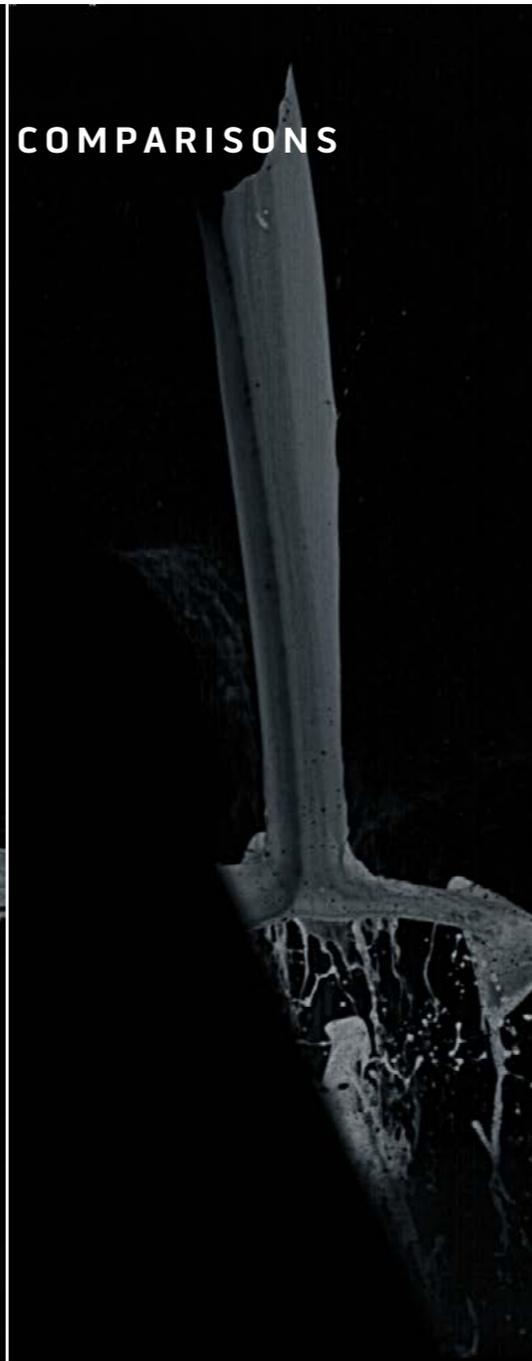
a new incentive for the establishment and development of global platforms with the aim of creating long-term networking platforms, establishing scientific and research

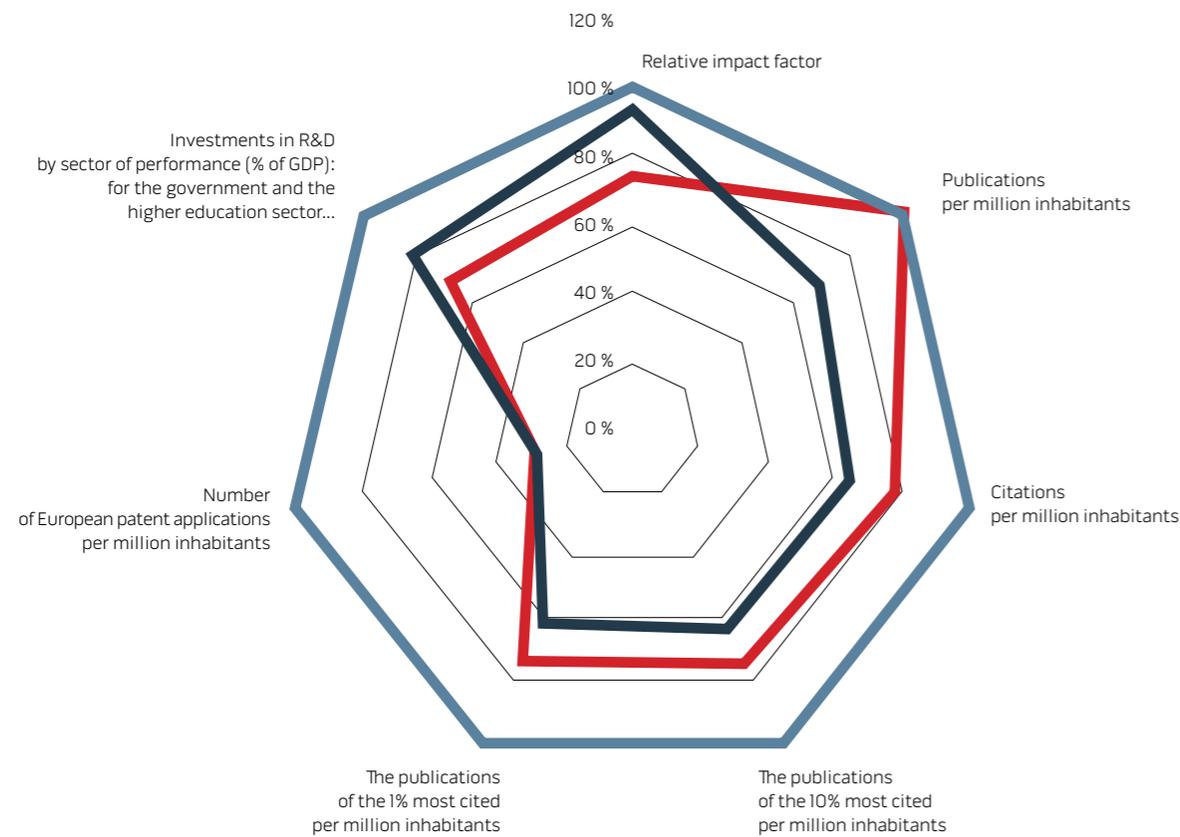
(project) cooperation and enabling knowledge exchange.

The ASEF Institute received funding through this mechanism in 2017.



INTERNATIONAL COMPARISONS





— Slovenia
 — 9th EU country
 — 14th EU country

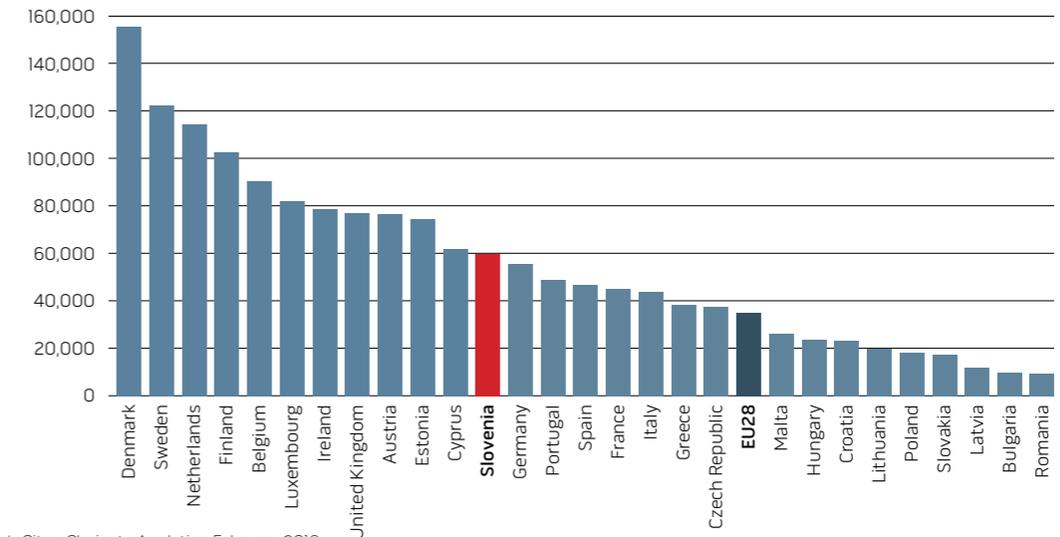
The diagram shows the majority of standard bibliometric and other quantitative indicators that are used for monitoring research activities worldwide and are also included in the Resolution of the Research and Innovation Strategy of Slovenia 2011-2020. The values for Slovenia are shown in relation to the EU member state ranked ninth (the upper third of member states). Information for the 14th country (the upper half of member states) is shown for comparison.

Source: InCites, Thomson Reuters/Science Metrix/Innovation Union Scoreboard/EURtat

Citations

According to the number of citations per million inhabitants, Slovenia is in 12th place, above the EU average for the 2013–2017 period. In the same period, Denmark is the country with most citations per million of population followed by Sweden, the Netherlands and Finland.

Number of citations per million inhabitants of the EU Member States in the period 2013–2017

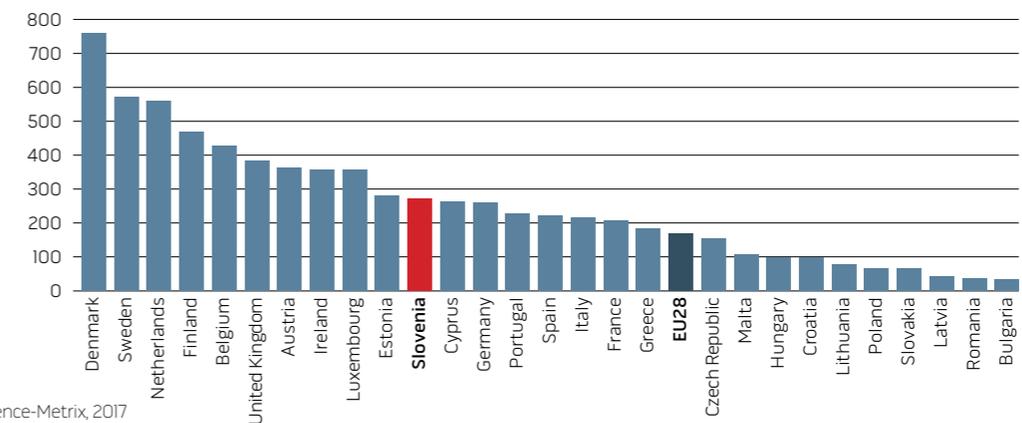


Source: InCites, Clarivate Analytics, February 2018

10 % of highly cited publications

The established bibliometric indicator used for international comparison is the number of publications of researchers in a particular country who are ranked among the 10 % of highly cited publications globally in a specific scientific field. This includes the publications in journals indexed in the Scopus bibliographic database. A four-year period including the year of publication is taken into consideration. From 2004 onwards, Slovenia has exceeded the average growth in the EU within the top 10 % of highly cited publications per million of population. According to the latest data from 2014, it ranks 11th among the EU Member States.

Number of publications within the 10% highly cited per million inhabitants in the EU Member States in 2014



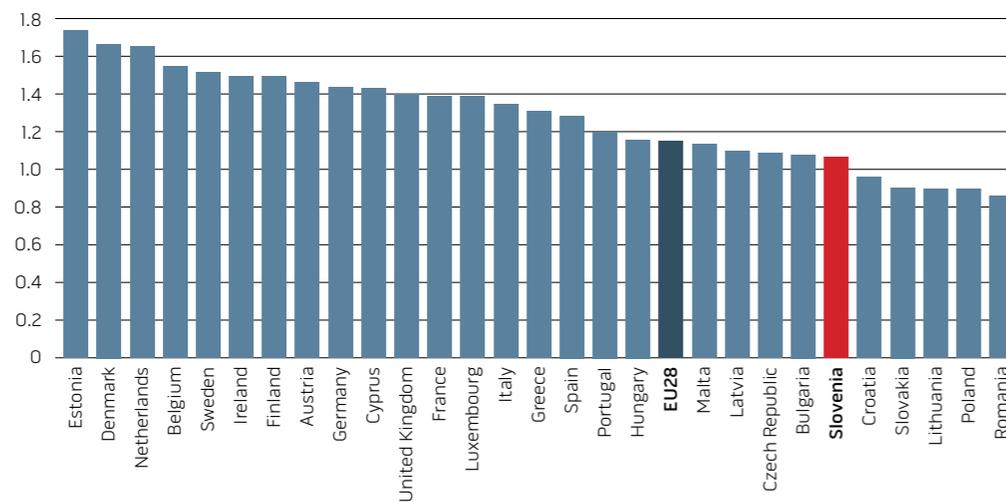
Source: Science-Metrix, 2017

Relative impact factor

The relative impact factor is a standard international bibliometric indicator measuring the ratio between the received citations and the number of publications in a particular country according to the worldwide average impact factor in a particular scientific field. Slovenia ranks 23rd

among the EU Member States for the 2013–2017 relative impact factor. Despite the above-average growth of the impact factor, the value of this indicator is still below the European average due to the high number of publications.

Relative impact factor for the EU Member States for the period 2013–2017



According to data from 2018, the value of the relative impact factor is equal to the value of 2017, which is 1.06. In 2017, for the first time since Slovenia has monitored this indicator, Slovenia exceeded the global average (1.00).

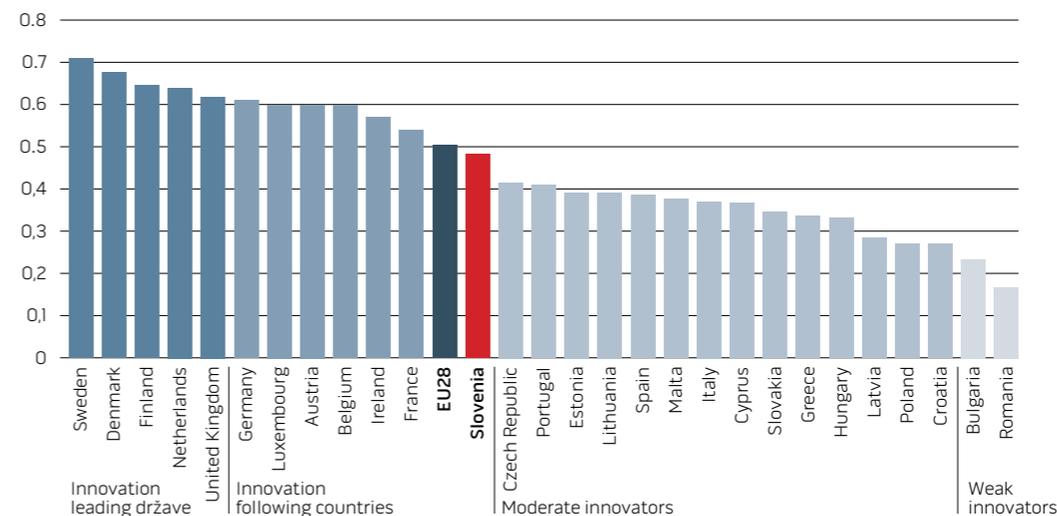
Source: InCites, Clarivate Analytics, February 2018

Innovation index

The Innovation Union Scoreboard provides a comparative assessment of the innovation performance of individual countries. It is a composite indicator building on data for more than twenty indicators covering the educational structure, openness and excellence of the research system, financing, support to investment, cooperation and entrepreneurship and on the intellectual capital. Countries are classified into four groups

according to their degree of innovation, with innovation leading countries comprising the first group, innovation following countries in the second group, moderate innovators in the third group and weak innovators in the fourth group. In 2016, Slovenia was ranked 12th among the innovation followers of EU Member States in terms of the indicators mentioned above.

Innovation index for the EU Member States in 2016



International comparisons and other analyses are published at www.arrs.gov.si/sl/analize/.

Source: Innovation Union Scoreboard, 2017

ABOUT THE AGENCY



Strategic orientations of the Agency's operation and development

- Sound implementation of activities according to the legal bases, Decision Establishing the Slovenian Research Agency, and applicable national strategic documents.
- Transparency and responsiveness.
- Optimization of instruments and setting-up pilot instruments.
- Monitoring the effects of the implementation of the activities.
- International integration and comparability.
- Transition to fully electronic services.
- Communication with the public and science promotion based on three core principles: open, responsive and informative communication.

Internal organizational units

Director's office

The Director's office carries out specialised, advisory, coordination and administrative-technical tasks, and coordinates the work of joint tasks with the Agency's internal organizational units and other bodies.



prof. dr. József Györkös, Director



dr. Lidija Tičar Padar, Deputy Director

Department of Research Programmes, Young Researchers and Analysis and Monitoring

This department evaluates and selects research programmes and carries out tasks related to the young researchers programmes. It analyses and monitors the development of scientific research activities and actively develops the area of science promotion. The department is involved in the ERA-net Norface and the Joint

Programming Initiative Urban Europe. The department also communicates with the public and promotes science, the aim being more professional reporting on science and on the operation of the science system in the Republic of Slovenia.

Head of Department: Dr. Marko Perdih, Assistant Director



Tina Vuga, Public Relations

Department of Research Projects

This department carries out tasks in the field of evaluation and selection of research projects. Within its scope of operation, it organizes the procedures for substantive monitoring and control of co-funding, implementation and attainment of the objectives of research projects. The main activities of this department

are the launching of the call for proposals to receive co-funding for research projects and the launching of the call for proposals to receive co-funding for the Targeted Research Programmes projects.

Head of Department: Simon Ošo, Assistant Director

Department of Research Infrastructure and International Cooperation

This department carries out tasks in the field of research equipment and infrastructure programmes, central specialised information centres, scientific literature and bibliographic databases, international scientific research cooperation, promotion of science abroad, and involvement of researchers in the activities of international scientific associations. Its tasks range from activities within

the mechanism of leading agencies to activities related to the fostering of participation in the calls for proposals for European research programmes, the setting up of complementary scheme in connection with the calls for proposals of the European Research Council and the hosting of third country researchers.

Head of Department: Mojca Boc

Ten years of the Agency's electronic business

Junija In June 2017, we marked ten years from the first electronic document created by users in the eForms portal. This year, 98% of documents were digitally signed.

On the portal, researchers and research organisations can easily arrange all the procedures for the Agency's major funding mechanisms (research programmes, research projects and young researchers). From submission of an electronic application to a public tender or call, submission of content reports, arrangement and allocation of the research load in the group, to arrangement of a researcher's employment percentage. In 2017, the portal was upgraded with the eEvaluation module, which is intended for foreign evaluators with the aim of obtaining coordinated evaluations of calls for tenders.

Department of Legal and General Affairs

The Department of Legal and General Affairs carries out tasks in the fields of law and labour law procedures. It conducts administrative procedures regarding access to public information and keeping of private researchers register. The department manages the Database of Research and Development Actors. The department also carries out tasks related to personnel and human re-

sources management. It carries out procurement procedures as well as other procedures related to the acquisition of funds and services, and provides for the maintenance of the Agency's business premises and equipment. The department serves as the Agency's head office, archives documentary materials and maintains the archive.

Head of Department: Katarina Hren

Department of Finance and Accounting

The department carries out tasks related to the financial operations of the Agency. It is responsible for planning, implementing, recording and reporting on the financing of scientific research activities, programme tasks, the functioning of the Agency, and the securing of the Agency's sol-

vency. It is also responsible for putting in place payment, recovery and control mechanisms, implementing accounting tasks, and coordinating the conclusion of joint contracts with research activity operators.

Head of Department: Mojca Kastelc Selan

Department of Information Technology

The Department of Information Technology lays the expert groundwork for the determination and implementation of the Agency's information policy, provides information support for business processes and coordinates the development of in-

formation and communication infrastructure. The department manages projects for the installation, operation and maintenance of hardware, system software and basic user interface software tools.

Head of Department: Mitja Tomažič

The overview of the funding in 2017 according to the programme sub-items on an accrual basis

	Realised 2017 (in €)
FOUNDER'S OBLIGATIONS AND INFRASTRUCTURE PROGRAMMES	33.041.892
The PRI founder's obligations	16.392.498
Infrastructure programmes – material costs	8.398.205
Reimbursement of work-related costs	4.283.560
Infrastructure programmes – salaries	3.967.629
RESEARCH PROGRAMMES AND PROJECTS	85.610.856
Research projects	23.837.050
Research programmes	57.893.801
ERA projects	88.328
ESF in ERC projects	2.686.099
Targeted research programmes - competitiveness	1.105.578
TRAINING AND DEVELOPMENT OF SCIENTIFIC STAFF	19.737.023
Young researchers	17.135.093
Postdoctoral projects	2.362.626
Promotion of the employment of young doctors	239.305
RESEARCH EQUIPMENT	1.039.690
Research equipment	1.039.690
SCIENTIFIC LITERATURE, MEETINGS AND OSIC	7.122.748
Domestic popular scientific periodicals	90.000
Domestic scientific periodicals	1.009.999
Scientific monographs	317.999
Foreign periodicals and databases	5.447.063
OSIC - centralized specialized information centres	257.686
INTERNATIONAL SCIENTIFIC COOPERATION	1.670.150
CEA, cooperation within the EU	472.016
International projects, bilateral cooperation	571.283
Encouraging applications for EU projects	325.000
Visits to ERC project leaders	33.466
Promotion of Slovenian science abroad	184.424
Operation of Slovenian scientific associations worldwide	83.961
Total:	148.222.360

Overview of funding by year is available at www.arrs.gov.si/sl/finan/.

Public calls and tenders that started in 2017

Domestic tenders and calls

	Publication date
Public call assigning mentor places to research programmes in 2017	27.01.2017
Public call for research programme funding	10.02.2017
Public tender for granting concessions for carrying out public service in the field of research activities in the form of research programmes	10.02.2017
Public tender for co-financing the publication of scientific monographs in 2017	31.03.2017
Public tender for co-financing the purchase of international scientific literature in 2017	19.05.2017
Public call for (co-)financing research projects in 2018	16.06.2017
Public tender for selecting research projects of the Targeted Research Programme »TRP 2017«	13.10.2017
Public tender for co-financing programmes of the activities of central specialized information centres during the period 2018–2019	17.11.2017
Public call for the submission of infrastructure programmes for financing in the period 2018–2020	08.12.2017

International tenders and calls

	Publication date
Public tender for payment of a one-time financial contribution toward the costs of preparation and application of projects in the framework of the EU Horizon 2020 Programme for Research and Innovation (2017)	27.01.2017
Public tender for co-financing of the Slovenian share of joint Hungarian-Slovenian projects, where the NKFIH (National Research, Development and Innovation Office) acts as the lead agency	10.02.2017
Public tender for postdoctoral research scholarships of the Japanese Society for the Promotion of Science (JSPS) for 2017	15.02.2017
Public tender for co-financing of scientific research cooperation between the Republic of Slovenia and the French Republic - PROTEUS Program, 2018-2019	24.02.2017
Public tender for the co-financing of scientific and research cooperation between the Republic of Slovenia and the Republic of Austria in the period 2018–2019	03.03.2017
Public tender for (co-)financing of scientific research cooperation between the Republic of Slovenia and the United States of America in the period 2018–2019	10.03.2017
Public tender for co-financing of activities in international scientific associations in 2017	10.03.2017
Public tender for co-financing of the Slovenian share of joint Austrian-Slovenian projects, where FWF (FWF Der Wissenschaftsfonds) acts as the lead agency	06.03.2017

Public tender for co-financing of activities related to the promotion of Slovene science abroad and the linking of scientific achievements in 2017	31.03.2017
Public tender for co-financing of scientific and research cooperation between the Republic of Slovenia and the Republic of Serbia in the period 2018–2019	21.04.2017
Public tender for co-financing of scientific research cooperation between the Republic of Slovenia and the Republic of Argentina in the period 2018–2019	12.05.2017
Public tender for the co-financing of scientific and research cooperation between the Republic of Slovenia and Croatia in the period 2018–2019	26.05.2017
Public tender for the co-financing of scientific research cooperation between the Republic of Slovenia and Japan in the period 2018–2020	09.06.2017
Public tender for co-financing of scientific and research cooperation between the Republic of Slovenia and the Federal Republic of Germany in the period 2018–2019	09.06.2017
Public call for co-financing of projects with the Marie Skłodowska-Curie Seal of excellence	13.09.2017
Public tender for (co-)financing visits to ERC project leaders in 2018	15.09.2017
Public tender for co-financing of scientific research cooperation between the Republic of Slovenia and the People's Republic of China in the period 2018–2020	20.10.2017
Public tender for the co-financing of scientific and research cooperation between the Republic of Slovenia and Israel in the period 2018–2020	10.11.2017
Public tender for co-financing of scientific and research cooperation between Slovenia and Turkey in the period 2018–2020	17.11.2017
Public tender for postdoctoral research scholarships in Japan for researchers from the Republic of Slovenia in 2018	01.12.2017
Public tender for co-financing of the Slovenian share of joint Flemish-Slovenian projects where the Research Foundation (Flanders, FWO) acts as the lead agency	01.12.2017
Public tender for co-financing of scientific research cooperation between the Republic of Slovenia and the Italian Republic in the period 2018–2020	15.12.2017
Public tender for co-financing of scientific and research cooperation between the Republic of Slovenia and Montenegro in the period 2018–2020	15.12.2017
Public tender for co-financing of scientific and research cooperation between the Republic of Slovenia and the Commission for Alternative Energy and Atomic Energy (CEA) of the French Republic in the period 2018–2019	15.12.2017
Public tender for the payment of a one-time financial contribution toward the costs of preparation and application of projects in the framework of the EU Horizon 2020 Programme for Research and Innovation (2018)	22.12.2017

EXCELLENT IN SCIENCE



Excellent in Science

Excellent in science is a project carried out by the Agency in the framework of science promotion. It is a selection of the most significant achievements of the previous year by members of the scientific research councils of individual disciplines. The selected achievements are presented every autumn at events open to the public in the form of short popular lectures.

In 2017, the achievements of researchers were presented at six events organized by the Agency in cooperation with the consortium of the European Researchers' Night, associates and collaborators of the Science on the Street project, the Slovenian

Ethnographic Museum, the Slovenian Academy of Sciences and Arts and the Novo mesto secondary school.

Presentations of the achievements are available on the Videolectures.net web portal.

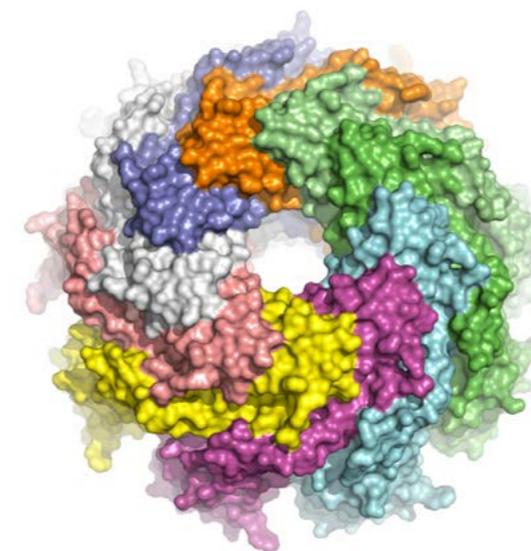
Natural sciences

Protein nanopore 3D structure

Lysenin is a protein toxin that is used by earthworms to defend them from parasitic microorganisms. Lysenin is similar to pore-forming toxins produced by certain bacteria that cause food poisoning. Structural features of these toxins have been known for more than 20 years, however, the toxic mechanism that leads to formation of pores on the target membrane is still largely unknown. The study revealed that lysenin forms

extremely stable nanopores on the surface of lipid membranes. Lysenin nanopore is assembled from nine monomers. Pore formation includes significant rearrangements of the lysenin structure. Understanding of structural features and molecular mechanism of protein nanopores assembly will enable novel nanobiotechnological applications and development of defence strategies against bacterial toxins.

Prof. dr. Gregor Anderluh, National Institute of Chemistry (gregor.anderluh@ki.si)



Source: Podobnik M, Savory P, Rojko N, Kisovec M, Wood N, Hambley R, Pugh J, Wallace EJ, McNeill L, Bruce M, Liko I, Allison TM, Mehmood S, Yilmaz N, Kobayashi T, Gilbert RJ, Robinson CV, Jayasinghe L, Anderluh G. Crystal structure of an invertebrate cytolytic pore reveals unique properties and mechanism of assembly. *Nature Communications* 7:11598; doi:10.1038/ncomms11598.
Hyperlink: <http://www.nature.com/articles/ncomms11598>

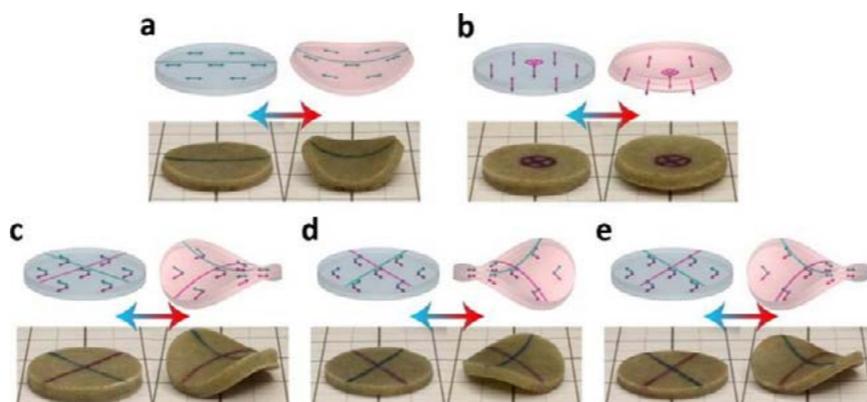
Polymer-dispersed liquid crystal elastomers
A new class of smart soft materials

The strong thermomechanical response (shape changes induced by temperature) of liquid crystal elastomers (LCEs) could be exploited in new generations of mechanical actuators. Unfortunately, efficient implementation suffers from a rather tedious synthesis procedure that imposes severe restrictions on the specimen shape and on the application of conventional polymer molding technology.

The above problem is resolved by preparing polymer-dispersed liquid crystal elastomers (PDLCEs), specifically by doping conventional silicone elastomers with LCE microparticles. In PDLCEs, temperature-responsive anisotropic shape memory of the microparticles is transferred to the whole material, provided that the particles are oriented in the external magnetic field and their alignment

stabilized by crosslinking the polymer matrix. Such an approach allows the preparation of thermomechanically functionalized elastomeric objects of arbitrary sizes and shapes. The applicability of this newly developed material was demonstrated by preparing samples of identical disc-like shape and size, imprinted with shape memory corresponding to all basic mechanical deformation modes, i.e. bend, cup, saddle, left-, and right-handed twist deformation (Figs. 1a-e, respectively). This was achieved within a relatively simple double-layer geometry with layer-specific modulation of the LCE microparticle orientational order. PDLCEs thus represent a promising new material for applications in future additive manufacturing technologies, e.g. for 3D printing of shape-programmable soft artefacts.

Prof. dr. Boštjan Zalar, Jožef Stefan Institute (bostjan.zalar@ijs.si)



Thermomechanical deformation modes of PDLCE specimens.

Source: A. Rešetič, J. Milavec, B. Zupančič, V. Domenici, and B. Zalar, "Polymer-dispersed liquid crystal elastomers", *Nature Communications* 7, 13140 (2016).
Hyperlink: <http://www.nature.com/articles/ncomms13140>

New method for preparation of fluorinated chiral alcohols

Life itself strictly uses one structural form of a chiral compound such as L-amino acids and D-sugars, which can be otherwise synthesized in the laboratory in all its multiple structural forms, referred to as stereoisomers. Each stereoisomer can possess different bioactivity, therefore inciting chemists to design synthetic strategies which lead to the single desired stereoisomer.

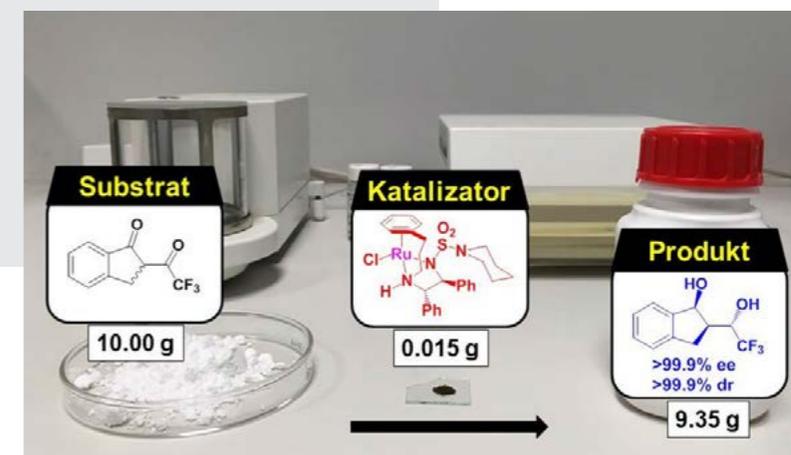
Asymmetric homogeneous catalysis which combines inorganic and organic chemistry, is a specially-attractive synthetic route to access one determined structural form of a chiral compound. It is based on the use of a very small amount of a chiral catalyst that is a substance which performs the transformation without being consumed itself.

We have invented new chiral catalysts which proved to be very efficient in the asymmetric transformation of ketones to stereomerically pure alcohols by reduction reaction. These catalysts and such methodology were applied to the preparation of stereomerically pure fluorinated

dialcohols. In our examples of ketones, a classical non-asymmetric transformation would lead to a mixture of 8 stereoisomers, compared to a single stereoisomer having 3 contiguous chiral centres which was obtained following our asymmetric methodology. This was achieved in one-pot via two consecutive "dynamic kinetic resolutions/asymmetric transfer hydrogenations", which is an unprecedented transformation in the literature.

This methodology definitely enriches the fluorine research area, and the generated compounds with excellent enantiopurity could be further elaborated for higher molecular complexity. The work was selected as "Synfact of the Month" (*Synfacts* 2016, 6, 589).

Dr. Barbara Mohar, National Institute of Chemistry (barbara.mohar@ki.si)



Source: Andrej Emanuel Cotman, Dominique Cahard, Barbara Mohar, *Angew. Chem. Int. Ed.* 2016, 55, 5294-5298. Stereoarrayed CF₃-Substituted 1,3-Diols by Dynamic Kinetic Resolution: Ruthenium(II)-Catalyzed Asymmetric Transfer Hydrogenation.
Hyperlink: <https://onlinelibrary.wiley.com/doi/full/10.1002/anie.201600812>

The sea level rise impact on four seashore breeding birds: the key study of Sečovlje Salina Nature Park

Sea level rise is one of the most obvious consequences of climate change. The densely populated coastal zones are particularly exposed to this process. If for humanity more serious problems from that perspective are still ahead, the opposite is true for many coastal wetlands around the world. The flora and fauna of these special ecosystems is already responding to increased environmental pressures. Anthropogenic coastal activities are constantly shrinking wetland areas and, in addition, periodical flooding is more and more frequent owing to rising sea levels. In the Sečovlje Salina Nature Park, some breeding birds (the Kentish plover, the Little and the

Common tern and the Black-winged stilt) indicate the upcoming changes with their spatial nesting pattern as they evidently occupy different breeding niches. Spatial environmental impact studies have an applicative value for all stakeholders who directly or indirectly manage protected areas. This study discusses the objective guidelines in the direction of preserving protected habitats and related organisms in the Sečovlje Salina Nature Park and develops a methodology, which is transferable to the remaining wetlands in mid-latitudes that are exposed to the sea level rise process and consequent loss of biodiversity.

Assist. prof. dr. Danijel Ivajnsič, The Faculty of Natural sciences and Mathematics, University of Maribor



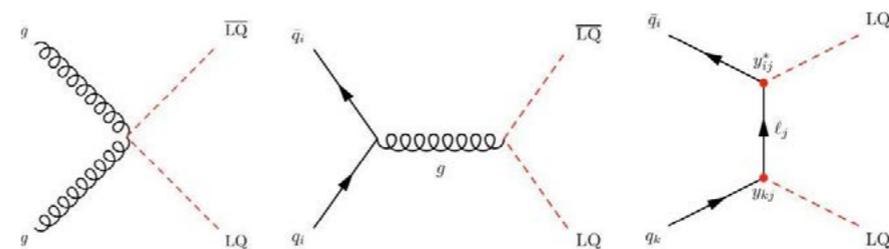
Source: Ivajnsič, D., Lipej, L., Škornik, I. et al.: The sea level rise impact on four seashore breeding birds: the key study of Sečovlje Salina Nature Park. *Climatic Change* (2017) 140: 549. doi:10.1007/s10584-016-1854-3. Hyperlink: <https://link.springer.com/article/10.1007/s10584-016-1854-3#article-dates-history>

Physics of leptoquarks

Leptoquarks are hypothetical particles with spin either 0 or 1 which may, contrary to the bosons of the Standard Model, convert leptons to quarks or vice versa. Their presence is expected in the context of Grand Unified Theories, where it is predicted that leptons and quarks are indistinguishable at small length scales. The review article compiles relevant results from leptoquark phenomenology, which connects theoretical predictions in leptoquark models to the experimental searches at particle colliders. We have presented the limits on leptoquark masses and couplings due to constraints from precise low-energy measurements,

such as electrical and magnetic dipole moments, atomic parity violation, neutral meson mixing, meson decays, and rare lepton decays. At the high-energy frontier we have underlined complementarity between precise measurements of electroweak processes, top quark physics and Higgs boson decays. Finally, we have also reviewed the theoretical and experimental status in direct searches for leptoquarks in colliders. The review will help in guiding the community in leptoquark searches. Their experimental discovery would be of fundamental importance for physics beyond the Standard model.

Assist. prof. dr. Nejc Košnik, Faculty of Mathematics and Physics, University of Ljubljana, Jožef Stefan Institute (nejc.kosnik@ijs.si)



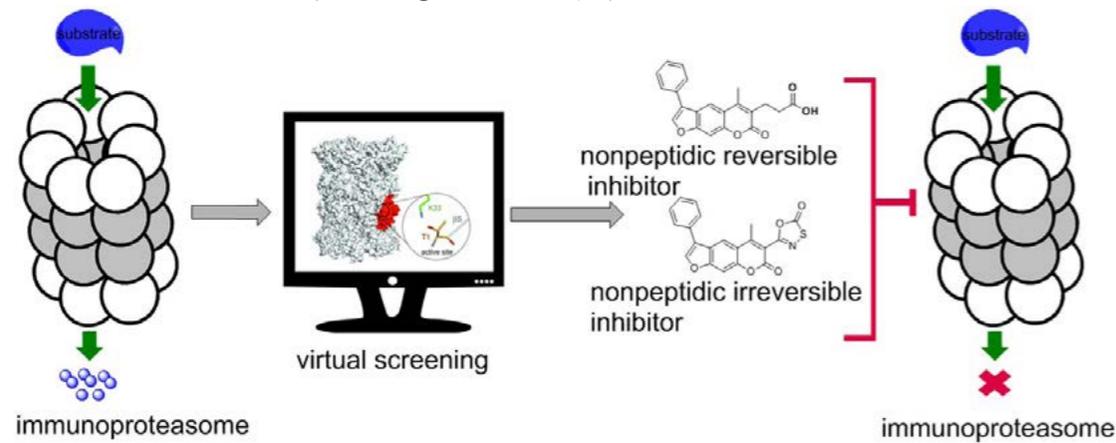
Source: I. Doršner, S. Fajfer, A. Greljo, J.F. Kamenik, N. Košnik, Physics of leptoquarks in precision experiments and at particle colliders, *Phys.Rept.* 641 (2016) 1–68. Hyperlink: <https://arxiv.org/abs/1603.04993>

Nonpeptidic Selective Inhibitors of the Chymotrypsin-Like (5i) Subunit of the Immunoproteasome

The immunoproteasome is an enzyme with three distinct catalytically active subunits. Elevated expression of the immunoproteasome has been associated with autoimmune and inflammatory diseases, as well as various types of cancer. Recent research has shown that its inhibition is a viable approach in the treatment of autoimmune diseases. The majority of known inhibitors of the immunoproteasome are restricted to peptide-based compounds that are prone to poor metabolic stability and low bioavailability. In this study, the authors used virtual-screening and subsequent chemical optimization to develop nonpeptidic inhibitors of the immunoproteasome. They focused on reversibly and irreversibly acting compounds. Biochemical evaluation

showed that these compounds selectively block the chymotrypsin-like (5i) subunit of the human immunoproteasome. The undesired inhibition of the remaining two subunits of the immunoproteasome and the constitutive proteasome was negligible. Thus, the researchers at the Faculty of Pharmacy and collaborators confirmed the hypothesis that selective inhibition of the immunoproteasome can be achieved with nonpeptidic compounds. Molecules of this type have several advantages; besides better stability it is also possible to cover greater chemical space during optimization. The discovered inhibitors will thus pave the way toward either more potent inhibitors and/or compounds with improved physico-chemical properties.

Prof. dr. Stanislav Gobec, Faculty of Pharmacy, University of Ljubljana (stanislav.gobec@ffa.uni-lj.si)



Source: Sosič, I.; Gobec, M.; Brus, B.; Knez, D.; Živec, M.; Konc, J.; Lešnik, S.; Ogrizek, M.; Obreza, A.; Žigon, D.; Janežič, D.; Mlinarič-Raščan, I.; Gobec, S*. Nonpeptidic selective inhibitors of the chymotrypsin-like (5i) subunit of the immunoproteasome. *Angewandte Chemie International Edition* 2016, 55, 5745–5748. Hyperlink: <https://www.ncbi.nlm.nih.gov/pubmed/27037901>

Monitoring the Potoška planina landslide (NW Slovenia) using UAV photogrammetry and tachymetric measurements

The fact that Slovenia is highly susceptible to slope mass movements underlines the need for more intensive observation and monitoring of landslides in Slovenia, with the ultimate aim of defining prevention measures and reducing the hazards associated with slope mass movements in the future.

In order to recognize and understand the slope mass movements and their dynamics it is crucial to apply a flexible and reliable monitoring system to monitor visible surface changes through time and space. Monitoring of changes on the surface and observation of surficial displacements can be accomplished using different surveying techniques.

In order to estimate surface movement patterns at the Potoška planina landslide, periodic monitoring was conducted using different surveying techniques: UAV-based photogrammetric measurements that provide high-resolution images, while tachymetric geodetic measurements enable accurate control of photogrammetric assessed surface displacements.

Based on our results, it was concluded that current available modelling data, such as displacement rates, elevation change assessments and estimated transported volumes, contribute significantly to a better understanding of the behaviour and dynamics of the Potoška planina landslide in the near real time.

The results of the research and analysis represent a significant knowledge in the field of recognition and understanding of slope mass movements. The study combines the results and analyses of two independent disciplines, engineering geology and geodesy and proves their importance in the knowledge of slope mass movements that has a key role in the prevention measures.



Dr. Tina Peternel, The Geological Survey of Slovenia, (tina.peternel@geo-zs.si)

Source: PETERNEL, Tina, KUMELJ, Špela, OŠTIR, Krištof, KOMAC, Marko. Monitoring the Potoška planina landslide (NW Slovenia) using UAV photogrammetry and tachymetric measurements. *Landslides*, ISSN 1612-510X. [Print ed.], 2017, vol. 14, no. 1, p. 395-406, doi:10.1007/s10346-016-0759-6. Hyperlink: <https://link.springer.com/article/10.1007/s10346-016-0759-6>

Novel organocatalysts based on camphor

Organocatalysis refers to the use of small organic molecules as catalysts for organic reactions. The majority of highly active organocatalysts is based on a limited set of chiral 1,2-diamine building blocks, which are by-products of the metabolism of living organisms or their derivatives. Our researchers were the first to synthesize chiral 1,3-diamine building blocks from camphor and use them for the preparation of bifunction-

al non-covalent organocatalysts. These catalysts are useful in various organic reactions and exhibit high catalytic activity and stereoselectivity (up to 99% ee). They are substrate tolerant, insensitive to moisture and air, and are active in an aqueous medium. Quantum chemical methods indicate they operate according to a mechanism that has been considered as less likely in the literature. The discovery is an important milestone in the development of organocatalysis and organic chemistry, as it has been assumed that the best bifunctional organocatalysts are based on 1,2-diamine building blocks. Due to the easy accessibility of camphor from natural sources, the development of these catalysts is an important contribution to sustainable development and development of environmentally friendly technologies.

Assist. prof. dr. Uroš Grošelj, Faculty of Chemistry and Chemical Technology, University of Ljubljana
(Uros.Groselj@fkkt.uni-lj.si)
Dr. Sebastijan Ričko, Faculty of Chemistry and Chemical Technology, University of Ljubljana
(Sebastijan.Ricko@fkkt.uni-lj.si)



Source: Ričko, Sebastijan, and Uroš Grošelj. Sinteza potencialnih organokatalizatorjev na osnovi kafre: doctoral dissertation. Ljubljana: S. Ričko, 2016. Print.
Hyperlink: <https://plus.cobiss.si/opac7/bib/1536971715>

The comparability of a biosimilar to a reference molecule has to be demonstrated as part of a drug approval process to assure efficacy and safety of the proposed biosimilar. The paper describes a systematic combined approach of using nuclear magnetic resonance and mathematical metrics to evaluate similarity to the reference product. The aim of the method is to transform the complex structural information to similarity indices, which are used to evaluate the level of similarity to the reference molecule. The meth-

odology described in paper was used to compare filgrastim used for treatment of neutropenia (decreased level of white blood cells) and rituximab, which is used for treatment Non-Hodgkin's lymphoma, chronic lymphocytic leukaemia as well as immunological diseases. The fingerprint-like analytical similarity which was showed contributed to the totality of evidence in demonstration of biosimilarity which in term led to registration and subsequent marketing authorization of both biosimilar drugs.

Prof. dr. Uroš Urleb, Faculty of Pharmacy, University of Ljubljana

Biosimilar structural comparability assessment by NMR: from small proteins to monoclonal antibodies

Source: Nature Publishing Group; Scientific reports; 2016; Vol. 6; p. 32201-1-32201-12.

Engineering Sciences and Technologies

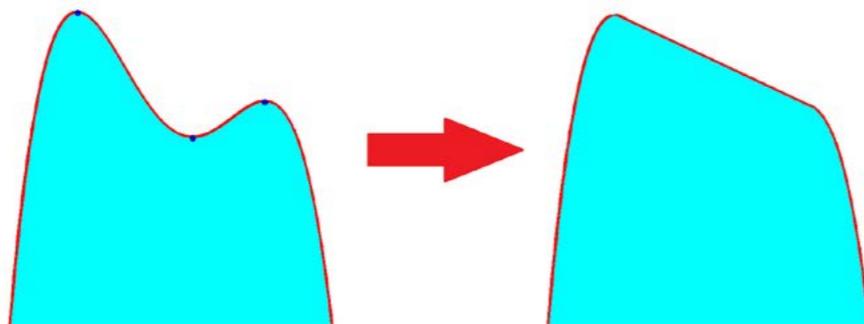
Convexity and real algebraic geometry

In the book Optimization of Polynomials in Non-Commuting Variables Dr. Klep and co-authors Dr. Burgdorf and Dr. Povh comprehensively present the results of optimization of non-commutative polynomials, which has been the subject of intensive research by the authors during recent years. An important quality of this book is the presentation of algorithms to implement this optimization, as well as the open source software package NCSOS tools, which numerically implements all these algorithms. The package was developed by Dr. Kler, Dr. Povh and Slovenian author, Dr. Cafuta. The presented results have direct use, for example, in quantum physics, where the programs of the NCSOS

tools package can be used to find the upper limits for Bell's inequalities, which are used in quantum mechanics to investigate entanglement. In a paper titled Matrix Convex Hulls of Free Semialgebraic Sets, Dr. Klep and an American co-author formulate and demonstrate several basic notions of non-commutative real algebraic geometry. The article deals with theoretical concepts, especially convexity, and presents among other topics, an effective method for the use of dimensional extensions to find convex shells (a two-dimensional example is illustrated above), which can be used directly in all areas where non-convexity is an obstacle to the effective implementation of algorithms.

Prof. dr. Igor Klep, Faculty of Mathematics and Physics, University of Ljubljana (igor.klep@fmf.uni-lj.si)

Prof. dr. Janez Povh, Faculty of Mathematics and Physics, University of Ljubljana (janez.povh@lecad.fs.uni-lj.si)

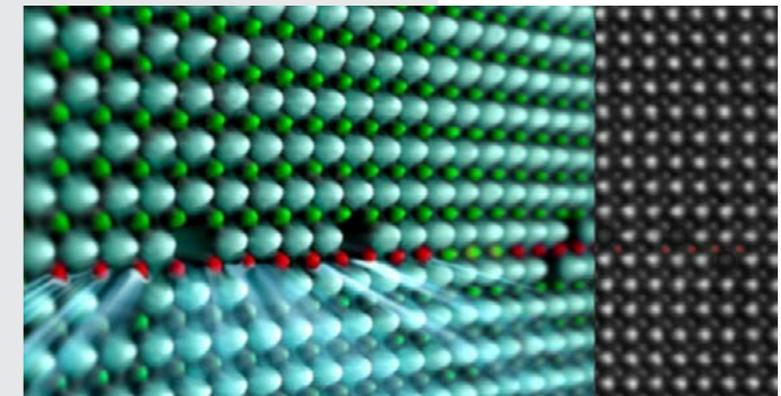


Source: Igor Klep: Matrix Convex Hulls of Free Semialgebraic Sets, Trans. Amer. Math. Soc. 368 (2016) 3105–3139 (v soavtorstvu z J. W. Heltonom in S. A. McCulloughom)
Igor Klep: Optimization of Polynomials in Non-Commuting Variables, SpringerBriefs in Mathematics, Springer-Verlag, 2016. ISBN 978-3-319-33336-6 (co-authorship with S. Burgdorf in J. Povhom)

Interpretation of electric conductivity of domain walls in bismuth ferrite

Ferroelectric bismuth ferrite is being extensively studied as a candidate material for high-temperature piezoelectric devices. The drawback for practical utilization is its high electrical conductivity an important contribution of which stems from local conduction at the domain walls. Despite the fact that the conductivity of the domain walls was already proven in 2009, until now there was no consistent explanation of the mechanism. Researchers from Jožef Stefan Institute and National Institute of Chemistry, in collaboration with colleagues from Switzerland and Japan, were the first to identify accumulation of charged defects at domain walls in bismuth ferrite. This study explains the mechanism of the p-type hopping conduction at the domain walls in bismuth ferrite and shows that the local domain-wall conductivity can be tailored by controlling the atmosphere during

high-temperature annealing. The study, which results were published in the prestigious Nature Materials, was entirely designed and implemented at both Slovenian institutions, and will enable further development of materials with controlled local conductive properties for use in sensors, actuators, ultrasound converters and will contribute to the development of domain wall nano-electronics.



Point defects (red coloured Iron 4+ and Bismuth vacancies) at the domain wall in bismuth ferrite.

Assist. prof. dr. Andreja Benčan, Jožef Stefan Institute

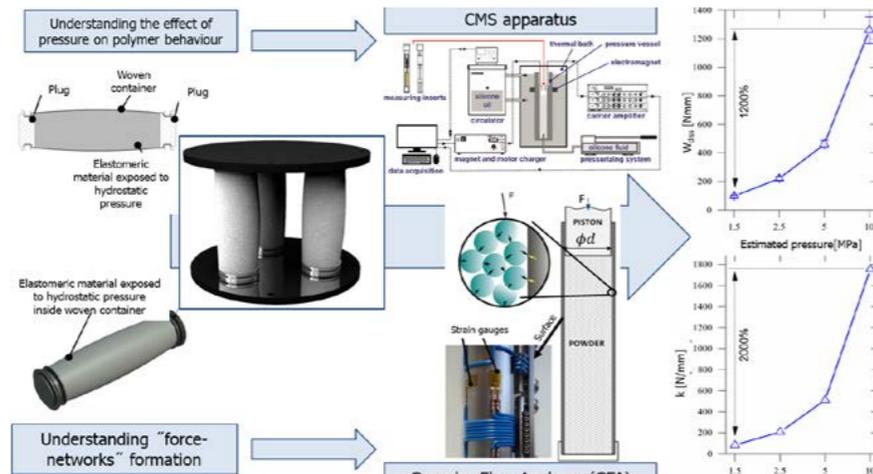
Source: Tadej Rojac, Andreja Benčan, Goran Dražič, Naonori Sakamoto, Hana Uršič, Boštjan Jančar, Gašper Tavčar, Maja Makarovič, Julian Walker, Barbara Malič & Dragan Damjanović, Domain-wall conduction in ferroelectric BiFeO₃ controlled by accumulation of charged defects, Nature Materials 16, 322–327 (2017).
Hypelink: <https://www.nature.com/articles/nmat4799>

Technological breakthrough in the field of vibration damping, shock and noise

New granular damping elements, which surpass all existing technical solutions at least ten times represent technological breakthrough in the field of vibration damping, impact loading and noise reduction. The patented achievement combines developed basic knowledge (i) the influence of pressure on the behaviour of polymeric materials, and (ii) the process of forming a »force-network« in granular materials. We have found that: (a) the dissipative modulus of viscoelasticity can be continuously changed by exposing material to hydrostatic pressure. Furthermore, this allows matching polymeric characteristics with frequency/velocity of mechanical loading; (b) appropriate particle size distribution of granular materials can change their »flowability« and thus the size of the generated »contact

force field«, which is another important dissipative mechanism. In prototype damping elements, the hydrostatic pressure was generated using granular materials obtained from scrap rubber that was encapsulated with a container from basalt and/or graphite fibres. We have demonstrated that dissipated energy of elements at higher pressures increased up to 10 times and stiffness up to 20 times. Patented damping elements represent a completely new and effective way of damping vibrations and noise. They consist of a woven basalt (or graphite) tube filled with polymeric granular material under pressure. They can be used for earthquake protection, protection of devices and machines, and protection of cars against impact loading in accidents.

Dr. Marko Bek, Faculty Of Mechanical Engineering, University of Ljubljana



Source: Patent - Emri Igor, Bernstorff, Bernd Steffen von. Dissipative bulk and granular systems technology: EP2700839 (B1). München: Europäisches Patentamt, 2016. [COBISS.SI-ID 12444187] Hyperlink: <https://plus.cobiss.si/opac7/bib/12444187>

Innovative hybrid control system for a gait rehabilitation device

Gait rehabilitation after injuries or neural impairments is a comprehensive and demanding treatment process for both the patient and therapists. Researchers from the Faculty of Electrical Engineering in cooperation with the University Rehabilitation Institute Soča developed a gait rehabilitation platform that ensures safe and almost unconstrained motion of the patient during therapeutic sessions in controlled environment. Control over the motion of the device is shared between the patient, the therapist and the navigation system based on the agreed therapy schedule. Embedded computer system uses sensor data to measure the perturbations in patient's position in order to determine the patient's

intentions. The computer joins the calculated estimation of the desired velocity and turning rate with the information of the environment to prevent collisions and thus support safe manoeuvres. Intuitive and simple control interface enables the patient and the therapist to fully devote themselves to the rehabilitation process. Combined control over the device is supported with the concept of virtual course, where the patient's ability to follow the predefined path is assessed and the result used to dynamically switch between observed patient's intentions and the outputs of the navigation computer. Positive test results obtained in real clinical environment support the presented approach to gait rehabilitation.

Dr. Matevž Bošnjak, The Faculty of Electrical Engineering, University of Ljubljana (matevz.bosnak@fe.uni-lj.si)



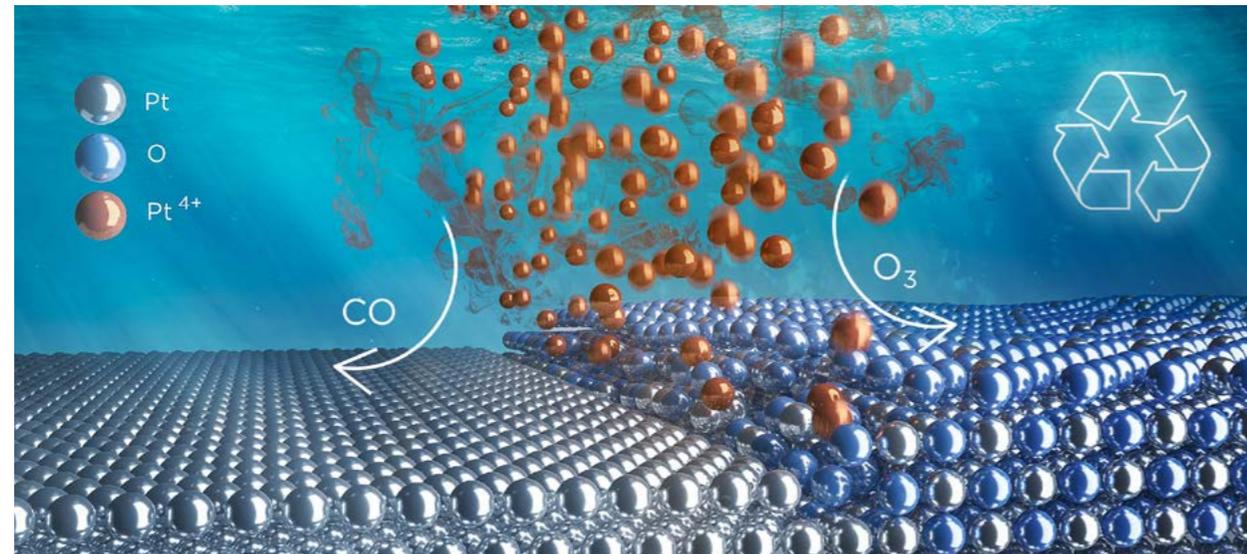
Source: Matevž Bošnjak, Igor Škrjanc; Embedded Control System for Smart Walking Assistance Device; IEEE Transactions on Neural Systems and Rehabilitation Engineering; Volume: 25 Issue: 3 Hyperlink: <https://ieeexplore.ieee.org/document/7451260/>

Green platinum recycling through effective dissolution via the process of surface potential alteration

A modern digital society will be based on a hydrogen and circular economy, where energy conversion and recycling of critical raw materials (urban mining) will play a vital role. Platinum metals are used as catalysts, contacts in electrical circuits and jewellery. A new way of dissolving platinum is proving to be an environmentally less aggressive and harmful process compared to the state-of-the-art (aqua regia) process. Aqua-regia is a very dangerous hot mixture of concentrated hydrochloric and nitric acids. The breakthrough originates from

studies in the field of degradation of platinum catalysts in electrochemical devices, such as fuel cells. It was seen that precious metals are effectively dissolved in alternating operating conditions (potential cycling, where the surface of the metal is repetitively oxidized and reduced). This type of corrosion has been named transient dissolution. The discovery was published in collaboration with the Max-Planck Institute in Düsseldorf and Helmholtz-Institute in Erlangen in the prestigious journal Nature Communications.

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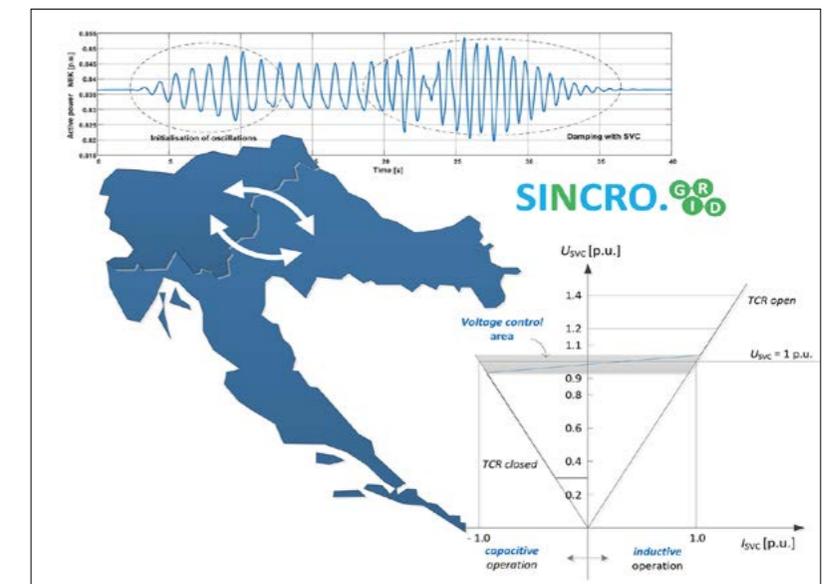
Source: HODNIK, Nejc, BALDIZZONE, Claudio, POLYMEROS, George, GEIGER, Simon, GROTE, Jan-Phillip, CHEREVKO, Serhiy, MINGERS, Andrea, ZERADJANIN, Aleksandar, MAYRHOFER, Karl. Platinum recycling going green via induced surface potential alteration enabling fast and efficient dissolution. Nature communications, ISSN 2041-1723, Oct. 2016, vol. 7, str. 1-6, doi: 10.1038/ncomms13164. [COBISS.SI-ID 6027290]
Hyperlink: <https://www.nature.com/articles/ncomms13164>

SINCRO.GRID project – modelling and dynamic analysis of power-electronic based compensation impact on Slovenian and ENTSO-E electric-power systems operation

European power system interconnection was not designed for circumstances we are facing nowadays in terms of electricity-market deregulation and de-carbonization of society. Its development is strongly oppressed by the public and consequently the risk of electricity-supply failures constantly increases. In the Slovenian electrical region, longer-lasting voltage-related problems are especially troublesome. This led to a submission of a common-interest project proposal to European Union by both Slovenian as well as Croatian transmission system operators. The project was categorized into a smart-grid topic, titled SINCRO.GRID. However, before European Union financing was confirmed, technical argumentation of

project's positive impact in the European level had to be provided. Our argumentation was based on the ENTSO-E power-system stability enhancement. It was clearly demonstrated, what kind of applications are required for successfully coping with electromechanical oscillations and how they should be controlled. At the same time, solutions for voltage-related problems were derived for anticipated cases with increased level of intermittent renewable power generation units. As a result, the optimal location and size of power-electronic based applications was suggested. European Union accepted the project proposal with Slovenian transmission system operator as a leading partner, based on the best scored application.

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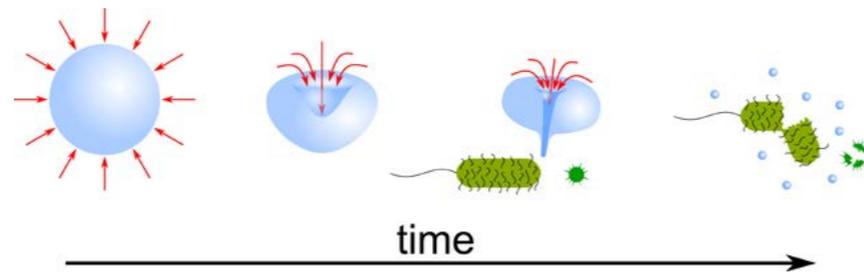
Source: <https://www.eles.si/projekt-sincro-grid/ozadje>
Hyperpovezava: <https://www.eles.si/projekt-sincro-grid/ozadje>

Use of hydrodynamic cavitation in (waste)water treatment

The goal of biological waste-water treatment is a stepwise oxidation of organic pollutants aiming to achieve complete mineralization. Numerous wastewater constituents are persistent to biodegradation, hence other abiotic treatment processes are being investigated - also cavitation. In present industrial practice of waste water treatment cavitation is not present. Although some laboratory experiments exist, the methods have not been applicable to practical use. The research activities were therefore directed to acquire additional knowledge and experience on theoretical level and finally promote their transfer to applicative level, together with development of new technologies. We have shown the possibility of energy and

environmentally acceptable water treatment by cavitation. We have successfully removed pharmaceuticals, cyanobacterias, algae, bacteria Legionella and were the first who showed the possibility of virus inactivation, all by cavitation. The project was concluded with an invitation for a scientific paper in a special issue of the journal Ultrasonic Sonochemistry (Cleaning with Bubbles), in which the most important conclusions of our experimental work are collected. The results were presented in 8 peer reviewed scientific papers and 4 patents, which were cited more than 200 times. Also, the successful ERC-CoG grant (CABUM) by Matevž Dular bases on the findings of this work.

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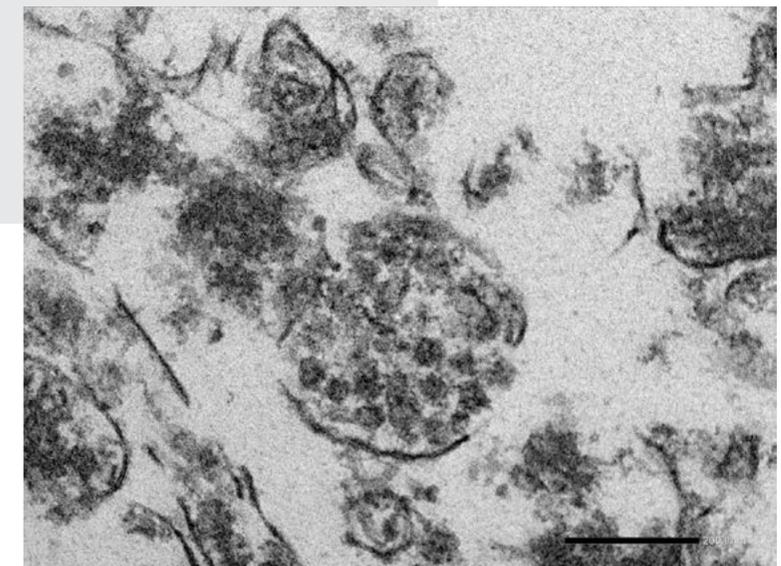
Source: DULAR, Matevž, GRIESSLER BULC, Tjaša, GUTIÉRREZ-AGUIRRE, Ion, HEATH, Ester, KOSJEK, Tina, KRIVOGRAD-KLEMENČIČ, Aleksandra, ODER, Martina, PETKOVŠEK, Martin, RAČKI, Nejc, RAVNIKAR, Maja, ŠARC, Andrej, ŠIROK, Brane, ZUPANC, Mojca, ŽITNIK, Miha, KOMPARE, Boris. Use of hydrodynamic cavitation in (waste)water treatment. Ultrasonics Sonochemistry, ISSN 1350-4177, 2016, vol. 29, str. 577-588, doi: 10.1016/j.ultsonch.2015.10.010. [COBISS.SI-ID 3649871]
Hyperlink: <https://www.sciencedirect.com/science/article/pii/S1350417715300535?via%3Dihb>

Medical sciences

Zika virus associated with microcephaly

In February 2016, researchers from the Faculty of Medicine published a break-through discovery that presents for the first time the foetal brain pathology, associated with Zika virus vertical transmission from mother to foetus. In this report, they describe the case of an expectant mother who had a febrile illness with rash while living in Brazil at the end of the first trimester of pregnancy. Severe foetal brain anomalies and intrauterine growth retardation were observed by ultrasound in the 32th week of gestation. Due to a poor prognosis for baby neonatal health, the mother requested a medical termination of pregnancy. A foetal autopsy revealed severe microcephaly and absence of brain folds. High load of Zika virus RNA was con-

firmed in the brain samples with absence of other possible pathogens. Electron microscopy of the brain demonstrated clusters of virus-like particles morphologically consistent with flaviviruses and complete genome of Zika virus was recovered from the foetal brain. Results of their study present the first and the most compelling evidence that congenital CNS malformations associated with Zika virus infection in pregnancy are a consequence of viral replication in the foetal brain.



Poljšak-Prijatelj M. and Kolenc M.: Group of Zika viruses in damaged brain cell (Transmission electron microscope - 120 kV Jeol JEM 1400Plus)

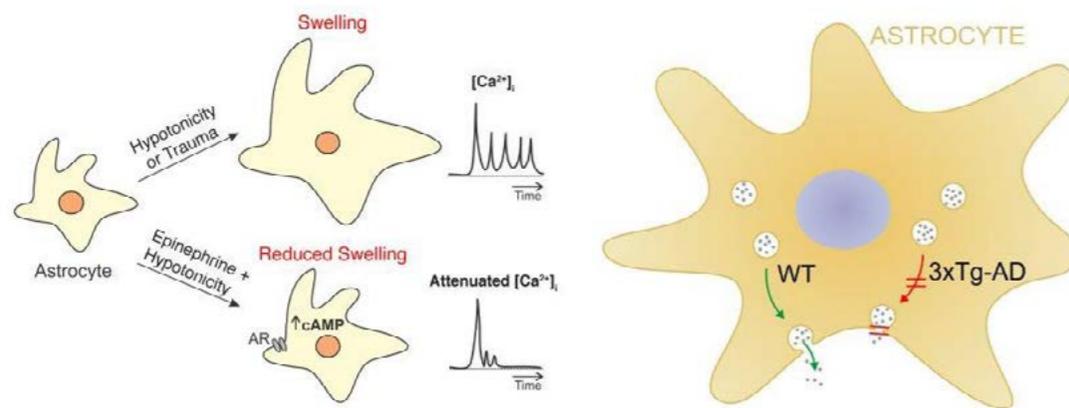
Source: Mlakar J., Korva M., Tul N., Popović M., Poljšak-Prijatelj M., Mraz J., Kolenc M., Resman Rus K., Vesnaver Vipotnik T., Fabjan Vodusek V., Vizjak A., Pižem J., Petrovec M., Avšič Županc T. Zika Virus Associated with Microcephaly. N Engl J Med 2016; 374:951-8.
Hyperlink: <http://www.nejm.org/doi/full/10.1056/NEJMoal600651>

Glial cells in brain edema and Alzheimer's disease

The brain does not contain only neurons. In the neo-cortex, which represents the majority of the brain mass, non-neuronal cells predominate. The latter include glial cells, including astrocytes. For almost a century, astrocytes in the brain were considered merely a part of connective tissue, however it is now well accepted that these cells participate in many (patho)physiological processes in the brain. We have revealed in two publications in the same volume of *Glia* that astrocytes also play a role in two common neurological conditions: in cerebral edema and in Alzheimer's disease. In trauma astrocytes begin to swell (cellular edema). A new endogenous protective mechanism

was discovered, mediated by the activation of the adrenergic system, thereby reducing the swelling of astrocyte caused by the traumatic brain injury. In another study, the results on a mice model of Alzheimer's disease (3xTg-AD) revealed that the Alzheimer's disease is not only a result of changes in neurons, but also arises due to astroglial defects at the level of the mobility of secretory vesicles and the release of the growth factors from these vesicles. These discoveries opened up opportunities for the development of new strategies for the treatment of neurological diseases, including neurotrauma and neurodegeneration that are based on targeting glial cells.

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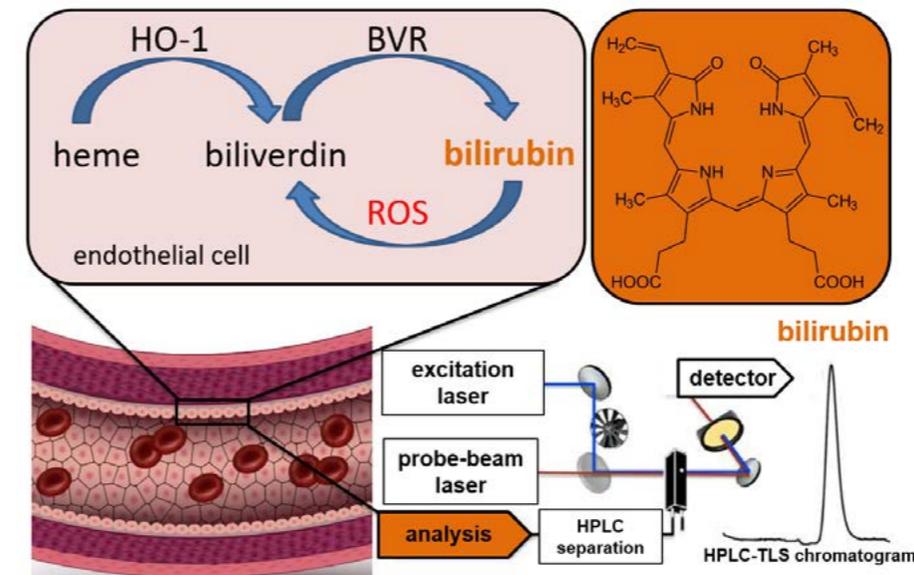
Source: Vardjan et al. *Glia* 2016, Adrenergic activation attenuates astrocyte swelling induced by hypotonicity and neurotrauma. *Glia*, ISSN 0894-1491, Jun. 2016, vol. 64, iss. 6, str. 1034-1049. [COBISS.SI-ID 32590297]
Hyperlink: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4841273/>

Bilirubin is an endogenous antioxidant in the endothelium of the vascular wall

Bilirubin is a strong endogenous antioxidant with an anti-inflammatory and anti-thrombotic activity. It is negatively correlated with the risk of cardiovascular diseases, such as ischemic heart disease, hypertension, type II diabetes, metabolic syndrome and obesity. In this research, we have demonstrated for the first time that bilirubin is not present only in serum but it is also endogenously present in vascular endothelial cells, which are essential for maintaining a normal vascular function. By developing novel HPLC-TLS analytical methods, we were able to quantify low concentrations of bilirubin in endothelial cells. We discovered that intracellular levels of bilirubin can be increased by induction of genes for its synthe-

sis (proof of endogenous formation of bilirubin in the endothelium) and/or by increasing the concentration of bilirubin in extracellular medium (proof of bilirubin uptake from serum into endothelium). We determined also the cellular anti-oxidant activity of bilirubin (EC50 = 11 nM), which is within the range of measured free bilirubin concentrations in serum (10-15 nM). These findings demonstrate that we can improve endothelial anti-oxidant capacity already by minor changes of bilirubin concentration in the endothelium. Our discovery opens new potential pharmacological targets (proteins, which are engaged in bilirubin homeostasis) for treatment of cardiovascular diseases.

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Prof. dr. Mladen Franko, University of Nova Gorica
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Source: Žibera L, Martelanc M, Franko M, Passamonti S. Bilirubin is an Endogenous Antioxidant in Human Vascular Endothelial Cells. *Scientific reports*. 2016;6:29240.
Hyperlink: <https://www.nature.com/articles/srep29240>

Treatment of head and neck cancer using electrochemotherapy

Presented are the results of an international, prospective, multicentre study of the treatment of skin cancer of the head and neck using electrochemotherapy. The research was conducted in the framework of the international consortium InspECT (International Network for Sharing Practices on Electrochemotherapy), part of which are the Clinic for Otorhinolaryngology and Cervicofacial Surgery and the Institute of Oncology Ljubljana. The study confirmed the efficacy and safety of skin tumour treatment using electrochemotherapy and rendered initial confirmation of the specifics to be taken into account when selecting patients.

The treatment was most effective in basal cell carcinomas, with 97% of the cases responding to treatment. In other histological types, response to treatment was achieved in 74% of cases. Several researchers from Slovenia took part in the research, significantly contributing to its implementation and to the preparation of a scientific article published in the reputable European Journal of Cancer, with IF = 6.16 (22/213; Q1) in the field of oncology. The results of the study have significantly influenced the use of electrochemotherapy worldwide and in Slovenia.

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Published in *European Journal of Cancer* 63 (2016)

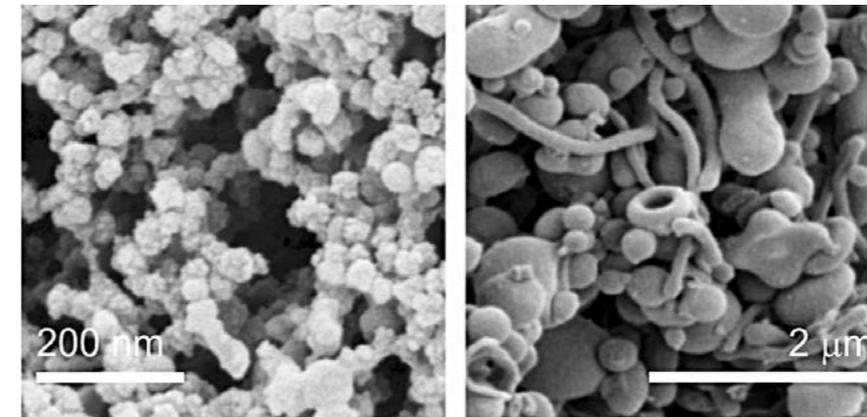
Bertino G., Sersa G., De Terlizzi F., Occhini A., Plaschke C. C., Groselj A., Langdon C., Grau J., McCaul J. A., Heuveling D., Cemazar M., Strojjan P., de Bree R., Leemans R., Wessel I., Gehl J., Benazzo M. European Research on Electrochemotherapy in Head and Neck Cancer (EURECA) project: Results of the treatment of skin cancer. *Eur J Cancer* 2016; 63: 41-52.

Evidence-based clinical use of extracellular nanovesicles in nanomedicine

In an article published in the reputable journal *ACS Nano* with IF 13.3, a review is presented of the work performed to date of the clinical use of extracellular vesicles and the anticipation of further developments in this field. Veronika Kralj-Iglič was invited to publish an article on the basis of her long-standing and pioneering work in the field of extracellular vesicles, which includes theoretical, experimental and clinical work. As part of this work, she has associated with many colleagues at home and abroad, led local research projects and coordinated the European project in the framework of the

EUREKA initiative. Extracellular vesicles are membrane-enclosed cell fragments, which are an important intercellular communication system and participate in the physiological and pathophysiological processes in the organism. The article presents the existing and potential use of extracellular vesicles in nanomedicine. The article combines experiences and predictions for the use of extracellular vesicles in therapy. They are expected to be useful in the diagnosis and therapy of various diseases, and also in industry.

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Extracellular vesicles isolated from pleural fluid of a patient with lung cancer (left) and extracellular vesicles isolated from blood of a healthy subject (right).

Source: FAIS, Stefano, O DRISCOLL, Lorraine, BORRÀS, Francesc E., BUZAS, Edit I., CAMUSSI, Giovanni, CAPPELLO, Francesco, CARVALHO, Joana, SILVA, Anabela Cordeiro da, PORTILLO, Hernando del, EL ANDALOUSSI, Samir, FICKO TRČEK, Tanja, KRALJ-IGLIČ, Veronika, BEDINA ZAVEC, Apolonija, et al. Evidence-based clinical use of nanoscale extracellular vesicles in nanomedicine. *ACS nano*, ISSN 1936-0851, 2016, vol. 10, iss. 4, pp. 3886–3899, illustr. [COBISS.SI-ID 5001579]
Hyperlink: <https://pubs.acs.org/doi/full/10.1021/acsnano.5b08015>

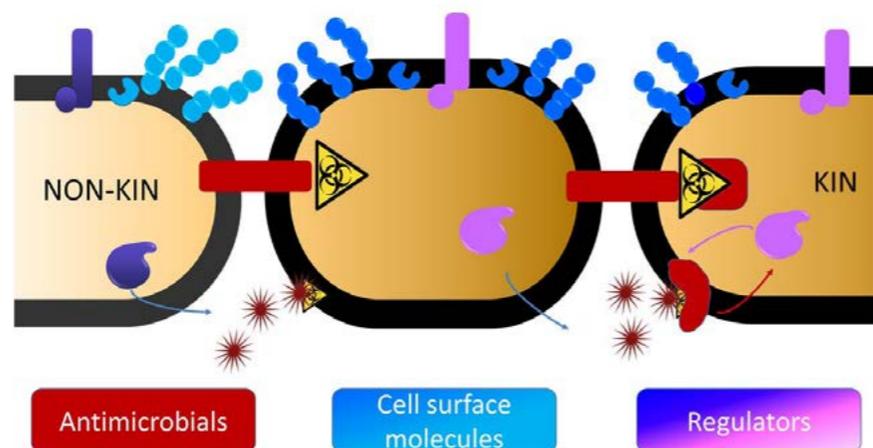
Biotechnical sciences

How bacteria discriminate kin from non-kin?

The ability to discriminate kin from non-kin allows one to help those that share his/her genes and thus promotes their evolutionary success. Bacteria are also able to discriminate between kin and non-kin strains of one species. They achieve this during group movement (swarming), where they merge with kin but not with non-kin. In collaboration with colleagues from Harvard University we show for the first time that kin discrimination relays on intercellular attack and defense molecules as well as on surface properties of these bacteria. Only those cells

that contain the right set of immunities will survive and be treated as kin. These kin discrimination genes are numerous and vary greatly between strains in both conservation and expression levels. This research is important because it reveals for the first time molecular properties of kin discrimination determinants. This knowledge is relevant for applications of bacteria for plant health, it opens a potential for new discoveries of anti-infectives and provides better understanding of population dynamics in microbiomes of plants, animals and humans.

Prof. dr. Ines Mandič Mulec, Biotechnical Faculty, University of Ljubljana



Source: Lyons N.A., Kraigher B., Stefanic P., Mandič-Mulec I., & Kolter R. (2016) A Combinatorial Kin Discrimination System in *Bacillus subtilis*. *Current Biology* 26(6):733-742. Hyperlink: <https://www.ncbi.nlm.nih.gov/pubmed/26923784>

Elderberry fruits and flowers - elixir of health

Differences in the content of sugars, organic acids, total phenolics and antioxidative activity have been evaluated among three different elderberry species (*Sambucus nigra*, *S. cerulea*, *S. javanica*) and seven interspecific hybrids. The highest content of sugars has been determined in the fruits of JA x CER hybrid and the lowest in fruits of (JA x NI) x cv. Black Beauty hybrid. *S. nigra* berries contained highest levels of total organic acids. *S. nigra* and (JA x NI) x CER flower extracts were characterized by 1.3- to 2.8-fold higher content of total sugars compared to other species/hybrids analysed. Total phenolic content (TPC) in berries ranged from 3687 to 6831 mg GAE per kg FW and in flowers from 7.41 to 32.36 mg GAE per g DW. The highest TPC has been determined in *S. nigra* fruits and flowers. The ABTS scavenging activity of the analysed elderberry extracts differed significantly among species and hybrids and ranged from 44.87 to 118.26 mM trolox/kg DW in flowers and 3.2 to 39.59 mM trolox/kg FW in fruits. The following interspecific hybrids are potentially interesting for further breeding studies as they accumulate high levels

of phenolics in fruit: JA x RAC, JA x CER in (JA x NI) x 'Black Beauty' and in flowers: (JA x NI) x CER in (JA x NI) x NI in (JA x NI) x 'Black Beauty'.



The results of the present research may help to promote the cultivation and further improvement of genotypes, interesting for food-processing and pharmaceutical industries, which could offer healthy and tasty elderberry products.

Assist. prof. dr. Maja Mikulič Petkovšek, Biotechnical Faculty, University of Ljubljana

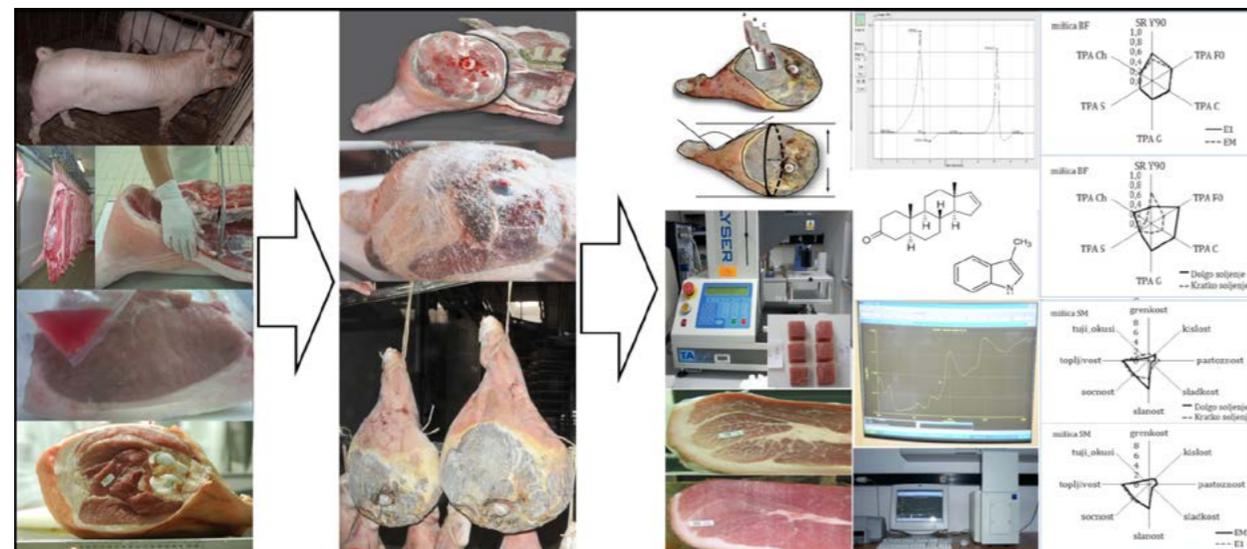
Source: MIKULIČ PETKOVŠEK, Maja, IVANČIČ, Anton, SCHMITZER, Valentina, VEBERIČ, Robert, ŠTAMPAR, Franci. Comparison of major taste compounds and antioxidative properties of fruits and flowers of different *Sambucus* species and interspecific hybrids. *Food chemistry*, ISSN 0308-8146. [Print ed.], 2016, vol. 200, p. 134-140, doi:10.1016/j.foodchem.2016.01.044. [COBISS.SI-ID 8360825]. Hyperlink: <https://www.sciencedirect.com/science/article/pii/S0308814616300462?via%3Dihub>

Rearing pigs without castration – an issue for traditional meat products

To prevent the occurrence of boar taint in meat, the majority of the piglets are surgically castrated. But as this practice is being abolished in the EU, raising uncastrated males may present a serious issue for meat processing industry, especially in the case of high quality products like dry-cured ham, where the quality of raw material is essential. Besides boar taint, the meat of uncastrated males has low fat content and altered physico-chemical properties, which can negatively affect salt uptake and the development of typical sensory properties of dry-cured hams. Salt is important for product stability and its distinctive taste, but also negatively

affects human health. Our goal was therefore to investigate the impact of castration and salting on the quality of the dry-cured ham. Salt reduction substantially affected product quality, but not always positively (increased proteolysis, soft texture, inferior sensory profile). The use of hams from uncastrated males resulted in lower quality product (i.e. saltier, drier, harder, darker and less marbled). The boar taint substances decreased in hams during ageing, but due to high off-flavour presence (associated to higher proteolytic potential) hams from uncastrated males were still found less acceptable than that from castrates.

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Assoc. prof. dr. Meta Čandek Potokar, Agricultural Institute of Slovenia
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Source: ŠKRLEP M., ČANDEK-POTOKAR M., BATOREK LUKAČ N., PREVOLNIK POVŠE M., PUGLIESE C., LABUS-SIÈRE E., FLÒRES M. Comparison of entire male and immunocastrated pigs for dry-cured ham production under two salting regimes. Meat Science, 2016, 111: 27-37.
Hyperlink: <https://www.sciencedirect.com/science/article/abs/pii/S0309174015300802>

Damages caused by wild predators' attacks on livestock are one of the main challenges in predator management worldwide. Livestock owners and governments use various non-lethal and lethal methods to protect their domestic animals. However, not all of these methods are effective. In a high-ranking scientific journal, we published a critical review of the effectiveness of management methods used for preventing livestock depredations across North America and Europe. Results indicate that management practice in many countries still relies on non-effective or untested methods. Review also showed that in general non-lethal methods (e.g. guarding dogs and electric fences) are more effective than lethal removal of predators by shooting, trapping or poisoning. 80% of non-lethal tests effectively reduced damages on livestock, while lethal removal was effective only in 29% of tests. In several cases, the damages even increased after killing of predators, which is most likely connected with destabilized social structure in predator populations.

Assist. prof. dr. Miha Krofel, Biotechnical Faculty, University of Ljubljana

Source: Vir: Treves, A., Krofel, M., Mcmanus, J. 2016. Predator control should not be a shot in the dark. Frontiers in Ecology and the Environment, 14: 380-388.
Hyperlink: <http://onlinelibrary.wiley.com/doi/10.1002/fee.1312/abstract>

Effectiveness of management methods to prevent livestock depredations by wild predators

Based on these results we recommended increased use of non-lethal methods, which are more effective and at the same time preserve predator social structure. The publication received notable attention among the experts and general public, as well national and international media. Our results will be important for future improvement in prevention of damages caused by wild predators that are suffered by livestock owners. At the same time, recommendations will help in conservation of wildlife and natural functioning of the ecosystems.



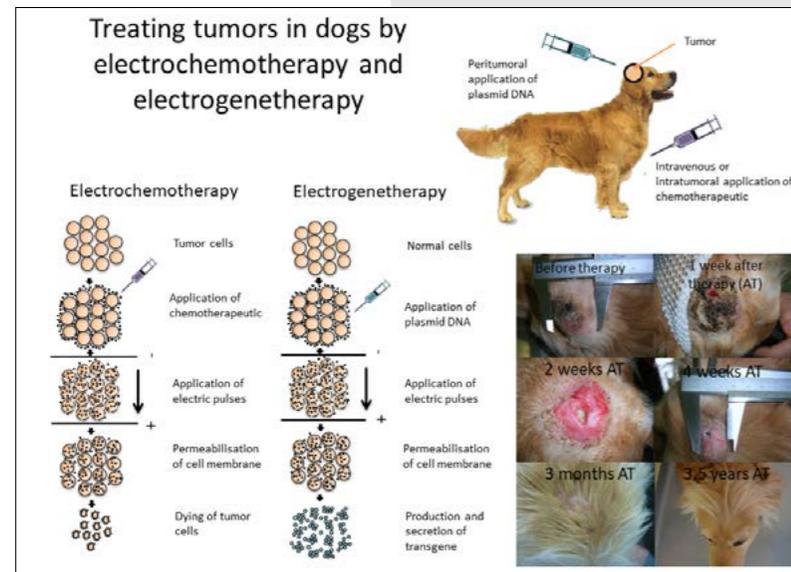
Treating tumours in dogs by electrochemotherapy and electrogenetherapy

Electrochemotherapy combined with peritumoural interleukin-12 (IL-12) gene electrotransfer was used for treatment of mast cell tumours in 18 client-owned dogs at the Clinic for Small animals of Veterinary faculty Ljubljana. Local tumour control, recurrence rate, as well as safety of combined therapy were evaluated. One month after the therapy, no side effects were recorded and good local tumour control was observed with high complete responses rate (66%), which even increased during the observation period to 72%. IL-12 gene electrotransfer resulted in detectable serum IFN- and/or IL-12 lev-

els in 78% of patients. In the treated tumours, vascular changes as well as minimal T-lymphocytes infiltration was observed. After 1 week, the plasmid DNA was not detected intra- or peritumorally and no horizontal gene transfer to commensal bacteria was observed. In summary, our study demonstrates high antitumour efficacy of electrochemotherapy combined with IL-12 electrotransfer, which also prevented recurrences or distant metastases, as well as its safety and feasibility in treatment of canine mast cell tumours.

Meaning and usability: Electrochemotherapy and electro-gene therapy have proved to be very effective and safe for the treatment of tumours in dogs. The successfulness of the therapy is specially appreciated in tumours, which are too big for the surgical removal or are not responsive to standard chemotherapy. Application of these therapies on veterinary patients serves as a translational model for humans.

Prof. dr. Nataša Tozon, Veterinary Faculty, University of Ljubljana



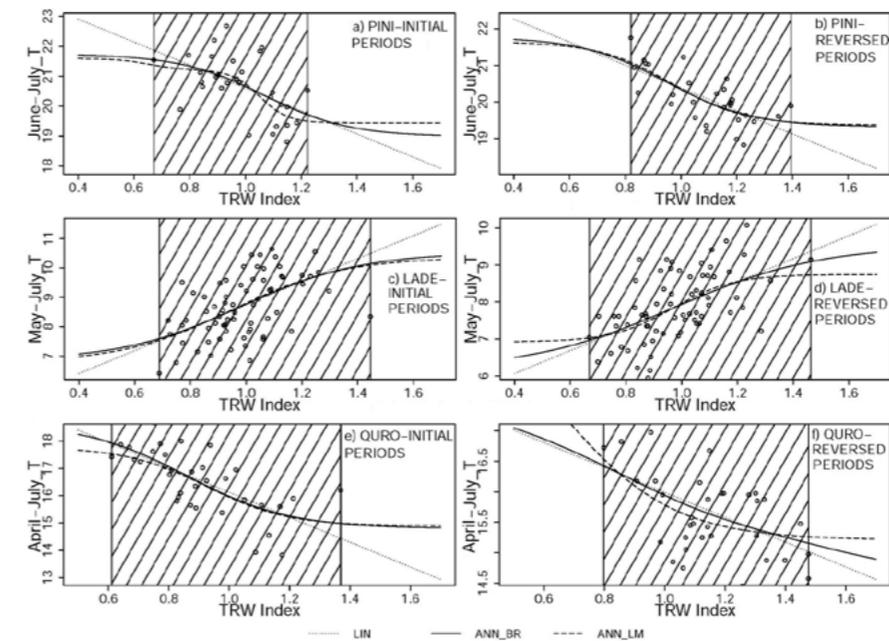
Source: Čemažar M., Ambrožič Auguštín J., Pavlin D., Serša G., Polj A., Krhač Levačić A., Tesič N., Lamprecht Tratar U., Rak M., Tozon N. Efficacy and safety of electrochemotherapy combined with peritumoural IL-12 gene electrotransfer of canine mast cell tumours. *Vet Comp Oncol* 2016; doi:10.1111/vco.12208. Hyperlink: <http://onlinelibrary.wiley.com/doi/10.1111/vco.12208/abstract>

Should artificial neural networks replace linear models in tree ring based climate reconstructions?

Studies focused on tree ring – climate relationships usually use linear methods to find the optimal transfer function. In our study, three sites with three different tree species from the Western Balkan region were selected to compare linear and artificial neural network (ANN) nonlinear models and to see whether linear models can be potentially replaced with ANN in climate reconstruction. Within the basic research project J4-5519 we tested a new methodological approach. For each site, one linear and two different ANN models were calculated.

For all analysed sites, we found a better fit using the advanced technique of ANN. All calibration and verification statistics were in favour of ANN models. A climate variable was reconstructed for a selected site using linear and nonlinear ANN methods. We demonstrated that ANN is always a more effective method, which always produces better results than linear models. The key to success is a properly selected training algorithm, which prevents overfitting and can find the optimal transfer function, also linear, if that is the case.

Assist. prof. dr. Tomislav Levanič, Slovenian Forestry Institute (tom.levanic@gozdis.si)



Comparison of linear and nonlinear ANN models for three tree species and sites in Western Balkans

Source: Jevšenak J., Levanič T., 2016. Should artificial neural networks replace linear models in tree ring based climate reconstructions? *Dendrochronologia* 40, 102–109; COBISS.SI-ID 4703654. Hyperlink: <https://www.sciencedirect.com/science/article/pii/S112578651630090X>

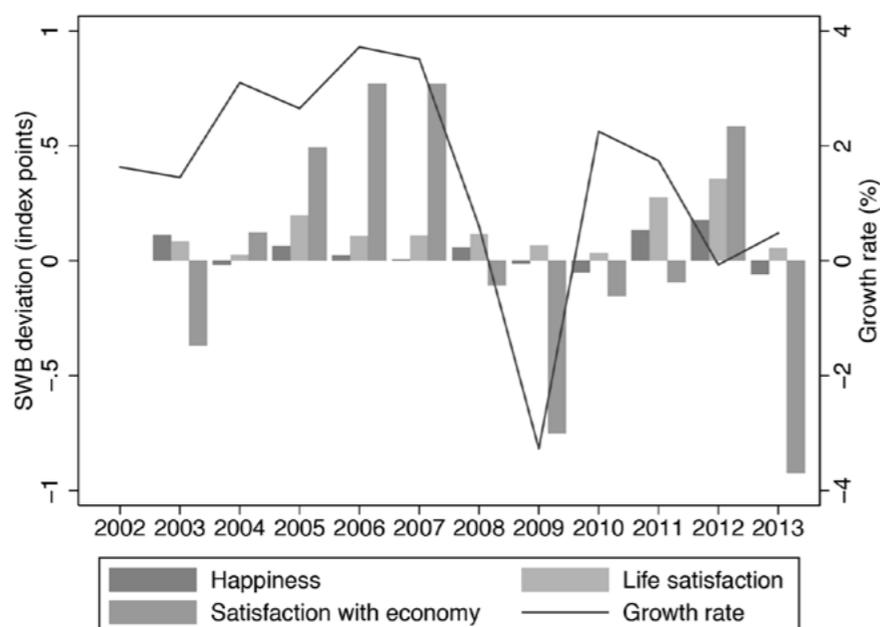
Social sciences

Subjective well-being during the 2008 economic crisis: identification of mediating and moderating factors

We examine the effects of the 2008 economic crisis on the reported subjective well-being (SWB) of nationally representative samples in 36 mainly European countries between 2002 and 2013. We study how SWB fluctuates along the business cycle, and how it is mediated by individual and country-level socioeconomic factors. Our key finding is that the economic crisis had a negative and S-shaped effect on SWB, implying diminishing marginal sensitivity at higher income losses and gains. During the economic downturn, roughly half of individual-level and macro-level determinants exhibit notable changes in significance and/or magnitude of

the effect on SWB. This is taken as an indication of psychological adaptation and shifting reference frames. Had the effects of explanatory variables remained unchanged at their boom period values, the deterioration of SWB due to changes in SWB determinants would be more severe by a third. Five factors display an augmented effect on happiness and life satisfaction during the crisis (below-average income, the Gini index, attitude towards income equality, religiosity, and conscientiousness), while two determinants exhibit attenuated impact on the SWB measures (relationship status and unemployment rate).

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Source: Gonza, G., & Burger, A. (2017). Subjective well-being during the 2008 economic crisis: identification of mediating and moderating factors. *Journal of Happiness Studies*, 18(6), 1763-1797.
Hyperlink: <https://link.springer.com/article/10.1007/s10902-016-9797-7>

Neoliberalism, postcommunism and law

Neoliberalism represents the revival of economic liberalism that has been taking place since the late 1970s. Its main premise is that the market is morally and practically superior to government and any form of political control intended to improve on market outcomes. Central and Eastern European countries (CEEs) were global leaders in the adoption of neoliberal ideas and policies during the 1990s and 2000s. Almost all CEEs adopted neoliberal ideas and policies at a dramatic rate and are now among the most open economies in Europe. This was particularly true during the early transition period, when neoliberalism emerged as a virtually

unchallenged ideology strongly dominating the course of economic and political reforms in the region. CEEs largely followed the script written by the authors of the Washington consensus and implemented monetary stabilization, economic liberalization, and a grand-scale privatization of the largely state-owned economy. This article traces the role of law during the first 25 years of transition and its relationship with neoliberal policies and institutions that were put in place in CEEs. It does so chronologically, through three different periods of transition, which also represent the quite different roles that the law assumed in the process.

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Source: BUGARIČ, Bojan. Neoliberalism, postcommunism and law. *Annual review of law and social science*, ISSN 1550-3585, 2016, vol. 12, str. 313-329, doi: 10.1146/annurev-lawsocsci-110615-084545. [COBISS.SI-ID 14882641]
Hyperlink: <http://www.annualreviews.org/doi/10.1146/annurev-lawsocsci-110615-084545>

Developing and evaluating an active workplace for office workers



As part of the project, we developed a diagnostic method for measuring the adaptation of skeletal muscles to exercise or work. This method allows us to capture new information replacing the previous established standard in this area. With previous publications we have shown that the new method allows calculating muscle composition and muscle tone. As part of the research work on the article, we obtained co-financing from the Health Insurance Institute

of Slovenia for the project entitled "Active seating for health and higher work efficiency". We have developed a prototype of an active workplace for office workers who are considered as endangered profession in terms of metabolic and cardiovascular health. The active workplace allows low-intensity and moderate-intensity physical activity, without interrupting their work. With a complex cause-and-effect research plan, we have demonstrated that the use of such a workplace positively affects our health and simultaneously does not impair working efficiency (even improves it in some parameters). The article was published in the scientific journal SCI, which is one of the exceptional scientific achievements of A⁺. All three authors are members of the Institute for Kinesiological Research of the Science and Research Centre Koper. The achievement is even greater, since Katja Koren, PhD was also a young researcher at the time of writing, and for this contribution she received the Messenger of the Science SRC award for top achievements of promising researchers.

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Source: KOREN, Katja, PIŠOT, Rado, ŠIMUNIČ, Boštjan. Active workstation allows office workers to work efficiently while sitting and exercising moderately. *Applied Ergonomics*, ISSN 0003-6870. [Print ed.], maj 2016, vol. 54, str. 83-89, ilustr.
Hyperlink: <https://www.sciencedirect.com/science/article/pii/S0003687015301137?via%3Dihb>

The problem of multitasking while driving

Reaction time is a key factor of road safety. Studies show that reaction time increases with the chronological age of drivers, especially in situations requiring multi-tasking from the driver, e.g. in intersections, in heavy traffic, during telephone calls (also hands-free). In an experiment carried out with 351 drivers aged between 20 and 80, on the safe driving course in Vransko, we examined how the reaction times of variously aged groups of drivers differ when braking, when drivers drive in silence and braking is their only task, and when drivers are asked a question just before the signal to brake occurs and they answer during the signal. Results have shown that distractors, such as conversation while driving, greatly increase reaction time, with the effect increasing progressively from the age of 20. Differences between drivers also increase progressively with chronological age; despite distractors, one quarter of drivers over 65 react as quickly as younger drivers aged 20 to 34. The study is important because it

was carried out in a real environment, not on a driving simulator, and included the entire age range of participants, from young to older drivers. The study revealed that some of the beliefs about older drivers are mistaken. Changes in response rates do not occur suddenly at the age of 60 or 65; some drivers react as quickly as young drivers, despite advanced age.



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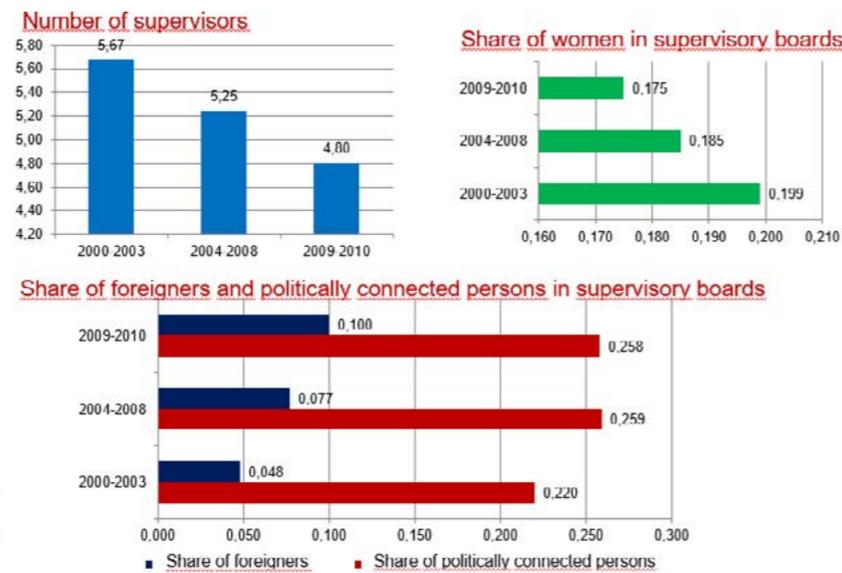
Source: SVETINA, Matija. The reaction times of drivers aged 20 to 80 during a divided attention driving. *Traffic injury prevention*, ISSN 1538-9588, 2016, vol. 17, iss. 8, pp. 810-814, ilustr., doi:10.1080/15389588.2016.1157590. [COBISS.SI-ID 60115042].
Hyperlink: <https://plus.si.cobiss.net/opac7/bib/60115042>

Political connections, corporate governance and business performance in Slovenia

In the article, we present and test the theory of how political connections (often associated with political corruption) affect corporate governance and business efficiency. Our model is based on the premise that, in the case of underdeveloped democratic institutions that do not punish political corruption, the political links of companies have a negative impact on business performance. A model-derived hypothesis is checked on an almost complete population of Slovenian public limited liability companies with more than 100 employees. Based on data about the structure of supervisory boards and financial data from balance sheets and perfor-

mance during the 2000-2010 period, we have shown that companies with a higher share of politically linked supervisors have lower productivity. The article was published in a magazine that ranks among the most important magazines in the field of economic and business sciences and was included in the FT50 list, which comprises the 50 most influential journals in the world and is used to classify the research work of business schools. The work was also cited in the recommendations of the European Commission to Slovenia in 2014, and its findings were used in the reform of the management of state property of the Republic of Slovenia.

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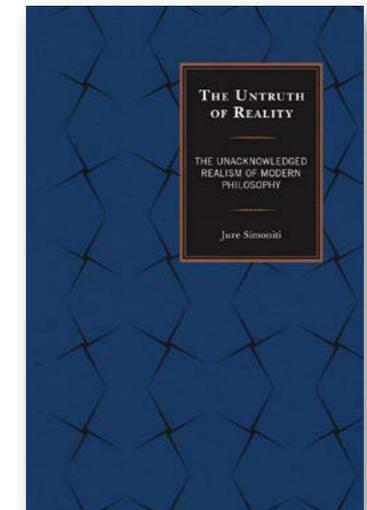
Source: DOMADENIK, Polona, PRAŠNIKAR, Janez, SVEJNAR, Jan. Political connectedness, corporate governance, and firm performance. Journal of business ethics, ISSN 0167-4544, Dec. 2016, vol. 139, iss. 2, pp. 411-428

Humanities

The monography: The Untruth of Reality. The Unacknowledged Realism of Modern Philosophy

The monograph The Untruth of Reality. The Unacknowledged Realism of Modern Philosophy represents an important breakthrough in the field of contemporary philosophy for four reasons at least. 1. The book intervenes in an original way into the debate on realism and anti-realism, which recently became a topical issue due to the efforts to abandon the common conviction of there being insurmountable barriers between the so-called continental and analytical philosophy, and to reconnect the two seminal traditions. 2. The conceptual basis of the book is defined by the notions of German Idealism, and one of its theses claims that the last philosopher unequivocally acknowledged by both traditions, Kant, can actually provide incentives for an entirely different relation to realism as is commonly surmised. Accordingly, 3., the book opposes the usual and prevalent diagnosis upon which the entire continental philosophy after Kant is synonymous with anti-re-

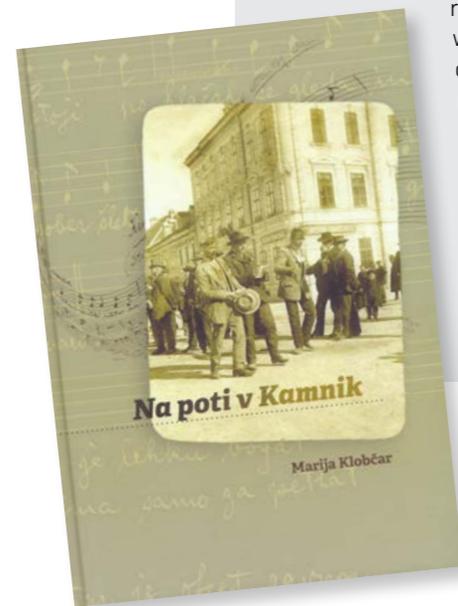
alism. 4. Thereby, the book enters a direct confrontation with one of the most up-to-date and progressive philosophical movements of the recent era, Speculative Realism (Meillassoux, Harman, Hamilton Grant, Brassier), which regards Kant as the original advocate of "correlationism" (i.e., that the world is nothing but a mirror image of the subject himself, the correlate of his representations) and, hence, its prime opponent. Instead, Simoniti points out the hidden, overlooked elements of realism in both German Idealism and modern, post-Kantian philosophy in general. The book thus investigates the relations between the procedures of idealization and the processes of de-symbolization, and argues that the paradigms of consciousness and language are not necessarily incompatible with realism, but rather open new and broader possibilities for the world to reveal itself beyond and behind the limits and limitations of the human, linguistic spirit.



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Source: SIMONITI, Jurij. The untruth of reality : the unacknowledged realism of modern philosophy. Lanham [etc.]: Lexington Books, 2016. VI, 189 str. ISBN 978-1-4985-1840-6. [COBISS.SI-ID 62800482] Hyperlink: <https://plus.si.cobiss.net/opac7/bib/62800482>

The monography: *On the Way to Kamnik*



The monography *Na poti v Kamnik* [On the Way to Kamnik] is an ethnological and folklore study presenting the life and folk creativity of the wider Kamnik area from the end of the eighteenth century to the present. It is based on extensive archival material, thorough fieldwork, and theoretical reflections. The main research focus is on the relationship between the town and the countryside: how the countryside has changed in contact with the town, and

how the town changed when its residents used rural folk culture to express their independent ethnic identity. The study features many new findings in terms of both the life it discusses and song creativity. It uses songs, including ones created in the town, to reveal various social relationships, thereby also shedding light on certain historical processes. The main research thread is a mocking song about the Kamnik burghers, which portrays stereotypes and the nationalisation of folk culture. The analysis in this manner draws attention to the background of strong social conflict during WWII as well as the post-war period.

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Source: KLOBČAR, Marija, ŠIVIC, Urša (urednik). *Na poti v Kamnik*, (Zbirka Folkloristika, 7). 1. izd. Ljubljana: ZRC SAZU, Založba ZRC, 2016. 301 str., ilustr. ISBN 978-961-254-853-7. [COBISS.SI-ID 282481664]
Hyperlink: <https://plus.si.cobiss.net/opac7/bib/282481664>

The Eisenkappel Passion Play

A Comedy of the Suffering of Christ Formerly Performed in Eisenkappel on Holy Thursday and Easter Monday. Editio princeps

The Eisenkappel Passion Play is one of the more important discoveries in early modern Slovenian literature and Slovenian drama in general. The manuscript, created at the end of the eighteenth century, features older and completely unknown Baroque dramatic texts. This play continued to be performed in Eisenkappel as late as in 1800. It consists of three separate parts, and, with 123 paragraphs and 2,758 rhymed lines, it is one of the longest Slovenian dramatic texts.

This critical edition shows that the Eisenkappel manuscript contains older versions of this Baroque play that originate from the lost seventeenth-century Slovenian Jesuit plays. Using the critical transcription method, it reconstructs the verse structure and dialect reading form of the text. It draws attention to the traces of the Passion play's older bases and reconstructs the manner in which an unknown author reworked the play at the end of the eighteenth century to save it from being banned by the Enlightenment authorities. The author included certain passages from the oldest Slovenian dramatic tradition in the manuscript that cannot be found anywhere else: the mystery scenes about the Mother

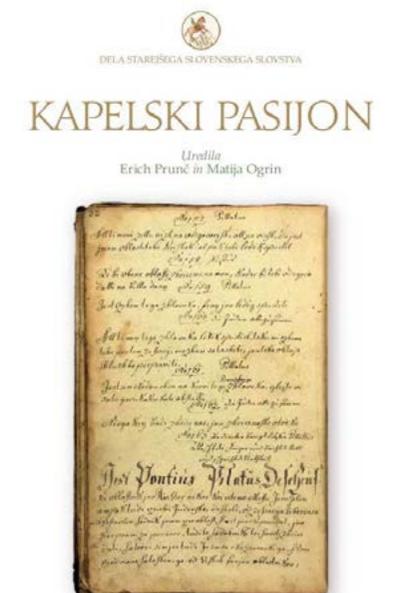
of God and the repentant sinner, and the weighing of a deceased person's soul are prime-quality Baroque texts that have been preserved in Slovenian literature thanks to the Eisenkappel writer.

This critical edition of the Eisenkappel Passion Play provides a new perspective on the beginnings of Slovenian drama: its oldest manuscripts have been preserved in Carinthia, rather than in central Slovenia. The oldest elements found in this Passion play are also the oldest dramatic texts in Slovenian. Thus, Slovenian Baroque literature does not begin only after 1670 with Matija Kastelec, but with the text tradition of the Jesuit plays preserved in the Eisenkappel Passion Play.

The electronic version contains a facsimile, a diplomatic transcription, a critical transcription, annotations, and extensive critical commentary with a glossary of archaic vocabulary. It allows a parallel display of the facsimiles and both transcriptions as well as a parallel display of both transcriptions. The diplomatic transcription was also manually lemmatized, and accordingly each token in the transcription is furnished with a lemma and shown in the concordances.

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Vir: PRUNČ, Erich (avtor, urednik, prevajalec), OGRIN, Matija (avtor, urednik). *Kapelski pasijon* : komedija od Kristusoviga trplinja, katiro so nekidej na te veliki četrtki inu na te velikonočni ponedelki v Kapli Špilali : editio princeps : znanstvenokritična izdaja, (Dela starejšega slovenskega slovstva, knj. 1), (Zbrana dela slovenskih pesnikov in pisateljev, knj. 267). Ljubljana: Založba ZRC, ZRC SAZU; [Celje]: Celjska Mohorjeva družba, 2016. 548 str., fotogr. ISBN 978-961-254-961-9. [COBISS.SI-ID 287127552]
Hyperlink: <https://plus.si.cobiss.net/opac7/bib/287127552>



The scientific monograph: IM SCHUTZ UND SCHIRM DES REICHES
Spielräume der Reichspolitik der innerösterreichischen Stände im 16. Jahrhundert



The scientific monograph by Sašo Jerše *Im Schutz und Schirm des Reiches. Spielräume der Reichspolitik der innerösterreichischen Landstände im 16. Jahrhundert*, which was published in 2016 by Böhlau Verlag, one of the most esteemed scientific publishing houses in the German-speaking area, is focused on an analysis of delegations of the Inner Austrian provinces of Styria, Carinthia and Carniola at the diets of the Holy Roman Empire in the 16th century and, consequently, on an analysis of the "foreign" policy of provinces of the so-called Inner Austria. At that time, the Inner Austrian provinces, which were a part of the empire, sent their delegations to diets in order to secure help from the estates with defending themselves against the Ottoman Empire, which had been threatening the provinces and the empire itself since the mid-15th century. On their missions, these delegations showed great negotiation skills and achieved successes that outlasted the delegations' terms of

office, for they did not only secure the empire's help to the provinces against the Ottoman Empire, but also strengthened their legal status within the empire. In a time of confessional and political conflicts, which denote the second major topic of the late 16th century, besides the Ottoman threat, the legal relationships defined at the imperial or state level were of key importance for resolving and appeasing these conflicts.

The study by Sašo Jerše is innovative both in choice of topic, as outlined above, and in its research approach. Namely, Jerše discusses a highly traditional political and diplomatic topic using the concepts and methods of the new cultural history in analysing the legal and formal sphere of the politics on the one hand and the symbolic and demonstrative one on the other. By doing so, Jerše's study clearly demonstrates this intertwinement and the political respectively legal and symbolic potential which results from it.

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Source: JERŠE, Sašo. *Im Schutz und Schirm des Reiches : Spielräume der Reichspolitik der innerösterreichischen Landstände im 16. Jahrhundert*, (Veröffentlichungen der Kommission für Neuere Geschichte Österreichs, Bd 110), (Forschungen zur geschichtlichen Landeskunde der Steiermark, Bd 68). Wien; Köln; Weimar: Böhlau, 2016. 290 str. ISBN 978-3-205-79695-4. [COBISS.SI-ID 284219904]
Hyperlink: <https://plus.si.cobiss.net/opac7/bib/284219904>

Moving Places: Relations, Return and Belonging

Moving Places, published by Berghahn Books, one of the leading publishers in the field of anthropology, draws together contributions from Europe, Latin America, Asia and Africa, exploring practices and experiences of movement, non-movement and place-making. The book focuses on "moving places": places with locations that are not fixed but relative. Locations appearing to be reasonably stable, such as home and homeland, are in fact always subject to practices, imaginaries, and poli-

tics of movement. Bringing together original ethnographic contributions with a clear theoretical focus, this volume spans the fields of anthropology, human geography, migration, as well as border studies, and serves as teaching material in related programs.

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Assoc. Prof. Jaka Repič, anthropology, Faculty of Arts, University of Ljubljana



Foto: Daniela Vávrová

Source: Gregorič Bon, Nataša, in Jaka Repič (ur.) 2016. *Moving Places: Relations, Return and Belonging*. New York in Oxford: Berghahn Books, 240 str. COBISS.SI-ID: 627684
Hyperlink: <http://www.berghahnbooks.com/title/GregoricBonMoving>



Slovenian Research Agency

Abbreviated name: ARRS

Year of foundation: 2004

Core activity: Performance of professional, development and executive tasks relating to the implementation of the Resolution on Research and Innovation Strategy of Slovenia 2011-2020 and other tasks with statutory duties in public interest in order to ensure permanent, professional and independent decision-making on the selection of programmes and projects financed from the national budget.

Number of employees as of 1 January 2017 in accordance with the staffing plan: 47

Funds received from the national budget for scientific-research activities in the 2017 financial year: EUR 148.2 million

Basic documents: Research and Development Act (Official Gazette of the Republic of Slovenia, nos. 22/06 – official consolidated text, 61/06 – ZDru-1, 112/07, 9/11 in 57/12-ZPOP-1A)
Decision establishing the Slovenian Research Agency (Official gazette of the Republic of Slovenia, nos. 123/03 and 105/10)
Resolution on Research and Innovation Strategy of Slovenia 2011-2020 (Official gazette of the Republic of Slovenia, no. 43/11)

Website: www.arrs.gov.si/en