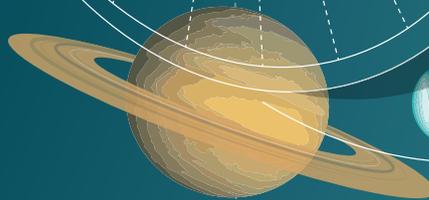
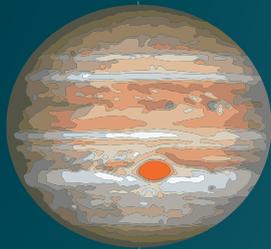

ANNUAL REPORT

2022



arrs

SLOVENIAN RESEARCH AGENCY

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**Prof. Dr. Mitja
Lainščak,**
Agency Director



THEY SAY THAT CHANGE IS THE ONLY CONSTANT IN LIFE, and there were many in 2022. After the COVID-19 pandemic, life has started to return to normal and the research community and its related organisations have entered a new era. It took a lot of time and effort to consolidate and adopt a new Scientific Research and Innovation Activities Act which entered into force at the beginning of 2022. The Act very precisely defines stable funding and provides several financial means that, at least to some extent, are available for new instruments and other new elements within the research landscape. The Agency has employed additional staff due to setbacks from previous years, requirements from the new Act and according to the Recovery and Resilience Plan that constitutes a completely new task for the Agency. International activities and personal meetings, eagerly anticipated after the pandemic by many participating parties, have also intensified. At the same time and in compliance with the Agency's activities, we continued to build the IT support and launched a new public communication scheme.

Throughout the year, the focus was on the implementation of the new Act, where all stakeholders had to roll up our sleeves and harmonise the mode of operation with the provisions of the Act. Stable funding was introduced and provided research organisations with autonomy over the fund allocation. The Act also defined the growth dynamics of the Agency's budget, which is in its initial years earmarked for stable funding and elimination of disparities in the funding of research organisations.

Funding for other key items has also increased, while the Agency has taken over tasks under the Recovery and Resilience Plan and initiated activities in the field of mobility and calls for projects of a higher value, i.e. from basic science to more advanced technological development. In accordance with the provisions of the Act and planned activities, the Agency completely fulfilled the work plan and allocated practically 100% of the estimated budget between the foreseen providers of research activities.

Due to an increase in the scope of activities and past insufficiency in this regard, the Agency was very active in the field of employment in 2022, and currently stands at approximately one third of the intended objective in terms of employment structure. However, the Agency, despite all the effort, failed to employ some personnel and that is why certain activities are still provided by external contractors. Also, even after the Agency manages to achieve the foreseen employment plan, it will have approximately 50% less employees to implement a programme of similar scope and complexity compared to similar agencies abroad. In this context, the capacity building of the Agency will be key in the coming years if we want to efficiently develop the Slovenian research area.

After the COVID-19 pandemic, national and international cooperation with visits and meetings was restored. The Agency organised several networking events between Slovenian and foreign researchers in the international arena and was ac-

tively involved in the operations of international agencies. Activities were also in place to make new contacts in Slovenia and abroad with the aim of establishing instruments of cooperation with new countries. The Agency's management paid numerous visits to research organisations to gain insight into the current situation and needs of the research community. These meetings led to intensive exchange of views and information and laid down the foundation for further development of Agency operations.

In 2022, the Agency took more active steps to implement the activities under the communication plan. The ARRS Day was organised without any pandemic-related restrictions and included a presentation of excellent achievements in

science. The Agency started to prepare several projects to establish a regular communication with the public that will be to a great extent realised in the coming months.

2023 will also be full of challenges, with new public calls, further increase of research funding, and the consolidation of international activities and public communication. We are entering the phase of restructuring the Agency and clustering basic sciences with the field of innovations. All this will only be possible with the cooperation of all current and potential new stakeholders with the aim of optimising investments in research for the further development and competitiveness of Slovenia.

Prof. Dr. Igor Emri,
the president
of the Agency's
Management
Board



THE MEMBERS OF THE MANAGEMENT BOARD (MB) ARE RESPONSIBLE for supervising the Agency's operations associated with the management of assets allocated to fundamental and applied research. Applied research is the precondition and basis of socio-economic and technological development that is reflected in the quality of life of citizens, which is nicely summarised by the saying of Louis Pasteur: "Research is the foundation of progress." The MB has to take a socially responsible role, which is internalised and pursued by MB members. The statistical data of the Institute of Macroeconomic Analysis and Development (UMAR) for 2022 indicates that Slovenian researchers have a lot of "work" to do in the field of consolidating the role of science in society. First, it is necessary to understand that publications as such are not a "result" of research work, but rather only a reviewed record of the "result" that assumes a social value usually only after it is innovatively linked and/or upgraded with the "results" of researchers from other fields, disciplines and sciences.

Breakthrough ideas, in most cases generated by individuals, are born randomly in a suitably stimulative milieu which provides and encourages the exchange of knowledge and ideas between different fields, disciplines and sciences. These environments abroad, particularly in the USA, are provided at research and education (university) campuses that enable the cooperation of researchers already during master and doctoral studies. Unfortunately, there is no such arrangement in Slovenia.

Therefore, funding methodology is the only

instrument that can be used for (soft) guidance of the research activity of individual researchers and research groups. Simply put, researchers, knowledge operators and creators of inventive ideas that may lead to technological and social breakthroughs must be put at the centre. At the same time, we require instruments to promote "cooperation" and "networking" among researchers within a particular field, and between different fields and sciences.

Last year, the MB proposed two instruments, the implementation of which will most certainly contribute to a higher number of research projects based on inventions and innovations that may result in technological breakthroughs, and raise the quality of life for all citizens who actually fund the research. The basic idea of both instruments is provided below.

The first instrument is some kind of "substantial" presentation of researchers who are recipients of Agency funds. The substantial presentation of achievements will contribute to the establishment of cooperation between researchers within individual sciences and between them and raise awareness of the fact that a publication is NOT a "result", but only its reviewed record. A researcher will arrange and edit their presentation page by himself/herself. The presentation of the researcher will include the following information: (a) name and surname, photo and contact details; (b) short description of his/her expert knowledge; (c) substantial description of the most significant achievement of his/her professional career with an indication of selected publications and/or patents prov-

ing that the researcher is a holder (owner) of the described intellectual property; (d) substantial description of the most significant achievement in the last 5 years (points c and d may be joined); and (e) substantial presentation of activities planned for the next 3 years.

The second instrument is a proposal for a new method of funding research that will promote the cooperation of researchers at the national level, competition at the international level, and integration of all the best researchers in tackling important technological, legal, social and economic issues. It must be pointed out that this instrument also solves the problem of project evaluation, which has been one of the major issues of the Agency for the past 30 years.

The new method of funding consists of three "pillars". Pillar I is intended to establish cooperation and networking among researchers within an individual field, and between different fields and sciences, and to provide an excellent inventive, research-based doctoral education, which includes and brings together researchers from all higher education organisations and institutes. Pillar I also provides funds for draw-

ing up cutting-edge international projects that are the content of Pillar II, and innovation projects of national importance that are in terms of content covered by Pillar III.

Pillar II is designed to reward excellence in fundamental research and competitiveness in the international arena. The Slovenian Research Agency provides a group or an individual with appropriate additional funds which a researcher continues to receive for one year after the completion of a foreign project. The additional year is intended mainly for the application of a new international project and/or project under Pillar III.

Pillar III is intended for the promotion of research-based inventions and innovations that may lead to technological, legal, social and economic breakthroughs. These are substantially specific technological, legal, social and economic projects of national importance that contribute to the increase of knowledge in all segments of society and raise the quality of life of all residents of Slovenia.

INTRODUCTION

Prof. Dr. Peter Križan,
President of
the Agency's
Scientific Council



W

WITH THE ASSISTANCE OF THE AGENCY'S PERSONNEL, the Scientific Council strives to efficiently and transparently provide funds for the best research ideas and thus contribute to a good research environment in Slovenia.

Without any doubt, the focus in 2022 was on the coordination of the Agency's work with the new act in the field of research. In this process, a consultative working group, comprising representatives of the Agency and researchers from universities and institutes, was of great assistance. The Scientific Council wishes to make a constructive contribution to the successful transition of research organisations to a new mode of work with a great level of autonomy. In this regard, we seek ways to present examples of best practices in Europe that already incorporate this kind of operation. We are also considering initiatives for research organisations to cooperate in external management evaluation with established European experts.

Research projects are an important instrument of research support. It is a very competitive way of funding, since we can only finance about 200 of the approximately 1000 project applications. By changing the rules of the call, we also strive to simplify the procedures and provide greater transparency. Among other things, we regularly update the base of international reviewers, experts who assess research proposals in a specific scientific field. The procedure of assessing the projects was strengthened with scientific editors, and in the medium-term, we anticipate the introduction of evaluation panels modelled on the European Research Council and several European agencies for research

funding. In the call for projects for 2023, a minimum quota was introduced for the first time for the middle generation of scientists in addition to the already established scheme for young doctors.

We try to make projects more attractive with increased flexibility in order to facilitate the return of Slovenian scientists from abroad; we are also considering a scheme that would interest and attract established researchers. Recently, there have also emerged new opportunities for cooperation in multilateral projects and projects in the so-called complementary scheme, which is an important stimulus for applicants of prestigious projects of the European Research Council.

Research programmes provide a stable component for funding research. We are preparing for an evaluation of research programmes adopting the panel structure of the European Research Council; this scheme will be gradually introduced in the coming years. Excellent research equipment has an important role in providing appropriate conditions for research. Last year, the assets for this kind of support increased, and significant increases are also planned in the coming years; we are thinking about reducing the share of own means and potential extension of the range of beneficiaries for future calls.

The Scientific Council of the Agency remains open to the comments and suggestions of scientists to further improve the Agency's operations as an important element of the research climate in Slovenia, and strives for successful cooperation with the scientific community.

Management board of the agency

The Agency's Management Board is the managing authority of the Agency. It is composed of seven members appointed by the Government of the Republic of Slovenia for a term of five years with an option of reappointment. The president and vice-president are elected by the members of the Agency's Management Board. In 2022, the members of the Management Board were as follows:



Prof. Dr. Igor Emri
President



Prof. Dr. Egon Pelikan
Vice-president



Dr. Gabrijela Horvat



Fidel Krupić



Dr. Tina Tomažič



Prof. Dr. Janez Bonča



Prof. Dr. Marta Klanjšek Gunde

Scientific council of the agency

The Scientific Council is the top expert body of the Agency. It is composed of six members and covers all scientific disciplines. Based on the proposal of the Science and Technology Committee of the Republic of Slovenia, the minister responsible for science appoints the members and the president of the Agency's Scientific Council for a five-year term, without the option of reappointment. In 2022, the Scientific Council of the Agency was composed as follows:



Prof. Dr. Peter Križan
President | Natural sciences and mathematics



Prof. Dr. Željko Knez
Deputy president | Engineering



Prof. Dr. Ksenija Geršak
Medical sciences



Prof. Dr. Janko Kos
Biotechnical sciences

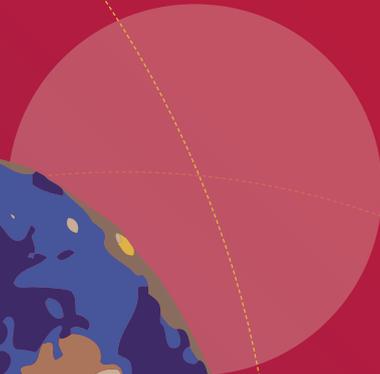
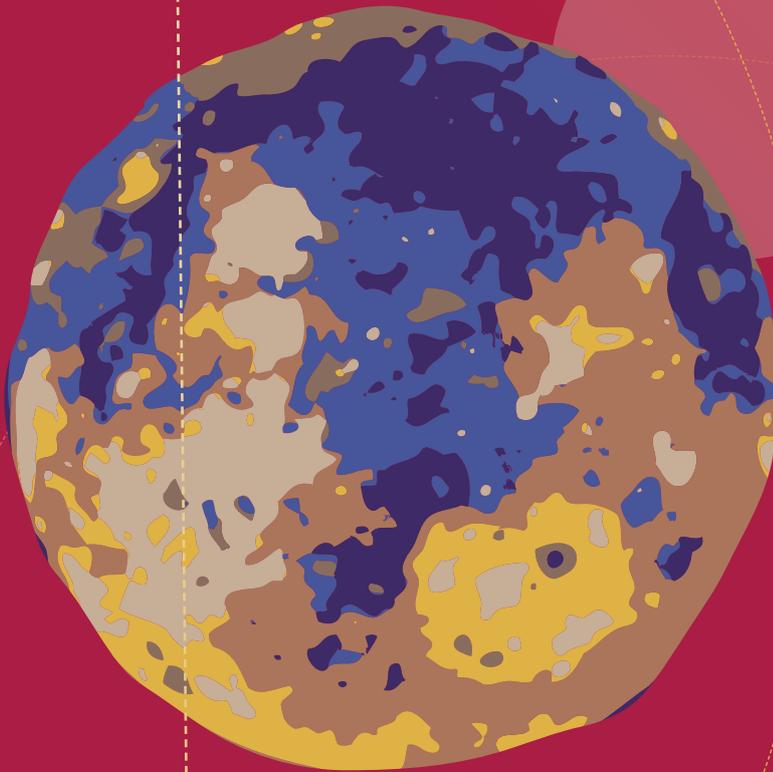
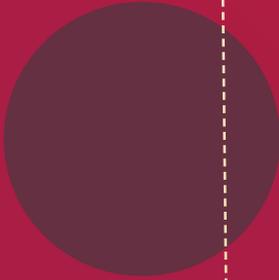


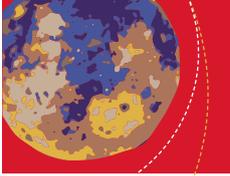
Prof. Dr. Miha Škerlavaj
Social sciences



Prof. Dr. Alenka Zupančič Žerdin
Humanities

IN THE SPOTLIGHT





Prof. Dr. Bojan Mohar

recipient of the project of the European Research Council (ERC) titled KARST

The project titled KARST awarded to Prof. Dr. Bojan Mohar from the Faculty of Mathematics and Physics, University of Ljubljana, is an interdisciplinary international European Research Council (ERC) project for synergy research (ERC Synergy) in the field of studying karst watercourses. Karst watercourses are very precious but also pose a great risk says Prof. Mohar. They are a source of drinking water for approximately 25% of the world's population and can reach a very rapid flow of water and transfer potential pollution.

In terms of climate change, we have to be prepared for extreme events, such as floods or prolonged draught. Key phenomena associated with extreme events are still beyond the existing capacities of modelling. KARST will establish the next generation of stochastic modelling frameworks for forecasting karst processes, evaluate the vulnerability of karst watercourses, and estimate their response to extreme events. The new approach will interconnect structures and models at all levels, beyond the limitations of currently existing computer simulations. Prof. Dr. Bojan Mohar is a **Slovenian-Canadian mathematician** conducting research at the Institute of Mathematics, Physics and Mechanics in Ljubljana, and at the Simon Fraser University, one of the most reputable universities in Canada. As an outstanding mathematician Prof. Mohar is a holder of several awards and prizes: the Zois Prize, the Euler Prize, and the John L. Synge Award presented by the Canadian Royal Society. He is a member of the Slovenian Academy of Engineering and a member of the Canadian Royal Society.

As an outstanding expert, he conducts research and works in the fields of **graph theory and theoretical computer science**. His resounding achievements in algebraic graph theory are used in computer science and can be associated with the operation of Google's search engine. He has achieved many **breakthrough results** in **topological graph theory**.

Prof. Bojan Mohar, last year you were awarded a prestigious European Research Council (ERC) project called KARST. It deals with research of karst watercourses which provide a source of drinking water for 25% of the world's population. You are a mathematician, but for us lay people to understand important mathematical science in research, such as the underworld of karst waters, some additional explanation is needed.

First, I would like to touch on the data, which we came across while preparing the project, namely that approximately 25% of the global population drink water of karst origin. Karst as distinctly evident in Slovenia is very rare. Perhaps there are some regions in Mexico and China, however karst underground waters are found all over the world. In many parts of Europe, almost without exception, in all European countries we find some form of karst water catchment area.

Here, in this project funded by the European Research Council (ERC) it is a case of synergy research joining researchers from several fields who want to combine their knowledge to reach a comprehensive result that cannot be achieved individually. I participate as a mathematician and in this regard I am not a specialist of karst and the karst world. Here in Slovenia we are surrounded by karst and learn about it in primary school, we come to know karst phenomena and karst water catchment areas, but as a mathematician I am not an



Photo: Courtesy of Simon Fraser University

Almost 25% of the global population drinks water of karst origin.

expert. However, it is true that during the preparation of the project I have learnt a lot about the karst world and what we want to achieve.

ERC projects are highly respected globally and the final application is quite demanding. As I understand it, this is an interdisciplinary international project worth almost 9.9 million EUR over a period of six years, and it will have four partners as holders.

That's right. It is a so-called synergy project. The ERC views these projects as the crown of research, where knowledge from different complementary areas are combined to achieve new, breakthrough results. There are four lead researchers in our synergy project, each with their own group. A colleague from France, physicist Benoît Noetinger from the IFPEN institute in France, deals with hydrology in porous media and similar environments. Marco Dentz from the IDAEA-CSIC institute in Spain is a renowned hydrologist studying the transfer of pollutants in non-structured media, such as water. Then there is another karstologist, hydrogeologist Philippe Renard from the University of Neuchâtel in Switzerland, who is perhaps the most familiar with the karst underworld, a great expert in this field. And I was included in the group as a mathematician who will try to transfer modern mathematical methods, in particular graph theory and network theory, into the respective field and use them to obtain intended results.

Considering the immense work to combine different scientific disciplines, how is the group formed in a joint project? Four partners joined forces – from France, Switzerland, Spain and Slovenia. All of these countries have a karst region in their geographical position and certainly also great knowledge and experience in research. What brought you together in this interdisciplinary group – a physicist, a hydrogeologist, a hydrologist and you as a mathematician?

The research of karst waters reaches back more than one hundred years. Slovenian karstologists have an important role in the modern research of this field. It turns out that in recent years we have acquired knowledge that was not deemed possible before. For example: over the past ten or twenty years, the breakthrough understanding was reached on the flow of liquids in porous media. This field evolved in particular from the extraction of energy products from sandstone, e.g. gas and oil in Canada. Knowledge about how to understand the flow of liquid or gas in such geographic systems was developed. The karst system is perhaps more difficult to describe with common mathematical methods due to its multi-dimensionality. In the karst world, there are flows in large cave systems as well as in small ones where water flows through very fine sandstone. We want to design a theory to describe the movement of liquids from the most simple flow through the rocks to a large river catchment. At this point, the approach to the karst system is different from known systems, and as an expert in the field of graph theory I want to contribute to the development of applicable models.

How has this field been studied so far, given that you intend to establish a stochastic modelling framework for forecasting karst processes?

You have mentioned that we wish to set up a stochastic model. What is it about? The karst world is hidden from our eyes and also hidden from the possibilities of examining it, since it is not a simple matter of large caves where water flowing underground would be seen. That is why there is a need to establish, based on known data and measurements, what kind of system or network of watercourses there is underground in order to foresee what can happen to it.

As an expert in the field of graph theory I want to contribute to the development of applicable models.

Your findings will also have wider social importance in terms of climate change or in terms of plans for taking care of water systems in specific regions. Have you already foreseen this in the project preparation phase?

This is one of our objectives. Climate change brings unknown weather conditions. Perhaps precipitation will be much heavier than it is now. And one of our goals is to understand what would happen in this case. How will watercourses react? When there is increased laminar flow causing water to swirl, very unexpected processes may occur in this underground world. And what could happen in that case? I hope that our models can be used to foresee such conditions for certain areas. Later on, our knowledge could be used by anyone. Also floods, massive floods can occur. We witnessed such cases decades ago in France, and several times in Slovenia. Another aspect we address does not only cover the water flow, but also studies on how water carries different materials, for example pollutants, which could occur at any location. That is why we wish to define this part so that our knowledge could be useful in the event of disasters.

What about drought?

Things are different when it comes to drought. Because the quantity of water is decreasing it would be good to establish what kinds of underground water supplies there are. And I presume that unforeseen hydrologic conditions could emerge in the case of major draughts. We hope that managers of water resources will make good use of our findings in the future.

So that means basic research with a very large applicative potential.

At this point I would like to emphasise again that this is basic research. As long as we are thinking about basic research we are not interested in the way this knowledge will be used specifically. However, every researcher also has an eye open to the applicability of their findings. In this way there

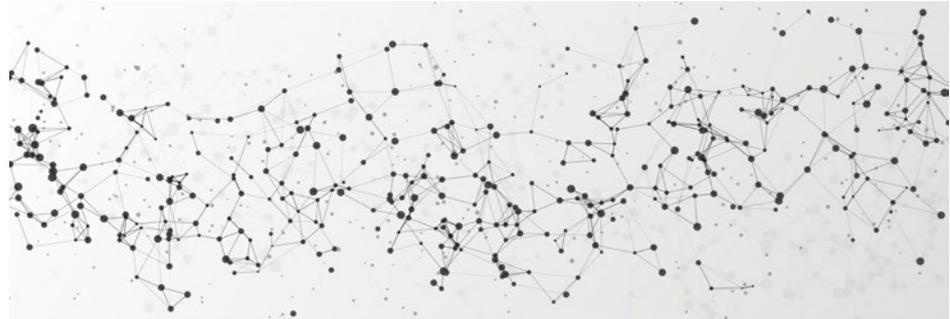
are many dimensions of how to use this knowledge. We hope that we will be able to popularise or spread the knowledge of our achievements so that they may be used for the benefit of society as a whole.

Today we all rely on technological progress. Currently the focus is on artificial intelligence and cognitive science. So the question arises about whether your findings regarding karst waters as a kind of network can be applied to another field, or discipline, for example medicine, to the nervous or vascular system?

As a mathematician I consider every structure abstract. A network is for me an abstract network and if it happens to fit into the karst water system we can foresee certain characteristics of this system. At the same time the methods we will develop would have to be applicable to any area where networks of this kind occur. To be more specific: one of the network dimensions foreseen in our research is how to transfer knowledge from local information to global information. In other words, how to understand measurements in local network sections and extrapolate them to the entire network. Meaning, how to make a transition from the local to the global. Similar types of problems emerge in other scientific disciplines. You have mentioned something which we have also written down in the proposal of our project, for example the capillary system in a human body. It is similar, since capillaries have different flow lengths, from short to long. Or for example, glacial melt generating underground water systems that gradually change just as is the case in karst. In glaciers, this is happening on a daily or annual basis, while in the karst system a bit slower, from century to century. We expect this research to be applicable, and I really hope that its use will be expanded to other fields.

The projects presented by candidates before the ERC commission require careful

The image has been designed using assets from Freepik.com



preparation and then elaborate defence. How did this part take place, in particular in terms of wider interdisciplinary and international cooperation?

Yes, a lot of effort was put into a good quality research proposal. It is important to know how to convince the ERC to fund a proposed research. Also the interview conducted by the group in front of the panel evaluating the proposal is important. Of 300 synergy proposals, only 30 were awarded, meaning that competition is fierce. We also knew that the interview must be well executed. We worked on the preparations for several months. We also had a one-week meeting to prepare the presentation of the interview before the European Commission. We carried out several rehearsals so to speak, test interviews with people who are experts in this field. Via Zoom, we had a panel of six people who have already participated as research applicants by themselves or taken part in panels with the European Council. They helped us experience the presentation before the panel in Brussels. I believe this was very useful. And I strongly suggest to anyone embarking on this journey to prepare themselves thoroughly for this interview. The panel is composed of different researchers who must select the most significant proposals among thirty or forty different scientific disciplines. Of course, they can decide on the basis of reviews prepared by experts, but the panel also comprises people who are not necessarily experts, for example in the field of hydrology or geology. It could be that our panel included

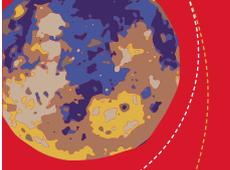
physicists or oceanographers, people from different fields, and they had to be convinced that our vision was the right one.

You are an internationally established expert, scientist and researcher. The ambitions among scientists to apply for an ERC grant at some point require a certain reflection and process. Is it a matter of a well-constructed idea, strong basic research or the potential of truly innovative applications? Do you also need to be self-confident? How useful is advice from experienced colleagues? And above all, hard work and intellectual effort are required. What would be your advice?

It is a combination of all you have mentioned. The European Research Council (ERC) awards only the most ambitious research. One must have a vision, present a problem that is significant and has potential or foreseeable applications. If I turn back to our project, we wish to reach the edge of the known breakthrough in the field of karst hydrology, and acquire new knowledge which we are not able to define at this point. As one of our colleagues said: "If we manage to deliver what we have planned, university textbooks in this field will have to be written anew." It is therefore a subject which we imagine will change research in the entire field. And what would be my advice to applicants? If they want to succeed, they have to take the application seriously, and select research in the field that is not only significant for a specific group but for the whole world. In short, hard work, preparations, ambitions and ideas.

Interview recording:
<https://www.youtube.com/watch?v=aqx98F15cfA>





Dr. Zala Lenarčič

recipient of the ERC project titled "Weakly driven quantum symmetries (DrumS)"

Winning an ERC project is also a sort of personal empowerment.



Foto: Marjan Verč

In recent years, Slovenia is becoming increasingly successful in obtaining the prestigious ERC projects. One of the recipients is Dr. Zala Lenarčič, head of the group for Non-equilibrium Quantum Systems and a colleague in the Department of Theoretical Physics at the Jožef Stefan Institute. She was awarded a prestigious five-year ERC Starting Grant in the approximate amount of EUR 1.5 million.

She applied her project with the ERC panel for solid state physics as a first choice, and as a second choice with the panel for basic building blocks of matter. The fact that the panel of first choice received 101 project proposals for funding, while awarding only 15, is of particular significance for the awarded project. It is the first Slovenian ERC project under this panel that will be led by a female researcher. She impressed the European Commission with her innovative scientific proposal "Šibko vzbujane kvantne simetrije (DrumS)", "Weakly driven quantum symmetries (DrumS)". The purpose of the DrumS project is to study the realistic potential of non-equilibrium quantum systems with symmetries. Unusual symmetries are theoretically interesting in physics, but it is almost impossible to find them in nature or generate them in an experiment. The goal of the DrumS project is to demonstrate that excitation with approximate symmetries may bring real systems into exotic states that could be fundamentally surprising, while at the same time having practical value for quantum technologies. The DrumS project will form theoretical forecasts and proposals of protocols to stabilise exotic quantum phenomena in realistic conditions, i.e. with laser excitation of materials and in quantum simulators. The proposed fundamental concept of compensating symmetry imperfections by excitation could revolutionise the field of energy extraction, high-temperature insulators, exotic superconductivity, and stability of quantum simulators. If the theory is followed by the experimental

confirmations of Dr. Zala Lenarčič's scientific partners in Europe, the DrumS project will pave the way for new functions of quantum technologies.

Dr. Zala Lenarčič, last year you were awarded the European Research Council (ERC) project. Projects approved by the ERC are the most desired projects in the international competition, they are really significant. How would you assess the importance and weight of your success with the call?

Yes, the ERC is one of the best known and desired international projects. For example, it opens the door to the most prestigious universities abroad. That is why many people decide to apply, making the competition really stiff. The success is also a recognition among colleagues within the scientific community, recognition among young researchers that apply for doctoral and postdoctoral positions. As a result, better researchers apply to work with ERC recipients. Winning an ERC project is also a sort of personal empowerment.

It is a project intended for starting an independent research career (ERC Starting Grant) for the period of five years, titled Weakly driven quantum symmetries (DrumS). Can you explain the questions or the topic you will address?

Very broadly speaking, I deal with a quantum description of the world in cases where quantum mechanics is relevant, for example to describe the properties of materials and their functionalities. A quantum description is very difficult, since its

Very broadly speaking, I deal with a quantum description of the world in cases where quantum mechanics is relevant.

complexity grows exponentially with the number of participating elements, for example electrons. That is why we are developing so-called quantum simulators, quantum computers that are supposed to directly simulate quantum systems. More specifically, I am interested in what happens with quantum systems when they are driven outside their equilibrium; how they react, how they relax, how to change the properties of materials through excitation. For example, what happens if we direct a laser on the material, how will this material react and what will be its new properties? In my ERC project, we want to characterise the conditions and protocols under which the properties of materials drastically change.

What title did you give to your project?

Šibko vzbujanje kvantne simetrije, "Weakly driven quantum symmetries (DrumS)". DrumS comes from the English title, and I chose the acronym because a drum is also a symmetrical object. Its shape enables excitation that causes a powerful sound. In a similar way, I ask how to play with quantum systems in order to generate a strong response.

Research in physics is supposed to have an equivalent in nature, at least that is how we laypersons imagine it. But you will look for answers to fundamental questions of how to describe quantum systems driven out of equilibrium while stabilising new states through excitation. And here, you say that nature is usually chaotic and hard to describe in classic and quantum systems. Can you elaborate?

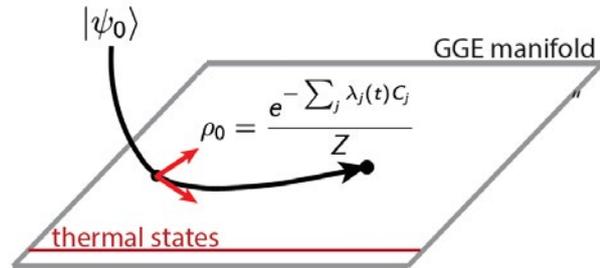
It's true. It turns out that nature is usually chaotic if we excite it, and therefore difficult to describe, but on the other hand it is also predictable. Let me explain this with a simple example. If we take cold coffee and add hot milk, their mixing will be hard to predict exactly, but after a while we will have a somewhat warmer coffee with milk. And it is similar with quantum

systems. If we excite them, over time the majority will relax into a state that at least locally seems thermal, with the temperature depending on the energy put into the system through excitation. This is difficult to derive and prove exactly with mathematics, but we know more or less what to expect. There are special systems, so-called integrable systems, that have many more rules about their dynamic development. The rules limit the possibilities and prevent the mixing, as mentioned before in the case of coffee. These rules are a result of additional symmetries that cause specific quantities never to change. Due to all these rules, integrable systems are easier to describe and are a sort of fascination for mathematical physicists. The consequence of these symmetries and rules are also very unusual properties, e.g. energy transport without losses. Integrable systems are a kind of mathematical construct and practically non-existent in nature. There will always be disturbances present in reality that cause losses, e.g. in transport. In my ERC project, we seek protocols with which we could compensate for unavoidable losses with excitation and yet stabilise special quantum states.

Your research falls under basic research, but it also contains a purpose of applicability. How would you position the area of your research in terms of breakthrough?

I think that my programme is situated somewhere between the idealised world that fascinates mathematical physicists and how the implications of this can be transferred into the real world. As I mentioned, we first wish to theoretically show that losses can be compensated by excitation in materials and quantum simulators that are approximately describable with special models. I hope this will inspire experimental colleagues to show, for example, that a method with weak laser excitation can achieve massive energy flows that could be used for cooling. My project

Integrable systems are a kind of mathematical construct and practically non-existent in nature.



Introduce super projector on tangential modes [PRB 97, 165138 (2018)]

$$\hat{P}X = - \sum_{ij} \frac{\partial \rho_0}{\partial \lambda_j} (\chi^{-1})_{ji} \text{tr}[C_i X], \quad \chi_{ij} = - \text{tr}[C_i \frac{\partial \rho_0}{\partial \lambda_j}]$$

Equations of motion for $\lambda_j(t)$

$$\hat{P}\dot{\rho}_0 = - \sum_{ij} \frac{\partial \rho_0}{\partial \lambda_j} (\chi^{-1})_{ji} \text{tr}[C_i \epsilon \hat{D} \rho_0]$$

$$\dot{\rho}_0 = \sum_j \frac{\partial \rho_0}{\partial \lambda_j} \dot{\lambda}_j \quad \rightarrow \quad \boxed{\dot{\lambda}_j = - \sum_i (\chi^{-1})_{ji} \text{tr}[C_i \epsilon \hat{D} \rho_0]}$$

has four sections that address four different types of idealised models and seeks new applications in real materials and simulators.

In recent months, the public is in awe of the power of AI with the ChatGPT generative language model that has stirred up many fields of work. How can we use artificial intelligence to describe the quantum systems that are the topic of your research?

With the fast pace of development, a sort of revolution has occurred in our field as well. Initially, artificial intelligence, or more precisely a neural network, was used in a similar way as in image recognition systems, i.e. to recognise different quantum phases. Then the use branched out significantly. For example, I work on a project where we use neural networks to classify the complexity of states in an excited quantum system. Using a neural network, we found how complex the system is in different phases of development, which

helps us in designing effective minimum descriptions. One of the important lines of research is the use of neural networks to record the wave function of quantum states because neural networks are very expressive and suitable for this exponentially difficult task. It is clear that neural networks are in this case only a tool, the advantages and weaknesses of which are only starting to become clear.

The field of quantum technologies is definitely a studied topic of science. There are high expectations about how we might upgrade our development with quantum knowledge. And for this reason, it is understandable that global intellectual and scientific experts are warning us to: "Protect your quantum talent." How do you see these warnings?

Sometimes, I am surprised at the potential our knowledge has, how highly we are actually valued on the market. For example, two of my friends decided to join start-ups in the field of quantum computing, in

Sometimes, I am surprised at the potential our knowledge has, how highly we are actually valued on the market.

California and in Israel. They are both well financially rewarded for their knowledge and work. But at the same time, under the contract, they must not reveal what they actually do. We were colleagues at the university, we shared all of our knowledge and our research was made public. Then, they had to sign contracts with non-disclosure clauses. This is of course understandable when knowledge becomes a commercial commodity and is part of competitions and rivalries that are now taking place between the USA, Europe and China. But on the other hand, I find this quite shocking, since in the academic world we are used to all of our research being available from freely accessible servers. It is thrilling that our knowledge is so valued, but at the same time it feels strange when knowledge is concealed, when there is no more academic spirit, or sharing of everything. I think that we are still getting used to the demarcations between the academic and technological worlds.

Will the project with pertaining funds – you received approximately 1.5 million EUR for a period of five years – enable more creative scientific freedom for you and at the same time spur the entire scientific community? What do you reckon?

Since it is a five-year project, I think that it gives me an opportunity to address important issues with coherence and synergy. I hope that in this way we will be able to convince the scientific community that these are relevant questions and raise interest in others to start thinking along these lines. Major projects also strengthen the recognition and attractiveness of Ljubljana's scientific community. That is why more and more people decide to come to us to complete their postdoctoral training, despite our uncompetitive salaries compared to other European countries. At least with the ERC projects, we are now able to offer 20% higher salaries to colleagues working on the project under the

new Act. It is a step forward, although we are not yet at the level of western Europe. In some countries, the persons awarded ERC projects have complete freedom in determining salaries. In Slovenia, we are still limited by the salaries applicable to the public sector.

How are you planning to compose your research group? What are your limitations in selecting colleagues, are you allowed to form an internationally mixed group or does the group need to be composed of only Slovenian researchers?

Excellence is the criterion. We employ doctoral and postdoctoral researchers. The latter are usually foreigners, since mobility is promoted in science. Two Italian colleagues are joining us in autumn. Doctoral students can be from Slovenia or abroad. However, I was surprised that there was no interest for my doctoral positions among Slovenian students. It seems that Slovenian students are not familiar with the ERC programme.

The application to such demanding calls as the ERC is, is very difficult and stressful. What are the key characteristics, both personal and professional, in applying to a call?

I decided to apply to place myself at a level that is comparable with colleagues abroad, since they can offer higher salaries and sometimes a group is already formed within their primary position, which is not the case in Slovenia. Here, you have to prepare projects practically for every colleague. And yes, salaries are one of the reasons why foreign researchers do not decide to work in Slovenia. In terms of this purely financial standpoint, the ERC project provides me with a possibility to offer at least 20% better conditions. It is important that ERC is a form of medium-term funding and thus also ensures creative peace, a kind of security to focus on things that are important. And what are the characteristics of a candidate? You need

You need a strong idea that is modern and relevant and which the panel will view as worth funding.

a strong idea that is modern and relevant and which the panel will view as worth funding. Through past achievements you have to show that you are able to realise what you promised.

How does the process of presenting and defending the project before the ERC panel take place? The ERC mechanism is intended primarily to promote the development of basic research, but in recent years broader, long-term benefits of research are stepping to the fore. What are your experiences and thoughts?

Technically, the application has two written parts. The shorter one sums up the subject and must be understandable to a wider panel, while the second part is intended for reviewers from your specific field of science. They assess in more detail whether your proposal is feasible and interesting. If you are invited to the second round, you must deliver a 30-minute defence with a presentation where you explain the programme more broadly to the panel which chooses the recipient of funds. Impact or influence is part of the application; it is necessary to point out what the broader contribution of the respective programme is. Nevertheless, I would say that there is less emphasis on applicative aspects at the ERC compared to other calls. At the ERC, the basic aspect and contribution to scientific society are still at the fore of the assessment.

In the rapid development of scientific disciplines, there is an increasing number of breakthrough ideas that occur almost as a rule with long-term research and study. Despite the fact that competition is becoming fiercer, what would you suggest to your research colleagues? How does one give an idea more substance, how does one place it in a broader scientific development, where does one seek support and advice? How do we maintain scientific integrity?

First, it is important to examine and know the field, understand the open questions

and feel that you possess an alternative view that will change the approach and perhaps also draw the attention of the community to see the problem from another angle. That was also my story. Alternatively, you can have an *out of the box idea* and hope that the community will recognise it as a breakthrough. These are probably two types of ideas that I think have potential for the ERC. I felt that I knew how to make a set from seemingly unrelated fields. With non-equilibrium protocols I want to show that things which seem to be impossible are possible.

I was pretty self-sufficient in writing. I felt that I knew how to present the idea, so I prepared the written part almost without external help. In the oral part I included many different colleagues who had already defended their project at the ERC, I invited a specialist for presentations, and the Ministry organised a test interview. I wanted to receive a wider response because the panel was very diverse, with only one or two members coming from my field of expertise. Because there are many people included in your preparations you receive mutually exclusive advice which leads to endless corrections that no longer converge. In the final phase, it is important to ask yourself again, what are you, what is your presentation, what is your idea, and make time for your own thoughts and to finalise the preparation in your own way.

Are self-confidence and a clear view of your idea the most important?

To be perfectly honest, the ERC is becoming a kind of business. Because it is so highly valued and desired by many people, there are services that help you draw up the written part and prepare you for an interview. I asked myself whether this was really science as it should be? In the sense that we need external services to come up with an attractive proposal. It can happen that you lose yourself in the process,

Interview recording:
<https://youtu.be/ThjHVraLI-8>



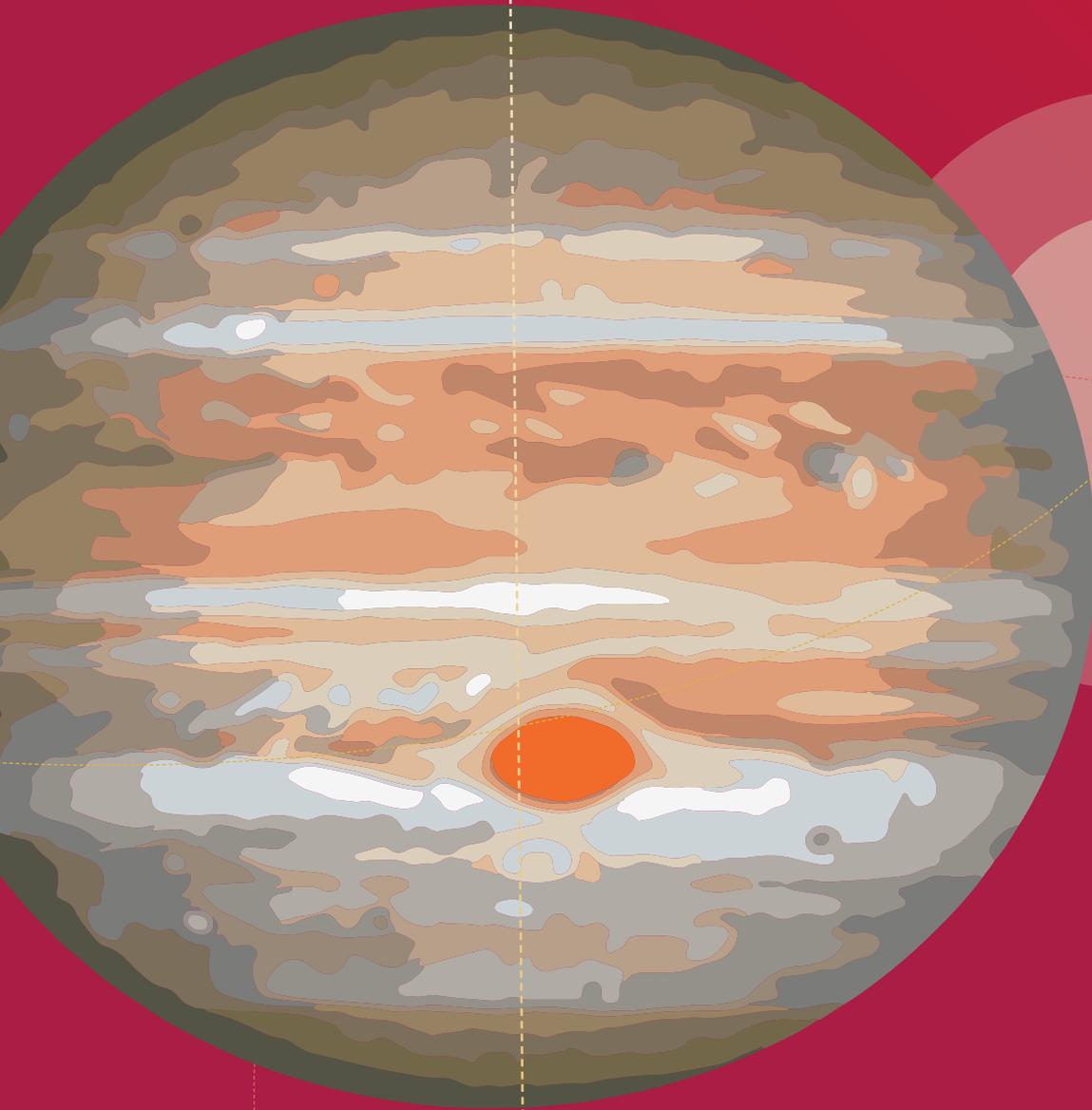
I felt that I knew how to present the idea, so I prepared the written part almost without external help.

that your idea is lost, that you lose focus because you are following the advice of so many specialists about how to express your own thoughts. I thought it would be better to go my own way, at least in the written part. To make my integrity clear, because there is a risk that the proposal completely loses its plot.



ANNUAL REPORT **2022**

HIGHLIGHTS





Promotion and spreading scientific knowledge

The fundamental objective of the Agency in the field of communication with the public is to contribute to a more comprehensive, objective and credible reporting and public discussion on science and the scientific system in the Republic of Slovenia.

In 2022, the Agency enhanced its operation in the field of promoting science with the awareness that successful communication with interested parties and the target public is based on an appropriately designed strategy of communication that defines the main communication objectives and activities. In accordance with the Public communication strategy, the Agency started to develop measures for implementing communication activities in 2022, and in December organised the fifth national event "ARRS Day: Supporting Excellence".

ARRS day 2022: supporting excellence

ARRS Day 2022 was dedicated to the new generation of young researchers. It was held on 1 and 2 December in the Grand Hotel Union in Ljubljana under the honorary patronage of the President of the Republic of Slovenia, Borut Pahor.

During the event new developments in the field of Agency operation were presented, from the stable funding scheme to the supporting instruments for applying to European calls.

The plenary part of ARRS Day 2022 was highlighted by the discussion on the position and future of Slovenia within the European Research Council (ERC). Within the scope of the round table "Young Researchers in the region: Opportunities and Challenges" a discussion was held on the topic of possible inclusion of young people in the field of research at home and abroad. The first day was rounded off by a reception for the new generation of young researchers. On the second day, there was a round table addressing the topic of the impact factor of scientific journals in Slovenia with the participating scientific journal editors and library representatives.



ARRS Day 2022 in numbers

2 days

2 round tables

4 keynote speakers

21 research achievements presented

OVER 25 participants in discussions

OVER 150 domestic and foreign participants

As part of the event, there was also the 11th edition of the project for promoting science **Excellent in Science**. Within the scope of the project, 52 research achievements were selected in 2022, of which the 21 most prominent from all scientific disciplines were presented during the event.

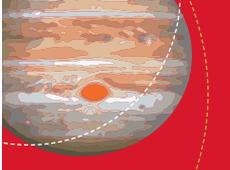
Over 150 young and experienced researchers, mentors and representatives of education and research organisations from Slovenia and abroad attended the event.



Photo: Videa produkcija

More information on the event is available at <https://danarrs.si/>.





International cooperation of the Agency

The Agency is focusing on opening up opportunities for enhanced international scientific cooperation.

First phase:
establishing and
strengthening
international
connections

Incentives:

- **Bilateral cooperation** – co-financing bilateral cooperation; concluded agreements between the Republic of Slovenia and 37 countries around the world
- **COST actions** – strengthening international connections
- **Horizon Europe** – encouraging applications to EU framework programmes by co-financing the preparation and application of EU framework programme projects
- **Scholarships for visits to ERC grant holders** – visits of 3 to 6 months to ERC grant holders. After the visit, the researcher visiting the ERC grant holders must submit an application to one of the three ERC calls (the time period is determined in the call).

Second phase:
incentives
for enhanced
international
scientific
cooperation

Options – public calls and invitations:

- **Lead Agency scheme – Weave research project:** Austria (FWF), Belgium–Flanders (FWO), Czech Republic (GACR), Poland (NCN), Switzerland (SNSF), Croatia (HRZZ)
- **Lead Agency scheme – bilateral projects:** Hungary (NKFIH)
- **ERC complementary scheme:** offers the opportunity for adapted research projects entered into the European Research Council (ERC) international call and exceeding the co-financing ceiling established by the Agency to be awarded funds as national research projects (duration up to 3 years)
- **Marie Skłodowska-Curie Seal of Excellence – MSCA:** applicants to the MSCA IF calls for individual scholarships who are awarded the Seal of Excellence (score of 85% or more) in the evaluation procedure can be awarded funds as national research projects (with a duration of up to 2 years)
- **ERA projects** – international calls of networks in ERA:
 - JPI Urban Europe (since 2015)
 - NORFACE (since 2005)
 - PRIMA (since 2018)
 - DUT (since 2022)

More information:
<http://www.arrs.si/sl/medn/>





Stable funding

Pursuant to the Scientific Research and Innovation Activities Act (ZZrID) that entered into force in 2022, the Agency introduced a significant new feature, i.e. the stable funding of scientific research activities and thus provided autonomy to the recipients of stable funding of scientific research activities. The first contractual period of stable funding covers the 2022–2027 period.

Research organisations that had research and infrastructure programmes or only research programmes on the day ZZrID entered into force are entitled to stable funding for the first contractual period; this excludes companies that are not entitled to stable funding.

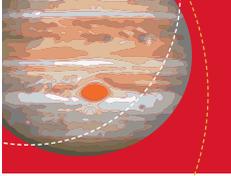
The stable funding of scientific research activities comprises funds that cover four pillars according to the purpose of funding.

THE PILLARS OF STABLE FUNDING ACCORDING TO PURPOSE

PILLAR NAME	PURPOSE OF FUNDING
Institutional funding pillar (ISF)	Funding of infrastructure, management and supporting activity and other institutional infrastructure.
Programme funding pillar (PSF)	Funding of research programmes and young researchers.
Development funding pillar (RSF)	Funding activities to promote the development of scientific research and infrastructure activities (in terms of quality, creativity and innovation, internationalisation, openness, knowledge transfer and cooperation with the environment that contribute to achieving objectives and results, and implementation of measures or tasks in the field of scientific research activities defined in the strategic documents of the country and the EU, while taking into account the mission and strategy of the individual recipient of stable funding).
National research programmes (PNR)	Funding national research of topics determined by the Government of the Republic of Slovenia at the proposal of the line ministry.

More information on stable funding is available at the web page <http://www.arrs.si/sl/stabilno/>.





ARRS mechanisms of competitive funding

Doctoral level

up to doctoral degree

Postdoctoral level

up to 3 years after obtaining a doctorate degree

Research projects

-

Postdoctoral research project (basic or applied)

Public call for (co)financing research projects

International cooperation

-

ERC complementary scheme

Public call for (co)financing adapted research projects

-

Visits to ERC grantees

Public call

-

-

MSCA Seal of Excellence

Public call

MSCA Seal of Excellence

Public call

-

MSCA Seal of Excellence

Public call

-

-

-

-

-

Projects of bilateral cooperation

Public calls for individual countries

COST actions

Postdoctoral level

up to 5 years after obtaining a doctorate degree

Young doctor

up to 10 years after successfully defending the first doctorate

Established researcher

Research project (basic or applied)

Public call for (co)financing research projects

Research project (basic or applied)

Public call for (co)financing research projects

Research project (basic or applied)

Public call for (co)financing research projects

ERC complementary scheme

Public call for (co)financing adapted research projects

ERC complementary scheme

Public call for (co)financing adapted research projects

ERC complementary scheme

Public call for (co)financing adapted research projects

Visits to ERC grantees

Public call

Visits to ERC grantees

Public call

Visits to ERC grantees

Public call

Lead Agency scheme

Public calls of partner LA agencies

Lead Agency scheme

Public calls of partner LA agencies

MSCA Seal of Excellence

Public call

MSCA Seal of Excellence

Public call

MSCA Seal of Excellence

Public call

Reimbursement of expenses – Horizon Europe

Public call

Reimbursement of expenses – Horizon Europe

Public call

Reimbursement of expenses – Horizon Europe

Public call

JPI Urban Europe

International call

JPI Urban Europe

International call

NORFACE

International call

Projects of bilateral cooperation

Public calls for individual countries

Projects of bilateral cooperation

Public calls for individual countries

Projects of bilateral cooperation

Public calls for individual countries

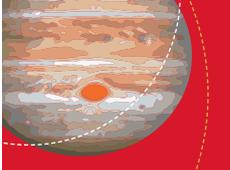
COST actions

COST actions

COST actions

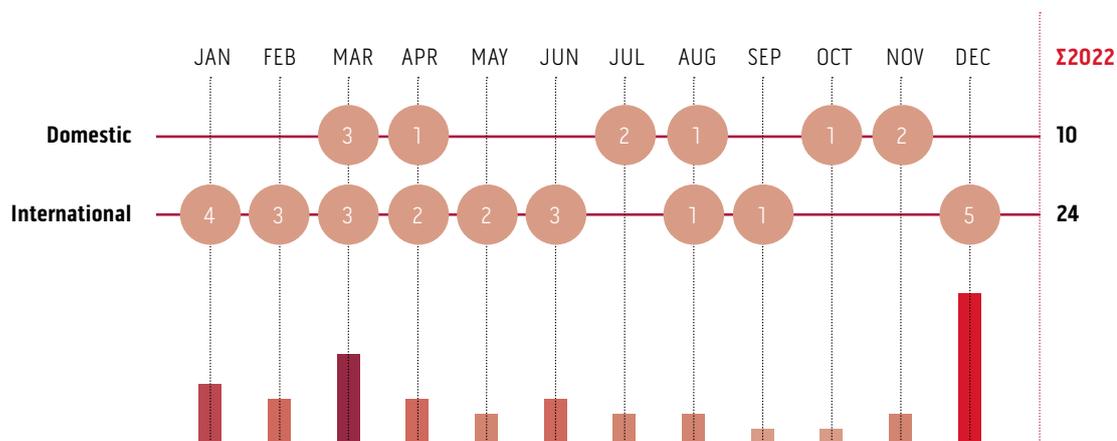
Information on other available mechanisms of (co)financing are accessible at: <https://www.arrs.si/sl/razpisi/>





Public invitations and calls published in 2022

NUMBER OF PUBLISHED PUBLIC INVITATIONS AND CALLS ACCORDING TO THE MONTH OF PUBLICATION



OVERVIEW OF DOMESTIC INVITATIONS AND CALLS

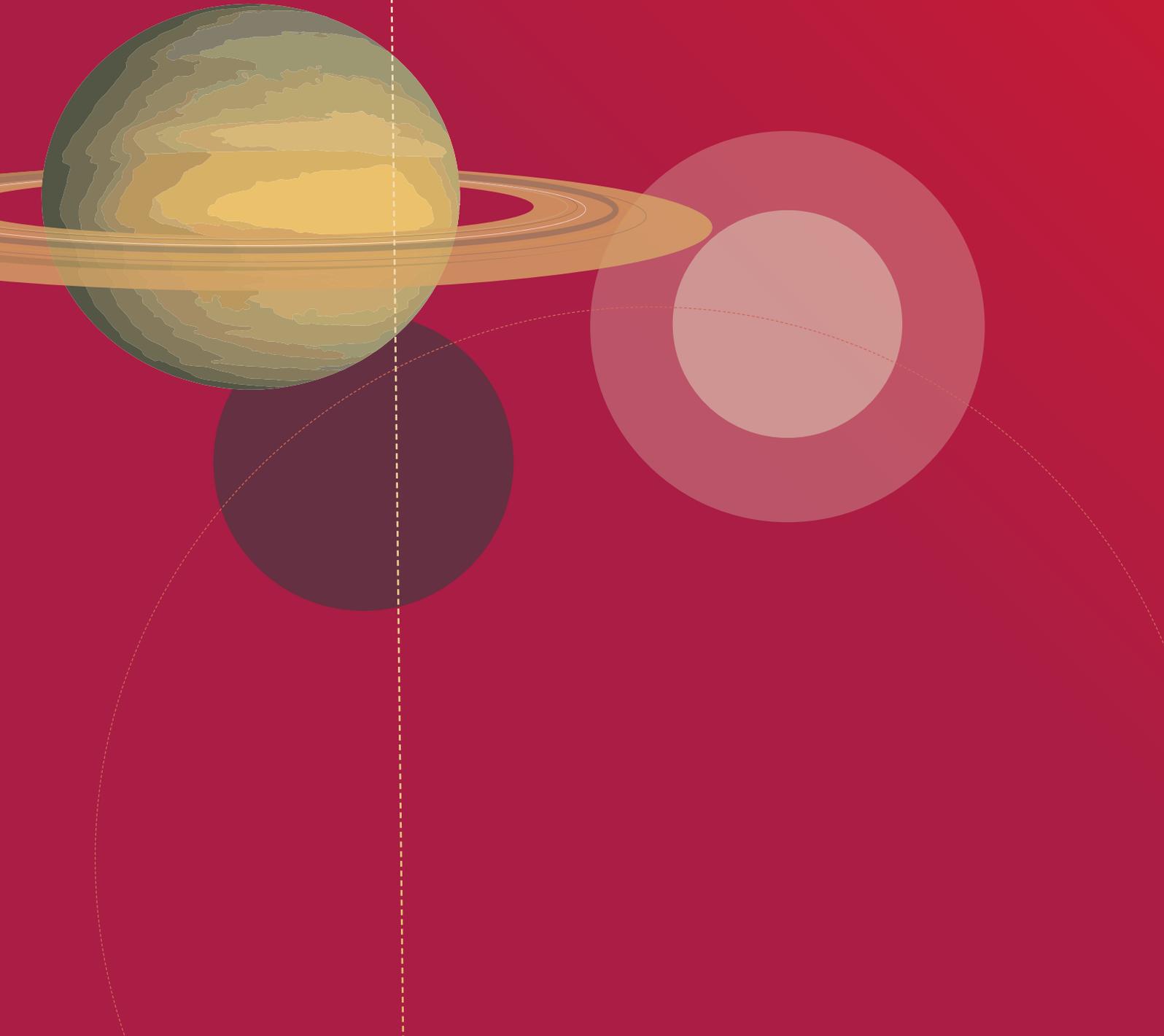
	DATE OF PUBLICATION
Public call for awarding research projects within the Target Research Programme "CRP 2022" in 2022	18 March 2022
Public call for co-financing the publishing of scholarly monographs in 2022	18 March 2022
Public call for the evaluation of research programmes – 2022	22 March 2022
Public call for awarding research projects within the Target Research Programme "Our food, rural areas and natural resources" in 2022	22 April 2022
Public call for the reimbursement of costs for scientific publications in open access (for 2022)	8 July 2022
Public call for co-financing the purchase of international scientific literature in 2022	8 July 2022
Public call for co-financing the purchase of research equipment (package 21)	26 August 2022
Public call for co-financing activity programmes of central specialised information centres for research activity in the 2023–2025 period	28 October 2022
Public call for co-financing the publishing of Slovenian science periodicals in 2023 and 2024	11 November 2022
Public call for co-financing the publishing of Slovenian popular science periodicals in 2023 and 2024	11 November 2022

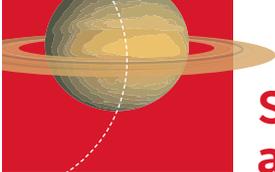
OVERVIEW OF INTERNATIONAL CALLS AND INVITATIONS

	DATE OF PUBLICATION
Public call for co-financing scientific research cooperation between the Republic of Slovenia and the Republic of Turkey in the 2022–2024 period	14 January 2022
Public call for co-financing the Slovenian section of joint Hungarian–Slovenian projects with NKFIH (National Research, Development and Innovation Office) as the lead agency	14 January 2022
Public call for co-financing the Slovenian section of Weave bilateral or trilateral joint research projects with FWO (The Research Foundation – Flanders, FWO) as the lead agency	21 January 2022
Public call for co-financing scientific research cooperation between the Republic of Slovenia and the French Republic in the framework of the PROTEUS programme in 2023 and 2024	28 January 2022
Public call for co-financing the Slovenian section of Weave bilateral or trilateral joint research projects with GAČR (Grantová Agentura České Republiky) as the lead agency	18 February 2022
Public call for co-financing the Slovenian section of Weave bilateral or trilateral joint research projects with SNSF (Swiss National Science Foundation) as the lead agency	18 February 2022
Public call for co-financing scientific research cooperation between the Republic of Slovenia and the Republic of Croatia in the 2023–2024 period	18 February 2022
Public call for co-financing scientific research cooperation between the Republic of Slovenia and the Republic of Austria in the 2023–2024 period	18 March 2022
Public call for co-financing scientific research cooperation between the Republic of Slovenia and Montenegro in the 2023–2024 period	25 March 2022
Public call for co-financing scientific research cooperation between the Republic of Slovenia and the Republic of Serbia in the 2023–2025 period	25 March 2022
Public call for co-financing scientific research cooperation between the Republic of Slovenia and the Federal Republic of Germany in the 2023–2024 period	8 April 2022
Public call for co-financing memberships of Slovenian societies and associations of societies in international science associations in 2022	8 April 2022
Public call for co-financing activities related to the promotion of Slovenian science abroad and integration of scientific achievements in 2022	6 May 2022
Public call for co-financing the Slovenian section of Weave bilateral or trilateral joint research projects with FWF (Fonds zur Förderung der wissenschaftlichen Forschung) as the lead agency – published in 2022	13 May 2022
Public call for co-financing scientific research cooperation between the Republic of Slovenia and Japan in the 2023–2025 period	3 June 2022

	DATE OF PUBLICATION
Public call for co-financing the Marie Skłodowska-Curie research projects – Seal of Excellence	10 June 2022
Public call for co-financing the Slovenian section of Weave bilateral or trilateral joint research projects with HRZZ (Hrvatska zaklada za znanost) as the lead agency	10 June 2022
Public call for (co)financing visits to ERC project leaders in the 2023-2025 period	26 August 2022
Public call for co-financing the Slovenian section of Weave bilateral or trilateral joint research projects with NCN (Narodowe Centrum Nauki) as the lead agency for the 2023–2028 period	23 September 2022
Public call for the payment of a single financial contribution towards the costs of preparing and submitting applications for projects within the Horizon Europe Framework Programme for Research and Innovation in the EU (for the period from 1 December 2022 to 31 May 2023)	9 December 2022
Public call for co-financing the Slovenian section of Weave bilateral or trilateral joint research projects with FNR (Luxembourg National Research Fund) as the lead agency in 2022	16 December 2022
Public call for postdoctoral research scholarships in Japan for researchers from the Republic of Slovenia in 2022	16 December 2022
Public call for co-financing scientific research cooperation between the Republic of Slovenia and the United Kingdom of Great Britain and Northern Ireland from 1 May 2023 to 30 April 2025	16 December 2022
Public call for co-financing adapted research projects within the complementary scheme for applications to European Research Council (ERC) calls	23 December 2022

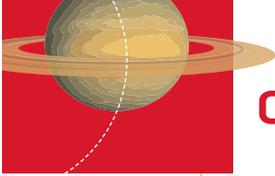
ABOUT THE AGENCY





Strategic guidance on agency operation and development

-
- Sound implementation of activities according to the legal basis, Decision Establishing the Slovenian Research Agency, and applicable national strategic documents
 - Transparency and responsiveness
 - Optimisation of existing instruments and setting-up pilot instruments
 - Monitoring the effects of the implementation of activities
 - International integration and comparability
 - Transition to fully electronic services
 - Open communication with the public and promotion of science



Organisational structure of the agency

Organisational structure of the agency

Scientific Council of the Agency

- *Permanent expert bodies (scientific research panels for individual disciplines)*

Agency Director

- Department of Stable Funding
- Department of Research Projects
- Department of International Cooperation and Popularisation of Science
- Department of Research Infrastructure and Analyses
- Department of Legal and General Affairs
- Department of Information Technology
- Department of Finance and Accounting
- Department of Recovery and Resilience Plan

- *External expert panels*
- *Commissions*

Management Board of the Agency

- *Reviewers*

Internal organisational units

To implement its tasks the Agency is structured into internal organisational units that are in terms of organisation subordinated to the Director, and through the execution of their tasks combine meaningfully connected fields in terms of substance to enable expert, efficient and economic performance of activities for which the Agency has been founded. With a new organisation and systematisation of posts applicable from 1 July 2022 departments have been reorganised as stated below.

Director's office

The Director's office carries out specialised, advisory, coordination and administrative-technical tasks, and coordinates work on joint tasks with the Agency's internal organisational units and other Agency bodies. The Director's office is also responsible for communication with the public.

Department for stable funding

Head of department:
Dr. Primož
Pristovšek

The department carries out tasks related to the four pillars of stable funding: (1) the institutional pillar of funding scientific research activities with the aim of funding infrastructure, management and supporting activities and other institutional infrastructure; (2) the programme pillar of funding scientific research activities, including research programmes and young researchers and mentors; (3) the development pillar of funding scientific research activities with the aim of funding activities for promoting the development of scientific research and infrastructure activities; and (4) the national research programme.

Department of research projects

Head of department:
Dr. Nika Razpotnik
Visković

This department carries out tasks in the field of evaluation and selection of research projects. Within its scope of operation, it organises the procedures for substantive monitoring and control of co-financing, implementation and attainment of research project objectives. The main activities of this department are the launch of the call for (co)financing research projects and the launch of the call for awarding research projects of the Target Research Programme (CRP).

Department of international cooperation and popularisation of science

Head of department:
Mojca Boc

The department carries out tasks in the field of bilateral and multilateral international scientific research cooperation and the involvement of researchers in the activities of international scientific associations. It performs tasks within the scope of the lead agency mechanism, Seal of Excellence, encouraging applications to public calls of EU framework programmes for research and innovations, and in the field of cooperation of Slovenian research organisations in international research and development projects. It also carries out activities to promote and popularise science.

Department of research infrastructure and analyses

Head of department:
Simon Ošo

The department carries out tasks in the field of research equipment and infrastructure programmes, bibliographic databases, science and popular science publications and scholarly monographs, open access to scientific publications and research data. It performs tasks in the field of collecting and processing data on the engagement of researchers in the acquisition of funds of other users, it analyses and monitors the development of scientific research activities, monitors the quality of Agency work and prepares a substantial part of the work programme and the Agency's annual report.

Department of finance and accounting

Head of department:
Mojca Kastelc
Selan

The department carries out tasks related to the Agency's financial operations. It is responsible for planning, implementing, record keeping, and reporting on funding for scientific research activities, as well as the Agency's programming tasks and operation. It ensures the Agency's solvency. The department is responsible for putting in place payment, recovery, and control mechanisms; it also carries out accounting tasks and coordinates the conclusion of joint contracts with research activity operators.

Department of legal and general affairs

Head of department:
Katarina Hren

The Department of Legal and General Affairs carries out tasks in the field of law and labour law procedures and conducts administrative procedures regarding access to public information and keeping of the private researchers register. The department is also responsible for keeping the register of research and development activity operators, and carries out tasks regarding personnel and human resource management. In addition, it carries out public tendering procedures and other procedures related to the takeover of resources and services and is responsible for ensuring the maintenance of Agency offices and equipment. The department also carries out the main office tasks, as well as tasks related to the storage of documentary material and maintenance of the archive.

Department of information technology

Head of department:
Tomaž Žitnik

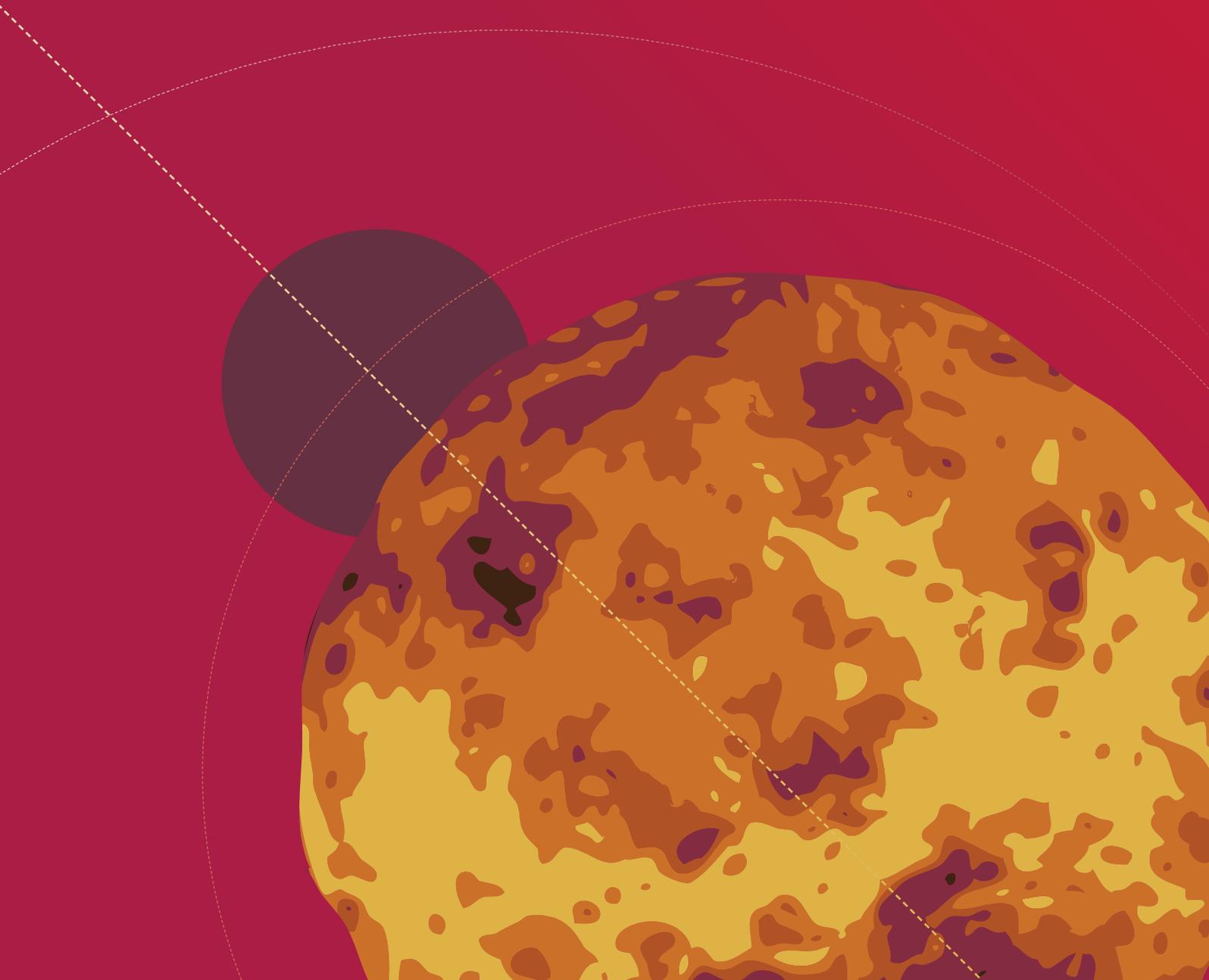
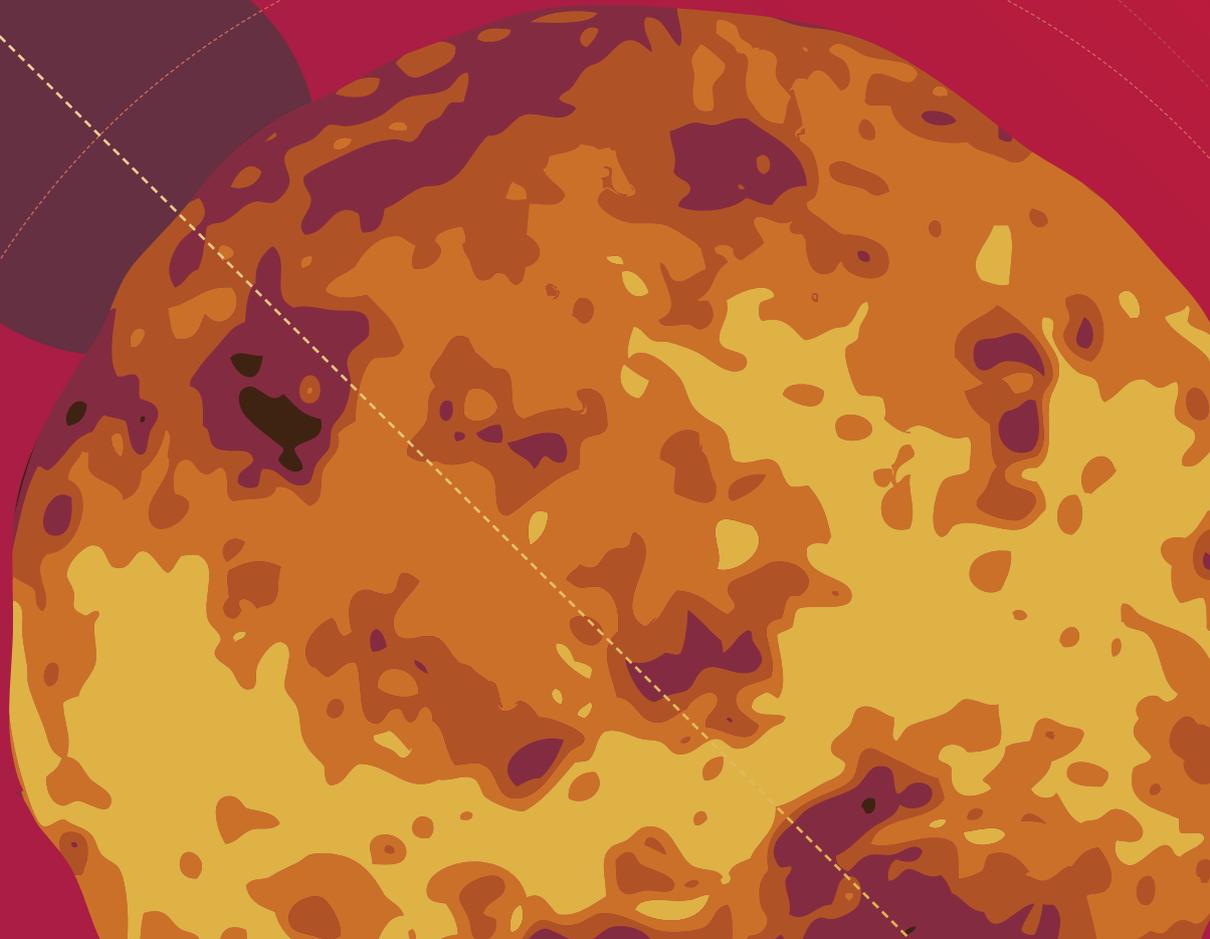
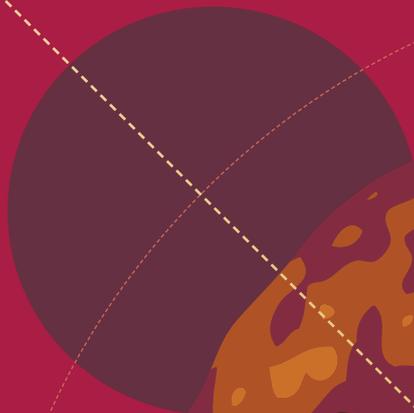
The Department of Information Technology draws up expert bases to determine and implement the information policy of the Agency, provides IT support to business processes and coordinates the development of information and communication infrastructure. It also performs project management for installing, operating and maintaining hardware, system software and basic software tools for users.

Department of recovery and resilience plan

Head of department:
Dr. Lidija Tičar Padar

The Department of the Recovery and Resilience Plan is a new department aimed at executing reform activities and two investment measures from the Recovery and Resilience Plan. The reform part – operation and management of the RDI system – is carried out under the programme of Activities to Enhance the Agency and R&I Management System. The planned projects under the first investment for Co-financing research and innovation projects to support the green transition and digitalisation will be focusing on long-term major collaborative programmes for research and innovation on the TRL 3-6 scale. The second investment is aimed at co-financing projects and programmes to enhance the international mobility of Slovenian researchers, research organisations, and to encourage the international integration of Slovenian applicants, and to reintegrate postdoctoral researchers into Slovenian research institutions.

FINANCIAL REPORT





Financing structure

In 2022, the tasks were focused on providing conditions for carrying out scientific research activities and monitoring the purpose of carrying out scientific research activities. An extensive part of the activity was the execution of stable funding of scientific research activities and fundamental, applied and postdoctoral projects.

In 2022, EUR 273.8 million were allocated from the budget of the Republic of Slovenia via the Slovenian Research Agency to fund scientific research activities, which is EUR 48.7 million or 22% more than in 2021 and represents the highest increase in the observed period. The Agency's budget for funding scientific research activities has been increasing since 2015.

In 2022, the share of Agency resources for funding scientific research activities in the budget of the Republic of Slovenia increased as well, namely from 1.67% (in 2021) to 1.97% (in 2022) and thus approached the value of 2020, i.e. 2%.

A detailed overview of the funding of research activities by year is available on the web page:

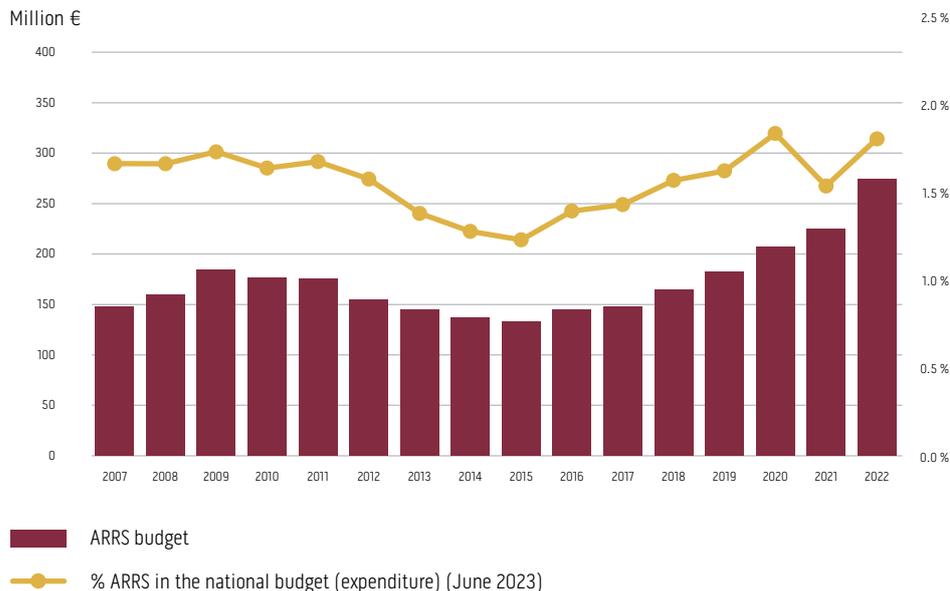
www.arrs.si/sl/finan/letpor/.



More information and charts on the scope and structure of Agency funds from the state budget are available on the web page <http://www.arrs.si/sl/analyze/obseg01/pr.asp>.

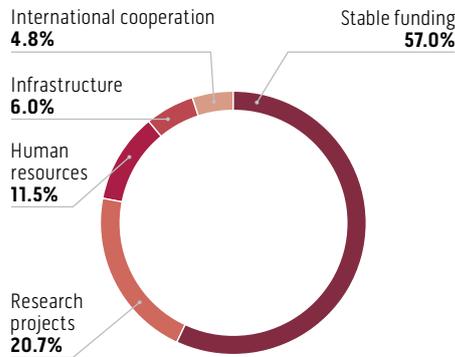


AGENCY RESOURCES FOR FUNDING SCIENTIFIC RESEARCH ACTIVITIES AND THE SHARE OF THE RESPECTIVE FUNDS IN THE BUDGET OF THE REPUBLIC OF SLOVENIA IN THE 2007–2022 PERIOD

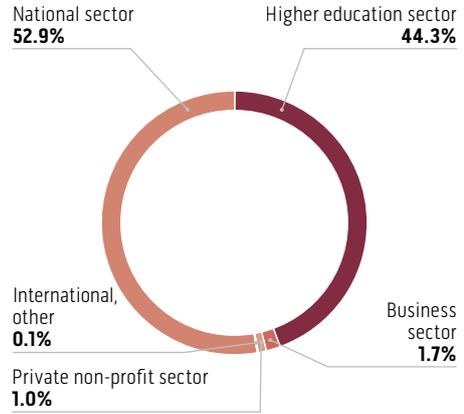


Agency Funds in 2022

AGENCY FUNDS PER MECHANISM CLUSTER



AGENCY FUNDS PER ACTIVITY SECTOR



Research programmes

Long-term funding of the research expected to be current and useful over a prolonged period. In 2022, funding of the majority of research programmes became stable funding.

Research projects

Co-financing of fundamental, applied and postdoctoral research projects and projects of target research programmes (CRP). CRPs are established, implemented and financed in cooperation with individual ministries and other interested budget users.

Human resources – Young researchers

Funding of postgraduate studies and training of researchers aiming to obtain a doctorate. In 2022, young researchers were switched to stable funding, their training is funded from the programme pillar of the recipient of stable funding.

International activity

Co-financing the projects within the complementary schemes of the ERC and the schemes of lead agencies (Lead Agency Agreement), visits to ERC project leaders, introducing projects on the basis of the Marie Skłodowska-Curie Seal of Excellence, co-financing the international bilateral cooperation, promotion of cooperation between research organisations in the Horizon Europe calls and supporting international associations, ERA projects, promotion of Slovenian science abroad and integration of scientific achievements.

Research infrastructure

Co-financing of infrastructure programmes, science and popular science periodicals and scholarly monographs, founding obligations, the COBISS system and other library and information activities and infrastructures, international journals and databases, and research equipment.

Institutional financing

RESEARCH PROGRAMMES

82.8

MILLION EUR

FOUNDER OBLIGATIONS

53.8

MILLION EUR

INFRASTRUCTURE PROGRAMMES

20.4

MILLION EUR

HUMAN RESOURCES – YOUNG RESEARCHERS

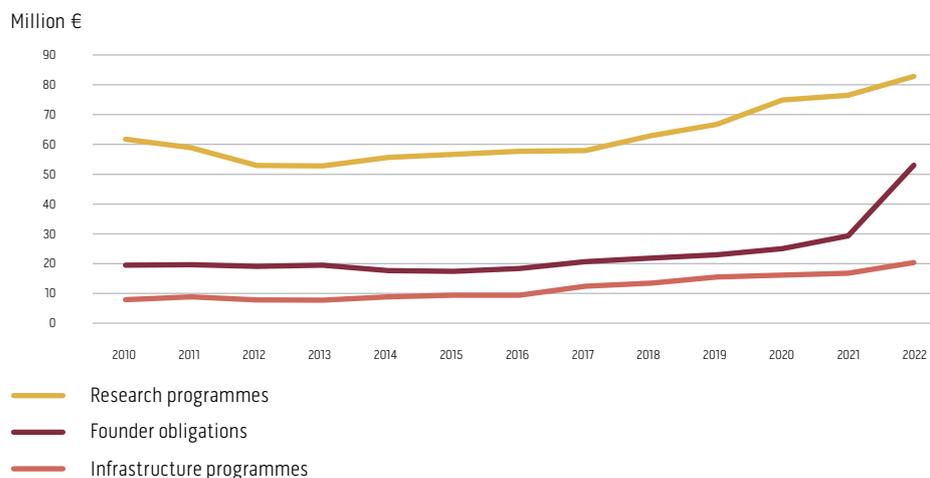
31.4

MILLION EUR

Research programmes, infrastructure programmes and founder obligations comprise a stable aspect of research funding. In 2022, funding of the majority of research programmes became stable funding. In 2022, founder obligations and infrastructure programmes were included in stable funding, which is also intended to cover fixed operating costs, management costs, maintenance costs and reno-

vation of real estate, equipment and some other operating costs. In 2022, the trend of fund growth continued in all three fields of institutional funding, in particular in the field of founder obligations.

In 2022, young researchers were included in stable funding. Their training is financed from the funds of the programme pillar of the recipient of stable funding.



Research programmes

Research programmes became a part of the programme funding pillar in 2022, except in the part that is in the first contractual period implemented by companies. Recipients of stable funding determine the content, scope, and method of implementation of the research programme

and the leader of research programme in their Act. In 2022, there were 111 recipients of funds for research programmes. In 2022, the Agency paid EUR 82.8 million for the co-financing of research programmes, i.e. 30.2% of the total Agency budget.

AGENCY FUNDS FOR RESEARCH PROGRAMMES BY SECTOR OF ACTIVITY IN EUR AND PERCENTAGE

Government sector	€ 46,482,971	56.1%
Higher education sector	€ 34,749,776	42.0%
Business sector	€ 1,302,006	1.6%
Private non-profit sector	€ 250,868	0.3%
Total	€ 82,785,621	100%

Founder obligations and infrastructure programmes

Founder obligations are obligations of the founder towards public research and infrastructure institutes whereby the Agency covers fixed operation costs related to

the core research or infrastructure activities. In 2022, EUR 55.6 million were paid for founder obligations, which is 20.3% of the total Agency budget.

AGENCY FUNDS FOR FOUNDER OBLIGATIONS BY SECTOR OF ACTIVITY IN EUR AND PERCENTAGE

Government sector	€ 31,305,186	59.1%
Higher education sector	€ 21,296,978	40.2%
Business sector	€ 320,181	0.6%
Private non-profit sector	€ 75,117	0.1%
Total	€ 52,997,462	100%

Infrastructure programmes support research work. The central role of research infrastructure is to ensure a high-quality research environment. In 2022, EUR 17.8

million were paid for infrastructure programmes, which is 6.5% of the total Agency budget.

AGENCY FUNDS FOR INFRASTRUCTURE PROGRAMMES BY SECTOR OF ACTIVITY IN EUR AND PERCENTAGE

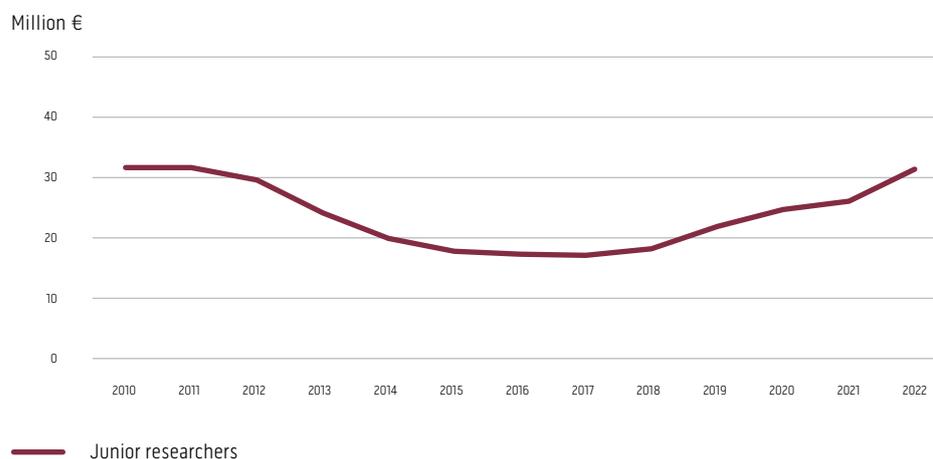
Government sector	€ 14,156,650.23	69.6%
Higher education sector	€ 4,716,890.45	23.2%
Business sector	€ 296,566.96	1.4%
Private non-profit sector	€ 1,180,253.33	5.8%
Total	€ 20,350,360.97	100%

Human resources – young researchers

The programme of training young researchers falls under human resources. The programme has run with a great success since 1985 and has significantly contributed to the improvement of the quality and scope of research and to the rejuvenation of research groups. By financing young researchers, the Agency wishes to renew research and pedagogical staff in research organisations, increase the research capacity of groups to carry out

programmes of public service in the field of research activities of fundamental, applied and development projects, and increase personnel potential for the Slovenian economy and other socially relevant areas. Since 2017, which saw a reversal of a negative trend, funds for young researchers have been increasing on an annual basis; the funds amounted to EUR 31.4 million in 2022, which is EUR 5.3 million more than the year before.

FUNDING FOR YOUNG RESEARCHERS



With the inclusion of young researchers training into the programme pillar of stable funding the publication of the call for application, selection of mentors and candidates for young researchers fall under the responsibility of the stable funding re-

ipient. The recipient defines the number of places for doctoral students, mentors, training programmes, criteria, methods of evaluation and selection of candidates for young researchers in their Act.

AGENCY FUNDS FOR RESEARCH PROGRAMMES BY SECTOR OF ACTIVITY IN EUR AND PERCENTAGE

Government sector	€ 12,505,504	39.8%
Higher education sector	€ 18,833,574	59.9%
Business sector	€ 36,574	0.1%
Private non-profit sector	€ 67,633	0.2%
Total	€ 31,443,285	100%

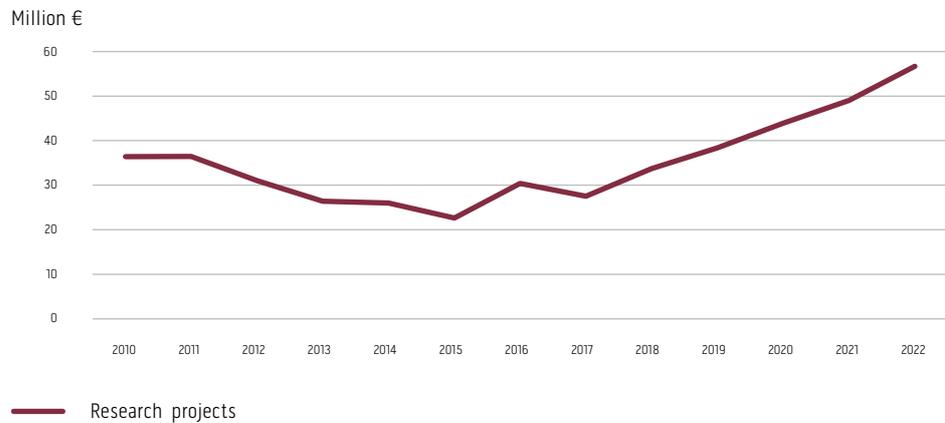
Competitive financing

RESEARCH PROJECTS
56.7
MILLION EUR

The selection and co-financing of a research project is linked to public calls. Successful proposals of projects fulfilling all prescribed conditions that are selected in the two-phase procedure based on the peer reviews prepared by foreign experts and the proposal of expert bodies of the Agency are co-financed for the period de-

termined in the public call. The funding of research projects increased in 2022. The trend of increasing funds for research projects has continued since 2017. In 2022, the funding of research projects increased from EUR 49 million (in 2021) to EUR 56.7 million.

FUNDS FOR RESEARCH PROJECTS



Research projects

FUNDAMENTAL RESEARCH PROJECTS
41.9
MILLION EUR

The research projects include fundamental research projects, applied research projects, postdoctoral research projects, and projects of target research programmes (TRP). In 2022, the Agency co-financed research projects in the amount of EUR 56.7 million. The share for projects

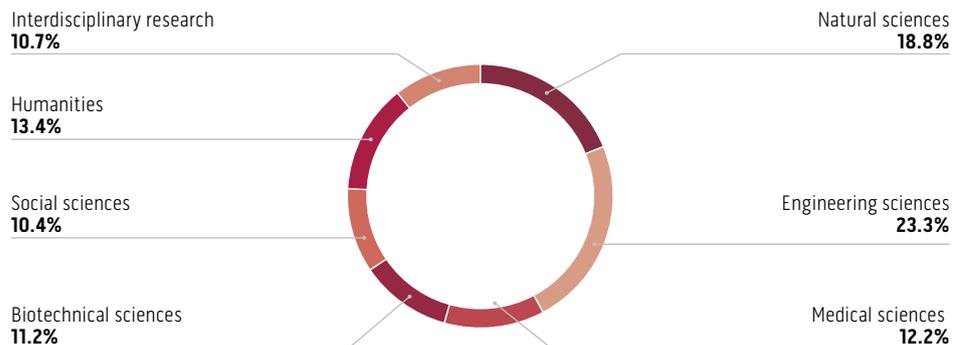
in the total Agency budget was 20.7%. Compared to the previous year, the funds increased by EUR 7.7 million. The majority of funds were allocated to projects in the field of technology (23.3%) and natural sciences (18.8%).

APPLIED RESEARCH PROJECTS
7.9
MILLION EUR

POSTDOCTORAL RESEARCH PROJECTS
4.5
MILLION EUR

PROJECTS OF TARGETED RESEARCH PROGRAMMES
2.5
MILLION EUR

FUNDS FOR RESEARCH PROJECTS BY DISCIPLINE

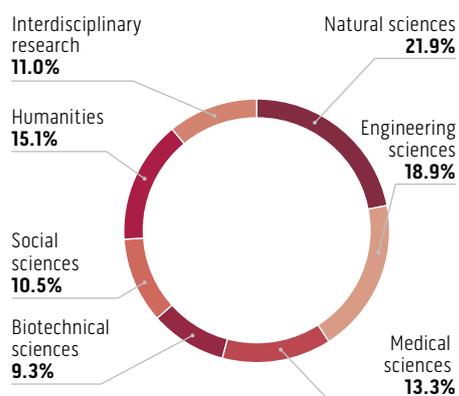


Fundamental and applied research projects

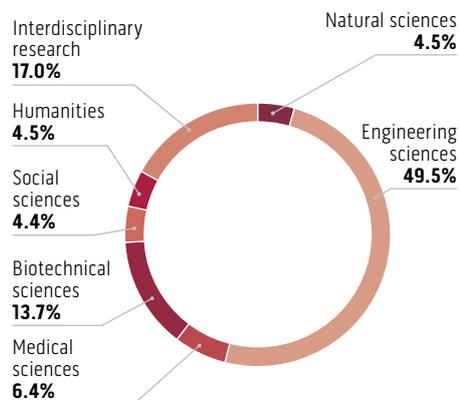
Fundamental research projects are original experimental or theoretical works aiming to discover new knowledge on the basics of phenomena and perceptible facts. The purpose of applied research projects is to discover new knowledge direct-

ed in particular to a practical objective or purpose. In 2022, the Agency used funds from the national budget to co-finance fundamental research projects in the total amount of EUR 41,9 million and applied research projects in the total amount of EUR 7.9 million.

AGENCY FUNDS FOR FUNDAMENTAL RESEARCH PROJECTS BY DISCIPLINE



AGENCY FUNDS FOR APPLIED RESEARCH PROJECTS BY DISCIPLINE



Fundamental and applied projects led by young doctors (maximum ten years after successfully defending their doctoral thesis) are a special category. They are

paid special attention in the public call for co-financing research projects. In this way, the Agency promotes the inclusion of younger scientists in research activities.

SCIENTIFIC DISCIPLINE	FUNDAMENTAL AND APPLIED PROJECTS IN MILLION EUR	FEMALE RESEARCH LEADERS (SHARE OF PROJECTS MANAGED BY WOMEN)	JUNIOR LEADERS	
			JUNIOR LEADERS (SHARE OF JUNIOR RESEARCH LEADERS)	JUNIOR RESEARCH LEADERS (SHARE OF WOMEN AMONG JUNIOR LEADERS)
Natural science	9.5	30.2%	20.4%	25.1%
Technology	11.8	22.8%	20.9%	42.0%
Medicine	6.1	42.4%	27.1%	38.2%
Biotechnology	5.0	38.2%	28.3%	16.6%
Social sciences	4.7	37.8%	28.3%	43.5%
Humanities	6.7	45.7%	30.1%	61.7%
Interdisciplinary research	5.9	41.6%	26.8%	35.8%
Total	49.7	34.9%	24.9%	38.5%

The funds for fundamental and applied research projects by scientific discipline with shares allocated for projects managed by female researchers and junior researchers. The last column includes the data on the share of funds for projects managed by junior female researchers.

Postdoctoral projects

As an important instrument for networking, mobility and flow of researchers, the Agency uses funds from the national budget to co-finance postdoctoral research projects, both fundamental and applied, that are implemented to allow researchers to obtain additional research

experience and knowledge after receiving their doctoral title. The number and value of projects increased compared to 2021. In 2021, the Agency used funds from the national budget to finance 108 postdoctoral projects in the amount of EUR 3.7 million, while in 2022 it financed 111 postdoctoral projects in the amount of EUR 4.5 million.

THE FUNDS FOR POSTDOCTORAL RESEARCH PROJECTS BY SCIENTIFIC DISCIPLINE FOR PROJECTS MANAGED BY FEMALE RESEARCHERS.

SCIENTIFIC DISCIPLINE	ASSETS IN EUR	FEMALE RESEARCH LEADERS (SHARE OF PROJECTS MANAGED BY WOMEN)
Natural science	971,725	55.6%
Engineering	1,026,359	42.7%
Medicine	598,012	85.6%
Biotechnology	546,220	75.8%
Social sciences	478,678	63.4%
Humanities	809,283	49.7%
Interdisciplinary research	86,254	100%
Total	4,516,531	59.7%

Targeted research programme (CRP)

CRP is a form and manner of implementing the Slovenian Development Strategy and the Slovenian Scientific Research and Innovation Strategy and is designed as an instrument to integrate the country to meet its needs, research community and wider public in terms of specific priority topics. The basic purpose of CRP is to provide research bases for decisions in pre-

paring, adopting and implementing development policies of public interest and monitoring and supervising their execution. Compared to the previous year, the resources for co-financing CRP increased in 2022. In 2022, EUR 2.5 million of funds were allocated to CRP (in 2021 EUR 2.2 million were allocated).

SCIENTIFIC DISCIPLINE	ASSETS IN EUR	FEMALE RESEARCH LEADERS (SHARE OF PROJECTS MANAGED BY WOMEN)
Natural science	204,226	35.0%
Engineering	373,895	36.9%
Medicine	247,501	49.8%
Biotechnology	826,133	37.1%
Social sciences	659,489	44.9%
Humanities	129,056	22.8%
Interdisciplinary research	53,790	100.0%
Total	2,494,090	40.8%

The funds for CRP by scientific discipline for projects managed by female researchers.

In 2022, the Agency, with the approval of the Ministry of Agriculture, Forestry and Food of the Republic of Slovenia, published a public call for the selection of research projects within the Targeted research programme **“Our food, rural areas and natural resources”** in the field of the following thematic clusters:

- Smart, resilient and competitive agriculture, forestry and fisheries, and the food processing sector,
- Environmental protection and sustainable management of natural resources,
- Quality of life, safe and healthy food, strengthening of economic activity in rural areas,
- Building and transfer of knowledge and fact-based policy.

In 2022, the public call for the selection of research projects within the Targeted research programme **“CRP 2022”** was also published for the following fields:

- Inclusive, healthy, safe and responsible society,
- Highly productive economy that generates added value for all,
- Learning for and through life,
- Preserved healthy natural environment,
- High level of cooperation, training and effective governance.

Scientific literature

SCIENTIFIC LITERATURE

1.79

MILLION EUR

INTERNATIONAL PUBLICATIONS AND DATABASES

49.0

MILLION EUR

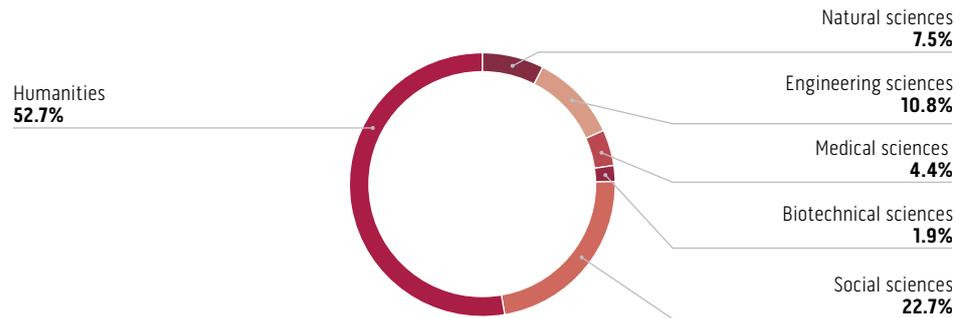
The Agency co-finances electronic access to the most recent scientific databases and the purchase of international scientific literature to provide availability of and access to international scientific and expert data for the needs of research, education and development activities. The literature is publicly available in all libraries, research organisations and the COBISS system.

Based on the call, the Agency co-finances the issuing of publications with popular scientific and scientific content. In this way it aims to provide the issuing of popular science and science publications

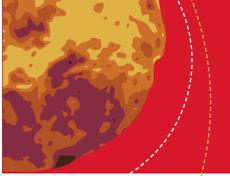
that are important for promoting the interest of general public, in particular of the young, in natural science and technology. The Agency also co-finances the issuing of scholarly monographs that are important for developing the Slovenian scientific terminology, presenting scientific achievements and finding in Slovenia and abroad, and for promoting scientific culture.

Co-financing the scientific press, including domestic science and popular science publications amounted to EUR 1.34 million in 2021, while EUR 0.45 million was paid for scholarly monographs.

FUNDS FOR SCIENTIFIC LITERATURE* BY DISCIPLINE



*Domestic periodic popular science publications, scientific periodic publications, scholarly monographs



International activity

INTERNATIONAL
RESEARCH PROJECTS

11.9
MILLION EUR

INTERNATIONAL
MOBILITY

0.4
MILLION EUR

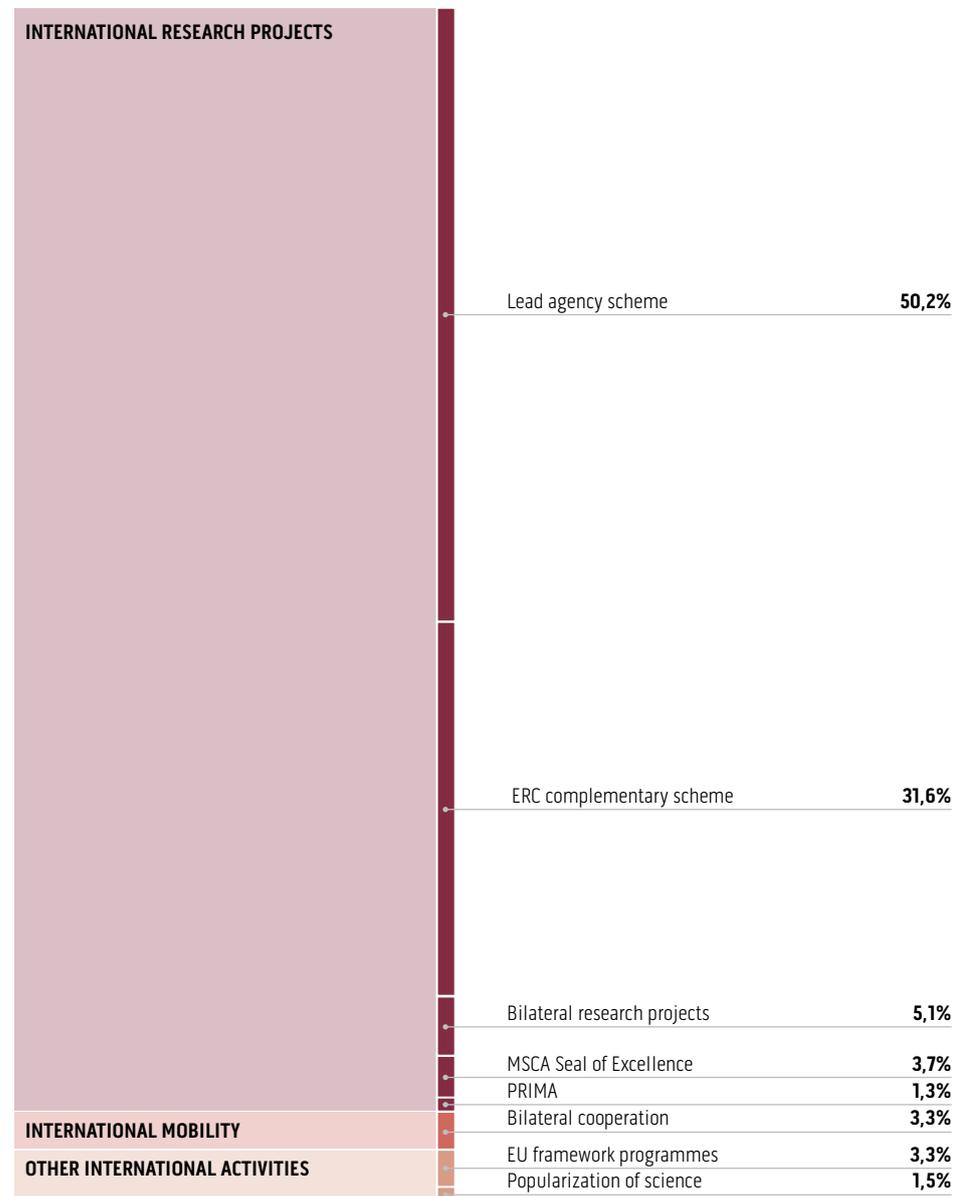
OTHER
INTERNATIONAL
ACTIVITIES

0.6
MILLION EUR

Science and research are becoming more integrated in the international environment and directly and complementarily connect different fields. With the aim of promoting international cooperation and networking, the international activity of the Agency is focusing on three main pil-

lars: international research projects, international mobility and other international activities. In 2022, the Agency allocated over EUR 12.9 million to financing international activity. The majority of funds went to the Lead Agency scheme.

FUNDS FOR INTERNATIONAL ACTIVITY



International research projects

LEAD AGENCY SCHEME

6.5

MILLION EUR

ERC COMPLEMENTARY SCHEME

4.1

MILLION EUR

BILATERAL RESEARCH PROJECTS

0.7

MILLION EUR

MSCA SEAL OF EXCELLENCE

0.5

MILLION EUR

PRIMA

0.2

MILLION EUR

The first pillar of the agency's international activity is composed of international research projects comprising of: the Lead Agency scheme, ERC complementary scheme, bilateral research projects (CEA China projects), Marie Skłodowska-Curie Seal of Excellence projects, and research projects of the PRIMA programme.

The Lead Agency scheme enables researchers to apply for funding a joint research project to one of the agencies (Lead Agency) that is responsible for implementing the evaluation procedure of the joint application of the research project. Cooperation according to this principle is ensured by the fact that the Agency acts as the Lead or partner agency. In 2022, the Agency allocated EUR 6.5 million to (co)finance the Lead Agency scheme and thus (co)financed 91 international research projects.

In 2022, cooperation according to the principle of Lead Agency was possible based on bilateral agreements and within the Weave financing scheme under which the Agency cooperated with agencies from: Austria (FWF), Belgium/Flanders (FWO), Czech Republic (GAČR), Croatia (HRZZ), Poland (NCN) and Switzerland (SNSF). In addition, cooperation with the Hungarian national institute of research, development and innovations was also possible, namely based on a bilateral agreement on cooperation according to the Lead Agency scheme.

The **ERC complementary scheme** is intended for researchers who have achieved a threshold for potential (co)financing in the ERC review procedure but were not selected for (co)financing by the ERC. The purpose of the scheme is to provide applicants with conditions to improve the initial idea of their research project so that

the leader of the research project gains better chances with his/her re-application to be awarded an ERC project. In 2022, the Agency allocated over EUR 4.1 million for the (co)financing of 52 research projects under the ERC complementary scheme.

The **(co)financing of bilateral research projects** took place in coordinated cooperation with the Ministry and Agency in 2022. In 2022, the Agency (co)financed 14 bilateral research projects with the French Alternative Energies and Atomic Energies Commission (CEA) and two bilateral research projects with the People's Republic of China. The Agency allocated over EUR 658,000 to the (co)financing of 16 bilateral research projects in 2022.

Slovenia participates in the **European Commission's Marie Skłodowska-Curie scheme – Seal of Excellence**, which annually awards the so-called Seal of Excellence to all MSCA research projects achieving the score of 85% or more. This is a confirmation of the internationally recognised excellence of research projects and stimulates countries to finance these research projects from the national budget without any additional national evaluation procedures. In 2022, the Agency (co)-financed 11 research projects of this kind in the total amount just under EUR 476,000.

PRIMA is a partnership of 19 countries in the field of research and innovation in the Mediterranean region and acts as a joint scientific, financial and administrative management through a single secretariat. The partnership is active in three key areas focusing on the Mediterranean: management of waters, agricultural systems and agri-food chains. In 2022, the Agency (co)financed six PRIMA research projects in the total amount of EUR 164,000.

International mobility

BILATERAL COOPERATION

0.4

MILLION EUR

The second pillar of the international activity covers: bilateral projects, ERC hosting, COST, JSPS scholarships and hosting researchers from third countries.

In the field of bilateral cooperation, the competent Ministry makes decisions on concluding multinational agreements and on active bilateral cooperation, and negotiates with partner countries on call specifications that do not directly stem from the legal bases of the Agency. The latter assumes the role of the Lead Agency that (co)finances bilateral cooperation with the aim of enhancing scientific research cooperation with partner countries, establishing new, sustainable international partnerships and increasing the share of young researchers in consortia of international research projects. The Republic of Slovenia has signed international agreements with 37 countries, while in 2022 it had active cooperation with 19 countries. The Agency allocated over EUR 427,000 to the (co)financing of 329 bilateral projects.

The **ERC visiting scheme** is also a part of international mobility. It enables researchers to visit former and current ERC project leaders abroad. Its purpose is to train applicants for preparing their applications with the aim to increase the possibility of being awarded their own ERC project. The Agency recognises the potential of this scheme, but unfortunately visits were not possible in 2022 due to the COVID-19 pandemic.

The **COST instrument**, which is an inter-governmental framework for cooperation of research organisations from different European countries in the field of science and technology, is also included in international mobility and enables the coordination of nationally funded research at the European level by research agencies that operate in the same field or work on the same issue. The Agency does not (co)finance activities under this instrument, but rather encourages the active participation of Slovenian researchers in COST actions, also by appointing members of the so-called COST action board members.

Other international activities

POPULARISATION OF SCIENCE

0.2

MILLION EUR

EU FRAMEWORK PROGRAMMES

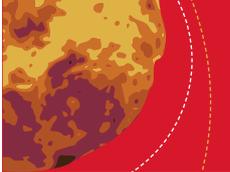
0.4

MILLION EUR

Under the Public call for promoting Slovenian science abroad, the Agency encourages activities of **promoting Slovenian science** abroad and linking scientific achievements where adequate international and expert participations are granted. The programme provides cooperation with Slovenian research organizations and researchers from abroad as well as cooperation with Slovenian researchers working abroad. In 2022, the Agency allocated EUR 194,000 to the activities pro-

moting Slovenian science abroad.

With a single financial contribution, the Agency also encourages the cooperation of Slovenian research organisations that exceeded the threshold of achieved points in the evaluation procedure in calls within the EU framework programmes (**Programme for Research and Innovation in the EU, Horizon Europe**). In 2022, the Agency allocated EUR 434,000 to the respective field.



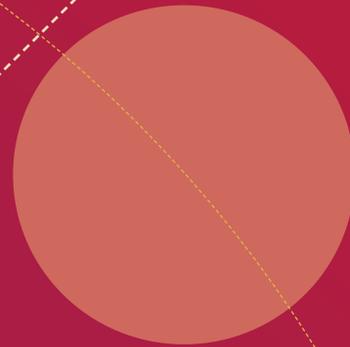
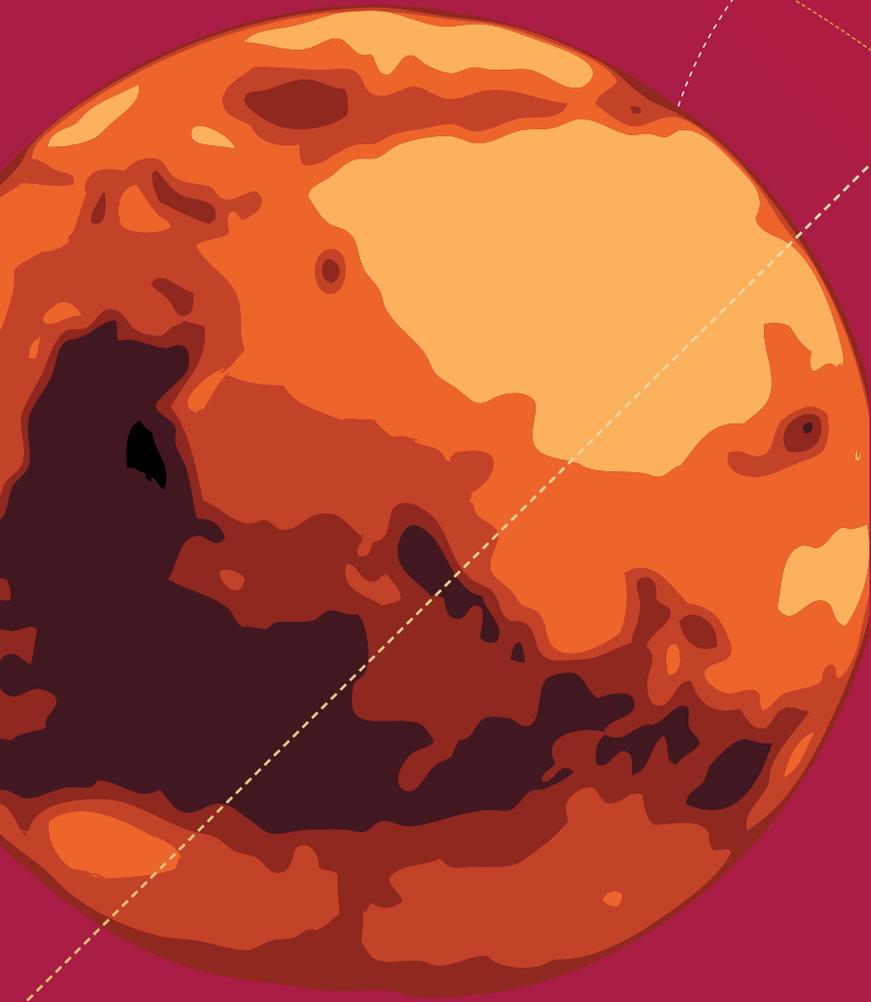
Overview of financing in 2022 per programme item in accordance with the accrual principle

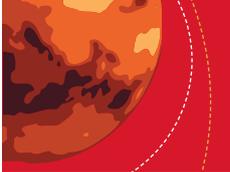
	REALISATION IN 2022
FOUNDER OBLIGATIONS AND INFRASTRUCTRE PROGRAMMES	€ 73,347,822.88
ISF-management and supporting activities	€ 52,376,288.77
ISF-infrastructure	€ 16,573,223.77
Founder obligations for PRO	€ 621,173.14
Infrastructure programmes – material costs	€ 2,599,748.00
Infrastructure programmes – salaries	€ 1,177,389.20
RESEARCH PROGRAMMES AND PROJECTS	€ 147,548,704.93
PSF-Research programmes	€ 82,018,554.79
Research projects	€ 49,715,556.49
Research programmes	€ 767,065.30
ERA projects	€ 151,266.88
ERA-EU projects	€ 148,634.43
ESF and ERC projects	€ 11,251,771.61
Targeted research programmes – competitiveness	€ 2,494,089.30
Open access	€ 1,001,766.13
TRAINING AND DEVELOPMENT OF SCIENTISTS	€ 35,959,814.75
PSF-Young researchers	€ 31,415,030.03
Young researchers	€ 28,254.24
Post-doctoral projects	€ 4,516,530.48
INTERNATIONAL SCIENTIFIC COOPERATION	€ 1,743,409.52
Cooperating in the EU area	€ 658,499.88
International projects, bilateral cooperation	€ 427,714.44
Promotion of applications to European projects	€ 434,000.00
International promotion of science	€ 194,155.41
Operation of Slovenian science associations abroad	€ 29,039.79
RESEARCH EQUIPMENT	€ 6,723,742.87
Research equipment	€ 6,723,742.87
SCIENTIFIC LITERATURE AND OSIC	€ 8,662,704.48
Slovenian popular science periodicals	€ 89,999.92
Slovenian science periodicals	€ 1,247,294.07
Scholarly monographs	€ 448,604.70
Foreign periodicals and databases	€ 6,595,074.79
OSIC – Central Specialised Information Centres	€ 281,731.00
TOTAL	€ 273,986,199.43

Overview of financing by year is available on the web page: <http://www.arrs.si/sl/finan/letpor/>



INTERNATIONAL COMPARISONS



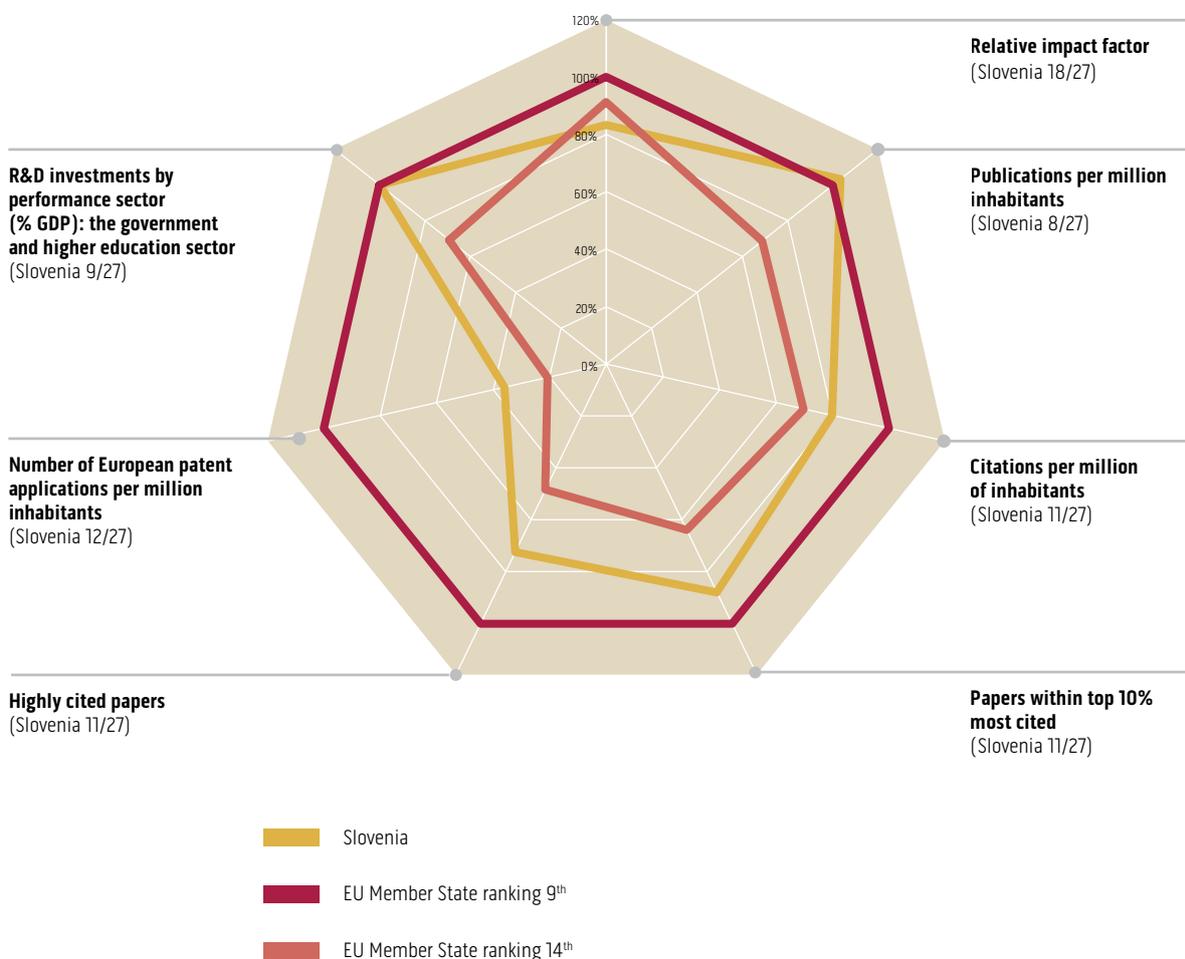


International comparisons

Overview

The chart shows the majority of standard bibliometric and other quantitative indicators that are used globally to monitor research activity, and some of them are also included in the new Resolution on the Slovenian Scientific Research and Innovation Strategy 2030. The values for Slovenia are shown relative to the ninth EU country (the top third of countries). The data for the 14th EU country (top half of countries) is given for comparison.

Each indicator is provided with the position of Slovenia among the 27 EU Member States. Slovenia is ranked in the top third of countries in terms of publications per million inhabitants and in terms of investments in research and development. Other indicators, according to which Slovenia is ranked in the top half of EU Member States, indicate that Slovenian scientific and research activity is successful.

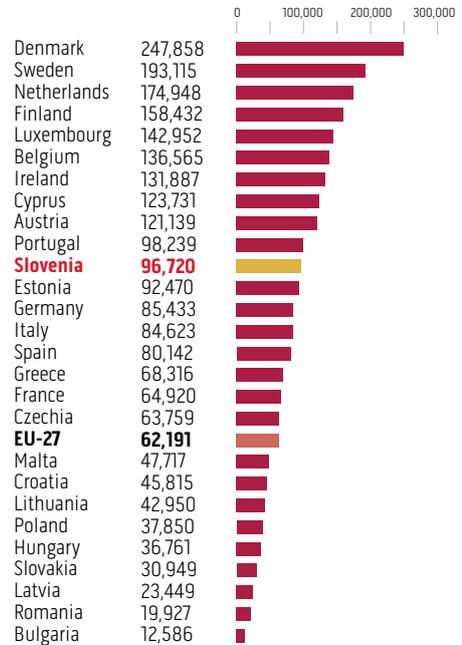


Source: InCites, Thomson Reuters/Science Metrix/Innovation Union Scoreboard/Eurostat | April 2023

Citations

In terms of citations per million inhabitants, Slovenia ranks 11th in the 2018–2022 period, which is above the EU average. In the observation period, Denmark had the most citations per million inhabitants, followed by Sweden, the Netherlands and Finland.

NUMBER OF CITATIONS PER MILLION INHABITANTS OF EU MEMBER STATES IN THE 2018–2022 PERIOD

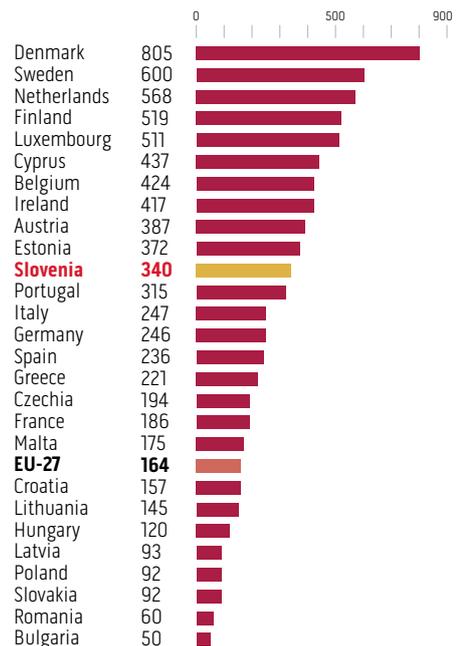


Source: InCites, WoS, April 2023

The top 10% most cited publications

An established bibliometric indicator for international comparisons is the number of published works that rank among the 10% most cited works in the world for a given field of research. This encompasses works published in journals indexed in the Scopus bibliographical database. A four-year citation period is taken into account, including the year of publication and three subsequent years. Since 2004, Slovenia has exceeded the EU average in terms of the 10% most cited published works per million inhabitants. According to the most recent data for 2019 Slovenia ranks 11th among EU member states.

THE NUMBER OF PUBLISHED WORKS RANKING AMONG THE 10% MOST CITED WORKS PER MILLION INHABITANTS FOR 2019 FOR THE EU MEMBER STATES



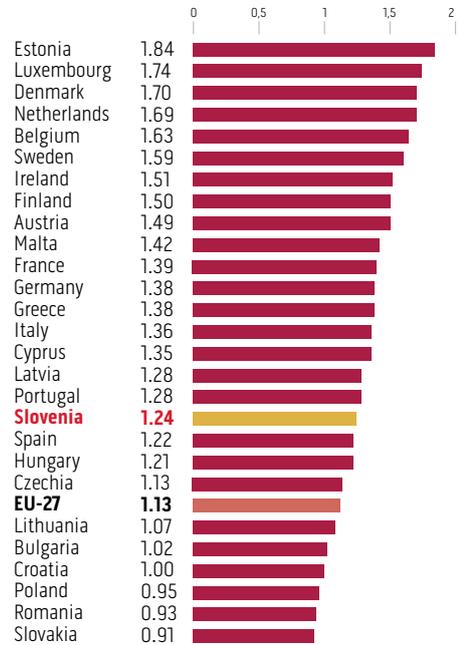
Source: SciVal, April 2023

Relative impact factor

The relative impact factor is the standard international bibliometric indicator measuring the ratio between the number of received citations and the number of published works in a given country compared to the global average impact factor for an individual field of research. In terms of the relative impact factor, Slovenia ranks 18th among EU member states.

The value of the relative impact factor for Slovenia in the 2018–2022 period is 1.24, which is somewhat higher than in the previous year (1.23). In 2022, Slovenia was also ranked above the European average (1.13).

RELATIVE IMPACT FACTOR FOR EU MEMBER STATES IN THE 2018-2022 PERIOD

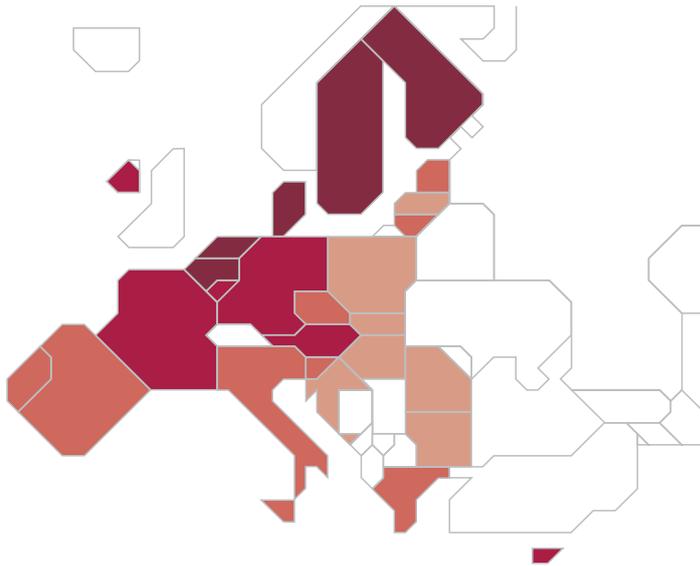


Source: InCites, WoS, April 2023

Innovation index

The joint innovation index (Innovation Union Scoreboard) provides an overview of the innovation activities of individual countries. It is comprised of 32 indicators that include data on the educational structure, openness and excellence of the research system, financing, support and investment, connections, entrepreneurship and intellectual capital.

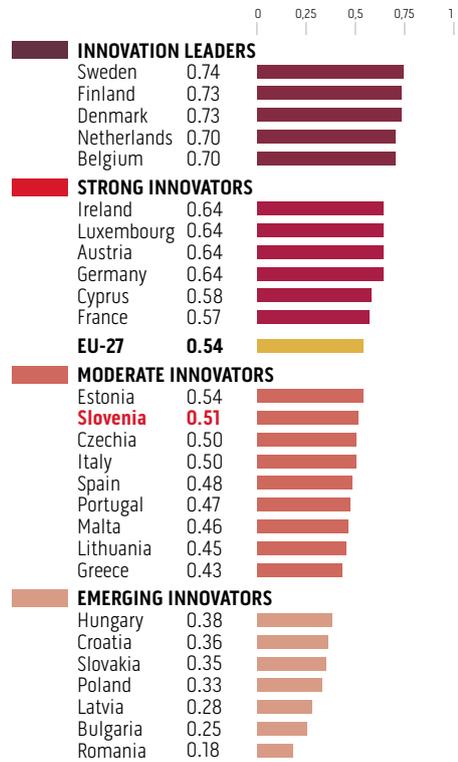
In terms of the level of innovativeness, the countries are divided into four groups: the first group being innovation leaders, the second being strong innovators, the third being moderate innovators, and the fourth being emerging innovators. Given the listed indicators, in 2022 Slovenia ranked in the group of countries that fall under moderate innovators.



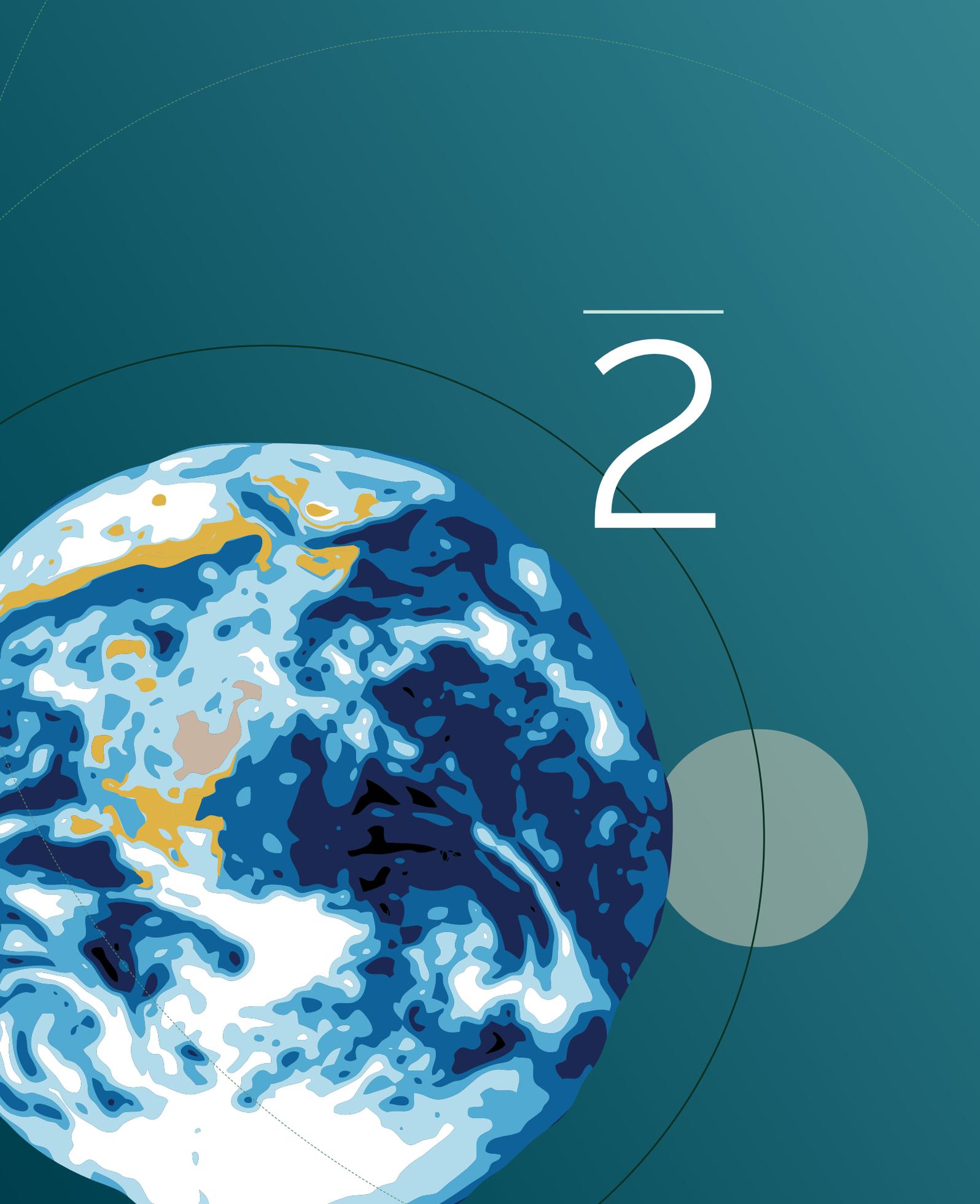
International comparisons and other analyses are available at: www.arrs.si/sl/analize/



JOINT INNOVATION INDEX FOR EU MEMBER STATES IN 2022



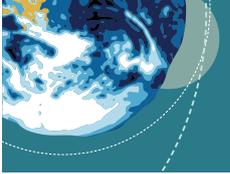
Source: European and Regional Innovation Scoreboards, April 2023



EXCELLENT
IN SCIENCE
2022

Excellent in science is a project carried out by the ARRS as part of the agency's endeavours to promote science. The project presents a selection of the most prominent achievements from the past year.

In 2022, some of the selected achievements were presented at the national event titled ARRS Day 2022: Supporting Excellence held on 1 and 2 December 2022 in Ljubljana. The selection of achievements was proposed by members of Scientific Research Councils for each scientific discipline and was confirmed by the agency's Scientific Council.



Minimal surfaces from a complex analytic viewpoint

AUTHORS

Dr. Franc Forstnerič, Dr. Antonio Alarcón and Dr. Francisco J. López

CONTACT

DR. FRANC FORSTNERIČ,
FACULTY OF MATHEMATICS AND PHYSICS,
UNIVERSITY OF LJUBLJANA,
FRANC.FORSTNERIC@FMF.UNI-LJ.SI

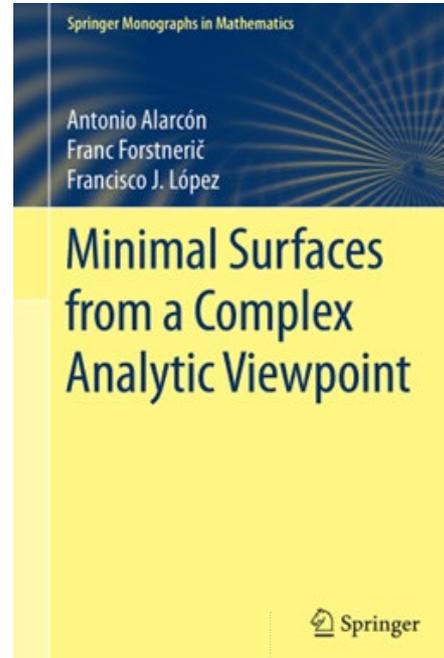
DOI

[10.1007/978-3-030-69056-4](https://doi.org/10.1007/978-3-030-69056-4)



The monograph contains the first comprehensive treatment of the theory of minimal surfaces in Euclidean spaces based on complex analytic methods. After the first two introductory chapters, the main focus is on recent results, many of which resulted from the collaboration between the authors of the monograph and their co-workers during the last decade. Among the major novelties, we mention the development of the approximation and interpolation theory for minimal surfaces, including those with finite total Gaussian curvature, treatment of the homotopy structure of the space of all minimal surfaces parameterized by a given open Riemann surface, the recent construction of minimal surfaces with a given Gauss map, solution of the classical Calabi-Yau problem concerning the existence of complete bounded minimal surfaces with Jordan boundaries of a given conformal type, and the introduction and development of minimally convex hulls of compact subsets in Euclidean spaces. An important novelty is the development of the Riemann-Hilbert boundary value problem for minimal surfaces which led to a major breakthrough on the Calabi-Yau problem.

Source: ALARCÓN, Antonio, FORSTNERIČ, Franc, LÓPEZ, Francisco J., *Minimal surfaces from a complex analytic viewpoint*, (Springer monographs in mathematics). Cham: Springer, cop. 2021. XIII, pp. 430, illustr. ISBN 978-3-030-69055-7. ISBN 978-3-030-69056-4.



Discovery of a spin liquid on the triangular spin lattice with dominant Ising exchange interaction

AUTHORS

Dr. Tina Arh, Biprojit Sana, Dr. Matej Pregelj, Dr. Panchanan Khuntia, Dr. Zvonko Jagličić, Dr. Manh Duc Le, Dr. Pabitra Kumar Biswas, Dr. Pascal Manuel, Dr. Lucile Mangin-Thro, Dr. Andrew Ozarowski and Dr. Andrej Zorko

CONTACT

DR. ANDREJ ZORKO,
JOŽEF STEFAN INSTITUTE,
ANDREJ.ZORKO@IJS.SI

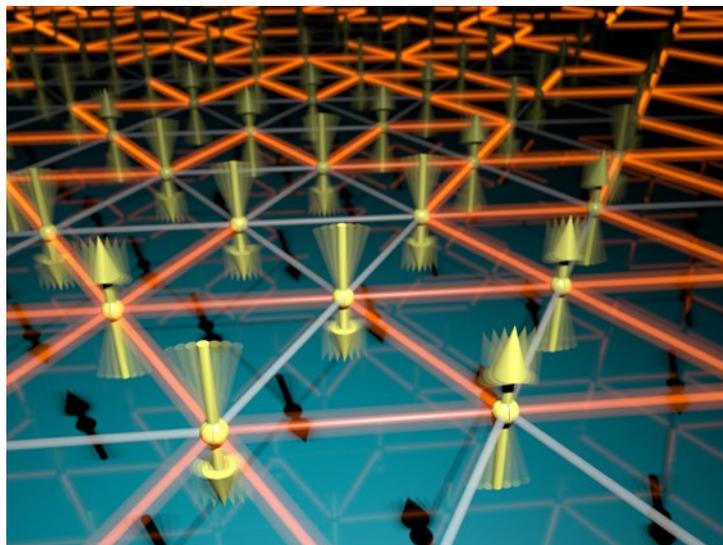
DOI

[10.1038/S41563-021-01169-Y](https://doi.org/10.1038/S41563-021-01169-Y)



The work, published in the prestigious *Nature Materials* journal, reports the first case of a quantum spin liquid on a triangular spin lattice with a dominant Ising exchange interaction. Such a state remains magnetically disordered even at zero temperature, yet it is also strongly quantum entangled. This is important both from a fundamental point of view as a realization of a quantum state at the macroscopic level, as well as from the applications point of view, as quantum spin liquids are promising for quantum computing. Moreover, this is the first confirmation of Wannier's prediction of a spin liquid on the Ising triangular lattice dating back to 1950. The discovery was warmly accepted both at home and abroad, with numerous (at least 17) media reports. The PI and leading author of the publication, Prof. Dr. Andrej Zorko, was invited to write a popular article about the discovery for the Science section (*Znanost*) in the Delo newspaper. He was also awarded the prestigious *2022 Science Impact Award* by the Science and Technology Facilities Council, United Kingdom, and was invited as a speaker of the largest American physics conference APS March Meeting 2023, after winning the *Robert E. Marshak Lectureship Award*.

Source: ARH, Tina, PREGELJ, Matej, JAGLIČIĆ, Zvonko, ZORKO, Andrej, et al. The Ising triangular-lattice antiferromagnet neodymium heptatantalate as a quantum spin liquid candidate. *Nature Materials*. [Online ed.]. 2022, vol. 21, pp. 416-422. ISSN 1476-4660.



Spider webs as powerful biofilters

AUTHORS

Dr. Matjaž Gregorič, Dr. Denis Kutnjak, Dr. Katarina Bačnik, Dr. Cene Gostinčar, Dr. Anja Pecman, Dr. Maja Ravnikar and Dr. Matjaž Kuntner

CONTACT

MATJAŽ GREGORIČ,
RESEARCH CENTRE OF THE SLOVENIAN ACADEMY
OF SCIENCES AND ARTS,
MATJAZ.GREGORIC@ZRC.SAZU.SI

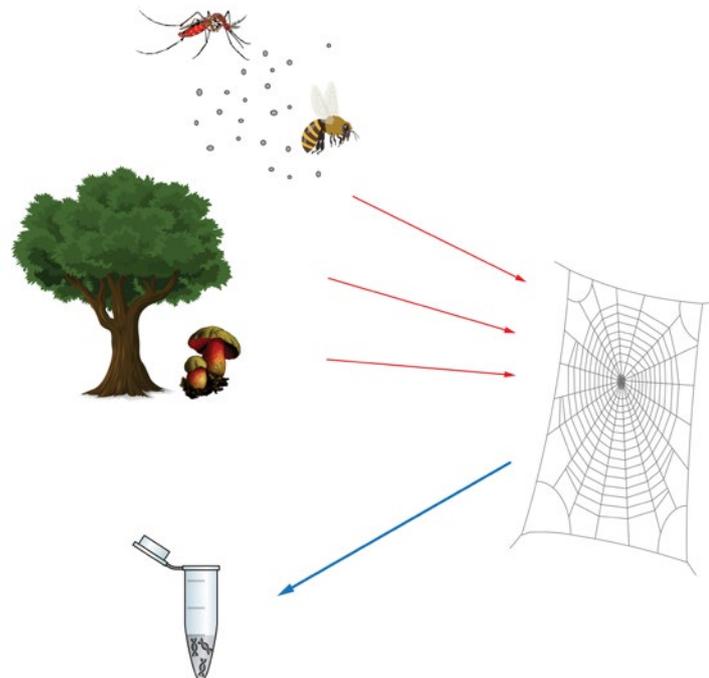
DOI

[10.1111/1755-0998.13629](https://doi.org/10.1111/1755-0998.13629)



Over the last few centuries, biodiversity has been declining at a rapid rate, threatening not only the loss of Earth's evolutionary history, but also the loss of valuable ecosystem services and human wellbeing. The application of biological data to relevant societal problems is largely limited by the numerous shortcomings of traditional monitoring and identification of biodiversity. Novel molecular approaches such as sampling of environmental DNA (eDNA), i.e. obtaining genetic material directly from environmental samples in the absence of biological source material, can potentially overcome the limitations of traditional methods. In this research, we investigated the potential of spider webs as natural filters of eDNA from the air. We show that genetic remains on spider webs allow the detection of even the smallest target organisms, e.g. agricultural pests or rare, endangered, and invasive species. Also, we demonstrate that eDNA from spider webs is useful in research of community compositions, with potentially highly detailed temporal and spatial information, which could facilitate future monitoring of entire groups, e.g. wild pollinators.

Source: GREGORIČ, Matjaž, KUTNJAK, Denis, BAČNIK, Katarina, GOSTINČAR, Cene, PECMAN, Anja, RAVNIKAR, Maja, KUNTNER, Matjaž. Spider webs as eDNA samplers: biodiversity assessment across the tree of life. *Molecular ecology resources*. 2022, pp. 1-12, illustr. ISSN 1755-098X.



Oxidative cleavage of C-C double bond with hydrogen peroxide for conversion of biomolecules (lignin, cinnamic acids) to useful compounds (vanillin)

AUTHORS

Dr. Monika Horvat Zagorec and
Dr. Jernej Iskra

CONTACT

DR. JERNEJ ISKRA, FACULTY OF CHEMISTRY AND
CHEMICAL TECHNOLOGY, UNIVERSITY OF LJUBLJANA,
JERNEJ.ISKRA@FKKT.UNI-LJ.SI

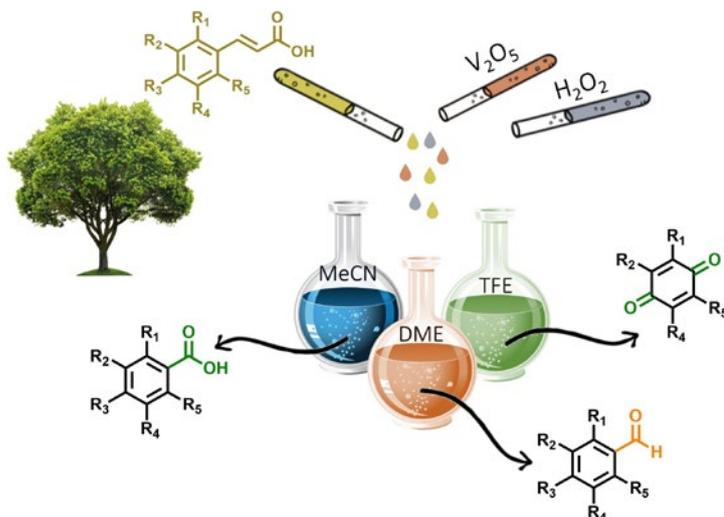
DOI

[10.1039/D1GC04416H](https://doi.org/10.1039/D1GC04416H)



Lignocellulosic biomass (LCB) is a renewable source of organic carbon and thus a natural source for the production of chemicals. Lignin is the least useful part of LCB and the only sustainable source of aromatic molecules in nature. Ferulic acid, which can be extracted from wheat straw, can be converted by oxidative cleavage into vanillin, which has a market value of 100 million euros and an annual demand of 20,000 MT. The method described in this paper allows the conversion of ferulic acid into vanillin with only H_2O_2 and the simple catalyst V_2O_5 . We also report on a study in which the green metrics of our method were compared with methods from the literature and a biotechnological process. It turned out that our method is much more suitable and environmentally friendly than those published so far. The method is also suitable for various cinnamic acid derivatives, styrene derivatives and lignin. The choice of a suitable solvent influences the selectivity of the reaction, and the oxidative cleavage of the double bond can lead to aromatic aldehydes, acids or quinones. The method allows the oxidative cleavage of a single C-C bond in lignin, whereby we have achieved a direct and selective conversion of lignin to vanillin. Lignin is a mixture of different aromatic units, but we have proven that with the right choice of wood (softwood) and solvent (DME) we can isolate vanillin with a yield comparable to an industrial process.

Source: HORVAT, Monika, ISKRA, Jernej. Oxidative cleavage of C–C double bond in cinnamic acids with hydrogen peroxide catalysed by vanadium(V) oxide. *Green chemistry*. 7 Mar. 2022, vol. 24, iss. 5, pp. 2073-2081, illustr. ISSN 1463-9262.



Control of rapid protein secretion from cells by chemically regulated split proteases

AUTHORS

Dr. Arne Praznik, Dr. Tina Fink, Nik Franko, Dr. Jan Lonžarić, Dr. Mojca Benčina, Nina Jerala, Dr. Tjaša Plaper, Samo Roškar and Dr. Roman Jerala

CONTACT

DR. ROMAN JERALA,
NATIONAL INSTITUTE OF CHEMISTRY,
ROMAN.JERALA@KI.SI

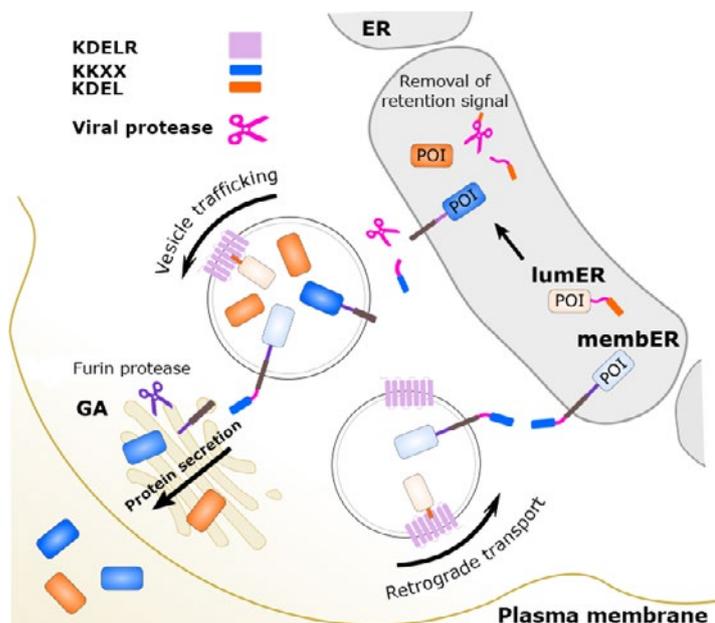
DOI

10.1038/S41467-022-28971-9



Synthetic systems for secreting proteins from mammalian cells mostly rely on regulating the expression of secreted proteins, which takes hours before the protein is formed and secreted from the cells, making such systems too slow for applications where the protein needs to be secreted in minutes instead of hours. Here, we developed two systems - memBER and lumER - in which secreted proteins are previously expressed and retained on the way to the cell membrane. Upon addition of the appropriate small molecule, chemically inducible proteases cleave off the retention signal from the selected protein, allowing its passage to the plasma membrane and secretion. Since the secreted proteins are already synthesized and retained in the endoplasmic reticulum, our systems are several hours faster than comparable systems based on the induction of expression of the secreted protein. We demonstrated the application of our systems to control the secretion of diverse therapeutic proteins in mammalian cells, such as anti-inflammatory cytokines and insulin, and to control the translocation of surface receptors used in cancer immunotherapy. As both systems are modular, they are suitable for use with different proteins.

Source: PRAZNIK, Arne, FINK, Tina, FRANKO, Nik, LONZARIĆ, Jan, BENČINA, Mojca, JERALA, Nina, PLAPER, Tjaša, ROŠKAR, Samo, JERALA, Roman. Regulation of protein secretion through chemical regulation of endoplasmic reticulum retention signal cleavage. *Nature communications*. 14 Mar. 2022, vol. 13, pp. 1-14, illustr. ISSN 2041-1723.



Attic dust: an archive of historical air contamination of the urban environment and potential hazard to health?

AUTHORS

Dr. Martin Gaberšek, Dr. Michael J. Watts and Dr. Mateja Gosar

CONTACT

DR. MARTIN GABERŠEK,
GEOLOGICAL SURVEY OF SLOVENIA,
MARTIN.GABERSEK@GEO-ZS.SI

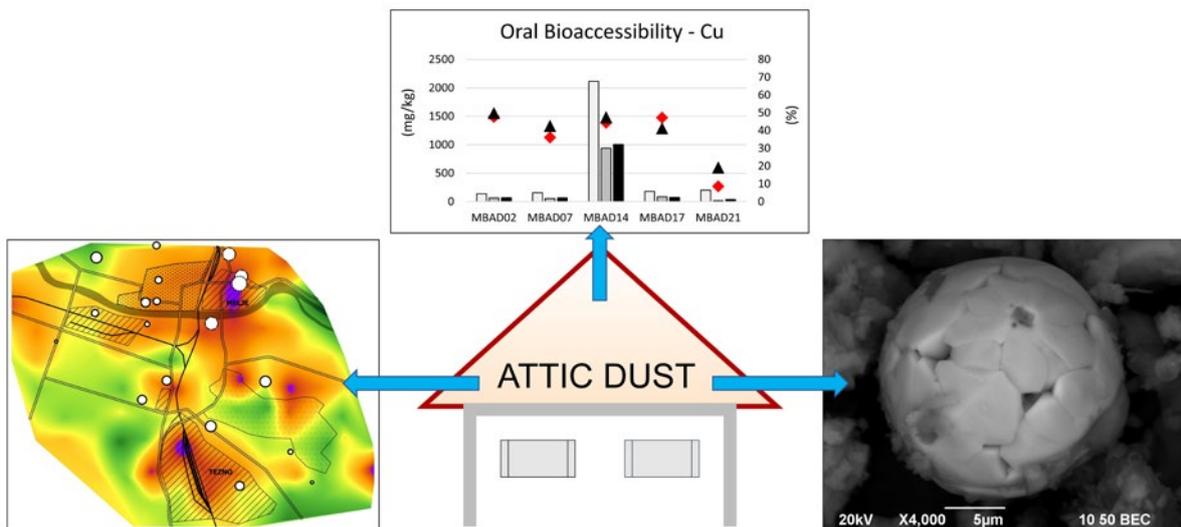
DOI

[10.1016/J.JHAZMAT.2022.128745](https://doi.org/10.1016/J.JHAZMAT.2022.128745)



Due to its properties, attic dust is an excellent medium for studying past pollution with particulate matter and potentially toxic elements (PTE) in the urban environment. Its possible negative effects on human health were not studied in the past. Using various analytical methods, we studied the entire "life cycle" of attic dust: from determining the historical sources of emissions of solid particles (dust), to the processes that take place in attics after the deposition of particles, and their behaviour in the human digestive tract in the case of ingestion (bioaccessibility of PTE). The identified properties of attic dust and the possibility of long-term human exposure indicate that this type of dust is not only a good archive of past pollution but may also pose a risk to human health. Such comprehensive researches of attic dust in urban settlements are rare, but important because they contribute to the understanding of past anthropogenic impact on the environment and identification of pollutant sources. They contribute to the understanding of cycling of solid particles with PTE over a longer period of time and to the identification of potential risks to human health.

Source: GABERŠEK, Martin, WATTS, Michael J., GOSAR, Mateja. Attic dust: an archive of historical air contamination of the urban environment and potential hazard to health?. *Journal of hazardous materials*. [Print ed.]. 2022, vol. 432, 14 pp. ISSN 0304-3894.



Primary trifluoroborate-iminiums facile access to chiral α -aminoboronic acids via Ru-catalyzed asymmetric hydrogenation and simple hydrolysis of trifluoroborate moiety

AUTHORS

Dr. Andrej Šterman, Dr. Izidor Sosič and Dr. Zdenko Časar

CONTACT

DR. ZDENKO ČASAR,
FACULTY OF PHARMACY, UNIVERSITY OF LJUBLJANA,
AND LEK PHARMACEUTICALS D.D.,
ZDENKO.CASAR@FFA.UNI-LJ.SI AND
ZDENKO.CASAR@SANDOZ.COM

DOI

10.1039/D1SC07065G



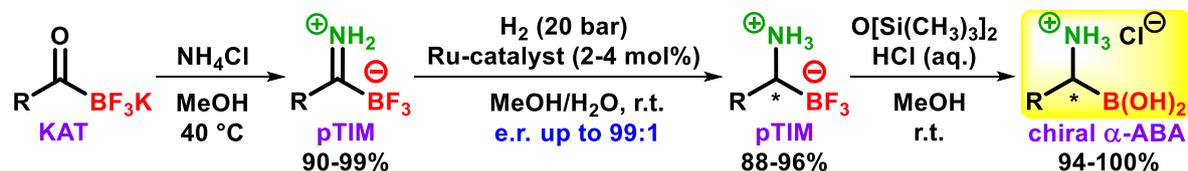
α -Aminoboronic acids have great potential in chemistry and medicine, as they are key building blocks of boron-containing drugs for cancer treatment, but access to them is challenging. This has limited the development of selective and effective anticancer agents of this class.

In the achievement, the authors describe the asymmetric synthesis of various α -aminoboronic acids from potassium acyltrifluoroborates using green solvents in only three synthetic steps. The authors first developed an efficient method for the preparation of primary trifluoroborate-iminiums (pTIM). In the second step, they developed an efficient method for the stereoselective hydrogenation of these compounds to trifluoroborate-ammoniums (pTAM) in excellent yields and with high enantioselectivity using a chiral ruthenium catalyst. In the last step, a new benign method for converting trifluoroborates into boronic acids was described.

The usefulness of the developed methodology was illustrated by the simplest synthesis of the anticancer agents bortezomib and ixazomib. The developed methodology enables access to selective proteasome inhibitors, which is important for the development of more advanced drugs.

Source: ŠTERMAN, Andrej, SOSIČ, Izidor, ČASAR, Zdenko. Primary trifluoroborate-iminiums enable facile access to chiral α -aminoboronic acids via ru-catalyzed asymmetric hydrogenation and simple hydrolysis of trifluoroborate moiety. *Chemical science*. 2022, vol. 13, issue. 10, pp. 2946-2953, illustr. ISSN 2041-6539.

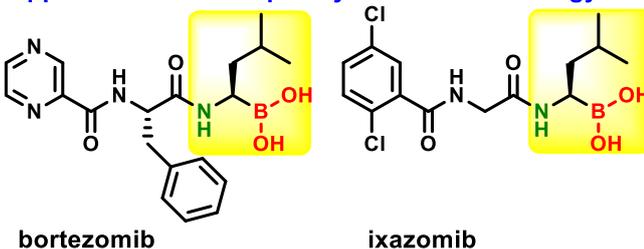
Potassium acyltrifluoroborates (KAT): starting reagents for the formation of chiral α -aminoboronic acids (α -ABA) and anti-cancer drugs



Key features of synthetic methodology:

- simple reactions in green solvents
- benign reagents
- no chromatographic purification
- easy access to peptides
- broad substrate scope
- excellent yields
- high enantioselectivity

Application of developed synthetic methodology:



The impact of temperature inversions on black carbon and particle mass concentrations in a mountainous area

AUTHORS

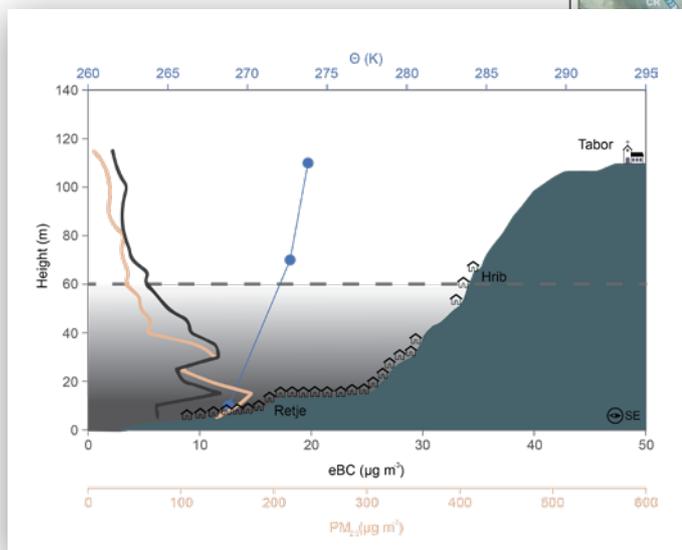
Dr. Kristina Glojek, Dr. Griša Močnik, Dr. Honey Dawn C. Alas, Andrea Cuesta-Mosquera, Dr. Luka Drinovec, Dr. Asta Gregorič, Dr. Matej Ogrin, Kay Weinhold, Dr. Irena Ježek, Dr. Thomas Müller, Dr. Martin Rigler, Dr. Maja Remškar, Dr. Dominik van Pinxteren, Dr. Hartmut Herrmann, Dr. Martina Ristorini, Maik Merkel, Miha Markelj and Dr. Alfred Wiedensohler

CONTACT

DR. KRISTINA GLOJEK,
CENTRE FOR ATMOSPHERIC RESEARCH,
UNIVERSITY OF NOVA GORICA,
KRISTINA.GLOJEK@UNG.SI

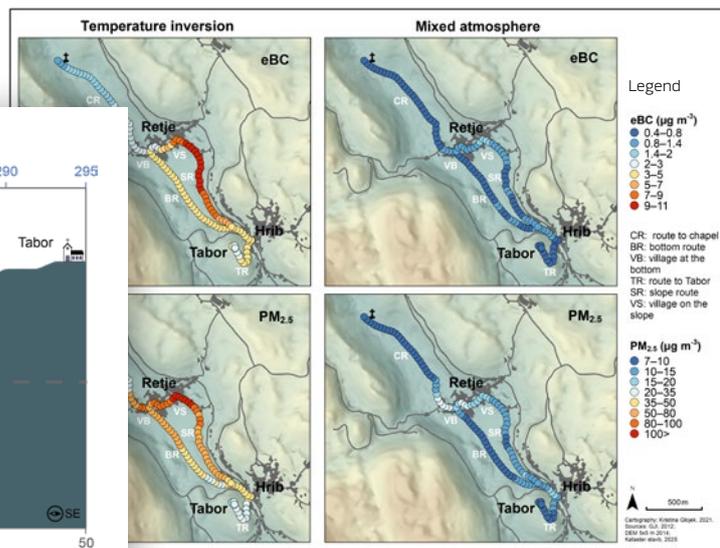
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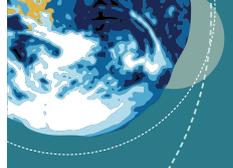
10.5194/ACP-22-5577-2022



Residential wood combustion is a widespread practice with a serious impact on air quality, especially in mountainous areas. However, little is known about the air pollution processes in rural shallow hollows. The studied karst hollow is representative of mountainous and hilly rural areas with residential wood combustion. Mobile and stationary air pollution sampling was performed in the winter of 2017/2018. The study showed that aerosol pollution events in the relief depression were associated with high local emission intensities originating almost entirely from residential wood burning and shallow temperature inversions. An association between temperature inversions and high eBC and PM concentrations was found. The latter suggests that even a small number of emission sources (total 243 households in the studied hollow) in similar hilly and mountainous rural areas with frequent temperature inversions can significantly deteriorate local air quality. During temperature inversions the measured mean eBC and PM_{2.5} mass concentrations in the whole hollow were as high as 4.5 m⁻³ and 48.0 μg m⁻³, respectively, which is comparable to larger European urban centres, whereas concentrations at the bottom of the hollow reached the levels of the most polluted areas (200 μg m⁻³ PM_{2.5}).

Source: GLOJEK, Kristina, MOČNIK, Griša, ALAS, Honey Dawn C., CUESTA-MOSQUERA, Andrea, DRINOVEC, Luka, GREGORIČ, Asta, OGRIN, Matej, WEINHOLD, Kay, JEŽEK, Irena, RIGLER, Martin, REMŠKAR, Maja, MARKELJ, Miha, et al. The impact of temperature inversions on black carbon and particle mass concentrations in a mountainous area. *Atmospheric chemistry and physics*. 2022, vol. 22, iss. 8, pp. 5577-5601, illustr. ISSN 1680-7316.





Reaction path analysis of CO₂ reduction to methanol through multisite microkinetic modelling over Cu/ZnO/Al₂O₃ catalysts

AUTHORS

Dr. Anže Prašnikar, Dr. Damjan Lašič Jurkovič and Dr. Blaž Likozar

CONTACTS

DR. ANŽE PRAŠNIKAR,
DEPARTMENT OF CATALYSIS AND CHEMICAL
REACTION ENGINEERING-D13,
NATIONAL INSTITUTE OF CHEMISTRY,
ANZE.PRASNIKAR@KI.SI

DR. BLAŽ LIKOZAR,
DEPARTMENT OF CATALYSIS AND CHEMICAL REAC-
TION ENGINEERING-D13, NATIONAL INSTITUTE OF
CHEMISTRY,
BLAZ.LIKOZAR@KI.SI

DOI

[10.1016/J.APCATB.2021.120190](https://doi.org/10.1016/J.APCATB.2021.120190)

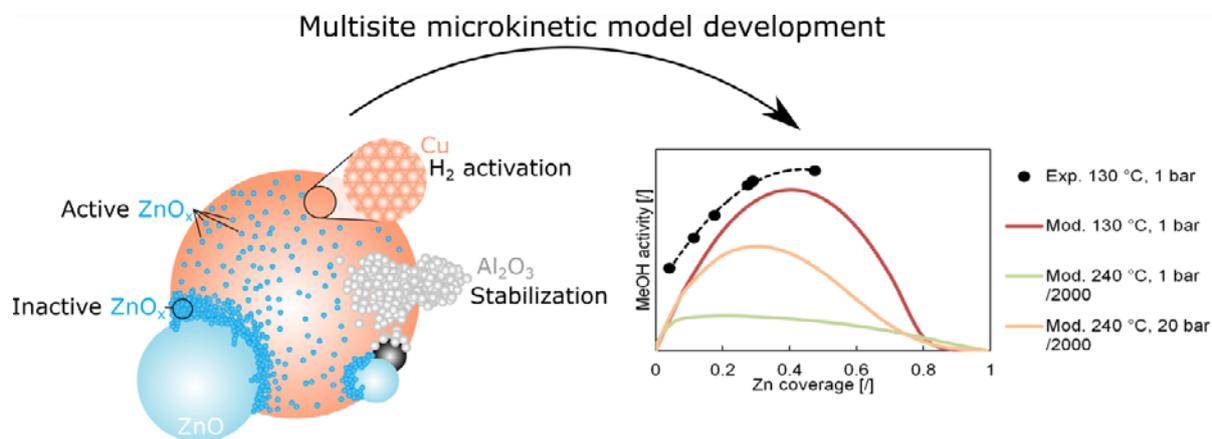


The performance of the industrial catalyst for methanol synthesis (Cu/ZnO/Al₂O₃) is very difficult to determine precisely due to its variable and complex structure. Determination of the mechanism and active site of the reaction was performed by a combination of comprehensive catalyst characterization, catalytic testing, and microkinetic modelling. As an industrial catalyst is processed in different gas mixtures, the structure and composition of the catalyst surface changes, affecting the final activity. From this we deduced that the most important parameters are the exposed surface of the copper nanoparticles and their coverage with zinc. Zinc can form an alloy with copper and pass into the interior of the nanoparticle under reductive conditions and back to the surface of the particle under oxidizing conditions. Over time, the zinc in the form of oxide forms a layer that covers the copper, reducing its activity. We have combined these facts to create a microkinetic model based on quantum chemical calculations that includes two types of active sites: Cu-Cu sites for hydrogen activation and Zn-Cu sites for adsorption of carbon dioxide on methanol. This is the first study to establish a quantitative relationship between the catalyst structure and its catalytic activity.

The research was carried out as part of a PhD thesis on a project involving the National Institute of Chemistry and partners from Iceland (CRI) that operates the first factory for the synthesis of methanol from CO₂, which also made our work industrially relevant through cooperation.

The research is a continuation of the study on industrial catalyst deactivation mechanisms (Prašnikar, Pavličič, et al. *Ind. Eng. Chem Res.*, 2019), where a critical difference between the synthesis of methanol from fossil fuels and from CO₂ was precisely determined, namely the formation of water vapour during CO₂ conversion which causes catalyst deactivation. These findings contributed to the development of more stable catalysts.

Source: PRAŠNIKAR, Anže, LAŠIČ JURKOVIČ, Damjan, LIKOZAR, Blaž. Reaction path analysis of CO₂ reduction to methanol through multisite microkinetic modelling over Cu/ZnO/Al₂O₃ catalysts. *Applied catalysis. B, Environmental*. [Print ed.], 5 Sep. 2021, vol. 292, [article no.] 120190, pp. 1-10.



Rare-earth recycling needs market intervention

AUTHORS

Dr. Koen Binnemans, Dr. Paul J. McGuinness and Dr. Peter Tom Jones

CONTACT

DR. PAUL J. MCGUINNESS,
INSTITUTE OF METALS AND TECHNOLOGY,
PAUL.MCGUINNESS@IMT.SI

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[10.1038/S41578-021-00308-W](https://doi.org/10.1038/S41578-021-00308-W)



With millions of new electric vehicles, urban scooters and electric bicycles on the road, and increased electricity production by direct-drive wind turbines, the availability of rare earths (REEs) is a serious concern. This commentary examines the status of the primary production and recycling of key REEs for Nd–Fe–B permanent magnets (neodymium, praseodymium, dysprosium and terbium) and discusses whether market intervention is needed to initiate REEs recycling.

Given the growing demand for Nd–Fe–B-based permanent magnets for power generation and mobility, and the challenges associated with primary mining – especially for places like Japan or Europe where there are no active REE mines – the challenge of providing access to rare earths, the possibilities of urban mining and recycling of devices containing rare earths should be seriously considered. When a REE embedded device reaches its end of life (EoL), REE recycling can be considered as two separate recycling methods.

The first method is direct magnet-to-magnet recycling. Nd–Fe–B permanent magnets have been manufactured since the mid-1980s. These magnets are in disk drives, motors, generators, MRI scanners and many other untraceable devices. Separating these magnets at their EoL is probably the most active area of recycling now. Another, “chemical” route is to take REE-based alloys or components and recycle them back into individual rare earths using pyrometallurgical and hydrometallurgical processes. Such indirect recycling gives us the greatest flexibility, as the rare earths from the recycled Nd–Fe–B magnet could be reused, for example, in laser crystals, luminescent materials, nuclear reactor control rods or in new Nd–Fe–B magnets.

Predicting the future is risky. However, demand for rare earths is sure to grow rapidly as the electric-vehicle revolution continues and direct-drive wind turbines are installed along our coasts. The almost inevitable result will be an increase in prices, but the question is, will this be enough to encourage the economics of recycling? In any case, from the point of view of the best use of resources, it seems pointless to have millions of tons of valuable materials in landfills, as well as the loss of materials in suboptimal recycling processes, which mainly focus on the extraction of platinum group metals and not REE.

Source: BINNEMANS, Koen, MCGUINNESS, Paul J., JONES, Peter Tom. Rare-earth recycling needs market intervention. *Nature reviews. Materials*. 2021, 3 pp. ISSN 2058-8437.



Dependence of the wear resistance of additive-manufactured maraging steel on the build direction and heat treatment

AUTHORS

Dr. Bojan Podgornik, Mario Šinko and Dr. Matjaž Godec

CONTACT

DR. BOJAN PODGORNİK,
INSTITUTE OF METALS AND TECHNOLOGY,
BOJAN.PODGORNİK@IMT.SI

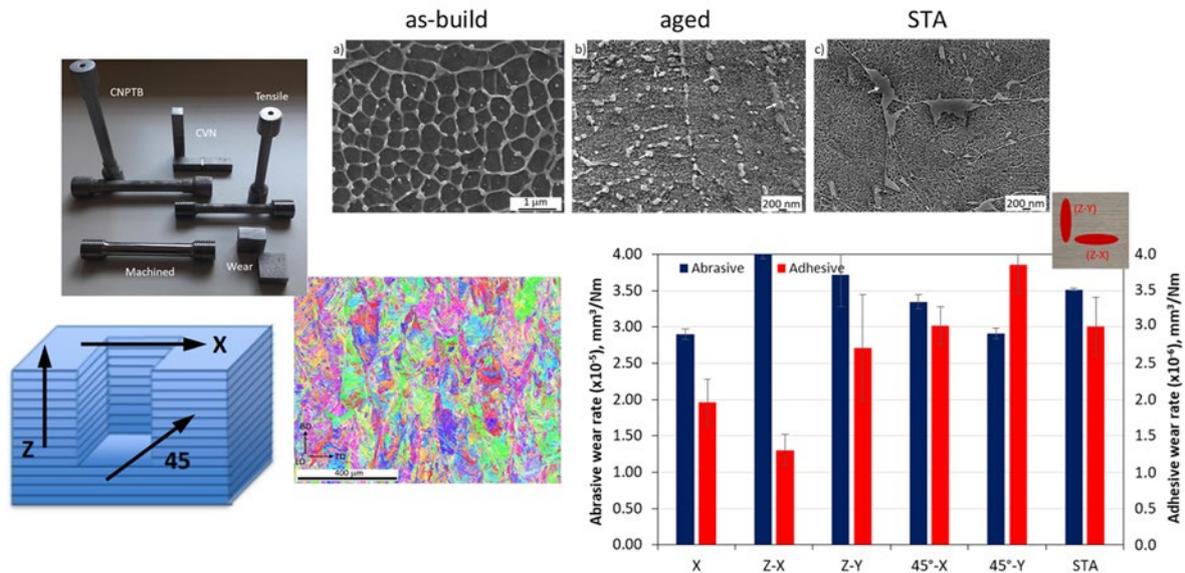
DOI

10.1016/J.ADDMA.2021.102123



Additive manufacturing of metallic materials is becoming very common, with the development of microstructure and properties being known to be influenced by laser power, energy density, scanning speed and strategy. However, the influence of the direction of building/printing as well as additional heat treatment require further investigations and research. The achievement is thus focused on the investigation of the printing direction influence of the direction of printing and heat treatment on the development of the microstructure and the related mechanical and anti-wear properties of maraging steel produced by selective laser remelting. The results show that although maraging steel with a very fine microstructure, being free of defects and orientation, can be produced by additive manufacturing, the building direction plays an important role. The horizontal printing direction gives greater strength and elastic properties, better resistance to crack initiation and breaking, and superior resistance to abrasive wear. However, it can be up to 20% worse when it comes to resistance to crack propagation. In addition to better resistance to crack propagation, the vertical direction also provides good resistance to adhesive wear, but only if sliding takes place along the layers. Additional heat treatment homogenizes the microstructure and eliminates its anisotropy, but causes a drop in properties.

Source: PODGORNİK, Bojan, ŠINKO, Mario, GODEC, Matjaž. Dependence of the wear resistance of additive-manufactured maraging steel on the build direction and heat treatment. *Additive manufacturing*. [Web version.]. Oct. 2021, vol. 46, pp. 1-10, illustr. ISSN 2214-7810.



Mixed supervision for surface-defect detection

AUTHORS

Jakob Božič, Dr. Domen Tabernik and Dr. Danijel Skočaj

CONTACT

DR. DANIJEL SKOČAJ,
FACULTY OF COMPUTER AND INFORMATION SCIENCE,
UNIVERSITY OF LJUBLJANA,
DANIJEL.SKOCAJ@FRI.UNI-LJ.SI

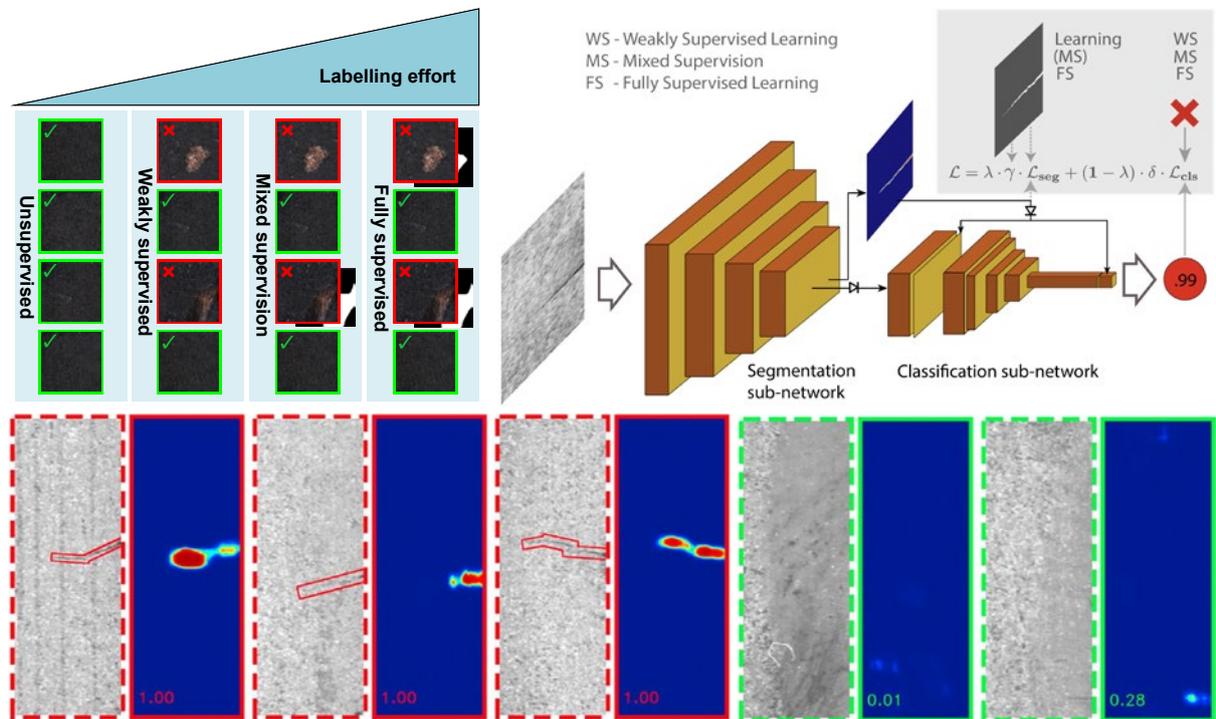
DOI

10.1016/J.COMPIND.2021.103459



In the context of the Industry 4.0 paradigm, procedures for visual inspection of product surfaces in production processes are becoming ever more important, as they ensure high product quality. Our proposed approach enhances these processes by allowing faster and more efficient adaptation of production systems to new products. We achieved this by shifting the paradigm of solving this particular problem; rather than being based on explicit programming of individual specific solutions, our approach is data driven and based on deep learning. It builds a decision model directly by using images of products without and with defects, which are annotated either at the level of individual pixels or only at the level of images. Based on the developed end-to-end deep convolutional neural network architecture, the model learns to efficiently predict whether a given input image of a product surface contains a defect. We evaluated the approach on real samples from the industrial environment. The obtained results are better than the results of comparable approaches and indicate a great potential for practical use. The developed procedure is very flexible and general; it can be applied for detection of various defects on different surfaces.

Source: BOŽIČ, Jakob, TABERNIK, Domen, SKOČAJ, Danijel. Mixed supervision for surface-defect detection: from weakly to fully supervised learning. *Computers in industry*. Aug. 2021, vol. 129. ISSN 0166-3615.



D3S – a deep learning method for tracking by segmentation

AUTHORS

Dr. Alan Lukežič, Dr. Jiří Matas and Dr. Matej Kristan

CONTACT

DR. MATEJ KRISTAN,
FACULTY OF COMPUTER AND INFORMATION SCIENCE,
UNIVERSITY OF LJUBLJANA,
MATEJ.KRISTAN@FRI.UNI-LJ.SI

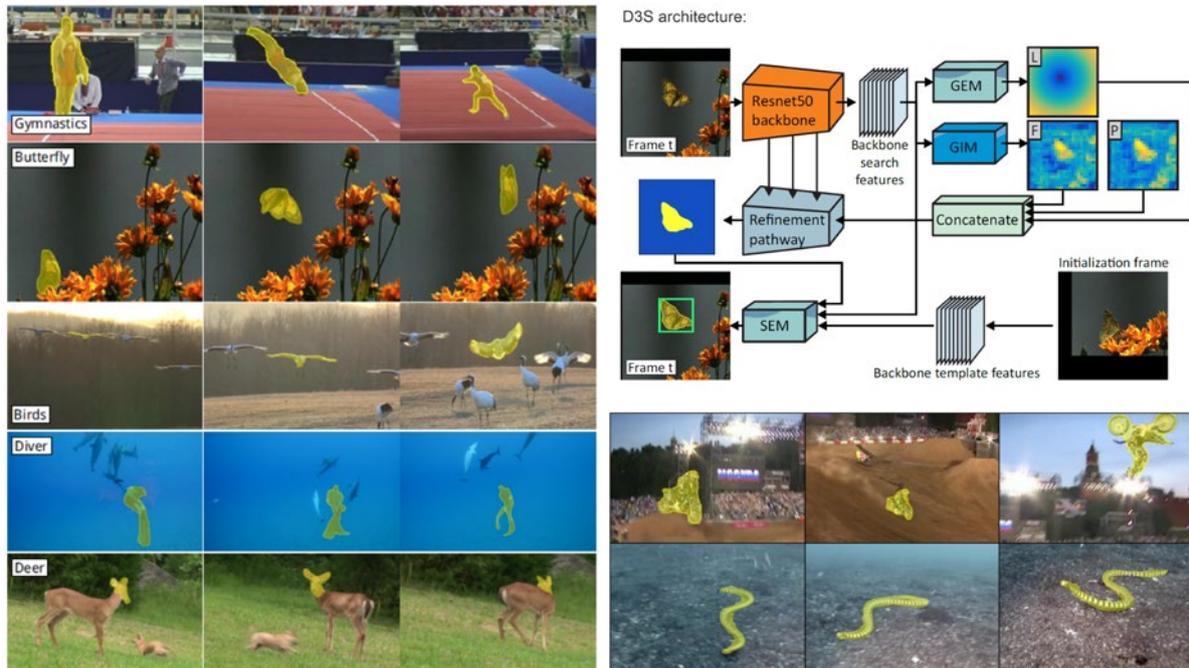
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10.1109/TPAMI.2021.3137933



We propose a new family of deep models for tracking general objects in video. The main challenge lies in the requirement to localize the target in all video frames given only a single annotated example of the target in the first frame. The tracker thus has to learn and robustly adapt to the object's change of appearance even if the object substantially deforms. Classical methods localize the object by only a bounding box, while D3S enables simultaneous localization and robust segmentation. A preliminary version was published at the premier computer vision conference CVPR2020, followed by the extended version in IEEE TPAMI 2021, which with IF>24 is at the very top of the most prestigious computer science journals, and the first in the field of computer vision and artificial intelligence. Together, the two publications were well cited (over 180 times), which testifies to the high profile of the research. The fact that many of the best trackers of the international challenge in visual tracking VOT2021 were based on the ideas presented in D3S further confirms the impact of D3S.

Source: LUKEŽIČ, Alan, MATAS, Jiří, KRISTAN, Matej. A discriminative single-shot segmentation network for visual object tracking. *IEEE Transactions on Pattern Analysis and Machine Intelligence*. Dec. 2022, vol. 44, no. 12, pp. 9742-9755, illustr. ISSN 0162-8828.



Electric-bus routes in hilly urban areas: overview and challenges

AUTHORS

Dr. Gregor Papa, Dr. Marina Santo Zarnik and Dr. Vida Vukašinović

CONTACT

DR. GREGOR PAPA,
JOŽEF STEFAN INSTITUTE,
GREGOR.PAPA@IJS.SI

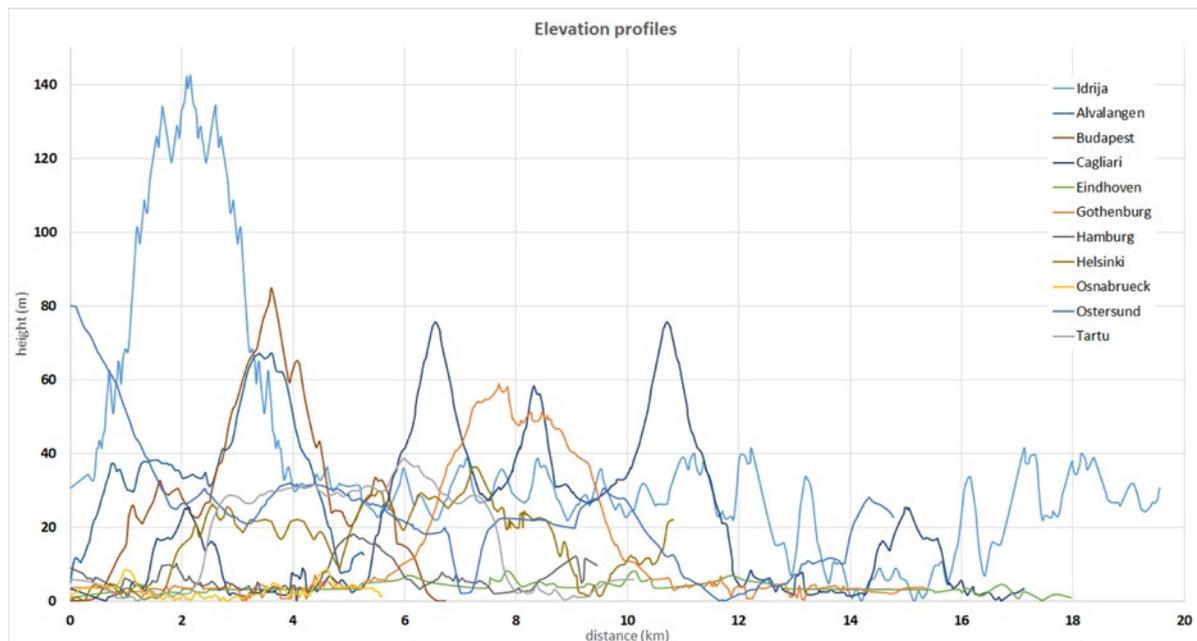
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[10.1016/J.RSER.2022.112555](https://doi.org/10.1016/j.rser.2022.112555)



The electrification of public transport in cities is expanding and fully electric buses (EB) offer a great opportunity due to their high energy efficiency. We present modern technologies related to electric buses, looking in more detail at the impact of route topography and climate on battery performance. A brief overview of the EB routes in Europe is included, which reveals a lack of very demanding benchmark routes, where new technologies can be tested from the perspective of seamless driving in difficult conditions. The EA test routes set up in many cities allow testing in different (easy) driving conditions, but there remains a need for benchmark routes located in challenging environments. We suggest a new, demanding, hilly benchmark route, which provides adequate conditions for the technical assessment of the electrification of urban traffic in a geographically specific area with particularly demanding driving conditions and includes all the essential characteristics of urban routes.

Source: PAPA, Gregor, SANTO-ZARNIK, Marina, VUKAŠINOVIĆ, Vida. Electric-bus routes in hilly urban areas: overview and challenges. *Renewable & sustainable energy reviews: an international journal*. [Print ed.]. 2022, vol. 165, pp. 112555-1-112555-19. ISSN 1364-0321.



Plasmonic surfaces for the recognition of mycotoxins

AUTHORS

Dr. Neelakandan Marath Santhosh, Dr. Vasyi Shvalya, Dr. Martina Modic, Dr. Nataša Hojnik, Dr. Janez Zavašnik, Jaka Olenik, Martin Košiček, Dr. Gregor Filipič, Dr. Ibrahim Abdulhalim and Dr. Uroš Cvelbar

CONTACTS

DR. VASYL SHVALYA,
JOŽEF STEFAN INSTITUTE,
VASYL.SHVALYA@IJS.SI

DR. UROŠ CVELBAR,
JOŽEF STEFAN INSTITUTE,
UROS.CVELBAR@IJS.SI

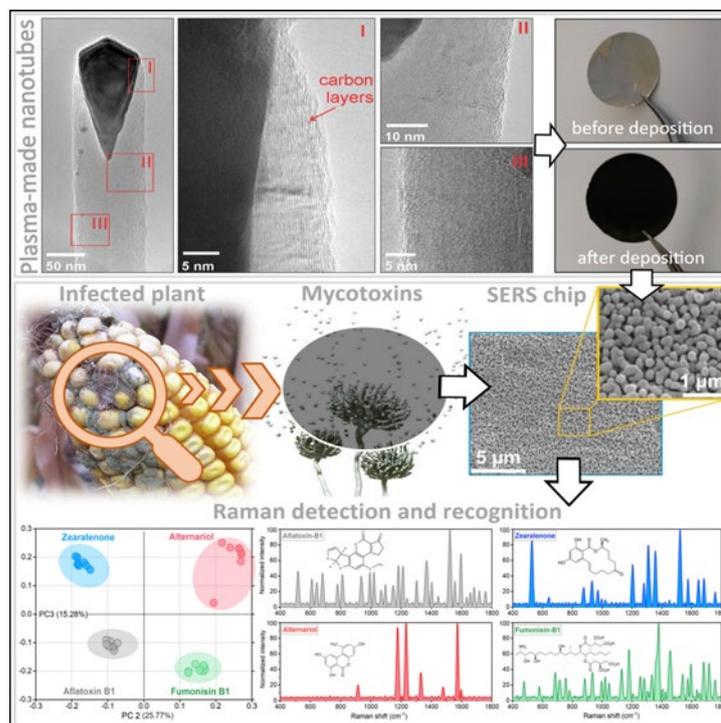
DOI

[10.1002/SMLL.202103677](https://doi.org/10.1002/SMLL.202103677)



Mycotoxins are natural toxins that are secondary metabolites of moulds and are widely spread in both agriculture and the food industry. Some mycotoxins can cause cancer, immune deficiency and other diseases even in very small amounts. Their presence must be confirmed by mass spectroscopy or other complex methods such as enzyme-linked immunosorbent assays (ELISA), gas or liquid chromatography in approved laboratories. As part of this achievement, we have developed a new detection platform based on plasmonic structures that can detect even extremely small amounts of mycotoxins, is affordable and environmentally friendly as it uses carbon nanostructures. The plasmonic surface enables the rapid detection of very low concentrations (ppb) of toxins and amplifies the spectral signals of Raman spectroscopy up to 5×10^7 . In addition, the enabled signal surface analysis identifies and categorises the most important spectral features of the different toxins. Since Raman spectroscopy is portable and our system is based on enhanced surfaces, we can take samples directly at the point of collection. This is a key element for the possibility of broad application in the future.

Source: SANTHOSH, Neelakandan Marath, SHVALYA, Vasyi, MODIC, Martina, HOJNIK, Nataša, ZAVAŠNIK, Janez, OLENIK, Jaka, KOŠIČEK, Martin, FILIPIČ, Gregor, ABDULHALIM, Ibrahim, CVELBAR, Uroš. Label-free mycotoxin Raman identification by high-performing plasmonic vertical carbon nanostructures. *Small*, ISSN 1613-6829, 2021, vol. 17, iss. 49, pp. 2103677-1-2103677-11, illustr.



Research on innovative machining processes for achieving sustainable and clean processes in production

AUTHORS

Saša Tešić, Dr. Djordje Cica, Dr. Stevo Borojević, Dr. Branislav Sredanović, Dr. Milan Zeljković, Dr. Davorin Kramar, Dr. Franci Pušavec, Dr. Luka Sterle, Dr. Peter Krajnik, Vasja Roblek, Dr. Maja Meško and Dr. Borut Likar

CONTACTS

DR. FRANCI PUŠAVEC,
FACULTY OF MECHANICAL ENGINEERING, UNIVERSITY
OF LJUBLJANA,
FRANCI.PUSAVEC@FS.UNI-LJ.SI

DR. BORUT LIKAR, FACULTY OF MANAGEMENT,
UNIVERSITY OF PRIMORSKA,
BORUT.LIKAR@FM-KP.SI

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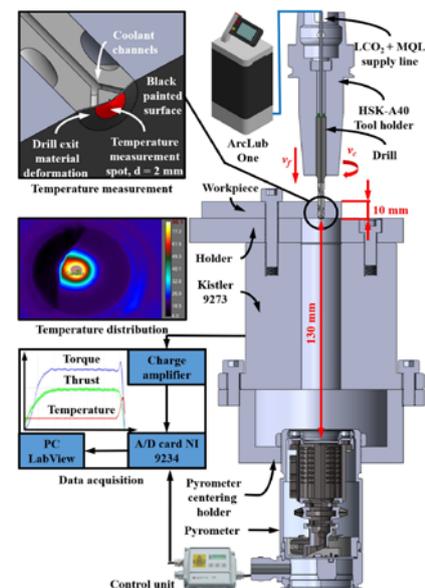
The research “The role and meaning of the digital transformation as a disruptive innovation on small and medium manufacturing enterprises” addresses important findings on the impact of digital transformation and how disruptive innovations influence organisational change. It also illustrates the critical drivers of innovation in organisations and the three main groups of disruptive innovations and their impact on future smart factory development, namely the following: technological changes, the emergence of innovative products, business models and solutions, and organisational culture as one of the crucial key success factors.

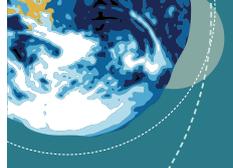
The other two contributions of the research show the practical aspect of successfully raising the innovation to the industrial level. It concerns the substitution of problematic oil emulsions with liquid CO₂, which leaves the processed surface clean and dry. In addition, the group was the first to successfully upgrade this system with non-oil-based dry lubricants (hard lubricants). With this, we have developed the first system capable of individually adjusting the lubrication and cooling effect. The solution represents an outstanding achievement in the field. This is confirmed by publications, as well as recently started collaborations with global companies in this field ADRIA MOBIL, SECO/SANDVIK, GF+, OPEN MIND, VESTAPLINE and HSTEC.

Source 1: TEŠIĆ, Saša, CICA, Djordje, BOROJEVIĆ, Stevo, SREDANOVIĆ, Branislav, ZELJKOVIĆ, Milan, KRAMAR, Davorin, PUŠAVEC, Franci. Optimization and prediction of specific energy consumption in ball-end milling of Ti-6Al-4V alloy under mql and cryogenic cooling/lubrication conditions. *International journal of precision engineering and manufacturing. Green engineering*. Nov. 2022, iss. 9, pp. 1427–1437, illustr. ISSN 2198-0810.

Source 2: STERLE, Luka, KRAJNIK, Peter, PUŠAVEC, Franci. The effects of liquid-CO₂ cooling, MQL and cutting parameters on drilling performance. *CIRP annals*. 2021, vol. 70, iss. 1, pp. 79-82, illustr. ISSN 0007-8506.

Source 3: ROBLEK, Vasja, MEŠKO, Maja, PUŠAVEC, Franci, LIKAR, Borut. The role and meaning of the digital transformation as a disruptive innovation on small and medium manufacturing enterprises. *Frontiers in psychology*. 2021, vol. 12, art. 592528, pp. 1-18, illustr. ISSN 1664-1078.





Risk factors for cold-induced anaphylaxis: results of the COLD-CE study

AUTHOR

Dr. Mojca Bizjak

CONTACT

DR. MOJCA BIZJAK,
UNIVERSITY CLINIC GOLNIK,
MOJCABIZJAK@KLINIKA-GOLNIK.SI

DOI

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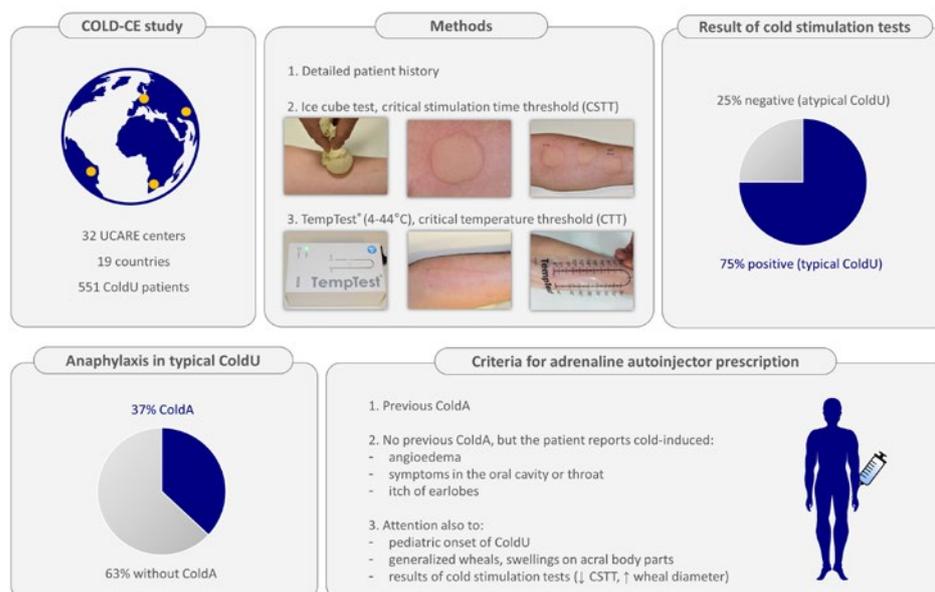
[10.1111/ALL.15274](https://doi.org/10.1111/ALL.15274)



Cold urticaria can manifest with anaphylaxis, which has been poorly researched. An adrenaline autoinjector should be carried by patients at risk for cold-induced anaphylaxis, but it has been undefined which patients require it. COLD-CE (i.e. Cold urticaria and other cold induced reactions – comprehensive evaluation) was an international, cross-sectional study, which included the largest number of cold urticaria patients so far. It was carried out at 32 GA²LEN UCAREs (i.e. Urticaria Centers of Reference and Excellence). Detailed history data was taken and testing with an ice cube and TempTest® device (4-44°C gradient) performed. Tests were positive in 75% of patients and anaphylaxis occurred in 37% of them. Less than 10% of anaphylaxis patients had received adrenaline. We identified clinical risk factors for cold-induced anaphylaxis, which is defined as acute cold-induced involvement of the skin or visible mucosal tissue and cardiovascular, respiratory, or gastrointestinal manifestations. We believe our study results will contribute to improved clinical care of cold urticaria patients worldwide.

Source 1: BIZJAK, Mojca (author, corresponding author), KOŠNIK, Mitja, DINEVSKI, Dejan, THOMSEN, Simon Francis, FOMINA, Daria, BORZOVA, Elena, KULTHANAN, Kanokvalai, MESHKOVA, Raisa, AHSAN, Dalia Melina, AL-AHMAD, Mona, MILJKOVIĆ, Jovan, TERHORST, Dorothea, MAURER, Marcus (author, corresponding author), et al. Risk factors for systemic reactions in typical cold urticaria: results from the COLD-CE study. *Allergy*. [Online ed.]. Jul. 2022, vol. 77, iss. 7, pp. 2185-2199, illustr. ISSN 1398-9995.

Source 2: BIZJAK, Mojca (author, corresponding author), KOŠNIK, Mitja, DINEVSKI, Dejan, THOMSEN, Simon Francis, FOMINA, Daria, BORZOVA, Elena, KULTHANAN, Kanokvalai, MESHKOVA, Raisa, AARESTRUP, Fernando Monteiro, AHSAN, Dalia Melina, TERHORST, Dorothea, MAURER, Marcus (author, corresponding author), et al. Adrenaline autoinjector is underprescribed in typical cold urticaria patients. *Allergy*. [Online ed.]. Jul. 2022, vol. 77, iss. 7, pp. 2224-2229, tables. ISSN 1398-9995.



ColdA, cold-induced anaphylaxis; ColdU, cold urticaria; UCARE, GA²LEN urticaria centers of reference and excellence, <https://ga2len-ucare.com>

Oxidative stress boosts gasdermin D pore-forming activity and pyroptosis

AUTHORS

Dr. Charles L. Evavold, Dr. Iva Hafner Bratkovič, Pascal Devant, Jasmin M. D'Andrea, Elsy M. Ngwa, Elvira Boršič, Dr. John G. Doench, Martin W. Lafleur, Dr. Arlene H. Sharpe, Dr. Jay R. Thiagarajah and Dr. Jonathan Kagan

CONTACT

DR. IVA HAFNER BRATKOVIČ,
NATIONAL INSTITUTE OF CHEMISTRY,
IVA.HAFNER@KI.SI

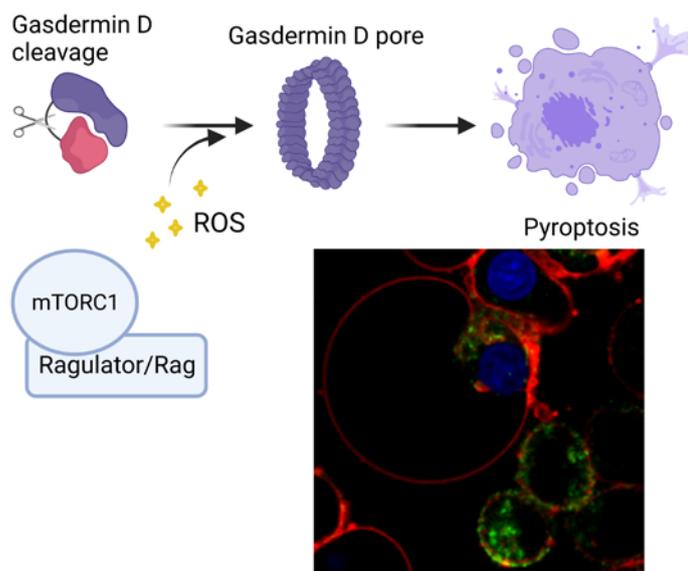
DOI

[10.1016/J.CELL.2021.06.028](https://doi.org/10.1016/J.CELL.2021.06.028)



Innate immunity is crucial for a prompt response to infection and injury, however, chronic inflammation importantly contributes to the pathophysiology of common non-communicable diseases such as neurodegenerative diseases, type 2 diabetes, and cardiovascular diseases. A necrotic cell death, pyroptosis, plays an important role in driving inflammation. Gasdermin D is dormant in the cytosol until cleavage enables the release of the N-terminal domain of gasdermin D that forms membrane pores leading to pyroptosis. It was unknown whether it is possible to regulate pore formation and pyroptosis after gasdermin D cleavage has occurred. The study used a forward genome-wide genetic screen that identified the Ragulator-Rag complex as necessary for gasdermin D pore formation. Mechanistic analysis revealed that the Ragulator-Rag/mTORC1 axis stimulates reactive oxygen species production which enhances pore formation downstream of gasdermin D cleavage. These results reveal new options for the suppression of pyroptosis and novel interventional strategies for inflammatory diseases.

Source: EVAVOLD, Charles L., HAFNER BRATKOVIČ, Iva, DEVANT, Pascal, D'ANDREA, Jasmin M., NGWA, Elsy M., BORŠIČ, Elvira, DOENCH, John G., LAFLEUR, Martin W., SHARPE, Arlene H., THIAGARAJAH, Jay R., KAGAN, Jonathan C. Control of gasdermin D oligomerization and pyroptosis by the Ragulator-Rag-mTORC1 pathway. *Cell*. 19 Aug. 2021, vol. 184, iss. 17, pp. 4495-4511, illustr. ISSN 0092-8674.



Interactome screening of C9orf72 dipeptide repeats reveals VCP sequestration and functional impairment by polyGA

AUTHORS

Dr. Janja Božič, Dr. Helena Motaln, Dr. Anja Pucer Janež, Lara Markič, Priyanka Tripathi, Alfred Yamoah, Dr. Eleonora Aronica, Dr. Youn-Bok Lee, Raphael Heilig, Dr. Roman Fischer, Dr. Andrew J. Thompson, Dr. Anand Goswami and Dr. Boris Rogelj

CONTACT

DR. BORIS ROGELJ,
DEPARTMENT OF BIOTECHNOLOGY B3,
JOŽEF STEFAN INSTITUTE,
BORIS.ROGELJ@IJS.SI

DOI

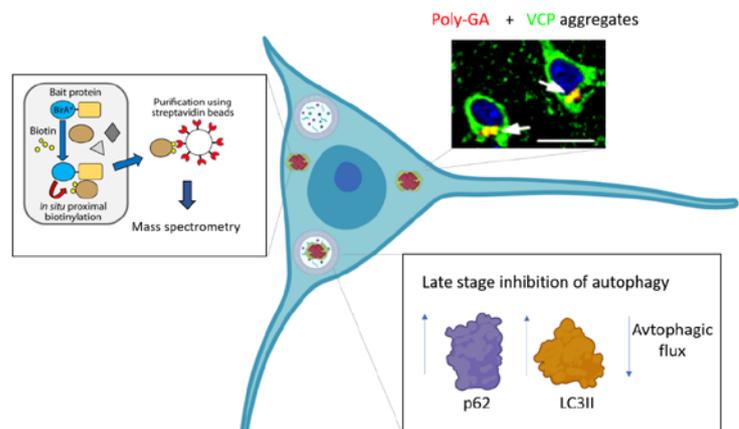
[10.1093/BRAIN/AWAB300](https://doi.org/10.1093/BRAIN/AWAB300)



Neuronal cell death is a phenomenon that leads to the development of dementia and age-related neurological movement disorders. From a molecular pathology perspective, abnormal accumulation of certain proteins occurs in the brains of patients. The TDP-43 protein accumulates in frontotemporal dementia (FTD) and amyotrophic lateral sclerosis (ALS), as well as in Alzheimer's disease (AD). In ALS and FTD, the most commonly mutated gene, C9ORF72, is the major genetic cause of cytoplasmic accumulation of TDP-43 in neurons. Mutation in the C9ORF72 gene allows transcription of toxic RNAs and synthesis of poly-dipeptides, the effects of which on disease are not yet clear. Using screening methods such as proximity biotinylation, mass spectrometry, and bioinformatics, our group has identified proteins that associate with toxic poly-dipeptides (GA, GR, PR, PA, GP) in living cells. Our achievement is the identification, validation and functional confirmation of the protein-protein interaction between poly-GA dipeptides and the VCP protein in neurons, which plays a key role in removing excess proteins from the cell in the process of autophagy. Since TDP-43 is also involved in this interaction, we are continuing our research to regulate this interaction to reduce the toxicity of the C9ORF72 mutation and enable neuron survival.

Source: BOŽIČ, Janja, MOTALN, Helena, PUCER JANEŽ, Anja, MARKIČ, Lara, ROGELJ, Boris, et al. Interactome screening of C9orf72 dipeptide repeats reveals VCP sequestration and functional impairment by polyGA. *Brain: journal of neurology*. 2022, vol. 145, no. 2, pp. 684–699, illustr. ISSN 0006-8950.

Interactome screening of C9orf72 dipeptide repeats reveals VCP sequestration and functional impairment by polyGA



Contaminants of emerging concern - How can we control them with algae?

AUTHORS

Dr. Tjaša Griessler Bulc, Dr. Gianluigi Buttiglieri, Dr. Ester Heath, Dr. David John Heath, Dr. Darja Istenič, Dr. Ana Kovačič, Dr. Justyna Piechocka, Dr. Franja Prosenč and Dr. David Škufca

CONTACT

DR. TJAŠA GRIESSLER BULC,
FACULTY OF HEALTH SCIENCES,
UNIVERSITY OF LJUBLJANA,
TJASA.BULC@ZF.UNI-LJ.SI

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[10.1016/J.JHAZMAT.2021.126284](https://doi.org/10.1016/J.JHAZMAT.2021.126284)



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[10.1016/J.SCITOTENV.2021.146949](https://doi.org/10.1016/J.SCITOTENV.2021.146949)



Algal technologies are nature-based solutions for wastewater treatment that remove various pollutants and produce water for irrigation and biomass as fertilizer for agriculture, which can be important in times of resource scarcity. Contaminants of emerging concern in wastewater, such as pharmaceuticals, pesticides, and plasticizers, limit the safe reuse of water and algae biomass. They often have negative consequences for health and the environment, such as toxicity and hormonal disruption in humans and other organisms in the environment. In the research, we developed an analytical method for determining contaminants of emerging concern in water and algal biomass, which helped to understand their removal mechanisms in algae-based wastewater treatment systems. We achieved almost complete removal from wastewater at the laboratory level for most of the 28 contaminants of emerging concern. Their removal was also confirmed in a pilot-scale algal pond, where we achieved up to 92% removal efficiency. The research was presented in four related publications in excellent journals. The achievement contributes to our understanding of mechanisms in biological systems and health as well as environmental risk management when recovering resources for agriculture.

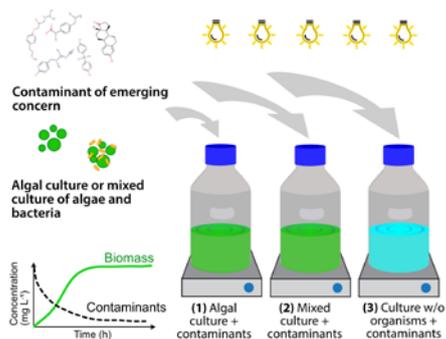
Source 1: ŠKUFCA, David, PROSENC, Franja, GRIESSLER BULC, Tjaša, HEATH, Ester. Removal and fate of 18 bisphenols in lab-scale algal bioreactors. *Science of the total environment*. Jan. 2022, vol. 804, pp. 149878-1-149878-9. ISSN 0048 9697.

Source 2: ŠKUFCA, David, KOVAČIČ, Ana, GRIESSLER BULC, Tjaša, HEATH, Ester. Determination of 18 bisphenols in aqueous and biomass phase of high rate algal ponds: development, validation and application. *Chemosphere*. [Print ed.]. May 2021, vol. 271, pp. 129786-1-129786-8, illustr. ISSN 0045-6535.

Source 3: PROSENC, Franja, PIECHOCKA, Justyna, ŠKUFCA, David, HEATH, Ester, GRIESSLER BULC, Tjaša, ISTENIČ, Darja, BUTTIGLIERI, Gianluigi. Microalgae-based removal of contaminants of emerging concern: mechanisms in *Chlorella vulgaris* and mixed algal-bacterial cultures. *Journal of hazardous materials*. [Print ed.]. 2021, vol. 418, pp. 126284-1-126284-11. ISSN 0304-3894.

Source 4: ŠKUFCA, David, KOVAČIČ, Ana, PROSENC, Franja, GRIESSLER BULC, Tjaša, HEATH, David John, HEATH, Ester. Phycoremediation of municipal wastewater: removal of nutrients and contaminants of emerging concern. *Science of the total environment*. Aug. 2021, vol. 782, pp. 1-6, illustr. ISSN 0048-9697.

LAB-SCALE STUDIES



PILOT-SCALE STUDIES



Natural killer cells selectively kill cancer stem cells and increase their sensitivity to chemotherapy in the brain tumor glioblastoma

AUTHORS

Dr. Barbara Breznik, Dr. Meng-Wei Ko, Christopher Tse, Po-Chun Chen, Emanuela Senjor, Bernarda Majc, Anamarija Habič, Nicolas Angelillis, Dr. Metka Novak, Dr. Vera Župunski, Jernej Mlakar, Dr. David Nathanson and Dr. Anahid Jewett

CONTACT

DR. BARBARA BREZNIK,
NATIONAL INSTITUTE OF BIOLOGY,
BARBARA.BREZNIK@NIB.SI

DOI

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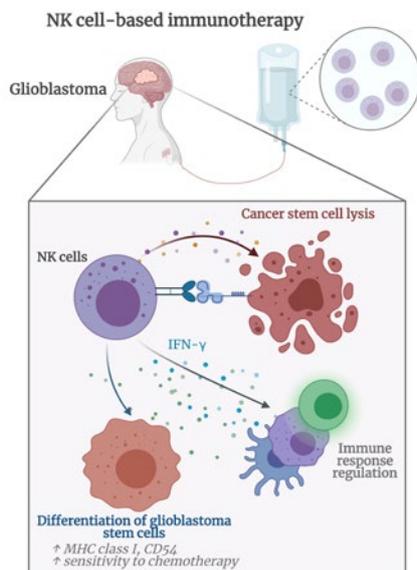
Glioblastoma remains the deadliest primary brain tumour. Immunotherapy with natural killer (NK) cells is a promising strategy in the treatment of this cancer, as NK cells destroy therapy-resistant glioblastoma stem cells.

We found that super-activated NK cells destroy glioblastoma stem cells in 2D and 3D tumour models *in vitro*. If glioblastoma stem cells were differentiated, the cytotoxicity of NK cells decreased, which was associated with altered expression levels of binding molecules for NK cell receptors. NK cells are not only cytotoxic cells, but also secrete the pro-inflammatory cytokine IFN- γ , increase the amount of CD54 immune molecules and major histocompatibility complex (MHC) class I on the surface of glioblastoma cells, and increase the sensitivity of glioblastoma stem cells to chemotherapy. Our results show that immunotherapy with super-activated NK cells could represent an effective and complementary treatment approach for glioblastoma, as the action of NK cells can reduce immunosuppression in patients and increase the effectiveness of standard treatment.

NK cells were detected in the perivascular regions of glioblastoma tissues of patients and were also in direct contact with glioblastoma stem cells in tumorspheres *in vitro*. This indicates their ability to infiltrate glioblastomas and selectively target glioblastoma stem cells.

However, known glioblastoma cell plasticity and heterogeneity is urging the research into designing a personalized approach that needs to be considered when applying NK immunotherapy in glioblastoma treatment.

Source: BREZNIK, Barbara, KO, Meng-Wei, TSE, Christopher, CHEN, Po-Chun, SENJOR, Emanuela, MAJC, Bernarda, HABIČ, Anamarija, ANGELILLIS, Nicolas, NOVAK, Metka, ŽUPUNSKI, Vera, MLAKAR, Jernej, NATHANSON, David, JEWETT, Anahid. Infiltrating natural killer cells bind, lyse and increase chemotherapy efficacy in glioblastoma stem-like tumorspheres. *Communications biology*. 2022, vol. 5, pp. 1-15, illustr. ISSN 2399-3642.



Evaluation of novel cathepsin X inhibitors *in vitro* and *in vivo* and their ability to improve cathepsin B-directed antitumor therapy

AUTHORS

Dr. Ana Mitrović, Dr. Janja Završnik, Dr. Georgy Mikhaylov, Dr. Damijan Knez, Dr. Urša Pečar Fonovič, Petra Matjan Štefin, Dr. Miha Butinar, Dr. Stanislav Gobec, Dr. Boris Turk and Dr. Janko Kos

CONTACT

DR. ANA MITROVIĆ,
JOŽEF STEFAN INSTITUTE,
ANA.MITROVIC@IJS.SI

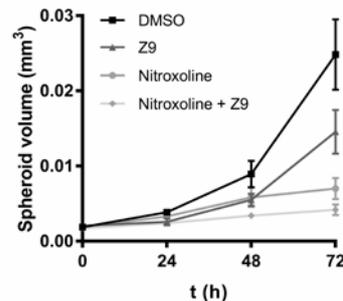
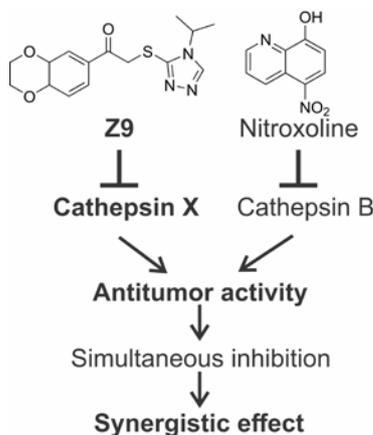
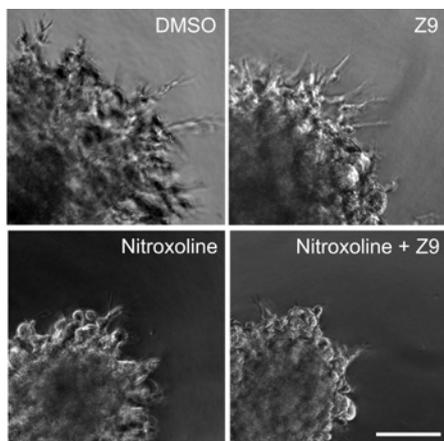
DOI

10.1007/S00018-021-04117-W



New therapeutic targets and new therapeutic approaches are key to improving anti-tumour therapy. Promising candidates are lysosomal cysteine cathepsins, proteolytical enzymes involved in various steps during cancer progression. Among them, cathepsin X, which acts solely as a carboxypeptidase, has received much attention. Our results indicate that the triazole-based selective reversible inhibitor of cathepsin X named Z9 significantly reduces tumour progression, both *in vitro* in cell-based functional assays and *in vivo* in two independent breast tumour mouse models. Among others cathepsin X contributes to cancer progression by compensation of cathepsin B activity loss. We confirmed that cathepsin B inhibition is compensated by an increase in cathepsin X activity and protein levels. The simultaneous inhibition of both cathepsins B and X with potent, selective, reversible inhibitors exerted a synergistic effect in impairing processes of tumour progression in *in vitro* cell-based assays of tumour cell migration and spheroid growth. Inhibitor Z9 impairs tumour progression both *in vitro* and *in vivo* and can be used in combination with other peptidase inhibitors as an innovative approach to overcome resistance to antipeptidase therapy.

Source: MITROVIĆ, Ana, ZAVRŠNIK, Janja, MIKHAYLOV, Georgy, KNEZ, Damijan, PEČAR FONOVIČ, Urša, MATJAN-ŠTEFIN, Petra, BUTINAR, Miha, GOBEC, Stanislav, TURK, Boris, KOS, Janko. Evaluation of novel cathepsin-X inhibitors *in vitro* and *in vivo* and their ability to improve cathepsin-B-directed antitumor therapy. *Cellular and molecular life sciences*. 2022, vol. 79, no. 1, pp. 34-1-34-14. ISSN 1420-682X.



Genetics of childhood obesity: heterozygous genetic variants in recessive genes of the leptin-melanocortin pathway

AUTHORS

Dr. Robert Šket, Dr. Primož Kotnik, Dr. Barbara Jenko Bizjan, Valentina Kocen, Dr. Matej Mlinarič, Dr. Tine Tesovnik, Dr. Maruša Debeljak, Dr. Tadej Battelino and Dr. Jernej Kovač

CONTACT

DR. JERNEJ KOVAČ,
CLINICAL INSTITUTE OF SPECIAL LABORATORY
DIAGNOSTICS, UNIVERSITY CHILDREN'S HOSPITAL,
UNIVERSITY MEDICAL CENTRE LJUBLJANA,
JERNEJ.KOVAC@KCLJ.SI

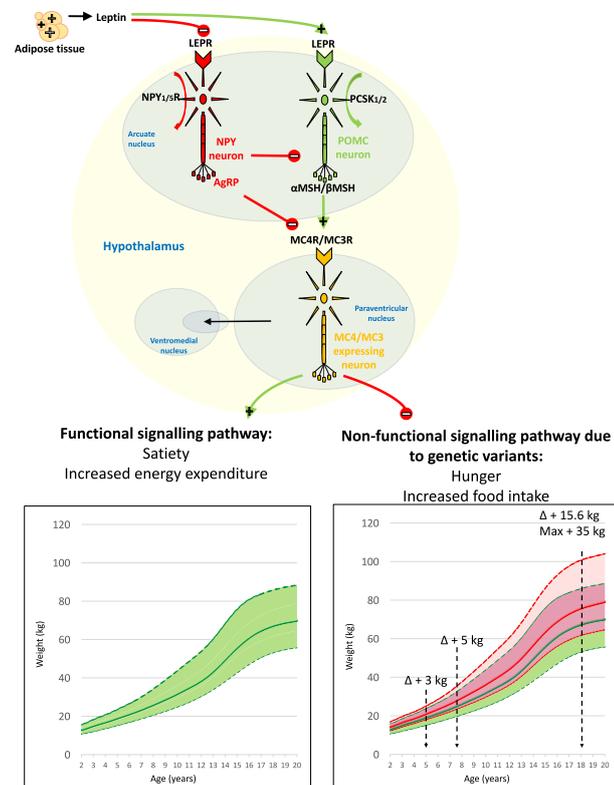
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Childhood overnutrition and obesity have a negative impact on quality of life. While genetic factors play a significant role in obesity development, accounting for 40-70% of the variation in BMI, monogenic obesity caused by a single gene variant is rare, occurring only in 1 out of 1000 new-borns. Identifying such variants in childhood is crucial for effective clinical intervention. Thus, we sequenced the central genes of the leptin-melanocortin pathway in the hypothalamus, which regulates appetite, in 5% of the Slovenian paediatric population with obesity (N=1508). We assessed the impact of genetic variants on weight gain and predicted weight gain trajectories in children with detected variants. The prevalence of variants is 1 in 150-850 children in the general population, higher than previously estimated. These variations result in an average weight gain of 7-15 kg by age 18, and up to 35 kg in extreme cases. Approximately 6% of children with obesity have a genetic predisposition to develop it, highlighting the importance of early identification of at-risk populations and innovative clinical approaches for obesity management and prevention in childhood.

Source: ŠKET, Robert, KOTNIK, Primož, JENKO BIZJAN, Barbara, KOČEN, Valentina, MLINARIČ, Matej, TESOVNIK, Tine, DEBELJAK, Maruša, BATTELINO, Tadej, KOVAČ, Jernej. Heterozygous genetic variants in autosomal recessive genes of the leptin-melanocortin signalling pathway are associated with the development of childhood obesity. *Frontiers in endocrinology*, ISSN 1664-2392, 2022, vol. 13, pp. 1-12.



Energy and nutritional composition of school lunches in Slovenia: the results of a chemical analysis in the framework of the national school meals survey

AUTHORS

Rok Poličnik and Dr. Jerneja Farkaš Lainščak

CONTACTS

ROK POLIČNIK,
NATIONAL INSTITUTE OF PUBLIC HEALTH,
ROK.POLICNIK@NIJZ.SI

DR. JERNEJA FARKAŠ LAINŠČAK,
NATIONAL INSTITUTE OF PUBLIC HEALTH AND
GENERAL HOSPITAL MURSKA SOBOTA, SLOVENIA,
JERNEJA.FARKAS@SB-MS.SI

DOI

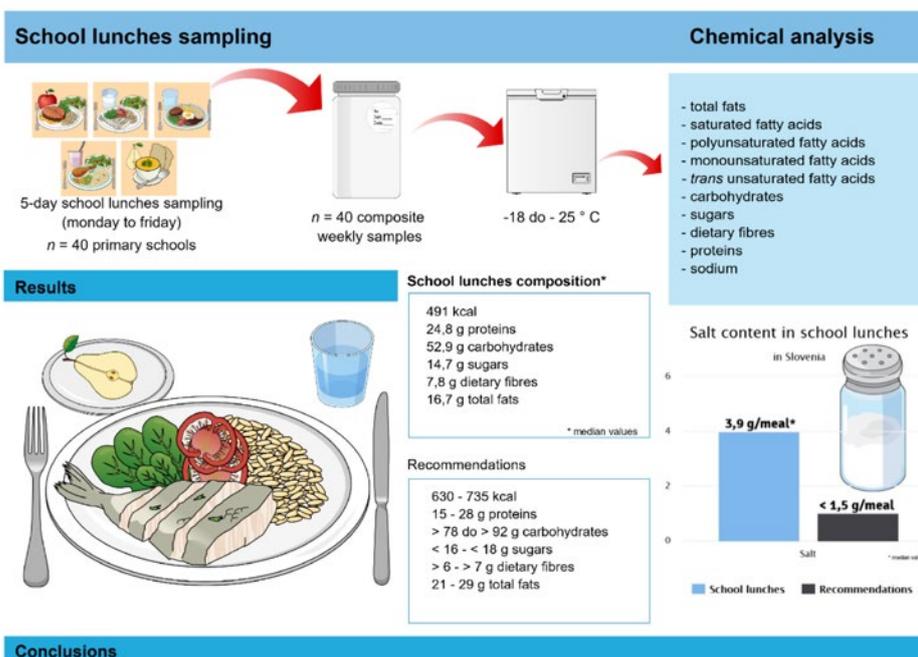
[10.3390/NU13124287](https://doi.org/10.3390/NU13124287)



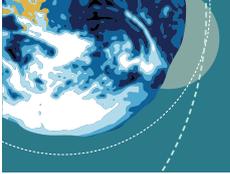
A study was conducted on the composition of school lunches in Slovenia, which took place from January to September 2020 in primary schools across the country ($n = 40$). Sampling of school lunches was performed in schools. The chemical analysis of a 5-day sample of school lunches (40 composite weekly samples; 200 school lunches) intended for adolescents aged 10 to 13 years was carried out in a national reference laboratory. The results of the analysis were compared with national dietary guidelines. The study results show that school lunches have a lower average energy value compared to recommendations. Lower values were also found for carbohydrates and total fats. Exceeded values were found for salt, saturated and polyunsaturated fatty acids. The contents of protein, dietary fibres, and sugars were in line with the recommendations.

The findings of our study indicate the need for prompt public health measures to implement national dietary guidelines in educational institutions, provide training for school staff, and educate and raise awareness among children and parents about the long-term harmful effects of excessive salt intake.

Source: POLIČNIK, Rok, ROSTOHAR, Katja, ŠKRJANC, Barbara, KOROUŠIČ-SELJAK, Barbara, BLAZNIK, Urška, FARKAŠ-LAINŠČAK, Jerneja. Energy and nutritional composition of school lunches in Slovenia: the results of a chemical analysis in the framework of the national school meals survey. *Nutrients*. 2021, vol. 13, no.12, pp. 4287-1-4287-13. ISSN 2072-6643.



The study on the quality of school lunches showed a lower energy value than recommended, as well as lower values of carbohydrates and total fats in school lunches. Exceeded values were found for salt, saturated and polyunsaturated fatty acids. The content of proteins, dietary fiber, and sugars was in line with dietary guidelines.



Immunocastration in adult boars as a model for late-onset hypogonadism

AUTHORS

Dr. Nina Batorek Lukač, Dr. Kevin Kress, Dr. Marjeta Čandek-Potokar, Dr. Gregor Fazarinc, Dr. Martin Škrlep, Dr. Klavdija Poklukar Žnidaršič, Dr. Raffael Wesoly, Dr. Volker Stefanski and Dr. Milka Vrecl

CONTACT

DR. NINA BATOREK LUKAČ,
AGRICULTURAL INSTITUTE OF SLOVENIA,
NINA.BATOREK@KIS.SI

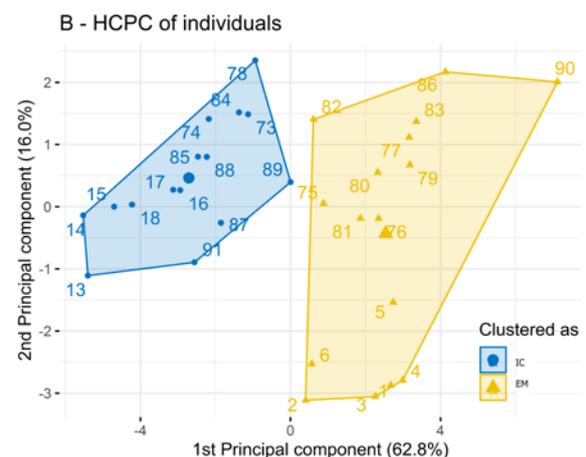
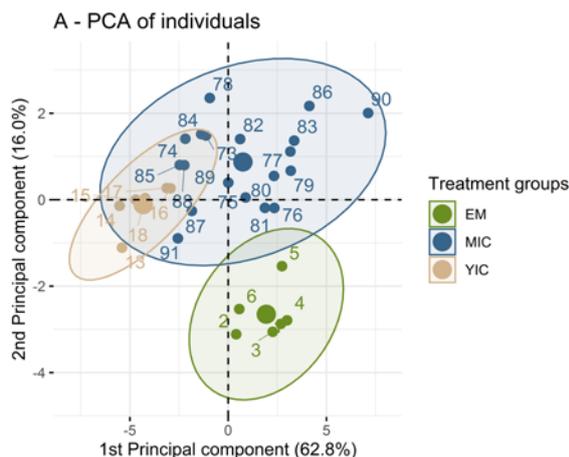
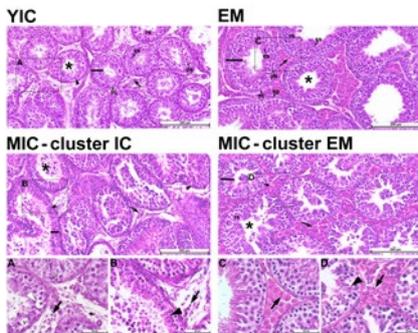
DOI

[10.1111/ANDR.13219](https://doi.org/10.1111/ANDR.13219)



While immunocastration has been extensively studied in male pre-pubertal pigs, there are few data on older, sexually mature animals. To understand the physiological effects of androgen deprivation in the late stage of sexual development, we compared mature immunocastrated boars to young male immunocastrated pigs and young entire males. We hypothesized that the timing of gonadotropin-releasing hormone suppression would influence the extent of inhibition of reproductive function, histological structure of testicular tissue, and expression levels of selected genes related to steroid metabolism. Antibody titres, hormonal status, and histomorphometric analysis of testicular tissue were subjected to principal component analysis followed by hierarchical clustering, which allowed us to reliably separate animals that had achieved hypogonadism. In mature post-pubertal boars, immunocastration resulted in a progressive but variable regression of testicular function. In some individuals, reproductive function was restored and thus a third vaccination required. Testosterone and nucleus to cytoplasm ratio of Leydig cells were found to be the best indicators of the successful immunocastration in sexually mature animals, while the gonadosomatic index and parenchyma colour were identified as the best indicators for assessing the success of immunocastration at slaughter line.

Source: BATOREK LUKAČ, Nina, KRESS, Kevin, ČANDEK-POTOKAR, Marjeta, FAZARINC, Gregor, ŠKRLEP, Martin, POKLUKAR, Klavdija, WESOLY, Raffael, STEFANSKI, Volker, VRECL, Milka. Immunocastration in adult boars as a model for late-onset hypogonadism. *Andrology*. 2022, vol. 10, iss. 6, pp. 1217-1232, illustr. ISSN 2047-2927.



Demonstrational gardens with EDTA-washed soil. Part I: Remediation efficiency, effect on soil properties and toxicity hazards

AUTHORS

Dr. Simon Gluhar, Dr. Anela Kaurin, Dr. Neža Finžgar, Marko Gerl, Dr. Damijana Kastelic and Dr. Domen Leštan

CONTACT

DR. DOMEN LEŠTAN,
BIOTECHNICAL FACULTY, UNIVERSITY OF LJUBLJANA,
DOMEN.LESTAN@BF.UNI-LJ.SI

DOI

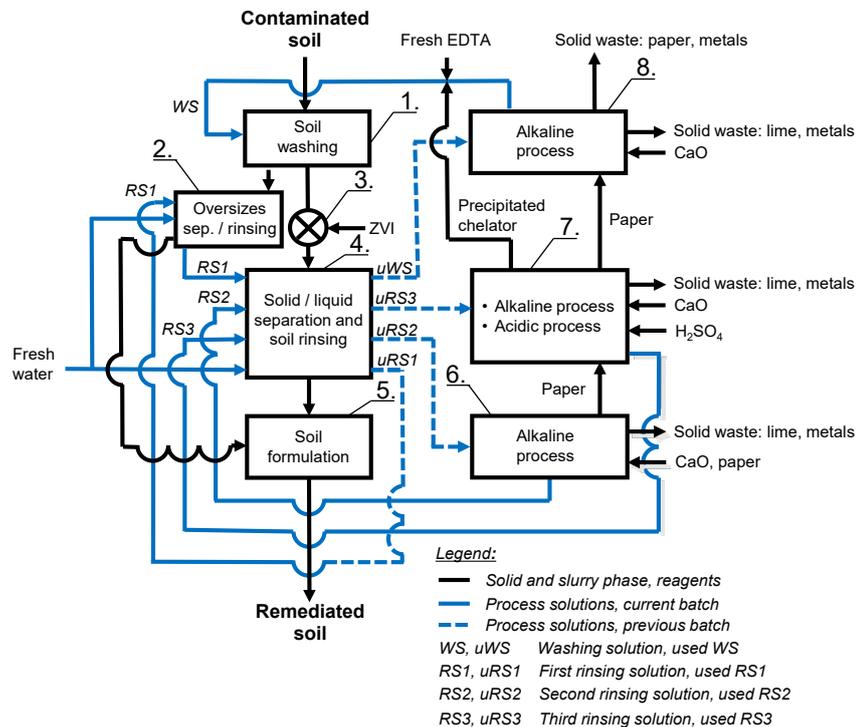
[10.1016/J.SCITOTENV.2021.149060](https://doi.org/10.1016/J.SCITOTENV.2021.149060)



Soil contamination with metals is a worldwide problem. In ReSoil, the soil is washed with a ligand solution that transfers metals from the solid phase to a solution. The ligand and solutions are recycled in a closed process in a pH gradient with inexpensive and harmless materials. No wastewater is generated, solid waste is a source of raw materials in the circular economy. The addition of zero valent Fe immobilizes metals unavailable to the ligand and prevents harmful emissions from the treated soils.

At the demonstration plant in Prevalje, 20 t of Pb and Cd-contaminated soil from the Mežika Valley was cleaned. 71% of Pb and 53% of Cd were removed, and their bioavailability decreased by 4.3 and 2.7 times, respectively. Beds with cleansed soil were constructed as lysimeters, in which 11 vegetable species were grown in 6 rotations. The concentration of metals in soil leachate was low throughout the experiment. The remediation did not affect the properties and function of the soil or the growth of the plants. The concentration of Pb in the edible parts of plants decreased from 76% in peas to 95% in kohlrabi and of Cd from 33% in carrots to 91% in leeks and radicchio. According to legislation, the levels were acceptable in most vegetables. The results were published in three consecutive articles in the same issue of STOTEN magazine.

Source: GLUHAR, Simon, KAURIN, Anela, FINŽGAR, Neža, GERL, Marko, KASTELEC, Damijana, LEŠTAN, Domen. Demonstrational gardens with EDTA-washed soil. Part I, Remediation efficiency, effect on soil properties and toxicity hazards. *Science of the total environment*. 2021, vol. 792, pp. 1-12 (149060). ISSN 0048-9697.



Improving accessibility and bioactivity of raw, germinated and enzymatic-treated spelt (*Triticum spelta* L.) seed antioxidants by fermentation

AUTHORS

Dr. Marjeta Mencin, Dr. Polona Jamnik, Dr. Maja Mikulič Petkovšek, Dr. Robert Veberič and Dr. Petra Terpinč

CONTACT

DR. PETRA TERPINČ,
BIOTECHNICAL FACULTY, UNIVERSITY OF LJUBLJANA,
PETRA.TERPINČ@BF.UNI-LJ.SI

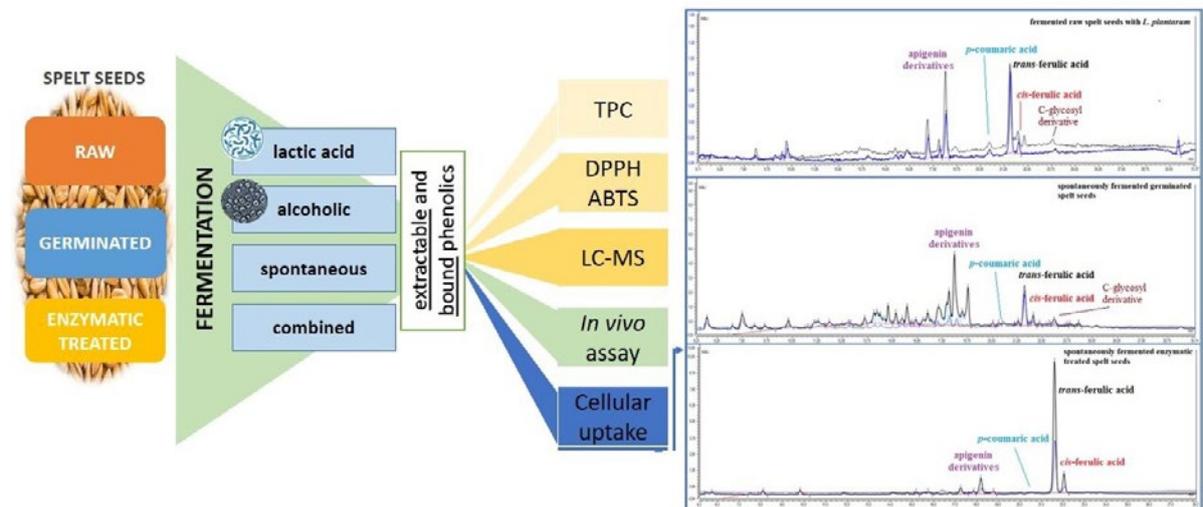
DOI

10.1016/J.FOODCHEM.2022.133483



The aim of our study was to determine the influence of different types of fermentation on the content of total and individual phenolic compounds and on their *in vitro* and *in vivo* antioxidant activity of raw, germinated and enzymatically treated spelt seeds. We found that lactic acid, alcoholic, combined, and spontaneous fermentation of raw, germinated, and enzymatically treated spelt seeds significantly increased the ratio of extractable bound phenolic compounds and thus positively affected the accessibility of spelt antioxidants. The combination of biotechnological processes acted synergistically and therefore represented the most effective way to increase the content of phenolic compounds and their antioxidant activity. The maximum content of extractable and bound individual phenolic compounds and the *in vitro* antioxidant activity of the extracts were determined in germinated spelt seeds fermented with *Saccharomyces cerevisiae*. For extractable phenolic compounds, the content of *trans*-ferulic acid increased the most in the germinated seeds fermented with yeast, by 30-fold; for bound phenolic compounds, the content of *cis*-ferulic acid increased by 6-fold in the raw seeds fermented with yeast. The samples that showed *in vivo* antioxidant activity were mainly extractable fractions of fermented seeds, with spontaneous fermentation of germinated and enzymatically treated seeds being the most effective in reducing intracellular oxidation. The key factor for the demonstrated *in vivo* antioxidant activity of fermented raw and germinated spelt seeds was the higher cellular uptake of flavonoids and the lower uptake of hydroxycinnamic acids. According to the results of the study, we believe that the combination of biotechnological processes is a promising approach to improve the bioaccessibility of health-promoting compounds in cereals.

Source: MENCIN, Marjeta, JAMNIK, Polona, MIKULIČ PETKOVŠEK, Maja, VEBERIČ, Robert, TERPINČ, Petra. Improving accessibility and bioactivity of raw, germinated and enzymatic-treated spelt (*Triticum spelta* L.) seed antioxidants by fermentation. *Food chemistry* [Print ed.], 2022, vol. 394, pp. 1-12, art. 133483, illustr. ISSN 0308-8146.



Effect of intrabronchial administration of autologous adipose-derived mesenchymal stem cells on severe equine asthma

AUTHORS

Dr. Neža Adamič, Dr. Sonja Prpar Mihevc, Dr. Rok Blagus, Dr. Petra Kramarič, Dr. Uroš Krapež, Dr. Gregor Majdič, Dr. Laurent Viel, Dr. Andrew Hoffman, Dr. Dorothee Bienzle and Dr. Modest Vengušt

CONTACT

DR. MODEST VENGUŠT,
VETERINARY FACULTY, UNIVERSITY OF LJUBLJANA,
MODEST.VENGUST@VF.UNI-LJ.SI

DOI

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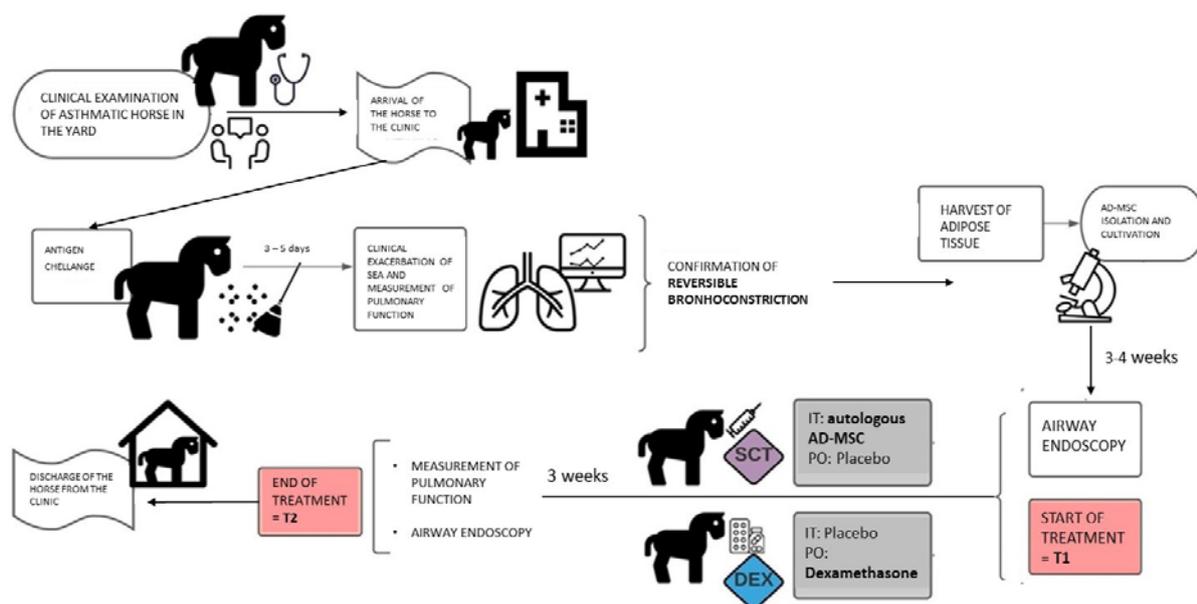


Severe equine asthma is a common chronic respiratory disease and a significant equine health and welfare problem. The evolution of regenerative medicine has enabled several new therapeutic strategies that primarily target the severity of the immune response and minimize the likelihood of side effects that occur after the use of conventional therapeutic strategies. Therefore, the objective of this study was to evaluate the safety and therapeutic efficacy of intrabronchial administration of adipose-derived mesenchymal stem cells (AD-MSC) in asthmatic horses.

AD-MSC administration significantly improved clinical score, decreased expression of IL-17 mRNA and IL-1 β , IL-4, TNF α protein levels, and had a positive long-term effect on SEA.

Intrabronchial administration of autologous AD-MSC had a limited short-term anti-inflammatory effect and a positive long-term effect on SEA. These results are critical for a more detailed understanding of inflammation in SEA and the development of alternative therapies to treat equine asthma and/or obstructive airway diseases in other species, including humans.

Source: ADAMIČ, Neža, PRPAR MIHEVC, Sonja, BLAGUS, Rok, KRAMARIČ, Petra, KRAPEŽ, Uroš, MAJDIČ, Gregor, VIEL, Laurent, HOFFMAN, Andrew M., BIENZLE, Dorothee, VENGUŠT, Modest. Effect of intrabronchial administration of autologous adipose-derived mesenchymal stem cells on severe equine asthma. *Stem cell research & therapy*. Jan. 2022, vol. 13, iss. 1, pp. 1-14, illustr. ISSN 1757-6512.



Quantitative risk assessment of exposure to *Mycobacterium avium* subsp. *paratuberculosis* (MAP) via different types of milk for the Slovenian consumer

AUTHORS

Dr. Tanja Knific, Dr. Matjaž Ocepek, Dr. Andrej Kirbiš, Dr. Branko Krt, Dr. Jasna Prezelj and Dr. Jörn Martin Gethmann

CONTACT

DR. TANJA KNIFIC,
VETERINARY FACULTY, UNIVERSITY OF LJUBLJANA,
TANJA.KNIFIC@VF.UNI-LJ.SI

DOI

[10.3390/foods11101472](https://doi.org/10.3390/foods11101472)



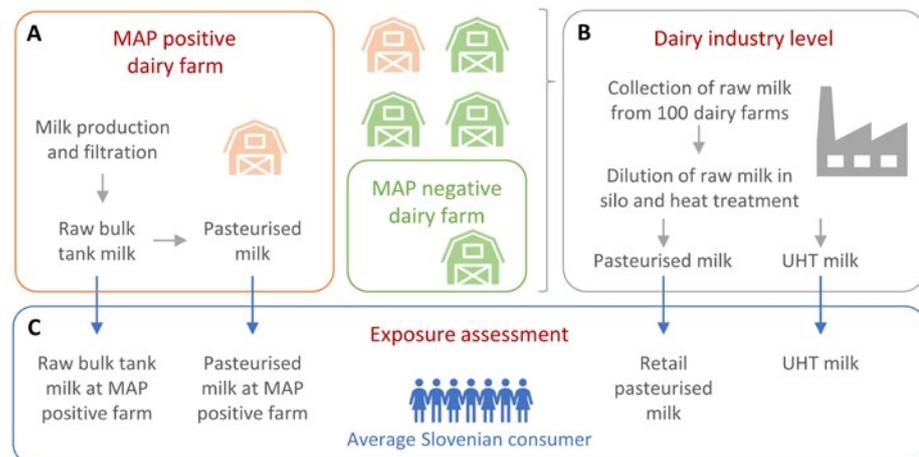
MAP is associated with Crohn's disease and several other chronic diseases in humans. The main source of MAP for humans is thought to be cattle, in which it causes paratuberculosis. We developed a stochastic model using demographic data on dairy herds, milk production and sales in Slovenia, prevalence results from our modelling studies and data on epidemiological characteristics of MAP from the literature.

We estimated the overall risk of exposure to MAP via milk for Slovenian consumers as low, negligible for pasteurized retail and other processed milk, and high for raw milk from farms with paratuberculosis. Therefore, vulnerable groups, people with pre-existing conditions and infants, are advised to avoid consuming raw milk or to boil the raw milk before consumption.

This study has shown that despite the lack of empirical data, it is possible to gain a comprehensive insight into the risk of human exposure to MAP through modelling. Our results can provide support for informed decision-making on control measures for the control of MAP in Slovenia and other countries with a similar structure of dairy farms.

Source: KNIFIC, Tanja, OCEPEK, Matjaž, KIRBIŠ, Andrej, KRT, Branko, PREZELJ-PERMAN, Jasna, GETHMANN, Jörn Martin. Quantitative risk assessment of exposure to *Mycobacterium avium* subsp. *paratuberculosis* (MAP) via different types of milk for the Slovenian consumer. *Foods*. 2022, vol. 11, iss. 10, art. 1472, pp. 1-20, illustr. ISSN 2304-8158.

Schematic structure of the model for quantitative risk assessment of exposure to MAP via different types of milk for the Slovenian consumer. The model consists of three parts: (A) a farm-level sub-model, (B) a dairy industry-level sub-model, and (C) a potential human exposure sub-model.



Structural basis for the constitutive activity and immunomodulatory properties of the Epstein-Barr virus-encoded G protein-coupled receptor BILF1

AUTHORS

Dr. Naotaka Tsutumi, Dr. Qianhui Qu, Dr. Maša Mavri, Maibritt S. Baggesen, Dr. Shoji Maeda, Deepa Waghay, Dr. Christian Berg, Dr. Brian K. Kobilka, Dr. Mette Marie Rosenkilde, Dr. Georgios Skiniotis and Dr. Christopher K. Garcia

CONTACTS

DR. MAŠA MAVRI,
VETERINARY FACULTY,
UNIVERSITY OF LJUBLJANA,
MASA.MAVRI@VF.UNI-LJ.SI

DR. CHRISTOPHER K. GARCIA,
DEPARTMENT OF MOLECULAR AND CELLULAR
PHYSIOLOGY, STANFORD UNIVERSITY,
KCGARCIA@STANFORD.EDU

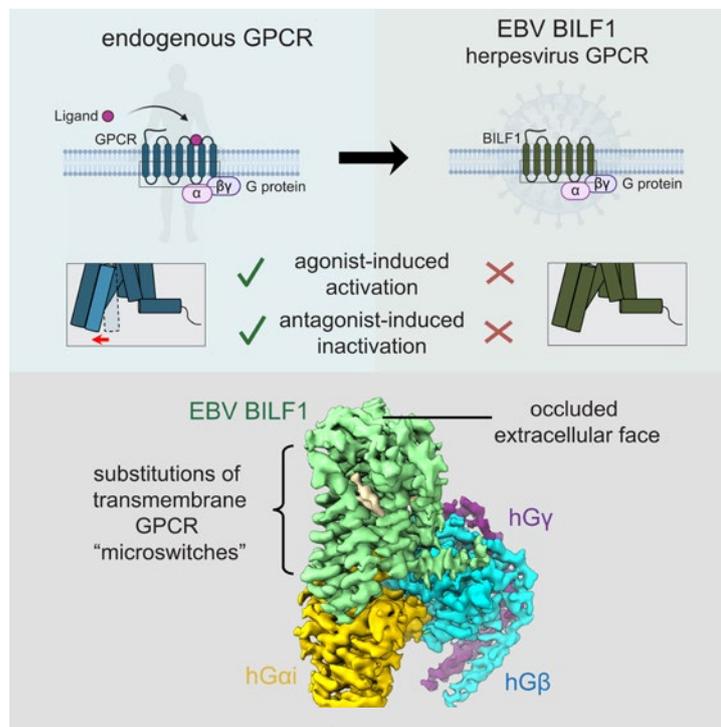
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A G-protein coupled receptor (GPCR) BILF1 is encoded in the genome of human Epstein-Barr virus and plays an important role in viral pathogenesis, immunosuppression and oncogenesis. The BILF1 receptor therefore represents an important drug target against EBV infection. Albeit continuing efforts to determine a specific inhibitor, BILF1 remains an orphan receptor. To reveal its structural properties, we have used cryo-electron microscopy. The structure and mechanism of signalling shows robust constitutive activity of the receptor which is a foundation for further studies aiming to finally determine the BILF1 antagonist. The receptor structure in complex with G α i showed that the receptor resembles lipid GPCR structure and not chemokine structure as was initially expected. The second extracellular loop (ECL2) blocks typical chemokine binding sites which indicates the receptor's ability for autonomous activation. By amino acid exchange at positions important for GPCR activation we have studied the importance of specific motifs for the receptor's constitutive activity. We have shown that the mutations do not significantly affect the receptor's activity which confirms its robust constitutive activity.

Source: TSUTSUMI, Naotaka, QU, Qianhui, MAVRI, Maša, BAGGESEN, Maibritt S., MAEDA, Shoji, WAGHRAY, Deepa, BERG, Christian, KOBILKA, Brian K., ROSENKILDE, Mette Marie, SKINIOTIS, Georgios, GARCIA, K. Christopher. Structural basis for the constitutive activity and immunomodulatory properties of the Epstein-Barr virus-encoded G protein-coupled receptor BILF1. *Immunity*. [Online ed.]. 2021, vol. 54, no. 7, pp. 1405-1416, illustr. ISSN 1097-4180.



Hydrodynamic cavitation efficiently inactivates potato virus Y in water

AUTHORS

Dr. Arijana Filipić, Dr. Tadeja Lukežič, Dr. Katarina Bačnik, Dr. Maja Ravnikar, Meta Ješelnik, Tamara Košir, Dr. Martin Petkovšek, Dr. Mojca Zupanc, Dr. Matevž Dular and Dr. Ion Gutiérrez-Aguirre

CONTACT

DR. ION GUTIERREZ AGUIRRE,
DEPARTMENT FOR BIOTECHNOLOGY AND SYSTEMS
BIOLOGY, NATIONAL INSTITUTE OF BIOLOGY,
ION.GUTIERREZ@NIB.SI

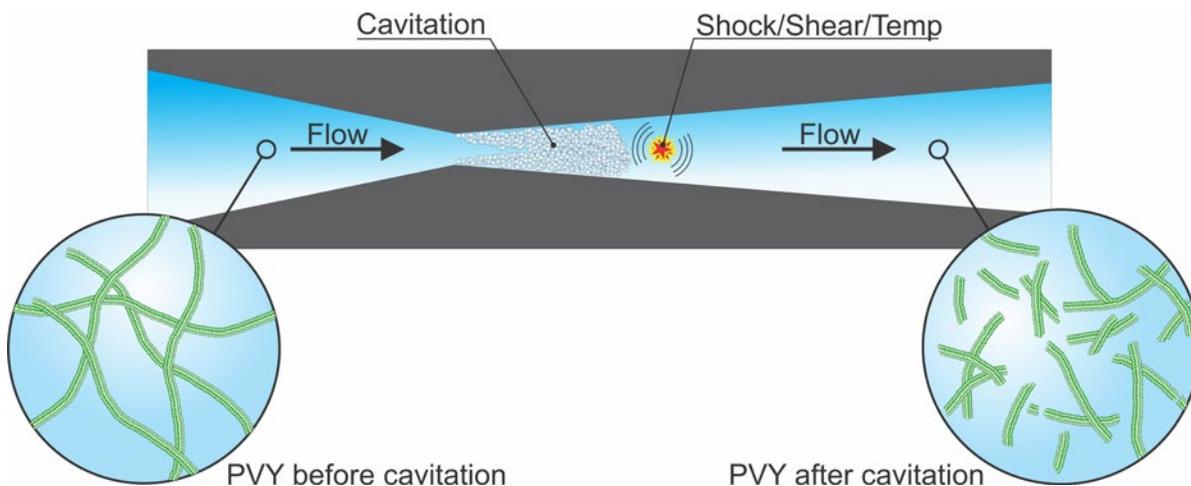
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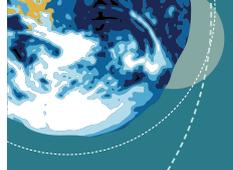
[10.1016/J.ULTSONCH.2021.105898](https://doi.org/10.1016/J.ULTSONCH.2021.105898)



A large amount of the global water reserves is used for irrigation. The need for water will continue to increase along with the growth of the population and due to climate change, which we have also witnessed in the summer seasons of the last few years. A solution to this problem is the reuse of wastewater and the introduction of irrigation systems that recycle water. Unfortunately, by reusing water, we also facilitate the spread of viruses. Plant viruses can destroy crops, leading to large financial losses and food shortages, so effective inactivation of harmful viruses in water is very important. In our recent work published in the renowned journal *Ultrasonic Sonochemistry*, we studied the inactivation of potato virus Y (PVY) using an environmentally friendly method, hydrodynamic cavitation. PVY is the most important viral pathogen of potato crops and can be transmitted by water. In this study, we successfully achieved inactivation of PVY in water samples. In addition, we proved that hydrodynamic cavitation destroys the integrity of viral particles and can cause minor degradation of viral RNA. We also showed that for viral inactivation, the mechanical effects of cavitation are more important than the oxidative ones.

Source: FILIPIĆ, Arijana, LUKEŽIČ, Tadeja, BAČNIK, Katarina, RAVNIKAR, Maja, JEŠELNIK, Meta, KOŠIR, Tamara, PETKOVŠEK, Martin, ZUPANC, Mojca, DULAR, Matevž, GUTIÉRREZ-AGUIRRE, Ion. Hydrodynamic cavitation efficiently inactivates potato virus Y in water. *Ultrasonics Sonochemistry*. January 2022, vol. 82, pp. 1-19





Higher education students' achievement emotions and their antecedents in e-learning amid COVID-19 pandemic: A multi-country survey

AUTHORS

Dr. Daniela Raccanello, Dr. Roxana Balbontín-Alvarado, Dr. Denilson da Silva Bezerra, Dr. Roberto Burro, Dr. Maria Cheraghi, Dr. Beata Dobrowolska, Dr. Adeniyi Francis Fagbamigbe, Dr. MoezAllIslam Ezzat Faris, Dr. Thais França, Dr. Belinka González-Fernández, Dr. Rob Hall, Fany Inasius, MM, Sujita Kumar Kar, MD, Dr. Damijana Keržič, Dr. Kornélia Lazányi, Dr. Florin Lazăr, Dr. Juan D. Machin-Mastromatteo, Dr. João Marôco, Dr. Bertil P. Marques, Dr. Oliva Mejía-Rodríguez, Dr. Silvia Mariela Méndez Prado, Alpana Mishra, MD, Dr. Cristina Mollica, Dr. Silvana G. Navarro Jiménez, Dr. Alka Obadić, Dr. Md. Mamun-ur-Rashid, Dr. Dejan Ravšelj, Dr. Sanja Tatalović Vorkapić, Dr. Nina Tomažević, Dr. Chinaza Uleanya, Dr. Lan Umek, Giada Vicentini, MSc, Dr. Özlem Yorulmaz, Dr. Ana-Maria Zamfir and Dr. Aleksander Aristovnik

CONTACT

DR. ALEKSANDER ARISTOVNIK,
FACULTY OF PUBLIC ADMINISTRATION,
UNIVERSITY OF LJUBLJANA,
ALEKSANDER.ARISTOVNIK@FU.UNI-LJ.SI

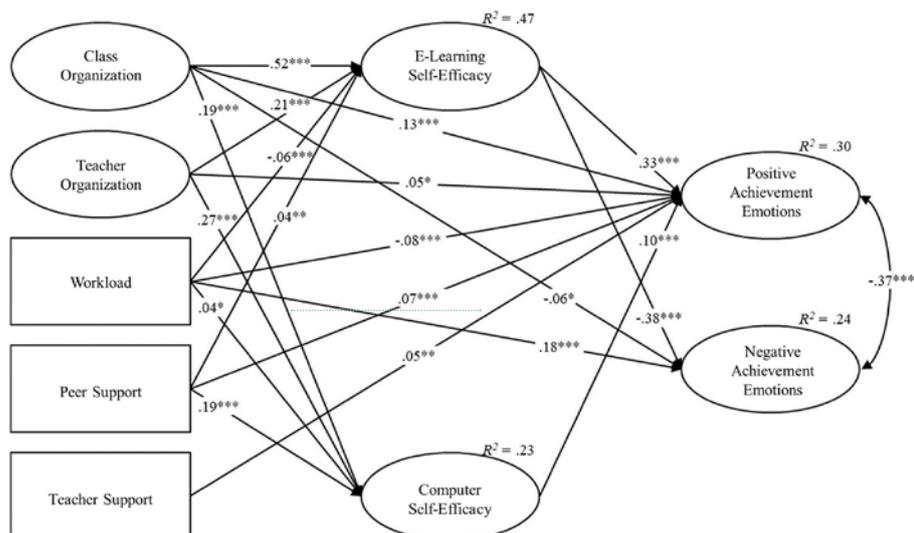
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10.1016/J.LEARNINSTRUC.
2022.101629



The article is the result of an international study that was designed by CovidSocLab, established at the Faculty of Public Administration (University of Ljubljana). The outbreak of the COVID-19 pandemic has greatly affected the psychological state of higher education students around the world. The research addresses the possibilities of generalizing the control-value theory of achievement-related emotions in the context of e-learning, focusing on their antecedents. The research involved 17,019 higher education students from 13 countries during the first wave of the COVID-19 pandemic. A structural equation model revealed that proximal antecedents (e-learning self-efficacy, computer self-efficacy) mediated the relation between environmental antecedents (cognitive and motivational quality of the task) and positive and negative achievement emotions, with some exceptions. The model was invariant across country, area of study, and gender, however, the rates of achievement emotions varied according to these same factors. Beyond their theoretical relevance, the findings of the research represent a good basis for the development of appropriate recommendations in the implementation of e-learning on the example of higher education. A comprehensive comparative analysis represents an important source of information for numerous stakeholders at the international (e.g. European Union), national (e.g. ministries) and organizational level (e.g. rectors/deans, educators) for the development of appropriate psychological support and other support measures aimed at maintaining the well-being and performance of students during extraordinary circumstances.

Source: KERŽIČ, Damijana, RAVŠELJ, Dejan, TOMAŽEVIČ, Nina, UMEK, Lan, ARISTOVNIK, Aleksander, et al. Higher education students' achievement emotions and their antecedents in E-learning amid COVID-19 pandemic: a multi-country survey. *Learning and instruction*. [Print ed.]. 2022, vol. 80, pp. 1-10, illustr. ISSN 09594752.



The role of moral foundations, anticipated guilt and personal responsibility in predicting anti-consumption for environmental reasons

AUTHORS

**Dr. Barbara Culiberg, Dr. Hichang Cho,
Dr. Mateja Kos Koklič and Dr. Vesna
Žabkar**

CONTACT

DR. BARBARA CULIBERG,
SCHOOL OF ECONOMICS AND BUSINESS,
UNIVERSITY OF LJUBLJANA,
BARBARA.CULIBERG@EF.UNI-LJ.SI

DOI

[10.1007/S10551-021-05016-7](https://doi.org/10.1007/S10551-021-05016-7)



Because of the negative impact on the environment, more and more people are thinking about reducing their consumption. Under the influence of Greta Thunberg, movements against air travel have sprung up all over the world. The paper examines environmental anti-consumption in the context of air travel, which belongs to the intersection of research on sustainable consumption and anti-consumption. While previous research relied on social-cognitive factors to explain consumption reduction, we have addressed the moral and emotional factors that contribute to this decision. The testing of the conceptual model on a sample of 511 respondents showed that those who feel responsible for the environment and anticipate feeling guilty about travelling by air are more likely to reduce their consumption (i.e. air travel). Limiting air travel also depends on the moral foundations of the individual. Anticipated guilt encourages word-of-mouth, while personal responsibility drives individual environmental activism. In addition, the intention to reduce consumption has a positive effect on activism and word-of-mouth.

Source: CULIBERG, Barbara, CHO, Hichang, KOS KOKLIČ, Mateja, ŽABKAR, Vesna. The role of moral foundations, anticipated guilt and personal responsibility in predicting anti-consumption for environmental reasons. *Journal of business ethics*. 2023, vol. 182, pp. 465-481. ISSN 0167-4544.



What shall I compare thee to? Legal journals, impact, citation and peer rankings

AUTHOR

Dr. Janja Hojnik

CONTACT

DR. JANJA HOJNIK,
FACULTY OF LAW, UNIVERSITY OF MARIBOR,
JANJA.HOJNIK@UM.SI

DOI

[10.1017/LST.2020.43](https://doi.org/10.1017/LST.2020.43)



The pressure to distinguish high quality from lower quality law journals is intensifying. To contribute to this debate, citation-based and peer-review-based ranking of law journals are paralleled in the paper, using qualitative and quantitative analyses. It is found that all law journals that are considered as journals of the highest quality by legal experts are also ranked highly in the Web of Science (WoS) and that 40 percent of the law journals categorized by peers as "internationally leading" are not listed in WoS. It hence explores what the editors of some internationally leading law journals that are not listed in the WoS think about applying to this ranking. The paper offers data to support that legal scholarship is characterised by highlighted regionalism in academic publishing and citation patterns. It concludes that there is no perfect indicator of quality and that no evaluation system will ever convince every legal scholar in the world and that the WoS could be adopted as a rigorous and internationally recognized index for law journals only if it was better aligned with the Leiden Manifesto.

Source: HOJNIK, Janja. What shall I compare thee to? Legal journals, impact, citation and peer rankings. *Legal studies*, ISSN 0261-3875, June 2021, vol. 41, iss. 2, pp. 252-275.



CITATION CONTRIBUTIONS BY COUNTRIES/REGIONS, 2015-2016

	USA	UK	CONTINENTAL EUROPE	REST OF THE WORLD	NO AFFILIATION DATA ⁷³
Yale LJ	62	0	0	2	13
Stanford LRev	48	0	1	1	4
Harvard LRev	27	0	0	0	77
Columbia LRev	79	1	1	3	3
CMLRev	0	13	38	4	2
European LJ	9	23	58	1	2
Modern LRev	0	66	5	10	4
Cambridge LJ	0	27	1	10	0
Melbourne ULR	2	8	4	54 ⁷⁴	3
Rev. Espanola de Derecho Constit.	0	0	65 ⁷⁵	4 ⁷⁵	3
J African L	2	3	1	32 ⁷⁷	1
Am J Int L	28	14	9	5	28
Eur J Int L	13	26	37	27	1
Chinese J Int L	2	11	9	23 ⁷⁸	7

Source: Calculations based on data in Incites Journal Citation Reports, Clarivate Analytics

Enhancing sociality, self-presentation, and play: a case study of digital scenarios among schoolchildren in an epidemic context

AUTHORS

**Dr. Tanja Oblak Črnič and
Dr. Barbara N. Brečko**

CONTACT

DR. TANJA OBLAK ČRNIČ,
FACULTY OF SOCIAL SCIENCES,
UNIVERSITY OF LJUBLJANA,
TANJA.OBLAK@FDV.UNI-LJ.SI

DOI

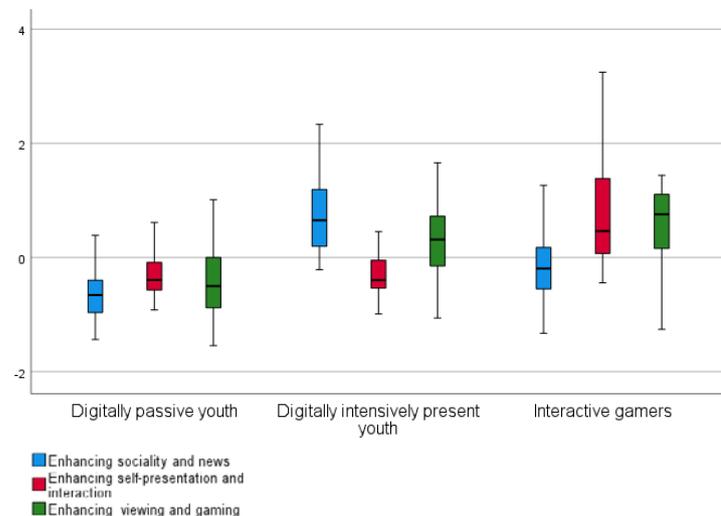
[10.1080/1369118X.2021.1994632](https://doi.org/10.1080/1369118X.2021.1994632)



This study explores what types of digital life scenarios children practiced while facing the challenges of epidemic isolation, in which distance learning and limited social contact depended largely on new digital platforms. The study of children's mediated activities within epidemic isolation is approached from the perspective of radical contextualism, which has been widely used since the ethnographic turn in audience research that began in the late 1980s. The aim of the study was to identify the predominant experiences of isolated everyday life in a case study of schoolchildren and uncover typical collective groupings among young people. Based on a "follow the child" perspective, an online survey was conducted at a selected primary school, targeting children from 6th to 9th grade. The survey captured children's perceptions of online education and distance learning, prevalent digital use and their personal digital positioning. The collected sample of 110 schoolchildren was categorised using a cluster analysis to identify the typical scenarios of digital usage and the diversity of online practices for enhancing sociality, self-presentation and play. The article represents one of the first interdisciplinary studies of the changing everyday life among schoolchildren who faced the loss of social contacts and shift of everyday activities to online platforms during the first wave of the Covid-19 epidemic in 2020. From the perspective of media and internet studies, it contributes to a deeper understanding of children's digital scenarios during extreme social situations. It is a unique achievement in the national territory with strong international potential, which enables further research of everyday digital practices among young people beyond epidemic conditions.

Source: OBLAK ČRNIČ, Tanja, BREČKO, Barbara Neža. Enhancing sociality, self-presentation, and play: a case study of digital scenarios among schoolchildren in an epidemic context. *Information, communication & society*. 2022, vol. 25, no. 4, pp. 552-569. ISSN 1369-118X.

DIGITAL SCENARIOS AMONG THE THREE CATEGORIES OF YOUTH (FACTOR WEIGHTS)



Characterisation of peri-urban landscape based on the views and attitudes of different actors

AUTHOR

Dr. Vita Žlender

CONTACT

DR. VITA ŽLENDER,
URBAN PLANNING INSTITUTE
OF THE REPUBLIC OF SLOVENIA,
VITA.ZLENDER@UIRS.SI

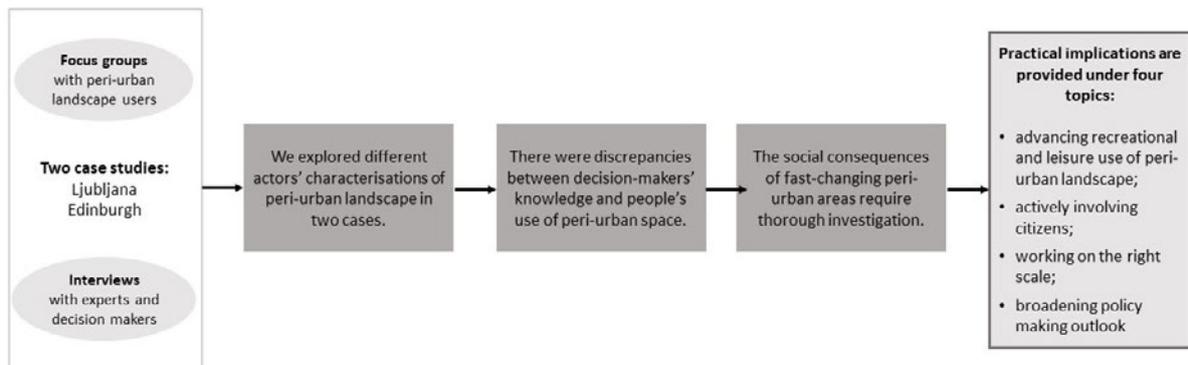
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[10.1016/J.LANDUSEPOL.2020.105181](https://doi.org/10.1016/J.LANDUSEPOL.2020.105181)



Interest in the peri-urban landscape has grown steadily over the last decade as researchers seek to clarify the character of the space that links the urban and rural environment. However, peri-urban typologies and different perspectives on the relation between peri-urban, urban and rural areas remain unresolved. The present study hypothesizes that exploration and discussion of the views and attitudes of peri-urban landscape users within the frame of current planning-related concepts and practices may make this complexity easier to understand. Using focus groups and interviews in the cities of Ljubljana and Edinburgh, the findings highlight some discrepancies between decision-makers' knowledge and opinions and users' views and use of the peri-urban landscape. The study concludes that more inclusive and sustainable planning of peri-urban areas in the future will depend on gathering information about *what is going on in the peri-urban landscape*. The study also provides guidelines for landscape planners and decision makers.

Source: ŽLENDER, Vita. Characterisation of peri-urban landscape based on the views and attitudes of different actors. *Land use policy*. [Print ed.]. 2021, vol. 101, iss. 105181, pp. 14 ISSN 0264-8377.



The Yugoslav national idea under socialism: What happens when a soft nation-building project is abandoned?

AUTHOR

Dr. Tomaž Ivešić

CONTACT

DR. TOMAŽ IVEŠIĆ,
STUDY CENTRE FOR NATIONAL RECONCILIATION,
TOMAZ.IVESIC@SCNR.SI

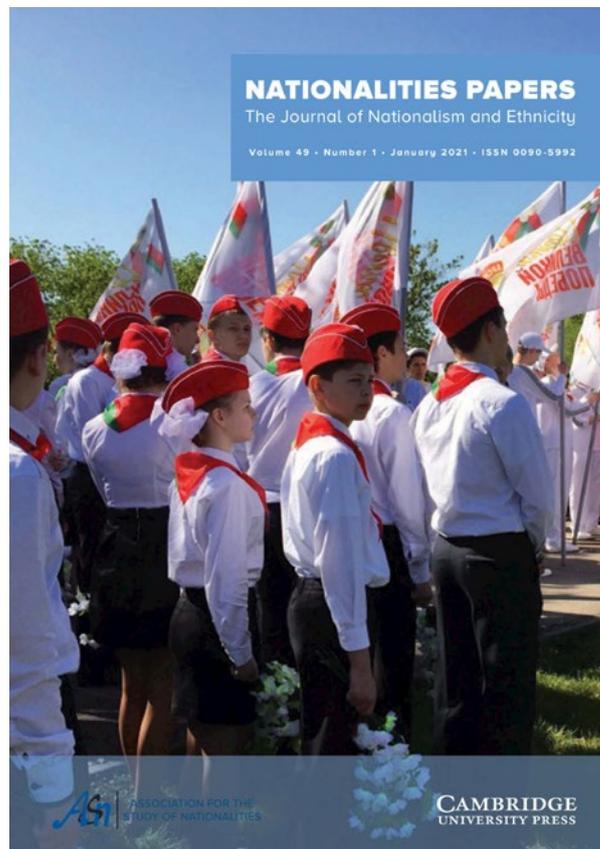
DOI

[10.1017/NPS.2019.121](https://doi.org/10.1017/NPS.2019.121)



This article by Tomaž Ivešić, PhD, was published in the prestigious international journal *Nationalities Papers*, which is published by the Cambridge University Press. The journal's impact factor for 2021 was 1.067; within History, the journal is ranked in Q1, and its SJR for 2021 was 0.38. The article has received considerable response: it has already been cited in other original scientific articles and a bachelor's thesis at the University of Zagreb as well as placed in the Further Reading section of the English Wikipedia entry on Yugoslavism. The article responds to an uncharted spot in Yugoslav socialism, resolving the dilemma about whether there was a nation-building project in post-1945 Yugoslavia. Ivešić finds that there was and presents a theoretical-methodological approach to exploring a new concept of "soft nation-building". The concept is applicable in other comparable studies for Czechoslovakia and the Soviet Union in the period after 1945/1948. The article is expected to remain relevant in the future and to serve as an unavoidable literature choice for researchers into the nationalisms and socialism of South-Eastern and Eastern Europe.

Source: IVEŠIĆ, Tomaž. The Yugoslav national idea under socialism: what happens when a soft nation-building project is abandoned?. *Nationalities papers: the journal of nationalism and ethnicity*, ISSN 0090-5992, 2021, vol. 49, iss. 1, pp. 142-161.



An integrative approach to neighbourhood sustainability assessments using publicly available traffic data

AUTHORS

Dr. Špela Verovšek, Dr. Matevž Juvančič, Dr. Simon Petrovčič, Dr. Tadeja Zupančič, Dr. Matija Svetina, Dr. Miha Janež, Dr. Žiga Pušnik, Nina Velikajne and Dr. Miha Moškon

CONTACT

DR. ŠPELA VEROVŠEK,
FACULTY OF ARCHITECTURE,
UNIVERSITY OF LJUBLJANA,
SPELA.VEROVSEK@FA.UNI-LJ.SI

DOI

10.1016/J.COMPENVURBSYS.
2022.101805



Travel times and their variability can be used to propose a range of sustainability indicators. We introduce a data collection and analysis framework to be employed as an integral part of a neighbourhood sustainability assessment (NSA). The proposed framework performs a targeted selection and evaluation of NSA indicators based on publicly available traffic data, specifically addressing short-term observations of travel times and traffic counts. Entailing a modular approach, we demonstrate the applicability of travel time measures by combining different datasets, various variability estimators, and visualisation methods, to advance the interpretation strength of the assessment. Implemented are regression methods based on cosinor models, which facilitates analysis of rhythmic behaviour in travel time trends. Analyses of rhythmicity give straightforward insights into travel time trends, appropriate for comparative analysis and thus well-suited for use in urban monitoring practices.

Source: VEROVŠEK, Špela, JUVANČIČ, Matevž, PETROVČIČ, Simon, ZUPANČIČ, Tadeja, SVETINA, Matija, JANEŽ, Miha, PUŠNIK, Žiga, VELIKAJNE, Nina, MOŠKON, Miha. An integrative approach to neighbourhood sustainability assessments using publicly available traffic data. *Computers, Environment and Urban Systems*. [Print ed.]. Jul. 2022, vol. 95, pp. 1-14. ISSN 0198-9715.

The six strategic routes mapped – each of the observed neighbourhoods is the origin of two routes, one heading to the city centre (lighter colour tones) and one heading to the Shopping and services centre BTCity (darker colour tones) shopping and service centre; (base layer: Google Inc., 2021).

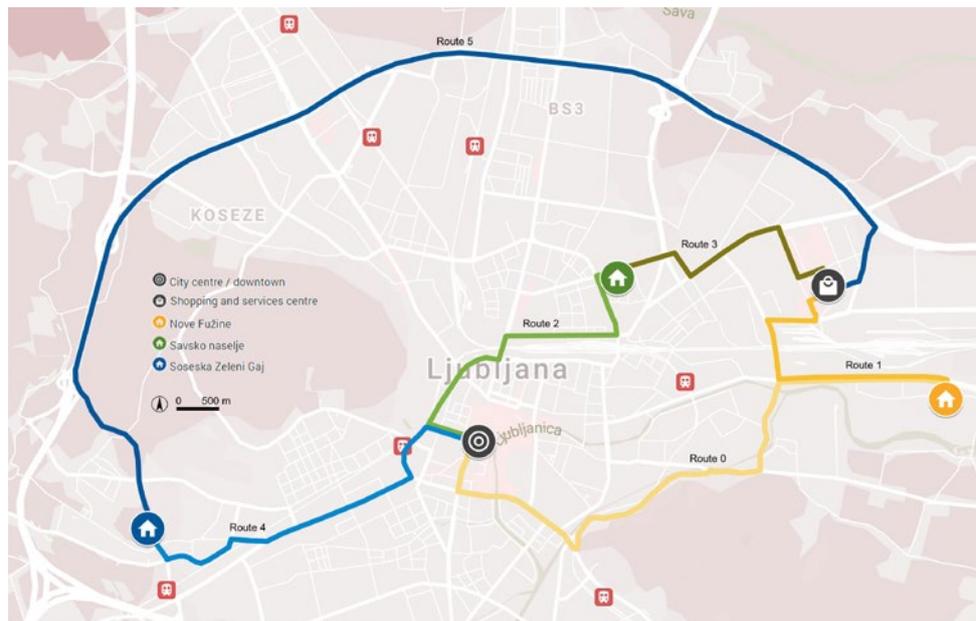
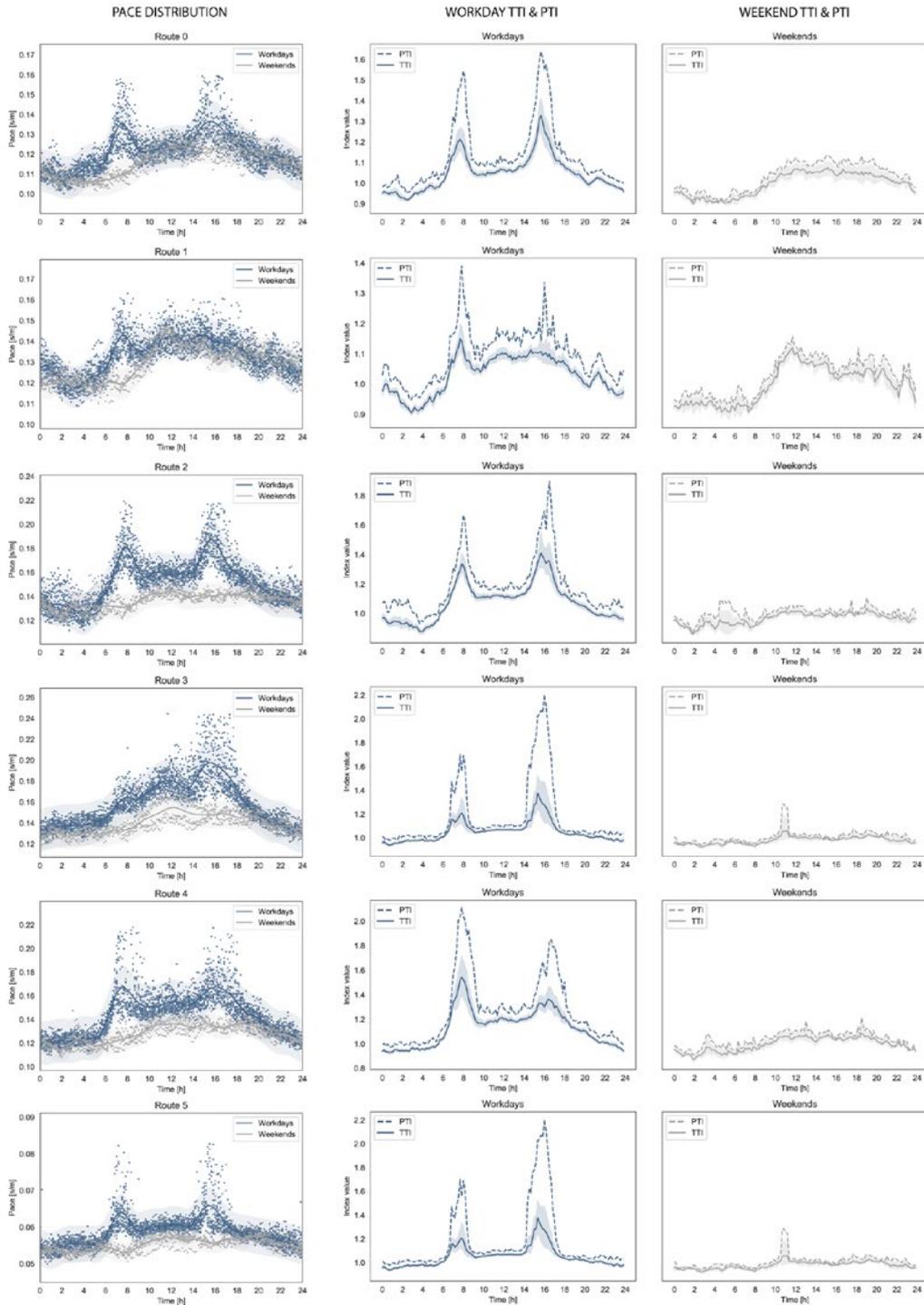


Figure 2. Comparison of travel time rate (pace) distribution with TTI (travel time index) and PTI (planning time index) separately by workdays/weekends.



Exploring user experience in digital libraries through questionnaire and eye-tracking data

AUTHORS

Maja Kuhar and Dr. Tanja Merčun Karž

CONTACT

DR. TANJA MERČUN KARIŽ,
FACULTY OF ARTS, UNIVERSITY OF LJUBLJANA,
TANJA.MERCUNKARIZ@FF.UNI-LJ.SI

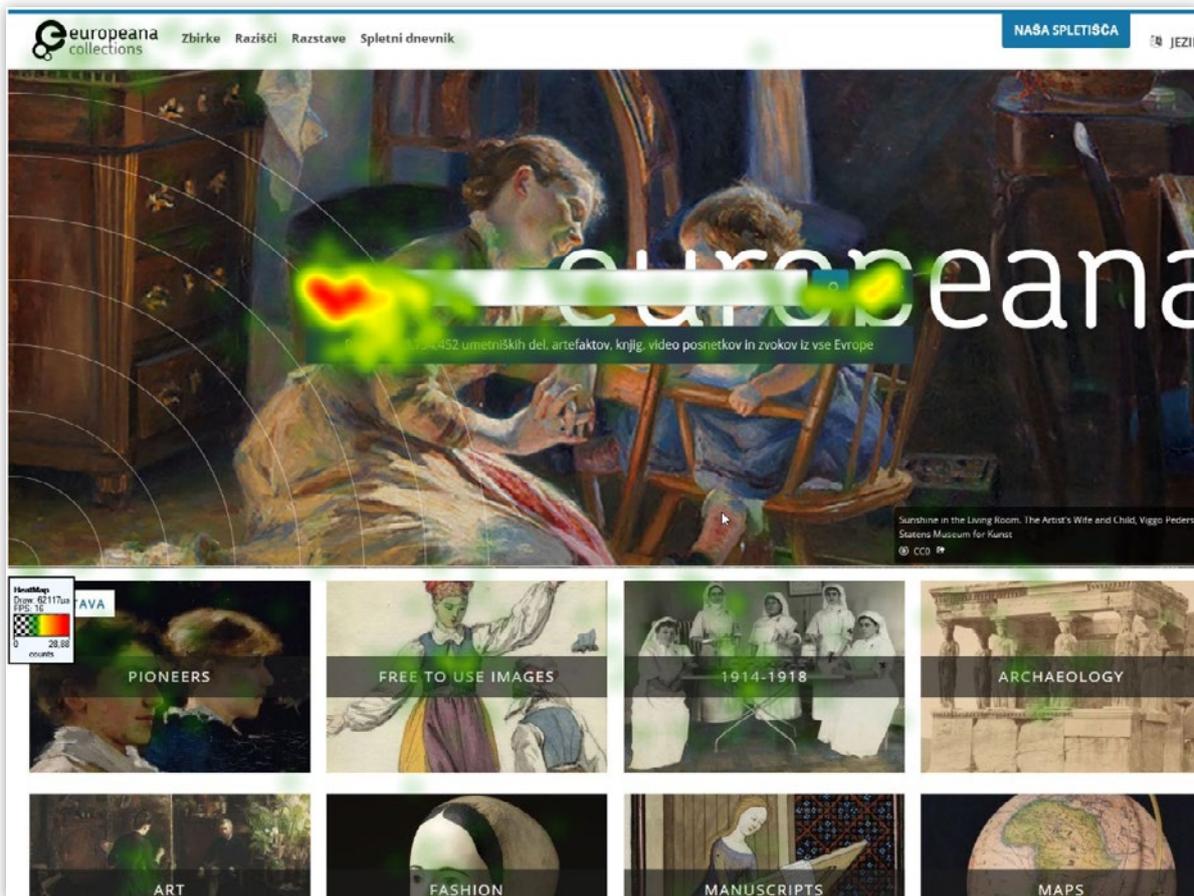
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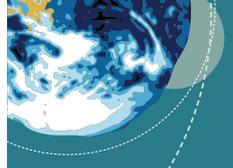
[10.1016/J.LISR.2022.101175](https://doi.org/10.1016/J.LISR.2022.101175)



Developing and maintaining digital libraries is one of the most important tasks of libraries and other cultural heritage institutions. However, to be successful, digital libraries must not only offer rich collections, but also a holistic user experience. This research tested two approaches that are rarely used in evaluating digital libraries: eye-tracking observation and user experience questionnaires focusing on emotions during interaction and user perception of the system. The results show the potential of the two different methods for digital library evaluation and development, and identify interesting correlations between the results of the two methods, which provide a starting point for a better understanding of digital library users' interaction, emotions, and perceptions and point to important design features of digital libraries that contribute to a better user experience.

Source: KUHAR, Maja, MERČUN, Tanja. Exploring user experience in digital libraries through questionnaire and eye-tracking data. *Library & Information Science Research: an international journal*. [Print ed.]. Jul. 2022, vol. 44, iss. 3, pp. 1-11, illustr. ISSN 0740-8188.





The fire that embraced Europe. Narodni dom in Trieste 1920-2020

AUTHORS

Dr. Borut Klabjan and Dr. Gorazd Bajc

CONTACT

DR. BORUT KLABJAN,
SCIENCE AND RESEARCH CENTRE KOPER,
BORUT.KLABJAN@ZRS-KP.SI

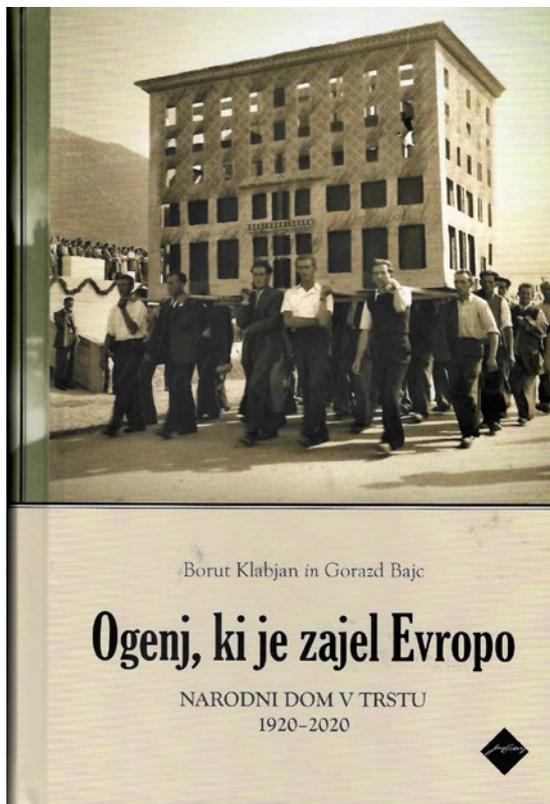
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Ogenj, ki je zajel Evropo. Narodni dom v Trstu 1920-2020 [The Fire that embraced Europe. Narodni dom in Trieste, 1920-2020], is the first book that addresses from multiple perspectives the arson, the symbolic meaning and the historical circumstances of the Narodni dom in Trieste. Until 1920, when it was burnt by the Fascists and Italian nationalists, the Narodni dom was the centre for Slovenes living in Trieste, the city with the biggest Slovene population at that time. This episode represents the starting point and a privileged viewpoint to investigate the history of Europe in the twentieth century. Based on a meticulous historical analysis, the book intertwines different methodologies and extensive archival material. Because of its clear style and a vivid approach, it attracted the attention of the academic sphere and of the non-academic public. The translation into Italian was published in 2023 by Il Mulino, one of the most prestigious Italian scholarly publishers, while Boris Pahor, probably the best known Slovene writer and a witness of the arson, suggested that every European should read this book. In it they will find the beginning of European modern history, the birth of dictatorships in Europe.

Source: KLABJAN, Borut, BAJC, Gorazd. *Ogenj, ki je zajel Evropo: Narodni dom v Trstu 1920-2020*. 1st ed. Ljubljana: Cankarjeva založba, 2021. 456 pp., illustr. ISBN 978-961-282-484-6.



OLiT: open source software for processing LiDAR data

AUTHORS

Dr. Benjamin Štular, Dr. Stefan Eichert and Dr. Edisa Lozić

CONTACT

DR. BENJAMIN ŠTULAR,
RESEARCH CENTRE OF THE SLOVENIAN ACADEMY
OF SCIENCES AND ARTS,
benjamin.stular@zrc-sazu.si

HYPERLINK

[https://github.com/
stefaneichert/
openlidartoolbox](https://github.com/stefaneichert/openlidartoolbox)

DOI

[10.3390/RS13163225](https://doi.org/10.3390/RS13163225)



Open LiDAR Toolbox OLiT is an open source software for processing LiDAR data. It is based on the scientific publication of algorithms.

LiDAR is the first technology that enables systematic prospection of archaeological features even in forests. For example, since 43% of the EU is covered by forests and LiDAR in forests has so far shown that it can increase the number of known archaeological features by at least a factor of 5, there is potential to increase the number of known archaeological sites in the EU by at least 235%. But, as the results of the last decade show, such a volume of data cannot be fully exploited by a small number of interdisciplinary specialists working with archaeological LiDAR. It is essential to involve as wide a range of archaeologists as possible.

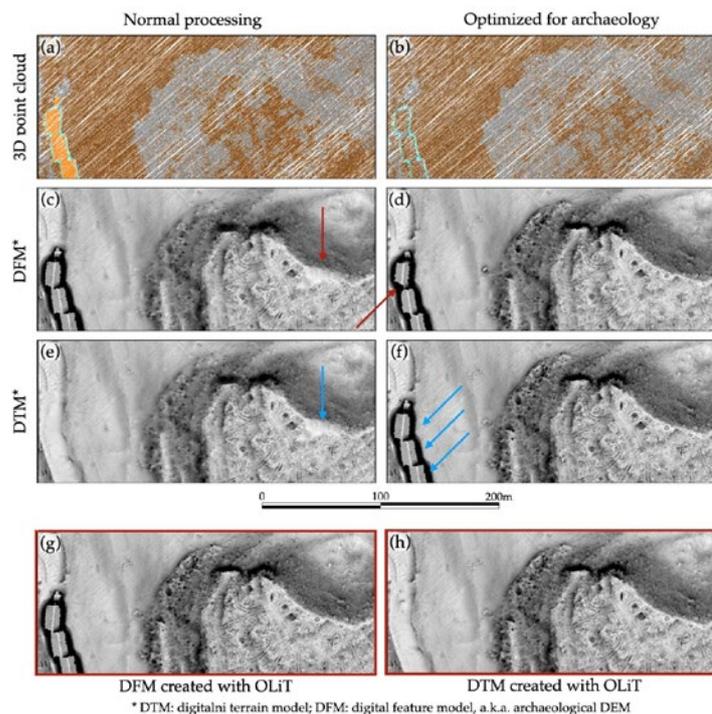
The importance of OLiT for the development of science lies precisely in this: it makes LiDAR data processing accessible to all archaeologists. A task that used to require 64 operations in five software packages and a multitude of knowledge-based decisions is accessible with OLiT at the single click of a mouse.

The idea and the research design originate from Slovenia (Štular, Lozić), while the programming is the work of an Austrian colleague (Eichert).

Source 1: EICHERT, Stefan, ŠTULAR, Benjamin, LOŽIĆ, Edisa. *Open LiDAR Toolbox*. Version 2.0. Wien: NHM; [Ljubljana]: ZRC SAZU; Graz: University, [2021].

Source 2: ŠTULAR, Benjamin, EICHERT, Stefan, LOŽIĆ, Edisa. Airborne LiDAR Point Cloud Processing for archaeology: Pipeline and QGIS Toolbox. *Remote sensing*. 13 August 2021, vol. 13, issue 16, 3225, pp. 1-37, illustr. ISSN 2072-4292.

OLiT: Open LiDAR Toolbox



In the silence of memory. "Exodus" and Istria

AUTHOR

Dr. Katja Hrobat Virloget

CONTACT

DR. KATJA HROBAT VIRLOGET,
FACULTY OF HUMANITIES,
UNIVERSITY OF PRIMORSKA,
KATJA.HROBAT@FHS.UPR.SI

HYPERLINK

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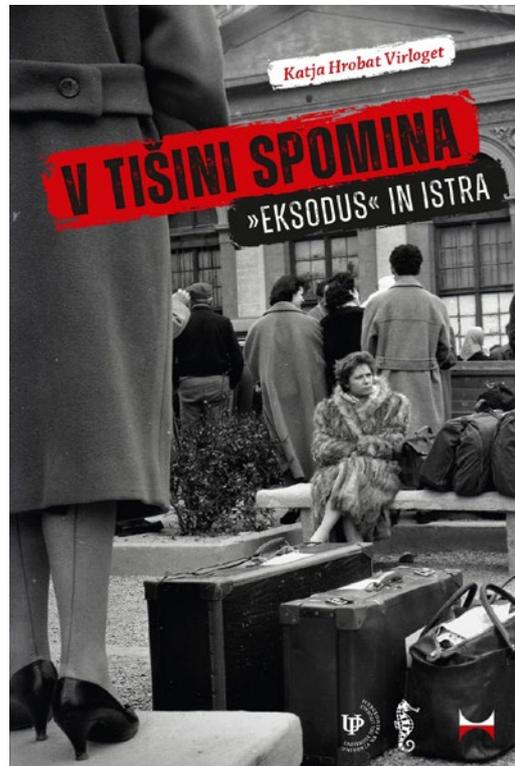
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[10.26493/978-961-293-062-2](https://doi.org/10.26493/978-961-293-062-2)



The monograph, based on ten years of field work, focuses on the voluntary nature of post-war migration in Istria. From a micro perspective, i.e. with ethnographic testimonies of a wide variety of individuals, but embedded in theoretical literature and comparable analyses abroad, it presents a multifaceted view on migration, revealing that the "voluntary" decision has always been socio-historically, politically and economically conditioned. The distinguishing feature of the work is that it goes beyond the strict ethnic or linguistic frames that have usually been attributed to this phenomenon until now. Here, the author pays special attention to the issues of silence and censorship in memory studies, which have been emphasized so far mainly in French anthropological literature, but completely neglected in Slovenian studies. It analyzes whose memories are visible or silenced, and above all it gives to the latter a voice and the opportunity to be heard. By researching what is kept silent, the author also establishes new areas of interdisciplinary collaboration, this time between anthropology, psychotherapy and psychoanalysis. The book points out that everyone can be both a perpetrator and a victim, but that it is precisely the recognition of this circumstance, the recognition of our own pain as well as the pain of the other that enables a potential reconciliation and coexistence.

Source: HROBAT VIRLOGET, Katja. V tišini spomina: "eksodus" in Istra. Koper: Založba Univerze na Primorskem; Trst: Založništvo tržaškega tiska, 2021. 315 pp., illustr. ISBN 978-88-7174-293-9, ISBN 978-88-7174-291-5.



Do you read Cankar?

AUTHOR

Dr. Vesna Mikolič

CONTACT

DR. VESNA MIKOLIČ,
SCIENCE AND RESEARCH CENTRE KOPER,
VESNA.MIKOLIC@ZRS-KP.SI

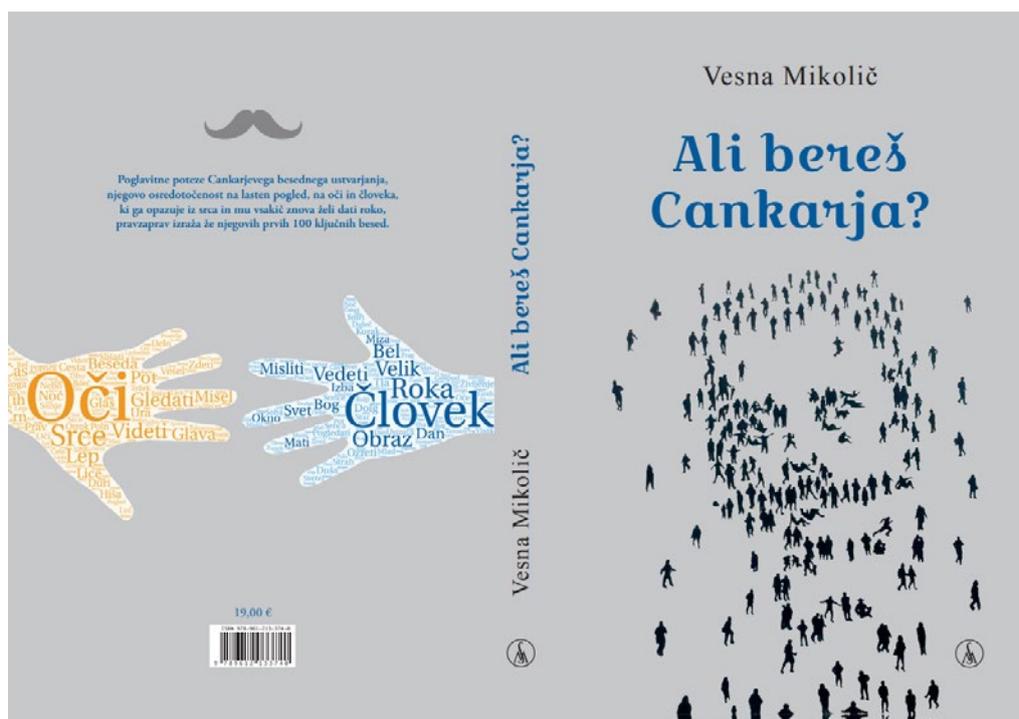
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The scientific monograph was prepared with the aim of contributing to a new reading of Ivan Cankar. The starting point of the innovative research and reading approach is the author's assumption that any artistic language is to be understood, just as we should understand any language we use. Within the framework of interdisciplinary research in the fields of keyword theory, corpus linguistics, literary pragmatics, and literary history, Vesna Mikolič opens up literature through language, combining linguistic and literary analyses with digital humanities methods and reading strategies. Thus, she identifies and analyzes 500 of Cankar's keywords, which are presented in lists by frequency and in alphabetical order. In addition, the main outcomes of the research are an organized corpus of Cankar's texts, an explanation of Cankar's linguistic and stylistic processes, new insights into Cankar's symbolism and ideas, the (inter)cultural significance of his keywords, and the emphasis on the mood of Cankar's text. These findings form a new five-step reading system that provides an easier yet deeper entry into the light, not just dark, world of this important Slovenian classic.

Source: MIKOLIČ, Vesna. *Ali bereš Cankarja?*. Ljubljana: Slovenska matica, 2021. 146 pp., illustr. Razprave in eseji, 79. ISBN 978-961-213-374-0. ISSN 1408-4511.



The history of music in the Slovene lands 3: music in the Slovene lands between 1800 and 1918

AUTHORS

Dr. Aleš Nagode, Dr. Nataša Cigoj Krstulović, Dr. Primož Kuret, Dr. Špela Lah, Dr. Darja Koter, Dr. Nejc Sukljan, Lidija Podlesnik Tomašikova, Dr. Jernej Weiss, Dr. Gregor Pompe, Dr. Matjaž Barbo, Dr. Urša Šivic, Dr. Vesna Venišnik Peternelj, Dr. Maruša Zupančič and Simona Moličnik

CONTACT

DR. ALEŠ NAGODE,
FACULTY OF ARTS, UNIVERSITY OF LJUBLJANA,
ALES.NAGODE@FF.UNI-LJ.SI

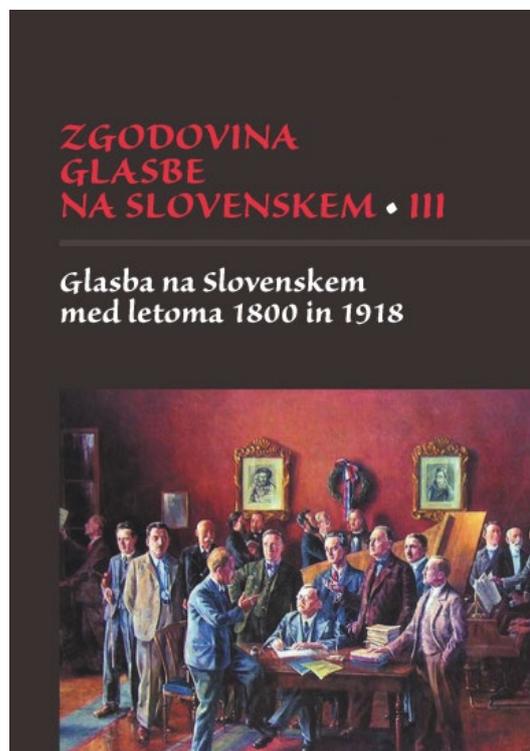
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[10.4312/9789610605270](https://doi.org/10.4312/9789610605270)



The monograph gives a historical overview of music in Slovenia in the long 19th century, which was crucial for the later emergence of national music. It is thus a turning point, when the foundations of social organisation and cultural life, which also determine our present, underwent fundamental changes. In the period under consideration, the philosophical ideas of the Enlightenment matured into political programmes, which in turn became a web of events that gradually undermined the structure of the European political and cultural order that had grown over centuries. Given the dynamics of creative circumstances in the 19th century, the narrative focuses on individual musical genres, as well as institutions and environments. The book attempts to cover 19th century musical culture in Slovenia as comprehensively as possible, including the important achievements of individual composers. The work has two goals: it provides an updated overview, incorporating research findings from the last two decades, and it removes some ideological and methodological biases that were present in the older Slovenian musicological literature. The content of the book was designed by Dr. Nataša Cigoj Krstulović and finally edited by Dr. Aleš Nagode.

Source: NAGODE, Aleš (ed.), CIGOJ KRSTULOVIČ, Nataša (ed.), KURET, Primož, LAH, Špela, KOTER, Darja, SUKLJAN, Nejc, PODLESNIK TOMÁŠIKOVÁ, Lidija, WEISS, Jernej, POMPE, Gregor, BARBO, Matjaž, ŠIVIC, Urša, VENIŠNIK PETERNELJ, Vesna, ZUPANČIČ, Maruša, MOLIČNIK, Simona. *Zgodovina glasbe na Slovenskem. 3, Glasba na Slovenskem med letoma 1800 in 1918*. 1st ed. Ljubljana: Znanstvena založba Filozofske fakultete: Založba ZRC, 2021. XIX, 582 pp., illustr., notes, portraits. ISBN 978-961-06-0529-4.



Seeing God in the image of Mary: cross readings of a medieval Benedictine convent seal

AUTHOR

Dr. Mija Oter Gorenčič

CONTACT

DR. MIJA OTER GORENČIČ,
FRANCE STELE INSTITUTE OF ART HISTORY,
RESEARCH CENTRE OF THE SLOVENIAN ACADEMY
OF SCIENCES AND ARTS,
MIJA.OTER@ZRC-SAZU.SI

DOI

10.4324/9781003179054-3



SI AS 1063, Collection of documents, document no. 4271, Seal of the Benedictine monastery Gornji Grad



The motif on the seal from 1337 was identified by the author as a visualisation of verse 1:13 of the Song of Songs (*Fasciculus myrrhae dilectus meus mihi, inter ubera mea commorabitur*). Among the written sources that have had the greatest influence on the creation of the motif of the standing Virgin Mary holding Christ on the cross, the mediaeval interpretations of the Song of Songs have proved to be decisive. The Marian interpretations from the first half of the 12th century by Rupert of Deutz and Honorius Augustodunensis, based on the works of the older exegetes, stand out. In the woodcut edition of the Canticum Canticorum of 1465-1470, the same motif is depicted next to this verse, but more than a century later. The extraordinary popularity of interpretations of SS 1:13 from Bede Venerabile onwards suggests that such images must have been widely used before the 15th century. So far, only a single fresco of this verse is known in the Cistercian monastery in Chełmno, where this image was depicted as one of the scenes within the cycle of the Song of Songs. The article reveals that the image on the seal from 1337 is the oldest known depiction of this motif in Western European art. The author identifies the Opening Virgin as a sculptural parallel to this depiction. She also points out that the distortion caused by seeing the image – that Mary appears in the place that God normally occupies in depictions of the Throne of Mercy – must have been intentional. The juxtaposing and downright equating of the role of Mary with that of God the Father is found in several mediaeval texts. Moreover, the Mother Mary often appears in the same formulations as God the Father. In the visual arts, this kind of equivalence resonated nowhere more so than in unusual iconographic solutions. In conclusion, the author states that the seal is not only a brilliant visualisation of the verse SS 1:13, but at the same time an ingenious connection with the verse from the Song of Songs 8:6: *Set me as a seal upon your heart*.

Source: OTER GORENČIČ, Mija. Seeing God in the Image of Mary: Cross Readings of a Medieval Benedictine Convent Seal. In: ZNOROVSKY, Andrea-Bianka (ed.), JARITZ, Gerhard (ed.). *Marian Devotion in the Late Middle Ages: Image and Performance* (Studies in Medieval History and Culture). London; New York: Routledge, 2022, pp. 31-51, illustr.

Forgotten values of industrial city still alive: What can the creative city learn from its industrial counterpart?

AUTHORS

Dr. Jani Kozina, Dr. David Bole and Dr. Jernej Tiran

CONTACT

DR. JANI KOZINA,
ANTON MELIK GEOGRAPHICAL INSTITUTE,
RESEARCH CENTRE OF THE SLOVENIAN ACADEMY
OF SCIENCES AND ARTS,
JANI.KOZINA@ZRC-SAZU.SI

DOI

[10.1016/J.CCS.2021.100395](https://doi.org/10.1016/J.CCS.2021.100395)

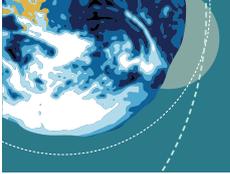


In recent times, the creative city agenda has evolved into a predominantly neoliberal policy instrument, which often increases urban inequalities characterised by gentrification, precariousness, and segregation. The main objective of this paper is to elevate the discussion on the creative city and its socially regressive urban policies by promoting the forgotten values of the industrial city not only as its predecessor but also as its contemporary offering development alternatives. We conducted 23 semistructured interviews with key stakeholders in the industrial town of Velenje, Slovenia, which grew as a socialist town after WWII in Yugoslavia. Our results suggest that collective knowledge, memories, emotions, and reflections maintain the inseparable values of industrialism and socialism on which the town was founded. They have shaped a specific cultural environment, a concentration of tacit knowledge, attitudes, values, and traditions related to solidarity, mutual respect, multiculturalism, comradeship, equality, and diligence. We conclude that creative cities could learn from their industrial counterparts by establishing a more inclusive urban governance and promoting social innovation.

Source: KOZINA, Jani, BOLE, David, TIRAN, Jernej. Forgotten values of industrial city still alive: what can the creative city learn from its industrial counterpart?. *City, culture and society*. 2021, vol. 25, 13 pp., illustr. ISSN 1877-9166.

Industrial culture in a post-socialist urban context	Socially favourable aspects of industrial culture	<ul style="list-style-type: none"> - collective values of industrialism and socialism - diverse social practices - free social services - good internal collaboration - networking and community building - high degree of multiculturalism and tolerance
	Lock-in effects of industrial culture (endogenous factors)	<ul style="list-style-type: none"> - a need for long-term restructuring and industrial modernisation and diversification - lack of a specific developmental vision - 'miners' mentality'
	Neoliberal threat of post-industrial transition (exogeneous factors)	<ul style="list-style-type: none"> - gradual shift in values - intolerance and social polarisation - diminished social responsibility of companies

Deconstruction of industrial culture in the post-socialist city of Velenje, Slovenia



**“... in unmoving and unmoved footsteps”.
Early modern Good Friday processions as a project of Counter-Reformation and Catholic renewal**

AUTHOR

Dr. Jaša Drnovšek

CONTACT

DR. JAŠA DRNOVŠEK,
CENTRE FOR APPLIED RESEARCH,
UNIVERSITY OF MARIBOR,
JASA.DRNOVSEK@UM.SI

DOI

[10.3986/9789610505082](https://doi.org/10.3986/9789610505082)



This groundbreaking cultural-historical and comparative study places the *Škofjeloški pasijon*, Slovenia's oldest surviving drama and a performance tradition that has been under UNESCO protection since 2016, on the European map of early modern passion processions for the first time in a systematic way. While drawing theoretically on Joachim Küpper's concept of cultural production, which understands culture as a virtual cultural net, it portrays processions as eminently political phenomena that could only have existed uninterrupted in the period of the Counter-Reformation and the Catholic renewal. The study sheds light on the history of the Capuchin and Jesuit orders, and draws on a wide range of theological, historiographical and literary sources to explain how, especially from the 17th century onwards, they contributed to the prosperity of passion processions in Catholic Europe through their increasingly extensive networks. In this context, the *Škofjeloški pasijon*, the manuscript of the Capuchin monk Romuald, is suddenly no longer only important for the development of Slovenian national identity, but above all as a firm and unignorable element of European cultural consciousness.

Source: DRNOVŠEK, Jaša. --- *in den vnbeweglichen vnd vnuerruckten Fußstapffen: frühneuzeitliche Karfreitagsprozessionen als Projekt der Gegenreformation und katholischen Erneuerung*. 1st ed. Ljubljana: Založba ZRC, 2020. 255 pp., illustr. ISBN 978-961-05-0507-5.



Principles behind structural heterogeneity of the intrinsically disordered protein complexes

AUTHORS

Dr. San Hadži, Dr. Remy Loris and Dr. Jurij Lah

CONTACT

DR. SAN HADŽI,
FACULTY OF CHEMISTRY AND CHEMICAL TECHNOLOGY,
UNIVERSITY OF LJUBLJANA,
SAN.HADZI@FKKT.UNI-LJ.SI

DOI

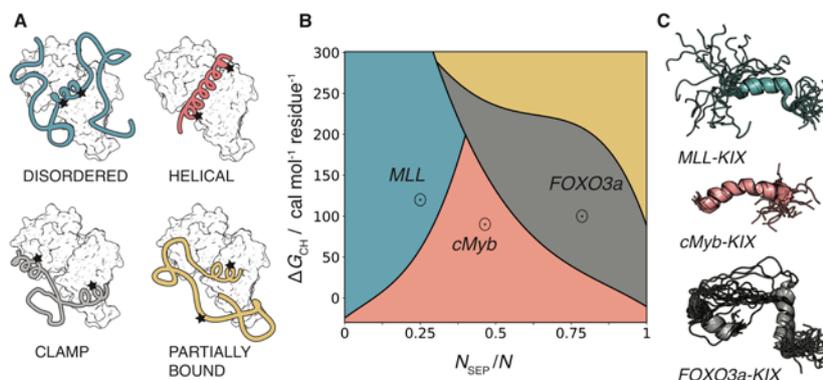
[10.1073/PNAS.2020562118](https://doi.org/10.1073/PNAS.2020562118)



Intrinsically disordered proteins (IDP) play important roles in different cellular processes and their function is typically mediated through interactions with globular proteins. In their free state IDPs have no defined conformation and are dynamic, but can become structured to different degrees upon binding globular proteins (see Figure). We developed a statistical thermodynamic model that explains the basic principles that define the final target-bound IDP conformation. The conformation depends mainly on the IDP folding propensity, which is defined by its amino acid sequence, and the distribution of IDP-target interactions (hot-spots). Using this model, we could successfully reproduce the dynamics of bound IDPs obtained using NMR relaxation experiments and how the target-bound IDP ensemble adapts to mutations in order to achieve an optimal balance between conformational freedom and interaction energy. Taken together, the presented sequence–ensemble relationship of fuzzy complexes explains the different manifestations of IDP disorder in folding-upon-binding processes.

Source: HADŽI, San, LORIS, Remy, LAH, Jurij. The sequence–ensemble relationship in fuzzy protein complexes. *Proceedings of the National Academy of Sciences of the United States of America*. [Online ed.], 14 Sep. 2021, vol. 118, iss. 37, pp. 1-9, illustr. ISSN 1091 6490.

Conformational phase space of IDP-target complexes. (A) The target-bound IDPs may acquire different macroscopic ensembles with a varying degree of disorder. (B) Phase diagram shows how hotspot distribution characterized simply by (N_{SEP}/N) and the average IDP folding propensity (ΔG_{CH}) determine the target-bound IDP ensemble. The model correctly predicts the conformation of three representative IDPs shown in panel (C)



Assessment of susceptibility to phthalate and DINCH exposure through single nucleotide polymorphisms in genes encoding CYP and UGT enzymes

AUTHORS

Dr. Anja Stajnko, Dr. Agneta Annika Runkel, Dr. Tina Kosjek, Dr. Janja Snoj Tratnik, Dr. Darja Mazej, Dr. Ingrid Falnoga and Dr. Milena Horvat

CONTACT

DR. MILENA HORVAT,
DEPARTMENT OF ENVIRONMENTAL SCIENCES,
JOŽEF STEFAN INSTITUTE,
MILENA.HORVAT@IJS.SI

DOI

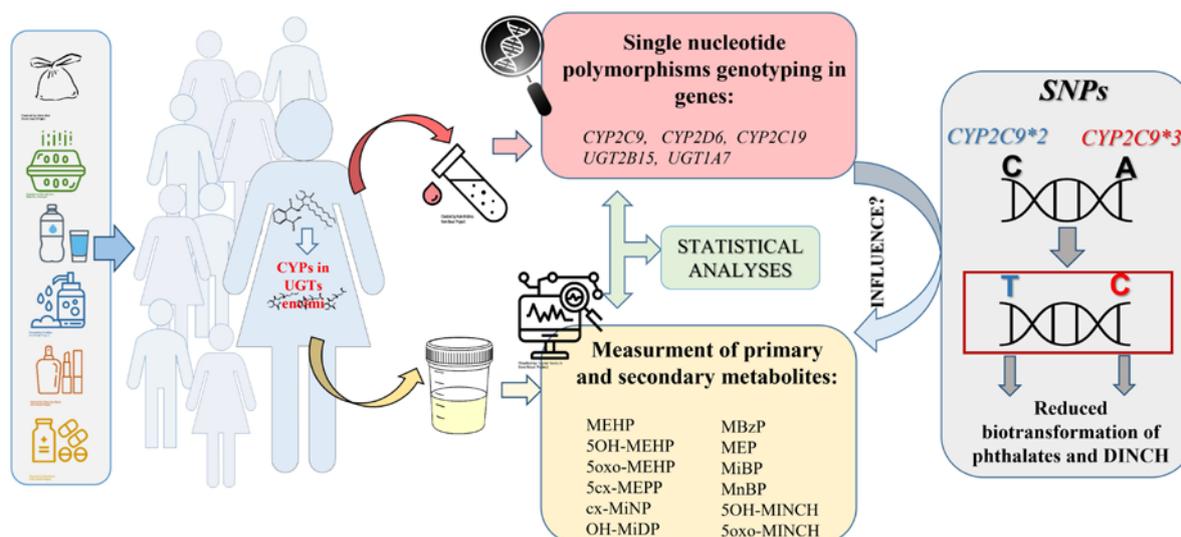
10.1016/J.ENVINT.2021.107046



Phthalates and their substitutes, of which DINCH is the best known, are synthetic compounds that are primarily used as plasticizers in plastics and as additives in various personal care products. Humans are exposed to these compounds through consumption of food and drink and via skin contact. Many studies have pointed out the harmful effects of these substances on health, especially on disturbances in the balance of hormones.

In the study, for the first time, we demonstrated the importance of genetic predisposition in exposure to phthalates and DINCH at the population level. More specifically, based on DNA genotyping and measurements of the concentration of primary and secondary metabolites of phthalates and DINCH in urine, we evaluated the influence of selected single nucleotide polymorphisms (SNPs) - in the genes encoding for cytochrome P450 enzymes and UDP-glucuronosyltransferase - on the metabolism of phthalates and DINCH in Slovenian men and lactating women. We identified 2 SNPs (CYP2C9*2 and CYP2C9*3) where carriers of the variant allele expressed significantly reduced metabolism of phthalates and DINCH compared to individuals with the absence of this allele. The results were particularly evident in the case of bis(2-ethylhexyl) DEHP phthalate, where in 9 individuals with a variant allele in both SNPs at the same time, the metabolism was reduced by up to 50%. In other words, these individuals consequently have an increased presence of more harmful primary metabolites in the body and are thus likely to be more susceptible to the negative effects of phthalate exposure.

Source: STAJNKO, Anja, RUNKEL, Agneta Annika, KOSJEK, Tina, SNOJ TRATNIK, Janja, MAZEJ, Darja, FALNOGA, Ingrid, HORVAT, Milena. Assessment of susceptibility to phthalate and DINCH exposure through CYP and UGT single nucleotide polymorphisms. *Environmental international*. [Print ed.], 2022, vol. 59, pp. 107046-1-107046-13. ISSN 0160-4120.



Environmental Kuznets curve in Southeastern Europe: The role of urbanization and energy consumption

AUTHORS

Dr. Miroslav Verbič, Dr. Elma Šatrović and Dr. Adnan Muslija

CONTACT

DR. MIROSLAV VERBIČ,
SCHOOL OF ECONOMICS AND BUSINESS,
UNIVERSITY OF LJUBLJANA &
INSTITUTE FOR ECONOMIC RESEARCH,
MIROSLAV.VERBIC@EF.UNI-LJ.SI

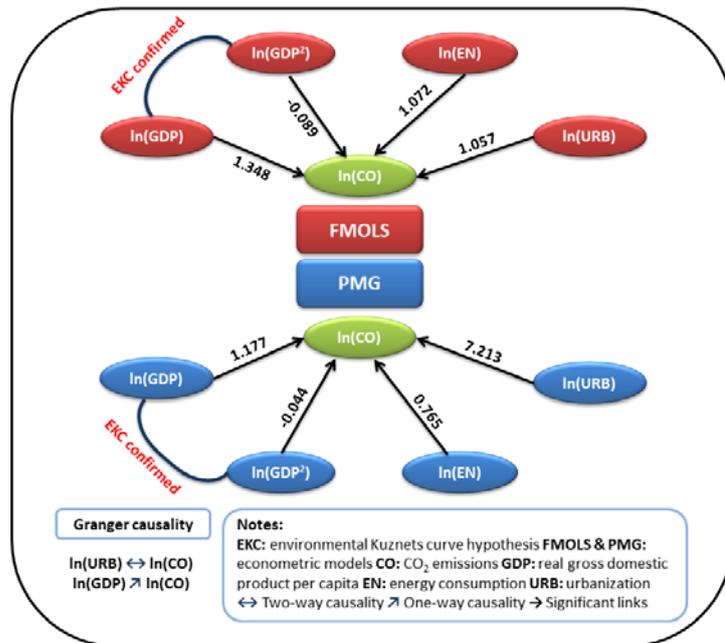
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[10.1007/S11356-021-14732-6](https://doi.org/10.1007/S11356-021-14732-6)



The contribution examines the validity of the environmental Kuznets curve hypothesis, which states that in the early stages of economic growth pollution emissions increase and environmental quality declines, but beyond some level of per capita income this trend reverses, so that economic growth leads to environmental improvement. Our choice of the Southeastern European region has been inspired by the fact that the well-preserved natural resources and rich biodiversity of these countries have been threatened by a sprawl of urban areas and infrastructure projects. Moreover, some of the cities in these countries rank among the worst in Europe in terms of air pollution. The contribution confirms the validity of the hypothesis in the long run in the region as a whole. Several contributions and novelties of the contribution should be highlighted. First, it addresses an important gap in the interdisciplinary literature by investigating the validity of the hypothesis for the examined countries. Second, it examines the impact of urbanization as a demographic factor in determining pollutant emissions. Third, it utilizes the panel Granger causality test based on vector error-correction modelling to investigate causalities among the variables. Last but not least, the research contributes to the literature in terms of methodology by accounting for cross-sectional dependence.

Source: VERBIČ, Miroslav, ŠATROVIĆ, Elma, MUSLIJA, Adnan. Environmental Kuznets curve in Southeastern Europe: The role of urbanization and energy consumption. *Environmental science and pollution research*, 2021, vol. 28, iss. 41, pp. 57807-57817. ISSN 0944-1344.



Slovenian Research Agency

SHORT NAME:

ARRS

YEAR OF ESTABLISHMENT:

2004

CORE ACTIVITY:

It pursues professional, development and executive tasks related to the implementation of the adopted Slovenian Scientific Research and Innovation Strategy or its individual parts, and the implementation of other tasks for promoting scientific research with the aim of providing permanent, professional and independent decisions on the selection of scientific research programmes and projects financed from the national budget.

NUMBER OF EMPLOYEES AS OF 1 JANUARY 2022 IN LINE WITH THE ESTABLISHMENT PLAN:

48

FUNDS RECEIVED FROM THE NATIONAL BUDGET ALLOCATED TO SCIENTIFIC RESEARCH ACTIVITIES IN THE 2022 FINANCIAL YEAR:

EUR 273.8 million

BASIC DOCUMENTS:

- Scientific Research and Innovation Activities Act (Official Gazette of the Republic of Slovenia, No. 186/21)
- Decision establishing the Slovenian Research Agency (Official Gazette of the Republic of Slovenia, No. 103/22 and 125/22)
- Resolution on the Slovenian Scientific Research and Innovation Strategy 2030 (Official Gazette of the Republic of Slovenia, No. 49/22)

ON-LINE ACCESS:

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Research Agency for 2022**

ISSUED BY

**Slovenian Research and
Innovation Agency**

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EDITED BY

Dr. Mojca Jakačič, Dr. Suzana
Seaptefrati, Ana Jakopin

CONTRIBUTIONS AND REVIEW

Prof. Dr. Mitja Lainščak, Dr. Igor Emri,
Prof. Dr. Peter Križan, Dr. Špela Stres,
Dr. Marko Perdih, Dr. Lidija Tičar Padar,
Dr. Primož Pristovšek, Katarina Hren,
Mojca Kastelc Selan, Mojca Boc, Dr.
Niža Razpotnik Viskovič, Simon Ošo,
Dr. Mojca Jakačič, Ana Klinar, M.A., Dr.
Jelka Fric Jekovec, Polona Novak

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