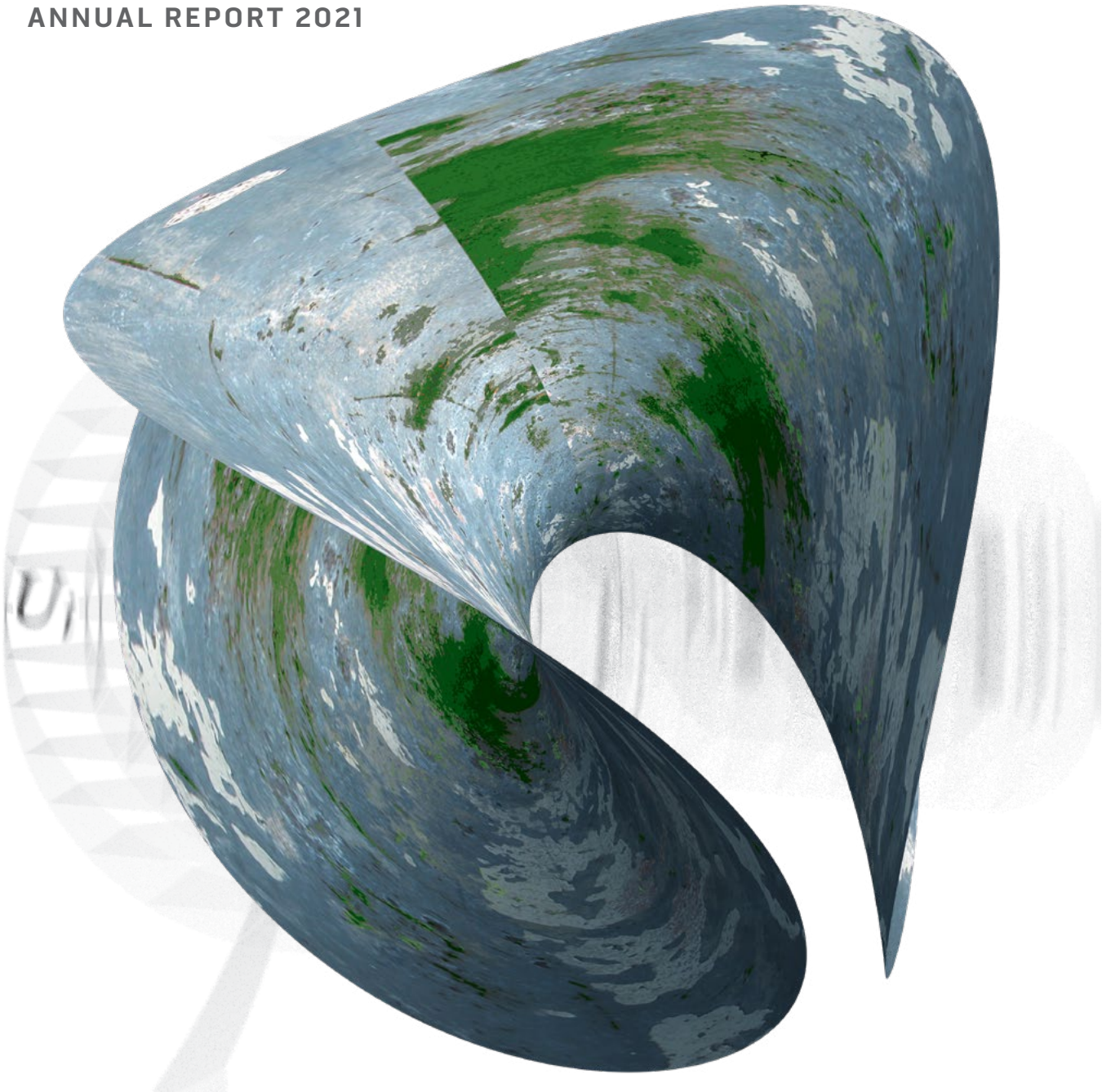


ANNUAL REPORT 2021



Introductory words



The desire for new knowledge is the basis for creating and developing appropriate conditions for life and living. Research depends on several factors that are either necessary or beneficial to obtain results and apply them to everyday life. Recently, the COVID-19 pandemic has been one of the major, if not the biggest challenge for the research world, regarding both its essential mission and the maintenance of basic operating conditions. These challenges have at least partly been alleviated by the increase in government funding for research. In 2021, the Scientific Research and Innovation Activities Act was adopted, which shows a conscious focus on the progress and competitiveness of our country. Researchers thus have solid reasons for optimism, which will however need to materialise in the future.

The Slovenian Research Agency has been pursuing its founding principles ever since its establishment and has been a loyal companion of the research community over the years. As a key national entity in the financing of research activities, it allocated practically the entire budget to research organisations in 2021, in accordance with the provisions in force. Furthermore, and likely for the last time, new research programmes and young

researchers were selected through a single tender, as these areas will henceforth be regulated in accordance with the new law. The Agency has gradually upgraded the information support for processes, the necessity of which became evident during the issues related to the public call for (co)financing of research projects in 2021 due to an outdated and decrepit information system. We have simultaneously devoted a lot of time and effort to personnel policy and laid the foundations for the urgently needed restaffing of Agency personnel.

Of course behind the results are always people who facilitate or enable research activity in Slovenia. Special thanks must be given to employees and researchers involved in the Agency's bodies and activities. It is because of them that the planned tasks are largely carried out within time limits and other norms, making it possible for the researchers to carry out their activities. We believe that we will be successful in 2022 as well, while we prepare for the formal conditions and implementation of the new law, which we plan to accomplish together with all stakeholders in the research community.

Prof. Dr. Mitja Lainščak,
Director



The Scientific Council of the Agency, with the help of the agency's employees, strives to ensure that the agency effectively and transparently facilitates the financing of the best research ideas and thus contributes to a good research atmosphere in Slovenia. Research projects are an important instrument in achieving this goal. It is a demanding process, as we can finance only about two hundred of the approximately one thousand projects submitted. Therefore, by making changes to the rules we are trying to simplify procedures and increase transparency. Among other things, we are constantly updating the database of international reviewers, experts who evaluate research proposals in each scientific field. We will engage more scientific editors to improve the project evaluation process

and in the medium term we foresee the introduction of evaluation panels following the example of the European Research Council and some European research funding agencies.

Already this year, we have enabled a greater flexibility in projects that facilitate the return of successful young Slovenian scientists from abroad. Recently, more possibilities are opening up in the field of multilateral projects and also in the so-called complementary scheme which is an important incentive for applicants of prestigious projects of the European Research Council. Next year, in addition to the already established scheme for young doctors, we will strive to introduce projects for the middle generation of scientists. During the pandemic, the promotion of science has gained additional importance; in this context we are planning a competitive public tender for the best proposals in this field.

Research programmes represent a stable component of research funding. With international reviewers we evaluated a large package of existing programmes in 2021 and selected new programmes for excellent research ideas and priority fields. Excellent research equipment plays an important role in ensuring suitable conditions for research: we are preparing a competitive public tender with a small participation from applicants which will be very interest-

ing especially for smaller research groups and young researchers with excellent ideas and references.

2022 will undoubtedly be marked by the adaptation of the agency's work to the new Research Act. A consultative working group of the agency's representatives and researchers from universities and institutes is helping us in this adaptation with constructive discussions.

The Scientific Council also wants to contribute constructively to the successful transition of research organisations to a new way of working with greater autonomy. In doing so, we are looking for ways to present examples of good practices from across Europe where they already work in this way. We are also thinking about incentives for research organisations to participate in the external evaluation of management with established European experts, and we are preparing for a panel evaluation of research programmes in each field.

The Scientific Council of the Agency remains open to comments and suggestions from scientists for further improvement of the agency's operations as an important element of the research atmosphere in Slovenia and wishes to successfully cooperate with the scientific sphere.

Prof. Dr. Peter Krizan,
President of the Scientific Council
of the Agency

2021 annual report

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Enneper minimal surface
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Contents

In the spotlight:

Prof. Dr. Franc Forstnerič	10
Assoc. Prof. Dr. Borut Klabjan	14
Assoc. Prof. Dr. Anna Sandak	18

Events and news

Financing structure

Institutional financing	26
Research programmes	27
Infrastructural programmes and founder obligations	28
Competitive financing	29
Research projects	30
Young researchers	34
Scientific literature	36
International activities	37

The Agency's international cooperation – highlights

International comparisons

About the Agency

Excellent in Science 2021

Natural sciences	59
Engineering	67
Medical sciences	76
Biotechnical sciences	84
Social sciences	92
Humanities	100
Interdisciplinary research	108



Dr. Jana Kolar
President

The Management Board

The Management Board directs, monitors and supervises the activities of the Agency. It consists of seven members nominated by the Government of the Republic of Slovenia for a term of five years. In 2021 the Management Board operated in the following composition:



Prof. Dr. Egon Pelikan
Vice-president



Dr. Emilija Stojmenova Duh



Dr. Tonček Kregar



Dr. Justina Erčulj



Prof. Dr. Janez Bonča



Prof. Dr. Marta Klanjšek Gunde

The Scientific Council

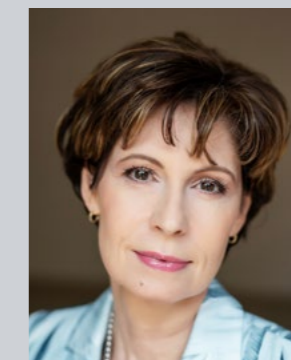
The Scientific Council is the Agency's highest professional advisory body. It consists of six members, covering all of the research studies within the Agency's classification. The Scientific Council was appointed by the Minister of Science, based on the proposal of the Science and Technology Committee of the Republic of Slovenia. The five-year term of current members ends in 2025.



Prof. Dr. Peter Križan
president
Natural Sciences and Mathematics



Prof. Dr. Željko Knez
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

Photos:
Peter Irman

ARRS funding mechanisms

	Doctoral level up to doctoral degree	Post-doctoral level up to 3 years after attaining a doctoral degree	Post-doctoral level until 5 years after attaining a doctoral degree	Young doctor up to 10 years after defending the first doctorate	Established researcher
				Research programme <i>Public tender and call</i>	Research programme <i>Public tender and call</i>
		Post-doctoral research project (basic or applied) <i>Public call for (co-)financing research projects</i>	Research project (basic or applied) <i>Public call for (co-)financing research projects</i>	Research project (basic or applied) <i>Public call for (co-)financing research projects</i>	Research project (basic or applied) <i>Public call for (co-)financing research projects</i>
Young researchers <i>Public tender MR and MR+ (calls from research organizations)</i>				Young mentor <i>Public tender MR</i>	Mentor MR and MR+ <i>Public tender MR</i>
		The ERC complementary scheme <i>Public tender for (co-)financing adapted research projects</i>	The ERC complementary scheme <i>Public tender for (co-)financing adapted research projects</i>	The ERC complementary scheme <i>Public tender for (co-)financing adapted research projects</i>	The ERC complementary scheme <i>Public tender for (co-)financing adapted research projects</i>
		Visits to ERC Grantees <i>Public tender</i>	Visits to ERC Grantees <i>Public tender</i>	Visits to ERC Grantees <i>Public tender</i>	Visits to ERC Grantees <i>Public tender</i>
				The lead agency scheme <i>Public tenders of partner LA agencies</i>	The lead agency scheme <i>Public tenders of partner LA agencies</i>
MSCA Seal of Excellence <i>Public call</i>	MSCA Seal of Excellence <i>Public call</i>	MSCA Seal of Excellence <i>Public call</i>	MSCA Seal of Excellence <i>Public call</i>	MSCA Seal of Excellence <i>Public call</i>	MSCA Seal of Excellence <i>Public call</i>
		Reimbursement of expenses – Horizon Europe <i>Public tender</i>	Reimbursement of expenses – Horizon Europe <i>Public tender</i>	Reimbursement of expenses – Horizon Europe <i>Public tender</i>	Reimbursement of expenses – Horizon Europe <i>Public tender</i>
				JPI Urban Europe <i>International tender</i>	JPI Urban Europe <i>International tender</i>
					NORFACE <i>International tender</i>
		International bilateral projects <i>Public tenders for individual countries</i>	International bilateral projects <i>Public tenders for individual countries</i>	International bilateral projects <i>Public tenders for individual countries</i>	International bilateral projects <i>Public tenders for individual countries</i>
COST actions	COST actions	COST actions	COST actions	COST actions	COST actions

- Research programmes
- Research projects
- Young Researchers
- International cooperation

Information on other available mechanisms available at: <http://www.ars.gov.si/sl/razpisi/>

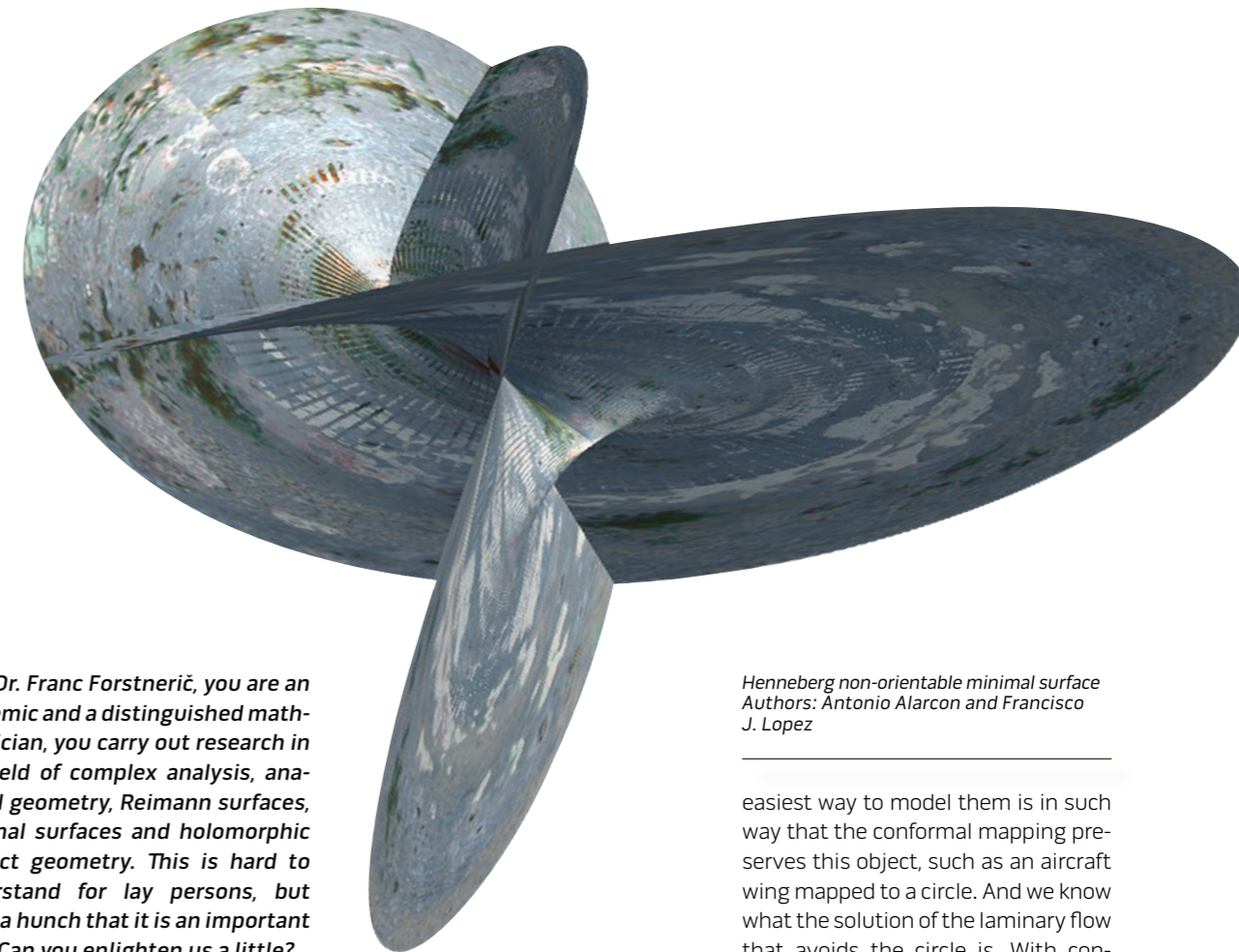
IN THE SPOTLIGHT

Prof. Dr. Franc Forstnerič is a mathematician, and this year's recipient of the prestigious European Research Council (ERC) project for established researchers. He received almost EUR 1.48 million for the project called Holomorphic Partial Differential Relations - HPDR that he will carry out at the Faculty of Mathematics and Physics, University of Ljubljana. This is the first ERC project in the field of mathematics in Slovenia.

Professor Forstnerič deals with complex variables and holomorphic mappings. He says that the project is to provide a more precise determination of the position and role of Oka variables in the classification of complex variables and a better understanding of the relation with metrical properties and other flexibility properties. The Oka theory provides solutions for a series of natural problems in a complex analysis and geometry; its applications also extend into several other areas of mathematics and beyond. He has been awarded the ERC project grant for the development of an extended form of the above-mentioned theory.

HOLOMORPHIC PARTIAL DIFFERENTIAL RELATIONS

Prof. Dr. Franc Forstnerič
ERC grant recipient



Prof. Dr. Franc Forstnerič, you are an academic and a distinguished mathematician, you carry out research in the field of complex analysis, analytical geometry, Riemann surfaces, minimal surfaces and holomorphic contact geometry. This is hard to understand for lay persons, but gives a hunch that it is an important field. Can you enlighten us a little?

A complex analysis means that it is built upon complex numbers. These are numbers that we can imagine as points in a plane. They have a real part and an imaginary part which serves as a range of complex numbers. In this range we can solve any polynomial equation, while we cannot do so in the real range. We say that this range is algebraically closed. On this range we build complex Euclidean spaces. This is a model for complex variables. We can imagine them as objects, or some type of surface that must have even dimensions. These are higher dimensional surfaces that are really modelled with small fragments of those surfaces. The way they are

Dr. Franc Forstnerič
Photo: Peter Irman

Henneberg non-orientable minimal surface
Authors: Antonio Alarcon and Francisco J. Lopez

stacked and glued with a special class of functions is called holomorphism. Holomorphic functions or mappings are the most important type of mappings. With ordinary, two-dimensional surfaces, the point is to look at mappings that preserve angles and orientation. This means that you have to have a surface where you are able to measure angles. And when we look at a pair of curves that intersect at a certain point with a certain angle and map them with a holomorphic mapping, the mapped curve must also intersect at the same angle. This conformity is very important due to its use. For example when we want to model laminary flows like those of air or liquid around a certain object, the

easiest way to model them is in such way that the conformal mapping preserves this object, such as an aircraft wing mapped to a circle. And we know what the solution of the laminary flow that avoids the circle is. With conformal mapping, we can map it back and get a picture of the laminary flow around the object. This way we can calculate the buoyancy of the object. In a higher dimension, the matter is somewhat more complicated, as there are not only angles but also additional information. But it is about the method of complex variables. And complex variables are well-studied objects, as this is the field of complex geometry which is also used in mathematical physics and broader.

Many speak of the beauty of mathematics. Where do you see this beauty? It seems to me that the research in mathematics is challenging in an intellectual as well as in an aesthetical sense. We have results that are technically important, but are not attrac-

tive. But we also have another type of results that are beautiful and based on some brilliant ideas that are not that technically complicated. The best feeling is when you think about problems for a long time, about the interdependence of concepts that create disorder at the beginning, and in time you start to recognise these internal connections between objects. Then you come up with an idea and are able to prove something beautiful. The most beautiful theorems are those that you can write down in a simple and short way, even though they are not evident. I was attracted to mathematics and its aesthetics, its inner order, from the very start. Mathematics is the creation of order in nature, in space, in all things. Mathematics can also be nicely connected to visual art.

For your extensive work you have successfully obtained an ERC project for established researchers, which is considered to be among the most prestigious in science. You succeeded with your presentation of the Holomorphic Partial Differential Relations project. This is the first ERC project in mathematics in Slovenia and that carries a special weight. How did you succeed, considering the fact that the research topic represents such an abstract subject?

ERC projects are awarded at three levels, and the smallest number of them is awarded in the group for established researchers. There were nine of those in mathematics, for all fields of mathematics.

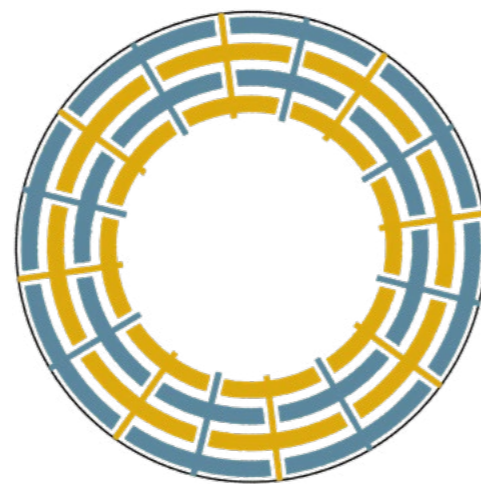
The term "holomorphic partial differential relations" is similar to "differential equations", just somewhat broader. Differential equations are equations that contain an unknown

function or mapping and the partial derivatives and relations between them. If we say equation, we mean equality, but we can also use the weaker concept of inclusion. This is a differential condition which is not

Mathematics is the creation of order in nature, in space, in all things. Mathematics can also be nicely connected to visual art.

exactly equality, but nevertheless connects the value and derivatives of the function or mappings. What is it about? If I have certain complex variables, I would like to know how many mappings of a certain special class of complex variables, called affines, there are into it. These can be inserted into a Euclidean space, into subsurfaces. They are called Stein variables, after the German mathematician Carl Stein who was the first to introduce them in 1951, and they represent a field of intensive research. We are interested in holomorphic mappings from such Stein variables into a certain concrete variable. The question is if I can find holomorphic mappings from Euclidean spaces into the most complex variable. It turns out that sometimes I can, and sometimes I cannot, depending on the complex structure in the variables. Here we have a dichotomy between two phenomena that are typical of complex structures. One phenomenon is called rigidity, the other one flexibility. The best known rigidity is Kobayashi hyperbolicity (after the Japanese mathematician Kobayashi). This concept means that I do not have constant holomorphic mappings from a complex plane into a given variable. The reverse concept, flexibility, means that I have many such mappings and I have to determine what 'many' is in

this sense. I have introduced the concept of Oka variables to this field. Oka Kiyoshi was a Japanese mathematician who started to explore this field and I have introduced this concept in his honour. In 1989, the French-Russian mathematician Mikhail Gromov introduced new ideas to the field. I have researched this first and characterised the Oka variables in many different ways. This means that I can change any mapping from an arbitrary Stein variable into a given variable in such way that I deform it into a holomorphism. And all these properties are now understood in the Oka variables. This was a long development, but, also with my endeavour, the Oka theory was introduced into the classification of mathematical fields. I consider this



*The Nadirashvili labyrinth used in the construction of bounded metrically complete minimal surfaces in Euclidean 3-space
Authors: Antonio Alarcon and Francisco J. Lopez*

a permanent contribution to mathematics and as the second such case in Slovenia.

With fundamental ERC projects there are no limits, as they finance applied

as well as fundamental science. They understand that there is no applied science without fundamental science; new ideas are always born in fundamental science and then applied. It is difficult to foresee in advance what will happen.

The ERC grant awards you approximately EUR 1,48 million for a period of five years. How will you organise your research? How will you select associates? Will the group only include Slovenian researchers or do you intend to attract foreign researchers as well?

I have a lot of freedom as far as this is concerned. In practice, this money means a partial employment for me, but I shall also include some post-doctoral researchers, let us

*Dr. Franc Forstnerič
Photo: Peter Irman*

say two, and one senior researcher. I have not planned for doctoral students, as we get those already within the ARRS research programme. The ERC plan is quite flexible, and includes money for equipment, travelling, conferences, publicly available publications etc. I know a few domestic colleagues whom I will partially include in the project. But my options are limited, as there are not enough of us to cover the entire project as well as our pedagogical obligations. And the search for post-doctoral researchers is not easy, as one has to find good people. I have found one good researcher who obtained a doctorate degree last year in Rome. We will have to publish additional calls. There is also a never-ending problem of poor attractiveness, probably due to financial incentives. But I hope we will manage somehow.

Considering the fact that you are the first Slovenian mathematician to receive an ERC grant what advice would you give to your colleagues who would like to apply to ERC calls in the future? Which are the most important conditions that a candidate must meet when applying?

This somewhat depends on the level that the candidate is applying for. If we are talking about established researchers, I have a feeling that the Committee wishes to finance ground-breaking ideas. If the project is set out as some type of technical continuation of an already established research programme, the possibility is smaller. But if you have your own ideas that seem interesting and display a possibility of success while opening new areas, the possibility is greater. The proposal must be balanced between the possibility of success and the possibility of realisation.





OPEN BORDERS

Assoc. Prof. Dr. Borut Klabjan
ERC grant recipient

Dr. Borut Klabjan, historian and scientific advisor at the Institute for Historical Studies of the Koper Scientific Research Centre, shares with the generations to whom he lectures his extensive scientific work and an insight enabling them to understand historical periods that in a way define the contemporary world. His broad scientific outlook, which is quite an indispensable asset to a historian, has been expanded at many universities and institutes in Central Europe. In the framework of the prestigious ERC Advanced grant for established researchers he is only the second Slovenian recipient in the field of social sciences and humanities. His project will study the diverse forms of integration that characterised the Alpine-Adriatic region during the Cold War. According to Dr. Klabjan, the research will provide an elaborate impression of Europe from the end of the World War II to the present day.

Dr. Borut Klabjan, you are a historian who studies the political and cultural history of Central and Eastern Europe in the 19th and 20th centuries. Your scientific interest also focuses on contemporary history. The body of your research is too vast to be covered briefly, but let me ask you anyway: what is your main focus?

Currently I am mostly focused on the issues of borders and changes in the northern Adriatic area in the 20th century, roughly at the transition from the old world that was disrupted by the World War I, and the resulting impact on the northern Adriatic region. I do not interpret this as merely local history, but as an understanding of



wider global processes. I am focusing on our domestic area, as this is the convergence point of virtually all the problems and issues that concerned world history at that time.

Your studies are rich in diversity. You have attained your education in an environment that we consider to be part of Central Europe – Trieste, Ljubljana, Bratislava, Venice, Prague, Berlin. What motivated you to study Central and Eastern Europe? From which point of view is the period of the 19th and 20th centuries interesting, perhaps even provocative and misunderstood?

I guess what attracted me was that all the places that you mentioned somehow feel like home. At the same time, the reason for my interest is that this is where the changes started when I began my studies. In the 1990s, this region underwent momentous changes. I realised that the changes do not originate from today,

Dr. Borut Klabjan
Photo: Tomaž Primožič

but have their roots in history. I wanted to address questions or issues that, although contemporary, reach far into the past, not only to the 20th century, but also the 19th century.

You are a recipient of prestigious funding from the European Research Council (ERC). You have been awarded 2.5 million EUR over a five-year research period for the Open Borders project. What will you study?

The ERC Advanced grant is very important in terms of project recognition, not only because of financial backing, but also because it gives the recipient a kind of prestige and satisfaction for all the work done thus far. The project will study the Alpine-Adriatic region which I am trying to understand and place into the wider European history. My starting point is that the current history of Europe is interpreted as the history of a split continent, a dichotomous continent divided into separate parts during the Cold War. That is only partially true. The project aims to remind the local, European, and global pub-

Cross-border "friendship track" meeting between Italy and Yugoslavia in 1985
Photo: Mario Magajna
Source: Department of History and Ethnography at the National and Study Library, Trieste, fund name: Primorski dnevnik.

lic that European history needs to be considered differently when seen from the perspective of the Alpine-Adriatic region. The perspective of Berlin, or divided Germany and divided Berlin, as we normally see it, is different.

Your project is one of the rare humanities projects to receive funding, which undoubtedly deserves additional attention. How did you prepare your presentation to convince the ERC committee?

There are a lot of applications, so the competition is quite tough. I started thinking about the project a few years ago and have been continuously adding to it and refining it in several stages. It took several years to prepare. Ultimately, when I thought it was the right time to apply, it all converged with the theme and events that we are



The first "Open Border" walking campaign between Italy and Yugoslavia organised in 1981
 Photo: Mario Magajna
 Source: Department of History and Ethnography at the National and Study Library, Trieste, fund name: Primorski dnevnik.

Will your work involve field research or will you just study archival material? Will you form your own research team to carry out the project? If yes, what kind of researchers will you engage, only historians or others as well?

The research will be carried out at the Scientific Research Centre in Koper. This is the host institution where I have been working as a researcher since the beginning of my career, and where I am now a scientific advisor at the Institute for Historical Studies. The project will be carried out within the framework and with the help of the Institute of Historical Studies staff. I have worked with some of the collaborators for many years, but they will not be the only people involved. I will also engage researchers from other backgrounds, for example from

the University of Ljubljana, and from abroad – from Italy, Croatia and Austria. A group of about ten researchers will be formed, particularly historians who will also use other research methods, mainly from the fields of sociology and anthropology. The project will not focus merely on archival sources, but will combine different methods, especially fieldwork, such as interviews with people, and other methods that are part of our methodology. This way, we will interweave a broader spectrum of humanities and social sciences.

What does selection from among close competition oblige you to do? Humanities projects do not often pass through the selection sieve.

The competition is fierce. I applied to many previous calls and was selected for other grants and projects, either at the Slovenian or international level. This means that when it came to the ERC application, I had already been kind of introduced to the task of application. I probably convinced the committee that I intended to contin-

going through at the moment. I submitted my application before the war in Ukraine broke out, and the interview with the committee took place in the early days of the war. I believe that this factor also influenced the commission's decision. The current narrative shows precisely the fact that we are defining Europe as "one against the other", as "East against West" and so on. My project looks at Europe's past from a slightly more complex point of view and not in such a black and white perspective.



Cross-border cooperation between the two police forces in the 1970s
 Photo: Mario Magajna
 Source: Department of History and Ethnography at the National and Study Library, Trieste, fund name: Primorski dnevnik.

ue my research by interweaving various contents, not only those of a historical nature. The results will be of interest to the general public as well as the narrow historical profession.

The title Open Borders suggests that the research will shed new light on the understanding of the Alpine-Adriatic region which may be exciting for the general public, but could it also be misunderstood?

I would not say misunderstood, but rather that we have not been thinking about possible misunderstandings. With the Open Borders project, I will try to answer questions that go beyond the Alpine-Adriatic region. This region is supposed to offer an alternative paradigm to the closing of borders in times of crisis, which is what we have experienced in recent years when var-

ious issues have arisen from the pandemic to terrorist attacks. The short-term instinct of individuals may be to hermetically seal the borders, but this has not led to any effective solutions to particular issues. Starting from the historical experience since the end of the World War II in the Alpine-Adriatic region we can see that, at a time when Europe was effectively being dismantled, individual countries belonging to different military, political and economic structures (here I mean Italy, Slovenia, and Croatia as part of Yugoslavia, and Austria, some of the countries were neutral, in NATO or non-aligned) were able to establish some kind of cooperation which was then extended to the whole of the Alpine-Adriatic region. This is how I am trying to offer a different picture of Europe at that time, one that was not split in two, and at the same time offer an alternative for the future of Europe, where the solution to individual issues lies not in closing borders but in cooperation. If this was possible during the Cold War, it is also possible in the Europe of the future.

Given your experience of applying for ERC funding, what advice can you give to fellow humanists who want to apply? What is most important when applying?

I think the most important thing is that you keep thinking about your project. I did not leave everything to the last minute, but instead elaborated the project over a long period of time. Take the advice given by professionals who work on this at the national level. It is important to listen to the experience of those who have been there before you. You need to choose the right research environment and host institution and make sure that your curriculum is appropriate for the grant or the funding you are competing for. In any case, the content of the project must be refined to the last detail. Every word counts, and because the multi-member committee has a lot to do, every little thing can make the difference between you and someone else. With very good professionals submitting applications the competition really is intense.

PROJECT ARCHI-SKIN

Assoc. Prof. Dr. Anna Sandak
ERC grant recipient

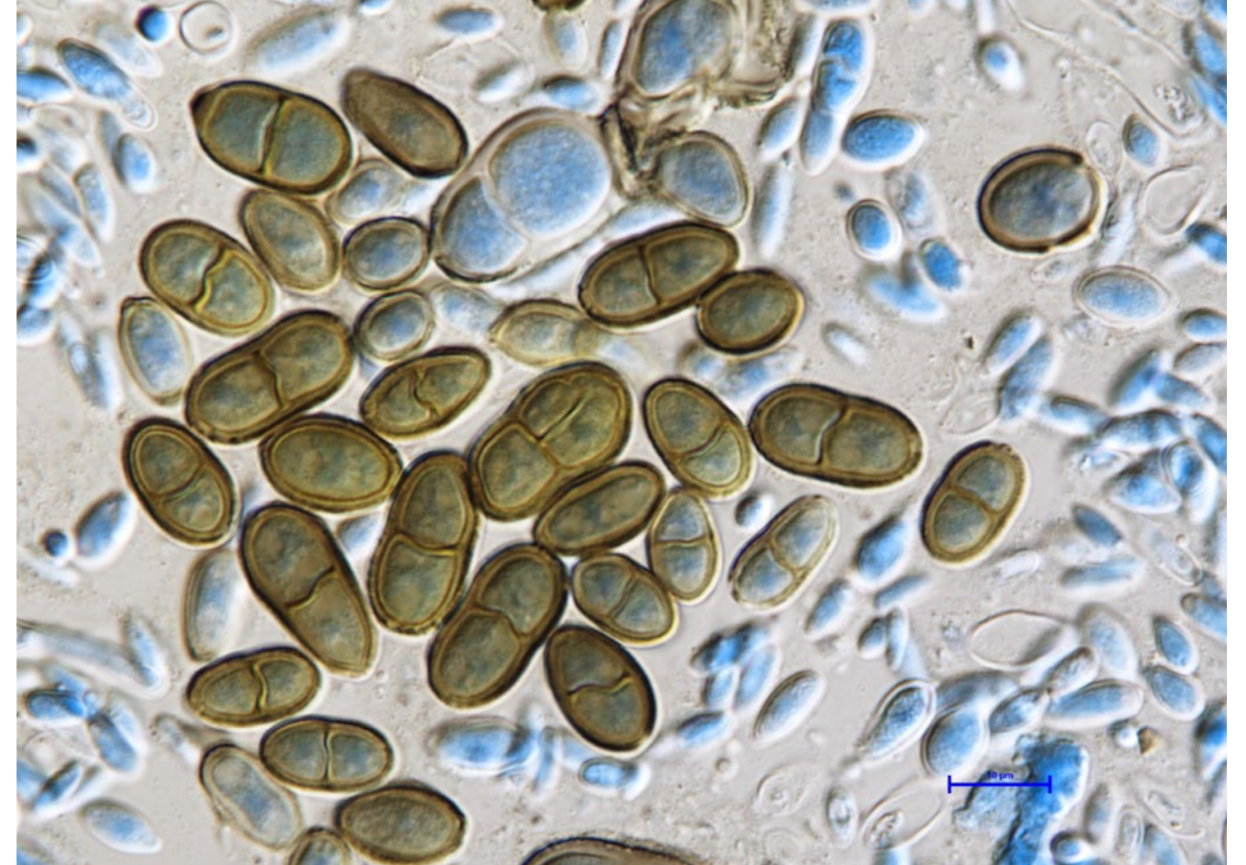


Dr. Anna Sandak, a successful Polish-born researcher with a PhD in wood science and an MSc in biology, was selected during the close competition for ERC project funding. She will lead her successfully launched ARCHI-SKIN project, a five-year

endeavour worth almost 2 million EUR, at the InnoRenew CoE host institution. Dr. Sandak submitted her project to the new ERC Materials Engineering panel within which only 12 projects were selected, thus indicating her remarkable

success. At the same time, this is the first ERC project in Slovenia to consolidate an independent research career.

As Dr. Sandak explains, she will develop a biofilm that protects surfaces made of biomaterials, concrete, plastics and metals, while at the same time having a natural self-repairing function. This innovation will accelerate the transition from traditional material concepts to the development of engineered living materials capable of interacting with each other and adapting to environmental change. This is a new concept in material protection, and the presence of living cells means that it has yet to be embraced by users. This innovation will certainly strengthen cooperation with industry in the future. The complexity of the project will go beyond laboratory research. The latest live-cell imaging tools will be used, as well as data science and machine learning.



Dr. Anna Sandak, you are a researcher at the InnoRenew CoE Centre of Excellence for Research and Innovation in Renewable Materials and Healthy Living. It is an institution with an outstanding research programme which is at the heart of a healthy environment. What attracted you to this field of work?

The research at InnoRenew CoE targets renewable materials and sustainable buildings, with emphasis on innovative approaches to the use of wood. Our core focus is on the creation of better built environments for people and the environment, using renewable materials. In 2017, I was invited to prepare a research and development plan and lead the wood modification group, which gives me a lot of freedom and independence in future research. We are approaching wood modification and functionalisation in new and alternative ways while taking into consideration the

Dr. Anna Sandak
Photo: Aleksander Zdjarsky

intrinsic properties of the material, fit-for-purpose performance and environmental aspects. I believe that our uniqueness is the implementation of biomimetic principles in the development of new materials and modification processes. This research path brought me to the ERC ARCHI-SKIN project within which we will advance the development of engineered living materials that can interact, adapt and respond to environmental changes.

You have a PhD in wood science and a Master of Science in biology. How do you combine the two fields in your research work? Have you found an interdisciplinary approach to research?

Indeed, I am a biologist and a materials scientist. The ARCHI-SKIN project allows me to integrate my experience related to multiscale characterisation and performance of biobased building materials with novel concepts of developing a living coating system. I believe that interdisciplinarity is key

Fungal cells that will be embedded in the living coating system developed by the ARCHI-SKIN project.
Photo: Faksawat Poohphajai (InnoRenew CoE).

to new discoveries today. I'm leading a wood modification group; a team of nine researchers from six different countries, including chemists, physicists, material scientists, engineers, biologists, and psychologists. I would like to consolidate my research with the ARCHI-SKIN project to achieve scientific excellence and push conventional materials engineering in a new direction.

You have been awarded a prestigious ERC project to consolidate your independent research career, and you will lead a 5-year project worth around 2 million EUR at the host institution InnoRenew CoE. What specifically will you be researching?

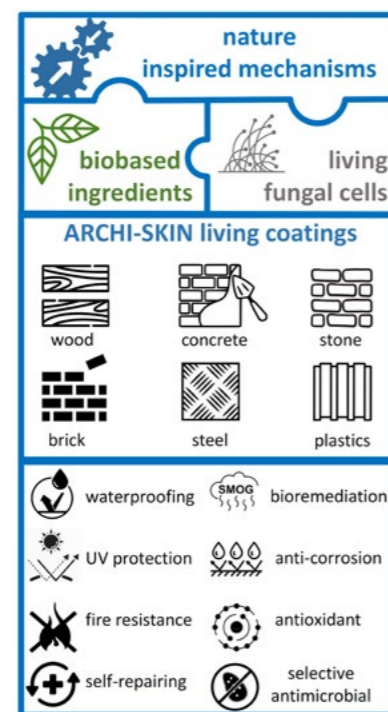
The overall objective of the ARCHI-SKIN project is to comprehensively evaluate the chemistry, structure and interaction of fungal biofilms, and to use what we learn to develop

a living architectural coating system. We will explore the design principles underlying fungal biofilms to advance the knowledge of how they work and what their properties are. To achieve this, we will develop new laboratory routines and use the latest tools in live cell imaging, data science and machine learning. My idea is to develop a bioactive protective coating system that works in harmony with nature and benefits from the synergetic efforts of living fungal cells, bio-based ingredients and bioinspired concepts for materials design.

How does one prepare an application for the ERC, how should you formulate your research focus in order to compete?

If you are referring to the preparation of a winning project application, I think there is no universal recipe to guarantee success. Nevertheless, some elements should be present in a good project proposal. The project should target needs that are stated in the specific call, which seems obvious. However, as scientists we are often tempted to propose something that is extremely interesting for us, but not necessarily for rest of the world. ERC calls are very flexible in this regard, there are 27 peer review panels covering most fields of science. Any topic can be submitted, but proposals should be "high-risk/high-gain" with objectives that are ambitious and beyond the state of the art. This gives a lot of freedom, but the proposed science must be possible to implement given what

you describe in the work plan. Finally, the principal investigator should convince reviewers that he/she is capable of conducting ground-breaking research and successfully executing the project. I believe that this is possible to achieve by working with a good, inspiring team and with support from the host institution.



The ARCHI-SKIN project concept.

You are doing fundamental research. Are you considering the possible applications of your research results, even though this is not an explicit requirement of the ERC?

Within ARCHI-SKIN we will develop a biofilm that protects biomaterial,

concrete, plastic and metal surfaces. The coating formulation will be optimised for various climates and possess novel properties such as self-repair and bioremediation. I believe that this will be highly attractive to the industrial sector, but I'm also aware of potential upscaling issues. Moreover, we are proposing a new concept of material protection, that, due to the presence of living cells, will need to be accepted by end-users. All those aspects will be researched during the project, and I hope to reinforce collaboration with industry in coming years.

ERC grants are prestigious and lend a great deal of recognition to scientific work. What advice would you give to your fellow researchers who want to apply for an ERC call? The competition is incredible every year, what advice could you give them?

Indeed, the competition is intense. The success rate this year was less than 12% but the grants give a lot of opportunities, so it is definitely worth trying. You should think out of the box and convince reviewers that you are the one who should conduct this research. You should demonstrate your passion, especially during the interview process during which you must be confident but not arrogant. There are different funding schemes depending on the stage of your career, so a second chance is possible. However there are certain threshold restrictions for re-applicants, so prepare your proposal very well and try! – he who never plays, will never win.

EVENTS AND NEWS

ARRS Day 2021: Supporting Excellence

The basic goal of public communication is to contribute qualified reporting to the public debate on science and the scientific system in the Republic of Slovenia.

The Agency has been increasing its science promotion activities since 2014. Communication with the public is based on the principles of openness, responsiveness and informativeness. Openness is understood as dialogue, responsiveness as appropriateness, and informativeness as providing information on current topics of Slovenian science and the scientific system.

In December 2021, the Agency organised the "ARRS Day: Supporting Excellence" for the fourth time. Due to the COVID-19 pandemic, the event was carried out online. The event took place under the auspices of the President of the Republic of Slovenia, Borut Pahor.

The introductory part of the event presented innovations and trends within the Agency's activities.

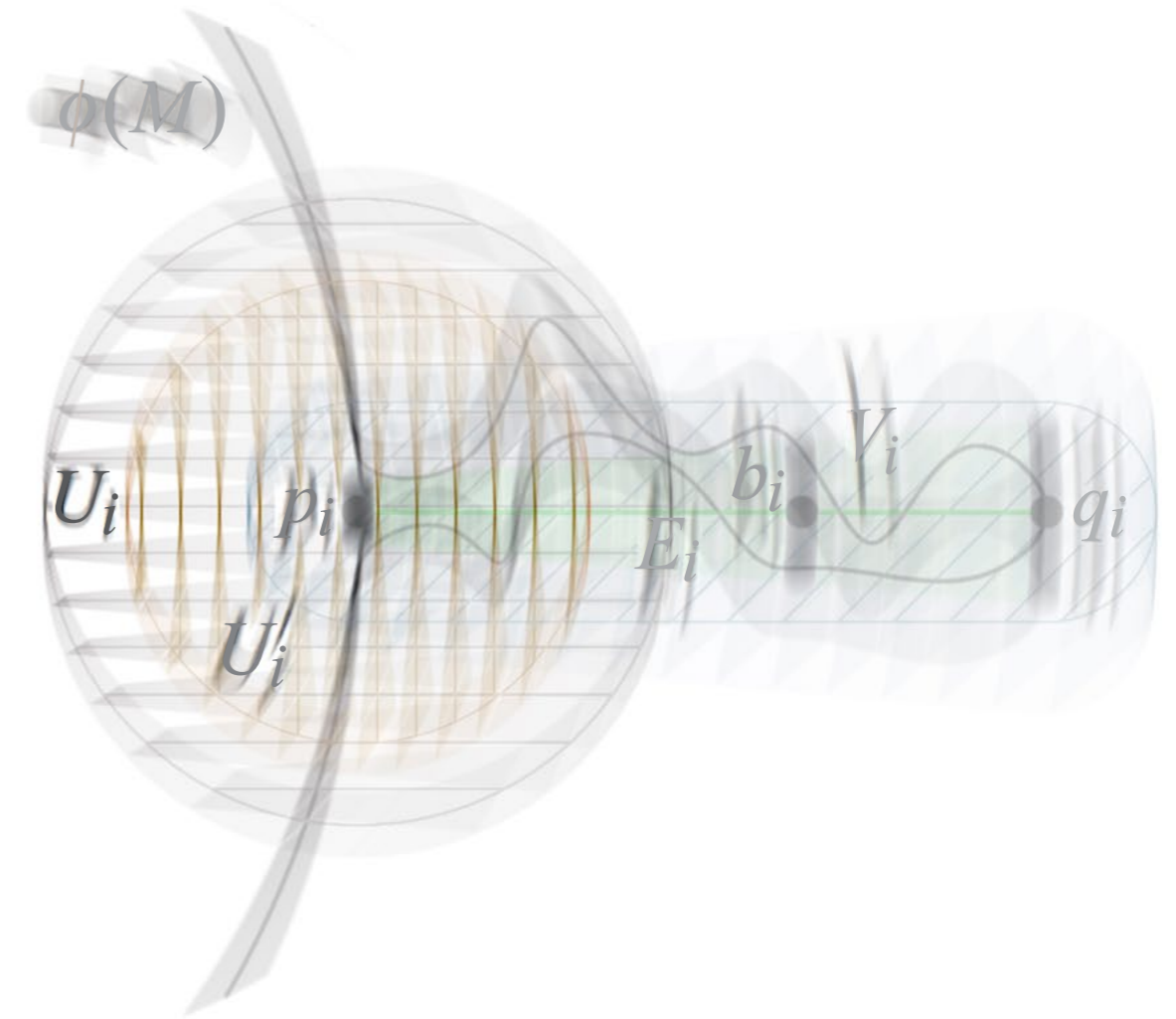
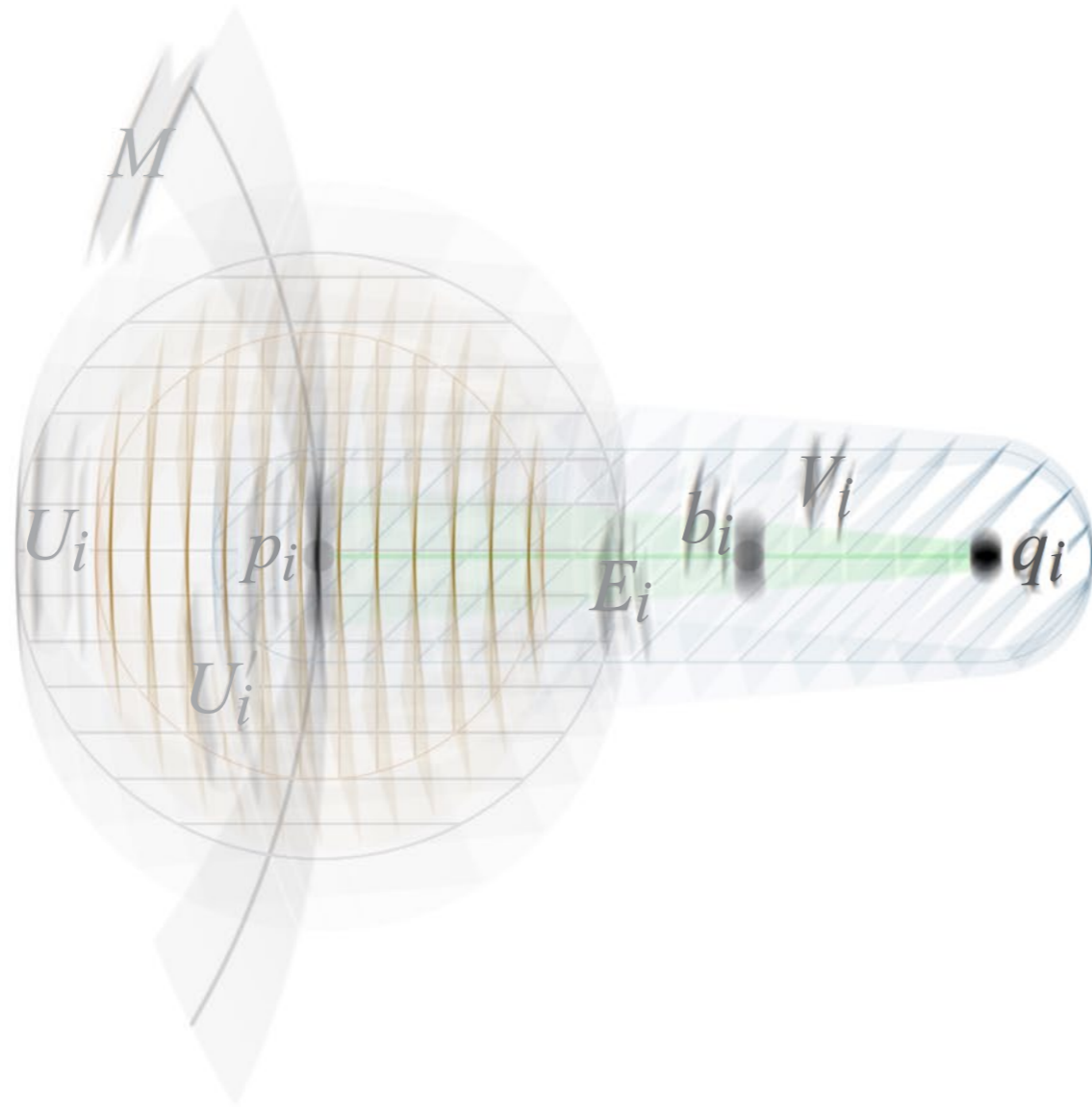
As part of ARRS Day 2021: Supporting Excellence a formal reception of the new generation of young researchers was held, also in a virtual form as a ceremonial address.

The keynote speaker was Dr. Mitja Slavinec, Secretary of State at the Ministry of Education, Science and Sport of the Republic of Slovenia.



The most prominent scientific achievements were presented as part of the

event. Within the science promotion project of ARRS, called Excellent in Science 2021, **54 research achievements** were chosen in 2021. Online presentations of the 21 most prominent from all scientific fields can be watched at www.danarrs.si.



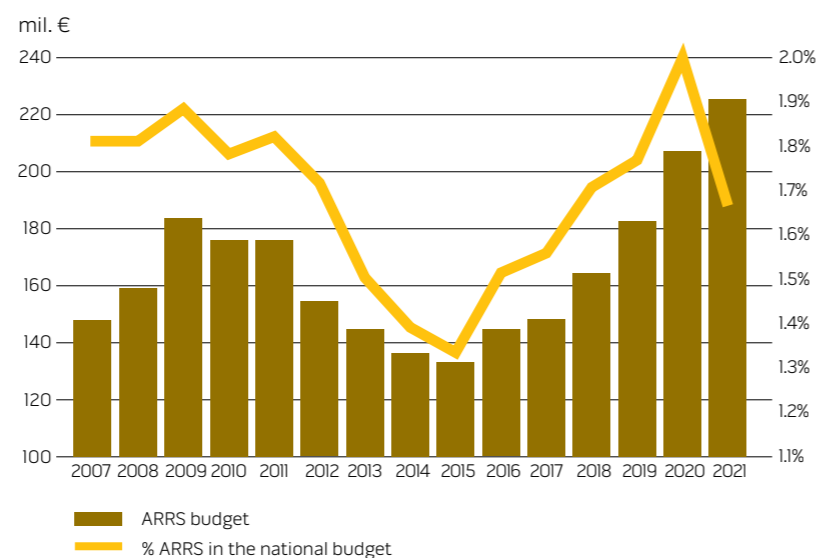
FINANCING STRUCTURE

In 2021, the budget of the Republic of Slovenia, through the Public Agency for Research Activities, provided EUR 225.1 million for the financing of research activities, which is EUR 18 million or almost 9% more than the year before.

The Agency's budget for research activities increased from EUR 175.9 million in 2011 to EUR 225.1 million in 2021, representing a difference of 27.9%. The first increase of funds after 2011 was recorded in 2016, and was 8.6% greater than the year before.

In 2016, 1.52% of the budget of the Republic of Slovenia was dedicated to the Agency for research activities, in 2021 this share was 1.67%.

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



A detailed overview of the financing of research activities is available on the following website: <http://www.arrs.si/sl/finan/letpor/>. More data and charts on the scope and structure of financing received by the Agency from the national budget are available on the following website: <http://www.arrs.si/sl/analize/obsegOI/pr.asp>.

Image on previous page:
Exposing edge points of domains in Riemann surfaces
Authors: Antonio Alarcon and Francisco J. Lopez
Editing: Žak Prinčič, M.Sc.

Agency funds in 2021

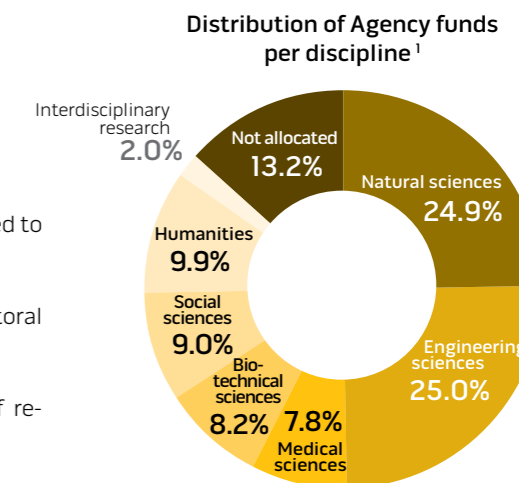
Research programmes: long term financing of research, which is expected to be relevant and applicable over a longer period of time.

Research projects: co-financing of fundamental, applied, and post-doctoral research projects, targeted research project programmes.

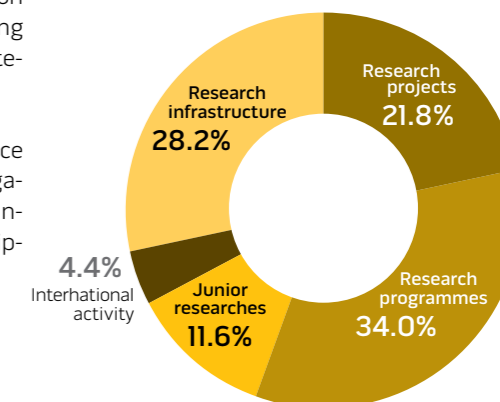
Young researchers: financing of postgraduate studies and training of researchers aiming to obtain their doctorate.

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

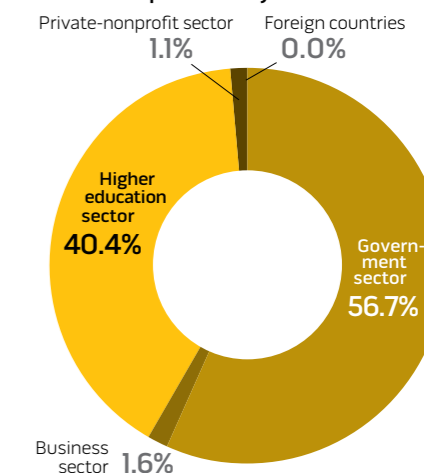
Research infrastructure: co-financing of infrastructure programmes, science and popular science periodicals and scholarly monographs, founder obligations, the COBISS system and other library and information activities and infrastructures, international journals and data collections, and research equipment.



Distribution of Agency funds per mechanism section



Distribution of Agency funds per activity sector

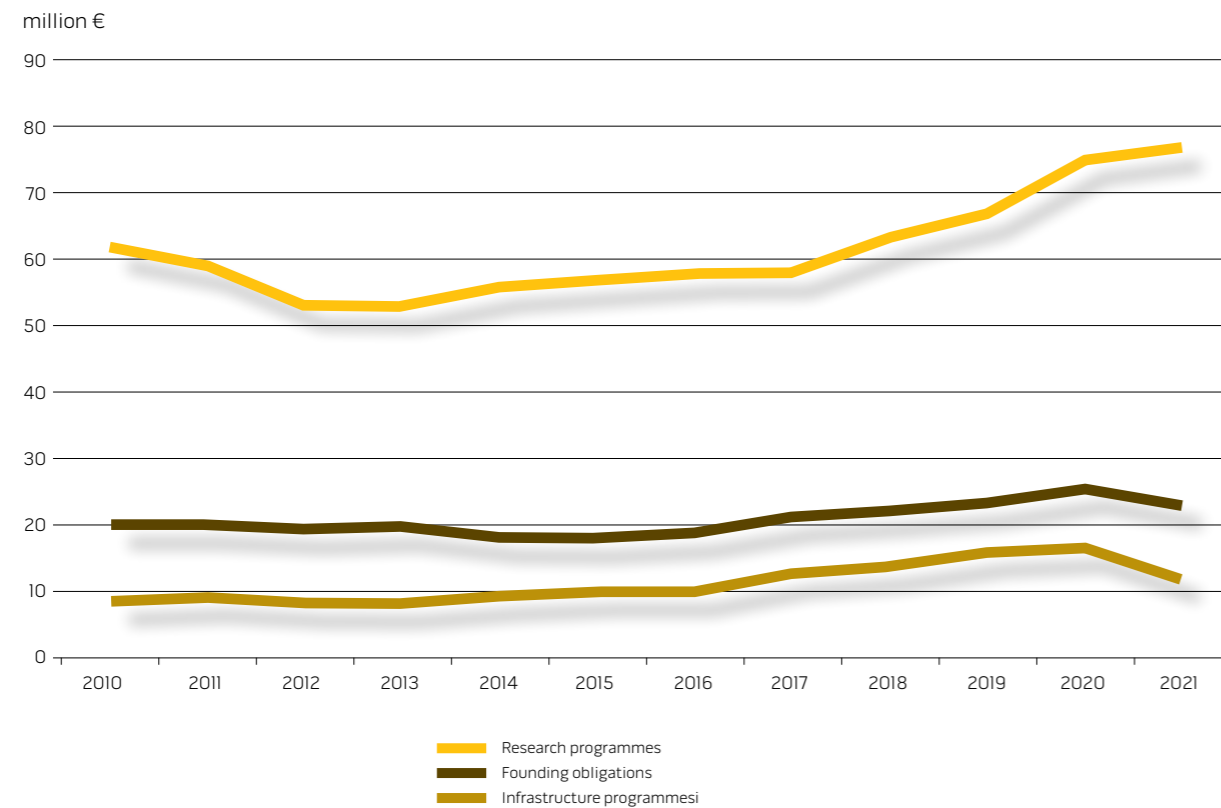


¹Funds for founder obligations, infrastructure programmes, international promotion of science, the operation of Slovenian associations around the world, promotion of applications to EU projects; OSIC and foreign journal databases cannot be broken down per discipline and are therefore not taken into account.

Institutional financing

Research programmes	EUR 76.5 million
Founder obligations	EUR 22.5 million
Infrastructure programmes	EUR 11.8 million

Research programmes, infrastructure programmes and founder obligations comprise a stable aspect of research financing. Due to austerity measures, the financing of research programmes in 2012 was reduced by 10% compared to the previous year. In 2014 and 2015, the Agency made use of long term stable financing to ameliorate the reduction of funding from 2012, allowing for an increase in research programme funding. The trend of slight growth in research programme funding was continued in the period from 2016 to 2021.



Research programmes

In 2021, the Agency dedicated EUR 76.5 million for the co-financing of research programmes, which represents 34.0% of the total budget. 302 research programmes were financed in 2021, of which 64 were in the field of natural sciences, 88 in engineering, 36 in medicine, 21 in biotechnology, 49 in the social sciences, and 44 in the humanities.

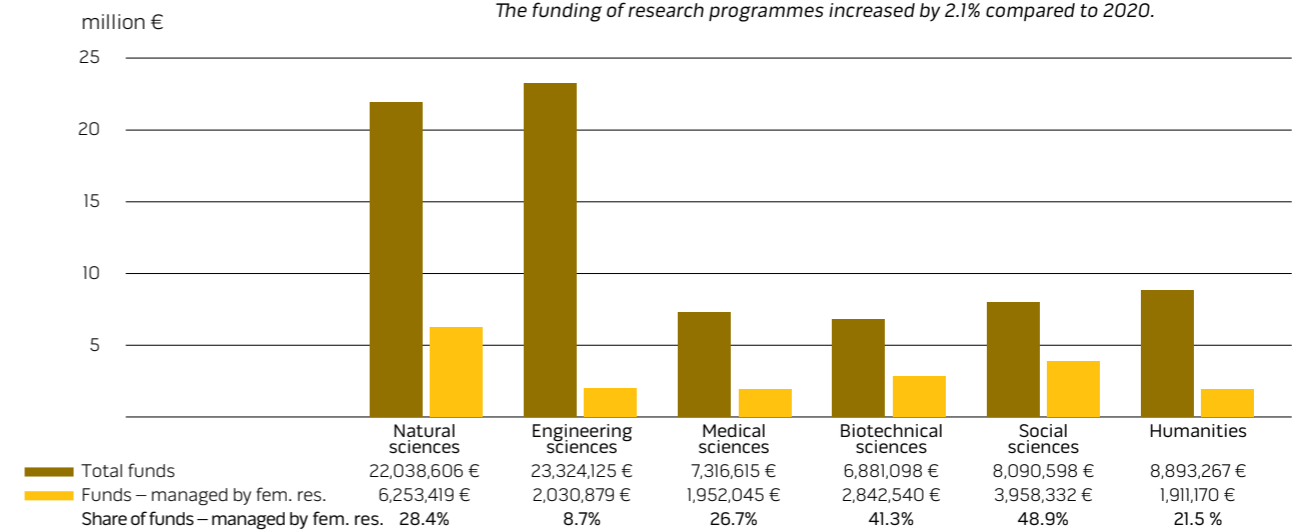
Invitation and call in 2020

Based on the public call for applications to increase the funding of research programmes related to the COVID-19 pandemic, published in 2020, the Agency increased the funding for 65 research programmes in 2020 and 2021. The COVID-19 public call was intended for public research organisations, established by the Republic of Slovenia, and research organisations awarded a concession for carrying out research programmes that had financing approved for 2020. The subject of the public invitation represented an additional research programme financing for the implementation of public service in the field of research with the purpose of developing new scientific findings that would contribute to COVID-19 management, treatment, and prevention, more specifically in five themes, organised into two groups.

Distribution of funding per activity sector in EUR

State sector	40,712,659
Higher education sector	34,664,968
Business enterprise sector	930,260
Private non-profit sector	236,421
Total	76,544,308

The funding of research programmes increased by 2.1% compared to 2020.



Infrastructure programmes and founder obligations

Founder obligations are obligations the founder has towards public research and infrastructure institutes, whereby the Agency covers fixed operation costs related to the core research or infrastructure activity. EUR 22.5 million was paid for founder obligations in 2021.

Founder obligation funding per activity sector in EUR

State sector	27,702,377
Higher education sector	1,575,676
Total	29,278,053

Infrastructure programmes support research work. The central role of research infrastructure is to ensure a high-quality research environment. EUR 11.6 million was paid for infrastructure programmes in 2021, which is 28% less than in 2020.

Infrastructure programme funding per activity sector in 2021 in EUR

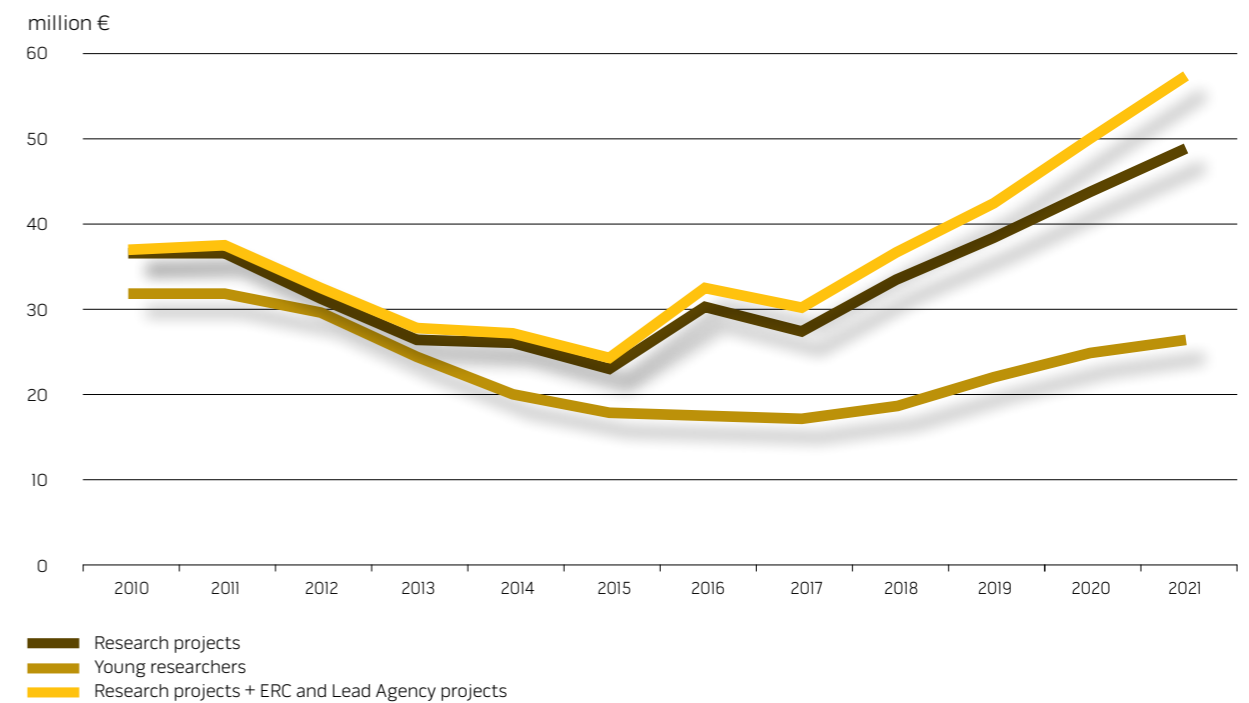
State sector	7,752,915
Business enterprise sector	84,765
Higher education sector	3,003,070
Private non-profit sector	806,978
Total	11,647,728

Competitive financing

Research projects **EUR 49.0 million**
 Young researchers **EUR 26.1 million**

In 2021, the funding of research projects increased by 11.6% compared to the year before. A significant decrease in funding was recorded in 2012, when the Agency did not finance any new research projects due to austerity measures. The financing of research projects increased by 58.1% between 2012 and 2021. The increase in funding for research projects in 2016 was due to austerity measures in previous years and consequent delays in the start of financing for research projects, particularly in 2013, which meant that 2016 saw the financing of more projects than usual in the past years. Since 2010 there has been a continued trend of reduced funding for the training of young researchers; in 2017, the funding decreased by 0.9% compared to the year before. In 2021, the funding increased by 5.6% compared to the previous year.

Funding for research projects and young researchers

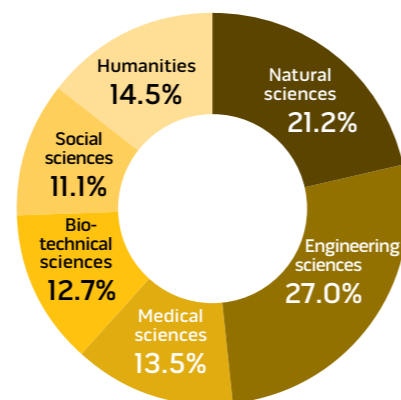


Research projects

In 2021, the Agency co-financed research projects in the amount of EUR 49 million. Project funding represents 21.8% of the Agency's total budget and is lower than in 2020 by 5.8%.



Funding for research projects per discipline



Fundamental and applied research projects

In 2021, with finances from the national budget, the Agency co-financed 566 fundamental research projects, with a total value of EUR 35.9 million. Funding increased by 12.9% compared to 2020. Young researchers (up to 10 active years after defending their doctoral thesis) conducted 172 fundamental projects, and received 31.5% of the funding allocated for fundamental research projects.

In 2021, with finances from the state budget, the Agency co-financed 106 applied research projects, with a total value of EUR 7.1 million, which is 8.2% more than in 2020.

Young researchers conducted 24 applied projects and received 23.7% of the funding allocated for applied research projects.

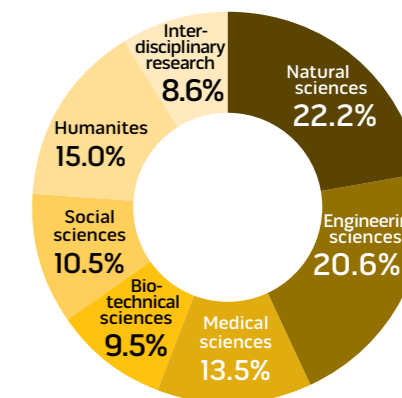
The evaluation methodology of applications to public calls stipulates that among the co-financed applied science projects at least 30% must be projects in the field of engineering, at least 20% in the field of biotechnology, at least 10% in the field medicine and social sciences, and at least 5% in the field of natural sciences. The structure of all (co)financed projects closely follows the implementation of the aforementioned methodology.

Discipline	Fundam. and appl. projects in EUR mil.	Female leaders	Junior project leaders	of which female researchers
Natural science	8.3	32.6%	29.0%	35.4%
Engineering	10.8	23.0%	23.8%	39.3%
Medicine	5.3	45.9%	33.1%	46.4%
Biotechnology	4.5	44.4%	32.6%	19.9%
Social sciences	4.1	38.7%	32.4%	51.4%
Humanities	5.8	46.7%	39.0%	53.0%
Interdisciplinary research	4.1	44.8%	28.6%	46.7%
Total	43.0	36.7%	30.2%	41.6%

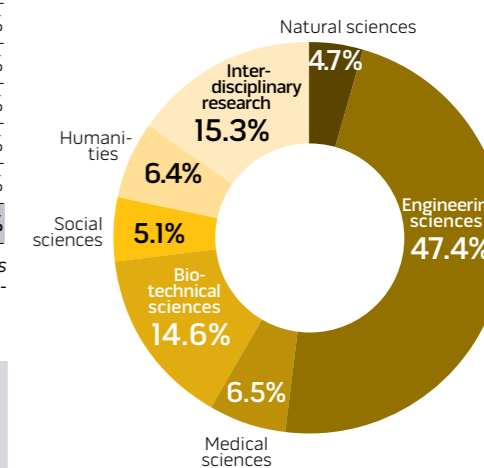
The funding of fundamental and applied research projects, and project shares, for projects led by female researchers and young researchers. Data about the share of funding for projects led by young female researchers are presented in the last column.

The evaluation methodology of applications to public calls dictates that at least 20% of the selected projects must be led by junior researchers (researchers with up to 10 active years after defending their doctoral thesis). This is how the Agency promotes the integration of young scientists into research activities.

Funding for fundamental research projects per discipline



Distribution of applied research project funding per discipline



Post-doctoral projects

In 2021, with state budget funds, the Agency financed 108 post-doctoral projects, in the total amount of EUR 3.7 million, which represents a decrease of 2.7% compared to 2020.

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

The funding of post-doctoral projects, and project shares, for projects led by female researchers

Discipline	Funding in EUR	Share – female project leaders
Natural science	863,057	48.0%
Engineering	849,500	27.5%
Medicine	430,198	96.2%
Biotechnology	393,008	79.7%
Social sciences	424,724	68.7%
Humanities	592,155	38.1%
Interdisciplinary research	175,266	54.5%
Total	3,727,908	53.3%

2021 call

The funding of research projects accepted for co-financing on the basis of the 2020 call began in 2021. The Agency published a call for co-financing research projects in 2021, the co-financing will begin in 2022.

Targeted research programme projects

In 2021, funds for the co-financing of targeted research programme projects amounted to EUR 2.2 million or 15.7% more than in 2020.

In 2021, 155 projects received funding in the framework of targeted research programmes.

The financing of targeted research programmes projects enables research support to interested ministries and other users for the design of strategic targets of Slovenia's development, and with decisions about fundamental development tasks,

which are imperative for the increase of Slovenian competitiveness, adaptability and innovation. Projects are thematically directed based upon the proposals of ministries and others responsible for specific areas of public interest.

In 2021, the Agency published a public call for targeted research programmes, more specifically the Public call for the selection of research projects within the framework of the "CRP 2021" targeted research programme.

In June 2020, the Agency, with the approval of the Ministry of Agriculture, Forestry and Food of the Republic of Slovenia, and based on the legal acts in force, published a public call for the selection of research projects within the framework of the targeted research programme titled "Zagotovimo.si hrano za jutri" (Ensuring food for tomorrow).

The subject of the Public call for the selection of research projects within the framework of the "Zagotovimo.si hrano za jutri" targeted research programme were topics and themes in the framework of the following focal points:

- Slovenian food security
- Competitiveness in food production and renewable natural resources
- Sustainable management of natural resources
- Rural development

The call concluded in October 2020 and 31 projects were accepted for co-financing. Co-financing of the selected projects started on 1 November 2020.

Young researchers

In 2021, the Agency financed 1042 young researchers. With a total funding of EUR 26.1 million which represents 11.6% of the Agency's total budget the amount of young researcher funding in 2021 was lower by 0.3% compared to 2020. The Agency enables young researchers to take part in research during their postgraduate studies on the basis of temporary employment contracts. Their wages, social contributions, and material and service costs are financed by the Agency. The average annual financing for one young researcher amounts to approximately EUR 30,000. Training funds are allocated for a temporary period of maximum four years for the duration of the doctoral study programme. The purpose of the programme is to rejuvenate the research staff and thus promote new ideas and approaches. The young researcher programme is a source of highly trained and motivated employees, who represent a large potential for the Slovenian economy and other socially important areas. Within the framework of the programme, approximately eight thousand young researchers were trained between 1985 and 2016.

In 2021, three young researchers received rewards for the early completion of training.

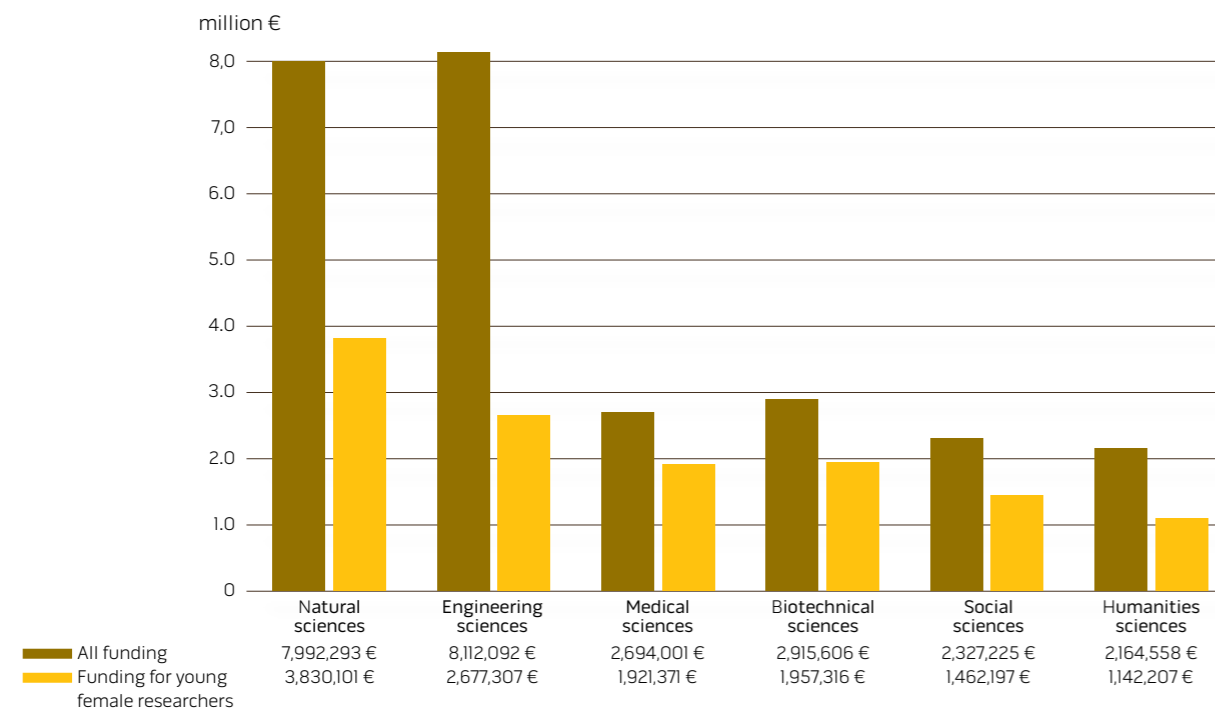
Promotion of junior mentors

The Agency rules state that 25% of the accepted mentors of young researchers within research organisations must be junior mentors.

2021 call

In January 2021, the Agency published a call for the allocation of mentorship positions within research programmes, leading to 230 mentorship positions being allocated to 174 research programmes: 68 in the natural sciences, 72 in engineering, 25 in medicine, 24 in biotechnology, 21 in the social sciences, and 20 in the humanities.

Funding for young researchers



Scientific literature

Scientific literature	EUR 2.26 million
International publications and data collections	EUR 6.11 million

The Agency co-finances electronic access to the latest scientific databases and the purchase of international scientific literature in order to ensure the availability and accessibility of international scientific and expert information for the purposes of research, educational and development activities. The literature is publicly available in all libraries, research organisations, and via the COBISS system. The Agency also co-finances science and popular science publications on the basis of a public call, with the aim of enabling the publication of those popular science publications which are important for the promotion of interest in science and technology among the general public, particularly among young people. The Agency also co-finances the publication of scholarly monographs that are important for the development of Slovenian scientific terminology, intended for presenting scientific achievements and findings in Slovenia and abroad, and for promoting scientific culture.

Co-financing of the scientific press, including domestic science and popular science publications, commanded a sum of EUR 1.34 million in 2021, while EUR 0.43 million was paid for scholarly monographs.

International activities

The ERC complementary scheme	EUR 2.89 million
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Within the complementary scheme, applicants from Slovenian research organisations who have been positively evaluated during European Research Council (ERC) calls, but were not selected for co-financing, have the possibility of applying for Agency funding with an adapted project, which, based on its objectives and scope of work, takes into account the time required to complete the adapted project as well as the amount of available funding. The Agency co-finances adapted projects which are primarily carried out in Slovenia based on a proposal from the Scientific Council and taking into account the available funding.

The purpose of the complementary scheme is to co-finance adapted research projects that have exceeded the determined success threshold in the process of an international evaluation, to ensure that the applicants have the appropriate conditions to further their scientific excellence and the initial idea of the research project. At the same time, the aim of the public call is to enable the leader of the adapted research project to submit an application for the ERC call after the project in question is completed.

In 2021, the Agency co-financed 51 projects within the complementary scheme framework, of which 27 were in the natural sciences (55.7% of funding), 13 were in engineering (31.0% of funding), 5 in the social sciences (6.6% of funding), 3 in the humanities (6.6% of funding) and 1 in biotechnology (0.2% of funding). Organisations in the state sector received 47.2% of funds while those in the higher education sector were allocated 52.8% of funds.

The calls are aimed at individual projects for excellent frontier research in all disciplines and are among the most competitive globally; the total success rate in the call is approximately 10%. The calls are open to all researchers, regardless of their current place of employment, with the condition that the acquired ERC project is conducted in Europe.

The frontier research evaluation system established by the ERC is considered to be an exemplary »peer review« system, and is recognised by fundamental research funding agencies worldwide.

The European Research Council was established in 2007. Today it operates within the excellent science pillar of the new framework project of the European union for research and innovation, Horizon Europe (2021-2027) and represents 17% of its budget. Since its inception, the ERC has financed more than 12,500 projects, selected from more than 65,000 applications. The recipients of ERC funding include nine Nobel laureates. In 2021 the total budget of the European Research Council amounted to approximately EUR 1.9 billion. More than 70-80% of the projects evaluated by an independent study resulted in scientific breakthroughs or major progress, while 25% contributed to important improvements.
Source: <https://erc.europa.eu/>

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

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

The ERC also enables applicants to apply for two additional calls that are not eligible for the complementary scheme:

- **ERC Proof of Concept** – constitutes a bridge between research and the earliest stage of market innovation. This call is open to researchers who have received ERC support.
- **Synergy Grants** – intended to support two to four excellent researchers and their groups in joining their complementary knowledge and resources and to tackle demanding research projects together. The aim is to make new discoveries where different scientific disciplines overlap as well as use new methods and techniques in research.

The call of the European Research Council – ERC

In 2021, EUR 2.2 million of funds available to researchers who are at the beginning of an independent research career (a Starting Grant) were awarded to Assist. Prof. Dr. Anna Dragoš from the Biotechnical Faculty, University of Ljubljana.

The goal of the "PHAGECONTROL - The evolution of host manipulation by bacteriophage" project is to research viruses that enter bacteria and alter their properties by incorporating the viral DNA into the bacterial DNA. Some altered properties of bacteria may be positive and beneficial for humans whilst others may change harmless bacteria into pathogens.

The following researchers were successful at the ERC call for renowned researchers in 2021:

Prof. Dr. Maruša Bradač from the Faculty of Mathematics and Physics, University of Ljubljana, with a five-year project FIRSTLIGHT that will study the period of dark age when the first galaxies ionised the neutral hydrogen and changed the space from impermeable to transparent for visible light.

Prof. Dr. Franc Forstnerič from the Faculty of Mathematics and Physics, University of Ljubljana, with a five-year project HOLOMORPHIC PARTIAL DIFFERENTIAL RELATIONS – HPDR. The project will enable the creation of an international group of researchers which will represent an important thematic extension of the existing group for complex analysis and geometry at the Faculty of Mathematics and Physics, University of Ljubljana, and the Institute of Mathematics, Physics and Mechanics.

Assoc. Prof. Dr. Borut Klabjan from the Institute for Social Studies ZRS Koper with the project OPEN BORDERS – 'Cold War Europe Beyond Borders: A Transnational History of Cross Border Practices in the Alps-Adriatic area from World War II to the present'. The purpose of the project is to study diverse forms of integration that characterised everyday life in the Alpine-Adriatic region after World War II.

In the framework of the ERC consolidation scheme, **Assoc. Prof. Dr. Anna Sandak** from the InnoRenew CoE Excellence Centre for research and innovation in the field of renewable materials and healthy living space was successful with the five-year project called "Bioinspired living skin for architecture ARCHI-SKIN". In the scope of the project researchers will study the development of a protective biotic coating that is manufactured from engineered living materials.

The lead agency scheme **EUR 4.5 million**

The Agency promotes international scientific research via the lead agency scheme. By means of a cooperation agreement between the agencies of various countries, researchers are able to apply collectively, as a joint research project, under the auspices of one of the agencies (the lead agency), which is tasked with implementing the review process. If the peer review process of the application is successful and the lead agency proposes co-financing of the project, then another agency takes on the co-financing of the researchers from its own country without conducting an additional review process. In 2021, the Agency co-financed 73 projects within the lead agency scheme, of which 35 were in natural sciences (44.6% of funding), 17 in engineering (22.5% of funding), four in medicine (5.41% of funding), three in biotechnology (5.1% of funding), five in the social sciences (5.1% of funding), seven in the humanities (12.6% of funding) and one interdisciplinary project (1.5% of funding). Institutions in the higher education sector received 50.9% of funds, institutions in the state sector 48% of funds, while those in the private non-profit sector were allocated 1.3% of funds.

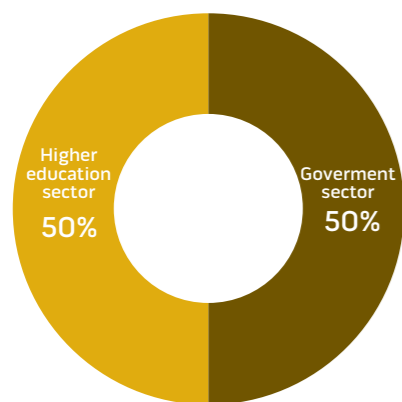
In 2021, projects were conducted in cooperation with:

- The Austrian Science Fund, FWF;
- The Czech Science Foundation, GACR;
- The Research Foundation Flanders, FWO;
- The Hungarian National Research, Development and Innovation Fund, NKFIH;
- The Polish National Science Centre, NCN;
- The Swiss National Science Foundation, SNSF.

International bilateral projects **EUR 0.9 million**

In 2021 international bilateral scientific cooperation was conducted by the coordinated efforts of the responsible ministry and the Agency. Cooperation was conducted with 18 countries – Austria, Bosnia and Herzegovina, Croatia, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Montenegro, Norway, Russia, Serbia, Turkey, and the United States of America. Bilateral cooperation in the form of research projects represents an upgrade of mobility in bilateral international cooperation. The Agency co-finances bilateral cooperation within the established instruments of bilateral cooperation. The taking on of new responsibilities for the co-financing of bilateral research projects is, in accordance with international agreements, carried out in the framework of the Agency's existing instruments. In 2021, bilateral cooperation for bilateral research projects with the People's Republic of China and the French Alternative Energies and Atomic Energy Commission (CEA) was co-financed. Scientific cooperation with the People's Republic of China was co-financed in the amount of EUR 88,428, and cooperation with CEA in the amount of EUR 603,269, which represents a 12.8% increase compared to 2020.

Distribution of funds for the Horizon Europe public call application incentive



Horizon Europe public call application incentive **EUR 6,000**

The Agency encourages the participation of Slovenian research organisations to apply to Horizon Europe calls. This allows for a continuous open public call for project applicants under the EU Horizon Europe Framework Programme for Research and Innovation. A one-time payment of the costs of project application is available to research organisations that are registered into the registry of research organisations maintained by the Agency on the day of submitting the application for the public call, and that act as co-ordinators or partners in a project submitted for funding to a call within the Horizon Europe Framework Programme for Research and Innovation. The amount of EUR 2,000 is available to help cover the costs incurred by the preparation and application of a project that has been submitted by an international consortium and coordinated by a Slovenian research organisation, whereas EUR 1,000 is available for the costs incurred by a Slovenian research organisation which submitted a project as partner in an international consortium or submitted a project independently if the call of the European Commission stipulated so.

In 2021 the number of applications decreased significantly compared to 2020 due to the transition from the Horizon 2020 programme to the new Horizon Europe framework programme followed by a delay in the publishing of public calls and consequently also in evaluation of applications to the Horizon Europe calls which influenced the Agency's payments based on this instrument.

Support for the promotion of science abroad and for membership in international associations **EUR 0.2 million**

The Agency co-finances the promotion of Slovenian science and knowledge by supporting active cooperation in events that are organised by renowned international associations, international organisations or the European Commission. Additionally, the programme facilitates cooperation with Slovenian research organisations and researchers from neighbouring states, as well as cooperation with Slovenian researchers working abroad. The call includes innovative activities for the promotion of Slovenian science abroad with the aim of supporting new breakthrough ideas in the field of science promotion and communication.

In 2021, the Agency (co)financed the following innovative activities:

- The Slovenian Press Agency (STA) – STAZnanost (STAScience) - podcasts and stories;
- The ASEF Institute for Education and Research – Development of global innovative communication of the Slovenian science and global platform for integration of excellent Slovenian scientists, professors and students;
- SiNAPSA, the Slovenian neuroscience association – UM (Upošteva je možgane) / BW (BrainWise);
- The EN-FIST Excellence Centre – EUROMAR 2021 conference;
- The AGUATERA advertising agency – Pitia – with a synergy of scientific views to a safe, green and digital future World;
- Metina lista, the institute for persons of broad views and active spirit – Metamorfoza (Metamorphosis) and Meta PHoDcast;
- Kvardakabra, society for the interpretation of science – Kvardakabra (Sci-highs);
- ZRC SAZU – further development of the Alternator web portal;
- The Slovenian Business and Research Association – Notification and promotion of Slovenian scientific and research organisations in the EU;
- The Slovenska matica society – Cooperation with related institutions and scientists abroad, supplying foreign libraries and lectureships with works by Slovenian authors, lectures of Slovenian scientists and book presentations;
- Science on the Street, Institute for the Promotion of Science – Science on the Street.

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

THE AGENCY'S INTERNATIONAL COOPERATION – HIGHLIGHTS

ARRS is one of the twelve European agencies that signed an agreement in 2020 on a multilateral Lead Agency funding scheme for the co-financing of scientifically excellent bilateral or trilateral Weave research projects. In addition to ARRS, the Agreement was also signed by: DFG (Germany), FNR (Luxembourg), FNRS (Belgium), FORMAS (Sweden), FWF (Austria), FWO (Belgium), GACR (Czech Republic), HRZZ (Croatia), NCN (Poland), RCN (Norway) and SNSF (Switzerland). The multilateral Lead Agency funding scheme builds on existing bilateral Lead Agency schemes and expands the collaboration between agencies in several countries.

The new funding scheme enables researchers to submit a Weave collaborative research project proposal with one of the agencies (Lead Agency) which carries out the evaluation procedure for such collaborative project proposals. In 2021 ARRS had this type of collaboration established with: FWF (Austria), FWO (Belgium), GACR (Czech Republic), HRZZ (Croatia), NCN (Poland), and SNSF (Switzerland). Within the five-year transitional period defined in the signed agreement, the collaboration under this instrument will be established with all the agencies that have signed the Agreement.

The currently ongoing collaboration based on the Lead Agency model with the Hungarian agency NKFIH in 2021 will remain unchanged and will follow the well-established processes.

Guiding principles of the Slovenian Research Agency for international cooperation: opening of opportunities for closer international cooperation in the field of science

First stage: establishing and strengthening international connections

Incentives:

Bilateral cooperation – mobility incentives, signed agreements between the Republic of Slovenia and 37 countries across the globe

COST actions – strengthening international connections

Horizon Europe – contributions towards application costs

Scholarships for visits to ERC grant holders (since 2016)

3 to 6-month visits 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 stage: incentives for closer international cooperation in the field of science

Possibilities – public calls and invitations:

1 Lead agency scheme – bilateral research projects

Austria (FWF), Belgium – Flanders (FWO), Czech Republic (GACR), Hungary (NKFIH), Poland (NCN), Switzerland (SNSF)

2 ERC complementary scheme (since 2011)

Possibility for adapted research projects that have achieved a grade exceeding the admittance threshold in ERC calls to be accepted for financing as national research projects (with a duration of up to 3 years and funding of up to EUR 200,000)

3 Marie Skłodowska-Curie seal of excellence – MSCA (since 2017)

Applicants for individual scholarship calls (MSCA IF) who receive a seal of excellence in the evaluation procedure (with a grade of 85% or over) can obtain funding as national research projects (with a duration of up to 2 years, and funding of up to EUR 77,000)

4 ERA projects – international calls of ERA networks

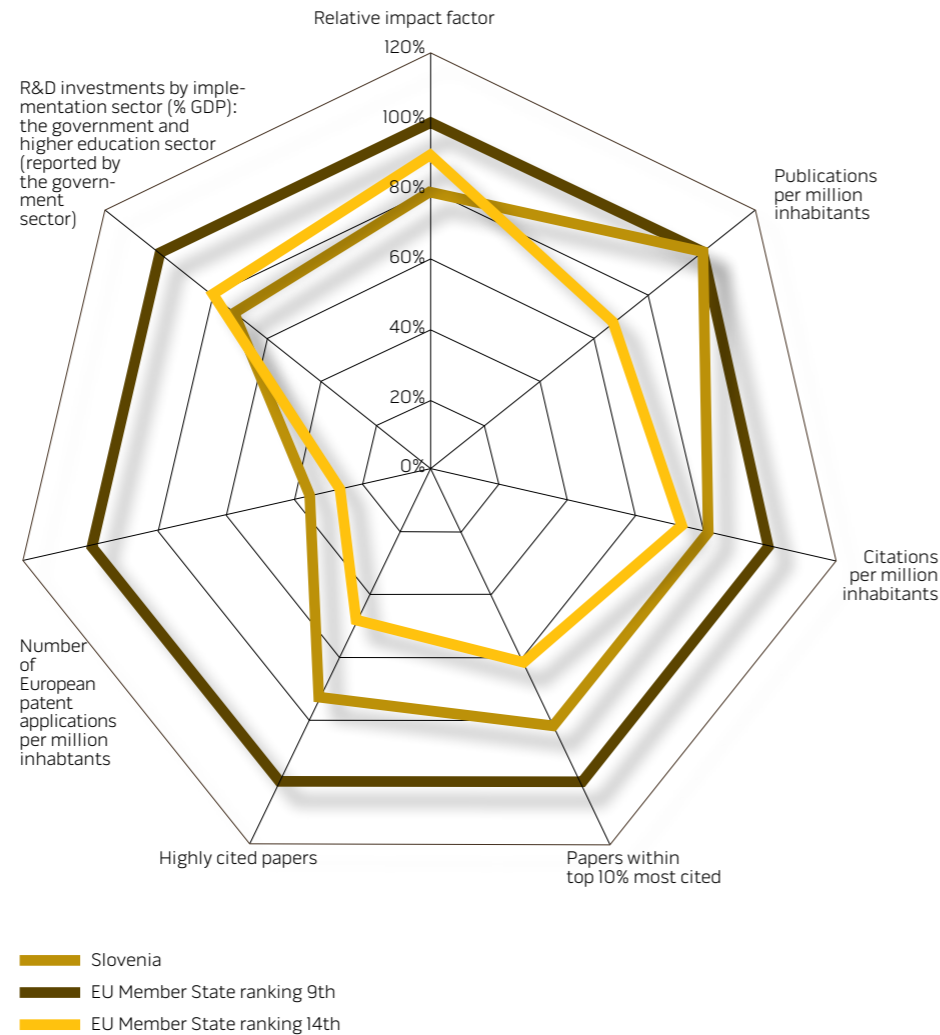
JPI Urban Europe (since 2015)

NORFACE (since 2005)

PRIMA (since 2018)

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

INTERNATIONAL COMPARISONS



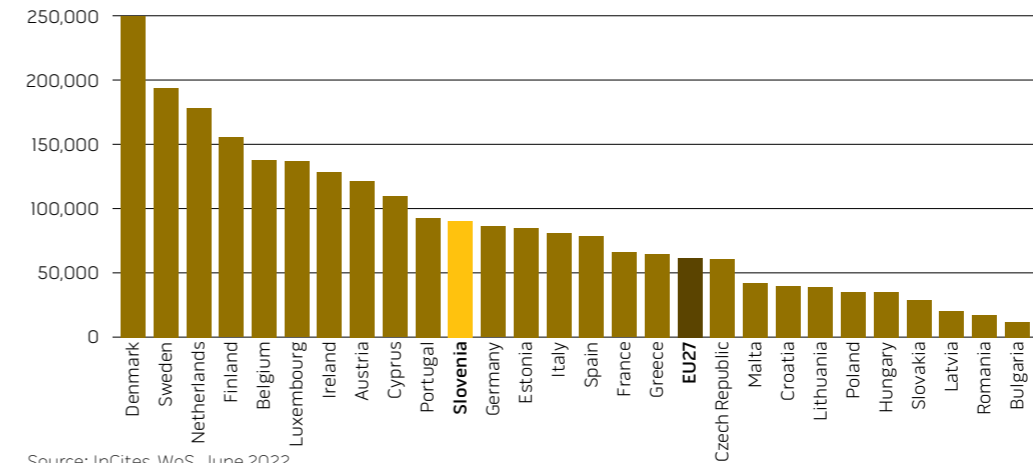
The diagram shows the majority of standard bibliometric and other quantitative indicators that are used to measure research activities across the world and that are also included in the Resolution on the research and innovation strategy of Slovenia 2011-2020. The scores for Slovenia are shown relative to the EU country ranking 9th (upper third of all EU countries). For comparison, data for the EU country ranking 14th (upper half of the countries) is also given.

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

Citations

According to the number of citations per million inhabitants Slovenia ranked 11th in the 2017-2021 period with 89,852 citations. In the same period, the number of citations per million inhabitants was the highest in Denmark, followed by Sweden, the Netherlands and Finland.

Number of citations per million inhabitants for EU countries in the 2017-2021 period

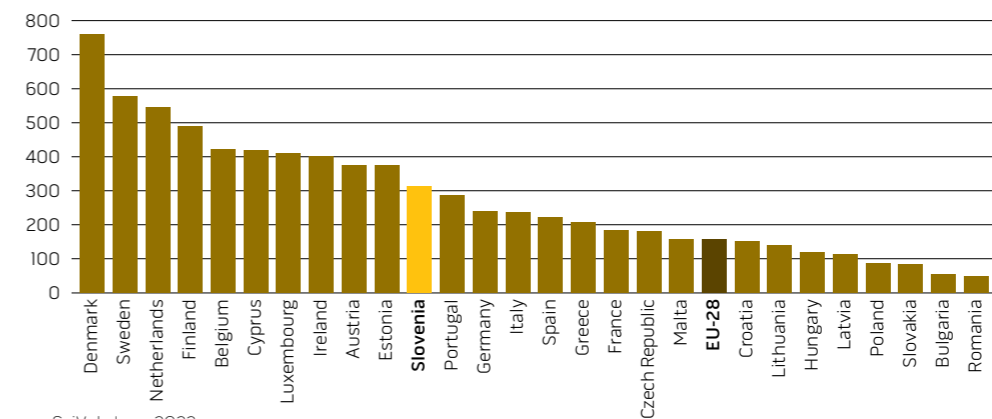


Source: InCites, WoS, June 2022

Published works among the 10% most cited

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 window 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 latest data for 2018 Slovenia ranks 11th among EU member states.

The number of published works ranking among the 10% most cited works per million inhabitants for 2018 for EU member states

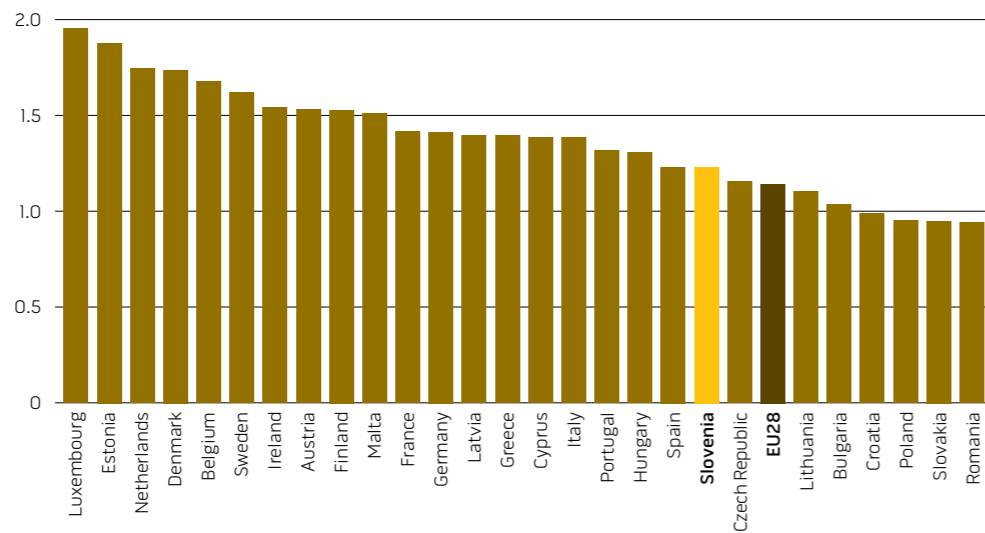


Source: SciVal, June 2022

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 20th among EU member states.

Relative impact factor for EU countries in the 2017-2021 period



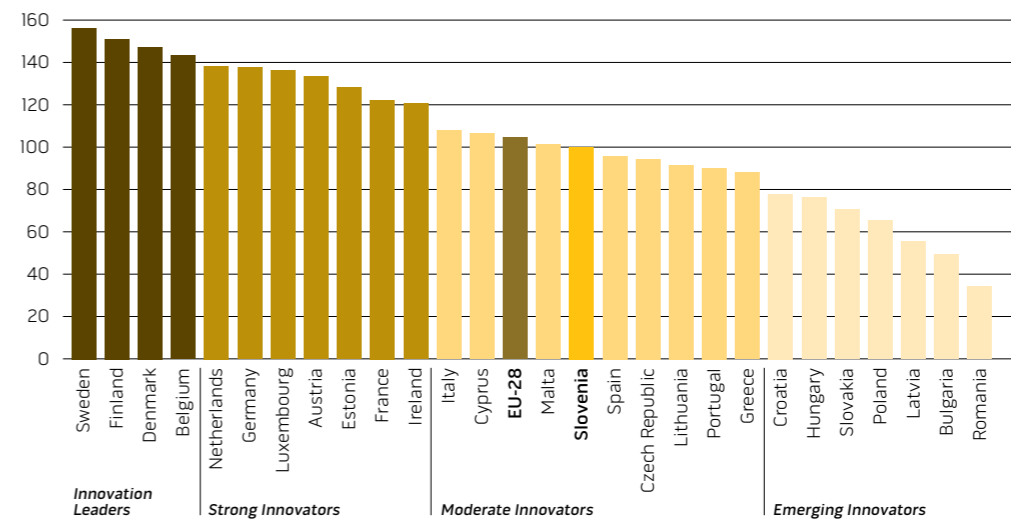
Data for 2021 shows that the relative impact factor (1.23) is somewhat lower than in 2020, when it amounted to 1.24. In 2021 Slovenia was again just above the European average (1.14).

Source: InCites, WoS, June 2022

Innovation index

The joint innovation index (Innovation Union Scoreboard) provides an overview of the innovation activities of individual countries. It is comprised of over twenty 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, Slovenia is among the following countries and ranks 16th among EU member states.

Innovation index for EU countries in 2021



International comparisons and other analyses are published on the following website: <https://www.arrs.si/sl/analize/>.

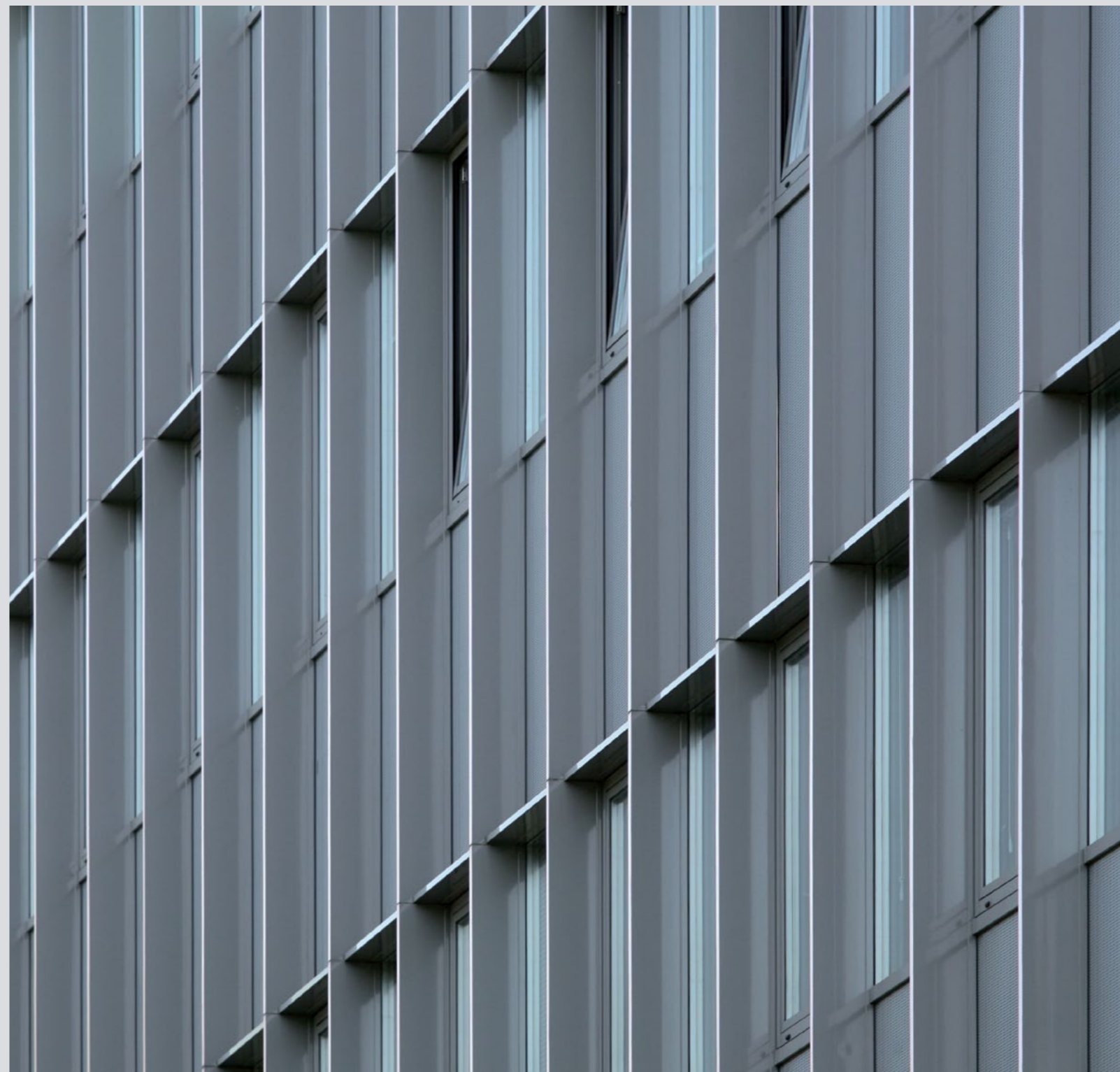
Source: European and Regional Innovation Scoreboards 2021

ABOUT THE AGENCY

Strategic orientations of the Agency's operation and development

- sound implementation of activities according to the legal basis, the Decision establishing the Public Research Agency of the Republic of Slovenia, 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;
- communication with the public and science promotion based on three values: openness, responsiveness, and provision of valuable information.

*Tivoli Center, Ljubljana, where the Slovenian
Research Agency is headquartered
Photo: Žak Prinčič, M.Sc.*



Internal organisational units

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 of Research Programmes and Young researchers, Analysis and Monitoring

This department evaluates and selects research programmes and carries out tasks related to the young researchers programme. It analyses and monitors the development of research activities and actively develops the area of science promotion. Department activities include international cooperation in the Norface network and the Urban Europe joint programming initiative, and the promotion of science.

Head of the department: *Dr. Marko Perdih*

Department of Research Projects

This department carries out tasks in the field of evaluation and selection of research projects. Within its scope of operation it organises the procedures for substantive monitoring and control of co-funding, implementation and attainment of research project objectives. The main activities of this department are the launch of the call for co-funding research projects proposals and the launch of the call for proposals to receive co-funding for the Targeted Research Programme projects.

Head of the department: *Simon Ošo*

Department of Research Infrastructure and International cooperation

This department carries out tasks in the field of research equipment and infrastructure programmes, science and popular science periodicals and scholarly monographs, international research cooperation, the promotion of science abroad, and the involvement of researchers in the activities of international scientific associations. Its tasks range from activities within the mechanism of leading agencies and the seal of excellence, to activities related to the fostering of participation in the calls for proposals for European research programmes, setting up the complementary scheme in connection with calls for proposals of the European Research Council, and the hosting of researchers from other countries.

Head of the Department: *Mojca Boc*

Department of Legal and General Affairs

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.

Head of the department: *Katarina Hren*

Department of Finance and Accounting

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 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.

Head of the department: *Mojca Kastelc Selan*

Department of Information Technology

The Department of Information Technology lays the expert groundwork for the determination and implementation of the Agency's information policy, provides information support for business processes and coordinates the development of information and communication infrastructure. The department manages projects for the installation, operation and maintenance of hardware, system software and basic user interface software tools.

Head of the department: *Dragan Nedeljković*

Overview of financing in 2021 per programme item in accordance with the accrual principle

Realisation in 2021 (in EUR)

FOUNDER OBLIGATIONS AND INFRASTRUCTURE PROGRAMMES	46,040,401
Founder obligations for PRO	22,556,984
Infrastructure programmes – material costs	11,647,728
Reimbursement of work-related costs	6,721,069
Infrastructure programmes – wages	5,114,620
RESEARCH PROGRAMMES AND PROJECTS	131,065,081
Research projects	43,037,067
Research programmes	76,544,308
ERA projects	129,025
ESF and ERC projects	8,615,249
Targeted research programmes	2,236,888
Open access	502,544
TRAINING AND DEVELOPMENT OF SCIENTISTS	29,933,682
Young researchers	26,205,775
Post-doctoral projects	3,727,907
RESEARCH EQUIPMENT	8,807,781
Research equipment	8,807,781
SCIENTIFIC LITERATURE, MEETINGS AND OSIC	8,158,702
Slovenian popular science periodicals	90,000
Slovenian science periodicals	1,247,398
Scholarly monographs	425,328
Foreign periodicals and databases	6,114,245
OSIC – Central Specialised Information Centres	281,731
INTERNATIONAL SCIENTIFIC COOPERATION	1,113,234
Cooperation with the EU (CEA)	691,698
International projects, bilateral cooperation	199,156
Promotion of applications to EU projects	6,000
International science promotion	192,996
Operation of Slovenian science associations abroad	23,384
Total:	225,118,881

The overview of funding per individual year is available on the following website: www.arrs.gov.si/sl/finan/

Public invitations and calls published in 2021

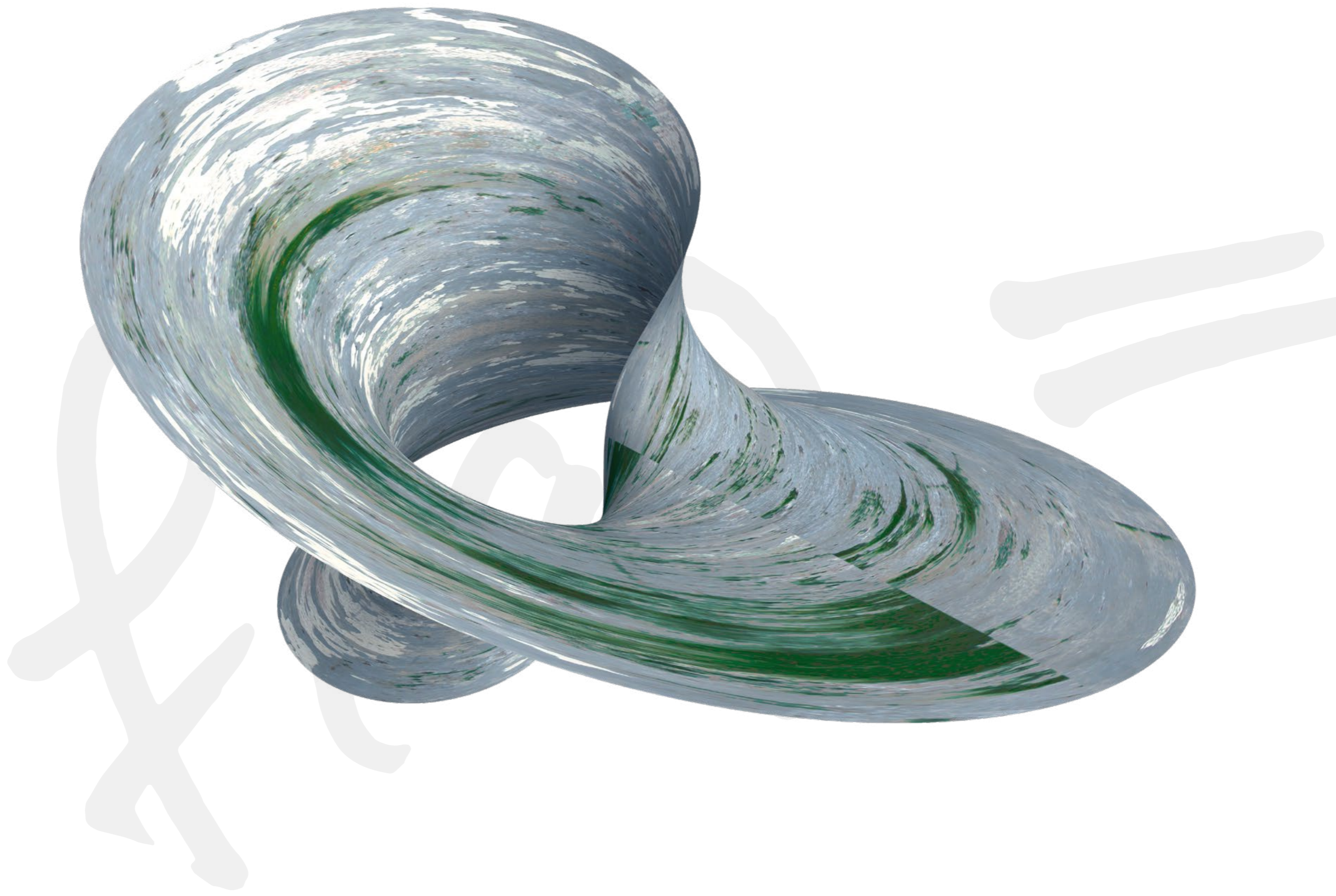
Domestic calls and invitations

	Publication date
Public call for the allocation of mentorship positions to research programmes in 2021	18 January 2021
Public call for the co-financing of scholarly monographs publishing in 2021	5 March 2021
Public call for the financing of research programmes by public research organisations - 2021	12 March 2021
Public call for the co-financing of research programmes with concession - 2021	12 March 2021
Public call for the award of a concession for carrying out public services in the field of research activities in the form of infrastructure programmes in the 2022-2027 period	23 April 2021
Public call for the submission of infrastructure programmes for the 2022-2027 period	23 April 2021
Public call for the co-financing of research equipment purchase – package 20	7 May 2021
Public call for the selection of research projects within the framework of the "CRP 2021" targeted research programme for 2021	28 May 2021
Public call for the co-financing of international scientific literature purchase in 2021	9 July 2021
Public call for the reimbursement of costs for scientific publications in golden open access (for 2021)	26 November 2021
Public call for the (co)financing of research projects in 2022	24 December 2021

International calls and invitations

	Publication date
Public call for the co-financing of the Slovenian section of Weave bilateral or trilateral joint research projects with FWF (Austrian Science Fund) as the lead agency	8 January 2021
Public call for the co-financing of the Slovenian section of joint Hungarian–Slovenian projects with NKFIH (National Research, Development and Innovation Office) as the lead agency	22 January 2021
Public call for the co-financing of the Slovenian section of Weave bilateral or trilateral joint research projects with FWO (The Research Foundation – Flanders, FWO) as the lead agency	22 January 2021
Public call for the co-financing of scientific research cooperation between the Republic of Slovenia and the French Republic in the framework of the PROTEUS programme in 2022 and 2023	29 January 2021
Public call for the co-financing of the Slovenian section of Weave bilateral or trilateral joint research projects with SNSF (Swiss National Science Foundation) as the lead agency	5 March 2021
Public call for the co-financing of the Slovenian section of Weave bilateral or trilateral joint research projects with GA ČR (Grantová Agentura České Republiky) as the lead agency	5 March 2021
Public call for the co-financing of activities related to the promotion of Slovenian science abroad and integration of scientific achievements in 2021	2 April 2021
Public call for the co-financing of memberships of Slovenian societies and associations of societies in international science associations in 2021	9 April 2021
Public call for the payment of a one-time 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 01/01/2021 to 30/11/2021)	14 May 2021
Public call for the co-financing of research projects between the Republic of Slovenia and the French Alternative Energies and Atomic Energy Commission (CEA) for the 2022-2024 period	9 July 2021
Public call for the co-financing of Marie Skłodowska-Curie Seal of Excellence research projects	13 September 2021
Public call for the co-financing of the Slovenian section of Weave bilateral or trilateral joint research projects with NCN (Narodowe Centrum Nauki) as the lead agency	17 September 2021
Public call for the co-financing of scientific research cooperation between the Republic of Slovenia and the United States of America in the period from 1 July 2022 to 30 June 2024	12 November 2021
Public call for the payment of a one-time 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 2021 to 30 November 2022)	3 December 2021
Public call for post-doctoral research scholarships in Japan for researchers from the Republic of Slovenia in 2022	24 December 2021

EXCELLENT IN SCIENCE
2021



Excellent in science is a project carried out by the ARRS as part of agency's endeavours to promote science.

The project presents a selection of most prominent achievements from the past year.

In 2021, some of the selected achievements were presented at **the national event titled ARRS Day 2020: Supporting Excellence** held on 16 December 2021. 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.

Image on the previous page:
Meeks' minimal Moebius strip in Euclidean 3-space
Authors: Antonio Alarcon and Francisco J. Lopez

Dr. Oliver Dragičević

p -ellipticity

The authors introduce the concept of p -ellipticity and, by virtue of several examples, indicate that it represents a natural connection between two of the fundamental notions in mathematical analysis and partial differential equations introduced more than 100 years ago, namely, the L_p spaces and elliptic partial differential operators. The classical ellipticity is the special case of p -ellipticity with $p=2$.

Many results obtained in the recent decades have been supporting the awareness that the properties of solutions to equations with complex coefficients notably differ from those pertaining to real coefficients. This discrepancy can now be explained in a transparent and simple manner through the prism of p -ellipticity, as the real elliptic matrices are precisely those that are p -elliptic for all indices $p>1$.

In articles by several mathematicians

from Europe and the US, the validity of the concept has up to now been confirmed in a series of theorems where the p -ellipticity was the key condition. These theorems feature examples from harmonic analysis, the theory of operator semigroups, regularity theory of elliptic equations etc. Consequently, the result in question, published in the prestigious Journal of the European Mathematical Society, represents a breakthrough in the extraordinarily lively field of elliptic partial differential equations.

Definition. Let $\Omega \subset \mathbb{R}^n$ be an open set and $p > 1$. A bounded complex matrix function $A : \Omega \rightarrow \mathbb{C}^{n \times n}$ is said to be p -elliptic, if there exists $C = C(A, p) > 0$ such that for almost every $x \in \Omega$ one has

$$\Re \langle A(x)\xi, \xi + |1 - 2/p|\bar{\xi} \rangle_{\mathbb{C}^n} \geq C|\xi|^2 \quad \forall \xi \in \mathbb{C}^n.$$

Dr. Oliver Dragičević, University of Ljubljana, Faculty of Mathematics and Physics, oliver.dragicevic@fmf.uni-lj.si

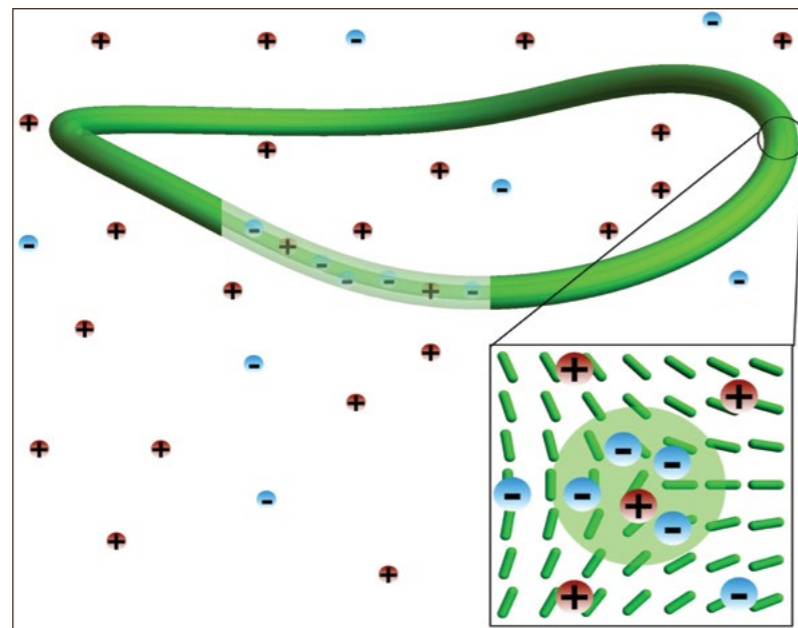
source: A. Carbonaro, O. Dragičević: Convexity of power functions and bilinear embedding for divergence-form operators with complex coefficients, J. Eur. Math. Soc. (JEMS) Volume 22, Issue 10, 2020, pp. 3175-3221, DOI: 10.4171/JEMS/984
hyperlink: <https://ems.press/journals/jems/articles/17037>

Dr. Miha Ravnik

Ionically charged topological defects in nematic liquids

The ability to spatially control electric charge has relevance in a range of fields – from charged polymers, biological and active matter, to colloidal materials, complex fluids, and even microelectronics. In this work, the authors showed with theoretical simulation approaches that topological defects in nematic electrolytes can perform as regions for local separation of electric charge, forming electrically charged defect cores, and in selected geometries also electrical multi-layers, which are a generalization of electrical double layers in isotropic electrolytes. Specifically,

they showed that ions couple very efficiently with defect core via ionic solubility, and with the surrounding orientational director field via flexoelectricity. The work was presented in three related high-rank publications, where the third study provided a theoretical explanation for the experiments performed at the University of Colorado Boulder. This achievement contributes to the understanding of electrostatic mechanisms in topologically soft matter, and is a possible first step towards understanding similar phenomena in related biological systems.



Dr. Miha Ravnik, University of Ljubljana, Faculty of Mathematics and Physics and Jožef Stefan Institute, Condensed Matter Physics F5, miha.ravnik@mf.uni-lj.si

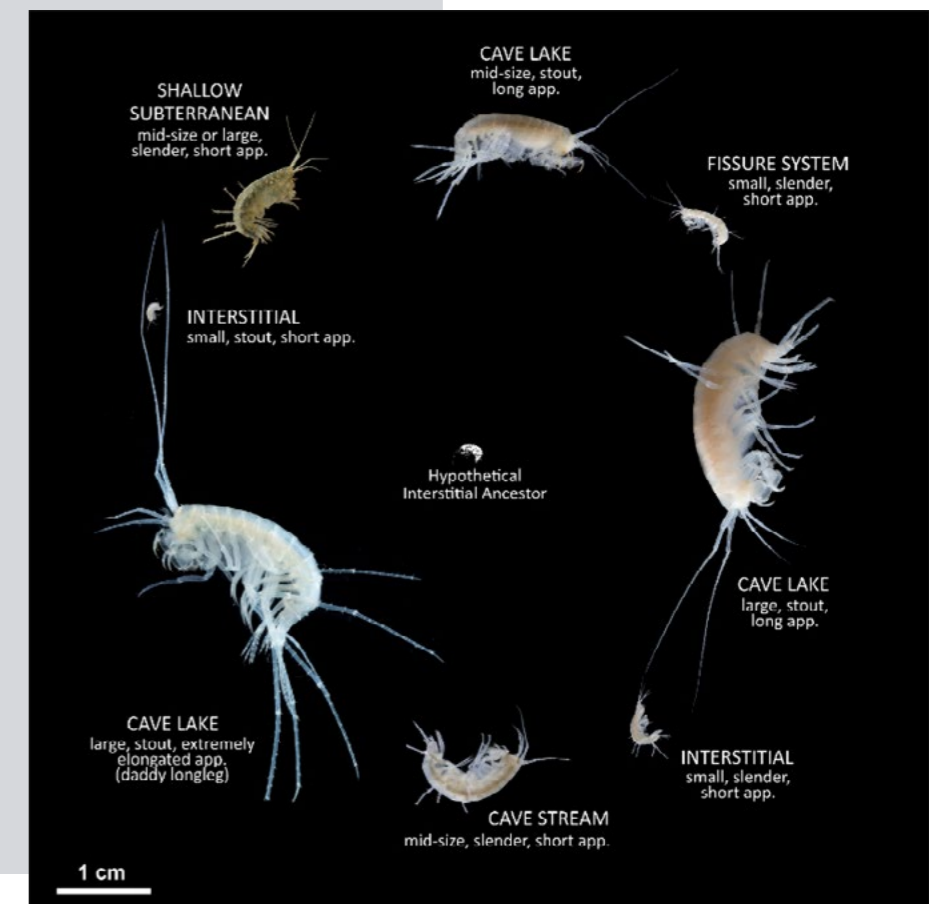
source: J. C. Everts, M. Ravnik. *Physical Review X* 11, 011054 (2021), doi: 10.1103/PhysRevX.11.011054.
 J. C. Everts, B. Senyuk, H. Mundoor, M. Ravnik, I. I. Smalyukh. *Science Advances* 7, eabd0662 (2021), doi: 10.1126/sciadv.abd0662.
 M. Ravnik, J. C. Everts. *Physical Review Letters* 125, 037801 (2020), doi: 10.1103/PhysRevLett.125.037801.
 hyperlink: <https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.125.037801>

Špela Borko

A subterranean adaptive radiation of amphipods in Europe

Adaptive radiations are bursts of evolutionary species diversification that have contributed to much of the species diversity on Earth. An exception is modern Europe, where descendants of ancient adaptive radiations went extinct, and extant adaptive radiations are small, recent and narrowly confined. However, not all legacy of old radiations has been lost. Subterranean environments, which are dark and food-deprived, yet buffered from climate change, have preserved ancient lineages. Here we provide evidence of an entirely subterranean adaptive radiation of the amphipod genus *Niphargus*, counting hundreds of species. *Niphargus* evolved from marine ancestors in territories that nowadays belong to Western Europe, and through the interstitials spread east- and southward. The uplift of carbonate massifs in South-Eastern Europe 15 million years ago followed by karstification opened up an unoccupied, predator-free space, constituting ecological opportunity, a key trigger of adaptive radiation. Our analyses suggest that orogeny spatio-temporally coincides with a major adaptive radiation, comprised of multiple subordinate adaptive radiations. The territories nowadays belonging to Slovenia were in the centre of these events. The discovery of adaptive radiation in an ecologically non-versatile en-

vironment is a surprise. The present study supports paleontological studies hypothesizing that several major adaptive radiations took place in the territories of Europe several million years ago. It partially explains the reasons for high subterranean biodiversity in Slovenia and reminds us that we should protect this piece of natural heritage.



Dr. Cene Fišer, University of Ljubljana, Biotechnical Faculty, cene.fiser@bf.uni-lj.si

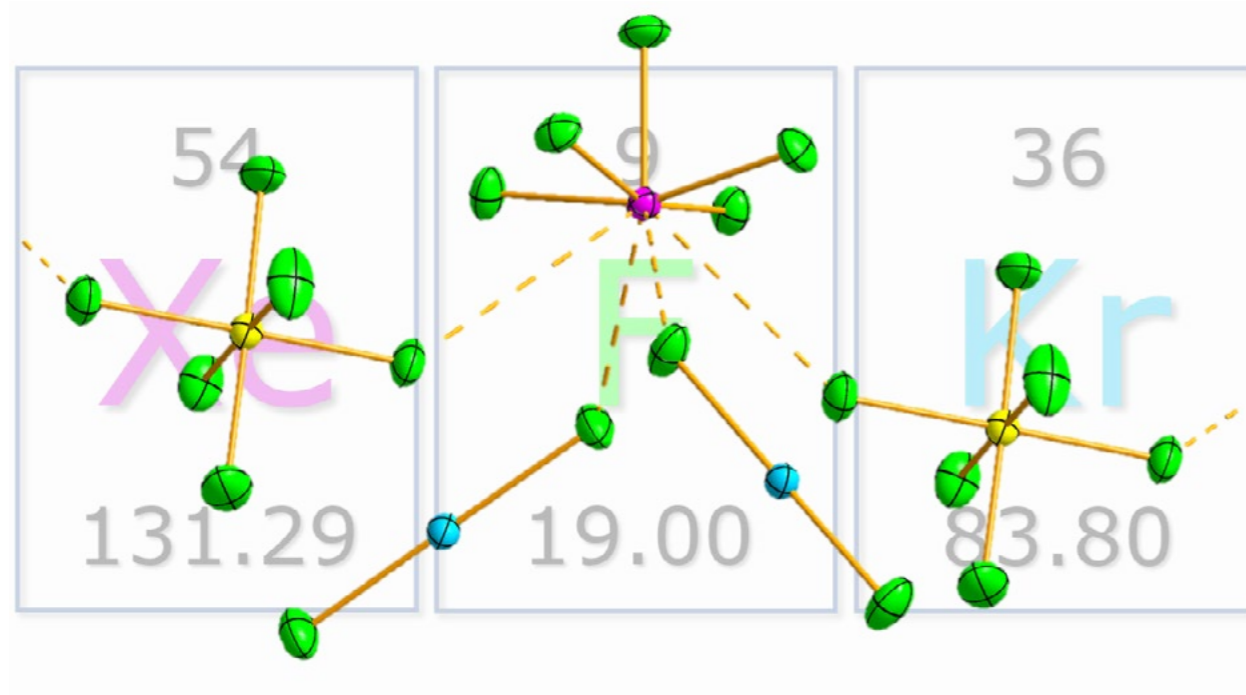
source: Borko, Š., Trontelj, P., Seehausen, O. et al. A subterranean adaptive radiation of amphipods in Europe. *Nat Commun* 12, 3688 (2021).
 hyperlink: <https://www.nature.com/articles/s41467-021-24023-w>

Dr. Matic Lozinšek

Mixed Noble-Gas Compounds of Krypton(II) and Xenon(VI)

The first xenon compound was synthesised more than half a century ago. The realisation that noble gases form compounds led to the synthesis of the first krypton compound within less than a year. However, the chemistries of these "reactive" noble gases have never become entwined as no compound containing both noble gases chemically bonded has been discovered until recently. The paper "Mixed Noble-Gas Compounds of Krypton(II) and Xenon(VI); [F5Xe(FKrF)AsF6] and [F5Xe(FKrF)2AsF6]" was published in the journal *Angewandte Chemie* and describes the synthesis, structural, and quan-

tum-chemical characterisation of the first compounds in which two noble gases, xenon and krypton, are chemically bound. In these complexes, which are very strong oxidants and were synthesised at low temperatures, krypton difluoride is coordinated to the pentafluoroxenon(I+) cation through a fluoride bridge. Rare coordination compounds in which a hydrogen fluoride molecule is coordinated to the aforementioned cation are also described. This work opens new possibilities in synthetic and coordination noble-gas chemistry. The paper received the "Hot Paper" editorial designation.



Dr. Matic Lozinšek, Jožef Stefan Institute, matic.lozinsek@ijs.si

source: M. Lozinšek, H. P. A. Mercier, G. J. Schrobilgen: Mixed Noble-Gas Compounds of Krypton(II) and Xenon(VI); [F5Xe(FKrF)AsF6] and [F5Xe(FKrF)2AsF6]. *Angewandte Chemie International Edition* 2021, 60, 8149–8156.
hyperlink: <https://doi.org/10.1002/anie.202014682>

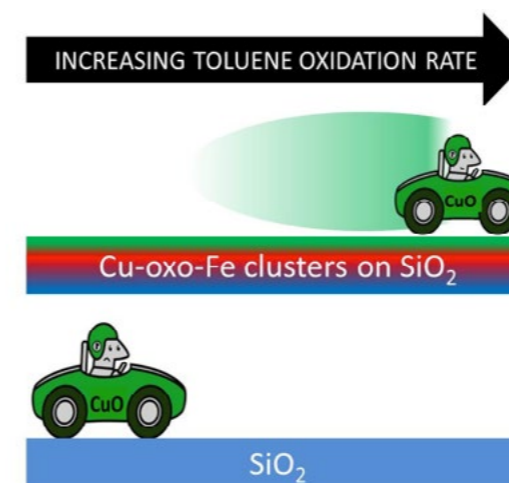
Dr. Nataša Novak Tušar

Synergistic effect of CuO nanocrystals and Cu-oxo-Fe clusters on silica support in promotion of total catalytic oxidation of toluene as a model volatile organic air pollutant

Volatile organic compounds (VOCs), emitted mainly from industrial processes, transportation and consumer products, represent the main class of air pollutants with toxic and carcinogenic nature. In the achievement, we focused on a nowadays fast developing research area to manage VOC exhaust by treating industrial waste gases with catalysts. In this work we report for the first time that the promotion of catalytic oxidation of toluene as a

model VOC is due to the synergistic redox effect between CuO nanocrystals and finely dispersed Cu-oxo-Fe clusters on mesoporous silica with defined Fe/Cu molar ratio. This increases the number and reactivity of adsorbed electrophilic (O^- in O_2^-) as well as nucleophilic lattice oxygen (O^{2-}) species at the CuO crystal and Cu-oxo-Fe cluster interface, thus providing up to twofold enhancement in catalytic activity for total oxidation of toluene.

Environmentally friendly and stable bimetal catalyst on porous support for total oxidation of volatile organic compounds in industrial waste air was synthesized and its performance was determined. The results are an important contribution not only to the field of air cleaning, but also to other research areas such as wastewater purification and the conversion of biomass to chemicals and fuels.



Dr. Nataša Novak Tušar, National Institute of Chemistry and University of Nova Gorica, natasa.novak.tusar@ki.si

source: DJINOVIĆ, Petar, RISTIĆ, Alenka, ŽUMBAR, Tadej, DASIREDDY, Venkata D. B. C., RANGUS, Mojca, DRAŽIĆ, Goran, POPOVA, Margarita, LIKOZAR, Blaž, ZABUKOVEC LOGAR, Nataša, NOVAK TUŠAR, Nataša. Synergistic effect of CuO nanocrystals and Cu-oxo-Fe clusters on silica support in promotion of total catalytic oxidation of toluene as a model volatile organic air pollutant. *Applied catalysis.B, Environmental*. [Print ed.], 5 Jul. 2020, vol. 268, pp. 118749-1-118749-10. ISSN 0926-3373.
hyperlink: <https://www.sciencedirect.com/science/article/pii/S0926337320301648>. [COBISS.SI-ID 40413445]. [JCR_SNP] IF = 16.683

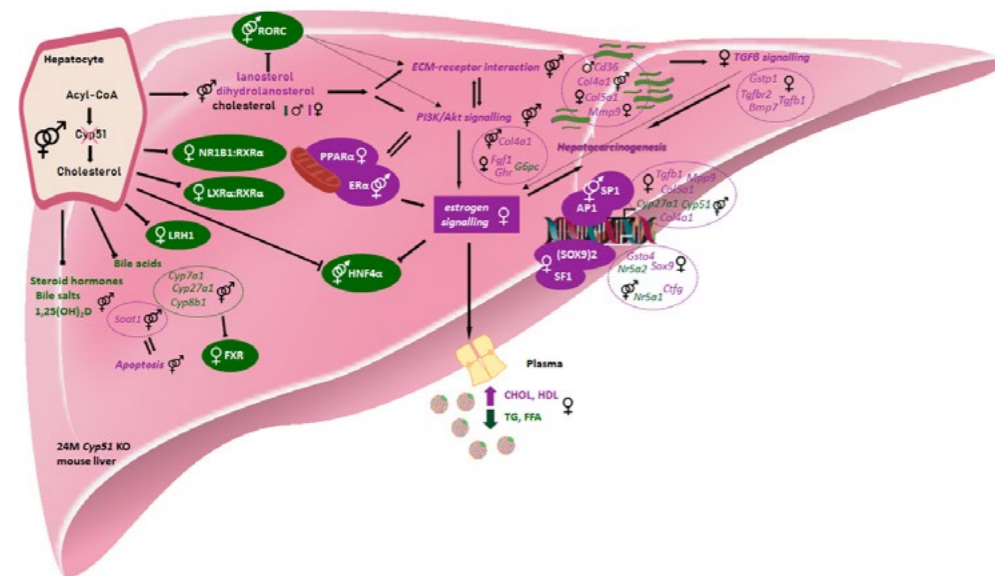
Dr. Damjana Rozman

Chronic Disruption of the Late Cholesterol Synthesis Leads to Female-Prevalent Liver Cancer

Hepatocellular carcinoma (HCC) is the second most common cause of cancer-related death, and the predominant cause of its development is disturbed metabolic processes in the liver. Maintaining cholesterol homeostasis is one of the crucial factors of metabolism, but the role of cholesterol in hepatocarcinogenesis remains unexplained. To deepen the understanding of the molecular mechanisms that regulate the metabolic-dependent development of HCC, we monitored changes in the liver of a mouse model (*Cyp51* KO) in aging mice. Phenotypic changes resulting from a targeted knock-out of the lanosterol 14 α -demethylase (CYP51) gene from the late part of cholesterol

synthesis in hepatocytes reflected in the development of liver tumours, with more pronounced liver tissue damage in the females. At the same time, several metabolic adaptations and transcriptome changes were observed. Those findings were aligned with data from the human HCC literature and are opening new horizons in understanding the liver tumorigenesis. They also offer new options for a more personalized approach and better treatment of liver disease also in females. Schematic representation of the course of hepatocarcinogenesis in mice with sex-related metabolic and transcriptional changes due to chronically impaired cholesterol synthesis at the site of lanosterol

14 α -demethylase (CYP51). Arrows indicate active links between enriched genes, KEGG pathways, and transcription factors that lead to the development of hepatocellular carcinoma. Blocked arrows represent repression when broken arrows mean possible regulation of a selected path or a connection between selected paths in mice. Purple-coloured metabolites, differentially expressed genes, KEGG pathways, and transcription factors are positively enriched, whereas green staining means negative enrichment. All selected mouse signalling and metabolic pathways are consistent with human HCC literature data.



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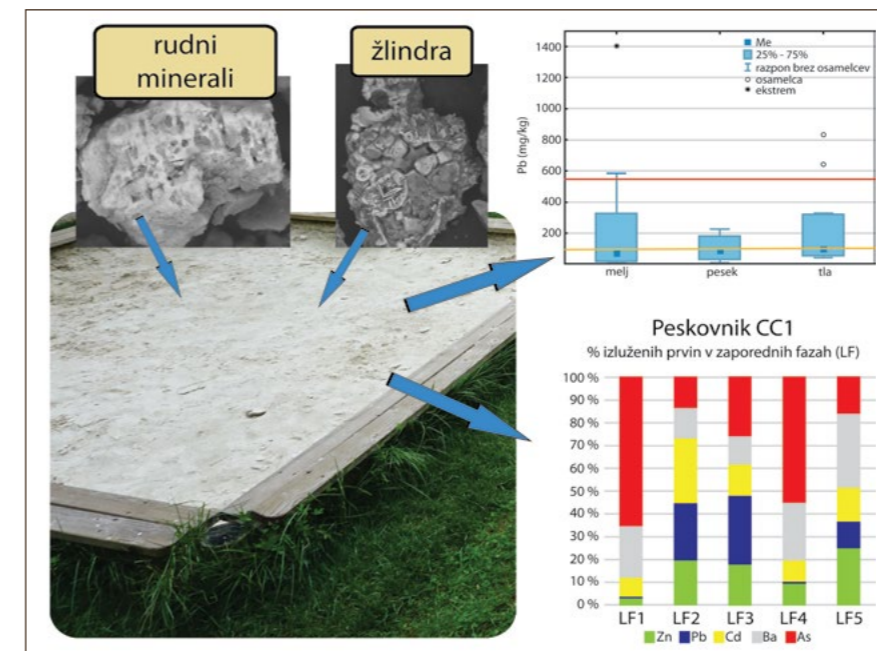
source: Blagotinšek Cokan Kaja, Urlep Žiga, Lorbek Gregor, Matz-Soja Madlen, Skubic Cene, Perše Martina, Jeruc Jera, Juvan Peter, Režen Tadeja, Rozman Damjana. Chronic Disruption of the Late Cholesterol Synthesis Leads to Female-Prevalent Liver Cancer. *Cancers* (Basel). 2020 Nov 9;12(11):3302. doi: 10.3390/cancers12113302. hyperlink: <https://www.mdpi.com/2072-6694/12/11/3302>

Dr. Nina Zupančič, Dr. Miloš Miler, Ana Ašler, Natalija Pompe and Dr. Simona Jarc

Contamination of children's sandboxes with potentially toxic elements in historically polluted industrial city

Sandboxes are a serious source of potentially toxic elements (PTE) for children. Celje is heavily polluted due to former smelting and iron processing. A few years ago, sand from waste of Pb-Zn mining in Mežica was used in some Celje sandboxes. Although the sand was replaced by uncontaminated one, geochemical analysis showed excessive contents of As, Ba, Cd, Pb and Zn. SEM/EDS analyses confirmed three possible sources of pollution: mining waste, emissions from local industry and material from old Zn smelting slag

stockpiles in Celje. The total health risk exceeded the critical value in one sandbox. Of particular concern is PTE bio accessibility, as PTEs are bound to highly soluble particles. Identification of the PTE carriers and the pathways by which they enter the sand and soil is essential for proper assessment of their bio accessibility. It is reasonable to calculate health risk indices not only on the basis of the total content of PTE but also on the basis of leachability according to most probable intake.



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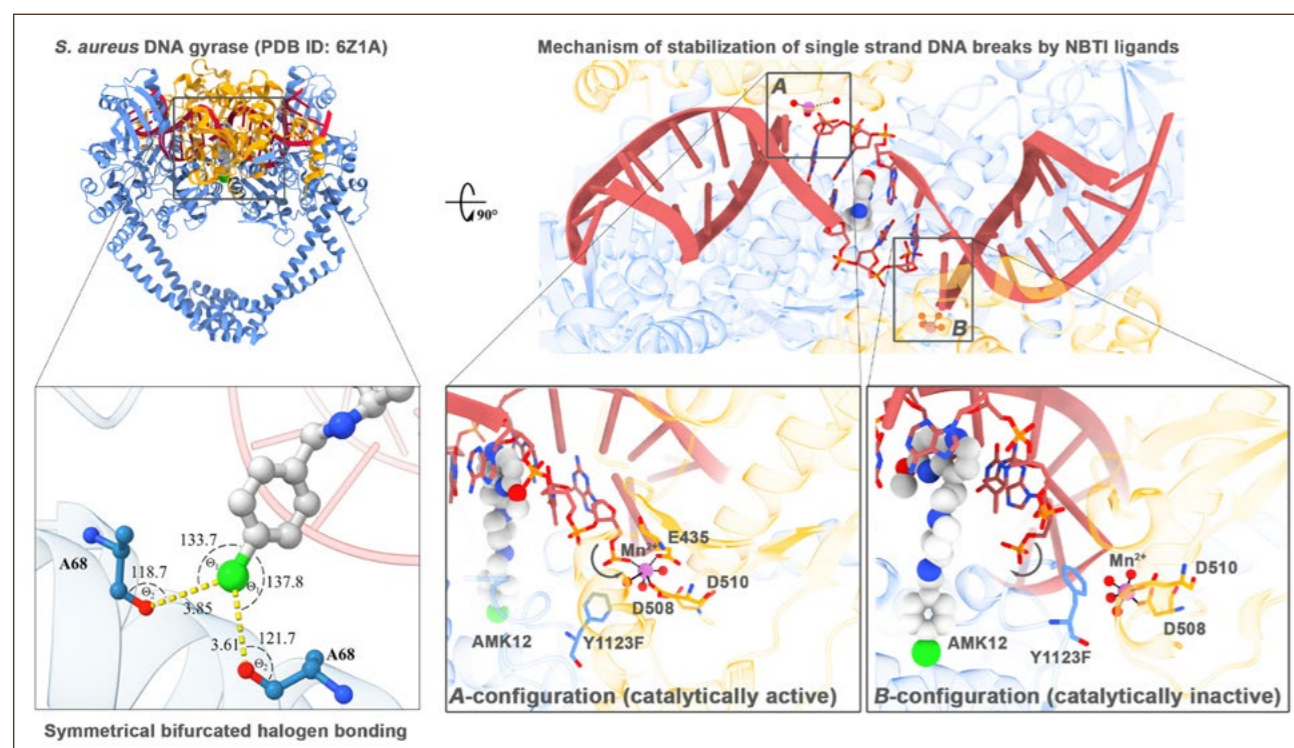
Dr. Nikola Minovski and Dr. Marko Anderluh

Potent DNA gyrase inhibitors bind asymmetrically to their target using symmetrical bifurcated halogen bonds

Novel bacterial topoisomerase inhibitors or NBTIs stabilize the complex between the DNA molecule and the DNA gyrase enzyme, causing bacterial cell death. The exact mechanism of stabilization by NBTIs has so far remained hypothetical, as researchers have postulated the possibility of the formation of a triple complex between single-stranded DNA breaks and the DNA gyrase enzyme by the NBTI molecule, however they failed to confirm this unequivocally.

In the framework of this research, we described the *in silico* design, synthesis, and biological evaluation of structurally related NBTIs comprising innovative fragments that bind to the DNA gyrase binding site. Our NBTIs demonstrated an extremely strong inhibitory activity on the isolated DNA gyrase enzyme and consequently a very potent antibacterial effect. The 3D crystal structure of the ternary complex of the innovative NBTI-DNA-DNA gyrase complex

presented in this research is the first of its kind where this mechanism is clearly demonstrated. Additionally, the presented structure disclosed the existence of a symmetrical bifurcated halogen bond between the innovative NBTI's fragment and the DNA gyrase binding site. This type of halogen bond contradicts the traditional interpretation and has so far been demonstrated only on crystal models of small molecules and not in biological macromolecules.



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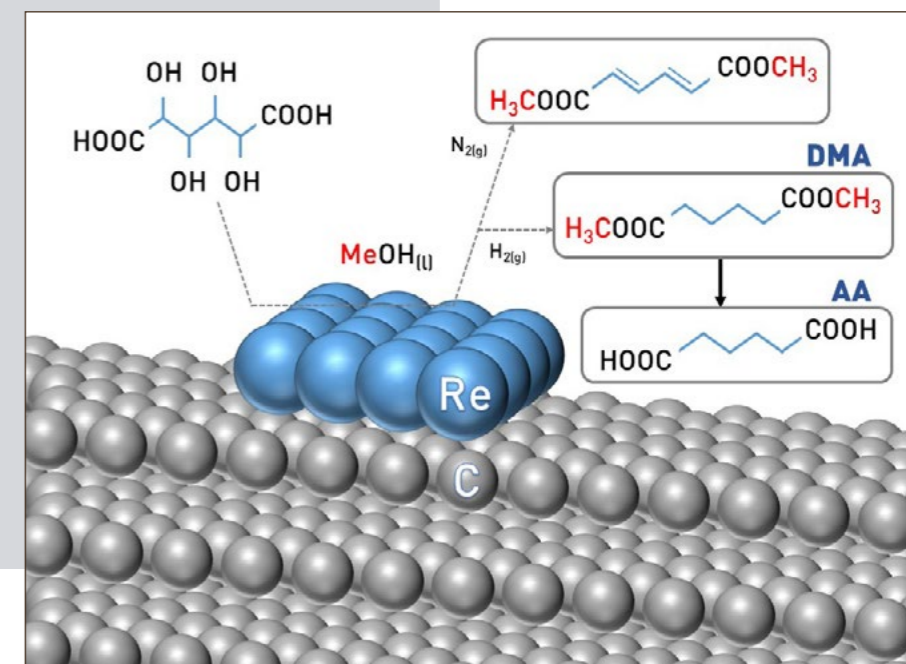
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Dr. Brigita Hočevar

H₂-Free Re-Based Catalytic Dehydroxylation of Aldaric Acid to Muconic and Adipic Acid Esters

A sustainable catalytic process for the production of bio-based adipic acid (AA) and its esters (DMA) has been developed. In contrast to the petrochemical commercial process, which produces a large amount of greenhouse gases (NO_x), the developed sustainable process does not produce any environmentally harmful by-products. Dehydroxylation – removal of hydroxyl groups – from aldaric acids is catalysed by a solid rhenium catalyst on carbon (Re/C). Methanol is used as a solvent, however, it has a multi-layered role in the process, as it serves as a solvent and as a hydrogen donor. Hydrogen produced from methanol is then used for hydrogenation of double bonds. The formation of hydrogen from methanol is strongly dependent on the reaction temperature, as it is not formed at the temperatures below 150 °C and thus selectively forms a product with double bonds, while at temperatures above 150 °C hydrogen is formed and hydrogenates double bonds to the final DMA. Methanol and catalyst are easily recycled from the final reaction mixture and both can be reused. A patent application was filed for the developed innovative process

(EP19192802.7), and the results of an extensive study of the tested reaction conditions were published in the prestigious international scientific journal (Angewandte Chemie International Edition, IF 12.96). The patented sustainable process represents an important alternative to the current petrochemical process, as it uses lignocellulosic biomass components as a feedstock, thus enabling independence from oil resources and the exploitation of locally available feedstocks from biomass.



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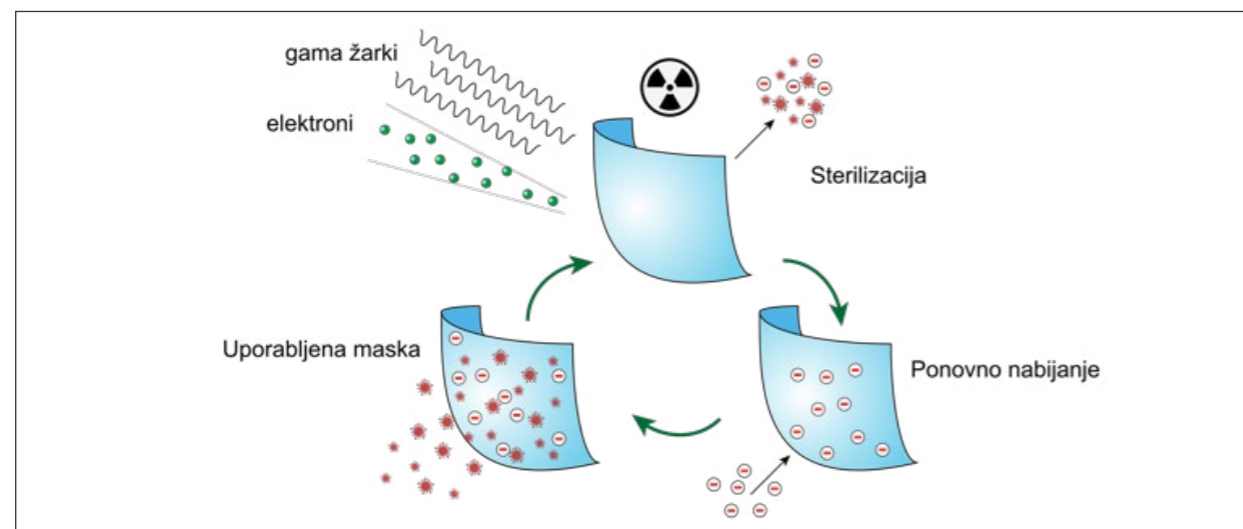
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Dr. Luka Snoj

Sterilization of polypropylene membranes of facepiece respirators by ionizing radiation

The SARS-CoV-2 virus which causes COVID-19 is transmitted through respiratory droplets and as aerosols when droplets are smaller than a few micrometres. The transmission of infection by airborne particles can be stopped with the use of FFP2 and FFP3 filtering facepiece respirators. In the first months after the outbreak of the COVID-19 pandemic, there was a shortage of respirators of this type on the market. This prompted the Jožef Stefan Institute to investigate ways to reuse the filtering facepiece respirators by sterilization with ionizing radiation, which is a commercial way of sterilizing other medical devices, as it allows rapid large-scale sterilization without the use of any harmful chemicals or high temperatures.

Filtering facepiece respirators were irradiated with gamma rays at the Jožef Stefan Institute's TRIGA Mark II reactor and at a commercial electron accelerator. In line with the existing research, we confirmed that the filtration efficiency of the filtering facepiece respirators decreases immediately after the irradiation, but we were the first to show that the filtration efficiency can be restored by reapplying the electrostatic charge, which we experimentally confirmed with surface charge measurements. Furthermore, we demonstrated that ionizing radiation can be used to restore the filtration efficiency two times, as further irradiation causes mechanical degradation of the filtering facepiece respirators.



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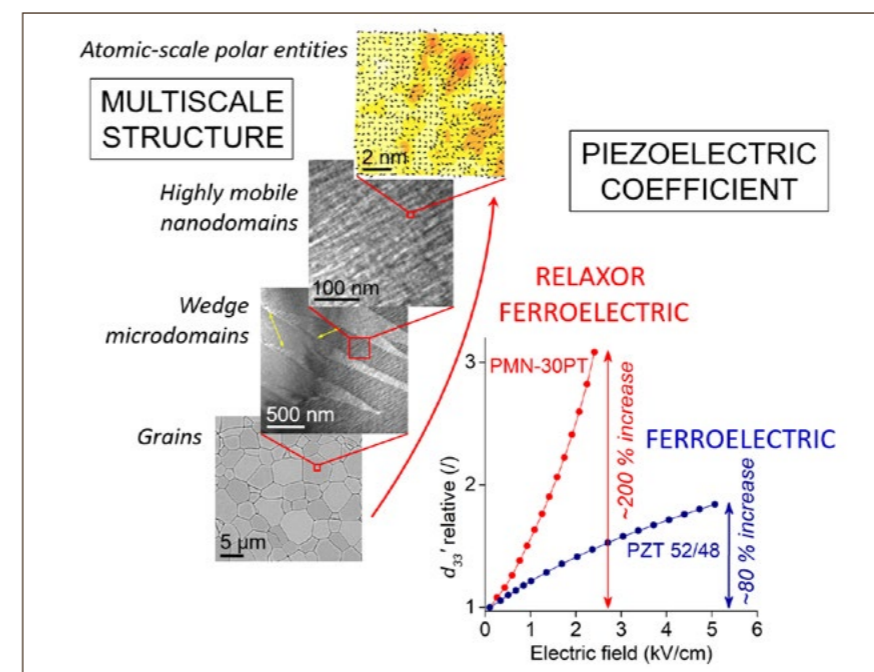
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Dr. Mojca Otoničar and Dr. Tadej Rojac

Disclosing the influence of polar disorder on the response dynamics of ferroelectric materials

Relaxor ferroelectrics exhibit giant electromechanical responses, making them highly desirable piezoelectric materials for energy conversion in electronics. To find out why this is the case for materials with a high degree of structural disorder, we have carried out an extensive experimental study involving several perovskite compositions and the use of different measurement techniques, from macroscopic measurements of the material properties to local structural analyses. This way, we have been able to uncover the

causal relationship between the structure of the materials and their functional properties. The research has revealed the unique dynamic response of relaxor ferroelectrics to the external field which is caused by a complex self-ordering at the atomic level as well as a hierarchical ordering of the ferroelectric domains that significantly affects the mobility of the domain walls. Our results open the door for the design of new environmentally friendly materials with high electromechanical response by structuring at different size scales.



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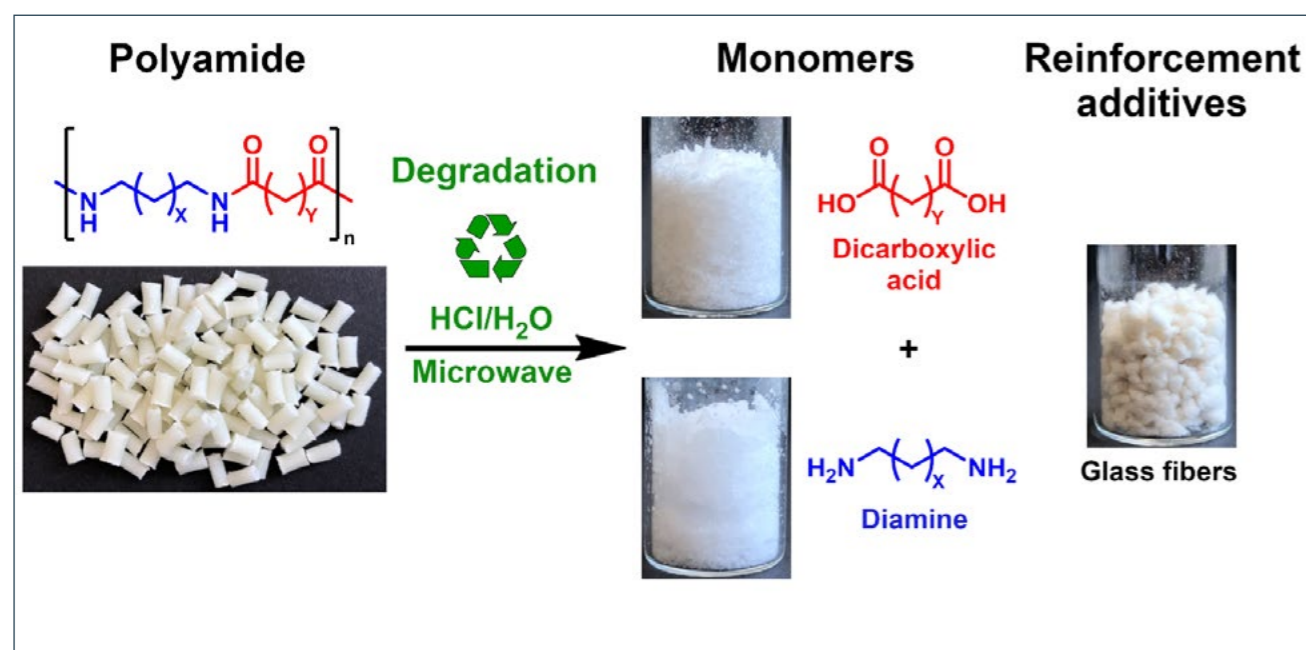
Dr. Ema Žagar and Dr. David Pahovnik

Chemical recycling of aliphatic polyamides by microwave-assisted hydrolysis for efficient monomer recovery

We have developed an efficient process for chemical recycling of short- and long-chain aliphatic polyamides (PA66, PA11, PA12 and PA1010). For each type of polyamide, we have determined the optimal experimental conditions under which they are completely degraded to the constituent monomers by microwave-assisted acid-catalysed hydrolysis. The extent of polyamide degradation was monitored by NMR spectroscopy and HPLC chromatography. We also developed procedures to isolate and purify the monomers, and

HPLC methods to determine their purity. The advantages of our chemical recycling method for aliphatic polyamides compared to known methods are the rapid (several minutes) and efficient degradation of polyamides to monomers without side reactions, which greatly simplifies the procedures for isolation and purification of the recovered monomers and reinforcing additives (glass fibres, carbon fibres) in the case of composites. The secondary raw materials obtained by this process are of comparable quality to

commercially available chemicals used in polyamide production. Recently, polymer recycling focuses on chemical recycling, in which polymers are degraded into basic building blocks or their derivatives, from which we can produce polymer materials of comparable quality to those made from primary raw materials. The development of new polymer recycling technologies thus enables more efficient recycling and a reduction of waste in the environment.



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Dr. Janko Slavič

SciPy 1.0: fundamental algorithms for scientific computing in Python

The SciPy numerical library for scientific computing has in its 20-year history become one of the most important numerical libraries and has a broad scientific influence on all sciences (technical, natural, social and humanistic). Some of the recent scientific contributions (such as imaging of the M87 black hole and identification of gravitational waves) would not have been possible without it. SciPy is an open source, numerical library in the Python environment. More than 600 scientists have been involved in its development in its 20-year history before the publication in Nature Methods (today, this number has risen to more than 1000). Researchers are developing the library transparently, both in development

and in ecosystem decision-making and management.

111 invited authors participated in the publication in the Nature Methods scientific journal. Among them was also the only Slovenian representative, Prof. Dr. Janko Slavič, member of the Mechanics in Engineering program group (P2-0263). The scientific paper describes the history, structure, principles of open cooperation and some recent and planned extensions of the numerical library.

The publication in Nature Methods has been gaining intense attention: since its publication in March 2020 until December 15, 2021, the article has gained 4262 citations in the Scopus database.



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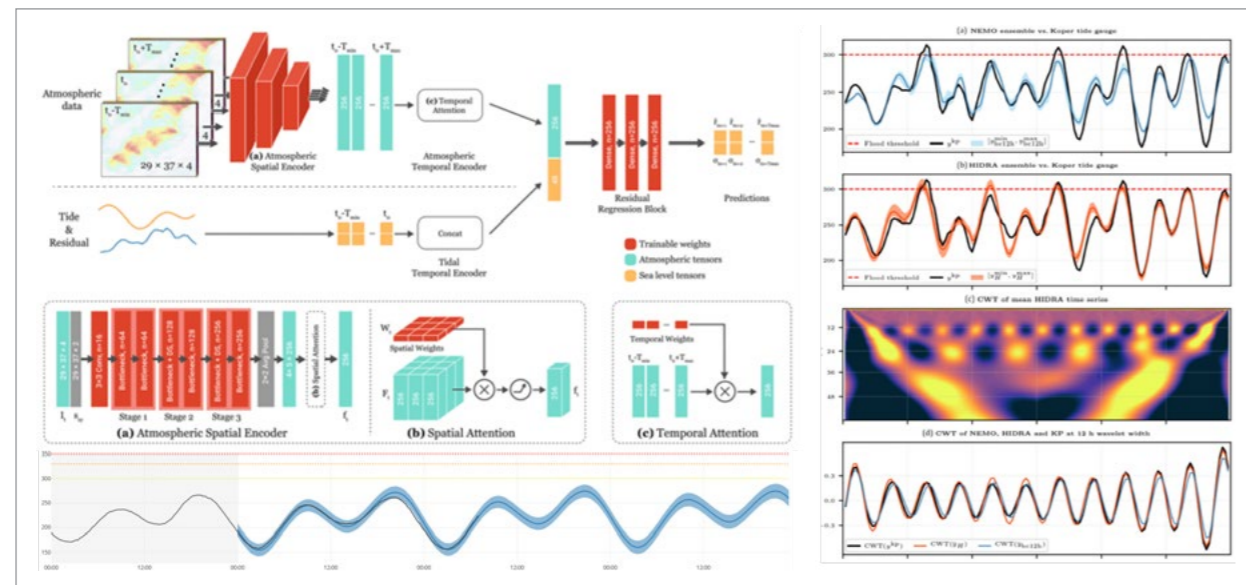
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Lojze Žust, Anja Fettich, Dr. Matej Kristan and Dr. Matjaž Ličer

HIDRA – a robust deep model for sea surface height prediction

Experts estimate that the frequency of floods in the northern Adriatic will increase tenfold by the end of the century. Accurate forecasting is therefore crucial for protecting the coastal population and the economy. However, coastal floods forecasting in the northern Adriatic is very challenging due to interactions between atmospheric phenomena, topographic specifics of air and sea flow and resonant properties of the Adriatic basin. The latter therefore requires simulation of coupled atmospheric and oceanic models, which is slow and subject to modelling errors. We developed a deep neural net-

work HIDRA, which predicts sea surface heights for the next 72 hours in a selected geographic point based on atmospheric time series forecast and the recent sea surface heights. HIDRA surpasses the most advanced operational model NEMO in accuracy, while being half a million times faster. This is the first machine learning method that surpasses ocean physical numerical models in this task while being real-time. HIDRA is already a part of operational analysis at the Slovenian Environment Agency, and its forecasts are publicly available (<https://bit.ly/hidra-forecast>).



HIDRA predicts the sea surface height in a specific geographic point three days into the future with an accuracy comparable to numerical models.

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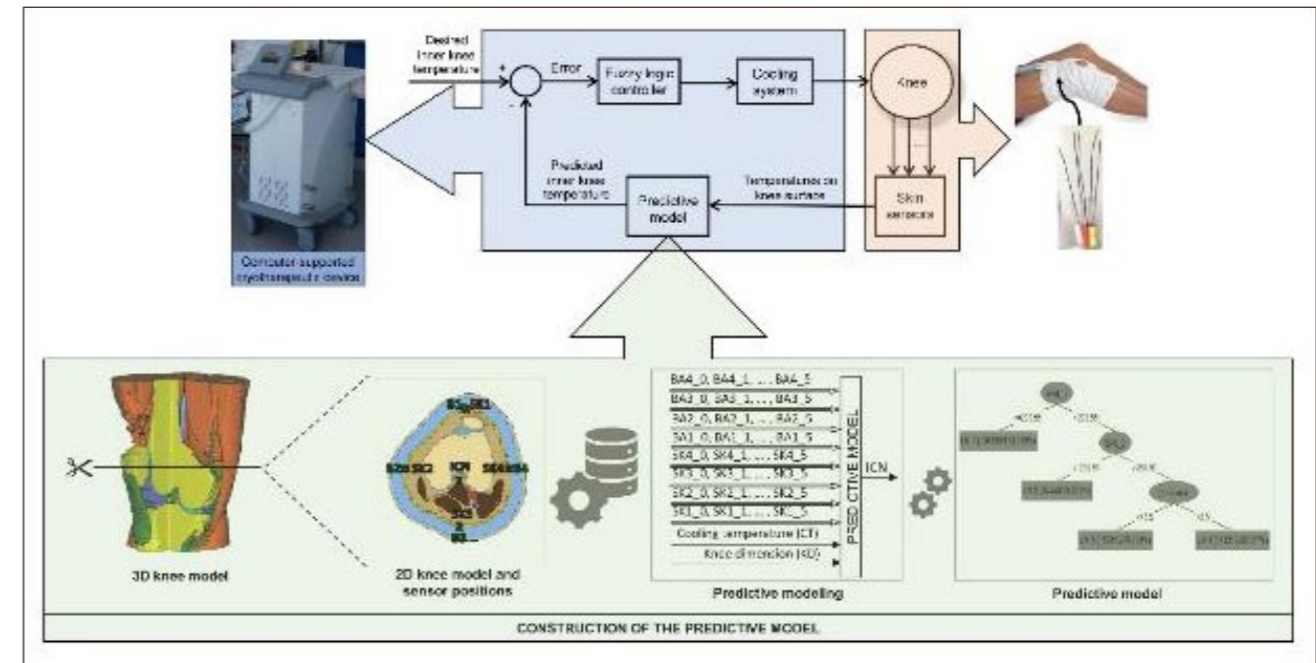
Dr. Aleksandra Rashkovska Koceva and Dr. Roman Trobec

Personalized Real-Time Control of Hidden Temperature Variables in Therapeutic Knee Cooling

We have formalized, implemented and evaluated a framework for personalized real-time control of inner knee temperature during cryotherapy. The framework is based on the feedback control loop that uses predicted instead of measured inner temperatures because measurements are not feasible or would introduce invasiveness into the system. It uses machine learning

to construct a predictive model for estimation of the controlled inner temperature variable based on other variables whose measurement is more feasible – temperatures on the body surface. The machine learning method uses data generated from computer simulation of the therapeutic treatment for different input simulation parameters. A fuzzy-logic controller is designed to provide

real-time control of the inner knee temperature by controlling the cooling temperature. Controlled therapeutic cooling can contribute to the development and standardization of various cryotherapeutic methods. The framework has been protected with a patent (WO2014/180941) and awarded a special prize for innovations in economy at ITTC 2013.



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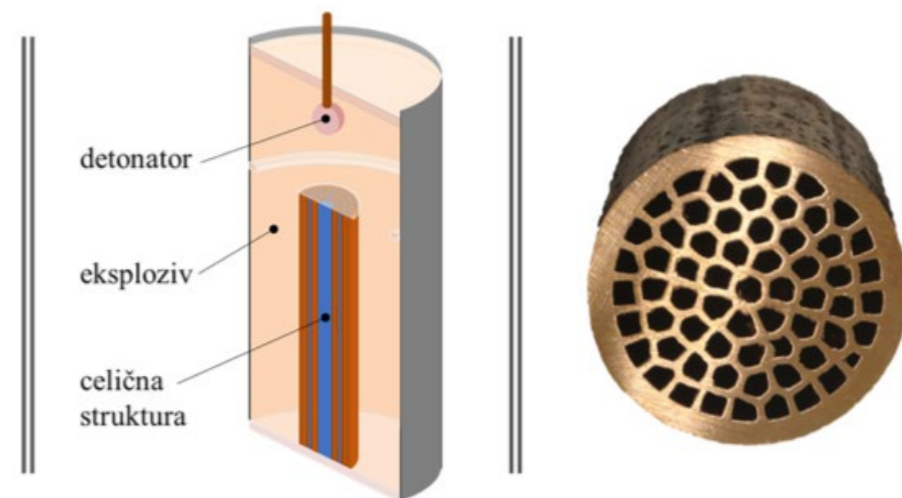
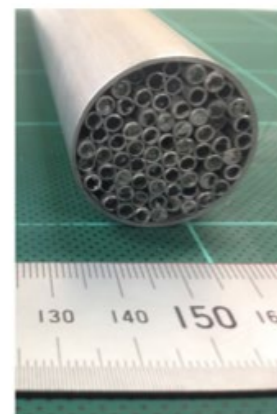
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Dr. Matej Vesenjāk, Dr. Matej Borovinšek, Dr. Nejc Novak, Dr. Miran Ulbin, Anja Mauko and Dr. Zoran Ren

Development and characterization of advanced metal cellular structures with longitudinally oriented pores

The development of new, multifunctional cellular structures and the characterization of their improved properties is significant for the next generations of modern products for lightweight design, energy absorption, heat exchange, etc. A new methodology of explosion welding of a pipe bundle was developed to produce cellular structures with longitudinally oriented pores (Uni-Pore), which is the subject of patent protection with Japanese patents JP6821150 and JP6856208. The shape and composition of newly developed cellular structures with targeted mechanical properties are

determined using a combination of advanced computer simulation and optimization methods. The mechanical behaviour of fabricated samples of different types and loading velocities was evaluated through experimental testing and advanced computer simulations. The granted patents and numerous scientific articles published in the most recognized international scientific journals result from many years of research collaboration with Kumamoto University in Japan in developing and fabricating advanced cellular metamaterials and structures.



Stacionarna naprava za brezkontaktni prenos električne energije

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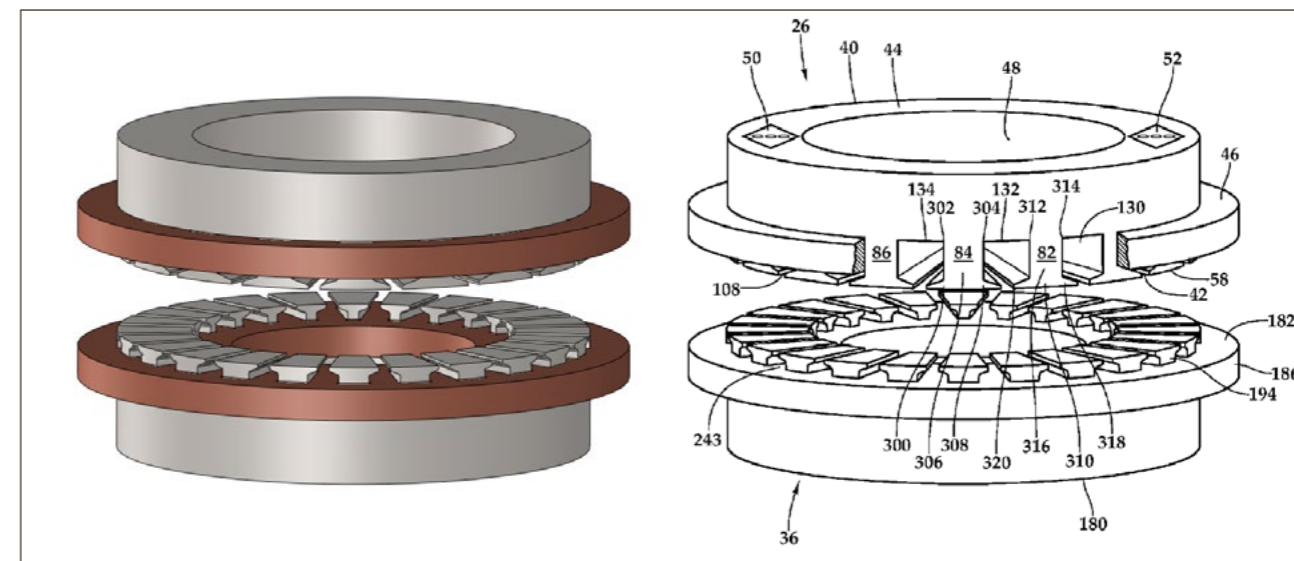
Dr. Damijan Miljavec, Dr. Mario Vukotić, Dr. Selma Čorović and Laslo Olah

Stationary device for contactless electrical energy transmission

In some cases, using a cable for electrical energy transmission might be impractical, unsuitable or even impossible. Such examples, where avoiding a cable would be reasonable, include for example: wireless battery charging of mobile phones and electric vehicles, underwater operation of vessels and operation in highly explosive areas. Modern inductive systems for electric energy transmission allow the transmission of relatively low powers between the primary and the

secondary system, due to the usage of air coils. This leads to a magnetic circuit with large reluctance, which demands high magnetizing current and/or high frequency operation for a sufficient amount of energy to be transferred in a reasonable time. High current reduces the efficiency and high frequency also limits the use of materials that could be utilized in such a device, and has a negative impact on the device surroundings. The presented invention improves

the existing limitations and increases the stability and functionality of the operation of such devices. The patented device increases the efficiency of contactless transmission of electricity from 80% to 95% in a power range from a few hundred Watts to tens of thousands of Watts. It should be emphasized that the device does not have harmful effects on its surroundings, due to the use of low frequencies and ferromagnetic magnetic circuits.



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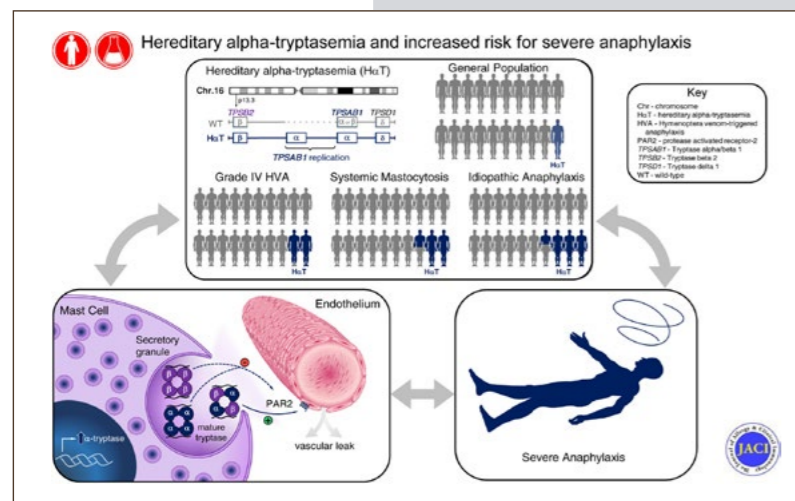
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Dr. Peter Korošec

Too much of an allergy-related gene makes anaphylaxis worse: the discovery of hereditary anaphylaxis

Many previous reports have linked elevated mast cell basal serum tryptase levels to the frequency and severity of anaphylaxis and mastocytosis (clonal mast cell disease). Although mastocytosis is the culprit in some individuals, it does not fully explain this clinical association. In this study, we determine the prevalence and associated impact of inherited tryptase genotypes on anaphylaxis in humans. We found that a heritable risk for severe anaphylaxis is associated with increased α -tryptase-encoding germline copy

number at *TPSAB1*, the genetic trait hereditary α -tryptasemia. Very importantly, we also provided a putative mechanism for this association. Increased α -tryptase-encoding germline copy number at *TPSAB1* induces an increase in acute endothelial cell permeability and thus hypotension and severe anaphylaxis selectively by mature α/β -tryptase heterotetramers, in a protease-activated receptor-2 (PAR2)-dependent manner. We confirmed those findings in an independent cohort and further demonstrated that clonal mast cell disease related to somatic KIT p.D816V was often found in individuals with normal basal serum tryptase and very severe venom-induced anaphylaxis. In aggregate, these findings identify the first common heritable genetic risk factor for anaphylaxis and clarify the long-held associations between elevated basal serum tryptase and anaphylaxis. This finding further suggests that targeting α/β -tryptase heterotetramers may provide clinical benefits in selected individuals with anaphylaxis.



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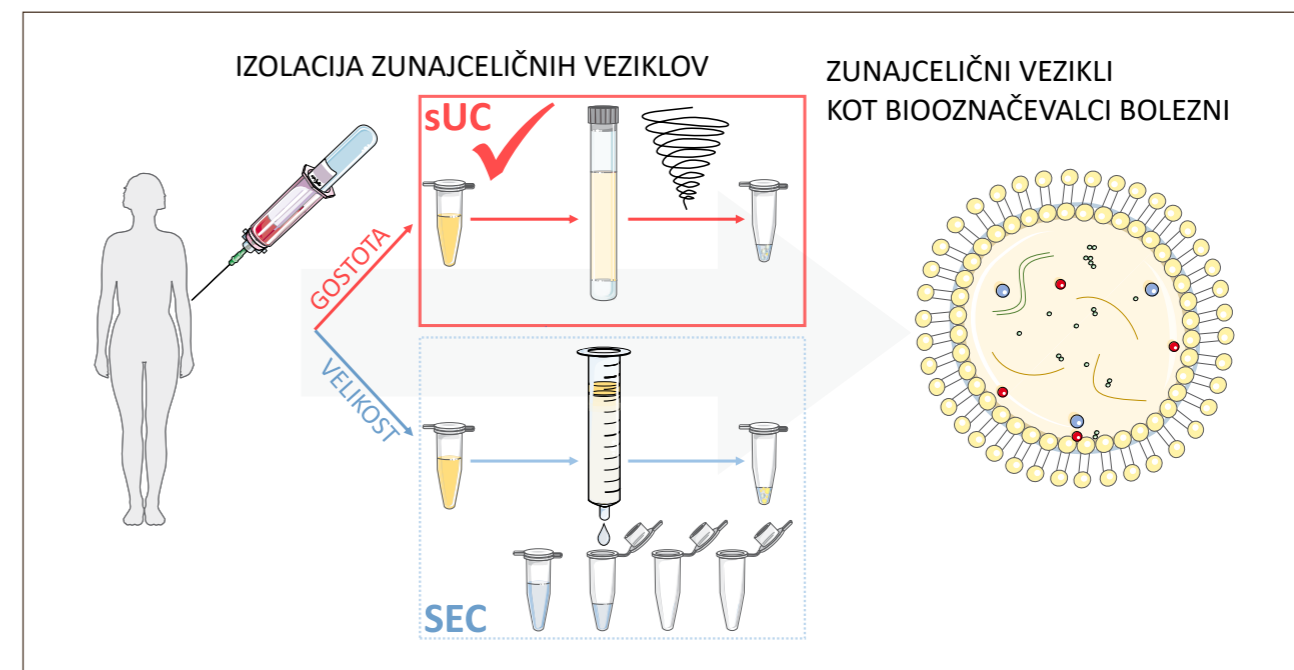
Dr. Metka Lenassi and Dr. Marija Holcar

Establishing the method for extracellular vesicle isolation from blood plasma for biomarker discovery

Extracellular vesicles are a newly discovered group of membrane nanoparticles secreted by all cell types. They accumulate in body fluids and reflect the (patho) physiological state of the parent cell, making them a new potential source of disease biomarkers. Human blood plasma is a very complex fluid commonly used for extracellular vesicle studies. Due to the small size and small amount of extracellular vesicles compared

to other plasma nanoparticles (e.g. lipoproteins, proteins and viruses), obtaining pure extracellular vesicles from blood plasma remains a challenge. Our goal was to introduce a simple method of isolating plasma extracellular vesicles that would allow their reliable quantification in clinical samples in the search for biomarkers of disease. Extracellular vesicles were isolated from the plasma of healthy volunteers using density- (ultracentrifugation on a

sucrose cushion; sUC) or size- (size exclusion chromatography; SEC) based methods of nanoparticle separation. Detailed analysis of isolated extracellular vesicles revealed that density-based isolation (sUC) is more appropriate, as it repeatedly leads to high purity of extracellular vesicles in sufficient concentration. In collaboration with clinicians, the method has been successfully used in several studies trying to identify new disease biomarkers.



Picture prepared with the help of Servier Medical Art (<http://smart.servier.com/>), licenced under the Creative Common Attribution 3.0 Generic License

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Dr. Marija Holcar, University of Ljubljana, Faculty of Medicine, marija.holcar@mf.uni-lj.si

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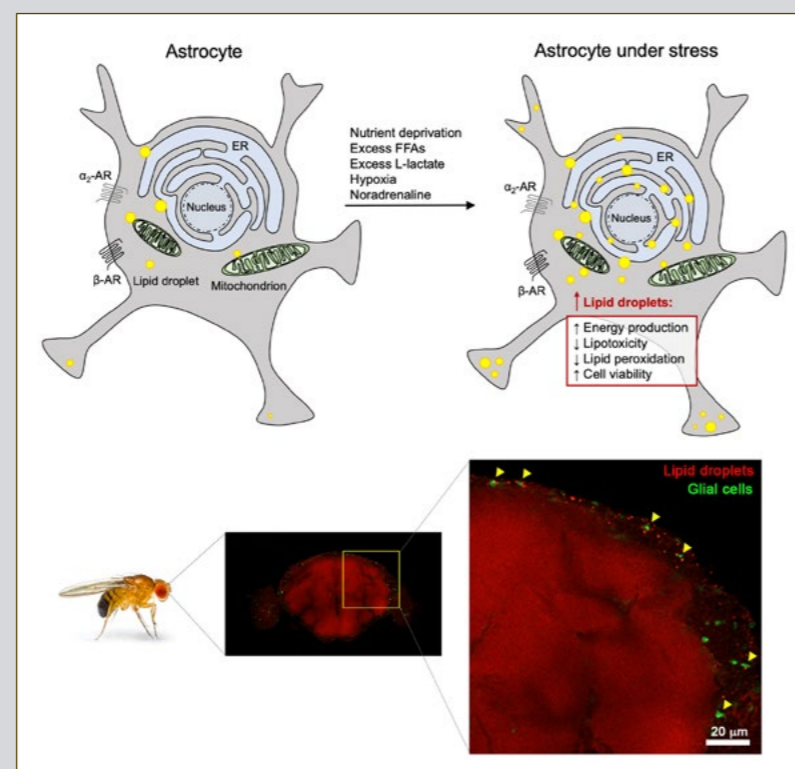
Dr. Nina Vardjan and Dr. Robert Zorec

Dysregulation of noradrenergic regulation of metabolism in astrocytes in neurodegeneration and intellectual disability represents a new target for drug development

Pathological changes in the brain are often associated with a reduction in the action of noradrenaline, a signalling molecule that among other things regulates brain metabolism. However, the mechanisms of noradrenaline action at the cellular level are poorly understood. Astrocytes are the neuroglial cells that maintain brain homeostasis. They uptake nutrients from the bloodstream and deliver them in the form of lactate to neurons. This is regulated by noradrenaline and is crucial for cognition, learning and memory formation. In the studies listed below, we show that under stress and in astrocytes harbouring TDP-43 protein inclusions, characteristic of the neurodegenerative disease ALS (amyotrophic lateral sclerosis), lipid droplet metabolism and noradrenaline-induced glycolysis and lactate production are altered, thereby affecting astroglial metabolic support to neurons. In addition, by developing a new experimental animal model of intellectual disability with a specific deletion of the gene for the Gdil protein in astrocytes, the results have revealed that astrocytes undergo an increase in glycolysis with

a negative impact on cognition. This was demonstrated by inhibiting glycolysis with a glucose metabolite (2-DG) that is not metabolized in glycolysis and is routinely used in clinical imaging. Our studies revealed that astrocytes contribute

to metabolic dysregulation in the brain in stress, ALS, and intellectual disability, representing a strong translational potential for the development of novel therapies for neurodegenerative and neurodevelopmental disorders.



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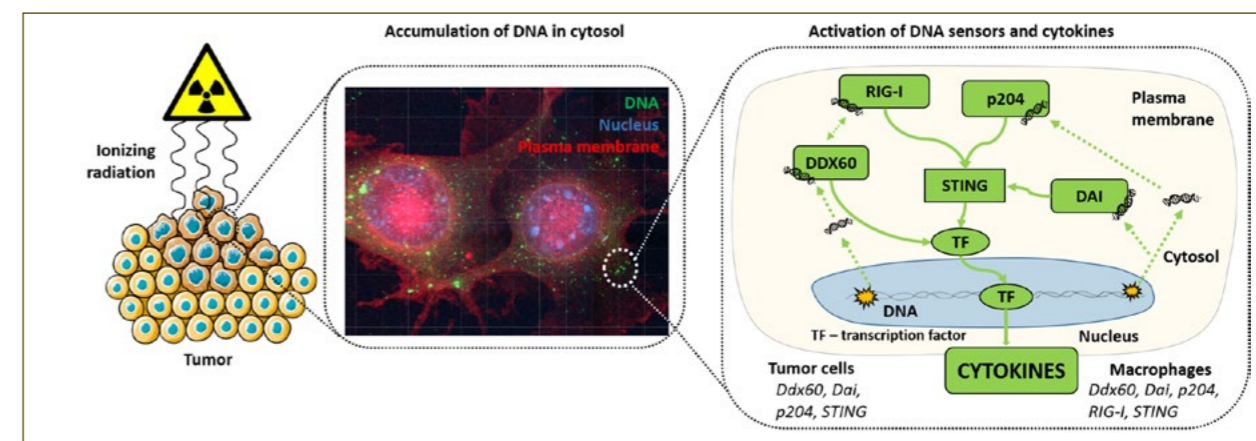
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Dr. Tanja Jesenko

Radiation Induced Upregulation of DNA Sensing Pathways is Cell-Type Dependent and Can Mediate the Off-Target Effects

This was a basic radiobiological study demonstrating that irradiation activates several DNA sensing pathways, which induce the production of cytokines that can mediate off-target effects on bystander cells or distant metastases. We demonstrate that tumour cells as well as macrophages accumulate DNA in their cytosol after irradiation. This accumulation activates several distinct DNA sensing pathways, most prominently activated DNA sensors being DDX60, DAI, and p204 in tumour cells and DDX60, DAI,

p204, and RIG-I in macrophages. This was accompanied by increased expression of cytokines, TNF α , and IFN β in tumour cells and IL1 β and IFN β in macrophages. We demonstrate that activation of signalling pathways is cell type-, dose- and time- dependent. Therefore, every cell type seems to have its unique response to radiation depending on the combination of activated DNA sensors. These results give insight into the mechanisms involved in the stimulation of antitumor immunity by radiation.



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source: JESENKO, Tanja, BOŠNJAK, Maša, MARKELC, Boštjan, SERŠA, Gregor, ŽNIDAR, Katarina, HELLER, Loree C., ČEMAŽAR, Maja. Radiation induced upregulation of DNA Sensing pathways is cell-type dependent and can mediate the off-target effects. *Cancers*, ISSN 2072-6694, 2020, vol. 12, pp. 3365-1-3365-23.

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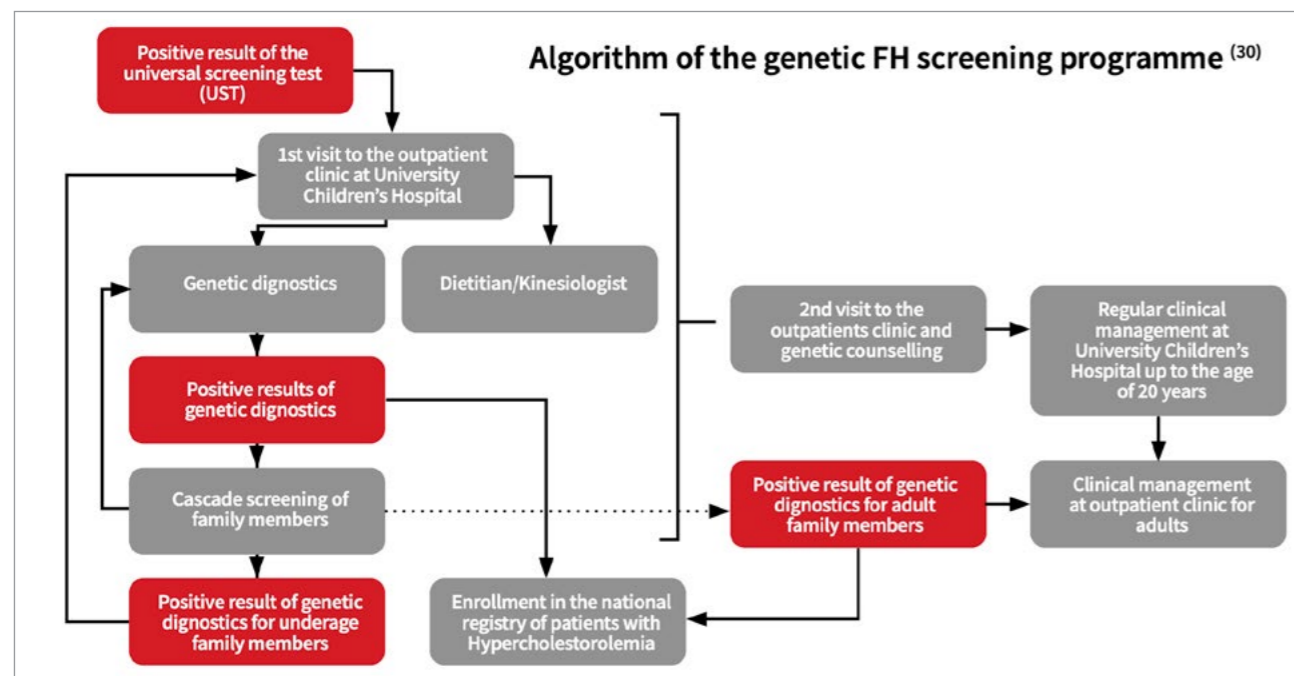
Dr. Urh Grošelj

Slovenian model of paediatric screening for familial hypercholesterolemia is part of white paper on cholesterol of World Heart Federation

Hypercholesterolemia is one of the major risk factors for cardiovascular diseases, which are the main cause of premature mortality globally. Early identification of people with familial hypercholesterolemia, which is the most common inherited metabolic disorder, but severely under-diagnosed, is one of the crucial measures in preventing premature cardiovascular complications. Globally, over 30 million of people

(>90% of all) live with undiagnosed familial hypercholesterolemia. In 2021, World Heart Federation introduced a White Paper on cholesterol with the aim to improve the situation globally. The White Paper specifically presents the Slovenian model of paediatric screening for familial hypercholesterolemia, which is coordinated, analysed and developed at the UMC – University Children's Hospital Ljubljana, and

thus enables the detection of the great majority of children and their parents with this metabolic disorder. The Slovenian program of early detection of familial hypercholesterolemia is thus considered as a model program, which may be applicable as an early identification of people with familial hypercholesterolemia also in other parts of the world, to help preventing their early cardiovascular complications.



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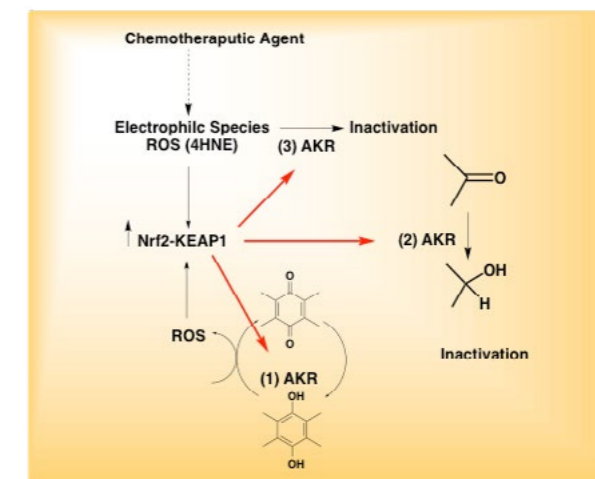
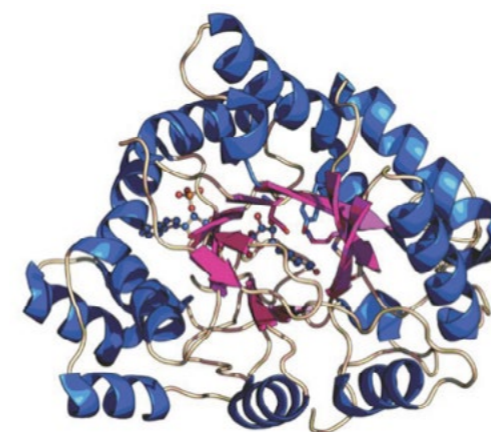
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Dr. Tea Lanišnik Rižner

Role of aldo-keto reductases in chemoresistance

Drug resistance (chemoresistance) is the major cause of unsuccessful cancer treatment. Chemoresistance is a complex phenomenon that includes many underlying mechanisms. Aldo-keto reductase (AKR) enzymes are implicated in resistance to cancer chemotherapeutic agents either because they are directly involved in their metabolism or help eradicate the cellular stress created by these agents (e.g. reactive oxygen species and lipid peroxides). Furthermore, this cellular stress activates the Nrf2-Keap1 pathway, and many human AKR genes are up-regulated by the Nrf2 transcription factor leading to a feed-forward mechanism to enhance drug resistance. Resistance to major classes of chemotherapeutic agents (anthracyclines; mitomycin;

cis-platin; anti-tubulin agents, vinca alkaloids and cyclophosphamide) occurs by this mechanism. Human AKRs are also involved in hormonal-dependent malignancies, and are up-regulated by anti-hormonal therapy providing a second mechanism for cancer drug resistance. The review manuscript describes the mechanisms of involvement of aldo-keto reductase enzymes in cancer chemoresistance and presents AKRIC inhibitors as new possible drugs that may improve the efficacy of existing chemotherapeutics. Studies in animal and cell models revealed that inhibitors of the Nrf2 system or pan-AKRIC inhibitors offer promise to surmount cancer drug resistance and/or potentiate the effects of existing drugs.



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Dr. Klemen Bohinc

Bacterial adhesion on medical surfaces

In this paper, we describe current studies of bacterial adhesion on medical surfaces. Special attention was paid to orthopaedic materials used for implants [1]. Orthopaedic implants are surgically implanted in the body to fix fractures, eliminate deformities, replace joints, and attach soft tissues. The study presents the latest techniques for the characterization of orthopaedic material surfaces. Modifications of orthopaedic material surfaces are described that improve osseointegration and reduce foreign body response or infection [1,2]. Strategies for reducing bacterial surface adhesion with coatings are presented [1,2]. The importance of this study was

to examine in detail the osteointegration and adhesion of bacteria to medical surfaces. A review of the studies known so far makes it possible to find original coatings of medical surfaces (orthopaedic implants [1], dental surfaces [3,4], catheter surfaces [5]) that reduce bacterial adhesion. In these studies [2,5], we developed polyelectrolyte coatings of metal and catheter surfaces. These coatings significantly reduce the adhesion of bacteria. The purpose of the study is to ensure better contact between biological tissues and medical surfaces and to reduce the risk of bacterial infections that such surfaces can cause.

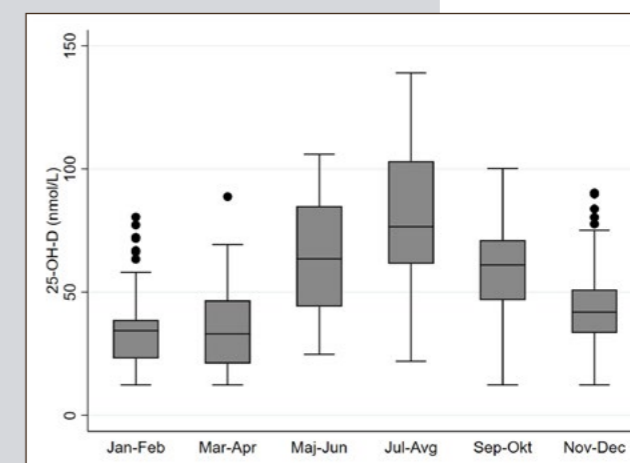
Dr. Klemen Bohinc, University of Ljubljana, Faculty of Health Sciences, klemen.bohinc@zf.uni-lj.si

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Dr. Igor Pravst, Dr. Katja Žmitek and Maša Hribar

Assessment of vitamin D status in Slovenian population and activities for reducing deficiency during COVID-19 epidemic

Vitamin D deficiency (VitD) is highly prevalent among different population groups across Europe, but the vitamin D status of the Slovenian population has not been previously evaluated. Sources of vitamin D in the human body include dietary intake, and ultraviolet B (UVB)-light-induced biosynthesis, which is scarce at our latitude – particularly during wintertime. To address the lack of epidemiological data on vitamin D status we conducted a nationally representative Nutrihealth study. Vitamin D status was determined by measuring the serum 25-hydroxy-vitamin D (25(OH)D) concentration; thresholds for deficiency and insufficiency were levels below 30 and 50 nmol/L, respectively. A particularly concerning situation was observed between November and April, when deficiency and insufficiency were found in about 40% and 80% of the adult population, respectively. This public health risk was particularly concerning also due to the COVID-19 pandemic. We therefore further researched the



gaps regarding the vitamin D knowledge in the general population and used our results for the preparation of a very successful raising awareness media campaign. Results from the epidemiological study are important for implementing appropriate public health actions to prevent vitamin D deficiency and insufficiency. At the same time, we substantially contributed to the general awareness about vitamin D deficiency risks.

Seasonal variation of mean serum 25-hydroxy-vitamin D concentrations in adult Slovenian population (Nutrihealth research; Slovenia, N = 280).

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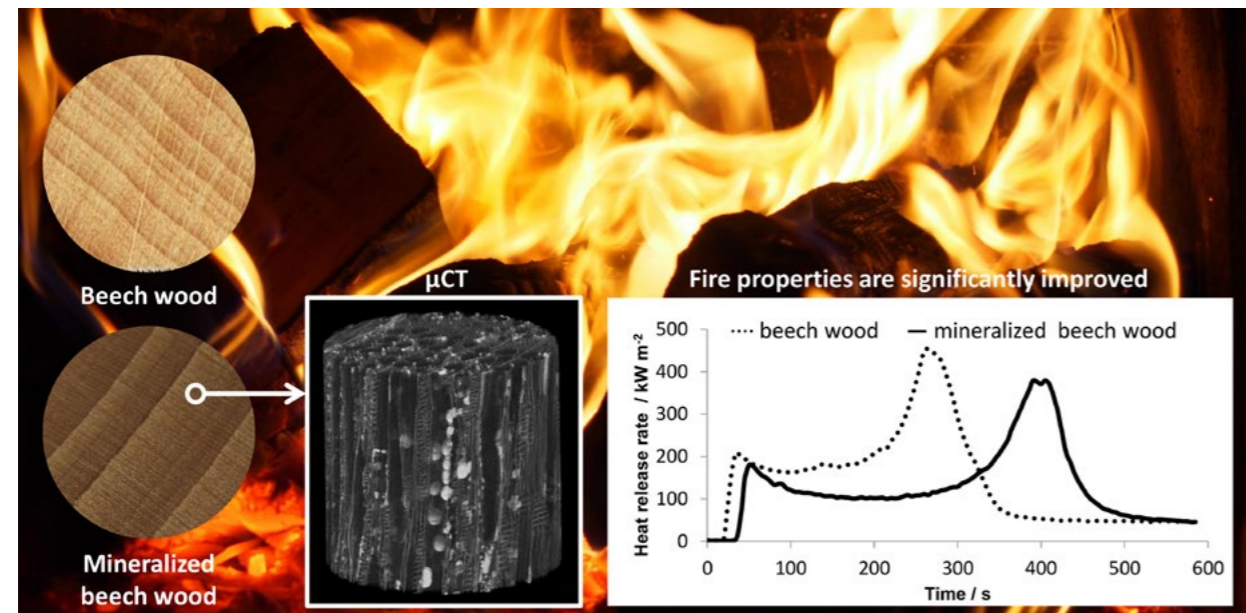
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Dr. Andreja Pondelak

Environmentally friendly process of wood mineralization for improving its flame retardancy

One of the main disadvantages of wood is its flammability. The fire retardancy of wood can be improved by adding flame retardants which, however, can be environmentally problematic, and are therefore limited and strictly controlled. The development of new, more environmentally friendly systems is therefore crucial. The incorporation of carbonates into the wood structure (mineralization) is environmentally friendly and presents an alternative to conventional flame retardants. We proposed, developed and described a new method of wood mineralization for improving its fire

resistance. The method is based on vacuum-pressure impregnation with an aqueous solution of calcium acetoacetate, which is transformed into CaCO_3 deep in the wood structure. We have shown that fire properties of mineralized beech significantly improve – the ignition time is extended, heat release over the first 600 s of the test ($\text{THR}_{600\text{s}}$) is reduced as well as the fire growth rate index (FIGRA). The proposed method represents a completely new way of incorporating carbonates into the wood structure and has therefore opened a new research area in the field of wood mineralization.



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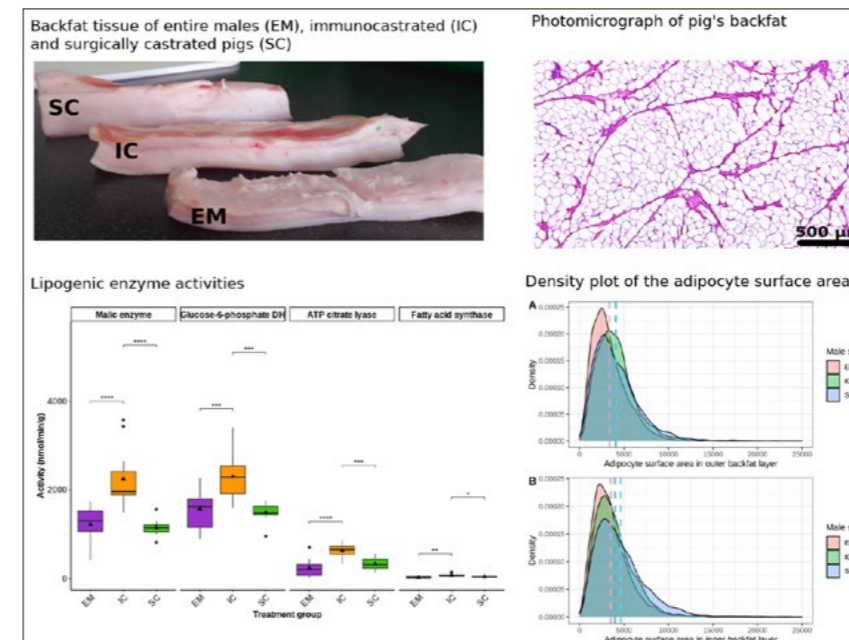
Klavdija Poklukar, Dr. Marjeta Čandek-Potokar, Dr. Milka Vrecl, Dr. Nina Batorek Lukač, Dr. Gregor Fazarinc, Dr. Kevin Kress, Dr. Ulrike Weiler, Dr. Volker Stefanski and Dr. Martin Škrlep

The effect of immunocastration on adipose tissue deposition and composition in pigs

Immunocastrated pigs differ in adipose tissue deposition and composition compared to entire males and surgically castrated pigs. Surgically castrated pigs exhibit increased carcass fatness, while the entire males show elevated leanness and decreased fat accumulation. Immunocastrated pigs after an efficient immunisation rapidly switch from a metabolism similar to that of entire males to that of surgically castrated pigs. The underlying mechanisms responsible for the deposition of ad-

ipose tissue are still not fully understood. Therefore, the objective of the present study was to characterise adipose tissue at histo-morphological and biochemical levels in all three sex categories. We have shown that the response to immunocastration is quite rapid, especially at the level of fat synthesis. Thus, immunocastrated pigs were found to have higher lipogenic enzyme activity than entire males and surgically castrated pigs, and to have larger adipocytes compared to entire males. In addition, the

changes in fatty acid composition after immunisation varied according to the fat depot and anatomical position. The fatty acid profile changed more rapidly in intramuscular fat and more slowly in subcutaneous adipose tissue at withers, where immunocastrated pigs were still closer to entire males than to surgically castrated pigs. This study will help understand the underlying mechanisms on fat accumulation in male sex categories and improve their fattening efficiency and meat quality.



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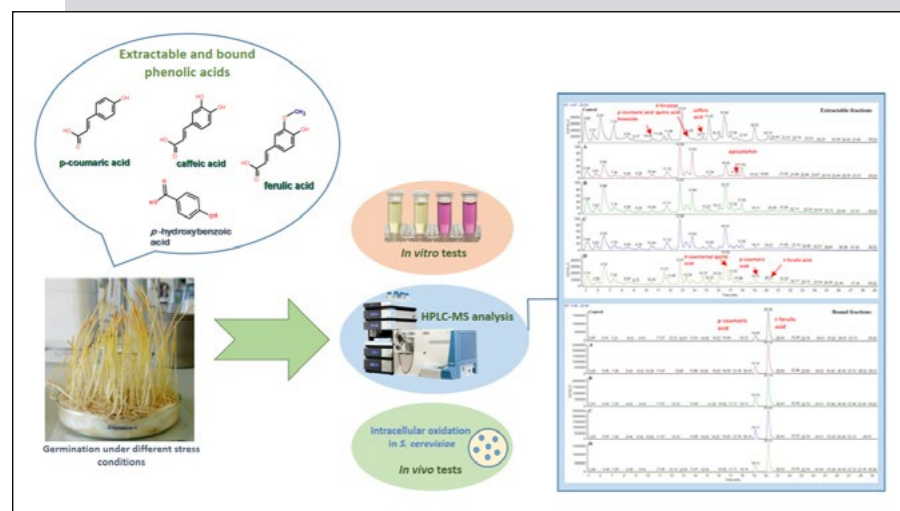
Marjeta Mencin, Dr. Helena Abramovič, Dr. Polona Jamnik, Dr. Maja Mikulič Petkovšek, Dr. Robert Veberič and Dr. Petra Terpinc

Abiotic stress combinations improve the phenolics profiles and activities of extractable and bound antioxidants from germinated spelt (*Triticum spelta* L.) seeds

According to the recommendations by various health organizations, the consumption of whole grains should be significantly increased in the future, as the adequate inclusion of dietary fibre and bioactive components in the daily diet is a protective factor against various chronic diseases. Spelt (*Triticum spelta*) is an important source of dietary fibre and phenolic compounds with strong antioxidant activity. Bound phenolic compounds are often overlooked in such studies because they can only be determined by hydrolysis of the plant matrix and are also resistant to enzymes in the digestive tract. Germination softens the seed structure, reduces the content of antinutritive components and improves the bioaccessibility and

availability of nutritionally important components. In this study, the germination of spelt seeds under different stress treatments was tested, with the aim of increasing the content of total and some individual antioxidants. Germination under combined stress of 25 mM NaCl and 50 mM sorbitol without subsequent mechanical stress had a significant effect on the extractable and bound phenolics contents and scavenging activities against different free radicals (DPPH[•], ABTS^{•+}, O₂^{•-}, ROO[•]) compared to the seeds where no stress was applied. Ferulic, *p*-coumaric, caffeic and *p*-hydroxybenzoic acids were the major bound antioxidants in spelt. Despite considerably lower content, extractable antioxidants were a relatively more

heterogeneous group. The bound phenolics also had greater antioxidant activity. Based on the model organism *Saccharomyces cerevisiae*, it can be concluded that the main antioxidants of spelt seeds cannot directly enter the cell and protect it from oxidation, so they probably need to undergo transformation beforehand. Our research shows that the biosynthesis and transformation of phenolic compounds also depends on specific stress conditions during germination. The research results open the possibility for the development of much-needed functional foods, since nutrient-deficient foods significantly contribute to a higher incidence of chronic diseases. Germination under abiotic stress is considered a safe, accessible and simple process, so potential products with improved nutritional value may also be well received by consumers.



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source: MENCIN, Marjeta; ABRAMOVIČ, Helena; JAMNIK, Polona; MIKULIČ PETKOVŠEK, Maja; VEBERIČ, Robert; TERPINC, Petra. Abiotic stress combinations improve the phenolics profiles and activities of extractable and bound antioxidants from germinated spelt (*Triticum spelta* L.) seeds. *Food Chemistry*, 2021, vol. 344, art no. 128704, pp. 1-12. hyperlink: <https://doi.org/10.1016/j.foodchem.2020.128704>

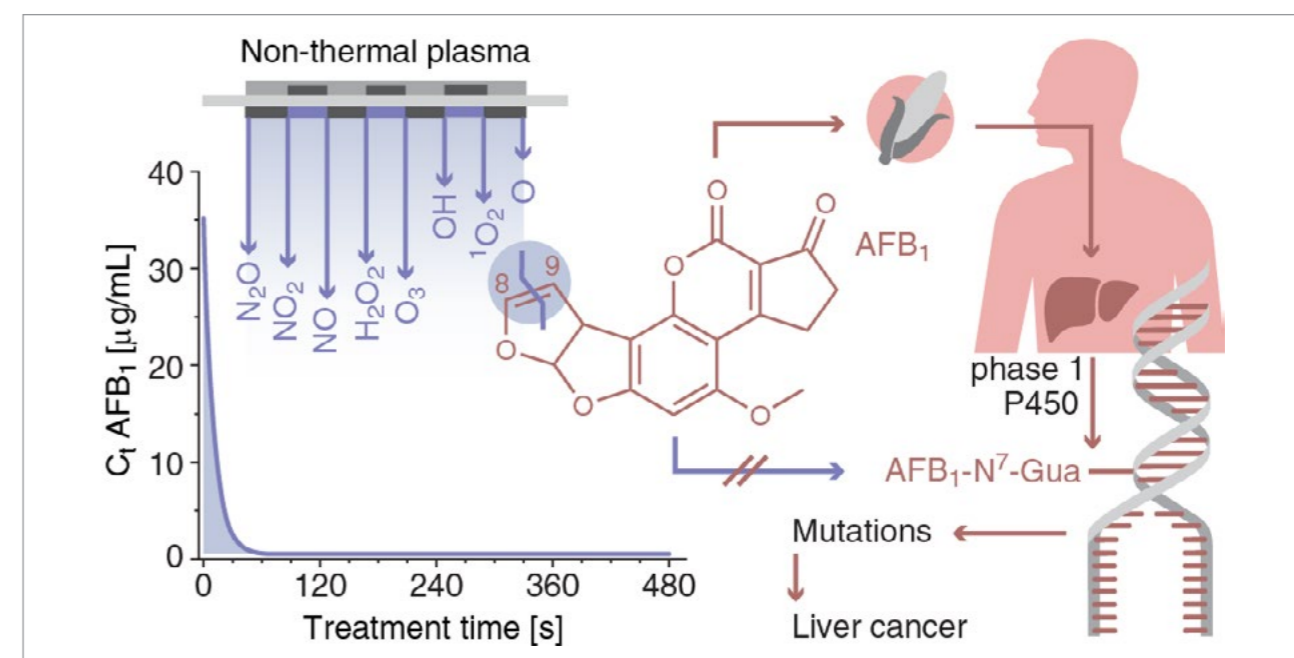
Dr. Nataša Hojnik and Dr. Martina Modic

Unravelling the Pathways of Air Plasma Induced Aflatoxin B1 Degradation and Detoxification

Researchers from the Jožef Stefan Institute, F6 Department (Department for Gaseous Electronics) have, together with their partners, published a paper in the "Journal of Hazardous Materials". The paper titled "Unravelling the Pathways of Air Plasma Induced Aflatoxin B1 Degradation and Detoxification" presented results collected as part of the project J4-1770 led by Dr. Martina Modic. The published research highlighted the global challenge of mycotoxin contamination of food, with a focus on aflatoxin B1 (AFB1), which

is considered to be one of the most potent natural carcinogens. Using an atmospheric pressure air plasma system, developed specifically for the project, the authors were able to achieve complete degradation of the AFB1 molecules within 120 s of exposure. Beyond demonstrating the efficiency of plasma mediated mycotoxin degradation, the team were the first in the world to elucidate the degradation mechanism and identify breakdown products. Using this insight, the toxic potential of plasma treated AFB1 was

examined and it was demonstrated that both its cytotoxic and genotoxic characteristics were successfully removed by plasma treatment. This research provided a key insight into the mechanisms of action of cold atmospheric pressure plasmas on mycotoxin contamination that is a blight to society. The research represents a major step, unlocking the full potential of plasma technology as an effective method for food decontamination with clear economic and societal benefit.



Cold atmospheric pressure plasma degradation of mycotoxin AFB1 and determination of the mechanisms involved in this process (Hojnik et al. 2021).

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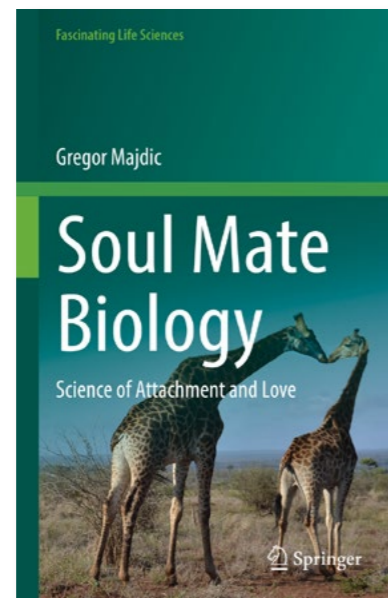
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Dr. Gregor Majdič

Soul mate biology – science of attachment and love

Gregor Majdič published a book about the evolution of love entitled *Soul mate biology – science of attachment and love*, with one of the world's largest publishing houses, Springer Nature. In the book which consists of 23 chapters, the author explains the scientific understanding of the feeling of love in a popular and widely understood way. The book describes the basic mechanisms of action of hormones, pheromones and the nervous system in the human and animal body, as well as the origin of sexual reproduction and the importance of gene recombination. The book describes in an interesting

way the different ways of mating and courting in different groups of animals such as fish, cephalopods, insects, birds and other animals, and in the last part of the book we learn what happens in human bodies and especially the brain when we are in love. The book is a remarkable and comprehensive review of scientific findings about what happens in human and animal bodies during mating, attachment, and love. The author presents the scientific findings in an interesting and widely understandable way, which is also accessible to readers who do not have extensive prior knowledge of neurobiology.



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source: Cham: Springer, 2021. XVII, 220 str., ilustr. ISBN 978-3-030-67211-9, doi: 10.1007/978-3-030-67212-6, 2A (Z, A, A, AI/2); verified by OSICN, Avtorji / Authors: MAJDIČ, Gregor. COBISS.SI-ID: 55158787
hyperlink: [doi:10.1007/978-3-030-67212-6](https://doi.org/10.1007/978-3-030-67212-6)

Dr. Alenka Nemeč Svete, Dr. Tomaž Vovk and Dr. Peter Kruljc

Effects of vitamin E and coenzyme Q10 on oxidative stress parameters in untrained leisure horses subjected to acute moderate exercise

Physical activity can cause oxidative stress and consequently lipid peroxidation in humans and animals. Lipid peroxidation can be prevented by dietary antioxidant supplements. Client-owned untrained leisure horses are often subjected to acute moderate physical activity. The aim of the study was to determine the effect of 14-day supplementation

with antioxidants (vitamin E, coenzyme Q₁₀ (CoQ₁₀) and their combination) and placebo on the oxidative stress parameters in untrained leisure horses subjected to acute moderate physical activity. The latter resulted in increased extent of lipid peroxidation and thus oxidative stress in horses supplemented with placebo and CoQ₁₀, but not in

horses supplemented with vitamin E, alone and in combination with CoQ₁₀. Based on the results, it can be concluded that vitamin E prevented lipid peroxidation resulting from moderate exercise and is therefore an effective dietary supplement of untrained leisure horses subjected to acute moderate exercise.



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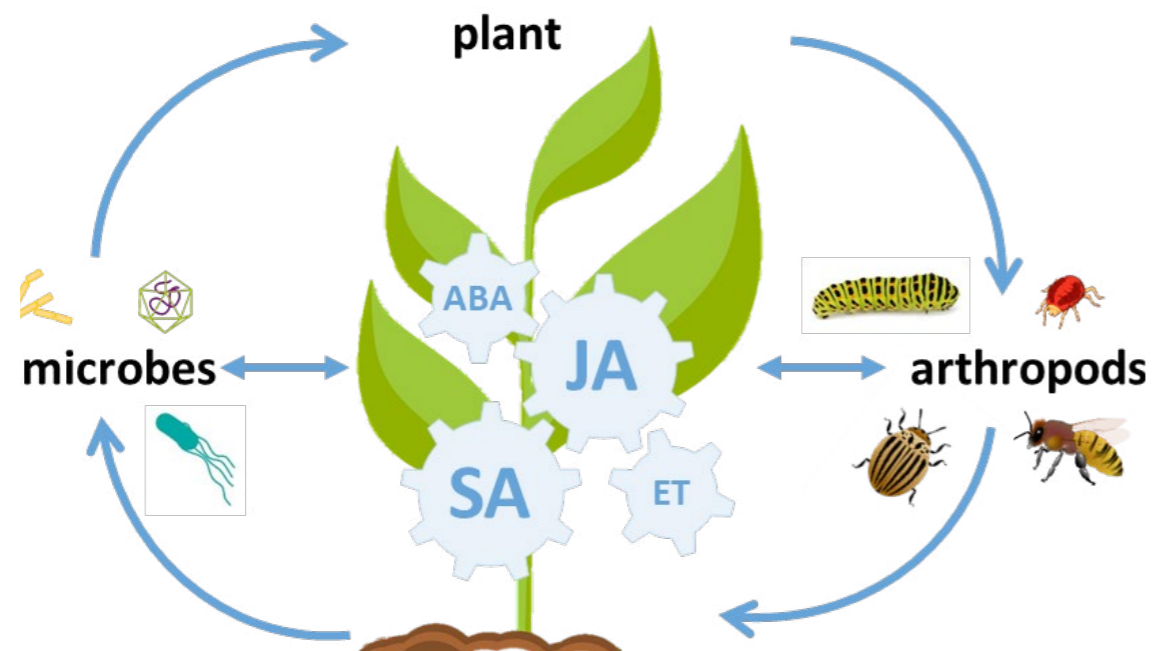
Dr. Kristina Gruden and Dr. Marko Petek

Ménage à trois – unravelling the mechanisms regulating plant-microbe-arthropod interactions and guidelines for their research

Despite the importance of the interactions between plants, microbes and arthropods in plant protection, the plant regulatory mechanisms in these interactions are poorly understood. NIB researchers, in collaboration with researchers from the Jožef Stefan Institute and abroad, studied the responses of plants to other organisms in the environment, thus paving the way for the smart use of microorganisms in agriculture. They analysed published mechanisms of plant immune response to two- or three-way interactions and looked for

potential common patterns in plant responses according to taxonomic groups or types of interactions. Although most signal modules that regulate two-way interactions are also triggered in three-way interactions, they often differ from the simpler interactions of two organisms in intensity and speed of response. These differences are essential for the outcome of the interaction in favour of the plant and as such the basis for planning the ecological protection of crops with beneficial microbes. The study was published as an opinion

article in one of the most recognized journals in the field of plant sciences, Trends and Plant Science. In order to prepare optimal mixtures of microorganisms for pesticides and to determine the right way to use them, it is necessary to understand the mechanisms that are triggered in the plant to make it more resistant. The article contributes to the understanding of the mechanisms of two- and three-way interactions and provides guidelines for steps that lead to the optimization of practical applications.



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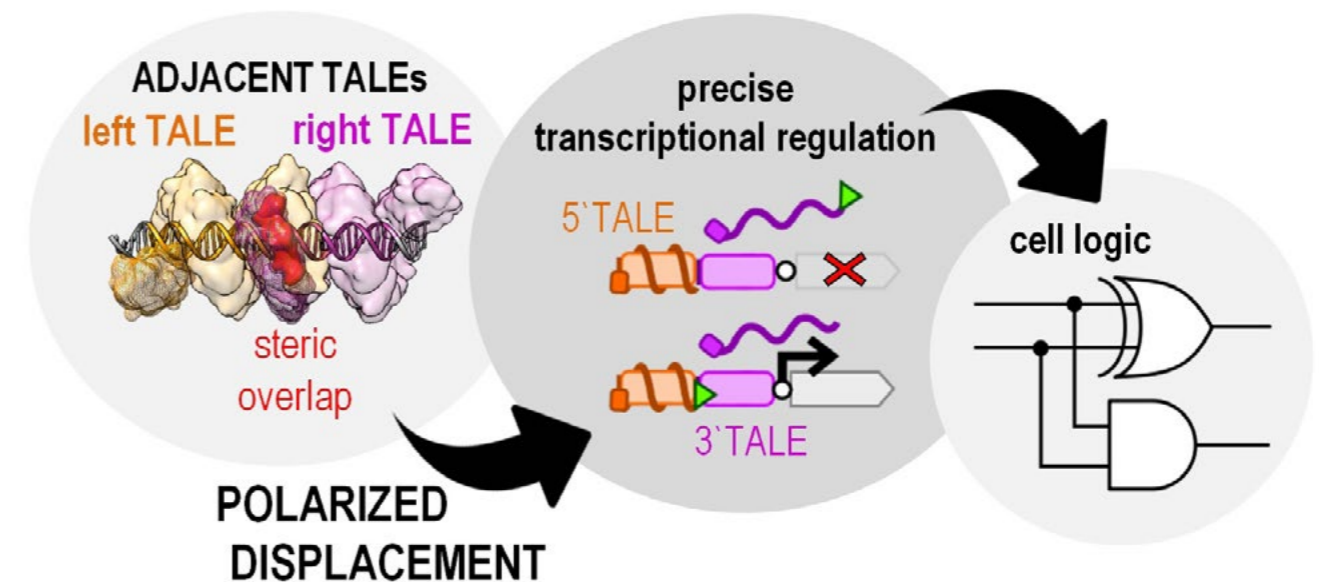
source: GRUDEN, Kristina, PETEK, Marko, PODPEČAN, Vid, et al. Ménage à trois: unraveling the mechanisms regulating plant-microbe-arthropod interactions. Trends in Plant Science. [Print ed.]. 2020, vol. 25, no. 12, pp. 1215-1226. ISSN 1360-1385. hyperlink: [DOI:10.1016/j.tplants.2020.07.008](https://doi.org/10.1016/j.tplants.2020.07.008).

Dr. Tina Lebar, Anže Verbič, Dr. Ajasja Ljubetič and Dr. Roman Jerala

Polarized displacement of proteins from DNA using TALE proteins

Regulation of gene transcription is performed by proteins that bind to DNA. Proteins called Transcription activator-like effectors (TALEs) are made up of modules, each of which recognizing a single nucleotide. Researchers from the Department of Synthetic Biology and Immunology of the National Institute of Chemistry report that a TALE protein can displace another TALE protein from DNA in a very unusual way. Amino-terminally bound TALE protein can displace carboxyl-terminally bound TALE protein, but not vice versa. The researchers elucidated the

mechanism of this phenomenon and used targeted protein displacement to improve the accuracy and efficiency of gene regulation. By chain displacement of a series of adjacent TALE proteins, they were able to demonstrate the preparation of efficient logic circuits in human cells. Fast dissociation of molecular complexes through binding of other tightly bound molecules is one of the important mechanisms in nature, and this research is the first time that molecular displacement has been designed and used for a completely new purpose.



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source: Nature Chemical Biology 15, 80–87 (2019) hyperlink: <https://doi.org/10.1038/s41589-018-0163-8>

Dr. Ana Kozina

Can FRIENDS for Life social-emotional learning programme be used for preventing anxiety and aggression in a school environment: 6 months, 1-year and 1-and-a-half-year follow-up

FRIENDS for life (Barrett, 2005) is an anxiety prevention programme that integrates cognitive behavioural approach with social and emotional learning methods. The current study examines the effects of the FRIENDS for life programme in a school environment, with results focusing on both anxiety and aggression. 4th-grade students in Slovenia (N = 85) were randomly assigned either to the intervention or to a no-treatment control group in a randomised

control study. We measured anxiety and aggression with AN-UD and AG-UD aggression scale at pre-, post-, half-year, one-year and one-year-and a half follow-up. The results were inconclusive with regard to the effectiveness of the programme. However, there is some indication of possible effects on the reduction anxiety and aggression in the boys' sub-sample. This was also the sub-sample that showed higher levels of anxiety and aggression at

baseline, suggesting possible difference in the effectiveness of the programme. The original scientific article focuses on the anxiety and aggression of students in the school environment and ways to prevent their negative consequences at the level of the individual, school and society as a whole. It ambitiously tries to address both, anxiety and aggression at the same time, using a single intervention.



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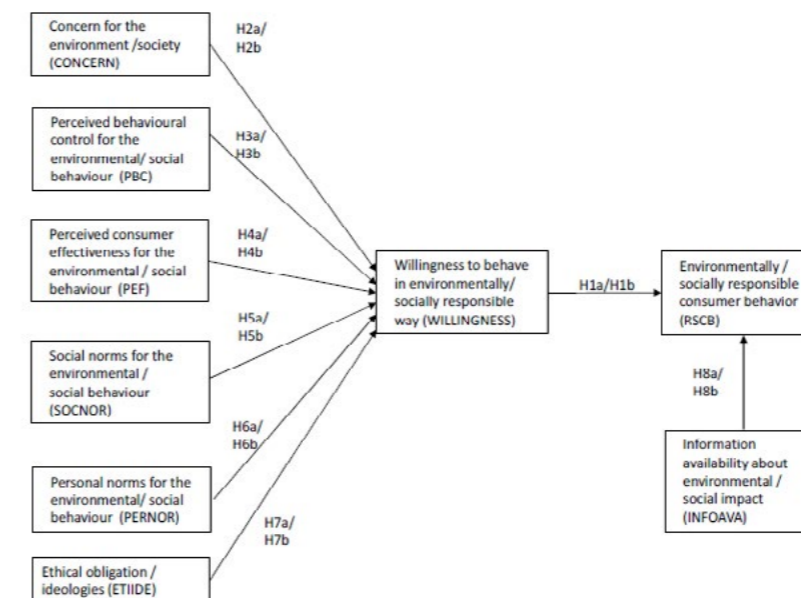
source: Kozina, A. (2021). Can FRIENDS for Life social-emotional learning programme be used for preventing anxiety and aggression in a school environment: 6 months, 1-year and 1-and-a-half-year follow-up. *European Journal of Developmental Psychology*, 18(2), 214-229.
hyperlink: <https://doi.org/10.1080/17405629.2020.1776103>

Dr. Vesna Žabkar

Antecedents of Environmentally and Socially Responsible Sustainable Consumer Behavior

Sustainable development meets the needs of present generations without compromising the ability to meet the needs of future generations. Research on sustainable consumption shows that attitudes and personal norms, in addition to past consumption, significantly determine purchasing intentions. Environmental and social issues are usually researched separately, with a greater emphasis on the natural environment. An article published in the *Journal of Business Ethics* (already over 30 citations in December 2021) shows that attitudes towards the environment in transition countries are changing and that

consumers are increasingly aware of the importance of sustainability. On the sample of Slovenian consumers, it researches the predecessors of both environmentally and socially responsible sustainable consumer behaviour and identifies the importance of consumer concerns (attitudes) for the environment/society, personal norms, ethical obligations and information availability about environmental/social impact. The article thus contributes to the analysis of development factors that affect the development of society (prosperity and social aspects) and the environment (economic growth and pro-environmental behaviour).



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source: Hosta, M., & Zabkar, V. (2021). Antecedents of Environmentally and Socially Responsible Sustainable Consumer Behavior. *Journal of Business Ethics*, 171(2), 273-293. doi:10.1007/s10551-019-04416-0
hyperlink: <https://link.springer.com/article/10.1007/s10551-019-04416-0>

Dr. Andrej Kirbiš

Cultural Participation of Young People in Slovenia and Europe

The scientific monograph *Cultural Participation of Young People in Slovenia and Europe* (2021) analyses the profiles, determinants, longitudinal trends, and consequences of young people's cultural participation. The book consists of fourteen chapters, the last presenting recommendations to decision-makers based on empirical data analyses in the remaining chapters. The authors investigate the conceptualisation, dimensionality and profiles of Slovenian youth in relation to their cultural participation, including through the use of information and communication technology (ICT). The authors also focus on studying the role of life courses in cultural participation and ICT use, the importance and characteristics of the family, and of young people's value orientations for their participation. In addition, subjective motives among young people and obstacles preventing

their participation in cultural life are examined, together with attitudes towards cultural institutions in Slovenia and satisfaction with the institutional cultural offer. In multilevel, cross-national comparisons, the authors examine the micro-level (individual) and macro-level (country) determinants of youth cultural participation in Europe. Finally, the consequences of young people's cultural participation for their health and developmental outcomes are also studied. The monograph presents the first comprehensive analysis of young people's cultural participation in Slovenia and Europe, combining quantitative and qualitative methodology. It shows the crucial importance of cultural participation for the health, well-being, school performance, political and civic engagement and social integration of our young people.



Dr. Jernej Letnar Čerňič

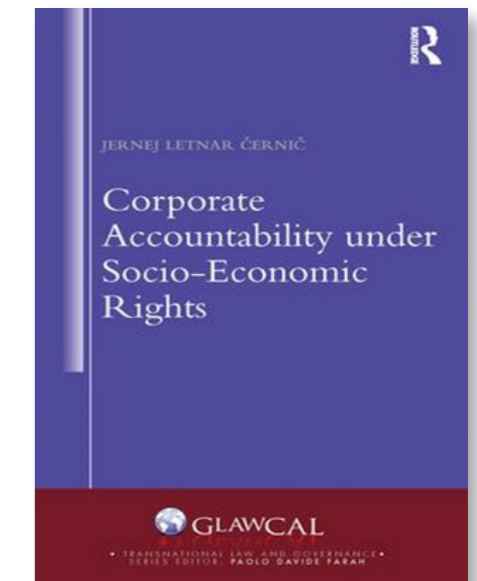
Corporate Accountability under Socio-Economic Rights

In recent decades, corporations have increasingly accepted that they have obligations to respect the socio-economic rights of individuals whose rights to livelihoods, education, food, health, housing and water are affected by the actions of corporations on a daily basis. Despite this, it is often difficult for victims to bring corporations to court for violations of their socio-economic rights. Domestic constitutional systems provide, at best, fragile and limited protections against adverse corporate activities, while international responses have been

lacking in creating obligations and accountability for corporations under socio-economic rights. In light of this, this book identifies and analyses the theoretical foundations and the existing scope of corporate accountability arising from socio-economic rights at both national and international levels. It exposes the stark need for greater clarity in the obligations and accountability of corporations, advocating a normative framework for corporate accountability for socio-economic rights in national legal orders which builds on existing mechanisms.



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source: KIRBIŠ, Andrej, TEMENT, Sara, LAHE, Danijela, VEZJAK, Boris, CUPAR, Tina, TAVČAR KRAJNC, Marina, JAVORNIK KREČIČ, Marija, LAMOT, Monika, KIRBIŠ, Andrej (urednik). *Kulturna participacija mladih v Sloveniji in Evropi*, (Zbirka Znanstvena monografija, 016), 1. natis. Maribor: Kulturni center, 2021. XXXV, 400 p. ISBN 978-961-7118-03-2.
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source: Čerňič, J. L. (2020). *Corporate Accountability Under Socio-economic Rights*. Routledge.
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Dr. Mojca Pajnik and Dr. Majda Hrženjak



Engendering Media Work: Institutionalizing the Norms of Entrepreneurial Subjectivities

The article brings innovative epistemological cognition and original empirical results about engendered media systems. Conceptually, the argument focuses on the notions of greedy organizations and *entrepreneurial subjectivity*, and it shows, based on the empirical analysis of television production in Slovenia, how fear of deteriorating social and economic situation puts pressure on journalists to normalize the demands of greedy organizations and to self-discipline in the subjectivity of hyperproductivity, multitasking, flexibility and constant availability

for work. The analysis shows that neoliberal labour market organizations exacerbate male-centred patterns of work cultures and reproduce the myths of gender equality and gender neutrality of precarization of work. Despite feminization of journalism, it is not recognized in media industries that the orientation towards hyperproductivity excludes social reproduction from the sphere of paid work and makes it a personal and an individual problem, while reducing female journalists to a position of adapting to allegedly gender-neutral work patterns.

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source: Mojca Pajnik, Majda Hrženjak, Engendering Media Work: Institutionalizing the Norms of Entrepreneurial Subjectivities, *Journalism*, 27. May 2020, online first, <https://doi.org/10.1177/1464884920922075>
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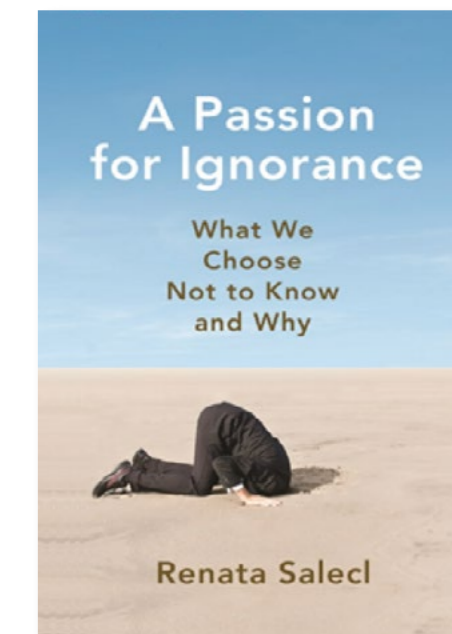
Dr. Renata Salecl

A Passion for Ignorance: What We Choose not to Know and Why

Prof. Dr. Renata Salecl published a high-profile book at Princeton University Press in September 2020, which has already been translated into Slovenian and Iranian. In 2022 the book will be published in Spanish, Turkish, Russian, Korean, Croatian and Serbian. The book is the result of the work Renata Salecl performed as part of the research program she leads at the Institute of Criminology at the Faculty of Law in Ljubljana.

Ignorance, whether passive or active, conscious or unconscious, has always been a part of human life. What has changed in our post-real, post-industrial world is that we often feel overwhelmed by a flood of information and fake news. Sometimes it seems impossible to distinguish between truth and untruth, which is why there has been opposition to the results of expertise and there is a growing number of people who are actively choosing to discard scientific knowledge. The dangers of this are obvious, but Renata Salecl points out that in certain moments when an individual is confronted with traumatic knowledge, ignorance can also have a positive side. Using findings from philosophy, social and psychoanalytic theory,

legal theory and criminology, Renata Salecl explores in her book how the passion for ignorance appears in various aspects of life today, from love, illness, trauma and fear of failure to genetics, forensics, data and new phenomena of violence. The key point of the book, however, is that an individual's attitude to knowledge is influenced by the fact that the individual feels ignored by others and unrecognized in society as such. The book also reflects the ignorance and denial that emerged with the Covid 19 pandemic and shows that a wealth of information about the pandemic does not necessarily lead to a reduction in ignorance. The book shows in an original way the complex nature of the problem of ignorance at the level of society and in the life of the individual. In times of fake news, it is necessary to explore a changed attitude towards knowledge and ignorance. Renata Salecl undertook the analysis of the problem of ignorance in an interdisciplinary way, which brings new knowledge and a new understanding of social events. Publication at a reputable international publishing house is a great recognition for Slovenian science.



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source: Salecl, R. (2020). *A Passion for Ignorance*. Princeton University Press.
hyperlink: <https://press.princeton.edu/books/ebook/9780691202020/a-passion-for-ignorance>

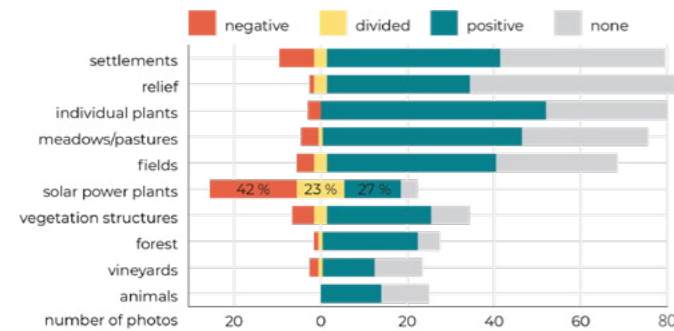
Dr. Tadej Bevk and Dr. Mojca Golobič

Perception of energy landscapes of the future

Despite high political and public support for the increase in the use of renewable energy sources (RES), concrete projects often evoke opposition based on unwanted landscape changes. In the research programme Landscape as living environment we explore the relationship between the quality of the

landscape and the use of RES. In a basic research project we found that Slovenians strongly support the use of RES and in the international project COST RELY we identified the criteria of good practice of spatial planning. In the Young Researcher programme, we found, through a study of the perception of landscapes with solar power plants, that these landscapes are ambiguous, as the solar power plant was often exposed as a visual disturbance, while also communicating values related to sustainable development. In addition to spatial factors, the social acceptability of energy landscapes is also influenced by cost-benefit distribution, transparent decision-making, and the contribution of the project to the climate objectives. Based on results we prepared recommendations for planning and design of solar power plants, which can create recognizable and efficient energy landscape of high quality.

Public participation in the study of RES impacts on landscape.
Author: Tadej Bevk



Ten most often photographed landscape features in public participation workshops with their connotations.

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source: Bevk, T., Golobič M. 2020. Contentious eye-catchers: Perceptions of landscapes changed by solar power plants in Slovenia. *Renewable Energy*, 152: 999-1010.
hyperlink: <https://doi.org/10.1016/j.renene.2020.01.108>

Dr. Jernej Mlekuž

The sausage that awakened a nation

Nations were not only created by politicians, poets, soldiers, diplomats and other people, but also by an uncontrollable multitude of things, non-humans, some of which have a prominent, special, honoured place. An article published in one of the most referenced and well-known journals in the field of historiography, *Rethinking History*, is based on the argument that the Carniolan sausage (kranjska klobasa) played an important role in the formation and development of Slovenian national awareness in the period between the Spring of Nations and the end of World War I. The Carniolan sausage was an integral part of a unified field of exchanges which enable the collective recognition of the members of the nation. The article then discusses

its place in banal nationalism – the daily nationalism that slips our attention and daily reminds people of their nationality. As a banal national symbol, highlighting national differences and significance, the Carniolan sausage was a constant reminder of the nation. In the last part, article analyses its role in nationalism from below, or everyday nationhood – the reproduction of nationhood by ordinary people in everyday life. The Carniolan sausage demonstrates that nationalism is not merely the result of a political programme or ideology, but primarily a network or collection of people, objects, practices, places, institutions, ideologies, technologies, ideas, symbols etc. which define the subjectivity of the people, and form their actions and imagination.



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source: MLEKUŽ, Jernej. The sausage that awakened a nation: the Carniolan sausage in the Slovenian national imagination, 1849-1918. *Rethinking history*, ISSN 1470-1154, 2020, vol. 24, iss. 3-4, pp. 503-522.
hyperlink: <https://www.tandfonline.com/doi/pdf/10.1080/13642529.2020.1831352?needAccess=true>, doi: 10.1080/13642529.2020.1831352. [COBISS.SI-ID 431221791]

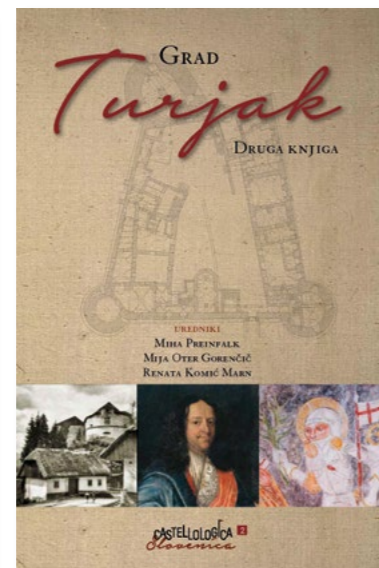
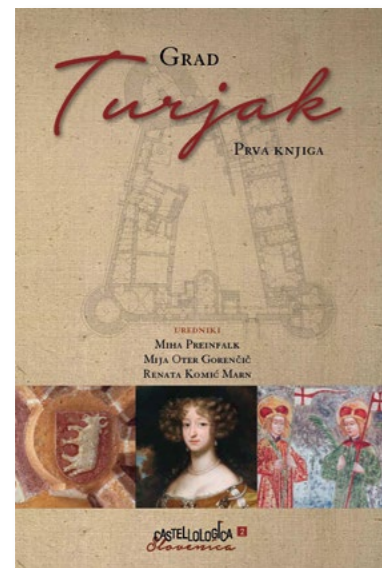
Dr. Miha Preinfalk, Dr. Mija Oter Gorenčič and Dr. Renata Komić Marn

Turjak Castle (Castellologica Slovenica, 2)

This interdisciplinary monograph on Turjak Castle in two volumes consists of 25 scholarly articles that discuss Turjak Castle from various perspectives as one of the most important and well-known castles and manors in Slovenia and the wider region. The articles present in detail the historical origins of the castle building in the Middle Ages and its oldest mention in historical sources,

the Auersperg family as the sole owner of the castle in its long history, the architectural development of the castle up to the present day, its earlier furnishings and the fate of the building during the World War II and after 1945. The authors also researched the surroundings of the castle, the Turjak borough, the nearby church of St. Achatius, the archives of Turjak and its Slovene documents,

the formation of the Turjak parish and the involvement of the castle and its former inhabitants in the local community and its historical memory. The detailed written articles are enriched with high-quality visual material. The book represents a fundamental historical and art-historical work, which will also form the basis for all further scientific (and popular) discussions about this monument.



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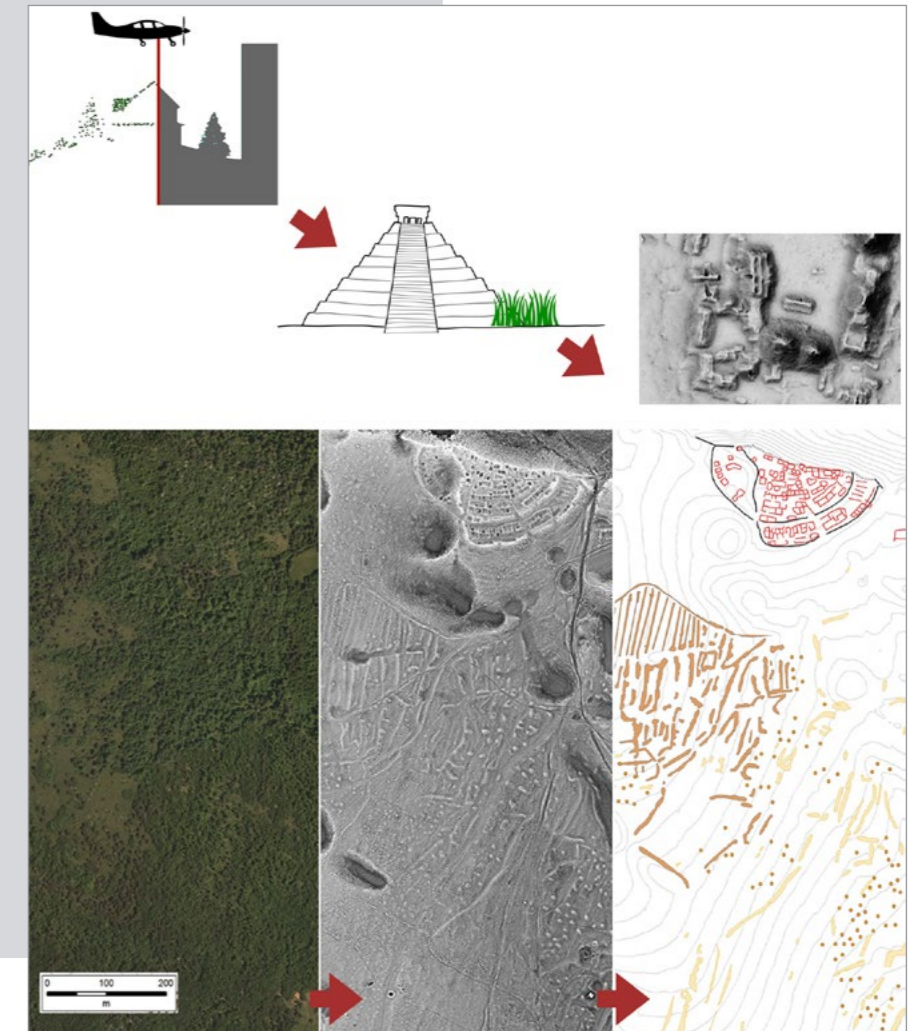
source: PREINFALK, Miha (editor), OTER GORENČIČ, Mija (editor), KOMIĆ MARN, Renata (editor). Grad Turjak. 1st ed. Ljubljana: Založba ZRC, 2020. 2 zv. (1276 pages), illustr. Castellologica Slovenica, 2. ISBN 978-961-05-0448-1. ISSN 2591-2569. [COBISS.SI-ID 17859843]

Dr. Benjamin Štular

Airborne LiDAR-Derived Digital Elevation Model for Archaeology

The use of airborne laser scanning data, also known as LiDAR, has become an essential part of landscape archaeology over the last two decades. The need for archaeology-specific data processing is well established. Nevertheless, little attention has been paid to the key element of this scientific process: the archaeological Digital Elevation Model (DEM).

Therefore, we have developed the concept of an "archaeological DEM", which we call Digital Feature Model (DFM). We also defined the morphological types of archaeological features and developed a confidence map tool (available as a free and open-source plugin for QGIS). This tool makes it possible for the first time to objectively determine the confidence level of archaeological interpretation of LiDAR data, which will increase the confidence of the archaeological community in this data source. The confidence map can also be an effective tool for all other scientific fields that use DEM for their analyses, e.g. geography, geology or forestry.



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source: ŠTULAR B., LOZIČ E., EICHERT S., Airborne LiDAR-Derived Digital Elevation Model for Archaeology, Remote Sens. 2021, 13(9), 1855; hyperlink: <https://doi.org/10.3390/rs13091855>

Dr. Dan Podjed

Why the World Needs Anthropologists

The edited volume *Why the World Needs Anthropologists*, published by the prestigious publishing house Routledge, is based on the long-standing efforts of Dr. Dan Podjed, ZRC SAZU, and other colleagues who founded the Applied Anthropology Network (AAN) of the European Association of Social Anthropologists (EASA) in 2010 and began organizing a series of international symposia in 2013. The book is based on the symposia *Why the World Needs Anthropologists* (Amsterdam 2013, Padua 2014, Ljubljana 2015, Tartu 2016, Durham 2017, Lisbon 2018, Oslo 2019, Online Symposium 2020, Prague 2021), which were attended by a total of around 3,000 people

from all over the world. In the book, the editors and distinguished contributors – including Prof. Thomas Hylland Eriksen, Prof. Sarah Pink, Dr. Joana Breidenbach, Prof. Riall W. Nolan, and many others – present their work and emphasize the value and importance of anthropology in today's world. Their contributions help to create a new paradigm of applied and engaged anthropology and demonstrate to academia and the general public the possibilities for applying anthropological approaches in practice, e.g. in governmental and nongovernmental institutions, in industry, in the development of people- and planet-friendly products and services, etc.



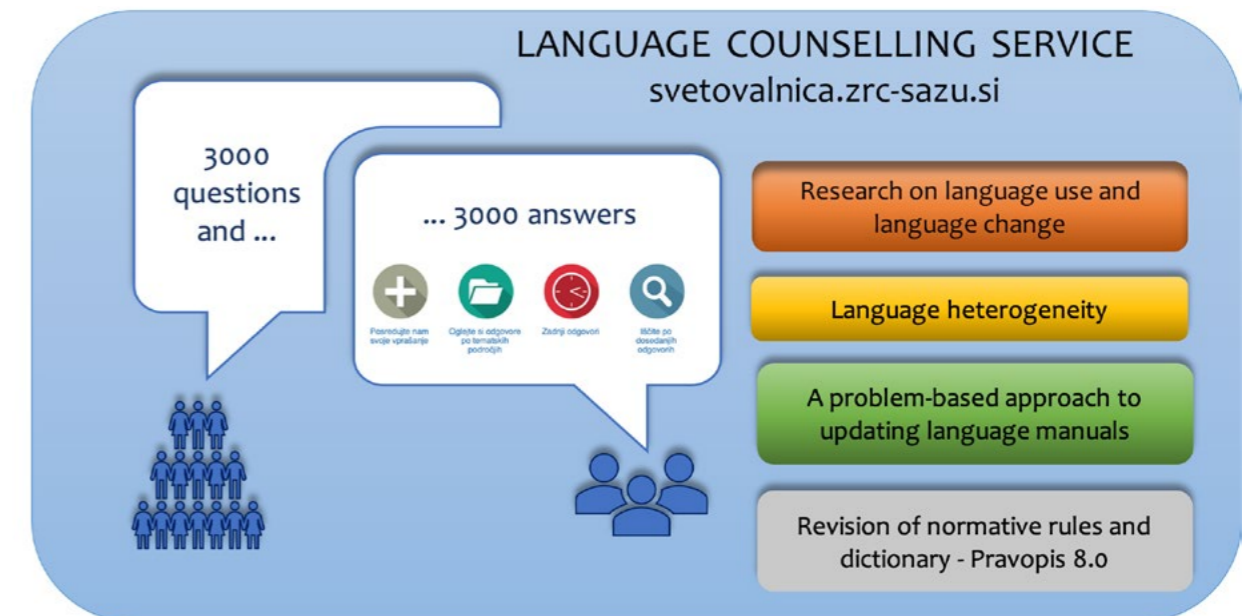
Dr. Helena Dobrovoljc

Language Counselling Service – an online manual with 3000 answers to language users' questions

For Slovenian linguistics, the establishment of the Language Counselling Service was a methodologically ground-breaking event that changed the design of standard language manuals, namely from upgrading of the traditional manual to a problem-oriented approach dictated by users' language problems. In the 21st century, with the electronic age and online communication, the standard Slovenian language has entered a phase of language norm heterogeneity; it increasingly contains elements that were not characteristic of it before.

Linguists no longer evaluate linguistic phenomena in a binary way, i.e. in terms of the non-standard elements in the language, but also in terms of the different communication positions and text types. The Language Counselling Service does not represent just a consultative intervention by a group of linguists in interaction with language users; it is an innovative way of obtaining data on language users who draw attention to phenomena not covered in previous manuals or not yet traced in language habits. Working with language users encourages

linguists to become more aware of the social and consensual nature of standard language, thus making it more adaptable to language habits, increasing its variability, and promoting greater tolerance of change in general. The linguists involved in the Language Counselling Service have set out these principles in the monograph entitled *Kje pa vas jezik žuli*. The monograph is an original attempt to unite the known and the unknown, to legitimise tacit deviations, and to simplify the linguistic norm without altering the value of language in the eyes of its users.



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source: PODJED, Dan, Meta GORUP, Pavel BORECKÝ in Carla GUERRÓN-MONTERO (ur.) 2021. *Why the World Needs Anthropologists*. Abingdon in New York: Routledge, Taylor & Francis Group.
hyperlink: <https://www.routledge.com/Why-the-World-Needs-Anthropologists/Podjed-Gorup-Borecky-Montero/p/book/9781350147133>;
<https://www.applied-anthropology.com/wna-book/>

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source: Dobrovoljc, H., Lengar Verovnik, T., Vranjek Ošlak, U., Michelizza, M., Weiss, P., & Gliha Komac, N. (2020). *Kje pa vas jezik žuli? Prva pomoč iz jezikovne svetovalnice*. Ljubljana: ZRC SAZU.
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Dr. Peter Stankovič

History of Slovenian Feature Film II: The Rebirth of Slovenian Film (1988–2004)

History of Slovenian Feature Film II: The Rebirth of Slovenian Film (1988–2004) is the second part of the project of history of Slovenian feature film undertaken by Peter Stankovič. In 2014, he has published a thorough study *History of Slovenian Feature Film I: Slovenian Classic Film (1931–1988)*, where he has analysed all Slovenian feature films made until the period when the established state producer-unit system has been supplanted by the system of independent producers.

In the second part of the project, he analyses the period between 1988 and 2004. The author argues that in this period Slovenian film has not only undergone a significant revival but that the feature films of this era also exemplify a series of stylistic traits that unify them into a coherent new cinematography. The most important traits are small stories with large existential implications, lyrical mise-en-scènes, sparkling wit and a measure of visual and aural stylisation of these films.

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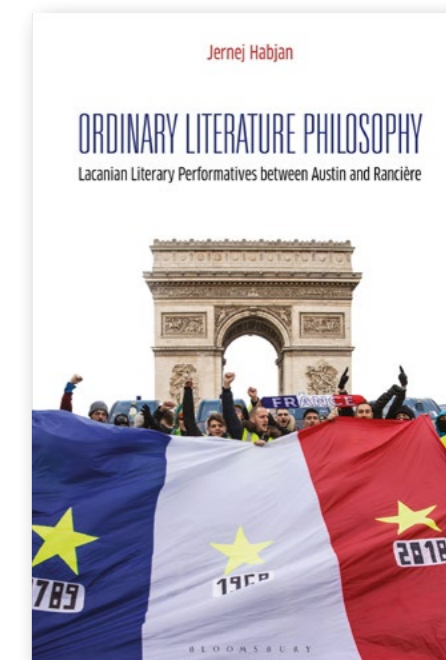
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Dr. Jernej Habjan

Ordinary Literature Philosophy: Lacanian Literary Performatives between Austin and Rancière

Jernej Habjan's book demonstrates how ordinary language philosophy unwittingly turned into what he calls ordinary literature philosophy. Once the Oxford philosophy of J. L. Austin, with its grounding of philosophy in ordinary language, entered the European debate it became part of continental philosophy and its focus on literary rather than ordinary language. In this tradition, Jacques Derrida and Judith Butler neglected Austin's general theory of speech

acts on behalf of his special theory of the performative, while bringing a new attention to the literary and the aesthetic. This leads Habjan to Jacques Rancière and Oswald Ducrot as they enable a final return to Austin beyond his continental reception. In this return, Habjan valorises Austin by turning to a theory as attractive, and as irreducible, to the continental tradition as Austin's own thought, namely Jacques Lacan's theory of the signifier.



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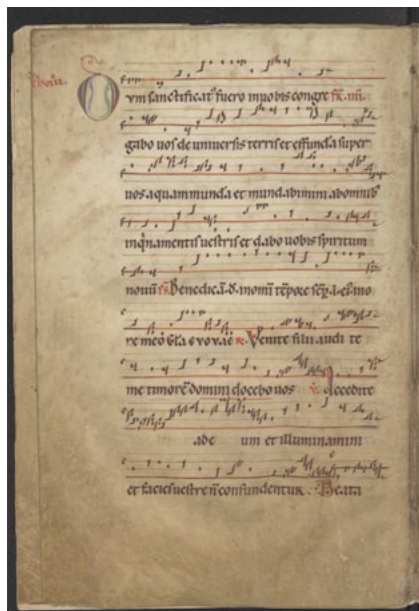
source: HABJAN, Jernej. Ordinary literature philosophy: Lacanian literary performatives between Austin and Rancière. London [etc.]: Bloomsbury Academic, 2020. 183 str. ISBN 978-1-3500-8607-4.
hyperlink: <https://www.bloomsbury.com/uk/ordinary-literature-philosophy-9781350086074/>

Dr. Jurij Snoj

Music Fragments from Slovenia: Towards a Reconstruction of the Medieval Plainchant Manuscript Production

The article results from systematic research of several fragments of medieval music manuscripts extant in Slovenian archives and libraries. It follows international research currents into medieval music fragments performed in numerous European countries, including Austria, Slovakia, Hungary, and Finland. It focuses primarily on plainchant fragments which represent the largest group within the preserved medieval music repertoire in this territory, currently comprising 215 registered units. The uncovered materials are analysed with regard to their liturgical content and types of the original manuscripts, date and place of their provenance, and notations. The question of the use of the original manuscripts and the time of their destruction is stressed as well. The author also discusses possible local uses of some fragments in the territory of present-day Slovenia and

in which ways such materials came to their present locations in general. Finally, some of the most compelling examples (intended for larger readership and specialists) are presented with detailed descriptions. The article is a part of a monograph written by the foremost European plainchant and mediaeval music scholars, published by one of the most prestigious publishing houses. In this way, Slovenian musicological mediaeval music studies were placed – with the maximum possible impact – within the European international context to which the discussed fragments already belonged in their own time. Therefore, the article is an essential contribution to our knowledge about musical life in Slovenia in the Middle Ages. Moreover, with its systematic and clearly outlined and readable content, it is readily accessible to all readers - scholars and other interested readers.



Dr. Matej Blatnik, Dr. David C. Culver, Dr. Franci Gabrovšek, Dr. Martin Knez, Dr. Blaž Kogovšek, Dr. Janja Kogovšek, Prof. Hong Liu, Dr. Cyril Mayaud, Dr. Andrej Mihevc, Dr. Janez Mulec, Dr. Magdalena Năpăruș-Aljančič, Dr. Bojan Otoničar, Dr. Metka Petrič, Dr. Tanja Pipan, Dr. Mitja Prelovšek, Dr. Nataša Ravbar, Dr. Trevor R. Shaw, Dr. Tadej Slabe, Dr. Stanka Šebela and Dr. Nadja Zupan Hajna

Karstology in the Classical Karst

As karstologists in the land of the Classical Karst, we develop the Karst Research Institute ZRC SAZU as a leading international research and educational centre on karst. Almost half of Slovenia consists of karst and more than half of the waters from which we are supplied come from karst aquifers. With the aim of understanding the three-dimensional karst landscape, we are integrating the research of the karst surface, caves, waters and ecology. We have combined the

research results of structural and geological mapping; of the research of the paleokarst of southwest Slovenia and Istria; of the shaping of the karst surface throughout the world; of cave sediments as traces of karst evolution; of the dissolution and deposition of flowstone in the Škocjan caves; of the monitoring of water quality on karst; of determining the structure of the epiphreatic zone of the karst aquifer; of cave microbiology; of the characteristics of subterranean habitats

and the history of the evolution of the Škocjan caves. Comprehensive approach is our advantage on an international scale. Basic karst research is the main mission of the Institute and a starting point for the modern development of international karstology and its application. We are also assisting in the development of karstology across the world, implementing the PhD programme in Karstology, and collaborating on planning life on karst and its protection.



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Dr. Anton Manfreda, Klara Ljubi and Dr. Aleš Groznik

Autonomous vehicles in the smart city era: an empirical study of adoption factors

Many places today are facing major changes and challenges arising from global environmental shifts, rapid urbanization and ageing infrastructure. On the other hand, digitalisation may bring new opportunities for individuals and cities, and the creation of the so-called concept of smart cities. Smart cities are namely focusing on finding solutions to these challenges and addressing key issues of modern life from transport, energy, the envi-

ronment and citizen involvement. Recently, smart mobility in particular, including autonomous vehicles, has been one of the most important elements in the development of smart cities. Thus, the purpose of the paper was to provide insights into the adoption of autonomous vehicles by millennials, as they represent an important group for both smart city concepts and new modes of transport. Research has confirmed that

factors such as fear of technology and vagueness of legal frameworks have a significant negative impact on attitudes towards autonomous vehicles, while on the other hand the expected safety significantly reduces these fears. Besides, the expected personal and social benefits, related either to time savings or care for the environment, have also an important role in this interplay of factors.



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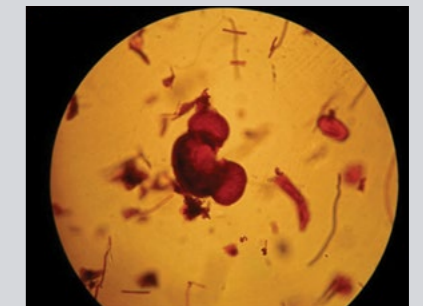
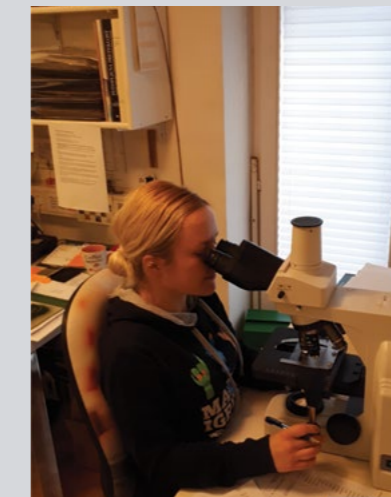
Dr. Maja Andrič

Vegetation dynamics and risk of forest fires in eastern and central Europe in the last 12.000 years

In this paper the impact of forest composition, land use and climate dynamics on the frequency and the intensity of fires in central and eastern Europe in the last 12.000 years was investigated. We used an extensive dataset of pollen and charcoal records, in combination with climate stimulations. In temperate forests biomass burning was high at ca. 45% tree cover, whereas in needle-leaf-dominated forests biomass burning was highest at 60–65% tree cover. In the entire study area, biomass burning was highest in the early and lowest in the middle Holocene, whereas interregional differences were largest in the last 4000-3000 years. Early- and Late Holocene fires were probably related to dry climate and human impact, leading to a

more open, fire prone landscape. In the future, fire risk mitigation will depend on the management of (forest) vegetation. The results of this

research help us understand how wildfire occurrence is influenced by forest type, climate fluctuations and human impact on the vegetation.



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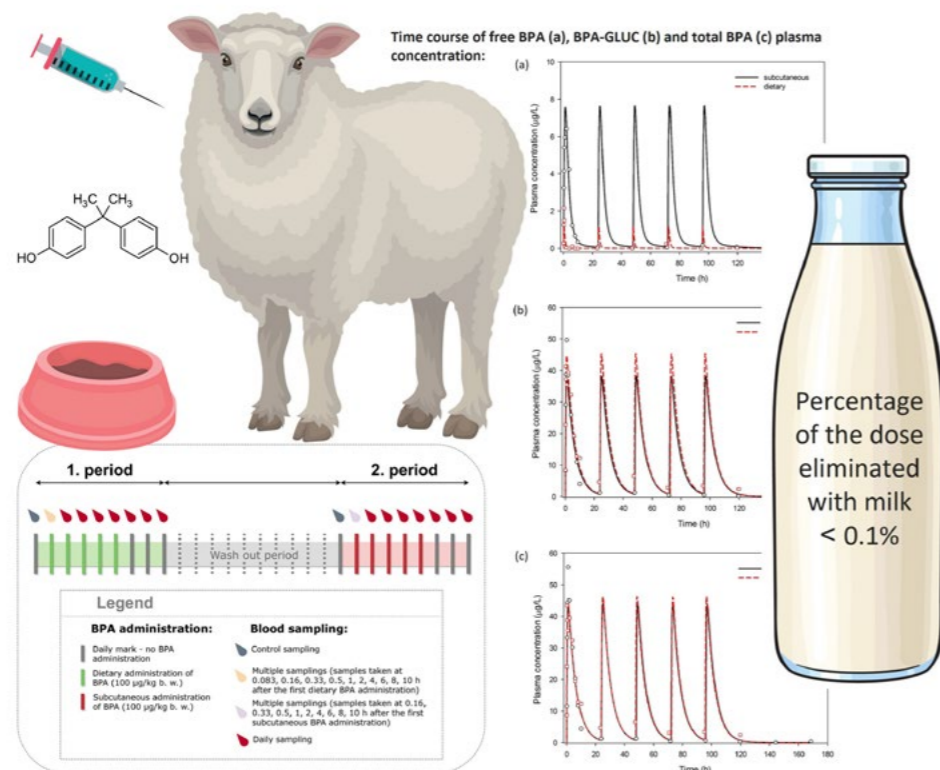
Sabina Šturm, Dr. Iztok Grabnar, Andrej Škibin, Dr. Milan Pogačnik and Dr. Vesna Cerkvencik-Flajs

Toxicokinetic study of bisphenol A in lactating dairy sheep

Bisphenol A (BPA) is an industrial chemical used in the manufacture of polycarbonate plastics and epoxy resins and is one of the endocrine disrupting chemicals. The aim of our preliminary study was to evaluate its exposure in one experimental sheep and estimate its amount in sheep's milk after multiple die-

tary and subcutaneous intake of a relatively low daily dose (100 µg/kg body weight). With the development of a toxicokinetic model, we estimated the percentage of BPA excreted in milk to be less than 0.1% of the dose, regardless of the route of administration. In addition, using a toxicokinetic model, we estimated

that BPA passes to the sheep mammary gland to a greater extent in the free, unconjugated form. Based on the latter finding and the measured values of bisphenol A glucuronide and total BPA in milk, we hypothesize that free BPA is likely to be subsequently metabolized in the mammary gland.



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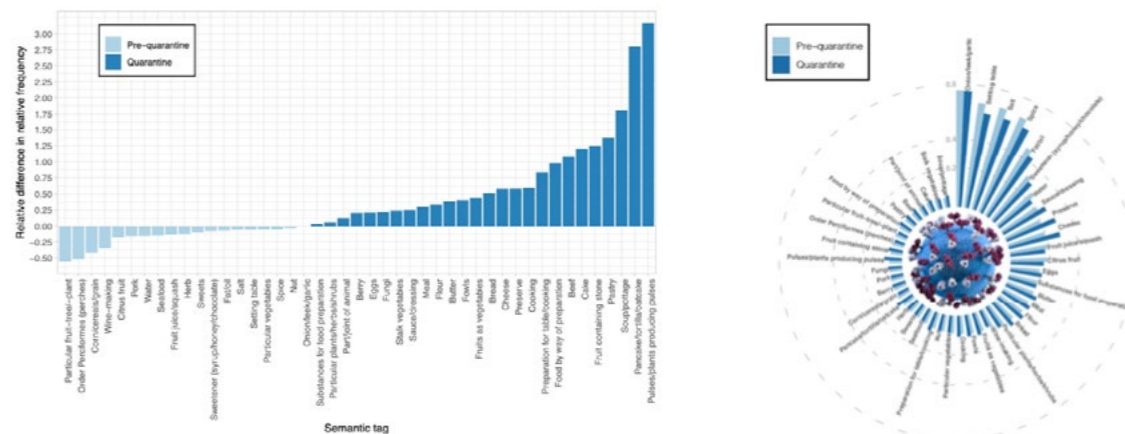
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Dr. Tome Eftimov, Gorjan Popovski, Dr. Matej Petković, Dr. Barbara Koroušič Seljak and Dr. Dragi Kocev

COVID-19 impact on food consumption process

We have developed a methodology for extracting information about ingredients from world-wide published recipes. The methodology has been developed using state-of-the-art AI methods that are used for text mining. Recipes are an example of unstructured data, where a lot of different writing styles are present, depending on how people express themselves. Analysing recipes before and during the first COVID-19 quarantine, we have found some interesting food consumption patterns. During the isolation due to the COVID-19 situation, users' interest increased relatively the most for recipes marked "Legumes and their fruits (dried beans, peas, lentils, beans, peas and beans)", "Pancakes and tortillas", "Soups", "Dough", "Stone fruit", "Cakes" and "Beef". On the contrary, interest decreased the most for recipes labelled "Perch (red fish)", "Cereals,

flakes and seeds", "Viticulture" and for those labelled "citrus", "pork", "water" and "seafood". On the other hand, we ate less fish and seafood, which was harder to access. Judging from the obtained results, we had more time during the pandemic to prepare homemade dishes, which are mostly less salted and sweetened than industrial products, and on the other hand, we ate less fish and seafood, which was harder to access. Most importantly, with the developed method, we have enabled extremely fast data review and real-time decision-making, which is crucial in such situations. At the same time, the given results predict possible health problems due to changes in eating habits. The results were recognized as globally important as the article has already attracted the attention of scientists and earned 44 citations.



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The Slovenian Research Agency

Short name: ARRS

Year of foundation: 2004

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

*Number of employees as of 1 January 2021
in accordance with the staffing plan:* 49

*Funds received from the national
budget for research activities in the
2021 financial year:* EUR 225.2 million

Basic documents: Research and Development Activity Act (Official Gazette of the RS, No. 22/06 - official consolidated text, 61/06 – ZDru-1, 112/07, 9/11, 57/12-ZPOP-IA in 21/18-ZNOrg)
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Website: www.arrs.si