10 YEARS PROLOEWE LOEWE RESEARCH INITIATIVES NETWORK

PROLOEWE NEWS

SPECIAL EDITION OCTOBER **2022**

CONTENTS

CONGRATULATIONS

© Bundesregierung/ Guido Bergmann.

BETTINA STARK-WATZINGER, Federal Minister for Education and Research

"Strong as lions! That's what you, dear active members of the ProLOEWE network, have been for ten years now. Chapeau! I was allowed to experience your strength personally during my time at the LOEWE Centre SAFE in Frankfurt. So now I congratulate you twice: as a former "LOEWin" and as a Federal Minister who follows your leaps in development with great interest.

It is impossible to imagine the Hessian scientific landscape without ProLOEWE, and you also have a good reputation at federal level! You succeed in making the state's top research visible and audible beyond Hessen's borders. From basic research to the marketability of Hessian innovations, from aluminium alloys to lemon batteries: ProLOEWE finds the right images and sounds.

My anniversary wish for you comes from the heart and in three words: Please keep it up!"

© tokography/Tobias Koch

VOLKER BOUFFIER, former Minister President of Hesse

"The promotion of science and especially of the LOEWE program has always been a personal concern of mine, and today I am pleased to say that together we have achieved a great deal: Excellent research is the basis for our country's success. In a globally networked, highly differentiated world, we will only be able to meet the challenges of the coming decades and maintain our high standard of living if we devote a great deal of public attention to cutting-edge research. This was the basic idea when we in Hessen launched our LOEWE program in 2008, which is unique in Germany to date. In the meantime, this program has grown into an outstanding scientific landscape with a total of 82 research clusters and centres in 14 funding phases, which has attracted great attention both nationally and internationally. This is due not least to the fact that a whole series of LOEWE projects have become institutes of scientific societies such as the Max Planck Society, the Fraunhofer Society or the Leibniz Association.

This success is due in particular to the researchers. However, I would also like to express my sincere thanks to the ProLOEWE network, which has been fostering exchange with each other and with the public for 10 years now. I wish you every success for your future work and all the best for your birthday!"

[1] The lemon battery experiment is a vivid example of the video explainer pieces that ProLOEWE offers online: https://proloewe.de/en/proloewe-wissenschaftsrallye/task/loewe-centre-emergencity-generate-electricity-with-a-lemon-battery/

© kunst.hessen.de

ANGELA DORN, Minister of Higher Education, Research, Science and the Arts looks back on ten years of ProLOEWE and comments:

"With ProLOEWE we are not only celebrating a decade of great networking activities and opportunities for excellent research. Within these ten years, you have also built up very good science communication. This is more important than ever: fear-mongering, manipulation and lies continue to weaken our "immune system", i.e. the very strength of our democracies. Knowledge is therefore the best "vaccine" in this regard – to be given in the form of clear facts, which we explain to our audiences in an understandable way. Society needs to understand not only facts and findings of science, but also how science works. At the same time, researchers need to learn how to convey their research findings to the public in a way that avoids misunderstandings as much as possible. With its work, ProLOEWE is an indispensable partner for our nationally unique research-funding program LOEWE. In order to lead our society into the future capable of change, we need thoughts and solutions of many clever minds. ProLOEWE gives them visibility. Congratulations on your tenth anniversary!"

© Sonja Rode

PROF. DR. UTE CLEMENT, President of the University of Kassel

"Innovative formats of modern science communication, an excellent Twitter presence and independent information on high-end research of the Hessian universities in the ProLOEWE NEWS – that is what ProLOEWE stands for. The University of Kassel congratulates on ten years of ProLoewe as a communication tool for the diverse and always excellent research of the LOEWE alliances. It makes me particulary proud to have ProLOEWE in Kassel. For five years we are hosting Tanja Desch and her team at the University of Kassel from where they manage their diverse activities. ProLOEWE strengthens trust in science, creates transparency and access even to complex scientific topics. After all, science communication is important so that knowledge, insight and facts help to shape social debates."

PROF. DR. ULRIKE NUBER, Speaker of the LOEWE research cluster FLOW FOR LIFE
"ProLOEWE is - and this also applies to the LOEWE program itself - what a lion symbolizes: strong, brave, initiative-taking, leading, and at the same time a social being that supports others. Congratulations on your anniversary! We are grateful to be a member of the pride since this year and look forward to the coming years together."

PROF. DR. STEPHAN BECKER and
PROF. DR. CHRISTOPH G. GREVELDING,
Speaker of the LOEWE research centre DRUID
"The LOEWE Centre DRUID congratulates ProLOEWE on its 10th anniversary and Tanja Desch and her team on all their great achievements! We joined this unique network in 2018 and are very thankful for the variety of initiatives by ProLOEWE that bring our research closer to society. We are very much looking forward to upcoming tweets, reports, video projects and much more!"

DR. WELSCH, Speaker of the LOEWE research cluster ACLF-I
"'And so it would probably be best not to be anxious about what others are doing, but to continually seek how far one can take it oneself.' With this quote from Johann Wolfgang von Goethe, we would like sincerely to congratulate ProLOEWE on its 10th anniversary and thank you for supporting our initiative. We send out warm birthday greetings and congratulations from the ACLF-I consortium!"

PROF. DR. SANDRA CIESEK, *LOEWE top professorship*
"Dear ProLOEWE team, a very happy birthday! For a top Hessian network there is a Hessian birthday serenade from Frankfurt: Badesalz – Happy Birthday -> YouTube. With this, we heartily congratulate on the 10th and wish the network and all involved many more happy and productive years, lots of exciting research and harmonious collaborations."

PROF. DR.-ING. MATTHIAS HOLLICK, Speaker of the LOEWE research centre emergenCITY
"LOEWE-emergenCITY sends you its warmest congratulations on your milestone birthday! Over the past ten years, you have become an essential part of the LOEWE network. True to the motto 'Do good and talk about it': We do research, you talk about it. Let's continue to work together to communicate our socially relevant results in a way that is easy to understand!"

PROF. DR. ELISABETH HOLLENDER and **PROF. DR. AXEL FANEGO PALAT**,
Speakers of the LOEWE research cluster Minority Studies – Language and Identity.
"Congratulations from the LOEWE Research cluster ‚Minority Studies - Language and Identity', based in Frankfurt and Gießen. The members of our cluster conduct research on sociolinguistic topics, communication and acts of identity-formation along linguistic and cultural lines among social groups that are jointly characterized by their experience of migration. Building networks is paramount to these groups. It is a central theme in our research, as it is for ProLOEWE. Therefore, we genuinely appreciate ProLOEWE's efforts. Our best wishes to the dynamic team!"

PROF. DR. AXEL JANKE and **PROF. DR. STEFFEN PAULS,**
Speakers of the LOEWE Centre TBG
„The LOEWE Centre for Translational Biodiversity Genomics (TBG) congratulates to the 10th anniversary of the ProLOEWE network as well! All participants benefit from the exchange between the projects and the diverse formats with which Hessian research is made visible to the public and politics. We thank you for the previous initiatives and the dedicated support on our way to establish Hesse as an international centre for biodiversity genomics."

PROF. DR. KAI VÖCKLER, Speaker of the LOEWE research cluster Infrastructure – Design – Society
"As a newcomer to the LOEWE program, the Offenbach University of Applied Sciences took over the coordination of the IDG Research Cluster in 2018. ProLOEWE has played a major role in making this start easier for us: with networking at the management and coordination level as well as with support in science communication – such as at the Hessentag or as part of the science rally. Many thanks to everyone at ProLOEWE for the exceptionally committed cooperation and continued success!"

PROF. DR. ANDREAS GATTINGER and **PROF. DR. LUTZ BREUER**,
Speaker of the LOEWE research cluster GreenDairy
"Congratulations, dear ProLOEWE team, on 10 years of excellent science communication with a constantly growing portfolio of interesting and innovative formats! We are pleased to be able to investigate the complex interrelationships of integrated animal-plant-agroeco-systems using the example of milk production on the organically managed Gladbacherhof of the Justus Liebig University as part of the LOEWE research funding. Best wishes for continued innovation in networking and communicating exciting LOEWE research topics!"

PROF. DR. FLORIAN R. GRETEN, Speaker of the LOEWE research centre Frankfurt Cancer Institute
"Happy anniversary dear ProLOEWE team, you have accompanied us wonderfully through the last years since the establishment of our LOEWE research centre FCI wonderfully through the public relations work! ProLOEWE enables great synergies between the LOEWE projects – this way, communication with the public as well as with politics is possible on a level that can only be achieved together. You network the projects on all levels. Through the lively and open exchange, both detailed questions are clarified in an uncomplicated manner and large projects are initiated. We look forward to the coming years with you."

PROF. DR. ANDREAS KLEIN, Speaker of the LOEWE research cluster FLAME
"LOEWE-FLAME extends its warmest congratulations on ProLOEWE's 10th anniversary! ProLOEWE combines interdisciplinary networking, exciting fundamental research and accessible as well as thoroughly prepared scientific topics. We value ProLOEWE as a reliable partner and we are looking forward to a continuous fruitful cooperation and to further innovative research projects."

GREETINGS

© Michael Frank

10 years of ProLOEWE, 14 years of LOEWE – reason enough to celebrate and an opportunity to look backward and forward.

Since 2008, the "State Offensive for the Development of Scientific and Economic Excellence" LOEWE has been promoting top-level research in Hesse. The strategic goals are raising the national and international research profile and further networking, especially between universities, non-university research institutions and industry. This ambitious, visionary research program is without doubt a success model. It has also led to the establishment of new, permanently federal-state funded research institutions in cooperation between non-university research institutions and universities (e.g. Senckenberg Biodiversity and Climate Research Center, IDeA Center DIPF, or SAFE).

The LOEWE program has survived several government formations, despite the intense budget battles between government departments, and is even to be increased to 100 million euros/year by the end of 2024. This due to the clever conception of the program, courageous politicians and the excellent collaborative research in Hesse. I wouldn't be possible without the ProLOEWE, the independent network of LOEWE projects, which is celebrating its 10th anniversary this year. The idea of ProLOEWE at the time of inception was that science itself needs active involvement in promoting this taxpayer-funded program in society, industry and politics besides being available as a contact for the media. Thanks to the dedicated work of its staff and the commitment of the spokespersons of the LOEWE research initiatives, the ProLOEWE network and its office have done this very successfully. I would like to take this opportunity to thank all those involved! As the founding spokesperson of the ProLOEWE network, my personal thanks go to the staff members who built up the network and the office at that time, especially Dörte Florack, who had overall responsibility: the small team was wonderful!

As we all know, communicating the scientific landscape to the outside world has become much more important today than it was ten years ago. The societal, economic, environmental and political challenges now present themselves as even more diverse and pressing. Expectations are growing for science to become more open, transdisciplinary and inclusive at the same time (compare, for example, UNESCO's 2021 recommendation on "Open Science"). I am sure that the LOEWE program and the ProLOEWE network will be able to cope with this high dynamic and the increasing pressure towards application, transfer and communication. In the interest of society as a whole, it is to be hoped that the LOEWE initiative in Hesse will also set an example in the other federal states!

As always, the usual birthday wish also applies to ProLOEWE: ad multos annos!

Prof. Dr. Dr. h. c. Volker Mosbrugger

© Paavo Blåfield/Universität Kassel

Congratulations ProLOEWE – here's to the next ten years of successful networking!

Volker Moosbrugger asked me at the beginning of 2015 whether I would like to stand for election as spokesperson for ProLOEWE. I was delighted and immediately agreed to this proposal. That I would do this one day was not necessarily foreseeable. "Totally stupid" was the unanimous tenor of my colleagues at that time. The LOEWE focus "ELCH", which I coordinate, had just joined the membership of ProLOEWE. Stupid to spend the research funds we had won so hard in the competitive review process on (unnecessary) additional tasks that was how we saw ProLOEWE at that time – and not on actual research. I am sure that similar discussions have taken place in most other LOEWE consortia and may still be taking place in some of the new ones. Over time, however, we became very aware of how important the work of ProLOEWE is for us and for the other LOEWE projects. Through the highly professional work of ProLOEWE, citizens are informed about the diverse topics of the LOEWE projects and sensitized to their particular importance. This is essential not only because we are all financed by tax money and thus by society, but also to increase acceptance for what we do in basic research. ProLOEWE is also a mouthpiece for politicians in order to make us scientists, with our usually quite specific needs, heard there as well. Politicians have to understand what we do and why we do it. The acting (and deciding) persons there are mostly not scientists. It is no trivial task to translate the findings into understandable language. Often hidden behind complex technical vocabulary and without making too many concessions to the accuracy of the presentation, science topics are hard to communicate. The technical vocabulary normally used was created precisely in order to describe the facts as accurately as possible. So a translation into more generally understandable language often goes hand in hand with a loss of definitional clarity. The team at the ProLOEWE office plays an outstanding role in the field of communication here . Thus, my attitude has changed from a rather ProLOEWE-skeptical person to a big supporter of ProLOEWE, which since 2017 is located at the University Kassel. Over time ProLOEWE developed a variety of external communication formats. Additionally, the network also offers the possibility of exchange among the scientists of the LOEWE projects, often with completely unexpected opportunities for new ideas and collaborations. Through this effort the LOEWE projects have grown together with ProLOEWE into a truly trusting and thoroughly influential network.

With this in mind, I wish you a lot of fun reading about 10 years of ProLOEWE and many new insights into Hesse's cutting-edge research. I wish ProLOEWE and all current and future LOEWE projects every success for the next ten years!

Prof. Dr. Arno Ehresmann

© Paavo Blåfield

Communicating science and generating enthusiasm – the network of LOEWE research initiatives has been doing this successfully for 10 years! Happy birthday ProLOEWE!

With this special issue, we are celebrating the 10th anniversary of a very special network. Since its founding in 2012, ProLOEWE has linked 15 LOEWE research centres and 67 research clusters, with hundreds of scientists, and made their research accessible to the public.

And what has this achieved? I personally have a very clear opinion on this: science thrives on networking and exchange. For this reason alone, ProLOEWE is important and right. Today, communication of science internally and externally is more indispensable than ever. In my opinion, ProLOEWE has the task of communicating science from the inside. Ideally in such a way that it becomes part of society, arouses understanding, interest and even enthusiasm.

This is exactly what ProLOEWE has been doing for years. Although I am undoubtedly biased as the acting spokesperson, I find what the small but mighty ProLOEWE-team has put together quite extraordinary body of work: The column „ProLOEWE-faces" on the homepage and in the ProLOEWE-NEWS, the great activities for young researchers on the Hessentag state fair, the ProLOEWE science rallye for pupils in the difficult Corona times and of course the Escape Room, the ProLOEWE-Mars Mission, which was used for the first time this year. These are only some of the projects that have particularly impressed me.

For all these and many more activities in 10 years of science communication and networking, I congratulate the team of the ProLOEWE office led by Tanja Desch very warmly and with full conviction and say „Thank you!" for the excellent work. I also extend an equally heartfelt „Thank you!" to the large LOEWE community. It is fun to see how enthusiastically the scientists implement these joint actions and make them a success.

Both LOEWE and ProLOEWE are unique and enjoy an excellent reputation in the scientific world. The best part is that bright minds get the opportunity to work on topics in interdisciplinary collaboration and make something great out of it. Just like the bright minds, the LOEWE research projects are spread throughout Hesse, enabling excellent, cutting edge research-related teaching at all Hessian university locations and transfer projects with regional companies. But above all, excellent research distributed across all scientific disciplines is funded throughout Hessen. The funding is open-topic (and that's a good thing!) but by no means arbitrary due to the rigorous review process, and thus automatically starts precisely where gaps in knowledge need to be filled with life.

I fully trust that this will continue for many years to come. Hessen will remain a highly attractive science location and ProLOEWE will accompany this for many years to come just as competently, sympathetically and individually as it has done for the last 10! !

Prof. Dr.-Ing. Hans-Peter Heim

LOEWE

Excellent Research for
Hessen's Future

PRO LOEWE

LOEWE Research Initiatives
Network

What is happening in Hessen's cutting-edge research? Which questions are the scientists dealing with, and what do they want to achieve? These are just some of the topics ProLOEWE has been dealing with since the **LOEWE** research centres and **LOEWE** research clusters joined forces to form **ProLOEWE, the network of LOEWE research projects**. Since then, their goal has been to jointly publish their activities and to create easy access to Hessian research, and especially to basic research.

Since the program start of **LOEWE** in 2008, **15 LOEWE research centres** and **67 LOEWE research clusters** have undergone fourteen funding series. **ProLOEWE** brings together the **LOEWE research centres and LOEWE research clusters**, with a total of around **1,150 employees in 2021**. Their work is made possible by **LOEWE** funding from the state of Hesse – and thus from society. Their topics range from medical research to innovative applied technologies and basic research in the natural sciences to cultural and social issues. Research is teamwork – often across the boundaries of disciplines and individual institutions.

10 YEARS ProLOEWE
LOEWE RESEARCH INITIATIVES NETWORK – OVERVIEW AND OUTLOOK

The leaders of the participating research projects together form the **ProLOEWE** Board of Directors. Since the end of September 2018, Prof. Dr.-Ing. Hans-Peter Heim (**LOEWE research cluster Safer Materials**, University of Kassel) has been the spokesperson of the directorate. Deputy speaker since November 2021 is Prof. Dr. Anke Becker (**LOEWE research centre SYNMIKRO and LOEWE research cluster MOSLA**, Philipps-Universität Marburg). The **ProLOEWE managing office** has been administratively located at the University of Kassel since 2017, with Tanja Desch as managing director and Vanessa Urbaniak (Samantha Pfanzer/interim) as PR assistant.

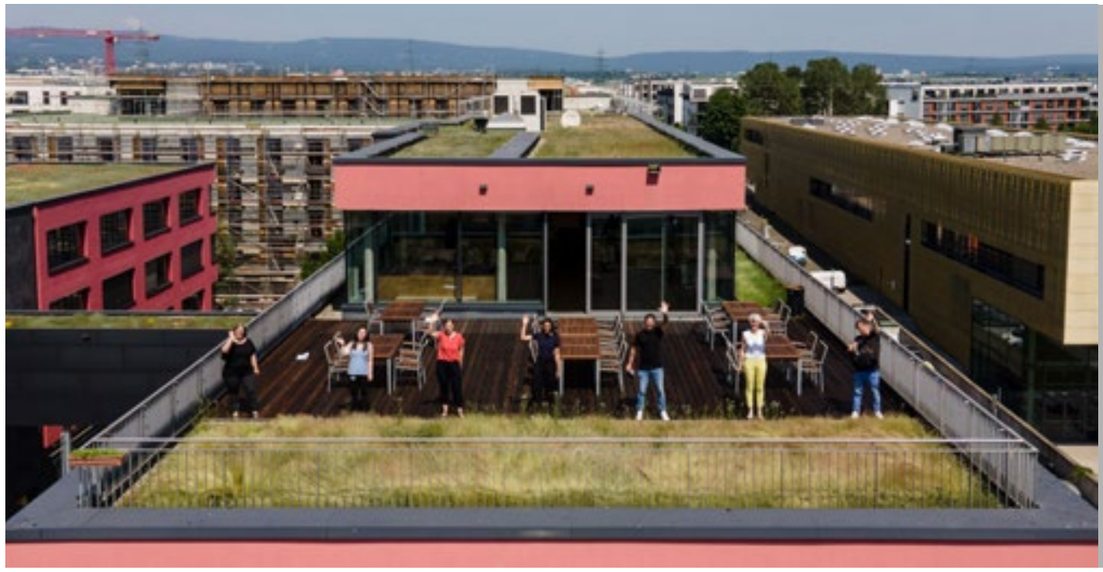
Since its inception, **ProLOEWE** has contributed to the integration of **LOEWE** projects internally and externally, increased visibility of basic research in Hessen, and a better understanding of the importance of the topic among the general public through a wide variety of measures. The network's activities include the **ProLOEWE Days**, „**LOEWE** science at your fingertips" at the "Hessen schafft Wissen" ("Hesse Knowledge Creation") booth at the Hessentagen, **ProLOEWE-NEWS**, proloewe.de, the network's website, the Twitter channel **@ProLOEWE** launched in 2020, and the **ProLOEWE Board of Directors meeting** held once a year. Most recently, ProLOEWE also added the **ProLOEWE-Science Rallye**: an interactive rally for the whole family; and in June this year the **ProLOEWE-Mars Mission**, a science escape room. Both formats, together with the **ProLOEWE image film**, ensured that integration between the **LOEWE** projects was intensified once more and that the **LOEWE program** received increased attention, especially from the public.

The latest project to be launched in July 2022 is **ProLOEWE's „Hessen's Top Research in 45 Minutes: What to do in a crisis?"** A virtual format in which **LOEWE** scientists give politicians a direct insight into their research topics, followed by direct and focussed interaction. The second part of the pilot of this format follows on November 14 with **LOEWE-GLUE and the topic „Tailored satchels for drugs free of side effects."**

We are using our first double-digit birthday to publish an anniversary edition of **ProLOEWE-NEWS**. Here you can find out more about some of the **ProLOEWE** projects, the latest from the **LOEWE research projects**, get to know a **LOEWE** scientist in the section **ProLOEWE** Personal and, starting on page 55, get an overview of the **LOEWE research centres and research clusters** funded since the start of the **LOEWE** program!

We hope you enjoy reading and hope you gain many interesting insights into Hessen's cutting-edge research!

21 STEPS TO THE FINISH LINE – THAT WAS THE CALL FOR THE **ProLOEWE SCIENCE RALLYE** IN AUGUST 2021.



Photos: Sascha Mannel

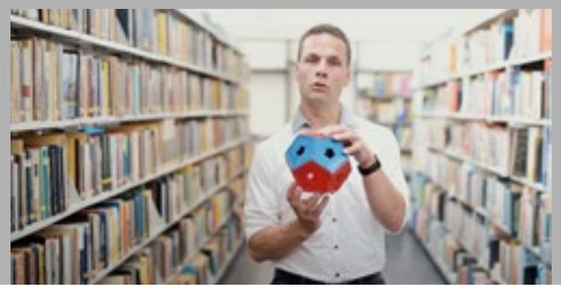
2021 was the second year in a row that many families found it a real challenge to keep their children and teens occupied during summer vacation. Due to Covid, options on how to spend time and where to go were severely limited. Six weeks of boredom? Not an option for the **LOEWE** network. A new format was needed! And after some thought, the idea for a virtual puzzle was born: the **ProLOEWE-Science Rallye**. The plan was to get as many **LOEWE** projects as possible to take part and come up with a task for their research area, write a (short) script, and especially get their young scientists to participate.

No sooner said than done: A Kassel film team, supported by **ProLOEWE**, traveled to the Hessian universities, colleges and institutes and shot the puzzle and solution videos on site.

The result was 21 documentaries on the Hessian **LOEWE** projects, covering a wide variety of topics from medicine, physics, geology and biology to mechanical engineering and materials science, which were posted on proloewe.de at the beginning of August and had to be solved and answers submitted by mid-September.

Children aged ten and over, young people and their families could take part. Exclusive prizes were up for grabs from each of the participating **LOEWE** projects, and those who solved all 21 tasks were in competition for the grand prize.

PRO LOEWE WISSEN-SCHAFTS-RALLYE



THE MAKING OF THE ProLOEWE SCIENCE RALLYE.

The intention behind the rallye was to give children, teenagers and their families a glimpse into the world of basic research, to show them that scientists are also "just normal" people and to engage their curiosity about research and science. It was especially nice to experience how much this project inspired the researchers themselves and with how much commitment and enthusiasm they threw themselves into the unusual roles of scriptwriters and actors!

The tasks themselves were partly simple arithmetic or problem solving, and curiosity and creativity were always called for: whether experimenting, painting, crafting or discovering previously unknown things in nature, the puzzles were varied, as were the prizes. The prizes included guided tours of research institutes and laboratories that usually have restricted access, museum visits, experiment boxes and much more.

On September 21, time was up and the solution videos were published as short films on proloewe.de.

P.S.: If you are curious, you can still watch the ProLOEWE-Science Rallye at proloewe.de – a prize in itself.

Three LOEWE projects, ALLEGRO, SMoLBits (Uni Kassel) and FLOW FOR LIFE (TU Darmstadt) presented themselves at the Campusfest of the Uni Kassel 2022 with their Science Escape Room.

ProLOEWE-MARS MISSION 2022

SUCCESSFUL – WORLD SAVED!

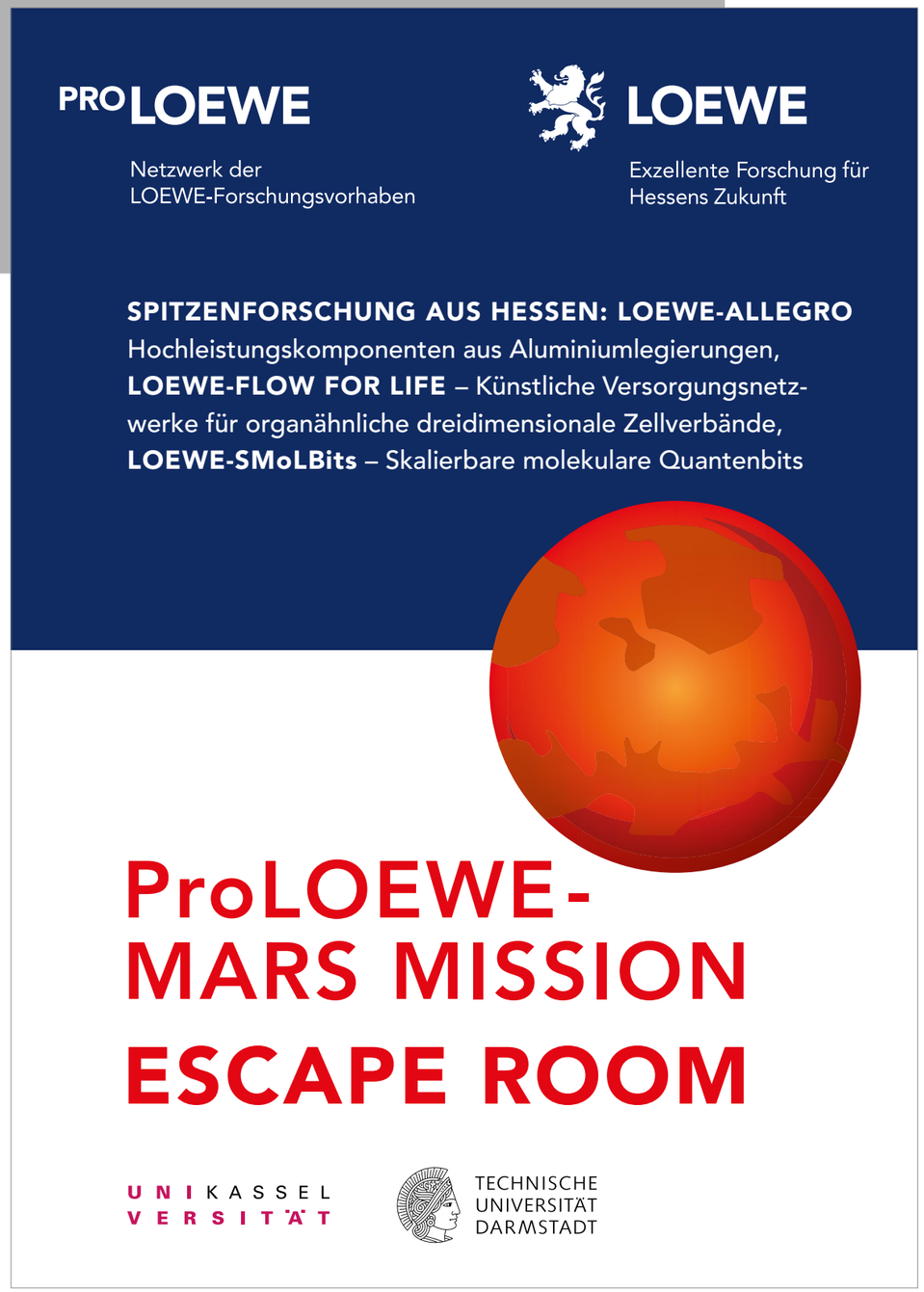
In the Escape Room the man from Mars is slowly getting up. Soon he will be fully activated and destroy Earth. The quantum computer shows the countdown: 15 minutes are all the time the visitors have on this mission to save the world from destruction. To accomplish this, they must first solve a variety of tasks to find the key that will prevent the Martian from powering up and causing disaster.

After two years of Covid lockdowns and canceled events, a campus festival was finally held again at the university in 2022. A welcome occasion to come up with something very special for the presentation of **LOEWE** projects at the summer festival of Kassel University, thought **ProLOEWE**: And so it became nothing less than a mission to Mars, which the team conceived together with the **LOEWE research clusters ALLEGRO**, **SMoLBits** and **FLOW FOR LIFE** and implemented in a workshop lasting several days.

The **Mars Mission "crew"** developed the title, story, and numerous puzzles for the Science Escape Room. For example, one puzzle is made of aluminum and iron, which is accompanied by a magnet. To progress, participants inside the escape room must figure out that the lighter and non-magnetic aluminum puzzle pieces, when put together, reveal the code to one of the numerous locks. Or a device that only lights up another code when all the numerous switches are in the right position. At another station, tiny, artificially produced "mouse embryo paws" must be counted in order to crack the next combination of numbers with the readily available microscope. But even the plug for the microscope is not easy to find.

After intensive planning, implementation and a few trial runs, everyone involved was looking forward to June 30, the day of the event. Early in the morning, construction fences were delivered, which were equipped with several tarps printed with Martian landscapes, serving as walls for the Escape Room. Inside, the project team set up the lab with the tasks and draped the Martian on the table – (another) custom-made item for the joint project. In the afternoon, the time had come and the first participants were able to enter the Escape Room, greeted by the janitor of the Mars Mission Lab, who, completely overtired, dropped himself onto the keyboard of the on-board computer and thus, to everyone's horror, started the countdown to disaster. On his desk, the Martian became more conscious by the minute, gradually rising more and more menacingly, accompanied by loud announcements and siren noises, increasing the stress and urgency of the timer counting down towards destruction. But all's well that ends well, (almost) all's well: in almost every run, Earth was saved from destruction.

And all the others will hopefully make it next time, because the **ProLOEWE Escape Room** was designed as a kit and is waiting for further missions in the **LOEWE universe**!



Photos: Sascha Mannel & Tanja Desch

MATTHIAS HOLLICK IS A FULL PROFESSOR AT TU DARMSTADT. HE IS HEADING THE SECURE MOBILE NETWORKING LAB (SEEMOO) IN THE DEPARTMENT OF COMPUTER SCIENCE SINCE 2009, AND ACTS AS THE SCIENTIFIC COORDINATOR OF THE LOEWE RESAERCH CENTRE emergenCITY. Foto: @faridehfotografie

Professor Matthias Hollick

Researcher for the future of our digital society

You have been conducting research on resilient cities as part of LOEWE emergenCITY since January 2020. As the centre scientific coordinator, what can you tell us about the project and its research focus? *LOEWE emergenCITY investigates how to conceive a resilient digital society, and we are particularly focusing on digital cities. We are on our way towards digitality, i.e., the firm integration of digitalization in all areas of life. However, we need to do a better job of shaping the digital transformation, because it harbors a number of risks if it is poorly executed.*

This is where the concept of resilience comes in as an indispensable characteristic for digitality. How do we define resilience in this context? Resilience refers to the ability of a system to absorb crises and shocks, to recover from them in a timely and sustainable manner, to enable emergency operation through adaptation and transformation, or to develop new types of functionality. In the process of coping with the crisis, resilient systems learn from the experience gained and continue to adapt and develop. As one example, resilient communication systems could have maintained communication channels for the public during the flood disaster in the Ahr Valley, thus saving lives.

Our research in emergenCITY aims to ensure that our cities and their inhabitants can deal with any imaginable and unimaginable crisis in the best possible way. If we succeed in designing and implementing resilient information and communication systems, this will be the basis for resilient digital cities in a free society. To this end, we are working in an interdisciplinary manner and cooperate closely with the population from the very beginning.

Digitization is taking on a bigger role than ever before. How well positioned are we in Germany (Europe) in this regard, and what do we urgently need to catch up on in the next 10 years? *At the moment, we have unfortunately become comfortable in the international midfield when it comes to digitization. In my opinion, we have the excellent experts we need to be at the top. My team and I place a lot of emphasis on research-oriented teaching, and I am always thrilled when I see innovative solutions from our students solving the most difficult challenges. At TU Darmstadt, we produce some of the best young researchers internationally in computer science. But subsequently, we as a society are not sufficiently successful in channeling this knowledge into innovative products, start-up companies, etc. I would wish for a more innovation friendly society. In this respect, I see the state as a regulator that must shape the framework conditions in such a way that innovations succeed more easily.*

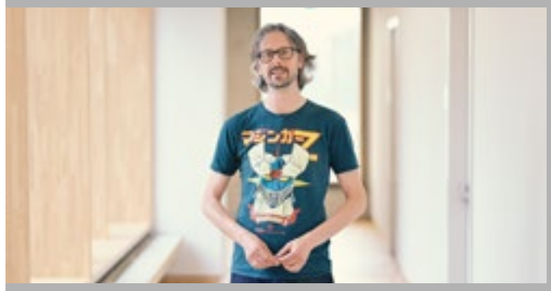
You have been working as a scientist for many years: Can you remember what was decisive for you in choosing this profession? *The third law of science fiction author Arthur C. Clarke is: „Any sufficiently advanced technology is indistinguishable from magic."* From an early age, I was curious and wanted to get to the bottom of things. Even more so, if their function was not apparent to me and thus seemed „magical". This curiosity led me to study engineering and subsequently science seemed to me the best place to spend a lifetime doing research.*

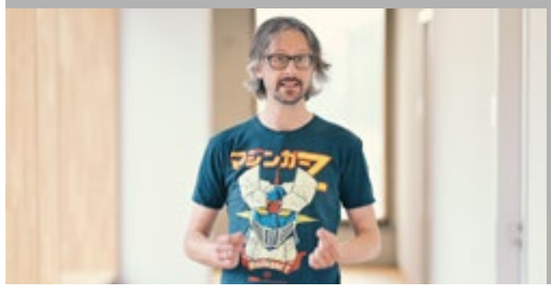
STEM subjects (science, technology, engineering and mathematics) are such an exciting and important field that we should integrate them much earlier and more intensively into education. I would like to see a scientist in residence at every school, conducting „crazy" experiments together with the children and thus laying the foundation for lifelong curiosity and creativity.

What makes basic research (always) exciting for you personally and why is it so important for our society? *Computer science is at the heart of the next great transformation of society. If we look at the past, we have evolved in the engineering sciences from steam engines to electrification and automation to digitization and „softwarization". I find it particularly exciting that my research topic lies at the heart of many scientific and societal grand challenges. It allows me to point out many new possibilities for shaping the future.*

The LOEWE research funding program of the state of Hesse has tremendous impact, and scientists in other German states wish for similar programs. What makes it special in your view? *Over the past 15 years, LOEWE has managed to promote the research strengths of Hessen's universities in a very targeted way. In other federal states, funding programs are sometimes designed for only one legislative period. In contrast, LOEWE is characterized by a continuity and reliability that is incredibly important for basic research and research as a whole. It is a good sign that our state government has recognized the importance of excellent and, above all, free research and is not constantly calling it into question.*

You are a scientist by vocation, which is very nice, but at the same time it means that you can never let go of your work: What do you do to compensate? *If you don't create space for yourself, your creativity suffers. For me, my family is a wonderful balance to work. Both areas of life are equally intense and demand strength, but they also inspire every day and – most importantly – both are very positive for me because they help moving the world forward. Seeing that I, as a father, doctoral supervisor or university lecturer, am making an important contribution to the development of the personalities of the next generation makes me proud and constantly pushes me forward. My family has always supported me, for which I am very grateful, and I try equally to promote a work-life balance in my team.*





Photos: Sascha Mannel

* In 1962, science fiction author Arthur C. Clarke defined three laws in his book „Profiles of the Future: An Inquiry into the Limits of the Possible" of which the third law is the best known and most frequently quoted: „Any sufficiently advanced technology is indistinguishable from magic."

SCIENTISTS FROM THE CEPTER-AG CHIOCCHETTI WITH HUMAN NEURONAL CELLS, WITH THE HELP OF WHICH DISEASE-RELEVANT GENE MUTATIONS COULD BE VALIDATED AND DISEASE PROCESSES FOR EPILEPSY AND AUTISM COULD BE FURTHER ELUCIDATED SCIENTIFICALLY.
Photo: CePTER

LOEWE-CePTER VALIDATES GENE ANALYSIS FOR CUSTOMISED DIAGNOSIS AND THERAPY OF EPILEPSY

As part of the **LOEWE research cluster CePTER-(Center for Personalized Translational Epilepsy Research)**, the research team led by Dr. Andreas G. Chiocchetti, Professor of Translational Child Psychiatry at the University Hospital Frankfurt, has succeeded in validating further disease-relevant gene mutations for epilepsy: in particular, the added value and necessity of broad genetic diagnostics in clinical practice are thus becoming clear.

By studying individual genes in detail, the research group has also been able to further elucidate disease processes (pathomechanisms) for epilepsy and autism from a scientific perspective. This was made possible by the strategic establishment of a development process under laboratory conditions (in vitro pipeline) for the functional analysis of genes, e.g. DEPDC5, a so-called risk gene for familial forms of epilepsy and autism. Mutations in this gene alter the mTOR signalling pathway in the brain.

In this way, the efficacy of a drug substance was tested directly at the gene level in the cell model. This not only validates and confirms therapeutic targets, but also provides a more detailed explanation of the observations from clinical studies, whereby the active substance showed an effect with mTOR mutations in epilepsy. Professor Chiocchetti's team combined the newly acquired data sets from this pipeline with data from patient-specific genetic studies. These were conducted at the Epilepsy Centre Frankfurt Rhine-Main or came from studies in which the Epilepsy Centre participated. However, the model has also shown that pathomechanisms specific to autism cannot be repaired in vitro by the medication tested, and can thus explain why the active substance used does not have a therapeutic effect in autism.

In the sense of tailor-made diagnostics and therapy of epilepsy, but also of other neurological disorders such as autism, this pipeline will be further expanded in the future to validate functional correlations of genetic risk factors, but also to detect new therapeutic targets. The publication of these new results is in progress.

LOEWE-FLAME SYMPOSIUM AT MSE CONGRESS 2022 – ANTIFERROELECTRIC DIELECTRICS FOR ENERGY STORAGE APPLICATIONS

As part of the hybrid Materials Science and Engineering Congress (MSE Congress), which took place from September 27-29, 2022, **LOEWE-FLAME** hosted the symposium „Antiferroelectric Dielectrics for Energy Storage Applications" at the Technical University of Darmstadt. The aim of the symposium was to discuss the recent progress and consequent challenges in the development, characterization and modeling of new dielectric materials for energy storage, with a particular focus on antiferroelectrics. Thus, the symposium provided an interdisciplinary platform for discussions, exchange of views and the establishment of future collaborations in this field.

With usually more than 1500 participants, the biennial MSE is one of the largest English-language congresses in the field of Materials Science and Engineering in Europe. Over the past ten years, the MSE Congress has developed into an international platform for experts in Materials Science and Engineering to present their research to a large international community and to network across disciplines and borders.

For more information on the symposium, please visit the website of the German Society for Materials Science e.V. at: dgm.de/mse/2022/.

The LOEWE project **„FLAME – Fermi Level Engineering of Antiferroelectric Materials for Energy Storage and Insulation Systems"** investigates how the properties of functional materials can be adjusted via their electronic structure.

Twelve research groups from the fields of materials science, geosciences, chemistry, electrical engineering and information technology will develop lead-free antiferroelectrics for capacitors with high energy and power density and for high-voltage insulators. These enable more efficient conversion and transmission of electrical energy from renewable sources and in electromobility. The project is being funded with 4,7 million euros from January 2019 to March 2023 by the State of Hesse within the 11th season of the LOEWE Initiative.

Photo: dgm.de

IMPRESSIONS FROM THE SYNMIKRO BIRTHDAY PARTY ON JUNE 21, 2022 IN MARBURG. ON THE PHOTOS FROM TOP LEFT TO BOTTOM RIGHT: MINISTER OF STATE ANGELA DORN, PRESIDENT OF THE PHILIPPS-UNIVERSITÄT MARBURG PROF. DR. THOMAS NAUSS, VISITORS INSIDE THE NEW EVENT ROOM, PROF. MARTIN THANBICHLER, PROF. TOBIAS ERB, PROF. ANKE BECKER, MAYOR OF THE CITY OF MARBURG, DR. THOMAS SPIES AND THOMAS NAUSS AT THE HANDSHAKE WITH A GUEST.T. Photos: Henrik Isenberg

LOEWE STORY OF SUCCESS: **SYNMIKRO** CELEBRATED ITS TWELVE YEAR OF EXISTENCE IN JULY.

With a symposium in the newly opened state-of-the-art building on Marburg's Lahnberge **SYNMIKRO**, established in 2010 as a **LOEWE research centre**, celebrated its twelfth anniversary from July 21-22. The focus of the celebration and the research is and was the question of how microorganisms can save our world. Among the guests who addressed the participants of the event with a greeting were Angela Dorn, Minister of Science and Art, Prof. Dr. Thomas Nauss, President of the University of Marburg, Anke Becker, Managing Director of **SYNMIKRO**, Prof. Dr. Gert Bange, Vice President for Research at the University of Marburg and Deputy Director of **SYNMIKRO** and Prof. Dr. Tobias Erb, Director and Head of the Department „Biochemistry and Synthetic Metabolism" at the Marburg Max Planck Institute for Terrestrial Microbiology and the Lord Mayor of the City of Marburg, Dr. Thomas Spies.

Science Minister Angela Dorn, was very sorry not to be able to attend the celebration in person and congratulated via video message: „Twelve years of **SYNMIKRO** have brought a lot of progress in science and teaching, in structures and in cooperation. Here, research is conducted under one roof, in the spirit of togetherness between the Max Planck Institute for Terrestrial Microbiology and the Philipps University of Marburg. This intensive cooperation was made possible by funding as a LOEWE research centre. The progress of **SYNMIKRO** shows once again that we are meeting the great challenges of our time with science and research."

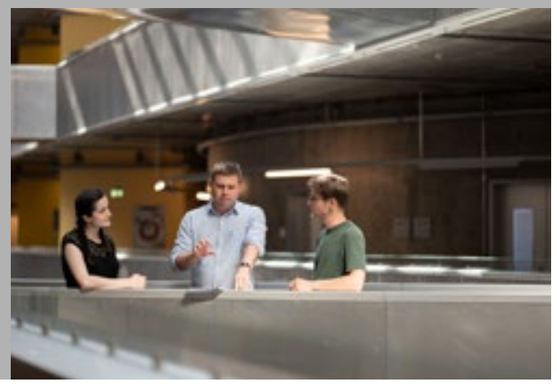
The success factors of interdisciplinary cooperation and excellent technical equipment was emphasized by the managing director of **SYNMIKRO**, Prof. Dr. Anke Becker "In **SYNMIKRO**, scientists with different experiences and expert knowledge come together. In addition to the planned exchange at scientific events, it is the chance encounters on the way or during breaks on campus and now in the new **SYNMIKRO** building that lead to exciting discussions, new approaches to problem solving and new creative ideas."

SYNMIKRO aims to explore the diverse interactions of microorganisms with their environment in molecular detail. New possibilities are created to harness their capabilities in a targeted manner. After all, microorganisms are real all-rounders: they produce and consume climate-relevant greenhouse gases, and influence soil fertility and biodiversity. In view of the current and future effects of climate change as one of the greatest challenges of our time, the research and teaching of **SYNMIKRO** focuses in particular on mechanisms, consequences and solutions of microbial transformations of greenhouse gases.

SYNMIKRO, founded in 2010 as a LOEWE research centre, became jointly owned by the Philipps-Universität Marburg (UMR) and the Max Planck Institute for Terrestrial Microbiology (MPI) in Marburg after LOEWE funding ended in 2019. **SYNMIKRO** is now a highly visible international research centre where more than 250 scientists from 27 nations successfully research and teach together. **SYNMIKRO**'s ranks include numerous prizes and individual grants, including three Heinz Maier-Leibnitz Prizes, nine ERC Grants, and five DFG Emmy Noether Groups. Since its inception, **SYNMIKRO** has graduated 210 PhD students (as of December 31, 2020), 89 of whom are women.

Since 2019, **SYNMIKRO** has raised nearly 29 million euros in third-party funding. In the previous ten years, a further 46 million euros in additional third-party funding was raised in addition to LOEWE funding.

LOEWE RESEARCH CENTRE DRUID
PRESENTS NEW FORMATS AFTER PROJECT EXTENSION



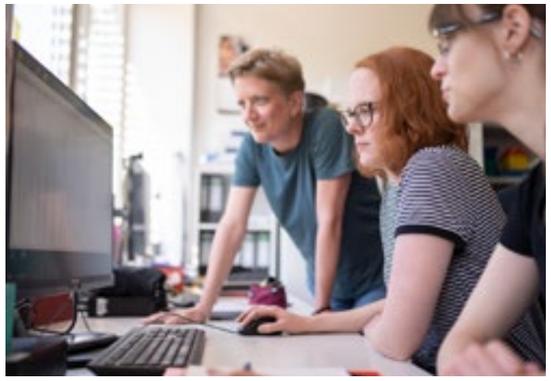
Bringing science out of its supposed ivory tower and making it accessible to the public and other stakeholders is a major concern for researchers. The modernization of the website of the **LOEWE research centre Novel Drug Targets against Poverty-related and Neglected Tropical Infectious Diseases (DRUID)**, which was completed at the beginning of the year, and the introduction of a new Twitter channel (@LOEWE_DRUID) were great opportunities to consider additional formats.

This gave rise to the idea of a series of online reports about the **LOEWE centre scientists**, which is launching in August. The reports deliberately focus on young scientists and the **DRUID** professors appointed as part of the research centre.

Detailed reports and exclusive photos are to focus on individuals and their personal motivation for choosing a career in science, for example, with pictures from the junior research groups of PD Dr. Simone Häberlein and Dr. Ross Douglas, who are presenting their work with leeches and parasites in cell culture and under the microscope.

The labs headed by Prof. Dr. Eva Herker (Philipps University Marburg), Prof. Dr. Jacomina Krijnse-Locker (Paul-Ehrlich-Institute in Langen), and Prof. Dr. Franco Falcone (Justus Liebig University in Giessen) are also highly motivated. The daily routine of these scientists is governed by particularly strict safety regulations on handling highly pathogenic viruses, extremely complex sample preparations and evaluations at the electron microscope, or tests on new drugs, vaccines, and diagnostics both for and against worm parasites. The new format will also present this information in an impressive manner.

In December 2021, the Hessian Ministry of Higher Education, Research, and the Arts announced that **DRUID** will be funded for another three years until 2024. The **LOEWE research centre** brings together Hessen's top medical universities, as well as the Paul Ehrlich Institute, the Fraunhofer Institute for Translational Medicine and Pharmacology, and the University of Applied Sciences in Giessen, to address urgent issues on identifying and characterizing potential targets in order to develop drugs and diagnostics against poverty-associated and neglected infectious diseases. These capacities and expertise that combined with great success during the establishment phase of the center are now, in the continuation phase, distributed across 29 research projects with more than 40 scientists. These projects fall under five different project areas, which are dedicated to the discovery and characterization of different target molecules in hosts and vectors. Since January 2022, not only have new research projects enriched the center and helped it refine its scientific profile, but there have also been changes in leadership; the scientific coordinator is now Prof. Dr. Stephan Becker whose home institution is the Philipps University of Marburg.



*For more information on the **LOEWE research centre DRUID,** please visit* https://www.loewe-druid.de/

AS PART OF THE ONLINE REPORT SERIES, THE LOEWE-DRUID SCIENTISTS WERE ACCOMPANIED WITH CAMERA FOR ONE DAY: WHAT DOES IT ACTUALLY LOOK LIKE WHEN SAMPLES ARE TAKEN, PREPARED AND ANALYZED? WHAT EQUIPMENT IS USED FOR THIS? AND HOW DO THE RESEARCHERS PROTECT THEMSELVES FROM EVERYDAY RISKS WHEN HANDLING LIQUID NITROGEN OR HIGHLY PATHOGENIC VIRUSES, BACTERIA, AND PARASITES? ANSWERS TO THESE QUESTIONS ARE PRESENTED IN SASCHA MANNEL'S PHOTOS, WHICH PROVIDE A VIVID INSIGHT INTO THE LOEWE CENTRE'S RESEARCH.
Photos: Sascha Mannel

PROF. CONSTANTIN A. ROTHKOPF, PH.D.
TU DARMSTADT
Photo: Sascha Mannel

NEW PERSPECTIVES FOR COGNITIVE SCIENCE AND AI IN HESSE: CONSTANTIN ROTHKOPF, **LOEWE-WhiteBox** SPOKESPERSON, AWARDED ERC GRANT FOR AI PROJECT

Artificial intelligence (AI) is permeating more and more areas of our everyday lives as a crucial key technology of the 21st century. The performance of AI promises increasing automation of tasks that previously only humans could manage thanks to their intelligence. However, in the meantime, even for researchers who develop such systems, decisions made by "their" AI are often hardly comprehensible.

And this is precisely where a problem arises that needs to be overcome: comprehensible and reliable predictions and decisions are indispensable for applications of Artificial Intelligence in business and society. Researchers in the **LOEWE research cluster "WhiteBox"** are therefore investigating how the "black box" of machine learning can be made more transparent. They are developing methods at the interface between Cognitive Science and AI to make Artificial Intelligence more understandable for humans.

Now, a prestigious prize has been awarded to one of the two speakers of the **LOEWE project**, which makes a decisive contribution to bringing Cognitive Science and Artificial Intelligence closer together at the TU Darmstadt and thus in Hessen, once again increasing the importance of the research location: The European Research Council awarded Constantin Rothkopf the "ERC Consolidator Grant" and is funding his project proposal "ACTOR – Towards a computational account of natural sequential behavior" with a total of two million euros over a period of five years.

After the initial results of the **LOEWE-WhiteBox** project, ACTOR will focus in particular on researching human action sequences. Not only classical lab experiments of perceptual psychology will be examined, but also everyday tasks from the real world, such as preparing a sandwich or navigating in unknown surroundings, in order to draw conclusions for research. The aim of the project is to gain a better understanding of human behaviour by means of cognitive computational models, i.e. by applying algorithms similar to Artificial Intelligence.

The **LOEWE research cluster "WhiteBox – Explainable Models for Human and Artificial Intelligence"** started on 01.01.2021 and will be funded by the state of Hesse with a total of 4.7 million euros until the end of 2025. It forms an interdisciplinary team with researchers from the fields of Cognitive Science, Artificial Intelligence and Machine Learning, Intelligent Autonomous Systems, Self-organising Systems, Sports Biomechanics, Neuroscience as well as Marketing & Human Resource Management. The spokespersons for the cluster are Constantin Rothkopf, Professor of Psychology of Information Processing and Director of the Centre for Cognitive Science at TU Darmstadt, and Kristian Kersting, Professor of Artificial Intelligence and Machine Learning at TU and co-spokesperson of the Hessian Centre for Artificial Intelligence (hessian.AI) based at TU Darmstadt.

BACKGROUND

The ERC Consolidator Grants are awarded by the European Research Council to researchers from all disciplines for a period of seven to twelve years after their doctorate. In this way, the European Union promotes promising research: the Consolidator Grant is aimed at researchers who already have an excellent track record and now need support for their groundbreaking research projects to achieve scientific consolidation. In the current ERC round, 313 grants were awarded to 2652 applications across Europe.

LOEWE RESEARCH CLUSTER BAMP!

PAPER AS A BUILDING MATERIAL

Paper is a renewable and sustainable material – which makes it quite exciting for science. Moreover, it is still insufficiently researched in many areas. The excellent perspective for the application of paper in the construction industry were the the impetus to apply for **LOEWE research funding**. **LOEWE-BAMP!** successfully emerged from the competitive process in 2016 and was funded with 4.6 Mill € from 2017 to 2021 to conduct basic research on the topic of building with paper. The interdisciplinary project with partners from architecture, civil engineering, chemistry, and mechanical engineering aimed at developing basic expertise for building with paper. This was done in order to enable the use of sustainable substitutes for building materials with poor recyclability or high CO_2 footprint. A strong research network with a high visibility in this field should be established at the Technische University of Darmstadt, Darmstadt University of Applied Sciences and the Technical University of Central Hesse as competent partners.

Natural materials such as wood and paper have been used for thousands of years and also play an essential role in modern construction. Examples range from laminated wood to gypsum fibreboards as well as laminates. In contrast to wood there was hardly any scientific basis for paper in these areas of application before **LOEWE-BAMP!** This expertise is crucial e.g., regarding the mechanics of paper-based constructions. Available products are based on empirical work by the manufacturers. At the same time, paper offers excellent potential for biobased applications in construction: it can be produced at low cost, it consists predominantly of a renewable raw material, it offers very good strength properties in relation to its own weight and can be used as a flat material with high porosity or even as a foam. In addition, it is also relatively easy to chemically functionalize.

This is a multitude of further reasons for scientists to take up the topic. Key research results of this **LOEWE funded project** include concepts for lightweight constructions with paper and tailor-made sustainable coating solutions for protection against moisture, fire or microbial infestation. Concepts and technologies for the manufacture of semi-finished products from paper, material and simulation tools for dimensioning and strength verification, as well as a large number of design ideas have been developed, often implemented in the form of demonstrators. Thus, valuable foundations have been established for innovations made of paper as a sustainable material of a bioeconomy for the field of construction.

Particularly noteworthy at this point is the invitation of **BAMP!** to the Venice Architecture Biennale, where the contribution was awarded the European Cultural Center Award (ECC award) in the category „University Project"! A success that can hardly be overestimated, especially in the international environment.

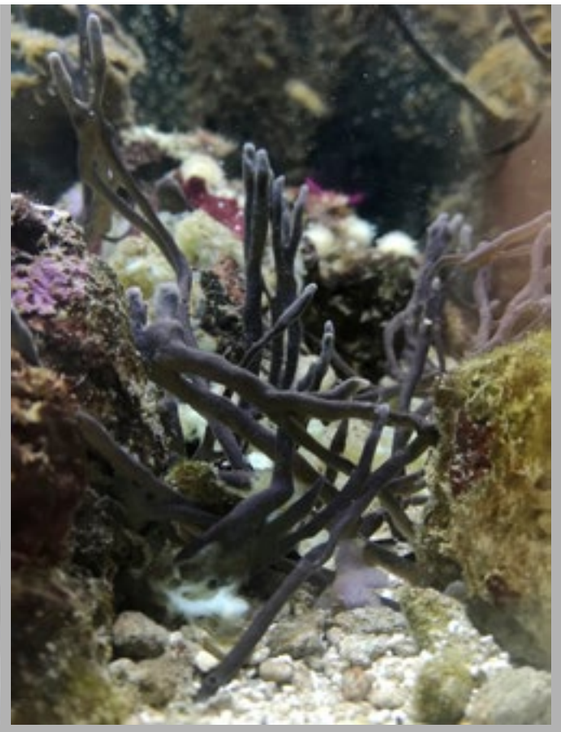
The high level of public attention for the project was also demonstrated by the very good participation of the industry at the network days. In the area of basic research interdisciplinary activities are also to be continued within the framework of a DFG Collaborative Research and a DFG Transregio. Furthermore, **BAMP!** has been the subject of several radio and television reports, which clearly shows how interesting the topic is for the public.

PERSPECTIVE SHOWROOM,, FGPG 2020.
Photo: Nina Christel, Subject area Plastic Design, Technical University of Darmstadt

LOEWE-BAMP! SCIENTISTS ARE USING THEIR RESEARCH WORK TO QUALIFY PAPER FOR USE IN THE CONSTRUCTION INDUSTRY: AS A RENEWABLE RAW MATERIAL, IT COULD MAKE A SIGNIFICANT CONTRIBUTION TO SUSTAINABILITY, PARTICULARLY IN THIS SECTOR. THEY HAVE NOW BEEN INVITED TO ATTEND THE VENICE BIENNALE OF ARCHITECTURE WITH THEIR PROJECT. Photo: Oskar Gerspach-Wolf

IN THE 'OCEAN2100' AQUARIUM FACILITY AT JUSTUS LIEBIG UNIVERSITY GIESSEN, SCIENTISTS INVESTIGATE HOW ORGANISMS LIVING IN CORAL REEFS REACT TO GLOBAL CHANGE SCENARIOS.

THE STINGING BLACK SPONGE DEFENDS ITSELF WITH NEMATOCYSTS – A CASE FOR **LOEWE TBG**



UNUSUAL AND UNEXPLORED: THE STINGING BLACK SPONGE NATIVE TO TROPICAL SEAS. Photos: Jessica Reichert

It started as a chance find in a research aquarium – now it is the protagonist of a new project at the **LOEWE Centre for Translational Biodiversity Genomics (LOEWE TBG)**: the stinging black sponge. And its martial name is not deceptive: like other marine sponges, it produces substances to defend itself against predators and competitors in coral reefs. In addition, the sponge is armed with stinging cells, so-called nematocysts, which are known from cnidarians such as jellyfish. Whether these cells secrete toxins and how and why the stinging black sponge acquires or forms them is what project leader Dr. Maren Ziegler and Dr. Jessica Reichert want to investigate in their research project 'The evolutionary origin of nematocysts in the stinging black sponge *Haliclona cnidata*' in their laboratory at the Department of Animal Ecology & Systematics at Justus Liebig University Giessen (JLU). In doing so, they enter completely new territory, as there is a lack of reliable knowledge about this unusual species to date. It is one of the approximately 11,000 sponge species officially described so far, but the natural distribution of the tropical sponge, which grows on hard substrate, is still unknown. It was probably brought to the marine aquarium system and climate simulation 'Ocean2100' in Giessen from Australia via reef rocks. Since it is not exposed to predators there, it can reproduce undisturbed by division – so-called vegetative reproduction –, grow well, and be analysed.

So far, there are different theories about its 'kleptocnidism', literally the stealing of nematocysts: The sponge could take up the cells or their precursor stages from other cnidarians such as corals from the surroundings. Perhaps it also lives in a symbiosis with cnidarians, which produce these cells and make them available to it. Or it has even taken up parts of a cnidarian genome and can now produce the cells on its own.

Ziegler and Reichert want to pursue these questions with experimental laboratory research and genome analyses. "Cnidarian cells in a sponge are a biological peculiarity. The stinging black sponge has obviously developed mechanisms to specifically place these cells, which are foreign to it, in its tissue and use them as a 'defensive wall'. The evolutionary processes behind such features fascinate us. They must be particularly complex – otherwise this phenomenon would certainly be found more often," explains Reichert. "If we were to find out that the sponge itself has developed mechanisms to produce this type of cell, it would be a sensation that could call into question the systematics of the cnidarian and sponge phyla. After all, nematocysts are the distinctive characteristic of the class of cnidarians," adds Ziegler, head of the 'Marine Holobiomics Lab' at JLU.

However, the two scientists are not only investigating evolutionary developments, but are also researching coral reefs as ecosystems and their reaction to climate change. They are also involved in international research on the influence of microplastics on coral reefs. In July 2022, they led the session 'Plastic in coral reefs' at the 15th International Coral Reef Symposium in Bremen. Since sponges are filter feeders, they play an important role in the food web of coral reefs and process the waste products of other organisms. Thus, the stinging black sponge could also be the focus of these current issues in future studies.

IMPRESSIONS FROM THE OPENING OF THE NEW COW BARN AT GLADBACHERHOF WITH THE LOEWE FOCUS GREENDAIRY TEAM AND GUESTS.. Photos: Claret Canelon

FROM LEFT: PROF. MARIA RENATE FINCKH (UNI KASSEL), PROF. LUTZ BREUER AND ANDREAS GATTINGER (JLU-GIESSEN), DEISE KNOP AND CHRISTIAN LAMBERTZ (BOTH JLU-GIESSEN) AND PROF. MARTIN KRAMER, JLU VICE PRESIDENT FOR RESEARCH.

LOEWE-GreenDairy ANALYSIS EFFECTS OF DIFFERENT FEEDING SYSTEMS ON MILK PRODUCTION

Since the beginning of this year the **LOEWE research cluster GreenDairy** of the Universities Giessen and Kassel is funded by Hessian State Ministry of Higher Education, Research and the Arts in the framework of the **excellence programme LOEWE** for four years with a total fund of 4.79 million €. The involved researchers of the research cluster study animal-plant agricultural systems that are both ecologically and economically sustainable and enable a special level of animal welfare. Furthermore, the Leibniz Centre for Agricultural Landscape Research (ZALF) is involved in the project.

A central role in the project plays the teaching and research unit Gladbacherhof, an organic farm of the University of Giessen. At the farm a new dairy barn, which is used as research facility of **GreenDairy**, is operated since June. With the dairy barn and the closely linked field experiments in arable and grassland farming a new platform for comparative, experimental agricultural systems was created.

In the state-of-the-art barn, which is designed for 128 dairy cows, robotic systems for milking, feeding, pasture management as well as manure removal is installed. The **GreenDairy** project focuses on a holistic comparison of the dairy value chain in a low-input and a high-input feeding system.

In both systems groups of 64 animals are raised in accordance with organic regulations, thus including pasture access, and are fed with feed grown on the farm: in the low-input system the diet is gras-based with minimal concentrate supplementation. In this group a yearly milk yield of 7.200 kilogram milk is expected. In the high-input group the animals are fed with the use of corn silage for a predicted milk yield of 9.000 kilogram.

The automatization and cutting-edge technical equipment allows a detailed data recording separately for both herds. With a robotic system the amount of feed is recorded, the milk is collected in different milk tanks and the slurry is stored separately.

In 14 sub-projects researchers are studying not only with performance of the dairy cows and yields of cash crops and grassland but also deal with animal welfare and health. Furthermore, they balance emissions of greenhouse gases in the barn and on the arable and grassland.

Key questions in the project are on the one hand how innovative agroecosystems can be established in practice and on the other hand whether the society is willing to support these innovations. To answer these questions **GreenDairy** cooperates with the farm network of the Upländer Bauernmolkerei, a regional and cooperatively organised organic dairy factory, to which the Gladbacherhof delivers its milk since many years.

On July 20, the research barn in Villmar-Aumenau was officially inaugurated and the team of **GreenDairy** met for its first time for the general assembly. Prof. Martin Kramer, Vice-President for Research and Graduate Studies of Giessen University pointed out that at the research facility organic animal production is not only studied at the scale of single animals but includes the whole food system animal-plant-environment-society. He complemented: „The research unit Gladbacherhof becomes a living lab with the new research dairy barn as its core element."

PIPETTING MEDIUM FOR CELL CULTURE.
Photo: Mathias Daum / Fotografie MD - 2020

LOEWE RESEARCH CLUSTER CompuGene AND iNAPO ESTABLISH SYNTHETIC BIOLOGY AS A PROFILE TOPIC AT TU DARMSTADT

The Centre for Synthetic Biology at TU Darmstadt has been in existence for two years. The **LOEWE research cluster CompuGene** and **iNAPO** provided important prerequisites for the foundation of the Centre in 2020. CompuGene was dedicated to researching new methods for generating genetic logic circuits with the help of computer models. The **iNAPO** focus area dealt with research into ion-conducting nanopores and their use in biosensor technology.

With the interdisciplinary Centre for Synthetic Biology, synthetic biology has now been established as a profile topic at the TU Darmstadt. It exemplifies how new avenues are being opened up in research in areas with high future potential.

Scientists from biology, chemistry, electrical engineering and information technology, materials science, physics and mechanical engineering are conducting joint research to combine the newly gained understanding of biological processes with the latest technology.

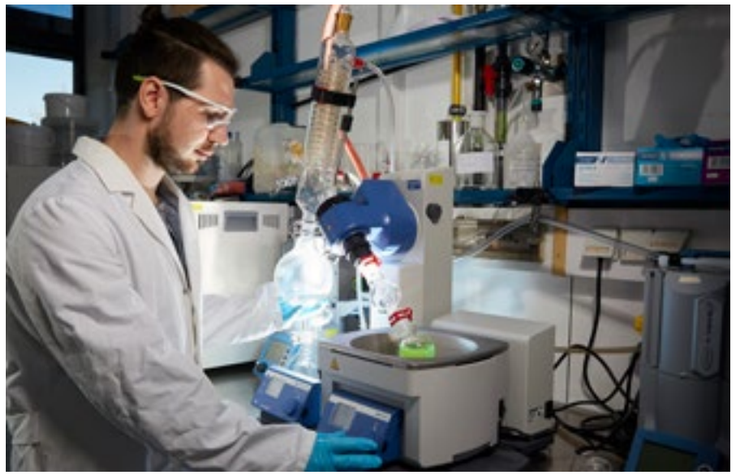
Synthetic biology describes the engineering approach to endow biological cells with new molecular functionality. Unlike traditional biotechnology, it follows the principle of achieving this functionality through the composition of individual, well-characterised, standardised molecular components. New methods of molecular biology, such as variants of the gene scissors CRISPR, help in this process. In parallel, the ability to design RNA molecules and proteins according to target specifications is currently developing rapidly. The potential applications span a very wide range: Intelligent biosensors for in vitro or point-of-care diagnostics, production of complex chemical compounds, production of optimised proteins such as enzymes, new (biocompatible) materials, new regulatory mechanisms for more robust plants and microorganisms and the generation of electrical energy.

Within the Centre, research is distributed across three scales: the molecular scale (DNA, RNA, protein, nanopores), the cellular scale (gene regulatory circuits, sensor technology, metabolic engineering) and the multicellular scale (3D bioprinting, synthetic organs).

An excellent example of research at the multicellular level is the **LOEWE research cluster Flow for Life**, which is also part of the Centre, in which synthetic organs are produced with the help of 3D bioprinting.

ROBOTICS PLATFORM ESTABLISHED WITHIN THE FRAMEWORK OF COMPUGENE.
Photo: Claudia Baier

Overall, the Centre for Synthetic Biology has succeeded in establishing an internationally visible focus on cutting-edge research in the Rhine-Main region, which sustainably promotes Hessen as a location for science and business and supports the transition to a climate-friendly economic system. This shows once again how important the funding of basic research – in this case by **LOEWE** – is in order to further develop Hessen and Germany as a location. The bioeconomy in particular is one of the most important growth markets of the future, with a growing demand for innovative effective sensors and foundations for a bio-based economy. Synthetic biology is a rapidly growing field that has the potential to influence virtually every aspect of our lives. Enormously important for this profound change is the social acceptance of synthetic biology, which is also promoted with various science communication formats within the framework of the Centre for Synthetic Biology.



EMPLOYEES IN THE iNAPO RESEARCH CLUSTER EXAMINE INTERNALLY CONDUCTIVE NANOPORES IN THE LABORATORY. Photos: Mathias Daum

FROM **LOEWE-Safer Materials** TO **BeBIO2**: INVESTIGATING AND OPTIMISING THE LONG-TERM DURABILITY OF IMPORTANT BIOPLASTICS AND BIOCOMPOSITES

Within the framework of the **LOEWE research cluster *Safer Materials***, methods and technical know-how were created through interdisciplinary cooperation to ensure the safety and reliability of materials within the range of their performance limits and under various external influences. The focus was on the selected material classes of high-strength concretes and steels, secondary aluminium, and natural fiber-reinforced plastics.

In addition to plastics made from renewable raw materials, such as PLA and PA11, "new" bioplastics and biocomposites, such as natural fiber-reinforced PA types and PBS, as well as new fields of application for existing types, are increasingly gaining in importance. However, the unclear data on the durability of these materials often leads to a rather conservative selection, usually limited to a few already known materials, which means that the potential of new materials is far too often not used due to concerns and limited possibilities of individual companies.

In order to change this in a sustainable way in the future, the findings from the studies on "safe and reliable materials" carried out within the framework of ***Safer Materials*** will now be used to focus on research on the topic of durability.

The **LOEWE research cluster *Safer Materials*** thus serves as a basis and starting point for the further development of the topic "Safe Structures" and lays an important foundation stone for the research program funded by the Federal Ministry of Food and Agriculture (BMEL) via the Agency of Renewable Resources (Fachagentur Nachwachsender Rohstoffe e. The aim of the **BeBio2** research network is to significantly improve the data on the durability of numerous bioplastics and biocomposites, to make them publicly accessible, and thus promote the increased use of biobased materials.

SAFER AND MORE RELIABLE MATERIALS – LOEWE *SaferMaterials*. Photo: Paavo Blafield

OUTDOOR WEATHERING TEST STAND IN THE BeBio2 RESEARCH NETWORK. Photo: IfW

To this end, scientists from the University of Kassel (Institute of Materials Engineering, Department of Plastics Engineering), the University of Stuttgart (Institute of Plastics Engineering), and the Fraunhofer Institute for Applied Polymer Research, together with Altair Engineering GmbH, have been working on the studies since October 2021. A further total of more than 50 industrial partners are also working on the project and contributing their expertise. In total, the research network is carrying out 12 sub-projects at the four participating research institutions and companies mentioned above. The projects either deal with cross-sectional topics, such as the hydrolysis resistance of PLA or deal with industry-specific applications of special bioplastics and are therefore assigned to either subproject area A "Consumer Products" or B "Industrial Products".

The investigations are aimed at the resistance to numerous factors, such as media, temperature, and biodegradation. The aim is to identify the influencing factors depending on the industry and to develop various aging scenarios. Thus, components in the engine compartment are affected by different influences (grease, oil, etc.) than toys (cleaning agents, etc.) or electrical items (temperature, etc.). In addition, the resistance is influenced by processing parameters and structural properties. Therefore, different products from a wide range of industries are to be tested in order to optimize suitable bioplastics in such a way that they can be used in the corresponding product sectors in the future.

SUNFLOWER-BASED PA WITH COTTON FIBRES. Photo: IfW

"UNDERSTANDING CLIMATE – LESSONS FROM THE PAST" A SPECIAL EXHIBITION BY THE **LOEWE RESEARCH CLUSTER VeWA**

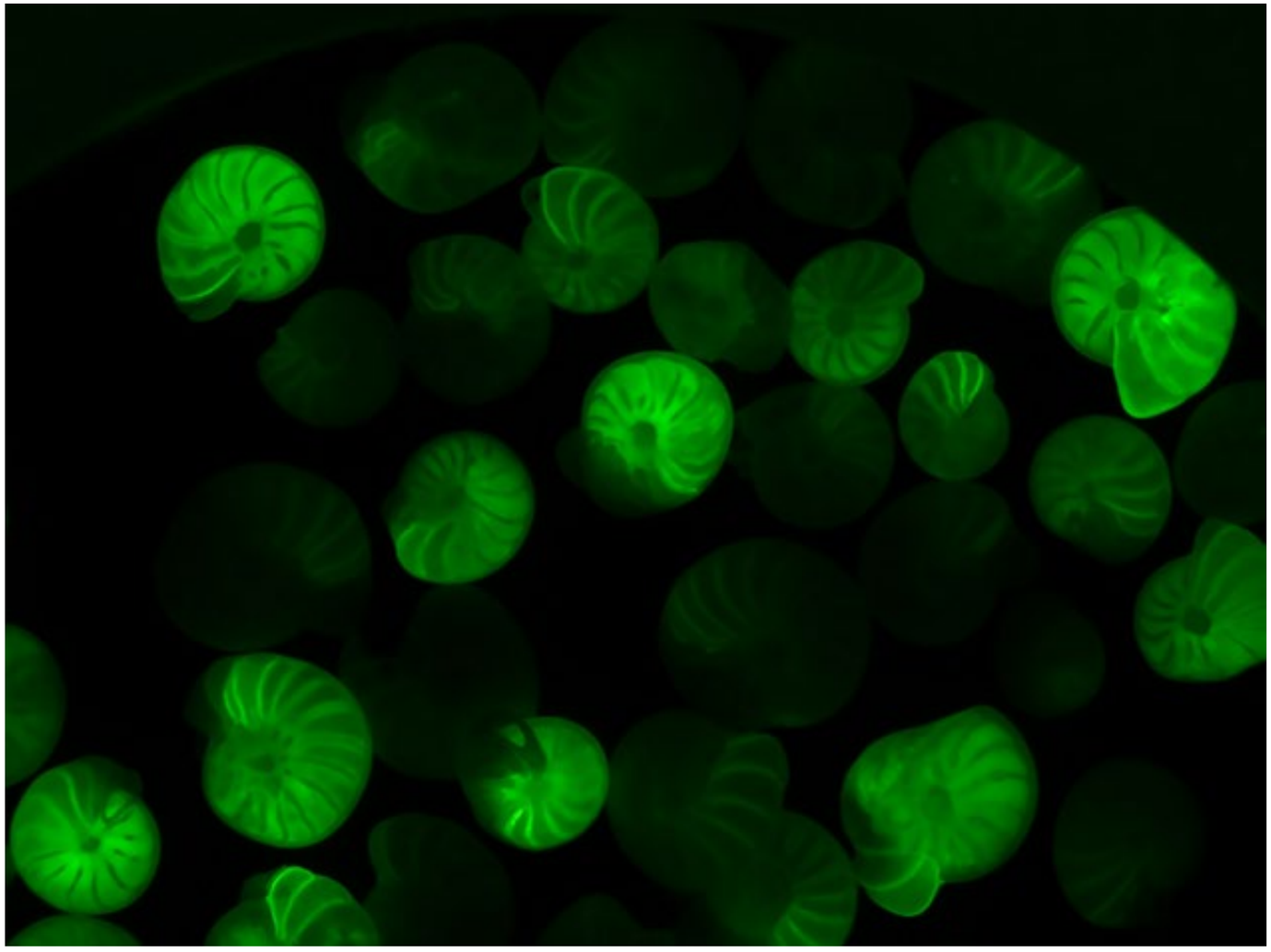
How do scientists study the climate of the past? And how does this knowledge help us better understand our future climate? These and other questions are explored in our special exhibition „Understanding Climate – Lessons from the Past" at the Senckenberg Naturmuseum in Frankfurt am Main between 21st October 2022 and 16th July 2023. It forms an integral part of the **LOEWE-funded research cluster 'Past warm periods as natural analogues of our ‚high-CO_2' climate future (VeWA)'** and represents one of the twelve sub-projects of the research consortium. With the Senckenberg Gesellschaft für Naturforschung as the main partner of **VeWA**, the choice of exhibition venue at the Senckenberg Naturmuseum was an obvious one.

Using the example of palaeoclimate research, the exhibition explores how scientific knowledge is generated. Researchers from the Goethe University Frankfurt and the Senckenberg Gesellschaft für Naturforschung take visitors on a discovery tour of Earth's past. Visitors look over scientists' shoulders and learn how they decode information from climate archives and thus determine past temperatures or atmospheric CO_2 concentrations of the Earth's deep history. These quantitative parameters allow researchers to test how well computer models actually reproduce Earth's climate. Such ‚climate hindcasting' thus facilitates further development of climate models in order to better forecast Earth's future climate with increasing atmospheric CO_2. Thus, visitors of the exhibition experience the exciting yet complex everyday life of researchers and learn about unresolved issues that still lie ahead.

As one outcome of the exhibition it should become evident for visitors that palaeoclimate research is a reliable and key basis for our better understanding the Earth System with its complex interactions. Based on this, visitors should be well placed for making informed decisions on an individual, societal and political level for the future of our planet.

The exhibition and interactive media formats enable dialogue and ample personal interactions between visitors and scientists and showcase where the knowledge exhibited in the museum is coming from.

For further information regarding our research out
outreach please visit www.vewa-project.de
or contact: vewa@senckenberg.de; vewa@em.uni-frankfurt.de



MICROSCOPE IMAGE OF FORAMINIFERA, MARINE MICROORGANISMS APPROX. 2 MM IN SIZE. THE BRIGHT GREEN COLOUR RESULTS FROM THE ADDITION OF THE FLUORESCENT COMPOUND CALCEIN, WHICH ENABLES RESEARCHERS TO IDENTIFY GROWTH OF THE ORGANISMS IN THE LABORATORY.
Photo: David Evans and Jonathan Erez

ONE OF FOUR MOBILITY FOCAL POINTS WITHIN THE MOBILITY DESIGN GUIDE
Picture: Andrea Krajewski, Sabine Reitmaier

SHAPING FUTURE MOBILITY: **LOEWE-IDG** PUBLISHES AN INTERACTIVE DIGITAL GUIDE FOR MOBILITY DESIGN

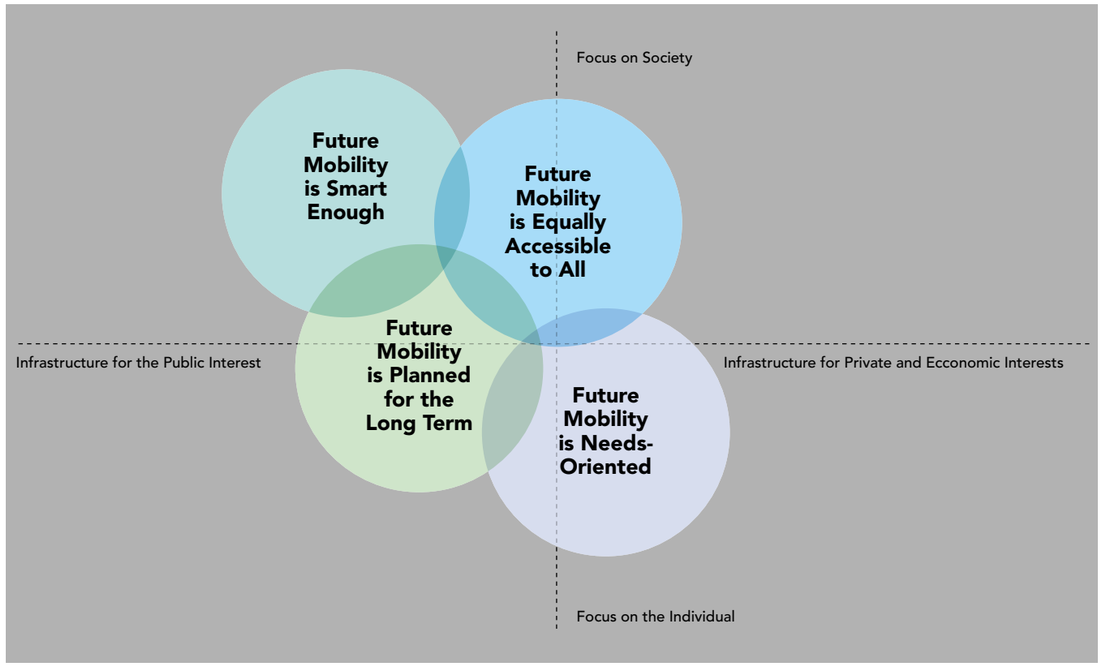
Climate change and resource scarcity as well as the steadily increasing traffic volume are making it all the more urgent to find new solutions for an environmentally friendly and humane mobility. Decisive here is not the means of transport itself, but rather the quality of movement: a new networked and intermodal mobility. However, this is not solely a political, organizational, and planning task, but instead represents special challenges for the disciplines of architecture and design.

A primary focus of mobility design is the shaping of the experience—how can interaction between users and transport infrastructure, means of transport, buildings, objects, and analog or virtual information, be configured in order to ensure a positive user experience? It mediates, via design decisions, between humans and the mobility system, influences user experience and can thus promote the acceptance of sustainable, socially compatible mobility.

LOEWE-IDG has been dedicated to this topic, as a research network of design (HfG Offenbach University of Art and Design), transportation planning (Frankfurt University of Applied Sciences), social science mobility research (Goethe University Frankfurt), architecture/urban design and multimedia communications (both Technical University of Darmstadt). In collaboration with Professor Andrea Krajewski (Darmstadt University of Applied Sciences) **LOEWE IDG** has created an interactive »Mobility Design Guide«: https://mobilitydesignguide.org. Politicians, urban and transportation planners, but also architects and designers are provided with inspiration, models, and research principles to support the planning and realization of future-oriented, sustainable mobility concepts. A decisive factor here is a user-centered perspective within a system-oriented approach.

The guide provides a demonstration and exploration of a user-oriented method for mobility design. Visitors can approach the complex topic of sustainable mobility from different viewing altitudes and along different access routes. Based on previous interviews with experts from the fields of architecture, consulting, design, public transportation services, politics, and urban and transportation planning, this was set up as a basic structure for the guide's information architecture: In order to provide orientation along access routes and viewing altitudes, the Mobility Design Guide was based on an interactive three-dimensional map of a generic city and its surrounding area that changes with the content. In this way, the Mobility Design Guide enables users to navigate from a highly abstract visual level (future visions and their mobility-related configurations) to a concrete, design-oriented level of action (design projects with specific goals). The contents of the guide include concepts and design projects from the fields of design and architecture, scientific investigations of transportation planning andsocial science mobility research, and communication technology experiments.

APPROACHING FROM DIFFERENT VIEWING ALTITUDES
Picture: Andrea Krajewski, Sabine Reitmaier



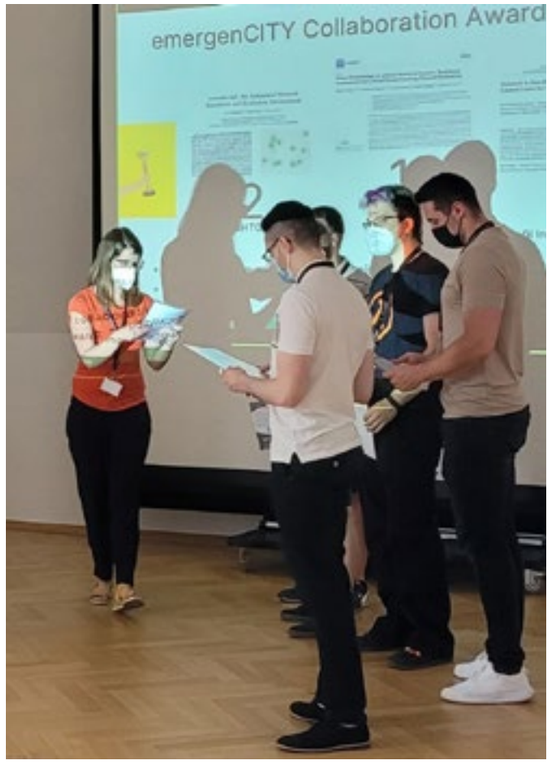
VISIONS OF THE FUTURE WITH FOUR FOCAL POINTS
Picture: Andrea Krajewski, Sabine Reitmaier

For further information on mobility design and the research conducted by **LOEWE-IDG** see also: *Mobility Design – Shaping Future Mobility, Vol. 1: Practice, edited by P. Eckart and K. Vöckler (Berlin 2022), Vol. 2: Research, edited by K. Vöckler, P. Eckart, M. Knöll and M. Lanzendorf (will be published in early 2023).*

LOEWE-emergenCITY: MORE AWARENESS FOR CRISIS-PROOF DIGITAL CITIES

Since 2020, the **LOEWE research centre emergenCITY** has been conducting research on the crisis resilience of digital cities: extreme weather events, cyber attacks, human or technical failure can shut down their entire critical infrastructures. To prevent this from happening and to enable a fast return to normality in the event of an emergency, the research centre is working on improving the resilience of digital cities and their infrastructures in various interdisciplinary projects.

A fixed part of the **LOEWE research centre** is the annual **"emergenCITY Week"** in which the exchange between the projects and disciplines is the central focus. The public was also invited to numerous events: For example, to the lecture series "Urban Resilience", which was organized in 2022 by the department "Design and Urban Development" under the leadership of **emergenCITY** professor Annette Rudolph-Cleff and the international research program "Designing Resilience Global". Speakers this year included Herbert Dreiseitl and Kongjian Yu, with topics such as climate resilience and urban planning options in the face of flood hazards, "sponge cities" for which heavy rain is not a problem, or, very specifically, how to cope with the flood disaster in the Ahr Valley.

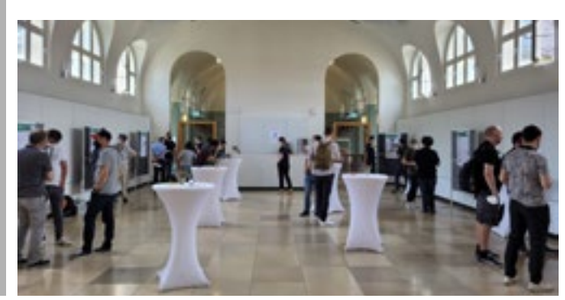


PRESENTATION OF THE EMERGENCITY COLLABORATION AWARD TO THE PRIZE WINNERS. Photo: Svenja Andresen

POSTER SESSION DURING EMERGENCITY WEEK 2022. Photo: Svenja Andresen

Another highlight was the workshop on "Hybrid Threats to Critical Infrastructures", which was organized jointly with the Schader Foundation and moderated by **emergenCITY** professor Christian Reuter. Here, experts from security authorities, companies, infrastructure operators and research discussed the issue of security for critical digital infrastructures. With increasing digitalization, extreme weather, technical problems or cyber attacks on networked infrastructures can lead to serious failures. According to the experts, such scenarios have the potential to shut down the supply of electricity, water, gas or communications. But how can we be better prepared if, depending on the hazard situation, a very different crisis response becomes necessary? According to the experts, it is important to practice various crisis management procedures. In Germany, however, there is still a need for an increased awareness of potential threats, especially in the area of IT security. One of the suggestions made was to set up a kind of relief organisation for the IT sector: a network of volunteers who can help in the event of cyber attacks on infrastructures.

The **emergenCITY week** concluded with a social event at which the professors who joined the **LOEWE research centre** since last fall presented their research priorities. These include developing early warning systems for flood hazards, visualizing hazardous situations in virtual reality, improving radar systems in rescue robotics, and the use of information and communication technology by civilians during war times. During the event, the "**emergenCITY** Collaboration Award 2021" was also presented, which honors outstanding interdisciplinary research work of the LOEWE Centre. The award was given to a publication on the resilience of water distribution systems and two papers dealing with improved monitoring of digital cities.



WORKSHOP AT THE SCHADER FOUNDATION. Photo: Svenja Andresen/Anne Hofmeister

CMMS-TALKS: LECTURE SERIES OF **LOEWE-CMMS** WITH RENOWNED SCIENTISTS FROM GERMANY AND ABROAD

The **LOEWE CMMS Talks** lecture series with external speakers from the international scientific community stimulates the **LOEWE CMMS** community. Every fortnight, speakers present their current research results on the topic of multi-scale modelling in the life sciences to scientists of the **LOEWE research cluster at FIAS (Frankfurt Institute for Advanced Studies)**. With their contributions, experts at the forefront of their fields encourage scientists to be more creative in their research.

The PhD students are enthusiastic: „The **CMMS Talks** support our doctoral work in a great way," says Tim Liebisch, a doctoral student in Franziska Matthäus' research group. „They represent the spectrum of **CMMS** topics very well and give us an overview which contact persons can be contacted for various questions." He also particularly likes the discussion time in the FIAS lounge following the lectures: „There we can ask questions directly and deepen contacts."

The series of events, taking place again in presence since the end of April 2022, kicked off with a talk on optimised biological systems. In his lecture, Prof. Gašper Tkačik from the Institute of Science and Technology (IST) Austria presented a new mathematical approach to quantify how much biological systems are optimised for a specific function. Tkačik presented several exemplary applications from the field of neuroscience and developmental biology. In his mathematical approach, he combines normative theories and statistical inference - actually opposing approaches: A normative theory in biology assumes that organisms have adapted to solve vital tasks efficiently. Statistical inference, on the other hand, uses data to determine model parameters without prior assumption of a biological function. Tkačik and his team combine the two, using simple examples from neuroscience and gene regulation to show how they more efficiently address fundamental challenges in high-dimensional biological systems. These novel approaches contribute to understanding how cells in biological systems „decide" into which tissue they will develop, or how neurons coordinate to relay signals most effectively.

In further lectures, two young female scientists from Goethe University, who were recently recruited for joint work at the **CMMS**, introduced themselves: Prof. Dr. Gemma Roig uses and develops artificial intelligence methods to extract information from multi-modal data sets (e. g. image, sound, and text) and trains Deep Neural Networks for visual tasks to gain insights into the functions of the visual cortex. Dr. Cornelia Pokalyuk outlined her work on discrete and stochastic modelling of invasion processes (such as the spread of diseases or parasites) on network structures, and presented mathematical approaches to analytically solve these systems.

The final lecture of the **CMMS Talks** series in the summer semester 2022 was also given by a Goethe University scientist: Dr. Arne Nägel described a computational approach for porous media, as a possible application, for example, in life sciences and for subsurface flows.

The series of **CMMS Talks** will be continued in the coming winter semester with renowned scientists from Germany and abroad. Information can be found on the FIAS page under Events.

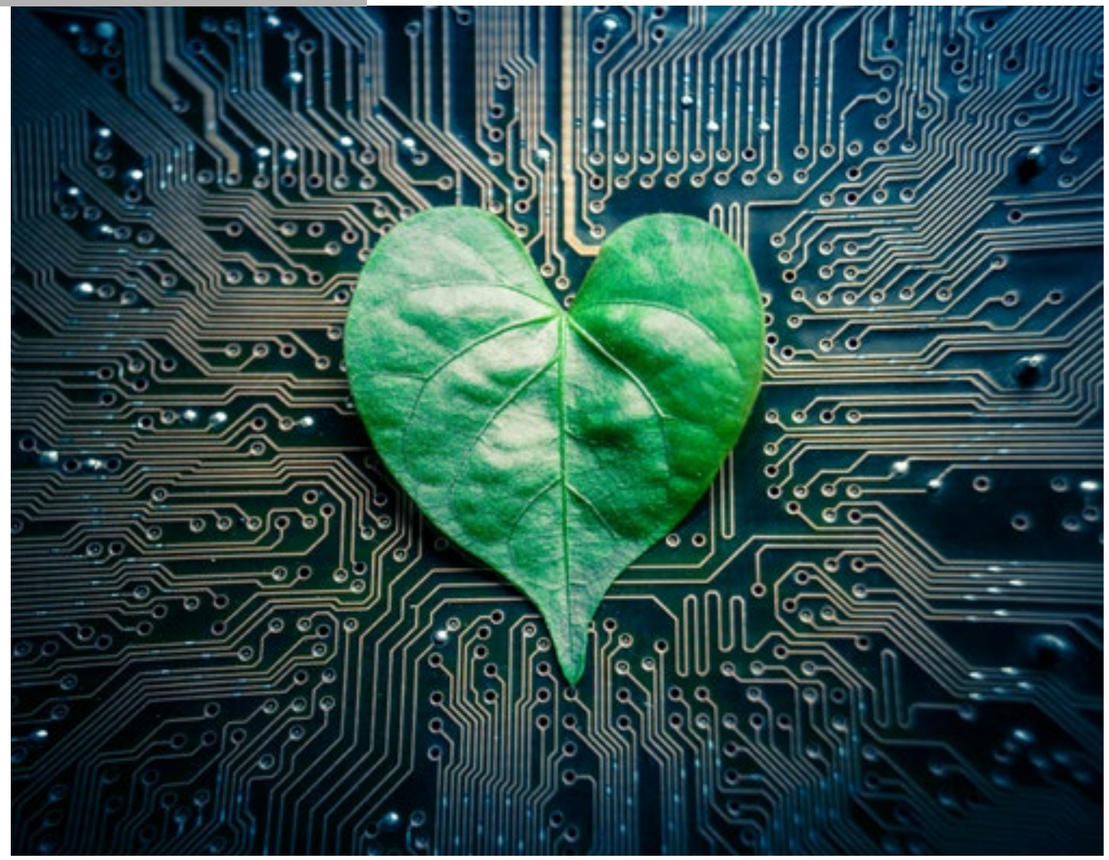


Photo: weerapatkiatdumrong/istockphoto

LOEWE-MOSLA: LONG-TERM DATA STORAGE OF THE FUTURE

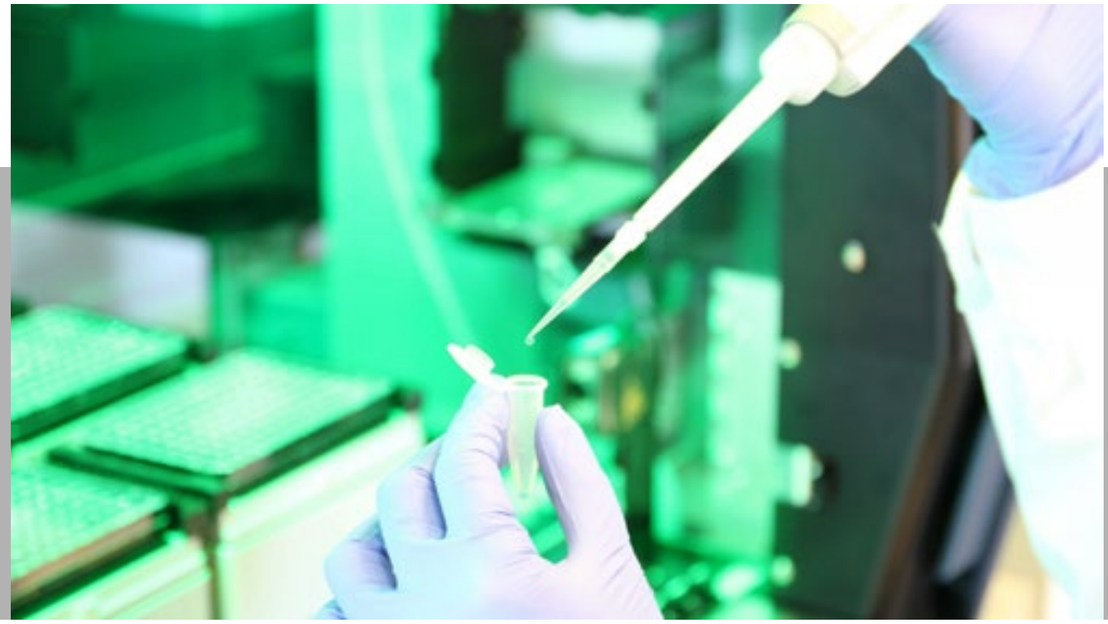
Living bacteria, quantum dots, and chemical compounds: These are supposed to be the future storage media? Absolutely! Admittedly, they will not replace the USB stick but will create long-term archiving opportunities. Moreover: In the future, you will not need to set up a laboratory in the basement to store vacation memories. In the **LOEWE research cluster MOSLA**, researchers from various disciplines, including computer science, biology, chemistry, and physics, work together in a broad and holistic approach to make just that possible.

LOEWE-MOSLA creates molecular memories for long-term archiving, associated methods, and software tools. Long-term storage of data is still a fundamental problem of our time. Even DNA alone is not yet the optimal solution to this problem, as chemically synthesized memories have been the primary means of storage. In the **LOEWE project MOSLA**, the scientists also use living bacterial cells because these bring essential additional capabilities: Bacterial cells can absorb DNA and thus store information. They have mechanisms for self-repair and self-replication. Especially as spores, they can survive for thousands of years under extreme conditions.

However, bacterial cells cannot be used as an information carrier in the blink of an eye. That is why **MOSLA** is also researching so-called cluster building blocks that can be printed. Quantum dots, whose physical and chemical properties allow for robust and easy-to-read data storage, can be printed using conventional equipment. "I will never forget the day we managed to print clusters on a substrate for the first time," said Prof. Stefanie Dehnen, "and in the most interdisciplinary research group I have ever been involved in – it was not only great fun but also very rewarding in many ways."

Both storage methods can hold a large amount of data. The **MOSLA DNA memory** can accommodate the current knowledge of humankind in one liter, and with encoded quantum dots, just under 4MB can fit on a Din A4 page of paper. In order to exploit these possibilities as far as possible, the scientists in the **LOEWE research cluster** area are also working, for example, on better algorithms for encoding and retrieving the stored data.

THE RESULT REPORT OF THE 2021 HIGHTECH FORUM, STORED ON SYNTHETIC DNA. Photo: Boris Trenkel



DNA MEMORIES CAN BE MADE IN THE LAB AND EASILY RETRIEVED VIA SEQUENCING. Photo: Andreas Kautz

Since the launch of **LOEWE-MOSLA**, there have been several other highlights that underscore the importance of the project for science and society: In 2021, the **LOEWE project** was asked by the High-Tech Forum to produce their final report in DNA. The request was successfully implemented, and the report was handed over to the former Minister of Science (Anja Karliczek) in April 2021. A citizen science project complemented this in cooperation with the Hightech Forum, where tubes with DNA storage were distributed to citizens. The associated task is to store the DNA under different conditions for five years and then send it back to the **MOSLA** consortium for decoding. Since the summer of 2021, **MOSLA** has also been a member of the global DNA Data Storage Alliance, which aims to create and promote an interoperable storage ecosystem based on DNA as a data storage medium. Members come from both industry and academic organizations. This is an excellent opportunity for **MOSLA**'s researchers to contribute their knowledge to a large international network and, at the same time, benefit from the exchange beyond Hesse and Germany.

A significant milestone in the **LOEWE funding of MOSLA** so far was also the, after long planning, in March 2022, held its first conference in collaboration with the Center for Interdisciplinary Research (Bielefeld): DSMM, the first „International Conference on Data Storage in Molecular Media".

A TEAM FROM THE MARBURG PHARMACY DEPARTMENT PLAYED A LEADING ROLE IN THE SEARCH FOR NEW TARGETS FOR DRUGS (FROM LEFT): JANIK BJÖRN HEDDERICH, MARGHERITA PERSECHINO, PETER KOLB AND MORITZ BÜNEMANN. Photo: Regina Gerlach-Riehl

LOEWE-GLUE DISCOVERS NEW BINDING SITES FOR DRUGS IN A COMPUTER-ASSISTED WAY, A MILESTONE IN THE FIGHT AGAINST SIDE EFFECTS

An international research team including scientists from the **LOEWE research cluster GLUE** has succeeded in finding new target sites for future drugs with the help of several softwares. The research team reported the results of the study, which is currently the most comprehensive analysis of GPCR binding pockets, in the scientific journal "Nature Communications" in May of this year.

G protein-coupled receptors, or GPCRs, form one of the largest families of proteins and are involved in numerous processes of life, such as inflammation, sensory processing and the action of hormones. This is reflected in the importance of these proteins for medicine: almost one-third of prescription drugs target a GPCR. "To block or stimulate these proteins, you need ligands that fit precisely into one of the proteins' numerous binding pockets," explains Professor Dr. Peter Kolb of Philipps University Marburg, one of the lead authors of the paper.

GPCR proteins serve to transmit signals from the outside of a cell to its interior, enabling the cell to respond to changes in its environment. To exert their effect, hormones and other endogenous messengers couple to the binding pockets of the GPCR proteins. If the binding pockets are specifically occupied with other agents, the effect of these messengers can be suppressed.

"However, the coupling sites that have been used so far are often very similar to each other," Kolb explains; "that's why drugs often show too little selectivity." This increases the risk of side effects. For example, beta blockers are used to block a GPCR protein in the heart, but if a similar target is switched off in lung tissue, this can trigger asthma attacks.

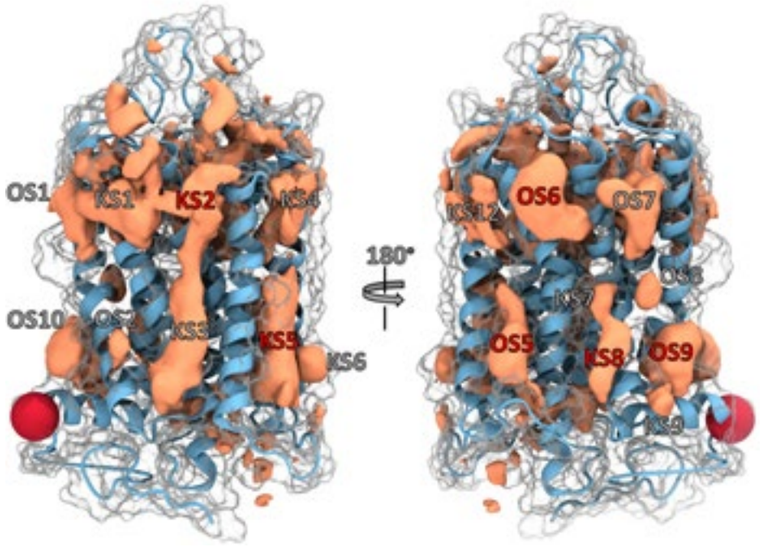
Scientists in the **LOEWE research cluster GLUE (GPCR Ligands for Underexplored Epitopes)**, which emerged from the research groups of Kolb and his Marburg colleague Professor Dr. Moritz Bünemann, are investigating how drugs can be tailored to precisely match their targets and thus trigger unintended side effects less frequently.

"We did a computer-based search for alternative binding sites on 113 different GPCR proteins," reports Kolb's collaborator and co-author Janik B. Hedderich. In the process, the algorithm simulated and analyzed what happens when small molecules couple to different sites on the proteins. The study covered the entire ensemble of all discernable pockets. "In this way, we actually found several binding pockets that have not been target areas before," Hedderich adds. Experimental studies on two of the binding pockets identified complement the calculations. "We inserted mutations into these two pockets," explains co-author Moritz Bünemann. "The results confirm that these protein segments have a crucial function for the activity of the GPCR proteins."

Professor Dr. Peter Kolb is professor of pharmaceutical chemistry at Philipps University. Janik Hedderich is completing his doctoral thesis in Kolb's research group. Professor Dr. Moritz Bünemann teaches pharmacology and toxicology in Marburg. He heads the Institute of Pharmacology and Clinical Pharmacy at Philipps University and is spokesperson for the **LOEWE research cluster GLUE**. **GLUE** is supported from 2020 to 2023 with a total of 4.6 million euros by the **research funding program "LOEWE" of the state of Hesse.**

In addition to the Marburg team, a Canadian research group participated in the research work.

Original publication: Janik B. Hedderich & al.: The pocketome of G protein-coupled receptors reveals previously untargeted allosteric sites, Nature Communication 2022, DOI: 10.1038/s41467-022-29609-6



THE EXEMPLARY REPRESENTATION OF A GPCR PROTEIN SHOWS ALREADY KNOWN (KS) AS WELL AS NEWLY IDENTIFIED BINDING POCKETS (OS) FOR WHICH COUPLING PARTNERS HAVE YET TO BE FOUND. Graphic: Janik Hedderich

INNOVATIVE PATHWAYS TO NEW DRUG-BASED THERAPIES: THE STRUCTURAL GENOMICS CONSORTIUM AT THE **LOEWE RESEARCH CENTRE FCI**

NOVEL COMPOUNDS, PRE-SELECTED IN HIGH-THROUGHPUT SCREENS AT THE FCI DRUG DEVELOPMENT PLATFORM IN COLLABORATION WITH THE SGC, ARE BEING TESTED IN PRECLINICAL MODELS. Photo: Andreas Reeg

The goal of the **LOEWE research centre Frankfurt Cancer Institute (FCI)** is to develop new, more effective therapeutic concepts for cancer patients. One way to achieve this is through new active substances that inhibit cancer cells in a targeted manner. Stefan Knapp (Head of the *Drug development* Platform at **FCI**) and Susanne Müller-Knapp (Chief Operating Officer, *Structural Genomics Consortium*) are pursuing innovative ways to do this with one of the most successful public-private partnerships, the *Structural Genomics Consortium (SGC)* (www.thesgc.org). The SGC follows a progressive open access model that is outstanding in the medical field, including not only the unrestricted exchange of information, but also the informal and rapid exchange of reagents and subject-specific knowledge. The partnership currently includes nine leading pharmaceutical companies and numerous academic research institutes. Despite the contrasting approach, „open science" vs. intellectual property, the companies are very interested in the collaboration, which via the open SGC model, enables rapid validation of targets in diverse diseases. The Open Science model is particularly valuable for rare diseases or diseases that primarily affect people for whose medical care few resources are available and which are therefore often not profitable in the usual business model of pharmaceutical drug development. For the further clinical development of new therapeutic concepts, the SGC has founded the charity „medicines for kids" (M4K-Pharma, https://m4kpharma.com/about/#agora-open-science-trust).

The SGC Frankfurt works closely with various research teams of the **FCI**. Both sides benefit from this partnership: While the SGC contributes its expertise in drug discovery by providing various screening libraries, in vitro assays and structure-based drug design, the molecules pre-selected in this way are evaluated by the **FCI** on various disease-relevant cancer models. This may lead to new applications as well as therapeutic approaches.

For example, the SGC has a large collection of donated chemical probes, biologically active small molecules that alter the properties of their target proteins. They have been donated to the SGC by companies in the SGC pharmaceutical network, but also by academic groups. The SGC validates the activity of these small molecules in standardized assays. In collaboration with Florian Greten's group, a donated chemical probes drug screen has identified a receptor as a target for the development of combination therapies with an approved cytostatic drug (toxic chemical substance used as a drug – mainly in chemotherapy of cancer). This highly selective receptor inhibitor, which has already been clinically tested in other diseases, showed a particularly strong synergistic efficiency in colorectal cancer organoid models in combination with the cytostatic drug; i.e. the growth of colorectal cancer cells in the organoids is not only inhibited with the combination, but the cancer cells die to a large extent. After further validation in preclinical models, it is planned to test the newly discovered drug combination in a clinical trial for its effect in colorectal cancer patients.

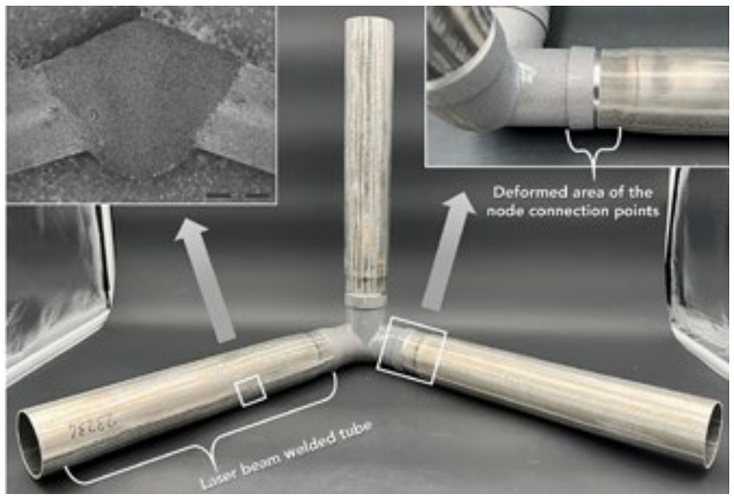
LOEWE'S ALLEGRO RESEARCH CLUSTER USES A DEMONSTRATOR TO SHOW HOW THE RESULTS OF EXCELLENT BASIC RESEARCH CAN BE USED IN EVERYDAY LIFE

The **LOEWE research cluster ALLEGRO** aims to make the mobility of today and tomorrow safer and more resource-efficient through innovative lightweight construction concepts based on sustainable high-performance materials.

High-strength lightweight metals such as the aluminum alloys in focus in **ALLEGRO** are used to produce lighter and stronger structures in a single process step, virtually in one go. Previously, these had to be treated subsequently, which was time-consuming and costly. In **ALLEGRO**, it has even been possible to control processes in such a way that the properties of a component can be adjusted point by point, so that the component behaves as it should at every point in the application; it is virtually programmed for reliable task fulfillment.

However, for the creation of complex systems, i.e. virtually all larger things and objects in our everyday lives, these components still have to be joined to form an overall structure. However, the properties that have been specifically adjusted beforehand are usually lost in conventional welding, and the high energy input in the so-called joining zone is the central problem here. A central challenge in **ALLEGRIO** is to join individual components together in such a way that they retain their target properties.

For this reason, two welding processes are used in **ALLEGRO** that are suitable for solving this task. One of these is laser beam welding. Due to the high welding speeds and the high energy density of the laser beam that can be achieved with this method, the joining zones are melted, but the heat introduced into the component is low. As a result, the properties in the joining areas change only slightly or not at all, and component distortion, which occurs with other welding processes, is also avoided.



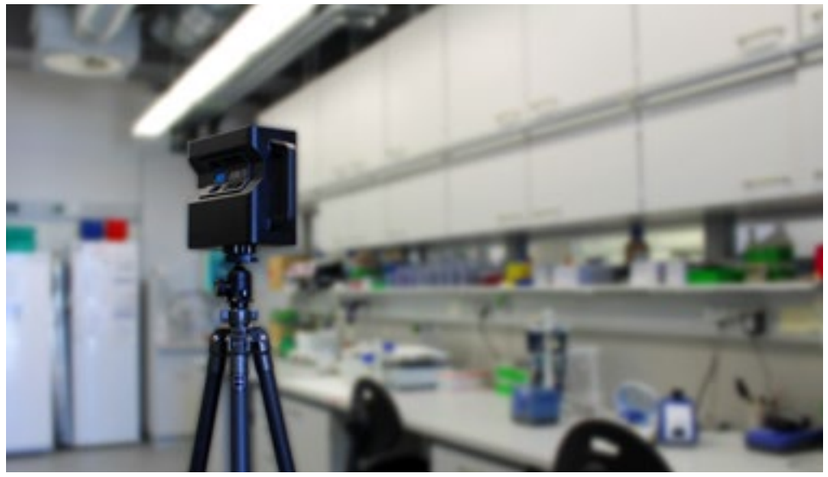
LOEWE'S ALLEGRO RESEARCH CLUSTER USES A DEMONSTRATOR TO SHOW HOW THE RESULTS OF EXCELLENT BASIC RESEARCH CAN BE USED IN EVERYDAY LIFE. Photo: ALLEGRO

In addition to laser beam welding, **ALLEGRO** also uses magnetic pulse welding. This process does not join components by melting the joint zone together, but rather – similar to explosion welding – two components are pressed together at high speed. Unlike explosion welding, however, no pressure wave is used to accelerate the components; instead, strong magnetic fields are used.

The demonstrator, an electric bicycle in the form of a cargo bike, figure 1, combines all the central scientific knowledge of the **ALLEGRO** project in a complex product, figure 2. The properties programmed locally in the manufacturing process and their preservation after application of the highly developed joining processes result in a complex object suitable for everyday use which is not only lightweight, sustainable and resource-efficient, but also exceptionally safe.

THE DEMONSTRATOR, AN INTEGRABLE BASKET FOR AN ELECTRIC CARGO BIKE, COMBINES ALL THE CENTRAL SCIENTIFIC KNOWLEDGE OF THE ALLEGRO PROJECT IN A COMPLEX PRODUCT (FIGURE1). Photo: ALLEGRO/CargoFactory

LOEWE-iCANx RESEARCH CAN ALSO BE EXPERIENCED AS A VIRTUAL TOUR FROM FALL 2022



USING THIS 3D CAMERA, STEFFEN BÖTTCHER AND HIS TEAM SCANS EVERY CORNER OF THE LAB AS PART OF THE "HESSEN SCHAFFT WISSEN" CAMPAIGN IN THE "SCIENCE SPACES" SERIES. Photo: Nadja Ritschel, iCANx

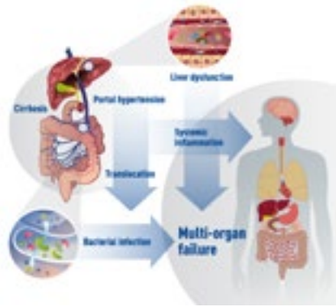
In the **LOEWE research cluster iCANx**, nearly 30 scientists – from medical doctoral students to professors - investigate how lung tumors and their environment influence each other. Furthermore, the role of other lung diseases, such as chronic obstructive pulmonary disease (COPD) or pulmonary hypertension, in cancerous processes are analyzed. With the aim to better understand these interactions and to develop therapy options from this knowledge, scientists from basic and clinical research at the three partner sites Giessen (Justus Liebig University), Marburg (Philipps University) and Bad Nauheim (Max Planck Institute for Heart and Lung Research) are working together across institutes and disciplines.

Already at the first virtual meeting of **iCANx** in November 2021, it became obvious that the interdisciplinary collaborations work well. Not only were many new research results presented and discussed, but also results of some projects have already been published, for example the study *Notch-dependent and -independent functions of transcription factor RBPJ* by the two **iCANx** researchers Tilman Borggrefe and Thorsten Stiewe, published in the journal *Nucleic Acids Research*. Accordingly, expectations and anticipation are high for the second **iCANx** *Retreat* in October 2022 at Schloss Rauischholzhausen. Another opportunity for lively exchange and new perspectives is offered by the **iCANx Minisymposia**, which take place twice a year and to which renowned international researchers are invited to present their current work.

The scientists at **iCANx** are particularly looking forward to make their work accessible to the public soon: As part of the "Hessen schafft Wissen" campaign, an **iCANx** laboratory has been 3D scanned as part of the "Science Spaces" series, making a virtual tour of the research laboratories possible. In this way, anyone interested in (basic) research can get an impression of the work in a molecular biology laboratory. The link to the tour will be available at www.uni-giessen.de/icanx soon.

THE **LOEWE RESEARCH CENTRES AND -CLUSTERS** SINCE THE START OF FUNDING IN 2008 AT A GLANCE

The following overview of all LOEWE research centres and -clusters contains texts that were created during the current phase of funding and are therefore still formulated in presence. For further development / status, please refer to the data listed below.



© ACLF-I

ACLF-I

Pathogenetic mechanisms of acute-on-chronic liver failure and therapeutic approaches: the aclf-initiative

Liver cirrhosis is the end stage of chronic liver disease and contributes significantly to all-cause mortality at 2% globally. The age-standardized mortality of liver cirrhosis in Europe is between 10% and 20%. Complications of cirrhosis often lead to acute-on-chronic liver failure (ACLF), characterized by additional organ failure of e.g. kidney and brain. ACLF is a highly dynamic disease process with high mortality (approximately 40% in 28 days). Due to its complexity and organ-spanning nature, ACLF is poorly understood and no specific therapeutic options exist. Liver transplantation is often not possible due to contraindications and lack of prioritization of affected patients. In the LOEWE research cluster „The ACLF-Initiative – Pathogenetic mechanisms of acute-on-chronic liver failure and therapeutic approaches" organ-specific and systemic mechanisms of organ failure and their influence on disease dynamics are investigated. Findings on immune modulation and inflammation resolution, among others, will contribute to the development of new therapeutic approaches in ACLF.

LOEWE RESEARCH CLUSTER

COORDINATOR . PD Dr. Christoph Welsch

PARTNERS . Goethe University Frankfurt, University Hospital Frankfurt am Main; Fraunhofer IME; Institute for Tumor Biology and Experimental Therapy, Georg-Speyer-Haus; Paul Ehrlich Institute
ASSOCIATED PARTNERS . Berlin Institute of Health, Charité Berlin; Max Delbrück Center for Molecular Medicine; Buchmann Institute for Molecular Life Sciences; Max Planck Institute for Biophysics

LOCATIONS . Frankfurt am Main

SUBJECT AREAS . Hepatology, Nephrology, Pneumology, Virology, Gastroenterology, Pathology, Oncology

FUNDING PERIOD . since 2022

COORDINATION OFFICE
Jennifer Biondo
Tel. +49 (0) 69 6301 80789
Jennifer.Biondo@kgu.de

INTERNET
www.loewe-aclf.com

© Thomas Ernsting

AdRIA

Adaptronics – Research. Innovation. Application.

Adaptronics – the term refers to intelligent systems that automatically adapt to changing operational conditions. Using as little energy and as few materials as possible, electronically controlled sensors and actuators monitor structures and, among other things, ensure lower levels of vibration, less noise and dimensional stability. As such, adaptronics offers multidisciplinary technology with an extraordinarily strong potential for innovation in the development of sustainable products. Possible applications range from mechanical and plant engineering, automotive engineering and structural and domestic engineering to medical engineering, security technology and energy technology. The LOEWE centre AdRIA conducts research across the entire development chain for adaptronic systems, from materials development, system integration and manufacturing through to application.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr.-Ing. Tobias Melz, Fraunhofer LBF

PARTNERS . Fraunhofer Institute for Structural Durability and System Reliability (LBF), Darmstadt
Technical University Darmstadt (until 2014)
Darmstadt University of Applied Sciences (until 2014)

LOCATION . Darmstadt

SUBJECT AREAS . Mechanical engineering, Electrical engineering, Information technology, Mathematics, Materials science, Chemistry

FUNDING PERIOD . 2008 to 2016

COORDINATION OFFICE
Prof. Dr.-Ing. Thilo Bein
Tel. +49 6151 705-463
Thilo.bein@lbf.fraunhofer.de

© Holger Jenss / Nicolas Wefers

ALLEGRO

High-performance aluminium alloy components

Aluminium and aluminium alloys have been important construction materials for decades and are indispensable, for example, in the field of aircraft construction. The key to exploiting the full potential of lightweight aluminium is to increase the geometric and microstructural complexity of products. To date, however, this has not been technologically possible.

The aim of the LOEWE research project ALLEGRO is to develop efficient new processes of integrated forming and heat treatment of aluminium wrought alloys based on transferable quantitative descriptions of the relevant interactions.

The most significant challenge for the scientists in this endeavour is the investigation of the mechanisms that determine the properties of the aluminium alloys. This is the key to producing components that meet particular requirements with a higher local resolution, ultimately making it possible to produce lighter components with enhanced characteristics.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr.-Ing. Prof. h.c. Stefan Böhm, University of Kassel

PARTNERS . University of Kassel, Institute for Production Engineering and Forming Machines (lead management)
Technical University Darmstadt, Fraunhofer Institute for Structural Durability and System Reliability LBF Darmstadt
Institute for Materials Science Technical University Darmstadt

LOCATIONS . Kassel, Darmstadt

SUBJECT AREAS . Mechanical and production engineering
Materials science and materials engineering

FUNDING PERIOD . 2018 to 2022

COORDINATION OFFICE
Dr. Seyedvahid Sajjadifar
Tel. +49 561 804-2949
sajjadifar@uni-kassel.de

INTERNET
https://www.uni-kassel.de/projekte/allegro

© Christian Lotze

AmbiProbe

Mass Spectrometry for in situ Analyses for the Health Care, Environment, Climate and Security Sectors

Mass spectrometry is a method used to analyse various substances. However, the devices used for this purpose are rather large and cumbersome. AmbiProbe is developing mass spectrometers with the aim to make the technology more mobile. In the future they could be used e.g. at airports to detect harmful substances, in the agricultural sector to spot fungal infections in individual grains and in operating theatres to identify tumors, even while an operation is in progress. For this task robust systems are needed. They must be able to analyse untreated samples that have not been prepared specifically for laboratory investigations. New strategies in chemical analysis methods and previously unexplored technological concepts will bring an unprecedented degree of mobility and immediacy, and will deliver outstanding levels of analytical significance and universality. The results achieved in the LOEWE research cluster are being worked on further in various follow-up projects.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Bernhard Spengler, Justus Liebig University Giessen

PARTNERS . Justus Liebig University Giessen
Goethe University, Frankfurt am Main
ASSOCIATED PARTNERS
German Cancer Research Center (DKFZ) Heidelberg
GSI Helmholtz Centre for Heavy Ion Research, Darmstadt

LOCATIONS . Gießen, Frankfurt am Main

SUBJECT AREAS . Chemistry, Physics, Engineering, Biology

FUNDING PERIOD . 2010 to 2013

COORDINATION OFFICE
Dr. Bernd Commerscheidt
Tel. +49 641 99-34162
bernd.commerscheidt@anorg.
chemie.uni-giessen.de

CULTURE AND SOCIETY . **UNTIL 2017**

© Asja Ebinghaus

Animals – Humans – Society

Animals – Humans – Society: Interdisciplinary Animal Studies
Under the central concept of "relationality", the research cluster conducts research into relations between human beings and animals in society. In considering the various relational levels, forms of "creating" animals – and hence the identification of human beings – in the fields of animal research, animal breeding, animal husbandry, animal presentation and animal representation are also investigated. Various protagonists are involved – human beings (breeders, farmers, animal keepers, artists, researchers) and animals (livestock, pets, laboratory animals, wild animals). In a dialogue between natural and cultural sciences, the projects investigate the origins, conditions and changes in relationships between human beings and animals. They therefore take historical, ethical and methodological matters into account. The aim is to advance current debates on the treatment of animals by systematically considering basic principles.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Mieke Roscher, University of Kassel

PARTNER . University of Kassel

LOCATION . Kassel

SUBJECT AREAS . Agricultural science (livestock ethology and animal husbandry, animal breeding), German studies (German mediaeval studies), History (modern and recent history, history of the early modern period, agricultural history), Art (general art history, modern art history), Philosophy (theoretical philosophy), Theology (Catholic theology/Biblical theology)

FUNDING PERIOD . 2014 to 2017

COORDINATION OFFICE
Susanne V. Weber
Tel. +49 561 804-7986
tier-mensch-gesellschaft@uni-kassel.de

CULTURE AND SOCIETY

© Takato Marui

Architectures of Order

Practices and Discourses between Design and Knowledge
Architectures of Order refers to the importance of order techniques in architectural practices and focuses on the relevance of architectural thought in social discourses. The project takes this context into account by understanding architecture as a cultural ordering practice that operates at the interfaces of control, knowledge, design and subjectivation. It asks, first, about the creation of order through architecture, second, about the significance of architecture for nonarchitectural order narratives, and third, about the interaction of both spheres. The project bundles competences in architectural history, history, cultural and media studies, sociology and design theory and integrates architectural design and media practice.

LOEWE RESEARCH CLUSTER

COORDINATORS
Prof. Dr. Carsten Ruhl, Goethe-Universität Frankfurt am Main
Prof. Dr. Christiane Salge, Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Goethe University, Frankfurt am Main
Technical University of Darmstadt
Max Planck Institute for European Legal History and Legal Theory

LOCATION . Frankfurt am Main

SUBJECT AREAS . Digital Design, Design and Urban Planning, Early Modern History, History and Theory of Architecture, Sociology of Culture and Knowledge, Art History, Media Studies, Legal History

FUNDING PERIOD . since 2020

COORDINATION OFFICE
Dr. Lena Holbein
holbein@kunst.uni-frankfurt.de

INTERNET
https://architecturesoforder.org/en/

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2022**

© M. Schuppich / adobe stock

AROMA*plus*

From plant-based raw materials to microbiological production – Aroma and functional compounds from vines and fruit
The use of flavors and functional compounds such as fragrances and vitamins is constantly increasing, not only in the food industry. The raw materials are usually of plant origin. Biotechnological methods with enzymes and microorganisms are becoming increasingly important for the creation of future, sustainable production methods. Possibilities here are on the one hand adapting preliminary stages, often from the metabolism of plants, and on the other hand de novo synthesis by microorganisms, such as yeasts, fungi and bacteria. However, little is known about the regulation and influence of these biosynthetic pathways in the context of production using these microorganisms. One of the goals of the LOEWE research project AROMAplus is to gain knowledge about the control of these pathways of microorganisms. Furthermore, the processing of grapevines and black currants and their by-products are the central biological basis for the generation of new value-added possibilities.

LOEWE RESEARCH CLUSTER

COORDINATOR
Dr. Christian von Wallbrunn, University of Geisenheim

PARTNERS . University of Geisenheim (lead management)
Justus Liebig University Gießen
DECHEMA Research Institute, Frankfurt am Main

LOCATIONS . Geisenheim, Gießen, Frankfurt am Main

SUBJECT AREAS . Microbiology, Biotechnology, Food chemistry, Viticulture and oenology, Horticulture

FUNDING PERIOD . 2018 to 2022

COORDINATION OFFICE
Lisa Zimmermann, B.Sc.
Hochschule Geisenheim University
Tel. +49 6722 502 -347
Lisa.Zimmermann@hs-gm.de

INTERNET
https://www.hs-geisenheim.de/aromaplus

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2021**

© FGPG / Gerspach

BAMP!

Building with paper – A renewable construction material
Wood is a renewable building material that has been both studied and put to practical use for thousands of years. Currently the first high-rise buildings are being constructed with wood – a use of the material that due to fire safety requirements and structural considerations long seemed inconceivable. This is where the LOEWE research cluster BAMP! directs its focus – on the research of the fundamentals of building with the material paper. While its use today is limited to applications such as gypsum plasterboard or cellulose insulation, this could develop into a far more extensive paper-based construction technology in some years – in which the ecological and economic aspects will be just as important as the design potential of the material. Paper is also interesting due to one critical advantage it has in comparison to wood: In the production of different types of paper it is possible to determine the structure of the material itself and thus to reinforce the desired characteristics. Wood by contrast has a structure that is predetermined by nature. For BAMP!, in addition to investigating scientific fundamentals, the focus will be on the development of temporary-use structures such as micro homes or emergency shelters. Technologies and systems for this type of production have not been extensively developed in Germany until now.

LOEWE RESEARCH CLUSTER

COORDINATORS . Coordinator: Prof. Dr. Samuel Schabel,
Representative: Prof. Dr. Ulrich Knaack,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt)
h_da – University of Applied Sciences
Technical University of Central Hesse (THM)

LOCATIONS . Darmstadt, Gießen

SUBJECT AREAS . Mechanical Engineering, Architecture, Chemistry, Building and Environmental Sciences

FUNDING PERIOD . 2017 to 2021

COORDINATION OFFICE
Dr.-Ing. Heinz-Joachim Schaffrath
Tel. +49 6151 16-22 5 88
schaffrath@papier.tu-darmstadt.de

INTERNET
https://www.tu-darmstadt.de/bauenmitpapier/

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2014**

© Jan Michael Hosan / Hessen schafft Wissen

BiK-F

Biodiversity and Climate Research Centre

Climate change is strongly influencing the biodiversity on earth. Which impact does global warming have on individual organisms, entire ecosystems and ecosystem functions, and what does that mean for us? To find answers to those questions, researchers are analysing the long-term, medium-term and short-term interactions between the climate and biodiversity. From the results and the models generated, they develop future projections and decision-making bases – not only for the UN Convention on Biodiversity, for example, but also specifically for individual actors in the health sector, who would like to know, among other things, how climate change is affecting the spread of disease-bearing insects. In 2015 BiK-F was given permanent status as a Leibniz Institute and is continuing its research as part of the Senckenberg Nature Research Society.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr. Dr. h. c. Volker Mosbrugger
Senckenberg Nature Research Society

PARTNERS . Senckenberg Nature Research Society, Frankfurt am Main, Goethe University, Frankfurt am Main, Institute for Social-Ecological Research, Frankfurt am Main, Deutscher Wetterdienst, Offenbach, EUMETSAT, Darmstadt

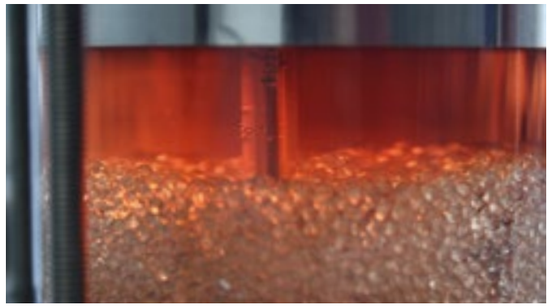
LOCATION . Frankfurt am Main

SUBJECT AREAS . Biology, Biochemistry, Climate research, Genetics, Geology, Medicine, Meteorology, Paleontology, Social ecology, Geography

FUNDING PERIOD . LOEWE Research Centre: 2008 to 2014
Established in the Leibniz Association since 2015

COORDINATION OFFICE
Dr. Kerstin Höntsch
Tel. +49 69 7542-1820
Kerstin.Hoentsch@senckenberg.de

BUSINESS AND TECHNOLOGY . **UNTIL 2013**



© Ibpt

BioIM

Biomedical Technology – Bioengineering and Imaging

Researchers observe mass transport in bioprocesses and tissues from an engineering perspective. The aim is to improve the production of innovative pharmaceuticals – e. g. on the basis of stem cells or viruses. To this end, the LOEWE research cluster BioIM makes use of innovative imaging procedures which provide insight into the production process. These methods should lead to automatic, reproducible procedures that guarantee highly purified and extensive production of medicinal products. Since 2014, BioIM's researchers have continued their work as partners of the LOEWE research centre for Insect Biotechnology and Bioresources.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr.-Ing. Peter Czermak,
Technische Hochschule Mittelhessen

PARTNERS . Technical University of Central Hesse (THM), Gießen (until 2013), Philipps University of Marburg (until 2011)

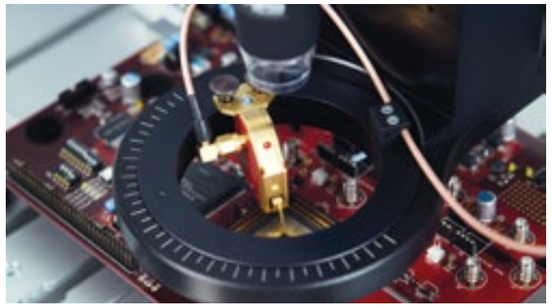
LOCATION . Gießen

SUBJECT AREAS . Bioengineering, Biotechnology, Pharmaceutics, Medical engineering, Optical technology

FUNDING PERIOD . 2008 to 2013

COORDINATION OFFICE
Dr. Christina Zinecker
Tel. +49 641 309-2635
christina.zinecker@kmub.thm.de

BUSINESS AND TECHNOLOGY . **UNTIL 2016**



© Katrin Binner / Fraunhofer SIT

CASED

Center for Advanced Security Research Darmstadt

How can current and future IT systems be sustainably secured? How does IT security enable innovation? CASED researches and develops practicable solutions for cyber security and the protection of privacy. Thanks to CASED, the attractiveness of the Darmstadt location as a place for cutting-edge research on IT security increased vastly. The German Federal Ministry of Education and Research (BMBF) therefore established the European Center for Security and Privacy by Design, the largest of the three government-funded cyber security competence centres, in Darmstadt. The US enterprise Intel operates its only research laboratory in Europe at CASED. Owing to the presence of CASED, a large number of other industries have been established at the same location. In addition, the German Research Foundation (DFG) authorised the Technische Universität Darmstadt to establish the first, and to date the only, German Collaborative Research Centre for fundamental cyber security research. This again highlights the excellence of the research location. At the end of a highly competitive process, the Technische Universität Darmstadt was also awarded additional funding by the German Council of Science and Humanities for a new cyber security research building, the aim being to further strengthen the position of the Technische Universität Darmstadt.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr. Michael Waidner,
Fraunhofer SIT and Technical University of Darmstadt

PARTNERS . Technical University of Darmstadt, Fraunhofer Institute for Secure Information Technology (SIT), Darmstadt Hochschule Darmstadt University of Applied Sciences

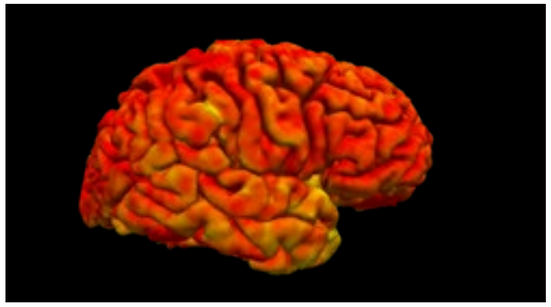
LOCATION . Darmstadt

SUBJECT AREAS . Informatics, Electrical engineering, Philosophy, Psychology, Law, Economics, Mechanical engineering, Physics, Biology, Mathematics

FUNDING PERIOD . 2008 to 2016

COORDINATION OFFICE
Dr.-Ing. Michael Kreutzer
Tel. +49 6151 16-6165
michael.kreutzer@cased.de

HEALTH . **UNTIL 2022**



© Prof. Dr. Susanne Knake / Philipps-Universität Marburg

CePTER

Center for Personalized Translational Epilepsy Research

Epilepsies represent a pathogenetically and clinically heterogeneous group of diseases for which only relatively unspecific and symptomatically effective therapies are available. In Germany, more than 600,000 persons suffer from epilepsy. Often patients receive a correct diagnosis of their condition only after years have passed, resulting initially in incorrect treatment. And many patients do not become seizure-free or suffer from treatment-related side effects. To improve the success of epilepsy therapy, personalised and, if possible, disease-modifying treatment (instead of merely symptomatic treatment) is required. The aim of the LOEWE research cluster CePTER is therefore the identification and validation of epilepsy-relevant disease factors, their therapeutic modification as well as the identification and validation of biomarkers of epilepsy and epileptogenesis. These goals are to be achieved with state-of-the-art molecular biological, clinical and experimental neuroscientific methods that are available to the LOEWE research network CePTER.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Felix Rosenow, MHBA,
Goethe University, Frankfurt am Main

PARTNERS . Goethe University Frankfurt am Main (lead management), Fraunhofer Institute for Molecular Biology and Applied Ecology (IME)/Project Group Translational Medicine and Pharmacology (IME-TMP), Ernst Strüngmann Institute, Max Planck Institute for Empirical Aesthetics, Frankfurt Institute for Advanced Studies, Philipps University of Marburg

LOCATIONS . Frankfurt am Main, Marburg

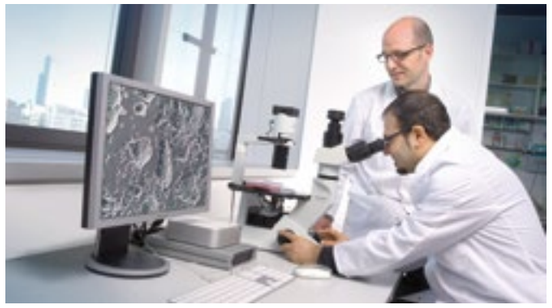
SUBJECT AREAS . Medicine, Neurosciences, Computer Science, Life Sciences

FUNDING PERIOD . 2018 to 2022

COORDINATION OFFICE
Natascha van Alphen
Tel. +49 69 6301 7083
Natascha.vanAlphen@kgu.de

INTERNET
www.uni-frankfurt.de/67689811

HEALTH . **UNTIL 2018**



© Jan Michael Hosan / Hessen schafft Wissen

CGT

Center for Cell and Gene Therapy Frankfurt

The LOEWE Centre for Cell and Gene Therapy aims to develop innovative cell and gene therapy procedures for more effective and safer clinical application. Scientists at the centre work on deciphering molecular mechanisms underlying regenerative processes mediated by stem cells and genetic reprogramming, on elucidating the potential use of immunocompetent cells for treatment of malignant diseases, and on delineating the genetic basis for leukemias and immune deficiencies. Clinical applications range from cell-based regenerative therapies of cardiovascular diseases to gene therapy for selected immunodeficiencies and to immune cell-stimulated treatment of cancer.

LOEWE RESEARCH CENTRE

COORDINATORS . Prof. Dr. Andreas Zeiher,
Prof. Dr. Stefanie Dimmeler, Prof. Dr. Hubert Serve,
Goethe University, Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main
Georg-Speyer-Haus, Frankfurt am Main
Max Planck Institute for Heart and Lung Research, Bad Nauheim
Paul-Ehrlich-Institut, Langen

LOCATIONS . Frankfurt am Main, Bad Nauheim, Langen

SUBJECT AREAS . Medicine, Biology, Chemistry, Biochemistry

FUNDING PERIOD . 2011 to 2018

COORDINATION OFFICE
Susanne Aulbach-Staab
Tel. +49 69 6301-80051
Susanne.Aulbach-Staab@kgu.de

HEALTH

© weerapatkiatdumrong / istockphoto

CMMS

Center for Multiscale Modelling in Life Sciences

CMMS is the Frankfurt centre for multi-scale modelling, analysis and simulation of biological processes located at FIAS (Frankfurt Institute for Advanced Studies). The long-term goal of CMMS is a comprehensive understanding of both simple molecular biological processes, such as the mode of action of an enzyme, as well as the complex behaviour of organisms.

Such an understanding is the basis for the adaptation of cell functions for biotechnological use as well as for the development of biomedical, pharmacological and agricultural applications. Advances in the development of high-resolution methods for the atomistic description of molecules, cells and cell systems using cryo-EM and light microscopy provide insights into molecular mechanisms and processes. By integrating this information into models and simulations, basic mechanisms and causalities are identified. This requires new technical, algorithmic and informatic solutions to overcome the scale constraint and the prediction of missing information in experimental data sets. The merging of theoretical competences and their interlinking with data from diverse experiments carried out independently on several scales is essential in order to develop new concepts for describing biological systems and deciphering the causes of diseases.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Franziska Matthäus, FIAS
matthaeus@fias.uni-frankfurt.de

PARTNERS . Frankfurt Institute für Advanced Studies (lead management), Max Planck Institute for Biophysics, Max Planck Institute for Brain Research (both Frankfurt), Buchmann Institute for Molecular Life Sciences

LOCATION . Frankfurt am Main

SUBJECT AREAS . Life Sciences, Biophysics, Neurosciences, Computer Sciences, Physical Biology, Mathematical Sciences

FUNDING PERIOD . since 2020

COORDINATION OFFICE
FIAS – Frankfurt Institute for Advanced Studies
Doris Hardt
Tel. +49 69 798-47613
hardt@fias.uni-frankfurt.de

INTERNET
https://fias.institute/de/projekte/cmms/

BUSINESS AND TECHNOLOGY . **UNTIL 2014**

© Katrin Binner / TU Darmstadt

Cocoon

Cooperative Sensor Communication

Mobile telephones, navigation devices, car keys – today numerous pieces of equipment send and receive signals without using wires. Cooperative sensor communication has the potential to provide many other services – in environmental protection, in medical care, in logistics and electromobility and in the provision of personalised information, for instance. The LOEWE research cluster Cocoon carries out fundamental research in the field of basic technologies and new network architectures. For example, the interlinking of many different services to form a "smart city" calls for an intelligent network of users, computers and a wide range of different devices. As in the development of new applications, the key criterion here is unimpeded and secure communication between increasing numbers of sensors. Building on the foundations of Cocoon, countless new research questions have emerged, such as how information and communication technology can connect people in a crisis and help them to work together, which is the topic of the newly founded LOEWE research cluster NICER.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr.-Ing. Abdelhak Zoubir,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt) (lead management), University of Kassel

LOCATIONS . Darmstadt, Kassel

SUBJECT AREAS . Electrical engineering and information technology, Informatics, Mathematics

FUNDING PERIOD . 2011 to 2014

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2019**

© Katrin Binner / TU Darmstadt

CompuGene

Computer-assisted processes for generating complex genetic circuits

Synthetic biology endeavours to equip biological systems with novel characteristics which are not present in nature and then to put these new characteristics to use. In addition to the new scientific and economic possibilities that can result from this type of undertaking, there are many challenges associated with it. Until now, the required genetic circuits – a combination of genes and the accompanying regulatory units – could only be generated through laborious trial-and-error procedures. The LOEWE research cluster CompuGene aims to reduce the effort required for this step through a close linking of the engineering and the natural sciences. After collecting raw data on the functioning of the biological molecule, its regulators and their interactions, circuit models will be modelled and designed on the computer using engineering principles. Following this, they can then be examined and adjusted in the laboratory. The new functional units should find uses in medicine, biotechnology and biocomputing.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Beatrix Süß, Prof. Dr. Heinz Koeppl,
Technical University of Darmstadt (TU Darmstadt)

LOCATION . Darmstadt

SUBJECT AREAS . Biology, Electrical Engineering, Information Technology, Physics, Chemistry, Mechanical Engineering, Computer Science, Social Science

FUNDING PERIOD . 2016 to 2019

COORDINATION OFFICE
Dr. Brigitte Held
Tel. +49 6151 16-20357
held@bio.tu-darmstadt.de

© Michael Kleinespel

Conflict Resolution

Extrajudicial and Judicial Conflict Resolution

Which types of conflicts did earlier societies bring before a court? Which did they resolve elsewhere? How and why is this decision taken today? Europe, the United States, Latin America and Asia: the comparative basic research carried out in the LOEWE research cluster focuses on conflicts and how they have been regulated in different historical periods and in different cultures. From legal, historical and cultural perspectives, the researchers seek to identify forms and patterns of dealing with conflicts, pursuing to that end a diachronic, intercultural and interdisciplinary approach. Their aim is to lay the foundation for a sound theory of conflict resolution. In its first three years the project has successfully strengthened Frankfurt as a hub for research on dispute resolution. It has also contributed to the transfer of knowledge between scholarship, politics and society, not least through an expert council that comprises practitioners of judicial/extrajudicial conflict resolution. An ambitious guest researcher programme guarantees international visibility.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Moritz Bälz, LL.M.
Goethe University, Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main
Max Planck Institute for European Legal History,
Frankfurt am Main (until 2014)
Frankfurt University of Applied Sciences
ASSOCIATED PARTNERS
Gesellschaft für Reichskammergerichtsforschung e. V., Wetzlar

LOCATION . Frankfurt am Main

SUBJECT AREAS . Legal History, Legal Science,
Historical Science, Sinology

FUNDING PERIOD . 2012 to 2015

© MKarin Knibba / Tagging Cloud

Cultural Skills

Cultural Skills and their Medialisation

In the digital era fundamental "cultural skills" such as reading and writing as well as narrative forms (in old and new media) undergo a far-reaching transformation. The LOEWE research cluster Cultural Skills and their Medialisation studied this phenomenon from a cross-disciplinary perspective. The project looked at how narration is used in weblogs und social media platforms for the purpose of identity formation and self-portrayal and how the medium of television changes the presentation of history. A study has also been made of the impact of digital networking on English as the "lingua franca" of scholarly communication. A further question was how the digital space could be used in the acquisition of language skills. The digital learning environment SKOLA was developed as a programme that helps students to learn academic writing.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Henning Lobin,
Justus Liebig University Giessen

PARTNERS . Center for Media and Interactivity (ZMI),
Justus Liebig University Giessen, Herder Institute, Marburg
Technische Hochschule Mittelhessen (THM), Giessen
ASSOCIATED PARTNERS
Technische Hochschule Mittelhessen, Gießen

LOCATIONS . Gießen, Marburg

SUBJECT AREAS . Linguistics, Literary and cultural studies,
History, Didactics, Psychology

FUNDING PERIOD . 2008 to 2012

COORDINATION OFFICE
Sabine Heymann
Tel. +49 641 99-16350
sabine.heymann@zmi.uni-giessen.de

© Paavo Blåfield / Universität Kassel

Desirable Difficulties in Learning

Desirable Difficulties in Learning: Cognitive Mechanisms, Developmental Preconditions, and Effective Implementation in Class

Easily learned and quickly forgotten? Studies in cognitive psychology with adults have shown that newly acquired knowledge lasts longer and is more easily transferred to new contexts if learning processes are deliberately made more difficult. Does that apply to children, too? What cognitive mechanisms and developmental preconditions determine the effectiveness of such learning difficulties? Researchers from the fields of psychology and educational science are exploring those questions in the LOEWE research cluster Desirable Difficulties for learning in mathematics and natural sciences. They also wish to study the extent to which learning difficulties – such as the temporal distribution of practice or the alternation of various topics during learning – can be deliberately used in educational contexts to enhance retention of what is learnt.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Mirjam Ebersbach, University of Kassel

PARTNER . University of Kassel,
Julius-Maximilians-University Würzburg

LOCATION . Kassel

SUBJECT AREAS . General Psychology, Developmental Psychology, Psychological Diagnostics, Social Psychology, Educational Psychology, Didactics of Mathematics, Didactics of Biology, Empirical School and Teaching Research

FÖRDERZEITRAUM . 2015 to 2018

COORDINATION OFFICE
Dr. Maj-Britt Isberner
Tel. +49 561 804-1905
maj-britt.isberner@uni-kassel.de

© Christina Mühlenkamp / UMR

Diffusible Signals

Impact of diffusible signals at human cell-microbe interfaces

Bacterial infectious diseases are among the most frequent causes of death worldwide. For about 100 years, antibiotics have been available as extremely successful drugs to combat bacterial infections. Due to antibiotic resistance, the most important drugs against infectious diseases are becoming increasingly ineffective. Furthermore, it seems that the development and course of infectious diseases, but also the protection against them, are influenced much more than previously assumed by the interactions of bacteria with each other and with human cells. The goal is to decipher the diffusible signals at the interfaces of microbe-host interaction under physiological and pathological conditions and to derive medical benefits. For this purpose, multi-resistant Gram-negative pathogens were selected as one of the central medical challenges from the perspective of the World Health Organization (WHO), national health systems and industry. The initiative analyzes the diffusible signals in this clinically very important infection process in an integrative manner and with approaches from medicine, bacterial and host biology and with the use of bioinformatics and artificial intelligence.

LOEWE RESEARCH CLUSTER

COORDINATORS
Prof. Dr. Bernd Schmeck, Philipps University of Marburg
Prof. Dr. Lennart Randau, Philipps University of Marburg

PARTNERS . Philipps University of Marburg (lead management),
Justus Liebig University Giessen,
Max Planck Institute for Terrestrial Microbiology, Marburg

LOCATIONS . Gießen, Marburg

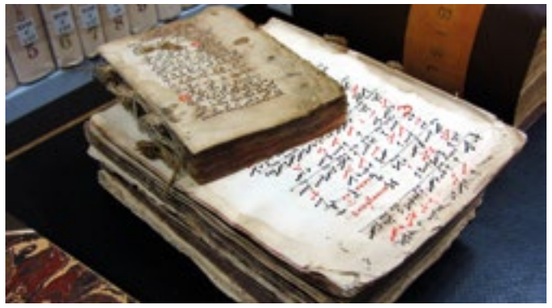
SUBJECT AREAS . Infectional Biology, Infectiology,
Computational Sciences, Microbiology, Biochemistry, Biophysics

FUNDING PERIOD . since 2021

COORDINATION OFFICE
Dr. Sabrina von Einem
Tel. +49 6421 28-65713
diffusible-signals@uni-marburg.de

INTERNET
https://www.uni-marburg.de/en/fb20/diffusible-signals

CULTURE AND SOCIETY . **UNTIL 2014**



© Thomas Jügel / Digital Humanities

Digital Humanities Hessen

Integrated Processing and Analysis of Text-based Corpora

How can information technology be used meaningfully and expediently for research in the humanities? In numerous sub-projects the researchers in the LOEWE research cluster Digital Humanities Hessen have explored the possibilities afforded by information technology and have further developed specific methodologies. For example, a special camera can detect hidden text, while manuscript stemmas drawn up with the aid of computer programs further investigations into the transmission history of ancient texts and help to reconstruct versions that are as close as possible to the originals. With its base in the LOEWE research cluster, this relatively young field of research has been successfully established in the Rhine-Main Region: in December 2014 the BMBF-funded Centre for the Digital Foundation of Research in the Humanities, Social, and Educational Sciences (CEDIFOR) began work. The service facility provides infrastructure and expertise for researchers in the humanities and social sciences in the Rhine-Main Region, who are thus able to carry out their own research projects.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Jost Gippert,
Goethe University, Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main
Technische Universität Darmstadt
Freies Deutsches Hochstift/Frankfurter Goethe-Museum (until 2014)
German Institute for International Educational Research (DIPF), Frankfurt am Main (since 2014)

LOCATIONS . Frankfurt am Main, Darmstadt

SUBJECT AREAS . Linguistics, Literature, History, Informatics

FUNDING PERIOD . LOEWE Research Cluster 2011 to 2013 & CEDIFOR BMBF funding since december 2014

COORDINATION OFFICE
Dr. Ralf Gehrke
Tel. +49 69 798-24681
gehrke@rz.uni-frankfurt.de

HEALTH

© Thomas Strecker

DRUID

Novel drug targets against poverty-related and neglected tropical infectious diseases

The global significance of neglected, poverty-associated tropical diseases such as dengue fever, Ebola and Zika virus infections, as well as leishmaniasis and schistosomiasis is receiving more and more recognition. More than a billion people in 149 countries suffer from neglected tropical diseases (NTDs). These can take on highly acute, life-threatening forms, but they can also lead to severe chronic illnesses. Fighting them is necessary from both a medical and a humanitarian standpoint and contributes decisively to breaking the cycle of poverty. Moreover, there are too few effective medications for most NTDs, a situation that is exacerbated by negative drug side effects and increasing microbial resistance. In the LOEWE research centre DRUID (Novel Drug Targets against Poverty-Related and Neglected Tropical Infectious Diseases), urgent questions will be addressed concerning the identification and characterization of potential target molecules for drug, and diagnostic tool development in the fight against tropical infectious diseases.

LOEWE RESEARCH CENTRE

COORDINATORS . Prof. Dr. Stephan Becker,
Philipps University of Marburg
Prof. Dr. Christoph Grevelding,
Justus-Liebig-Universität Gießen

PARTNERS . Philipps University of Marburg, Justus Liebig University Giessen, Goethe University, Frankfurt am Main, Paul-Ehrlich-Institute Langen, Technical University of Central Hesse Giessen, Fraunhofer Institute for Translational Medicine and Pharmacology ITMP

LOCATIONS . Gießen, Marburg, Langen, Frankfurt am Main

SUBJECT AREAS . Biochemistry, Medicine, Biology, Chemistry, Immunology, Pharmacology, Virology, Parasitology, Veterinary Medicine

FUNDING PERIOD . since 2018

COORDINATION OFFICE
Dr. Christina Brandstädter
Tel. +49 641 9939127
Christina.Brandstaedter@uni-marburg.de

INTERNET
www.loewe-druid.de/en/

NATURAL SCIENCE AND ENVIRONMENT **UNTIL 2022**

© Achilleas Frangakis / Goethe Universität Frankfurt

DynaMem

Dynamics of cell membranes

Cells are the basic building blocks of living organisms. They are surrounded and subdivided by membranes. Membranes are what make it possible for biological and chemical processes to successfully take place in the designated separate areas of the cell. There is a popular notion that membranes are fixed and rigid structures. In fact, this is not the case. Membranes are flowing structures that change their form, composition and function according to the varying conditions in the highly dynamic system of the cell. While there is a relatively good understanding of the static nature of biological membranes, the regulatory principles of changes in membranes and the dynamics of membrane systems in the cell still raise significant questions, including the resulting physiological effects of these mechanisms. The aim of the LOEWE DynaMem research cluster is to describe the molecular mechanisms of the intracellular membrane dynamics and their regulation in cells as well as to develop possibilities for modifying these dynamics. In addition to addressing diverse basic research aspects of these questions, the role of membrane dynamics will also be investigated in important processes such as aging, cell death, cancer, bone diseases, and parasitism.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Enrico Schleiff, Prof. Dr. Achilleas Frangakis, Goethe University, Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main (lead management)
Max-Planck-Institute for Biophysics Frankfurt am Main
Frankfurt Institute of Advanced Studies
ASSOCIATED PARTNERS
Johannes Gutenberg University Mainz
Max-Planck-Instituts für Polymerforschung

LOCATION . Frankfurt am Main

SUBJECT AREAS
Biology, Chemistry, Medicine, Physics, Systems Engineering

FUNDING PERIOD . 2018 to 2022

COORDINATION OFFICE
Dr. Bernd Märtens
Tel. +49 69 798-49418
b.maertens@em.uni-frankfurt.de

INTERNET
www.bio.uni-frankfurt.de/60615854/DynaMem

BUSINESS AND TECHNOLOGY . **UNTIL 2014**

© Erich Westendarp / pixelio.de

Dynamo PLT

Dynamic and Seamless Integration of Production, Logistics and Traffic

How should the decision-making processes in production, logistics and traffic be organised across companies and the public sector to ensure an optimal and seamless interplay between the three areas? As a result of globalisation, shorter innovation cycles and an increasing volatility in the markets, business enterprises are increasingly dependent on the performance of their partners in the value chain as well as on underlying traffic conditions. Moreover, the ease with which value creation networks can be established and integrated plays an essential role in determining the competitiveness of industrial locations. Dynamo PLV is developing methods and instruments for decision-making processes in the business sector and in politics that will help to ensure the seamless management of flows of goods and information in production, logistics and traffic. As an extension of the cooperation established in the LOEWE research cluster, Dynamo PLV will be continuing its practice-related exploration of instruments intended to provide support for interdisciplinary decision-making processes and will be transferring its findings to new teaching concepts. To support this research, funding has been obtained from public-sector project promoters such as the Federal Ministry of Education and Research and from private enterprises.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr.-Ing. Eberhard Abele,
Prof. Dr. Dr. h. c. Hans-Christian Pfohl,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Darmstadt University of Technology (lead management), EBS University of Economics and Law, Wiesbaden

LOCATIONS . Darmstadt, Wiesbaden

SUBJECT AREAS . Production Management, Logistics, Transportation, Business Administration, Information Technology, Organizational research

FUNDING PERIOD . 2011 to 2014

COORDINATION OFFICE
Ulrich Berbner
Tel. +49 6151 16-7368
berbner@bwl.tu-darmstadt.de

© JPaavo Bläfi eld / Universität Kassel

ELCH

Electron Dynamics of Chiral Systems

The rotational direction of molecules (chirality) is a key element affecting their behaviour in chemical reactions, and, in the case of biomolecules, their medical efficacy. Although there are certain complex methods that describe chirality, it is not yet understood how the rotational direction of the atomic structure of molecules affects the dynamics of molecular electrons. The LOEWE research cluster ELCH brings together scientists working in experimental and theoretical disciplines within the subject areas of physics and chemistry with a view to decoding the dynamics of the electron system of chiral systems and the basic principles of their genesis. Besides tackling these fundamental questions, the researchers hope to develop a highly efficient method for analysing molecular chirality that may be used, for instance, in the development of pharmaceuticals.

LOEWE RESEARCH CLUSTER

COORDINATOR
Prof. Dr. Arno Ehresmann (LOEWE), University of Kassel
Prof. Dr. Thomas Baumert (CRC), University of Kassel

PARTNERS . University of Kassel (lead management)
Justus Liebig University Giessen
Goethe University Frankfurt, Frankfurt am Main
Technical University of Darmstadt (TU Darmstadt)
GSI Helmholtz Centre for Heavy Ion Research, Darmstadt
Philipps University of Marburg

LOCATIONS . Kassel, Gießen, Frankfurt am Main, Darmstadt, Marburg

SUBJECT AREAS . Physics, Chemistry

FUNDING PERIOD . 2013 to 2016
Since 2018 CRC 1319 ELCH

COORDINATION OFFICE
Dr. André Knie (LOEWE)
Dr. Annette Becker (CRC ELCH)
Tel. +49 561 804 4575
annette.becker@uni-kassel.de

INTERNET
www.uni-kassel.de/elch

© Josh Hild

emergenCITY

The Resilient Digital City

How can the operation of cities with digitally networked infrastructures be ensured in extreme situations, crises and disasters? In 2050, two-thirds of the world's population are expected to live in cities. Their citizens are increasingly using digital infrastructures in all relevant areas: energy, transport, health and administration. This makes them dependent on these systems and, at the same time, renders them vulnerable to natural disasters, human or technical failure, crime, and terrorism. The LOEWE Centre emergenCITY is working on solutions that increase the safety and security of digital cities, even in crises. The solution concept is interdisciplinary and includes modern information and communication technology as well as the historical, legal, social, and structural aspects of urban planning. emergenCITY wants to create robust infrastructures that guarantee support during and after a crisis, to enable a return to normality as quickly as possible.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr.-Ing. Matthias Hollick,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt) (lead management), University Kassel, Philipps University of Marburg

LOCATIONS . Darmstadt, Kassel, Marburg

SUBJECT AREAS . Computer Science, Electrical Engineering, Mechanical Engineering, Civil and Environmental Engineering, Social and Historical Sciences, Architecture, Economics and Law

FUNDING PERIOD . 2020 to 2023

COORDINATION OFFICE
Dr. Anne Hofmeister
Tel. +49 6151 16-25482
manager@emergencity.de

INTERNET
https://www.emergencity.de

© Winfried Schönbach

FACE2FACE

Effects of Climate Change, Adjusting to Climate Change and Reducing Greenhouse Gas Emissions by 2050

The world is becoming warmer and the level of carbon dioxide in the air is increasing – in central Germany, too. What does climate change mean for agriculture in central Europe in the mid-21st century? In order to analyse the complex effects of global warming on plants, soils, microorganisms and insects, the LOEWE research cluster FACE2FACE is combining two large open-air test facilities to form one research platform: the Free Air Carbon Dioxide Enrichment (FACE) systems at Justus Liebig University Giessen and Geisenheim University. FACE systems can regulate the carbon dioxide concentration and air temperature over defined areas and thus make it possible to simulate various conditions. The scientists intend to use their findings to develop climate change adjustment strategies or ways of reducing the effects of global warming. They are focusing on the agricultural ecosystems pertaining to grassland, viticulture and horticulture.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Christoph Müller, PhD,
Justus Liebig University Giessen

PARTNERS . Justus Liebig University Giessen (lead management)
Geisenheim University
Philipps University of Marburg
Hessian Agency for the Environment and Geology, Wiesbaden
Max Planck Institute for Terrestrial Microbiology, Marburg

LOCATIONS . Gießen, Geisenheim, Marburg

SUBJECT AREAS . Agricultural sciences, Biology, Climatology, Phytomedicine

FUNDING PERIOD . 2014 to 2017

COORDINATION OFFICE
Prof. Jürg Luterbacher, PhD
Tel. +49 641 99-362 10
juerg.luterbacher@geogr.uni-giessen.de

© Stefan Streit

FCI – FRANKFURT CANCER INSTITUTE

Molecular Mechanisms of Therapeutic Responses in Tumors and Development of Individual Tumor Therapies

Clinical observations mechanistically explained to enable novel therapeutic approaches for patients. Cancer genomes can now be completely deciphered within a few days. However, genetic data is only partially sufficient to predict how well a particular patient will respond to the therapy, because it is necessary to know how the mutations affect the tumor cell and what effects this in turn has on the surrounding tissue and the immune system. It is the mission of the Frankfurt Cancer Institute (FCI) to investigate these complex processes. In addition, the FCI will develop individual therapeutic concepts based on a better understanding of the underlying molecular mechanisms. Interdisciplinary project teams work closely together to reach the next level of translation in iterative cycles between laboratory and patient. Here, a concept of translational cancer research is realized that covers the full spectrum from basic research on tumor mechanisms, drug development, to preclinical and clinical studies. Projects in the FCI are driven by interesting and challenging clinical observations and are supported by the continuous reciprocal exchange between clinical and basic research.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr. Florian R. Greten, Georg-Speyer-Haus

PARTNERS . Goethe University Frankfurt (lead management), Georg-Speyer-Haus, Max-Planck-Institute for Heart and Lung Research, Paul-Ehrlich-Institut

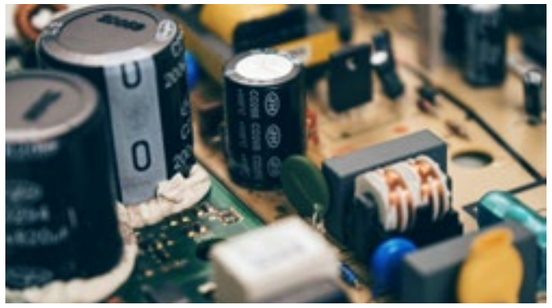
LOCATION . Frankfurt am Main

SUBJECT AREAS . Tumor biology, Clinical oncology, Clinical proteomics, Tumor metabolism, Preclinical models, Drug development, Clinical trials

FUNDING PERIOD . since 2019

COORDINATION OFFICE
Dr. Sandra Schmitz
Tel. +49 69 63395 707
schmitz@fci.health

INTERNET
www.fci.health



© Tide Heh

FLAME

Fermi Level Engineering of Antiferroelectric Materials for Energy Storage and Insulation Systems

Modern technologies are inconceivable without new materials, which possess improved or completely new properties. In order to contribute to a sustainable future, these materials should also make it possible to reduce the consumption of energy and raw materials. Furthermore, they should be build of environmentally friendly components and be manufactured using environmentally friendly processes. The LOEWE project FLAME uses previously unused relationships between the electronic structure of a material and its properties in order to produce antiferroelectric materials that do not contain toxic lead, which is required to obtain suitable properties. Such antiferroelectric materials can be used in capacitors in order to build more compact and efficient inverters that are needed, for example, to convert direct current into alternating current in electric vehicles and solar systems. In addition, they can also be used as insulators in high-voltage transmissions or for new cooling systems.

LOEWE RESEARCH CLUSTER

COORDINATOR
Prof. Dr. Andreas Klein, Prof. Dr. Karsten Albe,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt) (lead management)
Tongji University, Shanghai

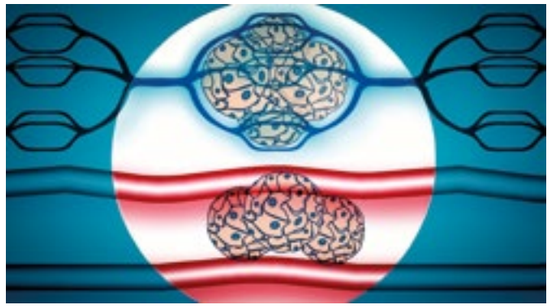
LOCATION . Darmstadt

SUBJECT AREAS . Materials and Earth Sciences, Chemistry, Electrical Engineering and Information Technology

FUNDING PERIOD . 2019 to 2023

COORDINATION OFFICE
Jessica Bagnoli, M.A.
Tel. +49 6151 16-20784
jessica.bagnoli@tu-darmstadt.de

INTERNET
www.flame.tu-darmstadt.de



© FLOW FOR LIFE

FLOW FOR LIFE

An artificial network for organ-like 3D cell aggregates

About 80% of drug candidates that have successfully passed the preclinical phase of drug development including animal tests fail in clinical trials as they turn out to be toxic or non-effective in humans. One of the major reasons for this high failure rate are animal models that do not adequately recapitulate human physiology and disease.

Three-dimensional tissue- or organ-like cell cultures produced in the laboratory are promising alternatives that allow for efficacy and toxicity tests on human cells outside the body. They could also be of interest for regenerative medicine in the future. However, the quality of organ-like cell cultures on a centimeter scale is currently not yet sufficient. In particular, there is a lack of a vascular system through which liquids can flow.

Scientists at the TU Darmstadt want to develop controllable and measurable, artificial supply networks in the framework of the LOEWE research initiative FLOW FOR LIFE. Their research aims at achieving a sufficient supply of nutrients and oxygen for organ-like three-dimensional cell cultures. The interdisciplinary team at the TU Darmstadt combines engineering and natural science expertise from five departments. FLOW FOR LIFE builds on Hesse's strengths in medical technology and pharmaceutical research and is supported by three Hessian companies: Merck Healthcare KGaA, B. Braun Avitum AG and the subsidiary Unicyte of Fresenius Medical Care.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Ulrike Nuber,
Prof. Dr.-Ing. Jeanette Hussong,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . TU Darmstadt, Merck Healthcare KGaA,
B. Braun Avitum AG, Fresenius Medical Care-Unicyte

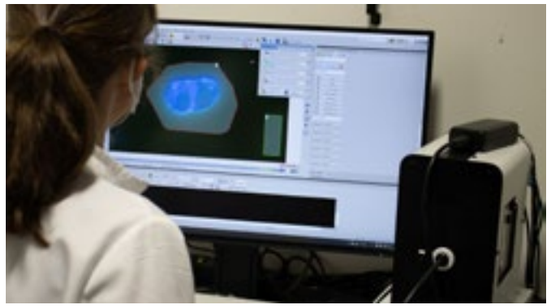
LOCATION . Darmstadt

SUBJECT AREAS . Mechanical engineering, biology, chemistry, physics, electrical engineering and information technology

FUNDING PERIOD . since 2022

COORDINATION OFFICE
Dr. Nils Offen
Tel. +49 6151 16-24603
nils.offen@tu-darmstadt.de

INTERNET
www.tu-darmstadt.de/flowforlife



© Regina Gerlach-Riehl

GLUE

G protein-coupled receptor Ligands for Underexplored Epitopes

The increase in life expectancy and quality of life of mankind is closely linked to the development of precisely acting and effective drugs. Approximately 30% of all approved drugs target receptors on cells that belong to the family of G protein-coupled receptors (GPCRs).

GPCRs due to their large number (about 400 representatives) and their medical importance, these receptors are of highest interest for drug development. GLUE (G protein-coupled receptor Ligands for Underexplored Epitopes) makes it its mission to explore epitopes as targets of potential drugs and their qualities of action. A new systematic approach with appropriate methods is being developed within the research network to identify ligands, detect their binding to alternative cavities (underexplored epitopes) and investigate their effect on the receptors. GLUE, coordinated by Prof. Dr. Moritz Bünemann, Philipps University Marburg, brings together internationally renowned research groups in computational drug discovery, pharmaceutical chemistry, biochemistry, structural biology, molecular, cellular and systemic pharmacology from the Universities of Darmstadt, Frankfurt and Marburg as well as the Max Planck Institute in Bad Nauheim to jointly exploit new cavities on GPCRs for drug discovery.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Moritz Bünemann, Pharmacology and Clinical Pharmacy, Philipps University of Marburg
Prof. Dr. Peter Kolb, Pharmaceutical Chemistry,
Philipps-Universität Marburg

PARTNERS . Philipps University Marbug (lead management), Goethe University Frankfurt, Technical University of Darmstadt (TU Darmstadt) , Max Planck Institute Bad Nauheim

LOCATIONS . Bad Nauheim, Darmstadt,
Frankfurt am Main, Marburg

SUBJECT AREAS . Computer-aided Drug Discovery, Pharmaceutical Chemistry, Biochemistry, Structural Biology, Molecular, Cellular Pharmacology

FUNDING PERIOD . since 2020

COORDINATION OFFICE
Dr. Christof Wegscheid-Gerlach
Tel. +49 6421 2825843
wegscheid-gerlach@uni-marburg.de

INTERNET
https://www.uni-marburg.de/de/fb16/forschung/verbund/glue

© Andreas Gattinger

GreenDairy

Integrated animal-plant-agroecosystems

Agriculture today, especially in animal production, is characterized by decoupled material cycles with high nitrogen surpluses, greenhouse gas emissions, competition for land, soil degradation and problems with animal welfare. Cattle farming in mixed farms for milk, meat and plant-based foods is one possible solution.

The aim is to develop innovative animal-plant agricultural systems that are both ecologically and economically sustainable and enable a special level of animal welfare and thus experience a high level of acceptance in society.

The LOEWE research cluster GreenDairy is based on the new research infrastructure of a digitalized dairy farming system at the Hessian State Domain Gladbacherhof. This system enables the comparison of so-called high- and low-input milk production systems with digital animal identifcation, grazing control as well as automatic feeding and milking systems. Low-input systems with grazing and predominantly roughage from grassland have so far been considered the standard in organic dairy farms. Alternatively, in the high-input system with grazing, the animals are also fed with a high proportion of the farm's own corn silage and grain.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Andreas Gattinger, Prof. Dr. Lutz Breuer, Justus Liebig University Giessen

PARTNERS . Justus Liebig University Giessen, University of Kassel

LOCATIONS . Gießen, Kassel

SUBJECT AREAS . Agricultural Science, Environmental Science, Biology, Chemistry

FUNDING PERIOD . since 2022

COORDINATION OFFICE
Dr. Christian Lambertz, Giessen University
Tel. +49 175-1814581
Christian.Lambertz@agrar.uni-giessen.de
Dr. Deise Knob, Giessen University
Tel. +49 6474-882127
Diese.Knob@agrar.uni-giessen.de

INTERNET
www.uni-giessen.de/greendairy

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2015**

© Jan Michael Hosan / Hessen schafft Wissen

HIC for FAIR

Helmholtz International Center for FAIR (Facility for Antiproton and Ion Research)

What is mass? Where does matter come from? How did the elements form in the Universe? By developing accelerators and detectors and refining theories, scientists at the LOEWE centre HIC for FAIR are preparing experiments for the particle accelerator known as FAIR – Facility for Antiproton and Ion Research. This international research site will go into operation in Darmstadt by 2018. Valuable "spin-offs" of the fundamental research done for FAIR are high-tech applications used, for example, in innovative energy-efficient computing systems and in tumour therapy. A prime example is the high-performance computer LOEWE-CSC located in Frankfurt-Höchst, one of the fastest and most energy-efficient computers in Europe.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr. René Reifarth,
Goethe University Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main (lead management), Technische Universität Darmstadt, Frankfurt Institute for Advanced Studies (FIAS), Justus Liebig University Giessen, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt
ASSOCIATED PARTNERS . Philipps-Universität Marburg Technische Hochschule Mittelhessen (THM), Giessen Campus University of Kassel, Darmstadt University of Applied Sciences

LOCATIONS . Frankfurt am Main, Darmstadt, Gießen

SUBJECT AREAS . Heavy ion physics, Theoretical physics, Monte Carlo simulations, Medical and biological physics, Detector physics, Accelerator physics, High-performance computing, Quantum field theory of strong interaction, Nuclear astrophysics / Cosmology, Particle physics, Nuclear physics

FUNDING PERIOD . 2008 to 2015

COORDINATION OFFICE
Gabriela Meyer
Tel. +49 69 798-47861
meyer@th.physik.uni-frankfurt.de

HEALTH

© iCANx

iCANx

Cancer – Lung (Disease) Crosstalk: Tumor and Organ Microenvironment

Lung cancer is the most common cause of death among cancers worldwide. In addition, the lung is a frequent site for secondary tumors (metastases) from, for example, breast, colon, as well as lung cancer itself. It is largely unknown how tumor cells can adapt to the local environment (organ microenvironment) to successfully spread to the lung and how they can transform this environment in their favor. Therefore, iCANx aims to elucidate the crosstalk between tumor cells and their microenvironment. Furthermore, iCANx investigates the impact of lung tumor-associated diseases such as chronic obstructive pulmonary disease (COPD), pulmonary hypertension and pulmonary fibrosis on lung cancer and lung metastasis. A deeper understanding of these complex interactions promises innovative therapeutic and curative approaches that target the organ- and tumor-specific microenvironment, for example, to prevent colonization of the lung in various cancers.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Till Acker, Justus Liebig University Giessen
Prof. Dr. Thorsten Stiewe (Deputy), Philipps University of Marburg
Prof. Dr. Rajkumar Savai (Deputy), Justus Liebig University Giessen and Max Planck Institute for Heart and Lung Research

PARTNERS . Justus Liebig University Giessen (lead management)
Philipps University of Marburg
Max Planck Institute for Heart and Lung Research

LOCATIONS . Giessen, Marburg, Bad Nauheim

SUBJECT AREAS . Lung cancer, tumor biology, tumor and organ microenvironment, lung diseases, preclinical models, tumor metabolism, tumor and immune cell crosstalk

FUNDING PERIOD . since 2021

COORDINATION OFFICE
Nadja Ritschel
icanx@uni-giessen.de
Tel. +49 641-99-30508

INTERNET
www.uni-giessen.de/icanx

CULTURE AND SOCIETY . **UNTIL 2014**

© fotorismus / Britta Hüning für IDeA

IDeA

Individual Development and Adaptive Education

At the IDeA centre, researchers from various disciplines investigate the individual learning and development processes in children of pre-school and primary school age. IDeA stands for "Individual Development and Adaptive Education". Empirical studies focus primarily on children who, because of various – (neuro-)cognitive and/or social – factors, are seen to be at greater risk of underachieving at school. IDeA investigates the developmental pathways of children in those age groups as the first step to finding out how learning environments can best be designed to provide support for the individual child in heterogeneous groups. IDeA research also takes account of educators and teachers, whose skills and attitudes are seen as immediately relevant for learning success. IDeA was the first LOEWE research centre to be given a long-term presence. Since July 2014 the coordination services and laboratory infrastructure has become a permanent pillar of the German Institute for International Educational Research (DIPF) in Frankfurt.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr. Marcus Hasselhorn, DIPF

PARTNERS . German Institute for International Educational Research (DIPF), Frankfurt am Main (lead management)
Goethe University, Frankfurt am Main
Sigmund-Freud-Institut, Frankfurt am Main

LOCATION . Frankfurt am Main

SUBJECT AREAS . Psychology, Educational science, Psycholinguistics, Neuroscience, Subject didactics, Psychoanalysis, Sociology

FUNDING PERIOD . LOEWE Research Centre 2008 to 2014
Established in the Leibniz Association since 2014

COORDINATION OFFICE
Dr. Ulrike Hartmann
Tel. +49 69 24708-390
u.hartmann@idea-frankfurt.eu

CULTURE AND SOCIETY . **UNTIL 2022**

© Annalena Kluge & Julian Schwarz / HfG Offenbach

Infrastructure – Design – Society

Infrastructure – Design – Society

Our mobility is on the verge of a major change. Today, individuals in large cities are already less and less dependent on a personal automobile, and the aim is to build on this trend. With mobile Internet functionality, a multitude of new forms of intelligent mobility are becoming available to provide economical, convenient and – most importantly – environmentally friendly transport. In the future, it will be possible for everyone to have a large number of different modes of transport at their disposal, to use just as they wish. To realise this, however, users of such systems need not only to feel safe but also comfortable in the various mobility spaces that are created. This is a major challenge for the design of such spaces, processes and systems. The focus must be on the needs of the various transport users when new, environmentally friendly mobility offerings are being designed. This is where the LOEWE research cluster "Infrastructure – Design – Society" gets started – with a systematic examination of the requirements for the design of a new, networked and multimodal mobility system in the Rhine-Main region.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Kai Vöckler,
HfG Offenbach University of Art and Design
Prof. Dr.-Ing. Petra K. Schäfer,
Frankfurt University of Applied Sciences

PARTNERS . HfG Offenbach University of Art and Design (lead management), Frankfurt University of Applied Sciences, Technical University of Darmstadt, Goethe University Frankfurt am Main
ASSOCIATED PARTNERS . ivm GmbH, House of Logistics and Mobility GmbH, Rhine-Main Transport Association GmbH

LOCATIONS . Offenbach . Darmstadt . Frankfurt

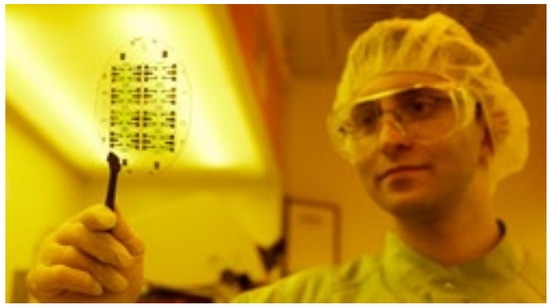
SUBJECT AREAS . Design, architecture/urban design, information and communication technology, transport planning and social science mobility research

FUNDING PERIOD. 2018 to 2022

COORDINATION OFFICE
Dr. Karin Gottschalk
Tel. +49 69 80059-230
project-mo.de@hfg-offenbach.de

INTERNET
https://project-mo.de/en/main-page-new/

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2019**



© Fotografie MD 2018 / Mathias Daum

iNAPO

Ion-conducting nanopores

The proteins contained in cell membranes, the so-called ion channels, recognise physical and chemical signals very selectively and transform these into measurable electrical signals. Potassium channels, as found for example in human cells as well as viruses, only allow potassium ions to enter, thereby playing an important role in the regulation of the blood glucose level as well as in the signal transmission between neurons. In the LOEWE research cluster iNAPO, biologists, chemists, physicists, material scientists, and electrical-technicians are working together to understand the structural and functional principles of these biological sensors and to imitate them. Working with the biological model, they want to build conductive nanosensors in solid materials which can then be used in analytics and biomedicine. In medical diagnostics, for example, highly sensitive sensors could be used to register tumour markers or other substances in a drop of blood and to convert the concentration of such substances into an electrical signal.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Wolfgang Ensinger,
Prof. Dr. Bodo Laube, Prof. Dr. Gerhard Thiel,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt)
GSI Helmholtz Centre for Heavy Ion Research, Darmstadt

LOCATION . Darmstadt

SUBJECT AREAS . Materials Science, Biology, Physics, Chemistry, Electrical Engineering, Information Technology

FUNDING PERIOD . 2016 to 2019

COORDINATION OFFICE
Dr. Melanie Mikosch-Wersching
Tel. +49 6151 16-21949
mikosch@bio.tu-darmstadt.de

INTERNET
https://www.inapo.tu-darmstadt.de

NATURAL SCIENCE AND ENVIRONMENT

© Jan Michael Hosan / Hessen schafft Wissen

Insect Biotechnology

Research Centre for Insect Biotechnology and Bioresources

Insects are the most diverse of all groups of organisms, with more species than any other. Their successful survival strategies can be traced right down to the molecular level. Insect biotechnology – also known as yellow biotechnology – uses biotechnological methods on insects (as well as on their molecules, cells, organs, and associated microbes) to develop products or services. The intent are new substances for applications in medicine, the sustainable protection of plants and industrial biotechnology. The Bioresources project group at the Fraunhofer Institute for Molecular Biology and Applied Ecology (IME) has been established in Giessen as part of the LOEWE research centre; the aim is for it to eventually become a Fraunhofer Institute.

LOEWE RESEARCH CENTRE

SPRECHER . Prof. Dr. Andreas Vilcinskas,
Justus Liebig University Giessen

COORDINATOR . Justus Liebig University Giessen
Technical University of Central Hesse (THM), Giessen
Goethe University, Frankfurt am Main (until 2013)
Fraunhofer Institute for Molecular Biology and Applied Ecology

LOCATION . Gießen

SUBJECT AREA . Entomology, Bioprocess engineering, Biochemistry, Molecular biology, Microbiology, Biotechnology

FUNDING PERIOD
LOEWE Research Cluster 2011 to 2013
LOEWE Research Centre Since 2014

COORDINATION OFFICE
Dr. rer. nat Ina Schüttmann
Tel. +49 641 972 19200
ina.schuettmann@ime.fraunhofer.de

INTERNET
www.insekten-biotechnologie.de

CULTURE AND SOCIETY . **UNTIL 2013**

© Katrin Binner / TU Darmstadt

Intrinsic Logic

Intrinsic Logic of Cities

Cities are highly complex social and spatial entities. What internal logic do they follow? What gives them a meaning, what makes them unique? What hidden structure undergirds their activities? Taking the working designation of "intrinsic logic" as the starting point, scholars from the social and cultural sciences, engineers and urban planners are working on the basics of a theory of cities. Working with case studies, they are exploring how a city uses available knowledge or generates new knowledge for its decision-making and operational processes. Particular attention is paid to cities' socio-ecological dimension by investigating the extent to which sustainability and sustainable development depends not only on what individuals do but also on the city's intrinsic logic. The key methodological tool are comparative urban case studies. Since the end of the LOEWE funding period, the work has continued in DFG-funded project clusters and a research group.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Dieter Schott,
Technische Universität Darmstadt

PARTNERS . Technical University of Darmstadt (TU Darmstadt) (lead management)
Hochschule Darmstadt University of Applied Sciences

LOCATION . Darmstadt

SUBJECT AREAS . History, Political science, Philosophy, Sociology, Linguistics, Urban research, Engineering

FUNDING PERIOD . LOEWE: 2008 to 2013 / DFG Project Group „Eigenlogik der Städte": 2011 to 2014 / DFG Research Unit „Wissensordnungen": 2012 to 2014 / DFG Project Group „Nachhaltige Entwicklung von Städten": 2012 to 2015

COORDINATION OFFICE
Wiebke Kronz
Tel. +49 6151 16-57420
kronz@stadtforschung.tu-darmstadt.de

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2016**

© Ewald Langer

IPF

Integrative Fungal Research

Yeasts, edible mould, penicillin – fungi play a substantial role in food production and medicine as well as in scientific research. There are more species of fungi than of plants, fish and mammals put together, and, after bacteria, fungi are the most widespread form of life on earth. Nonetheless, fewer than 10% of their species are known. In the LOEWE research cluster Integrative Fungal Research, biodiversity researchers work with biochemists, biotechnologies and molecular geneticists to expand knowledge of a range of different fungi, to establish new possibilities for their use and to develop new production procedures. They produce, for instance, antibiotics, platform chemicals, surface coatings and antioxidants for industry, medicine and food production.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Marco Thines, Prof. Dr. Helge B. Bode,
Goethe-University, Frankfurt am Main

PARTNERS . Goethe University Frankfurt am Main (lead management)
Senckenberg Society for Natural Research, Frankfurt am Main
Philipps University of Marburg
Justus Liebig University of Giessen
University of Kassel

LOCATIONS . Frankfurt am Main, Marburg, Gießen, Kassel

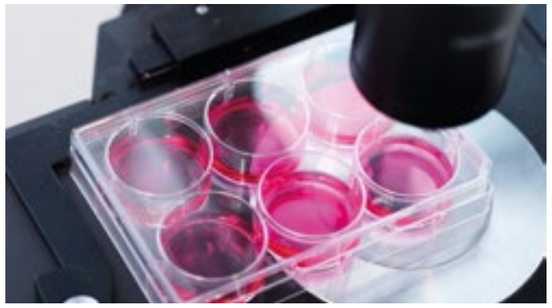
SUBJECT AREAS . Biology, Biochemistry, Biotechnology, Molecular Genetics

FUNDING PERIOD . 2013 to 2016

COORDINATION OFFICE
Katharina Hartmann
Tel. +49 69 7542-1836
katharina.hartmann@senckenberg.de

INTERNET
www.integrative-pilzforschung.de

HEALTH . **UNTIL 2011**



© Jan Michael Hosan / Hessen schafft Wissen

LiFF

Lipid Signalling Research Centre Frankfurt

Lipids (fats) are not only important energy stores and structural elements in cell membranes; they also play a key role in the transmission of signals between cells, thus regulating elementary cellular processes. Disruption to the transmission of signals leads to diseases such as diabetes, arteriosclerosis, inflammations and pain or even tumour diseases. LiFF is confident that a better understanding of the molecular processes in lipid-dependent signalling networks will lead to new methods of identifying biomarkers for diagnostics as well as the development of new therapeutics. Since October 2013 LiFF has continued to operate as the DFG's Collaborative Research Centre 1039 "Signalling by fatty acid derivatives and sphingolipids in health and disease".

LOEWE RESEARCH CLUSTER

COORDINATORS . Coordinator LOEWE: Prof. Dr. Dr. Gerd Geisslinger, Goethe University, Frankfurt am Main
Coordinator DFG: Prof. Dr. J. Pfeilschifter, Goethe University, Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main (lead management)
Max Planck Institute for Heart and Lung Research, Bad Nauheim

LOCATIONS . Frankfurt am Main, Bad Nauheim

SUBJECT AREAS . Inflammation, Molecular biology, Pharmaceutical chemistry, Biochemistry, Pharmacology, Clinical pharmacology, Molecular medicine, Physiology, Analytics

FUNDING PERIOD
LOEWE Research Cluster 2008 to 2011
DFG 1 October 2013 to 30 September 2017

COORDINATION OFFICE
Dr. Torsten Arndt
Tel. +49 69 6301-87159
t.arndt@zafes.de

CULTURE AND SOCIETY . **UNTIL 2017**

© Dr. Frank Domahs / Philipps-Universität Marburg

LingBas

Exploring Fundamental Linguistic Categories

Language is a central cognitive human ability and humankind's most important communication organ. Although people's brains are all very similar, there were, and still are, thousands of different languages, which are also constantly evolving. What are the common elements in this diversity? What fundamental categories – such as syllables or words – can be shown to exist everywhere and at all times? By studying the evolution of language over lengthy periods and analysing the structure and dynamics of German regional languages, the researchers in the LOEWE research cluster are seeking to identify and provide empirical evidence of fundamental linguistic categories. Taking these "universals" as their starting point, they are researching the relationship between language and the brain with a view to improving the diagnosis and therapy of language disorders.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Jürgen Erich Schmidt, Prof. Dr. Richard Wiese, Philipps University of Marburg

PARTNER . Philipps University of Marburg

LOCATION . Marburg

SUBJECT AREAS . Theoretical linguistics, Variational linguistics, Language typology, Clinical linguistics, Historical linguistics, Neurolinguistics

FUNDING PERIOD . 2012 to 2017

GESCHÄFTSSTELLE
Dr. Alexander Werth
Tel. +49 6421 28-24475
alexander.werth@staff.uni-marburg.de

HEALTH . **UNTIL 2018**

© Silke Schreiner / Justus-Liebig-Universität Gießen

Medical RNomics

RNA-regulated networks in human diseases

Ribonucleic acids – RNAs for short – assume a range of tasks in the human body: RNA molecules can, for example, transmit genetic information and regulate whether gene-encoded proteins are formed in cells as well as when this occurs and in what quantities. The discovery of new regulatory ribonucleic acids has resulted in recent years in the realisation that faulty RNA-dependent genetic regulation processes very often lead to disease. At the same time, new high-throughput sequencing technologies now make it possible to gather comprehensive data on regulatory RNA networks and their pathological changes. The LOEWE research cluster Medical RNomics wants to apply these new analytical methods to major commonly occurring diseases, particularly to tumour, infectious and cardiovascular diseases. This should not only give new insights into the disease-causing processes but, most of all, provide new diagnostic RNA biomarkers and pave the way for innovative therapeutic strategies.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Albrecht Bindereif, Justus Liebig University Giessen
Prof. Dr. Bernd Schmeck (deputy), Philipps-Universität Marburg

PARTNERS . Justus Liebig University Giessen
Philipps University of Marburg
Goethe University, Frankfurt am Main
Max Planck Institute for Heart and Lung Research, Bad Nauheim
ASSOCIATED PARTNERS
Life Technologies, Darmstadt
GenXPro, Frankfurt
BITE, Giessen
CSL Behring, Marburg

LOCATIONS . Gießen, Marburg, Frankfurt, Bad Nauheim

SUBJECT AREAS . Medicine, Biology, Chemistry, Biochemistry

FUNDING PERIOD . 2015 to 2018

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2021**

© Uwe Dettmar

MegaSyn

Control and design of megasynthases

With new knowledge surrounding the structures and functions of proteins, it is becoming increasingly possible to make use of natural systems (proteins, protein cascades and microorganisms) for the targeted production of biomolecules. The development of such customised and sustainable methods of synthesis is highly significant from a sociopolitical standpoint. The LOEWE research cluster MegaSyn focuses on the biosynthetic production of molecules that are technologically and pharmaceutically valuable, such as organic acids, antibiotics and immunosuppressants. These molecules are produced through so-called megasynthases, such as fatty acid synthases (FAS) or polyketide synthases (PKS) and nonribosomal peptide synthetases (NRPS). These processes involve very large multifunctional enzymes that link small carbon or amino acid units together with each other. The latest findings on the function and manipulation of megasynthases and new improved structural biological methods now make it possible to process these complex multifunctional enzymes in a more precise and systematic way. Customised megasynthases of this sort are being worked on in the LOEWE research cluster MegaSyn to facilitate the production of molecules with customised functions and characteristics.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Helge B. Bode, Prof. Dr. Martin Grininger, Goethe University, Frankfurt am Main

PARTNERS . Goethe University Frankfurt am Main
Philipps University of Marburg
Max Planck Institute of Biophysics, Frankfurt am Main
Max Planck Institute for Terrestrial Microbiology, Marburg
Technical University of Central Hesse (THM)
University of Applied Sciences Gießen

LOCATIONS . Frankfurt am Main, Marburg, Gießen

SUBJECT AREAS . Biochemistry, Biotechnology, Biophysics

FUNDING PERIOD . 2017 to 2021

COORDINATION OFFICE
Sophie Moktadir
Tel. +49 69 798-29558
http://www.bmls.de

HEALTH . **UNTIL 2014**

© MIBI / uni-giessen.de / Franz E. Möller

MIBIE

Male Infertility and Urogenital Infections

Every year around 200,000 couples are affected by unwanted childlessness in Germany. In roughly half the cases, the cause can be attributed to a fertility problem on the part of the man. Infections and inflammations frequently lead to impaired male fertility. MIBIE studies how infections and inflammations of the genito-urinary tract can lead to infertility and in so doing, combines fundamental research with clinical application. For instance, improved methods of examination have already made it possible to identify illness-related mechanisms, to distinguish between infectious and inflammatory causes and to target the treatment accordingly. In order to continue the joint interdisciplinary research, application has been made to set up a DFG research group. MIBIE will also continue to contribute its expertise to a German-Australian International Research Training Group (IRTG). The research cluster was also able to attract a DFG Workshop for Early Career Investigators, which will be conducted at Justus Liebig University Giessen in May 2015.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Wolfgang Weidner,
Justus Liebig University Giessen

PARTNERS . Justus Liebig University Giessen (lead management)
Philipps University of Marburg
Technical University of Central Hesse (THM)
ASSOCIATED PARTNERS
Kinderwunschzentrum Mittelhessen Wetzlar
School of Veterinary Medicine, Pennsylvania (USA)
RWTH Aachen University
University of Veterinary Medicine, Hannover

LOCATIONS . Gießen, Marburg

SUBJECT AREAS . Urology and andrology,
Medicinal microbiology, Reproductive biology

FUNDING PERIOD . 2011 to 2014

COORDINATION OFFICE
Prof. Dr. med. Florian Wagenlehner
Tel. +49 641 985 44516
Florian.Wagenlehner@chiru.med.uni-giessen.de

CULTURE AND SOCIETY

© Prof. Dr. Gholami

Minority studies

Language and Identity

How are factors such as language, religion or cultural heritage related in the context of minority migration?

Many people leave their homeland because they are persecuted and oppressed as members of minorities. By immigrating into a society that is new to them, they also become a minority in a foreign country. A new level is added to the level of linguistic, religious, ethnic and cultural identity in the country of origin. The LOEWE priority area „Minority Studies: Language and Identity" will explore this topic. The project pursues an interdisciplinary approach in the fields of language, history and society.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Elisabeth Hollender,
Goethe University, Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main
Justus Liebig University Giessen

LOCATIONS . Frankfurt am Main, Gießen

SUBJECT AREAS . Linguistics, Cultures and Arts, Law,
Computer science, Social science, Educational sciences,
History, Political sciences

FUNDING PERIOD . since 2020

COORDINATION OFFICE
Lucile Pineau
loewe-minderheitenstudien@uni-frankfurt.de
Tel. +49 69 798-24689

INTERNET
https://sprache-identitaet.uni-frankfurt.de/en/home-en/

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2022**

© Andreas Kautz

MOSLA

Molecular Storage for Long-Term Archiving

The LOEWE Research Cluster MOSLA (Molecular Storage for Long-Term Archiving) investigates transdisciplinary approaches to a fundamental problem of humankind: the long-term storage of information. The cluster drives further developments of molecular memories as alternative data storage media with the aim to prevent a Digital Dark Age (the loss of all digital information). The MOSLA researchers focus on two molecular information carriers: DNA and elemental organic cluster building blocks. MOSLA aims at increasing the storage density of DNA, e.g. through better algorithms for data encoding, the use of modified nucleotides, and to enhance stability of the DNA memory by encoding digital information in spore-forming microorganisms. Apart from the ability to form spores, microbial cells provide further advantages, such as mechanisms for DNA copying and repair. As a complementary strategy, storing information based on elemental organic cluster building blocks is studied. This format has a high potential to provide a robust data storage medium allowing for an optical data readout.

LOEWE RESEARCH CLUSTER

COORDINATOR
Prof. Dr. Dominik Heider, Prof. Dr. Anke Becker,
Philipps University of Marburg

PARTNERS . Justus Liebig University Giessen

LOCATIONS . Gießen, Marburg

SUBJECT AREAS . Computer Science, Biology, Chemistry, Physics

FUNDING PERIOD . 2019 to 2022

COORDINATION OFFICE
Dr. Jan-Wolfhard Kellmann
Tel. +49 6421 28 24400
jan-wolfhard.kellmann@synmikro.uni-marburg.de

INTERNET
www.mosla.mathematik.uni-marburg.de

NATURAL SCIENCE AND ENVIRONMENT

© Steffen Boettcher / Hessen schafft Wissen

Nature 4.0

Nature observation with networked sensor technology and artificial intelligence

The LOEWE Research cluster Nature 4.0 focuses on developing a networked senor system for biodiversity monitoring. The interdisciplinary project combines field observations by experts with networked remote sensing and environmental sensors attached to remote-controlled aircrafts, moving robots, trees and animals, as well as being used in environmental education projects. Microphone recordings, for example, provide the basis for the automatic recognition of bird or bat species. Combined with camera recordings and new types of radar sensors, it is possible to simultaneously classify the breeding and feeding resources of these animals, such as hollow trees or insects. Artificial intelligence is used to create small-scale differentiating maps of species diversity, ecosystem services and ecosystem functions from the data and relate them to environmental conditions. Thus, changing food resources or a changing microclimate can be related to changes in ecosystem services.

LOEWE RESEARCH CLUSTER

COORDINATOR
Prof. Dr. Thomas Nauss
Prof. Dr. Jörg Bendix

PARTNERS . Philipps-University of Marburg (lead management)
Justus Liebig University Giessen
Technical University of Darmstadt (TU Darmstadt)
Senckenberg Society for Natural Research

LOCATIONS . Darmstadt, Frankfurt am Main, Gießen, Marburg

SUBJECT AREAS . Geography, Biology,
Computer Science, Mathematics

FUNDING PERIOD . since 2019

COORDINATION OFFICE
Dr. Dirk Zeuss
Tel. +49 6421 28 25962
dirk.zeuss@uni-marburg.de

INTERNET
https://www.uni-marburg.de/en/fb19/natur40

HEALTH . **UNTIL 2014**

© Jan Michael Hosan / Hessen schafft Wissen

NeFF

Neuronal Coordination Research Focus Frankfurt

The human brain is made of billions of nerve cells. Higher brain activity such as cognition, language or memory is based on neuronal coordination, the coordinated exchange of signals between individual nerve cells and groups of nerve cells. If this coordination is disrupted, brain disorders occur. NeFF is analysing neuronal coordination in schizophrenia and autism as well as in Alzheimer's disease and multiple sclerosis. The scientists in the LOEWE research cluster are trying to determine indicators that will enable early diagnosis and allow therapeutic effects to be measured. To that end, they combine basic research with clinical neuroscience and mathematical modelling. In the field of neuromodulation, NeFF's aim is to continue the work in a DFG Collaborative Research Centre (CRC). In a CRC set up together with the Johannes Gutenberg University in Mainz, for which a full proposal is being prepared, the focus is on resilience: hardly any research has so far been conducted into the human ability to resist psychiatric and neurological diseases, which is of extreme clinical relevance.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Michael Wibral,
Goethe-Universität Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main
(lead management)
Max Planck Institute for Brain Research, Frankfurt am Main
Frankfurt Institute for Advanced Studies (FIAS)
Ernst Strüngmann Institute (ESI), Frankfurt am Main
Technical University of Darmstadt (TU Darmstadt)

LOCATIONS . Frankfurt am Main, Darmstadt

SUBJECT AREAS . Medicine, Biology, Physics,
Mathematics, Informatics

FUNDING PERIOD . 2011 to 2014

COORDINATION OFFICE
Prof. Dr. Michael Wibral
Tel. +49 69 6301-83193
wibral@em.uni-frankfurt.de

BUSINESS AND TECHNOLOGY . **UNTIL 2018**

© Jan Michael Hosan / Hessen schafft Wissen

NICER

Networked Infrastructureless Cooperation for Emergency Response

Crises, disasters and major catastrophic events are triggered by the forces of nature, human or technical failure or violence and terrorism. They present a threat to human life, public safety in the area concerned and interregional economics. Technical infrastructures are damaged or destroyed. The LOEWE research cluster NICER is exploring how infrastructureless information and communications technology can establish links between people in the event of a crisis, thus enabling them to work together to overcome the crisis. To that end, NICER focuses on three main research areas: (1) setting up autonomous, decentralised and robust "communication islands", (2) constructing "communication bridges" between communication islands and (3) operating an "overall network" of services and applications to enable cooperation in the crisis situation. For the areas referred to above, NICER is developing basic scientific and technological principles with a view to bringing about a dramatic increase in the long-term performance of infrastructurless communication.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Matthias Hollick,
Prof. Dr. Max Mühlhäuser,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt)
(lead management)
University of Kassel
Philipps University of Marburg

LOCATIONS . Darmstadt, Kassel, Marburg

SUBJECT AREAS . Informatics,
Electrical Engineering and Information Technology

FUNDING PERIOD . 2015 to 2018

HEALTH . **UNTIL 2015**

© Wolfram Schroll

NNCS

Non-neuronal Cholinergic Systems

Acetylcholine is an old neurotransmitter that does not only work in the nervous system. The vital molecule controls many bodily functions, in particular interaction with the environment. It sets barriers and regulates their permeability, for example that of skin and lungs and during the intake of food. It is also a component with a decisive impact on the functioning of the immune system – and can, conversely, be involved in the incidence of illnesses. How exactly does acetylcholine work? Which disorders cause diseases? How can this knowledge be applied? From fundamental research to clinical studies – the researchers in the LOEWE research cluster are focusing on the molecule's non-neuronal areas of activity.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Wolfgang Kummer,
Justus Liebig University Giessen

PARTNERS . Justus Liebig University Giessen (lead management)
Philipps University of Marburg (until 2014)
Goethe University, Frankfurt am Main
ASSOCIATED PARTNERS
National Institutes of Health, Bethesda, MD, USA (Dr. J. Wess)
University of California, Irvine, CA, USA, (Prof. Dr. S. A. Grando)

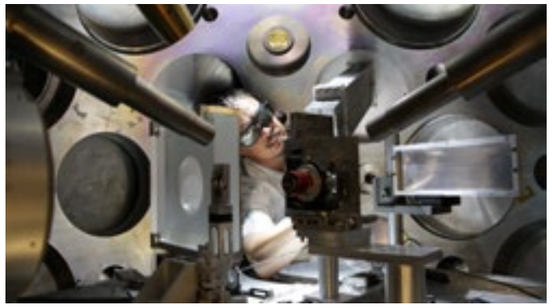
LOCATIONS . Gießen, Marburg (until 2014), Frankfurt am Main

SUBJECT AREAS . Biochemistry, Physiology, Anatomy,
Immunology, Pharmacology, Accident surgery, Dermatology,
Surgery, Anaesthesiology, Psychosomatics

FUNDING PERIOD . 2012 to 2015

INTERNET
https://www.uni-giessen.de/fbz/fb11/institute/anatomie/assoz/loewe

NATURAL SCIENCE AND ENVIRONMENT



© Markus Roth

Nuclear Photonics

Laser-based particle beams for fundamental physics and applications

Within the LOEWE research cluster Nuclear Photonics, scientists at TU Darmstadt study how modern laser systems can be used to develop novel particle sources and use them in basic research and applications. This work interconnects laser technology, accelerator science, and nuclear physics. Innovative sources of intense photon and neutron sources allow new insights into the structure of matter to be gathered and hold promises for future applications in research and development as well as industry and techology. With the LOEWE research cluster an international center in research and teaching is established: The experience of the closely collaborating groups is based on local research infrastucture in Darmstadt, in particular the superconducting Darmstadt electron accelerator S-DALINAC and the high-intensity laser system PHELIX at the GSI Helmholtz Research Centre for Heavy-ion Research. Students and partners in science and industry find here a contact point for nuclear-photonics research world-wide, in particular for future experiments at the new international major research infrastructure ELI (Extreme Light Infrastructure) with its pillars ELI-Beamlines in the Czech Republic and ELI-Nuclear Physics in Romania.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Dr. h.c. mult. Norbert Pietralla,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt)
ASSOCIATED PARTNERS
Extreme Light Infrastructure: ELI-Beamlines (CZ),
ELI-Nuclear Physics (RO)

LOCATION . Darmstadt

SUBJECT AREAS . Laser physics, Radiation physics,
Acclerator sciency, Nuclear physics

FUNDING PERIOD . since 2019

COORDINATION OFFICE
Professor Dr. Norbert Pietralla
Tel. +49 6151 16-23540
pietralla@ikp.tu-darmstadt.de

INTERNET
https://www.ikp.tu-darmstadt.de/forschung_kernphysik/
verbundprojekte/details/nukleare_photonik/index.de.jsp

HEALTH . **UNTIL 2013**

© Jan Michael Hosan / Hessen schafft Wissen

OSF

Oncogenic Signaling Frankfurt

The LOEWE research cluster OSF is studying basic issues relating to cancer research. What mechanisms at cell level lead to tumour formation? What happens to cause another tumour to be formed from an individual cell, for example, following therapy or during the spread of metastases? How do tumour cells affect the functions of normal cells in the immediate environment? The focus is on research into mechanisms of disrupted signalling in cancer cells. The aim is to open up new avenues for the successful treatment of tumours by gaining a better understanding of the molecular mechanisms. Can the genetics of new tumour suppressors be identified through innovative procedures? Can therapeutic agents be found that have an effect on the molecular developmental mechanisms? Since 2012, the researchers in the LOEWE research cluster OSF have been active partners in the German Consortium for Translational Cancer Research (DKTK), which was founded in 2012 as one of the German centres for health research with the German Cancer Research Centre (DKFZ) in Heidelberg as the core centre and seven partner locations.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Hubert Serve,
Goethe University, Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main
(lead management)
Georg-Speyer-Haus, Frankfurt am Main
ASSOCIATED PARTNERS
Justus Liebig University Giessen

LOCATION . Frankfurt am Main

SUBJECT AREAS . Medicine, Biology, Chemistry, Pharmacology, Biochemistry

FUNDING PERIOD . 2010 to 2013

COORDINATION OFFICE
Birgit Rosiejak
Tel. +49 69 6301-5459
Rosiejak@em.uni-frankfurt.de

HEALTH . **UNTIL 2020**

© Dr. Ute Neubauer

PHARMACEUTICAL RESEARCH

Translational Medicine and Pharmacology TMP

The costs of developing new medicines are high. In cooperation with industry and academic groups, the LOEWE research centre Translational Medicine and Pharmacology TMP has set its sights on helping to cut development costs. At the interface between preclinical research and clinical development and trials, the aim is to ascertain the effectiveness and safety of pharmaceutical substances as quickly as possible and hence to raise the success rates of clinical development. The LOEWE research centre is continuing and expanding the work begun in the LOEWE research cluster Applied Pharmaceutical Research (2012 – 2014). That includes the further strategic development of the Translational Medicine and Pharmacology project group (TMP) at the Fraunhofer Institute for Molecular Biology and Applied Ecology (IME), which is ultimately intended to become the first Fraunhofer Institute in Frankfurt. At the research centre, the Fraunhofer project group TMP works closely with the participating groups at Frankfurt's Goethe University and at the Max Planck Institute for Heart and Lung Research in Bad Nauheim.

LOEWE RESEARCH CENTRE

COORDINATOR
Prof. Dr. Dr. Gerd Geisslinger, Goethe University, Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main
(lead management)
Fraunhofer Institute for Molecular Biology and
Applied Ecology (IME), Aachen
Max Planck Institute for Heart and Lung Research, Bad Nauheim

LOCATIONS . Frankfurt am Main, Bad Nauheim

SUBJECT AREAS . Clinical pharmacology, Pharmacology, Biochemistry, Molecular biology, Medicinal chemistry, Cell biology, Clinical research

FUNDING PERIOD . LOEWE Research Cluster 2012 to 2014
LOEWE Research Centre 2015 to 2020
Since 2021 Fraunhofer-Institut ITMP

COORDINATION OFFICE
Dr. Torsten Arndt
Tel. +49 69 6301-87159
Torsten.Arndt@ime.fraunhofer.de

HEALTH . **UNTIL 2013**

© Anna Schroll / Hessen schafft Wissen

PreBionics

Preventive Biomechanics

The LOEWE research cluster PreBionics has set itself the objective of gaining a better understanding of the changes in tissue mechanics caused by ageing and illness. To that end, the researchers analyse soft tissue at the macroscopic, cellular and molecular levels. Using computer simulation techniques, for example, they analyse mechanical effects produced by supportive structures (seating systems, knee prostheses, implants, stents, etc.), deformations of blood vessels caused by movement, the mechanics of tumours and the effect of compressive forces for the formation of cartilage cells. Other research topics include the characterisation of the mechanical features of aortae and aortic aneurysms, the mechanics of the jaw, teeth and dental implants, and forces that affect people on bus journeys. The acquisition of external funds has secured the future of many of the projects already begun in the research cluster.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr.-Ing. Gerhard Silber,
Frankfurt University of Applied Sciences
Prof. Dr. Jürgen Bereiter-Hahn,
Goethe University, Frankfurt am Main

PARTNERS . Frankfurt University of Applied Sciences
(lead management)
Goethe University, Frankfurt am Main
Philipps-Universität Marburg (until 2012)
ASSOCIATED PARTNERS
University of Wuppertal
Johannes Gutenberg University Mainz
Fresenius University of Applied Sciences, Idstein
Catholic Clinic Mainz

LOCATION . Frankfurt am Main

SUBJECT AREAS . Medicine, Medical engineering, Biosciences, Sports sciences, Informatics, Engineering, Mechanical engineering

UNDING PERIOD . 2010 to 2013

COORDINATION OFFICE
Prof. Dr. Jürgen Bereiter-Hahn
Tel. +49 69 1533 2162
bereiter-hahn@preventive-biomechanics.eu

CULTURE AND SOCIETY . **UNTIL 2019**

© Rüdiger Krause

Prehistoric conflict research

Fortresses of the Bronze Age

Even today, Roman castles and fortresses from the Middle Ages continue to shape the cultural landscape of Europe. Less well known and also not so extensively researched are the fortified settlements with strong walls that were already being built in the Bronze Age. From the transitional period from the 17th to 16th century B.C., these fortifications served as protection against attackers and at the same time as power bases from which territories and transport routes could be controlled. The LOEWE research cluster "Prehistorical Conflict Research" aims to close this research gap and to apply an interdisciplinary approach to the study of the Bronze Age fortresses located between the Taunus and the Carpathians, which date back to some 4000 years ago. By investigating the theoretical basis of dominance and war in the Bronze Age as well as undertaking exemplary archaeological excavations, the phenomenon of the Bronze Age fortress should be better understood. This will involve a social-historical focus on violent conflicts in the Bronze Age and a comparison with conditions in the Middle Ages.

LOEWE RESEARCH CLUSTER

COORDINATORS
Prof. Dr. Rüdiger Krause, Goethe-University, Frankfurt am Main
Prof. Dr. Svend Hansen, German Archaeological Institute

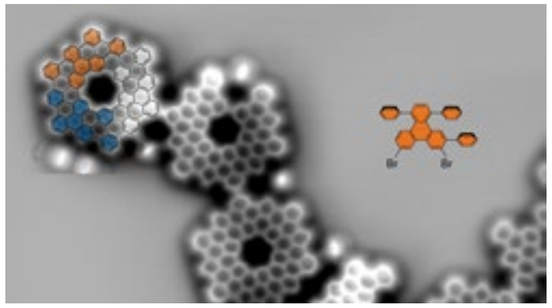
PARTNERS . Goethe-University, Frankfurt am Main,
Roman Germanic Commission of the German Archaeological Institute in Frankfurt

LOCATIONS . Frankfurt am Main, Berlin

SUBJECT AREAS . Archaeology, Prehistoric archaeology, History / Medieval history, Sociology

FUNDING PERIOD . 2016 to 2019

COORDINATION OFFICE
Marie-Hélène Haußels
Tel. +49 69 798-32122
haussels@em.uni-frankfurt.de



© Daniel Martín-Jimenez / Daniel Ebeling

PriOSS

Principles of on-surface synthesis

Organic nanostructures can be utilized in electronics devices such as microchips or in next-generation quantum computers. Lately, it was discovered that these functional nanostructures can be built very successfully on surfaces, a strategy denoted as "on-surface synthesis". However, in contrast to the well-established solution-based synthesis, which has been applied for over 200 years, on-surface synthesis is still in its infancy. The objective of the LOEWE focus group is to develop fundamental strategies of on-surface synthesis and to provide a toolset for this new method.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. André Schirmeisen,
Institute for Applied Physics, Justus Liebig University Giessen
Prof. Dr. Herrmann A. Wegner (deputy), Institute for Organic Chemistry, Justus Liebig University Giessen

PARTNERS . Justus Liebig University Giessen (lead management)
Philipps University of Marburg

LOCATIONS . Gießen, Marburg

SUBJECT AREAS . Physics, Chemistry, Materials Science

FUNDING PERIOD . since 2021

COORDINATION OFFICE
Dr. Daniel Ebeling
Tel. +49 641 99 33482
Daniel.Ebeling@ap.physik.uni-giessen.de

INTERNET
www.uni-giessen.de/forschung/prioss

© Claudia Junghänel / Herder-Institut, Marburg

Regions of Conflict in Eastern Europe

Interpretive knowledge as a prerequisite for solution oriented strategies

The dramatic developments in Ukraine in 2013/2014, the Crimean annexation in 2014 and the subsequent Western sanctions against Russia thrust the continent into a renewed East-West conflict. Although the Ukrainian-Russian crisis has been the most tangible element of this development, other unresolved regional conflicts in Eastern Europe have also garnered attention. The continued existence of such conflicts has led to the current conclusion that previous miscalculations were more the result of inadequate interpretations of the situation rather than a lack of factual knowledge. Accordingly, the LOEWE research cluster Conflict Regions in Eastern Europe aims to develop new forms of scholarly communication between the East and West and is guided by the principle of establishing interpretative insight as a prerequisite for devising resolution strategies to help mend the renewed rift in Europe. This LOEWE research cluster will seek to work out a new typology of conflict regions through direct dialogue with partners in Eastern Europe on the basis of a multi-perspective analysis of the past and present of these regions – using frames of reference from historical, linguistic, cultural, political and social studies.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Monika Wingender, Justus-Liebig-University Giessen, Prof. Dr. Peter Haslinger, Herder Institute for Historical Research on East Central Europe – Institute of the Leibniz Association, Marburg

PARTNERS . Justus Liebig University Giessen, represented by The Giessen Center for Eastern European Studies (GiZo), Herder Institute for Historical Research on East Central Europe – Institute of the Leibniz Association, Marburg
ASSOCIATED PARTNERS . Leibniz Institute Hessian Foundation for Peace and Conflict Research (HSFK), German Poland Institute Darmstadt (DPI), Center for Conflict Studies Marburg (ZfK), Schader Foundation Darmstadt

LOCATIONS . Gießen, Marburg

SUBJECT AREAS . Historical Sciences, Linguistics, Cultural Studies, Social Sciences

FUNDING PERIOD . 2017 to 2021

COORDINATION OFFICE
Dr. Aksana Braun
Tel. +49 641 99 31062
Aksana.Braun@gizo.uni-giessen.de

© Jürgen Lecher

Religious Positioning

Modalities and constellations in Jewish, Christian and Islamic contexts

The role of religions in today's globalized world is ambivalent. They do not only serve to promote meaning, orientation and cohesion, but also act as a driving force of conflicts that often culminate in violence. The interdisciplinary LOEWE research cluster "Religious Positioning" is devoted to the question under which conditions religious antagonisms in today's multi-religious and multicultural societies can be less destructively resolved. The project relies on the assumption that religions are fundamentally positional in character and thus potentially conflictual. At the same time, a religion's approach to religious plurality and difference does not necessarily have to assume aggressive forms. The LOEWE project is dedicated to the study of modalities of religious positioning that are capable of including a pluralistic view and investigates which historical, political and cultural constellations either promote or hinder such an approach. The project thus aims to contribute to the public discourse concerning migration, multi-religiosity, the encounter between of religions and the managing of religious conflicts.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Christian Wiese, Prof. Dr. Isabell Diehm (Co-Speaker), Goethe University, Frankfurt am Main

PARTNERS . Leibniz Institute Hessian Foundation for Peace and Conflict Research, Hessian Center for Political Education, Protestant Academy Frankfurt, Catholic Academy Rabanus Maurus, Central Council of Jews in Germany - Education Department, Jewish Museum Frankfurt, Bildungsstätte Anne Frank Frankfurt, Religious Education Institute of the Protestant Church of Kurhessen-Waldeck and the Protestant Church in Hesse and Nassau, Research College for Human Sciences Bad Homburg

LOCATIONS . Frankfurt am Main, Gießen

SUBJECT AREAS . Protestant Theology, Jewish Philosophy of Religion, Islamic Studies, Religious Studies, Jewish Studies, Educational Sciences, Ethnology Sociology

FUNDING PERIOD . 2017 to 2021

COORDINATION OFFICE
Dr. Nina Fischer
Tel. +49 69 79833386
N.Fischer@em.uni-frankfurt.de

© Katrin Binner

RESPONSE

Resource-Efficient Permanent Magnets by Optimised Use of Rare Earths

Permanent magnets are strategic materials for the energy turnaround; they are essential components in modern wind turbines and electromobility. High performance permanent magnets currently contain significant quantities of rare earth elements, which are mined under environmentally problematic conditions and, because of their limited availability, lead to market dependencies. In the LOEWE research cluster RESPONSE, scientists from the fields of material science, chemistry and mechanical engineering are seeking alternatives. They are taking advantage of new material concepts to develop innovative magnetic materials that, for example, make use of iron-cobalt alloys, manganese-based alloys and iron nitrides. The goal is to achieve a drastic reduction in the amount of critical rare earths used in permanent magnets or, if possible, to substitute them completely.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Oliver Gutfleisch,
Technical University of Darmstadt (TU Darmstadt)

PARTNER . Technical University of Darmstadt (TU Darmstadt)
ASSOCIATED PARTNERS . Fraunhofer Project Group for Materials Recycling and Resource Strategies (IWKS), Hanau

LOCATION . Darmstadt

SUBJECT AREAS . Materials science, Chemistry, Physics, Mechanical engineering

FUNDING PERIOD . 2014 to 2017

COORDINATION OFFICE
Sabine Crook
Tel. +49 6151 16-76195
crook@fm.tu-darmstadt.de

BUSINESS AND TECHNOLOGY . **UNTIL 2014**

© Thomas Ernsting / Hessen schafft Wissen

RITSAT

Ion Thrusters for Space Travel – Plasma Physics and Future Technologies

Ion thrusters are the marathon runners of the engines designed for space travel. They have relatively low levels of thrust and therefore, unlike chemical thrusters, are not well suited to transporting space probes or satellites into space. However, their endurance capacity and precision ensure the manoeuvrability of spacecraft in outer space and make it possible to overcome interplanetary distances. The application of ion thrusters in the removal of space debris such as disused satellites or upper rocket stages is now also a possibility; impulses transmitted to objects propel them out of the earth's orbit. The LOEWE research cluster RITSAT is developing and testing new and highly specialised ion thrusters. The contractually agreed cooperation with the German Aerospace Center (DLR) in Göttingen and Airbus safeguards the continuation of the foundational research on ion thrusters once the LOEWE funding has expired. The Technische Hochschule Mittelhessen will continue to participate in the development of electronic components through cooperative doctoral projects.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Peter J. Klar,
Justus Liebig University Giessen

PARTNERS . Justus Liebig University Giessen (lead management)
Technical University of Central Hesse (THM), Giessen
ASSOCIATED PARTNERS
German Aerospace Center (DLR) – Institute of Aerodynamics and Flow Technology, Göttingen, Max Planck Institute for Extraterrestrial Physics (MPE), Garching, GSI Helmholtz Centre for Heavy Ion Research, Darmstadt

LOCATION . Gießen

SUBJECT AREAS . Plasma physics, Aerospace physics, Materials science, Micro and nanotechnology

FUNDING PERIOD . 2012 to 2014

COORDINATION OFFICE
Dr. Martin Güngerich
Tel. +49 641 99-33102
Martin.Guengerich@exp1.physik.uni-giessen.de

BUSINESS AND TECHNOLOGY . **UNTIL 2019**

© House of Finance

SAFE

Sustainable Architecture for Finance in Europe

Fully operating financial markets are crucial to a flourishing economy, growth and prosperity. How much flexibility do they need to create scope for innovation and competition? On the other hand, how much regulation is needed to ensure stability? The LOEWE research centre SAFE – Sustainable Architecture for Finance in Europe, which is located in Goethe University Frankfurt's House of Finance, investigates the requirements of an optimal regulatory framework for the financial markets and their protagonists. Scholars from the fields of finance, micro- and macroeconomics, marketing, sociology and law focus first and foremost on the situation in Europe – also drawing on new, independently compiled data. SAFE's second pillar, the Policy Center, engages in a constant dialogue with members of governments and parliaments in Berlin, Brussels and Wiesbaden. The objective of the Policy Center is to give independent, research-based policy advice and, thus, to contribute to a sustainable, stability- and growth-oriented policy.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr. Jan Pieter Krahnen,
Goethe University, Frankfurt am Main

PARTNERS . Center for Financial Studies, Frankfurt am Main (lead management)
Goethe University, Frankfurt am Main

LOCATION . Frankfurt am Main

SUBJECT AREAS . Economics, Law, Sociology

FUNDING PERIOD . 2013 to 2019
Since 2020 LLeibniz Institute for Financial Research SAFE

COORDINATION OFFICE
Dr. Muriel Büsser
Tel. +49 69 798-34006
buesser@safe.uni-frankfurt.de

INTERNET
www.safe-frankfurt.de

BUSINESS AND TECHNOLOGY . **UNTIL 2018**

© Paavo Blåfield / Universität Kassel

Safer Materials

Safe and Reliable Materials

New materials often have significant advantages over traditional materials; for example, they can be lighter, harder, more flexible or more long-lasting. However, their damage tolerance is not always clear, which can lead to considerable safety risks in the event of unforeseen incidents. The objective of the LOEWE research cluster Safer Materials is to develop methods and technical expertise that will make materials safe and reliable when stretched to their performance limits and when subject to various external influences. In the focus of the investigations are the well-chosen material classes high-strength concretes and steels, secondary aluminium and natural fiber reinforced plastics. The researchers are also recording the interactions between human behaviour during production and processing and the material properties, a field that had previously been largely unexplored. The LOEWE research cluster is ultimately intended to become a new materials engineering subdiscipline at Kassel University.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr.-Ing. Hans-Peter Heim, University of Kassel

PARTNER . University of Kassel
ASSOCIATED PARTNERS
Institute of Production Technology and Logistics, University of Kassel, Institute of Structural Engineering, University of Kassel, Fraunhofer Institute for Applied Polymer Research IAP, Potsdam, Fraunhofer Institute for Systems and Innovation Research ISI / Karlsruhe Institute of Technology (KIT), Karlsruhe

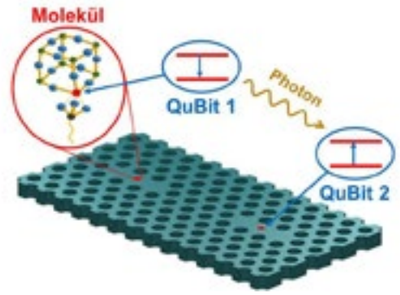
LOCATION . Kassel

SUBJECT AREAS . Materials engineering, Metallic materials, Plastics engineering, Structural materials and construction chemistry, Engineering mechanics, Foundry engineering, Solid construction, System and innovation research, Applied polymer research, Work and organisation psychologye

FUNDING PERIOD . 2015 to 2018

COORDINATION OFFICE
Dr.-Ing. Jan-Christoph Zarges
Tel. +49 561 804-2544
zarges@uni-kassel.de

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2023**



© Uni Kassel (https://www.uni-kassel.de/forschung/smolbits/smolbits/)

SMolBits

Scalable molecular quantum bits

Quantum computers promise to solve previously unsolvable problems with conventional computers. Leading global companies in this field are putting a lot of effort into achieving this goal, although the concepts currently used are very limited. The LOEWE focus "Scalable molecular quantum bits (SMolBits)" investigates a new concept in which single molecules are used as information units (quantum bits) to implement a scalable quantum computer. For this purpose, a technology platform based on a photonic chip should be realized on which individual molecules are linked to each other via light. This serves as the basis for scalable quantum processors that would be far superior to conventional binary computer systems. In order to achieve these goals, a seven-member consortium of different disciplines (chemistry, physics, electrical engineering) of the Center for Interdisciplinary Nanostructure Science and Technology (CINSaT) has joined forces.

LOEWE RESEARCH CLUSTER

COORDINATOR.
Professor Dr. Johann Peter Reithmaier, University of Kassel

PARTNERS . University of Kassel

LOCATIONS . Kassel

SUBJECT AREAS . theoretical physics, technological physics, chemistry, experimental physics and electrical engineering

FUNDING PERIOD . 2019 to 2023

COORDINATION OFFICE
secretariat: Regina Hajeck
phone: +49 561 804-4586
regina.hajeck@ina.uni-kassel.de

INTERNET
www.uni-kassel.de/forschung/smolbits/smolbits/

BUSINESS AND TECHNOLOGY . **UNTIL 2017**

© Paavo Blåfield / Universität Kassel

Social Link

„Always Online?" – a New Communication Paradigm for the Communication Society

Mobile communication has major advantages: it makes us more flexible and enhances many working procedures. However, permanent accessibility via mobile communication devices can be a source of stress; especially in the context of their job, many people are finding it difficult to consistently safe-guard private space. In the LOEWE research cluster Social Link researchers from informatics, information technology, psychology, law and economics are together working on a new communication paradigm that is intended to help people to find a work-life balance in the age of the internet. Through the application of compulsory rules about who should communicate or absorb what, when and how much, their aim is to help people to avoid stress. Alongside sustainable legal and psychological concepts, technical solutions are to be developed, for example, that – like an email spam filter – block specific information at certain times and in certain contexts so that it is not sent to the intended recipient.

LOEWE RESEARCH CLUSTER

COORDINATOR. Prof. Dr.-Ing. Klaus David, University of Kassel

PARTNERS . University of Kassel (lead management)
Technical University of Darmstadt (TU Darmstadt)

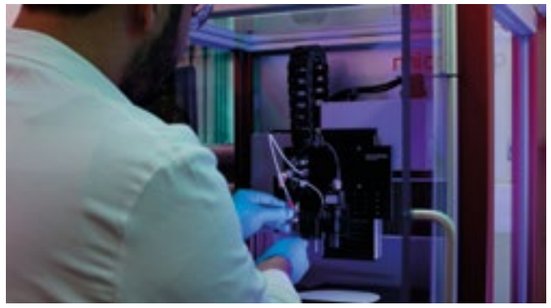
LOCATIONS . Kassel, Darmstadt

SUBJECT AREAS . Informatics, Communication technology, Business psychology, Business law, Applied information security, Marketing and human resources management

FUNDING PERIOD . 2014 to 2017

COORDINATION OFFICE
Michael Wojtek
Tel. +49 561 804-6058
michael.wojtek@comtec.eecs.uni-kassel.de

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2014**



© Katrin Binner / TU Darmstadt

SOFT CONTROL

Switching Surface Properties with Stimuli-responsive Soft Matter

Intelligent synthetic films consist of macromolecules that react to external stimuli such as light or electrical or magnetic fields, for example by making dynamic, reversible changes to their form or structure. If these molecules are applied to interfaces in very thin layers, they can be used in a targeted manner to switch the surface properties of substrate materials. The LOEWE research cluster SOFT CONTROL is conducting investigations to find out which polymers can be switched as homogeneously, quickly and efficiently as possible through external stimuli and hence to explore new application possibilities – for example, in printing technology, the management of chemical reactions or in medicine. SOFT CONTROL's objective is to continue its research in a DFG Collaborative Research Centre and will be preparing a full proposal in 2015.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Markus Biesalski,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt) (lead management)
Darmstadt University of Applied Sciences
Fraunhofer Institute for Structural Durability and System Reliability (LBF), Darmstadt

LOCATION . Darmstadt

SUBJECT AREAS . Chemistry, Biology, Physics, Biotechnology

FUNDING PERIOD . 2011 to 2014

COORDINATION OFFICE
Vanessa Schmidt
Tel. +49 6151 16-75140
schmidt@cellulose.tu-darmstadt.de

BUSINESS AND TECHNOLOGY . **UNTIL 2022**

© Florian Dewald

Software-Factory 4.0

Reengineering – better Availability of Software

Software-based systems have a central role in industrial production, in ensuring the reliability of transport systems, in automatic information processing, and for providing services. The correct functionality, efficiency, and security of software is crucial. Each of these aspects might make the difference between financial success and failure, sometimes even between life and death. The timely availability of suitable software is a critical success factor for companies and for entire economies. Moreover, it is a prerequisite for making modern societies function. Paradigm shifts in industrial production (Industry 4.0) and in automatic processing of information (Big Data) can only be realized if they are supported by suitable software systems. The LOEWE research cluster Software-Factory 4.0 uses a complementary approach to developing the needed software from scratch. The goal is to enable a more timely availability of suitable software by selectively adapting existing software systems to new requirements.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr.-Ing. Heiko Mantel,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt)

LOCATION . Darmstadt

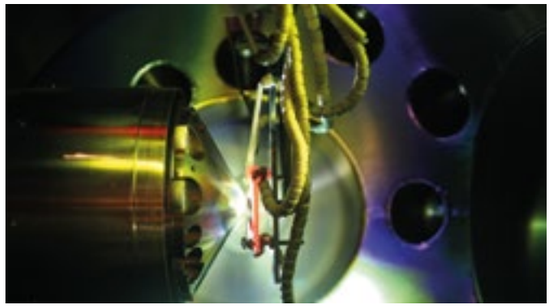
SUBJECT AREAS . Computer Science, Electrical engineering and information technology, Mechanical Engineering

FUNDING PERIOD . 2018 to 2022

COORDINATION OFFICE
TU Darmstadt
Software-Factory 4.0 Geschäftsstelle
+49 6151 16-25250
office@software-factory-4-0.de

INTERNET
www.software-factory-4-0.de

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2016**



© Justus-Liebig-Universität Gießen

STORE-E

Storage in Boundary Layers

Whether in connection with new energies or e-mobility, the storage of energy is of vital significance. In the LOEWE research cluster STORE-E chemistry, physics and materials science experts are conducting fundamental research in the field of chemical and electrochemical storage, with a view to enabling urgently needed new technologies. In cooperation with partners from the business sector, their aim is to explore what is needed to produce new, higher-performance batteries, storage catalytic converters and supercapacitors. The main focus is on the electrochemistry of solid materials and the development of new methods and materials. Particular attention is paid to the role played by inner interfaces.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Jürgen Janek,
Justus Liebig University Giessen

PARTNERS . Justus Liebig University Giessen (lead management)
Philipps University of Marburg
Technical University of Central Hesse (THM)

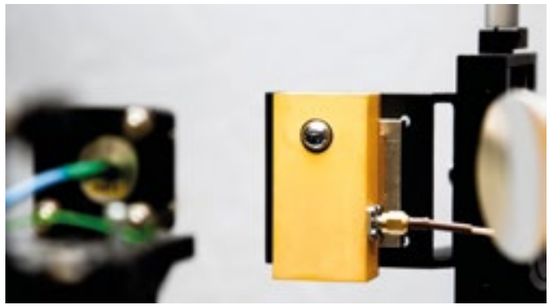
LOCATIONS . Gießen, Marburg

SUBJECT AREAS . Chemistry, Physics, Materials science

FUNDING PERIOD . 2013 to 2016

COORDINATION OFFICE
Dr. Joachim Sann
Tel. +49 641 99-34512
Joachim.Sann@phys.chemie.uni-giessen.de

BUSINESS AND TECHNOLOGY . **UNTIL 2016**



© Sebastian Strunck

STT

Sensors Towards Terahertz

Terahertz waves lie between microwaves and infrared waves. Compared with infrared waves, they penetrate many materials with a higher resolution than microwaves and thus enable the identification or contact-free characterisation and inspection of materials or biological tissue. The aim of the LOEWE research cluster is to conduct fundamental research for innovative terahertz technologies and sensor concepts. These make it possible, for example, to identify specific binding processes (antibody-antigen) by means of a spectral signature or to use imaging procedures to detect defects within or on the interfaces of a raw material or a workpiece without destroying it.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr.-Ing. Rolf Jakoby,
Technical University of Darmstadt (TU Darmstadt)

PARTNERS . Technical University of Darmstadt (TU Darmstadt) (lead management)
Goethe University, Frankfurt am Main

LOCATIONS . Darmstadt, Frankfurt am Main

SUBJECT AREAS . Physics, Electrical engineering, Information technology, Materials science, Chemistry

FUNDING PERIOD . 2013 to 2016

COORDINATION OFFICE
Dr.-Ing. Andreas Penirschke
Tel. +49 6151 16-3162
stt@imp.tu-darmstadt.de

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2017**

© Ralf K.Wegst

SynChemBio

Innovative Synthetic Chemistry for the Selective Modulation of Biological Processes

The goal of the chemists and pharmacists in the LOEWE research cluster Innovative Synthetic Chemistry is to produce bioactive chemical compounds with no other characteristics than those intended for them. By developing and applying innovative chemical strategies, they are seeking to contribute to the accurate steering of – naturally extremely complex – biological processes. The new methods are intended to be used for both research into biological processes and the production of pharmaceuticals. Among other things, the scientists are endeavouring to increase the precision of active agents until they can be considered free from side effects. The distinguishing feature of this research cluster is that a particularly broad range of chemical methods and compound classes in organic (small molecules, complex natural substances, diamondoids, modified biomolecules), inorganic (metal complexes, organometallic compounds, metal clusters) and nanoscale (metal nanoparticles, nano-cages, polymers) chemistry are being developed for specific application in biomolecular recognition.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Eric Meggers,
Philipps University of Marburg,
Prof. Dr. Harald Schwalbe (deputy),
Goethe University, Frankfurt am Main
Prof. Dr. Peter R. Schreiner (deputy),
Justus Liebig University Giessen

PARTNERS . Philipps University of Marburg,(lead management)
Goethe University, Frankfurt am Main
Justus Liebig University Giessen

LOCATIONS . Marburg, Gießen, Frankfurt am Main

SUBJECT AREAS . Chemistry, Pharmaceutics, Biosciences, Physics

FUNDING PERIOD . 2014 to 2017

COORDINATION OFFICE
Andrea Tschirch
Tel. +49 6421 28-25561
andrea.tschirch@staff.uni-marburg.de

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2018**

© Thomas Ernsting, Hessen schafft Wissen

SYNMIKRO

LOEWE Research Centre for Synthetic Microbiology

Microorganisms play an important role in nature and are used in many industrial fields. They supply energy, are essential for the production of many food items and, thanks to modern biotechnology, also produce a wide variety of chemicals. SYNMIKRO brings together classic analytical and synthetic research methods, ultramodern high throughput and imaging technologies and computer-based modelling methods in pursuit of a better understanding of the way in which microbial cells and their constituent parts function and in order to equip microorganisms with specifically tailored properties. Possible areas of application include the development of new pharmaceuticals and fine chemicals or the production of biofuels from biomass sources that do not biodegrade easily, such as wood and straw. From the outset the LOEWE centre has pursued a bioethical approach in its research activities.

LOEWE RESEARCH CENTRE

COORDINATORS . Prof. Dr. Anke Becker,
Prof. Dr. Peter Graumann (deputy),
Philipps University of Marburg

PARTNERS . Philipps University of Marburg, (lead management)
Max Planck Institute for Terrestrial Microbiology, Marburg

LOCATION . Marburg

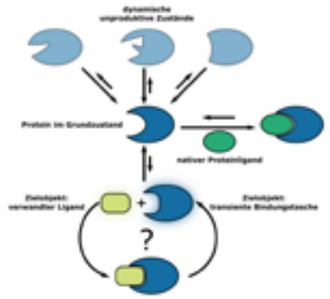
SUBJECT AREAS . Synthetic biology, Systems biology, Microbiology, Structural biology, Genetics, Pharmaceutics, Cell biology, Chemistry, Physics, Mathematics, Informatics, Bioethics

FUNDING PERIOD . 2010 to 2018
Since 2019 SYNMIKRO, Center for Synthetic Microbiology at the Philipps-Universität Marburg has been established

COORDINATION OFFICE
Dr. Jan-Wolfhard Kellmann
Tel. +49 6421 28 24400
jan-wolfhard.kellmann@synmikro.uni-marburg.de

INTERNET
www.uni-marburg.de/en/synmikro

HEALTH



© Luis Vollmers

TRABITA

Transient Binding Pockets for Drug Discovery

Usually, drug molecules bind to specific therapeutic target proteins and thereby regulate their activity. Those proteins remain in their native conformation, however they can form transient binding pockets temporarily. Often, drugs targeting these transient binding pockets have higher selectivity amongst other advantages, but on the downsides they are harder to discover.

The interdisciplinary consortium TRABITA was founded to facilitate the development of new therapeutic drugs for transient binding pockets. The project is supported by the Hessian Ministry of Science and Art, i.e. the LOEWE-Funding.

The project is designed to last for four years and is coordinated by the TU Darmstadt. The close cooperation with scientists of the h_da and of the Goethe-University is essential for the success of the project.

LOEWE RESEARCH CLUSTER

COORDINATOR
Prof. Felix Hausch, Technical University of Darmstadt (TU Darmstadt)
Prof. Dr. Stefan Knapp (Co-Speaker), Goethe University, Frankfurt am Main

PARTNERS
Technical University of Darmstadt (TU Darmstadt) (lead management)
Goethe University, Frankfurt am Main
University of Applied Sciences Darmstadt

LOCATIONS . Darmstadt, Frankfurt am Main

SUBJECT AREAS . Biophysics, Chemistry (protein models), Chemistry (chemical tools)

FUNDING PERIOD . since 2020

COORDINATION OFFICE
Prof. Dr. Felix Hausch
Tel. +49 6151 16-21245
felix.hausch@tu-darmstadt.de

INTERNET
https://www.chemie.tu-darmstadt.de/trabita/trabita_d/index.en.jsp

© Sascha Mannel

Translational Biodiversity Genomics

Understanding and protecting biodiversity

The diversity of species forms the foundation of our lives, and the evident diversity loss poses great challenges to society. The LOEWE Centre for Translational Biodiversity Genomics aims to better understand and protect biodiversity by investigating its genomic basis. The genome of an organism is found in the nucleus of each of its cells and contains all the information about the organisms' structure, properties and evolution. The genomic analysis of a wide variety of organisms adresses important and diverse questions: How can species be precisely determined on the basis of their genome? Which organisms form communities, and how is their genomic diversity influenced by environmental factors? Can the genomic information help to identify substances with economic or medical potential? Furthermore, the aim of the centre is the translation of basic research into services and applications relevant for industry and society. The research areas comprise of: Comparative Genomics, Natural Products Genomics, Genomic Biomonitoring and Functional Environmental Genomics.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr. Axel Janke, Senckenberg Nature Research Society and Goethe University, Frankfurt am Main

PARTNERS . Senckenberg Nature Research Society, Frankfurt am Main (management), Goethe University, Frankfurt am Main, Justus Liebig University Giessen, Fraunhofer Institute for Molecular Biology and Applied Ecology IME, Giessen, Fraunhofer Institute for Translational Medicine and Pharmacology ITMP, Frankfurt am Main, Max-Planck-Institute for Terrestrial Microbiology, Marburg

LOCATIONS . Frankfurt am Main, Giessen

SUBJECT AREAS . Biodiversity, Bioinformatics, Biomonitoring, Genomics, Natural Products Genomics

FUNDING PERIOD . since 2018

COORDINATION OFFICE
Dr. Julia Intemann
Tel. +49 69 7542-1824
julia.intemann@senckenberg.de

INTERNET
https://tbg.senckenberg.de

© Rolf K. Wegst / Philipps-Universität Marburg

Tumours and Inflammation

Tumours and Inflammation

Systemic and local inflammatory processes are a hallmark of many tumours and have a direct impact on tumour development. Around one-fifth of all tumorous diseases are now thought to be caused by chronic inflammation. It has long been known that patients who suffer from chronic inflammatory diseases, such as Crohn's disease, chronic gastritis and ulcerative colitis, have a higher risk of a tumour developing in the affected tissues or organs. Many environmental and lifestyle factors – for instance smoking, excessive alcohol consumption, obesity and sunburn – cause inflammatory reactions in the body and therefore increase the risk of cancer. The LOEWE research cluster "Tumours and Inflammation" investigated precisely how inflammatory and tumour cells affect each other as the first stage in the development of new cancer treatment strategies. Most of the research groups are continuing their work in the DFG-funded Collaborative Research Centre "Chromatin Changes in Differentiation and Malignancies" and at the newly established Centre for Tumour and Immunobiology.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Rolf Müller, Prof. Dr. Harald Renz, Prof. Dr. Michael Lohoff, Philipps University of Marburg

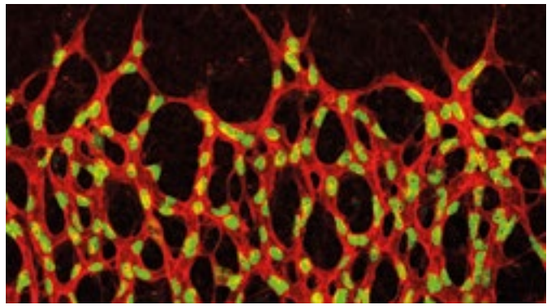
PARTNER . Philipps University of Marburg
ASSOCIATED PARTNERS . Justus Liebig University Giessen

LOCATION . Marburg

SUBJECT AREAS . Cell biology, Genetics, Molecular biology, Bioinformatics, Immunology, Medicine

FUNDING PERIOD . 2008 to 2012

COORDINATION OFFICE
Dr. Abdo Konur
Tel. +49 6421 28-26386
konur@imt.uni-marburg.de



© Michel Potente

Ub-Net

Ubiquitin Networks

Ubiquitin is a cellular all-rounder – it regulates the breakdown of proteins, the repair of DNA damage, signal transduction, cell death and many other processes. It occurs everywhere and is attached to other proteins in a variety of different ways, thus determining their fate. Errors in this sophisticated system have been linked to numerous diseases, e.g. cancer, Parkinson's, infectious diseases and inflammation. Ubiquitin even plays a role in biological ageing. Researchers call it a secret code, which is transmitted by ubiquitin and needs to be deciphered. This is where the LOEWE research cluster Ubiquitin Networks comes in. The cluster aims at analysing the molecular details of the ubiquitin networks in order to develop new therapeutic strategies.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Ivan Dikic,
Goethe University, Frankfurt am Main

PARTNERS . Goethe University, Frankfurt am Main (lead management)
Max Planck Institute for Heart and Lung Research, Bad Nauheim
ASSOCIATED PARTNERS . Merck-Serono GmbH, Darmstadt

LOCATIONS . Frankfurt am Main, Bad Nauheim

SUBJECT AREAS . Biochemistry, Molecular biology, Structural biology, Cellular biology, Developmental biology, Model organisms, Protein engineering, Bioinformatics, Systems biology, Physical biology, Biomedicine, Molecular haematology, Molecular oncology

FUNDING PERIOD . 2014 to 2017

COORDINATION OFFICE
Dr. Kerstin Koch
Tel. +49 69 6301-84250
k.koch@em.uni-frankfurt.de

© Jan Michael Hosan / Hessen schafft Wissen

UGMLC

Universities of Giessen and Marburg Lung Center

The lung is an "ecosystem" of its own. It is involved in an ongoing exchange with the environment, functions differently from all other inner organs and has its own pattern of diseases. The LOEWE centre UGMLC researches lung diseases: from acute ailments such as pulmonary infections through chronic complaints such as asthma to lung cancer. The research focuses on the molecular signalling pathways that underlie diseases which affect the lungs and respiratory tracts. This is taken as the starting point for the development of innovative therapeutic concepts as UGMLC sees itself as a research and treatment centre that brings together research and clinical competences. The aim is to enhance the molecular-based, customised and individualised diagnosis and therapy of ailments affecting the lungs and respiratory tracts.

LOEWE RESEARCH CENTRE

COORDINATOR . Prof. Dr. Werner Seeger,
Justus Liebig University Giessen

PARTNERS . Justus Liebig University Giessen (lead management)
Philipps University of Marburg
Max Planck Institute for Heart and Lung Research, Bad Nauheim

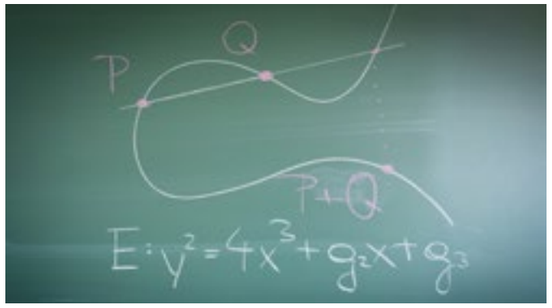
LOCATIONS . Gießen, Marburg, Bad Nauheim

SUBJECT AREAS . (Bio)Medicine, Genetics, Microbiology, Biochemistry, Signalling, Developmental biology

FUNDING PERIOD . 2010 to 2015

COORDINATION OFFICE
Dr. Sylvia Weissmann
Tel. +49 641 99-42411
sylvia.weissmann@ugmlc.de

NATURAL SCIENCE AND ENVIRONMENT . **UNTIL 2022**



© Felipe Fernandes

USAG

Uniformized structures in arithmetic and geometry

How can complicated geometric spaces be described by simpler spaces? An approach is offered by the concept of uniformization, which has its origin in the works of the famous 19th century mathematicians Bernhard Riemann and Felix Klein. This approach offers the possibility of substituting a complicated geometric space by a much simpler one without changing the local structure. The complexity is described by the inner symmetries of the simpler space. This basic idea has proved to be exceedingly powerful and has been generalized in various directions, e.g. in so-called non-Archimedean geometries. New insights are expected to be gained regarding current arithmetic and geometric problems of classification in the LOEWE research cluster "Uniformized Structures in Arithmetic and Geometry" by connecting various techniques of uniformization. The investigations in this undertaking will focus on algebraic varieties, i.e. solution sets of equation systems given by polynomials. Important examples such as elliptic curves and Calabi-Yau varieties also play a prominent role in applications in the areas of cryptography and mathematical physics. Cryptographic algorithms, which are based on elliptic curves and related number-theoretic structures, are used, for example, in encryptions employed for handling online shopping and mobile phone calls.

LOEWE RESEARCH CLUSTER

COORDINATORS . Prof. Dr. Jan Hendrik Bruinier,
Technical University of Darmstadt (TU Darmstadt)
Prof. Dr. Martin Möller (deputy),
Goethe-University, Frankfurt am Main

PARTNERS . Technical University of Darmstadt (TU Darmstadt),
Goethe-University, Frankfurt am Main

LOCATIONS . Darmstadt, Frankfurt am Main

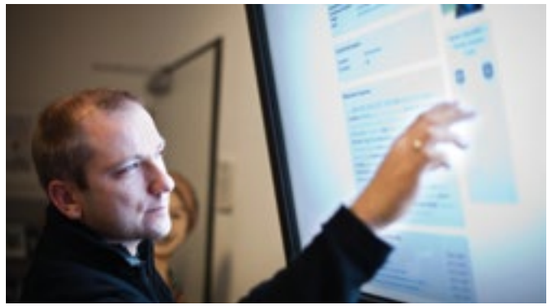
SUBJECT AREAS . Working Group Algebra,
FB Mathematics, TU Darmstadt;
Focus on Algebra and Geometry,
FB Computer Science and Mathematics, GU Frankfurt

FUNDING PERIOD . 2018 to 2022

COORDINATION OFFICE
Prof. Dr. Jan Hendrik Bruinier
Tel. +49 6151 16-22462
bruinier@mathematik.tu-darmstadt.de

INTERNET
http://www.mathematik.tu-darmstadt.de/loewe-usag

BUSINESS AND TECHNOLOGY . **UNTIL 2013**



© VENUS

VENUS

Designing Socio-Technical Networks in Situative Ubiquitous Systems

Information and communication technology is ubiquitous today. How can the development of new ubiquitous computing services and applications meet the users' technical and nontechnical expectations? Where is the overlap between technical developments and social acceptance? VENUS has delivered a software development methodology that takes systematic account of the interaction between technology, individual users and society. Questions of usability and confidence in the technology as well as legal and economic concerns are addressed. For example, VENUS has developed smartphone applications that provide help in organising social contacts without invading the private sphere more than the user would like.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Kurt Geihs, University of Kassel

PARTNERS . University of Kassel

LOCATION . Kassel

SUBJECT AREAS . Informatics, Business informatics,
Man-machine interaction, Law

FUNDING PERIOD . 2010 to 2013

COORDINATION OFFICE
Universität Kassel
Wissenschaftliches Zentrum ITeG
Geschäftsstelle
Pfannkuchstraße 1
34121 Kassel

NATURAL SCIENCE AND ENVIRONMENT

© Senckenberg

VeWA

Past warm periods as natural analogues of our 'high CO_2' climate future

What do we expect if the carbon dioxide content of the atmosphere doubles compared to pre-industrial levels? According to estimates by the Intergovernmental Panel on Climate Change (IPCC), such a greenhouse climate can be expected before the end of this century without effective countermeasures. The last time Earth experienced comparably high CO_2 levels more than 35 million years ago, during the Palaeogene. In the VeWA consortium, geologists, biologists, geographers and climate modellers have joined forces to quantitatively investigate the deep-time palaeoclimate and the palaeoenvironment as potential analogues of such high-CO_2 periods, ideally at seasonal resolution. At the same time, the VeWA team considers looking back also as a window into the future, since climate models for climate prediction can also be applied to the geological past, thus allowing their performance to be evaluated. VeWA uses the composition of marine organisms and that of sediments on land as climate archives, which also includes the World Heritage site Messel in Hessen. Overall, VeWA aims to reconstruct the climate on land and in the sea, the chemistry of the ocean and the development of biodiversity during high-CO_2 periods. The results and background will be presented in a hands-on exhibition at the Senckenberg Museum.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Wolfgang Müller,
Goethe University, Frankfurt am Main

PARTNER . Goethe University Frankfurt (lead)
Senckenberg Nature Research Society, Frankfurt am Main

LOCATION . Frankfurt am Main

SUBJECT AREAS . FB11 Geosciences/Geography (Institute for Geosciences, Institute for Atmosphere and Environment, Institute for Physical Geography)

FÖRDERZEITRAUM . since 2020

COORDINATION OFFICE
Karin Müßig
muessig@geo.uni-frankfurt.de

INTERNET
https://www.vewa-project.de/en/

BUSINESS AND TECHNOLOGY

© Pixabay

WhiteBox

Explainable models for human and artificial intelligence

Until a few years ago, intelligent systems such as robots and digital voice assistants had to be tailored towards narrow and specific tasks and contexts. Such systems needed to be programmed and fine tuned by experts. But recent developments in artificial intelligence have led to a paradigm shift: instead of explicitly representing knowledge about all information processing steps at time of development, machines are endowed with the ability to learn. With the help of machine learning it is possible to leverage large amounts of data samples, which hopefully transfer to new situations via pattern matching. Groundbreaking achievements in performance have been obtained over the last years with deep neural networks, whose functionality is inspired by the structure of the human brain. A large number of artificial neurons interconnected and organized in layers process input data under large computational costs. Although experts understand the inner working of such systems, as they have designed the learning algorithms, often they are not able to explain or predict the system's intelligent behavior due to its complexity. Such systems end up as blackboxes raising the question of how such systems' decisions can be understood and trusted.

LOEWE RESEARCH CLUSTER

COORDINATOR . Prof. Dr. Kristian Kersting,
Prof. Constantin A. Rothkopf, Ph.D.,
Technical University of Darmstadt (TU Darmstadt)

PARTNER . Technical University of Darmstadt (TU Darmstadt)

LOCATION . Darmstadt

SUBJECT AREAS . Human Sciences, Computer Science,
Biology, Electrical Engineering and Information Technology,
Law and Economics

FÖRDERZEITRAUM . 2021 to 2025

COORDINATION OFFICE
Dr.-Ing. Dirk Balfanz
Tel. +49 6151 16-23736
dirk.balfanz@cogsci.tu-darmstadt.de

INTERNET
https://www.tu-darmstadt.de/whitebox

IMPRINT

PUBLISHER
ProLOEWE. Netzwerk der LOEWE-Forschungsvorhaben
Tel. +49 561 804-2348
kontakt-proloewe@uni-kassel.de
www.proloewe.de

Postal address:
ProLOEWE
c/o Universität Kassel
Mönchebergstr. 19
34125 Kassel

Responsible . Tanja Desch
Picture editing . Tanja Desch
Design . Marc Guddorp . designstübchen . Osnabrück
Print . Fromm + Rasch GmbH & Co. KG . Osnabrück

PRO LOEWE

LOEWE Research Initiatives Network

LOEWE

Excellent Research for Hessen's Future