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PRO LOEWE NEWS

The LOEWE research initiatives report

FURTHER TOPICS, NEWS AND INFORMATION FROM THE LOEWE RESEARCH NETWORK IN THIS EDITION OF PRO LOEWE-NEWS, AVAILABLE AT WWW.PROLOEWE.DE AND ON TWITTER AT @PROLOEWE

Cover photo: A missing metabolic gene probably enables hummingbirds like the long-tailed hermit (Phaethornis superciliosus) to perform their energy-consuming hovering flight. Foto: Nicolas Defaux

LOEWE-TBG GENOMIC STUDY UNCOVERS POSSIBLE REASON FOR HUMMINGBIRDS' EXTRAORDINARY FLYING SKILLS

During hovering, hummingbirds flap their wings up to 80 times per second, creating the characteristic humming sound. No other form of locomotion in the animal kingdom consumes more energy. Accordingly, the metabolism of the small birds, which are often barely larger than a thumb, runs at full speed and is more active than that of any other vertebrate. An international team of scientists led by Prof. Michael Hiller from the **LOEWE Centre for Translational Biodiversity Genomics (LOEWE-TBG)** investigated the evolutionary adaptations of the metabolism that may have enabled the hummingbirds' unique flying abilities. Their study was published in the journal "Science".

To meet their energy needs, hummingbirds rely on the sugar in flower nectar. Hummingbird metabolism also has some distinctive features: they absorb sugar quickly, have highly active enzymes that process sugars, and can metabolise fructose just as efficiently as glucose – unlike, for example, humans.

Researchers from Frankfurt am Main and Dresden have now found out how this benefits the cells of the flight muscles that allow hummingbirds to hover. For their study, they sequenced the genome of the long-tailed hermit (*Phaethornis superciliosus*) and compared this and other hummingbird genomes with the genomes of 45 other birds, such as chicken, pigeon, or eagle. They discovered that the gene encoding the muscle enzyme FBP2 (fructose bisphosphatase 2) was lost in all studied hummingbirds. Interestingly, further investigations showed that this gene was already lost in the common ancestor of all living hummingbirds, during a period when hovering flight and nectar feeding evolved – around 48 to 30 million years ago.

"Our experiments showed that the targeted inactivation of the FBP2 gene in muscle cells enhances sugar metabolism. Furthermore, the number and activity of the energy-producing mitochondria increases in cells lacking FBP2. Since the FBP2 gene is only expressed in muscle cells, our results suggest that the loss of this gene in the hummingbird ancestor was likely a key step in the evolution of metabolic muscle adaptations required for hovering flight," explains study leader Michael Hiller, Professor of Comparative Genomics at the **LOEWE Centre TBG** and the Senckenberg Society for Nature Research in Frankfurt. "In addition to the loss of the FBP2 gene, other important genomic changes probably occurred in hummingbirds, which can certainly be clarified by further studies and experiments," Hiller says.

Scientists at the LOEWE Center TBG, among others, are researching the evolutionary adaptations of the hummingbirds' metabolism. Photo: Nicolas Defaux

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Loss of a gluconeogenic muscle enzyme contributed to adaptive metabolic traits in hummingbirds

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SCIENCE & FAMILY: MEN ARE IN DEMAND! LOEWE-FLOWFOR LIFE PANEL DISCUSSION MODERATED BY JOCHEN BREYER.

"That was the best panel discussion I have ever experienced at the TU Darmstadt," was the enthusiastic feedback of one visitor after the event "Science & Family: Men are in demand!". **LOEWE-FLOW-FORLIFE** together with **LOEWE-emergenCITY** and **ProLOEWE** had invited to this event on March 24. Three scientists presented their model of a modern family on the podium: Dr. Franz Baumdicker, a mathematician at the University of Tübingen, married to a mathematics professor at the TU Darmstadt. He lives the *„dual career couple* model" with his wife and three children, the advantages and disadvantages of which he presented to the panel, but at the same time also explained how to implement it in practice: "Make it clear as early as possible what you want in terms of career and family and how you want to realize it – and above all clarify it as a couple," Baumdicker told the panel.

Dr. Sebastian Braun and his wife, also with three children, live a different model. Both work 80 percent, the wife is a doctor, Braun himself a biologist. The couple lives in Sweden and benefits there from the flexible option of reduced working hours and very good and reliable childcare. Neither partner can imagine working 100 percent "in this case family, career and our health would probably suffer," says Braun.

The most unusual model of a modern family, even today, was presented by Dr. Florian Kaffarnik (biologist): He gave up his own career in favor of his wife, a professor, and their three children, and takes care of children and household. "When we're invited somewhere and other men ask me about my profession and I answer 'househusband,' I'm immediately written off," Kaffarnik says. "Many women, on the other hand, are enthusiastic and envy my wife."

Moderator Jochen Breyer, Dr Franz Baumdicker, Dr Kim Bräuer, Dr Florian Kaffarnik and Dr Sebastian Braun (from left to right). Photo: Michaela Becker-Röck

Discussed issues were put in a broader context by Dr. Kim Bräuer, sociologist, TU Braunschweig. She leads the fathers' project "You don't need to be Superheroes," for which she has conducted numerous interviews and conversations with men. She could confirm many of the issues and problems presented. But there is a clear sense that something is happening in our society, according to Bräuer: "Many men want to do things better and differently than their own fathers and get more involved in family life, raising children and the household."

In addition to personal tips from the discussion participants on how to reconcile a scientific career and family, specific suggestions were also made as to how our state research funding and universities could better support scientists with children. All in all, it was a very special and different kind of equality event – an enlightening discussion with fathers as role models and in a very relaxed atmosphere – which not only led to a lively exchange between the large number of listeners and the panelists, but also provided a number of humorous moments. With Jochen Breyer as the discussion leader, it was once again clear how crucial a skillful and empathetic moderation is for a successful event – thank you for that!

LOEWE-emergenCITY: LESSONS LEARNED FROM THE FLOOD 2021

The heavy rainfall event of summer 2021 in the Ahr valley with more than 180 deaths, hundreds injured and major devastation has pushed the debate on how to deal with such disasters to the top of the agenda. Prof. Dr. Michèle Knodt and Eva Platzer from the **LOEWE Centre emergenCITY** have taken a detailed look at disaster management. In an emergenCITY policy paper, they analyse the weaknesses of disaster management and provide recommendations for action

Many forces are involved in disaster operations of the magnitude of the Ahr Valley flood. In addition to the disaster management and administrative staff, these include the emergency forces on site, the politically responsible persons at different levels and also spontaneous helpers. Coordination between these units is therefore one of the major challenges, which can be optimized by adapting structures, improving training and operational concepts and establishing an interface with spontaneous helpers. Well-networked teams of experts could help here as a kind of rapid response force to support local disaster management staff members. In addition, political decision-makers at all levels should be actively involved in disaster management training and exercises in order to be able to react quickly and adequately in the event of a crisis.

The detailed policy paper can be found here: emergencity.de/s/pp3

Foto: Christian / Adobe Stock

LOEWE RESEARCH CLUSTER Tree-M: RESEARCH AS A BASIS FOR MAINTAINING THE HEALTH AND FUNCTION OF FORESTS

Forests play an essential role in global climate. They host an immense variety of microorganisms, exhibiting enormous biochemical and physiological diversity, which in turn can affect health and resilience of trees. These microorganisms and their complex interactions with the biotic and abiotic environment of their leaf habitat (the phyllosphere) are the focus of the research conducted in the **LOEWE research cluster Tree-M – "mechanisms of resilience and environmental impact of the leaf microbiome of trees"**, which started in January 2023.

With an interdisciplinary research cluster joining forces from the fields of microbiology, biochemistry, ecology, geography, and bioinformatics, research activities will for the first time investigate these microorganisms and their interaction networks on various scales, using pedunculate oak (Quercus robur) as a model. Over the duration of four years, research will thus cover individual bacterial cells (molecular mechanisms of bacterial enzymes as well as metabolic activities and their regulation), microbial communities (interactions within the leaf microbiome and with the abiotic environment) and cross-kingdom organismic interaction networks (microbiota-leaf-herbivore interactions).

The research cluster, which is funded with 4.5 million euros, operates under the coordination of the Philipps-University Marburg. Furthermore, researchers from the Max-Planck-Institute for Terrestrial Microbiology and the Justus-Liebig University Gießen are participating in the research project, as well as associated researchers from the Centre for Environmental Research Leipzig, the Albert-Ludwigs University Freiburg and the Microcosm Earth Centre. The team of researchers, headed by Prof. Dr. Anke Becker, Prof. Dr. Nina Farwig, and Prof. Dr. Tobias Erb as speakers, hope that the gained knowledge will help in the development of sustainable strategies that reduce the impact of climate change on this interaction network and can thus help sustain forest health and function into the future.

LOEWE RESEARCH CLUSTER CoroPan LED BY JLU GIESSEN SEEKS TARGETS FOR FUTURE THERAPIES AGAINST CORONAVIRUSES.

Wild animals such as bats are the natural hosts of numerous coronaviruses, including SARS-CoV-2, SARS-CoV and MERS-CoV. At least since the onset of the SARS-CoV-2 pandemic (COVID-19), we have known that these viruses are relatively easily transmissible to other animals and also to humans and can adapt very quickly to their new host.

The aim of the **LOEWE research cluster „Human and zoonotic coronaviruses: conserved targets for new therapeutic options in future pandemics"** – **CoroPan** for short – which was also launched at the beginning of the year, is therefore to protect ourselves better against pandemics triggered by coronaviruses in the future. **CoroPan**, which will receive funding of around 4.5 million euros over four years, is being led by the Justus Liebig University of Giessen (JLU). Goethe University Frankfurt am Main and Philipps University Marburg (UMR) are involved in the project.

"To counter the recurring threat, we need to investigate potential vulnerabilities in the already known representatives of coronaviruses that can serve as therapeutic targets," explains Prof. John Ziebuhr. "To do this, we need to know the molecular biology of different viruses in this virus family." With partners at the partici-

pating universities in Hesse, he is planning comparative studies on the molecular basis of the propagation and pathogenesis of coronaviruses as a basis for new therapeutic approaches.

John Ziebuhr's research interests include emerging infectious diseases at the German Center for Infection Research. He is particularly interested in identifying the molecular mechanisms and enzymes involved in the genome replication of these viruses. With his team and collaborative partners in Giessen, Marburg and Leiden, he has discovered potential new therapeutic approaches; these include the targeted silencing of a viral enzyme found only in coronaviruses and some related viruses, which is essential for their replication.

ANTIBIOTICS, DRUGS AND ROCK'N ROLL – FINDING SOLUTIONS FOR THE GLOBAL HEALTH CHALLENGE. 10TH ANNUAL CONFERENCE, SYNMIKRO, FORMERLY LOEWE CENTRE, 23 MAY, 2023, CINEPLEX MARBURG

Nature is an almost inexhaustible source of biologically active molecules: More than 200,000 different natural compounds have been isolated from plants and microorganisms and many of them are used in modern medicine as antibiotics, anti-cancer drugs and in other applications. However, genome sequencing has shown that so far only the tip of the iceberg is known and that there is an almost infinite amount of new compounds, yet to be discovered. But how can this potential be harnessed? How do we find these novel compounds and how can synthetic biology help us to produce them in a defined way and on an industrial scale?

To highlight recent breakthroughs, future trends in addressing this major challenge and to discuss the potential of biologically active compounds for new therapies, leading scientists from academia and industry will come together in Marburg on 23 May 2023. The organizers of the conference are Prof. Dr. Anke Becker, Managing Director of **SYNMIKRO** together with Prof. Dr. Bernd Schmeck, Speaker of the **LOEWE Focus Diffusible Signals** and Prof. Dr. Tobias Erb, Managing Director of the Max Planck Institute for Terrestrial Microbiology.

Participation in the symposium is free of charge, but registration is required: https://form.123formbuilder.com/6361218/synmikro-jahrestagung for your online registration. Further information also at proloewe.de News.

LOEWE-FCI: ERC CONSOLIDATOR GRANT FOR FLORIAN BÜTTNER

With the 'ERC Consolidator Grants', the European Research Council (ERC) supports excellent scientists in expanding their independent careers. This year, Florian Büttner, researcher at the German Consortium for Translational Cancer Research (DKTK), Goethe University Frankfurt and **LOEWE Center Frankfurt Cancer Institute**, has the honor to receive the prestigious ERC award and the associated two million euros in research funding over five years. He will use the funding to develop AI models that will reliably support clinicians in diagnosing cancer and providing personalized therapy recommendations for patients.

Machine learning algorithms are finding their way into many areas of medicine. And in doing so, they have the potential to support diagnostics and therapy recommendations while outperforming physicians in terms of accuracy and speed. But for artificial

Florian Büttner, a scientist at LOEWE-FCI and DKTK Professor of Bioinformatics in Oncology at Goethe University Frankfurt, wants his ERC-funded project to help enable clinicians to interact efficiently with AI models. Photo: Jens Braune del Angel

intelligence (AI) to be firmly embedded in routine clinical practice, good average performance in terms of speed and accuracy is not enough – physicians must be able to trust the AI's individual predictions one hundred percent, and that is not yet possible.

For example, it would be indispensable for the algorithms used to 'know when they don't know something' and to reliably communicate this to the treating physicians. Furthermore, transparency and fairness are indispensable, and AI would also have to maintain data protection and ensure that, in the end, humans always have 'the last word' in all decisions.

Florian Büttner, professor at Goethe University Frankfurt, wants to contribute to the development of trustworthy AI models with these characteristics with his ERC-funded project 'TAIPO: Trustworthy AI tools for personalized oncology'.

In doing so, he relies on close collaboration with clinically active researchers at FCI and DKTK and focuses on three areas of AI-based personalized oncology: the diagnosis of skin lesions based on dermoscopic images, the stratification (more accurate classification) of blood cancers based on omics data, and therapy recommendations for patients with metastatic breast cancer. Büttner's approach here is to develop a universally applicable methodology that can be easily transferred and used for other types of cancer.

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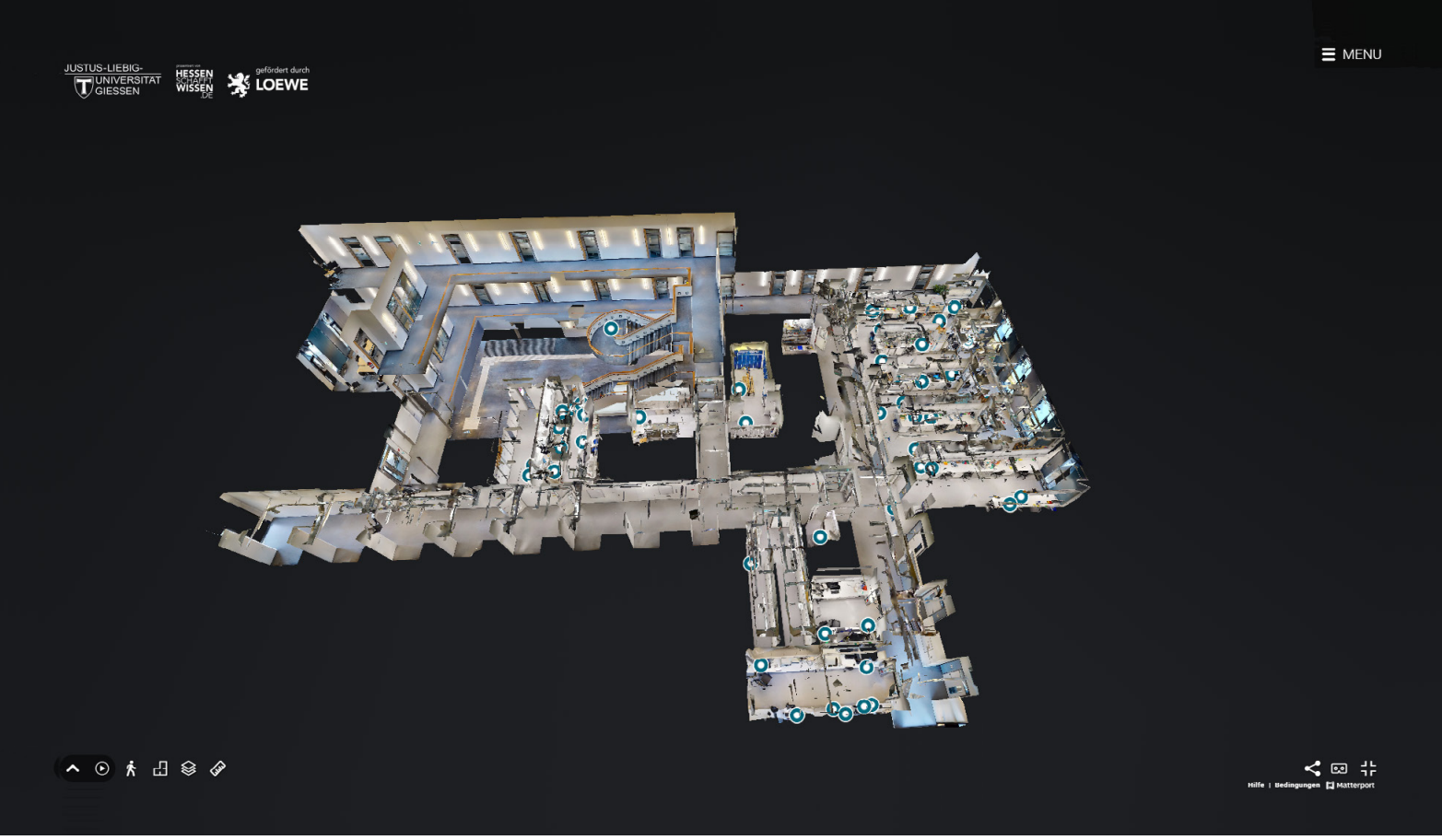


Overview of the 3D-scanned rooms of a LOEWE-iCANx laboratory within the Medical Research Center Seltersberg at the JLU Giessen. Photo: Hessen schafft Wissen/Steffen Böttcher

HESSEN AGENTUR'S "SCIENCE SPACES 3D" PROJECT ENABLES A VIRTUAL TOUR IN THE LABORATORY OF THE LOEWE RESEARCH CLUSTER "iCANx"

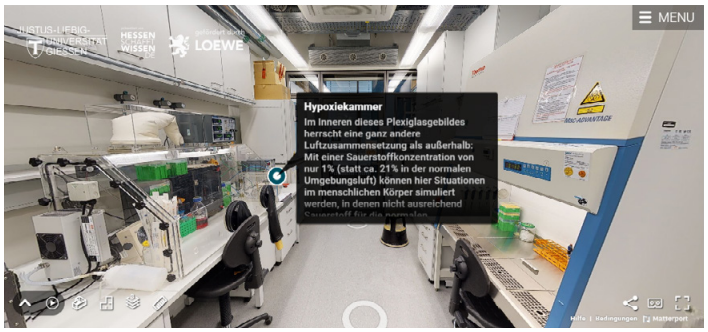
What does it actually look like in a medical research laboratory? What equipment and tools do scientists use there to identify new targets for cancer cells, for example? Since recently, you can see for yourself as part of the Hessen Agentur's "Hessen Schafft Wissen" ("Hesse Creates Knowledge") campaign: For the "Science Spaces 3D" series, the Institute of Neuropathology at the Justus Liebig University Giessen was 3D-scanned by Steffen Böttcher's team of photographers. Completely without the otherwise necessary access restrictions, it is now possible to virtually walk through not only the foyer of the state-of-the-art research building built in 2017, but above all also view the various rooms and instruments of neuropathology in which and with which researchers work: https://tinyurl.com/3dscan-icanx

The Institute of Neuropathology is part of the **LOEWE research cluster "iCANx: Cancer – Lung (Disease) Crosstalk: Tumor and Organ Microenvironment"** (pronounced "I can cross"), a joint research project of JLU Giessen, Philipps University Marburg and the Max Planck Institute for Heart and Lung Research in Bad Nauheim, which is funded since 2021. Together, more than 30 basic and clinical researchers are working on a better understanding of lung cancer. More specifically, **iCANx** scientists are studying the interplay between tumor cells and their immediate (micro)environment, which can be altered in part by lung diseases such as chronic obstructive pulmonary disease (COPD).

With "Hessen Schafft Wissen", the service company of the state of Hesse, "HA Hessen Agentur GmbH", has created a format to communicate complex science in a way that is understandable to the general public.

"With our contribution to the series 'Science Spaces 3D', we are pleased to make science come alive and to show what an exciting working environment research at the JLU, especially at the Department of Medicine, offers," says Prof. Dr. Till Acker, Director of the Institute of Neuropathology and spokesperson of **LOEWE-iCANx**.

As part of the "Science Spaces 3D" series, another former LOEWE focus, **LOEWE-ALLEGRO**, has already been 3D scanned, with others such as **LOEWE-FCI**, **LOEWE-emergenCITY** and **LOEWE-GreenDairy** to follow.



You can move freely in the 3D model. In addition, information points convey exciting knowledge about the devices in the iCANx research lab. Photo: Hessen schafft Wissen/Steffen Böttcher

Christiane Salge is Professor of Architecture and Art History at the Department of Architecture at Darmstadt University of Technology and deputy spokesperson for the LOEWE focus on Architectures of Order. Photo: Britta Hüning

Professor Dr. Christiane Salge
Mediator between past and future

Prof. Salge, you are the deputy spokesperson for the LOEWE focus on architectures of order, which has been funded since 2020 - what can one imagine by the title? *Architecture has a very strong impact on all of us; it orders society, both our private and public lives. In the focus area we investigate from different disciplinary perspectives how architecture affects social, cultural but also scientific-technical ordering practices, but also how architectural practices are influenced by society, culture and science. In my subproject we analyze knowledge orders in architectural teaching media and teaching concepts to investigate how the constitution of knowledge over the centuries has affected the design process of architects and thus the built environment and the ideas of order of the respective society.*

Would you like to tell us a little more about your personal career and why research in the humanities is so essential for society? *As a humanities scholar with a focus on the early modern period, I see my task as reconstructing history based on the sources, reflecting on it theoretically, communicating it to society, and at the same time taking a critical look at the present from this perspective. As an architectural historian, I worked only at humanities institutions until 2016. Since 2017, I have been a professor of art history at the Department of Architecture at the TU Darmstadt, thus training future architects. To impart to the students here a sensitivity for past architecture, but at the same time also a critical awareness of the tasks of the present, so that they respectfully pick up on the old with the current scientific and technical possibilities as well as their creativity, is a beautiful task.*

Which project within your field of research is keeping you most busy at the moment? *I am currently starting a project in which I am working on the digitization and indexing of part of our old art-historical glass slide collection. In addition to reproductions, it includes unique holdings, such as photographs from the Nazi art protection campaigns in France and Italy in the 1930s and 1940s, or images from the 1910s/1920s of buildings now destroyed by war. In addition, I am interested in the collection as a teaching medium, and this connects the project to the LOEWE focus on „Architectures of Ordering," because in this collection of slides the canon of knowledge of teaching architecture at a technical university in the 1960s and 1970s has been visualized and systematically ordered.*

LOEWE research funding in Hesse is something unique nationwide, and something that is the envy of other parts of Germany (and even beyond). What do you think makes the LOEWE program so enriching for scientists? *Apart from the wonderful opportunity to carry out my own sub-project with two motivated research assistants within four years, I have benefited above all from the interdisciplinary network that we have built up in the priority area. Especially for me, as a relatively new professor at TU Darmstadt, the LOEWE program was a great opportunity to establish contacts with colleagues at my own university but also at other research institutions in Hesse and to exchange ideas with scientists from a wide range of disciplines.*

The entire interview is available online at proloewe.de