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ZEIT GERMANY

Study & Research

DIE ZEIT

Read about Raúl, a student from the Dominican Republic living in Leipzig, on page 56

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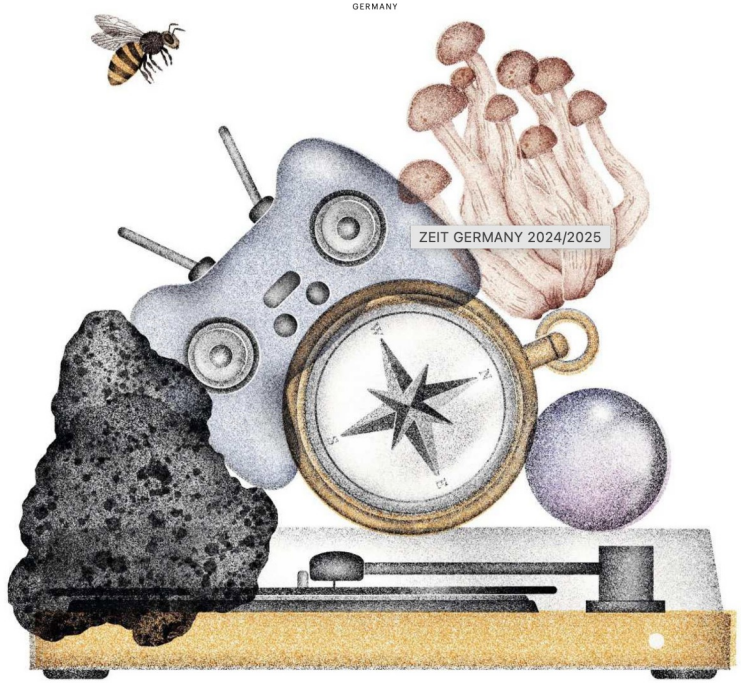
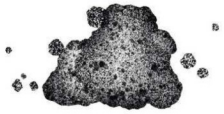


CUTTING-EDGE

With billions of euros in funding allotted to its research institutes, Germany is home to some of the world's quirkiest and most complex scientific research projects today

BY SAM GURWITT **ILLUSTRATION** SARAH MAFFÉIS

MOON-DUST SOLAR PANELS
TECHNISCHE UNIVERSITÄT BERLIN



Researchers aim to manufacture solar cells with resources abundant on the moon

It's not easy to get solar panels to the moon. Yet if humans ever build a base there, they'll need them. Researchers at Technische Universität Berlin (TU Berlin) may have found a solution. A team in the department of space technology aims to manufacture solar cells with two ingredients that are abundant there: lunar dust and sunlight.

Shooting prefabricated solar panels to the moon would be prohibitively expensive. "We want to use resources that are on the moon," explains aerospace engineer Juan Carlos Ginés Palomares, who leads the research project. A collaboration with JPM Silicon, it's funded by the German Aerospace Center.

It's just one application of moon dust being studied at TU Berlin. Other teams are looking into possibly using it for construction materials or even 3D printing.

For a few billion years, rocks careening through space have slammed into the moon, pulverizing its surface into a fine dust called lunar regolith. About 4 to 10 meters of the substance now cover the surface, says Stefan Linke, who heads the department's Exploration and Propulsion Working Group, which conducts the regolith research. Thanks to samples brought to earth by NASA's Apollo missions, scientists know not only the chemical composition of lunar regolith but also the size of its grains. A research facility at TU Berlin crushes various minerals to simulate the material.

Producing a solar cell requires creating a layer of silicon on a glass surface. The researchers are experimenting with a process that doesn't require extracting silicon from regolith first. Instead, they create glass by melting regolith between 1300 and 1500 degrees Celsius, depending on the type of dust. Next, they coat the glass with a layer of aluminum so thin that the metal can be extracted from rovers left on the moon.

Heating this aluminum-coated glass triggers a chemical reaction that produces a layer of silicon. After further chemical processing, this piece of glass becomes a functioning solar cell. Ginés Palomares says his team has produced small patches of silicon on a piece of regolith glass. He hopes to produce an even coating by the end of 2024.

BEETHOVEN'S BEAT
MAX PLANCK INSTITUTE FOR EMPIRICAL AESTHETICS, FRANKFURT AM MAIN

What can a few strands of Beethoven's hair tell us about how he came by his musical talent?

Two hundred years after his death, what can a few strands of Ludwig van Beethoven's hair tell us about the great composer's musical talent? That's what researchers at the Max Planck Institute for Empirical Aesthetics in Frankfurt am Main and their international collaborators wanted to know. Published in 2024, their study examines whether the strands of DNA hidden in that famously unruly hair showed a genetic propensity for rhythm.

"We decided to make no specific predictions and instead see this as an opportunity ... to discuss exactly why we cannot at the moment predict an individual's musical future based on a genome," says Miriam Mosing, head of the institute's behavior genetics unit. The team discovered that – rhythmically speaking – Beethoven's genes were unremarkable. They more closely resembled the genes of people who report that they cannot clap on a beat than those who can.

Mosing and the Frankfurt team were building on an extensive study into the genetic links to musicality recently undertaken with colleagues at the Max Planck Institute for Psycholinguistics in the Netherlands, the Karolinska Institutet in Sweden, Vanderbilt University in the US, and others.

In 2022, the teams worked with the US-based genetic testing company 23andMe to explore the genetic basis for rhythm, analyzing the genomes of over 600,000 people of European descent. The researchers managed to pinpoint 69 different locations on the human genome that seemed to correlate with a person's reported ability to clap on a beat. This, in turn, allowed the scientists to create what's called a polygenic score (PGS) for the musical skill called beat synchronization.

After a separate group of researchers sequenced Beethoven's genome in 2023, genetic researchers at the Max Planck Institute in Frankfurt had an idea: to use the data from their earlier studies to calculate Beethoven's own PGS for beat synchronization. That his score was low only underlines that Beethoven's staggering musical talent – including his indisputable genius with rhythm – depended on a lot more than just the genetic traits embedded in his DNA.

PHILOLOGY OF ADVENTURE
LUDWIG-MAXIMILIANS-UNIVERSITÄT
HEN

Researchers explore the literary history of adventure, from centuries ago right on up to today

"Your extraordinary adventure awaits," announces an ad for Air New Zealand. Don't forget to bring your Nalgene water bottle "for your everyday adventure." "Say yes to #hairventures."

As these and countless other slogans make clear, adventure sells. And advertisers peddling it can pique our imaginations by tapping into millennia of literary history. For the last seven years, scholars at Ludwig-Maximilians-Universität München (LMU) have been taking a deep dive into the history of the concept of adventure.

With fewer and fewer people writing literature professionally these days, the researchers wanted to "touch the core of our fascination with narratives," says Martin von Koppenfels, an LMU professor who initiated the study. The central idea? "To research the elementary driving forces of narrative using a single term, namely adventure," he says.

With funding from the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), the project – called "Philology of Adventure" – brings together literary scholars to approach the concept from their respective areas of expertise. The group has met regularly to analyze texts and present their work. Events include discussions with contemporary authors.

In the European narrative tradition, the modern understanding of the term "adventure" traces back to stories from the High Middle Ages (ca. 1050 to 1250 CE): those tales in which an aristocratic hero sets out on a quest for adventure. Later, during the Enlightenment, adventure stories began to be "denigrated as childish, premodern, naïve," says von Koppenfels. That's when literature began to focus on more realistic world representations.

But adventure narratives didn't die out. They simply rebranded. With the vast expansion of literacy in the 19th century, a new market emerged, especially for youth and children's literature. Adventure narratives thrived.

The conflict between "our fantasies and our social reality," as von Koppenfels puts it, is still a fundamental feature of literature and narrative art. Perhaps that's why the Nalgene brand of plastic is urging us to "find adventure" in everyday life – with a water bottle in hand.

BEE POETRY
FILMUNIVERSITÄT BABELSBERG
KONRAD WOLF

Perhaps one day, bee-to-poem translation will be possible with the use of artificial intelligence

With the help of humans and computers, Potsdam's bees are becoming poets. An interdisciplinary group of artists and technology experts at Filmuniversität Babelsberg is immersed in a novel art project: a poetic soundwalk that "translates" emotional and sensory expressions of bees into poetry. There's power, they posit, in trying to decipher what bees say to each other.

"There are other types of intelligence in the world, not only human intelligence," says Ula Sowa Przybylska, the artist and "visual anthropologist" leading the project. In 2023, Przybylska won an award from the university's Institute for Artistic Research, which is now funding the project.

A few researchers, including computer scientist Tim Landgraf of the Freie Universität Berlin, have been able to use AI to translate a few "basics" of bee language and even communicate back to them. But Przybylska and her team of (mostly) artists want to understand bees on a more emotional level.

The science of bee language allows only a glimpse into their communication patterns. AI can help analyze things like "what times of day they do what waggle dance, and what's the behavior that comes after this," she says. "But AI can't really tell us anything about their culture." That's why she and her team are letting the arts do what computers can't.

The Potsdam team will use AI to analyze existing data and their own recordings of bees to see what comes about. To make the "translations" more accessible to humans, Przybylska and her team have partnered with two poets. One will focus on sensory details, creating rhythms and sounds that mimic vibrations and other patterns with which bees communicate. The other will address the content of communication.

The poetry is hardly a straight translation, but that's not the point. The goal is to create something that will help people better understand bees, and more broadly natural surroundings, says Angela Brennecke, a Babelsberg professor who is supporting the project. The material the team collects and its experiences with AI may help advance the research so that one day bee-to-poem translation is possible.