

# hermann

News from the Helmholtz Association



## Dear Readers,



The well-respected professional journal *Science* has elected the ten most important scientific breakthroughs of the past year. Three of these included major involvement on part of the

Helmholtz Association. The first and foremost is the discovery of the Higgs boson, to which Helmholtz researchers from the Deutsches Elektronen-Synchrotron DESY have contributed. DESY was involved also in the worldwide first decoding of a biological structure by means of a free-electron laser. The third outstanding achievement is rooted in Oberpfaffenhofen: The German Aerospace Center has contributed to the development of a robotic arm, which can be controlled by thoughts. All these achievements are examples of the quality of research within the Helmholtz Association. The use of large-scale facilities and the development of new technologies in close co-operation with domestic and international partners contribute to mastering the present-day challenges to the benefit of society in general.

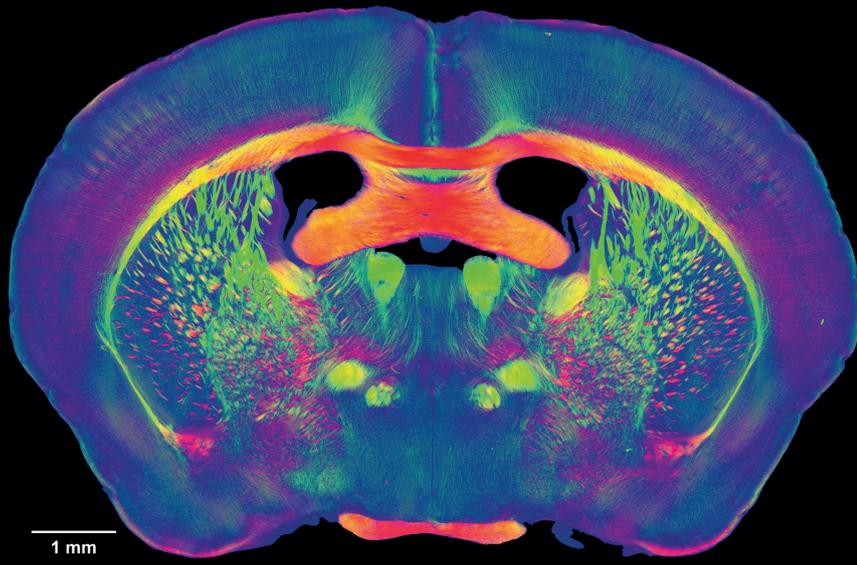
Wishing you enjoyable reading,

Yours faithfully, Jürgen Mlynek, President

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Axon sequences in a mouse's brain. Photo: Amunts, Zilles, Axer et. al./Forschungszentrum Jülich

## A Brain-like Computer

*With all its components and functions, the human brain continues to baffle science. Even supercomputers can hardly keep up in face of the brain's data transfer and processing capacities and its low energy consumption. In order to at least technologically approximate this performance and to learn more about how the brain works, how diseases of the nervous system originate and how they can be treated, more and more scientists put their bet on simulating the brain.*

Some 100 billion closely connected nerve cells ensure the function of our organs and senses, ensure that we process sensory perceptions, that we assess these and behave accordingly. The brain is capable of learning and even can repair itself. Scientists from the Forschungszentrum Jülich research centre intend to understand and simulate these characteristics in their full complexity. At the recently inaugurated simulation laboratory, the Simulation Laboratory Neuroscience, neuroscientists, medical practitioners, computer scientists, mathematicians and physicists combine their insights to jointly improve the simulation of the brain.

The Jülich-based supercomputers play a major role also in an ambitious pan-European project: the "Human Brain Project", co-ordinated by Prof. Henry Markram, École Polytechnique Fédérale de Lausanne, and Prof. Karlheinz Meier, University of Heidelberg, is to pool all hitherto known data regarding the human brain in one simulation. Every component, every function, even the genetic characteristics of the nerve cells are to be simulated within a Jülich-based supercomputer. The European Union has declared the project one of its flagship initiatives. It thus can contribute about half the costs totalling a billion Euro or more. The Jülich contribution, however, is not just to develop supercomputers, but also to examine nerve cells down to the tiniest detail. The combination of all knowledge is to advance the treatment of nerve-based diseases. So far, however, computers are not yet able to process the enormous amounts of data. Therefore, innovative technological progress must precede the medical insights. This may render the "Human Brain Project" a risk, but can contribute to revolutionising knowledge in more than just one field.

## In Brief

### Translation Error in the Brain

An international research team, including the German Center for Neurodegenerative Diseases in Munich and the Ludwig Maximilian University of Munich, has found out that in some cases of dementia, dormant parts of the genetic material are erroneously translated into unusual proteins. These proteins form the core of hitherto mysterious accretions that can be observed in certain genetically caused nerve system malfunctions. The astonishing aspect of the newly discovered proteins is the fact that they should not exist in the first place: the genetic material they are based on is missing the starting signal, therefore it ought not to be decoded at all.

### Wind Turbine Rotor Blades Made Intelligent

Rotor blade edges slanting forward or backward and servo tabs redirecting the wind as needs be: such active technologies are being tested already in the aviation industry and now are to be implemented also in wind energy generation. Since 31 January 2013, the Federal Ministry for the Environment funds the German Aerospace Center and other partners with 12 million Euro for the development and construction of such "Smart Blades".

### Intestinal Bacteria Influence Type 1 Diabetes

In mice, the composition of the intestinal flora influences the risk of contracting type 1 diabetes. Scientists at the Helmholtz Centre for Environmental Research in Leipzig have worked with special mice, which are particularly prone to developing type 1 diabetes. Usually, females are more susceptible than males. Prior to the disease manifesting itself, the scientists transferred the intestinal bacteria of male animals to females. It became apparent that females treated in this way developed immunity against a multitude of diabetes symptoms. They displayed also increased levels of the male sexual hormone testosterone, which the authors hold responsible for the preventive effect.



Radio detector for measuring cosmic radiation in Argentina. Photo: KIT/Tim Huege

## New Cosmic Radiation Detectors

*Since 2008, Dr Tim Huege and his Helmholtz Young Investigators Group at the Karlsruhe Institute of Technology (KIT) develop innovative detectors for the more detailed observation of cosmic radiation. The radiation particles are atomic nuclei hitting the Earth's atmosphere with in part high levels of energy. Although they have already been observed for about 100 years, their detailed origin remains hidden. Tim Huege's goal is to find the source of cosmic radiation by means of new technology.*

### **Mr Huege, why is it so difficult to measure cosmic radiation?**

The cosmic radiation particles only very rarely reach us. Low-energy particles, for example, from the sun or sources within our galaxy, are fairly frequent and can be measured with satellites or balloons. But the higher the energy level of the particles, the rarer they are. Yet we are most interested in exactly those particles with the highest energy, because they come from sources with the most extreme characteristics.

### **But do we not have accelerators capable of generating particles such as the Higgs boson? Would not that work also for cosmic radiation?**

No, the energy of the particles with the highest energy levels is much too great. The worldwide largest accelerator ring at CERN measures 27 kilometres. In order to generate particles with similarly extreme energy, one would need a ring the size of the orbit of Mercury (approx. 365 million km). We therefore need to measure the cosmic particles. However, as of a certain energy level these are so rare that we need an extremely large measuring surface.

### **How large are these measuring surfaces?**

Many square kilometres. Within that area,

numerous detectors are connected in a grid. At the Pierre Auger Observatory in Argentina, the currently largest cosmic radiation observation facility, 1,600 detectors are scattered across 3,000 square kilometres. There, two detector types are combined; we are now developing a third.

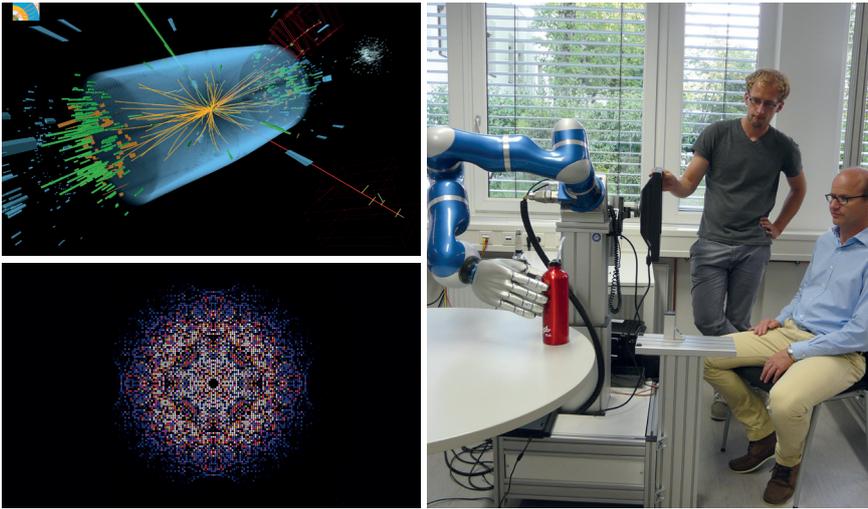
### **Why three types of measurement systems for just one particle?**

Cosmic radiation interacts with the atmosphere and does not even reach Earth in its original state. It causes an avalanche of other particles, a so-called air shower, which is several kilometres wide at ground level and which can be measured. A second effect – hence the second detector type – is caused by excitation of nitrogen in the atmosphere, which generates measurable UV radiation. Yet both detector types have their limitations: one measures only a small part of secondary particles, the other works only in clear, dark nights. We therefore need another measured variable and that is radio wave radiation. Air showers emit short radio impulses. We now have developed highly sensitive radio detector stations including their own electricity supply and wireless communication.

### **According to the Helmholtz programme, your Young Investigators Group expires this year, so what will happen then?**

The funding for this Young Investigators Group will stop. But the group was so successfully assessed, that my temporary contract now was changed to a permanent one – an absolutely unique feature of Helmholtz Young Investigators Groups. Given the basis of funding from the institute and by campaigning for additional third-party funds, I can thus continue my research.

*The interview was conducted by Andreas Fischer.*



Traces of the newly discovered particle in the CMS detector (upper left; Photo: CMS Collaboration, CERN), scatter plot of a crystalline enzyme (lower left; Photo: Karol Nass, CFEL), thought-controlled robotic arm (right; Photo: DLR)

## The Greatest Breakthroughs 2012

The Helmholtz Association was involved in three of the ten most important scientific breakthroughs in 2012: the discovery of the Higgs boson (Deutsches Elektronen-Synchrotron DESY), the development of a

thought-controlled robotic arm (German Aerospace Center) and the first decoding of a biological structure by means of a free-electron laser (DESY).

## More Pesticides In Spite of Genetic Engineering

As regards the utilisation and evaluation of pesticides, several aspects are currently subject to a controversy: the use of genetically engineered cultivated plants and the prognostic quality of public authority risk assessment for the protection of the environment.

Without doubt, the use of genetically engineered cultivated plants that are resistant to herbicides allows for effective weed control. However, as a study by the US-American Environmental Protection Agency EPA reveals, this always entails high herbicide application rates. Use of herbicides does not only increase in the short term when cultivating resistant crops. Studies show that due to weeds developing resistances large amounts of herbicides are required also in the long term. The same applies to genetically engineered plants, which themselves produce insecticides for repelling harmful insects: the insects develop resistances against these insecticides.

Public authorities attempt to forecast the effect of pesticides in open land by using simple testing systems that often have little similarity with nature. This is fraught with uncertainty and, for example, is illustrated by the relevance of certain insecticides with regard to the high death rate in

bee populations. Even low concentrations reduce the nascence of queens and the bees' ability to find back to their hive. It is obvious that the tests relevant for approval are unsuitable for predicting these kinds of effects. This is true also for the effect of pesticides on aquatic populations.



The SPEAR indicator system links the bioceonosis structure with the pollutant load.  
Photo: Tobias Hametner

The Helmholtz Association works on developing improved evaluation and forecasting processes for pesticides. At the Helmholtz Centre for Environmental Research – UFZ, for instance, the SPEAR indicator system was developed, linking the structure of a bioceonosis with the pollutant load. In addition, UFZ scientists provide advisory services to European institutions such as the European Food Safety Authority (EFSA).  
*Matthias Liess*

### FameLab Germany – Round 3

FameLab is an international competition for science communication and provides a stage for young natural scientists to explain their research in a humorous and thrilling manner – within only three minutes. The winners of the regional preliminaries in seven federal states gain participation in an exclusive master class focusing on the topics of communication and media worth 1,000 Euro. Then follows the German finals. The German winner will travel to the largest international science festival, the Cheltenham Science Festival, where the international FameLab finals will be held.

[www.famelab-germany.de](http://www.famelab-germany.de)

### New Helmholtz Exhibition

Ready for launch: on 13 March, the Helmholtz Association's new exhibition "Ideas 2020 – A Tour of Tomorrow's World" will be officially opened at the Paul-Löbe-Haus. Subsequently, it will travel throughout Germany during the next two years. The first stations include the Technologiezentrum in Jülich and the GEOMAR Helmholtz Centre for Ocean Research Kiel. The exhibition highlights major scientific research projects. What makes this exhibition special is its innovative concept inviting visitors to interact in a wide range of ways. The "Tour of Tomorrow's World" leads past seven pillars, illustrating seven great challenges, which may be admired, touched and changed.

### First Crowd Funding Project for Helmholtz Researcher

In December 2012, *hermann* reported on the internet platform [www.science-starter.de](http://www.science-starter.de), newly established by Wissenschaft im Dialog (WiD, Science in Dialogue), where scientists can obtain funding for small projects by sourcing from many individuals. Dr Christian Stern from the Helmholtz Centre for Infection Research in Braunschweig has been able to realise the first successful project funding on this new platform. He had campaigned for support for buying camera equipment. At present, Stern is travelling to visit laboratories all over the world and, with his new camera, to document the peculiarities of researchers' lives in different cultures.

## Focus on Doctorate

The ninth Helmholtz Juniors meeting took place in January at the Institute of Biomaterial Science of the Helmholtz Zentrum Geesthacht and at the Helmholtz Office in Berlin. The presence of 33 doctoral candidate representatives from 16 centres, 16 courses of study and 12 countries provided for an interdisciplinary and diverse meeting basis. The newly elected spokespersons for 2013 are Doaa Megahed (Max Delbrück Center) and Jacques Ehret; Michael Laxy (both Helmholtz Zentrum München) is the German-language contact person.



The Helmholtz Juniors. Photo: HZG

The Helmholtz Juniors aim to support doctoral candidates within the Helmholtz Association to create the best possible conditions for scientific work and a tailored education. Measures include the Helmholtz Networking Day: the most recent one was attended by 120 doctoral candidates from 16 centres, who took the opportunity of benefiting from workshops, application trainings, lectures, a job market and a panel discussion with Prof. Jürgen Mlynek.

Another important Helmholtz Juniors instrument is the doctoral candidate survey, which now was conducted for the third time and serves as a basis for discussion and suggestions for improvement. On average, more than 40 per cent of doctoral candidates at the centres participated in the survey; a quarter of these are foreign nationals. The survey revealed that the foreign doctoral candidates are well integrated. Most centres offer a well-structured doctoral course

within a graduate school, a service used by many doctoral candidates to high satisfaction. Financial security by way of salary for a part-time position or more is given, based on a very diverse range of payment models. Although the number of parents studying towards a doctorate is below the German average, excellent support is available. The details of the survey results are now subject to discussion.

*Fabian Frieß*

## Awards

The physicist Prof. **Rafal Dunin-Borkowski** from the Forschungszentrum Jülich research centre and the RWTH Aachen university receives an Advanced Grant by the European Research Council (ERC). This entails funding totalling 2.5 million Euro over five years. Dunin-Borkowski develops electron microscope imaging methods with the aim of rendering visible magnetic fields within materials and with a resolution to almost atomic scale.

The European Partnership to Alternative Approaches to Animal Testing (EPAA) has awarded Dr **Nils Klüver** from the UFZ the "EPAA 3Rs Science Award" endowed with 100,000 Euro. Klüver's

research project aims to further develop the fish embryo test as an alternative testing method to the acute fish test.

In the second selection phase of the **Helmholtz International Fellow Award**, the Helmholtz Association now has honoured nine scientists of outstanding excellence. The award is endowed with 20,000 Euro each and is addressed at researchers and science managers working abroad who have excelled in their work in fields of relevance to the Helmholtz Association. Further information: [www.helmholtz.de](http://www.helmholtz.de)

Since January 2013, the materials researcher Dr **Silke Christiansen** is head of the new institute "Nano Architectures

for Energy Conversion" at the Helmholtz Zentrum Berlin. For the development of the institute, Christiansen receives additional funding from the Helmholtz Recruitment Initiative to an amount of 600,000 Euro per year over five years.

As one of twelve universities, the **Karlsruhe Institute of Technology (KIT)** was chosen by "EXIST-Gründungskultur" and thus rewarded for its successes in the strategic promotion of spin-offs. For the purpose of creating a business incubator, the KIT will receive funding totalling approximately 3 million Euro over the course of the next three years. The aim is to extend the advisory service provision and to consolidate all activities within a business formation culture.

## Imprint

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### Note to the media:

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