UNIVERSITÄT BAYREUTH

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press release

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Rösch (second from the right) and members of his team insert a protein sample into the magnet of the 1 GHz spectrometer in order to study the protein's conformation.
photo: Jürgen Rennecke/press office University of Bayreuth

Cutting-edge technology: research on new drugs at gigahertz magnetic field at the University of Bayreuth

The University of Bayreuth supports research in the forefront of structural biology applied to molecular medicine, a field that was very successful in recent years. Scientists at this university focus, among others, on the development of antiviral drugs, novel antibiotics, and strategies against allergies. These projects rely heavily on the world's most powerful, high-resolution 1-GHz nuclear magnetic resonance (NMR) spectrometer, the second spectrometer of this field strength worldwide, after one that is located in Lyon/France. In contrast to the installation in Lyon, the Bayreuth spectrometer is a new generation instrument in the sense that it is equipped with a shielded magnet to avoid environmental disturbances and an internal helium cooling unit that reduces maintenance time to a minimum.

"The potential for basic and applied research in the field of molecular medicine based on structural biology techniques at the University of Bayreuth is tremendous, in particular considering the size of this university", to quote Prof. Dr. Paul Rösch, Chair of Biopolymers and Director of the Research Center for Bio-Macromolecules (BIOmac) at the University Bayreuth.

Rösch proudly points out the most recent results in several key areas:

Although antiviral therapies against HIV, the virus that causes AIDS, exist, the disease is not curable, and virus varieties emerge that are resistant to current drugs. "With the aid of NMR-spectroscopy at 1-GHz we are probing viral proteins such as reverse transciptase that are essential to the viral life cycle to create a structural basis for the development of innovative inhibitors of the enzyme", Rösch states.

The spectrometer is also used to investigate the huge protein RNA-polymerase (RNAP) that is responsible for the replication of bacteria and proteins that regulate RNAP activity. "The results from these studies are the structural basis for a targeted design of new therapeutics", Rösch says. "We strive to be on the forefront in the fight against microbes resistant to current antibiotics." Allergy research is another focus of structural biology based on NMR-spectroscopy in Bayreuth. The conformation and dynamics of protein allergens and their complexes with small molecules can be determined very precisely with the 1-GHz spectrometer. From these results modifications that transform allergenic proteins into non-allergenic varieties can be suggested, which, in turn, may eventually be used in immune therapy or other approaches. The NMR data obtained at 1 GHz also enables detailed views of various complexes of allergenic proteins, thus paving the way to understand their so far largely unknown physiological functions. This may finally lead to the substitution of allergenic proteins by non-allergenic ones in plants and foods.

"This spectrometer and the expertise of our researchers made us one of the leading facilities in the field of structural biology and molecular medicine worldwide. In addition to an internationally recognized center of NMR-spectroscopy for structural biology, we are home to distinguished scientists in protein X-ray crystallography, rendering the University of Bayreuth internationally competitive in these research areas", as Prof. Dr. Stefan Leible, president of the University of Bayreuth, explains. He adds: "This new spectrometer along with the unique expertise in structural biology present at the University of Bayreuth create a fantastic outlook for basic as well as applied research." Dr. Ludwig Spaenle, Bavarian State Minister of Education and Culture, Science and the Arts, confirms: "The 1-GHz NMR-spectrometer is an investment of outstanding scientific quality and national importance. The University of Bayreuth once again shows that – at least in Bavaria – even small universities are capable of achieving scientific excellence and claim a prominent place in the challenging competition of scientific institutions." Stefan Müller, Parliamentary State Secretay at the Federal Ministry of Education and Research, stresses: "The joint investment in this new NMR instrument by the Federal Republic and the State of Bavaria definitely furthers structural biology in Germany and beyond. This technology is among the most important of our times, it has the potential for huge contributions towards the solution of major social challenges such as new possibilities to eliminate causes of diseases."

Virtually all research groups in academia in the field of NMR-based structural biology supported the establishment of an internationally competitive NMR-infrastructure in Bayreuth. In addition to the University of Bayreuth, the universities of Erlangen-Nuremberg, Regensburg and Wuerzburg were the main applicants. The 12 million Euro instrumentation has been financed by the German Federal Government and the State of Bavaria. The 1-GHz spectrometer is also part of an EU-initiative to set up a network of biophysical research institutions that makes biophysical instrumentation accessible EU-wide. Thus, not only local and regional researchers are welcome to use the instrument but colleagues from Europe and around the globe are invited to make use of its capabilities.

The BIOmac laboratory is, apart from the Institut des Sciences Analytiques (ISA) in Lyon/France, the second institution in the field of molecular medicine, structural biology and chemical research worldwide that got equipped with an NMR-spectrometer with the currently strongest magnet available for such an application: a high-resolution magnet with a field strength of 23,4 Tesla, equivalent to a proton resonance frequency of 1 GHz.

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The University of Bayreuth at a Glance

The University of Bayreuth is a young, research-oriented campus university. The University's founding mission in 1975 was to support interdisciplinary research and teaching and to develop interdisciplinary research priorities with which it could strengthen its own profile.

Its research programmes and programmes of study are frequently updated and cover the natural sciences, law, business and economics, languages and literature, and cultural studies.

A good instructor-to-student ratio, high performance standards, interdisciplinary collaboration, and academic excellence have allowed the University to maintain its strong position in the rankings. The University of Bayreuth ranked 29th among the 200 best young universities in the world in this year's Times Higher Education (THE) Young University Rankings. The University is also a top choice for studying law, business and economics in Germany, as borne out in the university ranking published by the Centre for Higher Education (CHE) in May 2017.

The University of Bayreuth has been an international leader in African Studies for many years; the Bayreuth International Graduate School of African Studies (BIGSAS) is part of the Excellence Initiative by the German federal and state governments. High Pressure & High Temperature Research carried out at the Bavarian Research Institute of Experimental Geochemistry & Geophysics has also established a strong reputation worldwide. Polymer research at the University is a frontrunner in the funding ranking published by the German Research Foundation (DFG). The University of Bayreuth has a tight international network of strategically selected university partnerships.

There are currently around 13,300 students enrolled in 151 different programmes of study offered by the University's six faculties. With around 1,200 members of the academic staff (of whom there are 240 professors) and roughly 900 non-academic staff members, the University of Bayreuth is one of the region's largest employers (figures as of 1.12.2016).