Eröffnungsvortrag

Großes Physikalisches Kolloquium an der Universität zu Köln

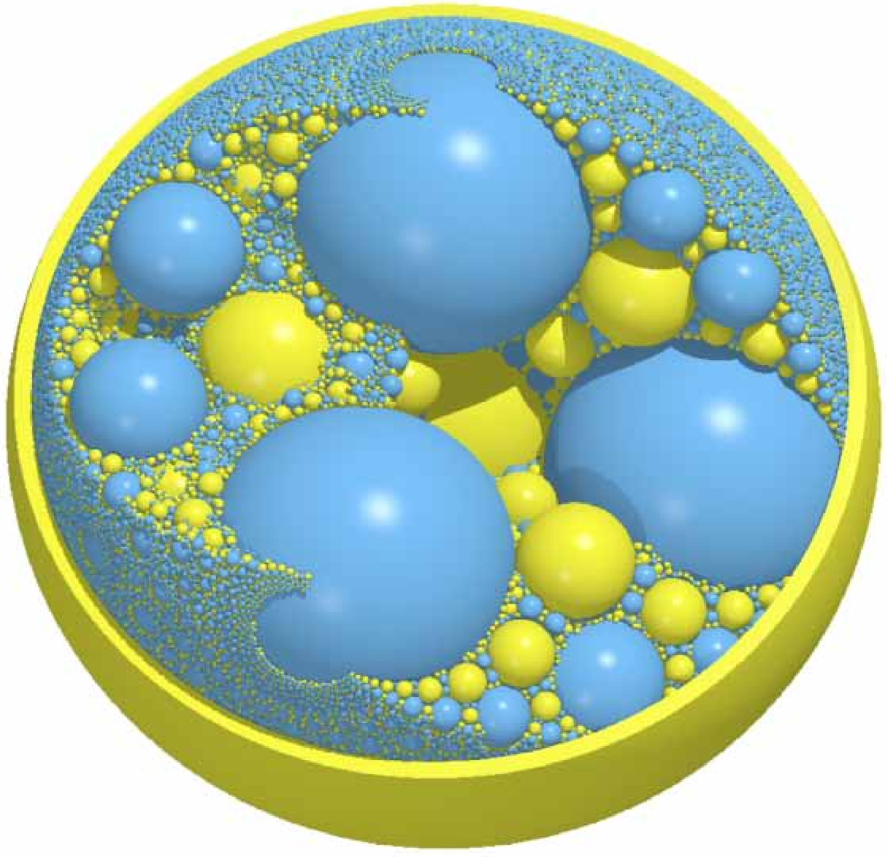
Prof. Dr. Hans Herrmann

ETH Zürich, Switzerland

17.04.2018
16^{45} Uhr / HS III

Rotating Matter: The Bearing State

Granular materials are characterized by an additional degree of freedom, rotations, which become particularly relevant for spherical particles. They allow for soft modes under shear which do find realizations for instance in tectonic faults. A packing of spheres is called bi-chromatic if every loop formed by contacts is even. In three dimensions, bi-chromatic bearings have many different sliding-free configurations, so called bearing states. If all loops have length four the system exhibits four continuous degrees of freedom and a systematic way of constructing such bearing states can be devised [1]. By considering spheres of different size, packings with bearing states can even be made space-filling. The construction and mechanical properties of such space-filling bearings will be discussed. Their bearing states can be viewed as a realization of solid turbulence exhibiting Kolmogorov scaling and anomalous heat conduction. In three dimensions a continuum of such configurations can be obtained as cuts through four-dimensional space-filling bearing states. Bearings states can be perceived as physical realizations of networks of oscillators with asymmetrically weighted couplings. These networks can exhibit optimal synchronization properties through tuning of the local interaction strength as a function of node degree or the inertia of their constituting rotor disks through a power-law mass-radius relation . Under this condition, the average participation per disk is maximized and the energy dissipation rate is homogeneously distributed among elementary rotors. The synchronization of rotations occurs in avalanches following a broad size distribution [2].



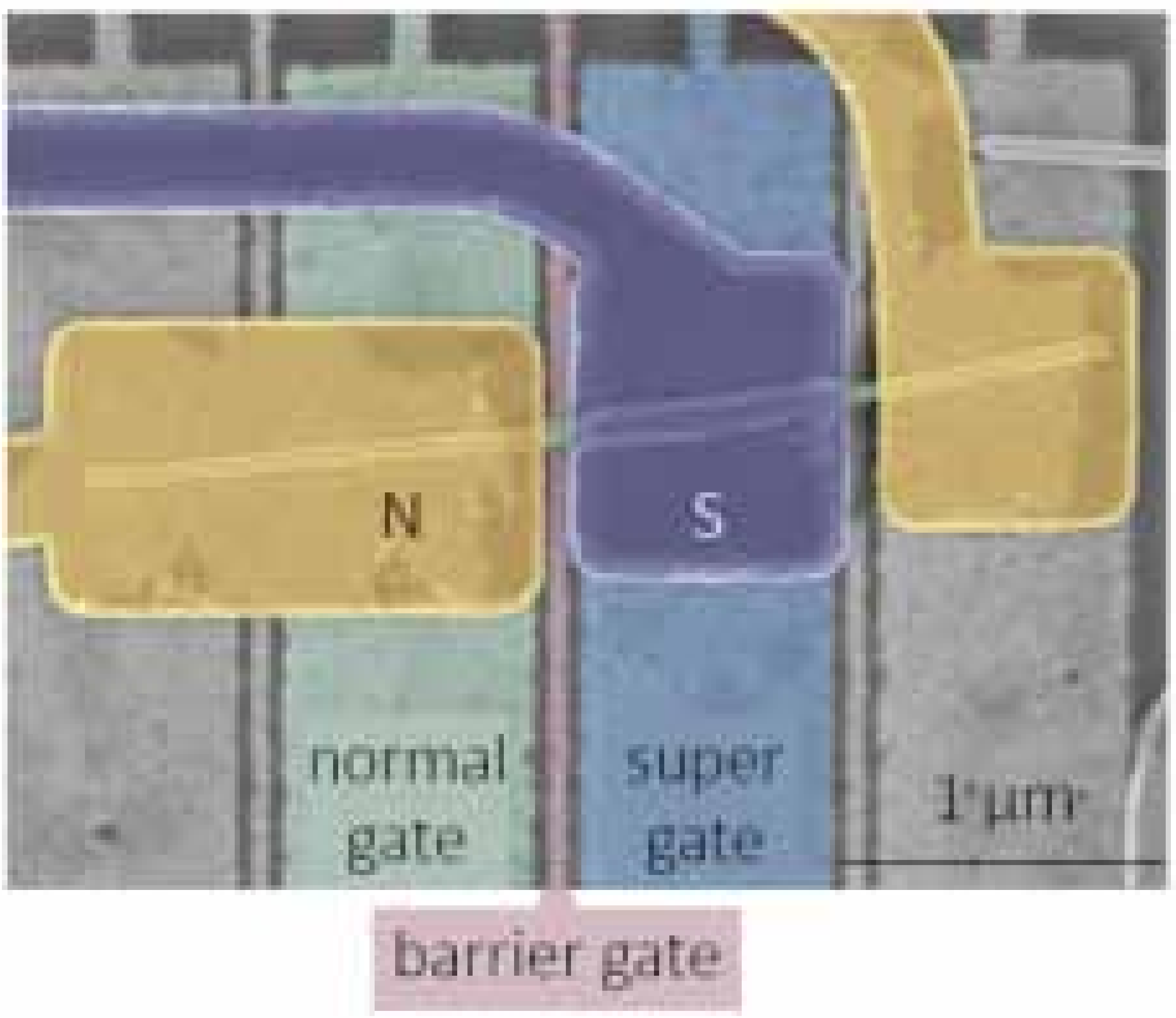
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Leo Kouwenhoven
TU Delft

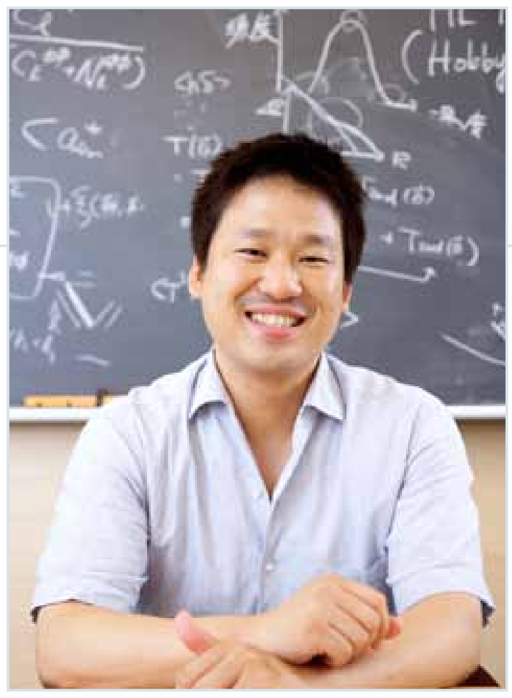
08.05.2018
16^{45} Uhr / HS III

Majorana Qubits

Majoranas in semiconductor nanowires can be probed via various electrical measurements. Tunnel spectroscopy have revealed zero-bias peaks in the differential conductance. New observations include quantum superpositions of Majorana states leading, for instance, to a 4pi current phase relation or a fractional Josephson effect. When the existence of Majoranas is firmly established, the next challenge is to build Majorana qubits. We discuss the different qubit schemes and report on our first building blocks. The promise of Majorana qubits is that the error rate is very low yielding a relativele simple scalable architecture.



Großes Physikalisches Kolloquium an der Universität zu Köln



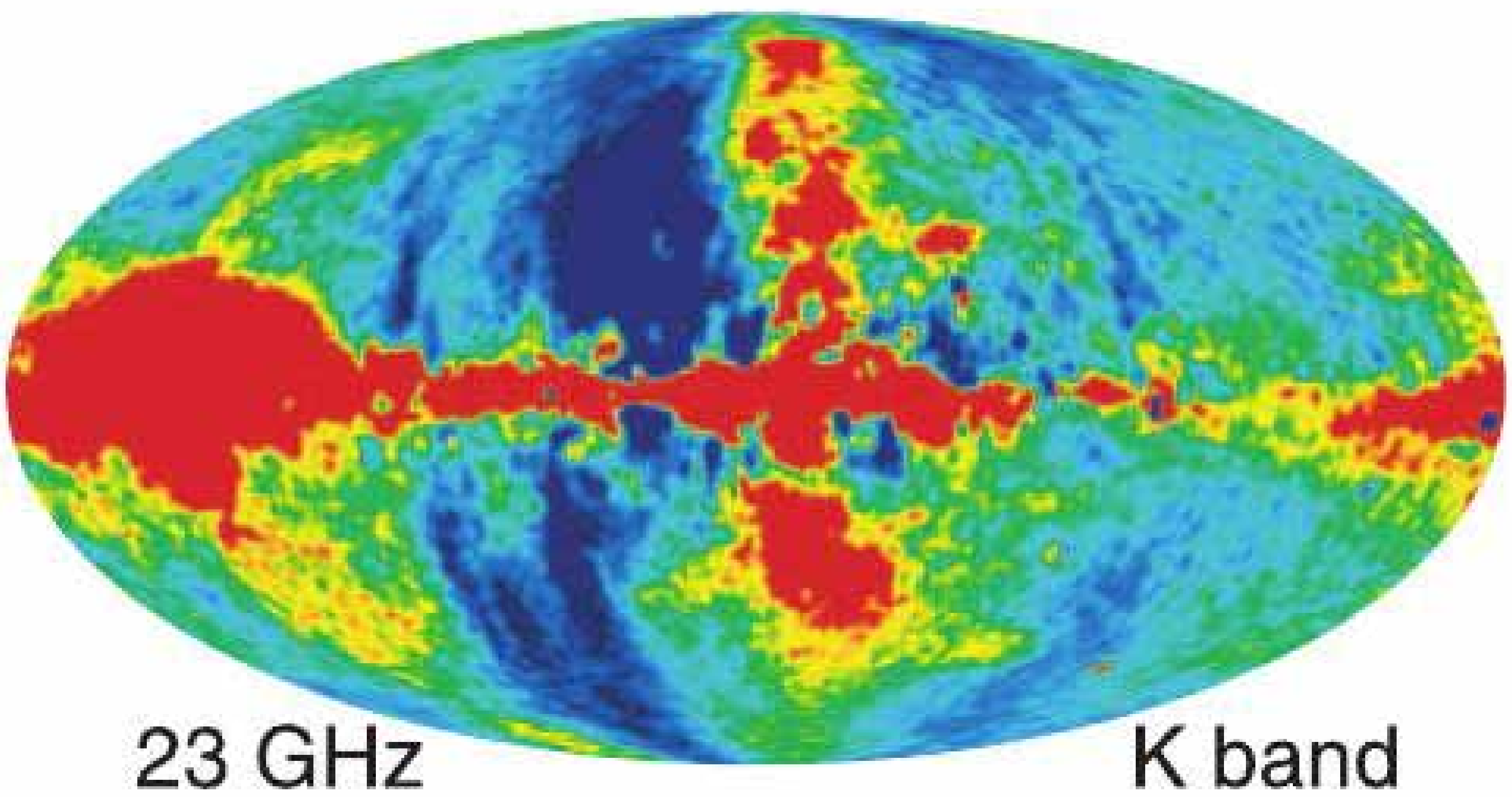
Prof. Dr. Eichiro Komatsu

MPA Garching

29.05.2018
16^{45} Uhr / HS III

Critical Tests of Theory of the Early Universe using the Cosmic Microwave Background

The Cosmic Microwave Background (CMB), the fossil light of the Big Bang, is the oldest light that one can ever hope to observe in our Universe. The CMB provides us with a direct image of the Universe when it was still an „infant“ - 380,000 years old - and has enabled us to obtain a wealth of cosmological information, such as the composition, age, geometry, and history of the Universe. Yet, can we go further and learn about the primordial universe, when it was much younger than 380,000 years old, perhaps as young as a tiny fraction of a second? If so, this gives us a hope to test cosmic inflation, the leading paradigm on the origin of our Universe at ultra high energies. In my talk I will review the physics of temperature and polarization anisotropies of the CMB and the key results from the recent experiments, and discuss future prospects on our quest to probe the physical conditions of the very early Universe.



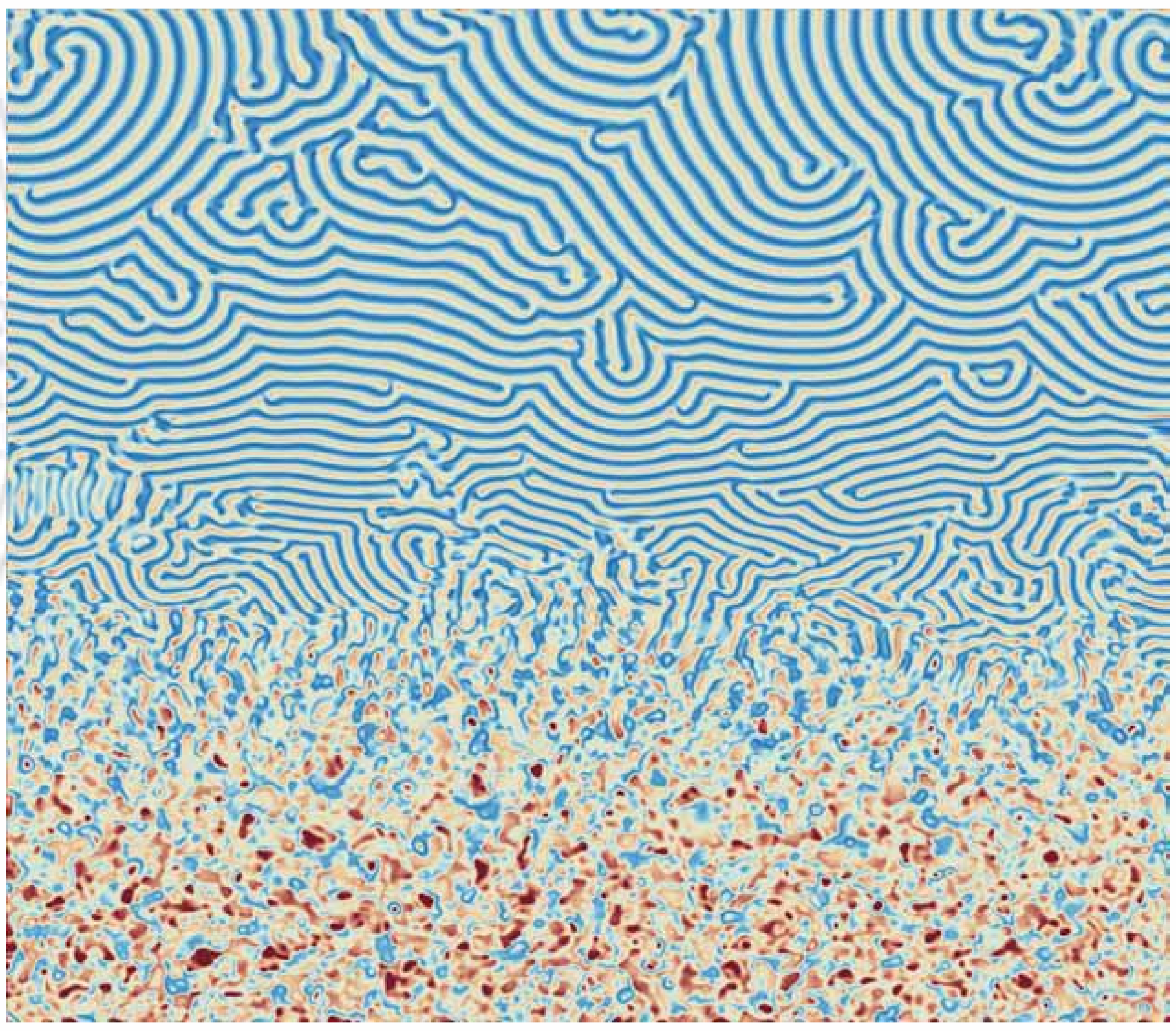
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Erwin Frey
Gründungskolloquium des Instituts für
Biologische Physik, LMU München

05.06.2018
16^{45} Uhr / HS III

Emergence and Self-Organisation in Biological Systems

Isolated systems tend to evolve towards thermal equilibrium, a special state that has been a research focus in physics for more than a century. By contrast, most processes studied in biological systems are far from equilibrium. A fundamental overarching hallmark of all these processes is the emergence of structure, order, and information, and we are facing the major challenge to identify the underlying physical principles. Two particular exciting problems are the self-organised formation of spatio-temporal patterns and the robust self-assembly of complex structures. In both fields there are recent advances in understanding the underlying physics that will be reviewed in this talk. In reaction–diffusion systems, it has been shown that the essential dynamics is the spatial redistribution of the conserved quantities which leads to moving equilibria. Efficient self-assembly of macromolecules and protein clusters is a vital challenge for living organisms: Not only are resources limited but also are malfunctioning aggregates a substantial threat to the organism itself.



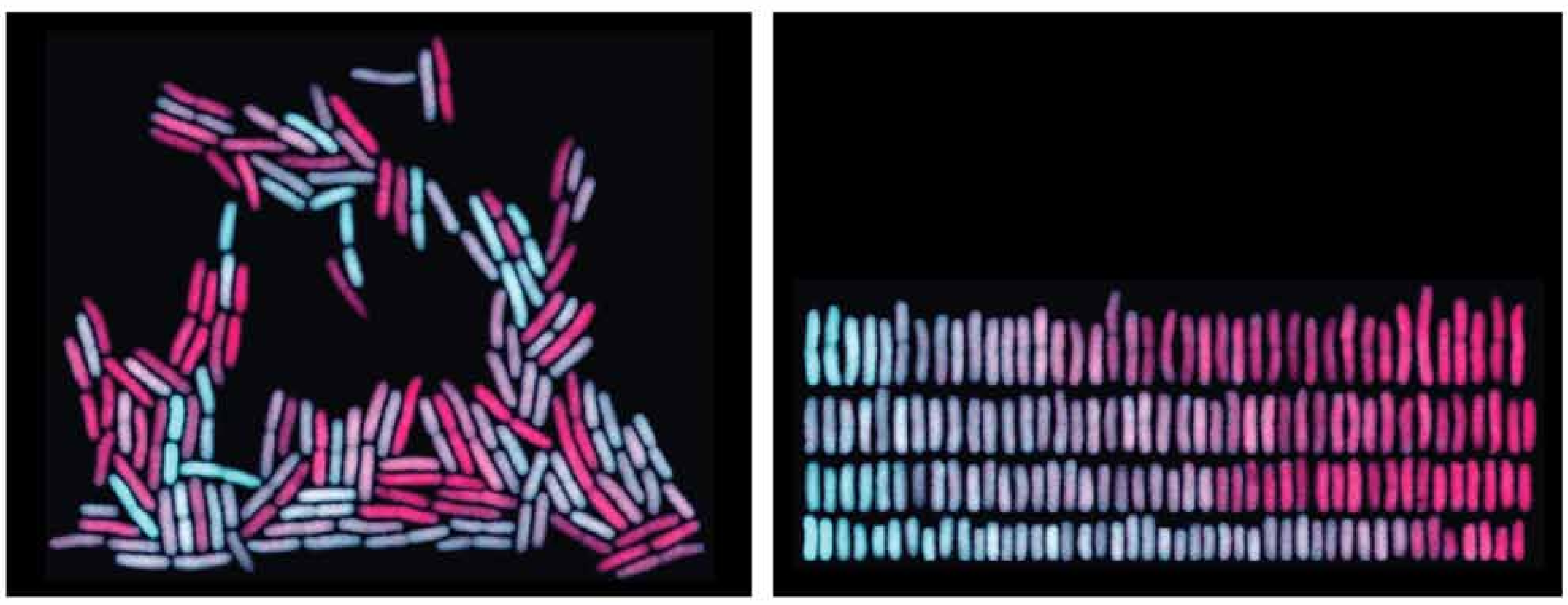
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Sander Tans
FOM Institute for Atomic and Molecular Physics,
the Netherlands

12.06.2018
16^{45} Uhr / HS III

Zooming in on bacterial adaptation, from individual cells to populations

My lab is interested in a range of cellular dynamics questions. We have used time-resolved microscopy of bacterial cell size and enzyme expression to reveal the inherent stochasticity of metabolic networks (Nature 2014) and how cells compensate for such variability during their cell cycle (Sci. Rep. 2015, BMC Biology 2016). Recently, we found that bacteria not only monitor length added during one cell cycle, but can also directly measure absolute size, using spatio-temporal protein oscillations of the Min proteins (Current Biology 2018). If time allows, I will discuss one of the following on evolutionary adaptation. Using genetically engineered signal transduction cascades and a novel theoretical framework, we found that knowledge only about the hierarchy with such cascades predicts certain types of epistasis (Nature communications, accepted). In another study, we have used time-lapse microscopy to identify a novel type of selective pressure on bacterial motility, which acts on the population rather than on the individual.



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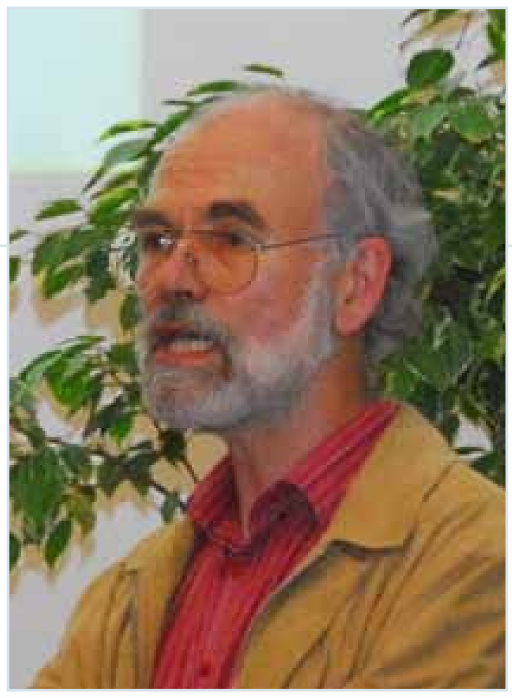

Prof. Dr. Jürgen Altmann
TU Dortmund

26.06.2018
16^{45} Uhr / HS III

Physics for Peace – Science and Technology for the Verification of Disarmament Treaties

With the important step of Disarmament Treaties comes the question of how to ensure verification. Jürgen Altmann has dedicated his research to this field. He will talk about various methods of verificationsuch as Seismic Sensors, Satellite Photos and Radionuclide Detection. His research mainly contributes to the Reduction and Prohibition of Nuclear and other Weapons

Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Klaus Kirch
ETH Zürich and PSI Villigen, Switzerland

10.07.2018
16^{45} Uhr / HS III

The electric dipole moment of the neutron

A permanent electric dipole moment (EDM) of a particle with spin violates time reversal symmetry. To date no finite EDM has been measured yet despite considerable search efforts world-wide and in various systems. The limits provide severe constraints on the Standard Model of Particle Physics and on theories beyond it. The most sensitive search for the EDM of the neutron is being pursued by the international nEDM collaboration at the Paul Scherrer Institute (PSI) in Switzerland. The high intensity proton accelerator at PSI provides up to 1.4 MW average beam power to targets producing the highest intensities of low momentum pions, muons and ultracold neutrons. After a brief review of the particle physics at PSI, I will give an introduction to the field of EDM research and its present status, including the latest update from the neutron EDM effort at PSI and a new result on oscillating EDM relevant to hypothetical ultra-light axion dark matter.