Eröffnungsvortrag

Großes Physikalisches Kolloquium an der Universität zu Köln

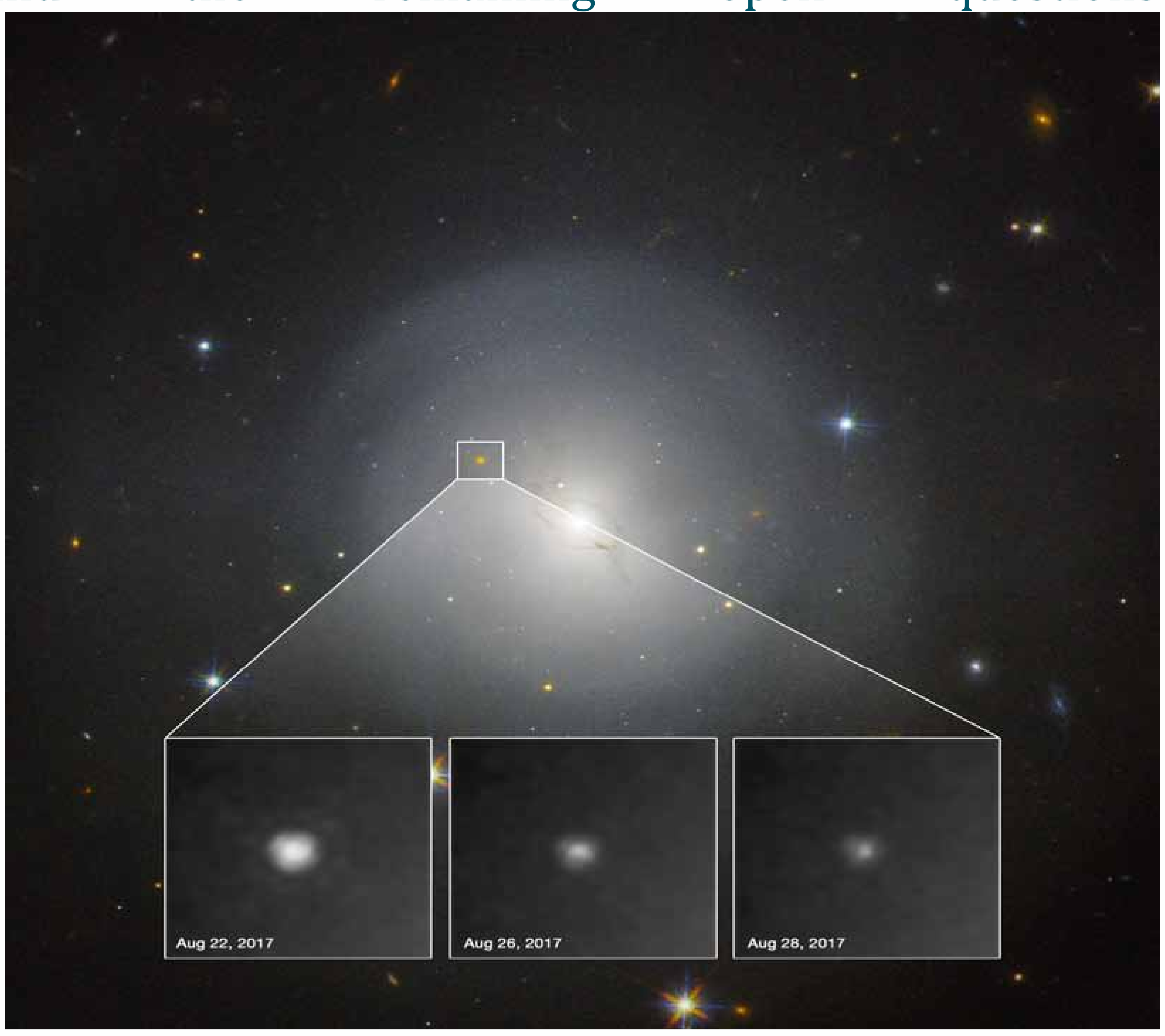
Prof. Dr. Gabriel Martínez Pinedo

GSI Helmholtzzentrum für Schwerionenforschung and Institut für Kernphysik (Theoriezentrum), Technische Universität Darmstadt

16.10.2018
16^{45} Uhr / HS III

Kilonova: an electromagnetic signal of heavy element nucleosynthesis

On August 17th 2017, the LIGO/VIRGO collaborations detected the gravitational signal GW170817 originating from a merger of two neutron stars. Shortly after an electromagnetic signal with an intrinsic brightness corresponding to thousand novas was detected by several telescopes worldwide lasting around a week. This kilonova signal has been predicted by theory long before and originates from the radioactive decay of freshly synthesized radioactive heavy nuclei produced by the r process. Hence, it answers one of the long lasting questions in nuclear astrophysics related to the astrophysical site of the r process. In this talk, I will summarize our current understanding of the r process, the answers provided by the recent observations and the remaining open questions.



Großes Physikalisches Kolloquium an der Universität zu Köln

Dr. Oliver Passon
Bergische Universität Wuppertal

30.10.2018
16^{45} Uhr / HS III

The history of early quantum theory: myth and facts

Although science teaching usually aimes at imparting current practices and theories, it is often framed historically. However, this ``quasi-history“ often distorts the actual course of events and presents the history of science as a cummulative sequence which finally led to the acceptance of the current theories. Thus, textbooks produce a sense of participation in a certain methodological and social tradition which may be fictitous. A classic example for quasi-history is the usual account of early quantum theory (1900-1923). [1]We argue that in this case the quasi-historical narrative actually fails to establish a rational tradition because it contains severe technical misconceptions.

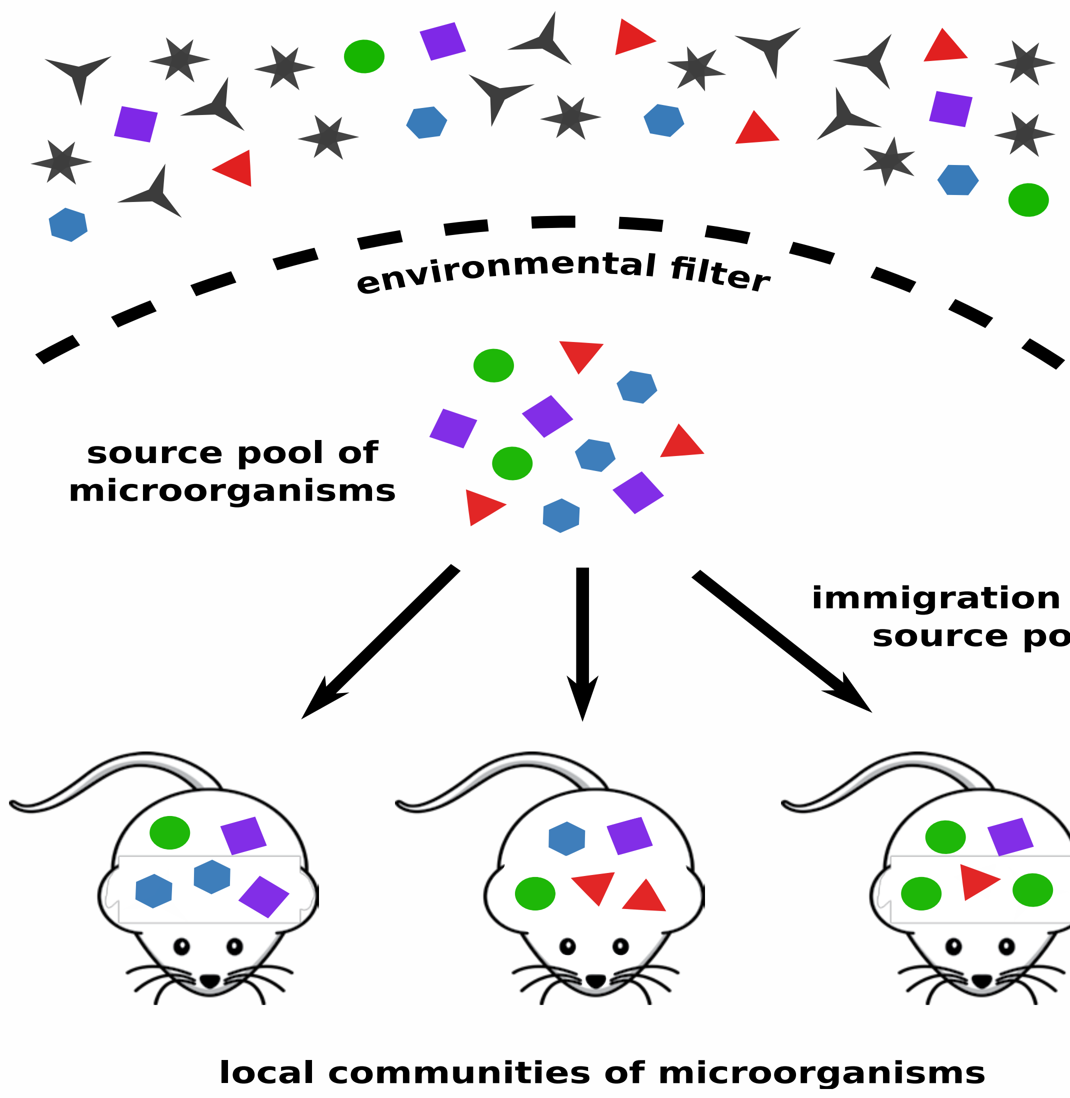
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Arne Traulsen
Max Planck Institute for Evolutionary Biology, Plön

20.11.2018
16^{45} Uhr / HS III

Stochastic and deterministic models of microbiomes

All animals and plants are associated to a huge number of microbes that live together with them or even within them. These microbes often have fundamental roles in the functioning of their hosts, from metabolic functions to defense against diseases. In many cases, a disease microbiome seems distinct from a healthy one. This multi-stability of microbiomes can be understood in terms of game theoretical models that describe the interactions between microbes, but it is challenging to assess the associated parameters from experimental data. On the other hand, many microbes will randomly vary in their abundance, such that stochastic models are more appropriate to describe them. In the most extreme case of neutral models, it is assumed that all microbes are identical. Such neutral models are widely used in theoretical ecology and they can be directly applied to the microbiomes of a wide variety of host organisms. Neutral models allow to identify key microbial types, which! are not necessarily those that are found in particularly high abundance.



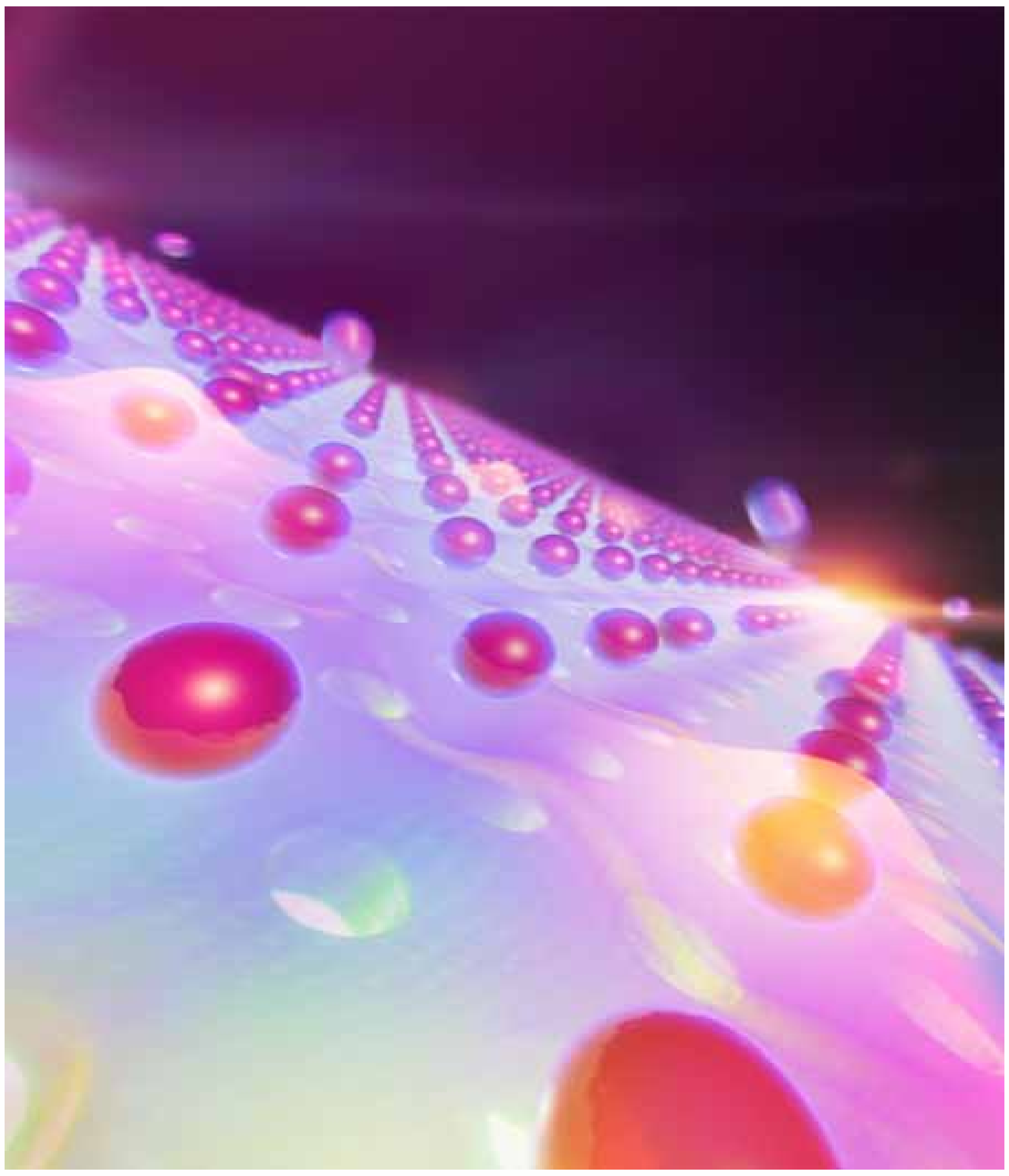
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Ignacio Cirac
Max-Planck-Institut für Quantenoptik Garching, Germany

11.12.2018
16^{45} Uhr / HS III

Quantum algorithms for quantum simulation and small devices

Quantum computers offer important speed-ups in the solution of a variety of problems. One of them is the simulation of quantum many-body systems, as they appear in atomic, condensed matter or high-energy physics, or quantum chemistry. Other, like SAT, are related to classical optimization problems. In this talk I will first review some of the quantum algorithms to simulate the equilibrium and dynamics of quantum many-body systems. Then I will present a hybrid quantum-classical algorithm to solve SAT problems with (relatively) small quantum devices.



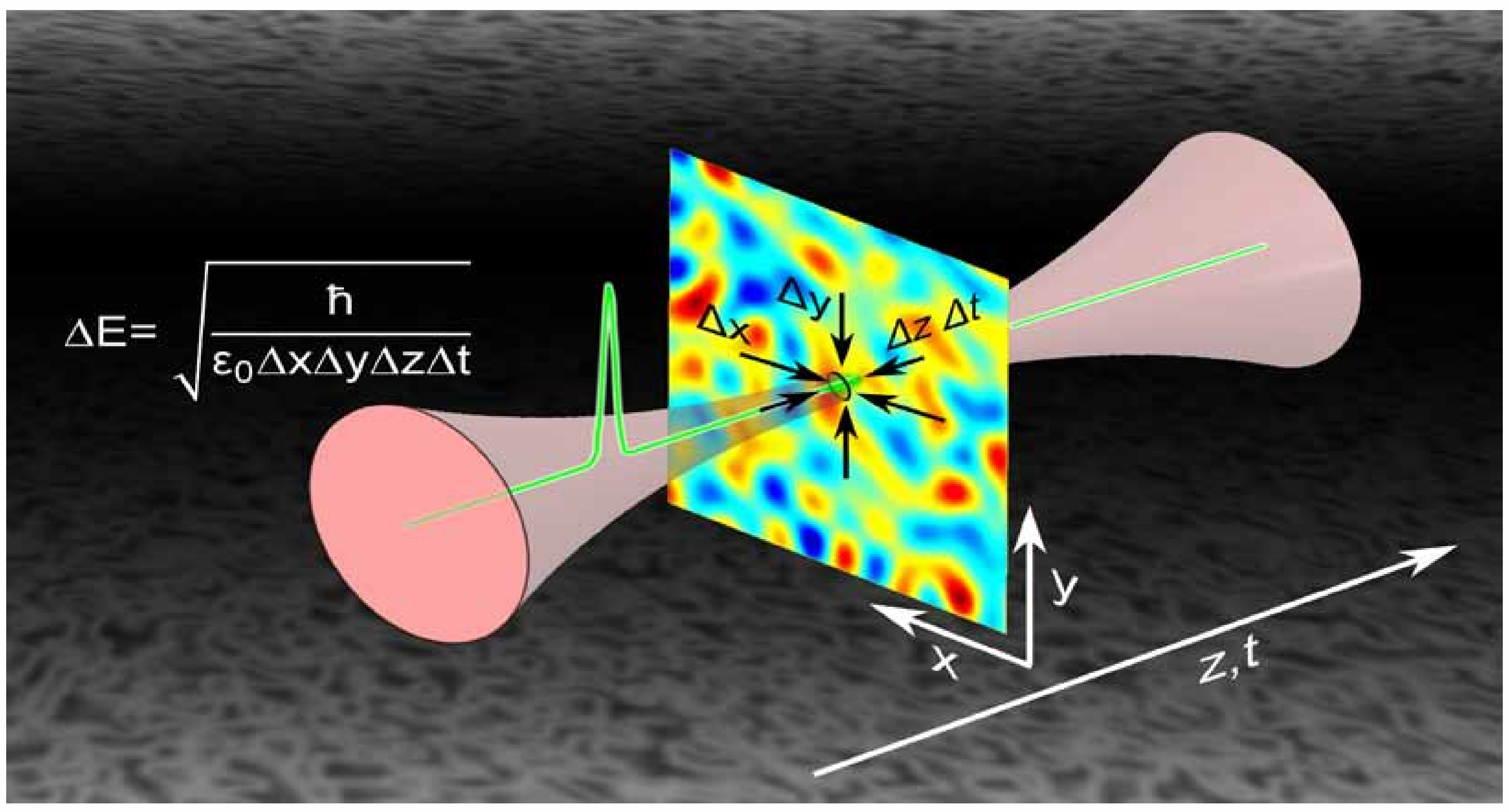
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Alfred Leitenstorfer
Department of Physics and Center for Applied Photonics, University of Konstanz, Germany

15.01.2019
16⁴⁵ Uhr / HS III

Four-Dimensional Quantum Physics

It is well known that confinement on spatial dimensions smaller than the de Broglie wavelength leads to significant changes of the properties of e.g. an electronic system. Enabled by precise control over electromagnetic fields on a sub-femtosecond scale, we explore the physics emerging when light and matter become confined also in the fourth dimension – time. In a first set of experiments, we study the attosecond transport of electrons over atomic-scale tunneling junctions when biasing with phase-locked single cycles of near-infrared radiation. Femtojoule pulse energies are sufficient to reach a non-perturbative regime of current densities, aiming at novel quantum transport phenomena which might arise even at room temperature. A second area concerns the subcycle quantum physics of light itself. Reading out the nonlinear displacement of valence electrons in a semiconductor with few-femtosecond resolution, we can directly sample the vacuum fluctuations of the electric field. Their variance is proportional to the inverse space-time volume over which a probe pulse averages. This truly four-dimensional quantum confinement allows us to detect and manipulate signals derived from purely virtual excitations.



Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Tommaso Calarco
Institute for Quantum Control, Peter Grünberg Institute (PGI-8), Forschungszentrum Jülich and Institute for Theoretical Physics, Cologne University

22.01.2019
16^{45} Uhr / HS III

Quantum technologies and quantum control

The control of quantum states is essential both for fundamental investigations and for technological applications of quantum physics. In quantum few-body systems, decoherence arising from interaction with the environment hinders the realization of desired processes. In quantum many-body systems, complexity of their dynamics further makes state preparation via external manipulation highly non-trivial. An effective strategy to counter these effects is offered by quantum optimal control theory, exploiting quantum coherence to dynamically reach a desired goal with high accuracy even under limitations on resources such as time, bandwidth, and precision.