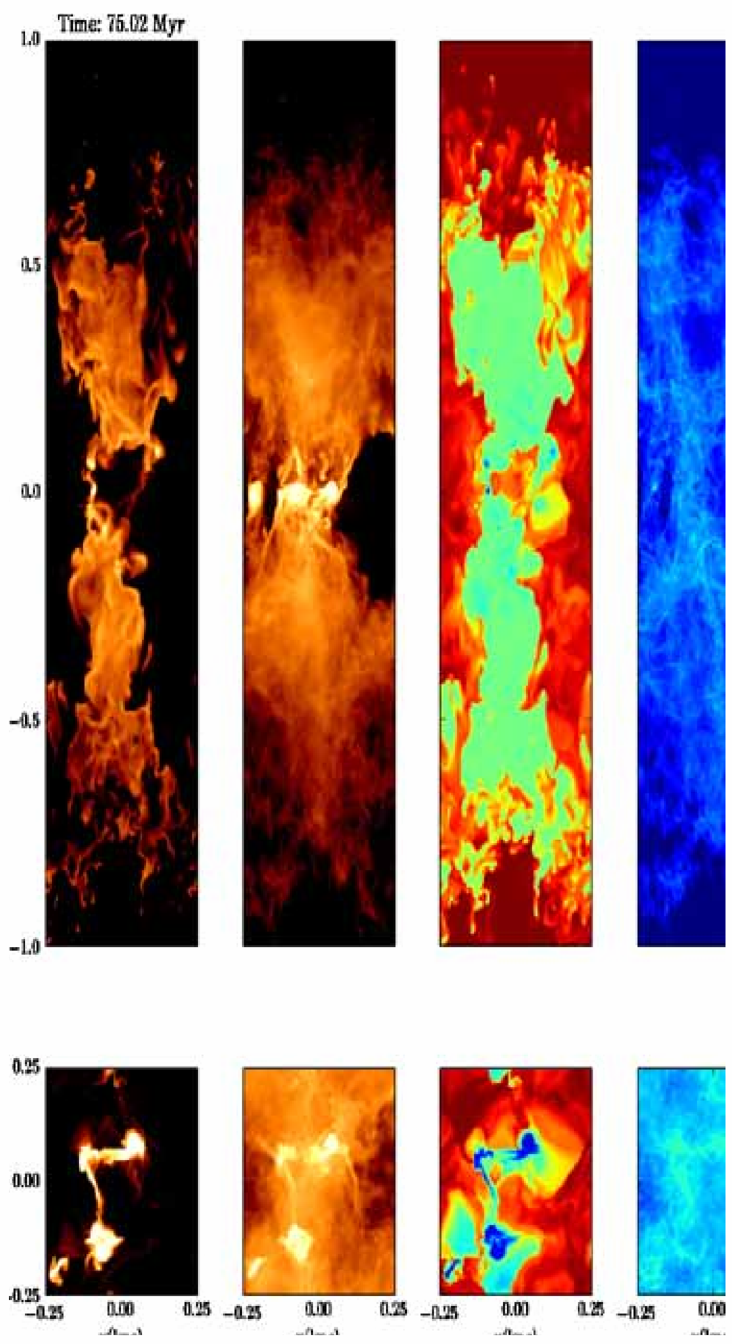
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Stefanie Walch
Universität zu Köln

11.11.2014
16^{45} Uhr / HS III

The full life-cycle of molecular clouds



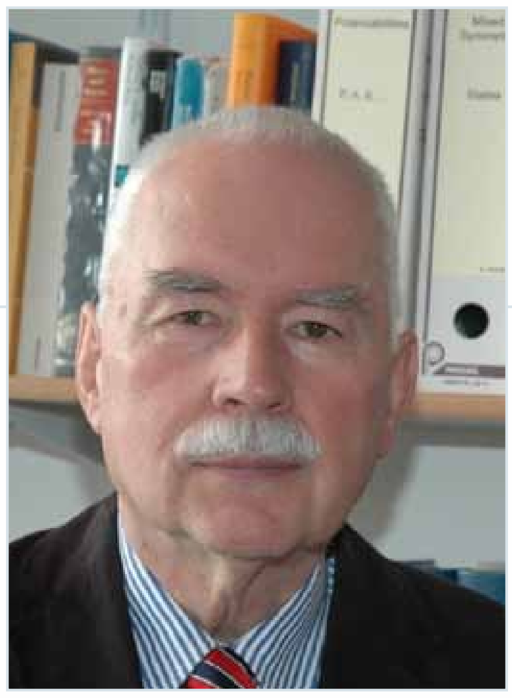
Molecular clouds are cold, dense, and turbulent filamentary structures that condense out of the multi-phase interstellar medium. They are also the sites of star formation. The minority of new-born stars is massive, but these stars are particularly important for the fate of their parental molecular clouds.

I will present results from high-performance, three-dimensional simulations that show the formation and dispersal of molecular clouds within representative pieces of disk galaxies. Apart from stellar feedback and self-gravity, we employ an accurate description of gas heating and cooling as well as a small chemical network including molecule formation and self-shielding. Gravitational collapse is compensated by stellar feedback, leading to the establishment of a dynamical equilibrium of the interstellar medium within the disk. I will discuss results for disks at different gas surface densities which e.g. demonstrate that the molecular gas mass fraction increases with gas surface density. Moreover, I will show that outflows generated by supernovae that explode within the parental molecular clouds may contain a significant fraction of diffuse molecular hydrogen that is not well traced by CO.

These simulations will bring forth a modern paradigm for the full life cycle of molecular clouds with important implications for galaxy evolution.

Großes Physikalisches Kolloquium an der Universität zu Köln

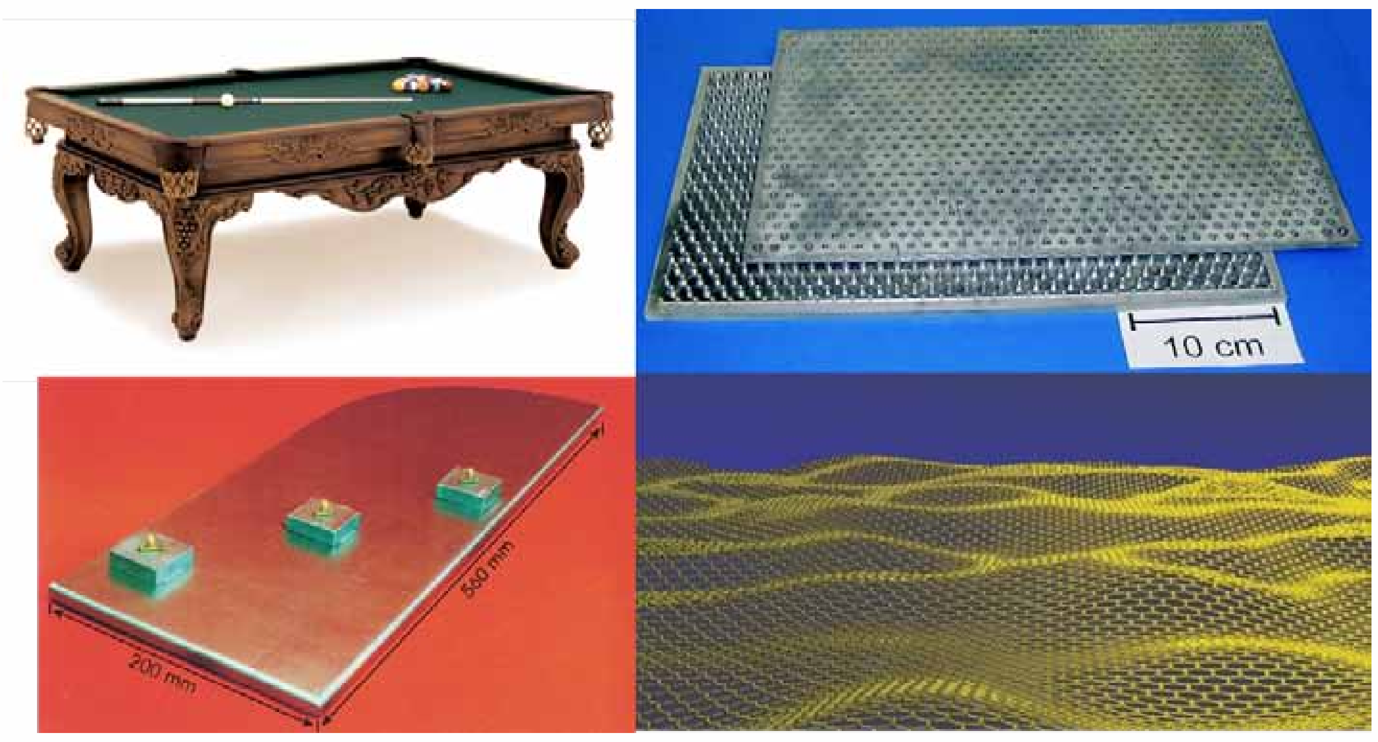
Prof. Dr. Dr. h.c. mult. Achim Richter
Technische Universität Darmstadt



25.11.2014
16^{45} Uhr / HS III

Schroedinger- and Dirac-Microwave Billiards, Photonic Crystals and Graphene

Flat closed and open microwave resonators shaped in the form of billiards are well suited to study the quantum mechanical behaviour of classically regular and chaotic systems, respectively. Thereby the formal analogy between the scalar Helmholtz and the non-relativistic Schroedinger equation, and also between the Helmholtz and the Dirac equation in the case of special photonic crystals embedded into the billiards, is exploited.



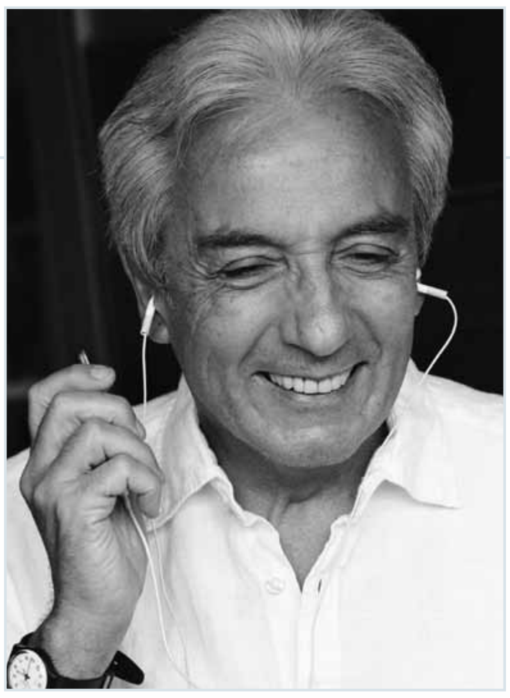
With chaotic Schroedinger billiards it is shown that their spectral properties exhibit universal features which are also evident in real microscopic systems of different scales, i.e. hadrons, nuclei, atoms, molecules, clusters and quantum dots. In Dirac billiards it is possible to simulate relativistic phenomena like those observed in Graphene.

With controllable macroscopic microwave billiards and photonic crystals as „analogue simulators“ we have thus - similar as in the case of ultracold gases - systems at hand whose Hamiltonian might be tailored to the one of the corresponding microscopic quantum systems.

Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Albert Fert
UMP CNRS-Thales & Université Paris-Sud, France

Nobel laureate in Physics, 2007



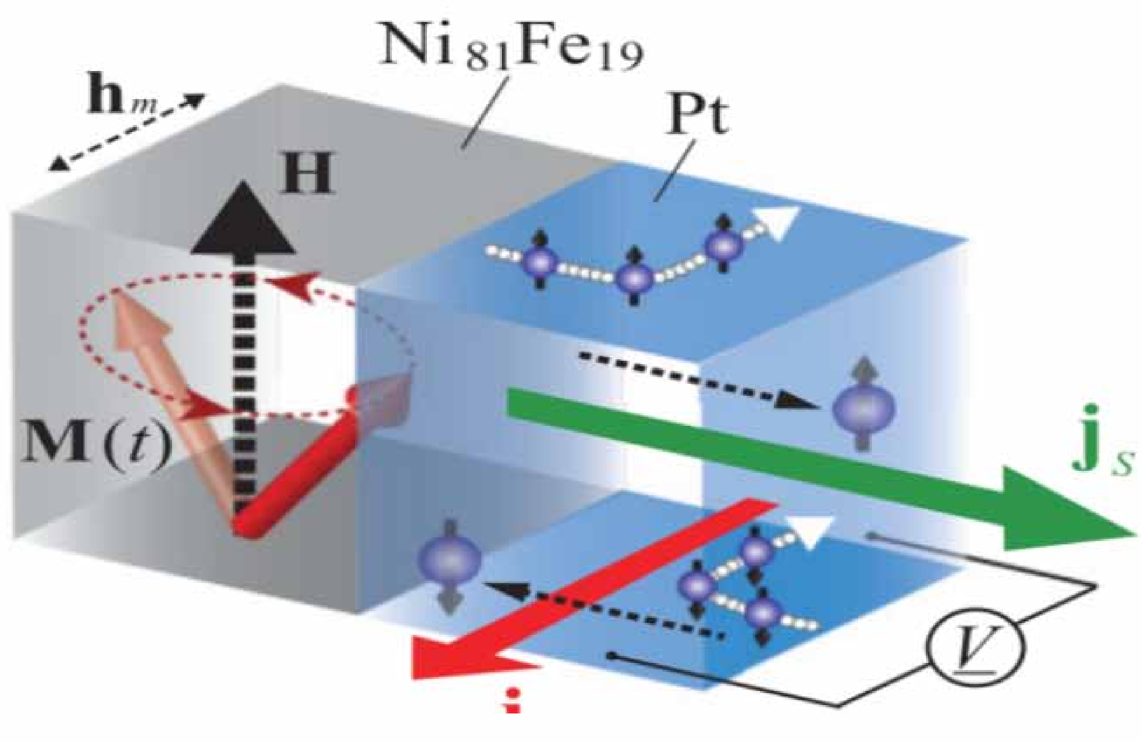
9.12.2014
16[45] Uhr / HS I
vorher:
BCGS Opening Event

Spin-orbitronics, a new direction for spintronics

Classical spintronic devices use the exchange interaction between conduction electron spins and local spins in magnetic materials to create spin-polarized currents or to manipulate nanomagnets by spin transfer from spin-polarized currents. A novel direction of spintronics – that can be called spin-orbitronics - exploits the Spin-Orbit Coupling (SOC) in nonmagnetic materials instead of the exchange interaction in magnetic materials to generate, detect or exploit spin-polarized currents.
This opens the way to spin devices made of only nonmagnetic materials and operated without magnetic fields. Spin-orbit coupling can also be used to create new types of topological magnetic objects as the magnetic skyrmions or the Dzyaloshinskii-Moriya domain walls. After a general introduction on spintronics, I will review recent advances in two directions of spin-orbitronics.

a) Nucleation, current-induced motion and pinning of individual skyrmions or trains of skyrmions in films or multilayers: I will focus on skyrmions induced by Dzyaloshinsky-Moriya interactions at interfaces of ferromagnetic layers with materials of large spin-orbit coupling and I will discuss their potential for applications.

b) Conversion between charge and spin current by SOC (Spin Hall Effect and Edelstein Effect): I will describe recent experiments and applications to the current-induced motion of magnetic domain walls and the switching of nanomagnets.



Großes Physikalisches Kolloquium an der Universität zu Köln

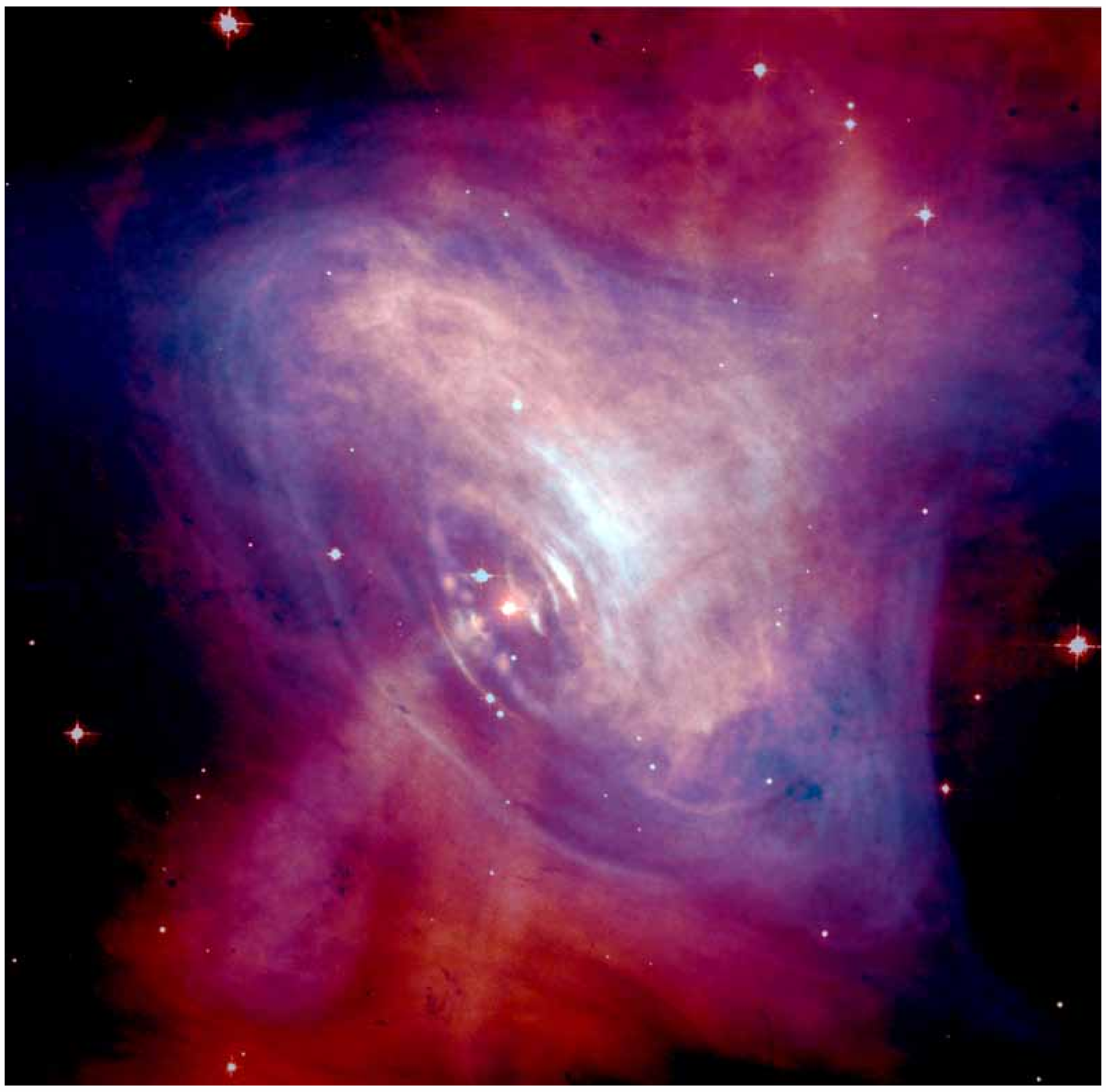
Prof. Dr. Jocelyn Bell Burnell
University of Oxford

13.1.2015
16^{45} Uhr / HS III

An introduction to pulsar physics

Pulsars (pulsating radio stars) are formed from the cores of massive stars that explode at the end of their lives (supernovae). They typically have a magnetic field $B \sim 10^8$ Tesla, densities of the order of $\sim 10^{15}$ g/cc, velocities v that come close to the speed of light c (all at the same time), and spin rapidly ($P \sim 10^{-3}$ to 10 s), so have some extreme physics.

This talk will introduce the main physical properties of pulsars and how they can be used to test some aspects of General Relativity, such as the existence of gravitational radiation, and provide a test of the strong principle of equivalence.



Großes Physikalisches Kolloquium im Wintersemester 2014/15 - **Hörsaal III der Physikalischen Institute**, Zülpicher Straße 77, 50937 Köln - www.physik.uni-koeln.de

Großes Physikalisches Kolloquium an der Universität zu Köln

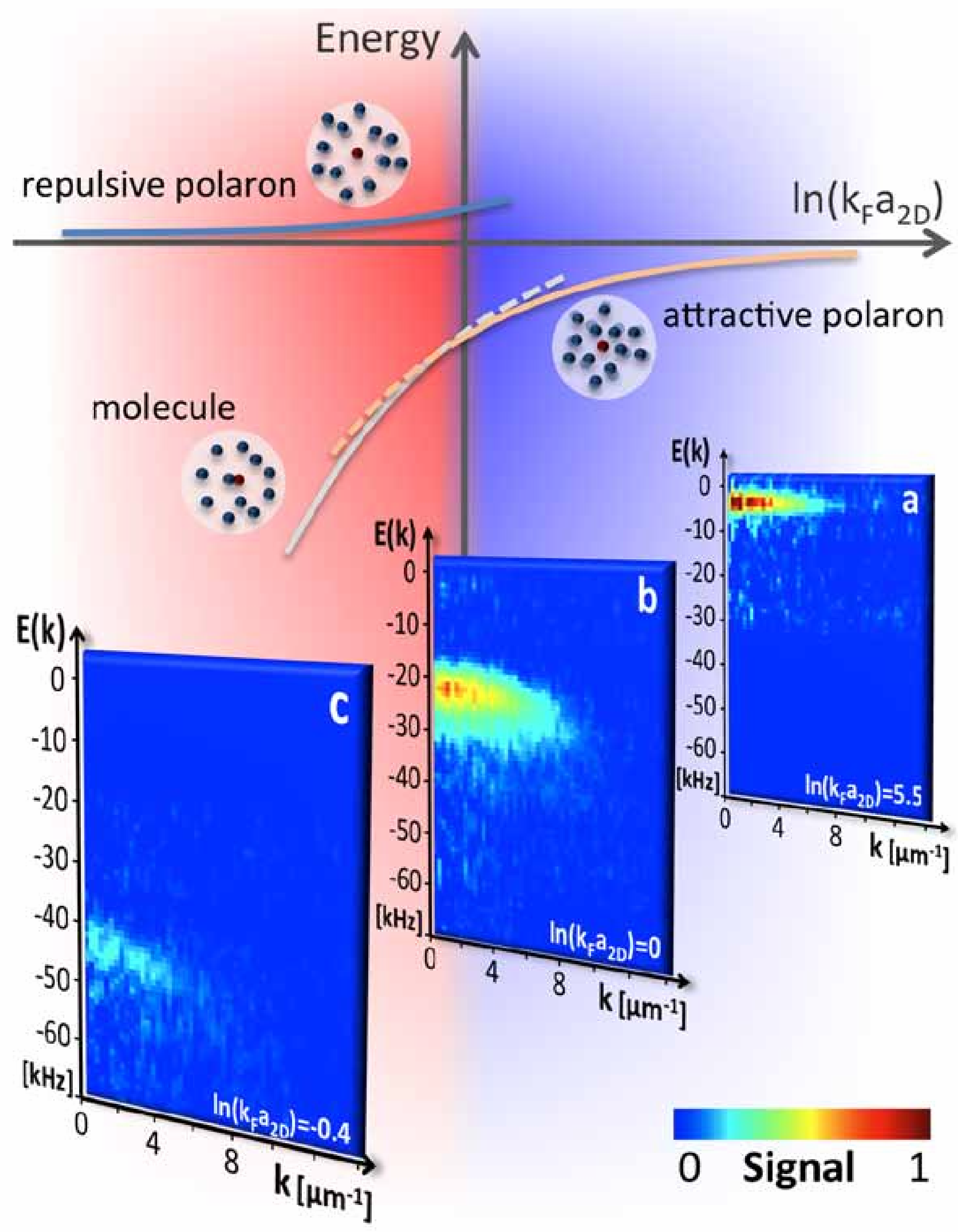
Prof. Dr. Michael Köhl
Rheinische Friedrich-Wilhelms-Universität Bonn

27.1.2015
16[45] Uhr / HS III

Ultracold atomic Fermi gases

Pairing of fermions is ubiquitous in nature and it is responsible for a large variety of fascinating phenomena like superconductivity, superfluidity of 3He, the anomalous rotation of neutron stars, and the BEC-BCS crossover in strongly interacting Fermi gases.

When confined to two dimensions, interacting many-body systems bear even more subtle effects, many of which lack understanding at a fundamental level. In particular, the questions how (Cooper-) pairing is established in strongly interacting systems and whether it precedes superconductivity are crucial to be answered. Atomic quantum gases at Nanokelvin temperature have emerged as a highly controlled and competitive system to investigate this physics from first principles.



We will present an overview over recent experiments, including the observation of a pseudo pairing gap above the superfluid transition temperature, the discovery of polaron quasiparticles, and spin-transport measurements.

Eröffnungsvortrag

Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr.-Ing. Robert Pitz-Paal
DLR Institut für Solarforschung, Jülich

14.10.2014
16^{45} Uhr / HS III

Solarthermische Kraftwerke zur Energieversorgung im Sonnengürtel

„Konzentrierende Solarsysteme funktionieren im Großen, wie Brenngläser im Kleinen: Sie bündeln Sonnenstrahlung, um Wärme zu erzeugen. Diese kann zur Stromproduktion, zur unmittelbaren Anwendung in technischen Prozessen oder in chemischen Reaktionen zur Erzeugung von Brennstoffen wie zum Beispiel Wasserstoff eingesetzt werden.

Im Vergleich zur Fotovoltaik, die die Energie des Lichtes in einem bestrahlten Halbleiter direkt in Strom umwandelt, besteht hier der Vorteil, dass sich die eingesammelte Wärme einfach und kostengünstig speichern lässt um bei Wolken oder in den Abendstunden zur Stromerzeugung genutzt zu werden. Damit lässt sich ein hohes Maß an Versorgungssicherheit erzielen. Heutzutage werden weltweit Parabolrinnenkraftwerke mit mehr als 3 GW Leistung bei Temperaturen von etwa 400°C kommerziell betrieben. Um die Kosten der Systeme weiter zu senken wird versucht die Sonne noch stärker zu bündeln um höhere Temperaturen erzielen zu können um damit die Gesamteffizienz des Kraftwerks zu erhöhen.

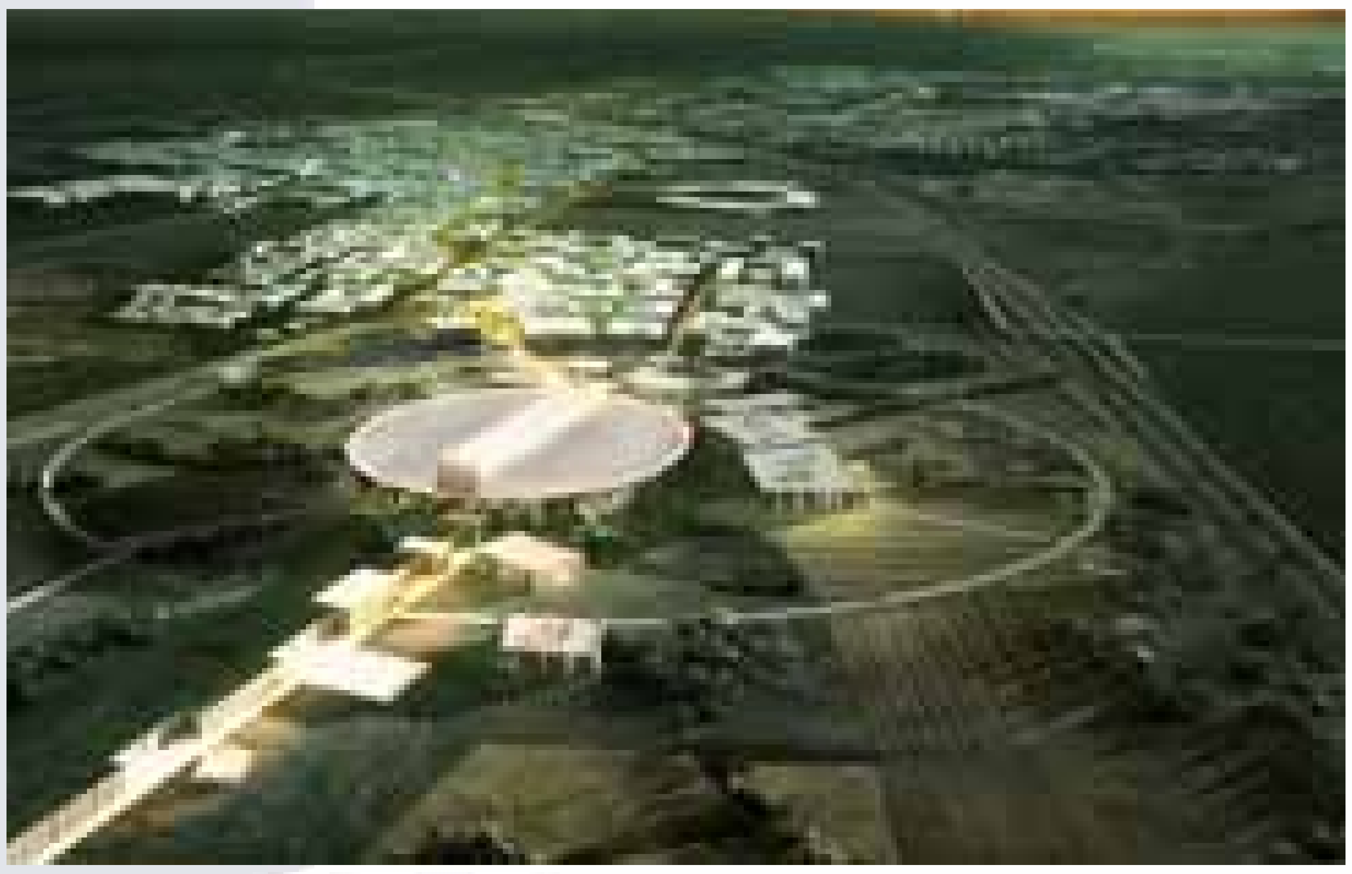
Großes Physikalisches Kolloquium an der Universität zu Köln

Dr. Dimitri N. Argyriou
European Spallation Source, Lund, Sweden

28.10.2014
16^{45} Uhr / HS III

The European Spallation Source: A Source for Discovery

Neutrons have been called beautiful because of their varied and unusual properties. The Nobel Laureate Bertram Brockhouse said of neutrons that if we did not have them, we would need to „invent them" in order to study novel states of matter.



The basic advantage of neutrons are that they are charge neutral and thus highly penetrating, they obey conservation laws that allow us to probe both the time and spacial domains of materials, they posses a magnetic moment that makes them a probe of choice to investigate magnetism in materials and finally the exhibit sensitivity to light elements.

These properties allow us to use neutrons in a large variety of ways to examine materials from both the fundamental and technological perspective. It is for these reason that neutrons are deployed on a diverse scientific areas such as archeology to ecology, from high-temperature superconductors to lipid membranes and proteins. The European Spallation Source (ESS), currently under construction in Lund Sweden, will be the brightest source of neutrons in the world, opening new horizons for materials research and fundamental physics. We shall look at some of the innovations of ESS that will enable transformative experiments using neutrons as well as at current trends in science that ESS can potentially impact.