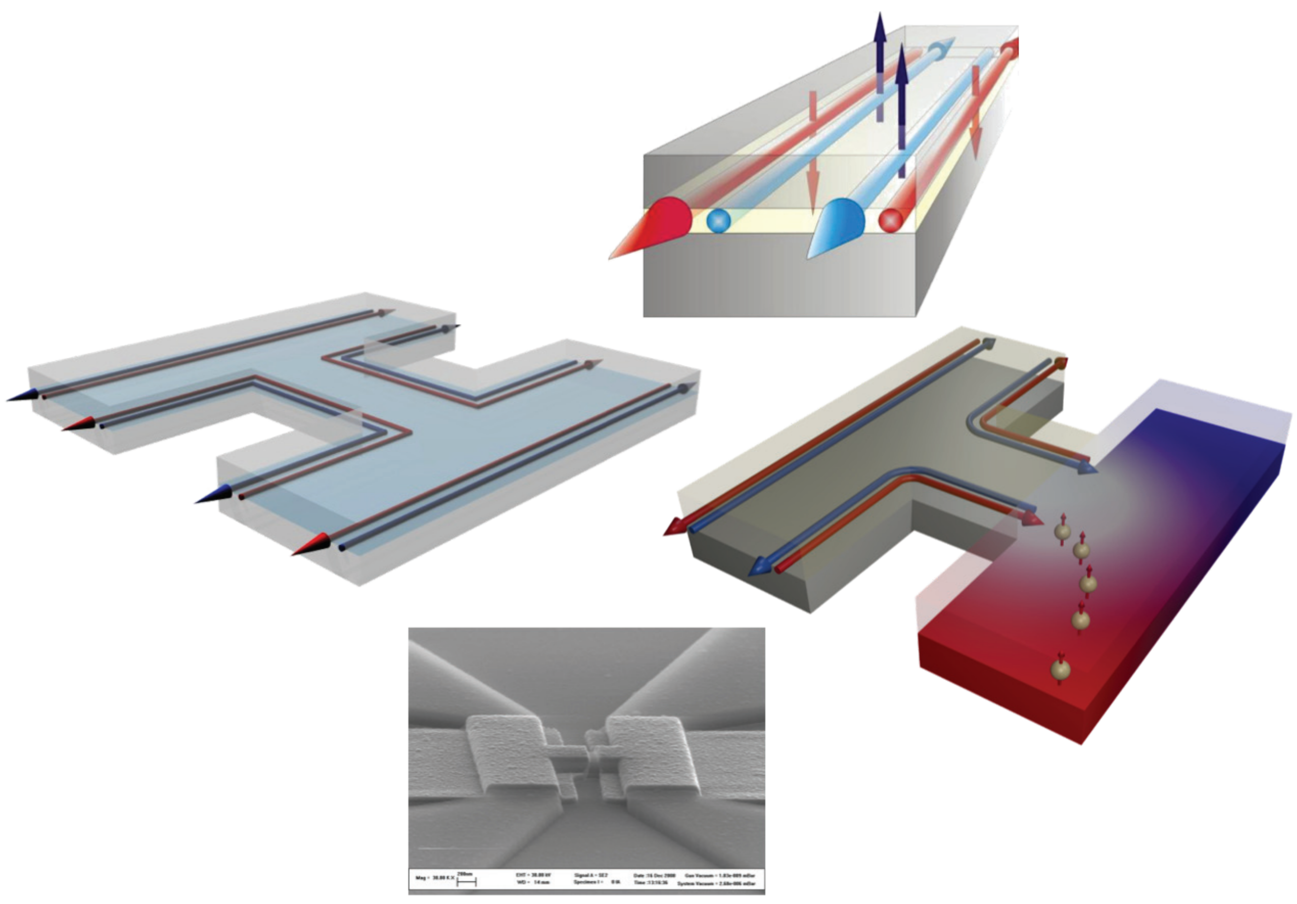
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Laurens Molenkamp
Universität Würzburg

29.4.2014
16^{45} Uhr / HS III

HgTe as a Topological Insulator

HgTe is a zincblende-type semiconductor with an inverted band structure. While the bulk material is a semimetal, lowering the crystalline symmetry opens up a gap, turning the compound into a topological insulator.



The most straightforward way to do so is by growing a quantum well with (Hg,Cd)Te barriers. Such structures exhibit the quantum spin Hall effect, where a pair of spin polarized helical edge channels develops when the bulk of the material is insulating.

Our transport data provide very direct evidence for the existence of this third quantum Hall effect, which now is seen as the prime manifestation of a 2-dimensional topological insulator.

To turn the material into a 3-dimensional topological insulator, we utilize growth induced strain in relatively thick (ca. 100 nm) HgTe epitaxial layers. The high electronic quality of such layers allows a direct observation of the quantum Hall effect of the 2-dimensional topological surface states. These states appear to be decoupled from the bulk. This allows us to induce a supercurrent is induced in the surface states by contacting these structures with Nb electrodes.

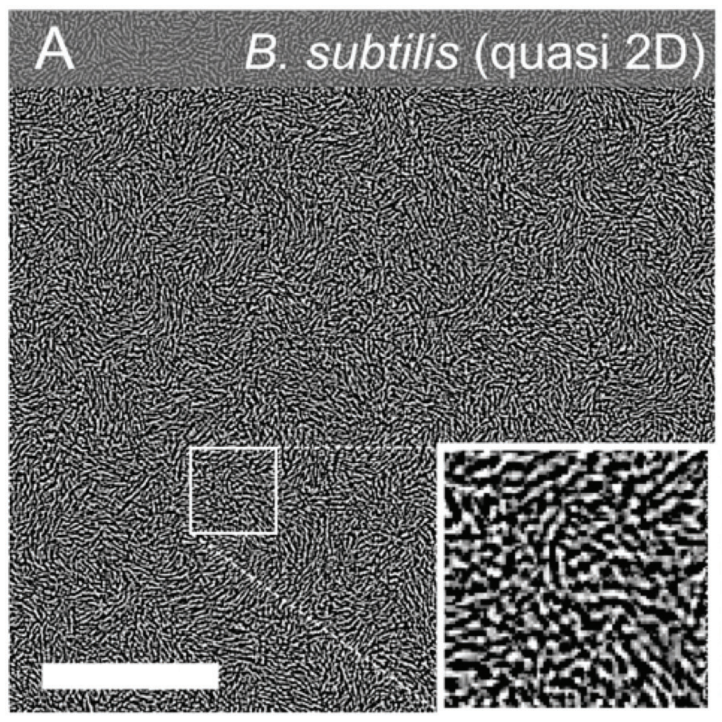
Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Hartmut Löwen
Universität Düsseldorf

13.5.2014
16^{45} Uhr / HS III

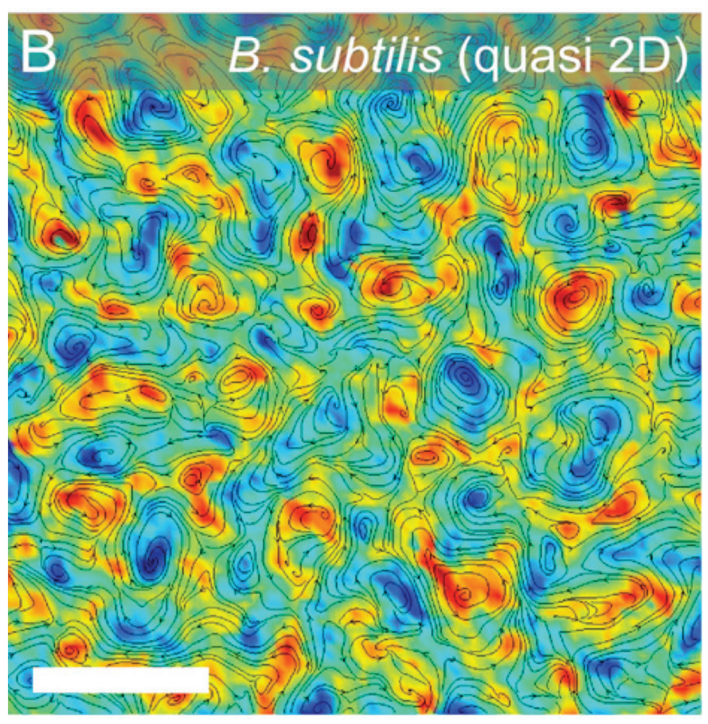
Physics of Active Matter

Ordinary materials are „passive“ in the sense that their constituents are typically made by inert particles which are subjected to thermal fluctuations, internal interactions and external fields but do not move on their own. Living systems, like schools of fish, swarms of birds, pedestrians and swimming microbes are called „active matter“ since they are composed of self-propelled constituents.



Active matter is intrinsically in non-equilibrium and exhibits a plethora of novel phenomena as revealed by a recent combined effort of statistical theory, hydrodynamics and real-space experiments.

The colloquium talk provides an introduction into the physics of active matter focussing on biological and artificial microswimmers as key examples of active soft matter. A number of single-particle and collective phenomena in active matter will be addressed ranging from the most disordered state of matter (turbulence) to the most ordered state of matter (crystal).



Großes Physikalisches Kolloquium an der Universität zu Köln

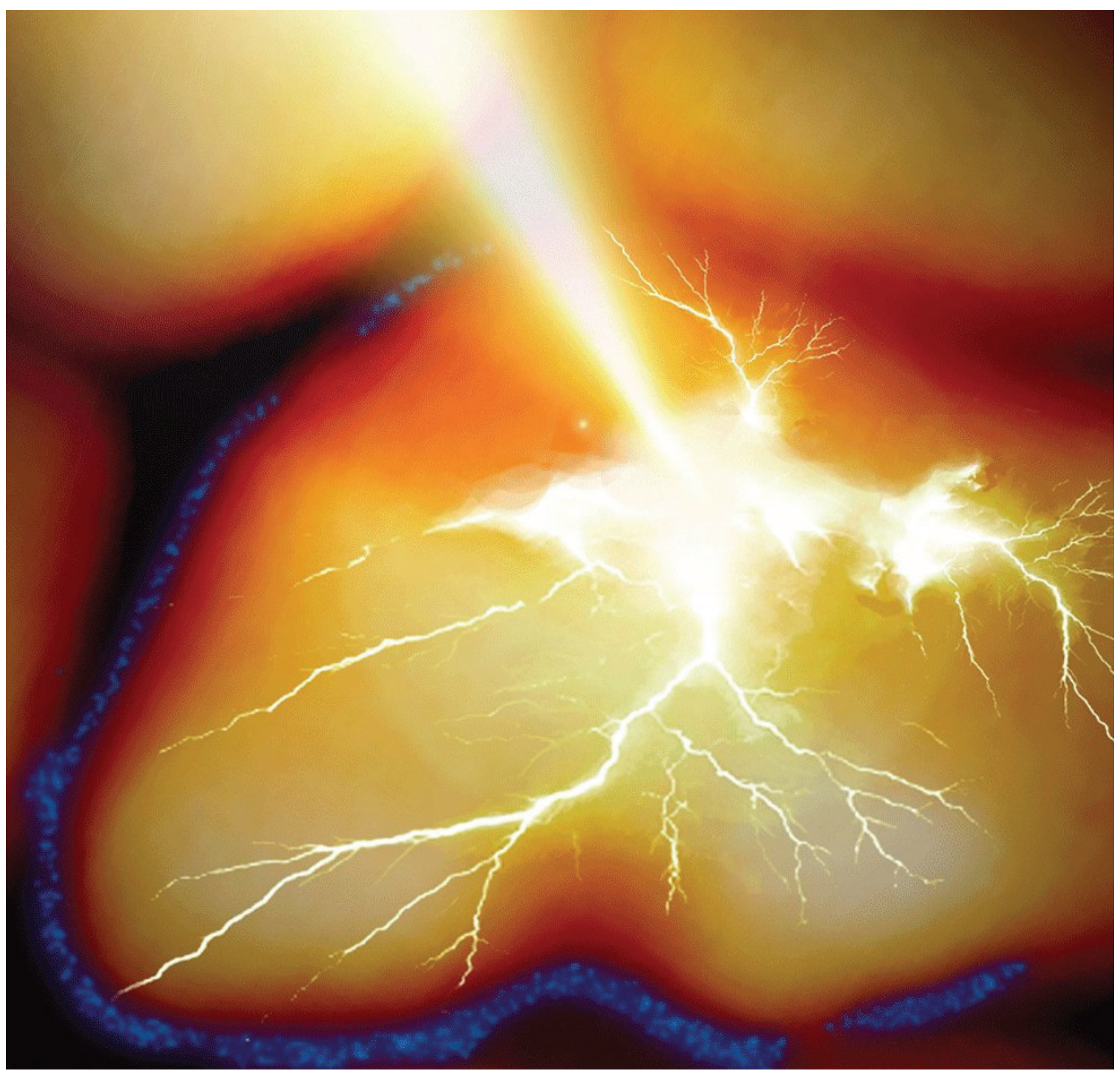
Prof. Dr. Paul van Loosdrecht
Universität zu Köln

27.5.2014
16[45] Uhr / HS III

Ultrafast Condensed Matter Science

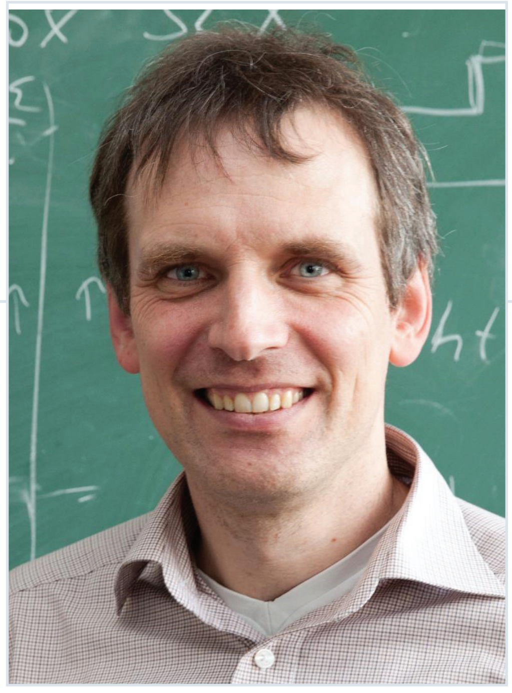
The fundamental time and length scales in condensed matter are in the femtosecond and nanometer regime. Recent years have shown a stormy development of experimental techniques to address materials precisely at these relevant scales. It is fascinating to see that it has become possible to measure the fundamental interactions determining the properties of condensed matter on their intrinsic time and length scales.

Even more exciting is that these developments opened the possibility to drive systems into novel states using intense short pulses of light; states which are not accessible under normal thermodynamic conditions. Challenging questions and topics which can now be addressed include how and how fast photons are being converted into charges in photovoltaic devices, the ultimate speeds of switching a memory bit, the new physics arising in systems far from thermal equilibrium, and finally the full optical control of states of matter.



Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Achim Rosch
Universität zu Köln



17.6.2014
16^{45} Uhr / HS III

Magnetic whirls in chiral magnets: skyrmions and monopoles

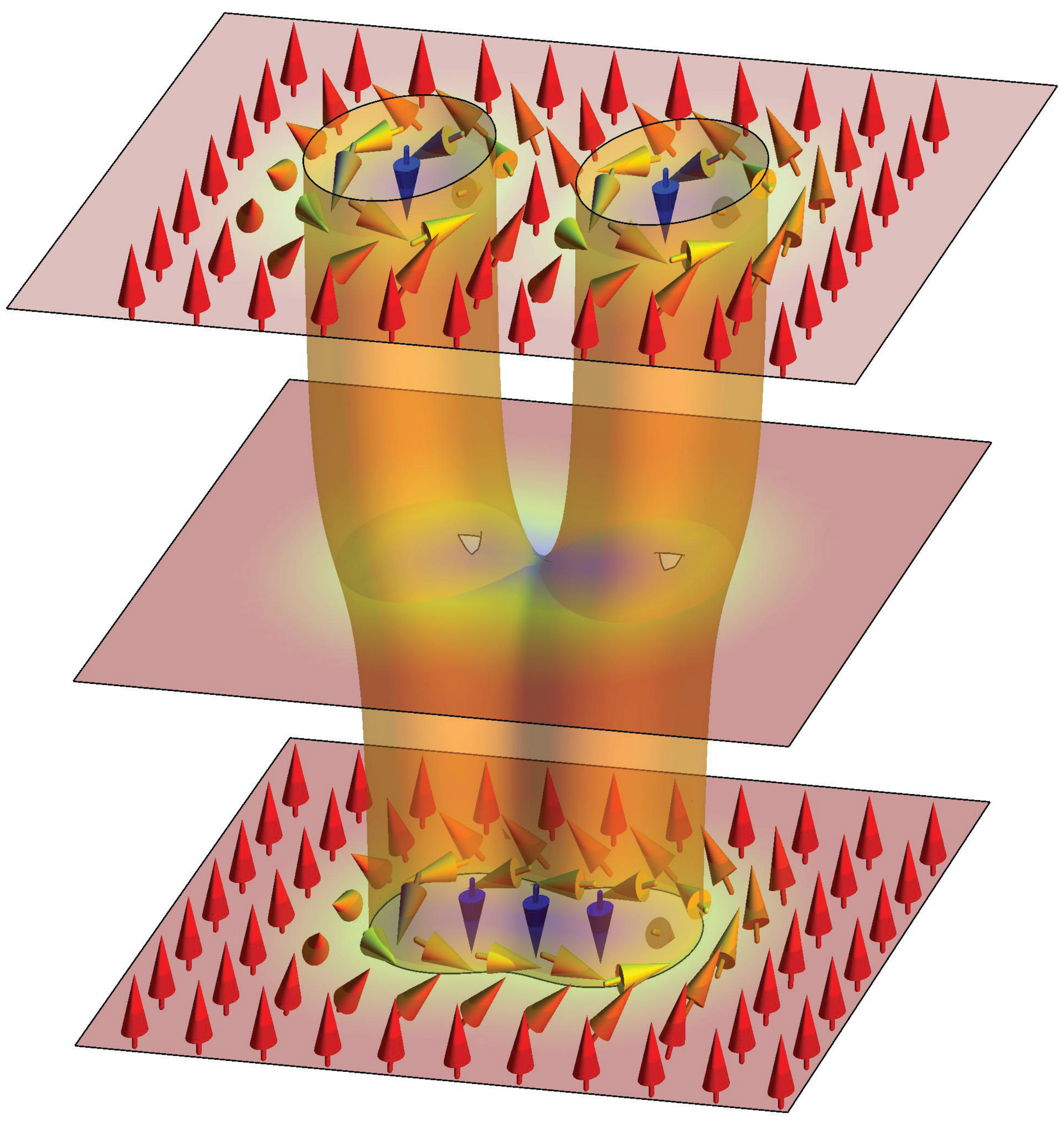
In chiral magnets and small magnetic fields lattices of magnetic whirls, so-called skyrmions, can be stabilized.

In the talk we discuss the fascinating properties of these magnetic whirls. In experiments, they can be manipulated by electric currents which are 5-6 orders of magnitude smaller than conventionally needed for the manipulation of magnetic structures. The very efficient coupling of the magnetic structure to currents is governed by quantum-mechanical Berry phases, which can be described by effective „emergent" electromagnetic fields.

The topological quantization of the the skyrmions thereby leads to a quantization of the emergent magnetic flux.

A change of topology has to occur by singular magnetic configurations which act as sources and sinks of the emergent magnetic flux.

Thereby they can be viewed as emergent magnetic monopols.



Großes Physikalisches Kolloquium an der Universität zu Köln

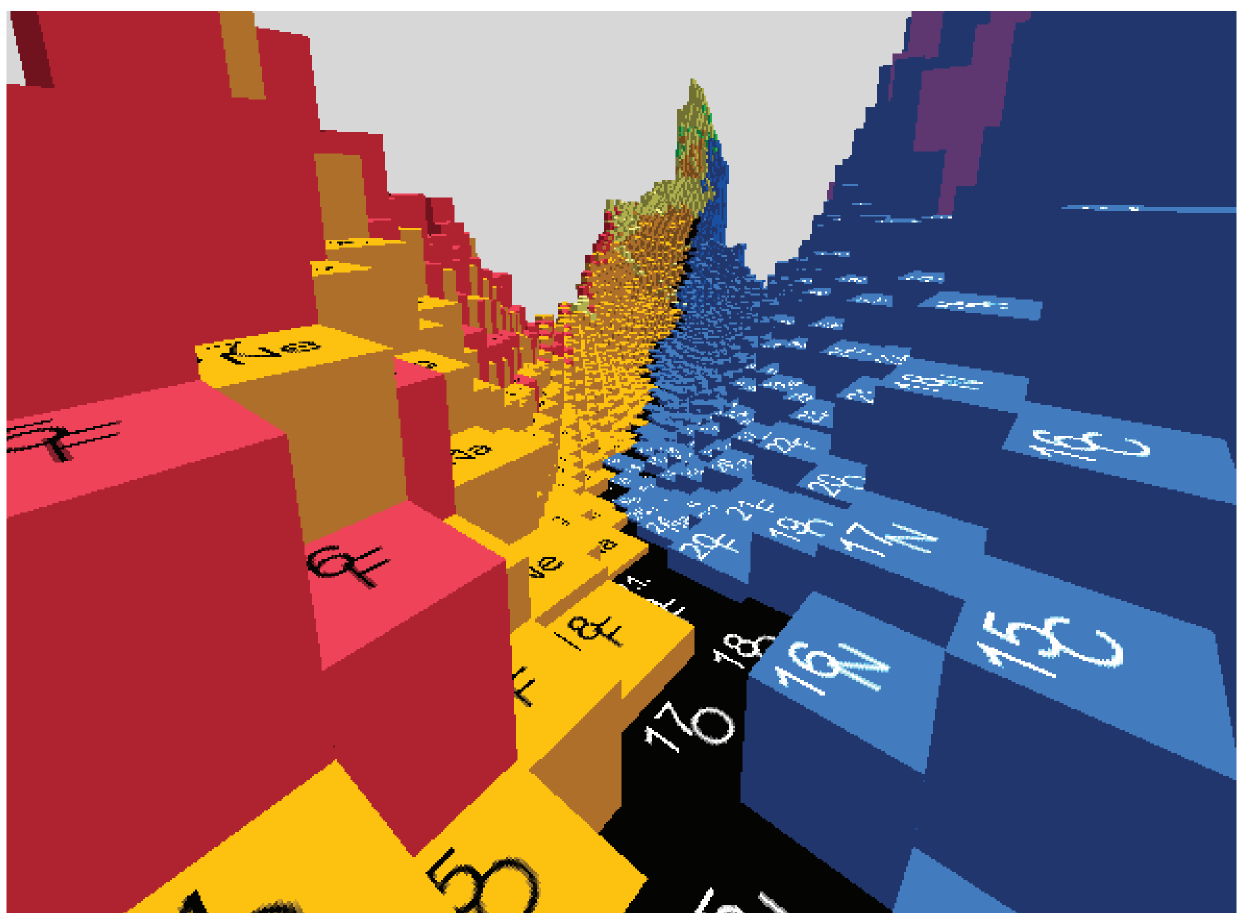
Prof. Dr. Mark Huyse
University of Leuven

1.7.2014
16^{45} Uhr / HS III

The rich revenue from the use of radioactive ion beams: recent highlights and scientific opportunities at the ISOLDE, CERN facility

This year the radioactive ion beam facility ISOLDE at CERN celebrates its fiftieth birthday. This world-leading ISOL (Isotope Separator On Line) facility is dedicated to the production of radioactive nuclei for many different experiments in the fields of nuclear and atomic physics, solid-state physics, materials science and life sciences.

Continuous developments in production techniques over the years have led to the largest variety of available radioactive beams of high isotopic and often isobaric purity.



In this talk an overview will be given of the present status of the facility illustrating the unique possibilities through recent physics highlights.

But also a look into the future will be given as a major on-going upgrade, called the HIE ISOLDE project, will boost ISOLDE to higher intensities and to higher energies for the post-accelerated radioactive beams opening up new possibilities and challenges.

Großes Physikalisches Kolloquium an der Universität zu Köln

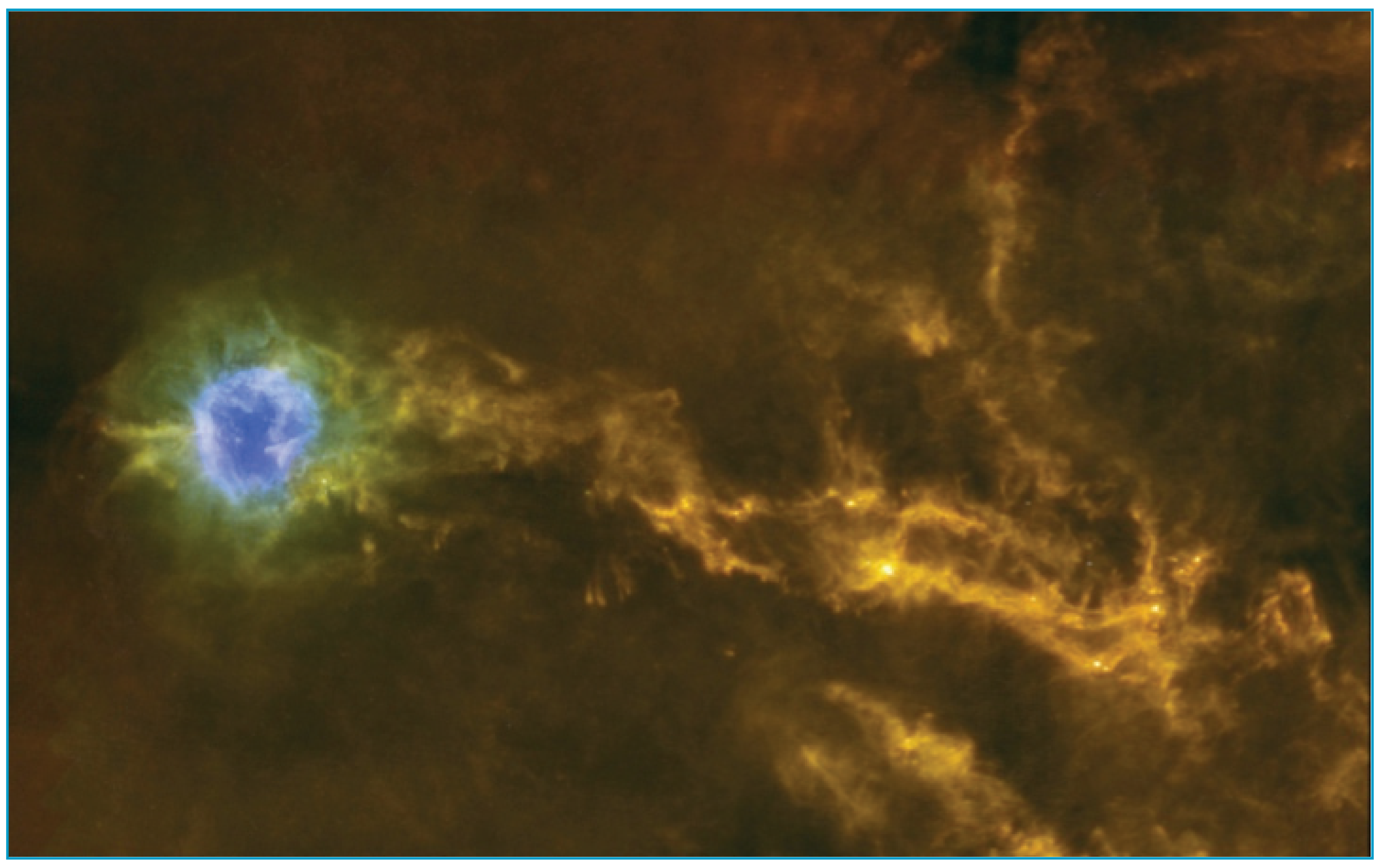
Dr. Philippe André
Laboratoire d'Astrophysique de Paris-Saclay, Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA)

15.7.2014
16[45] Uhr / HS III

From Filamentary Networks to Protostellar Cores in Giant Molecular Clouds: Toward a Unified Picture for Star Formation in Galaxies

Star formation is one of the most fundamental, most complex, and least understood processes in astrophysics. Recent surveys at infrared and submillimeter wavelengths with the Spitzer and Herschel space observatories suggest that star formation in dense molecular gas is governed by essentially the same "laws" in nearby Galactic clouds and distant external galaxies.

This raises the possibility of a unified picture for star formation in the Universe from small scales (individual clouds) to galaxy-wide scales. I will describe the scenario favored by Herschel studies of the nearest star-forming clouds of the Galaxy, which have provided us with unprecedented images of the initial and boundary conditions of the star formation process:



First turbulence stirs up the gas, giving rise to a universal web-like structure in the interstellar medium, then gravity takes over and controls the further fragmentation of filaments into prestellar cores and ultimately protostars. Despite an apparent complexity, global star formation may be governed by relatively simple universal laws from filament to galactic scales.

Eröffnungsvortrag

Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Christian Linsmeier
Institut für Energie- und Klimaforschung
Forschungszentrum Jülich

15.4.2014
16^{45} Uhr / HS III

Die erste Wand von Fusionsanlagen: Eine Herausforderung an Materialien und Komponenten

Die erste Wand in einer Fusionsanlage ist die Schnittstelle zwischen dem heißen Plasma und dem Vakuumgefäß. Hohe Teilchen- und Leistungsflüsse sowie Anforderungen wie niedrige Aktivierung durch die Fusionsneutronen, ausreichende Lebensdauer der Wand und der sichere Betrieb der Anlage mit Tritium, sind große Herausforderungen für Entwicklung und Charakterisierung von geeigneten Materialien und Komponenten.

ITER, der nächste Schritt auf dem Weg zu einem Fusionsreaktor, wird derzeit in Cadarache/Südfrankreich gebaut und wird Beryllium als Material der ersten Wand einsetzen. Grundlagenuntersuchungen erlauben eine Beschreibung der Rückhaltung und Freisetzung von Wasserstoff-Isotopen aus diesem Material. Für die erste Wand und den Divertor eines Fusionsreaktors hingegen sind gegenwärtig verfügbare Materialien und Komponenten unzureichend. Neue Materialkonzepte wie selbstpassivierende Wolframlegierungen und Wolfram-faserverstärkte Wolframkomposite sind mögliche Lösungen für die hochbelasteten Komponenten der ersten Wand.

Großes Physikalisches Kolloquium an der Universität zu Köln

Prof. Dr. Laurens Mohlenkamp
Universität Würzburg

29.4.2014
16^{45} Uhr / HS III

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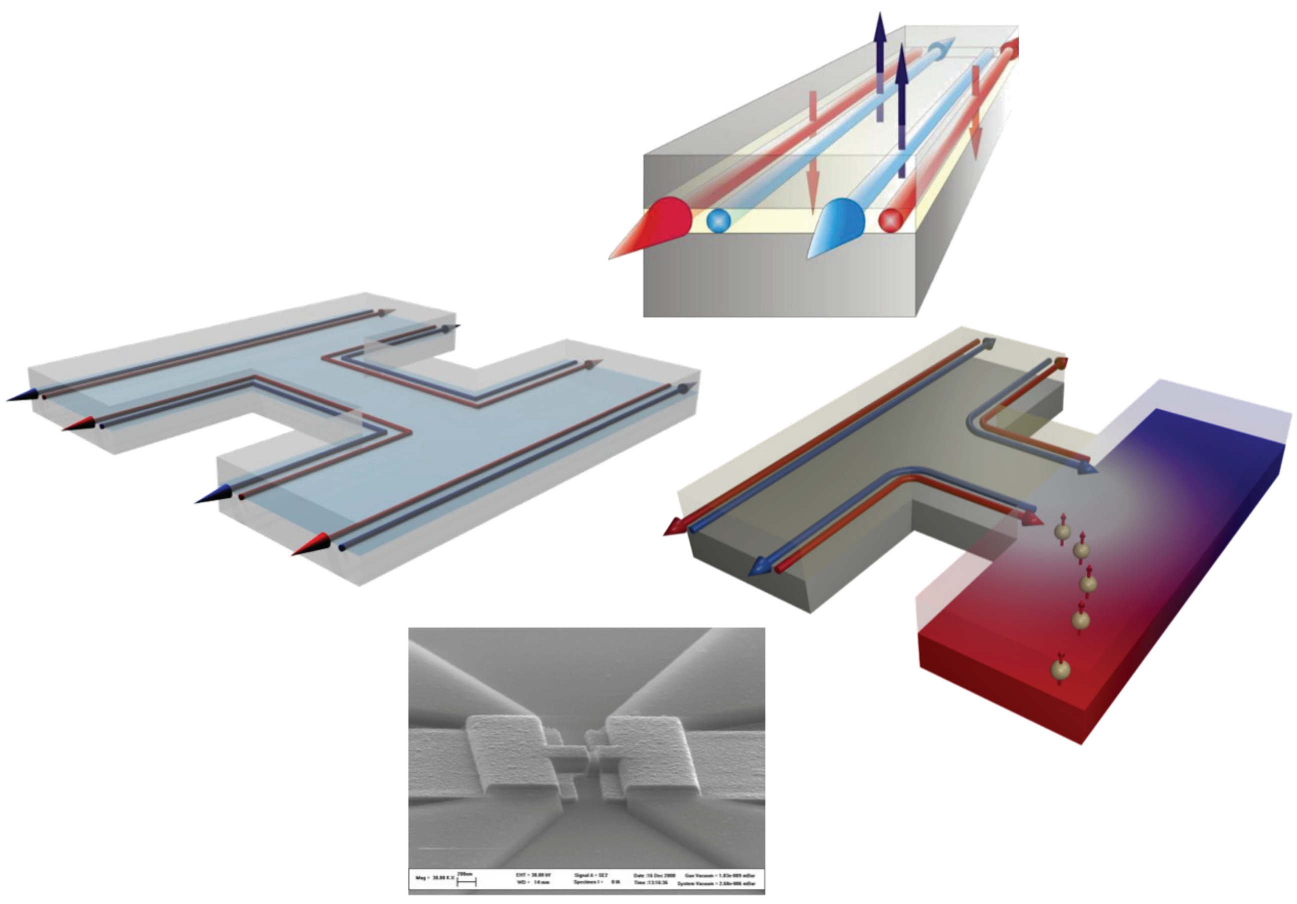

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