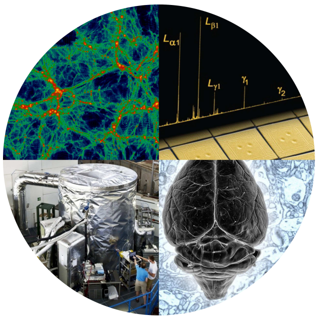

Münchner Physik-Kolloquium

Sommer 2016

Vortragsprogramm mit Abstracts

Beginn der Veranstaltungen ist um 17:15 Uhr, sofern keine besondere Anfangszeit vermerkt ist. Sämtliche Vorträge sind öffentlich bei freiem Eintritt. Die Art der Nachsitzung wird in der Veranstaltung bekannt gegeben.

LMU bezeichnet Vorträge im *Hörsaal H 030 der Fakultät für Physik / LMU* in der Schellingstraße 4, München.

TUM bezeichnet Vorträge im *Hörsaal 2 des Physik-Departments / TUM* am Forschungsgelände in Garching. Das Forschungsgelände kann mit der U6 (bis Garching-Forschungszentrum) erreicht werden.

Small, cold and universal: Cryogenic micro-calorimeters a new key technology

Prof. Dr. Christian Enss TUM **2016-04-18**

Kirchhoff-Institut für Physik, Universität Heidelberg

Magnetic micro-calorimeters belong to the most sensitive devices to measure the energy of single quanta. Their universal applicability for particles and radiation as well as their high resolving power makes them today a popular choice in many different experiments. Applications include X-ray spectroscopy, neutrino physics, material analysis, mass spectrometry and nuclear forensic. We will discuss the operating principle, the status of development and various recent applications.

The assembly of galaxies in dark matter haloes through cosmic time

Dr. Benjamin Moster LMU **2016-04-25**

University of Cambridge, UK

The field of galaxy formation is on the cusp of a tide of new data. To understand these in the context of an evolutionary picture, we need models that interpret the observed trends. Hydrodynamical simulations, have become the main tool for this. However, as the resolution in simulations is finite, not all of the physical processes are resolved. Consequently, simple prescriptions ('sub-grid' models) must be resorted to. Empirical galaxy formation models, on the other hand, provide a unique and direct link between galaxies and dark matter haloes, and do not depend on model assumptions on unresolved physics, only on gravity and observed galaxy properties.

One day in the life of a one-dimensional developing organism

Prof. Dr. Joel Stavans TUM **2016-05-02**

Department of Physics of Complex Systems, Weizmann Institute of Science, Israel

Within the last two decades it has become clear that cells having the same genetic information can behave very differently due to inevitable stochastic fluctuations in gene expression, known as noise. Noise can be advantageous in certain contexts but detrimental in others. How do cells in multicellular organisms achieve high precision in their developmental fate in the presence of noise, in order to reap the benefits of division of labor? We address this fundamental question from Physics and Systems Biology perspectives with cyanobacterial filaments, one of the earliest examples of multicellular organisms in Nature. These filaments form one-dimensional, nearly-regular patterns of cells of two types, a "1-d Ising model of development", when subjected to a specific environmental cue. The results of our statistical analysis illuminate the fundamental role that positive feedback, lateral inhibition and cell-cell communication play in the developmental program, and establish the spatial extent to which gene expression is correlated along filaments.

Towards a connectome of the whole mouse brain

Prof. Dr. Winfried Denk LMU **2016-05-09**
MPI für Neurobiologie, München

We are developing the tools and methods that should allow us to scale up serial block-face electron microcopy-based circuit reconstruction, which has been successfully used to reconstruct a region of the retina, to allow the reconstruction of an entire mouse brain. We have developed a suitable preparation of the mouse brain and are in the process of integrating a scaled up microtome with a multi-beam electron microscope that has recently been developed by Carl Zeiss and which provides the acquisition speed necessary to collect the data within a reasonable time span.

Quantifying stability in complex networks: From linear to basin stability

Prof. Dr. Jürgen Kurths TUM **2016-05-23**
Potsdam Institute for Climate Impact Research and Institute of Physics, Humboldt-Universität Berlin

The human brain, power grids, arrays of coupled lasers and the Amazon rainforest are all characterized by multistability. The likelihood that these systems will remain in the most desirable of their many stable states depends on their stability against significant perturbations, particularly in a state space populated by undesirable states. Here we claim that the traditional linearization-based approach to stability is in several cases too local to adequately assess how stable a state is. Instead, we quantify it in terms of basin stability, a new measure related to the volume of the basin of attraction. Basin stability is non-local, nonlinear and easily applicable, even to high-dimensional systems. It provides a long-sought-after explanation for the surprisingly regular topologies of neural networks and power grids, which have eluded theoretical description based solely on linear stability.

No qualms about quantum theory

Prof. Dr. Berge Englert LMU **2016-05-30**
National University of Singapore

Quantum theory is a well-defined local theory with a clear interpretation. No ''measurement problem'' or any other foundational matters are waiting to be settled. The answers to questions such as

- What is a physical theory?
- What are the preexisting concepts in quantum theory?
- Probabilities for what?
- What is state reduction? Do wave functions collapse?
- Is there instant action at a distant?
- Is quantum theory nonlocal?
- Where is Heisenberg's cut?
- How many interpretations do we need?
- Is there a measurement problem?

demonstrate the case.

Photonic structures – building blocks of future particle accelerators?

Prof. Dr. Peter Hommelhoff
TUM **2016-06-06**
Friedrich-Alexander Universität Erlangen-Nürnberg

Classical radio-frequency accelerators rely on microwave cavities through which charged particles propagate. By matching the microwave phase to the particle's position, efficient acceleration can be achieved. We could recently demonstrate that the same scheme – phase-synchronous particle acceleration – can also be achieved with laser light. Proper variation of the optical phase by virtue of a photonic structure allows efficient acceleration of particles propagating along the structure in a vacuum channel right with the optical field. Because of the high damage threshold of transparent optical materials, femtosecond laser fields exceeding 1 GV/m can easily be fed into the optical accelerator, leading to acceleration gradients larger than 1 GeV/m. Hence, classical radio-frequency accelerator gradients may be surpassed by at least two orders of magnitude, which may lead to accelerators smaller than their classical brethren by the same amount. So now the time is ripe to consider building a photonics-based vacuum channel accelerator, which may have intriguing applications in science and medical applications alike.

On-chip devices for stimulation and recording of communication in guided cell networks

Prof. Dr. Bernhard Wolfrum
LMU **2016-06-13**
Technische Universität München

Chip-based arrays for stimulation and recording of cell-network activity provide tools for investigating electrophysiological and neurochemical communication. For example, microelectrode arrays can be used for real-time recording of action potentials or vesicular neurotransmitter release from many individual cells in parallel. In the past, most of these studies have been performed on brain slices or randomly connected cell networks growing on the chip surface. Modifying the interface using micro- and nanofabrication technology can significantly enhance stimulation and recording capabilities. Here, we introduce signal amplification strategies based on electrochemical redox cycling, the repetitive oxidation and reduction of target molecules at closely-spaced electrodes in nanocavity devices. We show how the design of the interface affects electrical and electrochemical sensing performance, which could potentially be exploited for high-density imaging of synaptic activity. At the same time, the nanocavity devices can be used for applying stimulation at the single-cell level.

Excitons in semiconducting 2D materials

Dr. Alexey Chernikov TUM **2016-06-20**
Institut für Experimentelle und Angewandte Physik, Universität Regensburg

Since the discovery of graphene, a single sheet of carbon atoms, research focused on two-dimensional (2D) materials evolved rapidly due the availability of atomically thin, thermally stable crystals with intriguing physical properties. The 2D materials naturally inherit major traits associated with systems of reduced dimensionality: strongly enhanced Coulomb interactions, efficient light-matter coupling, and sensitivity to the environment. In particular, the considerable strength of the Coulomb forces between the charge carriers introduces a rich variety of many-body phenomena. In the class of 2D semiconductors this leads to the emergence of atom-like electron-hole quasiparticles, such as excitons, trions, and biexcitons, with unusually high binding energies and efficient light absorption.

In this talk, I will focus on the optical properties of 2D semiconductors, largely determined by strong excitonic resonances, as exemplified in recent works on atomically thin transition metal dichalcogenides. The observation of exciton binding energies on the order of many 100's of meV and the marked deviation of the electron-hole attraction from the conventional Coulomb law will be discussed. The results reflect both strong carrier confinement and the distinctive nature of dielectric screening in atomically thin materials.

Collective quantum dynamics: From ergodicity to many-body localization

Prof. Dr. Michael Knap LMU **2016-06-27**
Technische Universität München

It has been the believe that generic quantum many-body systems necessarily approach thermal equilibrium after a long time evolution. As a consequence any quantum information encoded in the initial state is lost in the course of the dynamics. However, recently the generality of this assumption of ergodic evolution has been put into question. In this talk, we will discuss how ergodicity—and with that fundamental concepts of statistical mechanics—can break down in a disordered many-body system by the phenomenon of many-body localization. Many-body localization describes an exotic phase of matter in which quantum information can prevail for infinitely long times even at finite temperatures. We will analyze the generic phase diagram of such systems, which consist of an ergodic phase at weak disorder and a many-body localized phase at strong disorder. Furthermore, we demonstrate how the peculiar properties of the many-body localization transition can be characterized in experiments.

Galactic cosmic rays, aerosols, clouds and climate: Results from the CLOUD project at CERN

Prof. Dr. Joachim Curtius
TUM **2016-07-04**
Institut für Atmosphäre und Umwelt, Goethe-Universität Frankfurt am Main

Clouds play a major role for the hydrological cycle, the radiation budget and climate on Earth. They are also the largest factor of uncertainty in the scientific understanding and prediction of climate change.

The CLOUD experiment at CERN allows to study aerosol and cloud formation under atmospheric conditions at a new level of precision. A focus of investigations are ion-induced aerosol formation processes using an elementary particle beam from CERN. Here, the potential role of galactic cosmic rays (and their modulation by the sun) for aerosols, clouds and climate is studied. The role of ionization for aerosol formation by different chemical systems of natural and anthropogenic origin is quantified. The experiments therefore yield a new understanding of pre-industrial and present-day aerosol sources and their influences on clouds and climate.

The talk presents an introduction on the role of aerosols and clouds for climate, an overview of the CLOUD chamber at CERN and of the findings from the recent experiments.

Relics from the Big Bang

Dr. Daniel Baumann LMU **2016-07-11**
University of Cambridge, UK

Observations of the cosmos using light are restricted to the time after the formation of the first atoms, 380,000 years after the Big Bang. To learn about earlier times requires either theoretical extrapolations, or the detection of new particles that can travel through the primordial plasma unhindered.

In this talk, I will describe how the detection of gravitons and neutrinos would allow us look back at the earliest moments in the history of the universe. I will discuss what observations of these relics can teach us about the physics of the early universe.

Allgemeine Informationen

Das Münchner Physik-Kolloquium ist das Podium der physikalischen Forschung im Münchner Raum. Es wird gemeinsam von den beiden Universitäten und den entsprechenden Max-Planck-Instituten veranstaltet. Die Vorträge berichten über aktuelle Themen der Physik und angrenzender Gebiete und spiegeln den interdisziplinären Charakter der modernen Physik wider.

Die Darstellung wird möglichst allgemeinverständlich gehalten, um auch physikalisch interessierte Zuhörer aus dem industriellen oder schulischen Bereich anzusprechen. Die Vortragenden sind ausgewiesene Fachleute auf dem jeweiligen Gebiet, zum Teil auch neu nach München berufene Wissenschaftler, die sich in diesem Rahmen einer breiteren Öffentlichkeit vorstellen wollen. Das Kolloquium stellt insbesondere für die Studenten der Physik eine einfache Möglichkeit dar, im Laufe eines Jahres alle wichtigen Arbeitsgebiete der gegenwärtigen physikalischen Forschung kennen zu lernen.

Es ist erklärtes Anliegen des Münchner Physik-Kolloquiums, die räumliche Trennung der Physik in die verschiedenen Forschungsstandorte in München und Garching durch eine gemeinsame Veranstaltung zu überbrücken. Dazu soll auch der alternierende Wechsel des Veranstaltungsorts beitragen.

Veranstaltende Einrichtungen

Max-Planck-Institute physikalischer Arbeitsrichtung
München / Garching

Technische Universität München
Physik-Department, James-Franck-Straße 1, 85748 Garching
TUM-Koordinatoren:
Prof. J. Finley, Prof. K. Krischer

Ludwig-Maximilians-Universität München
Fakultät für Physik, Schellingstraße 4, 80799 München
LMU-Koordinatoren:
Prof. B. Ercolano, Prof. J. Lipfert

Aktuelles Programm: http://www.ph.tum.de/kolloquium