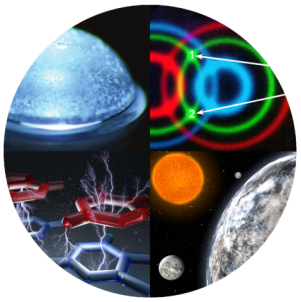

Münchner Physik-Kolloquium

at home! Sommer 2020

Dieses Semester findet das Kolloquium online statt: https://tum-conf.zoom.us/j/93234766313

Vortragsprogramm mit Abstracts

Beginn der Veranstaltungen ist um 17:15 Uhr, sofern keine besondere Anfangszeit vermerkt ist. Sämtliche Vorträge sind öffentlich bei freiem Eintritt.

Dieses Semester werden die Vorträge als Videoübertragung per Konferenzschaltung im Internet übertragen:

https://tum-conf.zoom.us/j/93234766313
Meeting-ID: 932 3476 6313
Passwort: Kolloquium
Software bitte möglichst vorab installieren.
Sollte es wieder möglich werden, zusätzlich Präsenzveranstaltungen durchzuführen, werden wir den Veranstaltungsort hier bekannt geben:
http://www.ph.tum.de/kolloquium

A century of Noether's theorem

Prof. Dr. Chris Quigg — **2020-05-04**
Fermilab, Batavia, Illinois, USA

In the summer of 1918, Emmy Noether published the theorem that now bears her name, establishing a profound connection between symmetries and conservation laws. The influence of this insight is pervasive in physics; it underlies all of our theories of the fundamental interactions and gives meaning to conservation laws beyond useful empirical rules. Noether's papers, lectures, and personal interactions with students and colleagues drove the development of abstract algebra, establishing her in the pantheon of twentieth-century mathematicians.

The talk will trace her path from Erlangen through Göttingen to a brief but happy exile at Bryn Mawr College in Pennsylvania, illustrating the importance of The Theorem for the way we think today.

Magic angle bilayer graphene – superconductors, orbital magnets, correlated states and beyond

Prof. Dr. Dmitri K. Efetov — **2020-06-15**
ICFO – Institut de Ciencies Fotoniques, Barcelona

When twisted close to a magic relative orientation angle near 1 degree, bilayer graphene has flat moire superlattice minibands that have emerged as a rich and highly tunable source of strong correlation physics, notably the appearance of superconductivity close to interaction-induced insulating states. Here we report on the fabrication of bilayer graphene devices with exceptionally uniform twist angles. We show that the reduction in twist angle disorder reveals insulating states at all integer occupancies of the four-fold spin/valley degenerate flat conduction and valence bands, i.e. at moire band filling factors $\nu = 0, +(-)1, +(-)2, +(-)3$, and reveals new superconductivity regions below critical temperatures as high as 3 K close to -2 filling. In addition, we find novel orbital magnetic states with non-zero Chern numbers. Our study shows that symmetry-broken states, interaction driven insulators, and superconducting domes are common across the entire moire flat bands, including near charge neutrality. We further will discuss recent experiments including screened interactions, fragile topology and the first applications of this amazing new materials platform.

Floquet topological phases with ultracold atoms in periodically-driven lattices

Prof. Dr. Monika Aidelsburger — **2020-06-22**
Ludwig-Maximilians-Universität München, and Munich Center for Quantum Science and Technology (MCQST)

Topological phases of matter exhibit remarkable electronic properties that offer unique possibilities for applications. A prominent example is the robust

quantization of the Hall conductivity in quantum Hall insulators. A widespread technique for generating topological band structures in synthetic systems, such as ultracold atoms in optical lattices, is Floquet engineering [1]. This method relies on the periodic modulation of the system's parameters to emulate the properties of a non-trivial static system and facilitated the realization of two paradigmatic topological lattice models: the Hofstadter and the Haldane model. Moreover, it inspired ideas for implementing complete lattice gauge theories [2].

The rich properties of Floquet systems, however, transcend those of their static counterparts [3]. The associated quasienergy spectrum can exhibit a non-trivial winding number, which leads to the appearance of anomalous chiral edge modes even in situations where the bulk bands have zero Chern numbers, hence, altering the well-known bulk-edge correspondence. A full classification of Floquet phases requires a new set of topological invariants. We have studied the rich Floquet phase diagram of a periodically-modulated honeycomb lattice using bosonic atoms. The novel properties of anomalous Floquet phases mentioned above open the door to exciting new non-equilibrium phases without any static analogue [4].

[1] A. Eckardt, Phys. Mod. Phys. 89, 311 (2017)
[2] C. Schweizer *et al.*, Nat. Phys. (2019); L. Barbiero *et al.*, Science Advances 5, eaav744 (2019)
[3] T. Kitagawa *et al.*, Phys. Rev. B 82, 235114 (2010)
[4] K. Wintersperger *et al.*, accepted in Nature Physics, arXiv:2002.09840

2020-06-29

Photovoltaic technologies as key pillar to a solution of the urgent climate crisis

Prof. Dr. Eicke Weber
European Solar Manufacturing Council ESMC, Albert-Ludwigs University Freiburg, and University of California, Berkeley, USA

2020-07-06

The weekly demonstrations of school children in the Fridays for Future movement, supported by Parents for Future, Scientists for Future and similar movements, is putting a constant, bright spotlight on the fact that the world is currently heading full speed like Lemmings towards a cliff with respect to the earth climate, that we might reach as early as 2030. More and more politicians and opinion leaders worldwide get aware of this clear and eminent danger for our climate system, that has been carefully studied by scientists in the IPCC.

The need to decarbonize emissions not only from our energy sector, but as well our transportation and industry sectors, requires rapidly implementing solutions on a global scale. We cannot wait till nuclear fusion might help to generate enough emission-free power, similarly, even rapid build-up of nuclear fission plants would come too late.

The needed, urgent transformation of our energy system to efficient use of ultimately 100 % renewable energy is now starting seriously. This will be based on all kinds of renewable energy, but solar and - on a second place - wind energy will provide the two most important pillars. This is a disruptive process, whose widespread impact can hardly be overestimated.

In the last few years, photovoltaic (PV) conversion of the sun's nuclear fusion energy has became cost-competitive with electricity produced by oil-fired power plants, new nuclear power plants, and diesel generators. Today, harvesting solar energy by PV is in many areas of the world the lowest-cost way to produce electricity. Global PV production capacity is expected to further double and triple from the current level of 100 GW/a, bringing global PV installations soon well into the Terawatt range. There seems to be no limit for the possibilities of a rapid build-up of power production based on solar photovoltaics.

A key factor for the needed further growth of renewable energy supply will be continuous technology advances in many areas, such as batteries, resulting in higher efficiencies at reduced cost. In addition, for many applications in densely populated areas cell efficiency will be even more important than lowest cost, to optimize the energy harvest from a given area.

In photovoltaics, crystalline Silicon technology currently represents more than 90 % of the global PV market. This well-known technology will still allow many technological advances, transitioning from the conventional back-surface-field (BSF) to the Passivated Emitter and Rear Contact (PERC) and then to higher-efficiency technologies. These will be introduced in the coming years, aimed at higher efficiencies at reasonable cost. However, for crystalline silicon this development is approaching a glas ceiling of 30 % efficiency, that is valid for all single-bandgap semiconductor materials. New approaches for even higher efficiencies require heterojunctions of materials with different bandgaps. Several promising approaches in this exciting field

will be discussed, including heterojunctions on silicon, that allow to combine well-established large-scale Silicon PV technology with new technologies, such as low-cost III/V or Perovskite layers.

2020-07-13

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 Studierenden 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.

Student event: Meet the speaker

We invite you to a **student-only** discussion-round with the speakers before each Munich Physics Colloquium talk. *Be curious and feel free to ask any question.*

Venue: Mondays, 16:00 h

more information:
https://www.moodle.tum.de/course/view.php?id=57309

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. B. Märkisch

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

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