<u>Quantum Transport and Topology</u>

The laws governing electrical transport change fundamentally, if an electronic device is reduced in size down to the free path of electrons. In the Integer Quantum Hall Effect (IQHE), for instance, resistance does no longer change linearly, but in a stepwise manner, due to the importance of quantized (Landau-)levels for charge transport in a strong magnetic field. Even more drastically is the fractional version of the quantum Hall effect, where new (quasi-)particles carry only a fraction of the elementary charge e.
The discovery of the Integer Quantum Hall effect in 1980, rewarded by the 1985 Nobel prize to Klaus von Klitzing, gives also one of the earliest examples of the importance of topological quantum numbers in condensed matter physics.
Modern approaches to condensed matter physics over the last decade emphasize the role of topology, the existence of properties, which cannot be changed gradually and, therefore, confer to interesting quantum-physical phenomena an unusual robustness and stability. A topological approach also highlights analogies and connections to other branches of physics, such as cosmology and elementary particle physics.

In this lecture, we want to explore quantum effects in transport:
From the early experimental observation of conductance quantization and the theoretical picture of Landauer of “transport as transmission” to the recent focus on topological properties and materials, such as topological insulators.

Lecturers:	Prof. Dr. J. Ankerhold, Dr. B. Kubala, Dr. C. Padurariu
Prerequisites:	Bachelor courses on Quantum Mechanics and Statistical Physics
Lecture:	3 hours weekly, Tu. 10 - 13 in N24/252
Exercizes:	2 hours weekly, Fr. 13-15 in H9 (starts in 2nd week of the semster) (reduced schedule for 2nd half of semster to allow for preparation of final talks)
Marking:	weekly assignments and end-of-semester talks

Lecture Syllabus:

1. Tunneling and Scattering Matrix Theory
2. Landau-levels and theInteger Quantum Hall Effect
3. Fractional Quantum Hall Effect, composite fermions
4. Majorana fermions and the Kitaev chain
5. Topological quantum numbers

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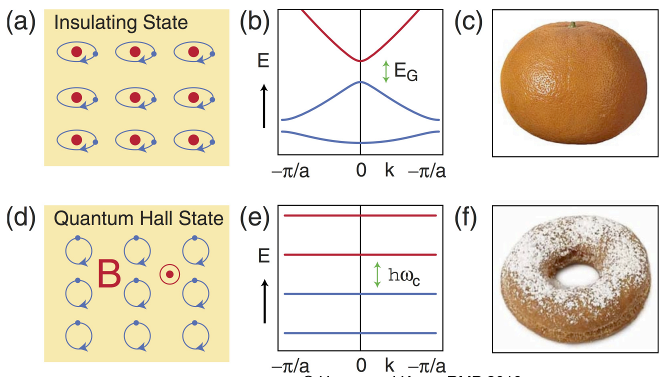

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