TECHNISCHE UNIVERSITÄT DRESDEN

Bereich Mathematik und Naturwissenschaften Fakultät Physik

PHYSIKALISCHES KOLLOQUIUM

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Thema: **Topological insulators go elemental**

Zeit und Ort: Dienstag, 28.11.2017, 16:40 Uhr
Recknagel-Bau, Hörsaal REC/C213, Haeckelstr. 3

Leiter: Prof. Dr. Matthias Vojta

Kurzfassung: Topological insulators (TIs) are perfect insulators in the bulk, while their boundaries carry topologically protected metallic surface or edge states. These states are spin-polarized and helical in nature, i.e. the spin is intrinsically locked to the electron´s momentum. As a consequence, backscattering is largely impeded, thereby strongly reducing the ohmic losses of surface (or edge) transport in TIs, with obvious application potential in semiconductor electronics. Furthermore, it has been proposed that TI-superconductor interfaces may host Maiorana fermion-like zero-energy quantum states of extraordinary large lifetimes, which could serve as solid-state realization of a qubit, the basic element for quantum computing. While many TI materials have been discovered since their original prediction about a decade ago, most of them seem unsuitable for actual applications. Either their complex composition makes it difficult to realize a truly insulating defect-free bulk (e.g., $Bi_2(Se,Te)_3$), or their volume band gap is too small to facilitate room-temperature applications (e.g., HgTe). Against this background the hunt is on for simple, e.g., elemental TIs with large band gaps. Here I will report on our experimental activities in epitaxial thin film growth of such materials and their characterization by photoelectron spectroscopy and scanning tunnelling microscopy. My examples range from α-Sn (aka grey tin) as a 3D topological material to "stanene" and "bismuthene" (graphene-like 2D modifications of Sn and Bi) as candidates for the Quantum Spin Hall effect.

Biographie: Ralph Claessen studied physics in Kiel and Cambridge (Diploma in 1986) and holds a Dr. rer. nat. from Christian-Albrechts-Universität zu Kiel (1991). In 1991 he was awarded a Feodor-Lynen-fellowship which he spent at the University of Michigan (with J.W. Allen). From 1992-97 he worked on his habilitation in the group of S. Hüfner in Saarbrücken. In 1998 he was appointed Associate Professor in Augsburg, before he accepted an offer for a Chair at Julius-Maximilians-Universität in Würzburg (2004). Claessen's research interests are targeted at electronic correlation phenomena and topological physics in complex solids, using mainly x-ray and electron spectroscopies as experimental tools. He is founding member and spokesperson of the SFB 1170 "ToCoTronics" in Würzburg (since 2015).