PHYSIKALISCHES KOLLOQUIUM

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Thema: New bismuth-based topological materials beyond Bi$_2$Te$_3$
(Antrittsvorlesung)

Zeit und Ort: Dienstag, 21.01.2020, 16:40 Uhr
Recknagel-Bau, Hörsaal REC/C213, Haeckelstr. 3

Leiter: Prof. Dr. Bernd Büchner

Kurzfassung: The mathematical concept of topology was found indispensable to explain quantum effects holistically, including the quantized spin-polarized surface states in the first 3D topological insulators (TI): Bi$_2$Te$_3$, Sb$_2$Te$_3$ and Bi$_2$Se$_3$ bulk crystals, and Bi$_{1-x}$Sb$_x$ alloys in 2007–2009. About a decade after these first experimental discoveries, topological materials science is rich and diverse, and bismuth-based inorganic solids hold a strong position in the field as promising topological quantum materials of various types. The pursuit of new materials is fueled by the great conceptual variety of possible quantum effects, quasiparticles and resultant physical properties of topological solids. Using the principles of crystal chemistry and chemical bonding, we put forward a handful of new material candidates with layered crystal structures built by certain bismuth fragments. Topological properties originating from interactions of these fragments with their structural environment are studied theoretically and experimentally. We carefully optimize crystal growth techniques for all these bulk materials and investigate their structural, magnetic and surface properties by the efforts of a large interdisciplinary consortium of experimentalists and theoreticians. As a result, we considerably extend the rich palette of exotic bismuth-based quantum materials and add new strong (Bi$_4$I$_4$) and weak 3D topological insulators (Bi$_2$Tel, Bi$_2$TeBr, Bi$_3$I$_2$Br$_2$), crystalline topological insulators (Bi$_3$Tel, Bi$_3$TeBr), topological semimetals (Bi$_3$Tel, Bi$_3$TeBr, GdBiTe, PtBiTe) and, finally, the long-sought stoichiometric magnetic topological insulators (MnBi$_2$Te$_4$, MnBi$_2$Te$_7$, MnBi$_6$Te$_{10}$).