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Orbital engineering as a route towards large-gap QSH insulators GANG LI, ShanghaiTech University, Shanghai, China, FELIX REIS, LENART DUDY, MAXIMILIAN BAUERNFEIND, STEFAN GLASS, Physikalisches Institut and Roentgen Center for Complex Material Systems, Universitaet Wuerzburg, Germany, WERNER HANKE, RONNY THOMALE, Institut fuer Theoretische Physik und Astrophysik, Universitaet Wuerzburg, Germany, JOERG SCHAEFER, RALPH CLAESSEN, Physikalisches Institut and Roentgen Center for Complex Material Systems, Universitaet Wuerzburg, Germany — Owing to the great potential in applications in spintronics and quantum computations, the search for quantum spin Hall (QSH) insulators with large gaps is highly desired for achieving increased operating temperatures. As initially predicted for graphene, a QSH state can, in principle, be achieved. However, the small intrinsic value and the effective second-order process of the spin-orbit coupling (SOC) in graphene limits the prospect of spin-field-effect applications. In this talk, we propose a new paradigm for QSH insulators with a large topological gap, where a substrate is not only stabilizing the quasi-2D topological insulators but, additionally, plays a pivotal role for achieving the large gap, via "orbital engineering". The gap is determined by the on-site, atomic SOC and not by the tiny higher-order perturbation term as in graphene. We show that this novel topological wide-gap scenario can be experimentally realized in the "bismuthene" system on top of the wide-gap substrate SiC(0001). A huge gap about 0.7 eV and conductive edge states are found, thus, paving the way for further fundamental studies and promising applications.

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