Theoretical search for realizations of the quantum anomalous Hall state

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Among topological insulator (TI) states, one of the conceptually simplest is the "quantum anomalous Hall" (QAH) or "Chern insulator" state in 2D, which can be regarded as the parent state out of which other TIs are built. A QAH system would exhibit a quantized Hall conductivity without the need for any external magnetic field, potentially even at room temperature. Only since 2013 have experimental realizations been demonstrated, but to date these are all based on thin films of magnetically doped TIs with gaps on the order of meV and quantized conductivity only in the sub-Kelvin range. In this talk I will review some of our attempts to design QAH systems that could exhibit bands gaps in the range of 100 meV and thus get closer to room-temperature operation, focusing on strategies in which atomic-layer engineering is used to fabricate monolayer-scale structures at surfaces and interfaces. I will mention our first attempts involving heavy-atom overlayers on insulating magnetic substrates and rare-earth rocksalt surfaces, and then discuss more recent work on double-perovskite monolayers and on rare-earth overlayers on CrSiTe₃. I will end by discussing the prospects for experimental realization of such structures, which still presents many challenges.