The birth of ferroelectric topological insulators

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Breaking internal material symmetries like time reversal with magnetism or gauge with superconductivity has always been of primary interest in the perspective of discovering novel states of matter. When combined with the recently discovered Dirac matter with non-trivial band topology, these symmetry breakings have allowed the recent breakthrough of the quantum anomalous Hall phase in magnetically-doped topological insulator; whereas topological superconductors are leading materials to evidence Majorana quasi-particles.

In this work, we initiate the case of *ferroelectric topological insulators* and see how 3D and 2D topological band structures evolve under a ferroelectric distortion. In particular, marrying topology and ferroelectricity allows to unravel the emergence of novel quasiparticles that mimic Weyl fermions, a gapless state with left or right-handed chirality, i.e., massless electrons with spin parallel or antiparallel to their momentum. The search of Weyl fermions in condensed-matter is motivated by their numerous specific properties highlighting their fundamental chiral nature.

To disclose the Weyl fermions in ferroelectric topological matter, we rely on lead salt materials such as PbSe and PbTe that have shown both non-trivial topology when Sn is added and ferroelectricity when Ge atoms are incorporated. Both concepts will be tackled in this talk, showing the possibility to reach topological and ferroelectricity at the same time. The growth of Ge-doped lead salts by molecular beam epitaxy is developed and will be discussed in a first place. Secondly, the resulting topological ferroelectric materials will be characterized using magneto-optical spectroscopy, X-ray diffraction and Angle-resolved Photoemission spectroscopy (ARPES). The combination of these three techniques allows us to have a complete overview on both the structural and electronic properties of such novel material system.