Interfacing topological materials: search for the origin of zero-energy modes and low-temperature dephasing

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I will review surprising phenomena observed when interfacing topological materials with normal metals, magnetic layers, superconductors, and amorphous semiconductors. In particular, point-contact spectroscopy with silver microcontacts reveals a transition to a low-temperature phase characterized by zero-energy modes superimposed on an energy gap showing a Bardeen-Cooper-Schrieffer-type of criticality. However, no global superconductivity is detected in these systems. An experimental[1] and theoretical[2] search for the origin of this striking behavior in diamagnetic, paramagnetic, and ferromagnetic topological crystalline insulators (Pb,Sn,Mn)Te will be presented. I will also touch upon the question of the effects of magnetic layers upon the topological surface Dirac cones as well as the interfacial physics of Weyl semimetals covered by various superconductor films.[3] Finally, I will discuss surprising Berry phase quantization on both sides of topological phase transition, revealed by experimental and theoretical studies of weak-antilocalization magneto-resistance in $Pb_{1-x}Sn_xSe$ epilayers.[4] The results also point to temperature-independent dephasing by amorphous Se overlayers, which is interpreted in terms of a hitherto overlooked contribution of mirror-symmetry breaking to dephasing.

References:

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