Optical signatures of Dirac electrons in the nodal-line semimetal ZrSiS under extreme conditions

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ABSTRACT

The layered, square-net material ZrSiS is considered as the prototype topological nodal-line semimetal, where the linearly dispersing bands cross along a line in reciprocal space and extend over a large energy range ~2 eV around the Fermi energy, without the presence of topologically trivial bands [1,2]. The profile of the optical conductivity of ZrSiS contains several characteristic features, which were interpreted in terms of signatures of Dirac electrons of the nodal lines and nodal surfaces – namely, a constant frequency dependence and a U shape ending at a sharp peak at high frequencies [3,4].

In this talk, the optical conductivity of ZrSiS and related compounds Zr*XY* (*X*=Si,Ge; *Y*=S,Se,Te) will be presented and related to the calculated electronic band structure [4]. Due to the layered crystal structure of ZrSiS, the optical response is highly anisotropic, with a reduced conductivity for the polarization of the incident radiation perpendicular to the layers. The application of high external pressure on ZrSiS induces new excitations in the optical conductivity spectrum caused by the enhanced interlayer interaction [5]. The related material ZrSiTe undergoes two Lifshitz transitions under pressure with major changes of the Fermi surface topology in the absence of lattice symmetry changes [6].

Keywords: nodal-line semimetal, optical conductivity, high pressure.

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