Unusual Shubnikov-de Haas oscillations in α-(BEDT-TTF)2I3 organic metal

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Abstract

Most of the materials studied by the physics of the condensed matter are composed of massive fermions which verify usual parabolic dispersion relations. Since the 2000s, with the discovery of the graphene, the physics of the condensed matter face the emerging of new materials having a linear dispersion relation: the Dirac materials. It is the case of the α-(BEDT-TTF)2I3 organic conductor (afterward, denoted aI3), under high hydrostatic pressure (P> 1,5GPa) . Contrary to the case of the purely two-dimensional graphene, the three-dimensional bulk structure of the aI3 compound allows to sound a physics much closer to the Dirac point. However, the coexistence of massive and Dirac fermions within the aI3 compound makes this physics particularly complex, but also rich and surprising. The Shubnikov-de Haas oscillations (semi-classical oscillations of the magnetoresistance) in αI3 under high pressures and very low temperatures (about 2GPa and 200 mK) are totally unusual. Indeed, if the periodic behavior in 1/B of these oscillations at low magnetic fields is well known and understood, it is not the case for the deviation from this behavior, which appears at higher magnetic fields (_˜10T). Similar but less pronounced results have been observed very recently in kind of topological insulators samples. We interpret this anomaly with an original theoretical model.

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