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Bismuth and graphite in the ultraquantum limit: signatures of fractional quantum Hall effect

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Bismuth and graphite are semimetals that possess both conventional massive and Dirac-like quasiparticle spectra. High quality graphite is a multi-layer system with nearly decoupled two-dimensional (2D) graphene planes, in which the integer quantum Hall effect has already been found [1]. On the other hand, the fractional quantum Hall effect (FQHE) has been observed for 3D bismuth in the ultraquantum limit (UCL), i. e. above the field that pulls all carriers into the lowest Landau level [2]. Recent measurements performed on quasi-2D graphite in magnetic field up to B = 57 T revealed well defined plateaus in the Hall resistance for B > 10 T, suggesting also the FQHE occurrence in graphite in the UCL [3]. A striking similarity of the obtained results with the FQHE measured for 2D electron system in a GaAs/AlGaAs quantum well [4] is found. Our present results indicate the interplay between FQHE and charge density wave states in graphite. We discuss the FQHE occurrence in bismuth and graphite within the framework of available theoretical models.

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