Upper critical field in superconducting transition metal dichalcogenide monolayers

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Abstract

Transition metal dichalcogenide (TMDC) monolayers are recently discovered two-dimensional (2D) materials with a hexagonal lattice structure similar to graphene, but with two inequivalent sites in the unit cell. They exhibit a particularly strong intrinsic spin-orbit coupling, acting as an effective Zeeman field which takes opposite orientations in the two different valleys. Intrinsic superconductivity at high doping has been experimentally confirmed in several of these compounds.
We calculate the effect of impurities on the superconducting phase diagram of transition metal dichalcogenide monolayers in the presence of an in-plane magnetic field [1]. Due to the strong intrinsic spin-orbit coupling, the upper critical field greatly surpasses the usual Pauli limit at low temperatures. We find that it is insensitive to intravalley scattering and, ultimately, limited by intervalley scattering.

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