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Aperiodic Shubnikov de Haas Oscillations in \( \alpha\)-(BEDT-TTF)\(_2\)I\(_3\)

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We report Shubnikov de Haas oscillations (SdH) in the organic metal \( \alpha\)-(BEDT-TTF)\(_2\)I\(_3\) under hydrostatic pressure up to 30T. Under the studied pressure of 2.2GPa, this quasi-2D electron system consists of Dirac fermions in coexistence with massive carriers \([1]\). Below 7T, SdH oscillations are periodic as a function of the inverse of the magnetic field and the origin intercept related to the Berry phase indicates that Dirac fermions are the involved carriers. However, above 7T, we find a clear increase of the frequency of the SdH oscillations implying a negative curvature in the Landau plot (figure 1, left). We interpret these unusual results within a theoretical model that takes into account an intrinsic distortion of the \( \alpha\)-(BEDT-TTF)\(_2\)I\(_3\) Dirac cones. This distortion, which is an asymmetric particle-hole parabolic correction (figure 1 right), is found to be independent of the Fermi level of the measured crystals \([2]\).

Fig. 1. left: Landau graph of the SdH oscillations in several crystals of \( \alpha\)-(BEDT-TTF)\(_2\)I\(_3\) (index \( n \) plotted versus the inverse magnetic field). The continuous line is the fit with the phenomenological model of distorted Dirac cones. right: Dirac cones with linear dispersion \((m=0)\) and distorted Dirac cones \((m>0)\).

References