Wannier Diagram and Brown-Zak Fermions of Graphene on Hexagonal Boron-Nitride

F. Libisch
T. Fabian, M. Kausel, L. Linhart, J. Burgdörfer
Institute for Theoretical Physics, TU Wien, Wiedner Haupstrasse 8-10/136, Vienna, Austria
Florian.libisch@tuwien.ac.at

The moiré potential of graphene on hexagonal boron nitride (hBN) generates a supercell sufficiently large as to thread a full magnetic flux quantum Φ_0 for experimentally accessible magnetic field strengths. Close to rational fractions of Φ_0, $p/q \cdot \Phi_0$, magnetotranslation invariance is restored giving rise to Brown-Zak fermions featuring the same dispersion relation as in the absence of the field. Employing a highly efficient numerical approach we have performed the first realistic simulation of the magnetoconductance for a 250 nm wide graphene ribbon on hexagonal boron nitride using a full ab-initio derived parametrization including strain [1]. The resulting Hofstadter butterfly is analysed in terms of a novel Wannier diagram for Landau spectra of Dirac particles that includes the lifting of the spin and valley degeneracy by the magnetic field and the moiré potential. This complex diagram (Fig. 1) can account for many experimentally observed features on a single-particle level [2,3,4], such as spin and valley degeneracy lifting and a non-periodicity in Φ_0.

References

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Figures

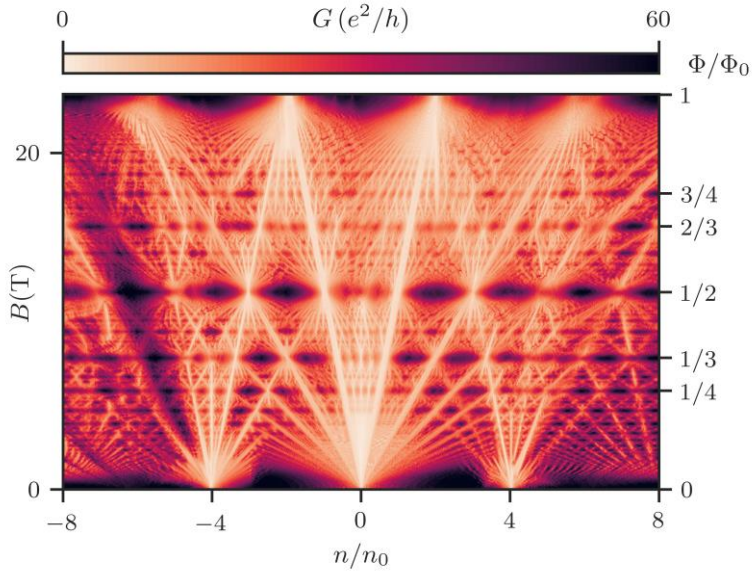

Figure 1: Conductance through graphene aligned on hBN as a function of charge carrier density and magnetic field.