Dirac points for twisted bilayer graphene with an in-plane magnetic field

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Abstract

When twisted bilayer graphene is put in a magnetic field parallel to the sheets of graphene (in-plane field), and the chiral limit is considered, flat bands disappear and Dirac points display fascinating dynamics as the twisting angle and the direction of the magnetic field vary. We provide a partial mathematical description of this dynamics - one surprising feature is that near magic angles, Dirac points are close to the Gamma point, rather than to the protected K points. For special directions of the magnetic field, we show that the Dirac points move, as the twisting angle varies, along straight lines and bifurcate orthogonally when those lines cross. At the bifurcation points the linear dispersion relation of the merging Dirac points disappears and a quadratic band crossing point (QBCP) is observed. We also show numerically that the qualitative aspects of the dynamics remain valid in the case of the full Bistritzer--MacDonald model. Joint work with Simon Becker, with contributions by Patrick Ledwith.