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Electrons at the monkey saddle: a multicritical Lifshitz point[1]
ALEX SHTYK, Harvard University, GARRY GOLDSTEIN, University of Cambridge, CLAUDIO CHAMON, Boston University — We consider 2D interacting electrons at a monkey saddle with dispersion $\propto p_x^3 - 3p_x p_y^2$. Such a dispersion naturally arises at the multicritical Lifshitz point when three van Hove saddles merge in an elliptical umbilic elementary catastrophe, which we show can be realized in biased bilayer graphene. A multicritical Lifshitz point of this kind can be identified by its signature Landau level behavior $E_m \propto (Bm)^{3/2}$ and related oscillations in thermodynamic and transport properties, such as de Haas-van Alphen and Shubnikov-de Haas oscillations, whose period triples as the system crosses the singularity. We show, in the case of a single monkey saddle, that the non-interacting electron fixed point is unstable to interactions under the renormalization group flow, developing either a superconducting instability or non-Fermi liquid features. Biased bilayer graphene, where there are two non-nested monkey saddles at the K and K' points, exhibits an interplay of competing many-body instabilities, namely s-wave superconductivity, ferromagnetism, and spin- and charge-density wave.

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