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Bilayer graphene with parallel magnetic field and twisting: Phases and phase transitions in a highly tunable Dirac system KUN YANG, National High Magnetic Field Laboratory and Department of Physics, Florida State University, Florida 32306, USA, BITAN ROY, Condensed Matter Theory Center, Department of Physics, University of Maryland, College Park, Maryland 20742, USA
— The effective theory for bi-layer graphene, subject to parallel/in-plane magnetic fields is discussed. We show that with a sizable in-plane magnetic field the trigonal warping becomes irrelevant, and one ends up with two Dirac points in the vicinity of each valleys in the low-energy limit, similar to the twisted bi-layer graphene. Combining twisting and parallel field thus gives rise to a Dirac system with tunable Fermi velocity and ultra violet cutoff. If the interactions are sufficiently strong, several fully gapped states can be realized in these systems, in addition to the ones in pristine setup. Symmetry based classification of the order parameters will be discussed. We also present the quantum critical behavior of various phase transitions driven by the twisting and the magnetic field. Effects of an additional perpendicular fields, and possible ways to realize the some of the new massive phases will be highlighted.

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