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Lattice Theory of Pseudospin Ferromagnetism in Bilayer Graphene: Competing Orders and Interaction Induced Quantum Hall States JEIL JUNG, FAN ZHANG, ALLAN MACDONALD, Department of Physics, University of Texas at Austin — In mean-field-theory bilayer graphene's massive Dirac fermion model has a family of broken inversion symmetry ground states with charge gaps and spin-valley flavor dependent spontaneous charge transfers between layers. We use a lattice Hartree-Fock model to explore some of the physics which controls whether or not this type of broken symmetry state, which can be viewed as a pseudospin ferromagnet, occurs in nature. We find that inversion symmetry is still broken in the lattice model and estimate that transferred areal densities are $\sim 10^{-5}$ per carbon atom, that the associated energy gaps are $\sim 10^{-2}$eV, the ordering condensation energies are $\sim 10^{-7} eV$ per carbon atom and the energy differences between competing orders at the neutrality point to be of the order of $\sim 10^{-9} eV$ per carbon atom. We explore the quantum phase transitions between different states induced by external magnetic fields and by externally controlled electric potential differences between the layers. We find, in particular, that in an external magnetic field coupling to spontaneous orbital moments favors broken time-reversal-symmetry states that have spontaneous quantized anomalous Hall effects. Our theory predicts a non monotonic behavior of the band gap as a function of electric field in qualitative agreement with recent experiments.

Jeil Jung
Department of Physics, University of Texas at Austin

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