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Theory of the magnetic-field-induced insulator in graphene JEIL JUNG, ALLAN MACDONALD, Department of Physics, University of Texas at Austin — Recent experiments have demonstrated that neutral graphene sheets become insulators when placed in an external magnetic field. This anomalous behavior is related to the unusual four-fold degenerate quantization of $n = 0$ Landau levels near the Dirac point which causes interaction physics to become important at quite weak magnetic fields. The ground state of a neutral system in a magnetic field is a bulk 2D insulator. Zeeman splitting favors a spin polarized state in which the two majority spin $n = 0$ levels are occupied. This solution supports edge states with non-trivial conducting properties. Under certain conditions these edge states can be very poor conductor, consistent with the large measured resistances. In our work we suggest an alternate explanation based on π-band tight-binding-model Hartree-Fock calculations which conveniently accounts for Landau level mixing between states near the Dirac point with other states more remote in energy. We find that when Landau level mixing is included the ground state is a density-wave state, related with the fact that $n = 0$ Landau levels in different valleys occupy different honeycomb sublattices. The density wave solutions do not support edge states and are immediately consistent with the very large measured resistance of the field-induced insulator state.

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