Condensed Matter Theory Center Seminar

Tuesday, February 19
11:00 am – 12:30 pm, Physics Building 2205

Robert Throckmorton

Florida State University

"Electronic Multicriticality in Bilayer Graphene"

We investigate interaction-induced symmetry-breaking phases in bilayer graphene within the framework of weak-coupling renormalization group (RG) methods. Starting from a low-energy effective theory, and working at finite temperature, we derive the flow equations for the coupling constants that appear in said theory and show how they may be used to determine the leading instabilities that the system may exhibit as it is cooled. We are able to determine all possible leading instabilities analytically. We then specialize our results to the case of microscopic finite-range, density-density, monotonically-decreasing repulsive interactions. We show that there is a relation between such a term, added to the tight-binding lattice Hamiltonian, and the coupling constants in the corresponding low-energy field theory, and use this result to map out the leading instability of the system as a function of interaction range and overall strength. We find that the system is unstable to a layer antiferromagnetic state, in which each layer possesses a ferrimagnetic arrangement of spins and the spins are oppositely-oriented between the two layers, at short ranges of the interaction and to a nematic state, in which the rotational symmetry of the system is broken, for long ranges. For intermediate ranges, we find instabilities toward both. Finally, we investigate the antiferromagnetic state in the presence of an applied perpendicular magnetic field within the framework of variational mean-field theory. We show how to determine the energy gap in the system, and find that it possesses a slight non-monotonic behavior at low fields and a quasi-linear dependence at high fields. We then compare this result to experimental findings.

(All are welcome to attend)

physics
University of Maryland