Quantum critical scaling in magnetic field near the Dirac point in graphene

BITAN ROY, IGOR HERBUT, Simon Fraser University — Graphene, a monolayer of graphite, exhibits some peculiar electronic properties which are consequences of the pseudo relativistic Dirac like excitations. The anomalous integer quantum Hall effect, i.e., plateaus in Hall conductivity \( \sigma_{xy} \) at filling factors \( f = \pm(4n + 2) \), which can be understood within the framework of non-interacting Dirac like quasiparticles is one of such. On the other hand, the appearance of additional Hall states at filling factors \( f = 0 \) and \( f = \pm 1 \) at higher magnetic fields calls for electron-electron interactions to be taken into account. Motivated by the recent measurement of the activation energy at the quantum Hall state at the filling factor \( f = 1 \) in graphene, I will discuss the scaling of the interaction-induced gaps in the vicinity of the Dirac point with the magnetic field. The gap at \( f = 1 \) is shown to be bounded from above by \( E(1)/C \), where \( E(n) = v_F \sqrt{2nB} \) is the Landau-level energy and \( C = 5.985 + O1/N \) is a universal number. The universal scaling functions computed exactly for a large number of Dirac fermions \( N \) will also be presented. The sublinear dependence of the gap at the laboratory fields of \( 10T < B < 50T \) for realistic values of short-range repulsion between electrons, in quantitative agreement with observation will also be presented.

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