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Title: "Interaction Driven Capacitance and Photoluminescence of Dipole Crystals in Double Mono-Layer Graphene in Strong Magnetic Fields"

Abstract: Fabrication of devices made by isolated Graphene or Graphene-like single layers (such as h-BN) has opened up possibility of examining highly correlated states of electron systems in parts of their phase diagram that is impossible to access in their counterpart devices such as semiconductor heterostructures. An example of such states are Graphene (or Graphene like) double layer electron-hole systems under strong magnetic fields where the separation between layers can be of the order of one magnetic length with interlayer tunneling still suppressed. In those separations correlations between electrons and holes are of crucial importance and must be included in determination of observable quantities. Here we report a thorough mean-field study of the coherent and crystalline ground states of the interacting balanced electron-hole Graphene systems in small and intermediate separations with each layer occupying up to four lowest lying Landau levels. We calculate the capacitance and photoluminescence spectrum of such states as a function of layer separation and filling factor. Our calculations show significant enhancement of the capacitance compared to geometrical value due to quantum mechanical corrections. For the optically pumped system, thanks to longer recombination time it is possible to assume the system is in the ground state before recombination. Using Hartree-Fock approximation we present a mean-field study of the possible spectra of dipole crystal at low filling factors. We also present predictions on the behavior of such spectra as a function of specific controlling parameters of the system, filling factor and layer separation. This study reveals a clear signal for detection of broken translational symmetry states of two dimensional quantum particles.