Realistic model for electron-electron interactions in graphene. João N. B. Rodrigues, National University of Singapore — We present a study of the effects of realistic electron-electron interactions in graphene at half-filling. Using projective quantum Monte Carlo simulations of electrons living on the honeycomb lattice and interacting through an effective Coulomb potential, we compute the antiferromagnetic ordering, the renormalized Fermi velocity and the quasi-particle residue as a function of the strength of the short-range and the long-range components of the effective Coulomb potential. We find that the short-range part of the effective Coulomb potential is more efficient in driving the semi-metal to Mott insulator transition than the long-range part. This transition is consistent with the Gross-Neveu-Yukawa critical theory. Far from the critical point the Fermi velocity renormalization is dominated by the long-range part of the interaction, being compatible with the predictions from perturbative theory for massless Dirac fermions interacting through a bare Coulomb potential. In contrast, close to the Mott insulator transition, the Fermi velocity behavior is modified by the short-range part of the potential. Interestingly, real graphene samples are generally in between these two regions. Finally, the quasi-particle residue is found to interpolate between unity and zero as we move from the weakly interacting regime into the close vicinity of the phase transition. This work was done in collaboration with Ho-Kin Tang, Jia Ning Leaw, Evan Laksono, Pinaki Sengupta, Fakher F. Assad and Shaffique Adam, and was supported by the National Research Foundation of Singapore (NRF-NRFF2012-01 and CA2DM mid-size Centre) and by the Singapore Ministry of Education (Yale-NUS College R-607-265-01312).