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Quantum Monte Carlo study of the renormalization of the Fermi velocity in graphene

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We report the results of Quantum Monte Carlo (QMC) simulations of graphene at large-scale lattices. In our study we accessed small enough temperatures and momenta to confirm the logarithmic divergence of the Fermi velocity at low energies in the non-perturbative regime. It appears that our QMC results lie in between predictions made by one-loop lattice perturbation theory (which substantially overestimates the effect) and Random Phase Approximation (RPA). We also probed the influence of short-range interactions on the long-range behavior of the Fermi velocity, by performing QMC calculations with the same long-range Coulomb tail but different cutoffs for the potentials at short distances.

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