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D3: Calculation of the Fermi Velocity renormalization in graphene

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Application of Hybrid Monte Carlo technique allowed us to perform the simulations of electronic properties of suspended graphene at large enough lattices to directly observe the infrared renormalization of the Fermi Velocity for the first time in non-perturbative Quantum Monte Carlo calculations. We compared the results with experiment, and demonstrated the agreement in the specific case, when short-range electron-electron interactions are taken from cRPA approximation. Comparison of HMC data with perturbative calculations made within the Lattice Perturbation Theory (LPT) and in continuum QED demonstrates the importance of lattice-scale physics for the quantitative description of the Fermi Velocity renormalization. We also discuss the role of the higher-order perturbative corrections beyond RPA level.

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