Quantum Monte Carlo study of the fermi velocity enhancement in graphene

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Abstract

The electronic property of graphene has been extensively studied in the past decade [1]. There is still ongoing debate on the role of electron-electron interaction in graphene [2]. In this work, we adapt the quantum Monte Carlo method to account for the long range Coulomb interaction in graphene. By analyzing the Fermi velocity of the half-filled Coulomb model in honeycomb lattice, we found the strong coupling regime and weak coupling regime are governed by two types of theory, namely, the renormalization group study that works when long range interaction dominates, and Gross-Neveu theory that works when short range interaction dominates. We deduce that neither theory alone can describe the physics of realistic graphene, because realistic graphene is located in the regime where the effects of long range interaction and short range interaction are competing with each other.

References

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