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Universality of conductivity in interacting graphene

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Graphene is a recently discovered material, which can be considered as the first realization of a two-dimensional crystal. Its unique physical properties elicited great interest in the condensed matter physics community, both from a theoretical and an experimental point of view.
Remarkably, some interesting features of graphene can be understood from a mathematically rigorous viewpoint. In this talk, I will consider the Hubbard model on the honeycomb lattice at half-filling, as a model for undoped graphene in the presence of short-range interactions. I will present a rigorous proof of the universality of the optical conductivity, which agrees with recent experiments: the conductivity has a universal value, which does not depend on the microscopic details of the model. In particular, there are no interaction corrections, provided that the interaction is weak enough. Also, I will report about recent progress in the understanding of the universality of the Hall conductivity in a related model, the interacting Haldane model. The results are based on a rigorous formulation of the Wilsonian renormalization group and on Ward identities. This is joint work with A. Giuliani and V. Mastropietro.

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