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Quantum phase transitions in graphene

Relativistic and topological effects, as well as non-linear interactions and disorder, play a key role to determine the unique properties of graphene. Experimental measurements have revealed that electronic localization in graphene, in the quantum Hall regime, is not entirely dominated by single-particle physics, but rather a competition between the underlying disorder and the repulsive Coulomb interaction exists. Indeed, the effect of interactions near the plateau-plateau (PP) and plateau-insulator (PI) quantum phase transitions (QPT), and in particular the role of multifractality, are not well understood at the moment. To measure experimentally the critical exponent of these transitions, we have studied the PI and PP QPTs in a wide temperature range (from 4 K up to 230 K) and at different gate voltages (V_G) in graphene

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We have studied also weak localization (WL) and antilocalization (WAL) in graphene at temperatures between 0.3 K and 15 K [4]. At low carrier density, we observed a transition from WL to WAL driven by the increasing of the magnetic field while at high carrier density, WAL was suppressed as a consequence of trigonal warping of the conical energy bands. We analyzed the magnetic-field-driven WL-WAL transition, evaluating the relative strengths of the various elastic-scattering mechanisms and estimating the decoherence lengths and rates as a function of temperature, using an alternative method with respect to previously reported studies.