Critical behavior of conductivity in the quantum Hall effect regime: interaction effects

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The lively interest in the study of two-dimensional gas in HgTe/CdHgTe-based structures is caused by the diversity of properties of these systems associated with the complex nature of their energy spectrum. In particular, at the critical width (6.3 nm) of quantum well (QW), a dispersion law similar to that of massless fermions in graphene is realized. The quantum Hall effect (QHE) in such systems is observed up to room temperatures in graphene and up to nitrogen temperatures in HgTe, which provides new opportunities for analyzing the predictions of scaling theory regarding the critical behavior of conductivity in plateau-plateau and plateau-insulator quantum phase transitions in the QHE regime. Both systems, graphene and HgTe-based QW as well as GaAs-based structures, demonstrated the importance of taking into account the scale of the random potential and the interparticle interaction when discussing the universality of the experimentally obtained values of critical exponents.
In this study, we discuss experimental results obtained on different two-dimensional semiconductor structures characterized by strong spin-orbit and electron-electron interactions, and focus on identifying the influence of the spin degree of freedom and topological features of the studied systems on the problem of the universality of critical exponents obtained when describing transitions between different quantum Hall liquids in the QHE regime. As a topologically nontrivial system, we consider a heterostructure with a HgTe-based double QW with layers of critical width.