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Quantized conductivity in low density Rashba systems

Rashba spin-orbit coupling (SOC) appears in 2D systems lacking inversion symmetry, and causes the spin-splitting of otherwise degenerate energy bands into an upper and lower helicity band. The goal of this study is to understand how impurity scattering affects transport in the ultra-low density regime where only the lower helicity band is relevant. A previous study has investigated the conductivity in this regime using a first Born treatment. In this work, we use the *full* T-matrix to uncover new features of the conductivity. We first compute the conductivity within a 'semiclassical' (Boltzmann) framework and show that it exhibits an unconventional density dependence due to the unusual group velocity of the single particle dispersion, as well as quantized plateaus as a function of the logarithm of the electron density. We then perform a quantum (Kubo) calculation and find that these plateaus persist in the full many-body theory. We suggest that this quantization may be seen in a pump-probe experiment.