Transport in Helical Luttinger Liquids

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Abstract

Domain walls in quantum Hall ferromagnets separate two topologically distinct fractional quantum Hall liquids with opposite spin polarization. Gapless helical one-dimensional channels flow along the domain wall. Na'{i}vely, these are two counter-propagating chiral states with opposite spins. However, experimental data shows a considerably smaller current diverted by the domain wall than expected in this picture. We calculated the charge, spin and neutral currents flowing through the domain wall in the Luttinger liquid model for spin-polarized and spin-unpolarized fractional quantum Hall states at a filling factor 2/3. Even for spin-conserving processes, the current diverted through the domaim wall is shown to be smaller than expected in the model for two non-interacting counter-propagating channels. Inclusion of a nuclei-induced spin-flip tunneling between polarized and unpolarized regions allows to explain the experimental data. Furthermore, modeling the domain wall as point contacts, we calculated the shot noise of the tunneling current in this system. For weak backscattering we find the charge q=e/2, while for weak tunneling q=e.

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