Charge fractionalization in quantum wires

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Although the unit of charge in nature is a fundamental constant, the charge of individual quasiparticles in some low-dimensional systems may be fractionalized. Quantum One-Dimensional (1D) systems, for instance, are theoretically predicted to carry charge in units smaller than the electron charge e. Unlike 2D systems, the charge of these excitations is not quantized and depends directly on the strength of the Coulomb interactions. For example, in a 1D system with momentum conservation, it is predicted that the charge of a unidirectional electron that is injected into the wire decomposes into right and left moving charge excitations carrying fractional charges f0e and (1-f0)e respectively1, 2. f0 approaches unity for non-interacting electrons and is less than one for repulsive interactions. In this work we provide the first experimental evidence for charge fractionalization in 1D. Unidirectional electrons are injected at the bulk of a wire and the imbalance in the currents detected at two drains on opposite sides of the injection region is used to determine f0. Our results elucidate further3, 4 the collective nature of electrons in 1D.