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Mapping out spin and particle conductances of a single-mode channel with tunable interactions MARTIN LEBRAT, SEBASTIAN KRINNER, ETH Zurich, CHARLES GRENIER, ENS Lyon, DOMINIK HUSMANN, SAMUEL HÄUSLER, ETH Zurich, SHUTA NAKAJIMA, Kyoto University, JEAN-PHILIPPE BRANTUT, TILMAN ESSLINGER, ETH Zurich — We study particle and spin transport in a single-mode quantum point contact, shaped by light potentials onto a charge neutral, quantum degenerate gas of ^{6}Li fermions with tunable interactions. The spin and particle conductances are measured as a function of chemical potential or confinement, covering weak attraction, where quantized conductance is observed, to the strongly interacting superfluid regime. Spin conductance exhibits a broad maximum when varying the chemical potential at moderate interactions, which signals the emergence of superfluidity. In contrast, the particle conductance is unexpectedly enhanced even before the gas is expected to turn into a superfluid: it shows conductance plateaus at non-universal values continuously increasing from 1/h to 4/h, as the interaction strength is increased from weak to intermediate. For strong interactions, the particle conductance plateaus disappear and the spin conductance gets suppressed, confirming the spin-insulating character of a superfluid. Our observations document the breakdown of universal conductance quantization as many-body correlations appear. This anomalous quantization is incompatible with a Fermi liquid description, shedding new light on the nature of the strongly attractive Fermi gas in the normal phase.

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