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Novel measurement techniques for probing quantum point contacts¹

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Conductance measurements of quantum point contacts (QPCs) reveal an anomalous plateau at roughly $0.7 \times 2e^2/h$, when the mode occupation is just short of making a fully transmitting 1D channel available. Past experiments have built a consensus that this so-called “0.7 structure” is related to electron spin and electron-electron interaction, but the detailed description remains controversial. We have performed measurements on two new kinds of devices which give new insight into the interactions of electrons in these clean quasi-one dimensional systems. One device allows us to measure the compressibility of the electrons in a QPC for the first several conduction modes. Comparison with density functional calculations give new information about the relative importance of interactions (including exchange) as the density in the QPC is depleted. The second device allows us to measure the local density of states (DOS) in the QPC as we tunnel directly into the constriction. Deviations from the 1D DOS would help to develop a more complete picture of the transport through a QPC. We acknowledge support from the ONR Young Investigator Program, Award No. N00014-01-1-0569 and a Research Corporation Research Innovation Award, No. RI1260.

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