Resonant Interaction Between Quantum Wires Coupled by a Quantum Dot

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A critical requirement for the implementation of future generations of nanoelectronics is the need to understand the nature of the interactions that arise between different devices when they are coupled *coherently* to each other. The presence of such interactions may actually allow for the demonstration of novel functionality, an example of which is provided by the recent theoretical proposal to exploit coupled *quantum wires* as the means of qubit realization [1]. In this report, we have studied the interaction between quantum wires, which are coupled to each other by means of a quantum dot (Fig. 1). In this structure, transport through either wire is expected to be influenced by the biasing condition of the other wire, and by the quasi-zero-dimensional electronic structure of the quantum dot. In our experimental investigations of this device, we have studied how the transport through one wire is modified, as the width of the other wire is varied. We present evidence for a resonant interaction between the two wires, the origins of which appear to require a many-body interpretation. In particular, we observe a resonant enhancement of the conductance through the upper wire, which is correlated to the *closing* of the lower wire (Fig. 2). We explore the connection of these findings to recent suggestions that a Kondo state may occur in point contacts in the region close to their conduction threshold [2,3].

[1] A. Bertoni *et al*., Phys. Rev. Lett. **84**, 5912 (2000).

[2] S. M. Cronenwett *et al*., Phys. Rev. Lett. **88**, 226805 (2002).

[3] Y. Meir, K. Hirose, and N. S. Wingreen, Phys. Rev. Lett. **89**, 196802 (2002).

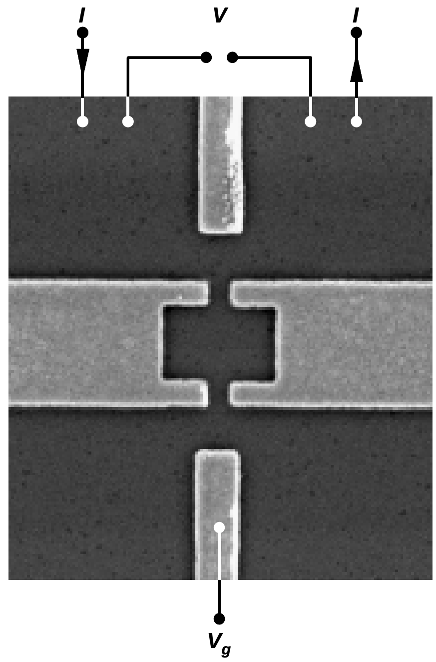

Fig. 1: SEM image of the structure studied. Current is passed through the upper wire and the voltage drop across it is monitored as the voltage applied to the lower gate is swept.

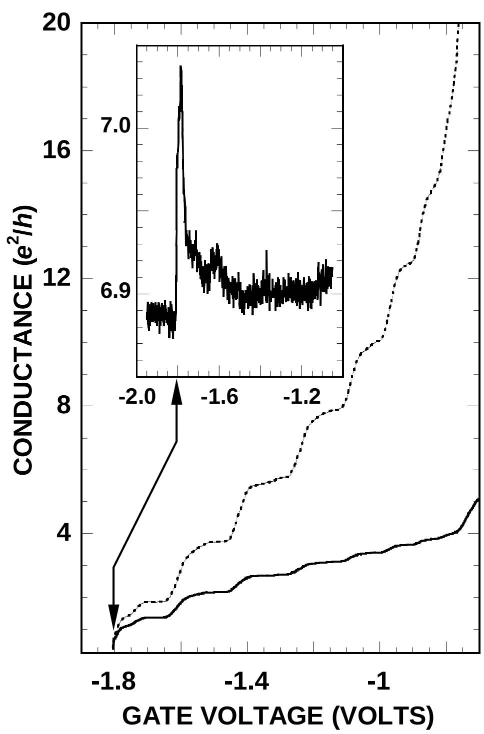

Fig. 2: Main panel shows the measure conductance through the quantum dot versus the gate voltage applied to the lower wire. Dotted line is same curve after subtracting a fixed resistance to account for the series resistance of the two dot point contacts. The inset shows the resonant feature observed in the conductance of the upper wire, as the lower wire closes.