Transport measurements on coupled single-electron devices

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We present measurements on two metallic single-electron devices consisting of two coupled single-electron transistors: a double-island transistor and a box/electrometer system. In both devices, the characteristic energy associated with the coupling plays a crucial role. Our experimental set-up allows for detailed studies of the transport properties in the regime of high conductance and at temperatures down to 25 mK [1].

For the double-island system, a variation of the parameters of the coupling junction reveals characteristic changes in the temperature dependence of the linear-response conductance. For the single-electron box, the coupling to a read-out device results in a broadening of the charge state transitions [2]. This device is studied in the superconducting as well as in the normal state.

For low temperatures, adequate theoretical modeling is achieved by analytically solving the master equation of the sequential tunneling model considering only the most relevant charge states. These calculations account for the individual capacitances and tunneling conductances of the system, including the capacitive crosstalk of the gates, and can be extended numerically to higher temperatures.

[1] C. Walisser, B. Limbach, P. vom Stein, R. Schäfer, C. Theis, G. Goeppert, and H. Grabert, cond-mat/0205220, Phys. Rev. B (to be published 15 September 2002).
[2] R. Schäfer, B. Limbach, P. v. Stein, and C. Wallisser, cond-mat/0205223 (unpublished).