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Induced Superconductivity in Nanowires and Nanotubes

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We study experimentally electron transport in 1 dimensional semiconductor nanowires (consisting of InAs and InP combinations) and carbon nanotubes. The wires are connected to superconducting source-drain contacts with gate electrodes in the substrate or on the surface. In the regime of weak coupling to the contacts we observe Coulomb blockade effects. We present level spectroscopy including a determination of the spin states. In the regime of strong coupling to the contacts interference effects are observed. In this regime and using superconducting contacts, we find supercurrents flowing through InAs-nanowires over micrometer length scales. The critical current is tunable by gate voltage, thus realizing so-called JOFETs (Josephson FETs) [1]. When we define quantum dots in between superconducting contacts the direction of the supercurrent is determined by the single electron spin state in the quantum dot [2,3].

1. Yong-Joo Doh, Jorden A. van Dam, Aarnoud L. Roest, Erik P. A. M. Bakkers, Leo P. Kouwenhoven, and Silvano De Franceschi, *Tunable supercurrent through semiconductor nanowires,* Science **309**, 272-275 (2005)
2. P. Jarillo-Herrero, J.A. van Dam and L.P. Kouwenhoven, *Quantum supercurrent transistors in carbon nanotubes,* Nature 439, 953-956 (2006)
3. Jorden A. Van Dam, Yuli V. Nazarov, Erik P.A.M. Bakkers, Silvano De Franceschi and Leo P. Kouwenhoven, *Supercurrent reversal in quantum dots,* Nature **442**, 667-670 (2006)