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Controlling the magnetic state of a carbon nanotube Josephson junction with the superconducting phase. RAPHAELLE DELAGRANGE, R. WEIL, A. KASUMOV, H. BOUCHIAT, R. DEBLOCK, LPS, CNRS, Univ. Paris-Sud, Orsay, France., D. J. LUITZ, LPT-IRSAMC, Universite de Toulouse and CNRS, Toulouse, France., V. MEDEN, Institut fur Theorie der Statistischen Physik, RWTH Aachen University and JARA, Aachen, Germany — The Kondo effect is a many-body phenomenon that screens the magnetic moment of an impurity in a metal. The associated singlet state can be probed in a single impurity by electronic transport in a quantum dot (QD), here made of a carbon nanotube (CNT), which provides a localized electron between the two contacts. Using superconducting leads, one can investigate the competition between the Kondo effect and the superconductivity induced in the CNT. The superconductivity can destroy the Kondo singlet in favor of a magnetic doublet, leading to a sign reversal of the supercurrent in the S-CNT-S junction. This singlet-doublet transition depends on the Kondo temperature and the superconducting gap, as well as the position of the impurity level. We demonstrate experimentally that the superconducting phase difference across the QD can also control this magnetic transition. We use the measurement of the relation between the supercurrent and this superconducting phase as a tool to probe the transition. We show that it has a distinctly anharmonic behavior, that reveals the phase-mediated singlet to doublet transition, in good agreement with finite temperature quantum Monte Carlo calculations. We extract as well a phase diagram of the phase-controlled quantum transition at zero temperature.

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