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Proximity and Anti-proximity effects in nanowires[1]

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Near a superconductor/normal-metal interface, the leakage of Cooper pairs extends superconducting behavior into the metal. The spatial range of this proximity effect in a normal metal can be as long as 1 m. However, when a ferromagnet is placed in contact with a superconductor, the Cooper pairs from the superconductor are not expected to survive beyond at most a few nanometers into the ferromagnet. Surprisingly we find when a cobalt nanowire as long as 600 nm is sandwiched between superconducting electrodes, it attains zero resistance at low temperature. For even longer wires, the transition to incomplete superconductivity via this (long range) proximity effect is foreshadowed by a large resistance peak (1). On the other hand when Zn nanowires of 40 nm diameter are contacted by superconducting electrodes, their superconductivity is unexpectedly suppressed (2). 1. Wang et al., PRL 102, 247003(2009); Nature Phys. 6, 389 (2010) 2. Tian et al., PRL 95, 076802 (2005); PRB 88, 064511 (2013)

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