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Cooper pair phase oscillation in thin Al superconductor induced by effective Zeeman splitting from spin injection[1] GUO-XING MIAO, JOCHEM NIETSCH, JAGADEESH MOODERA, MIT, Francis Bitter Magnet Lab
— By placing a superconductor (S) and a ferromagnet (F) in close contact, the superconductivity proximity effect induces transient Cooper pairs in F leading to FFLO [1,2] state, while the ferromagnetic proximity effect will populate the S region with non-equilibrium parallel spins. In our experiment, the spins are induced from both sides of the superconductor symmetrically through thin Al_2O_3 tunnel barriers. By toggling the two F layers between parallel and anti-parallel, we can effectively turn on and off the spin imbalance in the Al layer creating $> 1000\%$ MR. The Tc of Al layer is shifted between parallel and antiparallel states as a net result of the non-equilibrium spin population. Such Tc shift is observed to oscillate with Al layer thickness, which is a clear evidence that the effective Zeeman splitting caused by parallel spin population can also induce FFLO states in superconductors. The CPP conductance in such a structure also show dramatic difference between the two states. 1. P. Fulde and R.A. Ferrel, Phys. Rev. 135, A550 (1964) 2. A. I. Larkin and Y. N. Ovchinnikov, Sov. Phys. JEPT 20, 762 (1965)

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