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Critical Current Oscillations of Josephson Junctions with Ferromagnetic Layers[1] JOSEPH A. GLICK, MAZIN A. KHASAWNEH, BETHANY M. NIEDZIELSKI, REZA LOLOEE, W. P. PRATT JR., NORMAN O. BIRGE, Dept. of Physics and Astronomy, Michigan State University — Josephson junctions containing ferromagnetic layers are of considerable interest for the development of practical cryogenic memory and superconducting qubits. Such junctions exhibit a phase shift of π for certain ranges of ferromagnetic layer thickness. We present studies of Nb based micron-scale Josephson junctions using ferromagnetic layers of Ni, $Ni_{81}Fe_{19}$, or $Ni_{65}Co_{20}Fe_{15}$. By applying an external magnetic field, the critical current of the junctions containing $Ni_{81}Fe_{19}$ and $Ni_{65}Co_{20}Fe_{15}$ is found to follow a characteristic Fraunhofer pattern, and displays the clear switching behavior expected of single-domain magnets. However, the junctions containing Ni exhibit more complex behaviors. The maximum value of the critical current, extracted from the Fraunhofer patterns, oscillates as a function of the ferromagnetic layer thickness, indicating transitions in the phase difference across the junction between values of zero and π. We compare the data to previous work and to models of the 0-π transitions based on existing clean and dirty limit theories.

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