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Direct and Inverse Spin Switch Effect in Superconducting Spin Valves JIAN ZHU, CARL BOONE, XIAO CHENG, ILYA KRIVOROTOV, University of California, Irvine, KRIVOROTOV'S GROUP TEAM — We report the observation of direct and inverse spin switch effects in ferromagnet/ superconductor/ ferromagnet/ antiferromagnet (FM/SC/FM/AF) spin valves with FM = $Ni_{81}Fe_{19}$, AF = $Ir_{25}Mn_{75}$ and SC=Nb. In these spin valve structures, the magnetization of the free layer can be switched between parallel (P) and antiparallel (AP) orientations with respect to the orientation of the fixed layer by a small in-plane magnetic field. Near the superconducting transition temperature, the P state has a higher resistance than the AP state. This is the direct spin switch effect expected from the proximity effect in superconducting spin valves. However, when the fixed ferromagnetic layer is brought into a multi-domain state in zero magnetic field, resistance in this state becomes significantly higher than that of the P state and rapidly decreases to the P state value with increasing magnetic field. We explain this inverse spin switch effect by the formation of Néel - quasi-Néel domain wall pairs in the ferromagnetic bilayer. The Néel - quasi-Néel domain wall pairs induce stray magnetic fields with a significant component perpendicular to the plane of the sample. This field penetrates the SC and gives rise to vortex flow resistance. Our work shows that the inverse spin switch effect is magnetostatic in origin.

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