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Cryogenic Memories based on Spin-Singlet and Spin-Triplet Ferromagnetic Josephson Junctions[1]

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The last several decades have seen an explosion in the use and size of computers for scientific applications. The US Department of Energy has set an ExaScale computing goal for high performance computing that is projected to be unattainable by current CMOS computing designs [1]. This has led to a renewed interest in superconducting computing as a means of beating these projections. One of the primary requirements of this thrust is the development of an efficient cryogenic memory. Estimates of power consumption of early Rapid Single Flux Quantum (RSFQ) memory designs are on the order of MW, far too steep for any real application [1]. Therefore, other memory concepts are required. S/F/S Josephson Junctions, a class of device in which two superconductors (S) are separated by one or more ferromagnetic layers (F) has shown promise as a memory element. Several different systems have been proposed utilizing either the spin-singlet or spin-triplet superconducting states [2]. This talk will discuss the concepts underpinning these devices, and the recent work done to demonstrate their feasibility. [1] - Energy-Efficient Superconducting Computing - Power Budgets and Requirements, D. Scott Holmes, Andrew L. Ripple, Marc A. Manheimer, IEEE Trans. Appl. Supercon., Vol 23, No. 3, June 2013 [2] - B. M. Niedzielski et al., "Use of Pd-Fe and Ni-Fe-Nb as soft magnetic layers in ferromagnetic Josephson junctions for nonvolatile cryogenic memory," IEEE Trans. Appl. Supercond., vol. 24, no. 4, Aug. 2014, Art. ID. 1800307.

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