Conference on Frontiers of Nanoscience
24 August - 1 September 2015, Trieste, Italy

Ferromagnetic Josephson Junctions

Norman O. BIRGE
Michigan State University

Abstract:

The supercurrent in Josephson junctions containing ferromagnetic materials (called S/F/S junctions) decays and oscillates rapidly with increasing F layer thickness due to the large exchange splitting between the spin-up and spin-down electron bands in F. In the presence of non-collinear magnetization, Bergeret *et al.* predicted that spin-triplet pair correlations are generated, which are immune to the exchange field and hence persist over much longer distances in F [1]. Several experimental groups have confirmed the presence of such spin-triplet correlations in a variety of S/F and S/F/S systems. Our own approach is based on Josephson junctions of the form S/F′/F/F′′/S, with non-collinear magnetizations in adjacent ferromagnetic layers [2,3]. Such structures provide the possibility to control either the supercurrent amplitude or the phase across the junction (0-state or π-state) by rotating the magnetization of one of the three ferromagnetic layers. It is also possible to control the amplitude of the supercurrent and the phase across simpler S/F′/F/S junctions, which carry only short-range supercurrent. We will present our recent results with both types of devices, and we will review prospects for using such junctions as elements in a superconducting memory.

We acknowledge support from the US DOE under grant DE-FG02-06ER46341, from SPAWAR contract N66001-12-C-2017, from the U.S. Army Research Office, and from Northrop Grumman Corporation.

[1] F.S. Bergeret, A.F. Volkov, and K.B. Efetov, Phys. Rev. Lett., 86, 4096 (2001).
[2] T.S. Khaire, M.A. Khasawneh, W.P. Pratt, Jr., and N.O. Birge, Phys. Rev. Lett. 104, 137002 (2010); C. Klose et al, Phys. Rev. Lett. 108, 127002 (2012).
[3] M. Houzet and A.I. Buzdin, Phys. Rev. B 76, 060504(R) (2007).