Critical charge and spin Josephson currents through a precessing spin

C. Holmqvist, W. Belzig, and M. Fogelström

Fachbereich Physik, Universität Konstanz, D-78457 Konstanz, Germany
Department of Microtechnology and Nanoscience - MC2, Chalmers University of Technology, S-41296 Göteborg, Sweden

We present a theoretical study of two superconductors coupled over a spin. The spin is treated classically and is assumed to precess with the Larmor frequency due to an external magnetic field. The precession results in spin-dependent Andreev scattering and a non-equilibrium population of the Andreev levels. Charge and spin currents at zero temperature were studied previously. Here, we focus on the critical current as well as the corresponding spin currents at finite temperatures. At finite temperatures, the spin precession can enhance the supercurrent by a population redistribution. The enhancement leads to a modified current-phase relation and a non-monotonous critical current as function of temperature. This non-monotonous behavior is accompanied by a corresponding change in spin-transfer torques acting on the precessing spin and leads to the possibility of using temperature as a means to tune the back-action on the spin.