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Quantum processes in josephson point contacts

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Charge, spin and heat transport in nano-scale point contacts are governed by quantum processes and localized electronic states bound to the point contact. I discuss the quantum processes that lead to phase coherent transport of charge, energy and spin in Josephson point contact devices: (i) Multiple Andreev reflection and branch conversion transmission which leads to sub-gap conductance in ScS junctions, (ii) Resonant transmission of heat current in temperature- and phase-biased ScS junctions, and (iii) Spin mixing, i.e. unitary spin rotation induced at superconducting- ferromagnetic (SF) interfaces, which leads to superconducting spin currents, spin-triplet pairing correlations in SFS Josephson devices and long-range spin-transfer torques between nano-scale ferromagnets in coupled SFNFS devices. The latter may provide a basic element for constructing a class of spintronic devices with quantum control.

Biography

James A Sauls is Professor of Physics at Northwestern University. He received a PhD from State University of New York at Stony Brook, New York (1980), joined the faculty at Princeton University in 1982, then joined the Northwestern faculty in 1987. He held visiting faculty appointments at the University of Copenhagen and Joseph Fourier University, as well as an appointment as Director of Research at the CNRS laboratories in Grenoble, France. His expertise is in quantum field theory and condensed matter theory with applications to strongly interacting Fermi systems out of equilibrium. He is Fellow of the American Physical Society, was awarded the Max Planck research prize in theoretical physics in 1994 and the John Bardeen Prize for theoretical contributions to superconductivity in 2012.