Spin-resolved thermoelectric effects in a quantum dot devices coupled to ferromagnetic and superconducting electrodes

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Although, superconductors perfectly conduct electric current and are poor thermal conductors, they exhibit very small thermoelectric response. In the low-temperature limit, the transport occurs mainly through Andreev states. Due to particle-hole symmetry the resulting thermopower vanishes. To observe thermoelectricity one has to break the particle-hole symmetry which can be done using quantum-dot-based hybrid devices. The thermoelectric properties of hybrid systems based on a quantum dots attached to one superconductor and one metallic ferromagnet has been investigated. The interplay of Andreev tunneling of Cooper pairs and single-particle tunneling is examined. The latter is responsible for relatively large thermopower and figure of merit due to a diverging density of single-particle states at the superconducting gap edges. System with ferromagnetic and superconducting leads can also reveal spin thermoelectric phenomena. Finite superconducting gap is considered within the BCS theory, and the thermoelectric coefficients are calculated by means of nonequilibrium Green's function technique within Hartree-Fock like approximation with respect to the intradot Coulomb interaction.