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Nonlocal thermoelectric effects and nonlocal Onsager relations in a three-terminal superconducter/ferromagnet proximity system[1]
MATTHIAS ESCHRIG, Royal Holloway, University of London, PETER MACHON, WOLFGANG BELZIG, University of Konstanz, Germany — Heterostructures of ferromagnets and superconductors are presently subject of intense study since they show interesting phenomena based on the singlet-triplet conversion of pairing amplitudes at the interfaces, and the resulting spin-dependent proximity effect. Spectacular examples are long-range triplet Josephson currents due to inhomogeneous magnetic order, or due to the spin-dependence of the interface reflection and transmission amplitudes, which were confirmed in a set of pivotal experiments in 2010. Here, we study thermal and charge transport in a three-terminal setup consisting of a superconducting and two ferromagnetic contacts. We predict that the simultaneous presence of spin-filtering and of spin-dependent scattering phase shifts at each of the two interfaces will lead to giant non-local thermoelectric effects both in clean and in disordered systems. The symmetries of thermal and electric transport coefficients are related to fundamental thermodynamic principles by the Onsager reciprocity. Our results show that a non-local version of the Onsager relations for thermoelectric currents holds in a three terminal quantum coherent ferromagnet-superconductor heterostructure including spin-dependent crossed Andreev reflection and coherent electron transfer processes.

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