Magnonic to electronic thermoelectric spin current conversion beyond the tight-coupling limit

Emil Siuda[1] and Piotr Trocha[1]

[1] *Institute of Spintronics and Quantum Information,*
Faculty of Physics and Astronomy,
Adam Mickiewicz University, Poznań, 61-614, Poland

We investigate spin thermoelectric properties of a hybrid system consisting of a single-level quantum dot coupled to a magnetic insulator and a metallic electrode. The magnetic insulator serves as a source of magnons, while the metallic lead acts as a reservoir of electrons. A temperature gradient applied between the magnetic insulator and the metallic electrode induces a spin current flowing through the system. The magnonic (electronic) spin current generated in the system is converted into an electronic (magnonic) spin current by means of the quantum dot [1].
Transport properties are calculated using the nonequilibrium Green's function formalism within the linear response regime. This approach introduces nonproportionality relation between the heat currents and particle currents, allowing to go beyond the so called *tight-coupling limit* [2]. By expanding the spin and heat currents to first order in temperature and chemical potential differences, we introduce the basic spin thermoelectric coefficients, including the spin conductance, spin Seebeck coefficient, spin Peltier coefficient, and heat conductance.
Our results address an existing gap in the understanding of spin thermoelectric effects and provide deeper insight into spin caloritronic phenomena, offering a treatment of coherence effects and spectral broadening—valid across a broad range of coupling strengths, that is not available in standard weak-coupling master equation methods.

References:

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