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Novel contributions to the magnon drag thermopower in metal spintronics

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Metallic ferromagnets subjected to a temperature gradient exhibit a magnonic drag of the electric current, which has been recently shown to dominate the thermopower of elemental iron and copper over a broad range of temperatures. We address this problem by solving a stochastic Landau-Lifshitz equation to calculate the magnon-drag thermopower. The long-wavelength magnetic dynamics result in two contributions to the electromotive force acting on electrons: (1) An adiabatic Berry-phase force related to the solid angle subtended by the magnetic precession and (2) a dissipative correction thereof, which is rooted microscopically in the spin-dephasing scattering. The first contribution results in a net force pushing the electrons towards the hot side, while the second contribution drags electrons towards the cold side, i.e., in the direction of the magnonic drift. The ratio between the two forces is proportional to the ratio between the Gilbert damping coefficient α and the coefficient β parametrizing the dissipative contribution to the electromotive force.