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How to move domain walls in an antiferromagnet[1]

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Domain walls (DWs) in an easy-axis antiferromagnet can be driven by several stimuli: a charge current (in conducting antiferromagnets), a magnon current, and a temperature gradient. In this talk, we discuss the dynamics of a DW induced by two latter external perturbations, which are applicable in both metallic and insulating antiferromagnets. First of all, we study the Brownian dynamics of a DW subjected to a temperature gradient [1]. To this end, we derive the Langevin equation for the DW's center of mass with the aid of the fluctuation-dissipation theorem. A DW behaves as a classical massive particle immersed in a viscous medium. By considering a thermodynamic ensemble of DWs, we obtain the Fokker-Planck equation, from which we extract the average drift velocity of a DW. We briefly address other mechanisms of thermally driven DW motion. Secondly, we analyze the dynamics of a DW driven by circularly polarized magnons [2]. Magnons passing through a DW reverse their spin upon transmission, thereby transferring two quanta of angular momentum to the DW and causing it to precess. A precessing DW partially reflects magnons back to the source. The reflection of magnons creates a previously identified reactive force [3]. We point out a second mechanism of propulsion of the DW, which we term redshift: magnons passing through a precessing DW reduce their linear momentum and transfer the decrease to the DW. We solve the equations of motion for magnons in the background of a uniformly precessing DW with the aid of supersymmetric quantum mechanics and compute the net force and torque applied by magnons to the DW. The theory agrees well with micromagnetic simulations.

[1] S. K. Kim, O. Tchernyshyov, and Y. Tserkovnyak, Phys. Rev. B **92**, 020402(R) (2015)
[2] S. K. Kim, Y. Tserkovnyak, and O. Tchernyshyov, Phys. Rev. B **90**, 104406(E) (2014)
[3] E. G. Tveten, A. Qaiumzadeh, and A. Brataas, Phys. Rev. Lett. **112**, 147204 (2014)

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