Defect-influenced dynamics of Dzyaloshinskii domain walls under perpendicular and planar magnetic fields

Pierre Géhanne[a*], V. Jeudy[a], S. Rohart[a], A. Hrabec[a] and A. Thiaville[a]

a. Laboratoire de Physique des Solides, Univ. Paris-Sud, Université Paris Saclay, CNRS UMR 8502, 91405 Orsay

∗ pierre.gehanne@u-psud.fr

When dealing with the physics of spin current or domain wall manipulation at the interface between a ferromagnetic material and a metal with strong spin-orbit coupling, one has to take into account the presence of the interfacial Dzyaloshinskii-Moriya interaction (DMI). This antisymmetric exchange interaction appears in multilayer materials when the inversion symmetry is broken and can in some cases be comparable to the anisotropy energies, giving rise to new magnetization configurations such as skyrmions or chiral domain walls.

We study the dynamics of domain walls in Au/Co/Pt stacks, where the Cobalt thickness is around 1 nm. These stacks display perpendicular magnetic anisotropy as well as a strong interfacial DMI. It has been shown that the DMI changes the angle of the internal magnetization of the domain wall, from an achiral Bloch configuration to a chiral Néel configuration [1]. The energy and internal angle of such "Dzyaloshinskii domain walls" can be tuned by applying a strong static magnetic field in the plane of the sample [2], but the effects of chirality on the dynamics of domain walls are still to be understood.

Using a MOKE microscope built on purpose, we performed measurements of the velocity of the domain walls when subjected to out-of-plane magnetic field pulses over large ranges of amplitude and duration. The velocity/field curves display the creep, depinning and flow regime of motion [3]. Moreover, the velocity is found to vary by an order of magnitude with the in-plane field. Analyzing the universal behavior of the creep regime [4], we access to the material-dependent depinning parameters, and study their variation under the influence of DMI and in-plane field.

[1] A. Thiaville *et al.*, Dynamics of Dzyaloshinskii domain walls in ultrathin magnetic films, EPL, **100**, 57002 (2012)

[2] J. P. Pellegren *et al.*, Dispersive Stiffness of Dzyaloshinskii Domain Walls, Phys. Rev. Lett. **119**, 027203 (2017)

[3] P. J. Metaxas *et al.*, Creep and flow regimes of magnetic domain-wall motion in ultrathin Pt/Co/Pt films with perpendicular anisotropy, Phys. Rev. Lett. **99**, 217208 (2007).

[4] R. Díaz Pardo *et al.*, Universal depinning transition of domain walls in ultrathin ferromagnets, Phys. Rev. B., **95**, 184434 (2017)