Dramatic effect of curvature on motion of chiral domain walls

seminar

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Lecture Hall B.1.11

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Abstract

Current-driven motion of domain walls (DW) [1] is one of the most exciting avenues of research in spintronics with applications in memory and logic. Although, current-driven motion of DWs has been an intensive area of research for more than a decade, most of the experiments to date have focused on straight nanowires. Only recently has it been realized that the curvature of a nanowire can play an important role in the motion of chiral DWs [2]. Here we show that a chiral DW travelling along a curved path speeds up or slows down compared to its motion in a straight wire. The increase or decrease in speed depends on the sign of curvature or the configuration of DW and the difference in speeds can reach a factor of 10. While this property of DWs can potentially be useful for devices, it poses a significant problem to the operation of DW-based devices such as the racetrack memory which depend on the lock-step motion of DWs. This problem is eliminated in magnetic nanowires made out of synthetic antiferromagnetic structures (SAF) consisting of two magnetic sub-layers coupled via the exchange-coupling interaction. The adjoining DWs in such structures move at the same speeds as they do in a straight wire, thus reinforcing the attractiveness of a SAF structure for DW-based devices.

[1] Parkin S. et al. Nat. Nano. 10.3 (2015): 195-198.
[2] Garg, C. et al. Sci. Adv. 3.5 (2017): e1602804.
[3] Yang, S. et al. Nat. Nano. 10.3 (2015): 221-226.

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