Chiral spin textures on the racetrack

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Spintronics is a field of research that harnesses the electrons's spin to create novel devices especially for storing digital data that is the lifeblood of many of the most valuable companies today. Spintronics has already had two major technological successes with the invention and application of spin-valve magnetic field sensors that allowed for more than a thousand-fold increase in the storage capacity of magnetic disk drives that store >70% of all digital data today[1]. Just recently, after almost a 25 year exploration and development period, a high performance Magnetic Random Access Memory[2], that uses magnetic tunnel junction memory elements became commercially available. A novel spintronics memory-storage technology, Magnetic Racetrack Memory[3,4] is, I believe, on track to become the third major success of spintronics. Racetrack memory stores digital data in the form of chiral domain walls that are moved via spin currents along magnetic nano-wires to enable their writing and reading. Racetrack Memory promises a high performance, non-volatile magnetic memory-storage device that could replace magnetic disk drives [3].

Chiral domain walls are just member of an ever-expanding family of chiral spin textures that are of great interest from both a fundamental as well as a technological perspective [5]. Recently a zoology of complex spin textures stabilized by volume or interface Dzyaloshinskii-Moriya interactions have been discovered including, in our work, anti-skyrmions [6], elliptical Bloch skyrmions [7], two-dimensional Néel skyrmions [8] and fractional antiskyrmions [9]. Such nano-objects are potential candidates as magnetic storage bits on the racetrack. We also discuss our recent observation of Néel skyrmions in two distinct but closely related 2D van der Waal's ferromagnetic compounds [10]. We show that the crystal structures are substantially modified by self-intercalation, lowering the symmetry so as to allow for chiral spin textures that require acentric structures.

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