Chiral spin-orbitronics

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Over the past few years there have been remarkable discoveries in spin-based phenomena that rely on *spin-orbit coupling* that could spur the development of advanced magnetic memory devices. These include the formation of *chiral* spin textures in the form of Néel domain walls and topological spin textures, skyrmions, that are stabilized by a Dzyaloshinskii-Moriya exchange interaction. The Dzyaloshinskii-Moriya exchange interaction is derived from broken symmetries and spin-orbit interactions at interfaces or within the bulk of materials. Another important consequence of spin-orbit effects are the unexpectedly high conversion efficiencies of charge current to *chiral* spin current from topological spin textures and in conventional metals, via the spin Hall effect[1,2]. Such spin currents lead to giant spin-orbit torques that can be used to switch the magnetization in three terminal magnetic tunnel junction memory elements or can be used to move domain walls in Racetrack Memory memory-storage devices. Indeed record-breaking current-induced domain wall speeds exceeding 1,000 m/sec have recently been reported in atomically engineered synthetic antiferromagnetic racetracks in which the domain walls are "invisible" with no net magnetization[3,4]. More complex non-collinear spin textures include the recent discovery of antiskyrmions[5] in a Heusler compound.

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