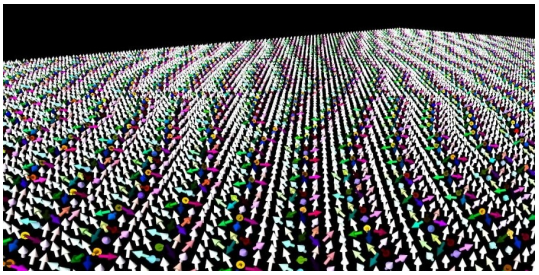

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Electrical manipulation of magnetic skyrmion in synthetic antiferromagnets and magnetic tunnel junctions for logic and memory applications

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Skyrmions are topological spin textures which hold great promise as nanoscale bits of information in memory and logic devices [1].
Although room-temperature ferromagnetic skyrmions and their current-induced manipulation have been demonstrated [2,3], their velocity has been limited to about 100 meters per second [3,4]. In addition, their dynamics are perturbed by the skyrmion Hall effect, a motion transverse to the current direction caused by the skyrmion topological charge.
Antiferromagnetic skyrmions allow these limitations to be lifted owing to their vanishing magnetization and net zero topological charge, promising fast dynamics without skyrmion Hall effect. In this talk, I will address the stabilization and current induced manipulation of skyrmions in compensated synthetic antiferromagnetic (SAF). I will first show that skyrmions can be stabilized at room temperature in Pt/Co/Ru based compensated SAFs and nucleated using local current injection and ultrafast laser pulses [5]. I will then show that SAF skyrmions can be moved by current at velocities over 900 m/s without skyrmion Hall effect [6]. Micromagnetic simulations and analytical models using experimental parameters show that this enhanced skyrmion velocity can be explained by the compensation of the gyrotropic force in the synthetic antiferromagnet. I will conclude the talk with recent results on the electrical nucleation and detection of a skyrmion in magnetic tunnel junctions, which is another important milestone for skyrmion based devices [7]. Our results open important paths toward the realization of logic and memory devices based on the fast manipulation of skyrmions.

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