All Electrical Nucleation, Motion and Detection of Room Temperature Magnetic Skyrmions

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It is a truth universally acknowledged, that a thin metallic ferromagnetic/non-magnetic interface in possession of a large spin orbit coupling and thus a strong interfacial Dzyaloshiniskii-Moriya interaction (DMI) is in want of the creation of a magnetic Néel skyrmion. Magnetic skyrmions are chiral spin structures which cannot be continuously deformed into another magnetic configuration, such as the ferromagnetic state4. Hence, they are topologically stabilised nanoscale structures. This stability, their small size (potentially as small as a few nm), and their predicted mobility under spin-torques at low spin current densities, has generated the current research efforts into their usability in novel magnetic information storage technologies.

Essential to this application is to be able to create, manipulate and detect magnetic skyrmions through purely electrical means. In this seminar, I will present results from work carried out in Leeds and with our collaborators at the Swiss Light Source at the Paul Scherrer Institute in Switzerland to demonstrate all three operations with and without applied global magnetic fields in thin film multilayers of Pt/Co/Ir and Pt/CoB/Ir. I will discuss the importance disorder and magnetic pinning in the thin film multilayers for the stability and motion of skyrmions. Contrary to what might be expected, in detection skyrmions via the hall effect, we find an expectedly large contribution to the hall signal that scales with the number and sense of the skyrmions being detected.

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