Tata Institute of Fundamental Research
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Seminar

Skyrmion: A Topological Spin Texture By Engineering Magnetic Multilayers

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The real-space topology in modern condensed matter physics, especially, nontrivial spin texture in magnetic skyrmion is rapidly moving to the centre of attention in spintronics owing to the bright prospects of skyrmionic materials advanced by the recent studies, showing that topology and physical properties of materials are increasingly linked. Such localized spin textures with particle-like properties usually appear in a stable lattice form in chiral magnets under applied magnetic fields and temperatures. Skyrmions observed in various geometries (bulk, thin films, interfaces) show the complex interplay of their properties with their topology. Therefore, the fascinating aspects of their dynamics and transport properties are believed to result in skyrmions as basic building blocks for information manipulation and storage. Theoretically, skyrmion states have been predicted to induce by an external magnetic field in magnets with nonzero Dzyaloshinsky-Moriya interaction (DMI). Furthermore, atomistic and micromagnetic models in magnetism allow to describe magnetic materials on the length scale of atomic lattices and above, respectively. Of particular interest is the atomic-scale skyrmions, whose stability is expected to be robust over a large range of magnetic fields and temperatures. This brings into play ultrathin layers of transition metals on heavy-metal substrate with nonmicromagnetically describable magnetic behavior due to the competing ferro- and antiferromagnetically coupled exchange interactions between different atomic sites that are finally the origin of stable exchange spin-spirals of atomic length scale. In this case, strong spin-orbit coupling in the presence of broken inversion symmetry ensures sizable DMI which selects a particular chirality of the spirals. Based on density functional theory and atomistic spin dynamics simulations, we have extended the micromagnetic concept of stabilizing skyrmions by applied magnetic fields to skyrmions stabilized by interlayer exchange coupling. This enables engineering zero field skyrmion in chiral magnets and provides a perspective direction to extend the number of possible chiral systems where magnetic skyrmions can be observed also at elevated temperatures.

Thursday, Sep 7th 2017

04:00 PM (Tea/Coffee at 03:45 PM)

Auditorium, TIFR-H (FReT-B)