Skymag

Spintronics is one of the most exciting topics in condensed matter physics which aims to harness the spin degree of freedom. While it has made a leap in data storage by providing sensitive detectors in magnetic hard drives, spintronics, however, turned out to be challeng- ing to communicate spin information in an energy efficient manner. On the other hand, magnonics utilise magnons, the collective excitation of electron spins, as information carriers with the prospect of energy efficient computing. Magnons are waves of the electrons' spin precessional motion that propagate without actual charge transport and its associated Ohmic. In the meanwhile, chiral spin textures, including chiral domain walls and skyrmions have recently appeared as one of the most exciting topics in spintronics community. Particu- larly, magnetic skyrmions are topologically protected spin textures with real-space topologi- cal properties and great potential in low-energy data storage industry. Aiming in taking ad- vantages of these two topics: we propose to study the interaction between magnonics and chiral spin textures for energy efficient spintronics.

Our proposal is motivated by the facts that both magnons and chiral spin textures share a common ground set by the interplay of dipolar, spin-orbit and exchange energies rendering them perfect interaction partners. Propagation of magnons is fast and sensitive to the con- figuration of spin textures. Chiral spin textures are robust, non-volatile and electrically repro- grammable on ultrashort timescales. The proposed research will be made possible by using ultrahigh vacuum magnetron sputtering, phase/momentum resolved Brillouin light scattering (BLS) spectroscopy, static/dynamic spin transport measurement, spin sensitive imaging techniques that are available from collaborative team. Specific strategy is the following: (I) systematically fabricate films with varying material specific parameters (thickness, composi- tion, stacking order) for desired properties (size, shape, density) of chiral spin textures. (II) utilise the asymmetric dispersion of magnons (spin-waves) for optimising the interfacial Dzyaloshinskii-Moriya interaction, (III) fabricate nanoscale devices to test the mutual interac- tion between magnons and skyrmions, through which the novel phenomena such as magnonic spin transfer torque, magnonic topological Hall effect will be revealed. A success of the proposed research could thus provide vast possibilities for combining the toolset of magnetic phenomena, adding important value to both magnonics and the fundamental un- derstanding of complex topological spin textures and establish an avenue for next-genera- tion energy efficient spintronics.