

# 2019 IBS – CALDES Special Seminar

- **Speaker :** Dr. See-Hun Yang (IBM Research-Almaden, USA)
- **Venue :** Seminar Room #201, Science building #3

- ✓ **Date & Time :** Wednesday, June 12 at 4PM
- ✓ **Title :** Chiral Spintronics

Chirality is one of the fundamental asymmetries in nature. Objects with chirality cannot be superimposed onto each other after mirror reflection operation like right and left hands. Archetypal examples of chiral objects are chiral molecules in stereoisomers and chiral magnetic domain walls whose chiralities are set by e.g. Dzyaloshinskii-Moriya interaction. Most importantly moving spins become chiral such that they can reciprocally interact with chiral objects thus allowing “Chiral Spintronics”. This means that spins traveling in a chiral object can be polarized or reversely spin angular momentum can be transferred to the chiral structure. In this talk I will review this emerging new field, the marriage of spintronics to chirality, by discussing recently discovered various novel torques and phenomena from chiral magnetic nanostructures to chiral molecules: spin-orbit torques from perpendicularly magnetized ultrathin films [1], exchange coupling torque [2] and novel new phase of domain wall dynamic, chiral exchange drag [3] from synthetic antiferromagnets, and efficient separation of chiral molecules, enantiomers, by magnetic structure [4]. In the end I will give an overall outlook on Chiral Spintronics and discuss potential applications from the new findings.

[1] K.-S. Ryu, L. Thomas, S.-H. Yang, and S. S. P. Parkin, “Chiral spin torque at magnetic domain walls”, *Nat. Nano.* **8**, 527 (2013).

[2] S.-H. Yang, K.-S. Ryu, and S. S. P. Parkin, “Domain-wall velocities of up to 750 m s<sup>-1</sup> driven by exchange-coupling torque in synthetic antiferromagnets”, *Nat. Nano.* **10**, 221 (2015).

[3] S.-H. Yang, C. Garg, and S. S. P. Parkin, “Chiral Exchange Drag and Chirality Oscillations in Synthetic Antiferromagnets”, *Nature Physics* 10.1038/s41567-019-0438-3 (2019).

[4] K. Banerjee-Ghosh, O.B. Dor, F. Tassinari, E. Capua, S. Yochelis, A. Capua, S.-H. Yang, S.S.P. Parkin, S. Sarkar, L. Kronik, L. T. Baczewski, R. Naaman, and Y. Paltiel, “Separation of enantiomers by their enantiospecific interaction with achiral magnetic substrates”, *Science* **360**, 1331 (2018).