Spintronics in Quantum Materials

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Abstract:

Recent advancements in spintronic techniques originally developed for spin-based devices now enable us to study fundamental spin physics of various quantum materials with unprecedented spin-current control and measurement, opening a new area of theoretical and experimental investigation of quantum systems. In the first half of the talk, we will discuss the development history of spintronics with a concrete example of the evolution of the domain-wall technology in spintronics. In the second part, we will introduce an emerging research area of spin transport in quantum materials which is fueled by the aforementioned advanced spintronic techniques. As examples, we will discuss our researches on the identification of 2D honeycomb ferromagnets as magnon topological insulators [1], which shows how spintronic techniques can be used for probing elusive quantum materials, and long-range spin transport mediated by a vortex liquid in superconductors [2], which shows that quantum materials can provide novel platforms for efficient spin-transport devices.

[1] S. K. Kim, H. Ochoa, R. Zarzuela, and Y. Tserkovnyak, "Realization of the Haldane-Kane-Mele Model in a System of Localized Spins," Phys. Rev. Lett. 117, 227201 (2016)
[2] S. K. Kim, R. Myers, and Y. Tserkovnyak, "Nonlocal Spin Transport Mediated by a Vortex Liquid in Superconductors," Phys. Rev. Lett. 121, 187203 (2018)