Unconventional Spin Transport in Quantum Materials

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Department of Physics Colloquium, University of Ulsan, December 2020

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 this talk, we will introduce this emerging research area of spin transport in quantum materials which is fueled by the global interest in quantum information science. As examples, we will discuss our discovery of a new magnonic topological insulator realized by a 2D honeycomb ferromagnet [1], which shows how spintronic techniques can be used for probing elusive quantum materials, and our prediction of 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. We will conclude the talk by offering a future outlook on quantum spintronics.

[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)