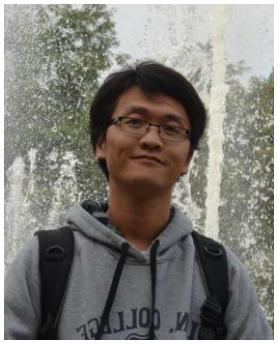
北京大学量子材料科学中心
International Center for Quantum Materials, PKU

Weekly Seminar

Pure spin current and spin Hall effect in antiferromagnetic insulators

Ka Shen 沈卡

Beijing Normal University



Time: 3:00pm, April. 7, 2021 (Wednesday)

时间: 2021年4月7日 （周三）下午3:00

Venue: Room W563, Physics building, Peking University

地点: 北京大学物理楼, 西563会议室

Abstract

Magnons in an easy-axis antiferromagnet with uniaxial anisotropy have two circularly polarized modes, which, very similar to the spin states of electrons, carry opposite angular momentum. Spin transport mediated by these antiferromagnetic magnons has attracted much attention recently. In this talk, we will discuss explicitly the role of different microscopic mechanisms behind. Specifically, we will show that the exchange interaction can lead to strong mode splitting and confluence processes, which change the magnon number but conserve the total angular momentum. Such processes can drive the two oppositely polarized magnon species to opposite chemical potentials, resulting in a pure magnon spin current, i.e., a counterflow of the two species without net magnon particle current [1]. The dipole-dipole interaction, on the other hand, is demonstrated to be able to introduce an effective magnon spin-orbit coupling, which then gives rise to electron-like spin-orbit phenomena, such as an intrinsic magnon spin Hall effect and D'yakonov-Perel'-type magnon spin relaxation [2]. Moreover, we show that the dipole-dipole interaction is able to generate Damon-Eshbach-type magnon surface modes [3]. In contrast to the nonreciprocity of the conventional Damon-Eshbach mode in ferromagnets, the surface modes in antiferromagnets experience a spin-momentum locking, just like the surface modes in an electronic topological insulator. Our work suggests that the antiferromagnetic insulators could be a suitable platform for exploring electron-like spin dynamics in insulators and designing novel spintronic devices.

[1] Ka Shen, Phys. Rev. B 100, 094423 (2019).
[2] Ka Shen, Phys. Rev. Lett. 124, 077201 (2020).
[3] Jie Liu, Lin Wang, and Ka Shen, Phys. Rev. Research 2, 023282 (2020)

About the speaker

Ka Shen received his B.S. and Ph.D. degrees from University of Science and Technology of China in 2007 and 2012, respectively. He then worked as postdoc at University of Missouri-Columbia and Delft University of Technology. In 2017, he joined the Center for Advanced Quantum Studies and Department of Physics at Beijing Normal University. His research interests focus on spin dynamics and spin transport in electronic and magnonic systems, in particular the spin-charge conversion and phonon-associated spin transport.