北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Spin waves and orbital contribution to ferromagnetism in the topological metal Fe_3Sn_2

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Time: 3:00 pm, Aug. 12, 2024 (Monday)

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Venue: Room w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Magnetic metals with kagome structure can host various topologically non-trivial spin or electronic states, providing an extraordinary platform for studying the fundamental physics of quantum materials. The metallic ferromagnet Fe_3Sn_2, built from compact AB-stacked kagome bilayers, shows a topologically non-trivial electronic band structure controllable by modest external magnetic fields[1-2] and hosts anomalous bulk properties, including a first-order spin reorientation transition[3], a large anomalous Hall effect[4], and skyrmionic bubbles[5]. Meanwhile the underlying physics is still under debate and requires spectroscopic understanding especially concerning the magnetic degrees of freedom. Using magnetic circular dichroism (MCD) in X-ray absorption and resonant inelastic X-ray scattering (RIXS) for the unambiguous isolation of magnetic signals, we report a nearly flat spin wave band and large (compared to elemental iron) orbital moment for Fe_3Sn_2[6]. As a function of out-of-plane momentum, the flat optical mode and the global rotation symmetry-restoring acoustic mode are out of phase, consistent with a bilayer exchange coupling that is larger than the already large in-plane couplings. Our results suggest the defining units of this very popular topological metal are therefore a triangular lattice of octahedral iron clusters rather than weakly coupled kagome planes. The spin waves are strongly damped when compared to elemental iron, opening the topic of topological interactions of topological bosons (spin waves) and fermions (electrons).

References

1.J-X. Yin et al., Nature 562, 91–95 (2018).
2.M. Yao et al., arXiv:1810.01514 (2018).
3.K. Heritage et al., Advanced Functional Materials 30, 1909163 (2020).
4.T. Kida et al., J. Phys.: Condens. Matter 23, 112205 (2011).
5.Z. Zhou et al., Adv. Mater 29, 1701144 (2017).
6.W. Zhang et al., arXiv:2302.01457 (2023).

About the speaker

Thorsten Schmitt is head of the Spectroscopy of Quantum Materials Group at the PSI Center for Photon Science of the Paul Scherrer Institut. He holds a PhD in Physics from Uppsala University, Sweden and a Dipl. Phys. degree from the Johannes Gutenberg-University of Mainz, Germany. He serves the scientific community in numerous beamline review panels. Thorsten Schmitt operates one of the world's most advanced soft X-ray RIXS facilities at the ADRESS beamline of the Swiss Light Source (SLS). His scientific research focuses on correlated-electron materials associated with phenomena such as superconductivity, metal-insulator transitions (MITs), charge order, magnetic order and low-dimensional magnetism.