Department of Physics
Condensed Matter Physics
Clarendon Laboratory, Parks Road, Oxford OX1 3PU

UNIVERSITY OF OXFORD

CONDENSED MATTER PHYSICS SPECIAL SEMINAR

Friday 28 August at 11:00
Simpkins Lee Seminar Room, Department of Physics
(https://maps.app.goo.gl/WjG71uLF2D48n85B6)

Artificial Symmetry Design for Emergent Spin Topologies and Their Excitations

Professor Jinxing Zhang
School of Physics and Astronomy, Beijing Normal University, Beijing, China
Key Lab of Multi-scale Spin Physics, Ministry of Education, China

Over the past decade, we have developed universal strategies (e.g. graded/varying strain, surface/interfacial chemistry, non-equivalent superlattice) to artificially control materials' symmetry and symmetry break for the emergent phenomena and functionalities, such as magnetoelectric phase transition, ferroelectric meta-surface, and topological spin textures, etc., which do not exist in their ground states. In this presentation, I will share with you one universal strategy for the symmetry design that can be extended into a broad variety of materials. We discover that broken space-inversion symmetry and accompanying "hybrid" Dzyaloshinskii-Moriya interaction can be driven by a graded strain in a correlated oxides, (La,Sr)MnO3. Such a symmetry design in this centrosymmetric ferromagnet results in the stabilization of multiple topological spin textures (skyrmions, spirals, bimerons, etc) [1,2]. By further engineering the electronic and spin structures simultaneously, we observe that a chiral magnonic edge state can efficiently propagate through the spiral nanochannels of (La,Sr)MnO3 with a low magnetic damping at room temperature. The selective control of spin-wave propagation prospects the potentials for fabricating nanoscale magnonics devices with ultralow energy consumption [3,4,5].

References:
[1] Y. Zhang, et al., Strain-Driven Dzyaloshinskii-Moriya Interaction for Room-Temperature Magnetic Skyrmions, Physical Review Letters 127, 117204 (2021);
[2] M. Cai, et al., Stabilization and Observation of Large-Area Ferromagnetic Bimeron Lattice, Physical Review Letters 135, 116703 (2025);
[3] C. Liu, et al., Current-controlled propagation of spin waves in antiparallel, coupled domains, Nature Nanotechnology 14, 691-697 (2019);
[4] Y. Zhang, et al., Switchable long-distance propagation of chiral magnonic edge states, Nature Materials 24, 69-75 (2025);
[5] Aiji Wang, et al., Magnetoelectric exchange spring for spin-wave logic with ultralow energy consumption, under review.

Host: Professor Arzhang Ardavan