UCR Physics and Astronomy

Condensed Matter Seminar

10 am Friday, Jan 10, MSE 117

Novel properties due to crystal symmetry in spin-splitting antiferromagnet and topological superconductor

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I will talk about the novel properties due to crystal symmetry spin-splitting antiferromagnets (AFMs) [*Nat. Commun. 12, 2846 (2021)*] (named as altermagnet in 2022) and in topological superconductor [*Nature 633, 71 (2024)*].

In spin-splitting AFMs, we propose the crystal-symmetry-paired spin-valley/momentum locking (CSVL/CSML), which is enabled by a crystal symmetry and intrinsically exists in AFMs (e.g., V_2Se_2O, V_2Te_2O, MnTe and RuO_2) [*Nat. Commun. 12, 2846 (2021)*]. CSML enables feasible controls of spin in AFMs by manipulating the corresponding crystal symmetry. Typically, one can use a strain field to induce net valley polarization/magnetization and use an electric field to generate a noncollinear spin current even without spin-orbit coupling. All the predictions have been confirmed in experiments [*arXiv:2407.19555*; *arXiv:2408.00320*]. These properties have helped us realize the electric readout and 180° deterministic switching of the Néel order in our experimental work in Mn_5Si_3 [*Sci. Adv. 10, eadn0479 (2024)*] and CrSb [*arXiv:2403.07396 Nature (accepted)*].

In topological superconductors, magnetic mirror symmetry can protect multiple Majorana zero modes (MZMs) in a single vortex, which allows feasible controls of hybridization of MZMs simply using an external field. This has been realized in our recent collaborative experimental works with Prof Jin-Feng Jia's group [*Nature 633, 71 (2024)*; *Quantum Frontiers 3, 20 (2024)*]. Similar properties can also be realized in superconducting CSVL/CSML materials.