

RICE QUANTUM GROUP MEETING SEMINAR SERIES



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| <u>Presenter:</u> | Jiaming Luo |
| Research Group: | Prof. Hanyu Zhu's group |
| Date: | March 3, 2023, Friday |
| Time: | 4PM - 5PM |
| Venue: | SST 300 |

Evidence for topological magnon-phonon hybridization in a 2D antiferromagnet down to the monolayer limit

Abstract:

Topological bosonic excitations such as photons, phonons, and magnons potentially enable low-loss transport of information and energy in analogy to electronic topological states. Compared with photons, phonons have smaller mode volumes that can increase the coupling strength with spins to reach the quantum coherent regime and enable atomic-scale chiral topological bosons. Van der Waals magnetic materials are promising to realize such states due to their recently discovered strong interactions among the electronic, spin, and lattice degrees of freedom. Here, we report the first observation of coherent hybridization of magnons and phonons in monolayer antiferromagnet FePSe₃ by cavity-enhanced magneto-Raman spectroscopy. The robust magnon-phonon cooperativity in the 2D limit, which accidentally occurs at zero magnetic fields, originates from the material's large single-ion anisotropy, weak interlayer exchange coupling, and bond-dependent spin-exchange interaction. We then identified nontrivial band inversion between longitudinal and transverse optical phonons caused by the strong coupling with magnons. The spin and lattice symmetry theoretically guarantee magnetic field-controlled topological phase transition, which is also verified by non-zero Chern numbers calculated from coupled spin-lattice model. The 2D topological magnon-phonon hybridization potentially offers a new route toward quantum phononics and magnonics with an ultras-small footprint.

Short Bio:

Jiaming Luo is a 3rd-year Ph.D. student in Applied Physics, working in the group of Professor Hanyu Zhu. His research centers around using ultrafast Terahertz spectroscopy to investigate non-equilibrium states in magnetic quantum materials. Jiaming can modulate the spin direction through the excitation of chiral phonons with spin-phonon coupling. Before his current research, Jiaming earned his B.S. in physics at Fudan University in Shanghai, where he worked with Prof. Hugen Yan on few-layer black phosphorus infrared photodetectors.

Note: Snacks and Coffee will be served during the event Wine & cheese will be served after the talk. Everyone is welcome to stay around after the seminar for further informal discussions.