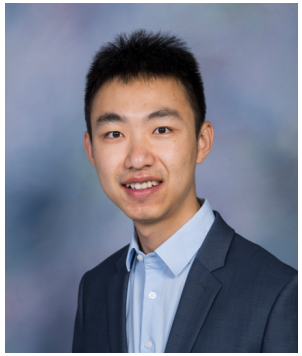
SFB 1432

Colloquium

Universität Konstanz

July 13, 2023
Talk at 15:15
in P 603
refreshment afterwards



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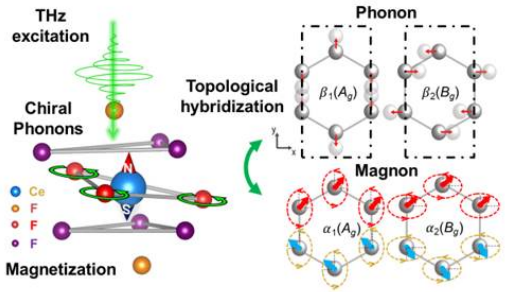
Chiral and coherent phonon-spin coupling in hexagonal lattices



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The electronic and magnetic properties of solids are fundamentally determined by the crystal structures. When the structure keeps evolving, the properties are usually determined by the instantaneous lattice configurations, but this may not always be true. When phonons are coherently excited in solids, the atoms oscillate back and forth around their equilibrium positions, and one would expect the perturbation on electronic properties to largely cancel out. But a qualitative change might be possible with atomic motions called “chiral phonons”, which break time-reversal symmetry and would in principle affect all properties protected by such symmetry. Chiral phonons with quantized angular momentum are simply guaranteed by multi-fold rotational symmetry, and thus are rather common in materials and have been predicted to cause unexpected magnetic, topological, and transport phenomena. In this talk, I will first briefly introduce the discovery of chiral phonons in two-dimensional (2D) semiconductors, which exhibit spin-valley locking and chiral electron-phonon coupling. I will then discuss the general properties of chiral phonons originating from time-reversal symmetry breaking, and give an example on the optical control and the magnetic properties of chiral phonons in rare earth halides. Finally, I will introduce quantum coherent spin-phonon coupling in 2D antiferromagnets, leading to magnon-phonon hybridization, nontrivial topology, and chiral edge states. Together, these phenomena demonstrate a new paradigm of dynamic structural-property relationship in quantum materials.