

# Inelastic x-ray scattering study of topological phonons

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Topological states in quantum materials are defined by bulk wave functions that possess nontrivial topological invariants. While edge modes are widely presented as signatures of nontrivial topology, how bulk wave functions can manifest explicitly topological properties remains unresolved. Here, using high-resolution inelastic x-ray spectroscopy (IXS) combined with first principles calculations, we report experimental signatures of topological phonons, including double Weyl, nodal line, and twofold quadruple Weyl phonons<sup>1-4</sup>. Our results establish IXS as a powerful tool to uncover topological wave functions, providing a key missing ingredient in the study of topological quantum matter.

## References:

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2. Miao et al., PRL 121, 035302 (2018).
3. Zhang et al., PRL 123, 245302 (2019).
4. Li et al., PRB 103, 184301 (2021).