Universität Münster

Allgemeines Physikalisches Kolloquium

Donnerstag, 26.11.2026 – 16 Uhr c.t.

IG1 – HS 2 | Wilhelm-Klemm-Str. 10

Kolloquiums-Kaffee ab 16 Uhr vor dem Hörsaal



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Morphic effects – phonon selection rules and magnetic order

The selection rules of optical phonons in a non-magnetic or paramagnetic solid are determined by the irreducible representations of the crystallographic point group. When the material orders magnetically, only those symmetry elements of the paramagnetic state, that will also leave the ordered spin configurations invariant, remain valid for the magnetic crystal and form the magnetic point group. The irreducible representations of the magnetic point group - the irreducible corepresentations - can now give rise to new selection rules and previously silent modes can become active of IR and Raman active phonon modes can occur in previously forbidden channels. These effects have been known and described several decades ago [1, 2], but only few examples of morphic effects of phonons have been reported in the past.

I will discuss our investigations of such morphic effects of phonons with regard to the collinear magnets $Co_2Mo_3O_8$, $Fe_2Mo_3O_8$, and $Mn_2Mo_3O_8$ [3, 4], all of which break the combined *PT*-symmetry operation of spatial inversion *P* and time inversion *T*. Hence, Kramers degeneracy is lifted and spin-splitting of electronic or magnon bands at general points in the Brillouin zone can occur. Moreover, I will discuss the behavior of phonons and magnons of these compounds in magnetic fields, where strong magnon-phonon hybridization and Faraday effects have been observed.

[1] E. Anastassakis and E. Burstein, Morphic effects. V. Time reversal symmetry and the mode properties of long wavelength optical phonons, Journal of Physics C: Solid State Physics **5**, 2468 (1972).
[2] C. J. Bradley and A. P. Cracknell, The Mathematical Theory Of Symmetry In Solids: Representation theory for point groups and space groups (Oxford University PressOxford, 2009).
[3] F. Schilberth, M. Kondákor, D. Ukolov, A. Pawbake, K. Vasin, O. Ercem, L. Prodan, V. Tsurkan, A. A. Tsirlin, C. Faugeras, P. Lemmens, K. Penc, I. Kézsmárki, S. Bordács, and J. Deisenhofer, Optical phonons as a testing ground for spin group symmetries, npj Quantum Materials **11**, 26 (2026).
[4] F. Schilberth, K. Vasin, M. Knauft, M. Kondákor, M. Vuckovic, N. Herrmann, K. Penc, M. Minola, B. Keimer, V. A. Martinez, K. Panda, A. A. Sirenko, L. Prodan, V. Tsurkan, A. A. Tsirlin, I. Kézsmárki, and J. Deisenhofer, Magnetic circular dichroism of THz modes and selection rules of Raman-active optical phonons in the polar altermagnet candidate Mn2Mo3O8 10.48550/arXiv.2608.01062 (2026), arXiv:2608.01062.

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Fachbereich Physik