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Neutron polarimetry study on the phonon-crystal field coupling in CeAuAl3

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The magnetoelastic coupling between phonons and f-electron transitions in crystal electric field (CEF) has been of interest for long time already but still lacks a systematic understanding. It was first recognized in 1980s in CeAl2 that showed an unexpected excitation spectrum. It was explained by a qualitative theory developed by Thalmaier and Fulde [2] but limited to this case. Such phonon-CEF coupling in CeAuAl3 seems to be exceptionally interesting. Just as CeAl2 it hosts a coupled phonon-CEF excitation that manifests in the measured spectra as an additional non-dispersive excitation at 8 meV. However, it also shows an anti-crossing of the CEF excitation at 5 meV and an acoustic phonon [3].
We have performed polarized inelastic neutron scattering measurements on CeAuAl3 to elucidate on the polarization of the coupled excitation as well as on the phonon-CEF anti-crossing. We have observed a transfer of the spectral weight between the magnetic and nuclear channels in the anti-crossing region. Most importantly we have adapted and extended the Thalmaier-Fulde model and performed calculations with McPhase software [4] that allow to quantitatively reproduce the measured spectra and the spectral weight transfer.

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[4] M. Rotter et al, J. Phys.: Condens. Matter, 24, 213201, (2012).

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