Experimental report

24/08/2022

Proposal: 4-04-510 **Council:** 4/2021

Title: Study of the charcter of the crystal field excitation in CeAuAl3 at the magnetic zone center and teh anti-crossing region

Research area: Physics

This proposal is a continuation of 4-04-490

Main proposer: Astrid SCHNEIDEWIND

Experimental team: Michal STEKIEL
Christian FRANZ

Local contacts: Mechthild ENDERLE
Ketty BEAUVOIS

Samples: CeAuAl3
CePdAl3

Instrument	Requested days	Allocated days	From	To
IN20	7	0		
ORIENTEXPRESS	1	1		
IN12	7	7	25/08/2021	01/09/2021

Abstract:

Hybridized excitations that comprise of well-known and well-understood collective modes have received increasing interest as the possible origin of novel functionalities and unconventional materials properties. In materials with strong electronic correlations, the effects of electron-phonon interactions are typically neglected, being deemed not important for the overall understanding.

In CeAuAl3 th coupling of crystal field (CEF) and phonons was observed by TAS(see PNAS 116 6695 (2019)), together with an anti-crossing along the c-direction of the TA phonon and the CEF. In a first experiment we studied their character with polirized neutrons, and found an unextected nuclear component of the CEF away from the anti-crossing Q-region.

For better understanding of the magnetoelastic hybridization, we propose a to verify and extend this observation. We ask for measuring the q-dependence of the nuclear and magnetic contribution of the CEF around different Gamma-points for energies (2.5...7)meV in the paramagnetic state of CeAuAl3 with full polarization analysis.

ILL 4-04-410 PROPOSAL experimental report

Study of the character of the crystal field excitation in CeAuAl3 at the magnetic zone center and the anti-crossing region

Astrid Schneidewind, Michal Stekiel, Petr Cermak, Christian Franz

CeAuAl3 shows a particular type of magnetoelastic coupling between the transitions of the Ce 4f electron in the crystal field (CEF) and phonons representing the collective lattice vibrations. This coupling results in appearance of an additional excitation line in the inelastic neutron scattering spectra. This line represents the coupled excitation between the CEF transition and phonon. It shows no dispersion in reciprocal space, similar to a localized CEF transition, but on the other hand it shows unusual intensity dependence on the momentum transfer, similar to phonons. In addition, there was an unusual transverse phonon-CEF transition anticrossing observed in CeAuAl3.

The goal of the measurements was to investigate the polarization of the coupled excitation and determine whether it changes as a function of momentum transfer. The secondary goal was to follow the changes in the polarization in the anticrossing region.

We were able to determine that the polarization of the coupled excitation is different in the (100) and (002) Brillouin zones, and it seems to follow the polarization of the 5 meV CEF transition. This suggests that the coupled excitation arises from the phonon coupling to the 5 meV excitation.

Secondly, we were able to confirm the anticrossing scenario followed the polarization changes.