

# Experimental report

14/02/2021

**Proposal:** 4-04-490

**Council:** 4/2017

**Title:** Nature of the magnetoelastic hybrid excitations in CeAuAl<sub>3</sub>

**Research area:** Physics

**This proposal is a resubmission of 4-04-484**

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**Samples:** CeAuAl<sub>3</sub>

Instrument	Requested days	Allocated days	From	To
IN22	0	8	04/07/2018	06/07/2018
			04/02/2020	10/02/2020
IN20	9	0		
IN3	1	1	03/02/2020	04/02/2020

## Abstract:

We propose to determine character of the unique anti-crossing between phonon and crystal field levels as well as the character of the new vibronic mode around 7.9 meV. Such an investigation is essential to resolve the opened questions about the origin of the observed magnetoelastic hybridization. In terms of the parameter range needed the spectrometer IN20 combined with an polarization analysis and orange cryostat would be ideally suited.

## Exp. Report: 4-04-490: Study of Vibron states in CeAuAl<sub>3</sub>

We proposed to determine character of the unique anti-crossing between phonon and crystal field (CEF) levels as well as the character of the new vibronic mode around 7.9 meV. Such an investigation is essential to resolve the opened questions about the origin of the observed magnetoelastic hybridization.

The proposal was started on IN20 with polarization analysis, but could not be performed due to radiation protection issues on IN20. It was shifted to IN22, stopped by an unexpected shutdown (06/07/2018), finally beamtime was given 02/2020 on IN22. The experiment was successfully performed but suffered from several technical problems, so the available time was reduced by 1.5d ays.

The goal of the experiment was focused during the beamtime on the character of the phonon and CEF around the q-range of the anti-crossing. The experiment was performed with an orange type cryostat at T = 10K, above magnetic order. The result is summarized in Fig. 1.

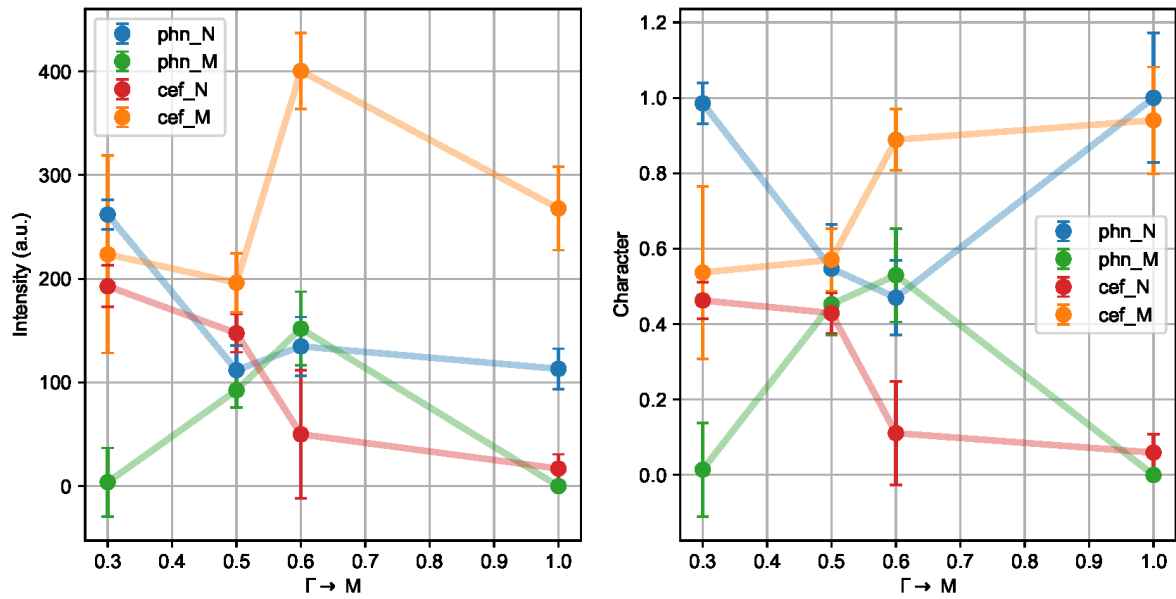


Fig.1: Absolut intensity and character of the phonon and the CEF level in CeAuAl<sub>3</sub> measured with full polarization analysis on IN22 at different q-points for different L-values along (20L). Clearly the phonon has nuclear character at the zone boundary and nearby the  $\Gamma$ -point but mixes with magnetic excitations in the anti-crossing region. The CEF is purely magnetic at the zone boundary, shows mixing character in the anti-crossing region, but also nearby the  $\Gamma$ -point.

While the behaviour of the modes for higher L-values seems to be reasonable, the low-L character(s) of the CEF is remarkable. From the experimental point of view, even showing limited statistics, the result seems to be conclusive, due to the fact that both modes are separated and can be detected individually as shown in Fig.2, lowest chart.

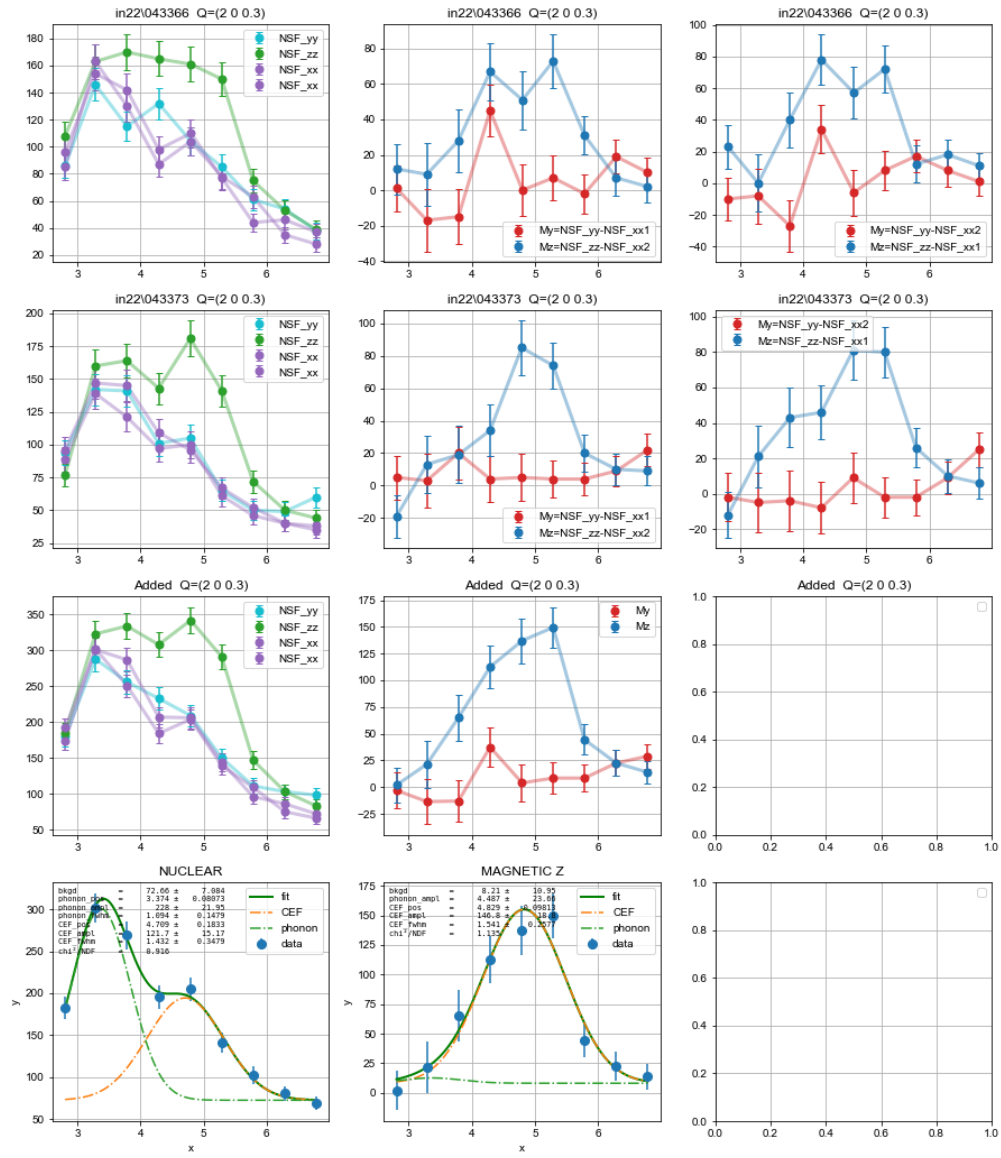


Fig.2: Energy scans on  $\text{CeAuAl}_3$  measured with full polarization at  $Q = (2\ 0\ 0.3)$  shown in the different polarization channels, and nuclear and magnetic components concluded from it, respectively (lowest line).