Experimental Report

Proposal: **4-01-1339** **Council:** 4/2014

Title: Quasielastic magnetic response in CeB6 and Ce0.72La0.28B6

This proposal is a new proposal

Researh Area: Physics

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Samples: CeB6
Ce0.72La0.28B6

Instrument	Req. Days	All. Days	From	To
IN12	10	5	20/11/2014	25/11/2014

Abstract:

We propose to study the momentum and temperature dependence of the quasielastic magnetic response in CeB6 and Ce0.72La0.28B6. In a number of previous experiments performed at the ILL, we have demonstrated that an intense quasielastic signal with a rich momentum-space structure persists above T_N up to room temperature. Its temperature scaling has been studied previously only on polycrystalline samples. Here we would like to verify if the momentum dependence of the quasielastic line width persists in the normal state or is only a property of the hidden-order phase. We also will measure a doped compound with 28% La concentration, which corresponds to the quantum critical point at which the AFM order is fully suppressed. This will let us study the influence of La concentration on the quasielastic line width and its T-dependence.

EXPERIMENTAL REPORT

Proposal number: 4-01-1339
Instrument: IN12
Date of experiment: 20 Nov – 25 Nov, 2014

The aim of the proposed experiment was to study the quasielastic signal to reveal

- the possible presence of **Q**-dependence of the quasielastic line width in the paramagnetic state.
- the possible deviation of the quasielastic line width from the $T^{1/2}$ scaling at low temperatures.
- the effect of the La doping on the quasielastic line width and its temperature scaling.

Our experiment was performed on the cold triple-axis spectrometer IN12. We used two single-crystalline samples with the different La doping level: 28% and 50% (~ 4 grams each). The samples have P-1 space group, lattice parameters are $a=b=c=4.14$ Å and $\alpha=\beta=\gamma=90°$. Both of them had a cylindrical shape Ø 6mm × 40–50mm and were prepared from isotopically enriched ^{11}B to minimize neutron absorption; $k_f=1.3$ Å^{-1} and was fixed. The temperature range during the experiment was between 1.5 K and 150 K. The samples were aligned for the most intense (1 1 0) and (0 0 1) reflections to enable measurements in the (*H H L*) scattering plane.

The main findings of our experiment are:

- We did not observe any notable deviation from $T^{1/2}$ scaling of quasielastic line width for our temperature range for 28% doped sample (Fig. 3). However, we did not perform low temperature scans due to the lack of measurement time. Results for the 50% doped sample were highly affected by cryostat leak.
- The quasielastic lines become marginally broader with La doping (Fig. 1-2).

The **Q**-dependence wasn't measured due to the lack of time.

Our data were affected by the leak of the cryostat (see Fig. 2 high temperature range), as seen both by the increased background above 77 K and by the fact that gas was found inside the cryostat when dismounting the sample. As a result, the background at $T > 77$ K (condensation of nitrogen), renders the data in Fig. 1 and a Fig. 2 unusable, leading to a loss of ~1.5 days of measurements.

Hereby the temperature dependence of the quasielastic lines width with the different doping level remains unclear. However the widths of the quasielastic line in CeB_6 parent compound [5] and in our 28% La doped are consistent.

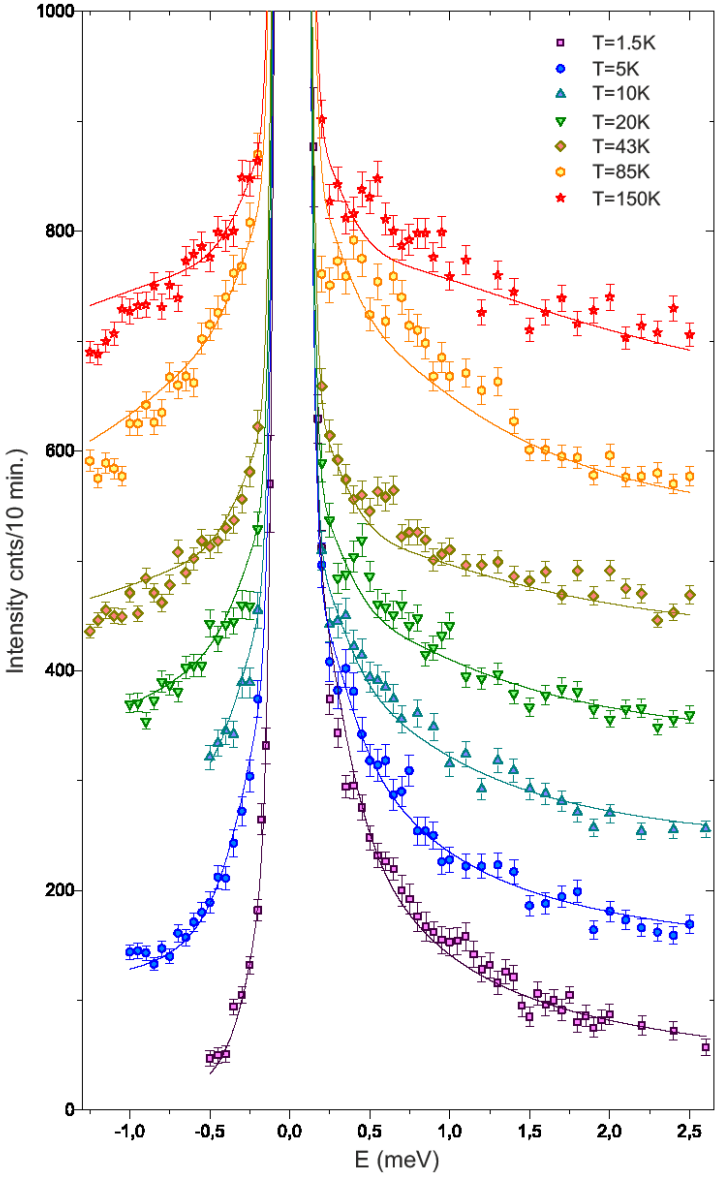

Fig.1 Inelastic scans at different temperatures of $Ce_{1-x}La_xB_6$, $x = 0.28$.

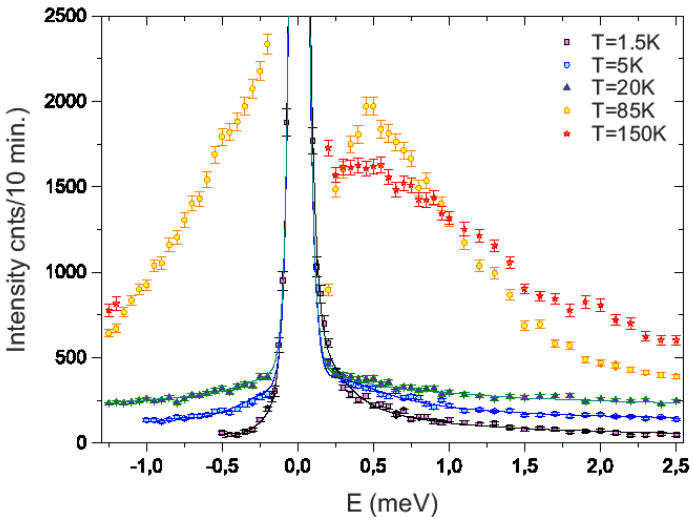

Fig.2 Inelastic scans at different temperatures of $Ce_{1-x}La_xB_6$, x=0.5

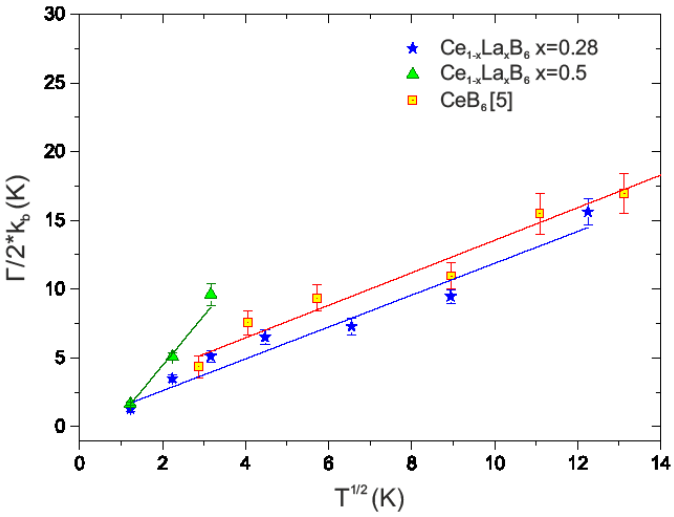

Fig.3 Temperature dependence of the width of quasielastic peaks for different doping levels.

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[5] S. Horn *et al*, EPJ B **42**, 125-134 (1981);