Experimental report

15/08/2017

Proposal: **4-02-448**

Council: 4/2015

Title: Nature of the neutron spin resonance in CeCoIn5

Research area: Physics

This proposal is a new proposal

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Samples: CeCoIn5

Instrument	Requested days	Allocated days	From	To
THALES	7	7	15/09/2016	22/09/2016

Abstract:

We found the resonance mode disperses upwards in Yb doped CeCoIn5. It is not clear whether it is due to Yb doping which significantly modifies the Fermi surface or it is also the case for undoped CeCoIn5. By studying the resonance we hope to clarify whether the resonance mode is due to itinerant electrons or local moments, and also shed light on the effect of Yb doping on the magnetic excitations.

Experiment report for 4-02-448

In this experiment we studied the temperature dependence of dispersive features in $CeCoIn_5$, uncovered previously [1]. We used helium-3 insert inside an orange cryostat as our sample environment to reach temperatures less than 1 K. Unfortunately in this experiment we encountered significant scattering due to helium gas, which strongly increased the background.

While some signal can be extracted by measuring above and below T_c (Fig. 1), the presence of a strong Q-dependent background makes extracting detailed temperature dependence very difficult. We have verified the nature of the strong Q-dependent background seen in measured by changing temperature of the outside orange cryostat, while maintaining the sample temperature constant (Fig. 2). The fact that the most dominant feature in the measured data is coming from helium gas can be directly seen in Fig. 2, where the sample temperature stays constant but the orange cryostat which has some helium gas is set to different temperatures.

The strong scattering from helium gas makes it very difficult to extract reliable information, since helium gas scattering relies strongly on temperature and there are small variations in that temperature as a function of time that was not recorded in the data log.

Our conclusion is that controlling the amount of helium gas in the orange cryostat is very important for such experiments, and found that previous experiments also suffered from similar issue, although not always [2]. It seems there is some random variable in this regard from the sample environment, which is critical for the success of an experiment. Perhaps the possibility of controlling and minimizing helium gas inside the orange cryostat with the helium-3 insert should be investigated.

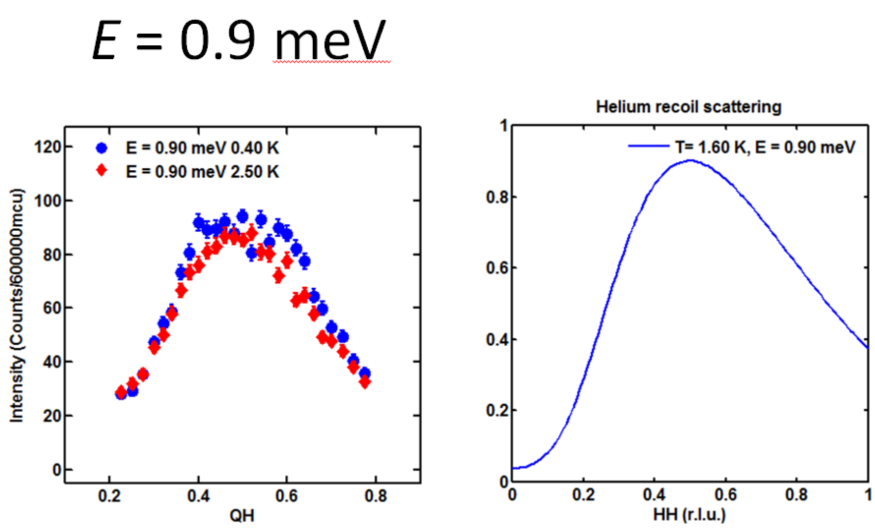

Figure 1. Left shows measured data above and below T_c, with a strong peak in momentum present at both temperatures. Right shows calculated helium gas scattering profile expected for this scan.

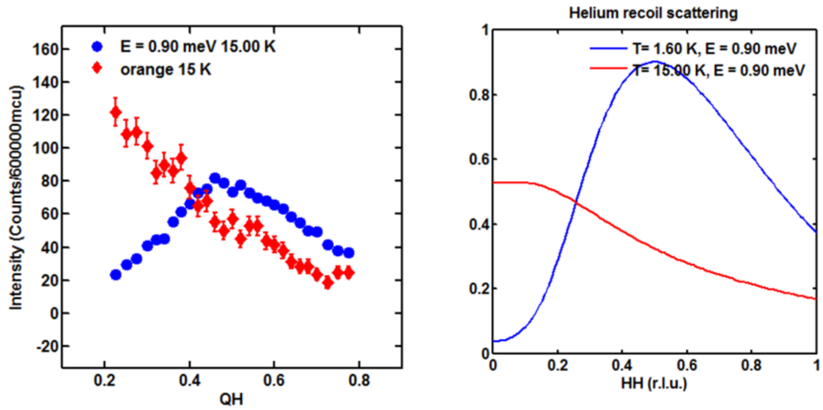

Figure 2. Left shows measured data with sample at 15 K and varying the outside orange cryostat from 1.6 K to 15 K. Right shows calculated helium gas scattering profile expected for this scan a the two temperatures.

[1] Y. Song *et al.*, Nat. Commun. **7**, 12774 (2016).

[2] Discussion with S. Raymond