Experimental report

15/09/2016

Proposal: 5-41-835 **Council:** 4/2015

Title: Unique magnetic structure of Tm2RhIn8

Research area: Physics

This proposal is a new proposal

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Samples: Tm2RhIn8

Instrument	Requested days	Allocated days	From	To
D10	6	5	07/12/2015	12/12/2015

Abstract:

Intermetallic compounds R2RhIn8 are structurally related to a class of Ce-based heavy-fermion superconductors. Study of their magnetic structure and behavior is important for understanding mechanism of the unconventional heavy-fermion superconductivity. Tm2RhIn8 is unique among the series exhibiting incommensurate magnetic structure with the Néel temperature of 4.1 K. We have determined two possible sets of propagation vectors from our previous experiment on CYCLOPS. The aim of the proposed experiment is to find out correct propagation and to reveal ground state magnetic structure of Tm2RhIn8.

5-41-835: Unique magnetic structure of Tm_2RhIn_8

Experimental report

Date: 7. – 12.12.2015

Exp. report written: 5.9.2016

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Instrument: **D10**

Previous results:

Intermetallic R_2RhIn_8 compounds are structurally related to a class of Ce-based heavy-fermion superconductors. Study of their magnetic behavior and magnetic structure is an important part in understanding of mechanism of the unconventional heavy-fermion superconductivity. We have studied the microscopic details of magnetic structures in R_2RhIn_8 compounds with R = Nd, Dy, Er and Ho [1,2] by means of single crystal neutron diffraction. The magnetic structures of these materials are characterized by commensurate propagation vectors (½, ½, ½) and (½, 0, 0), respectively. Tm_2RhIn_8 orders also antiferromagneticaly (below Néel temperature of 4.1 K), however the magnetic structure is described by incommensurate propagation vector as determined from our previous experiment on CYCLOPS instrument (TEST-2267). Moreover, we obtained more than one propagation vector able to describe the magnetic reflections measured by Laue diffraction.

Aims of the experiment:

The aim of the proposed experiment was to finish systematic studies of the R_2RhIn_8 materials and to discuss their magnetic properties and structures in general. We have found magnetic satellites in diffraction patterns of Tm_2RhIn_8 measured at 2 K using the CYCLOPS diffractometer. Two equivalent ways of indexing of the observed peaks were suggested and it is not possible to distinguish between them on the basis of Laue diffraction data. The experiment aims to decide on proper propagation vector as well as to fully determine ground state magnetic structure in Tm_2RhIn_8.

Results:

We have pre-oriented sample to have a-c plane within the scattering plane of D10 instrument. Such a sample allignment was chosen on the basis of our previous experiment employing Laue neutron diffraction and CYCLOPS experiment (TEST-2267) [3]. We oriented sample on strong reflections (200) and (005) resulting in UB matrix and lattice constants:

$$a = 4.548\ \text{Å}$$

$$b = 11.858\ \text{Å}$$

of tetragonal structure (space group *P4/mmm*). We have used flow LHe cryostat and it was not possible to stabilize temperature around 2.5K or do temperature scans.

First, we determined the propagation vector ***k* = (0.5, 0, 0.42)** with possible higher order harmonics to desribe measured magnetic reflections.

After taking the full reflection set with 1st order reflections at $\tau = k$, we have switched from 4 circle mode to 2-axis mode with energy analysis to have better signal/noise ratio. Temperature dependence of selected nuclear peaks showed no addtional contribution with ***k*** = 0.

The temperature dependence of the magnetic reflections at (0.5, 0, -2.42) and (0.5, 0, -2.58), see Fig. 1, result in determination of:

$$T_N = 4.02 \pm 0.02\ \text{K}$$

$$\beta = 0.46 \pm 0.08$$

We measured 68 independent magnetic reflections described by ***k* = (0.5, 0, 0.42)**. Moreover, detailed scans also showed clear existance of 3rd order harmonics pointing to squared up periodic structure. The detailed evaluation of the magnetic structure is currently in progress.

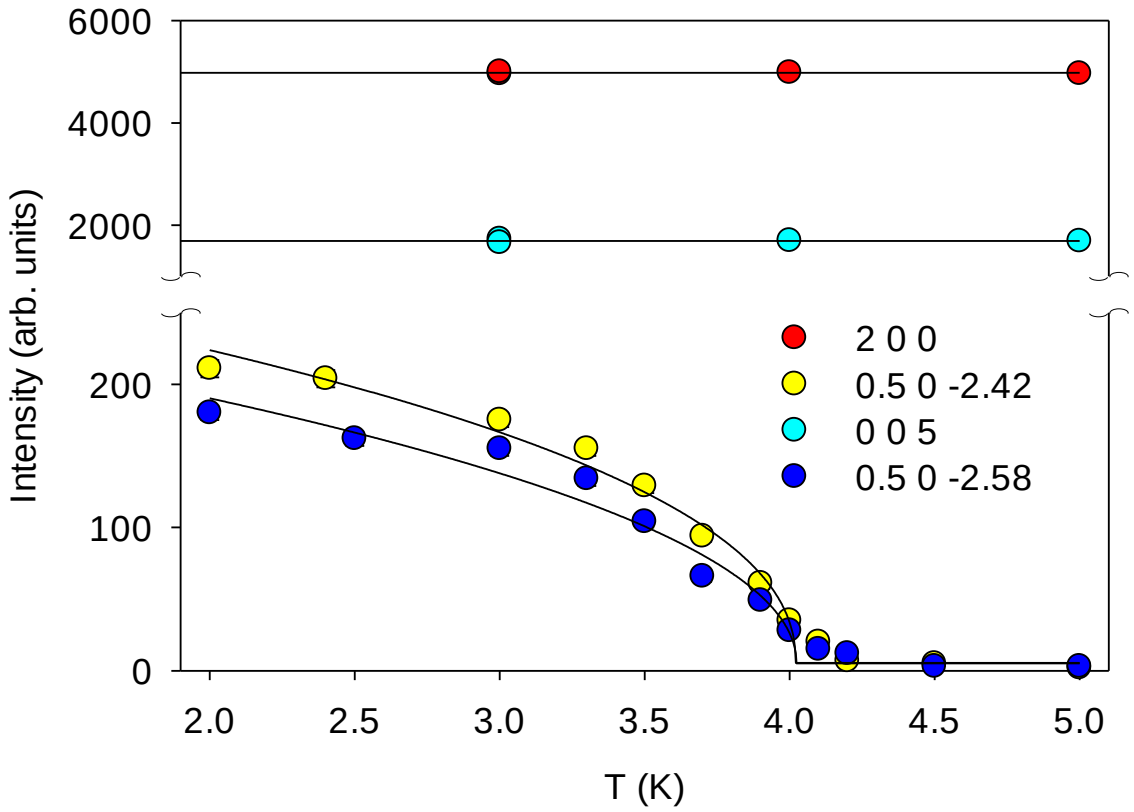

Fig. 1: Temperature dependence of selected magnetic and nuclear reflections measured on Tm_2RhIn_8 single crystal using D10 diffractometer.

References:

[1] P. Čermák, et al. Submitted to PRB, arXiv:1409.0433, 2014.

[2] W. Bao et al., Phys. Rev. B. 62 (2000), R14621-24.

[3] Experimental Report for proposal TEST-2267, ILL.