Experimental report

31/10/2017

Proposal: 5-42-370 **Council:** 4/2014

Title: Study of the antiferromagnetic andsuperconducting phase of Pr2Pt3Ge5

Research area: Physics

This proposal is a new proposal

Main proposer: Daniel MAZZONE

Experimental team: Jorge GAVILANO
Daniel MAZZONE

Local contacts: Charles DEWHURST

Samples: Pr2Pt3Ge5

Instrument	Requested days	Allocated days	From	To
D33	6	5	19/09/2014	24/09/2014

Abstract:

This proposal aims at studying the properties of the flux line lattice (FLL) of the magnetic superconductor Pr2Pt3Ge5. In this compound a magnetic order develops deep in the superconducting phase. Results from thermal property measurements revealed a coexistance of a (possibly multiple gap) superconducting phase with Tc = 7.8 K and two unknown antiferromagnetic phases with onsets at TN = 3.5 and 4.2 K.

Experimental Report

Study of antiferromagnetic and superconducting phase of $Pr_2Pt_3Ge_5$

Experimental team

D. Mazzone[1], J. Gavilano[1], R. Sibille[2],
D. Dewhurst[3], and M. Kenzelmann[1,2]

[1]*Laboratory for Neutron Scattering and Imaging, Paul Scherrer Institut, CH-5232 Villigen, Switzerland*

[2]*Laboratory for Scientific Developments and Novel Materials, Paul Scherrer Institut, CH-5232 Villigen, Switzerland*

[3]*Institut Laue-Langevin, 38042 Grenoble France*

The interplay between static magnetic order and superconductivity is competitive in most materials and arises primarily from conflicting Fermi surface states or magnetostatic interactions. $Pr_2Pt_3Ge_5$ is a conventional superconductor (T_c = 7.8 K) that features two antiferromagnetic transitions within the condensate (T_{N1} = 3.5, T_{N2} = 4.1 K) [1, 2]. We have succeeded in growing high-quality $Pr_2Pt_3Ge_5$ single crystals (~100 mg) using a Pt-Ge self-flux and studied the superconducting and magnetic properties of the system using neutron diffraction magnetization and transport measurements. In the superconducting state we find the onset of an incommensurate, amplitude modulated antiferromagnetic structure, **q** = (0, 0.85, 0), that becomes commensurate, **q** = (0, 1, 0), with decreasing temperature. Superconductivity is supressed with a magnetic field in a highly isotropic manner, while the field dependence of the magnetic phases depends strongly on the direction of the magnetic field [2]. These results demonstrate a complete and unique decoupling of magnetism and superconductivity.

Here we searched for a vortex lattice signal in the superconducting state of $Pr_2Pt_3Ge_5$ at T = 1.8, 3.6 and 4.5 K, above and below the respective antiferromagnetic transitions. Unfortunately we did not succeed in observing well-ordered flux lines, which we attributed to the disorder in the crystal and the finite superconducting volume fraction (see Ref. [2]). After three days we had to change our perspective of the experiment and finalized our dataset on the backup sample $Yb_3Rh_4Sn_{13}$, where the high flux of ILL was required. This data were published in Ref. [3] after the beam time.

We thank the Institut Laue-Langevin for the allocated beam time.

[1] N. H. Sung *et al.*, *Phys. Rev. B*, **86**, 224507 (2012).

[2] D. G. Mazzone *et. al.*, *arXiv :1508.02649*.

[2] D. G. Mazzone *et. al.*, J. Phys. Condens. Matter **27** 245701 (2015).

Proposal-number: 5-42-370 *Instrument:* D33

Local contact: D. Dewhurst