Experimental report

31/10/2017

Proposal: 4-01-1491 **Council:** 4/2016

Title: Study of the spin dynamics in the magnetically decoupled conventionalsuperconductor Pr2Pt3Ge5

Research area: Physics

This proposal is a new proposal

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Samples: Pr2Pt3Ge5

Instrument	Requested days	Allocated days	From	To
THALES	7	5	25/11/2016	30/11/2016

Abstract:

Pr2Pt3Ge5 is a 4f intermetallic compound that displays two antiferromagnetic phases deep inside the superconducting state. Our recent neutron diffraction studies showed that with decreasing temperatures the system orders first in an incommensurate amplitude modulated magnetic structure that becomes commensurate at lower temperature. The HT-phase diagram provided evidence for a complete decoupling of superconductivity and magnetism in this material. However, the nature of the microscopic interactions in the system remains unclear. In order to answer this open question we want to investigate the spin dynamics of Pr2Pt3Ge5 as a function of temperature.

Experimental Report

Study oft he spin dynamics in the magnetically decoupled conventional superconductor $Pr_2Pt_3Ge_5$

Experimental team

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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 performed inelastic neutron scattering on the cold triple-axis instrument Thales on a coalignment of five crystals with total mass $m \approx 0.5$ g that were oriented in the (0, *k, l*)-plane. The spectrometer was used in a *W*-configuration with k_f = 1.3 A^{-1}. We found that the crystallites were aligned within 0.2°. Typical (**q**, E)-maps collected at T = 3.9 and 2 K. Examples are shown in Fig. 1. We observe drastic differences of the excitation spectrum in the commensurate phase when compared to incommensurate one. The data is currently being analysed using Spin-W and will be part of a manuscript that will be written after its completion. We acknowledge the Insitut Laue-Langevin for the allocated beam time.

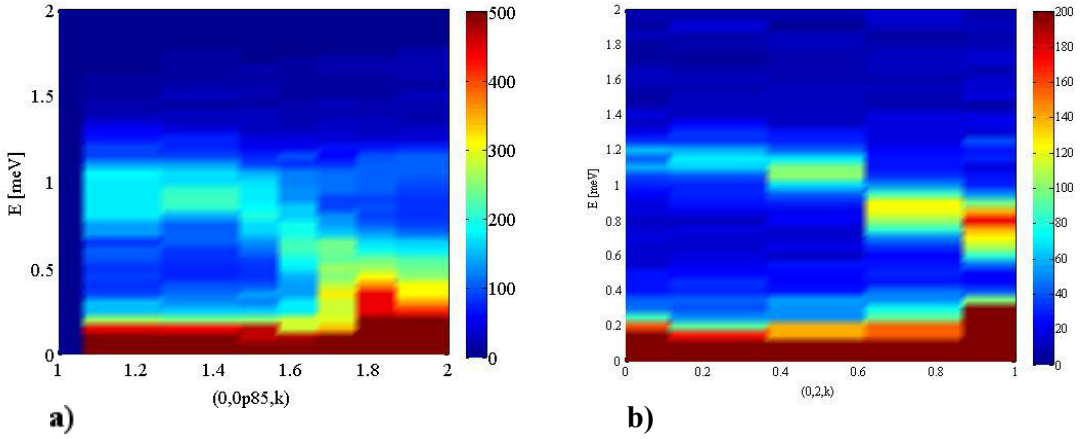

Fig. 1: Low energy excitation spectrum of Pr2Pt3Ge5 at a) T = 3.9 K in the incommensurate antiferromagnetic phase and **b)** T = 2 K the commensurate antiferromagnetic phase.

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

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

Proposal-number:	4-01-1491	*Instrument:*	Thales
Date of experiment:	25- 30.11.2016	*Local contact:*	M. Boehm, P. Steffens