Experimental report

26/08/2022

Proposal: 4-02-580 **Council:** 10/2019

Title: Magnetic fluctuations in the heavy-fermion paramagnetic superconductor UTe2

Research area: Physics

This proposal is a new proposal

Main proposer: William KNAFO

Experimental team: Georg KNEBEL
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Samples: UTe2

Instrument	Requested days	Allocated days	From	To
IN12	7	0		
THALES	0	5	19/03/2021	30/03/2021

Abstract:

Superconductivity and magnetic-field-induced superconductivity has been recently found to emerge below Tsc = 1.6-1.8 K in the paramagnetic heavy-fermion system UTe2. The upper critical field is strongly anisotropic and is near 35 T for the magnetic hard crystallographic direction b. It has been proposed that spin-triplet pairing is realised.

Here, we propose to study the magnetic fluctuations, which are suspected to drive to unconventional superconductivity in UTe2, by inelastic neutron scattering. The first target will be the study of the ferromagnetic fluctuations expected to develop at low temperature. The second target will be a search for antiferromagnetic fluctuations.

PROJECT SUMMARY REPORT

This document can be found on the INTERNET at the following address:
http://www.cordis.lu/improving/
(look under "Access to Research Infrastructures" and then
under "Information for Project Managers")

Project Title	Magnetic fluctuations in the heavy-fermion paramagnetic superconductor UTe2
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1. Project objectives (no more than 10 lines)

Superconductivity and magnetic-field-induced superconductivity has been recently found to emerge below Tsc = 1.6-1.8 K in the paramagnetic heavy-fermion system UTe2. The upper critical field is strongly anisotropic and is near 35 T for the magnetic hard crystallographic direction b. It has proposed that spin-triplet pairing is realised.
Here, we propose to study the magnetic fluctuations, which are suspected to drive to unconventional superconductivity in UTe2, by inelastic neutron scattering. The first target will be the study of the ferromagnetic fluctuations expected to develop at low temperature. The second target will be a search for antiferromagnetic fluctuations.

2. Main achievements and difficulties encountered (no more than 20 lines)

We have confirmed the presence of antiferromagnetic fluctuations with the incommensurate wave-vector k1 = (0, 0.57, 0). A quasielastic signal is found, whose momentum-transfer dependence is compatible with fluctuations of magnetic moments with a sine-wave modulation of wavevector
k1 and in-phase moments on the nearest U atoms. Low dimensionality of the magnetic fluctuations, consequence of the ladder structure, is indicated by weak correlations along the direction c. These fluctuations saturate below a temperature of 15 K, in possible relation with anomalies observed in thermodynamic, electrical-transport, and nuclear-magnetic-resonance measurements. The absence or weakness of ferromagnetic fluctuations in our data collected at temperatures down to 2.1 K and energy transfers from 0.6 to 7.5 meV is emphasized. These results constitute constraints for models of magnetically mediated superconductivity in UTe2.

work published in:
"Low-dimensional antiferromagnetic fluctuations in the heavy-fermion paramagnetic ladder UTe2",W. Knafo, G. Knebel, P. Steffens, K. Kaneko, A. Rosuel, J.-P. Brison, J. Flouquet, D. Aoki, G. Lapertot, and S. Raymond, Phys. Rev. B 104, L100409 (2021).