Experimental report

08/09/2022

Proposal: 4-02-598 **Council:** 10/2020

Title: Zeeman Splitting of the Resonance Mode in CeCoIn5

Research area: Materials

This proposal is a continuation of 4-02-519

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Experimental team: Jacques OLLIVIER

Local contacts: Jacques OLLIVIER

Samples: CeCoIn5

Instrument	Requested days	Allocated days	From	To
IN5	7	5	12/05/2021	19/05/2021

Abstract:

In the Q-phase of unconventional superconductor CeCoIn5, static spin-density-wave magnetic order (SDW) is formed at high magnetic field inside the boundaries of the superconducting dome. It is argued that the Q-phase represents the condensation of a "neutron spin resonance mode" (SRM) that is generated from quasiparticles at the nodes of the primary dx2-y2 superconducting gap. With samples oriented in the HHL scattering plane, a vertical magnetic field generates all four of the Q-phase SDW Bragg peaks in the horizontal scattering plane, thus the SRM has been previously studied with neutron scattering, where a doublet Zeeman splitting was observed. However, in principle the dx2-y2 gap symmetry allows four additional SRM positions outside the horizontal scattering plane. While it is known that no Q-phase forms at these positions, no studies have been conducted to determine the fate of the SRM. Armed with very large samples, we will use IN5 to measure the SRM simultaneously at the in-plane and out-of-plane positions, to determine whether the splitting of the SRM can explain the microscopic mechanism for why the Q-phase does not appear at these out-of-plane positions.

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David Tam
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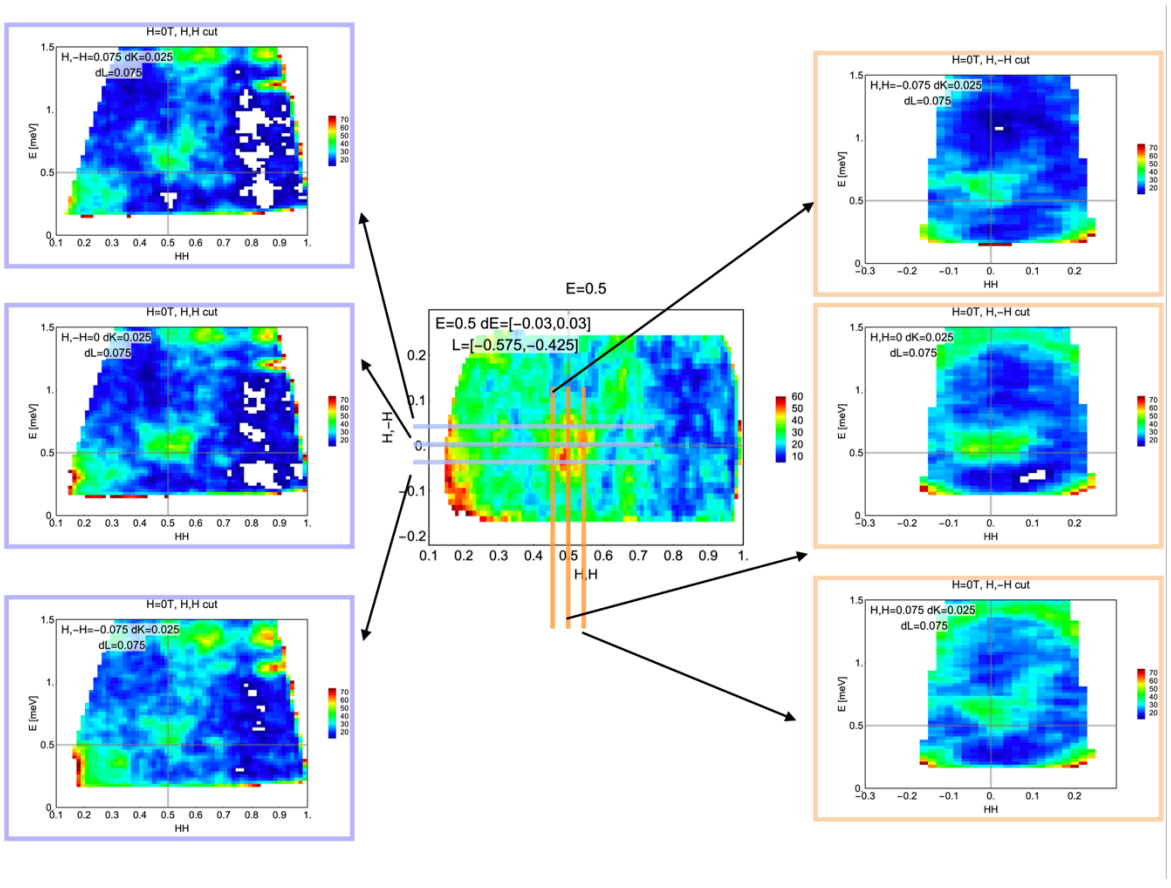
In this experiment we studied the inelastic excitations of CeCoIn5 near the spin resonance mode (SRM) position Q=(1/2,1/2,1/2) at H=0 and H=4 T applied along the [110] axis. Unlike previous experiments where the focus was on the HHL scattering plane, we used IN5 to investigate the effect of the magnetic field on the 4 satellites in the HK plane which comprise the SRM. In the end we determined that all 4 of the satellites follow the downward dispersion that was previously observed for the in-plane satellites. This leaves open the question of how the magnetic long-range order inside the Q phase is favored by the field in a sharply switchable manner.

SRM structure at H=0:



SRM structure at H=4 T: