Experimental report

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Proposal: CRG-2918 **Council:** 10/2022

Title: Magnetic excitations in ErB2

Research area: Physics

This proposal is a new proposal

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Samples: ErB2

Instrument	Requested days	Allocated days	From	To
IN12	4	4	29/03/2023	04/04/2023

Abstract:

ErB2 is a member of the class of hexagonal C32 rare-earth and transition-metal diborides - a series of materials comprising of the conventional high-temperature superconductor MgB2, as well as the itinerant-electron antiferromagnet CrB2. Our comprehensive measurements of the magnetisation, ac-susceptibility, specific heat and electrical transport properties reveal a transition to a magnetically ordered state at Tc=14K. Our recent single-crystal neutron diffraction measurements showed that below Tc ErB2 is a soft ferromagnet, an unexpected type of ordering given the unusual Hall resistivity, reminescent of exotic, topological kind of magnetic order. We want to investigate magnon dispersion relations in ErB2 as we expect that an unusual Hall resistivity might find a correspondence in unusual magnon dispersions.
We request 4 days of beamtime at IN12 equipped with an orangey cryostat. We will mount the sample with the hexagonal (hk0) scattering plane and measure magnon dispersion within the Brillouin zone with strong (100) magnetic reflection. ErB2 has one magnetic atom in unit cell and we expect just on magnon branch with energy in the range of kBTc-1.2 meV.

Experimental report

CRG-2918

Magnetic excitations in ErB2

We investigated the spectrum of magnetic excitations in ErB_2. We have employed the ARIANE data collection method, deployed for the first time at the ILL, with the help of our experimental team.

First, we have verified the presence of satellites around the magnetic reflection, as we were expecting an incommensurate ordering of magnetic moments. Measurements at 2 K did not show the presence of satellites.

Next, we measured inelastic spectra. We have set up ARIANE to covered the desired energy and momentum-transfer range for the overnight measurements. The algorithm and the instrument worked flawlessly, we collected the spectrum shown in Figure 1. It shows a parabolic dispersion, gapped at 0.5 meV with an unexpected loss of spectral weight in the vicinity of the Gamma point. We have performed additional scans to verify the spectral weight loss, and confirmed it is not an artifact of data collection. We continued to use ARIANE for measurements in other energy and momentum transfer windows with amazing results, grounded both in flawless operation and communication between ARIANE and IN12 instrument, as well as captivating, unexpected spectra of our system.

Using ARIANE was of major success for mapping unexplored regions of reciprocal space. Based on these initial maps, usually collected overnight, we were expanding the range and/or repeating selected scans with better resolution.

These measurements provided enough data to determine the gap and band of dispersive excitations in ErB2. We have used them for later proposals and further exploration of the system.

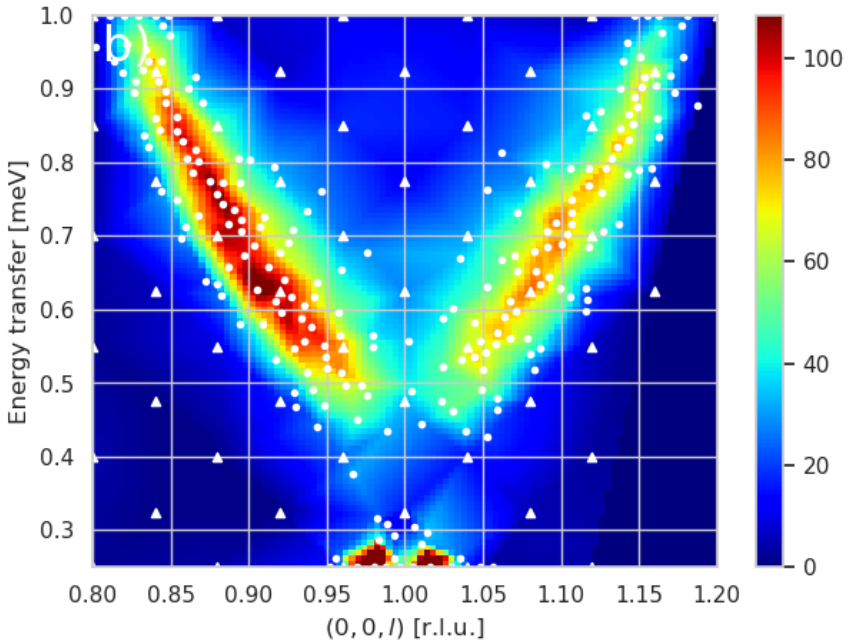

Figure 1. Excitation spectrum collected with ARIANE algorithm. Whit triangles show initial grid points measured by ARIANA, circles corresponds to next point chosen by the algorithm. Colormap shows the spectral weight interpolated between the measured points.