# Experimental report

08/09/2022

**Proposal:** **CRG-2884** **Council:** 4/2021

**Title:** Magnetic excitations in the topological f-electron magnet CeAgBi2

**Research area:** Physics

**This proposal is a resubmission of 4-01-1696**

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**Samples:** CeAgBi2

| Instrument | Requested days | Allocated days | From | To |
|---|---|---|---|---|
| IN5 | 6 | 0 | | |
| THALES | 8 | 0 | | |
| IN12 | 0 | 5 | 02/09/2021 | 07/09/2021 |

**Abstract:**

Recently, the first f-electron skyrmions were reported to emerge in a row of Gd-based bulk materials including Gd2PdSi3. Yet, an account of the underlying mechanism remained to date elusive. Neutron spectroscopy, a technique that typically qualifies for the study of the underlying interactions, is prevented in these materials due to the large neutron absorption of Gd. The tetragonal f-electron magnet CeAgBi2 is a another promising candidate material to host skyrmions and it represents further an ideal platform for experiments with neutrons. Namely, our recent neutron diffraction study suggests the emergence of a skyrmion lattice phase. In addition, our collaborators observed in the same phase a strong topological Hall effect. Yet, our diffraction study is not yet conclusive, as it suffers ambiguities due to the formation of magnetic domains. With this proposal, we will remove these ambiguities in order to obtain conclusive evidence. We will therefore perform neutron spectroscopy and measure magnon dispersions. In turn, we will determine the mechanism that underlies the putative skyrmion lattice phase in CeAgBi2. For this quest, we request beamtime either at IN5 or Thales.

# Magnetic excitations in the topological f-electron magnet CeAgBi2

The aim of this proposal was to measure magnetic excitations in the heavy-fermion material $CeAgBi_2$. Therefore, the dispersion of magnetic excitations was studied at the temperature $T$ = 2 K in the vicinity of $\boldsymbol{Q}$ = (0.8,0.8,0.5), where magnetic Bragg peaks are approximately located. The dispersion was studied in a sample orientation, where ($H$,$H$,0) and (0,0,$L$) were in the horizontal scattering plane.

The beamtime ran smoothly, i.e., the sample was well oriented and we did not face any technical problems.

To map out the dispersion of excitations, IN12 was operated in the double-focusing mode with incident wave-vectors $\boldsymbol{k}_i$ = 1.2 Å$^{-1}$ and 1.5 Å$^{-1}$, respectively. Data were recorded by energy scans for fixed momentum transfers as well as $\boldsymbol{Q}$-scans at different energy transfers.

An exemplary energy scan is shown in Figure 1. The recorded data show maxima at three energy transfers, which correspond to three different magnon branches.

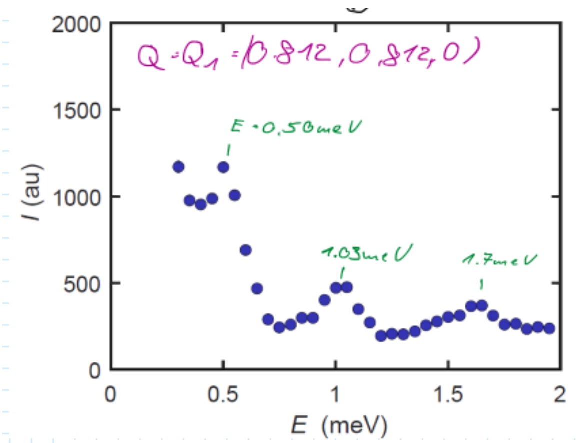

*Figure 1: Energy scan at the wave-vector* **Q** *=* **Q**$_1$*.*

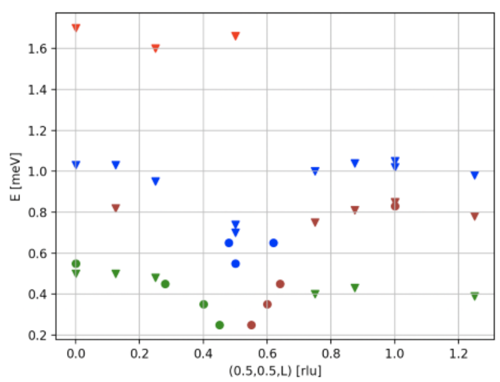

*Figure 2: Q-E map oft he magnetic excitations. Each symbol corresponds to a maximum in either a constant-energy or a constant-***Q** *scan.*

The data were summarized in $\boldsymbol{Q}$-$E$ maps, an example of which is shown in Figure 2 for the reciprocal space direction (001). In summary, the recorded dispersions show a multitude of branches.

We are currently writing up the results and preparing a manuscript that will be submitted soon.