Distorted helix in Eu-based magnetic semimetal EuZnGe

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1 Introduction

The search for new magnetic quantum materials with emergent electrodynamic responses is essential for future applications in spintronic technologies. Europium-based semimetals are a group of materials attracting growing interest due to the strong interplay between the conduction electrons and the underlying magnetic moments of Eu2+. Recent material searches along these lines have led to a rich series of discoveries highlighted by the giant magnetoresistance in a Zintl-compound Eu5In2Sb6 [1], and anomalous transport properties due to possible topological electronic bands in EuCd2Pn2 (Pn = As, Sb) [2].

In this study, we first report the magnetic properties of Eu-based semimetal EuZnGe, and clarify a distorted spiral spin structure [3].

2 Experiment

We performed the resonant x-ray scattering experiment of EuZnGe using a single crystal grown by Eu-Zn flux. The measurement was carried out at BL-3A by using the horizontally polarized x-ray in resonance with Eu L2 absorption edge (7.615 keV). The scattering plane was set to be (H, 0, L). The sample was loaded into a vertical-field superconducting magnet with the b axis parallel to the field direction.

3 Results and Discussion

We observe magnetic Bragg scattering in the (0, 0, L) scan as shown in Fig. 1(a). The scattering shows up around L = 7.5 – 7.6 with a double-peak feature indicating unconventional incommensurate spin structure. We find that the magnetic scattering shows a resonant feature in the energy dependence of the intensity (Fig. 1(b)), and disappears above the magnetic transition temperature.

The simple helical spin modulation with the modulation wavenumber q would show a single peak at (0, 0, 2n±q), where n is integers. The double-peak feature with diffuse intensity in-between suggests that the random mixture of the distorted spin configurations for q = 0.5 and 0.4. To clarify the possible spin structure in EuZnGe, we simulate the diffraction intensity profile by the 5- and 4-sublattice spin configurations as shown in Fig. 2(a). We successfully reproduce the intensity profile (Fig. 2(b)).

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References

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