Anisotropic magnetic diffuse scattering in a helical magnet ErNi2Ge2

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Magnetic frustration is one of the central issue of the magnetism for decades. Origins of the magnetic frustration are roughly classified into two categories, the geometrical frustration and the frustration in the exchange couplings such as in the ANNNI system. A rare-earth intermetallic compound ErNi2Ge2 is a latter type manget, showing a long-periodic magnetic structure[1].

In Ref.[1], they reported that ErNi2Ge2 has a sinusoidal modulated structure with the magnteic wave vector k = (0,0,0.757) and its magnetic moment forms an angle 64 deg. with the c-axis. However, it is not consistent with our magnetization measurements using single crystalline samples, which evidently indicate that the ab-plane is a magnetic easy plane and the magnetization component along the c-axis is less than 1/10 of that in the ab-plane.

In order to resolve this inconsistency, we have performed neutron scattering experiments using single crystalline samples on the triple-axis spectrometer T11 installed at the JRR-3M. A quantitative analysis of intensities of several magnetic reflections indicates that the moments lie in the ab-plane, rather than forming an angle 64 deg. with the c-axis, and form the helical modulation, not the sinusoidal one. This magnetic structure is consistent with our magnetization measurements and our crystalline electric field(CEF) analysis.

Furthermore, we found a characteristic magnetic diffuse scattering, as shown in Fig. 1. Below TN, the peak profile is composed of a long-range sharp peak and a short-range broad one. The broad one can be fitted with a Lorentzian. Interestingly, this magnetic diffuse scattering has a remarkable anisotropic nature, namely, the peak profile is broaden along the [1,0,0]- and the [1,1,0]-axis, whereas it is sharp along the c-axis enough to be considered as a resolution limit. These results indicate that the antiferromagnetic order of ErNi2Ge2 is composed of the long-range and the short-range orders. And also, they suggest that the short-range orders consist of one-dimensional long-range helices along the c-axis.

[1] G. Andre et al., J. Alloys Comp. 224 (1995) 253.

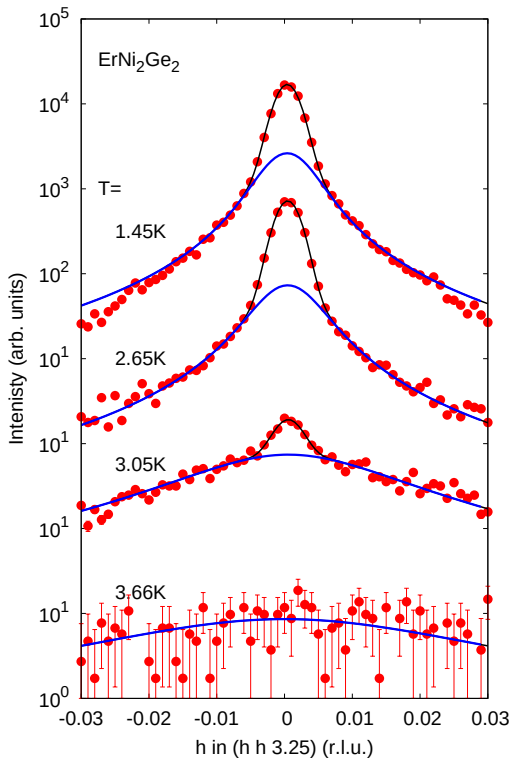

Fig. 1. Temperature variation of the magnetic scattering of ErNi2Ge2. Black solid lines represent the fitting results. Blue ones are the Lorentzian components.