# Magnetic structures of the centrosymmetric magnetic skyrmion host material $^{160}Gd_2PdSi_3$

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Gadolinium based intermetallics have recently attracted remarkable attention since a magnetic skyrmion lattice (SkL) state with a large topological Hall effect was discovered in a field-induced phase of a centrosymmetic triangular lattice magnet $Gd_2PdSi_3$[1]. To this date, a variety of centrosymmetric crystal structures have been reported to host the SkL state. For instance, a breathing kagome compound $Gd_3Ru_4Al_{12}$[2] and a tetragonal compound $GdRu_2Si_2$[3] also exhibit the SkL states in the field-induced phases. These results demonstrated that the origins of the SkL states in the Gd compounds are not the Dzyaloshinskii-Moriya interaction, which plays an essential role in skyrmion-host materials with chiral crystal structure, such as MnSi[4]. The microscopic mechanism to stabilize the SkL states in the centrosymmetric systems is still under debate.In the present study, we investigated the magnetic structures of $Gd_2PdSi_3$ near zero field in order to gain insight into the microscopic interactions regarding the magnetic moments in this system.

We grew an isotope-enriched $^{160}Gd_2PdSi_3$ single crystal by the floating zone method in order to reduce the strong neutron absorption of Gd. The crystal was cut into a plate shape with thickness of 1.0 mm and area of 16.2 mm2, and was loaded in a closed-cycle He refrigerator with the (*H,K*,0) scattering plane. We performed polarized neutron scattering experiment at PONTA(5G) spectrometer. The spectometer was operated in the *Pzz* longitudinal polarization analysis mode, in which Heusler crystal monochromator and analyzer were employed. The direction of the neutron spins were set to be parallel or antiparallel to the vertical direction by guide fields and a spin flipper. The beam polarization measured by a nuclear scattering from the sample was 0.84.

Figure 1 shows a scattering profile of the magnetic Bragg reflection at (0,*q*,0), where *q*~0.14 is the magnetic propagation wavenumber, measured at 2.5 K near zero field. We observed both spin-flip (SF) and non-spin-flip (NSF) intensities for this reflection. This indicates that the magnetic structure has the modulated spin components parallel to the *c* axis and that perpendicular to both the *c* axis and the *q*-vector. We also measured other magnetic reflections and concluded that the magnetic structure in the ground state is an elliptic screw-type structure. As the temperature is increased, the magnetic structure turns into a collinear sinusoidal magnetic structure. These results were posted in the arXiv preprint server [5].

We also performed unpolarized neutron diffraction measurements at FONDER(T2-2) and inelastic neutron scattering at HER(C1-1). The data analysis is in progress.

[1] T. Kurumaji *et al.*, Science **365**, 914 (2019).
[2] M. Hirschberger *et al.*, Nat. Commun. **10**, 5831 (2019).
[3] N. D. Khanh *et al.* Nat., Nanotech. **15**, 444 (2020).
[4] S. Muhlbauer *et al.*, Science **323**, 915 (2009).
[5] J. Ju et al., arXiv: 2208.08188

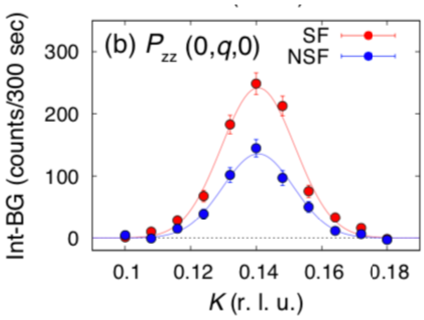


Fig. 1. Polarized neutron scattering profile of the magnetic Bragg reflection at (0,*q*,0) in the centrosymmetric skyrmion host material $^{160}Gd_2PdSi_3$. Blue and red symbols denote the intensities measured in the NSF and SF channels, respectively.