# Antiferromagnetic ordering of $Nd_3Rh_4Sn_{13}$

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Chiral symmetry of crystal structure causes topological electronic states [1]. It is an attractive topic to investigate spontaneous formation of the topological electronic state associated with structural phase transitions with chiral symmetry. Further, broken time-reversal symmetry owing to magnetic ordering in addition to broken spatial inversion symmetry is expected to cause exotic physical phenomena.

The $R_3Rh_4Sn_{13}$ materials undergo phase transitions to the chiral structures [2]. The $R$ = Ce compound was recently established to be Weyl–Kondo semimetal characterized by a linear dispersion relationship of Kondo hybridized electronic state [3]. The $R$ = La compound is a superconductor below 2.7 K in the chiral structure phase [2]. In present study, we investigated 4*f*-electron state in $Nd_3Rh_4Sn_{13}$, which was recently found to take the superlattice structure below approximately 335 K based on a synchrotron X-ray diffraction experiment [4].

Neutron diffraction (ND) experiments for the sample of $Nd_3Rh_4Sn_{13}$ synthesized using the molten Sn-flux method was performed at the powder diffractometer HERMES (T1-3). Measurement was conducted with neutron wavelength 2.2 Å and a $^3$He cryostat.

Figure 1 shows selected ND patterns measured at 0.64 (red circles) and 2.0 K (green line), and the Miller indices of fundamental and structural superlattice are also shown. The 2.0-K data shows a strong peak at 2 0 0, whereas no clear satellite peaks of the chiral structure indexed by the two half-integer indices are too small to be detected by the powder ND. The 0.64-K data measured below the magnetic ordering temperature at 1.65 K shows additional peaks at 1 0 0, 1 1 0, 1 1 1, 2 1 0, and 2 1 1, which mean the antiferromagnetic ordering characterized by the same periodicity as that of the crystal lattice.

The similar low-temperature enhancement of neutron diffraction peaks indexed by the integer Miller indices were observed for $Nd_3Co_4Sn_{13}$, which shows an antiferromagnetic ordering state below 2.1 K and the structural transformation at 124 K [5, 6]. We confirmed that the present ND intensities of $Nd_3Rh_4Sn_{13}$ are explained by the calculated result based on the proposed magnetic structure associated with the Nd ions of $Nd_3Co_4Sn_{13}$. It is an on-going issue to reveal a detailed magnetic structure superimposed on the structural superlattice in $Nd_3Rh_4Sn_{13}$.

The present study was performed under the approved proposal No. 22620.

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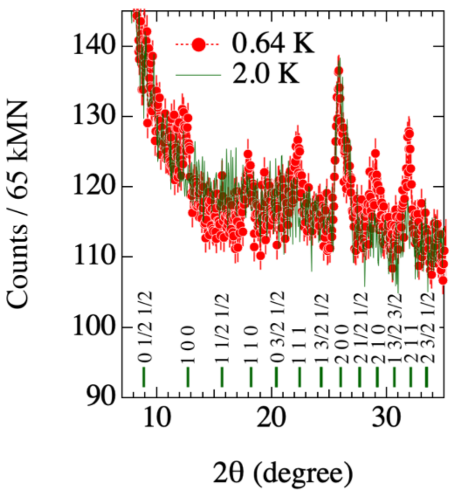


Fig. 1. ND patterns of $Nd_3Rh_4Sn_{13}$ at 0.64 and 2.0 K measured at HERMES.