Small angle neutron scatterings study on the cubic chiral crystal Pr5Ru3Al2

Koya Makino [1], Daisuke Okuyama [1], Maxim Avdeev [2], Kazuki Ohishi [3], Kunihiko Yamauchi [4], Tamio Oguchi [4], and Taku J. Sato [1]

[1] *Institute of Multidisciplinary Research for Advanced Materials, Tohoku University, Sendai, Japan*

[2] *Bragg Institute, Australian Nuclear Science and Technology Organisation, NSW, Australia*

[3] *Comprehensive Research Organization for Science and Society (CROSS), Tokai, Japan*

[4] *The Institute of Scientific and Industrial Research, Osaka University, Osaka, Japan*

The helical magnetic structure has attracted renewed interests because of the discovery of novel topological spin textures, for example magnetic skyrmions and chiral magnetic soliton lattices. For such spin textures, a finite antisymmetric Dzyaloshinskii-Moriya-type interaction is crucial, activated in noncentrosymmetric crystals. To date, such antisymmetric interactions have been studied mainly in 3d magnets, and few studies have been performed on 4f rare-earth (RE) magnets. Recently, Murashova et al. reported the RE-based chiral compounds RE5Ru3Al2 (RE = La, Ce, and Pr) with the space group I213. Nonetheless, their low-temperature magnetism was largely unexplored. Combining detailed magnetization and small-angle-neutron-scattering (SANS) measurements, we have scrutinized magnetic orderings in the Pr5Ru3Al2 compound at low temperatures under finite magnetic fields. In the magnetization study, we found at least four ordered phases in the ranges 1.9 < T < 3.8 K and 0 < H < 2500 Oe. The SANS study, performed using TAIKAN at J-PARC, revealed that under zero external field, two phases exists, characterized by the two distinct directions of their magnetic modulation vectors, q1 = (q q q): |q1| ~ 0.12 r. l. u. below 3.3 K, and q2 = (q q 0) : |q2| ~ |q1| observed for 3.3 K < T < 3.8 K. The magnetic modulation vectors under finite fields were similarly assigned. A first-principle electronic structure calculation has been made to understand those low-temperature ordered phases.