“Pulsed-field NMR study of field-induced magnetic states in square cupola antiferromagnet $Pb(TiO)Cu_4(PO_4)_4$“.

Yoshihiko Ihara, (Lecturer)

Faculty of Science, Hokkaido University

Magnetic quadrupolar spin structure realized in square cupola antiferromagnets $A(TiO)Cu_4(PO_4)_4$ (A = Sr, Ba, Pb) introduces intriguing magnetoelectric response and has been intensively investigated using microscopic measurement techniques, including neutron diffraction and NMR studies [1-4]. The low-field magnetic structure is modified by applying fields higher than ~15 T and accordingly modified magnetoelectric responses have been observed [5]. However, the magnetic structures in the field-induced state have not been investigated as the magnetic field required to induce metamagnetism exceed the limitation of conventional superconducting magnets. In this study, we study the field-induce magnetic states in $Pb(TiO)Cu_4(PO_4)_4$ by performing NMR measurement in pulsed fields [6]. We observed a clear splitting in the NMR spectrum at ~29 T applied along the [001] direction, at which a dielectric anomaly was observed but its origin has not been identified [7]. Combined with the cluster and classical mean-field theories, we suggest the magnetic structure of the Phase III, which appears before the full saturation.

[1] K. Kimura, et al., Nat. Commun. **7**, 13039 (2016).

[2] S. S. Islam, et al., Phys. Rev. B **97**, 174432 (2018).

[3] V. Kumar, et al., J. Mag. Mag. Mater. **492**, 165600 (2019).

[4] R. Rasta, et al, Phys. Rev. B **101**, 054417 (2020).

[5] Y. Kato, et al., Phys. Rev. B **99**, 024415 (2019).

[6] H. Kuhne and Y. Ihara, Cont. Phys. **65**, 40 (2024).

[7] A. Miyake, et al., Rev. Sci. Instrum. **91**, 105103 (2020).