Novel Magnetic Structures on Strongly Frustrated Lattices

Masashi Takigawa[1]

[1]*Institute for Solid State Physics, University of Tokyo*

Both localized moments and itinerant electrons on frustrated lattices provide promising playground to look for exotic ordering and fluctuation phenomena. In this talk I will discuss two frustrated systems, in which NMR has played powerful role for unambiguous determination of the magnetic structure. The first example is $SrCu_2(BO_3)_2$, a quasi-two dimensional magnetic insulator on the Shastry-Sutherland (orthogonal dimer) lattice. It shows a sequence of magnetization plateaus, which has been a subject of intense research since 1999. We have used a combination of torque and NMR measurements in high magnetic fields up to 34 tesla produced in LNCMI, Grenoble to determine the complete sequence of magnetic phases. Moreover, we have developed a systematic method to analyze the 11B-NMR spectra to determine the spin structure. We found a stripe order of triplets in all plateau phases. The sequence of plateaus and incommensurate phases combined with the evolution of spin structure allowed us to identify the magnetization process of $SrCu_2(BO_3)_2$ as an "incomplete devil's staircase". This work was done in collaboration with M. Horvatić, F. Mila, T. Waki, C. Berthier, S. Krämer, F. Levy, I. Sheikin, H. Kageyama, and Y. Ueda. The second example is the pyrochlore oxide $Cd_2Os_2O_7$. This material has been known for the continuous metal-insulator transition at 226 K since 1974, for which a Slater mechanism (opening of a band gap due to SDW order) was invoked. Recently, 5d pyrochlore oxides attract renewed interest because of the possibility of novel topological effects. We have performed ^{17}O-NMR measurements on a single crystal of $Cd_2Os_2O_7$ and found that the M-I transition is accompanied by an antiferromagnetic order with the all-in/all-out spin structure. Since this spin order does not break space group symmetry including the periodicity of the lattice, Slater mechanism should be irrelevant. We also discuss unusual thermodynamic and critical behavior. This work was done in collaboration with I. Yamauchi, J. Yamaura, and Z. Hiroi.