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NMR study of single crystal $SmRu_4P_{12}$

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$SmRu_4P_{12}$ exhibits two successive transitions at $T^* \sim 15$ K and $T_{\rm MI} \sim 16.5$ K [1]. Recently, some experimental reports suggested that the latter transition originates from octapole ordering at $T_{\rm MI}$ [2,3]. In order to microscopically study the ordering state below $T_{\rm MI}$, we have carried out ^{31}P-NMR measurements using a powder sample. The results are summarized as follows;

(i) The resonance shift for $T^* < T < T_{\rm MI}$ consists of field-independent and field-dependent terms. The field-independent component indicates that the some type of magnetic ordering takes place just below $T_{\rm MI}$ at least for $H > 0.8$ T. On the other hand, the field-induced component suggests the occurrence of multipole ordering, because similar behavior has been observed in some of the compounds which show the multipole ordering [4].

(ii) The result of T_1 measurements indicates that there are different types of magnetic fluctuations in $SmRu_4P_{12}$: one freezes below $T_{\rm MI}$ and the other does below T^*. This implies that the ordered state is not a simple dipole ordering.

These experimental results leads to consider the two possible types of multipole ordering [5]: pure octapole ordering or octapole + dipole ordering state. For the latter state, both components are expressed by an irreducible representation Γ_4^- in T_h symmetry.

In order to obtain further information of the symmetry of ordering, one need to measure the angle dependence of the NMR spectrum against field using a single crystal sample. We have recently introduced a new NMR probe with two-axes rotating system. Figure 1 shows a typical ^{31}P-NMR spectrum for $H \parallel (100)$. We will present detailed results in the session.

[1] K. Matsuhira *et al.*, J. Phys. Soc. Jpn. **71** (2002) Suppl. 237.
[2] M. Yoshizawa *et al.*, J. Phys. Soc. Jpn. **74** (2005) 2141.
[3] K. Hachitani *et al.*, Phys. Rev. B **73** (2006) 052408.
[4] See, for example, K. Ishida *et al.*, Phys. Rev. B **71** (2005) 024424.
[5] S. Masaki *et al.*, J. Phys. Soc. Jpn. **75** (2006) 15261.

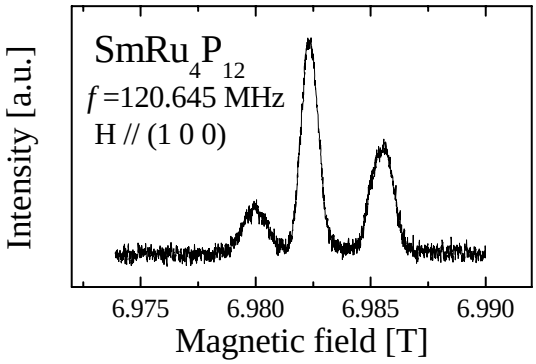

Figure 1: ^{31}P-NMR spectrum of single crystal $SmRu_4P_{12}$ for $H \parallel (100)$ and at $T = 20$ K.