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^{31}P-NMR Measurement on a Filled Skutterdite Compound $SmRu_4P_{12}$

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In order to obtain microscopic information on the two anomalies observed around the metal-insulator (M-I) transition (T_{MI}~ 16K) of $SmRu_4P_{12}$ [1, 2], we have carried out ^{31}P-NMR measurements on a powdered sample at various external magnetic fields H. It is worth noting that the broadened NMR spectrum below T_{MI} observed at high-H significantly defers in shape from that at low-H, and the threshold temperature of the linewidth broadening increases with increasing H.

At low H of ~1.3T, the sharp NMR line in the high-T paramagnetic state becomes broadened at 16.2 K, as was reported by previous NMR measurement [3]. The threshold temperature of the linewidth broadening is also consistent with T_{MI} reported previously by resistivity and specific heat measurements [1]. Below T_{MI}, the NMR linewith continues to increase without displaying any structure. At high-H, on the other hand, the NMR spectrum just below $T_{MI}(H)$ consists of rather narrow two resonance groups and broad lines (Fig. 1) . With decreasing T down to 13 K, the spectrum continues to change the shape to a more complicated structure. Such peculiar behavior is more remarkable as increasing field. $T_{MI}(H)$ gradually increases with increasing H and reaches to 16.7K at 7T [2]. These trends are consistent with the H-dependence of the specific heat [2]. It has been considered that the successive anomalies at ~ 16 K and ~ 13 K originate from the quadrupolar and antiferromagnetic orderings, respectively [1, 2]. The splitting of the NMR spectrum into two resonance groups below T_{MI} is considered to be caused by an antiferro-type orbital ordering. At ~ 13 K, however, we could not detect clear evidence for the magnetic ordering. Below ~10 K, the NMR spectrum becomes trapezoidal in shape and the width is independent of H. This is typical for the magnetic ordering in polycrystalline samples.

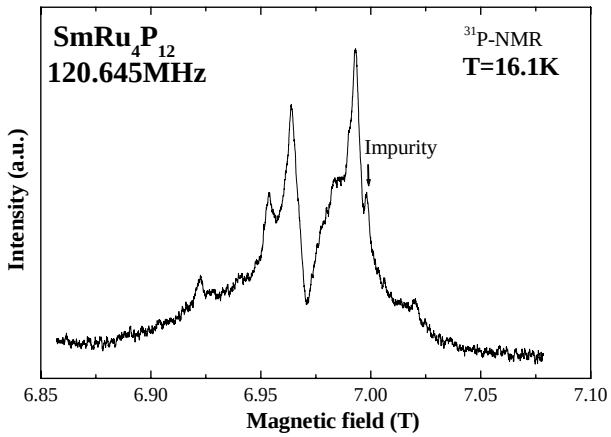

Fig. 1. ^{31}P-NMR spectrum at 7 T and 16.1 K (< T_{MI}).

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