

Possible Multipole State of $\text{SmRu}_4\text{P}_{12}$ Probed by μSR

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The filled skutterudite compound $\text{SmRu}_4\text{P}_{12}$ exhibits a metal-insulator (MI) transition at $T_{\text{MI}} \sim 16.5$ K. An entropy release $\sim R \ln 4$ below T_{MI} suggests that the crystalline-electric-field ground state is a Γ_{67} quartet with various multipole degrees of freedom. A spontaneous local field was detected below T_{MI} by zero field (ZF) μSR [1,2], indicating that a magnetic multipole ordering occurs at T_{MI} . The ^{101}Ru Mössbauer spectroscopy [3] and NQR [4] suggest that the ordered structure in ZF is antiferro-type with the wave vector $q = (100)$. A possibility of magnetic octupole ordering has been intensively discussed to explain anomalous elastic properties, field-temperature phase diagram, and suppressed dipolar moment [5,6]. However, the order parameter has not been established yet.

We will report μSR measurements on single crystalline samples of $\text{SmRu}_4\text{P}_{12}$ to investigate the nature of the multipoles in the ordered state. The muon localization site was determined to be (0.35,0,0.21) and equivalents, classified to the $24g$ site (Wyckoff notation) together with the ^{31}P site. We observed remarkable longitudinal relaxation in the ordered state, the magnitude of which was reduced below $T' \sim 3$ K [2]. We will discuss possible low-energy excitations of magnetic multipoles in the ordered state and their influence on the local magnetic probe on the basis of symmetry of the multipoles.

References

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