(O1-8)

Localized Motions of the La Atom in the Filled Skutterudite $LaOs_4Sb_{12}$ Revealed by ^{139}La-NMR and $^{121/123}$Sb-NQR

Y. Nakai,[1] K. Ishida,[1] H. Sugawara,[2] D. Kikuchi,[3] and H. Sato[3]

[1]Department of Physics, Graduate School of Science, Kyoto University, Kyoto 606-8502,
[2]Faculty of Integrated Arts and Sciences, University of Tokushima, Tokushima 770-8502,
[3]Graduate School of Science, Tokyo Metropolitan University, Hachioji, Tokyo 192-0397

Nuclear magnetic resonance (NMR) on La and nuclear quadrupole resonance (NQR) on Sb in La-based filled skutterudite $LaOs_4Sb_{12}$ were performed in order to shed the light on the rattling motions reported by various experiments[1,2]. $LaOs_4Sb_{12}$, in which the rattling motions are expected to be present, is a reference compound of unconventional heavy-fermion $PrOs_4Sb_{12}$[3] and $SmOs_4Sb_{12}$[4]. The nuclear spin-lattice relaxation rate divided by temperature $1/T_1T$ at the Sb site, which is in good agreement with the previous report[5], can be understood by the magnetic Korringa mechanism. On the other hand, $1/T_1T$ at the La site shows a broad maximum around 50 K, which is not ascribed to the magnetic anomaly. The width of the ^{139}La-NMR spectral tail starts to broaden below 100 K and becomes saturated below 50 K. Figure 1 shows the La-NMR spectrum at 4.2 and 100 K. Since the spectra hardly depend on magnetic fields, we ascribe the broadening to an emergence of electric field gradients (EFG) at the La site. These results suggest strongly that localized off-center modes exist at the La site, which are gradually freezing out with decreasing temperature, resulting in the emergence of EFG at the La site. We consider that this off-center modes are closely related with the rattling reported previously.

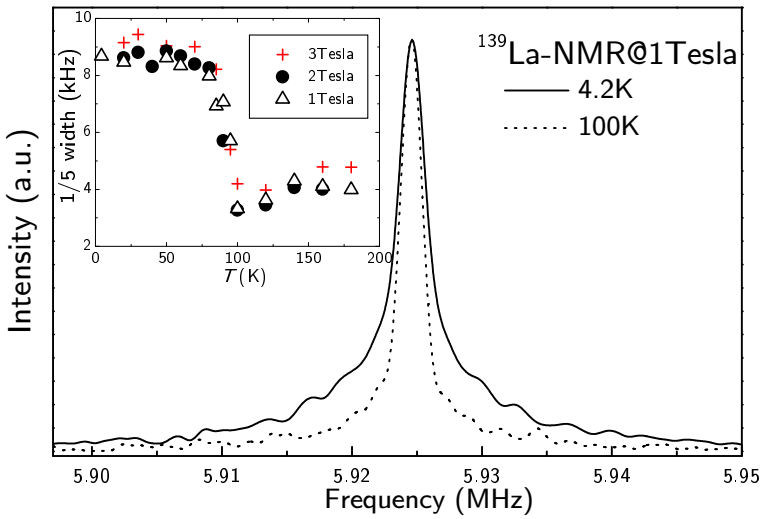

Figure 1: ^{139}La-NMR spectra for 4.2K and 100K. The peak-position for 4.2K is shifted 1kHz to compare each spectra. Inset; the T-dependence of full-width at fifth maximum (1/5 width) of ^{139}La-NMR spectra under various magnetic fields.

[1] V. Keppens *et al.*: Nature **395** (1998) 876.
[2] R. P. Hermann *et al.*: Phys. Rev. Lett **90** (2003) 135505.
[3] E. D. Bauer *et al.*: Phys. Rev. B **65** (2002) 100506(R).
[4] S. Sanada *et al.*: J. Phys. Soc. Jpn **74** (2005) 246.
[5] H. Kotegawa *et al.*: Phys. Rev. Lett **90** (2003) 027001.