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Quadrupolar split resonance of ^{8}Li in $LaAlO_3$

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$LaAlO_3$ is a wide bandgap, transparent oxide commonly used as a substrate for epitaxial film growth and as a vacuum-like electrically insulating layer in heterostructures. Below a soft-mode structural phase transition at about 800 K, it is rhombohedrally distorted from the ideal cubic perovskite structure as the AlO_6 octahedra rotate about the cubic $\langle 111 \rangle$ directions[1]. It is a popular substrate, in part, because Al does not support multiple oxidation states like Ni or Ti and because it is well matched to materials such as $LaNiO_3$ due to the similarity of their lattice constants. Here, we establish the behaviour of ^{8}Li in the bulk as a prerequisite to probing the surface effects of the rhombohedral distortion[2].

We report β-detected NMR of $^{8}Li^{+}$ implanted into a single crystal of rhombohedral $LaAlO_3$. Like other insulating perovskites[3], the resonance is quadrupole split, since even in the cubic phase, its interstitial site (the P-site, Wyckoff $3d$ in the cubic phase) is noncubic. In fact, the splitting in the perovskites[4] is the largest observed for ^{8}Li. The splitting is comparably large in $LaAlO_3$ ($\nu_q \approx 191.3$ kHz), but there is additional splitting due to the rhombohedral distortion.

1. The transition has been studied in some detail by conventional NMR, see e.g., F. Borsa et al, Phys. Lett. A 34, 5 (1971).
2. For example, see the case of $SrTiO_3$, Z. Salman et al., Phys. Rev. Lett. 96, 147601 (2006)
3. V. L. Karner et al., JPS Conf. Proc. 21, 011024 (2018)
4. This has proven useful for refining the value of the nuclear quadrupole moment, see e.g., A. Voss et al., J. Phys. G: Nucl. Part. Phys. 41, 015104 (2014)

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