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The Puzzle of the Missing ^{8}Li Signal in $LaAlO_3$ Layers

The perovskite rare-earth R nickelates, $RNiO_3$, are the prototypical example of a metal-insulator transition in a strongly correlated metal. The transition can be tuned by choice of R, but $LaNiO_3$ remains a metal. In superlattices (SLs) with interlayers of $LaAlO_3$, $LaNiO_3$ can be driven insulating and antiferromagnetic if they are thin enough [1]. We used ^{8}Li β-NMR, to study $LaNiO_3$ as a single crystal, thin film, and in SLs with $LaAlO_3$ [2,3]. In the SLs, we are unable to isolate the signal from ^{8}Li in the $LaAlO_3$ layers. To unravel this mystery, we compare spin-lattice relaxation and frequency comb measurements in a $LaAlO_3$/$LaNiO_3$ bilayer, and $LaNiO_3$ and $LaAlO_3$ crystals.

In a frequency comb, four frequencies simultaneously irradiate all four quadrupole satellites. The comb spectra of $LaNiO_3$ and $LaAlO_3$ are distinct, with the former having a single peak close to zero, while the latter has large quadrupolar splitting and a pattern consistent with its rhombohedral distortion. The comb of the bilayer shows features of both. Interestingly, we observe a significant signal from $LaNiO_3$, even at an implantation energy where we expect the ^{8}Li to be mostly in $LaAlO_3$. The spin-lattice relaxation measurements in the bilayer show no evidence of a non-relaxing component.

1. A. V. Boris et al., Science 332, 937 (2011)
2. V. L. Karner et al., Phys. Rev. B 100, 165109 (2019)
3. V. L. Karner et al., Phys. Rev. B. 104, 205114 (2021)

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