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Negative muon spin rotation and relaxation study on Li metal

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During the μ^-SR measurements on Li-ion battery materials, a part of implanted μ^- is naturally captured by Li nucleus, leading to the formation of muonic-Li species in target materials. The past μ^-SR study on Li metal shows the lack of relaxation in the TF-μ^-SR spectrum at room temperature [1], despite the presence of large nuclear magnetic fields at the muonic-Li position from the surrounding Li nuclei. Such phenomenon was explained by diffusion of a He-like muonic-Li in Li metal. On the other hand, the He diffusion in solids is reported as a thermally activated process based on a thermochronometry gas analysis [2]. Therefore, the TF relaxation rate in Li is expected to increase with decreasing temperature, as the muonic-Li diffusion is suppressed at low temperatures.
Nevertheless, the μ^-SR experiment on both natural Li and ^{6}Li indicates the absence of detectable TF relaxation rates even at the lowest temperature measured. This clearly excludes the scenario that the muonic-Li start to diffuse at a certain temperature below 300 K. Although the mechanism on such a zero TF relaxation rate is not fully understood, we could ignore the contribution from the muonic-Li on the asymmetry μ^-SR spectrum for the Li-ion battery materials.

[1] D. Favart et al., Phys. Rev. Lett. **25**, 1348 (1970).
[2] C. Huber et al., Geochimica et Cosmochimica Acta **75**, 2170 (2011).

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