Spin Dynamics of the *S* = 1/2 Frustrated Spin Chain $LiCuSbO_4$

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Introduction and Experimental

The *S* = 1/2 FM-AFM spin chains have been a subject of great interest both experimentally and theoretically since they host a variety of quantum phases, depending on the ratio $\alpha = J_2/J_1$, where J_1 is nearest-neighbor interaction and J_2 is next-nearest-neighbor interaction [1]. For $\alpha < \alpha_c = -0.25$, a short-range ordered phase occurs with a small but finite gap. The newly reported *S* = 1/2 frustrated FM-AFM chain compound $LiCuSbO_4$ is an enticing material to explore the rich physics of frustrated spin chains and quantum criticality, since there is no hint for magnetic ordering down to 100 mK and an experimentally accessible saturation field of H_c = 12 T [2].

To investigate the ground state in finite external magnetic fields, we performed low temperature ^{7}Li NMR experiments on a powder sample of $LiCuSbO_4$ in SCM1 at temperatures from 140 mK to 1000 mK and fields between 2 T and 16 T. The nuclear spin-lattice relaxation rate $1/T_1$ was measured using a standard inversion-recovery pulse sequence and a top-tuned configuration of the NMR circuit.

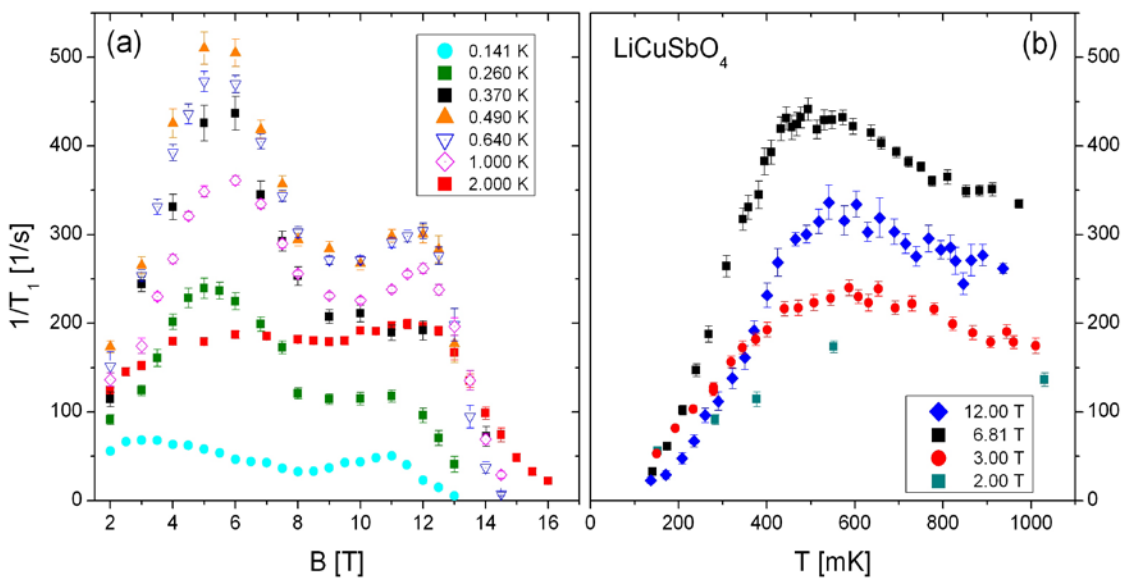

Figure 1. *(a) Field dependence of the nuclear ^{7}Li spin-lattice relaxation rate $1/T_1$ at different temperatures; (b) temperature dependence of $1/T_1$ at different fields.*

Results and Discussion

In **Figure 1** we summarize the results of the ^{7}Li NMR experiments. The field dependence of $1/T_1$ shows two humps at about 5.5 T and 12.2 T. The low-field hump is not characteristic for a homogenous spin chain system and might be due to the effect of an effective staggered field, arising from the alternate tilting of the CuO_6 octahedra.

The temperature dependence of $1/T_1$ shows a broad maximum at about 0.5 K for fields between 2 T and 12 T. This feature is reminiscent of an anomaly at T ~ 0.6 K, observed in low-temperature specific heat measurements for fields smaller than 13 T [2], and might indicate a multipolar transition, theoretically predicted for spin chain systems with competing FM-AFM exchange mechanisms.

References

[1] Drechsler, S.-L. *et al.*, Phys. Rev. Lett. **98**, 077202 (2007).
[2] Dutton, S.E., *et al.*, Phys. Rev. Lett. **108**, 187206 (2012).