Spin Dynamics of the Rhombohedral Pyrochlore Lattice $La_3Mn_2Sb_3O_{14}$

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Introduction

Geometrically frustrated magnets have attracted considerable attention in condensed matter physics. Traditionally, two-dimensional triangular and kagome lattices and three-dimensional pyrochlore lattice constitute prototypical examples of the geometrically frustrated magnets. In this project, we will investigate a newly-discovered rhombohedral pyrochlore lattice $La_3Mn_2Sb_3O_{14}$ (R-3m space group), in which the Mn1 and Mn2 sites form a network of corner-sharing tetrahedra [1,2]. The magnetic susceptibility and μSR measurements exhibit no evidence for long-range magnetic order down to 0.3 K. To elucidate the development of local spin correlations, the experimental technique with a much faster frequency domain is mandatory, i.e., high-frequency ESR.

Experimental

High-frequency ESR experiments were carried out at 240 GHz using a home-built superheterodyne spectrometer equipped with a 12.5 T superconducting magnet.

Results and Discussion

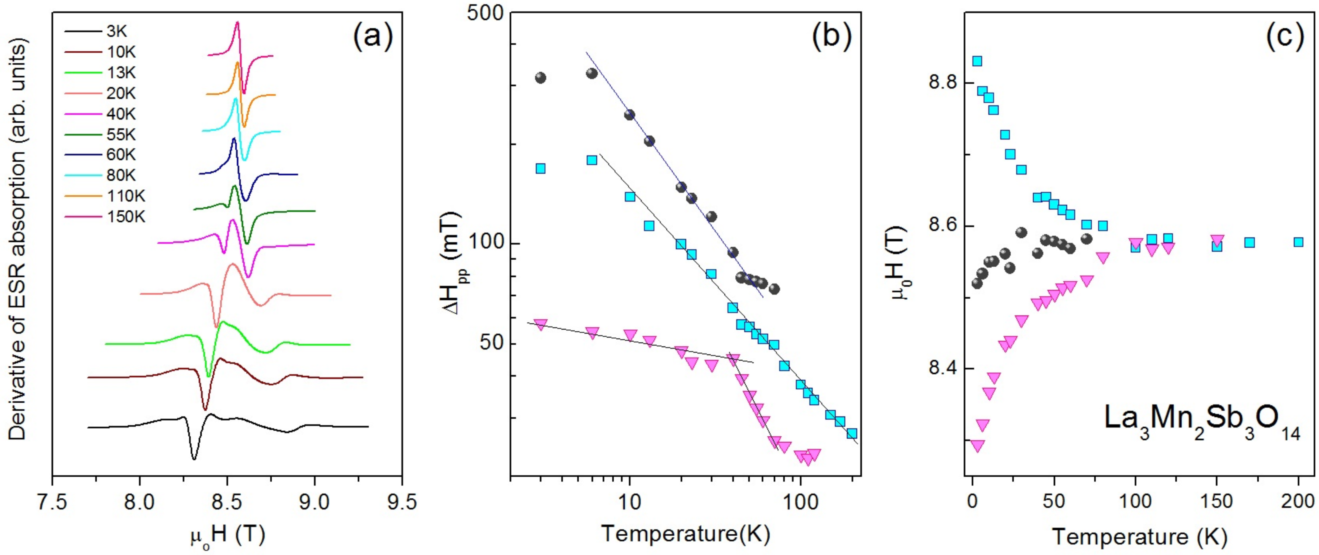

Fig.1 (a) Derivative of the ESR absorption spectra of the $La_3Mn_2Sb_3O_{14}$ as a function of temperature. The spectra are vertically shifted for clarity. Temperature dependence of (b) the resonance field, H_{res} on a log-log scale and (c) the peak-to-peak linewidth, ΔH_{pp}.

Fig.1(a) summarizes the temperature dependence of the ESR spectra. At high temperatures above 150 K, we observe a single Lorentzian absorption line, which originates from exchanged-coupled paramagnetic Mn^{2+} ions. With decreasing temperature, the spectra become broader, while the multiple absorption lines show up. This points towards the differentiation of local magnetic environments possibly due to quenched disorders.

In **Fig.1(b)** and **1(c),** we present the resonance field $H_{res}(T)$, and the peak-to-peak linewidth $\Delta H_{pp}(T)$ extracted by fitting the ESR data to a convolution of Lorentzian profiles. With decreasing temperature $\Delta H_{pp}(T)$ shows a quasi-power-law dependence, indicative of the development of correlated spin fluctuations. On cooling down below 100 K, $H_{res}(T)$ shifts to higher or lower fields, depending on the resonance lines. This means the formation of internal fields which are different in size and direction relative to the external field. The critical-like line broadening and the shift of the resonance field are characteristic for correlated random magnets. Taken together, we conclude that our ESR study reveals the highly correlated random magnetism due to a concerted interplay of frustration and quenched disorder.

Acknowledgements

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References

[1] Fu, W.T., *et al.*, J. Solid State Chem., **213**, 165 (2014).
[2] Chandragiri, V., *et al.*, Mater. Res. Express, **3**, 066102 (2016).