μSR Study of Spin ½ Kagome magnet Cu Volborthite (CVO)

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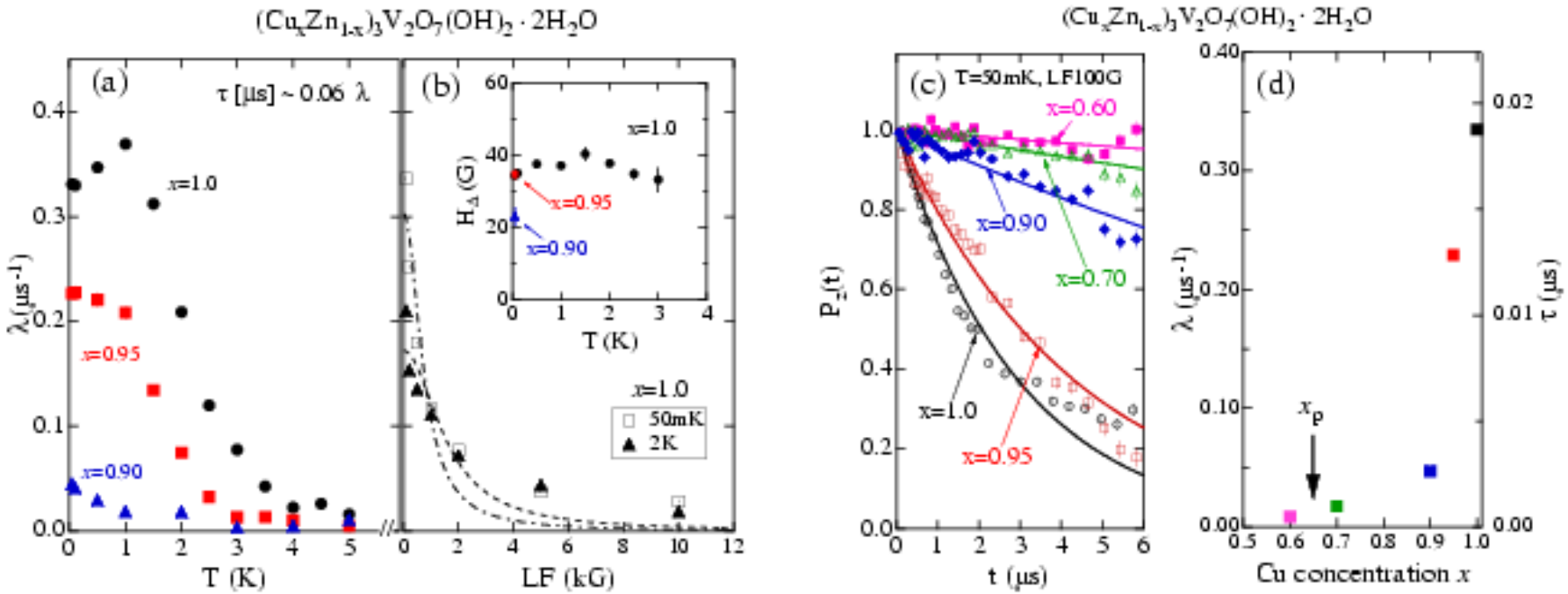
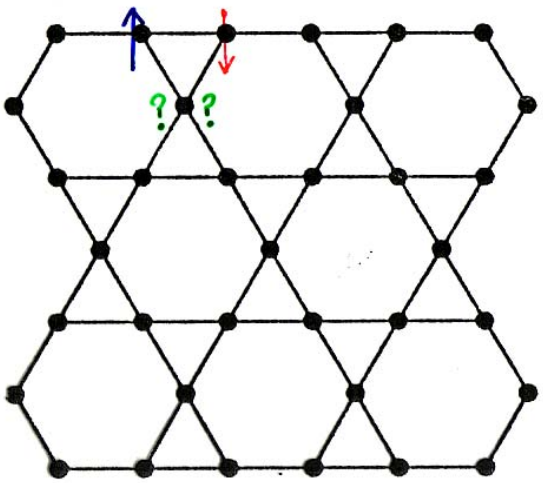


The muon spin relaxation rate $\lambda = 1/T_1$ observed in pure and Zn-doped CVO in a longitudinal field LF = 100 G. (b) The LF dependence of λ and the magnitude of instantaneous local field at the muon site. (c) The μSR spectra and (d) the relaxation rate λ and the corresponding Cu spin correlation time τ at T = 50 mK and LF 100 G, shown for various Cu concentraiton x.



Antiferromagnetically coupled spins on Kagome lattice are subject to geometrical frustration, as shown in the left figure. This situation results in a high degeneracy of ground state spin configuration and strong spin fluctuations. In 1994, our group discovered persisting spin fluctuations at low temperatures, indicative of quantum fluctuations, in S=3/2 Kagome system $SrCr_8Ga_4O_{19}$ (SCGO).

In 2001 Hiroi et al. reported Cu volborthite $(Cu_xZn_{1-x})_3V_2O_7(OH)_2 2H_2O$ (CVO) to have S=1/2 Cu moments with an antiferromagnetic exchange interaction J = 80 K on a highly 2-dimensional lattice of nearly Kagome configuration. We have performed μSR and susceptibility measurements on pure and (Cu,Zn) substituted CVO systems. As shown in the figure, the muon spin relaxation rate $1/T_1$ in a small longitudinal field (100 G) exhibits increase followed by saturation with decreasing temperature, with the field dependence confirming dynamic origin of relaxation. Slow Cu spin fluctuations of 2-20 ns time scale persist at T = 0 and magnetic dilution makes spin fluctuations faster. The instantaneous internal field value is consistent with the case where about 10 - 20 % of the Cu spins remain unpaired in the ground state, coexisting with the rest forming singlet pairs, in a novel type of ``spin-liquid'' state.

A. Fukaya, Y. Fudamoto, I.M. Gat, T. Ito, M.I. Larkin, A.T. Savici, Y.J. Uemura, P.P. Kyriakou, G.M. Luke, M.T. Rovers, K.M. Kojima, A. Keren, M. Hanawa, Z. Hiroi,

Muon Spin Relaxation and Susceptibility Studies of Pure and Doped Spin 1/2 Kagome-like system $(Cu_xZn_{1-x})_3V_2O_7(OH)_2\,2H_2O$

Phys. Rev. Lett. 91 (2003) 207603 [4 pages].

A. Fukaya is a female a post-doctoral scientist visiting from Japan.

We have also published another PRL paper in a different subject in 2003:

I.M. Gat-Malureanu, A. Fukaya, M.I. Larkin, A.J. Millis, P.L. Russo, A.T. Savici, Y.J. Uemura, P.P. Kyriakou, G.M. Luke, C.R. Wiebe, Y.V. Sushko, R.H. Heffner, D.E. MacLaughlin, D. Andreica, and G.M. Kalvius,

Field Dependence of the Muon Spin Relaxation Rate in MnSi,

Phys. Rev. Lett. 90 (2003) 157201 [4 pages].

I.M. Gat-Malureanu is a female graduate student of our group at Columbia Univ.