Frustrated Magnetism and Spin Liquids: An ideal S = ½ kagomé system?

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The idea of destabilizing a Néel state in favour of a spin liquid state by means of geometrical frustration was proposed long ago by Anderson in the context of triangular $S = ½$ antiferromagnets [1]. The RVB state (resonating valence bond), fundamental of a spin liquid, has since then been invoked in the case of a large number of systems, such as the high-T_c superconductors, spin ladders, etc. From a theoretical point of view, the RVB state, built from a macroscopic number of singlets, is considered to be the fundamental state of the S = ½ kagomé or pyrochlore lattices. On the experimental side, unconventional dynamics has been highlighted in several corner-sharing compounds, but none proved to be close enough to the ideal system to allow detailed comparison with theory. Recently, the x = 1 compound of the Paratacamite family $Zn_xCu_{4-x}(OH)_6Cl_2$ was revealed as a structurally perfect S = ½ kagomé system [2], expected for so long! In this family, the Cu/Zn doping induces a structural change from distorted pyrochlore to perfectly decoupled kagomé planes. Our Muon Spin Relaxation results prove the absence of freezing down to 50 mK << J ~ 190 K [3]. Nuclear Magnetic Resonance results bring insight into the intrinsic susceptibility and dynamical behaviour at low temperature [4]. A quick comparison will be made with the case of the triangular Heisenberg antiferromagnet $NaCrO_2$ [5].

[1] P.W. Anderson, Mater. Res. Bull. **8**, 153 (1973). For an introduction : B. Levy, Physics Today (February 2007)
[2] M. P. Shores, E. A. Nytko, B. M. Barlett, and D. G. Nocera, J. Am. Chem. Soc. **127**, 13 462 (2005)
[3] P. Mendels, F. Bert, M.A. de Vries, A. Olariu, A. Harrison, F. Duc, J.C. Trombe, J.S. Lord, A. Amato, and C. Baines, Phys. Rev. Lett. **98**, 077204 (2007)
[4] A. Olariu *et al*., in preparation
[5] A. Olariu, P. Mendels, F. Bert, B. G. Ueland, P. Schiffer, R. F. Berger, and R. J. Cava, Phys. Rev. Lett. **97,** 167203 (2006)