Fractalisation drives crystalline states in a frustrated spin system

Authors: Suchitra E. Sebastian, N. Harrison, P. Sengupta, C. D. Batista, S. Francoual, E. Palm, T. Murphy, N. Marcano, H. A. Dabkowska, and B. D. Gaulin

ArXiv.0707.2075

Recommended and Commentary by Steven M. Girvin, Yale University

Inorganic chemists have made fantastic progress in recent decades in synthesizing novel insulating magnetic compounds which exhibit frustration and quantum effects. $SrCu_2(BO_3)_2$ is, to a good approximation, a realization of the Shastry-Sutherland model whose 'dimer solid' ground state in zero applied field is exactly known. As increasing magnetic field is applied, this novel system exhibits a remarkable sequence of plateaux in its magnetization at rational fractional values of the saturation magnetization.

It is useful to think of starting with a fully polarized state and then overturning spins. These overturned spins can be viewed as hard core bosons which can condense into special gapped states at rational filling factors. A number of scenarios for dealing with the strong correlations have been suggested. One is that these special states may be related to quantum Hall states through a mapping of the hard core bosons onto fermions carrying pseudo magnetic flux [1]. The results of Sebastian et al. and recent other experiments [2,3] suggest that broken translation symmetry must be included to fully account for all of the observed fractions. New calculations and a clear discussion of the theoretical issues can be found in [4].

References:

1. G. Misguich, Th. Jolicoeur and S. M. Girvin, *Phys. Rev. Lett.* **87**, 097203 (2001).

2. M. Takigawa et al., arXiv:0710.5216v2 (2007).

3. F. Levy et al., Eur. Phys. Lett. 81, 67004 (2008).

4. J. Dorier, K. P. Schmidt, and F. Mila, arXiv:0806.3406.