

# Department of Physics

Condensed Matter Physics  
Clarendon Laboratory, Parks Road, Oxford OX1 3PU



## CONDENSED MATTER SPECIAL SEMINAR

Tuesday 16 April at 11.00am

### “Designer spin liquids”

Prof Nic Shannon

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The pyrochlore lattice has proved a rich source of spin liquids, both in theory, and in the experiment. The best known examples are “spin ices” such as  $\text{Dy}_2\text{Ti}_2\text{O}_7$ , which offer a concrete realisation of a  $U(1)$  lattice gauge theory, complete with magnetic monopole excitations. However many other spin liquid-materials are known, with many different types of phenomenology, motivating the question “what else is out there?”

In this talk we show how a variety of different spin liquids on the pyrochlore lattice can be generated systematically, by exploiting the degeneracies which arise where different forms of order meet. As examples we present the tensor spin liquid found in models of pyrochlores with anisotropic exchange interactions [1]; the nematic spin liquid found in frustrated quantum spin ice [2,3]; and a rank-2  $U(1)$  spin liquid found by perturbing a simple Heisenberg antiferromagnet [4].

In all cases, the predictions of the relevant gauge theory are compared with the results of Monte Carlo simulation, and predictions are made for the structure factors which would be observed in neutron-scattering experiments. The relevance of these results to experiments on pyrochlore magnets, is also discussed.

[1] Owen Benton, L.D.C. Jaubert, Han Yan and Nic Shannon, Nat. Commun. 7, 11572 (2016)

[2] Mathieu Taillefumier, Owen Benton Han Yan, L. D. C. Jaubert and Nic Shannon, Phys. Rev. X 7, 041057 (2017)

[3] Owen Benton, L. D. C. Jaubert, Rajiv R. P. Singh, Jaan Oitmaa and Nic Shannon, Phys. Rev. Lett. 121, 067201 (2018)

[4] Han Yan, Owen Benton, L. D. C. Jaubert and Nic Shannon, arXiv:1902.10934

**Host: Prof Radu Coldea**  
**Simpkins Lee Room, Beecroft Building**