Low Temperature Phase Diagram of the Pyrochlore Quantum Magnet $Tb_2Ti_2O_7$

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Introduction

Rare earth ions in the titanate pyrochlores $R_2Ti_2O_7$ form a lattice with corner sharing tetrahedra. This structure leads to geometrically frustrated nearest neighbor interactions and coupled with anisotropy and quantum fluctuations lead to unconventional ground states. In particular $Tb_2Ti_2O_7$ may be a good candidate for a 3D quantum spin liquid.

Experimental

The ac magnetic susceptibility of well characterized single crystals of $Tb_2Ti_2O_7$ was measured as a function of applied magnetic field from 200 to 10 mK. The measurements were carried out for several ac magnetic field excitations from 0.21 to 86 Hz with the applied dc field parallel to the [111] crystal axis. The ac magnetic field strengths ranged from 0.048 to 1.2 mT and were applied parallel to the dc magnetic field. The samples were grown using a floating-zone technique at a rate of 2.5 mm per hour in an oxygen atmosphere. [1]

Results and Discussion

The variation of the magnetic susceptibility χ with magnetic field is shown in **Figure 1**. Two peaks are observed for χ , one at low field H = 0.065T and the other at H = 0.6 T. The results are consistent with phase I being a quantum spin ice and phase II a quantum kagome ice.

Conclusions

Careful measurements of the magnetic susceptibility of $Tb_2Ti_2O_7$ show evidence for a new phase for magnetic fields 0.065<H<0.6 T.

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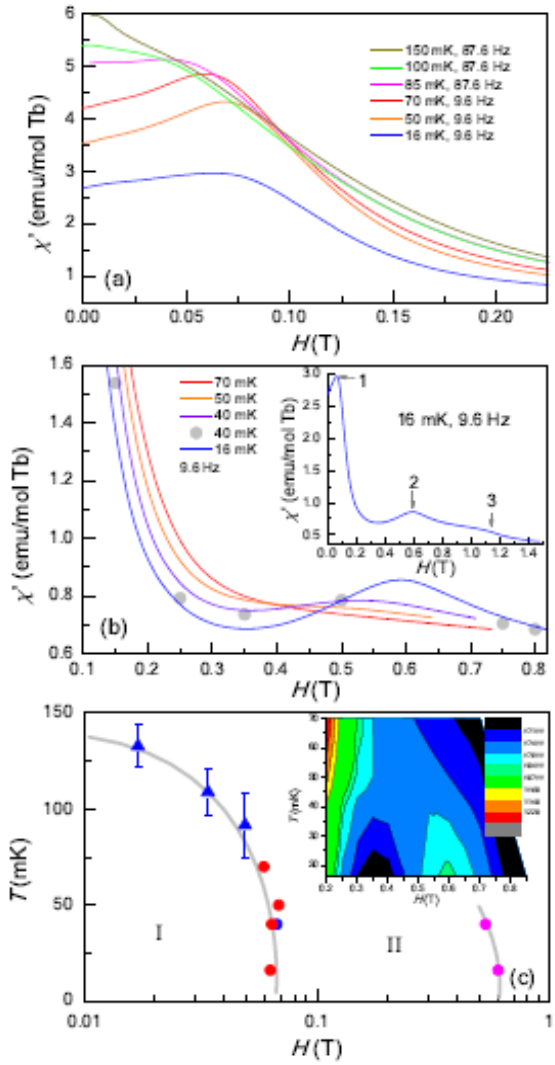

Figure 1. Observed field and temperature dependence of the magnetic susceptibility of $Tb_2Ti_2O_7$.

References

[1] Gardner, J.S.; Gaulin, B.D.; and Paul D.M.; J. Crystal Growth, **191**, 740 (1998).