Effects of the Applied Magnetic Field Orientation on the Ground State of Cs_2CuCl_4

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Introduction

Cs_2CuCl_4 is a S=1/2 frustrated antiferromagnet on an anisotropic triangular lattice that is believed to exhibit fractional spin excitations [1]. Furthermore, different types of exotic magnetically ordered phases are stabilized as magnetic field (H) is applied parallel and perpendicular to the spin planes [2]. Our NMR measurements confirm the presence of multiple field induced ordered phases, distinguishable by their local spin structure.

Experimental

^{133}Cs NMR data on single crystals of Cs_2CuCl_4 were obtained using the top-loading ^{3}He/^{4}He dilution refrigerator and the 18/20 T superconducting magnet at the milliKelvin facility at NHMFL. The RF probe, with a single axis goniometer, was provided by Lloyd Engel.

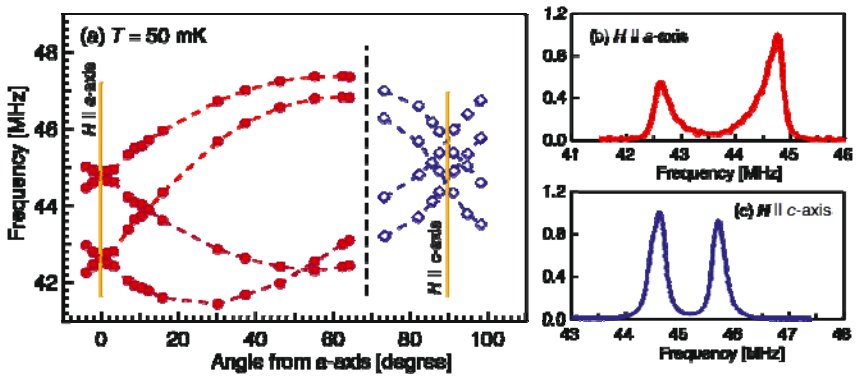

Fig 1. (a) Frequency of the resonance peaks as a magnetic field is rotated in the (ac)-crystal plane at T = 50 mK and $\boldsymbol{H}$ = 7 T. The typical spectra in an incommensurate (IC) **(b)** and a commensurate (CM) **(c)** state.

Results and Discussion

In Fig 1(a) the frequency of the ^{133}Cs(A) NMR spectral peaks at T=50 mK is plotted as a function of the angle (θ) between the $\boldsymbol{H}$ = 7 [T] $\boldsymbol{h}$ and the a-axis of the crystal. For $\boldsymbol{H}$ || a-axis (normal to the spin plane), an IC lineshape, characteristic of the spin cone state, is observed, (Fig. 1(b)). As the field is rotated away from the axis the number of peaks duplicates, due to an understood NMR effect. A field $\boldsymbol{H}$ || c-axis (to the spin plane) stabilizes a CM state (Fig. 1(c)). Tracing the peaks and spectral shapes as a function of θ we establish that a phase transition from an IC to a CM state occurs for θ = 69° ± 4°.

Conclusions

The results identified the angle (θ ~ 69°) between H and a-axis at which the phase transition from an IC to a CM state occurs.

Acknowledgements

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References

[1] Coldea, R., *et al.*, Phys. Rev. Lett. **86**, 1335 (2001).
[2] Tokiwa, Y., *et al.*, Phys. Rev. B, **73**, 134414 (2006).