^{133}Cs NMR Spin-Lattice Relaxation Rate in the Frustated Quantum Antiferromagnet Cs_2CuCl_4

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Introduction

Cs_2CuCl_4 is a 2D S=1/2 frustrated Heisenberg antiferromagnet (AF) on an anisotropic triangular lattice. It is one of only two candidate materials to show strong evidence for 2D spin liquid behavior. Furthermore, a magnetic field stabilizes exotic phases, as shown by neutron measurements[1]. NMR measurements[2] at 60 mK confirm multiple field induced phase transitions in a magnetic field applied perpendicular to the Cu chains, *c*-axis. The phases are identified by their local spin structure. Contrary to common belief the complexity of the local spin structure increases with applied longitudinal field.

Experimental

Our measurements of ^{133}Cs NMR spin-lattice relaxation rate (T_1^{-1}) data on Cs_2CuCl_4 single crystals were performed in the milliKelvin facility at the 18/20 T superconducting magnet with top-loading ^{3}He/^{4}He dilution refrigerator. These results provide information on the spin dynamics of each of the different field induced phases.

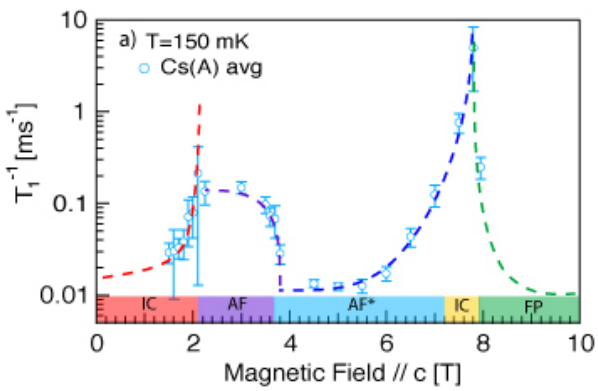

Fig. ^{133}Cs NMR spin-lattice relaxation rate as a function of the magnetic field oriented along the c-axis. Dashed lines are guide to the eye. Different phases from neutron scattering and NMR results are shown in various color: incommensurate (IC), commensurate (AF and AF*) and fully polarized state (FP).

Results and Discussion

In the figure we show the field dependence of the spin-lattice relaxation rate T_1^{-1} at T=150 mK. The phases identified from NMR results are reported in various colors and explicitly underline the multiple changes in the spin-lattice relaxation rate. In particular, a distinction between the two different commensurate phases is seen suggesting a variation in the spin dynamics, likely caused by two different spin gaps. It remains unclear why such behavior occurs since in general the spin gap is expected to close linearly up to the saturation field H_c (here at 7.9 T). The presence of the high field incommensurate state might be related to this unexpected spin dynamics behavior.

Acknowledgements

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References

[1] Coldea, R., *et al.*, Phys. Rev. Lett. **86**, 1335, (2001).
[2] Vachon, M-A., *et al.*, *to be published*.