Pressure-Driven Field-Induced Transitions in Triangular Lattice Antiferromagnet Cs_2CuCl_4

Zvyagin, S.A. (Helmholtz-Zentrum Dresden-Rossendorf, Dresden High Magnetic Field Laboratory); Graf, D. (NHMFL), Nojiri, H. (Tohoku University, IMR), Ono, T. (Osaka Prefecture University, Physics), and Tanaka, H. (Tokyo Institute of Technology, Physics)

Introduction

Spin-1/2 Heisenberg antiferromagnets on a triangular lattice are paradigmatic model systems, which have been intensively studied since the Anderson's conjecture of the resonating-valence-bond ground state in frustrated magnets [1]. In spite of numerous theoretical studies (which predict a rich variety of grounds states, ranging from a gapless spin liquid to the Néel order), many important details of their phase diagram remain controversial or even missing. The main goal of this work is studying the high pressure response of the triangular lattice antiferromagnet Cs_2CuCl_4 .

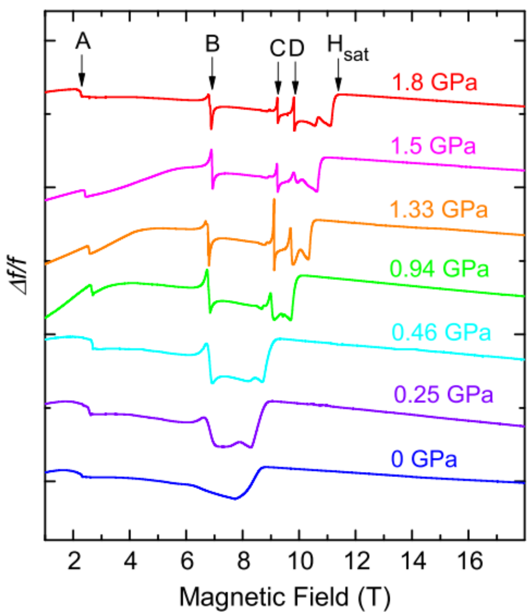

Fig. 1 Pressure dependence of TDO frequency changes in response to magnetic field (H II b, T = 350 mk; the data are offset for clarity).

Experimental

To measure magnetic phase diagram of Cs_2CuCl_4, we employed a radiofrequency tunnel-diode-oscillator (TDO) technique. During the field sweep changes in the magnetic permeability (i.e. magnetic susceptibility) lead to changes in the inductance of the oscillator tank coil, and, hence, in changes of the TDO circuit resonant frequency. The variations of the TDO resonant frequency $\Delta f/f$ as a function of magnetic field applied along the b-axis at different pressures were measured. The 18 T SCM-2 magnet system equipped with a ^{3}He inset was used.

Results and Discussion

Apart from a shift of the saturation field (which is evident of a significant increase of the exchange coupling parameters), our experiment revealed a number of magnetic anomalies, which are absent in Cs_2CuCl_4 at zero pressure (Fig. 1). The origin of the observed magnetic anomalies can be associated with significant changes in the dynamics of critical fluctuations in the vicinity of field-induced phase transitions, resulting in changes of the high frequency magnetic susceptibility. Although no signature of the 1/3 magnetization plateaus was observed, such a rich high-pressure phase diagram is evidence of a complex picture of magnetic interactions in Cs_2CuCl_4, including not only spatial, but also spin-space (asymmetric D-M interaction) components of the magnetic anisotropy. The identification of the novel field-induced high-pressure phases is in progress [1]. This experiment is supplemented by high-field, high-pressure electron spin resonance (ESR) measurements, allowing us to obtain important information on the exchange coupling parameters in this material.

Conclusions

Our high-pressure experiments indicated a substantial increase of the exchange coupling ratio in in Cs_2CuCl_4, revealing, on the other hand, a number of emergent field-induced phases.

Acknowledgements

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References

[1] Anderson, P.W., Mater. Res. Bull. **8**, 153 (1973).
[2] Zvyagin, S.A., unpublished.