High Frequency Antiferromagnetic Resonance in the Quasi-1D S = 1/2 Quantum Spin Chain $(TMTTF)_2SbF_6$

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Introduction

Quantum spin chains (S = 1/2, 1D) have attracted great interest for many years due to many non-classical properties (no antiferromagnetic order, quantum phases, spinon dynamics). One-dimensional organic conductors have been studied for many decades because of the rich temperature/pressure phase diagram. Here we studied the antiferromagnetic system $(TMTTF)_2SbF_6$ (T_N = 6 K) [1]. This material is considered as a model to describe a highly isotropic Heisenberg S = 1/2 chain. The purpose of this study is to measure its weak anisotropy and to see if the quantum fluctuations observed in anisotropic chains have an equivalent effect here.

Experimental

Experiments have been performed using the quasi-optical high frequency EPR spectrometer of the EMR Facility operating at 120, 240 and 336 GHz). A 700x200x100 micron-sized sample was used. Chain axis *a* (the hard anisotropic axis) was set as the rotation axis. All measurements were made at 3K.

Results and Discussion

The AFMR line is seen for all orientations. When the magnetic field is along principal magnetic axis, the line is broad and becomes sharp between these two axis. The anisotropy is very small confirming the highly isotropic Heisenberg chain model of $(TMTTF)_2SbF_6$. Anisotropy of the lines is barely the same as the g-factor anisotropy which made the estimation of magnetic anisotropy very difficult. A second line less anisotropic might be due to a sub-lattice structure caused by the charge ordered transition [2]. On the right side of **Figure 1**, a group of many sharp lines is observed. This group is isotropic and exist at higher temperatures ($T > T_N$); it might be due to extrinsic impurities.

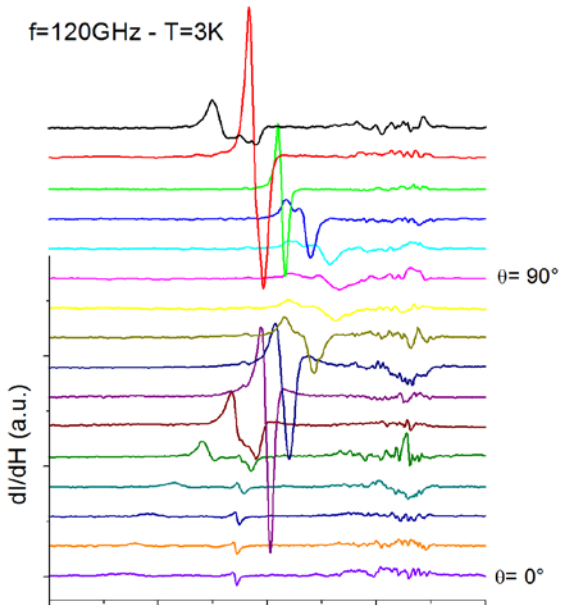

Figure 1. ESR signals of $(TMTTF)_2SbF_6$ at 3 K and 120 GHz. Static field rotates about *a* axis with a step of 9°. Each spectrum is recorded for a different orientation of the static field.

Conclusions

Very small magnetic anisotropy has been reported using HF-AFMR. A second signal was observed and is assumed to be signature of the charge order sub-lattice. More frequencies and orientations measurements will be performed in order to study the second line.

Acknowledgements

We thank NHMFL and CMS group's visiting program for financial support.

References

[1] C. Coulon, *et al.*, Phys. Rev. B, **33**, 6235-6242 (1986).
[2] C. Coulon, *et al.*, Phys. Rev., B **76**, 1-13 (2007).