# Controlling Spin States in Honeycomb Two-Dimensional Layered Solids Using Coherent Light

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## Introduction

Manipulation of spin and charge states using coherent light sources has gained an increasing scientific interest in the recent past, particularly in complex oxides, dilute magnetic semiconductors and topological materials. It has been reported [1-3] in melting the anti-ferromagnetism (AFM) and inducing ferromagnetism (FM), and in controlling the insulator-to-metal transition, spin-orbit coupling and stabilizing metallic phase at a remarkable level using a single light pulse, attributed to strong coherent and cooperative interaction between the incoming photons and the spins and the charges in the host. These exciting developments are promising for future spintronic research. However, to date, the fundamental knowledge and understanding in this area are limited as this field of research is relatively new.

## Experimental

Electron Spin Resonance of single crystals of $CrCl_3$ was measured in the multi-frequency (120, 240, and 336 GHz) heterodyne quasi-optical spectrometer equipped with a 12.5 T SC magnet in the Electron Magnetic Resonance facility [4]. The sample was mounted in an Oxford Instruments flow cryostat for temperature dependent measurements in the 1.5-400 K range. Optical excitation was provided by a white-light LED (~5 mW) mounted below the sample.

## Results and Discussion

The para/ferro-magnetic resonance spectrum at 120 GHz of a thin single crystal of $CrCl_3$ as a function of temperature is shown in **Fig.1** for a field perpendicular the crystal plane. The resonance shift corresponds to the temperature dependent volume magnetization of this ferromagnetic material with a Curie temperature ($T_C$) of 28 K. Below $T_C$ standing spin waves start to develop in this thin single crystal. Upon irradiation with amplitude modulated white light at $T_C$, a small shift in the field position of the resonance can be observed.

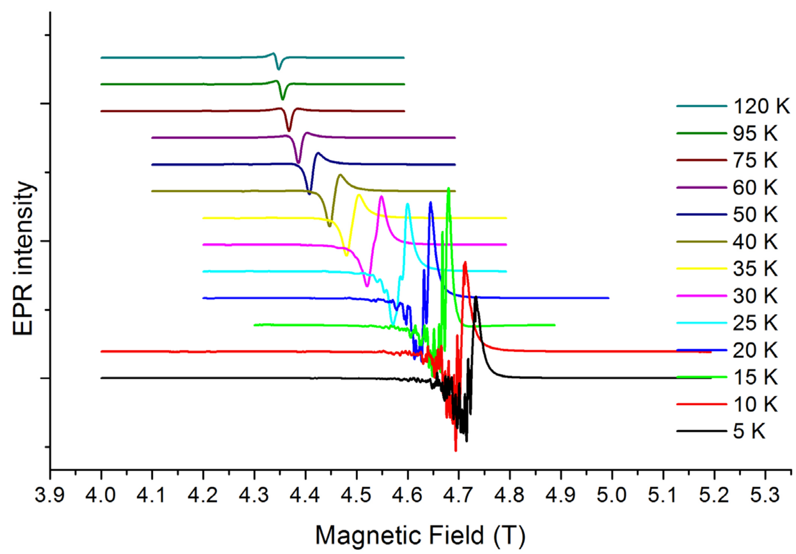


**Fig.1** Electron Paramagnetic/Ferromagnetic Resonance of CrCl3 single crystal at 120.00 GHz as a function of temperature.

## Conclusions

Further experiments with pulsed laser excitation are needed to study and characterize the time and field dependence of light induced changes in the magnetization and spin excitation spectra of $CrCl_3$ and $CrI_3$ ferromagnets.

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## References

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