



Magnetostatic effect on spin dynamics properties in antiferromagnetic Van der Waals material CrSBr



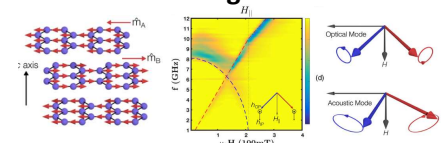
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Introduction

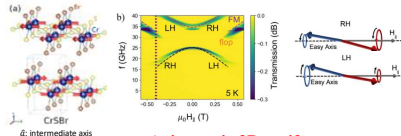
1. 2D Antiferromagnetic Resonance



David MacNeill et al. Phys. Rev. Lett. 123, 047204 (2019)

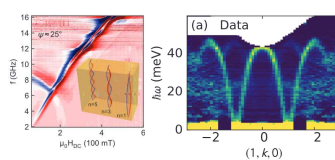
Weak interlayer coupling \Rightarrow GHz resonance frequency

2. CrSBr



Thow Min Jerald Cham et al. Nano Lett. 22,6716–6723 (2022)

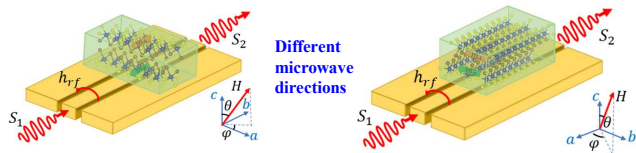
3. Spin wave in 2D antiferromagnet



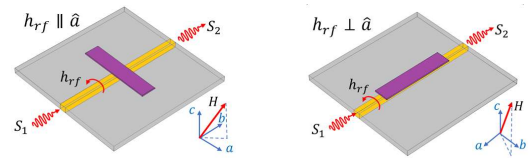
Lucky N. Kapoor et al. Adv. Mater. 33, 2005105 (2021)
Allen Scheie et al. Adv. Sci. 9, 2202467 (2022)

How does spin wave mode effect spin dynamics in 2D antiferromagnets?

Experiment

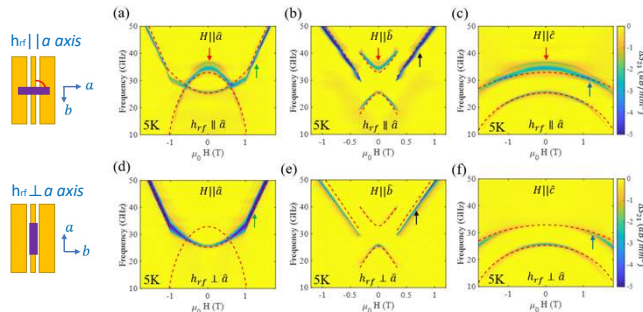


Simulation



Results

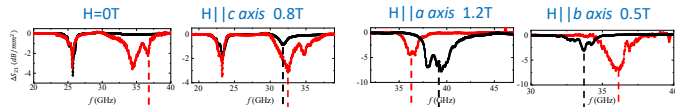
1. Field dependence



✓ Microwave Field dependence \leftarrow $h_{rf} \perp a$ axis \rightarrow $h_{rf} \parallel a$ axis

Antiferromagnetic region

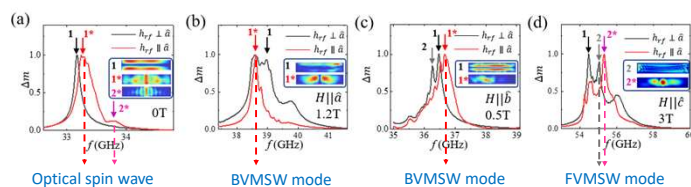
Ferromagnetic region



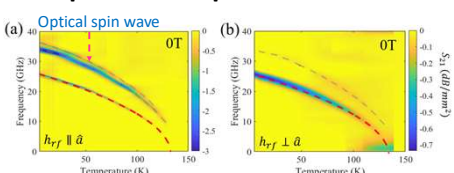
Optical spin wave Frequency changes with microwave directions

$h_{rf} \parallel H$ uniform FMR mode $h_{rf} \perp H$ BVMSW mode

✓ Simulation



2. Temperature dependence

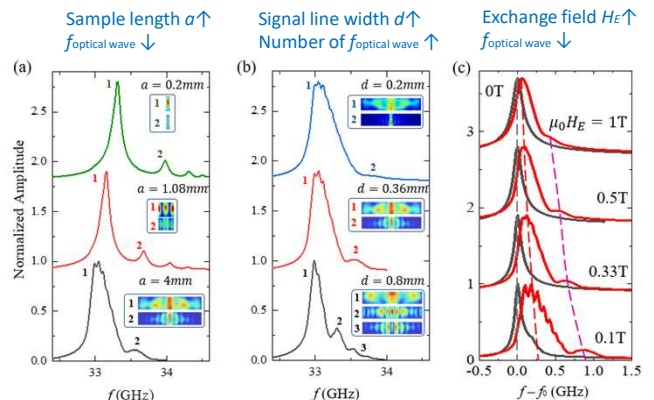


$$\omega \propto (T_N - T)^\gamma$$

$$T_c = (131.4 \pm 0.3)K$$
$$\gamma = 0.513 \pm 0.004.$$

Discussion

1. Antiferromagnetic region



2D antiferromagnet \Rightarrow Weak exchange coupling \Rightarrow Magnetostatic effect \Rightarrow Optical spin wave

2. Ferromagnetic region

Strong Magnetization + Weak exchange coupling \Rightarrow Magnetostatic wave

Conclusion

- Detailed investigation into antiferromagnetic resonance spectra of 2D antiferromagnet CrSBr.
- Notable dependency of the resonance frequency on the orientation of the microwave field due to the magnetostatic effect.