Electrostatic Control over the Magneto-Optics and the Magnetization Dynamics of $Cr_2Ge_2Te_6$

Marcos H. D. Guimaraes
Freddie Hendriks, Rafael R. Rojas-Lopez, Alexander Rudenko, Malte Roesner, Bert Koopmans
Zernike Institute for Advanced Materials, University of Groningen, The Netherlands
m.h.guimaraes@rug.nl

Van der Waals (vdW) materials are ideal systems for the study of spins and magnetism in low dimensions since they maintain their excellent optical, magnetic and electronic properties down to the atomically-thin limit. Because of their low dimensionality, these materials possess another exciting property, they are extremely sensitive to external stimuli, such as light and electric fields.

In this talk, I will show how we can reveal excitonic features and study the magnetization dynamics of a van der Waals magnetic semiconductor – $Cr_2Ge_2Te_6$ (CGT) – using magneto-optics. First I will discuss our recent results[1] on the magneto-optic Kerr effect (MOKE) spectroscopy in CGT, which shows a very strong magneto-optic response arising from excitonic effects. Additionally, I will show how we can control the magneto-optic efficiency of CGT through electrostatic gating, allowing us to modulate the MOKE signals by up to 65%. I will also discuss how we can study the magnetization dynamics of CGT using time-resolved magneto-optics and show how its strong magneto-optic response gives rise to a strong opto-magnetic phenomenon [2]. Finally, we can also use electrostatic gating to control both the magnetization dynamics and the opto-magnetics in CGT.

Our studies illustrate the potential of vdW magnets for combining optics, spintronics and magnetism, making them appealing for new opto-spintronic and opto-magnetic device architectures for future integrated photonic systems.

References

[1] F. Hendriks, et al., Arxiv 2408.09901 (2024)
[2] F. Hendriks, et al., Nature Communications, 15 (2024) 1298.

Figures

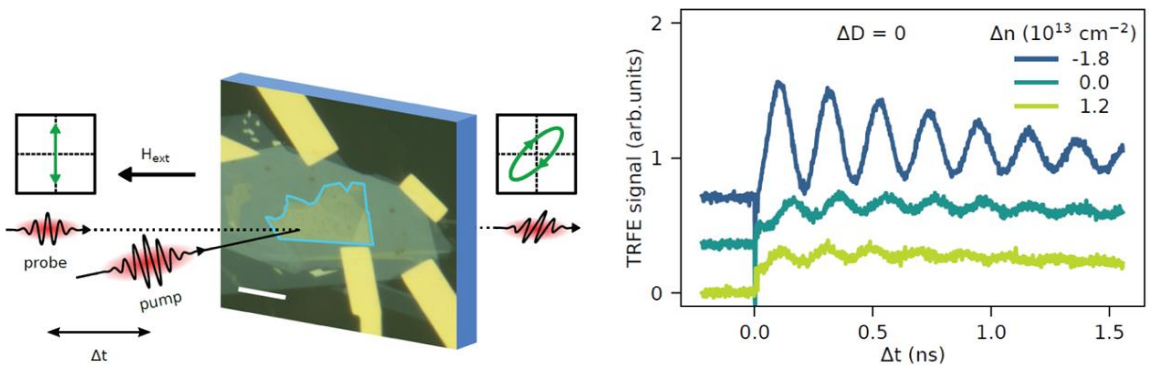

Figure 1: *Left*: Magneto-optics can be used to study the dynamics of CGT, with the initial torque and subsequent magnetization dynamics tuned using electrostatic gating. *Right*: Time-resolved magneto-optical signals as a function of pump-probe delay for different values of carrier density. Images adapted from reference [2].