

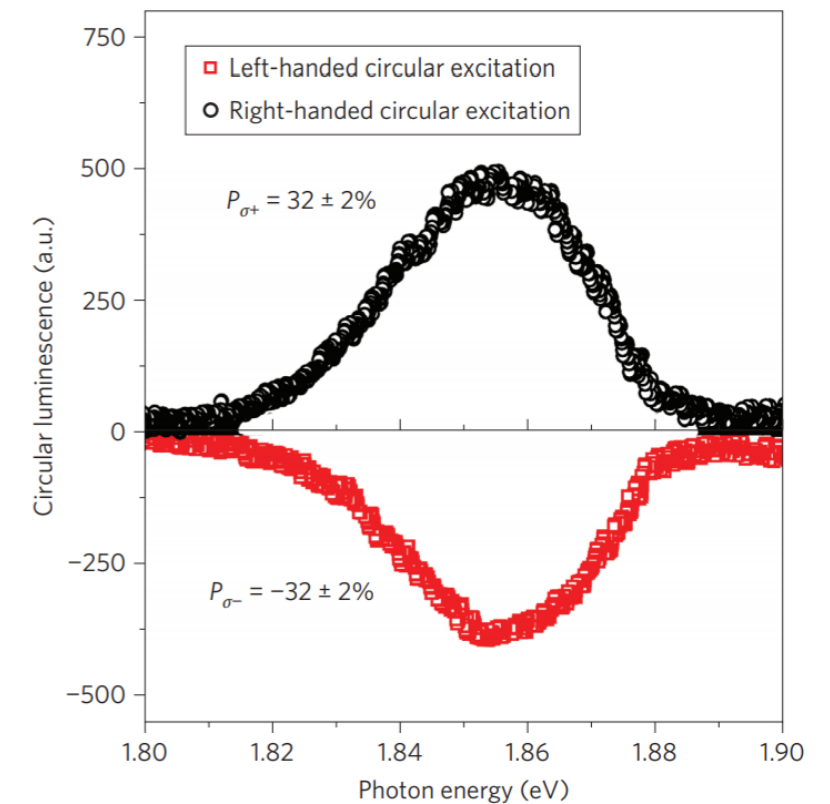
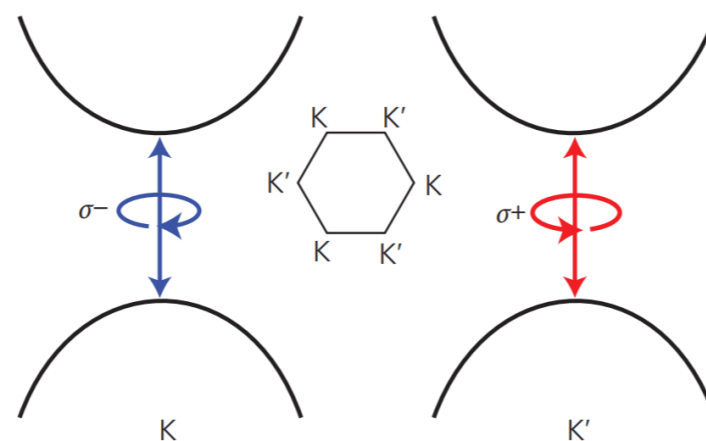
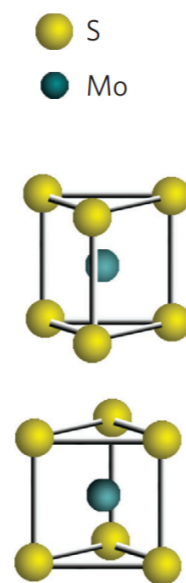
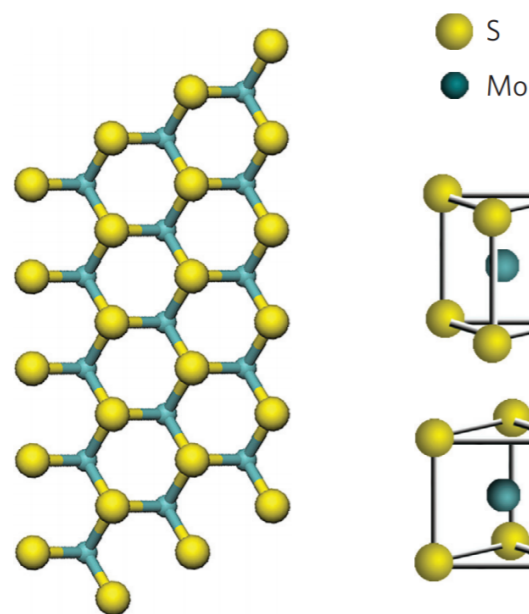
# Measuring strong field Valleytronics

I. Tyulnev, M. Enders, L. Maidment, L. Vamos and J. Biegert

# Valley polarisation

- Novel type of logical switch based on excitation into symmetry points in reciprocal space
- Demonstrated in transition-metal-dichalcogenide monolayers (e.g. MoS<sub>2</sub>)
- Selection rules from different coupling between Mo and S orbitals to circular pol. light

➔ excitation of carriers into K or K' valleys dependent on handedness

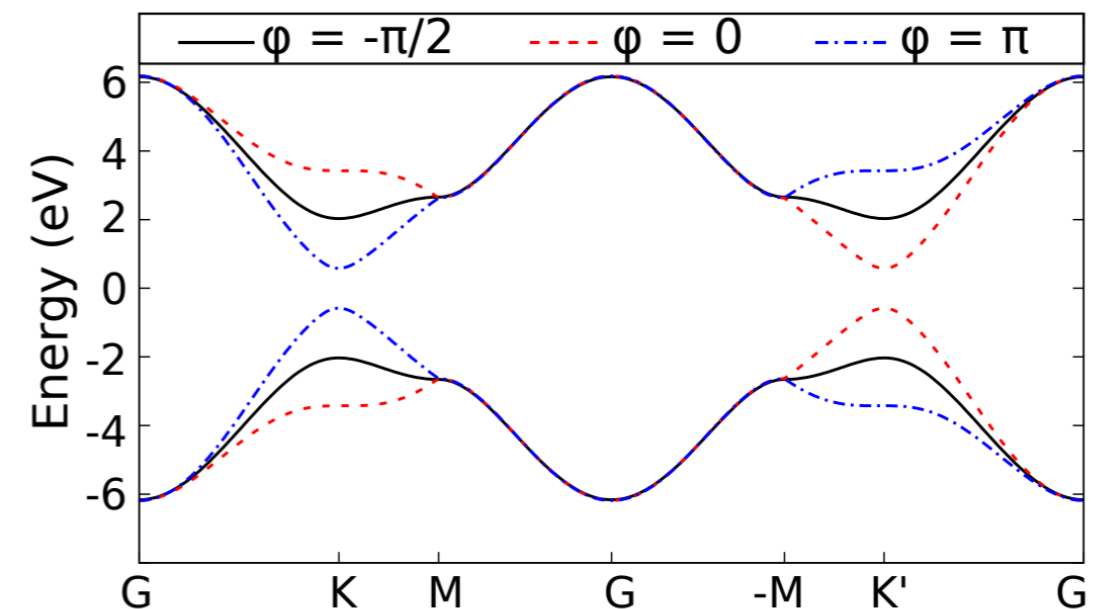
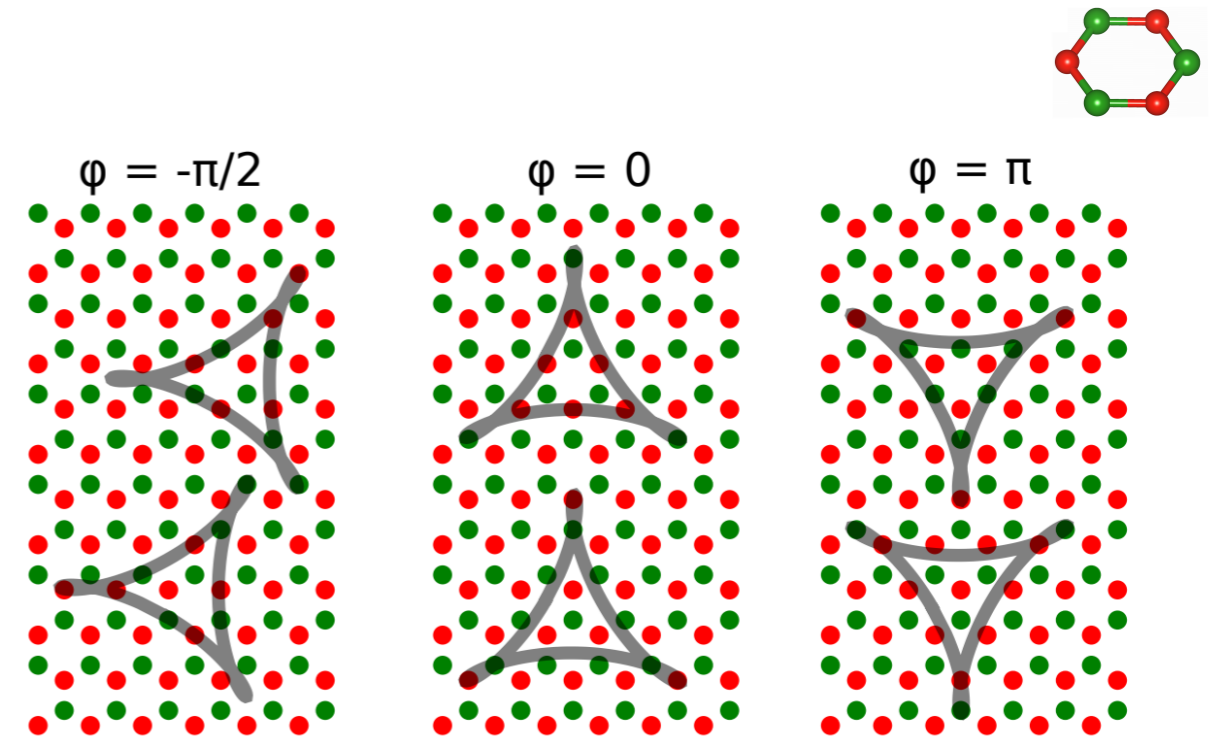


Adapted from  
H. Zeng et al. Nat. Nanotechnol. 7, 490 (2012)

# Light induced excitation in hexagonal-BN

- Trefoil shape:  
Interfering **left-handed circular** pol. beam with its **right handed circular 2<sup>nd</sup> harmonic**
- Breaking crystal symmetry with strong + off-resonant laser field reduces band gap

➔ Independent of specific material or driver wavelength!



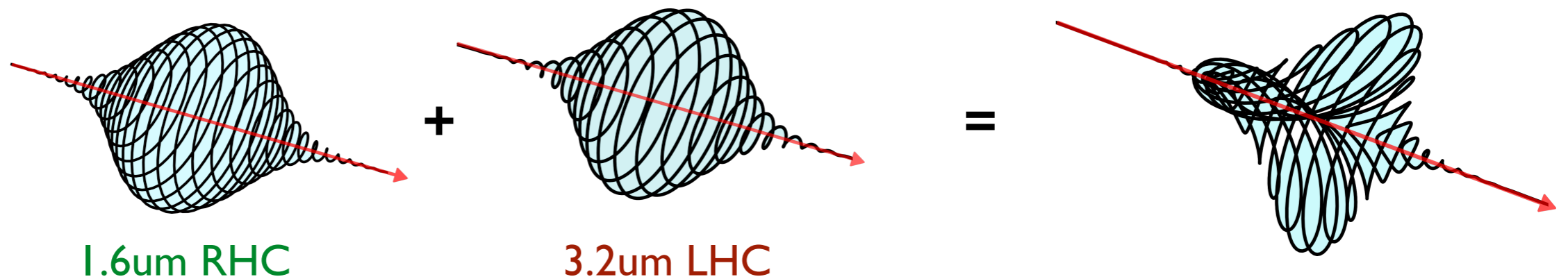
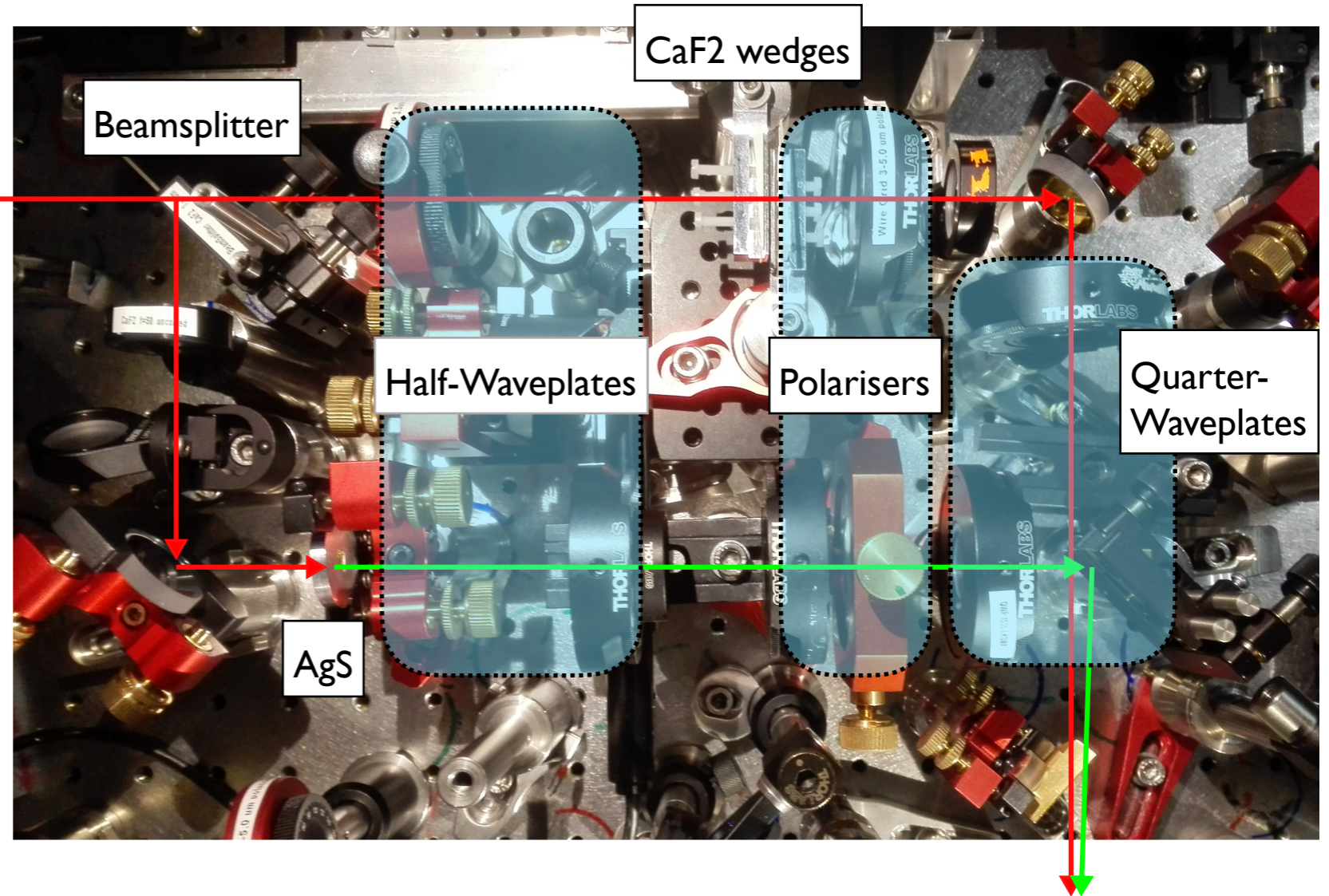
Adapted from

Á. Jiménez-Galán et al. Nat. Photonics 14, 728 (2020)

# Tailoring a field

160kHz 3 $\mu$ m OPCPA

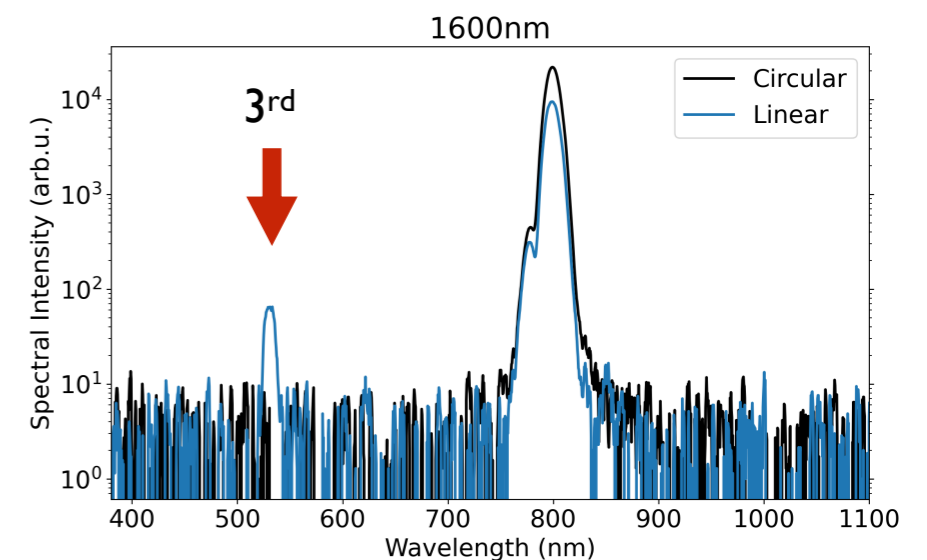
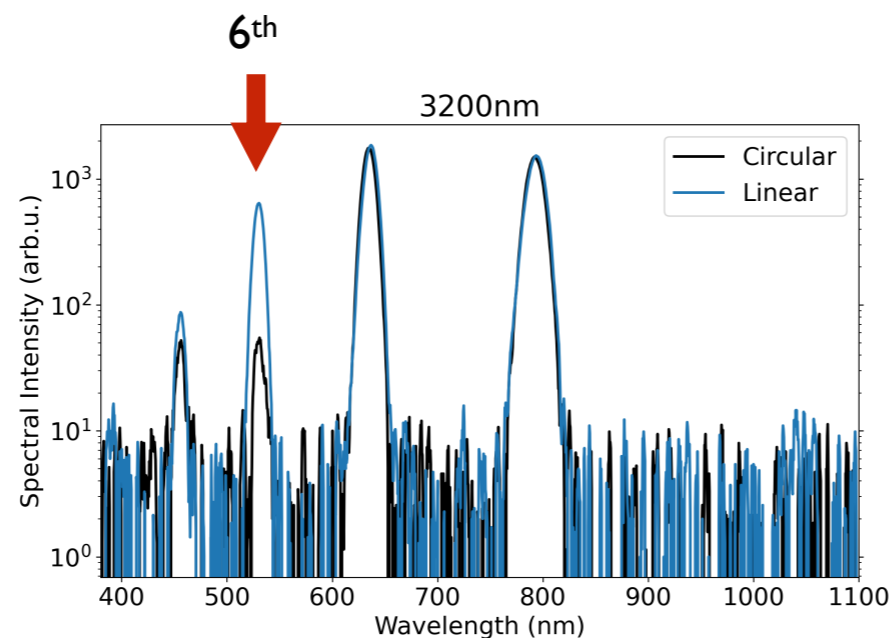
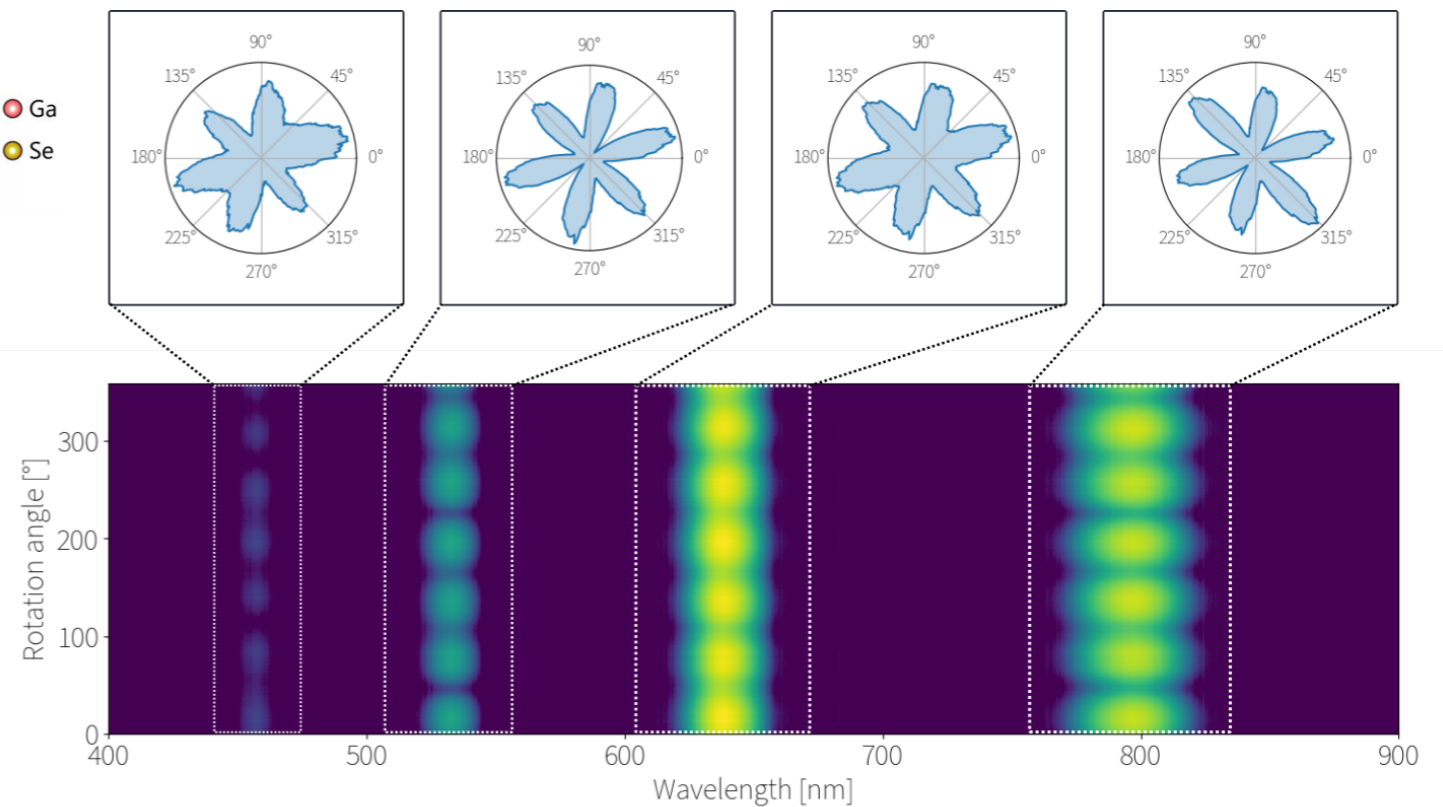
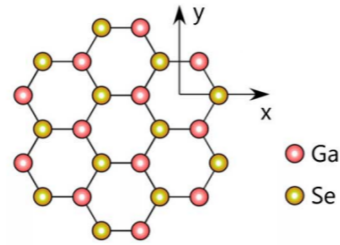
- Mach Zehnder like setup to independently adjust **fundamental** + **2<sup>nd</sup> harmonic**
- Intensity ratio: HWP + Polarisers
- Handedness: QWP
- Trefoil rotation: Delay wedges



# Characterisation with GaSe

- GaSe is a hexagonal crystal (bandgap 2.2 eV)
- Six-fold symmetry for linear light
- No angle dependence for circular light
- Circ. polarised light suppresses harmonic orders  $3n$

➔ Trefoil field must again show angle dependence!



Adapted from  
N. Saito et al. Optica 4, 1333 (2017)



**Thank you for your attention!**

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