Outlook for the Transient Grating lab

new experiments planned:

- measure carrier mobilities in perovskites (solar cell material)

- excite spin-valley grating in TMDCs (Transition Metal DiChalcogenides)

carrier mobilities in perovskites

Hybrid perovskites

- simple and cheap production (spin coating, printing)
- 3.8% efficiency in 2009 [1]
- 19.7% efficiency in 2017 [2]
- Recent record in efficiency 21.1% 2018 [3]
- 19 % efficiency with estimated 3.7years stability 2017 (multiple cations)[4]

[1] Kojima et al, J.Am.Chem. Soc.,2009
[2] Yang et al, Science,2017
[3] Sinkh et al, Adv. Funct. Mat., 2018
[4] Jodlowski et al, Nature energy, 2017

carrier mobilities in perovskites

$$Gu_{1.4}Cs_{4.3}Ma_{13.2}Fa_{72.9}Pb(I_{0.815}Br_{0.185})_3$$

What makes a good solar cell material?

- high absorption
- long carrier lifetime
- high carrier mobility

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What makes a good solar cell material?

- high absorption ✓
- long carrier lifetime ✓
- high carrier mobility → Transient Grating Spectroscopy

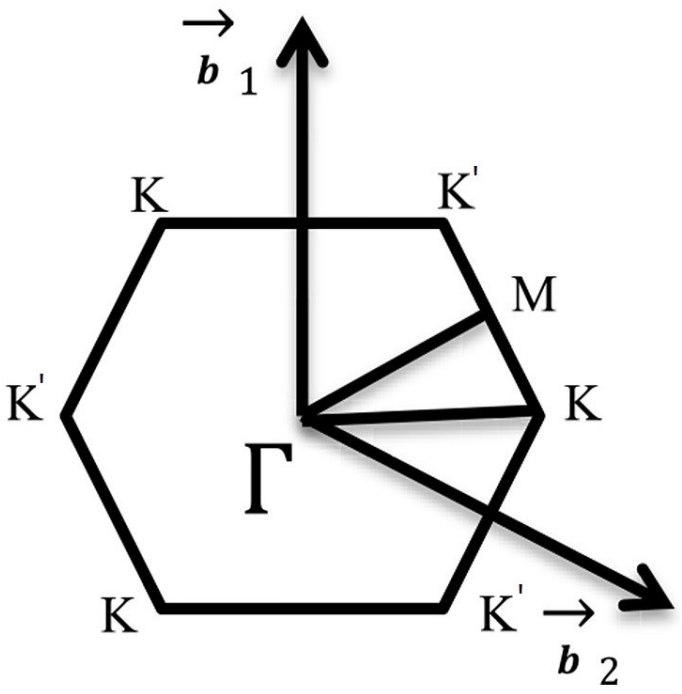
carrier mobilities in perovskites

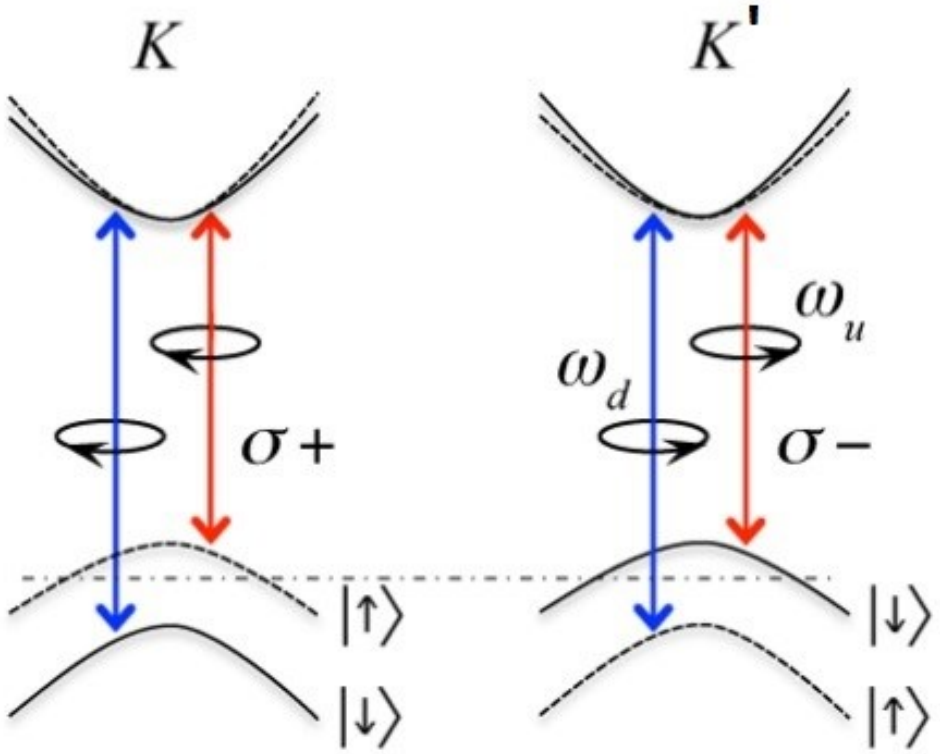
$$Gu_{1.4}Cs_{4.3}Ma_{13.2}Fa_{72.9}Pb(I_{0.815}Br_{0.185})_3$$

Challenge: Bandgap = 1.65 eV  tune laser wavelength

spin-valley grating in TMDCs

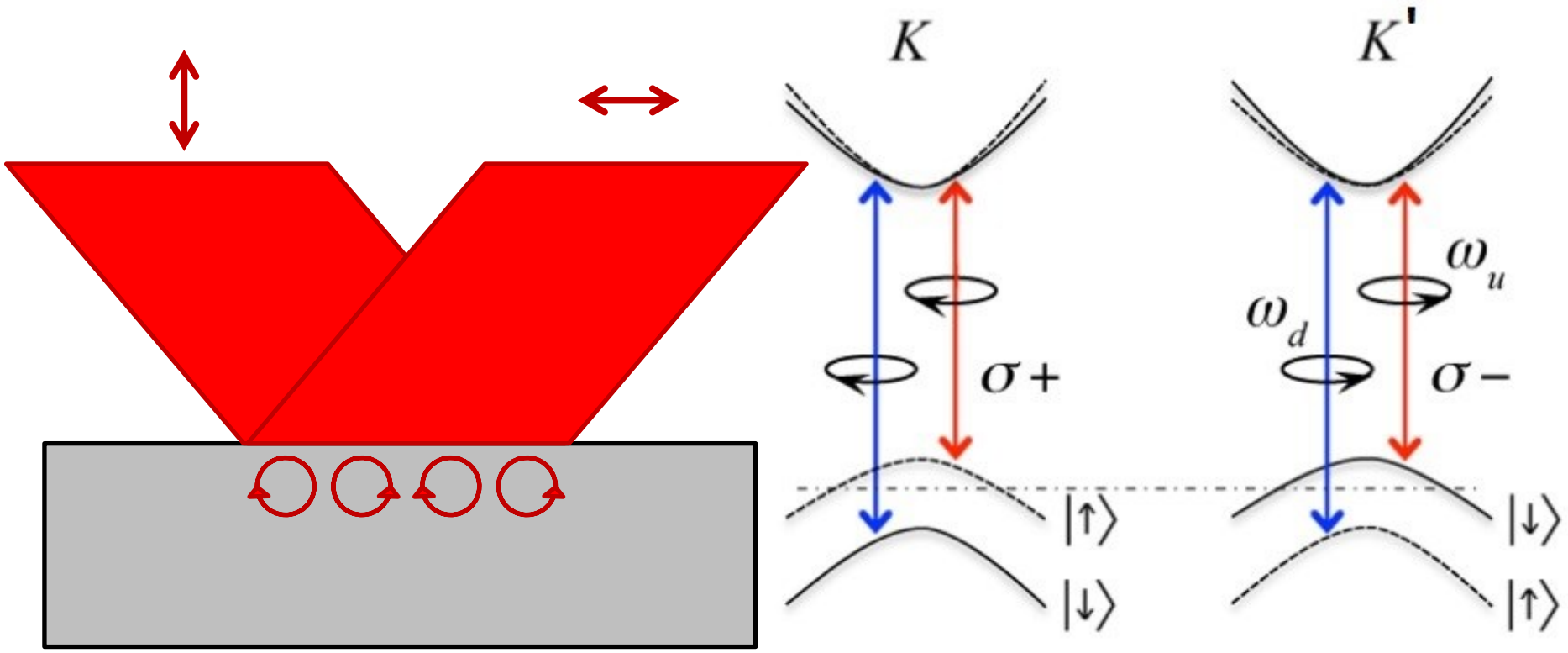
Monolayer: broken inversion symmetry
splitting of valence band
different at K and K’ valleys



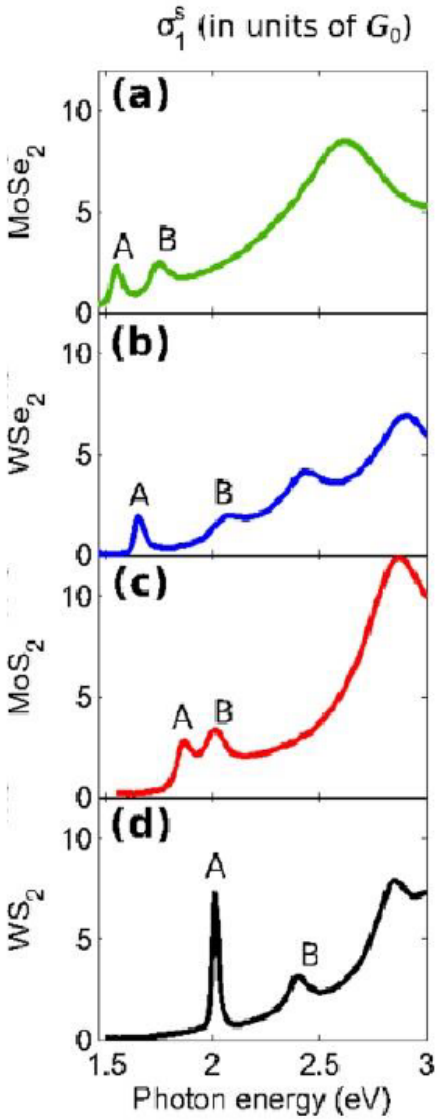


spin-valley grating in TMDCs

Idea: excite with cross-polarized pump pulses
create stripes of alternating hole populations



spin-valley grating in TMDCs



Bandgap

800nm

766nm

Choice of materials depends on bandgap

spin-valley grating in TMDCs

Challenges:

- Bandgap → tune laser wavelength
- suppression of stray light → ?
- sample size: tiny flakes → aim well
- interpretation of data: e/h/exciton diffusion, e/h intervalley scattering, recombination, substrate?

Thank you