EFFECT OF SCATTERING DYNAMICS ON DUST POLARIZATION

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ERC Grant 400880 (SAEMPL)
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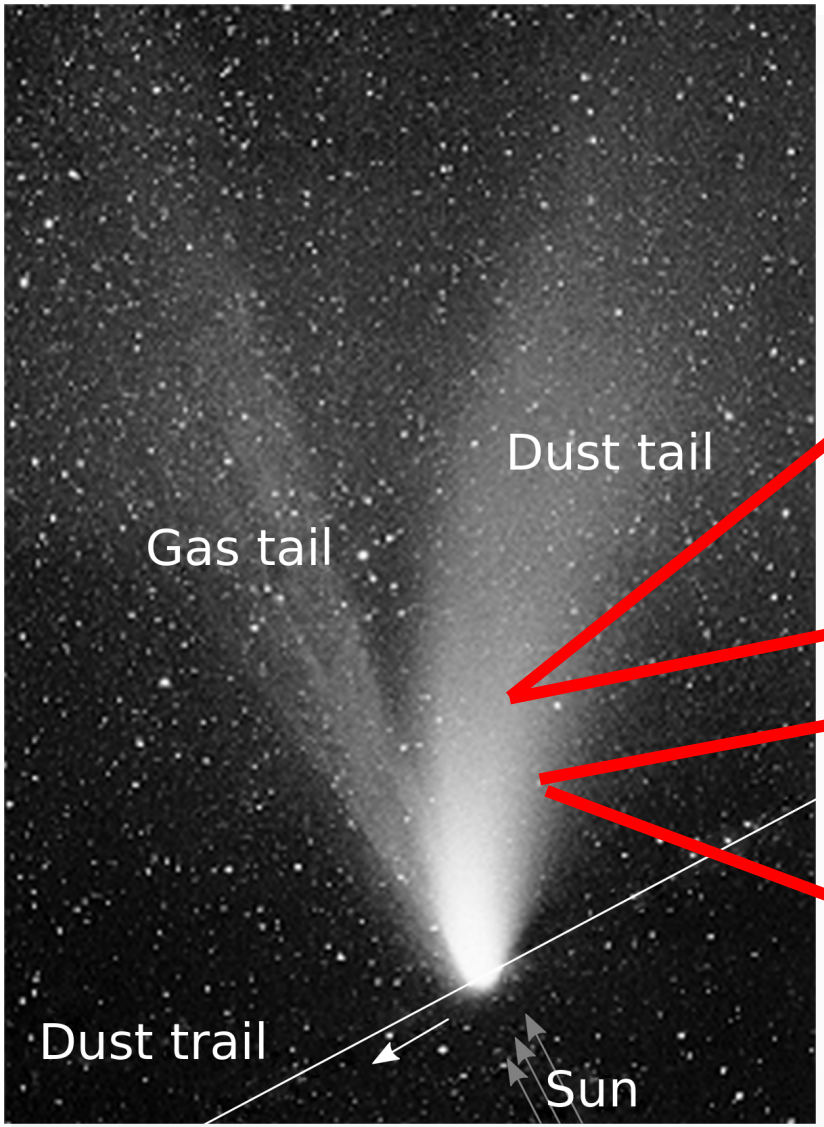
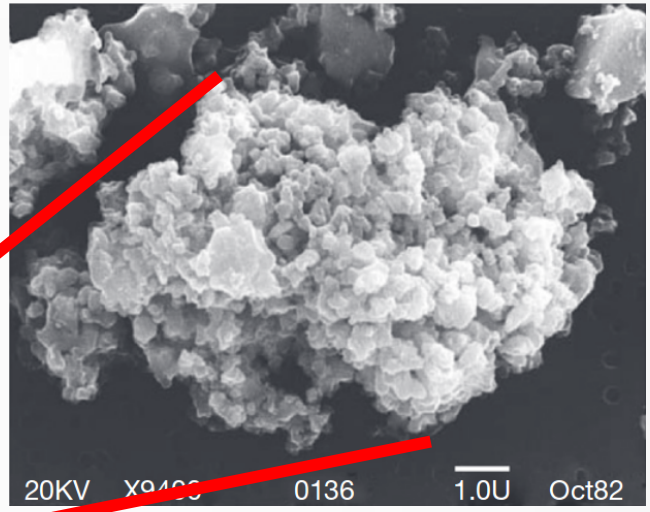
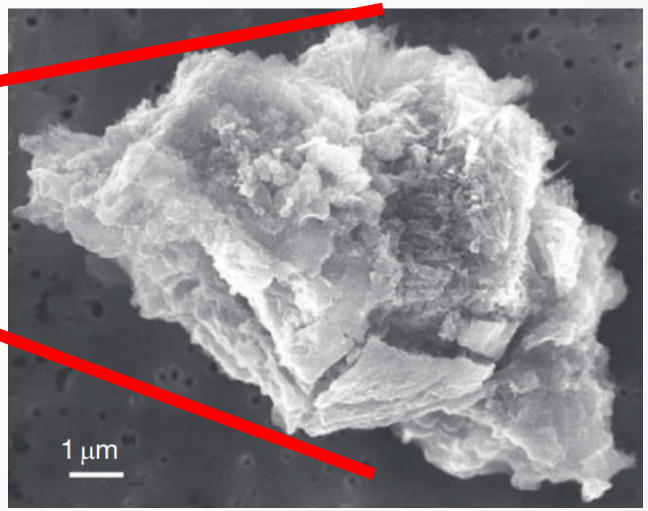


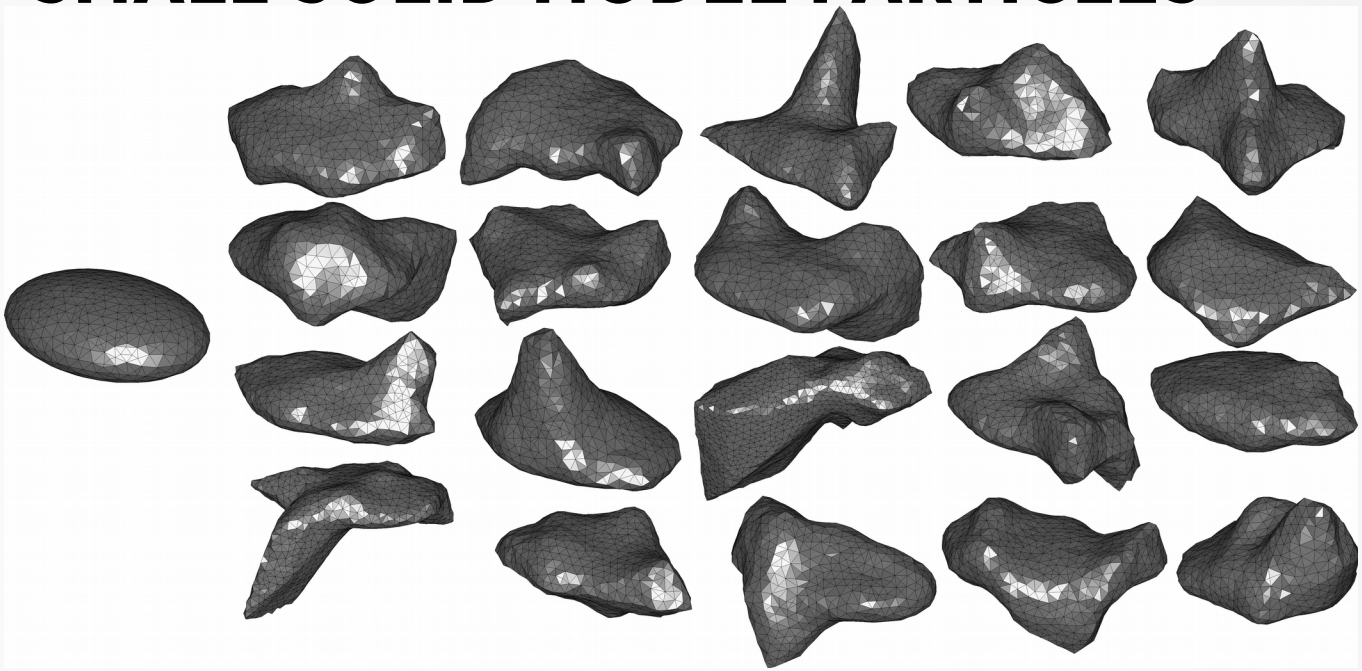




[Bradley, J.P., 2014, Treatise in Geochemistry, vol. 1. 287-308]

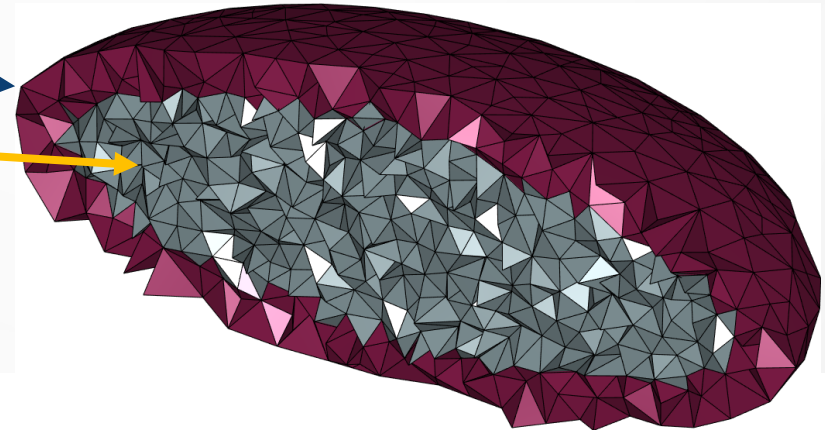
SMALL SOLID MODEL PARTICLES

Gaussian
Random
Ellipsoids

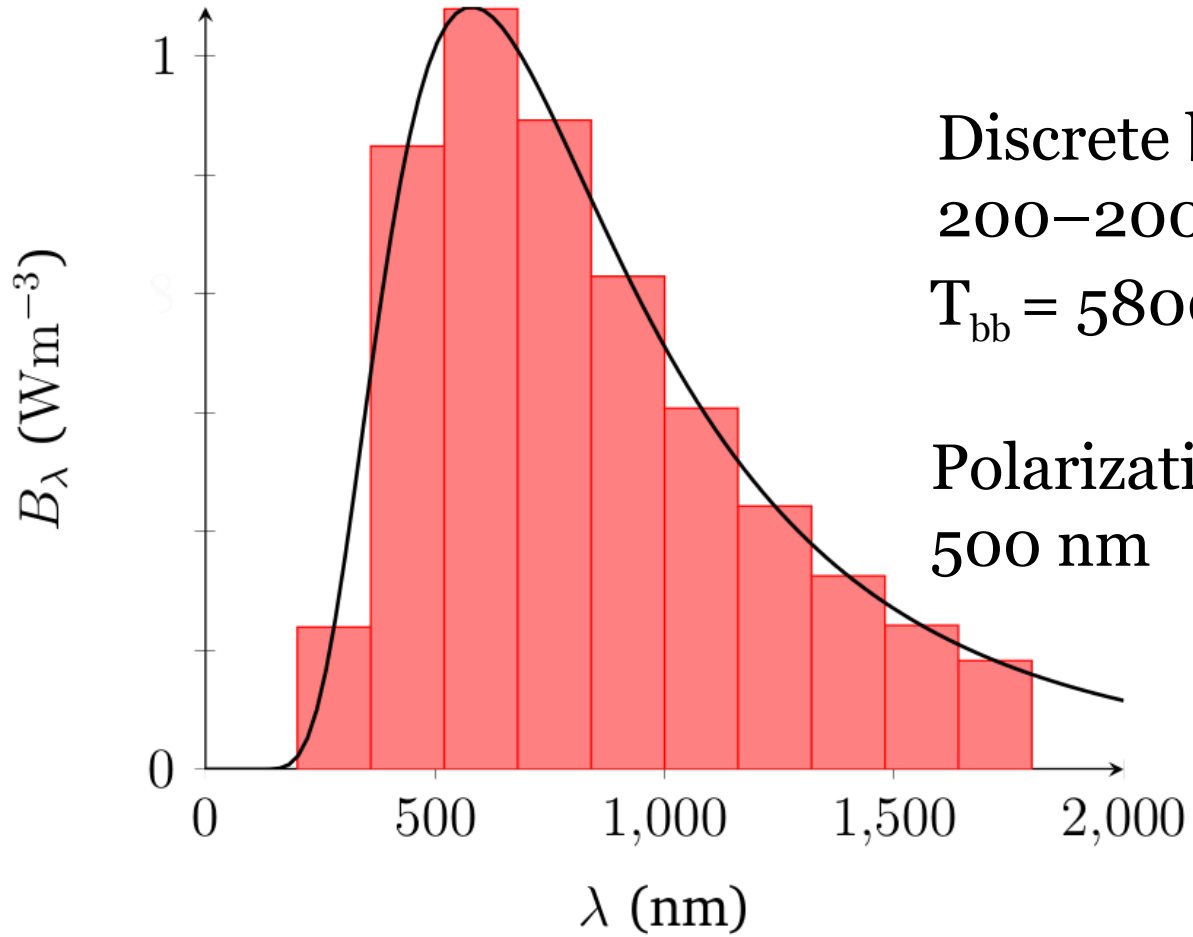


$\varepsilon_r = 1.95 + i0.78$

$\varepsilon_r = 1.69 + i0.000104$



RADIATION ENVIRONMENT

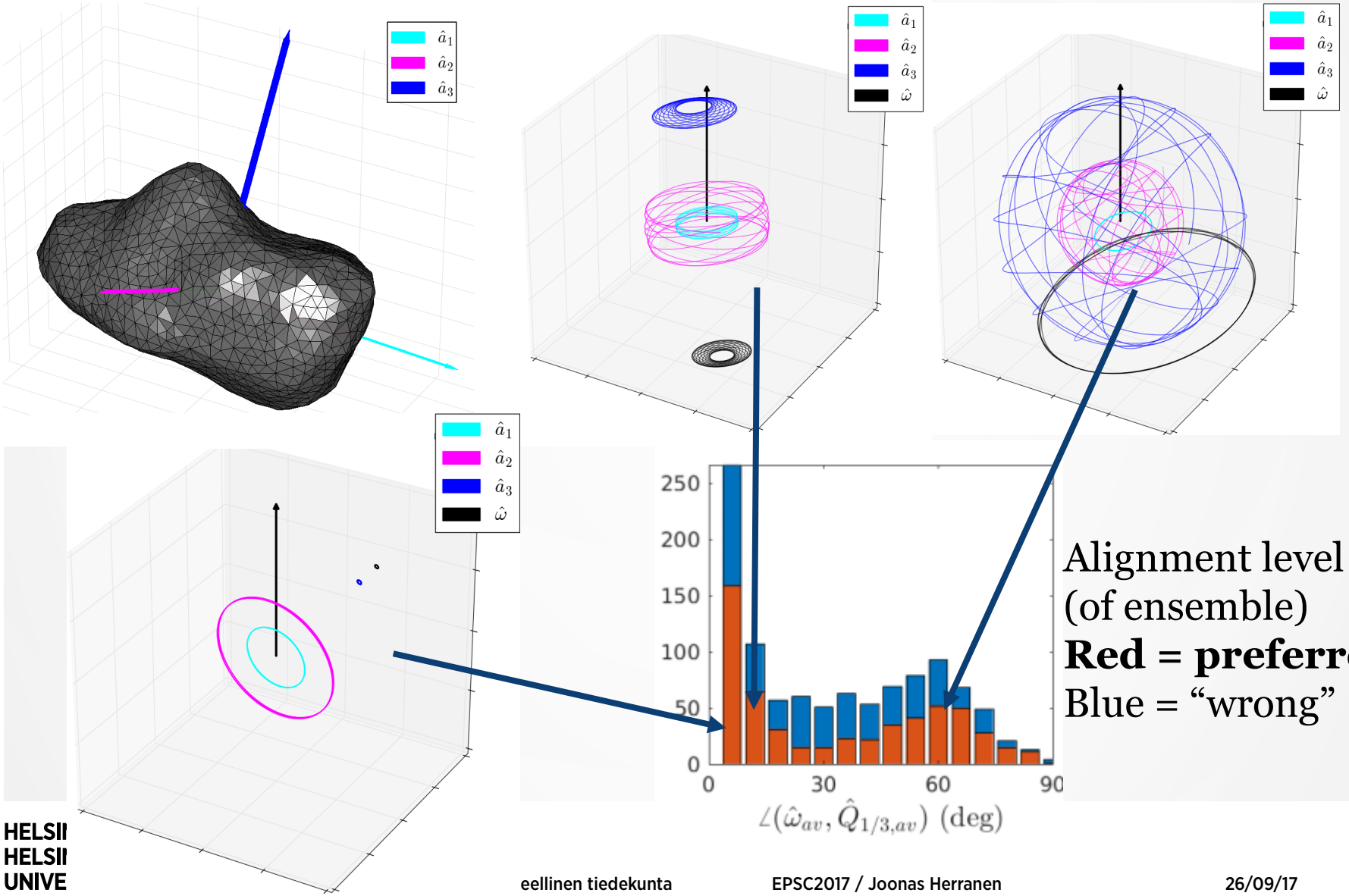


Discrete blackbody spectrum 200–2000 nm

T_{bb} = 5800 K

Polarization measurement at 500 nm

ANIMATIONS TO DATA (EXAMPLE)

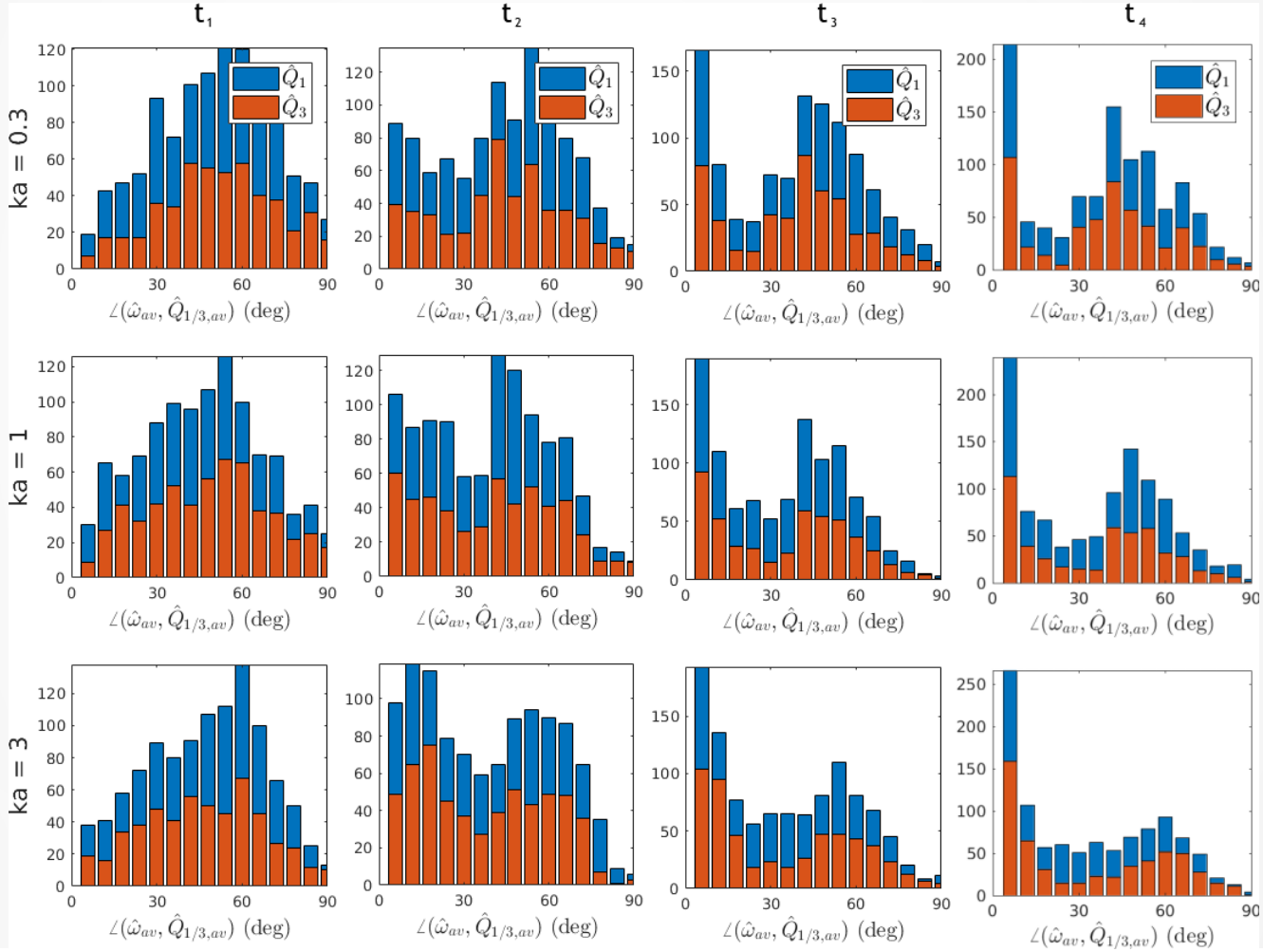


Alignment level
(of ensemble)
Red = preferred
Blue = “wrong”

ALIGNMENT LEVEL INCREASES IN TIME (EXAMPLE)

$t_1 < t_2 < t_3 < t_4$

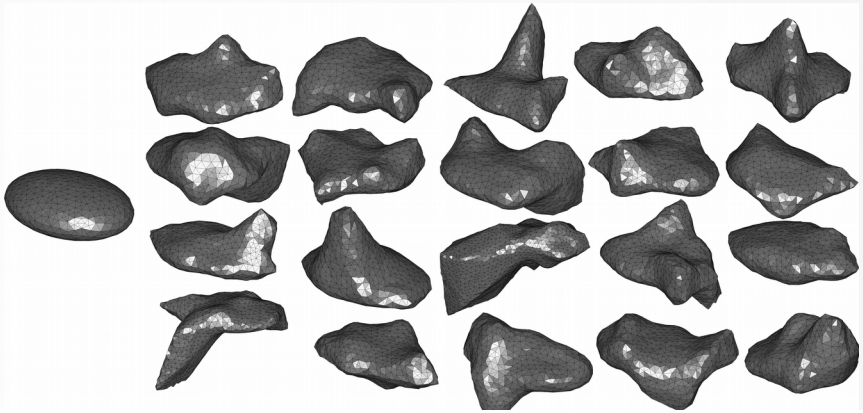
monochromatic radiation

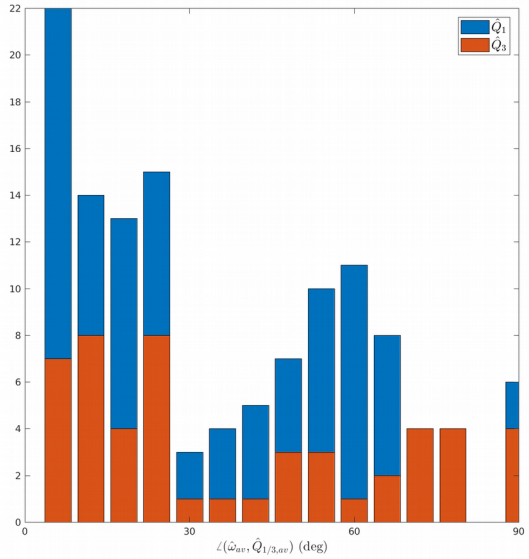


[Herranen et al. 2017 (under review)]

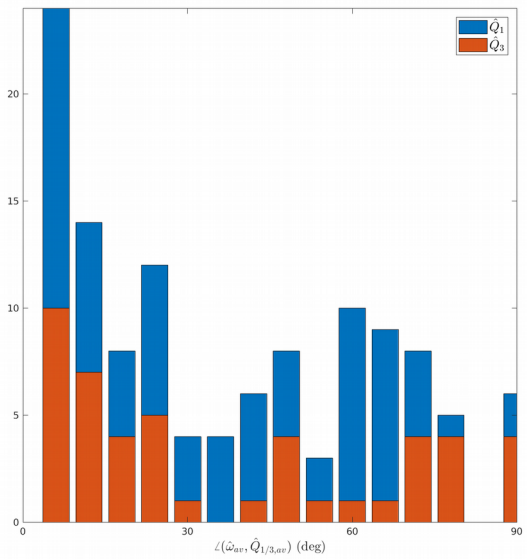
ALIGNMENT OF THE ENSEMBLE

Exact time scales depend on inertia and incident radiation intensity

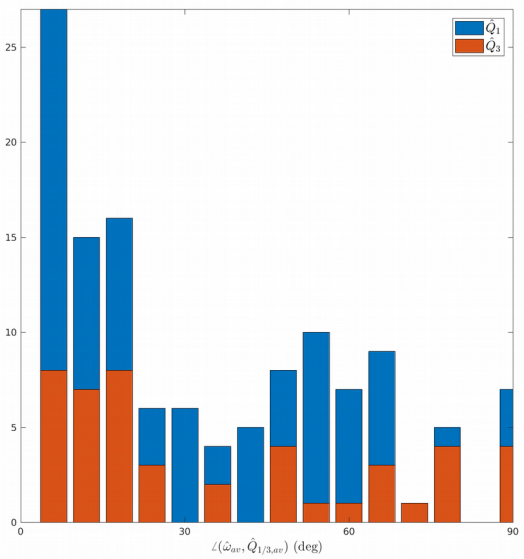




1e7 time steps

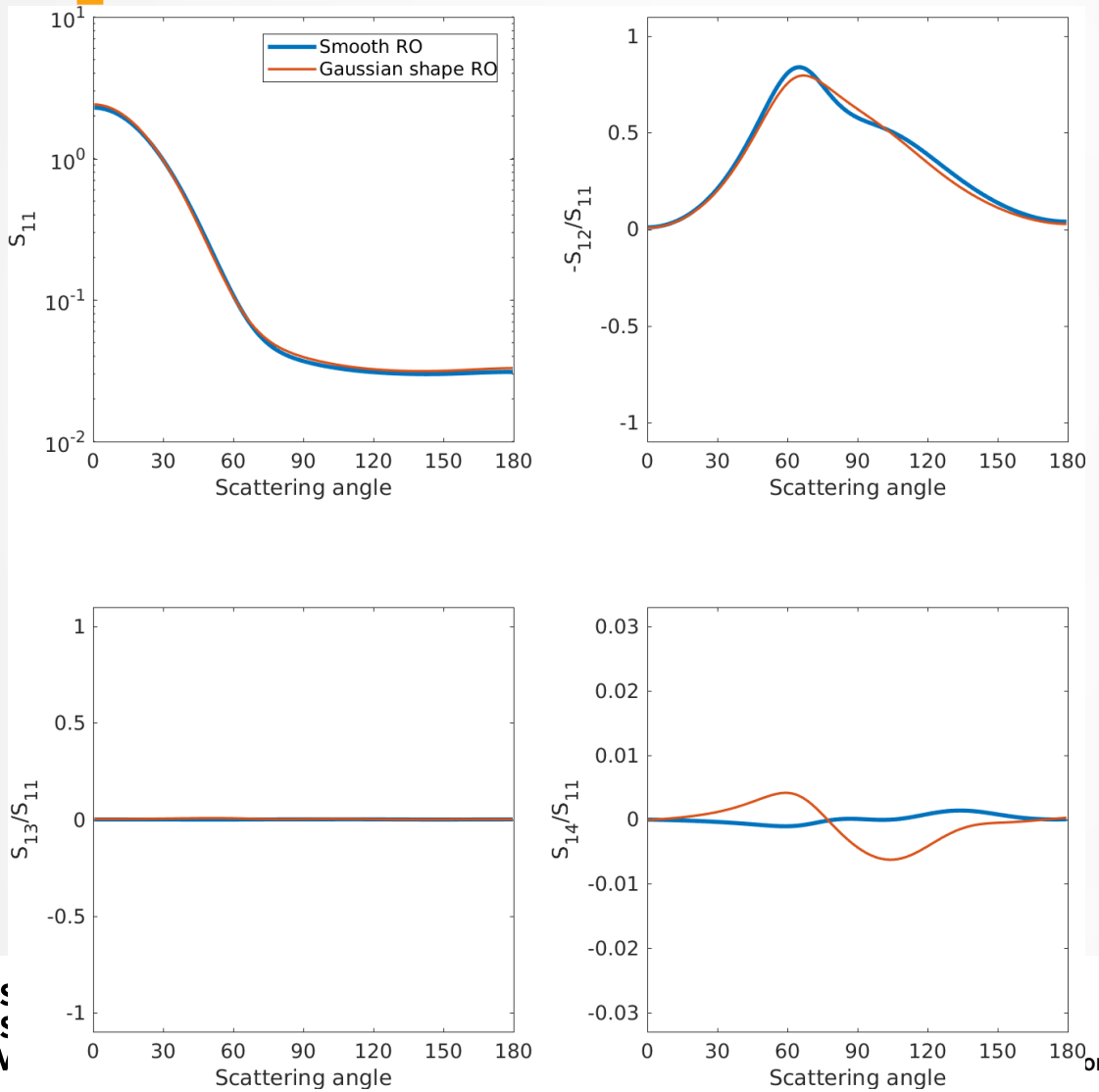


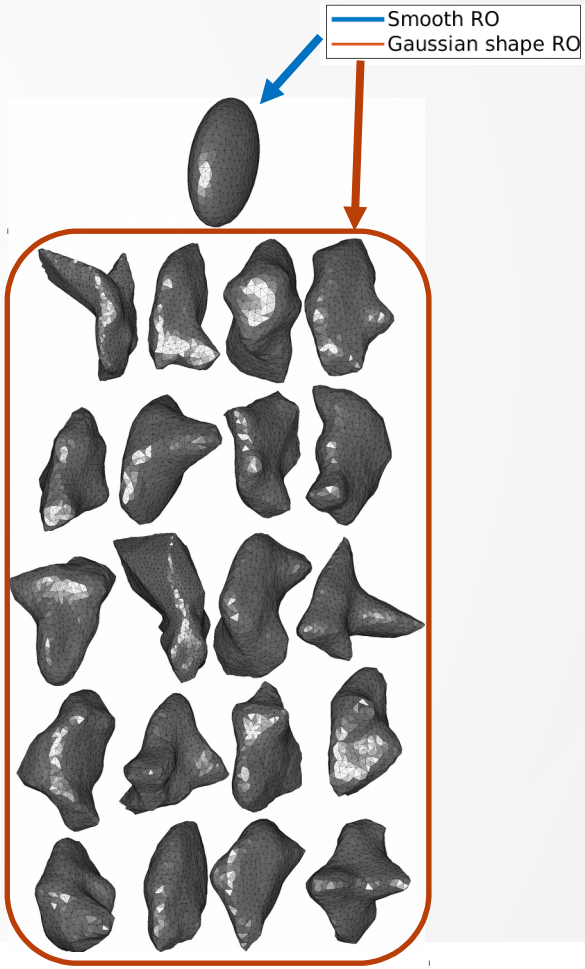
2e7 time steps



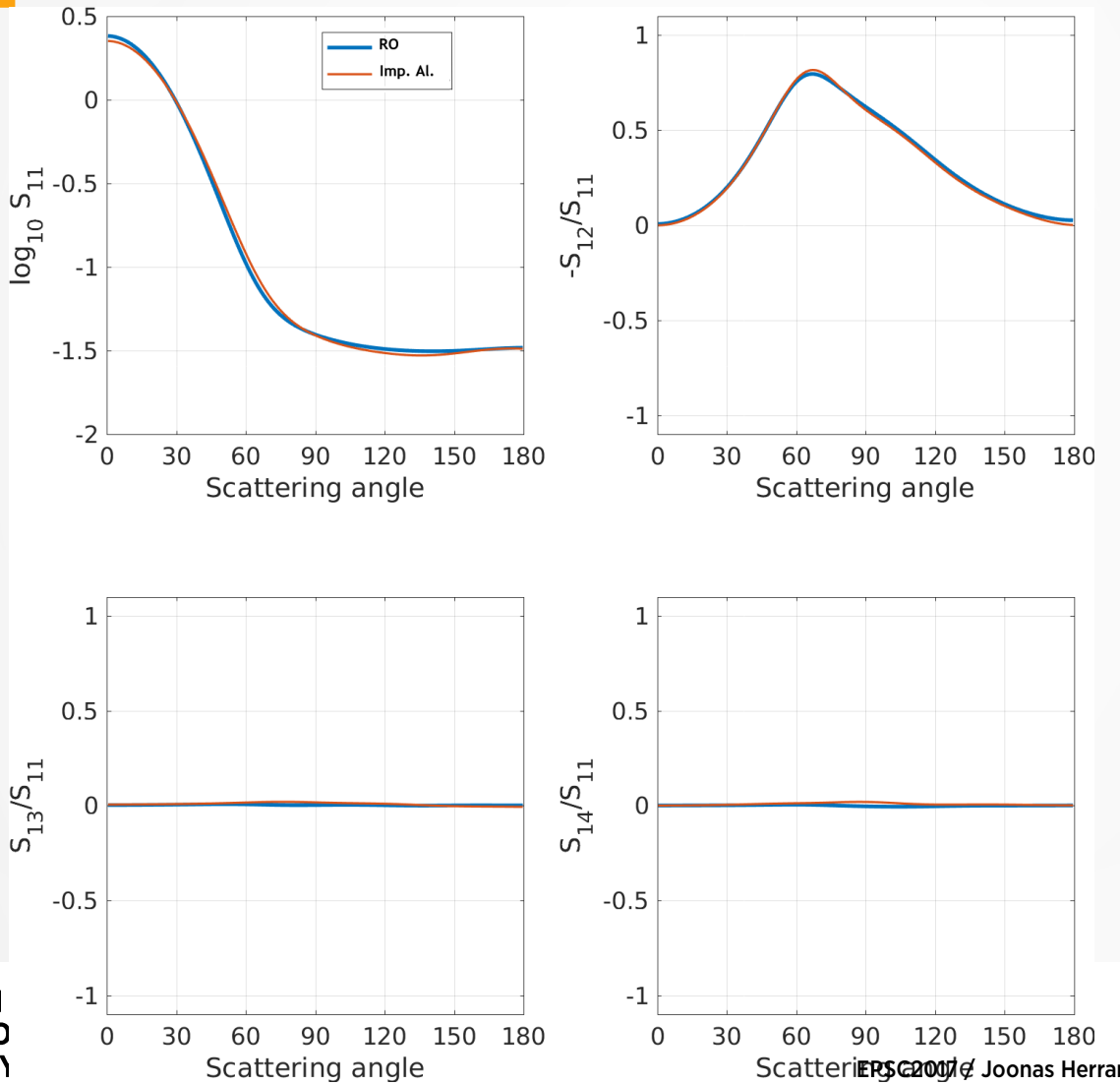
4e7 time steps

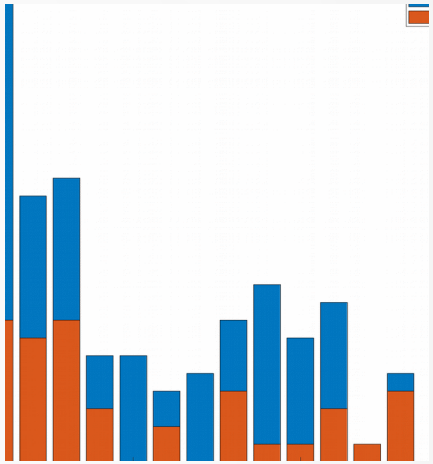
POLARIZATION RESULTS: RANDOM ORIENTATIONS (RO)

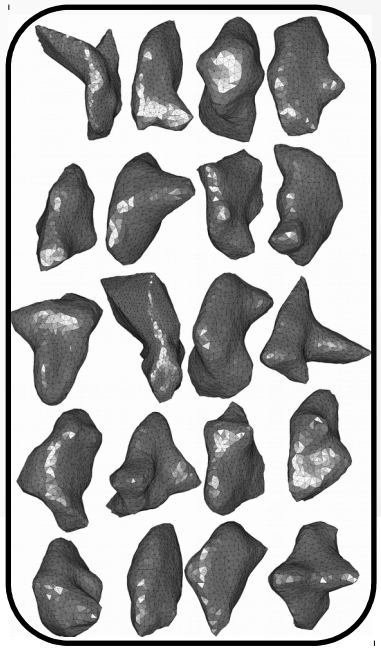




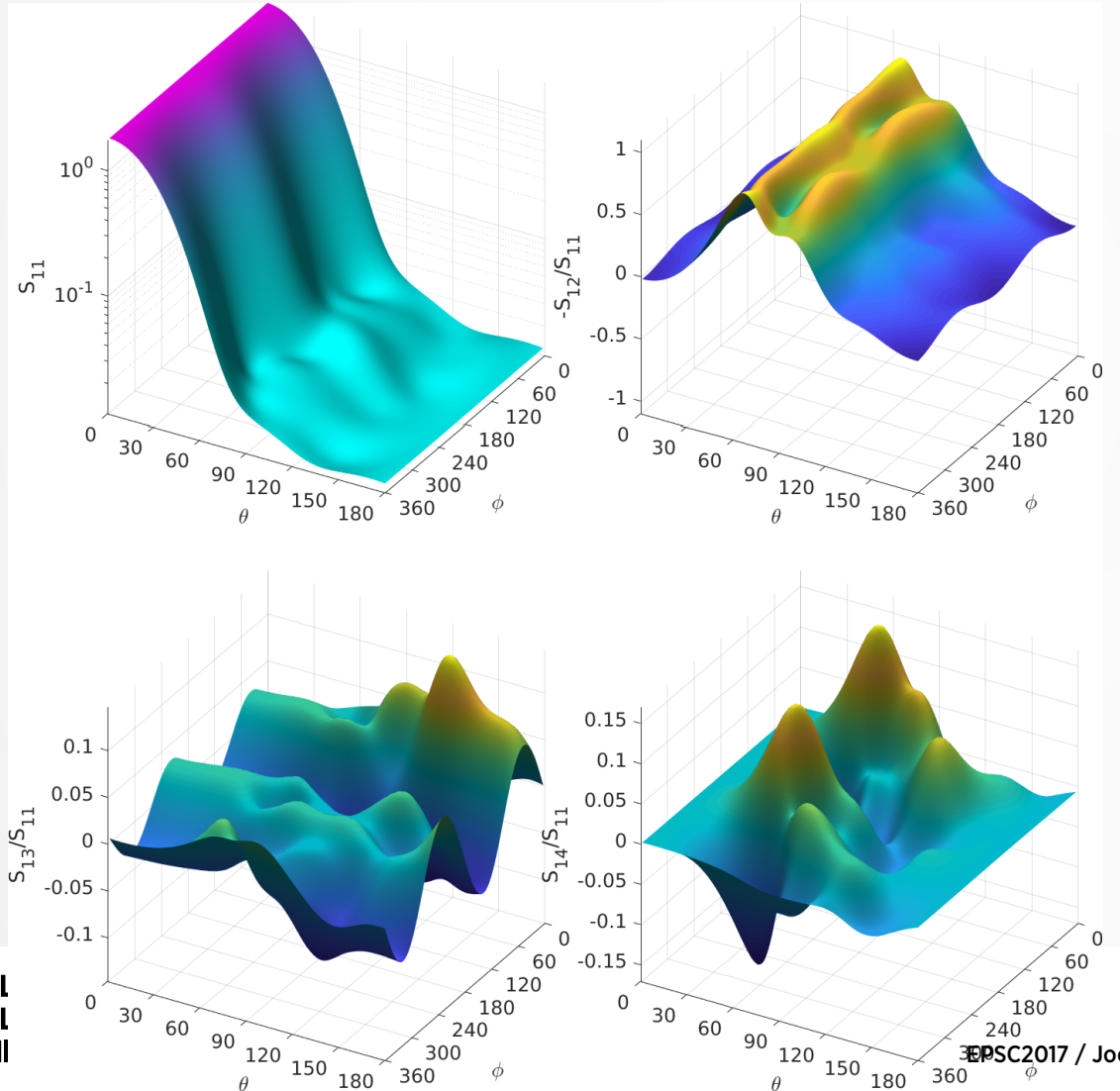
POLARIZATION RESULTS: RO VS IMPERFECT ALIGNMENT

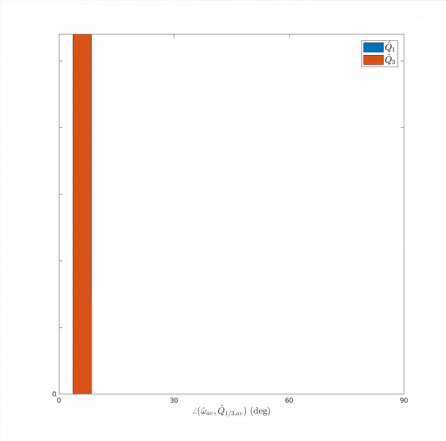


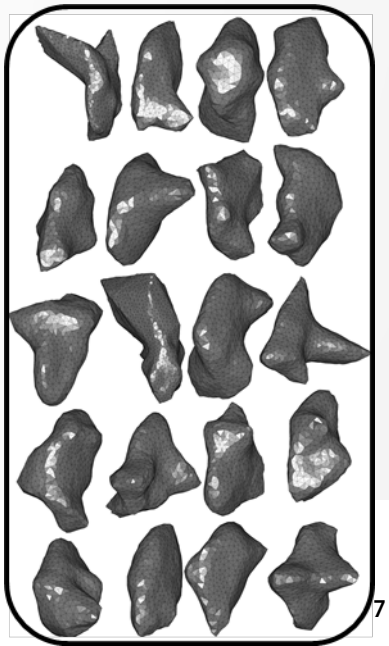




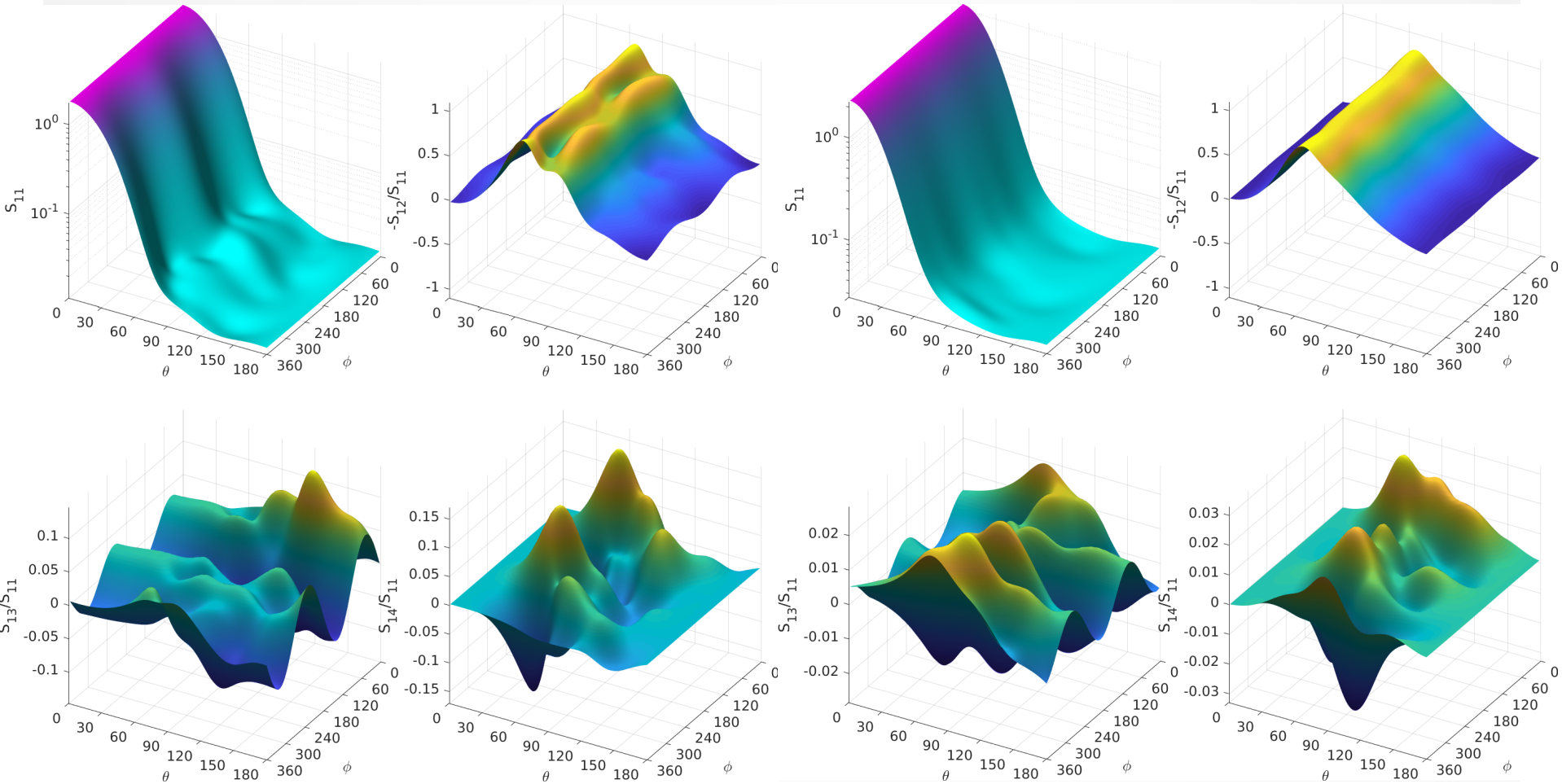
POLARIZATION RESULTS: PERFECT ALIGNMENT





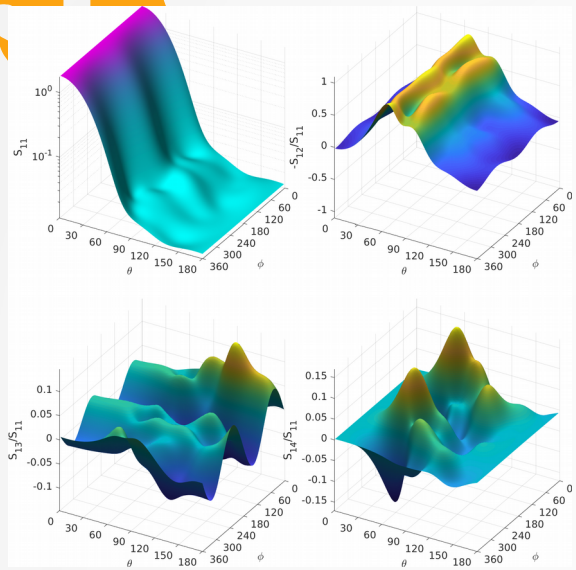


POLARIZATION RESULTS: PERFECT VS IMPERFECT

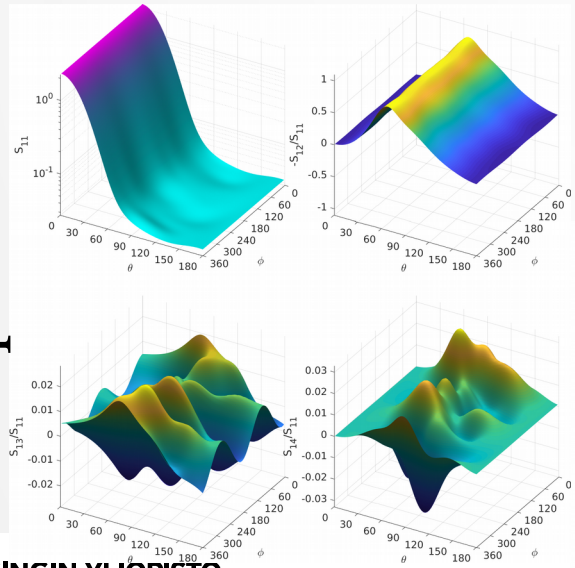


CONCLUSIONS

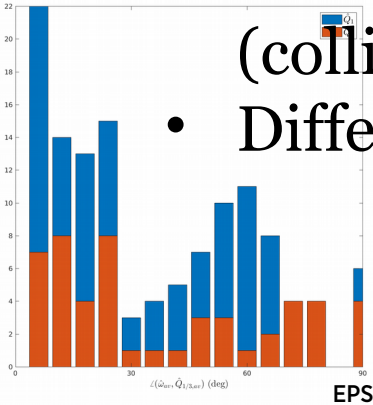
Perfect



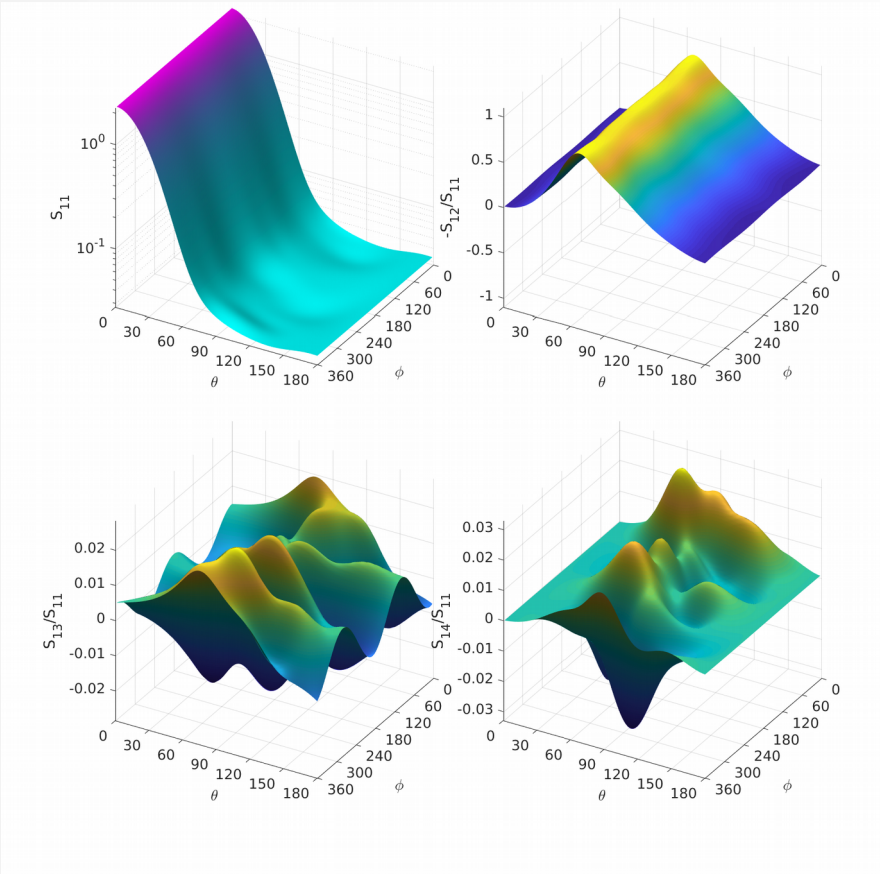
Imperfect



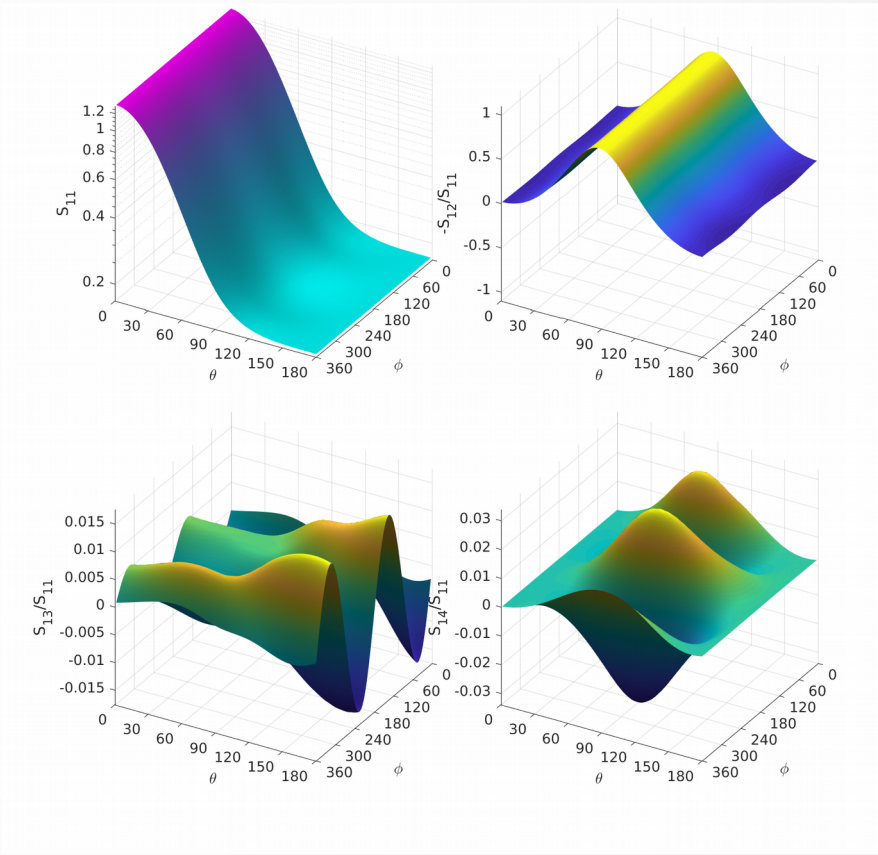
- Fast and accurate solution to a full problem, results encourage numerous applications
- Degree of circular polarization affected by alignment level
  - Exactly how: different & larger ensembles
- This calculation: low alignment level
  - Additional dynamical effects (collisions, drag, dissipation)
  - Different ensembles



POLARIZATION CURVES: 500 VS 1000 NM (IMPERFECT ALIGNMENT)

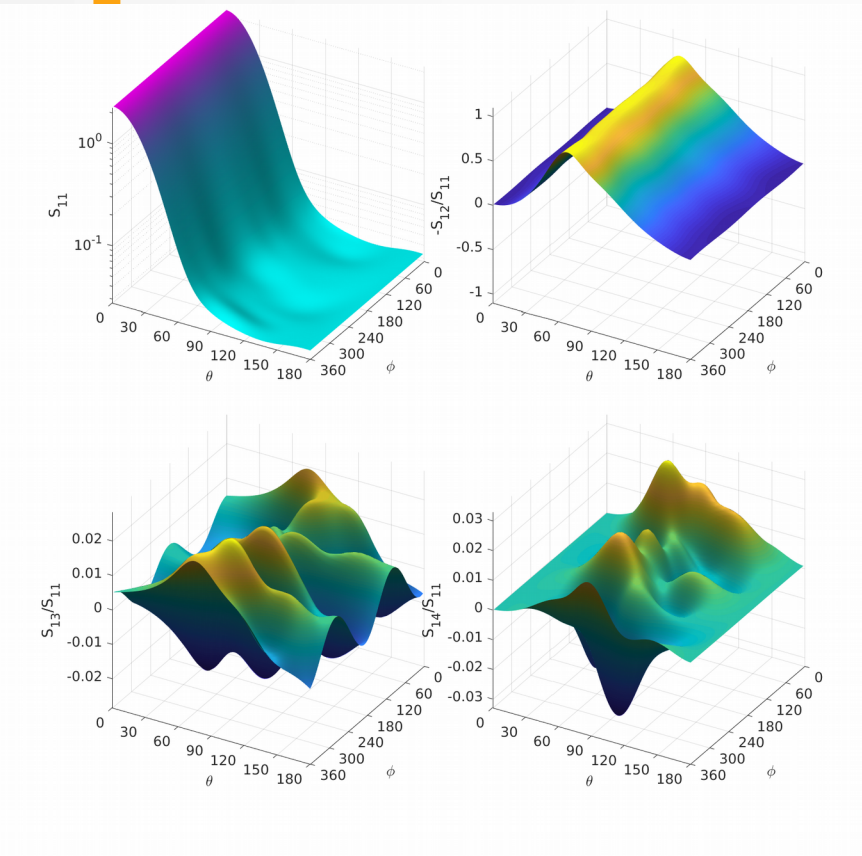


500 nm

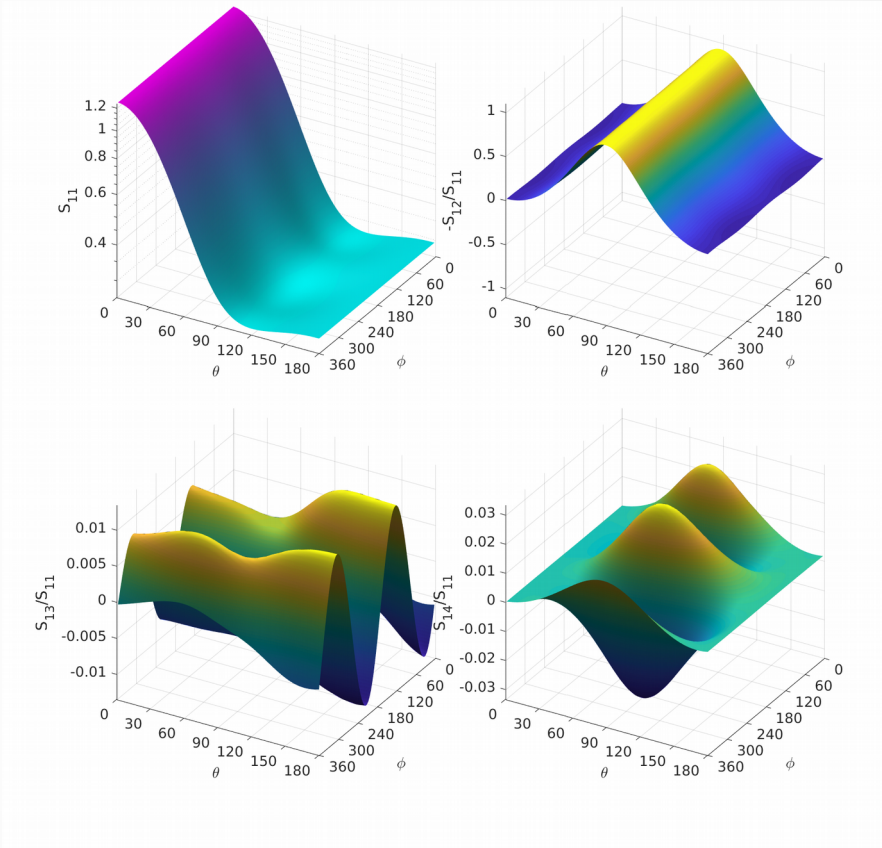


1000 nm

POLARIZATION CURVES: 500 VS 1200 NM (IMPERFECT ALIGNMENT)

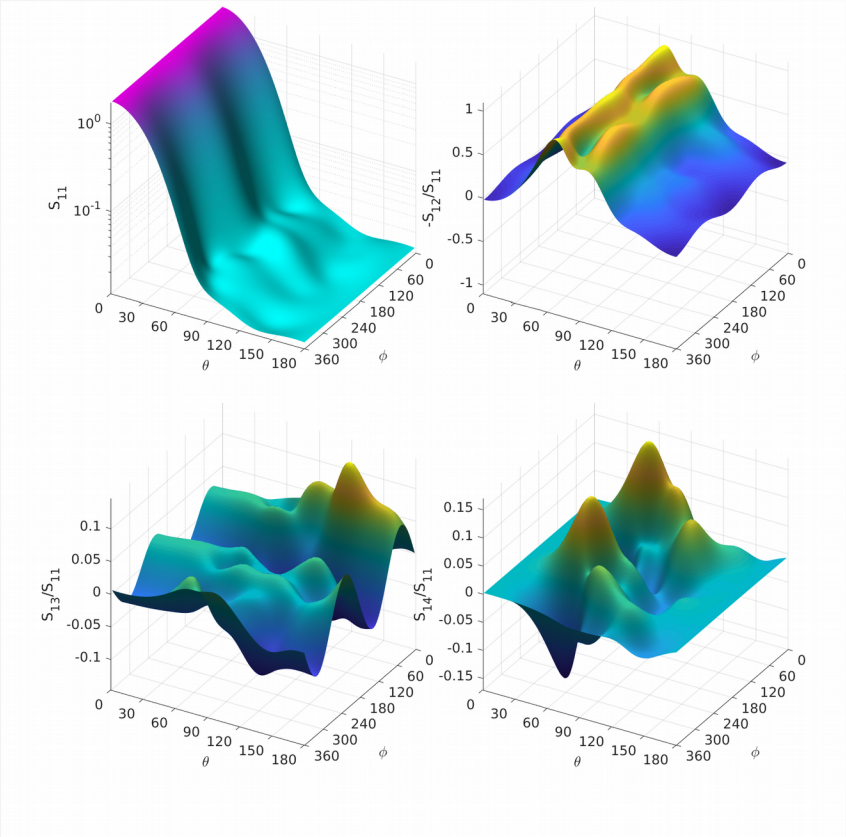


500 nm

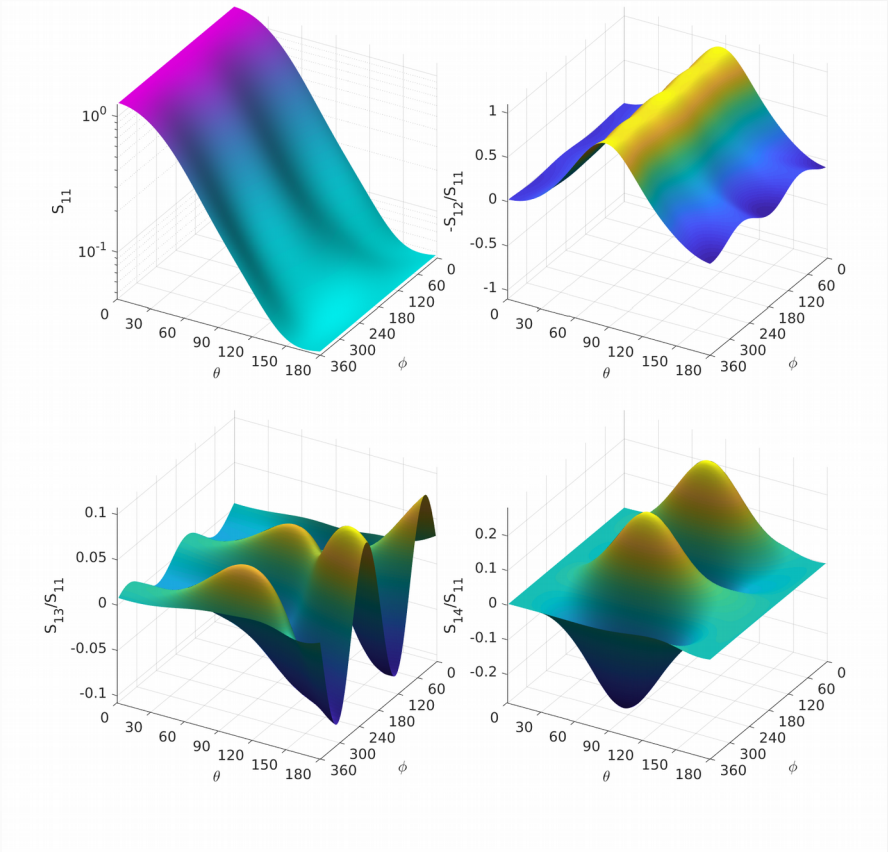


1200 nm

POLARIZATION CURVES: 500 VS 1000 NM (PERFECT ALIGNMENT)

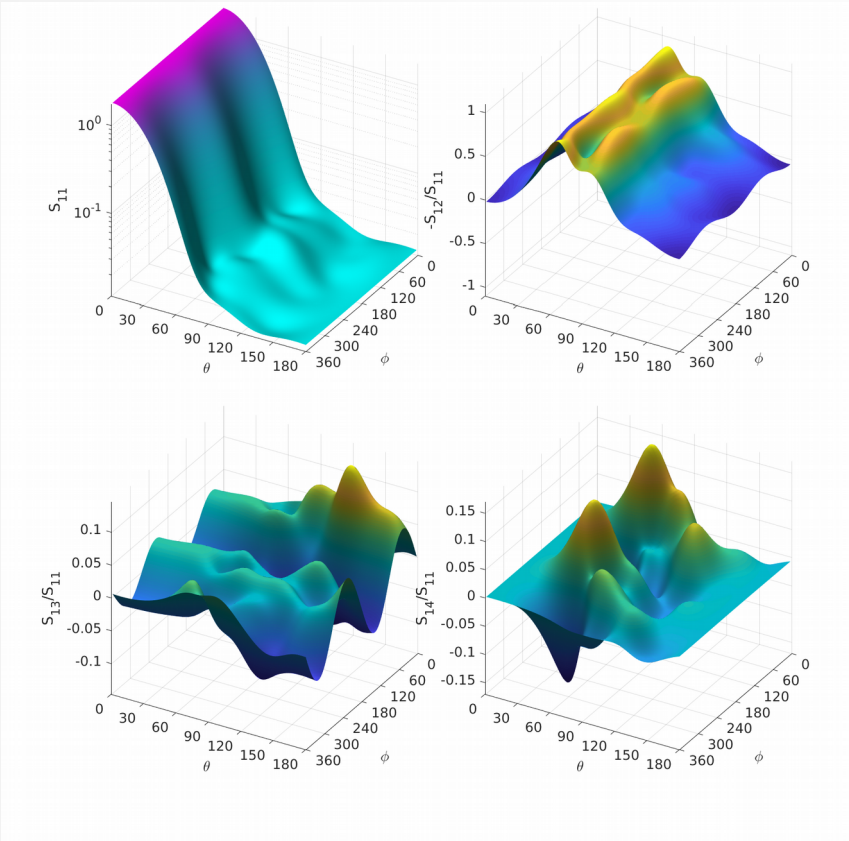


500 nm

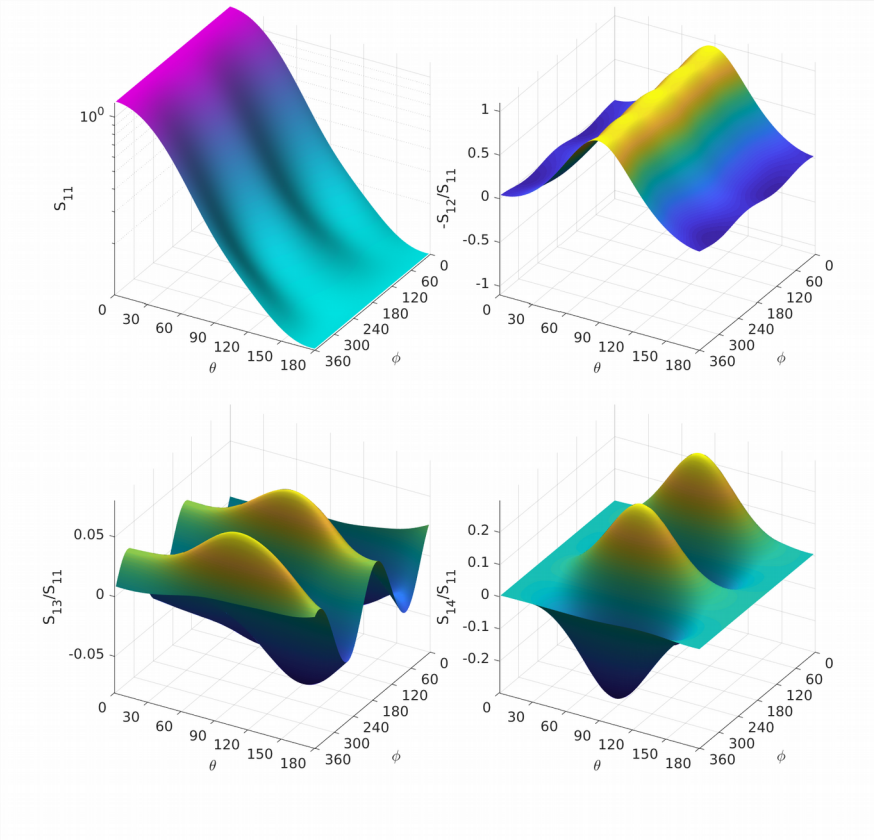


1000 nm

POLARIZATION CURVES: 500 VS 1200 NM (PERFECT ALIGNMENT)



500 nm



1200 nm