

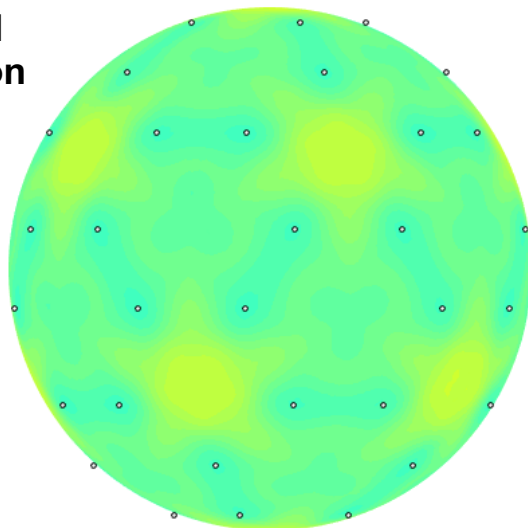
Low-Mode Asymmetry due to Polarization Smoothing in OMEGA Implosions



Scattered Light Distribution (J/sr)

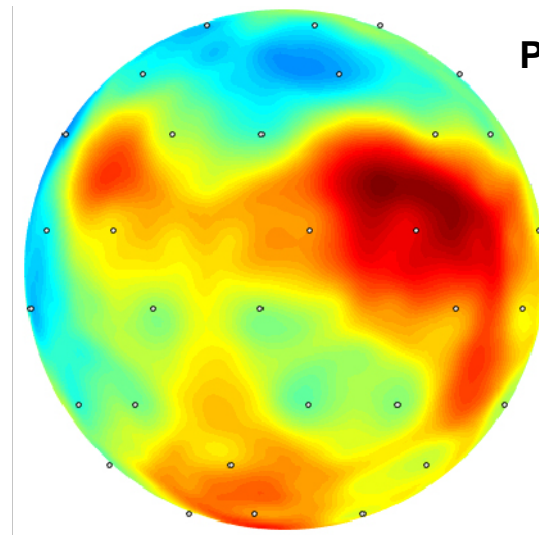
Balanced Polarization

P-V = 4.0 %
rms = 0.9 %



DPR Split Polarization

P-V = 26.1 %
rms = 4.8 %



E29234

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Non-uniformity in the measured scattered light during OMEGA implosions can be explained by modeling the polarization smoothing method



- Uniform laser energy absorption is essential for successful laser direct drive implosions but multiple diagnostics on OMEGA show an anomalously large variation in scattered light around the target chamber (tens of percent)
- OMEGA's polarization smoothing scheme uses distributed polarization rotators (DPRs) to split each beam into two orthogonally polarized beams that reach the target with an offset of 90 microns
- Large sections of each beam profile are effectively linearly polarized due to this offset which affects cross-beam energy transfer (CBET) causing the scattered light nonuniformity

Random Continuous Polarization plates should balance polarizations and produce symmetric absorption and scattering distributions



Collaborators

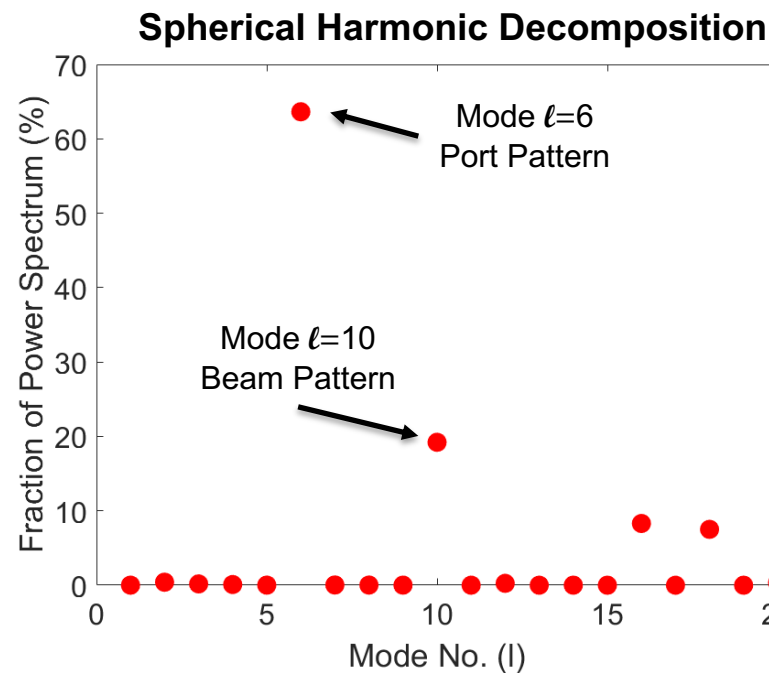
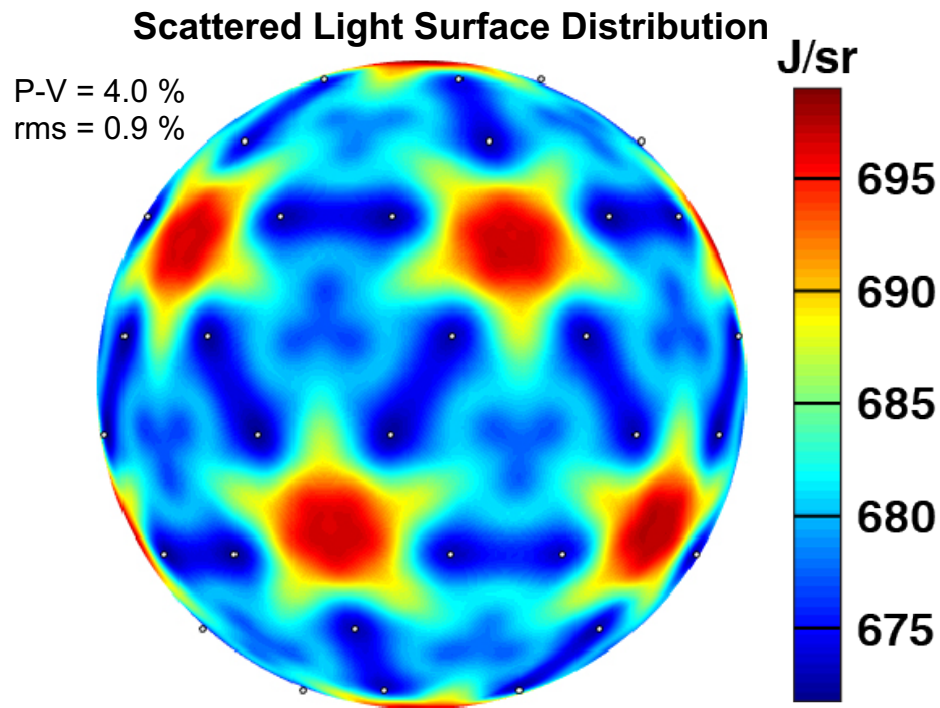


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**University of Rochester
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Modeling Omega implosions without a detailed treatment of DPR polarization smoothing predicts symmetric scattered light distributions over the target chamber



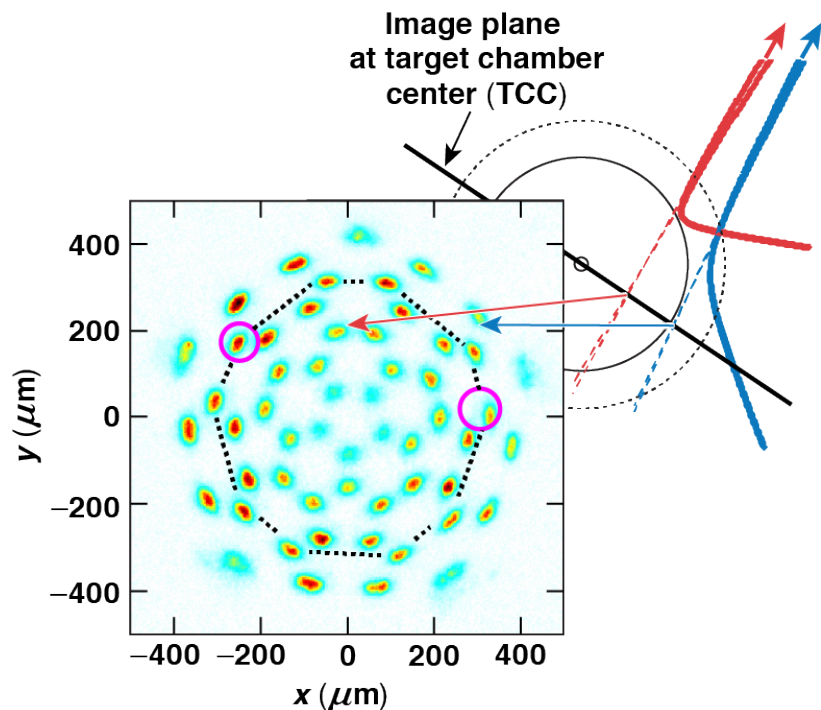
- Polarization smoothing treated using a simple factor¹

¹ P. Michel, Phys. Plasmas 20, 056308 (2013)

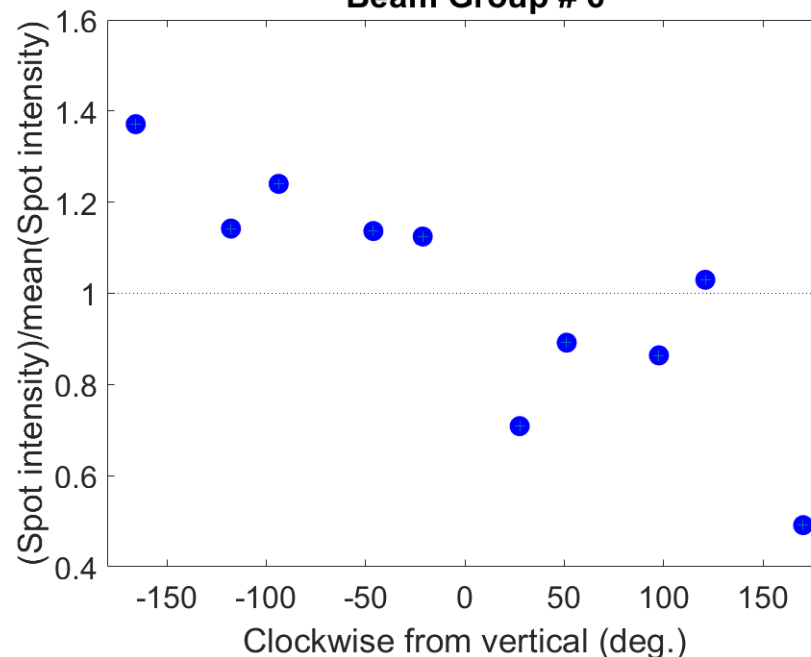


Scattered light diagnostics show non-uniformities around the chamber on the order of 10's of percent.

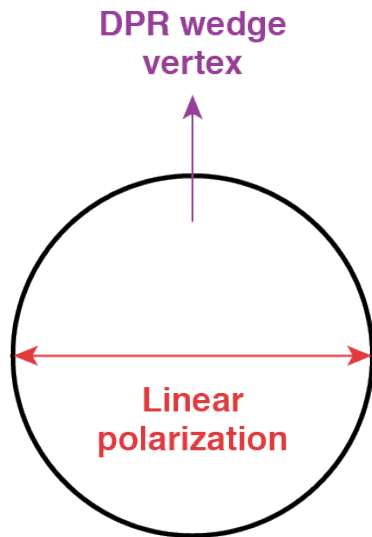
Scattered Light Imager



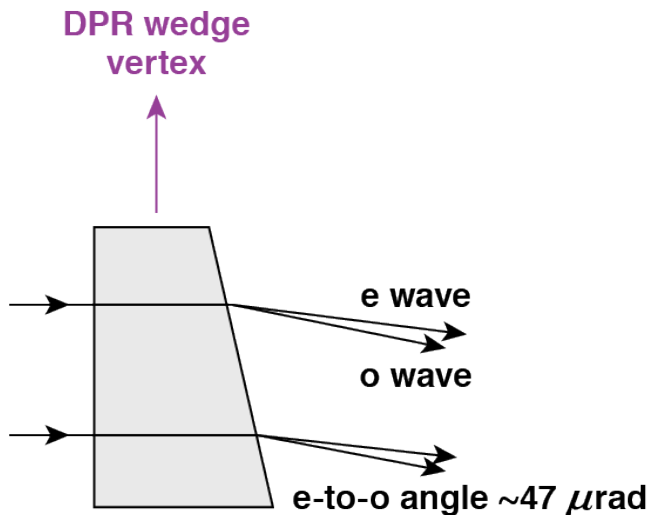
Beam Group # 6



OMEGA's polarization smoothing scheme uses DPRs to split each beam into two separate orthogonal polarizations with offset beam spots.

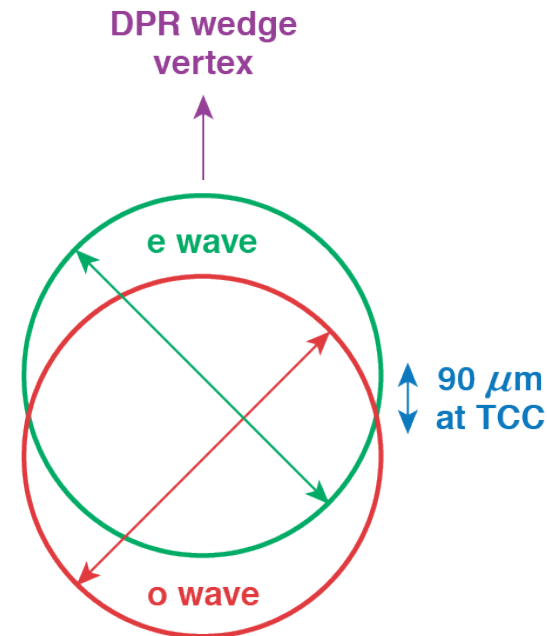


Before DPR



View along 3ω direction

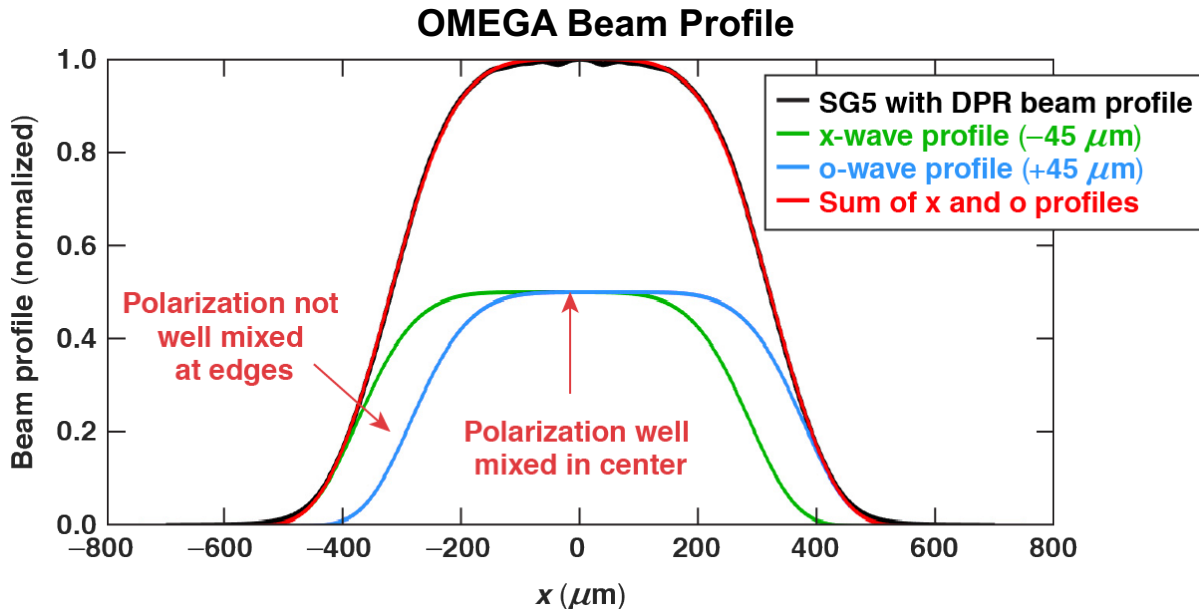
The split beams exit the DPR with slightly different angles



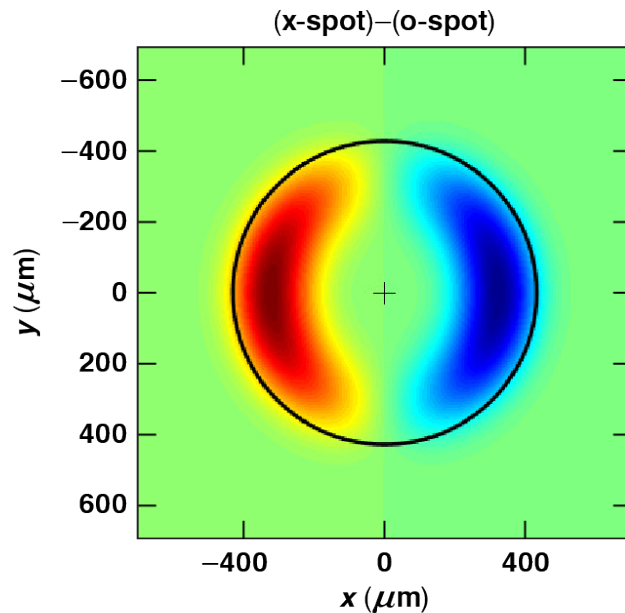
After DPR

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The 90 μm separation between spots at TCC suggests that polarization is not well mixed and is effectively linear over large sections of the beam profiles



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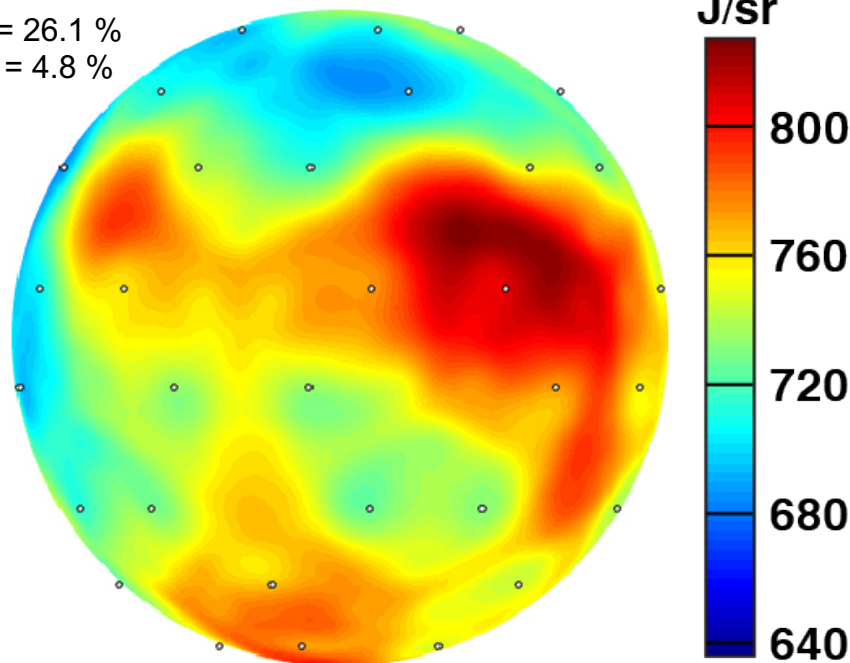


E29233

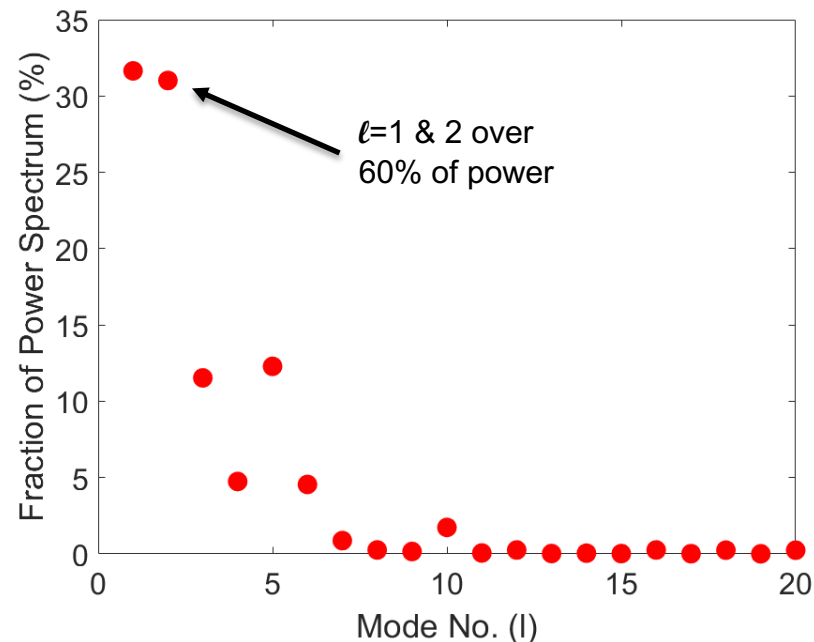
Modeling each OMEGA beam as two independent orthogonally polarized and offset beams predicts a large non-uniformity in the scattered light distribution due to CBET

Time-integrated Scattered Light

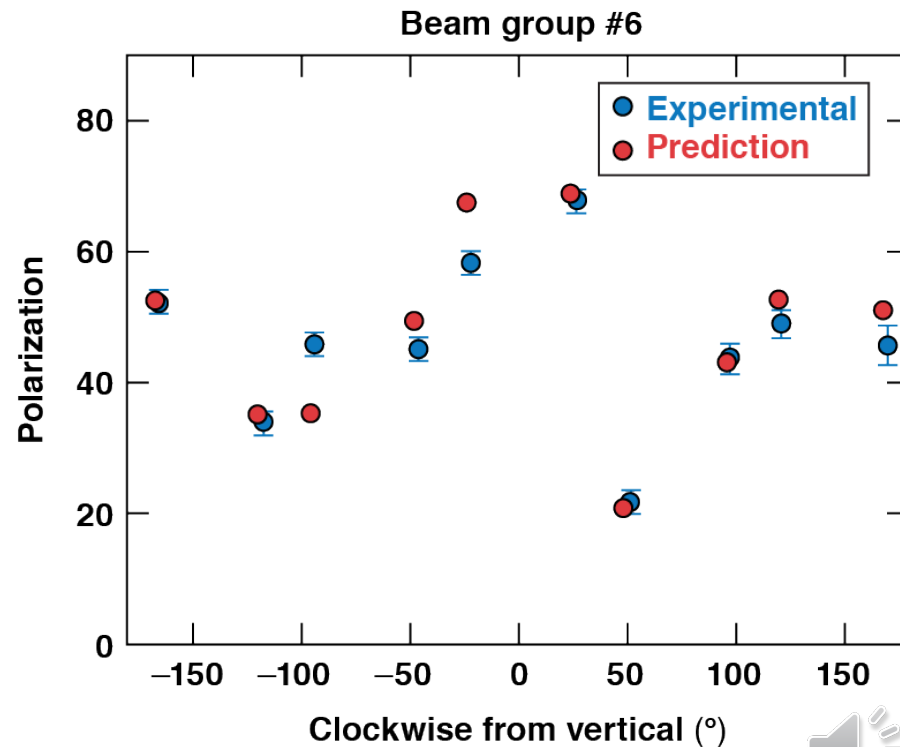
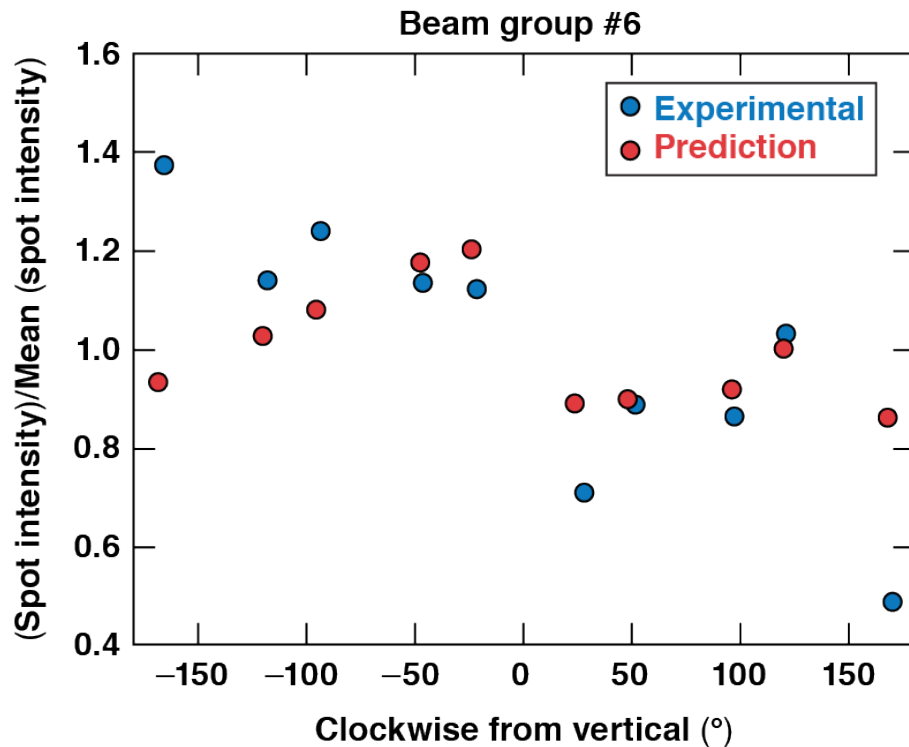
P-V = 26.1 %
rms = 4.8 %



Spherical Harmonic Decomposition

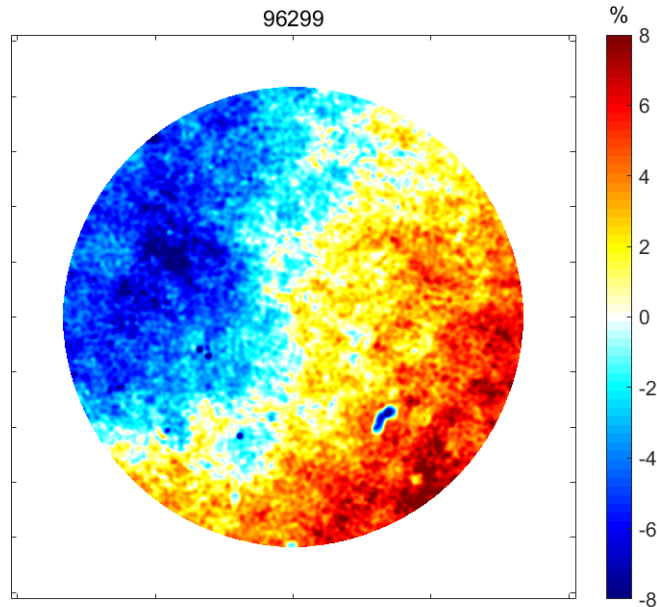


Predictions using DPR polarization imbalance reproduce the measured variation in intensities and polarizations of the beamlet spots in scattered light images

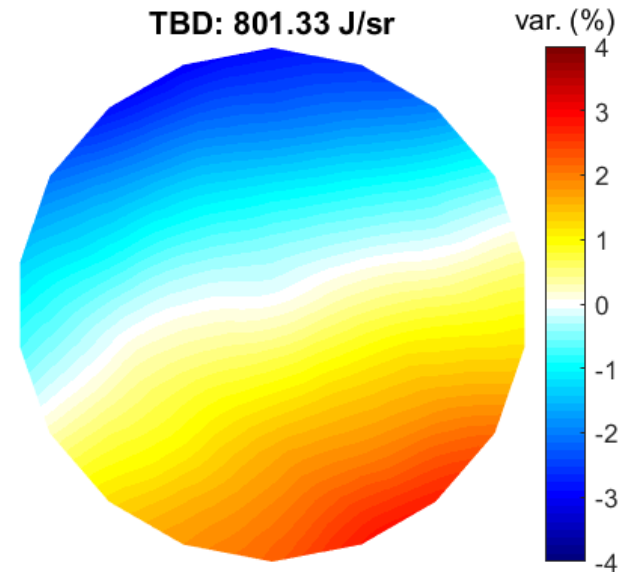


A simulated scattered light image is similar to the measured image but less overall variation is predicted

Scattered Light Witness Plate



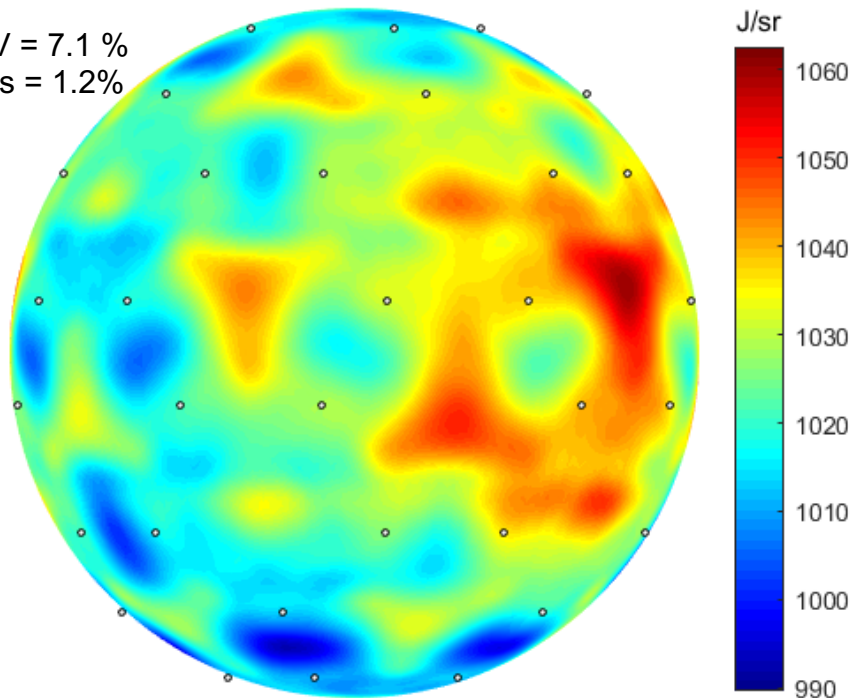
Predicted Image



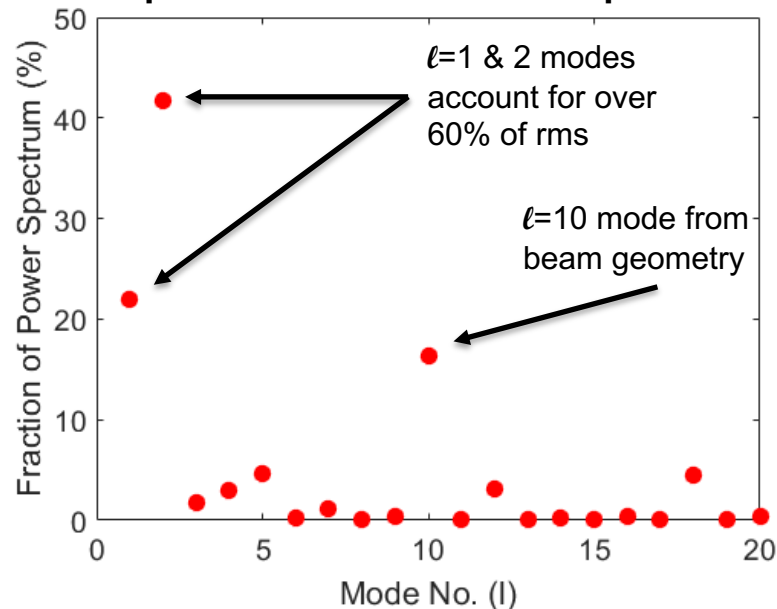
The absorbed power over the target surface is predicted to have a significant non-uniformity (but much less than the scattered light)

Time-integrated Absorbed Energy

P-V = 7.1 %
rms = 1.2%

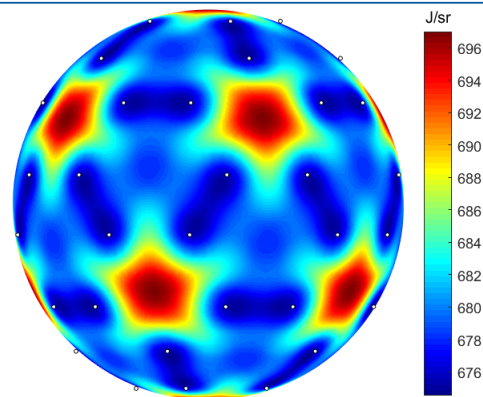
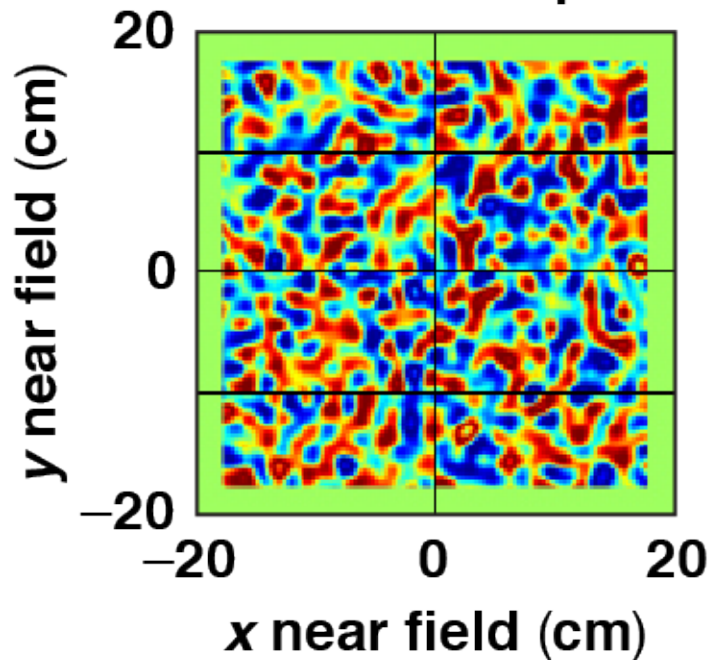


Spherical Harmonic Decomposition

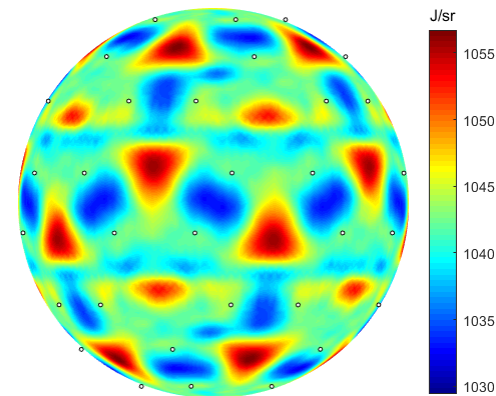


Replacing the DPRs with Random Continuous Polarization plates* is expected to balance polarization resulting in symmetric absorption and scattering

Random continuous polarization



Scattered Light
P-V = 3.3 %
rms = 0.8 %



Absorbed Energy
P-V = 2.6 %
rms = 0.4 %

*Designed by J. Marozas

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