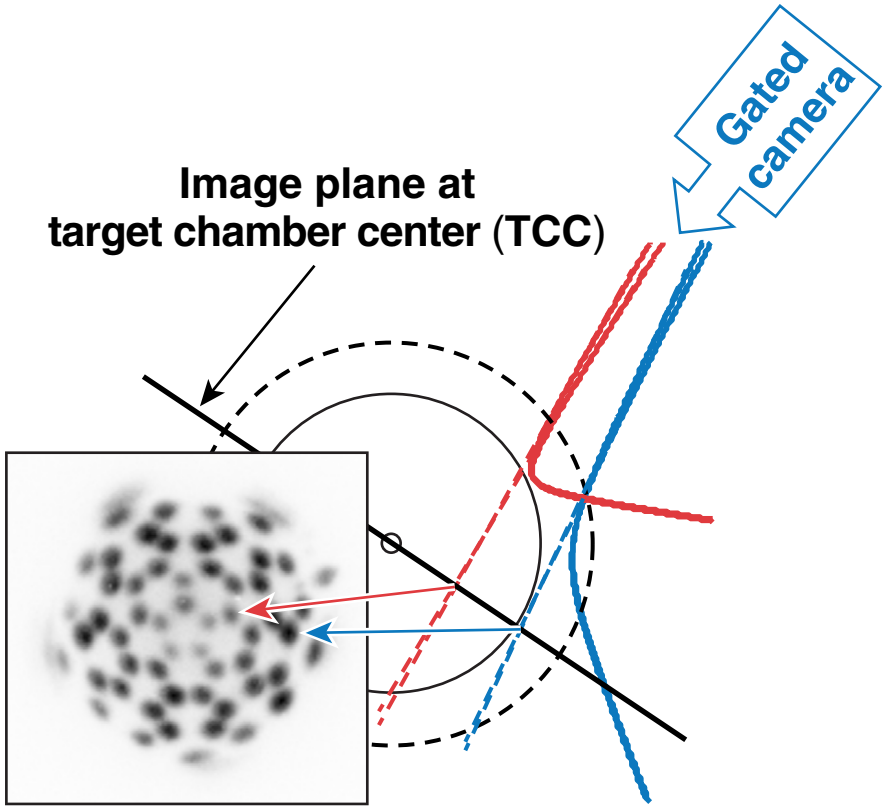
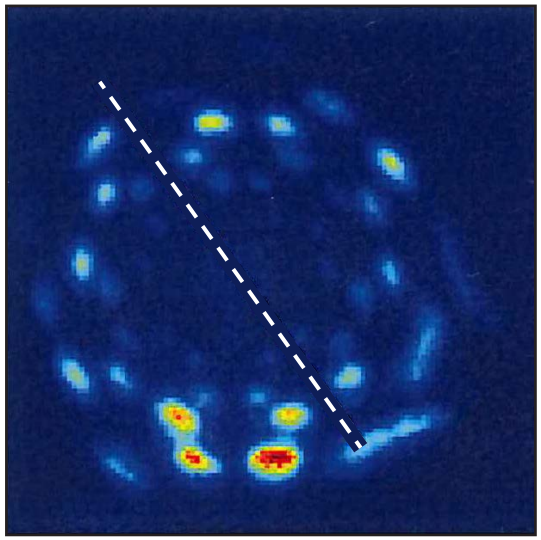
Polarization Dependence of Cross-Beam Energy Transfer in Unabsorbed Light Beamlets



With linearly polarized beams



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Laboratory for Laser Energetics

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Summary

Beamlet images show a strong effect of polarization on cross-beam energy transfer (CBET) in direct-drive implosions

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- Beamlet images are a diagnostic for detailed measurements of CBET in direct-drive implosions
- For polarized smoothed beams, the beamlet intensities are symmetric about the diagnostic symmetry axis
- For linearly polarized beams, an asymmetry in the intensities appears during the main drive part of the laser pulse when CBET is predicted to be strong

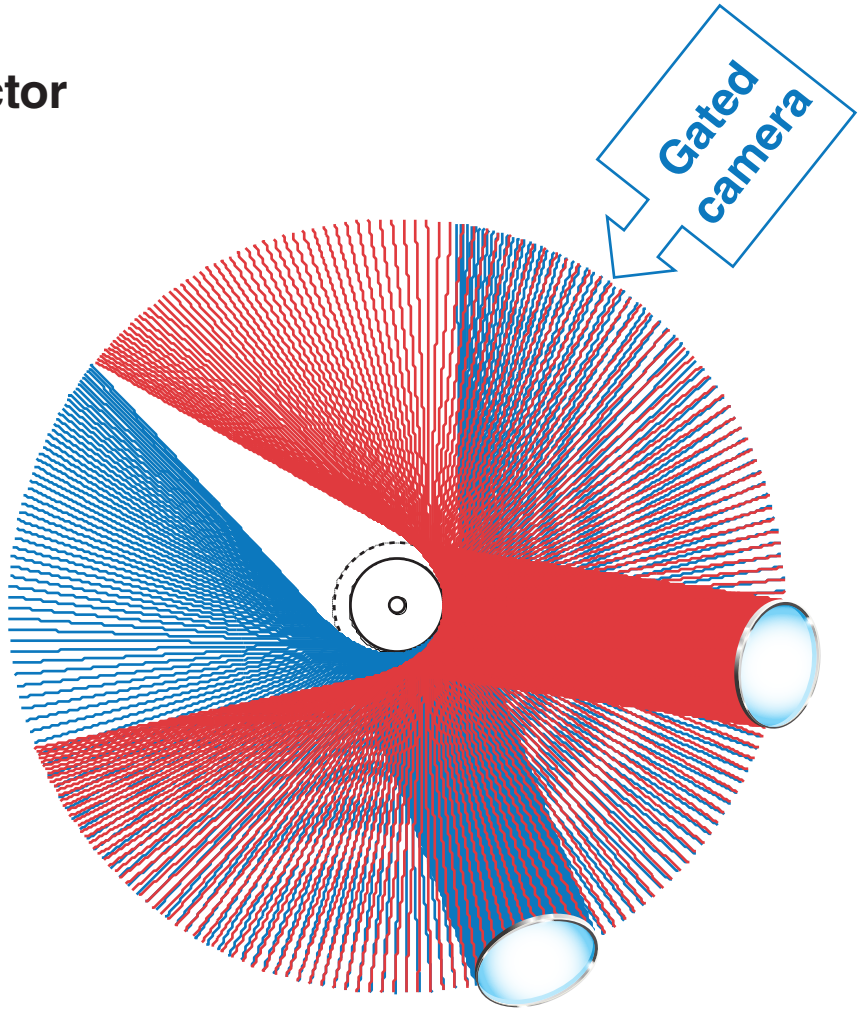
Collaborators

R. K. Follett, J. Katz, J. F. Myatt, W. Seka, and D. H. Froula

University of Rochester
Laboratory for Laser Energetics

A 351-nm camera records the unabsorbed light of a beamlet from each OMEGA beam

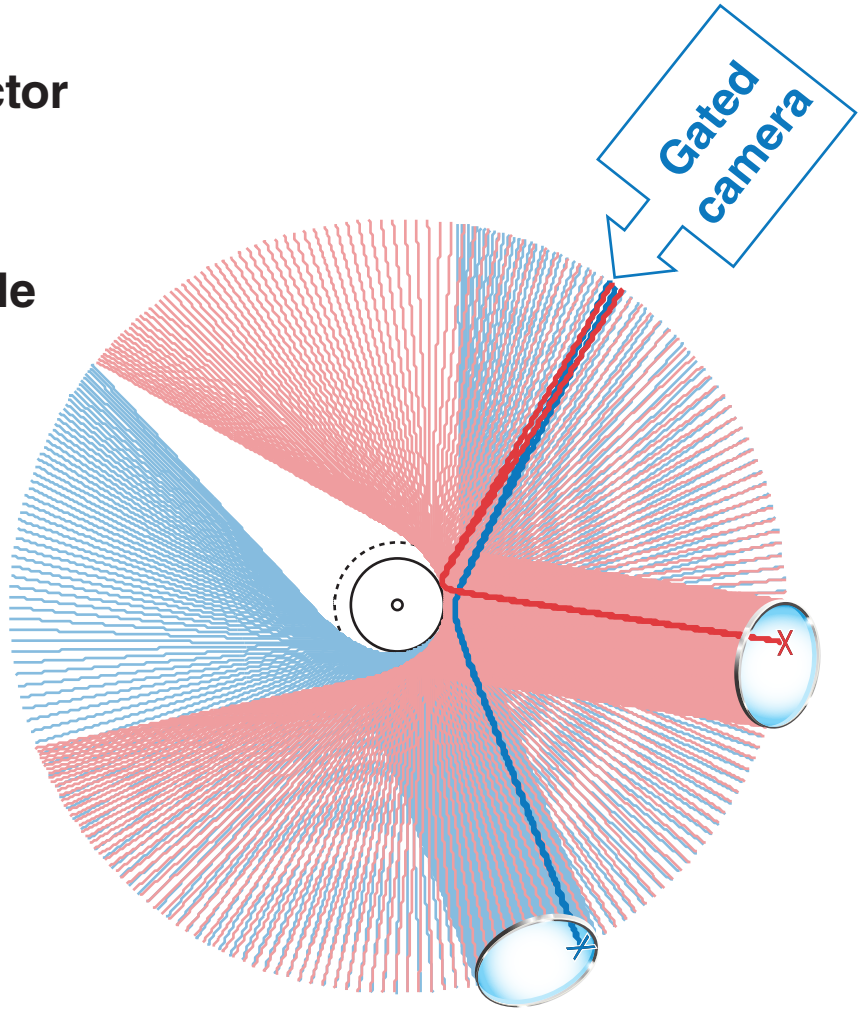
- **Light reaches a scattered-light detector originating from each beam**



E24108b

A 351-nm camera records the unabsorbed light of a beamlet from each OMEGA beam

- Light reaches a scattered-light detector originating from each beam
- Recorded light originates from a determinable point in a beam profile
  - impact parameter
  - polar angle



E24109b

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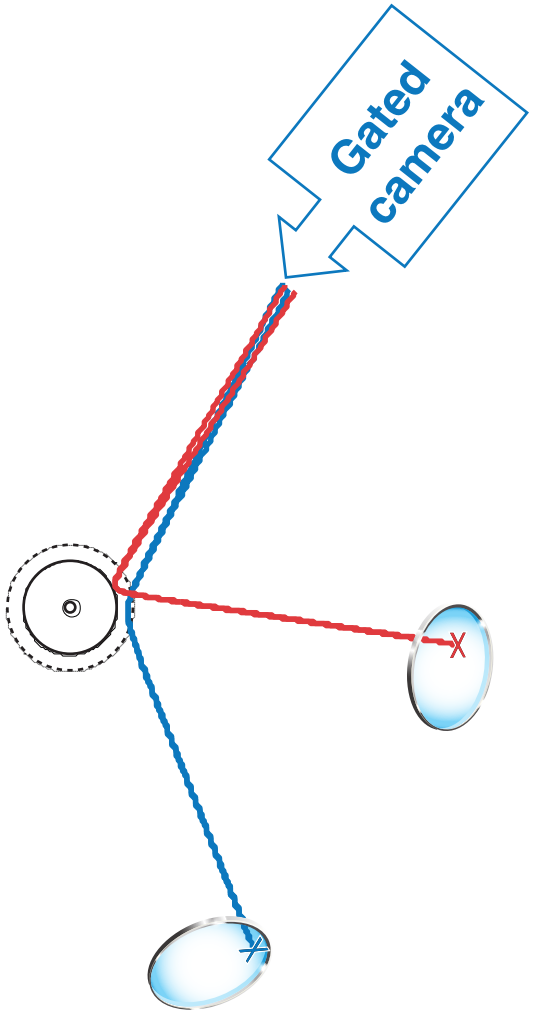
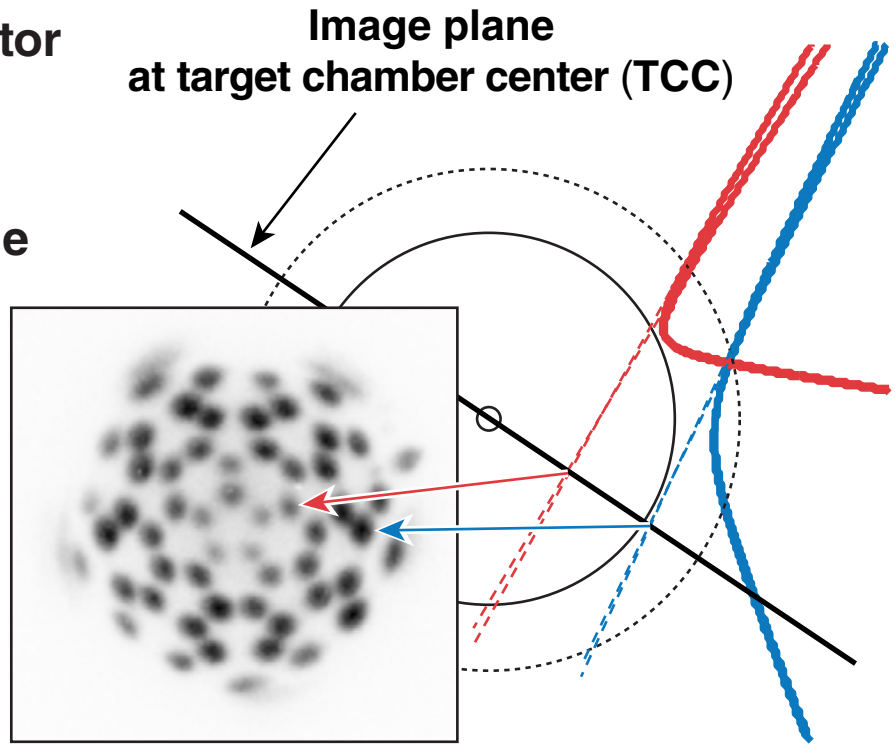
- This light can be considered as sampled from a small component of the incident beam
  - a “beamlet”



E24236b

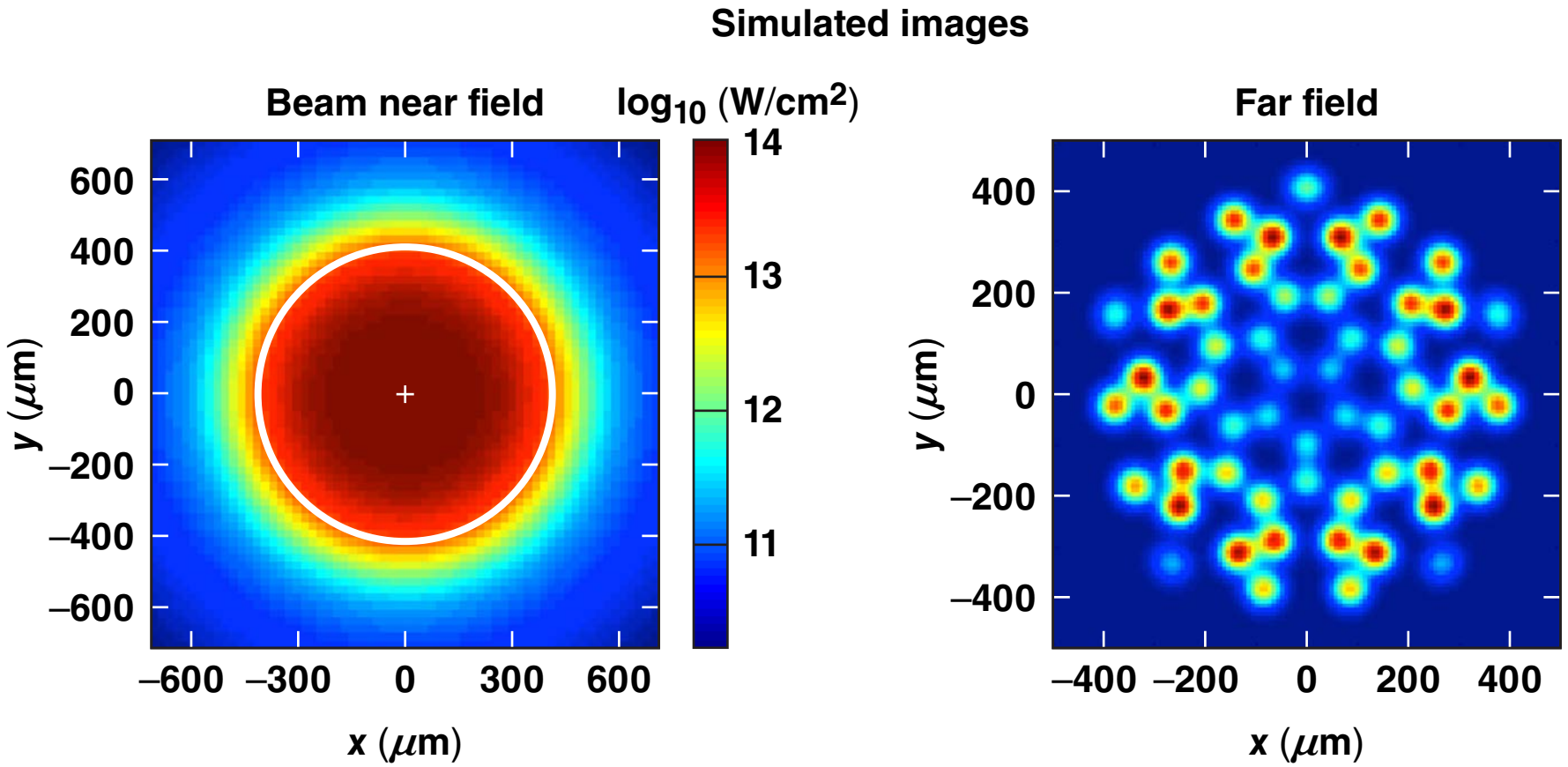
A 351-nm camera records the unabsorbed light of a beamlet from each OMEGA beam

- Light reaches a scattered-light detector originating from each beam
- Recorded light originates from a determinable point in a beam profile
  - impact parameter
  - polar angle
- This light can be considered as sampled from a small component of the incident beam
  - a "beamlet"
- Unabsorbed light from this beam appears as a spot in the image plane



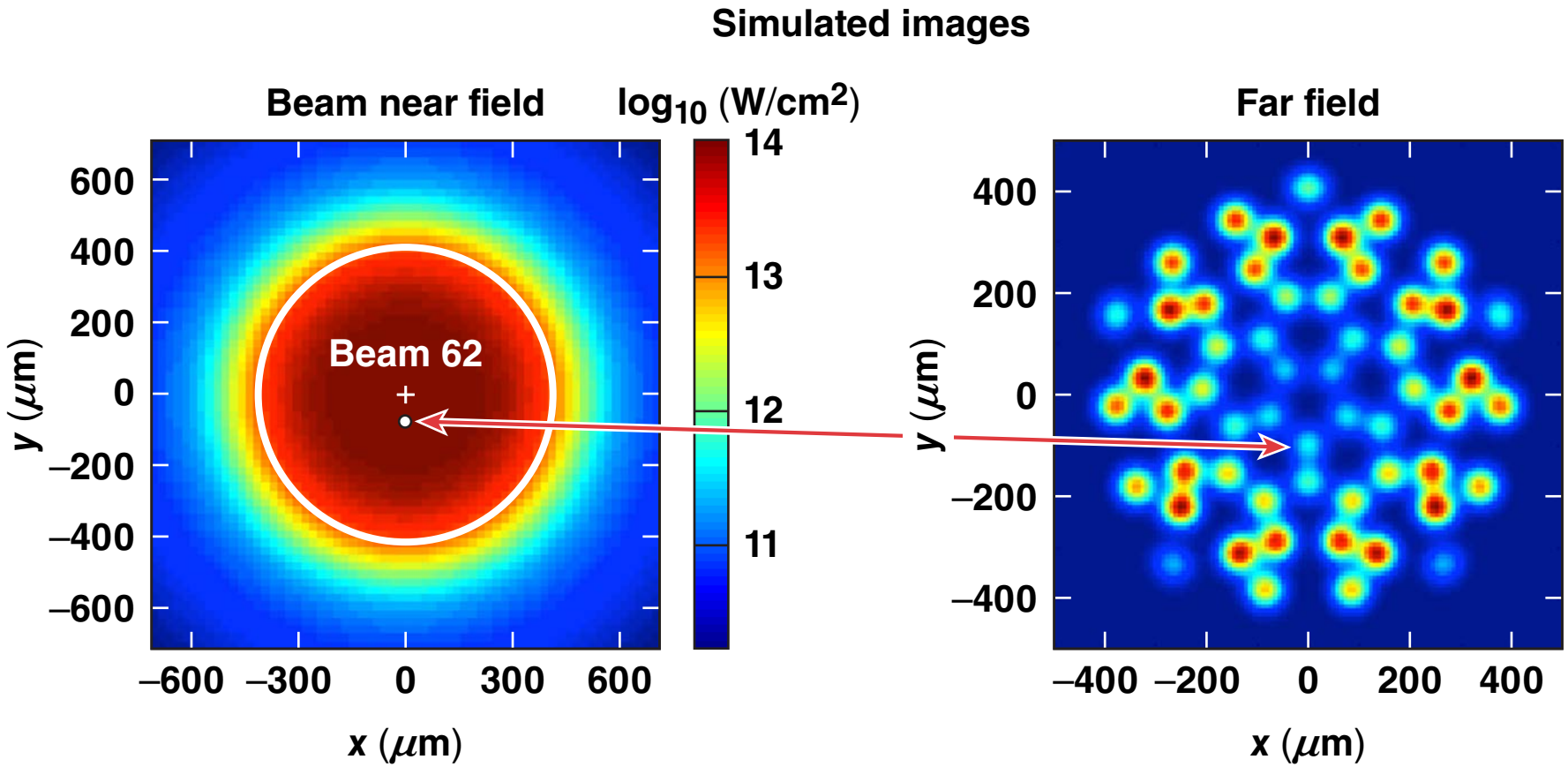
E24237b

Each beamlet originates from a specific location in its beam's profile



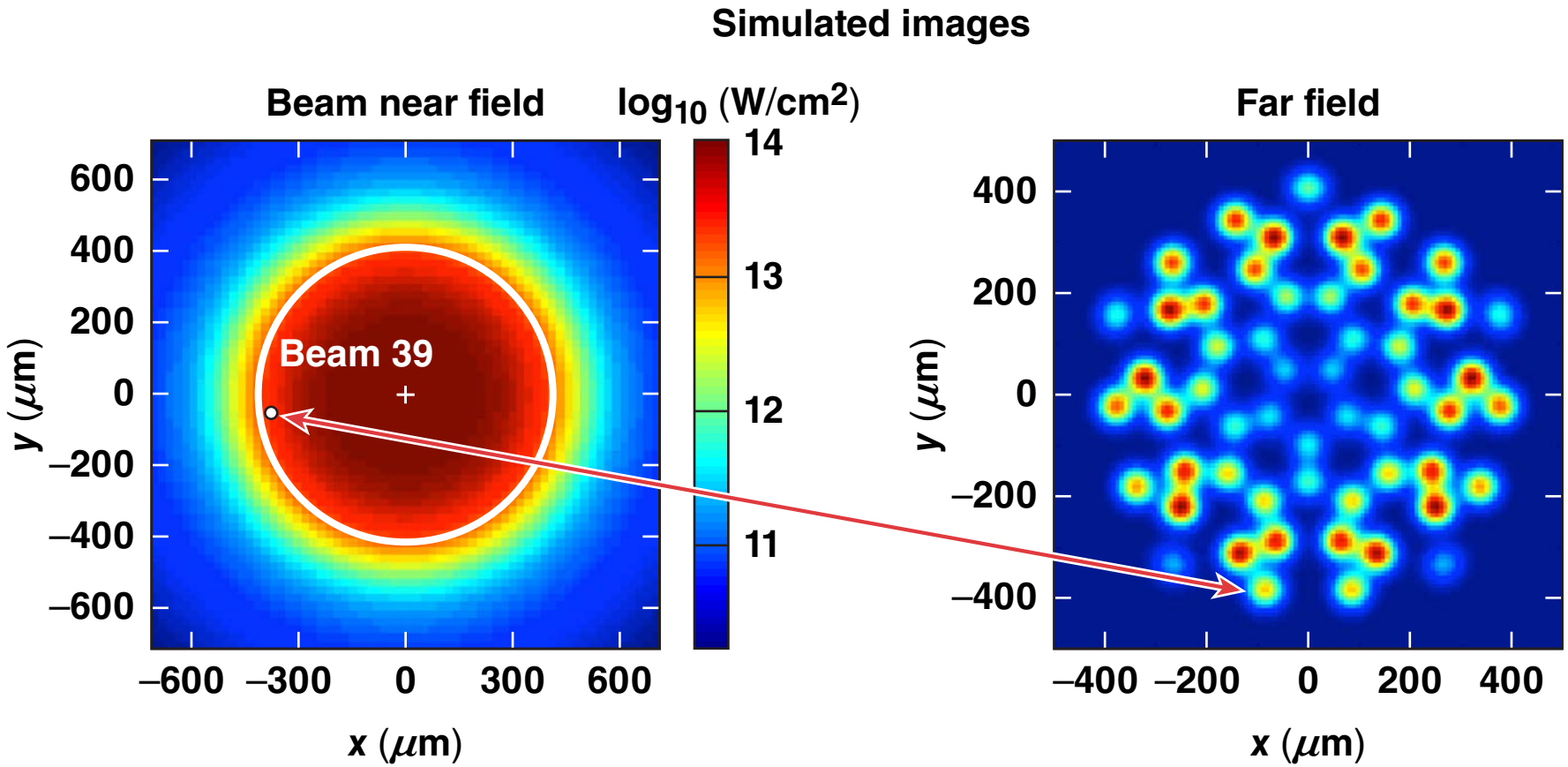
E24259b

Each beamlet originates from a specific location in its beam's profile



E24260b

Each beamlet originates from a specific location in its beam's profile



E24261b

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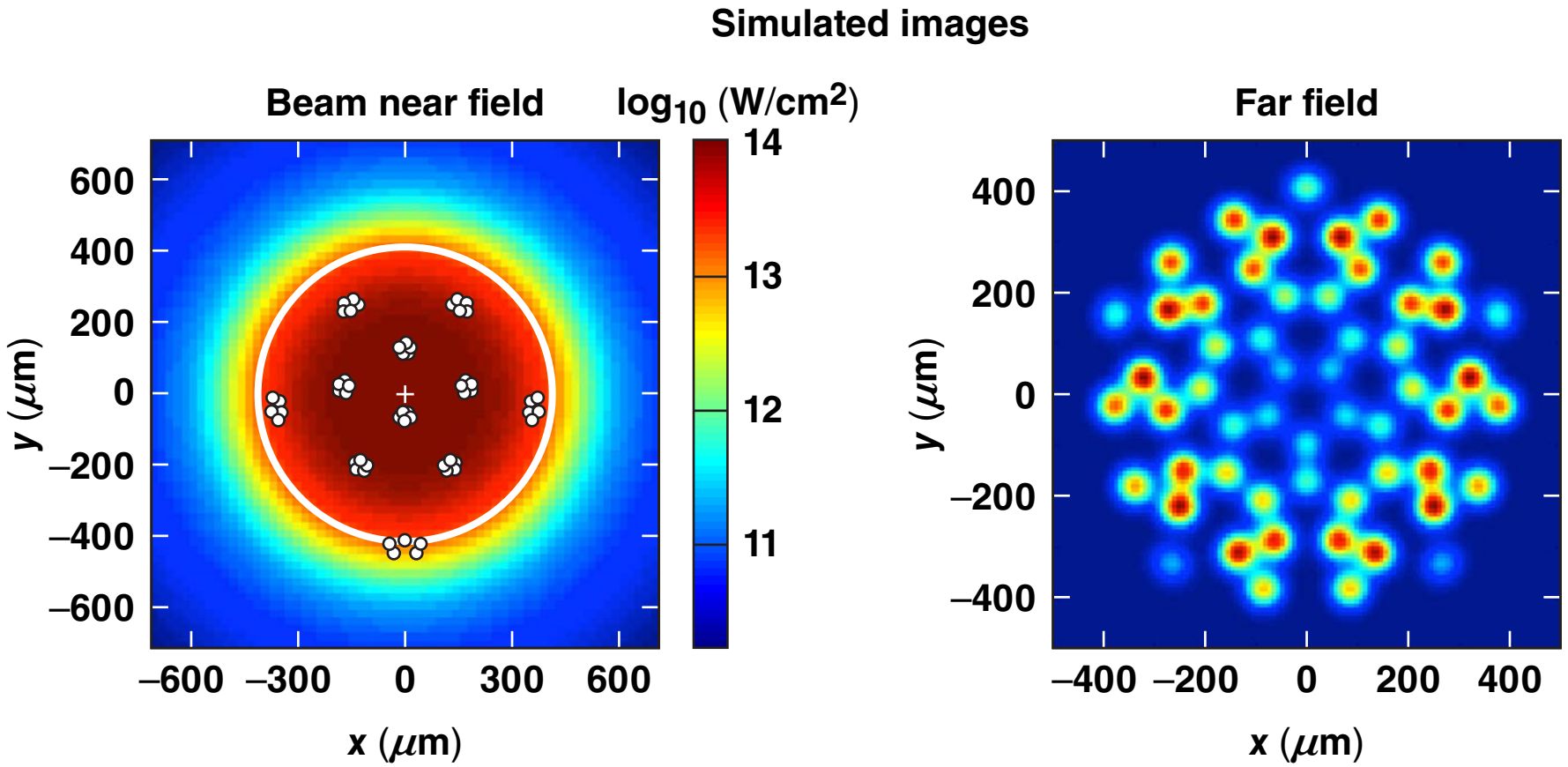
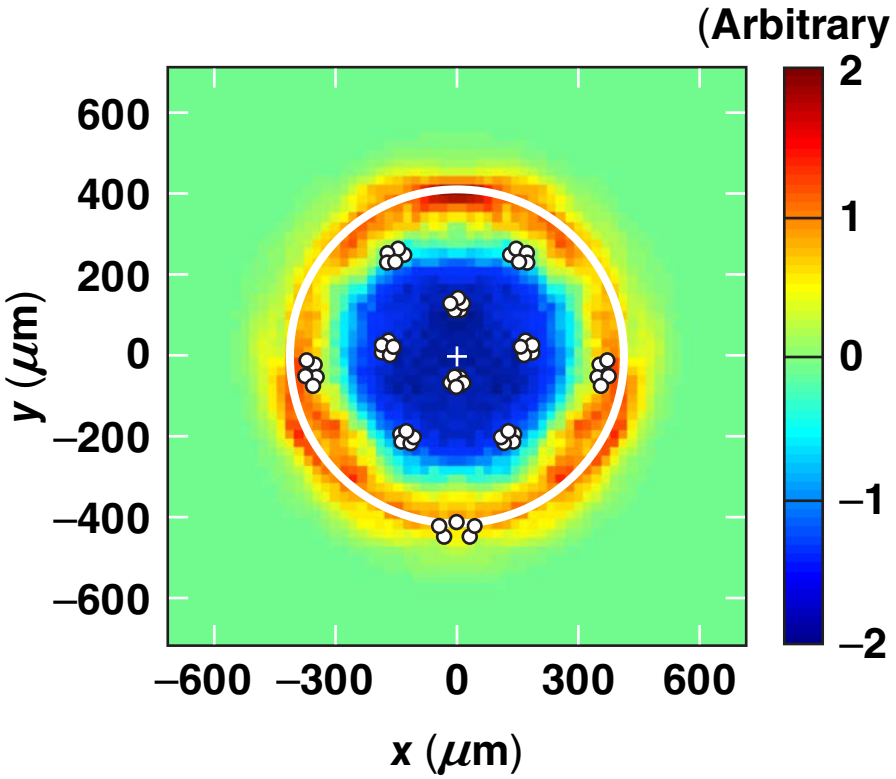
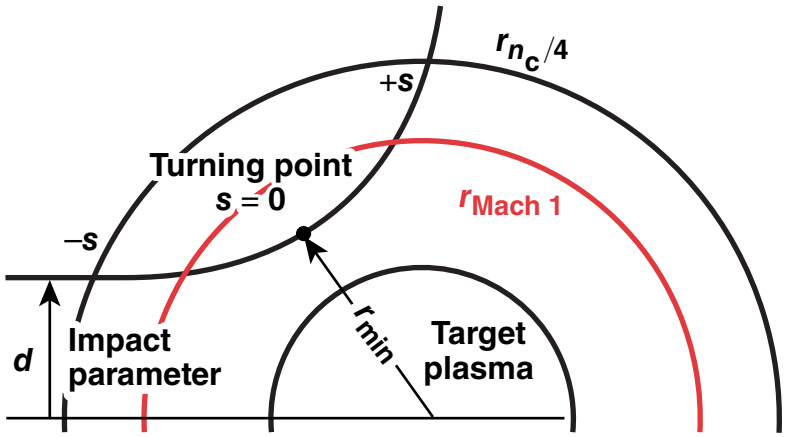


E24262b

The beamlet spots can be used to diagnose the variation in CBET over a beam profile

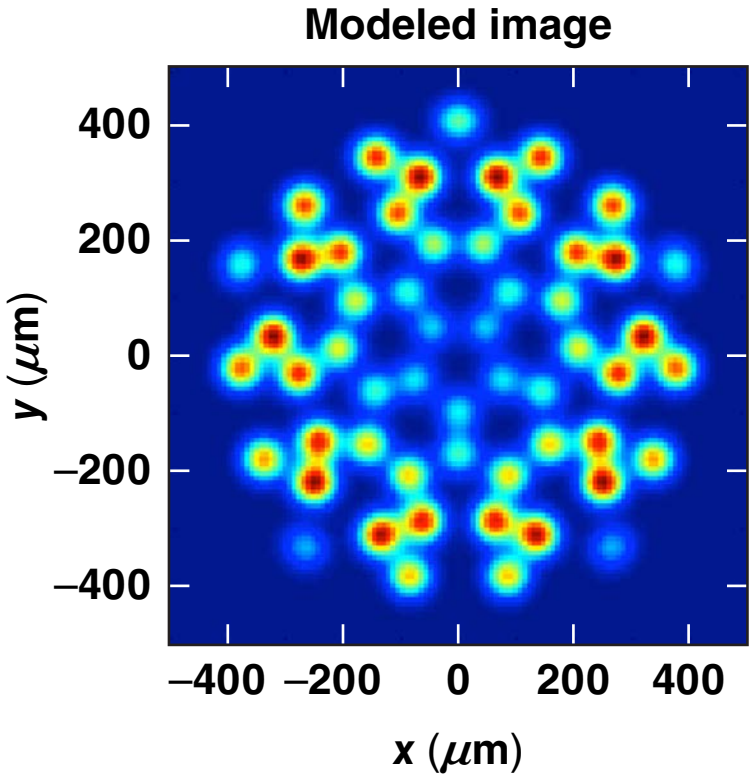


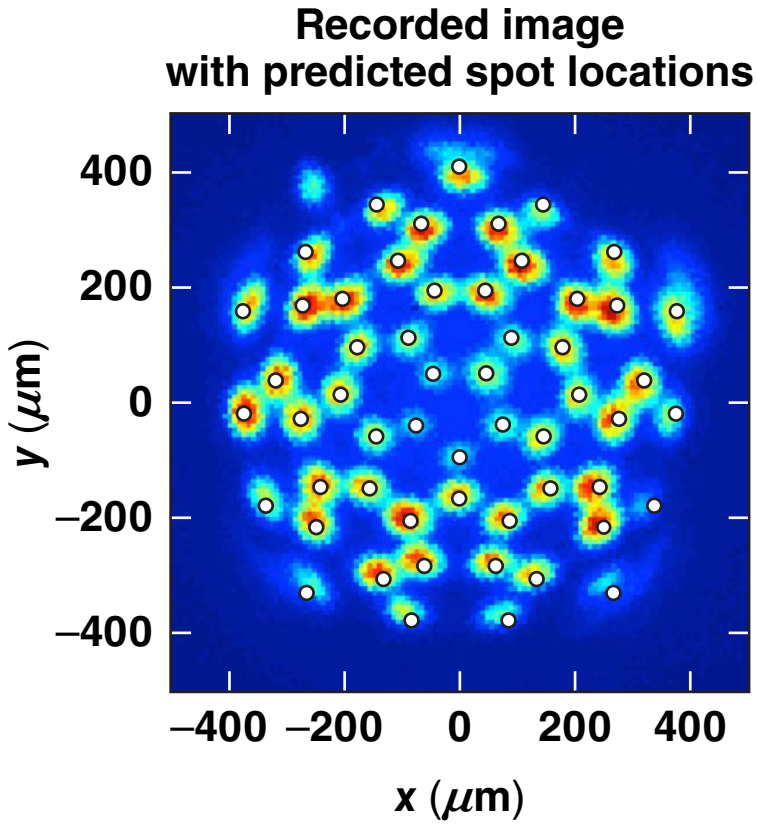


Some of the recorded beamlets experience net loss because of CBET while others gain.

E17999c

The beamlet spots are modeled using a 3-D CBET postprocessor for hydrodynamics codes*



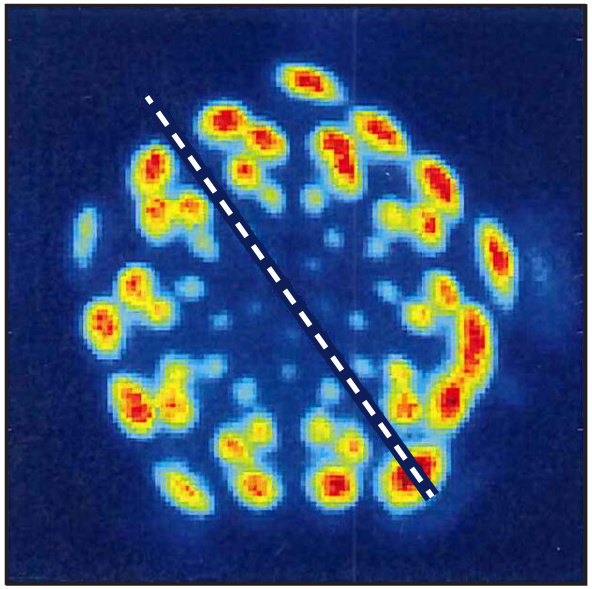


*D. H. Edgell *et al.*, "Cross-Beam Energy Transfer in Polar-Drive Implosions on OMEGA," to be submitted to Physics of Plasmas.

E24258a

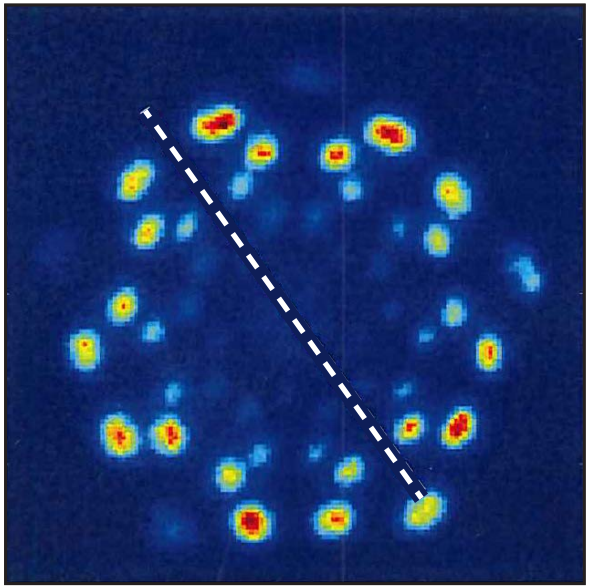
Beams with polarization smoothing produce fairly symmetric beamlet spot images

Early time
little CBET



DPR's
in

Late time
strong CBET



- Distributed polarization rotators (DPR's) split each beam into two orthogonal polarizations

E24744a

Polarization effects on CBET are believed to cause asymmetric images with linearly polarized beams

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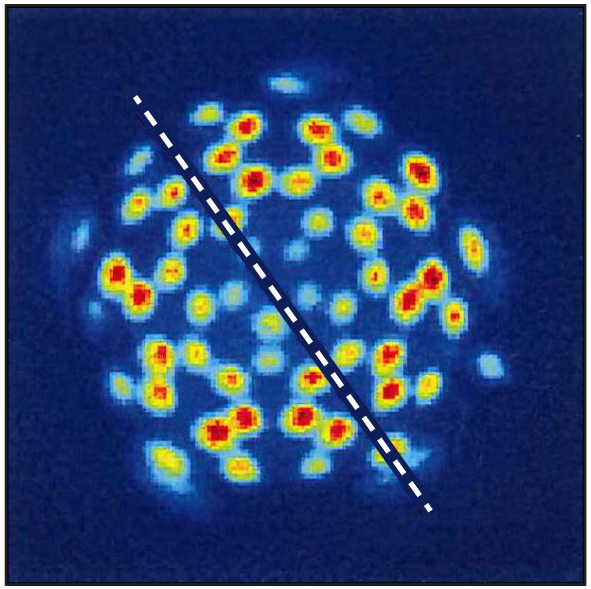
Early time
little CBET



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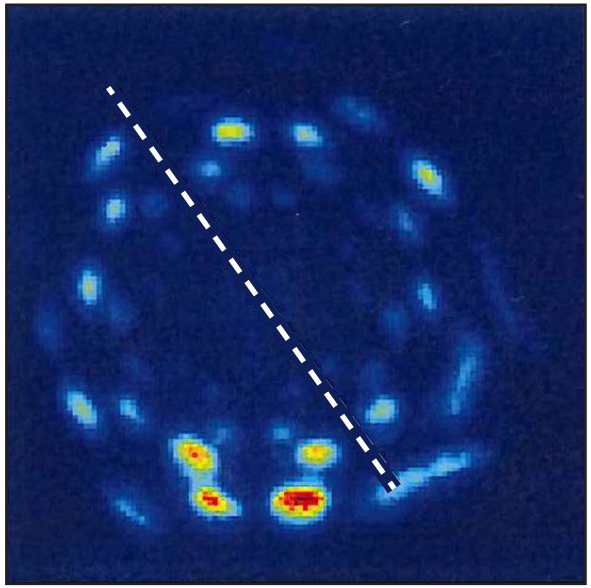
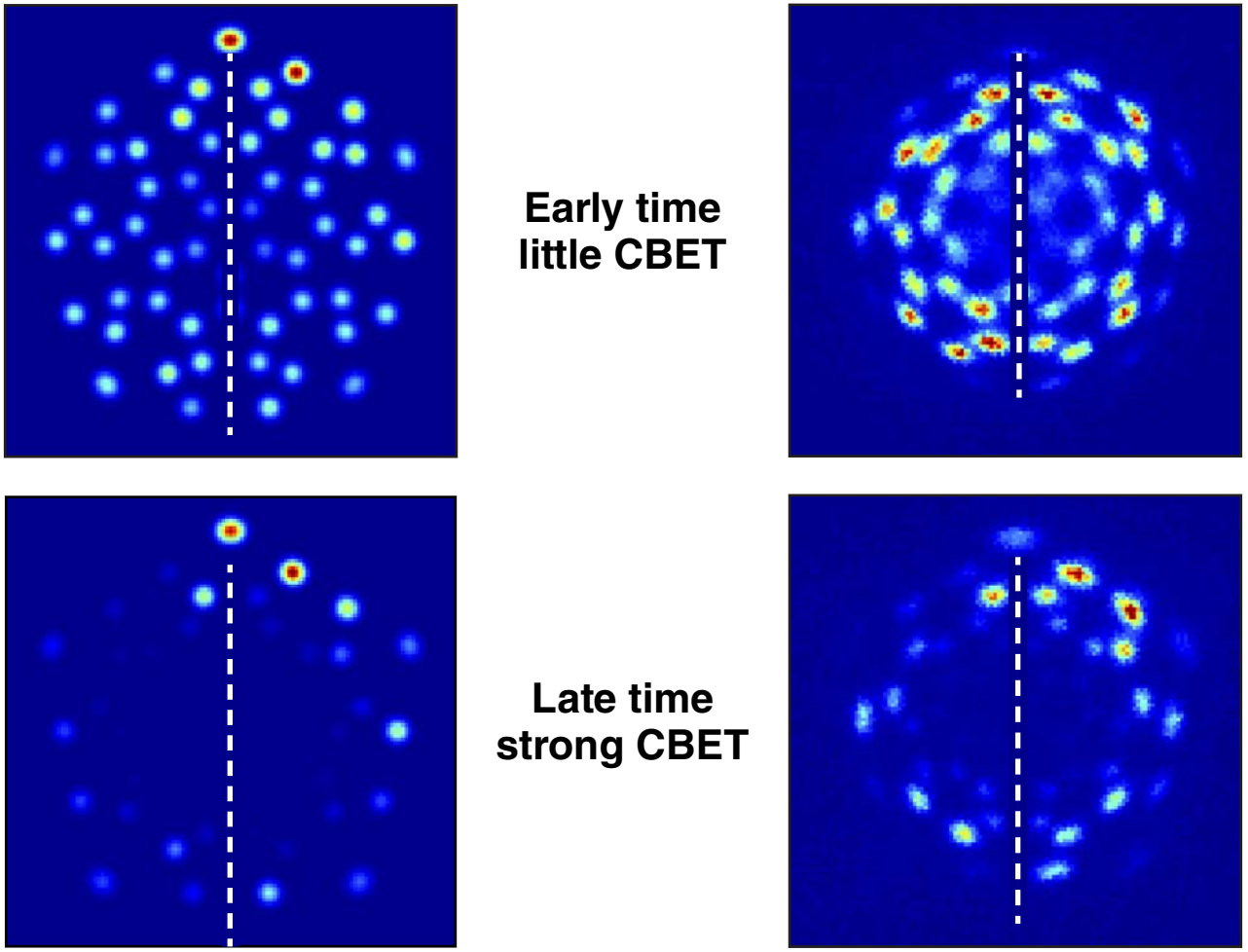


- Not a polarization effect from the diagnostic
- The coupling between beams in CBET is strongly affected by the relative polarization of the crossing beams*

*P. Michel *et al.*, Phys. Plasmas 20, 056308 (2013).

E24744b

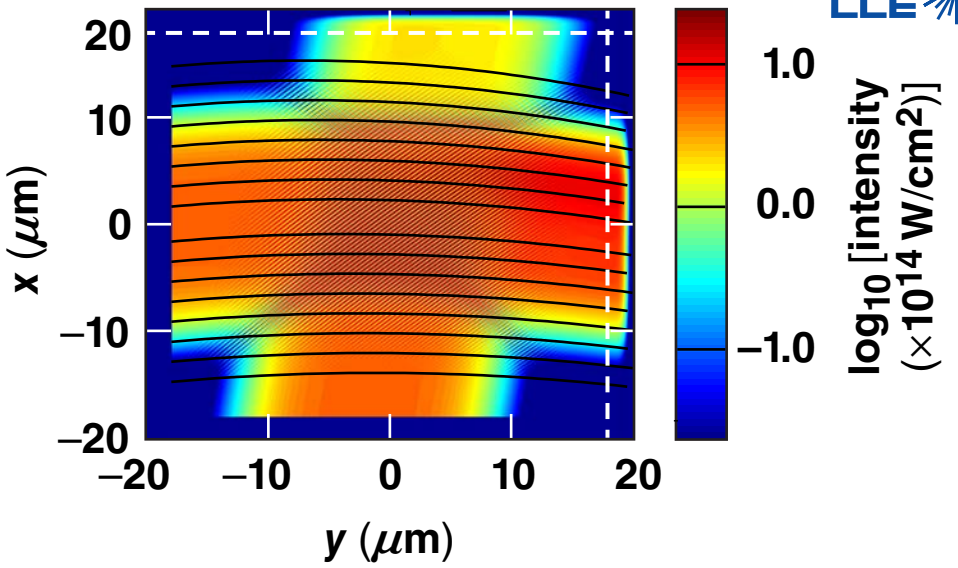
Asymmetric spot images are predicted when polarized beams are modeled in the CBET calculations

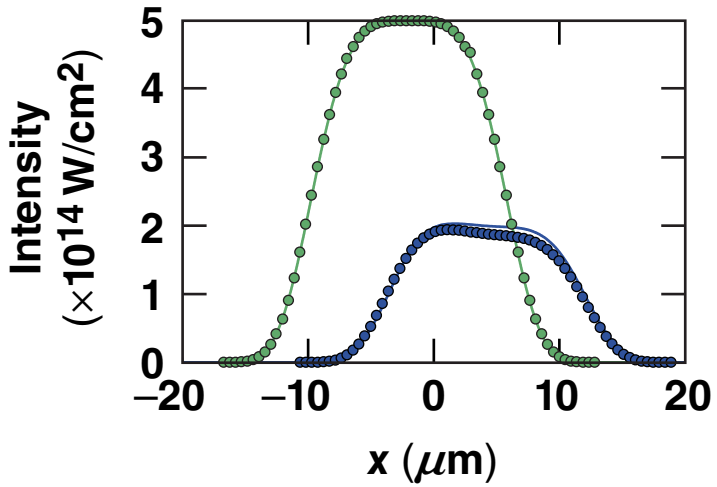


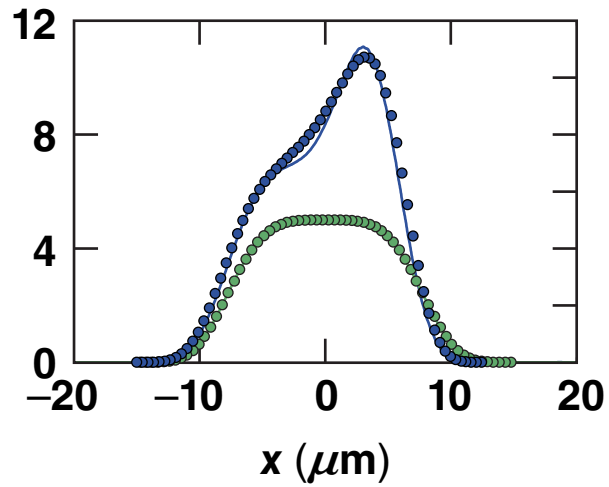
E25047

CBET modeling is being validated in comparisons with *LPSE* full electromagnetic-field code predictions*

- Preliminary results indicate that the models are in good agreement



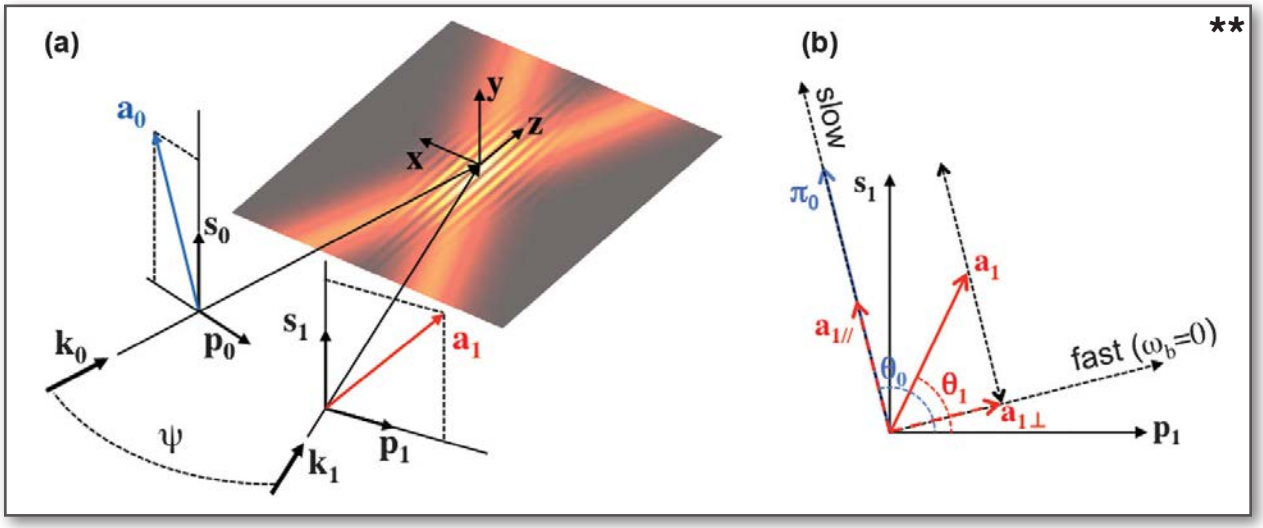




*J. F. Myatt, this conference.

E25139

The change in beamlet polarization caused by CBET may be needed in CBET modeling



- When a polarized beamlet undergoes CBET with a beamlet of a different polarization, the polarization of both beamlets will be altered*,**
  - only the shared component of polarization gains/loses energy

Changes in polarization caused by CBET on OMEGA should be measured to determine if it is a significant effect when summed over many beam crossings.

*D. Turnbull *et al.*, Rev. Sci. Instrum. 85, 11E603 (2014).
**P. Michel *et al.*, Phys. Rev. Lett. 113, 205001 (2014).

E25049

An upgraded diagnostic will improve our understanding of CBET beamlets and polarization effects

- Camera gate width will be reduced from ~3 ns to ~100 ps
  - eliminates time-integrating effects
- Telocentric optics will improve the beam symmetry from twofold to fivefold
  - better statistics when comparing beamlet intensities
- A Wollaston prism will split the image into orthogonal polarizations
  - can measure the beamlet polarization
  - will determine if the beamlet polarizations change significantly because of CBET under OMEGA conditions

Summary/Conclusions

Beamlet images show a strong effect of polarization on cross-beam energy transfer (CBET) in direct-drive implosions

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