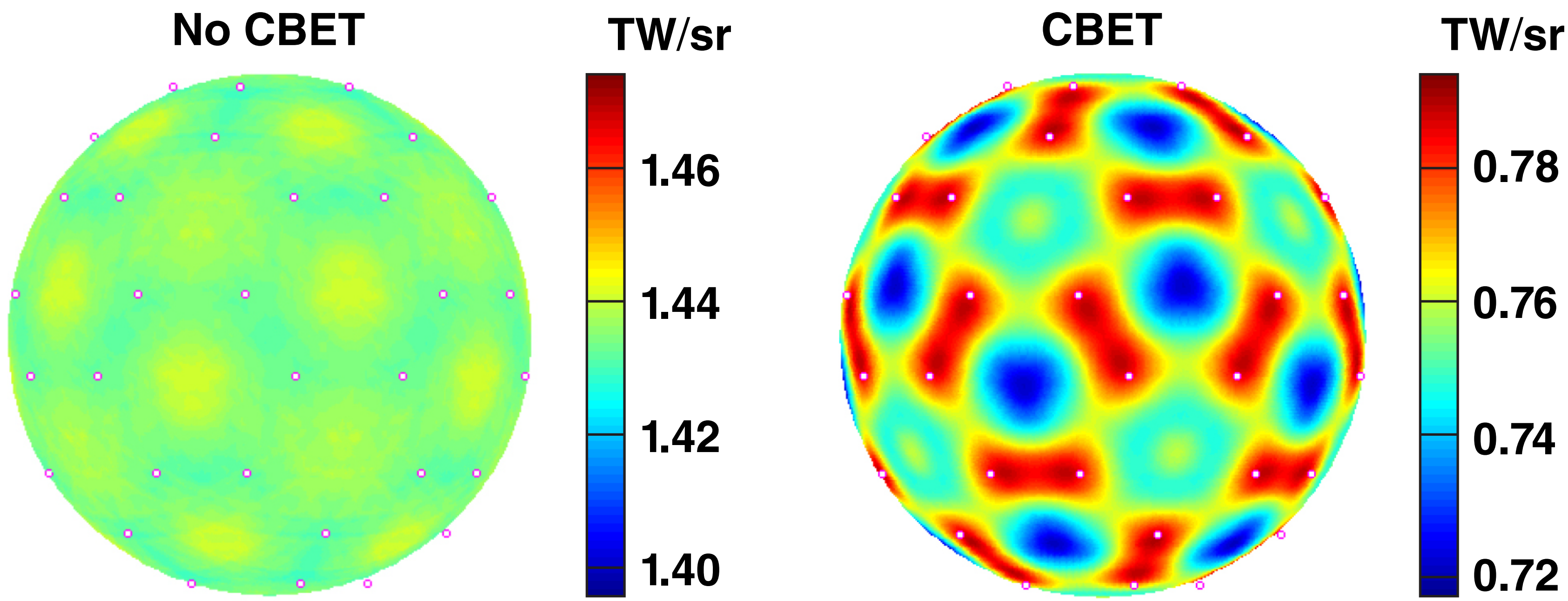
# Three-Dimensional Modeling of Cross-Beam Energy Transfer and Its Mitigation in Symmetric Implosions on OMEGA




1.44 TW/sr±0.16%

0.76 TW/sr±2.0%

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Summary

# Cross-beam energy transfer (CBET) modeling suggests that 3-D effects may be important for symmetric direct drive

UR LLE

- CBET between beams at angles of 40° to 110° are most significant
- Non-axially symmetric details of the absorption profile can increase the absorption rms (root mean square) over the target surface by an order of magnitude
- The total absorption and rms asymmetry can be greatly improved over a standard symmetric implosion by wavelength separating the three OMEGA beam legs

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D. H. Edgell *et al*., "Mitigation of Cross-Beam Energy Transfer in Symmetric Implosions on OMEGA Using Wavelength Detuning," to be published in Physics of Plasmas.

# Collaborators

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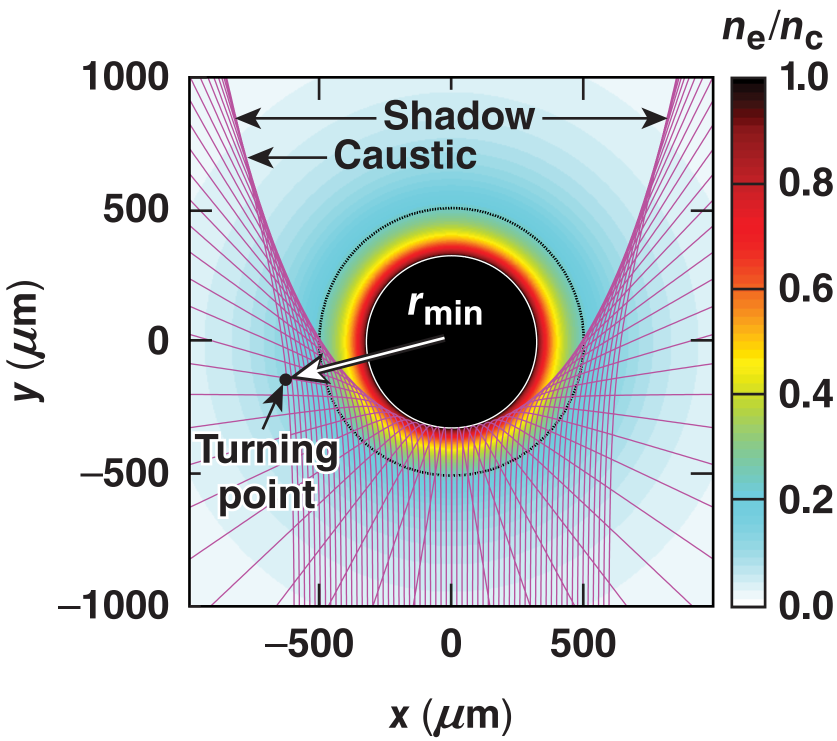
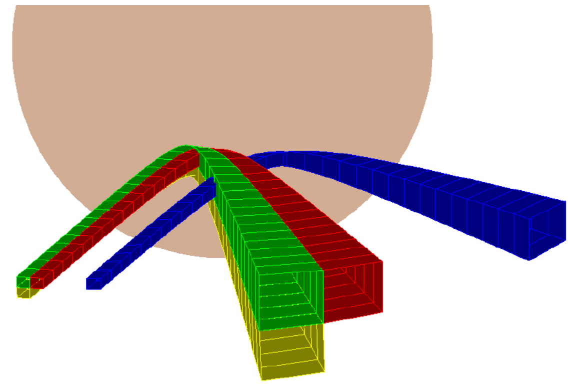
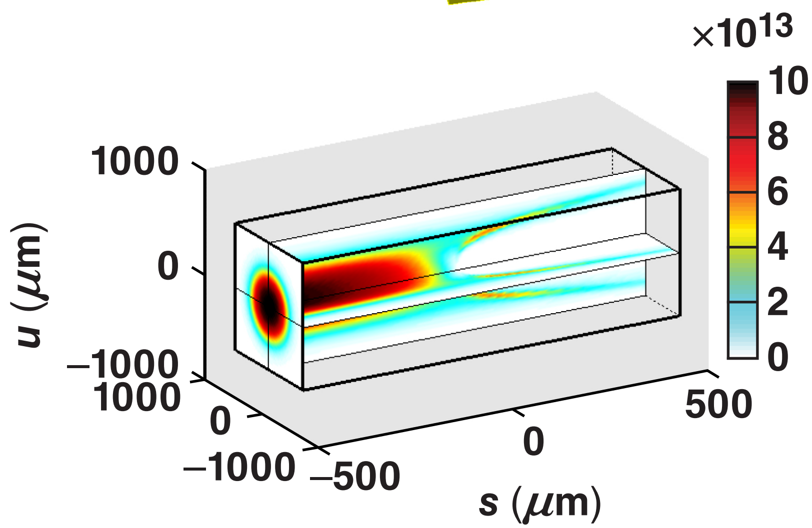
# Three-dimensional modeling uses a geometric optics ray-based model using the coronal plasma taken from hydrodynamic code



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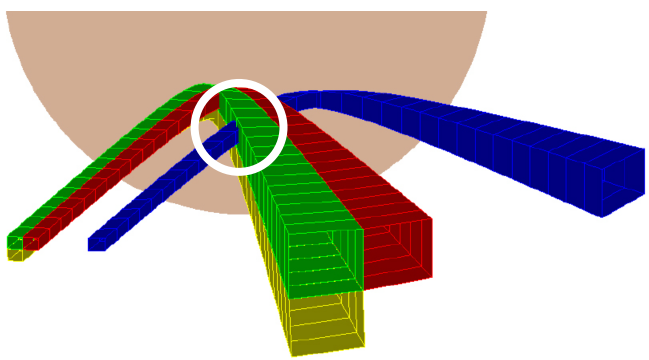
# CBET is calculated in each beamlet cell for crossings with all other beamlets

$$\omega_{IAW} = \omega_1 - \omega_2$$

$$\vec{k}_{IAW} = \vec{k}_1 - \vec{k}_2$$



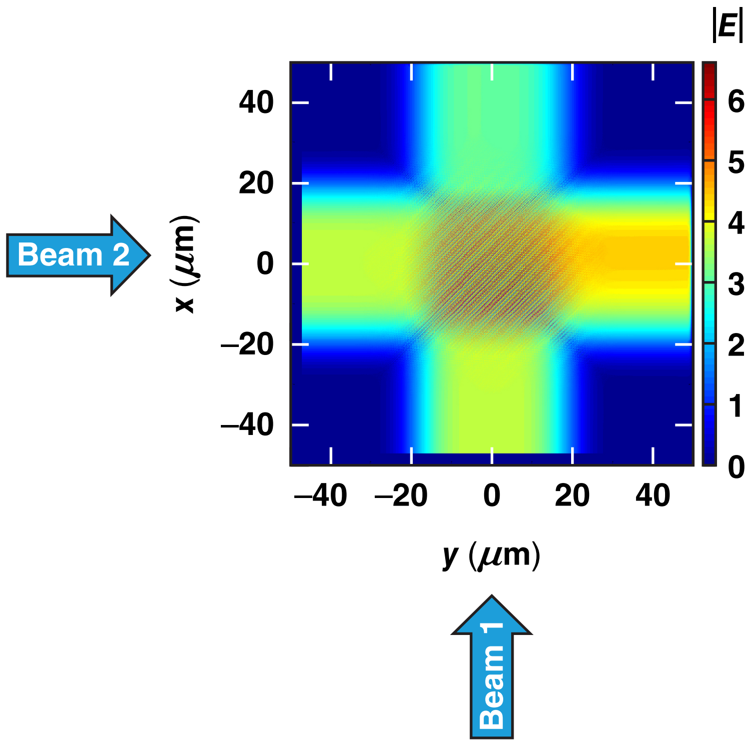
- Both intrabeam and interbeam crossings
- Beamlet intensities at crossings are determined using
  - inverse bremsstrahlung absorption
  - intensity law of geometric optics
  - CBET at crossings using a 3-D extension of Randall's quasi-slab model fluid model*

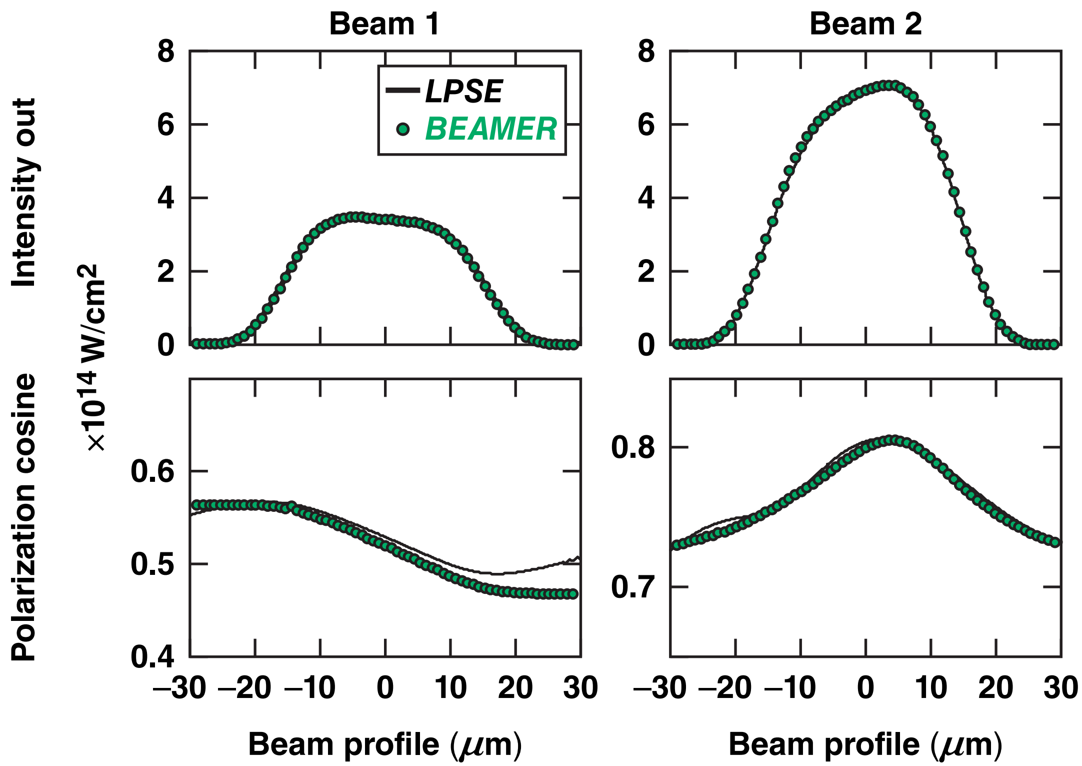
E25951

IAW: ion-acoustic wave

*C. J. Randall, J. R. Albritton, and J. J. Thomson, Phys. Fluids 24, 1474 (1981).

# The model is in good agreement with *LPSE** calculations of CBET in a simple geometry




*R. K. Follett *et al.*, ThP-2, this conference.
J. F. Myatt *et al.*, Phys. Plasmas 24, 056308 (2017).

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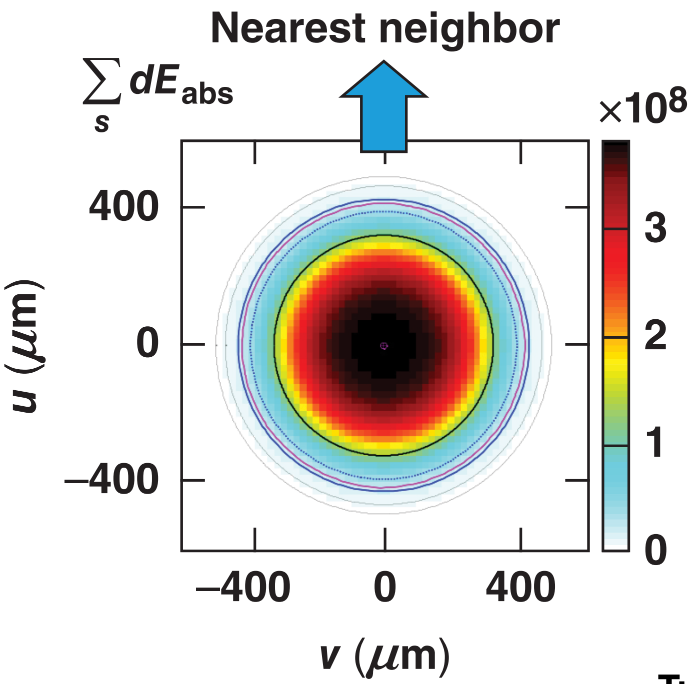
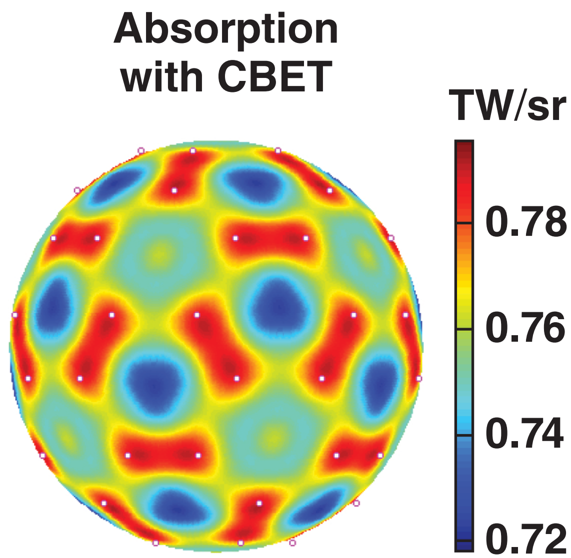
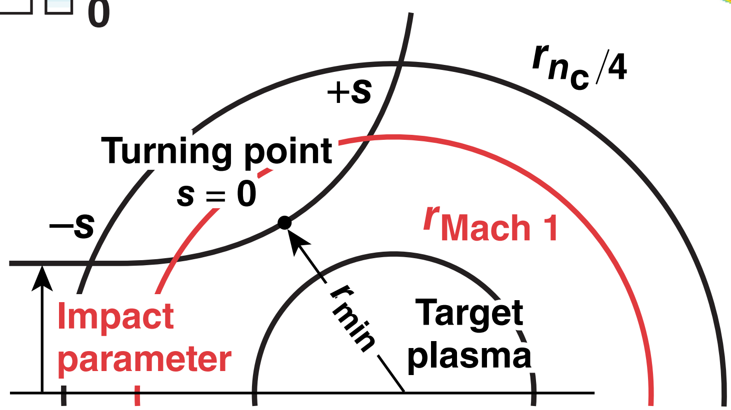
# To display 3-D calculations on 2-D slides we use integrated images and surface maps

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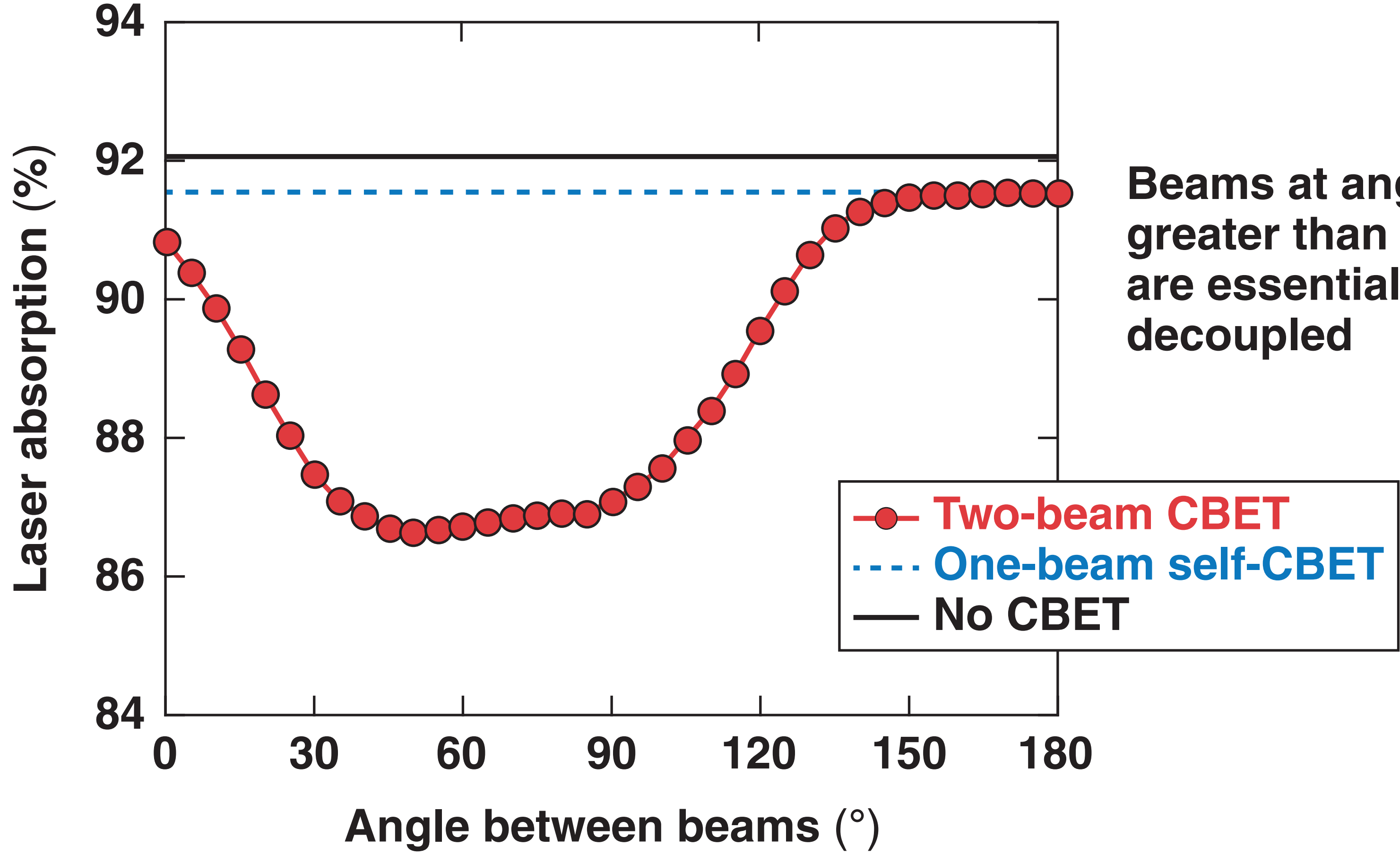
# Two-beam modeling shows that CBET exchange is strongest for beams that are at angles between 40-110°




Beams at angles greater than 150° are essentially decoupled

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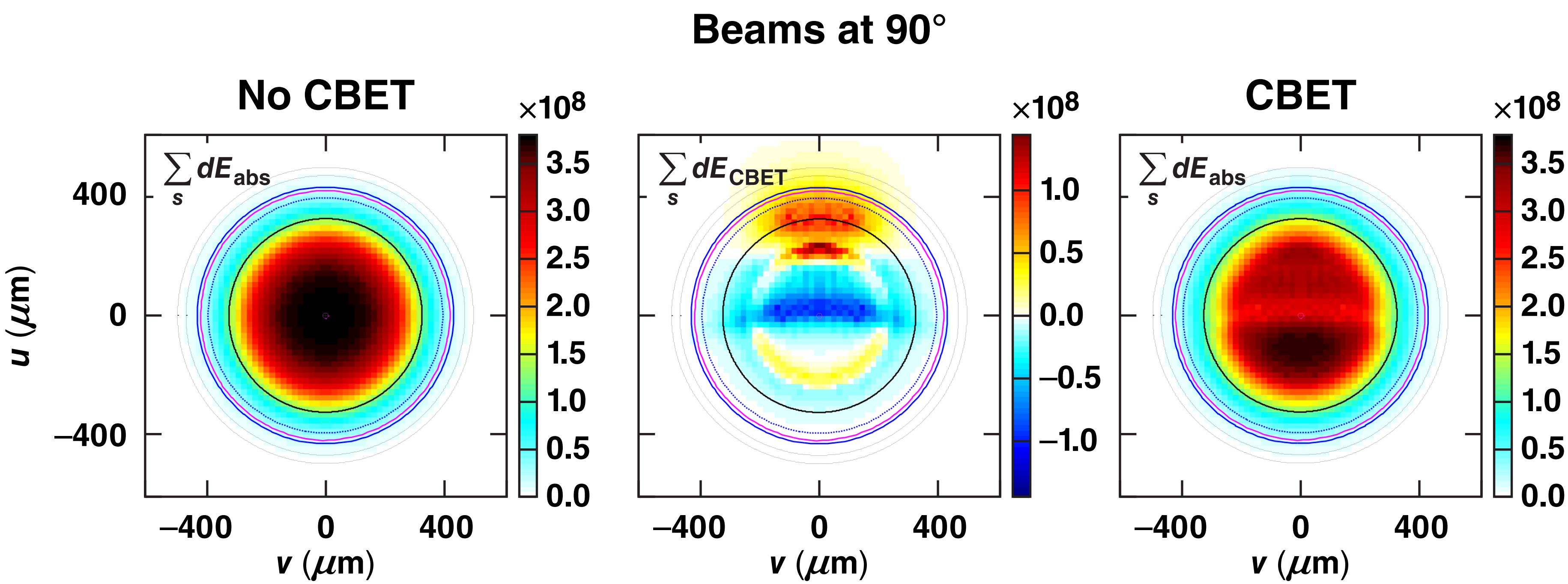
# CBET adds non-axisymmetric features to the beams' absorption profile that depend on their 3-D orientation

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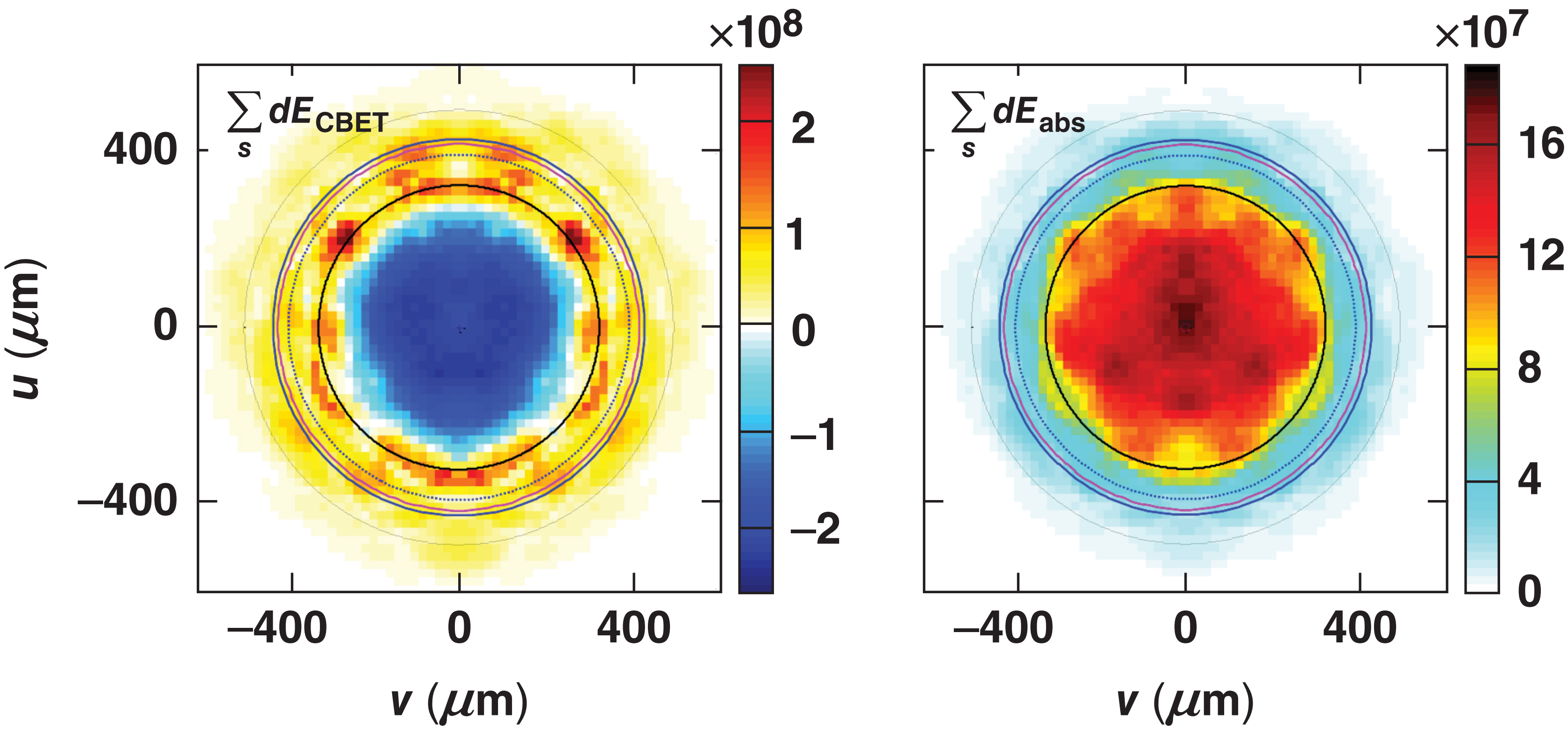
# For the OMEGA symmetric geometry, profile features are the sum of interactions between 60 beams

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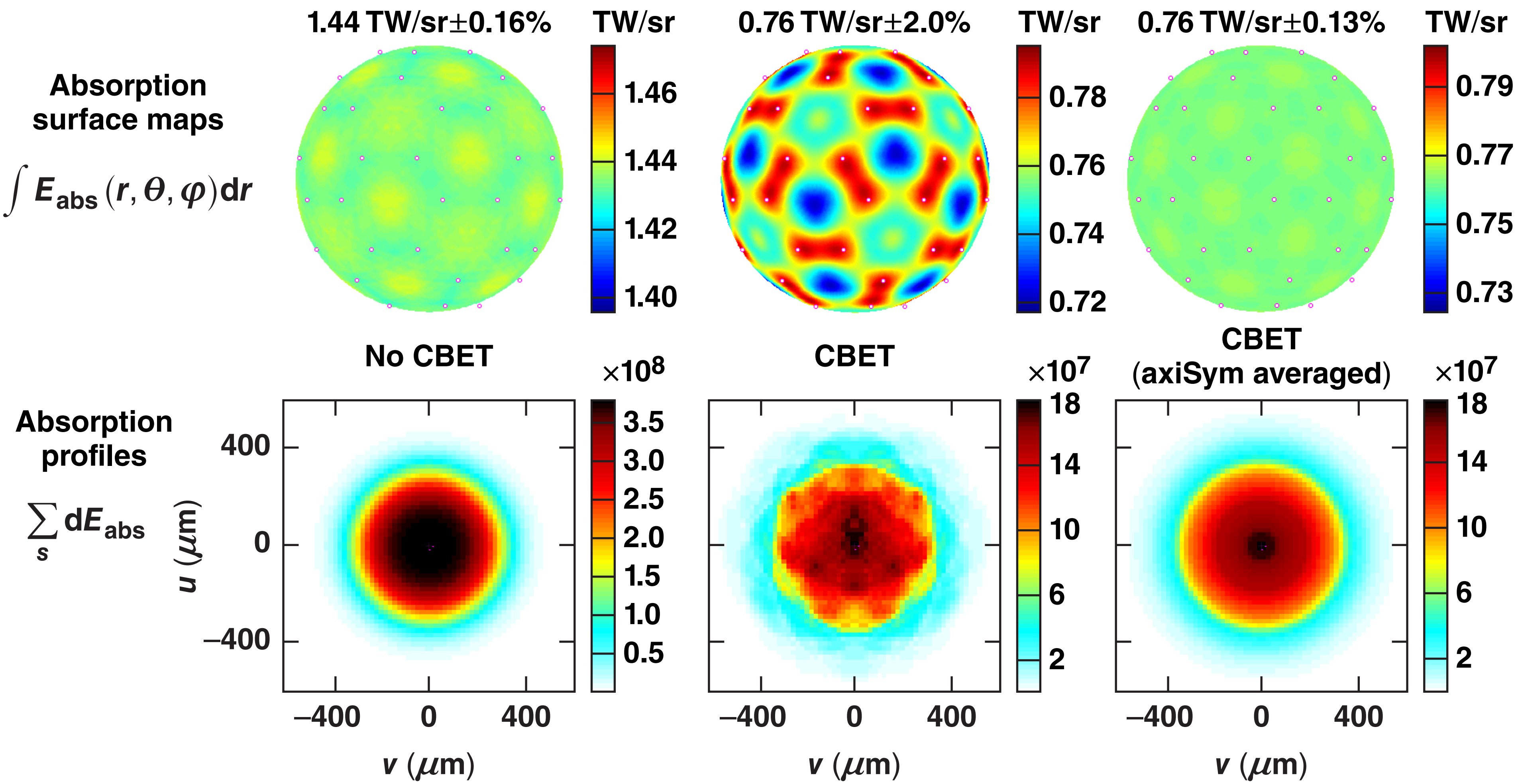
# CBET can increase the absorption nonuniformity of a symmetric implosion by an order of magnitude




The nonuniformity is not simply caused by 1-D CBET from inside to outside of beam profile.

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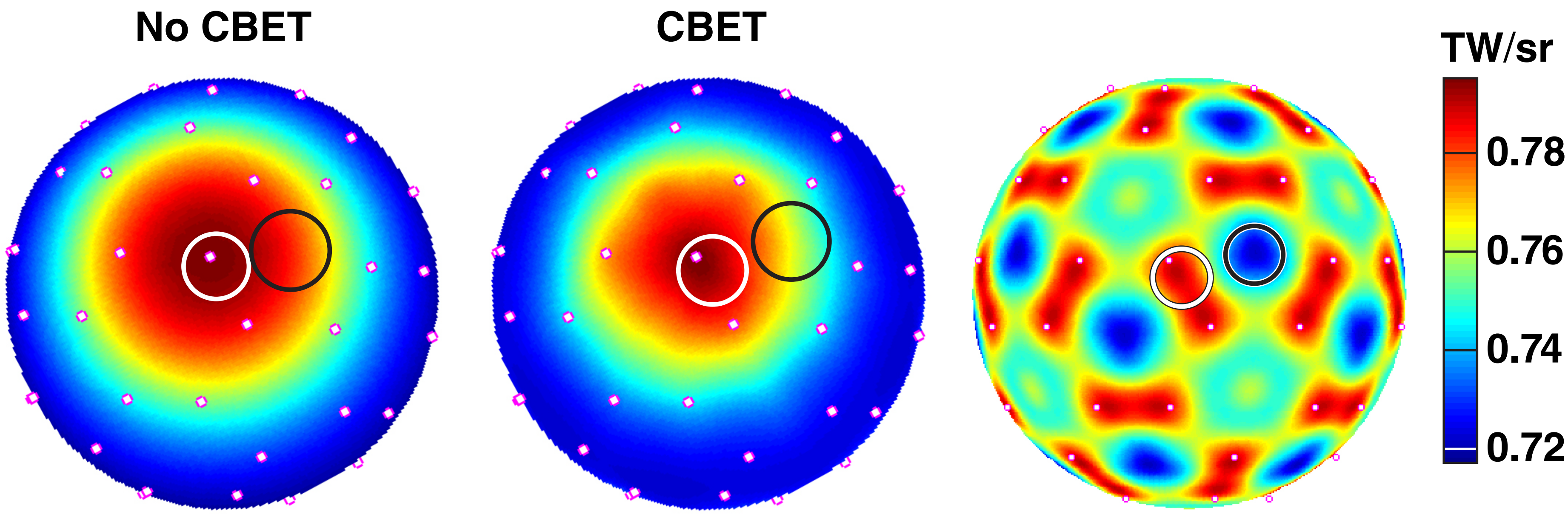
# The nonuniformity originates from the subtle non-axially symmetric details of the absorption profile

**Single-beam pattern**

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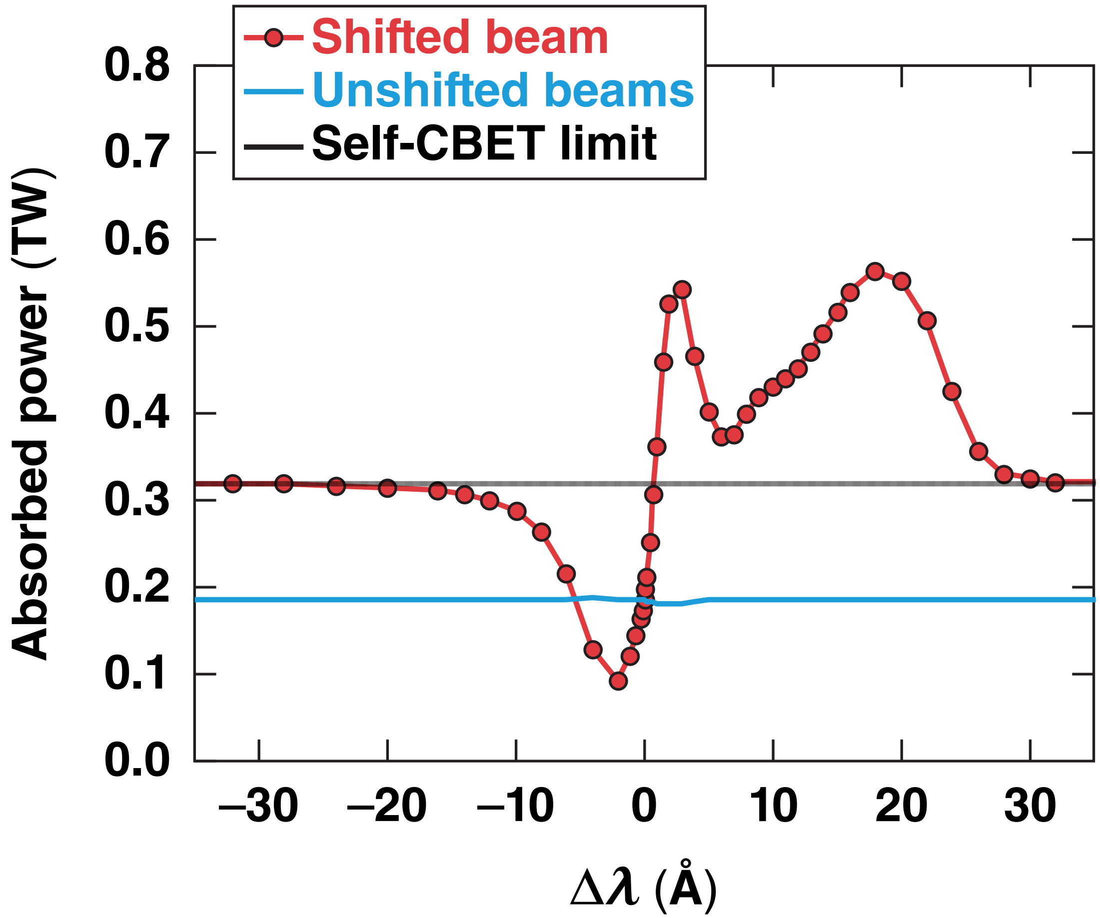
# Wavelength shifting a single OMEGA beam provides insight into multicolor CBET mitigation

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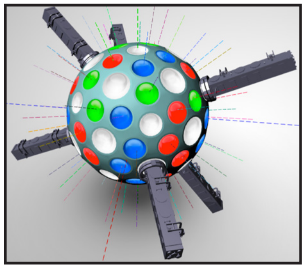
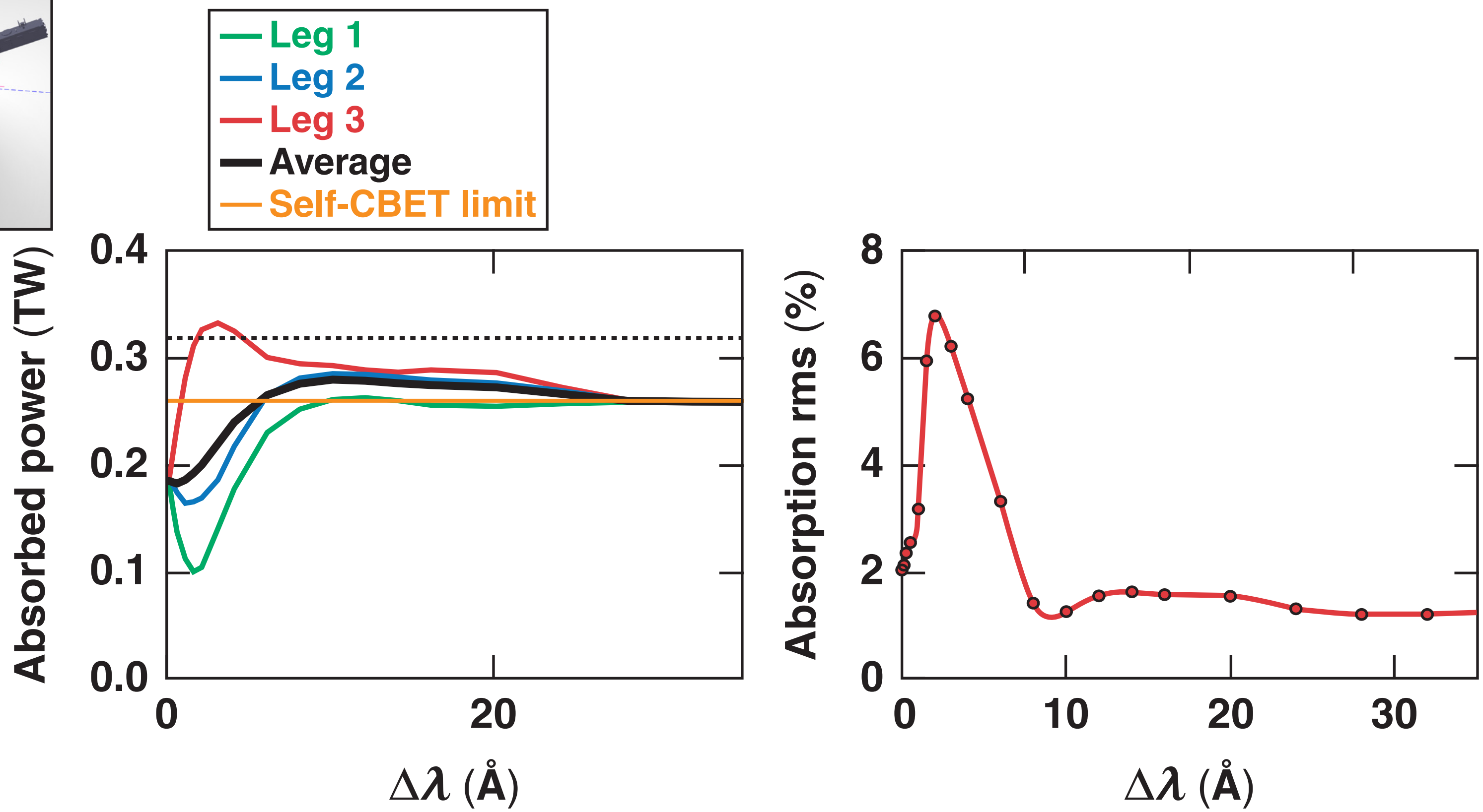
# Breaking cadence: Wavelength shifting the three OMEGA beamline legs to mitigate CBET






**There is a "sweet spot" around $\Delta\lambda$ = 10 Å, where the absorbed power is maximum and the nonuniformity is near minimum.**

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Summary/Conclusions

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