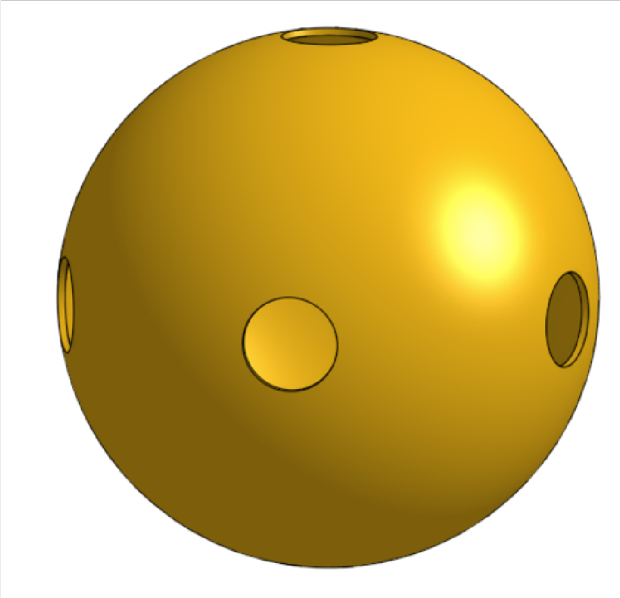
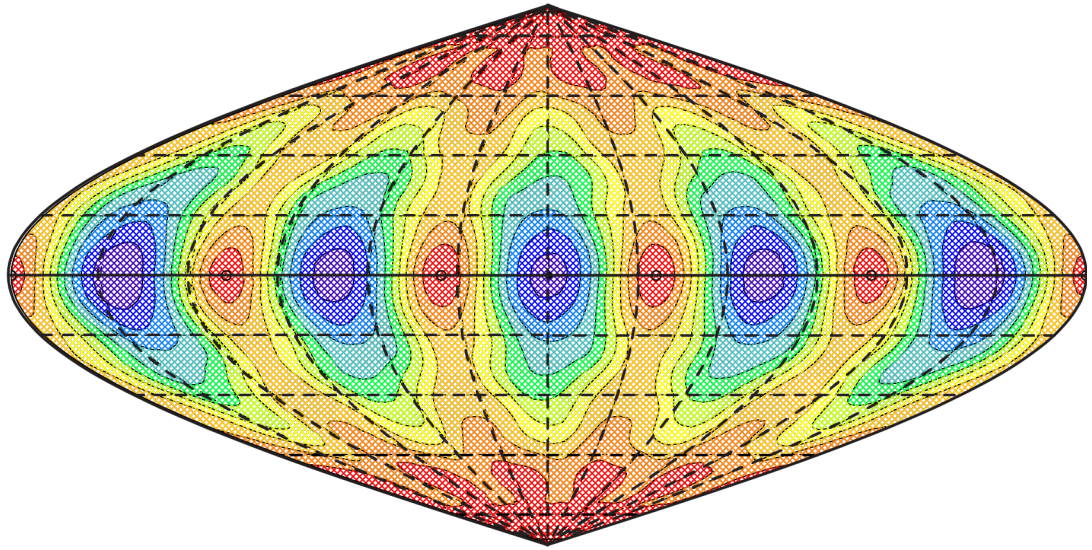
A Proposal for Spherical Hohlraum Experiments on OMEGA Using Seven Laser Entrance Holes





Capsule uniformity at albedo 0.85
rms ~ 0.6%

W. Y. Wang and R. S. Craxton
University of Rochester
Laboratory for Laser Energetics

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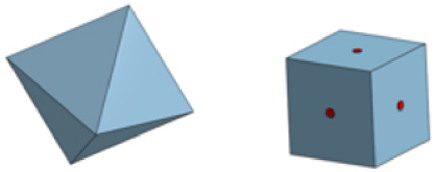
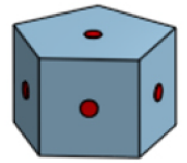
Summary

A seven-hole pentagonal prism (PEPR) hohlraum is well suited for 60-beam OMEGA experiments and offers a useful platform for studying spherical hohlraums

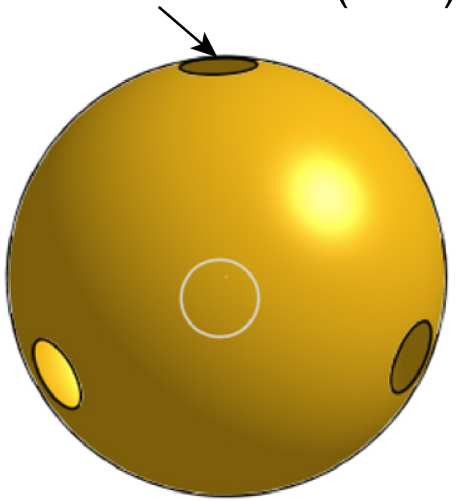
- **The PEPR hohlraum promises to provide insight toward the performance of octahedral (six-hole) hohlraums**
- **The PEPR hohlraum is well-matched to the symmetry of the 60-beam OMEGA laser**
- **High levels of capsule uniformity when driving PEPR hohlraums are predicted by the view-factor code *LORE* at all albedos**

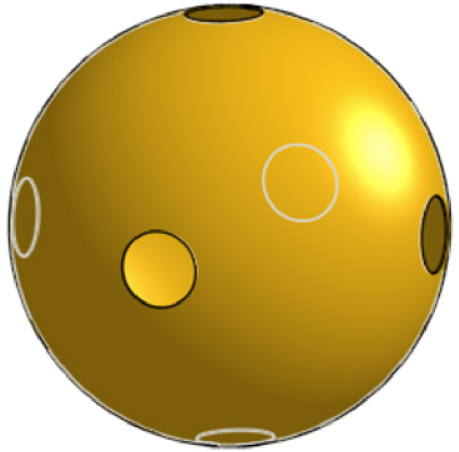
PEPR hohlraum experiments could be a useful platform to study the physics of spherical hohlraums

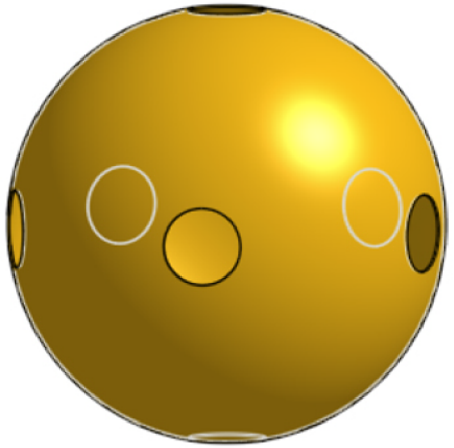




Laser entrance hole (LEH)







Tetrahedral hohlraum (demonstrated on OMEGA)*

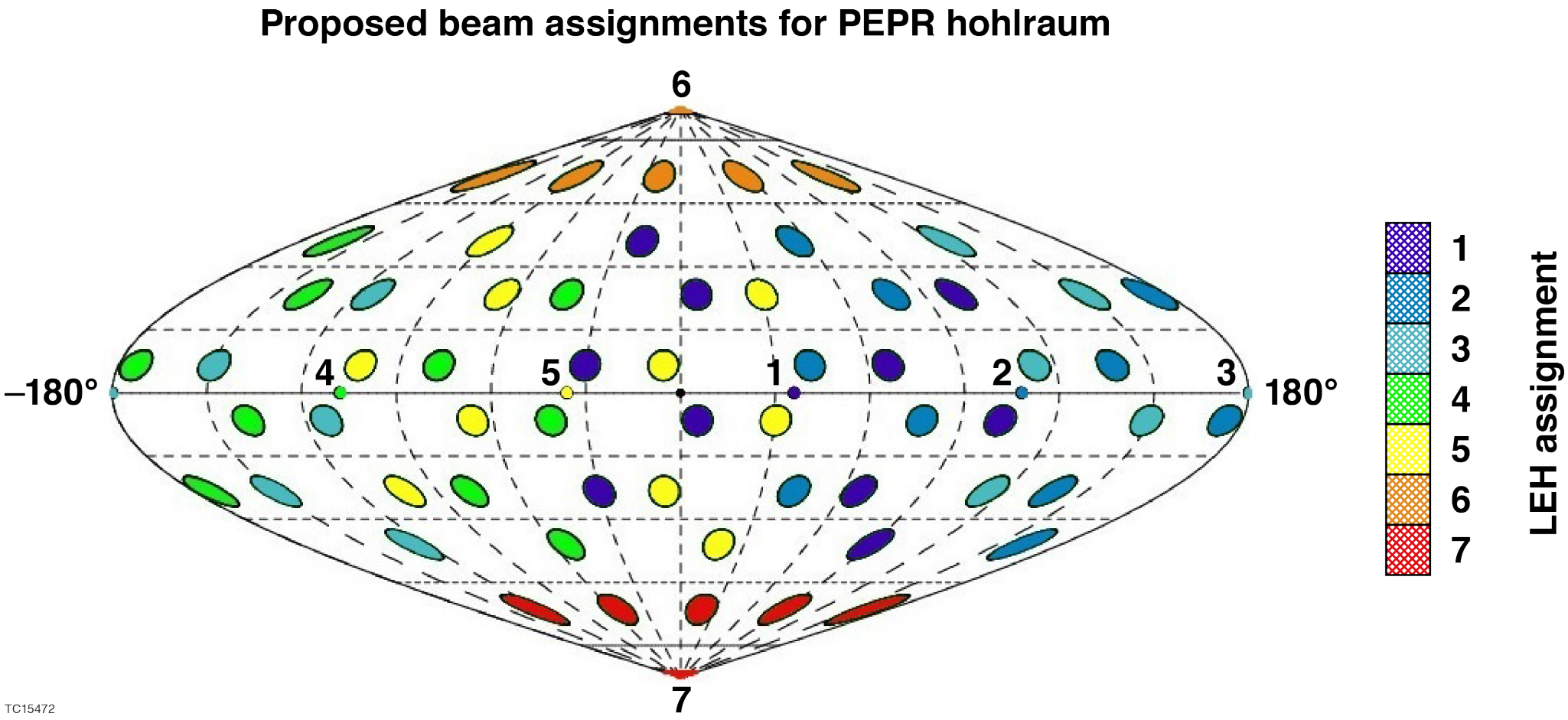
Octahedral hohlraum (proposed by Lan)**

PEPR hohlraum†

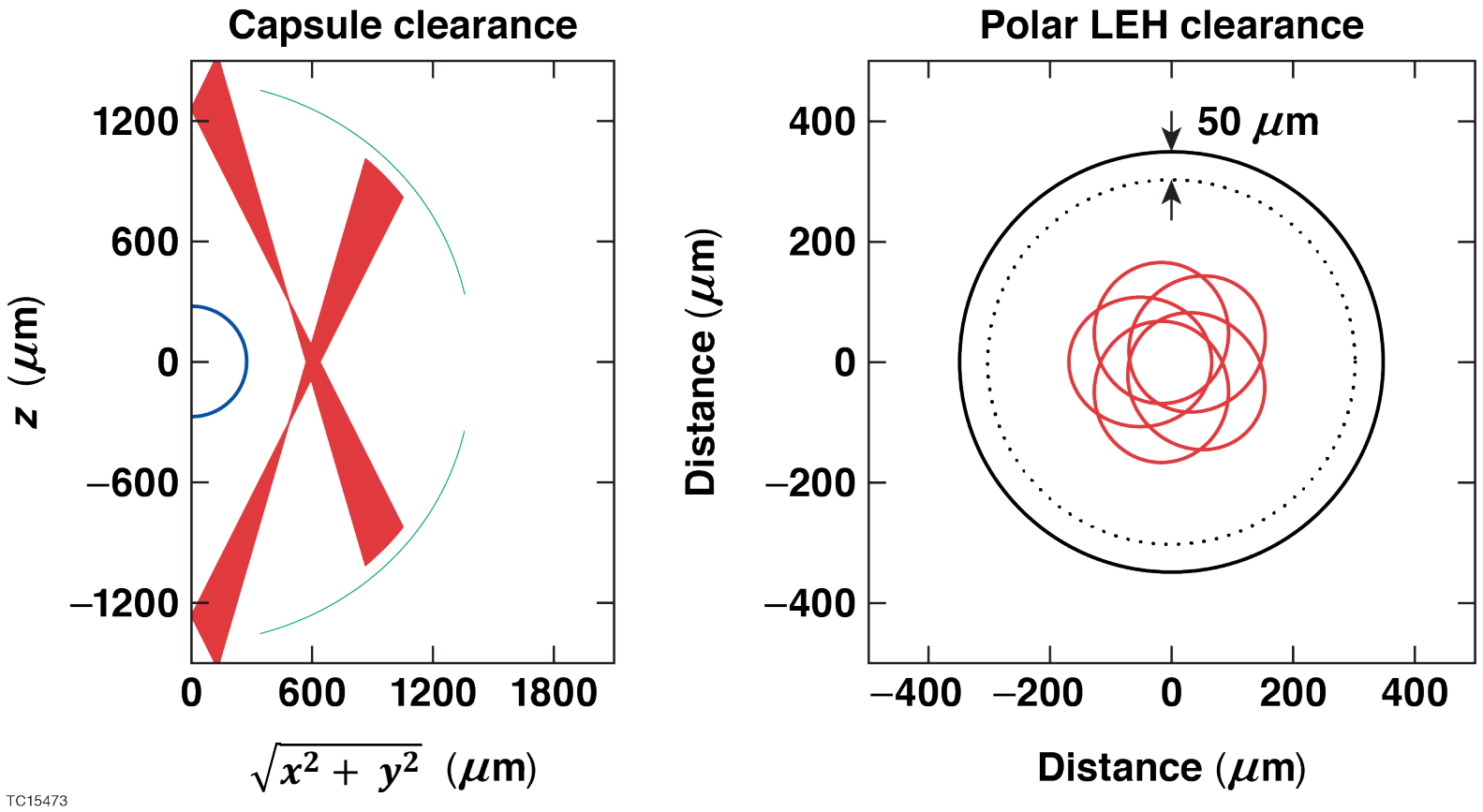
TC15471

* G. R. Bennett *et al.*, Phys. Plasmas 7, 2594 (2000).
** K. Lan *et al.*, Phys. Plasmas 21, 010704 (2014).
† W. A. Farmer *et al.*, Phys. Plasmas 26, 032701 (2019).

The PEPR hohlraum is well matched to the symmetry of the 60-beam OMEGA laser



The beam pointing design ensures capsule clearance and LEH clearance



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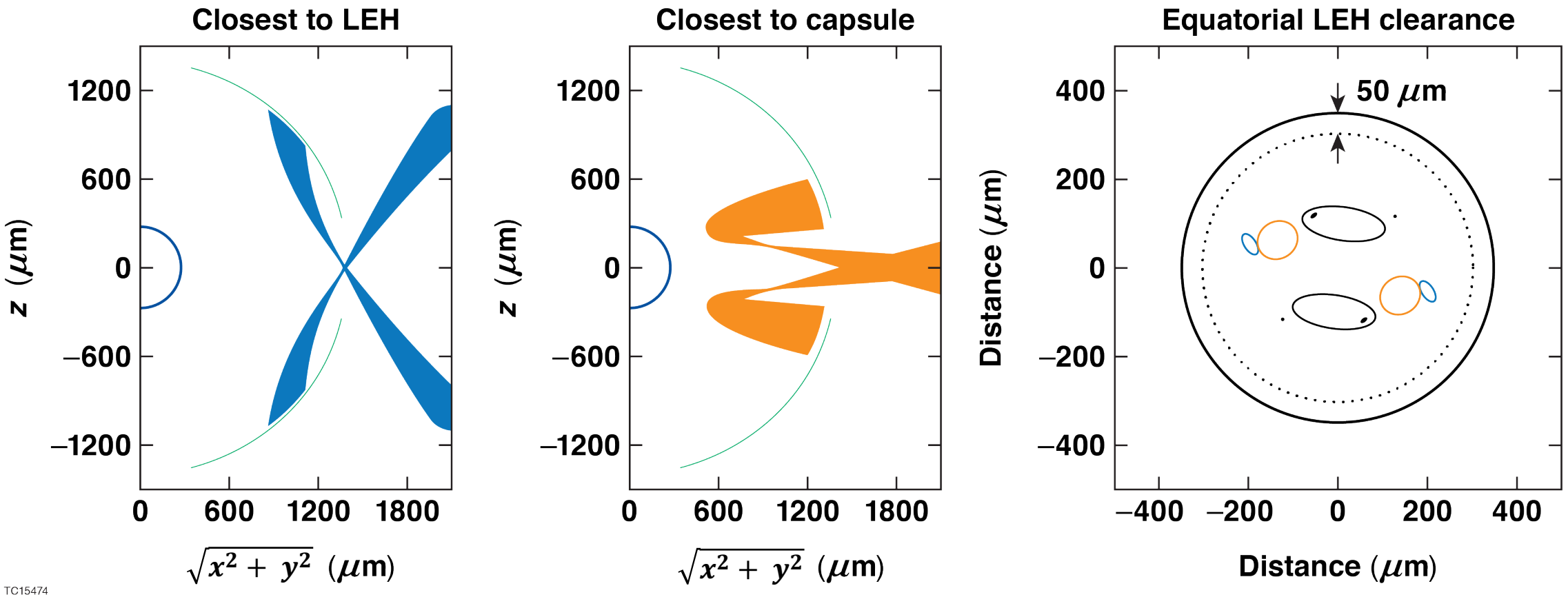
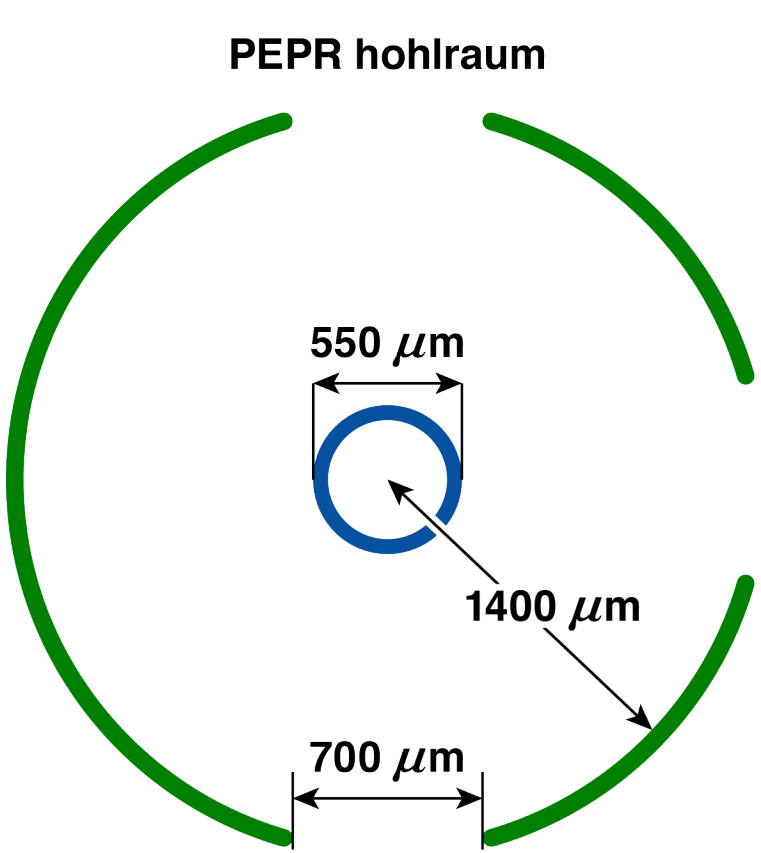
The same clearances are satisfied by the beams that enter the equatorial LEH's



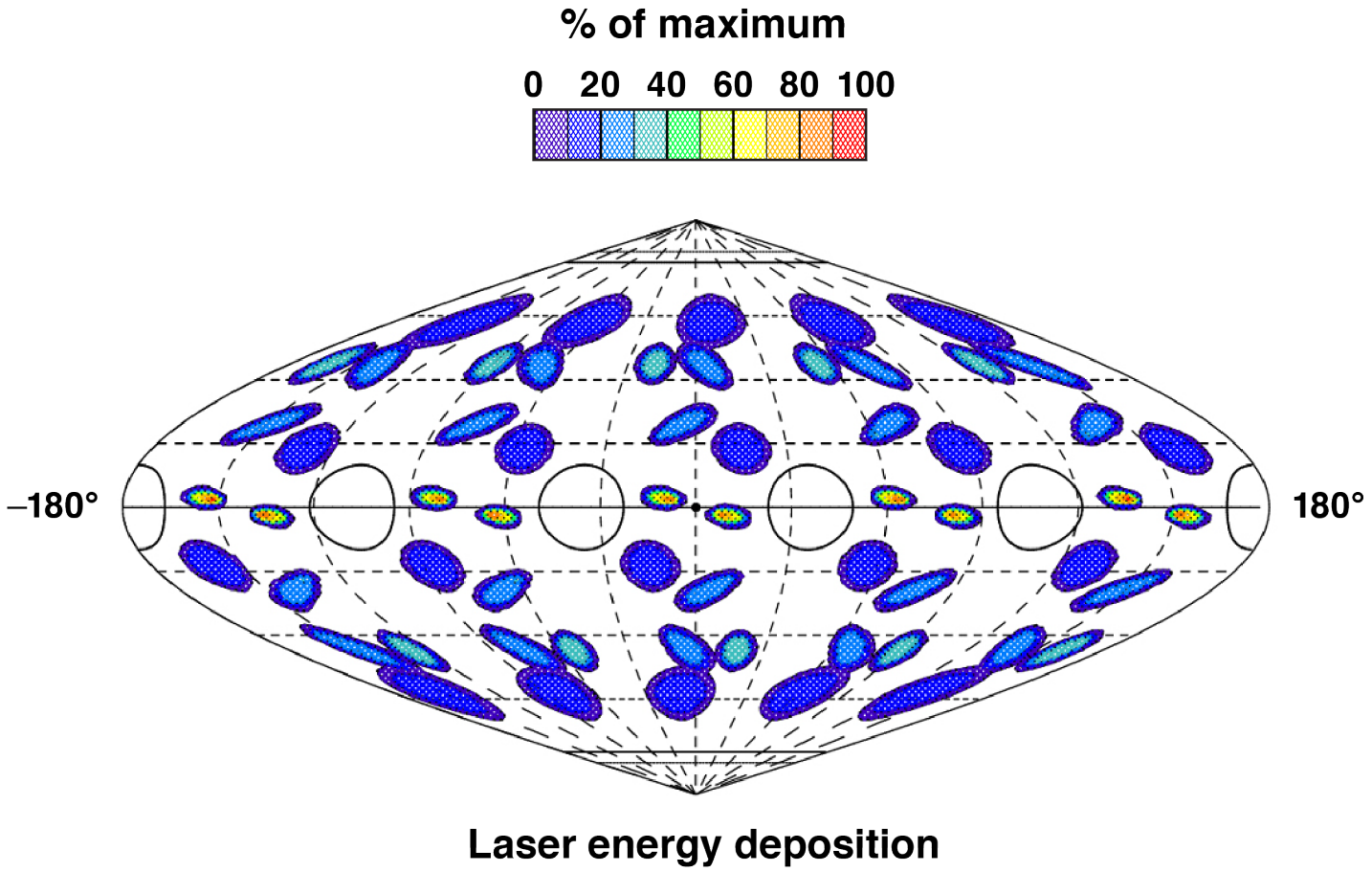
TC15474

Following the code *BUTTERCUP*,* *LORE* first calculates the deposited laser energy by ray-tracing beams through the LEH's onto the hohlraum wall



Case-to-capsule ratio = 5.09
Dimensions from Wallace**

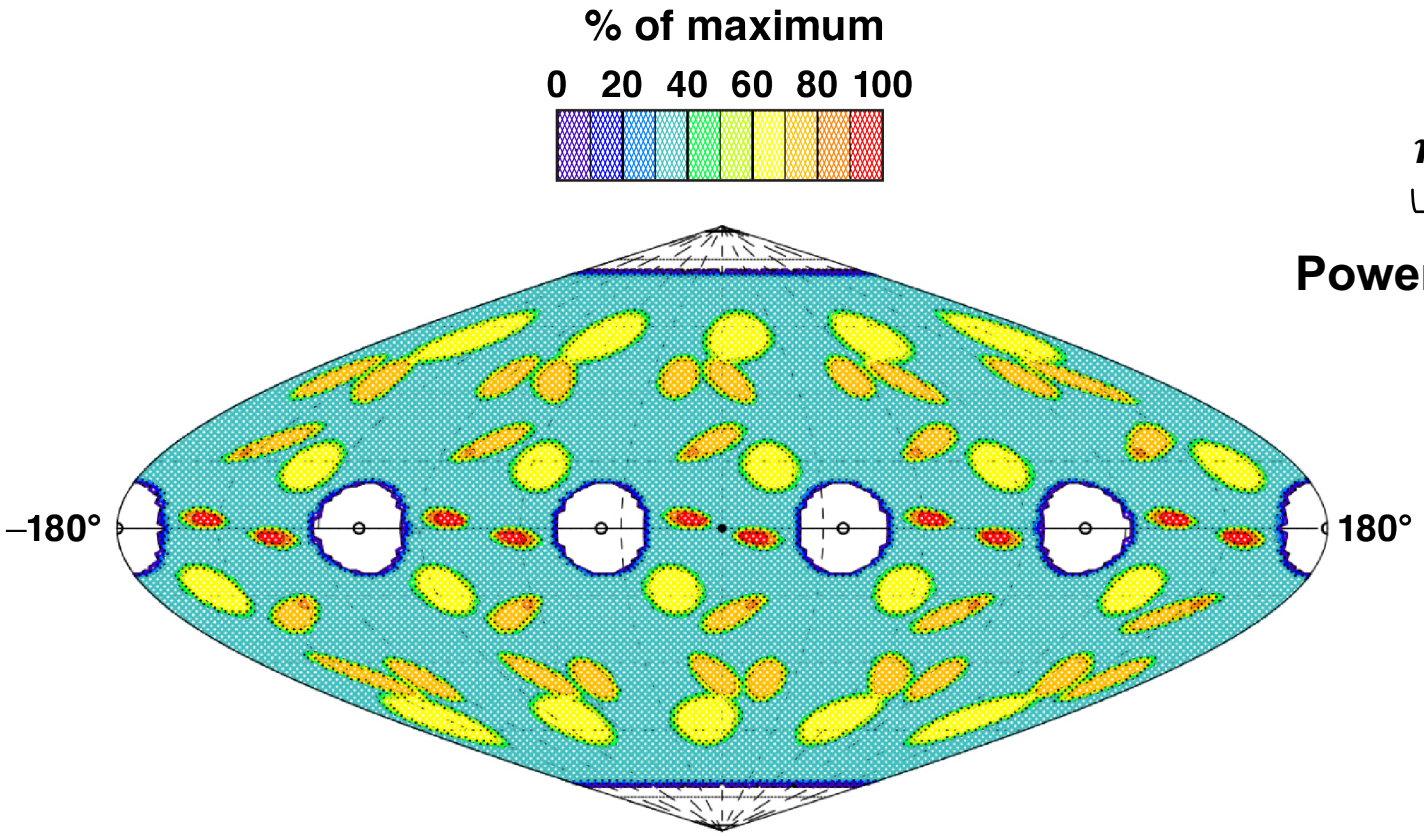
TC15475



Laser energy deposition

* J. D. Schnittman *et al.*, Phys. Plasmas 3, 3786 (1996).
** J. M. Wallace *et al.*, Phys. Rev. Lett. 82, 3807 (1999).

LORE calculates the effective radiation temperature T_e at each point on the hohlraum wall



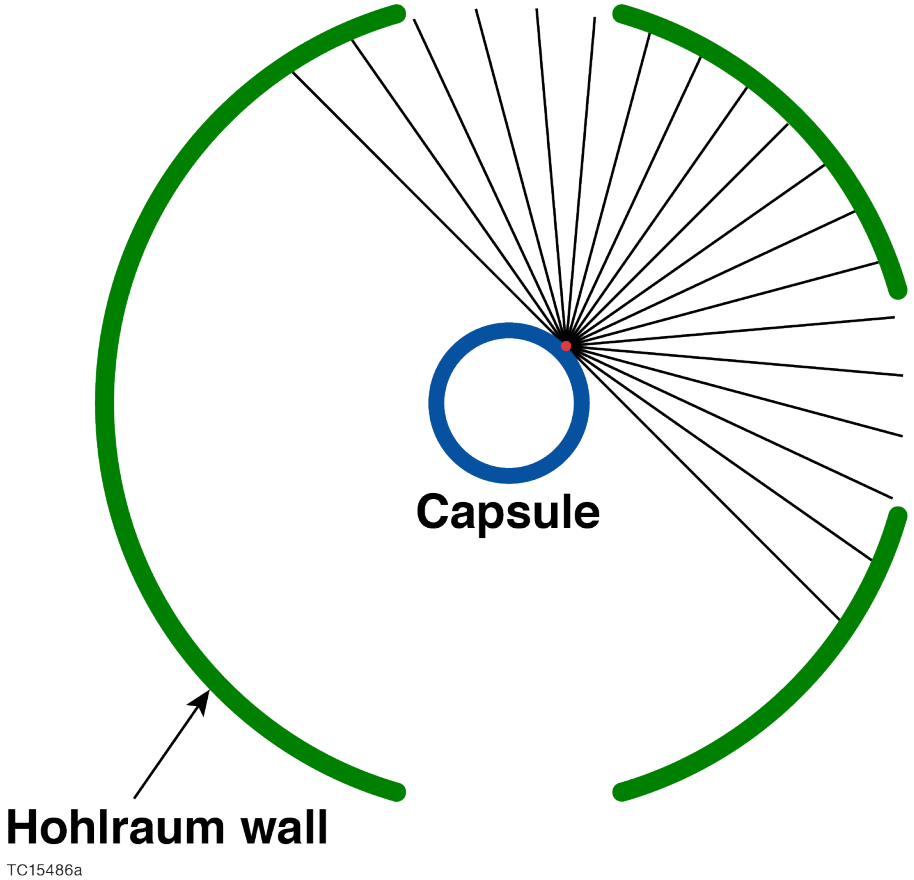
Effective radiation temperature

$$\underbrace{\eta_L P_L}_{\text{Power entering}} = \sigma T_R^4 \underbrace{[(1-\alpha_w)A_w + NA_h + (1-\alpha_c)A_c]}_{\text{Effective area}}$$

$$\sigma T_e^4 = \alpha_w \sigma T_R^4 + \eta_L I_L$$

TC15476

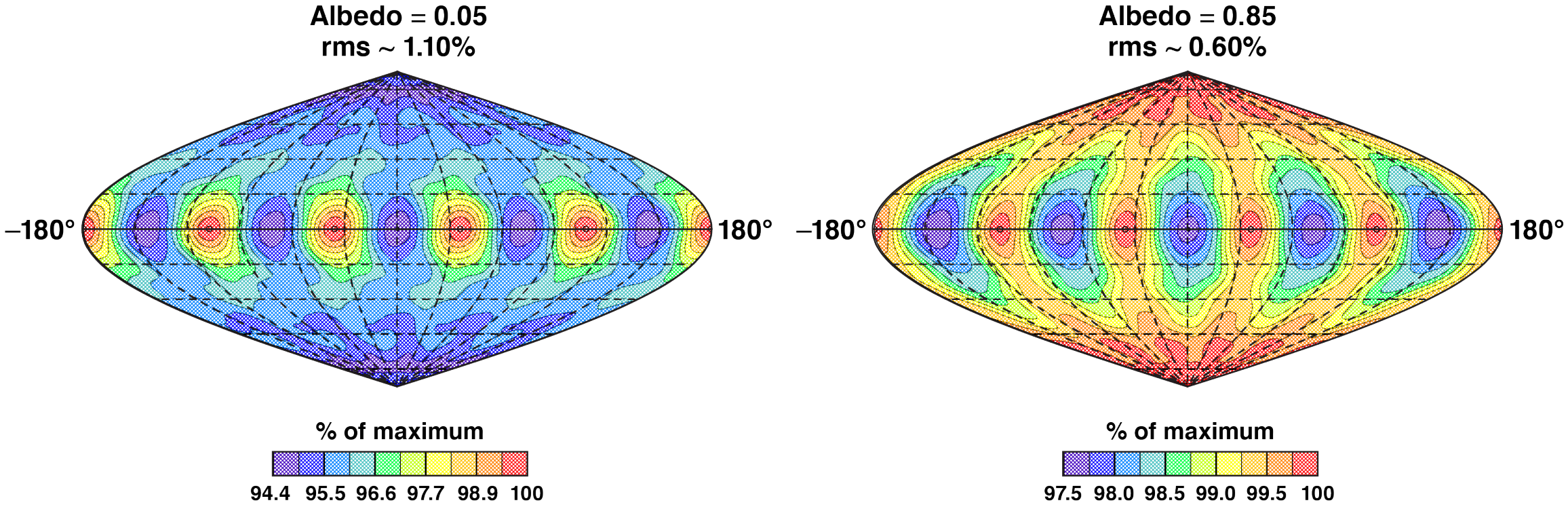
LORE scans over multiple points on the capsule and integrates the spectral brightness $\left(\sigma T_e^4/\pi\right)$ over all directions to determine the radiation flux



- 60,000 points
- 100,000 directions

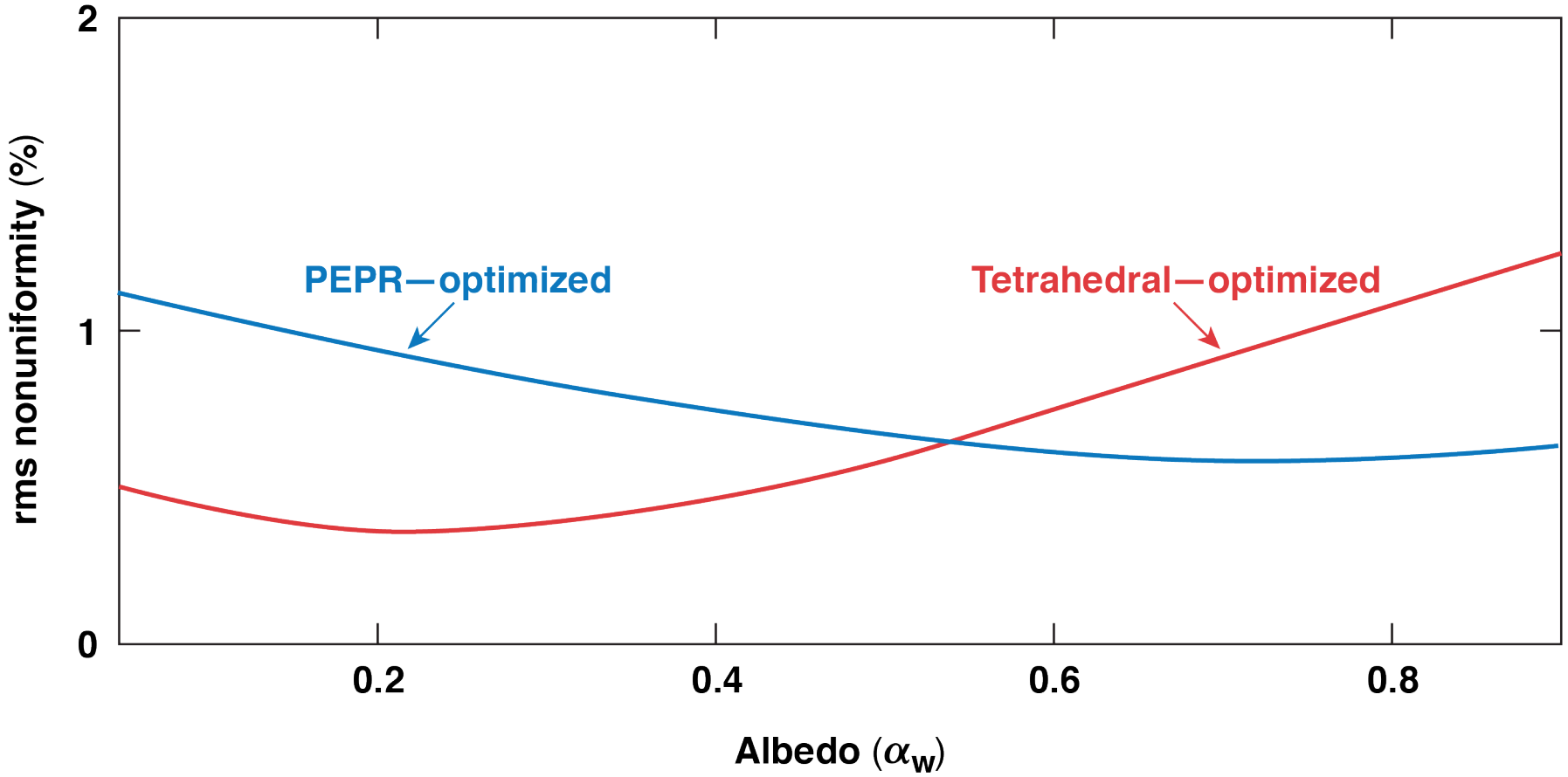
The poles of the capsule are underdriven at low albedo values, but overdriven at high albedo values

- Flux variations on the capsule



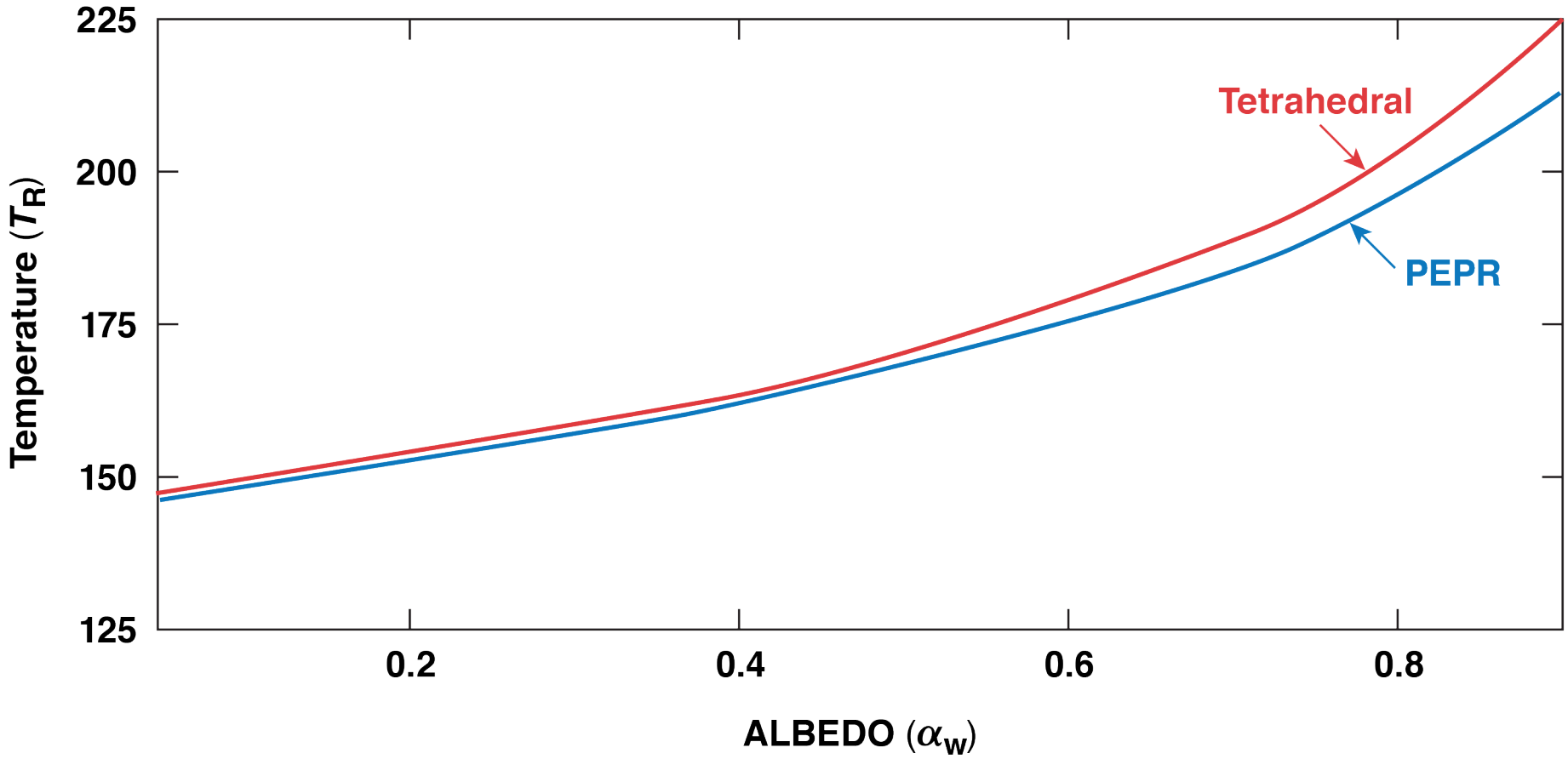
TC15478

The optimized PEPR hohlraum provides high levels of uniformity at all values of albedo

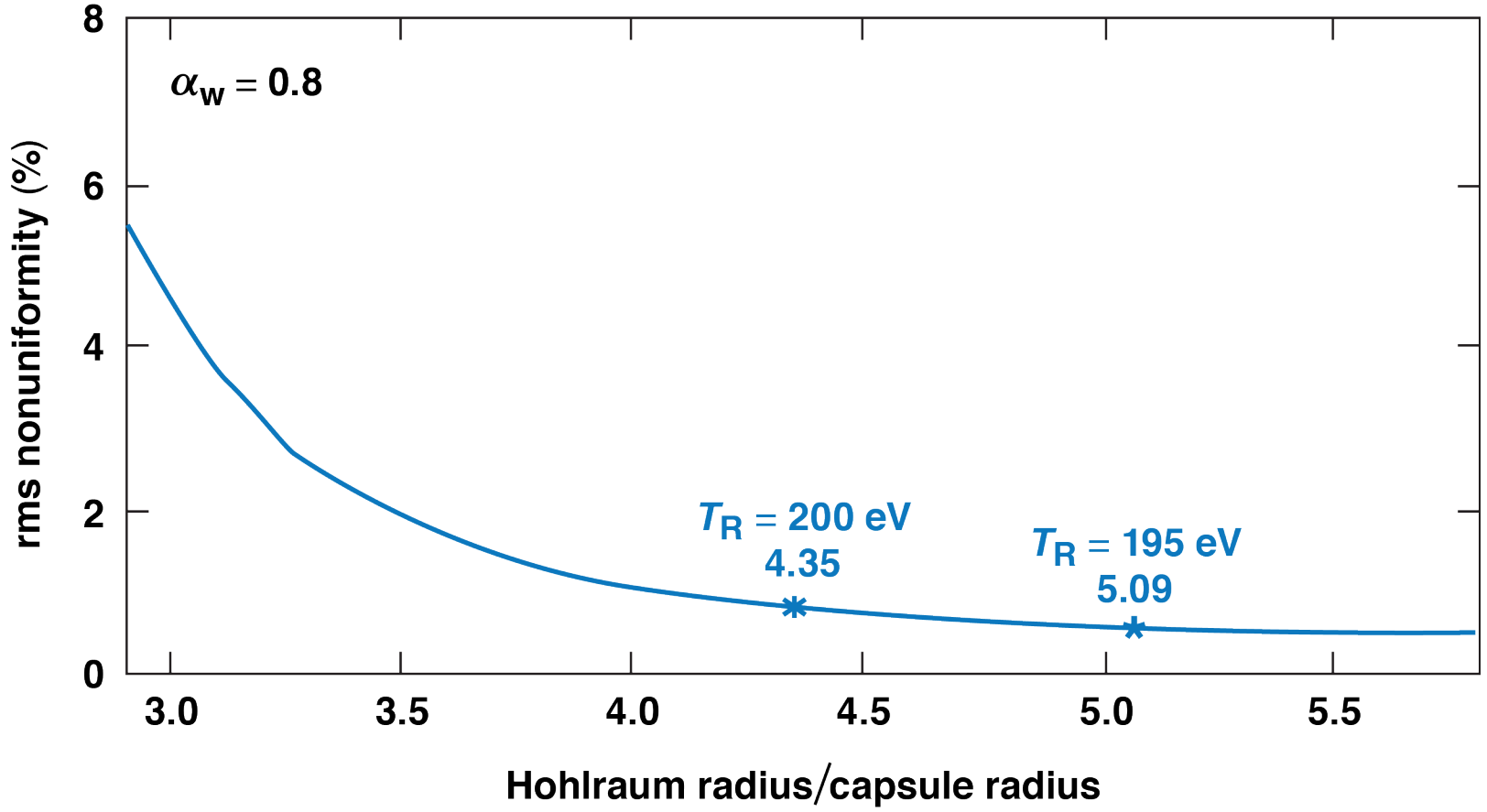


TC15479

For all values of albedo, the PEPR hohlraum provides slightly lower values of background radiation temperature T_R than the tetrahedral hohlraum



A T_R of 200 eV can be recovered by reducing the case-to-capsule ratio to 4.35, with the nonuniformity staying below 1%



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