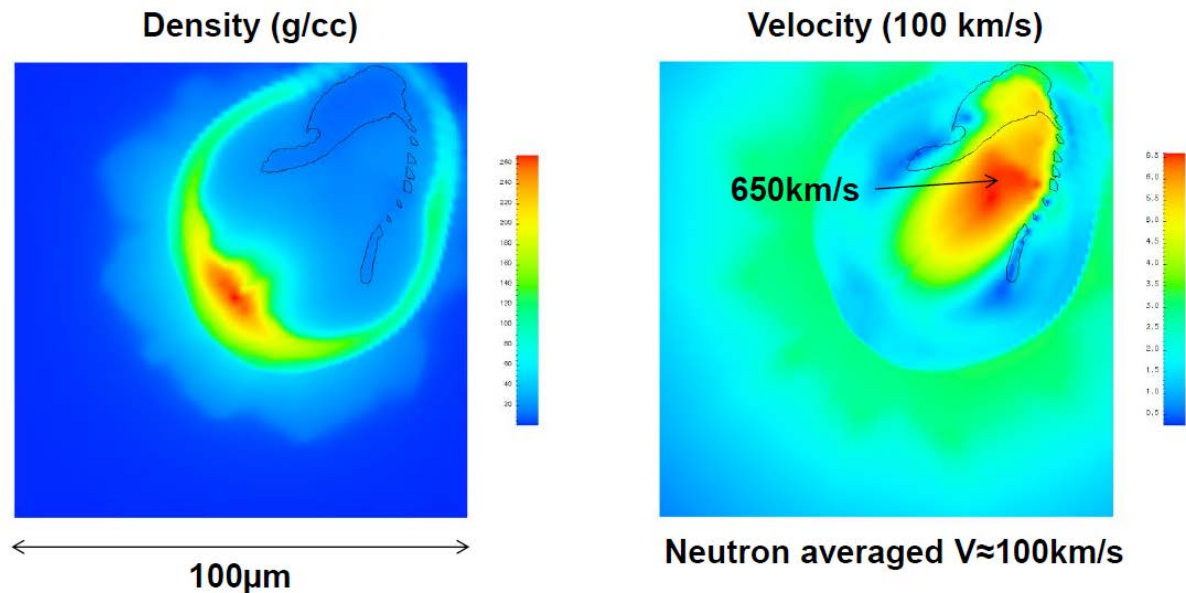


# 3D Picture of OMEGA Cryogenic Implosions from Simulations Using ASTER

## Equatorial view from 3D simulation



P. B. Radha  
Laboratory for Laser Energetics  
University of Rochester

Fiche #

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# 3D simulations indicate that relatively round cores are consistent with significant $T_{ion}$ variations in OMEGA cryogenic implosions



- **3D ASTER\* simulations can currently be used to simulate the effect of long-wavelength perturbations in OMEGA cryogenic implosions.**
- **The effect of target offset, beam-overlap, power imbalance, beam-mispointing, and beam-mistiming are simulated.**
- **With nominal sources of nonuniformity, simulations indicate significant residual kinetic energy due to the perturbations, primarily target offset and power imbalance.**
- **Inferred  $T_{ion}$  in nonuniform implosions can deviate up to ~2 keV depending on viewing angle due to residual flows.**
- **Self-emission x-ray images loosely reproduce the shape of the distorted implosion cores.**

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\* Written by I. Igumenshchev

- **ASTER\* is being used to guide interpretation of OMEGA cryogenic implosion results**



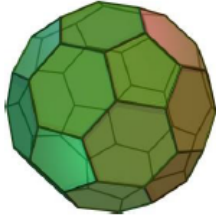
- **3D Eulerian on an orthogonal spherical grid**
- **Two-temperature (electron and ion), single-fluid, multiple materials**
- **Physics included:**
  - **Astrophysical Opacity tables and SESAME EOS**
  - **Spitzer heat conduction**
  - **Simplified laser deposition model includes effect of CBET**

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\*Igumenshchev et al, submitted to PoP.

# ASTER models cryogenic implosions with long wavelength perturbations in 3D

Truncated  
icosahedron



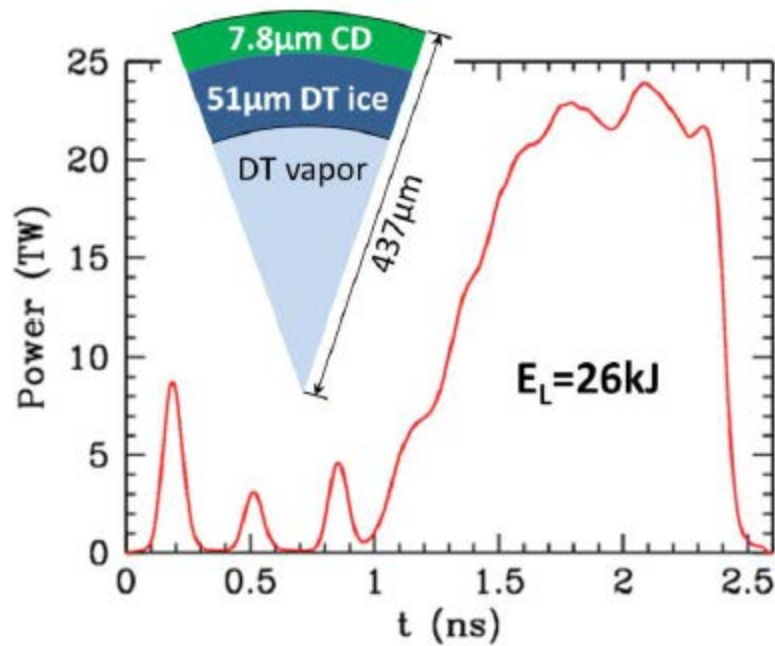
- OMEGA beam-port illumination

Sources with magnitudes suggested by indirect measurements:

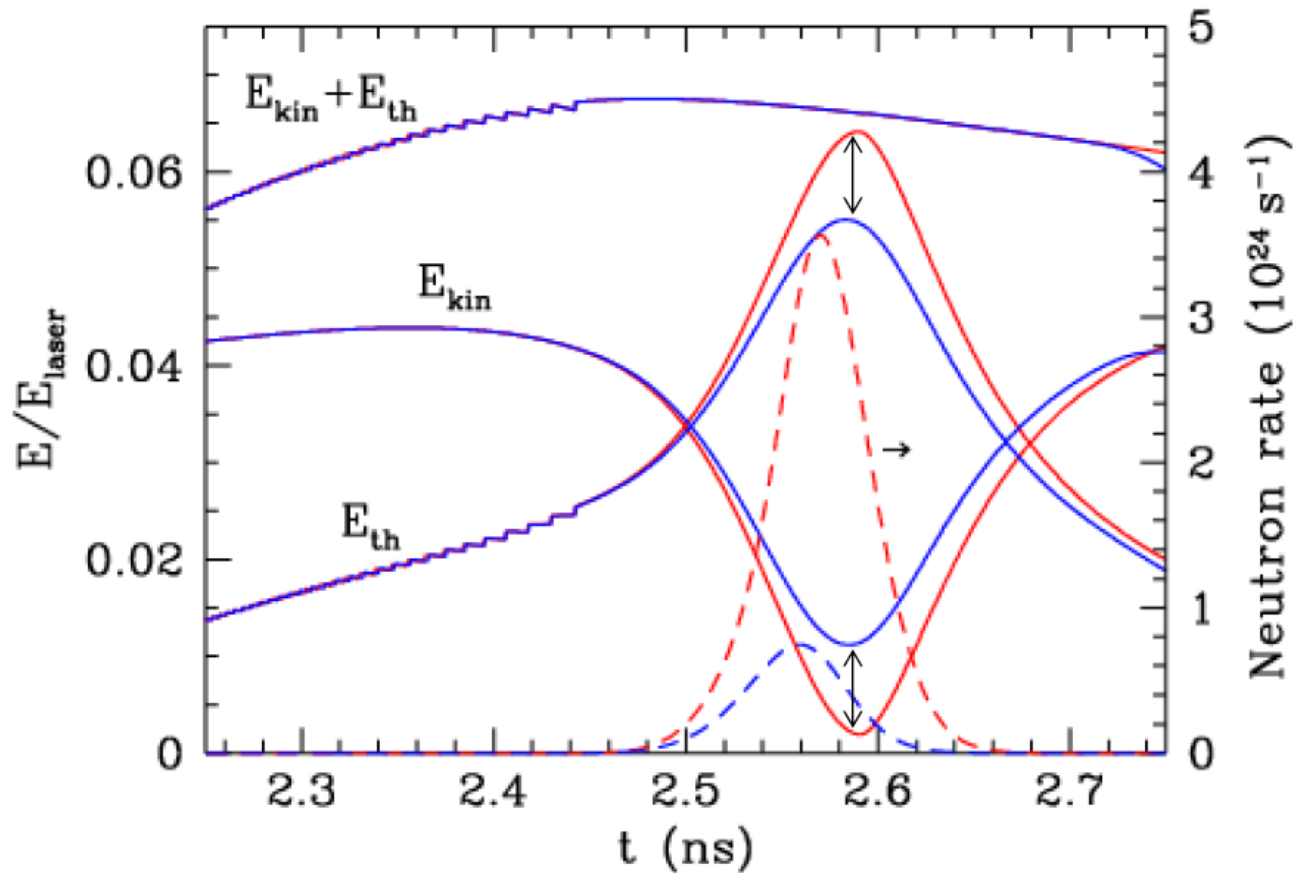
- Target offsets, from 10 to 20  $\mu\text{m}$
- Beam energy imbalance,  $\sigma_{\text{rms}} \sim 10\% - 20\%$
- Beam mispointing,  $\sigma_{\text{rms}} \sim 10 - 20 \mu\text{m}$
- Beam mistiming,  $\sigma_{\text{rms}} \sim 5 \text{ ps}$

# High adiabat implosions are being modeled with ASTER

## Nominal design ( $\alpha \sim 4$ )



# Perturbed implosions demonstrate large residual kinetic energy in the stagnating shell



— Uniform

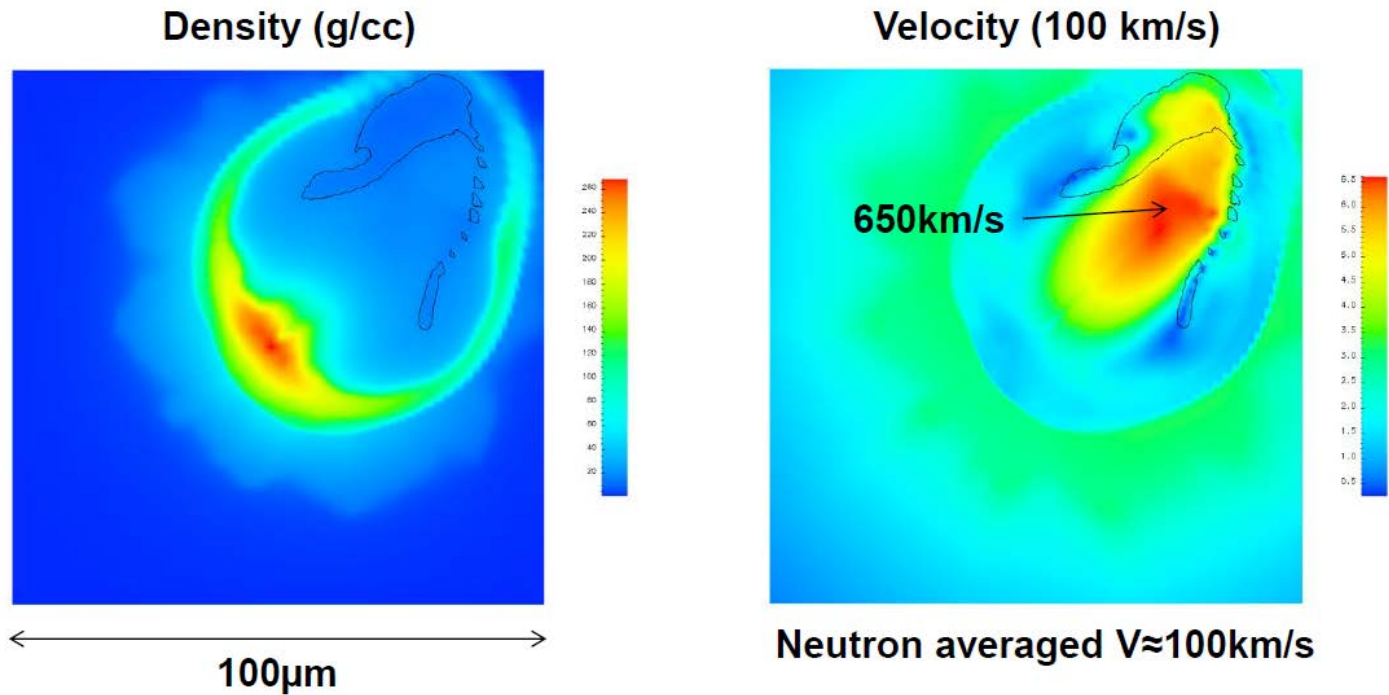
— Sources:

- Beam overlap
- 20- $\mu\text{m}$  offset
- 10% imbalance
- 10- $\mu\text{m}$  mispoint
- 5-ps mistiming

- The effect of beam port geometry, beam mistiming and beam mispointing is small

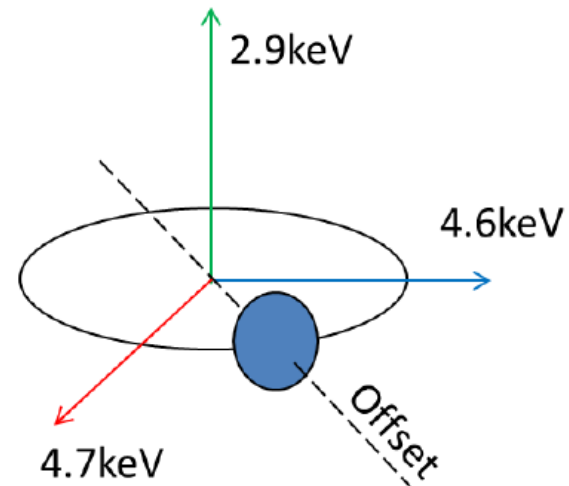
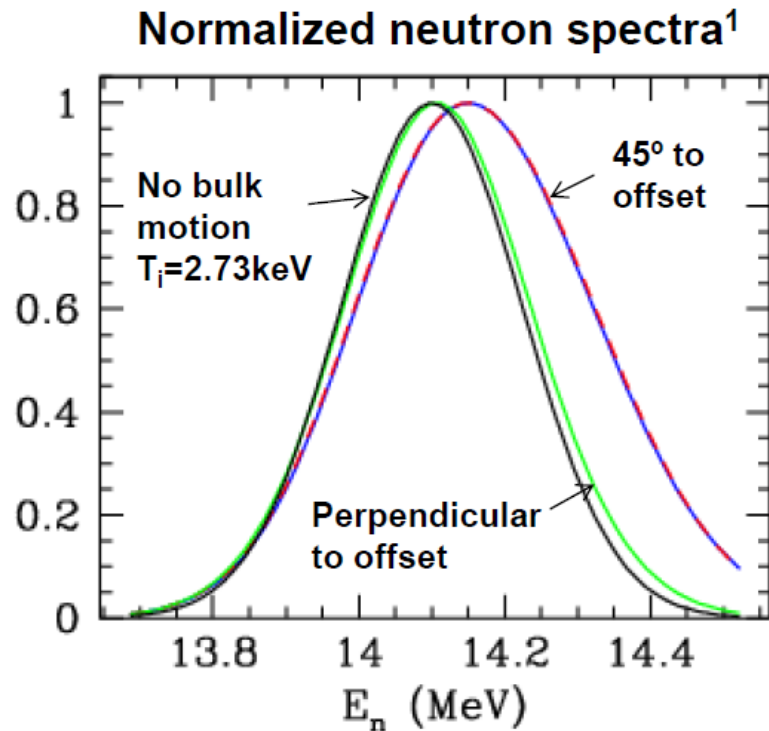
- Integrating over the volume within  $R=200\mu\text{m}$

# Target offset results in high velocity motion in the hot spot



Model A7 (20- $\mu\text{m}$  offset + other sources)  
Neutron peak,  $t=2.57 \text{ ns}$

# Residual motion in the hot spot results in a direction dependent $T_{ion}$



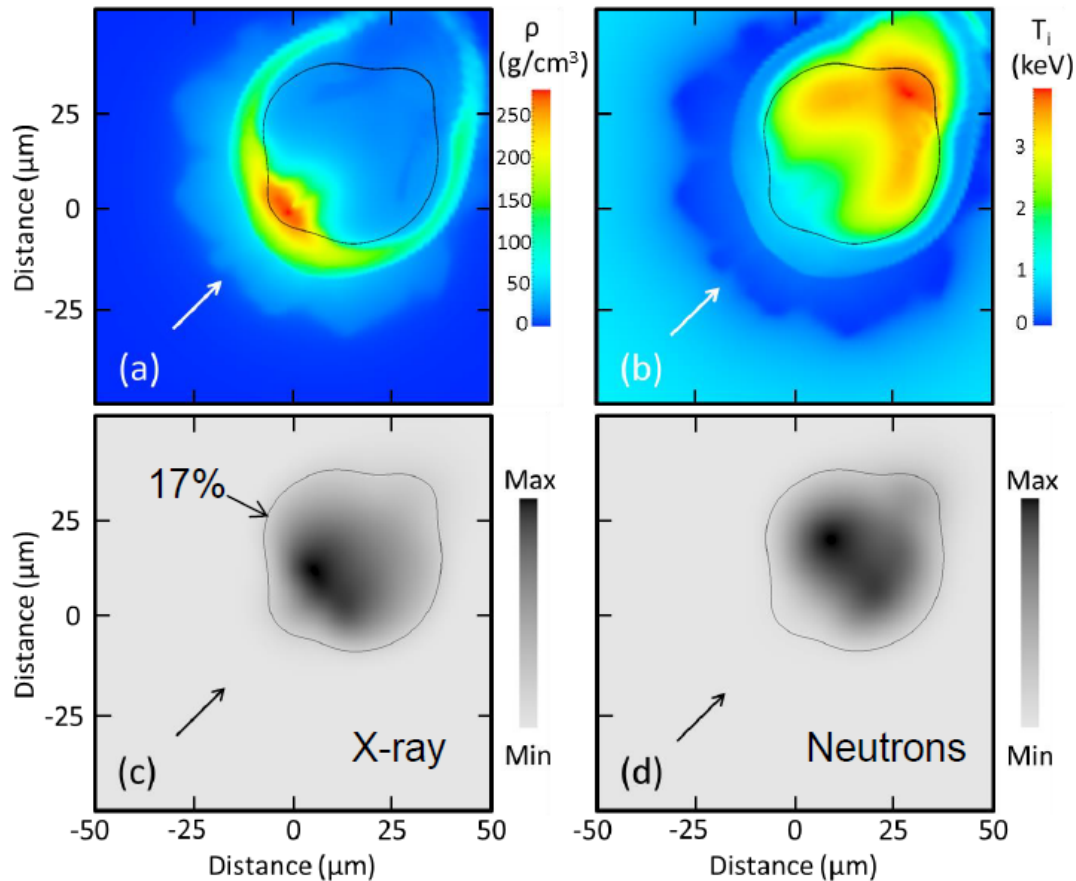
Measured  $T_i=3.6 / 3.7 / 4.6 \pm 0.5$  keV

<sup>1</sup> T. J. Murphy, PoP (2014).



# Hot spot distortion loosely reproduce x-ray images

## Equatorial cuts



Peak neutron production

$t=2.57$  ns

Sources:

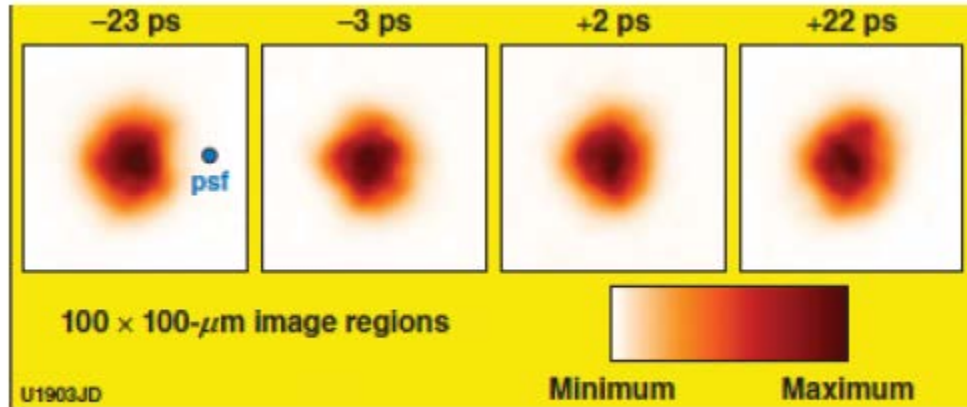
- 20- $\mu\text{m}$  offset
- beam overlap
- 10% imbalance
- 10- $\mu\text{m}$  mispointing
- 5-ps mistiming

30 ps gate width

6  $\mu\text{m}$  resolution

# Hot spot distortion loosely reproduce x-ray images

## Shot 77064



## Peak neutron production

