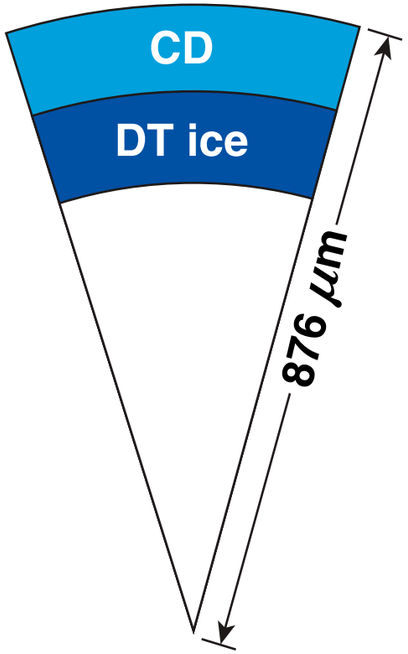
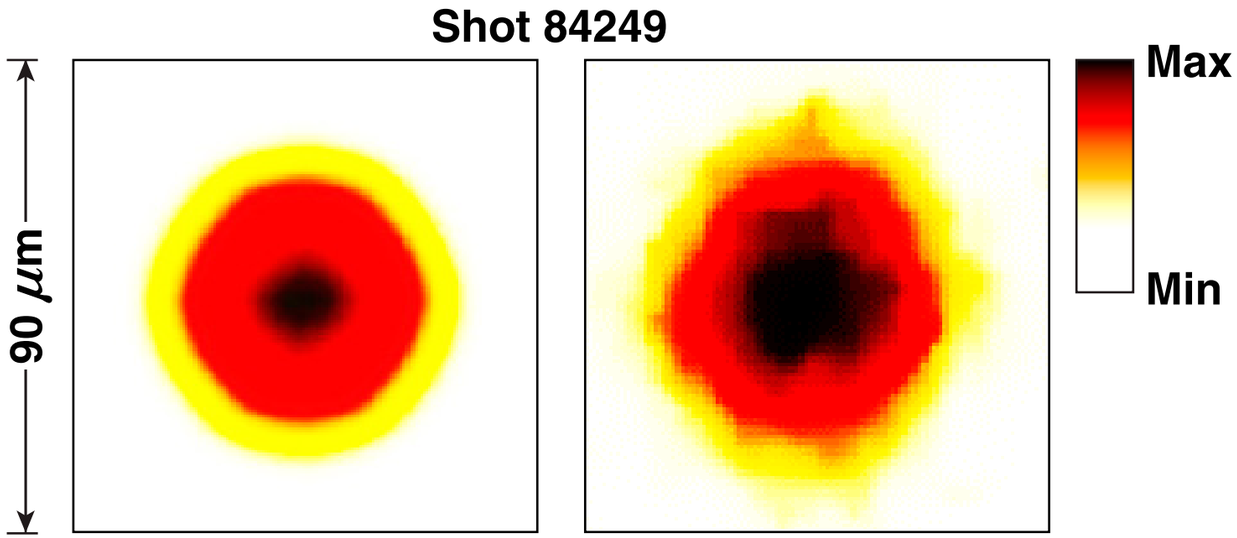
# Signatures of an Intermediate-Mode Asymmetry in OMEGA Implosions




D. Patel
University of Rochester
Laboratory for Laser Energetics

59th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Milwaukee, WI
23–27 October 2017

## Summary

# An intermediate mode coming from the OMEGA 60 beam-port geometry may explain the asymmetry observed in self-emission images of cryogenic implosions

- Framing-camera images taken during the acceleration phase of Ge-doped targets suggest an intermediate mode seeded by the OMEGA 60 beam-port geometry
- Simulations of the deceleration phase of a cryogenic implosion with this intermediate mode were performed using the 3-D hydrocode *DEC3D** and post-processed with *Spect3D*** to construct self-emission images
- *Spect3D* synthetic self-emission images exhibit similar shapes for the hot spot as observed in time-integrated, self-emission images of cryo implosions

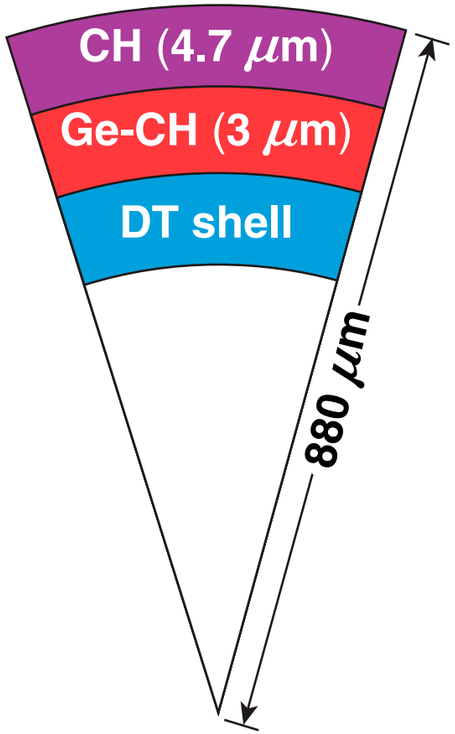
*K. M. Woo *et al.*, YO7.00014, this conference.
**_PrismSPECT_, Prism Computational Sciences, Inc., Madison, WI

# Collaborators

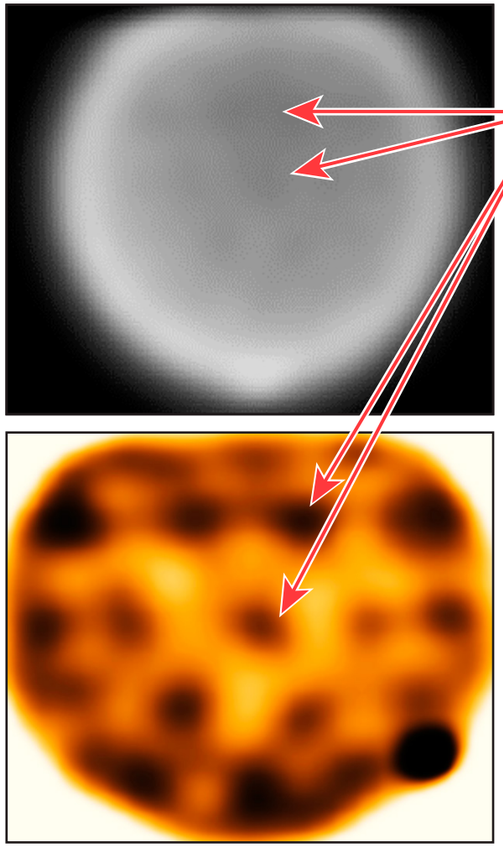
**R. Betti, K. M. Woo, D. T. Michel, R. C. Shah, F. J. Marshall, V. Gopalaswamy, A. Bose, D. Cao, J. P. Knauer, C. Stoeckl, and S. P. Regan**

**University of Rochester**
**Laboratory for Laser Energetics**

# Regions of lower emission were observed in time-resolved, acceleration-phase self-emission images of Ge-doped cryogenic implosions




Filtered image at 1.75 ns (peak power)




Processed image

Raw images were processed using a feature-detection algorithm to make features more visible

**Dark spots are regions ablating DT, while surrounding regions are still-ablating Ge-CH, suggesting we have higher laser illumination at these dark spots.**

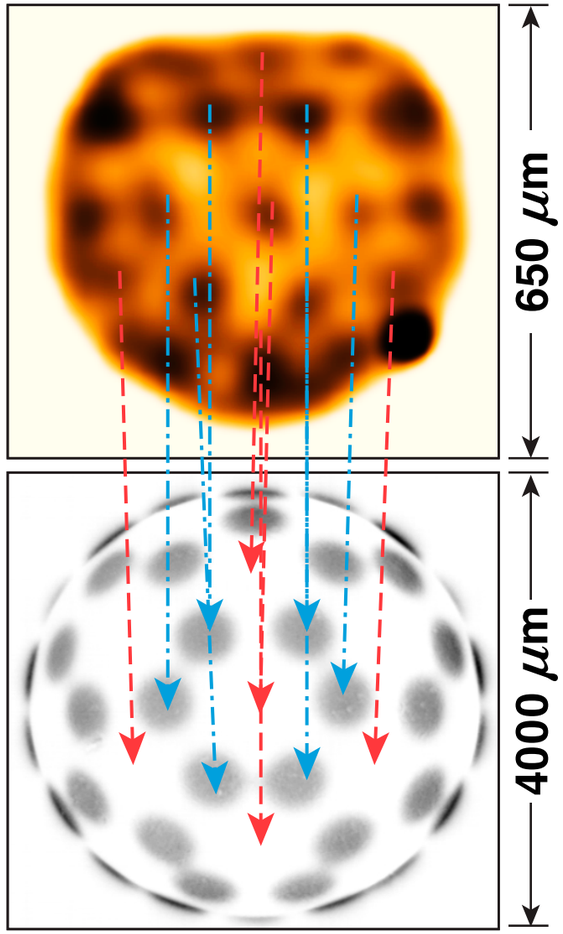
TC13820

D. T. Michel, Principal Investigator

# The regions of lower emission observed in Ge-doped cryo implosions bear a close resemblance to OMEGA 60 beam-port geometry

Framed image of the acceleration phase of a Ge-doped target implosion

Image from a pointing shot showing the location of beams on a 4-mm-diam Au target

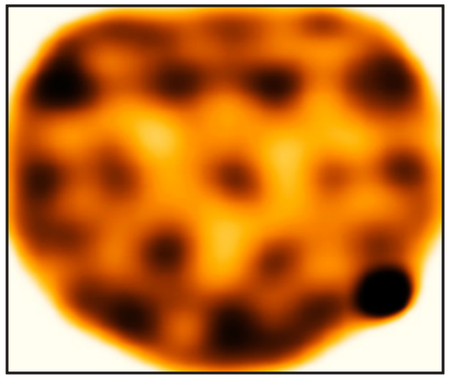


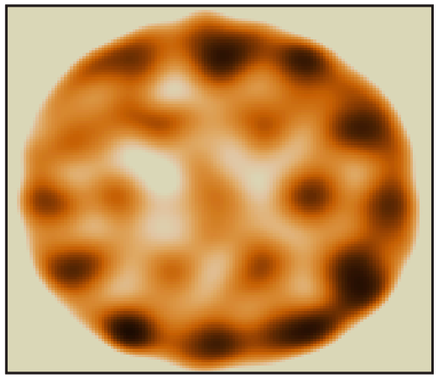

The level of contrast in the image is not indicative of the magnitude of variation in laser illumination

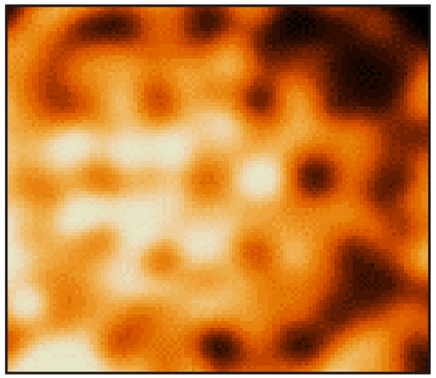
**Comparison with OMEGA 60 beam-port geometry suggests that we have higher illumination at the location of beam centers and at the centers of hexagons and pentagons.**

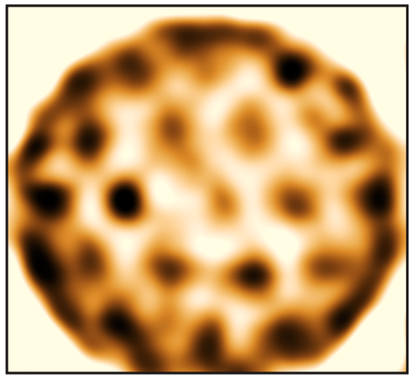
TC13821

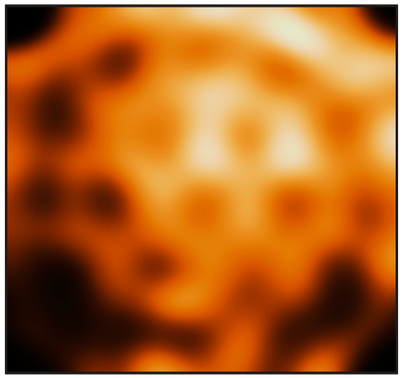
# Images from other Ge-doped implosions show that this is not an isolated occurrence


Shot 85423


Shot 85421

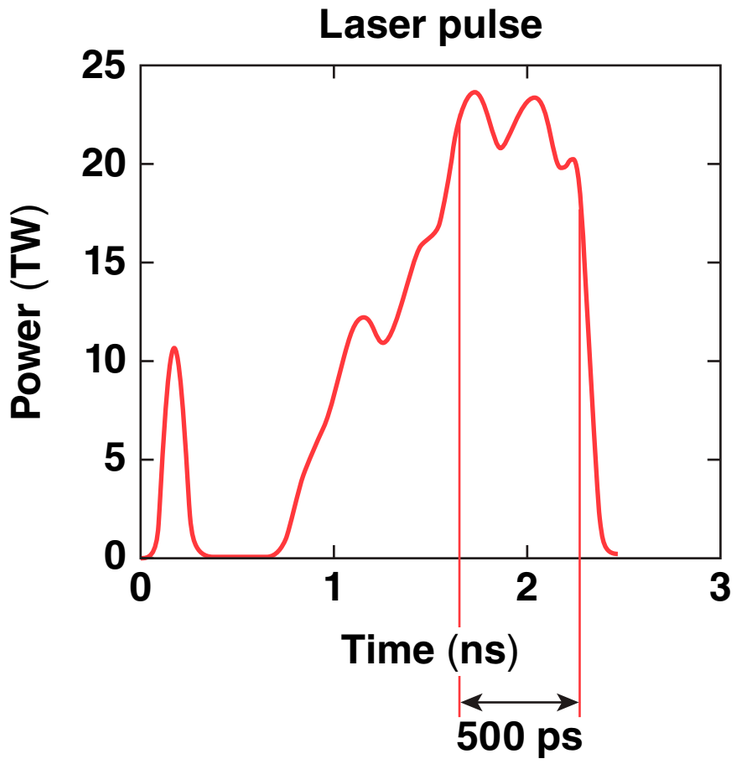

Shot 85414


Shot 83319

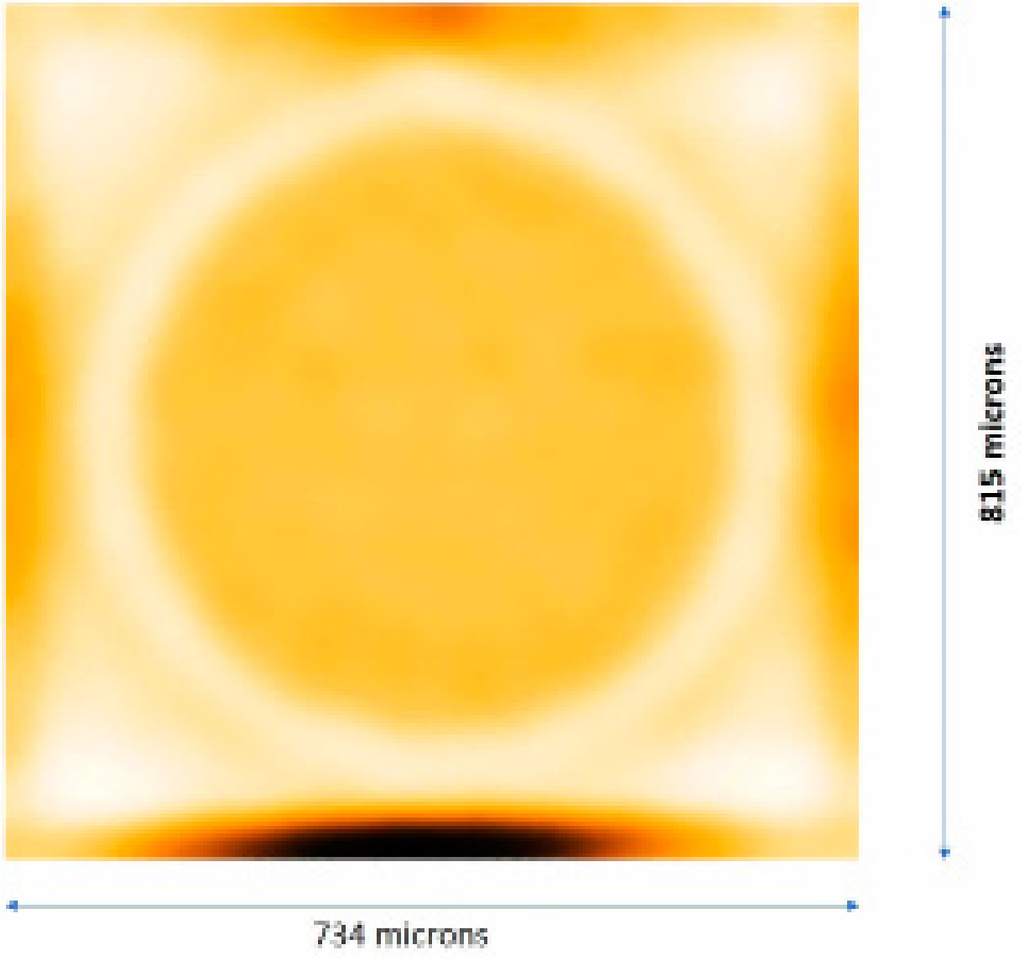

Shot 83321

**The same pattern appears in Ge-doped implosions performed months apart, removing power balance or target offsets as probable causes. This, in addition to its close resemblance to beam-pointing shot images, suggests that OMEGA's beam-port geometry is the most-probable cause.**

# Successive processed images for shot 85421 show that the nonuniformity pattern persists late into the acceleration phase

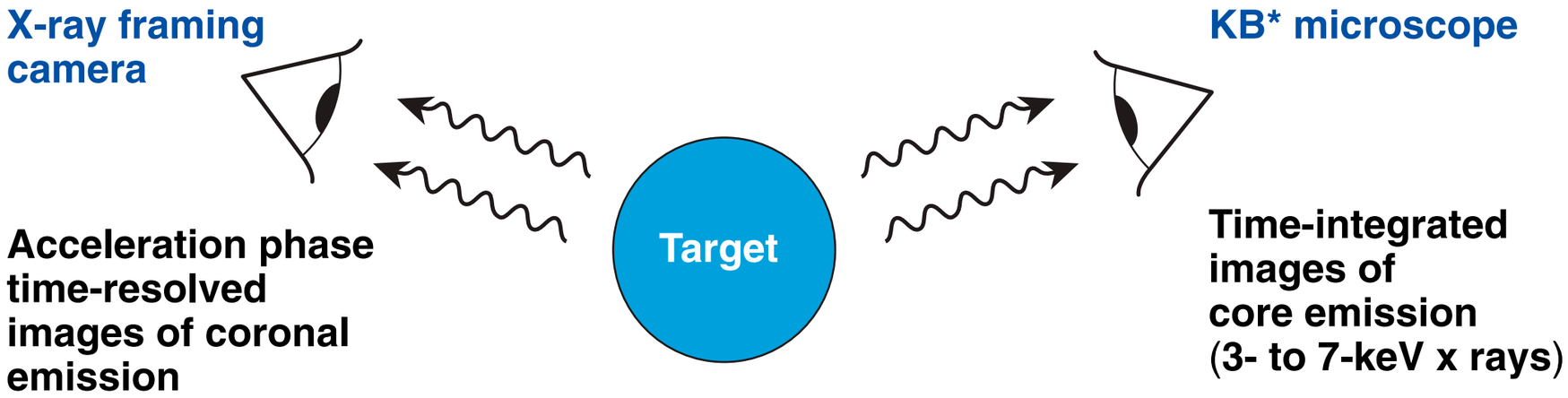







TC13937

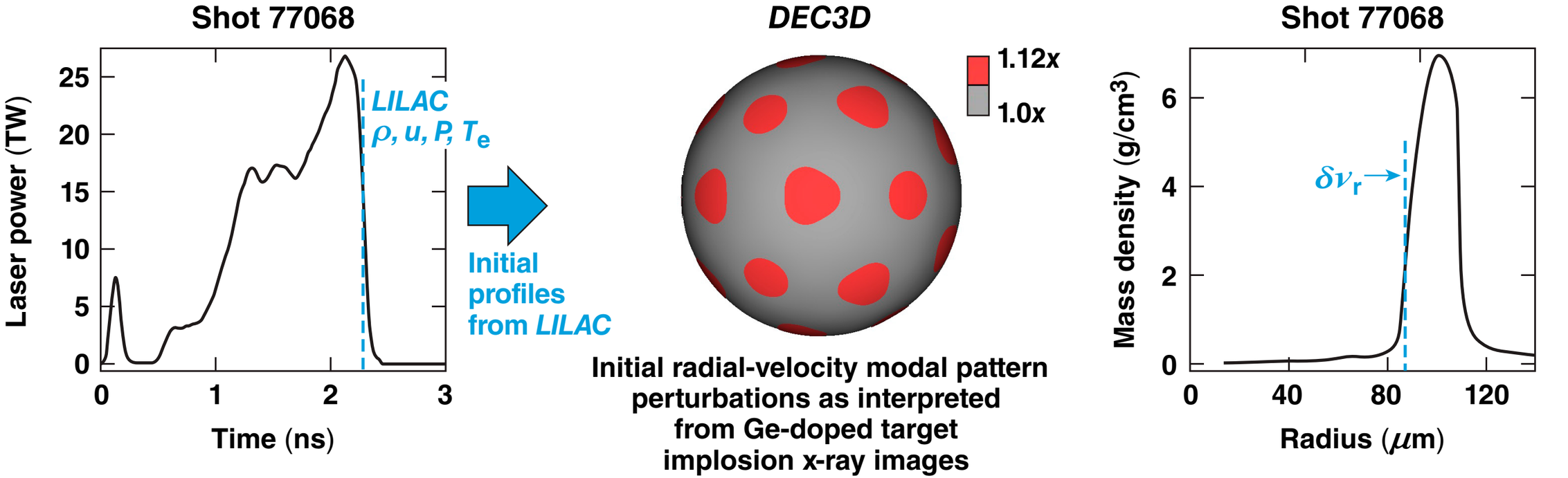
# Separate imagers provide x-ray self-emission images of acceleration and stagnation phases of OMEGA cryogenic implosions




**We are trying to relate asymmetries observed in early-time images to asymmetries observed in images of stagnated cores.**

*KB: Kirkpatrick–Baez

# The 3-D hydrocode *DEC3D* is used to simulate the deceleration phase with an intermediate mode seeded by OMEGA 60 beam-port geometry




- In the absence of a theory that could explain the observed nonuniformity pattern,* simulations were performed using a mode that approximately mimics the pattern while keeping the perturbation level at an arbitrarily chosen variable; we are searching for better ways to accurately represent the mode

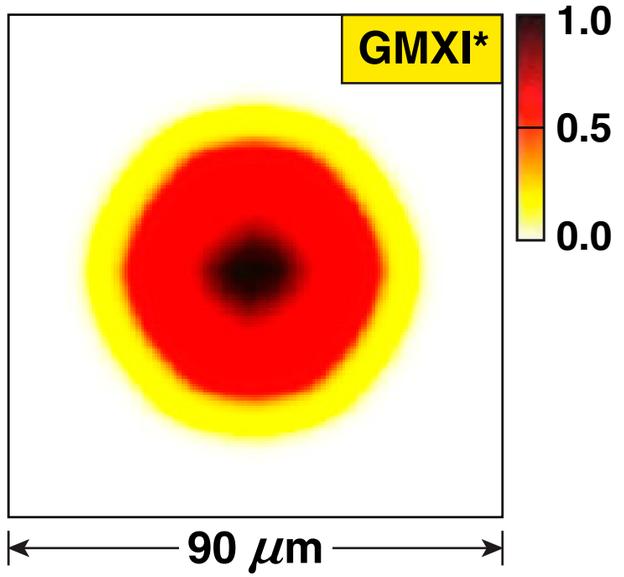
*Conversations with multiple LLE plasma physicists.

TC13822

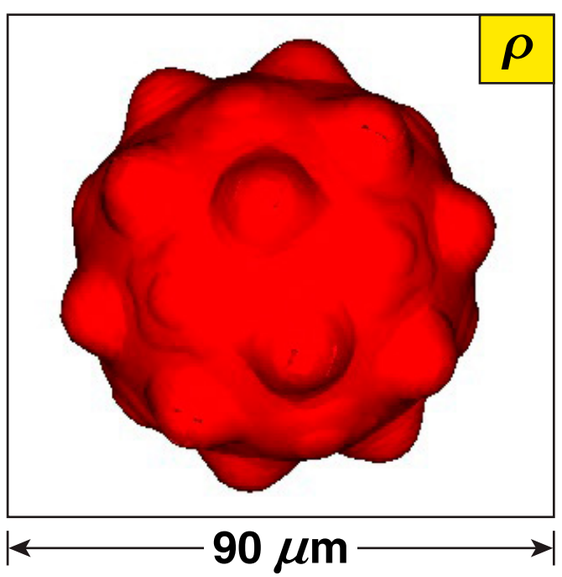
# Simulated self-emission images from *Spect3D* of a typical cryo implosion perturbed with the OMEGA port-geometry pattern exhibit a hexagonal shape

UR LLE

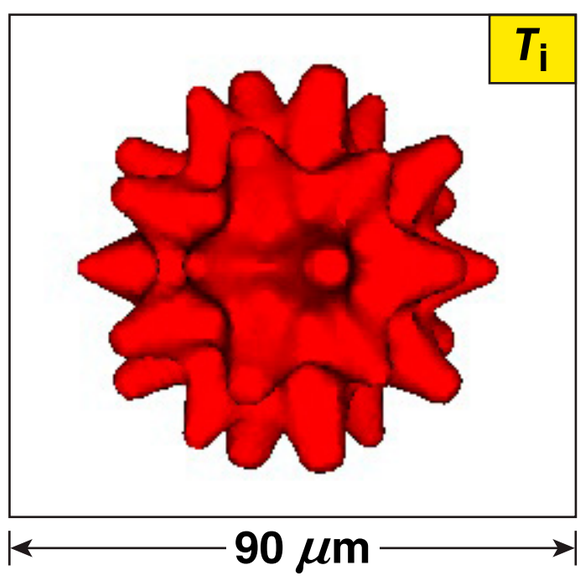
**Simulated self-emission image**




**Hydrodynamic profiles at stagnation**




3-D density contour at 30% of $\rho_{max}$

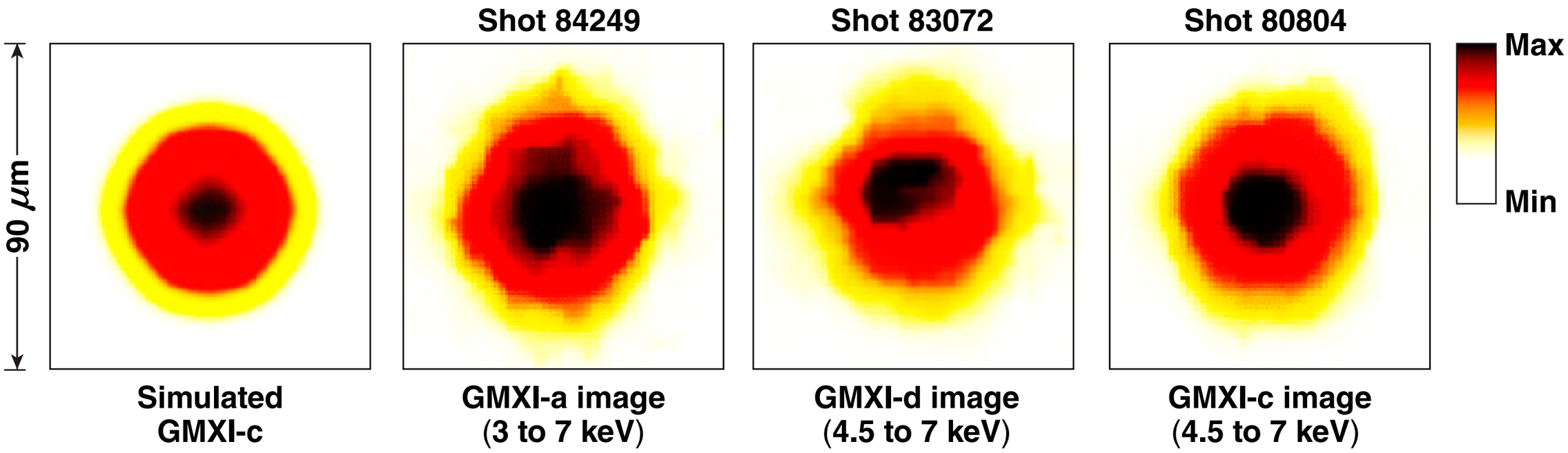



3-D temperature contour at 30% $T_{i_{max}}$

*GMXI: gated monochromatic x-ray imager

TC13824

# Integrated x-ray self-emission images of cryo implosions observed with the GMXI* often show a mid-mode asymmetry in the shape of the hot spot, similar to simulations

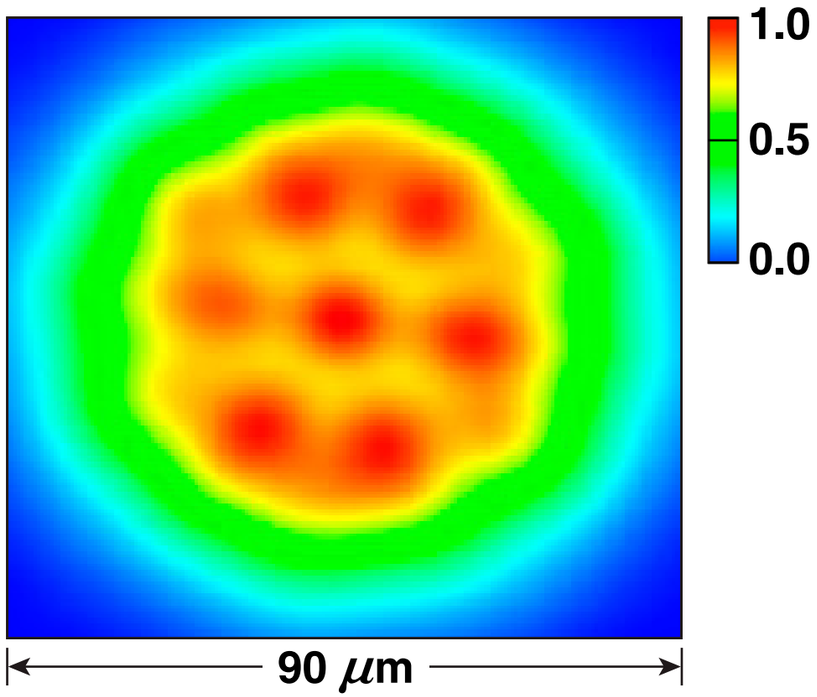



*F. J. Marshall and J. A. Oertel, Rev. Sci. Instrum. 68, 735 (1997).

TC13825

# A future direction is to use time-resolved self-emission images of the disassembly phase gated for lower photon energies to enhance these signatures

Simulated time-resolved image of self-emission at 2 keV




As low-energy photons are absorbed by shell $\rho R$, the emission pattern at lower energies carries the information of $\rho R$ modulation of the shell caused by Rayleigh–Taylor modes

TC13826

Summary/Conclusions

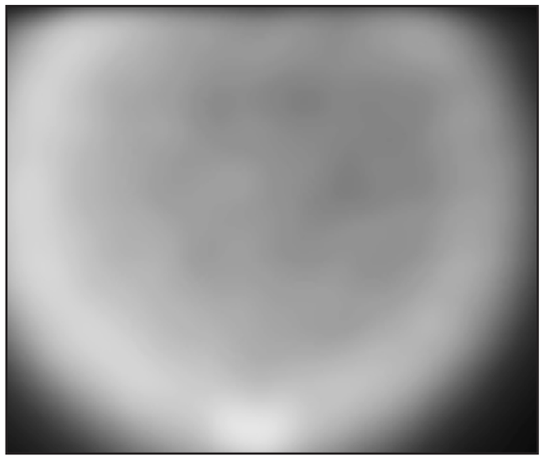
# An intermediate mode coming from the OMEGA 60 beam-port geometry may explain the asymmetry observed in self-emission images of cryogenic implosions

- Framing-camera images taken during the acceleration phase of Ge-doped targets suggest an intermediate mode seeded by the OMEGA 60 beam-port geometry
- Simulations of the deceleration phase of a cryogenic implosion with this intermediate mode were performed using the 3-D hydrocode *DEC3D** and post-processed with *Spect3D*** to construct self-emission images
- *Spect3D* synthetic self-emission images exhibit similar shapes for the hot spot as observed in time-integrated, self-emission images of cryo implosions

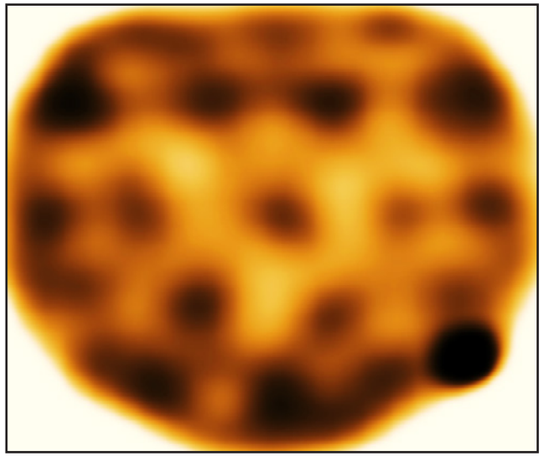
*K. M. Woo *et al.*, YO7.00014, this conference.
**_PrismSPECT_, Prism Computational Sciences, Inc., Madison, WI

TC13819a

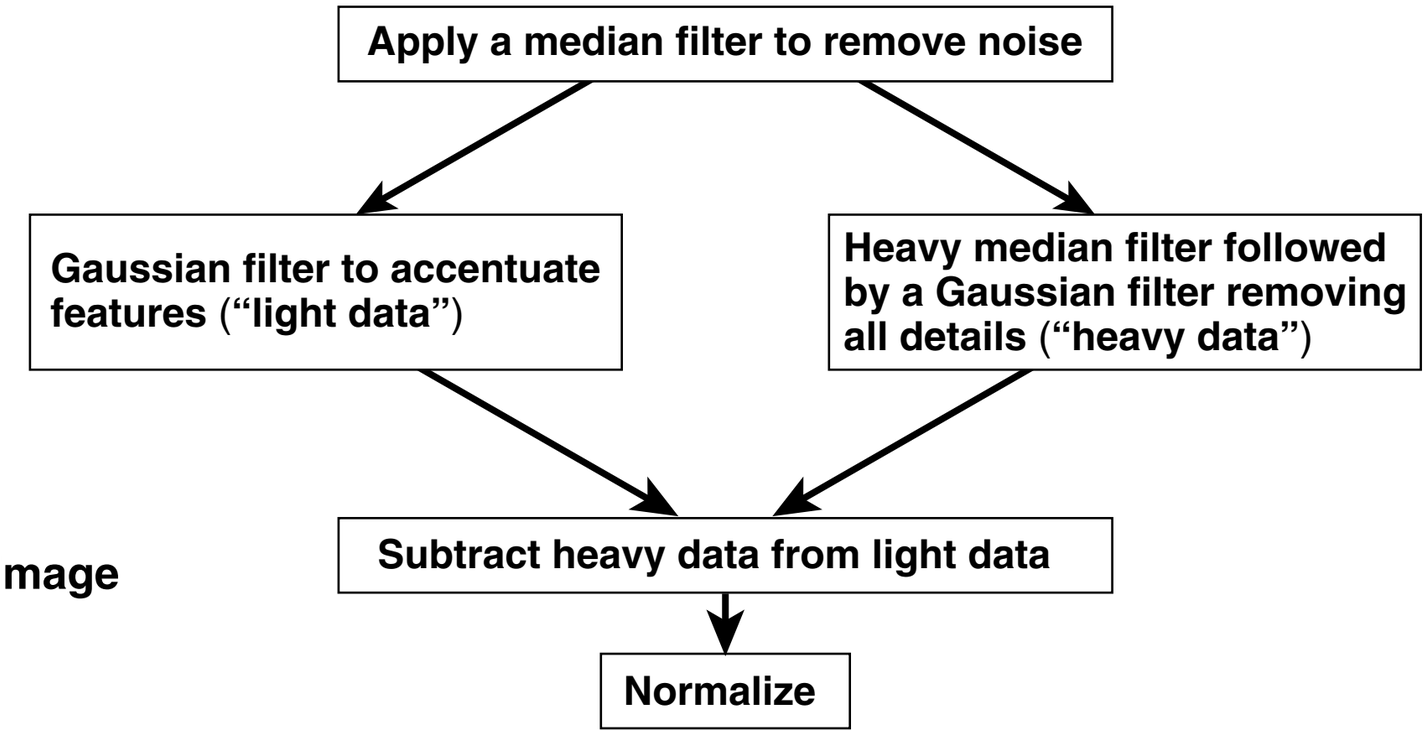
# A feature-detection algorithm is used to enhance weak features in raw images



Raw image

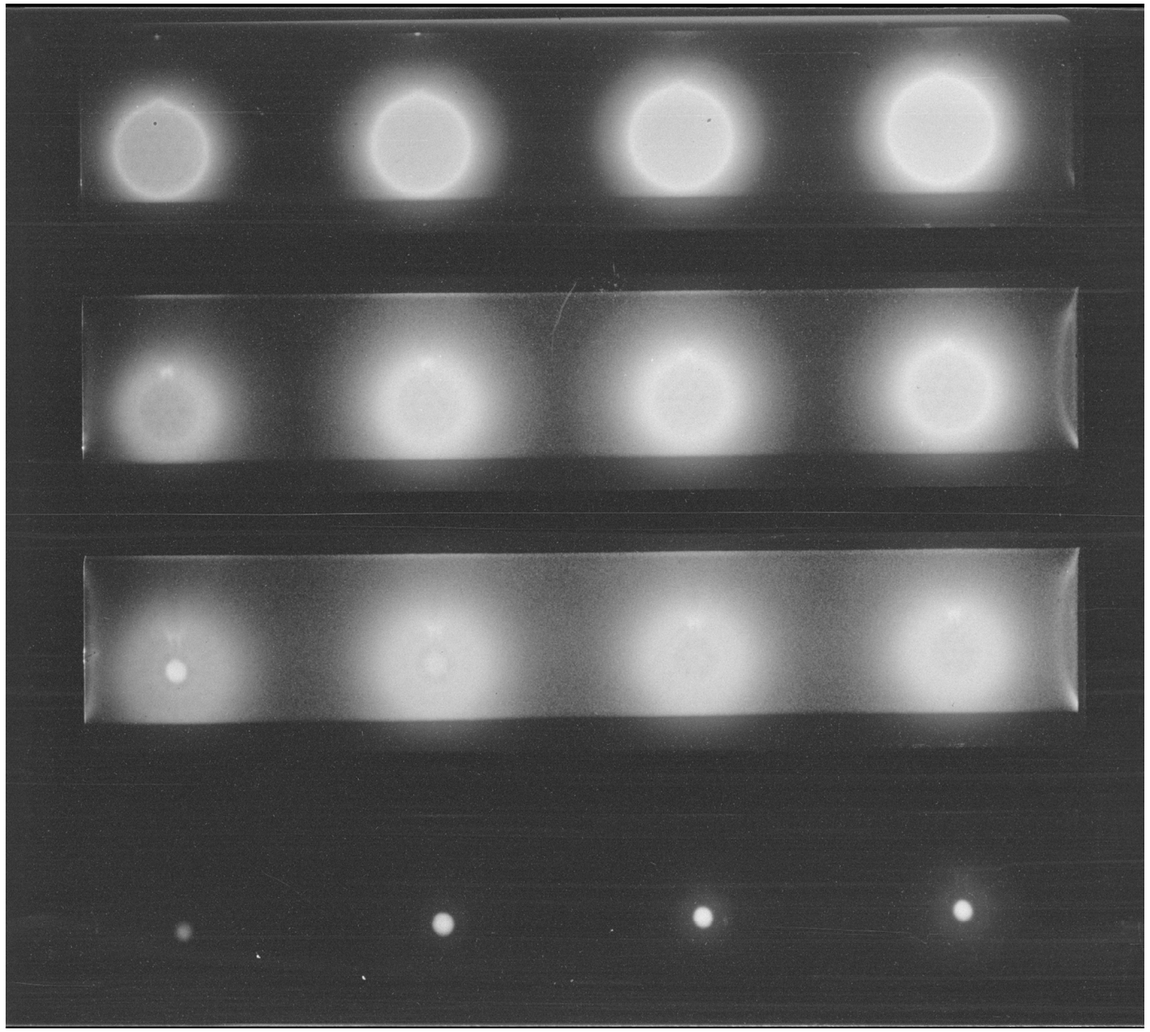


Processed image




TC13935

# Processed images from the same Ge-doped implosion 85423



TC13936