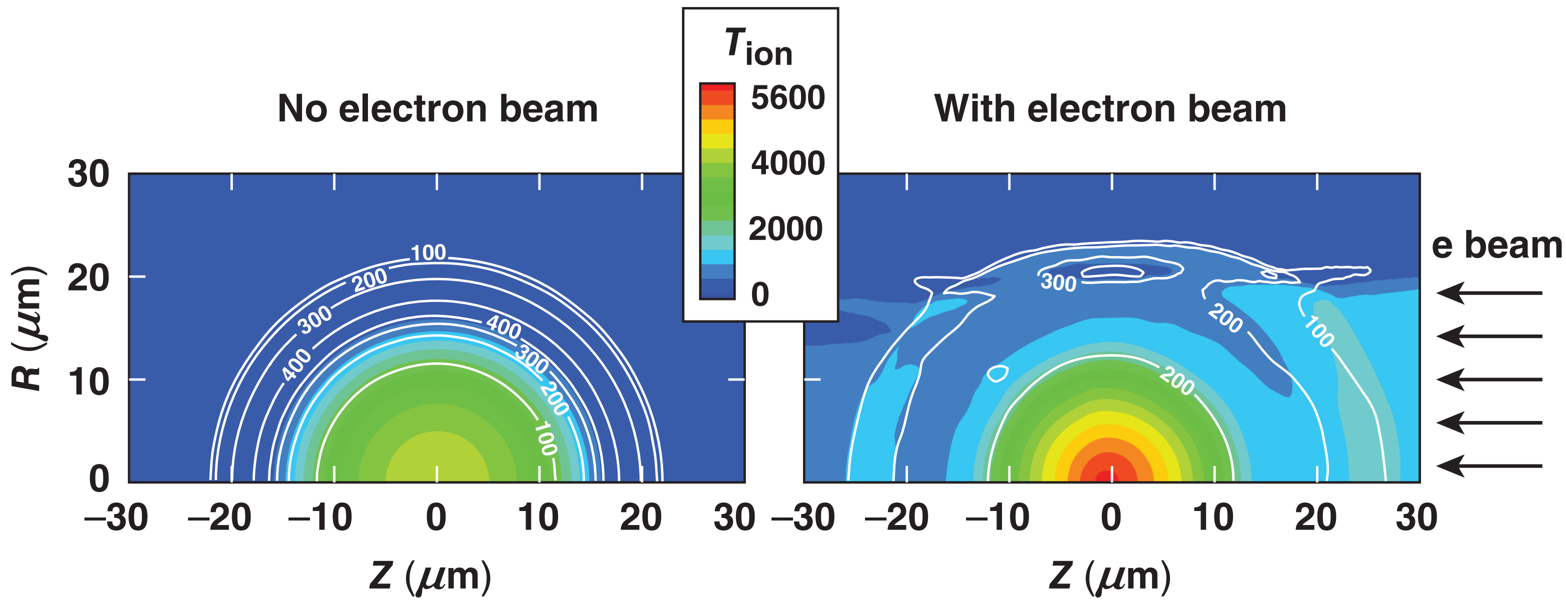
Hydrodynamic Simulations of Integrated Fast-Ignition Experiments Planned for OMEGA/OMEGA EP Laser Systems



J. A. Delettrez
University of Rochester
Laboratory for Laser Energetics

48th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Philadelphia, PA
30 October–3 November 2006

Summary

Increased neutron yields are expected in the integrated OMEGA/OMEGA EP fast-ignition experiments

- Simulations of the effect of the 2.6-kJ OMEGA EP beam on the yield of cryogenic targets were carried out for a 10-ps pulse.
- A three-fold increase in the yield was observed for two implosion conditions: uniform and with ice roughness.
- The increase in the yield resulted from increased mass density and ion temperature in the hot spot.
- For source divergence with a Gaussian pulse profile, the increase in the yield was a factor of two.

Collaborators

C. Stoeckl

J. Myatt

A. Solodov

S. Skupsky

V. N. Goncharov

The relativistic electrons are transported in the 2-D hydrodynamic code *DRACO*[1] with a straight-line model

UR LLE

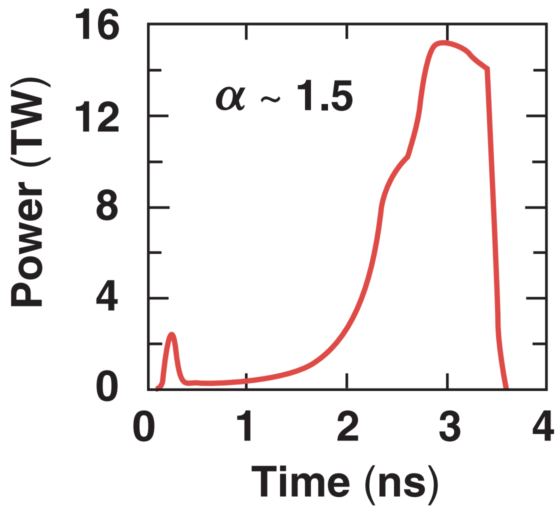
- The electrons are created parallel to the z axis with a flat profile or with a 30° spread with a Gaussian spatial profile.
- The electron source is a one-dimensional Maxwellian distribution computed self consistently from the laser intensity[2] and a conversion efficiency.
- The energy is deposited using a formulation by Li and Petrasso[3]
- Including the electric field has a negligible effect because of the high plasma densities in the imploded target.

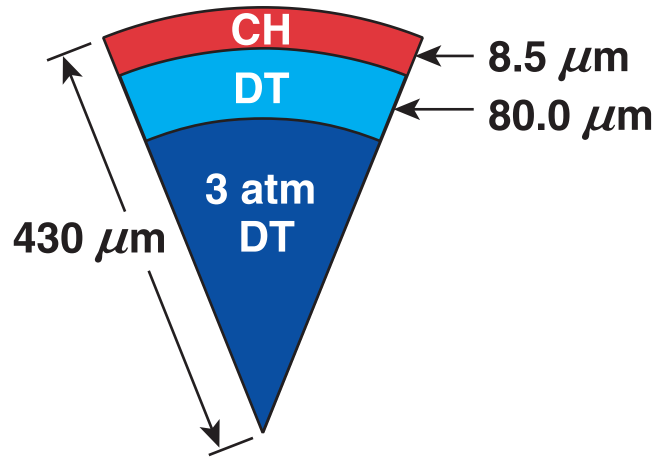
[1]P. B. Radha *et al*., Phys. Plasmas 12, 056307 (2005).
[2]S. C. Wilks *et al*., Phys. Rev. Lett. 9, 1383 (1992).
[3]C. K. Li and R. D. Petrasso, Phys. Rev. E 70, 067401 (2004).

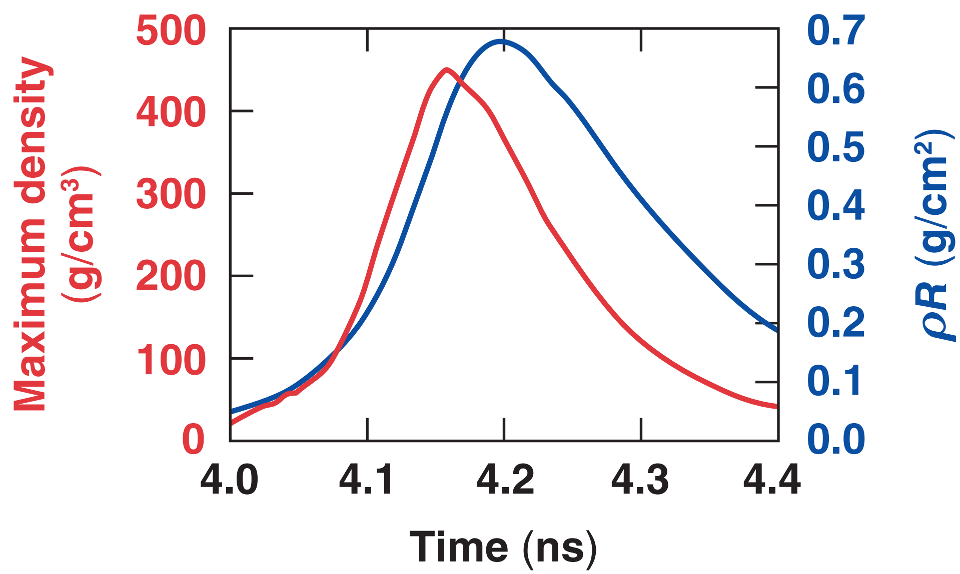
TC7491

2-D *DRACO* simulations were carried out to obtain the necessary core conditions

UR LLE



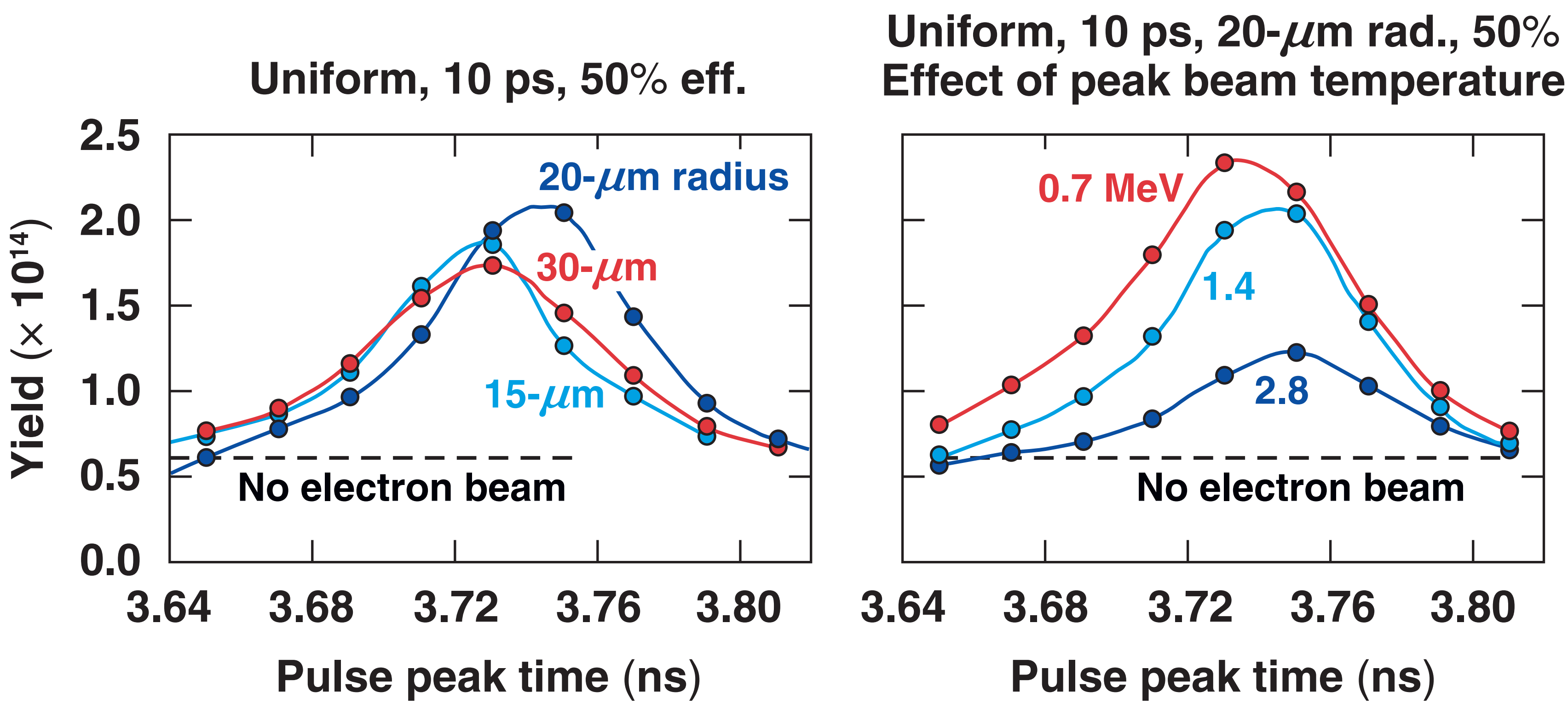




TC7492

The yield is sensitive to the peak electron source temperature

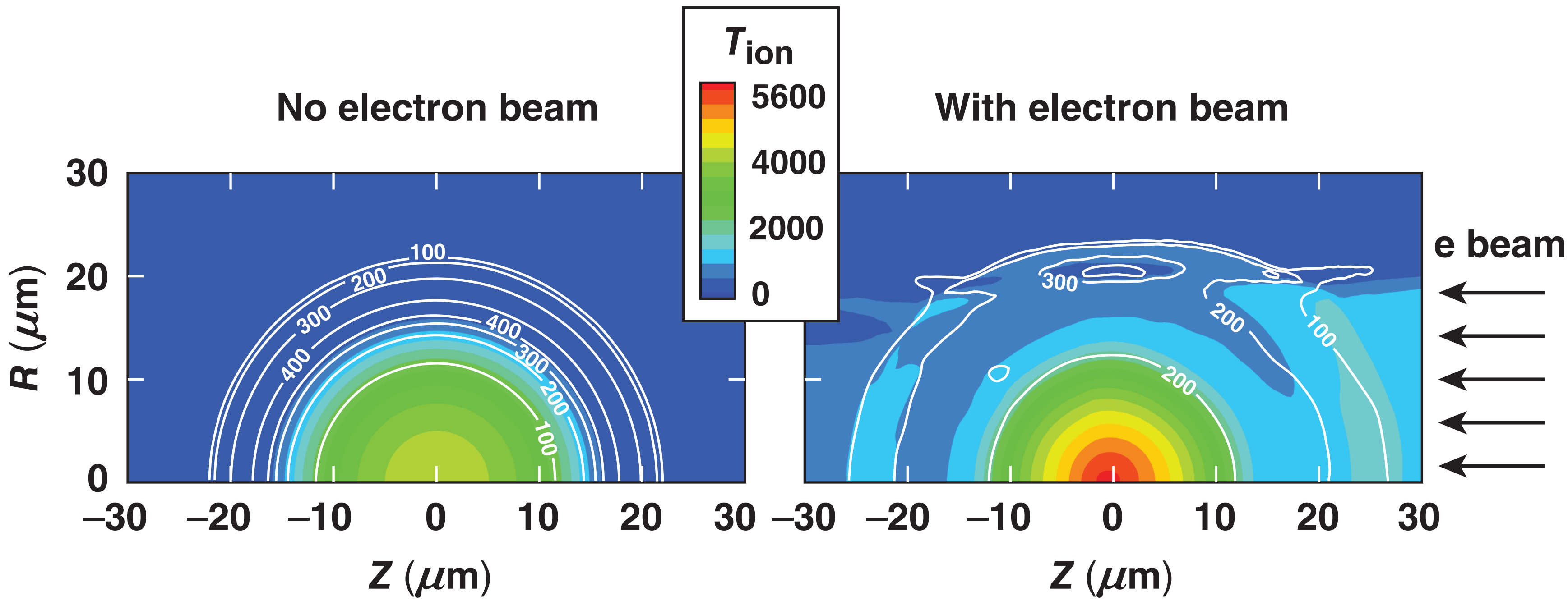
UR LLE



Flat beam profile, parallel to the z axis

TC7493

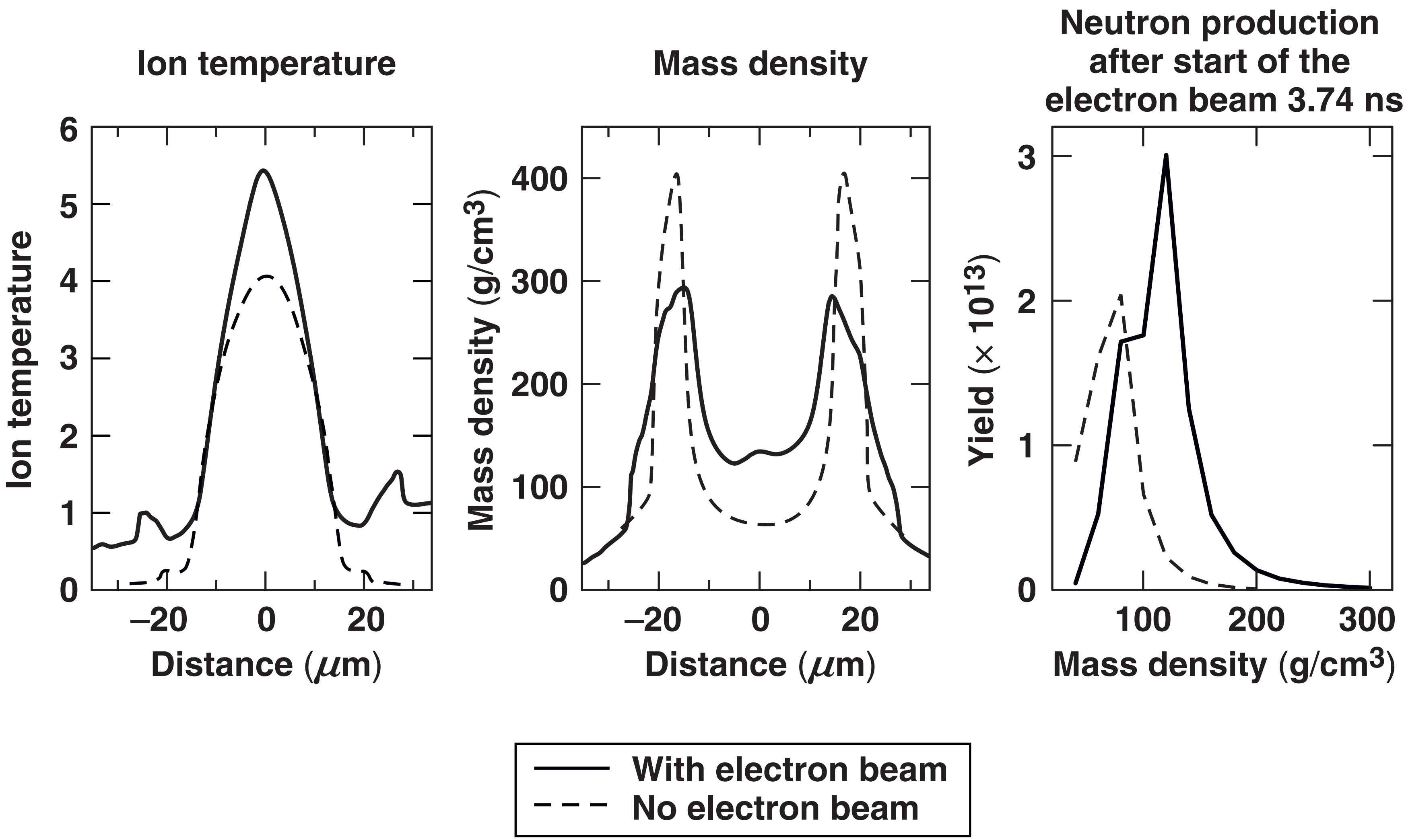
The high-density shell decompresses due to the heating by the electrons



EP beam at 3.76 ns, 10 ps, 20-μm radius

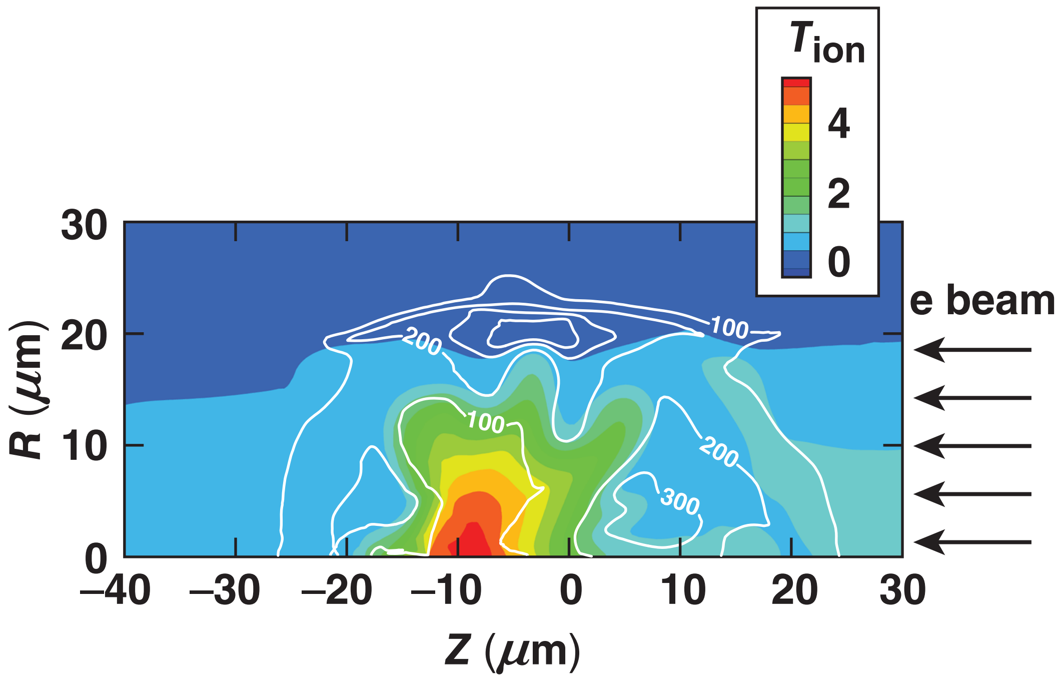
TC7494

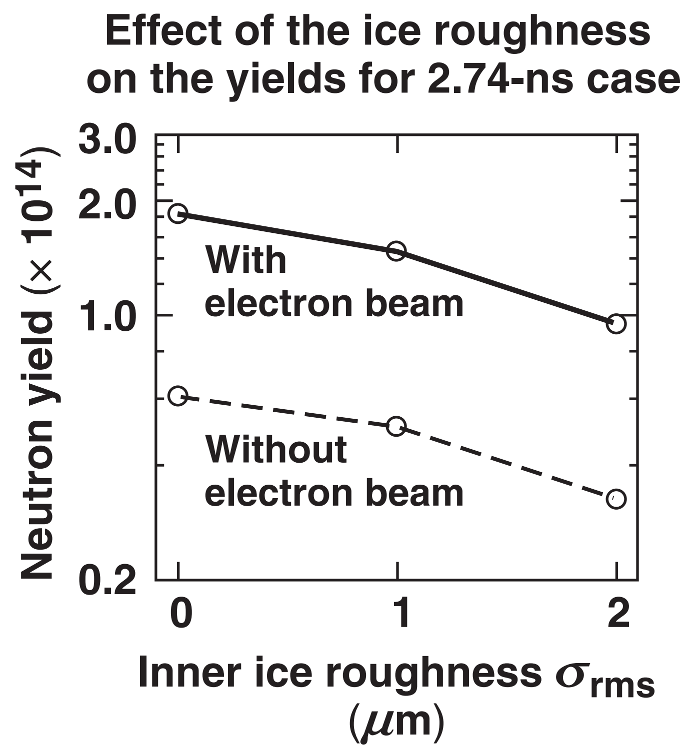
The increase in yield is due to an increase in the ion temperature and the mass density in the hot core



TC7495

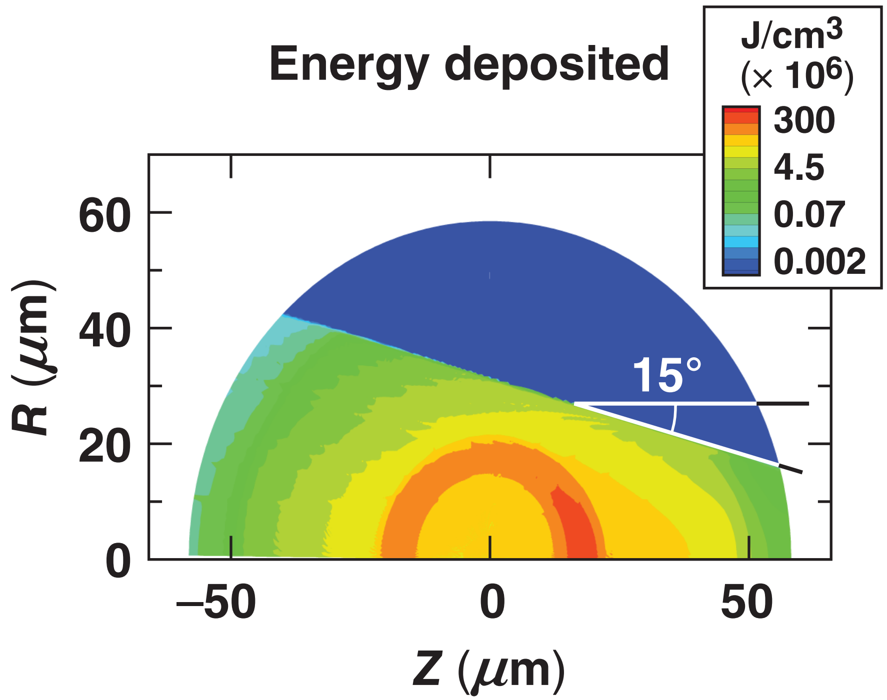
The increase in neutron yield remains the same for implosions including inner ice roughness

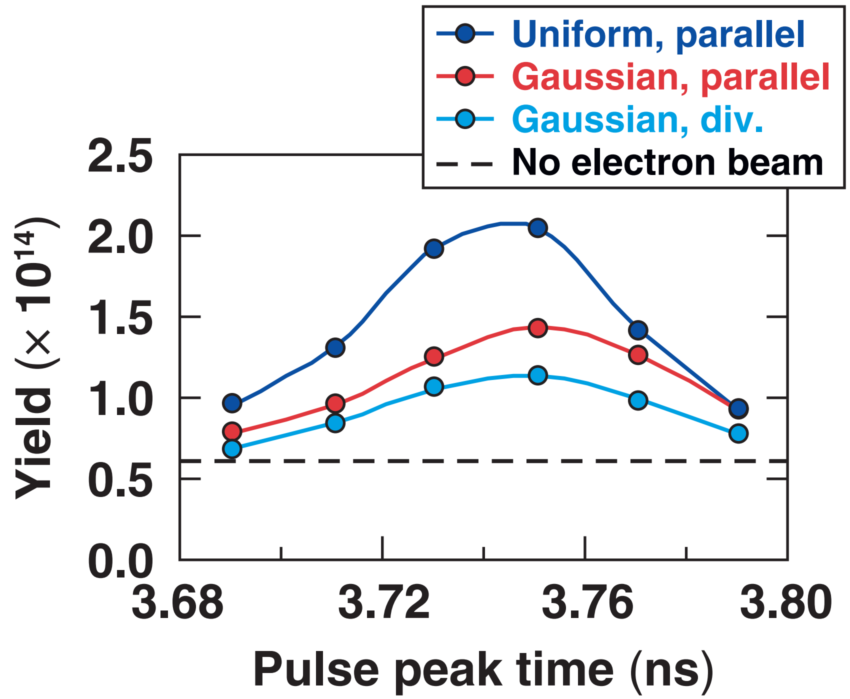




TC7496

The increase in neutron yield from a beam with a more realistic Gaussian spatial profile is reduced by a factor of two





- The Gaussian beam includes 80% of the energy in a 20-μm diam focal spot. Source is 60 μm from target center.
- A 30° electron beam divergence reduces the yield further.

TC7626

Summary/Conclusions

Increased neutron yields are expected in the integrated OMEGA/OMEGA EP fast-ignition experiments

UR LLE

- **Simulations of the effect of the 2.6-kJ OMEGA EP beam on the yield of cryogenic targets were carried out for a 10-ps pulse.**
- **A three-fold increase in the yield was observed for two implosion conditions: uniform and with ice roughness.**
- **The increase in the yield resulted from increased mass density and ion temperature in the hot spot.**
- **For source divergence with a Gaussian pulse profile, the increase in the yield was a factor of two.**