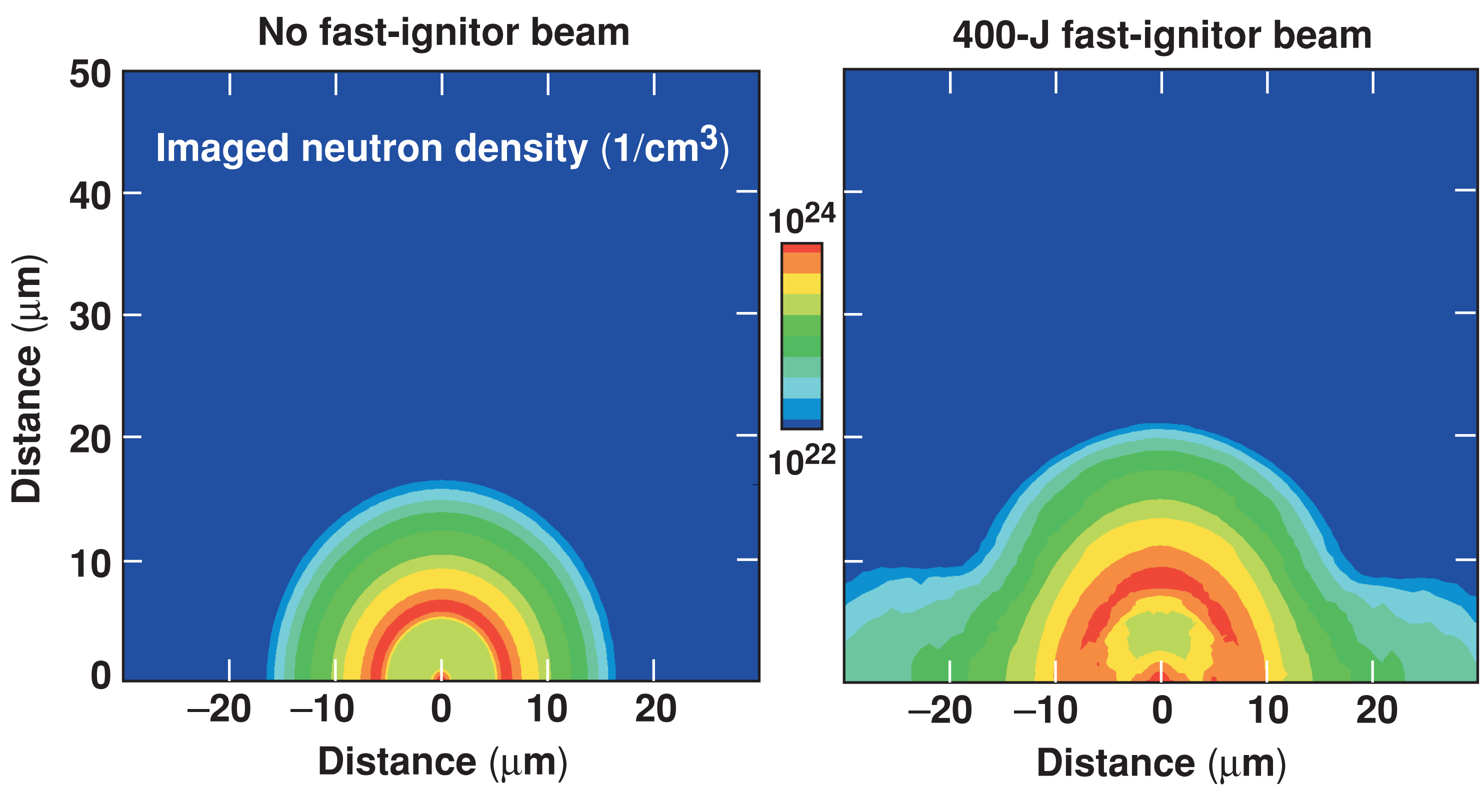
Simulation of Enhanced Neutron Production in OMEGA EP Cryogenic Implosions



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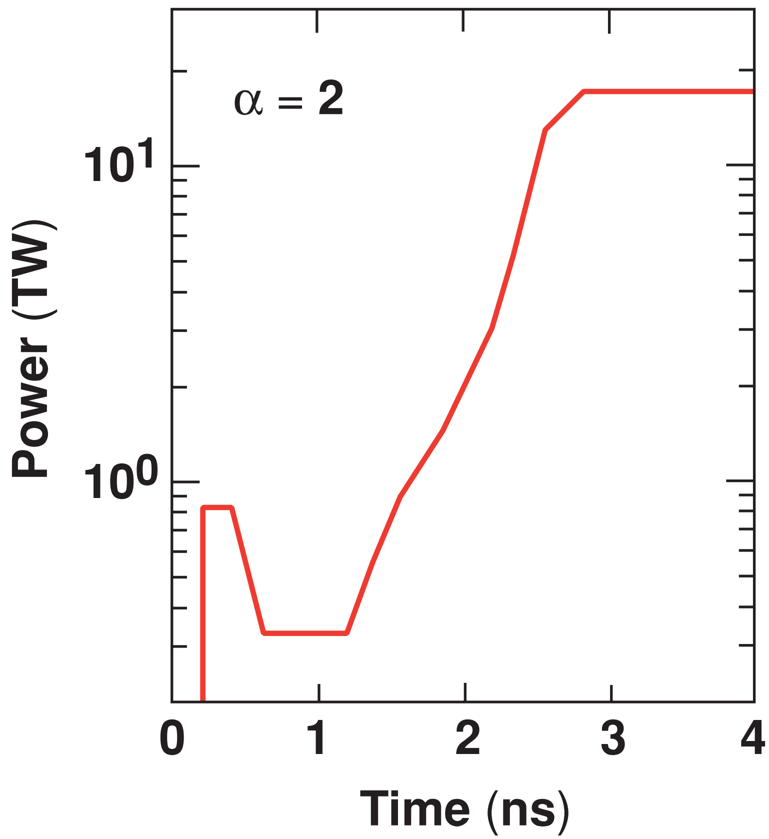
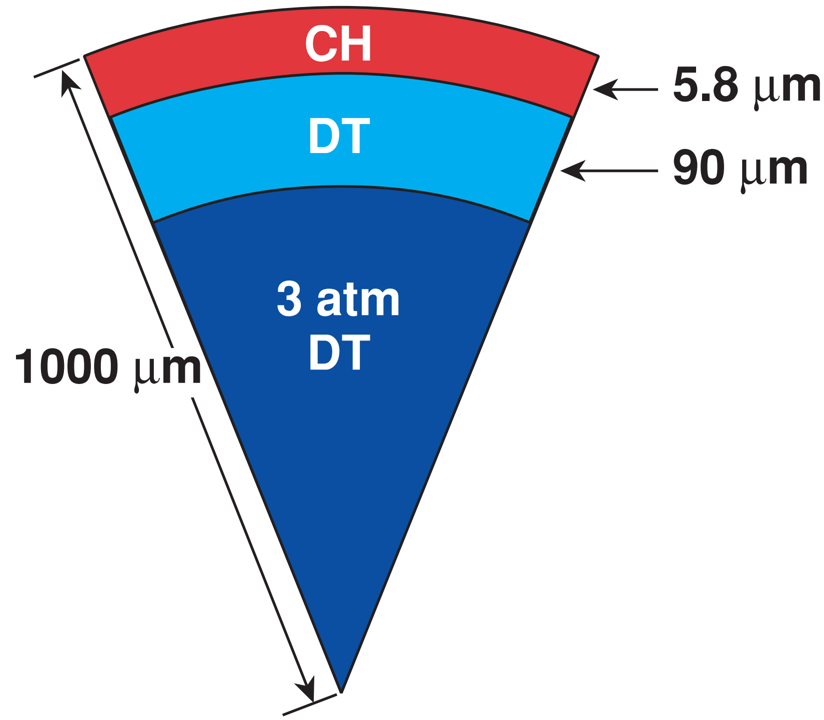
Summary

Interaction of the OMEGA EP beams with an imploding cryogenic capsule produces enhanced yield

- The OMEGA EP laser will add two short-pulse (2.5 kJ at 20 ps), high-intensity beams ($>10^{19}$ W/cm^2) to OMEGA to study the physics of fast ignition.
- A relativistic electron model had been added to the multidimensional hydrocode *DRACO*.
- Stagnation is modified by shocks driven by the electron-heated, high-density shell, depending on the timing of the beam:
  - an extra "spherical" kick at time of low shell ρR (<0.3 g/cm^2)
  - one-sided displacement at peak shell ρR (>0.4 g/cm^2)
- The total DT yield reaches 3×10^{15}, permitting the development of near-ignition neutron diagnostics for the NIF.

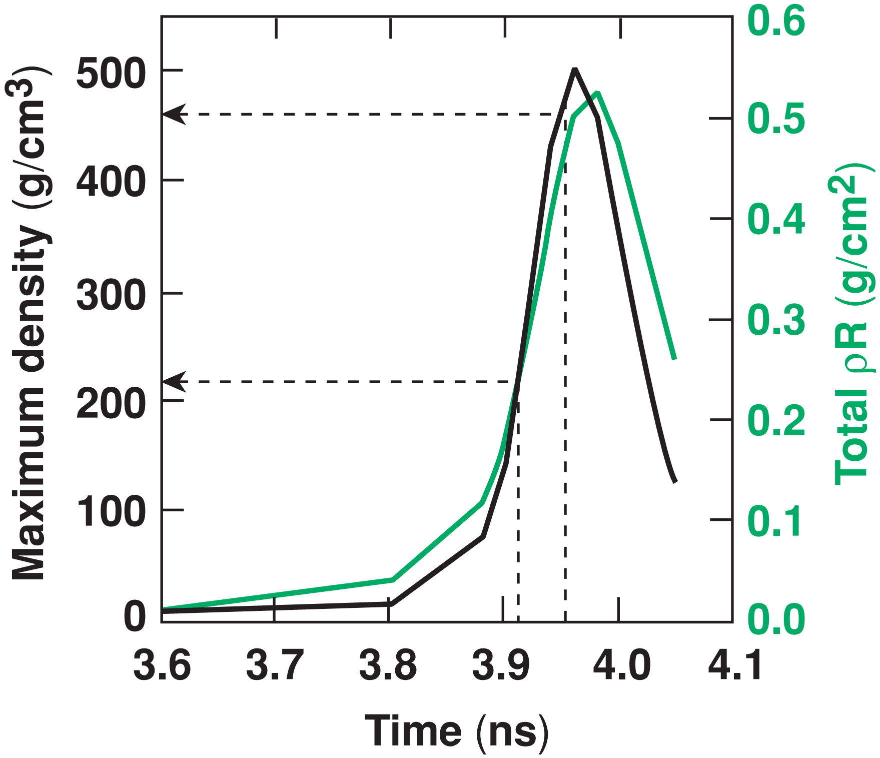
A direct-drive target was designed at OMEGA energy (25 kJ) to give > 300 g/cm^3 densities

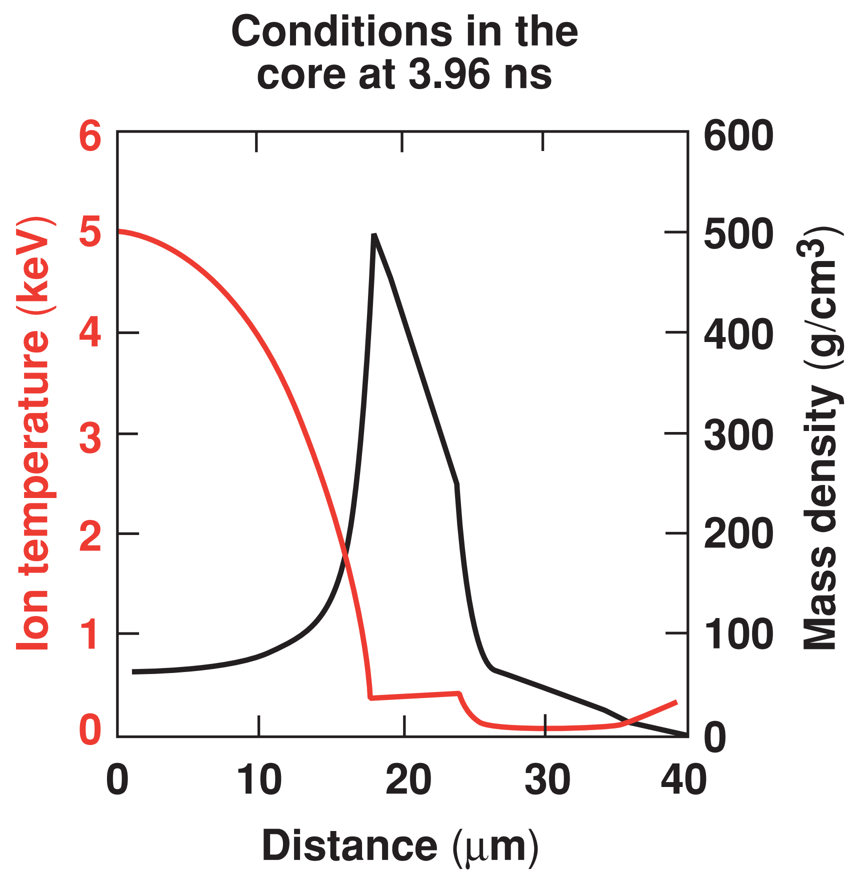




TC6195

Fast-ignitor mass densities are reached in 1-D simulation



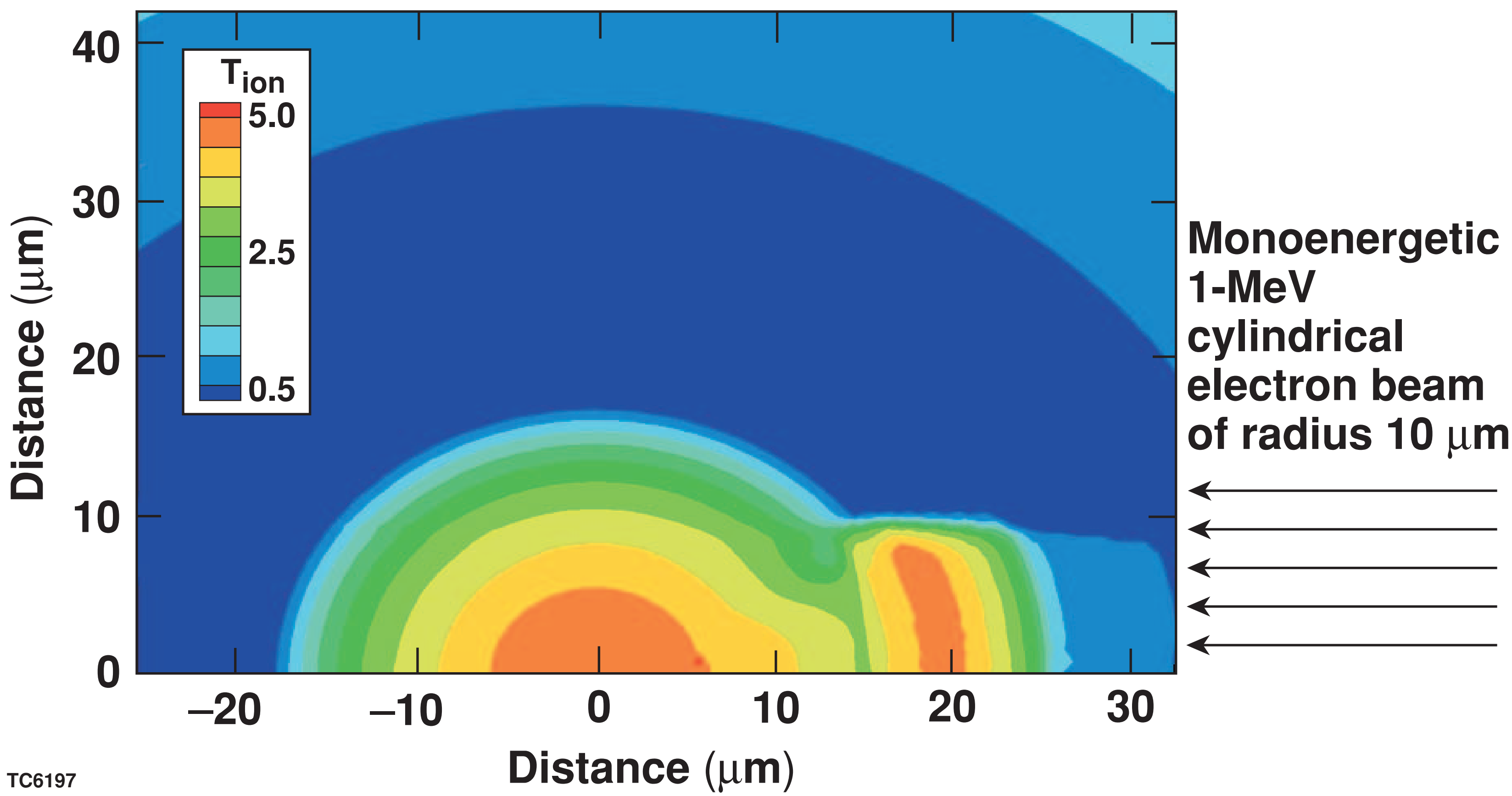


A 1-MeV electron has a range of about 0.4 g/cm^2.

TC6196

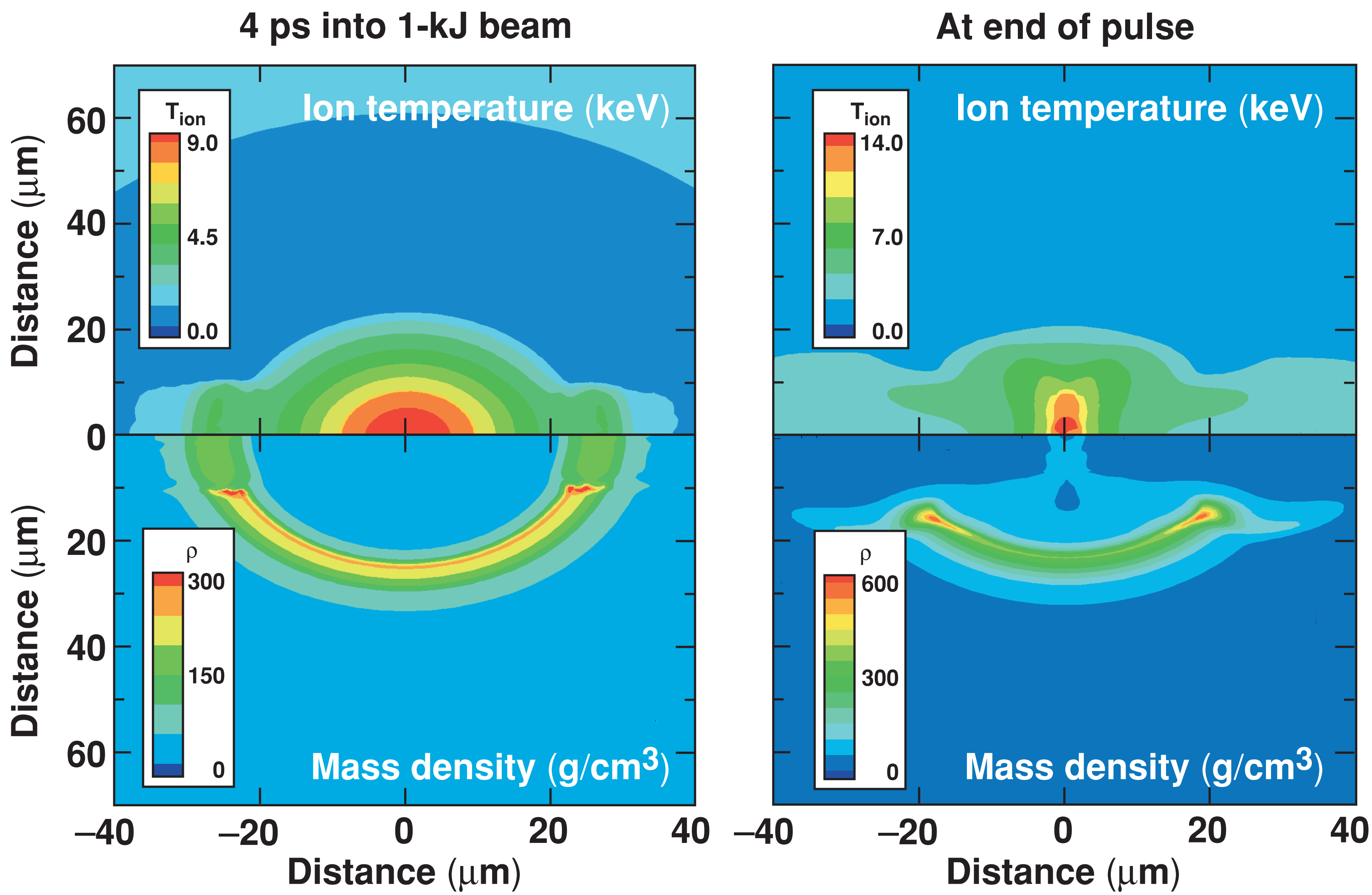
Simulations were carried out with a 20-ps, 1-MeV electron beam with total energies of 400 J and 1 kJ

- Electrons are instantaneously transported in a straight line through the target.
- They give their energy to the background electrons using a penetration depth formulation applied in each zone.



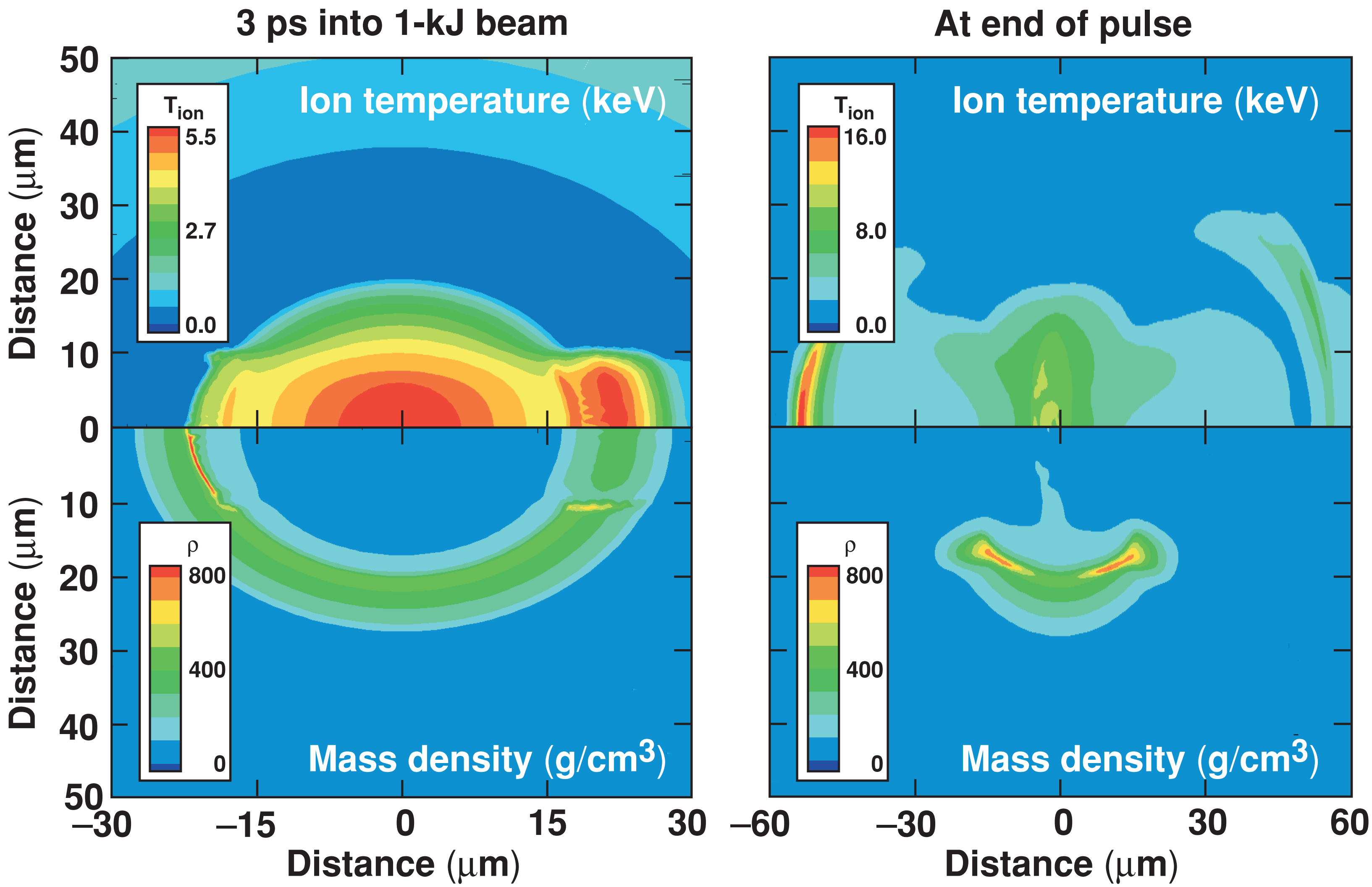
TC6197

At the low density (250 g/cm^3) the ignitor beam heats equally both sides of the core



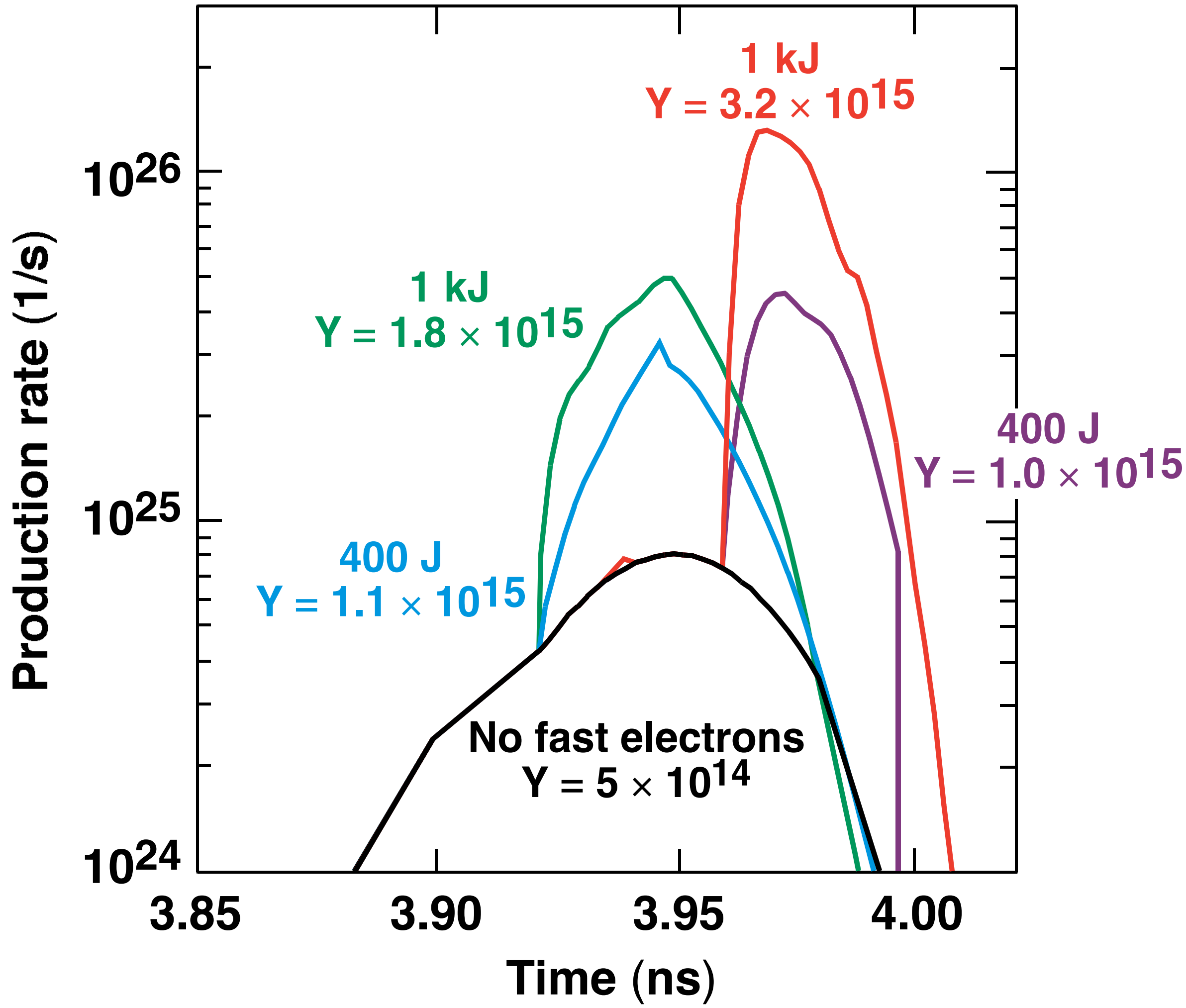
TC6198

At the peak of the density (500 g/cm^3) the ignitor beam heats mostly one side of the target



TC6199

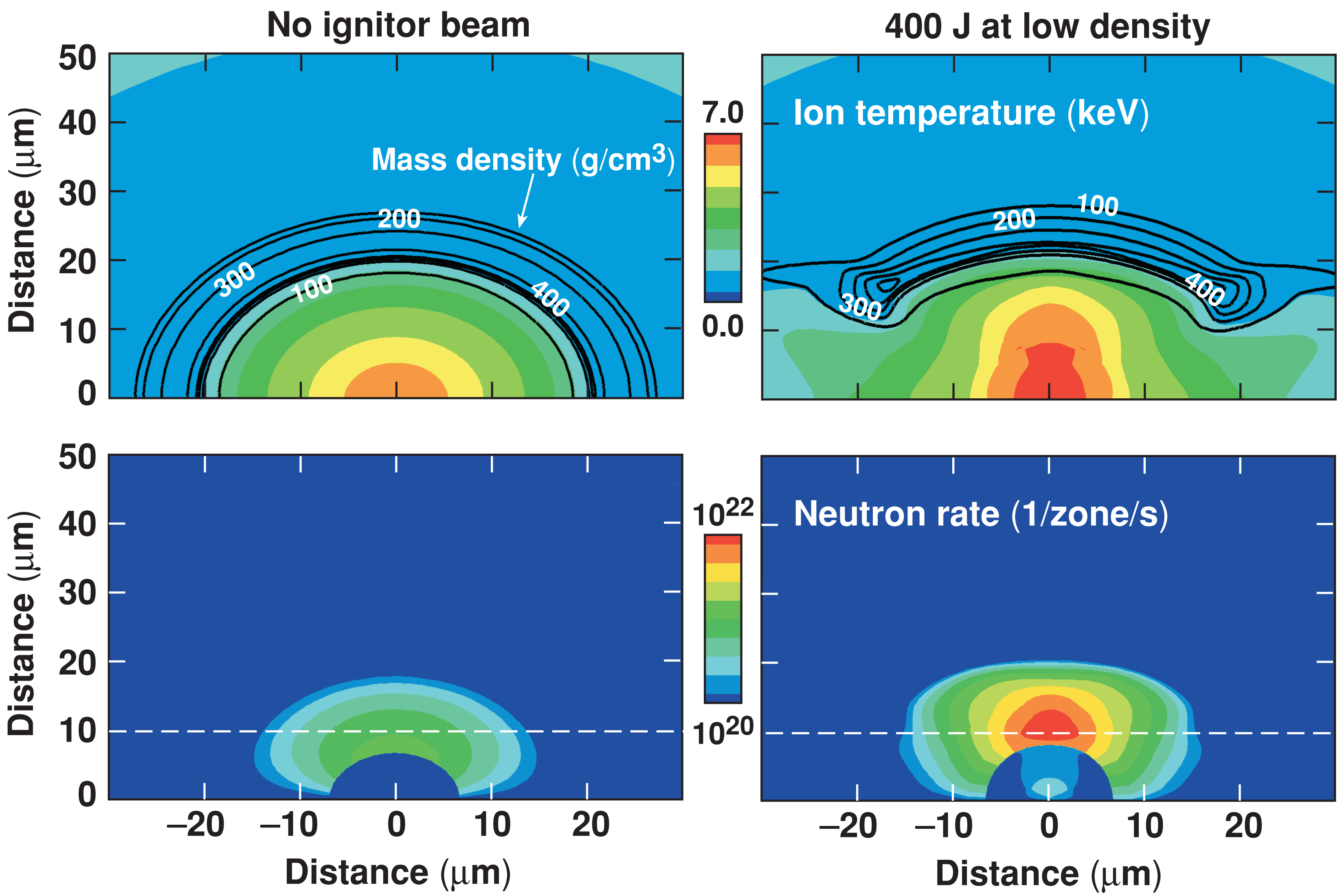
Timing the electron beam at the time of peak shell density produces a higher yield



The increased neutron rate can be easily diagnosed.

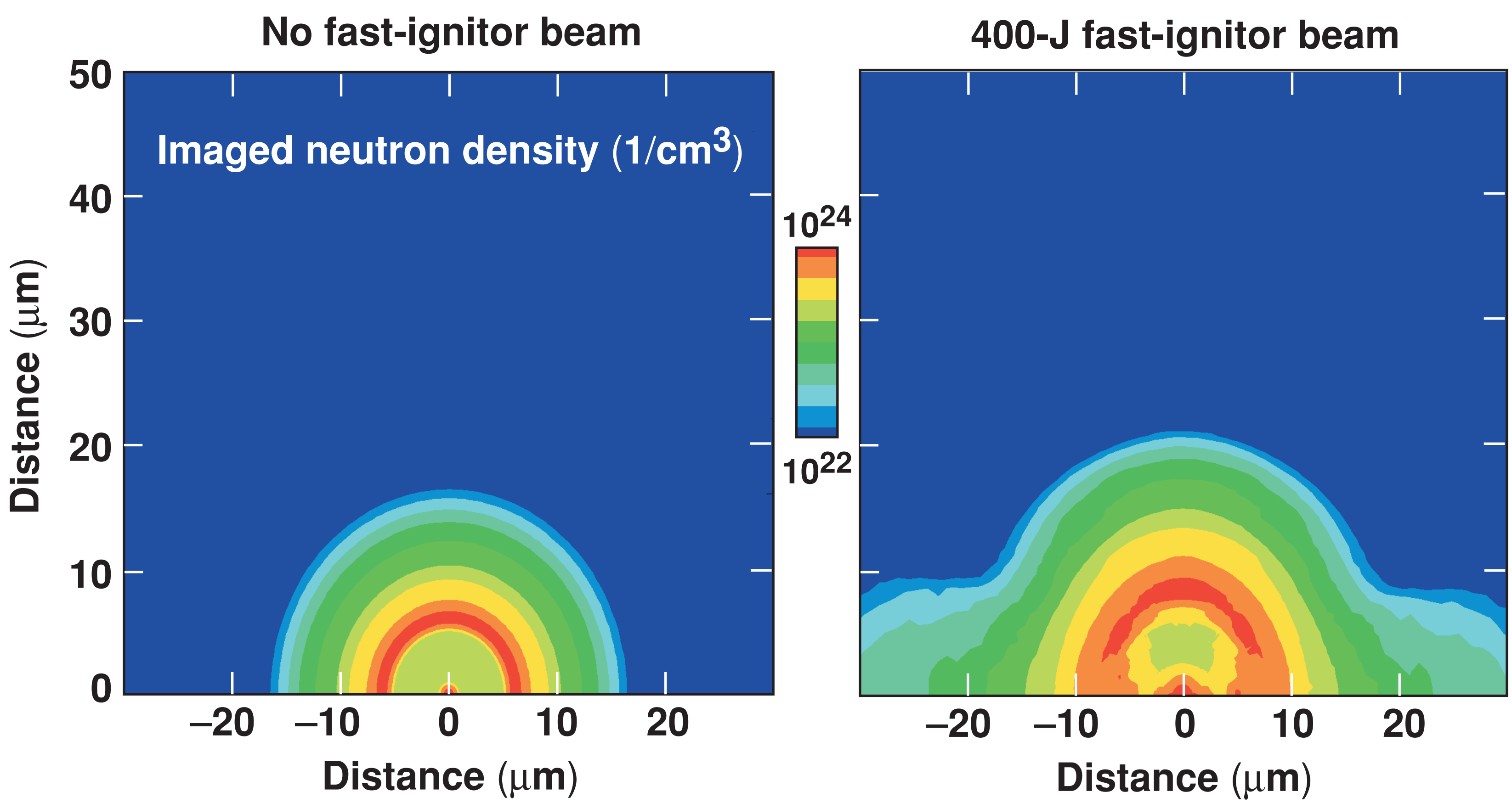
TC6200b

At peak neutron rate, the beam-heated region produces the enhanced neutron yield



TC6453

The ignitor beam causes neutrons to be produced over a large volume



TC6454

Summary/Conclusions

Interaction of the OMEGA EP beams with an imploding cryogenic capsule produces enhanced yield

UR LLE

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