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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

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

- 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 intensity² and a conversion efficiency.

- The energy is deposited using a formulation by Li and Petrasso³.

- Including the electric field has a negligible effect because of the high plasma densities in the imploded target.

2-D DRACO simulations were carried out to obtain the necessary core conditions.
The yield is sensitive to the peak electron source temperature.

**Uniform, 10 ps, 50% eff.**

Effect of peak beam temperature

**Uniform, 10 ps, 20-µm rad., 50%**

Flat beam profile, parallel to the z axis
The high-density shell decompresses due to the heating by the electrons.
The increase in yield is due to an increase in the ion temperature and the mass density in the hot core.

- **Ion temperature**
- **Mass density**
- **Neutron production after start of the electron beam 3.74 ns**

The graphs show the comparison between **With electron beam** (solid line) and **No electron beam** (dashed line). The x-axis represents the distance in μm, the y-axis represents the ion temperature and mass density in g/cm³, and the yield is shown in units of 10¹³.
The increase in neutron yield remains the same for implosions including inner ice roughness.

Effect of the ice roughness on the yields for 2.74-ns case

Neutron yield \( \times 10^{14} \) vs. Inner ice roughness \( \sigma_{rms} \) (\( \mu m \))

- With electron beam
- Without electron beam
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.
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