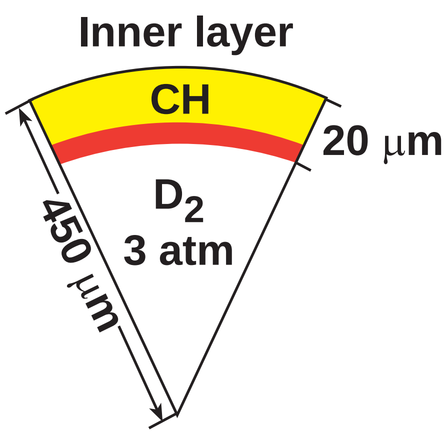
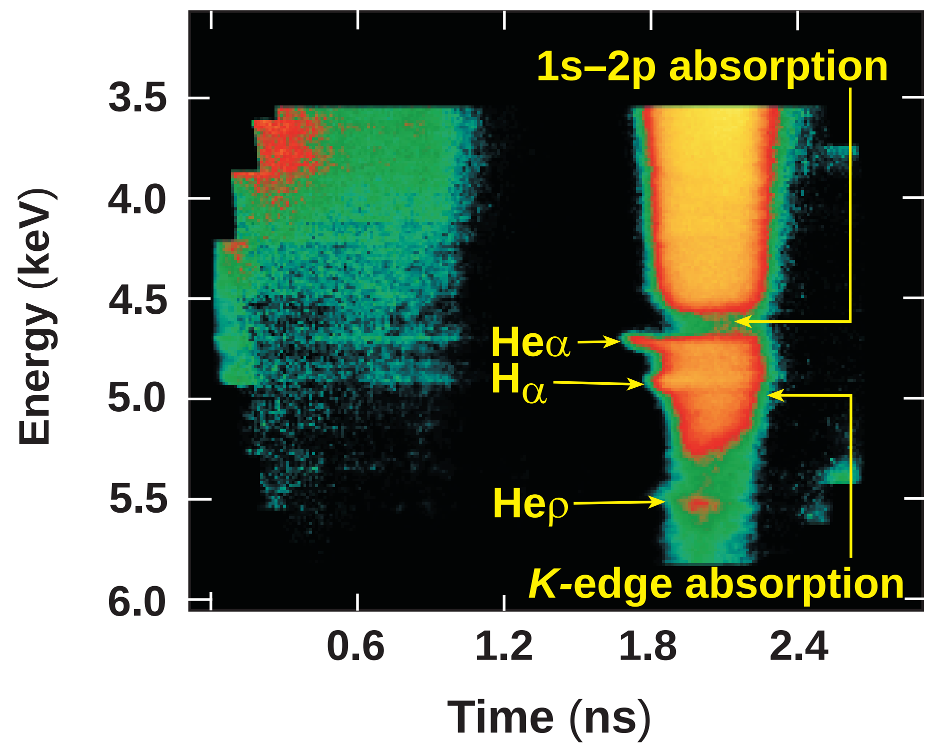
Time-Resolved Measurements of Compressed Shell Temperature and Areal Density with Titanium-Doped Targets on OMEGA





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Time-Resolved Measurements of Compressed Shell Temperature and Areal Density with Titanium-Doped Targets on OMEGA

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Time-resolved spectroscopic measurements of self-backlit implosions on the 60-beam, 30-kJ UV OMEGA laser system are used to determine shell temperature and areal density at peak of compression. The target shells have titanium-doped layers to probe temperature and areal density inside the shell. Both time-resolved and time-integrated measurements have been taken with 1-mm-diam, 20-μm-thick shells filled with 3 or 15 atm of D_2. The shell conditions are studied with 1-ns square, 6:1-contrast, 2.4-ns pulse shapes. The temperature of the hot part of the shell and the core has been measured from the continuum emission of the target, the temperature of the warm part of the shell has been measured from the spectral position of 1*s*-2*p* titanium absorption, and the minimum shell temperature has been measured from the spectral shift of the titanium *K* edge. The shell areal density has been measured from the titanium 1*s*-2*p* and *K*-edge absorption. This work was supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC03-92SF19460.

Collaborators

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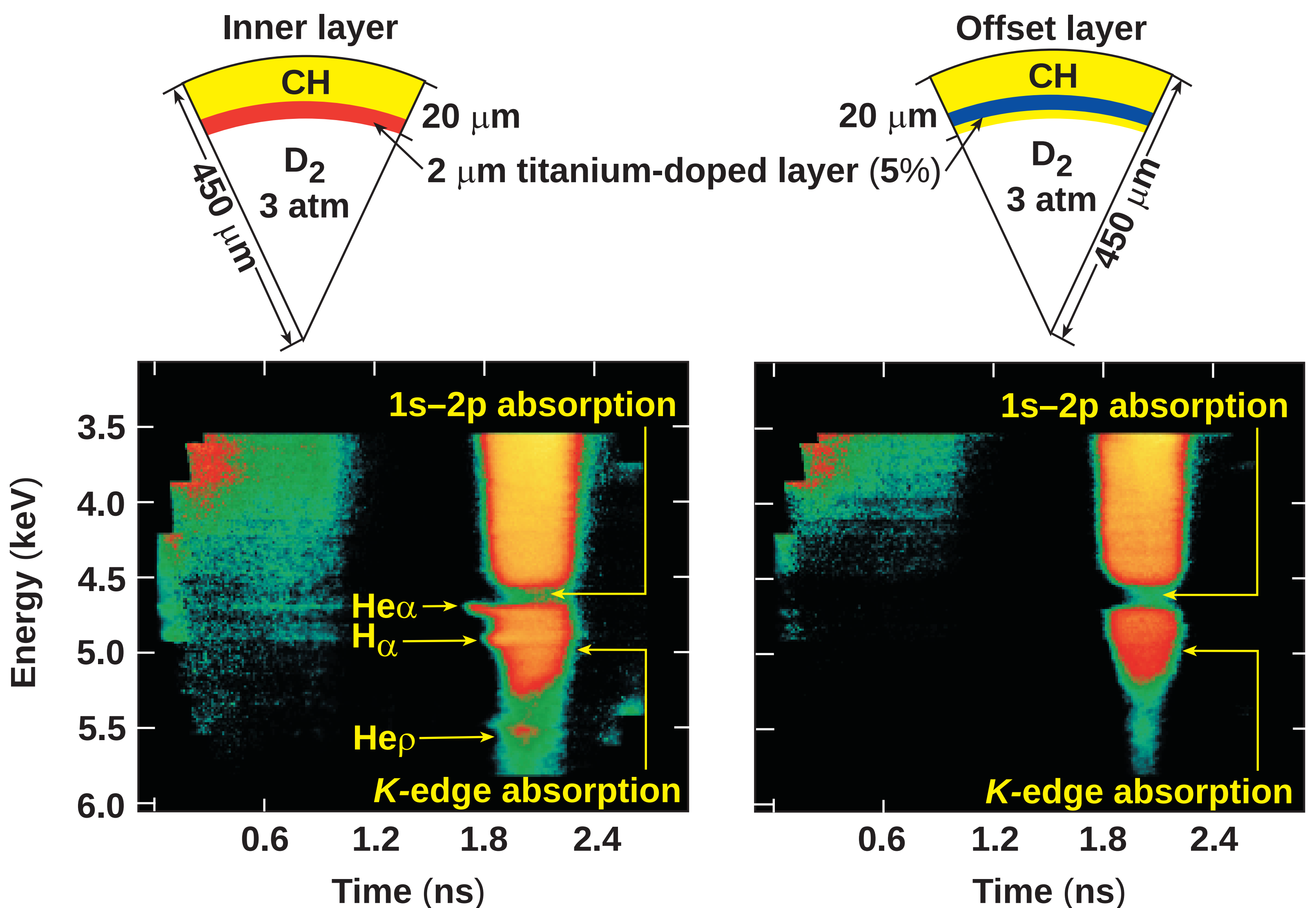
Summary

Measured peak areal density of the shell is ~100 mg/cm^2 with 20-μm-thick shells filled with 3 atm of D_2

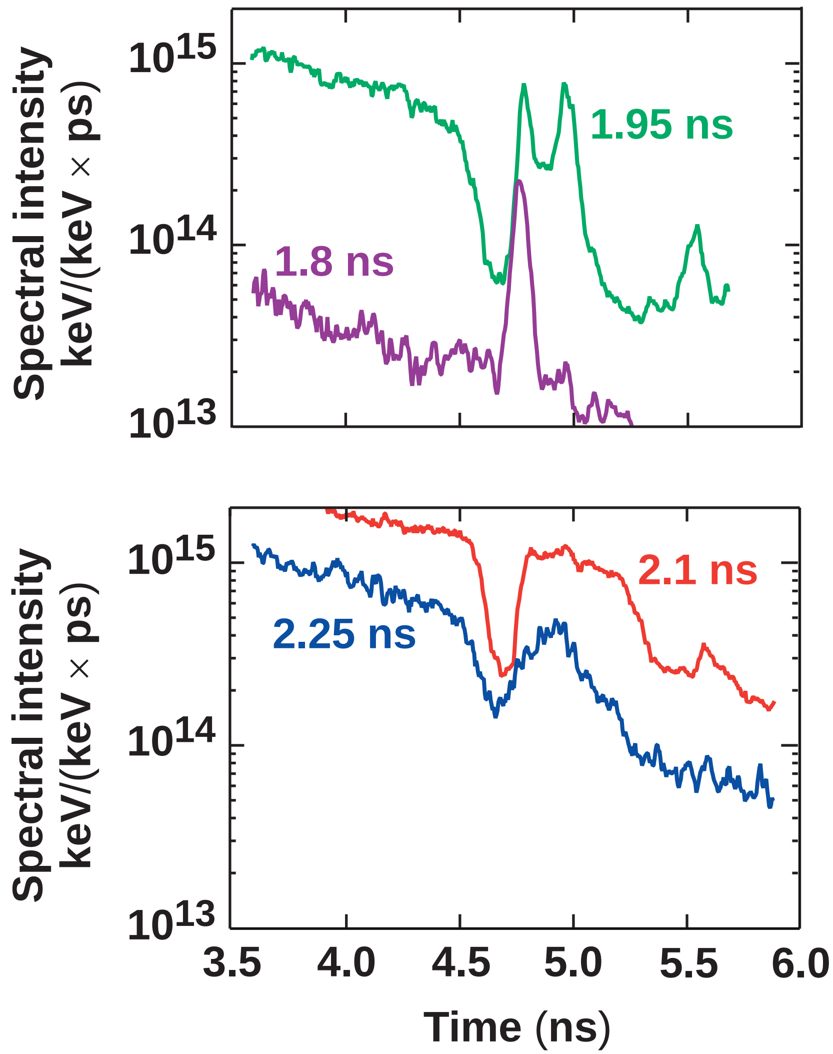
- Shell temperature and areal density are diagnosed using titanium-doped layers.
- Conditions in a “cold” shell (T < 500 eV) are measured with *k*-edge absorption, in a “warm” shell (T ~ 600–700 eV) with 1s–2p absorption, and in a “hot” shell (T ~ 1.0–1.5 keV) with continum emission.
- Measured shell areal density at peak compression is at least 100 mg/cm^2.
- Shell temperature varies from 200 eV to 1.5 keV at peak compression.

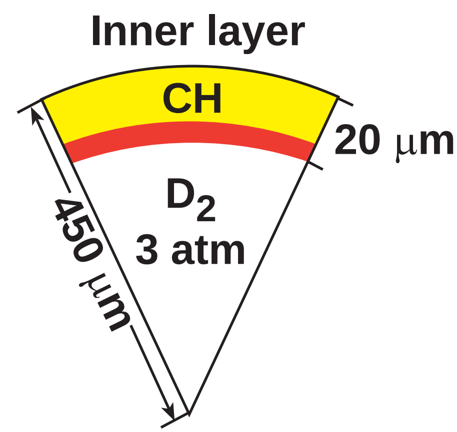
Targets with inner and offset titanium-doped layers are used to probe conditions in the shell



E10616

Measured spectra contain information about shell areal-density and temperature evolution





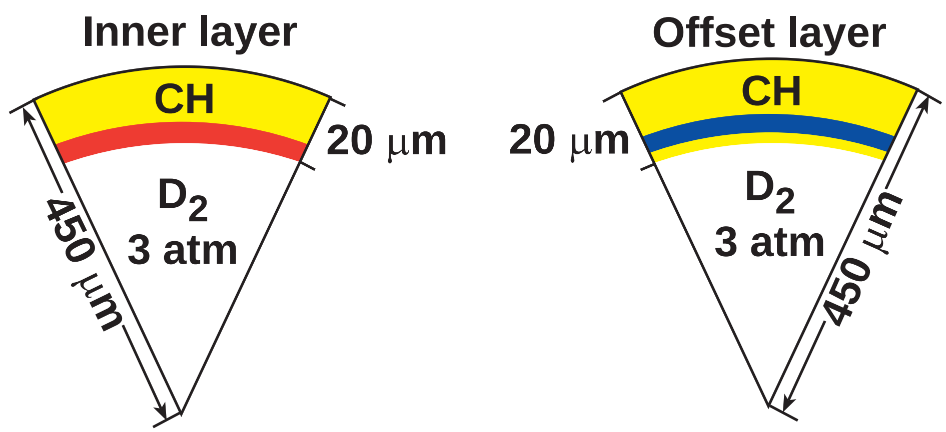
1. "Cold" shell (T < 500 eV) areal density from *K*-edge absorption

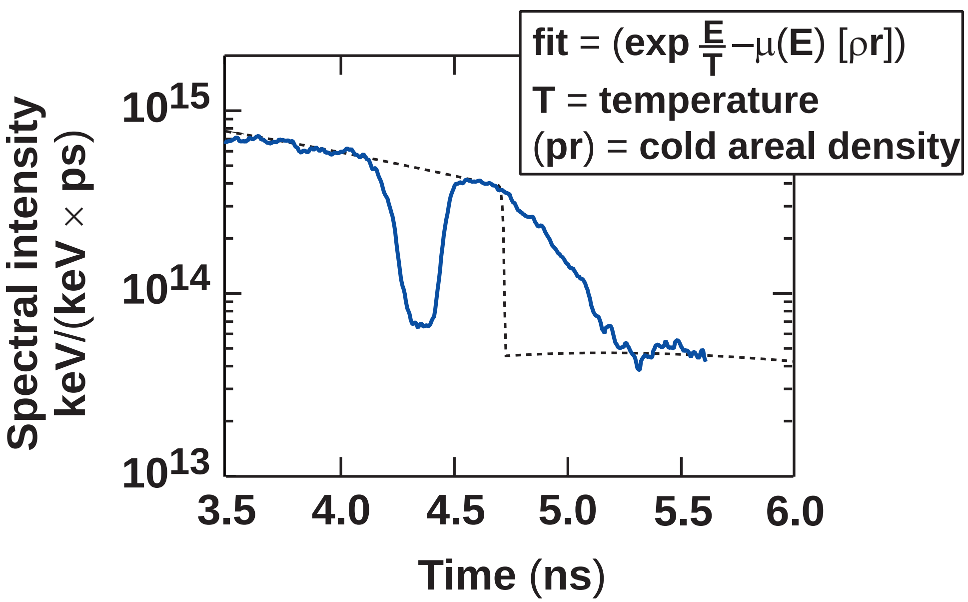
2. "Warm" shell (T ~ 600–700 eV) areal density from 1s-2p absorption

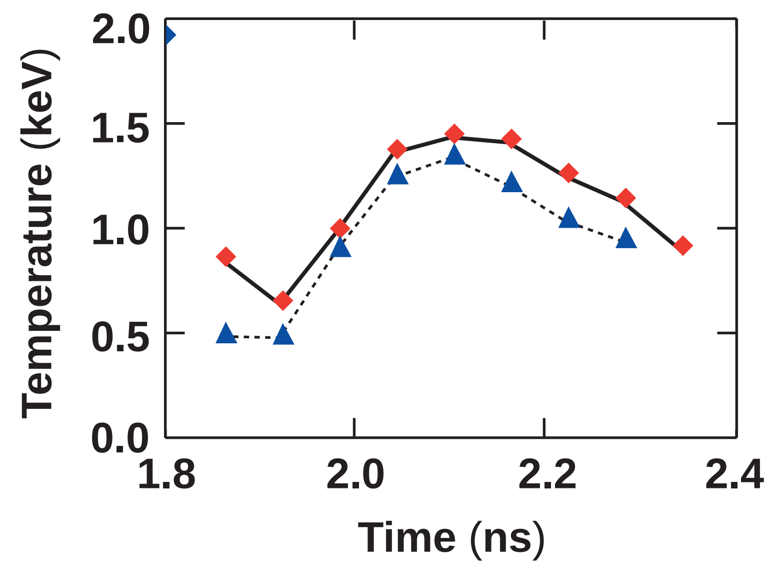
3. "Hot" shell (T ~ 1.0–1.5 keV) temperature from continum emission

E10617

Electron temperature from continuum emission is derived from the fit to experimental data

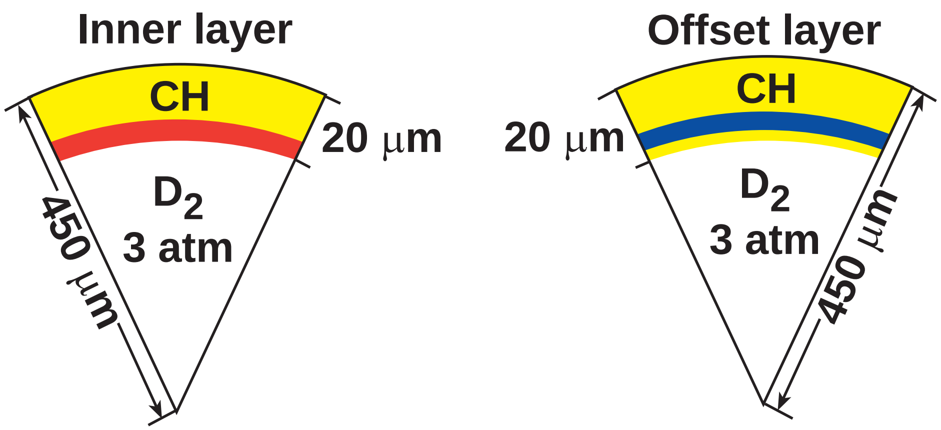


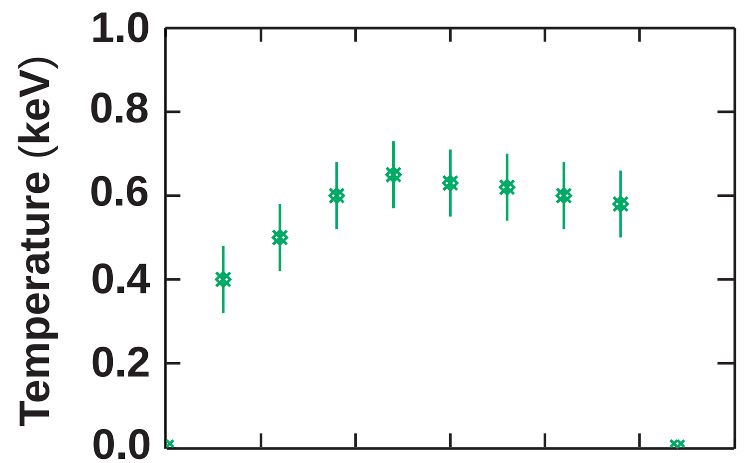


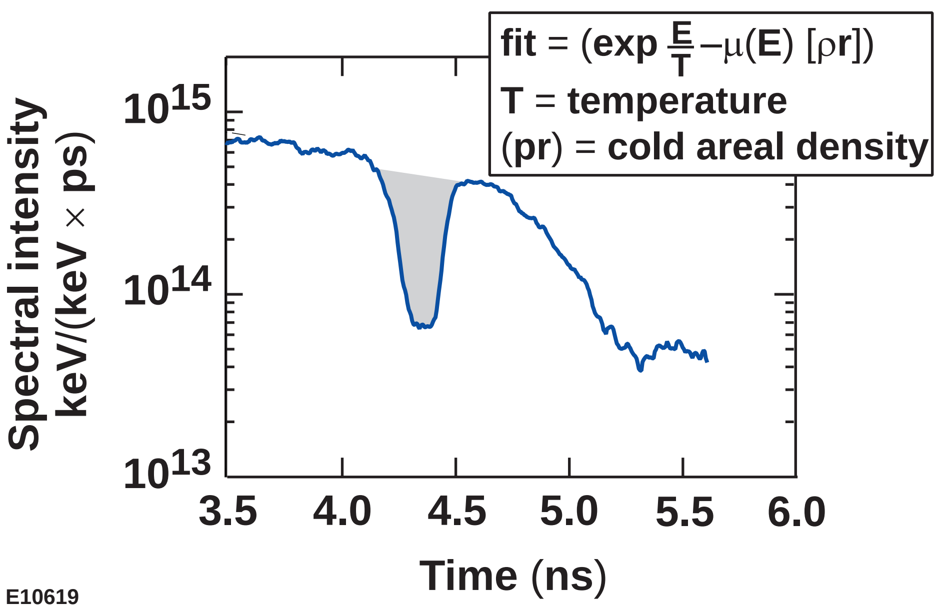


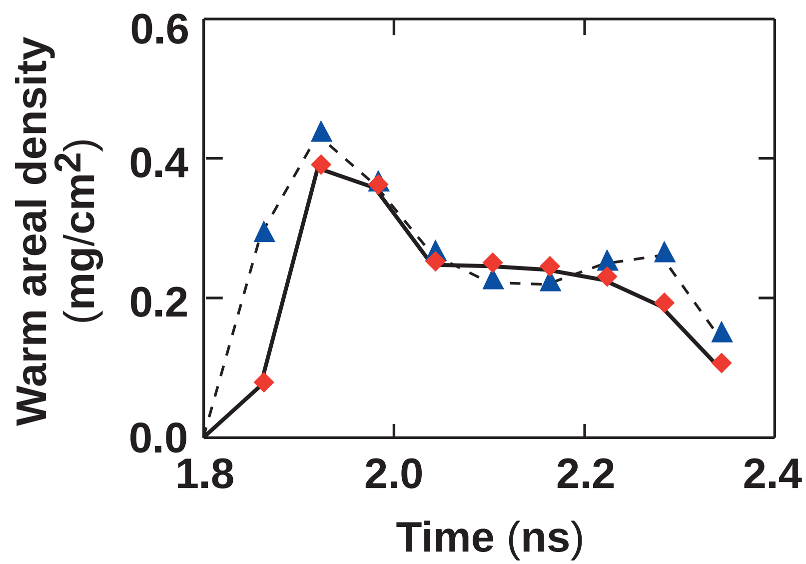
E10618

"Warm" shell areal density and temperatures is derived from the region of 1s-2p absorption



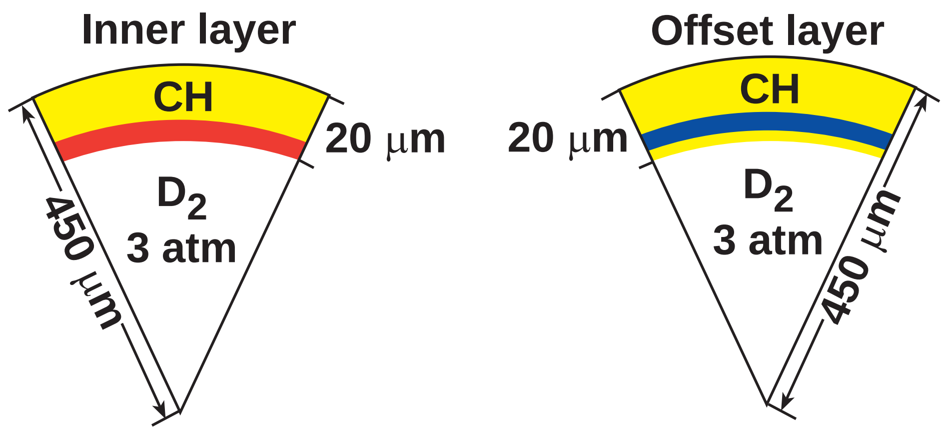


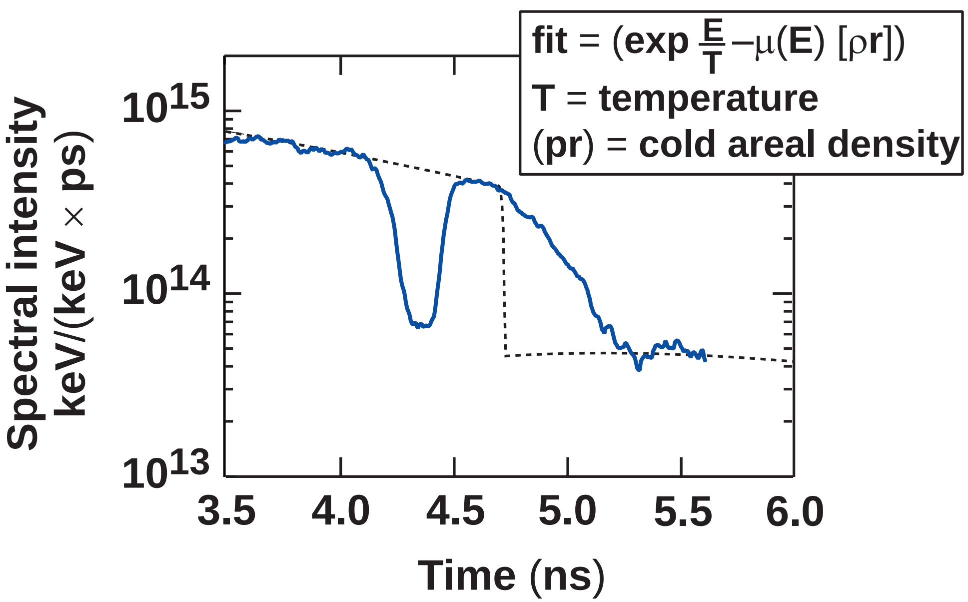


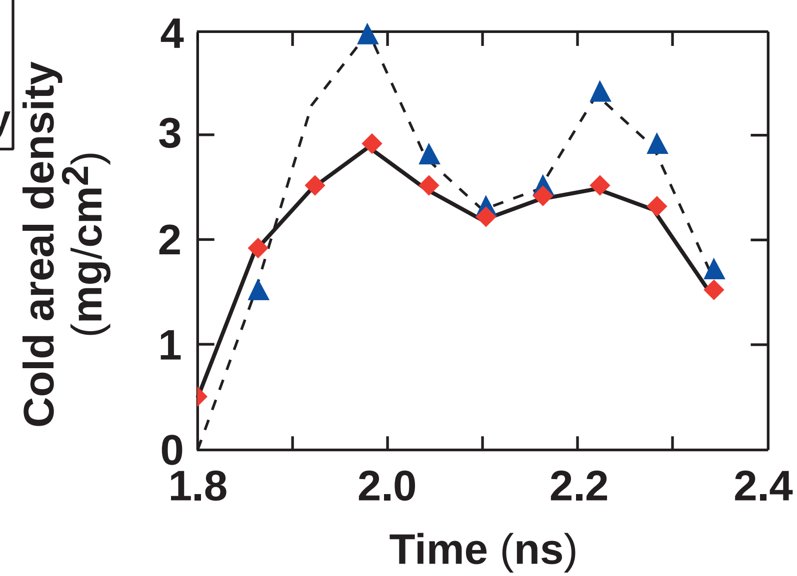


E10619

“Cold” shell (T < 500 eV) areal density is derived from the *K*-edge absorption

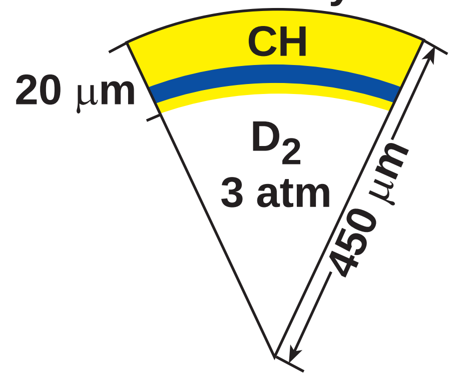


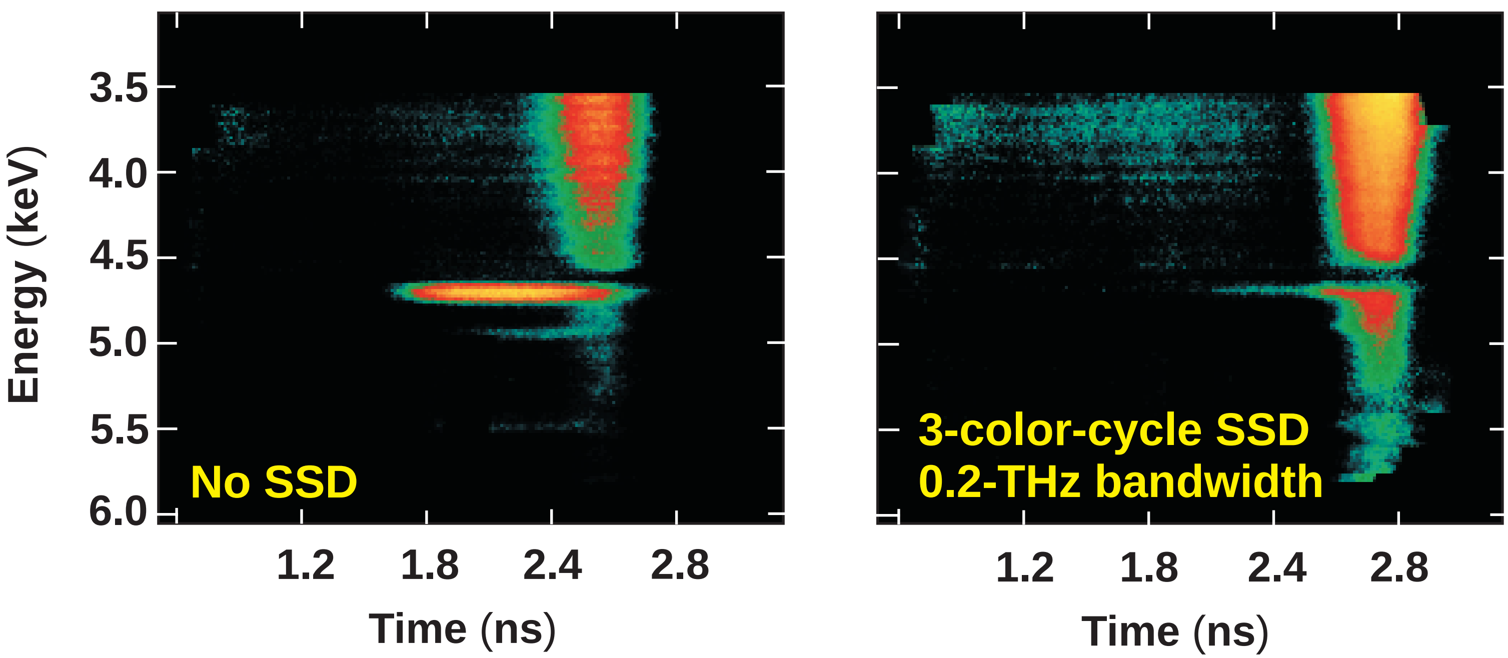




E10620

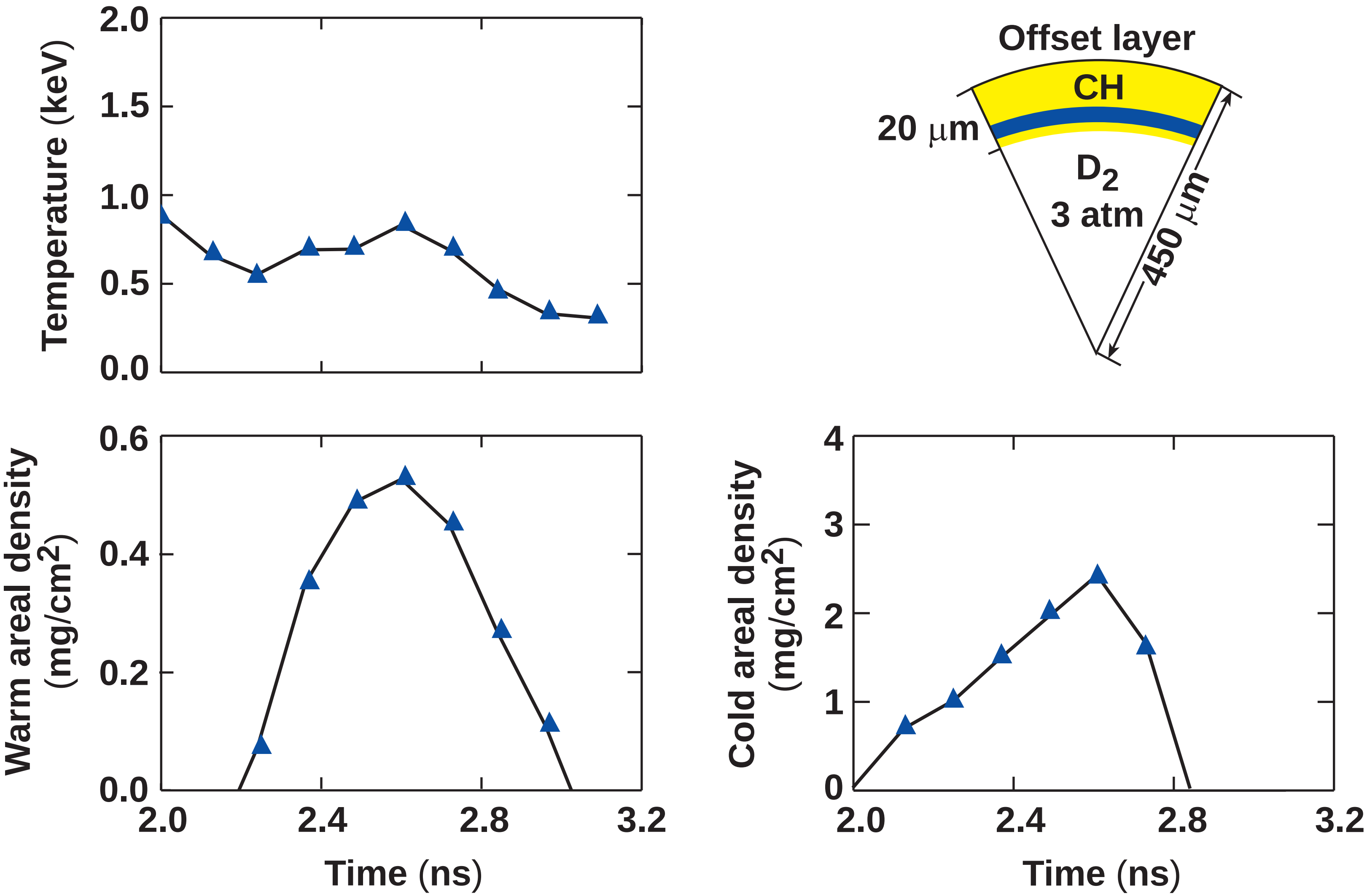
SSD improves target performance with pulse shape PS26





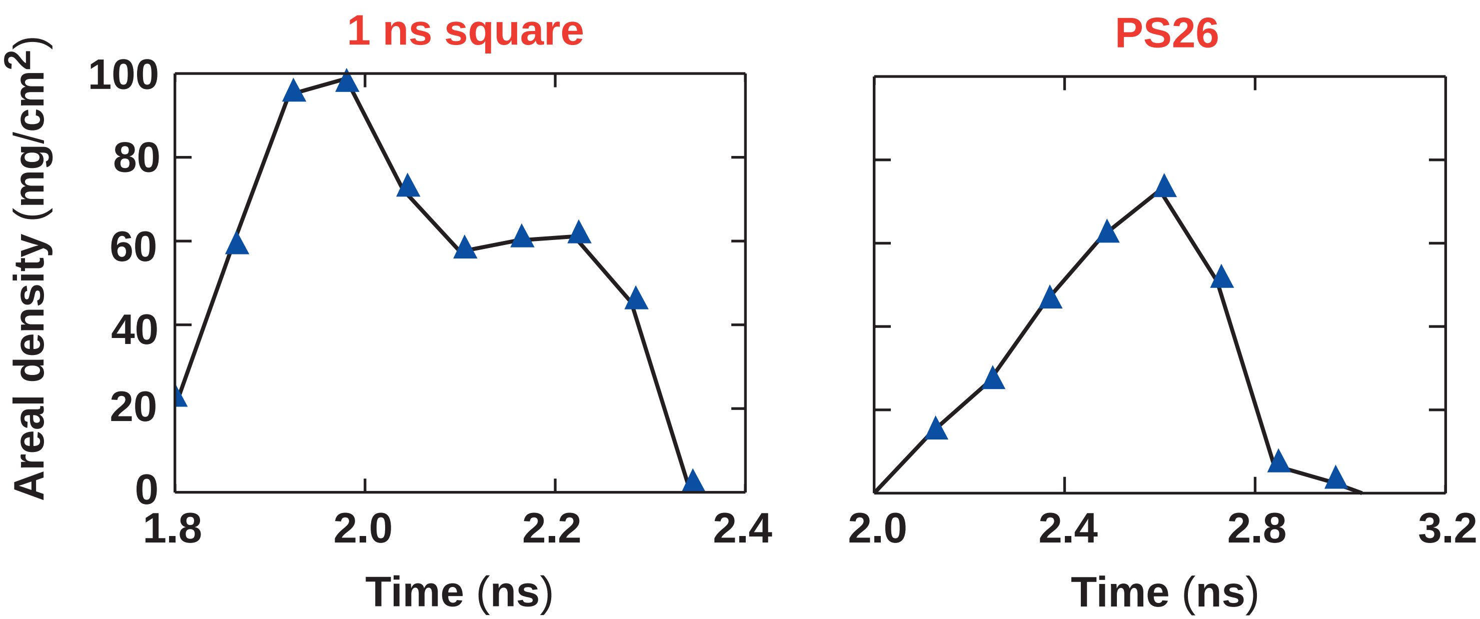
E10621

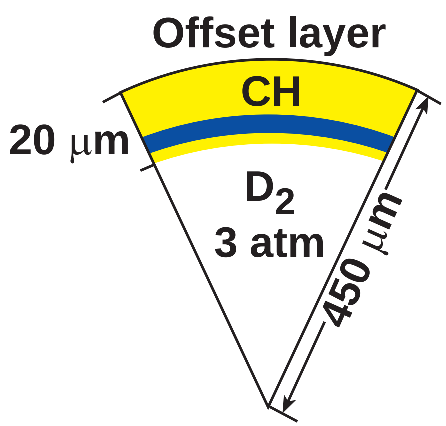
In implosions with PS26 the shell is colder and achieves less areal density than with the 1-ns square pulse shape



E10622

Shell areal density is higher in implosions with 1-ns square pulse shape than with PS26





Assumption: Half of the shell is ablated in the acceleration phase, and the rest is compressed as a titanium-doped layer.

E10623

Summary/Conclusion

Measured peak areal density of the shell is ~100 mg/cm^2 with 20-μm-thick shells filled with 3 atm of D_2

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