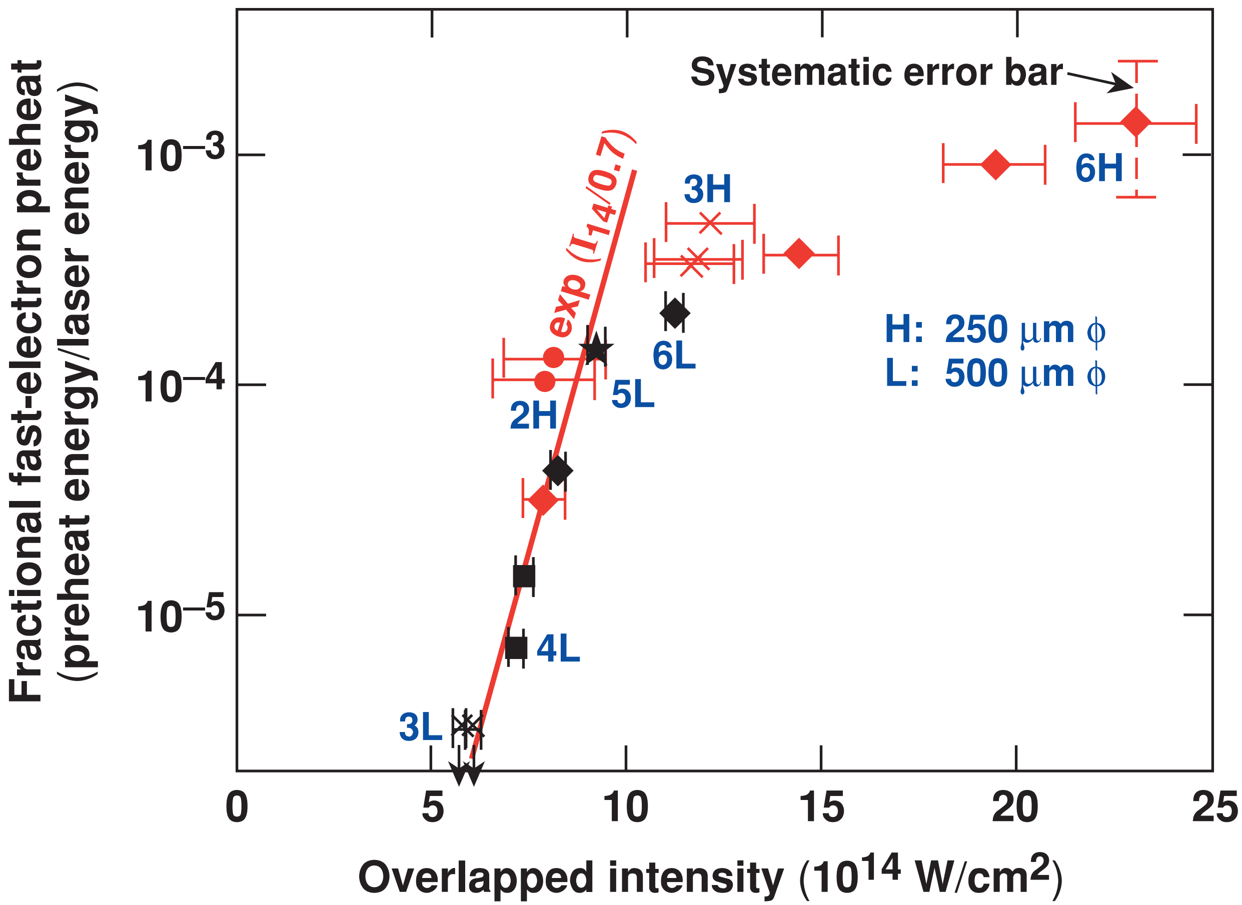
Experimental Scalings for the Two-Plasmon-Decay Instability



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33rd Anomalous Absorption Conference
Lake Placid, NY
22–27 June 2003

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Summary

The hot electrons from the TPD instability scale predominantly with intensity and density scale length

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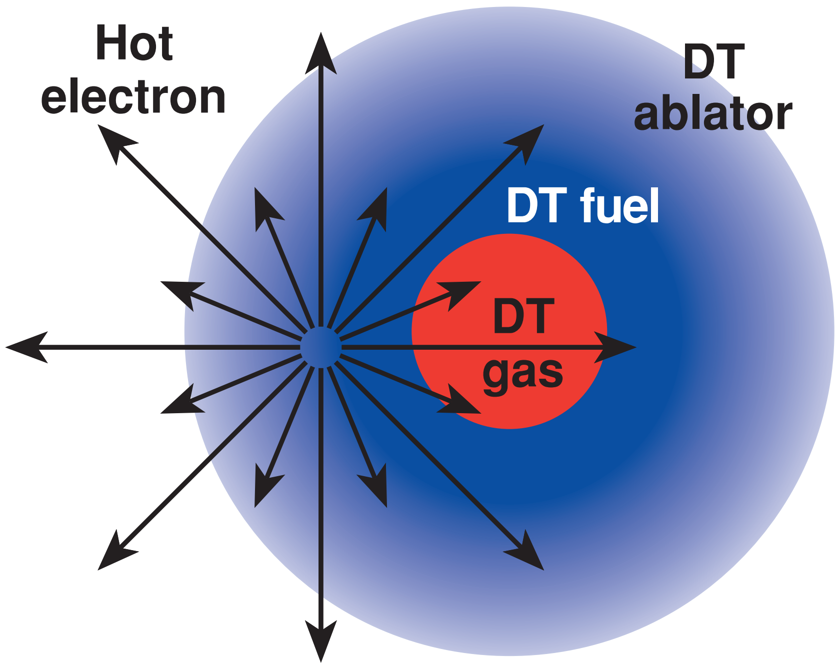
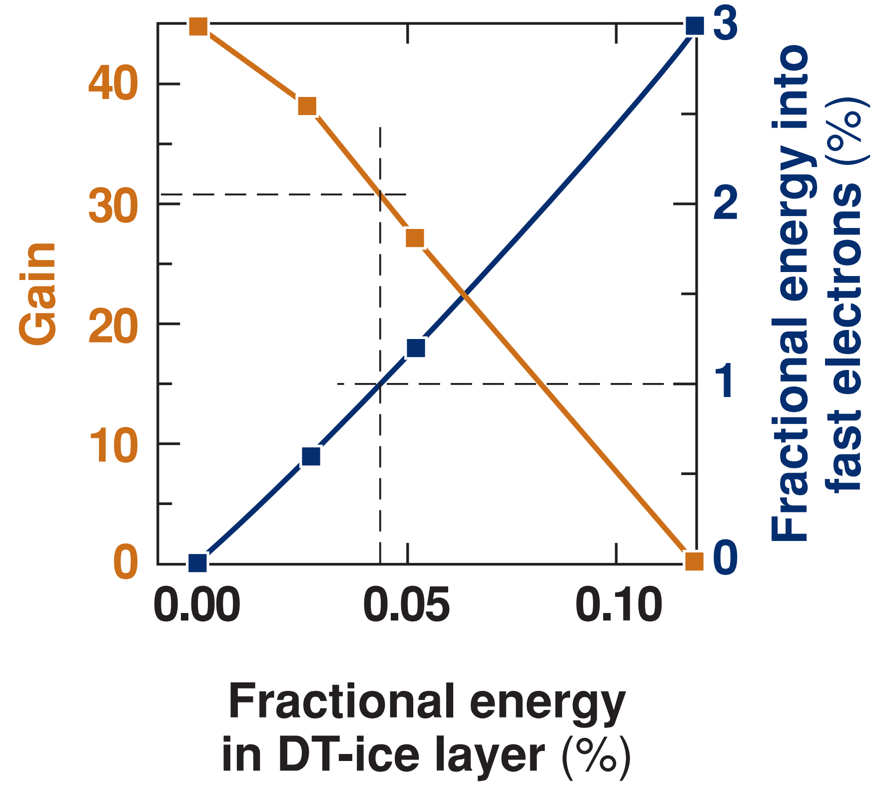
- The hot-electron production from the TPD instability shows a strong exponential scaling with total (overlapped) intensity in both planar and spherical experiments.
- The TPD instability appears to saturate above 10^{15} W/cm^2 for planar experiments with NIF-relevant scale length, at ~0.1% fractional preheat.
- Beam smoothing techniques affect the hot-electron production only moderatly, polarization wedges decrease (by a factor of 2) the hard-x-ray signal, 1-THz SSD increases the signal by 20%.
- The density scale length at quarter-critical density has a strong effect on the TPD instability, both in magnitude and scaling with intensity.

Hot electrons can significantly reduce the target gain

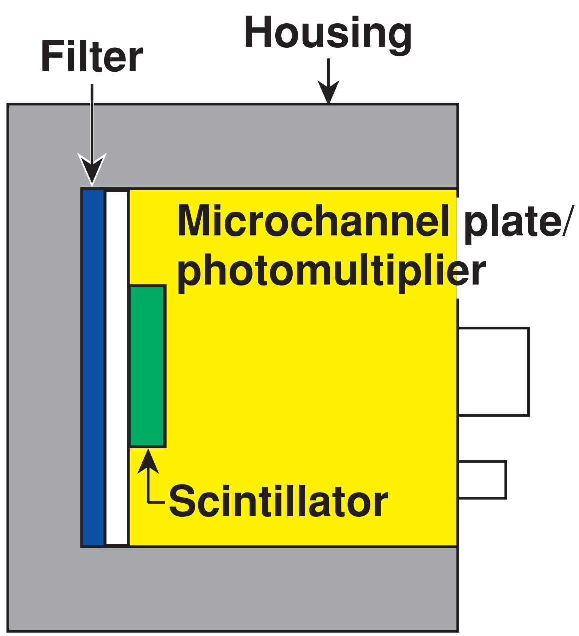
- The effect of an 80-keV hot-electron tail was simulated using the fast-electron package in *LILAC*.
- About 4% of the energy absorbed into fast electrons couples into the DT-ice fuel layer.

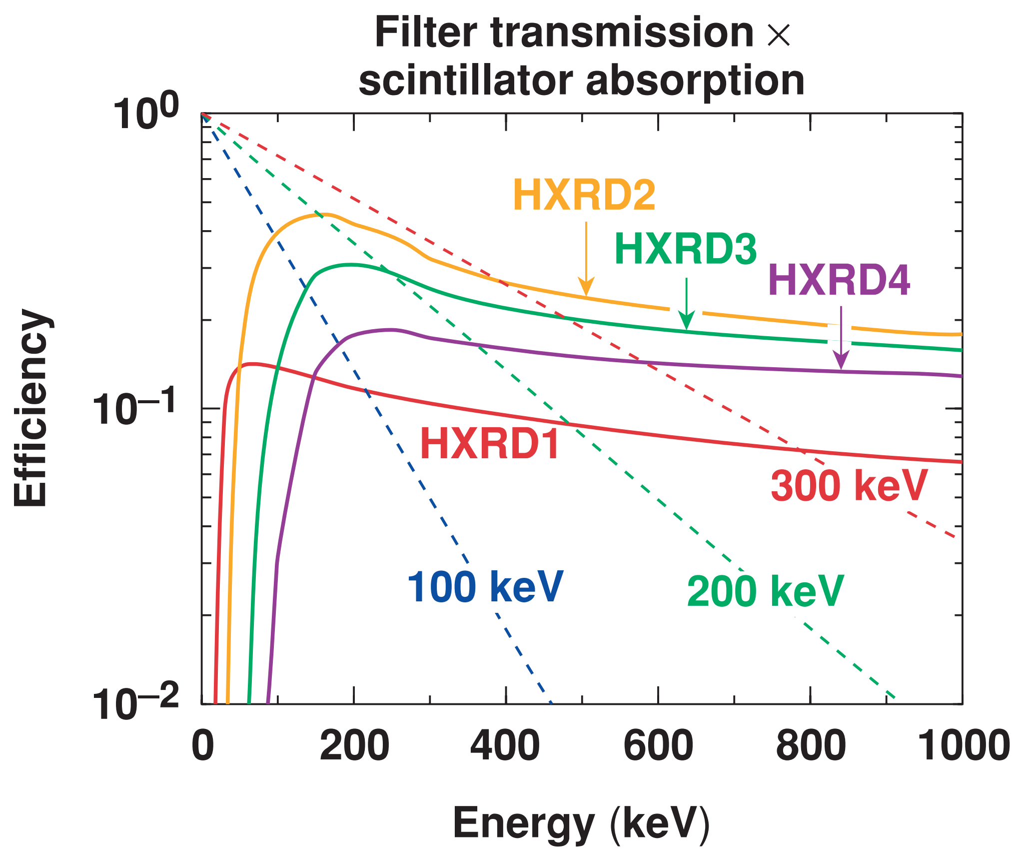




TC5003

Four hard x-ray detectors using single-edge-type filters are used to measure the hot-electron temperature

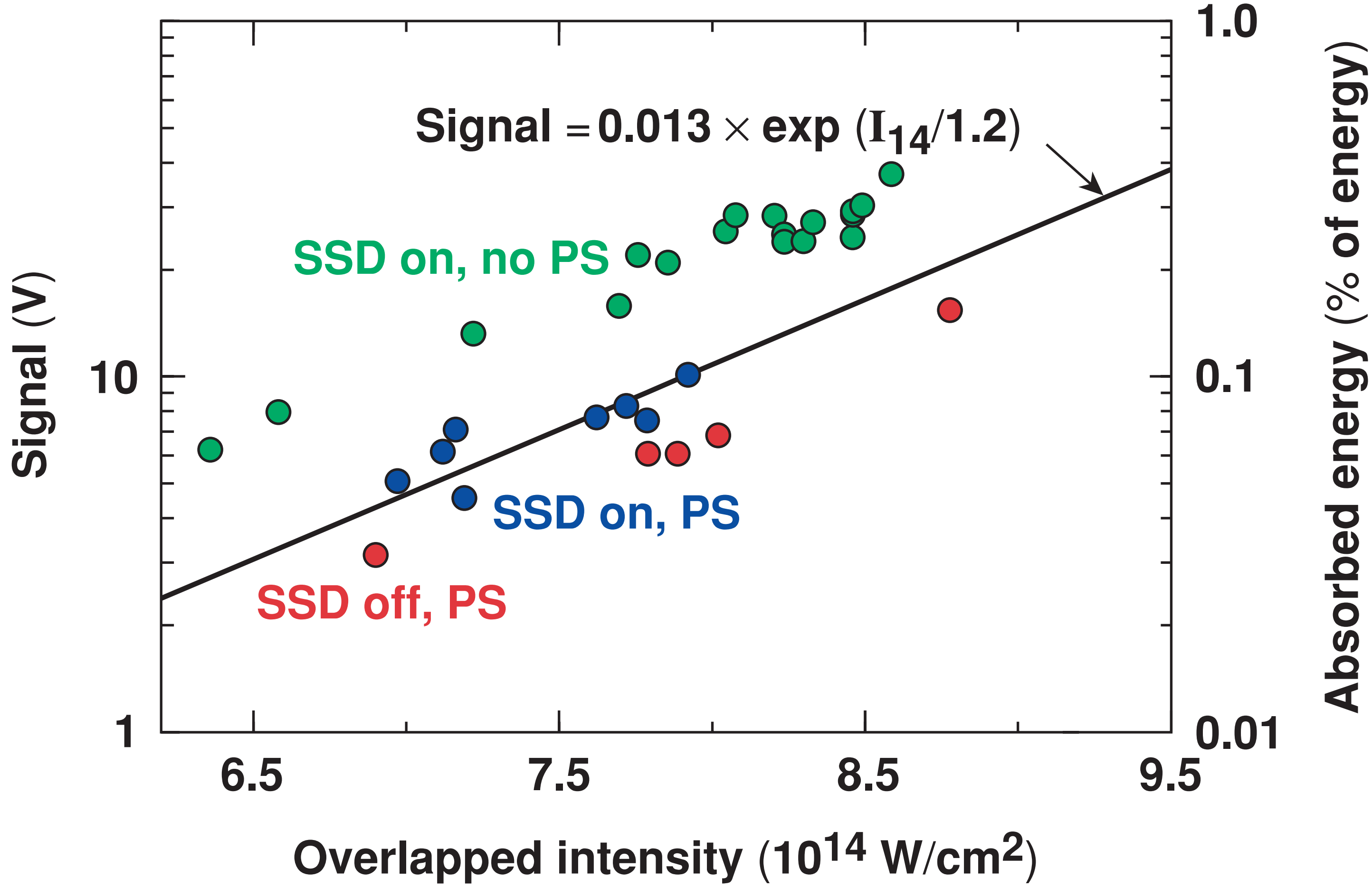




E10921

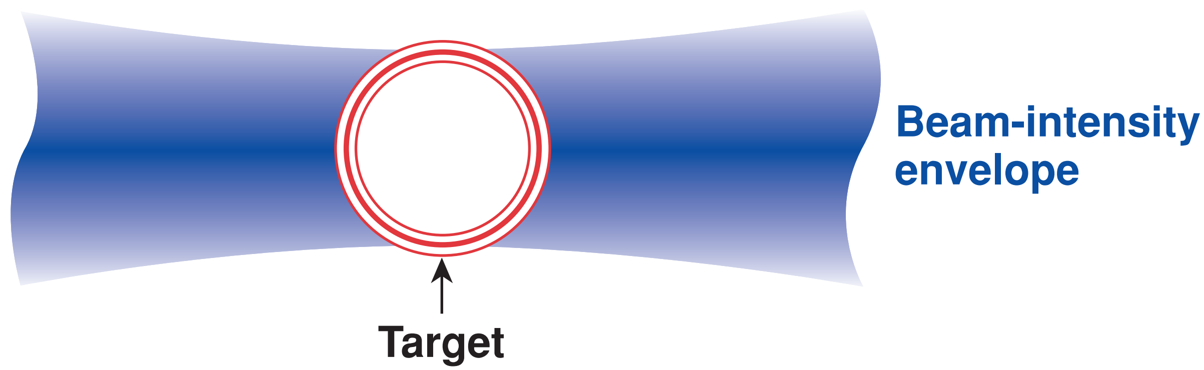
Improvements in the single-beam nonuniformity by SSD or PS affect the hard x-ray emission for spherical targets

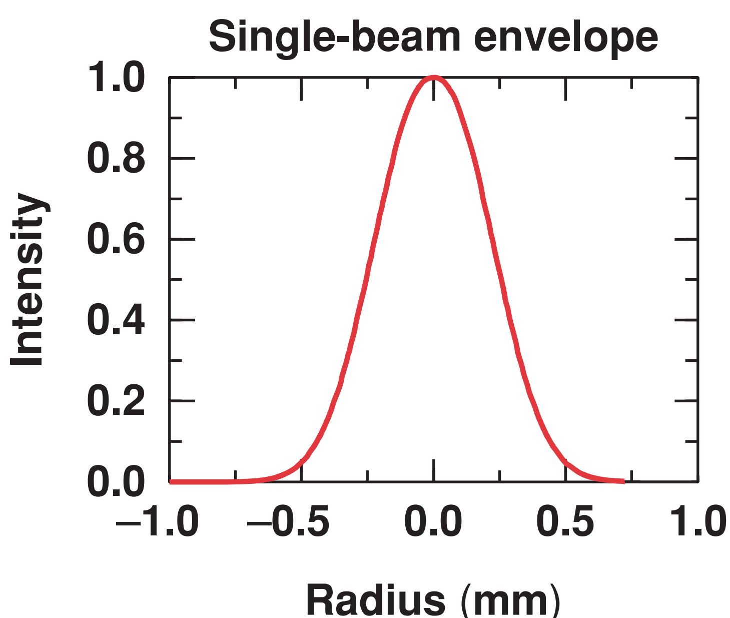
- CH shell, 950-μm diam., 1-ns square, varying single-beam intensity

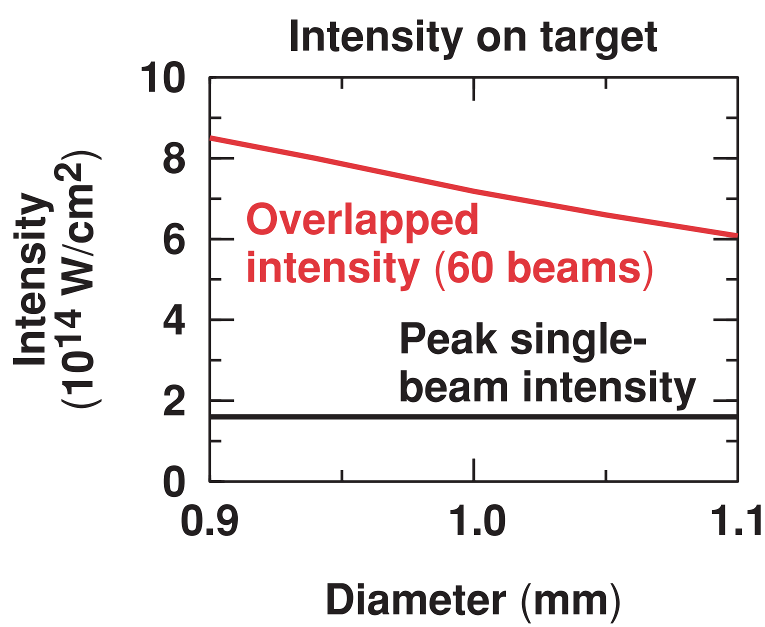


E10922

In spherical geometry, the overlapped intensity on target depends on the target diameter



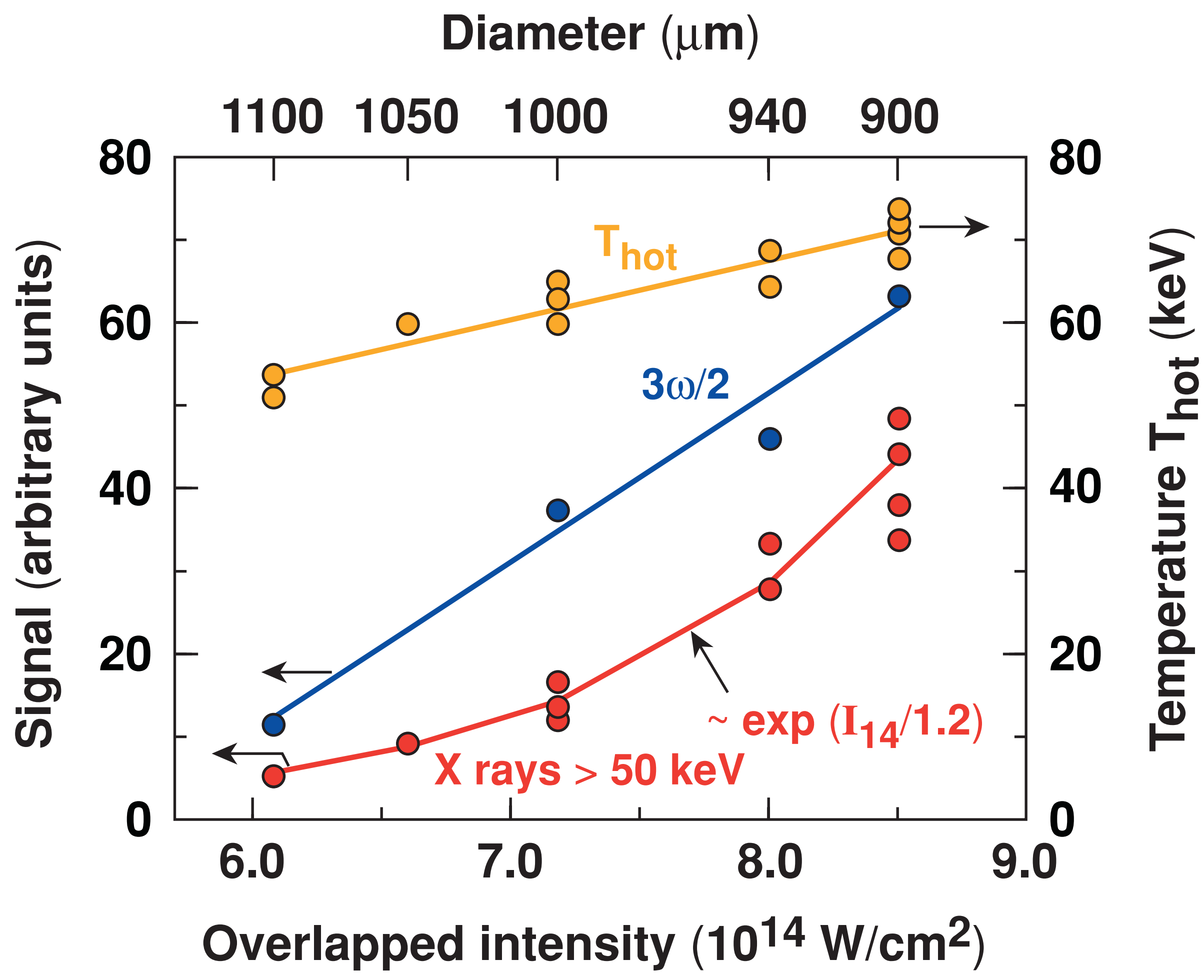




E10924

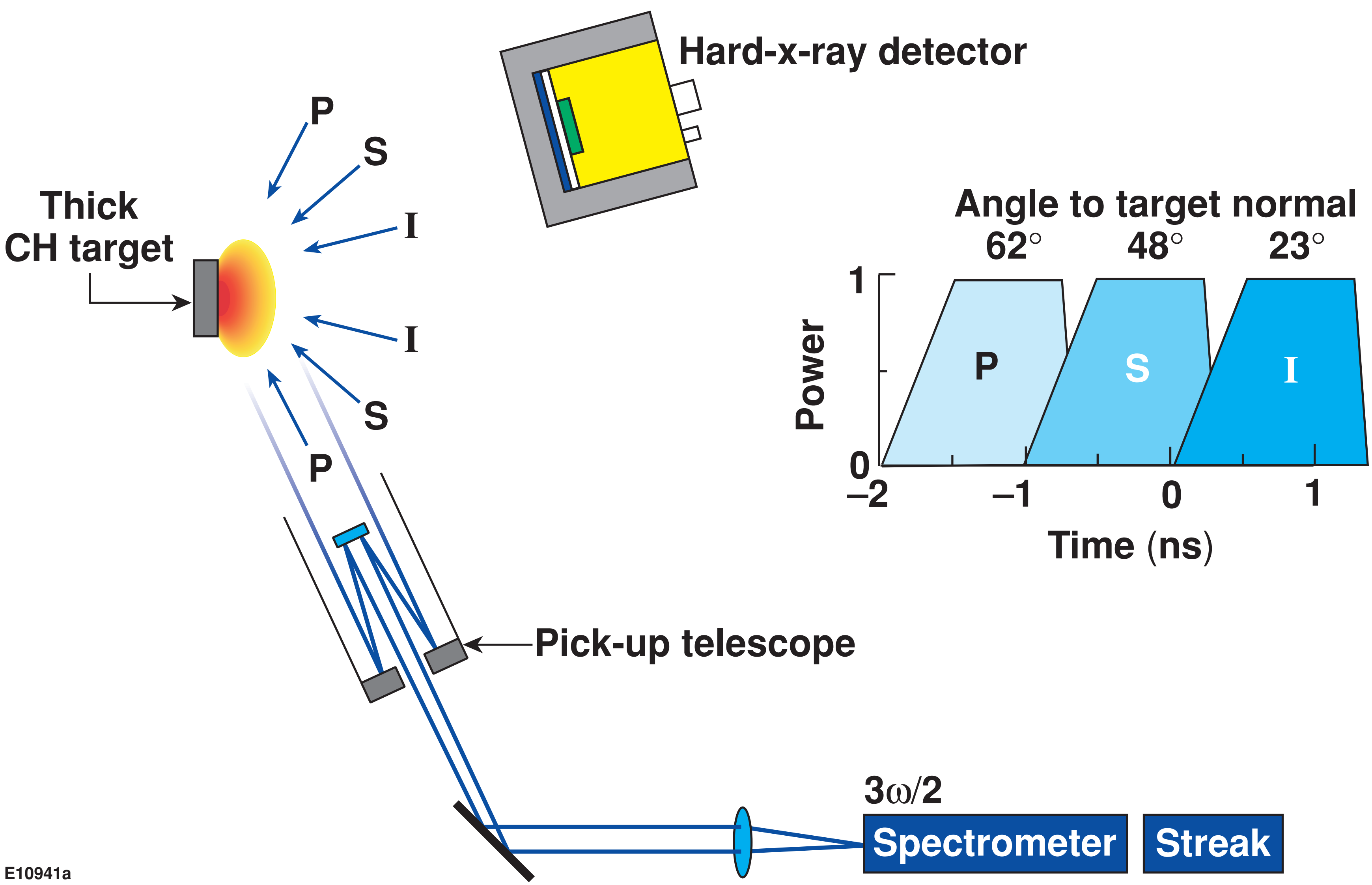
The TPD instability scales with overlapped intensity in spherical implosion experiments

- Data taken on 60-beam OMEGA shots with CH shells varying from 900-μm to 1100-μm diameter



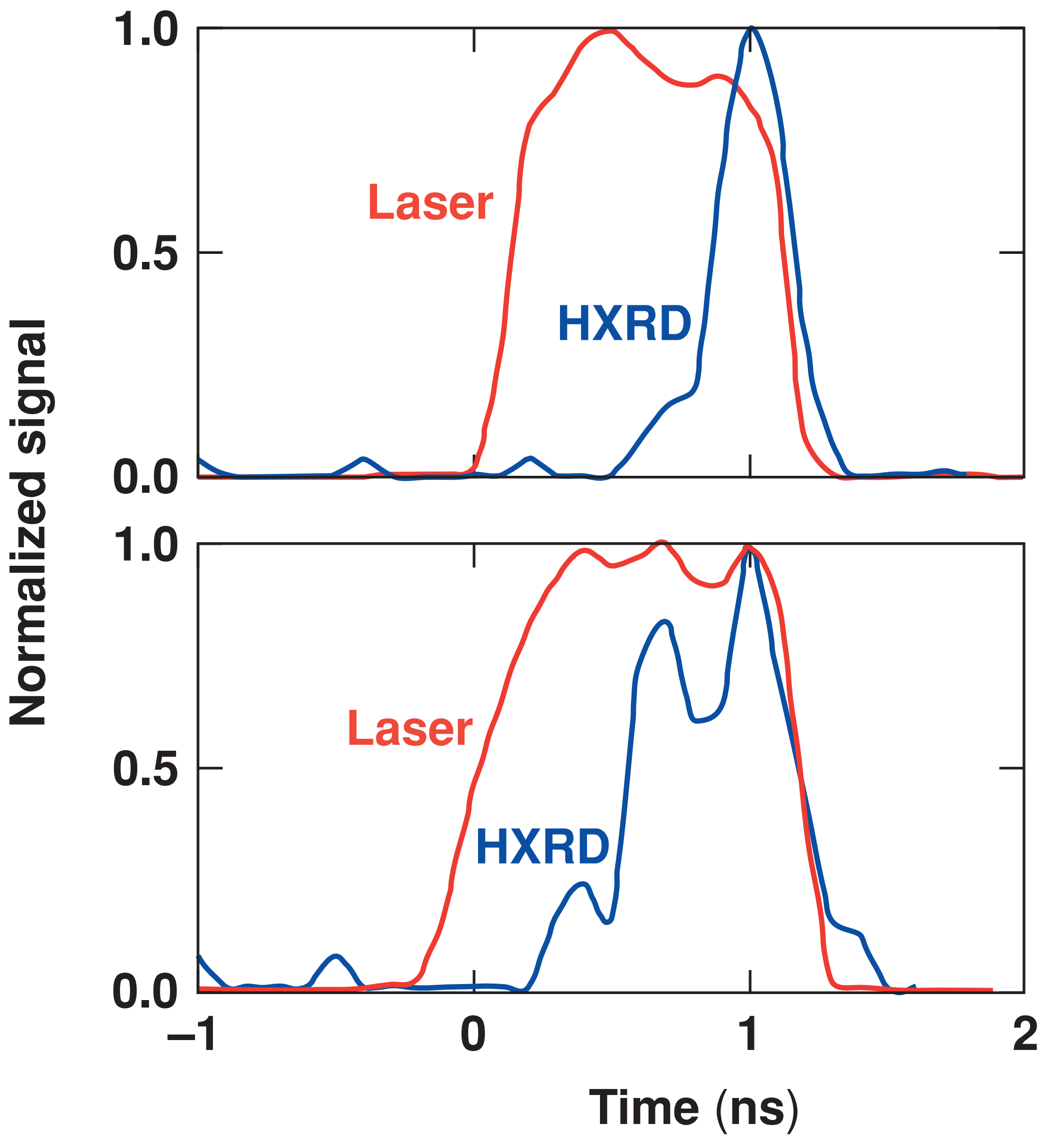
E11103

Planar-foil experiments use three sets of delayed beams, six of which are interaction beams



E10941a

For current OMEGA implosions the temporal evolution of the hard x rays reflects the increasing density scale length

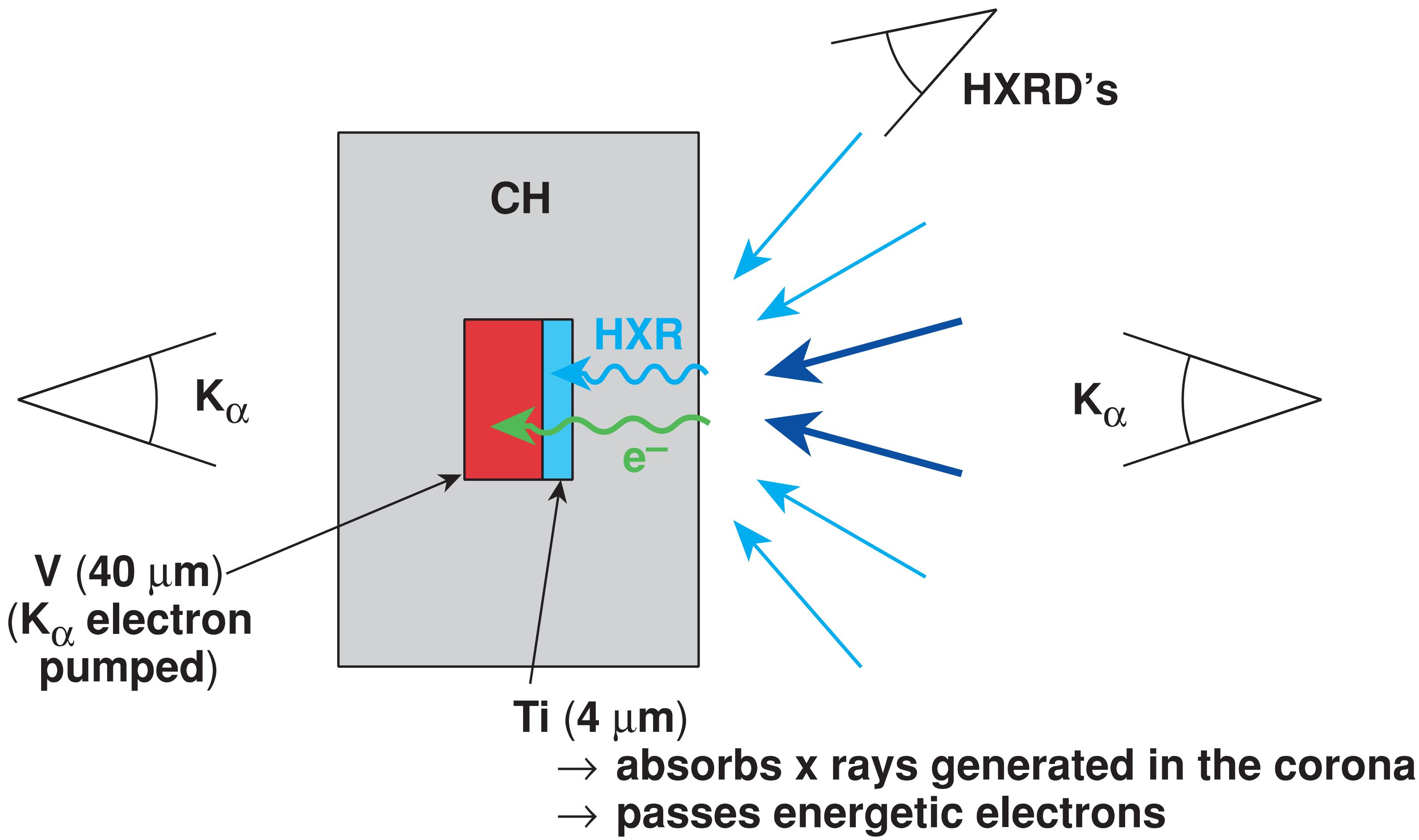


Current OMEGA implosion experiments

Multibeam, long-scale-length interaction experiments

The hard-x-ray detectors (scintillator-PMT) are cross-calibrated with K_α emission from special targets

- Comparison of signals and some analysis allow HXRD's to be absolutely calibrated for pure-CH or D_2 targets.



E11418

In planar experiments TPD scales with overlapped intensity and saturates above 10^{15} W/cm^2

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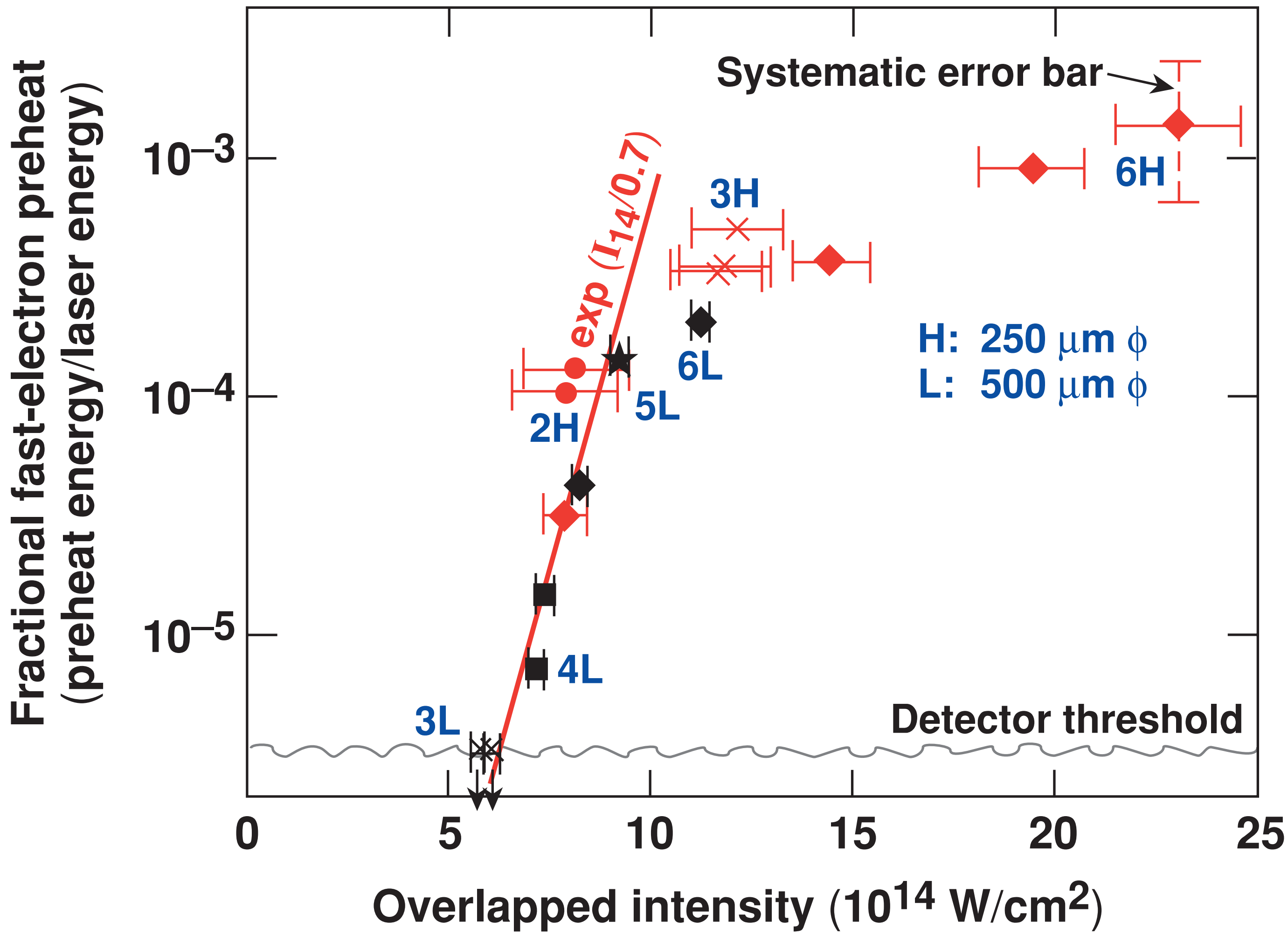
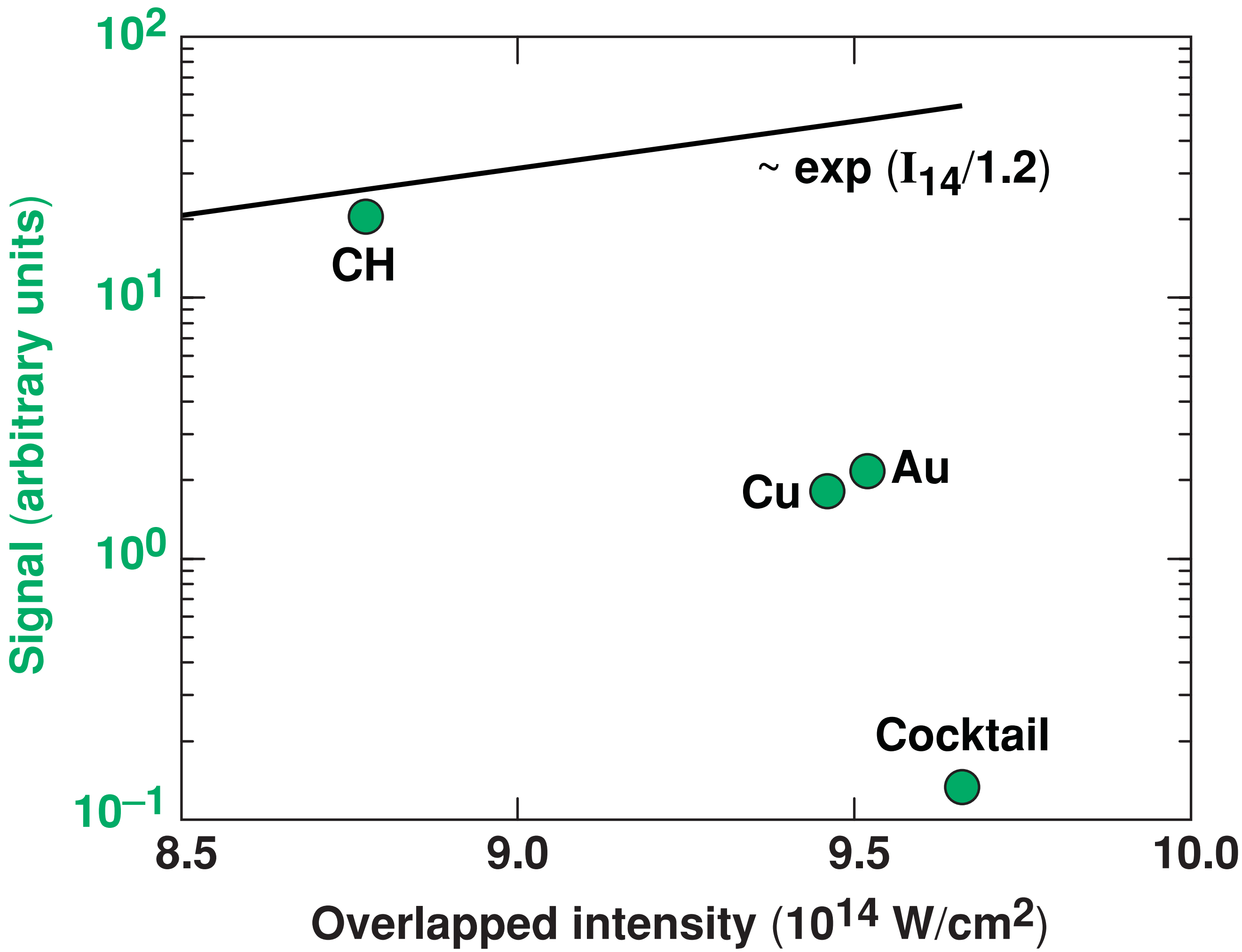
- Planar CH targets, 100 μm thick, multiple-overlapping beams



E12304a

The hard-x-ray signal is strongly affected by the density scale length

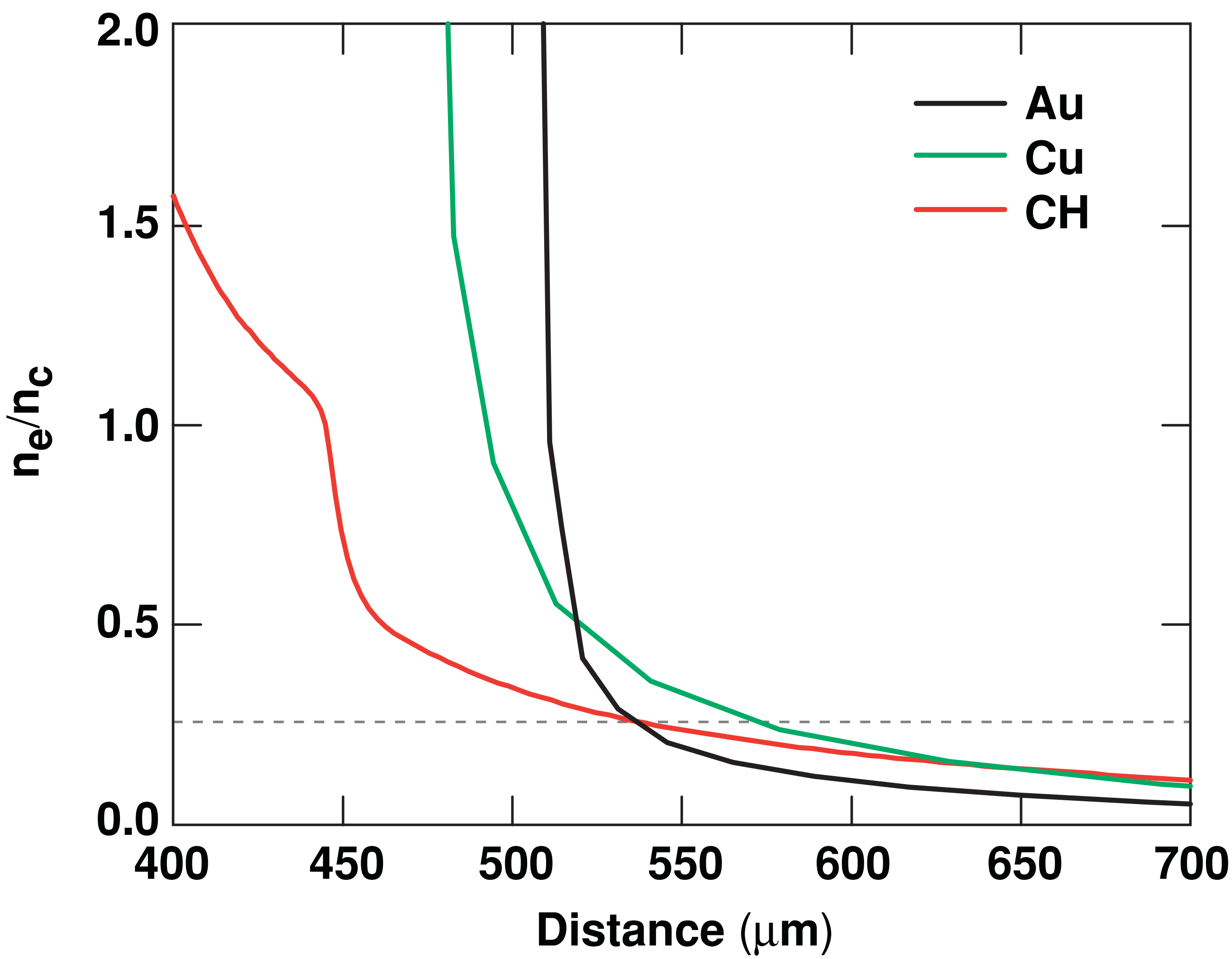
- CH shell, 950-μm diameter, 1 ns square, varying overcoat



E12301

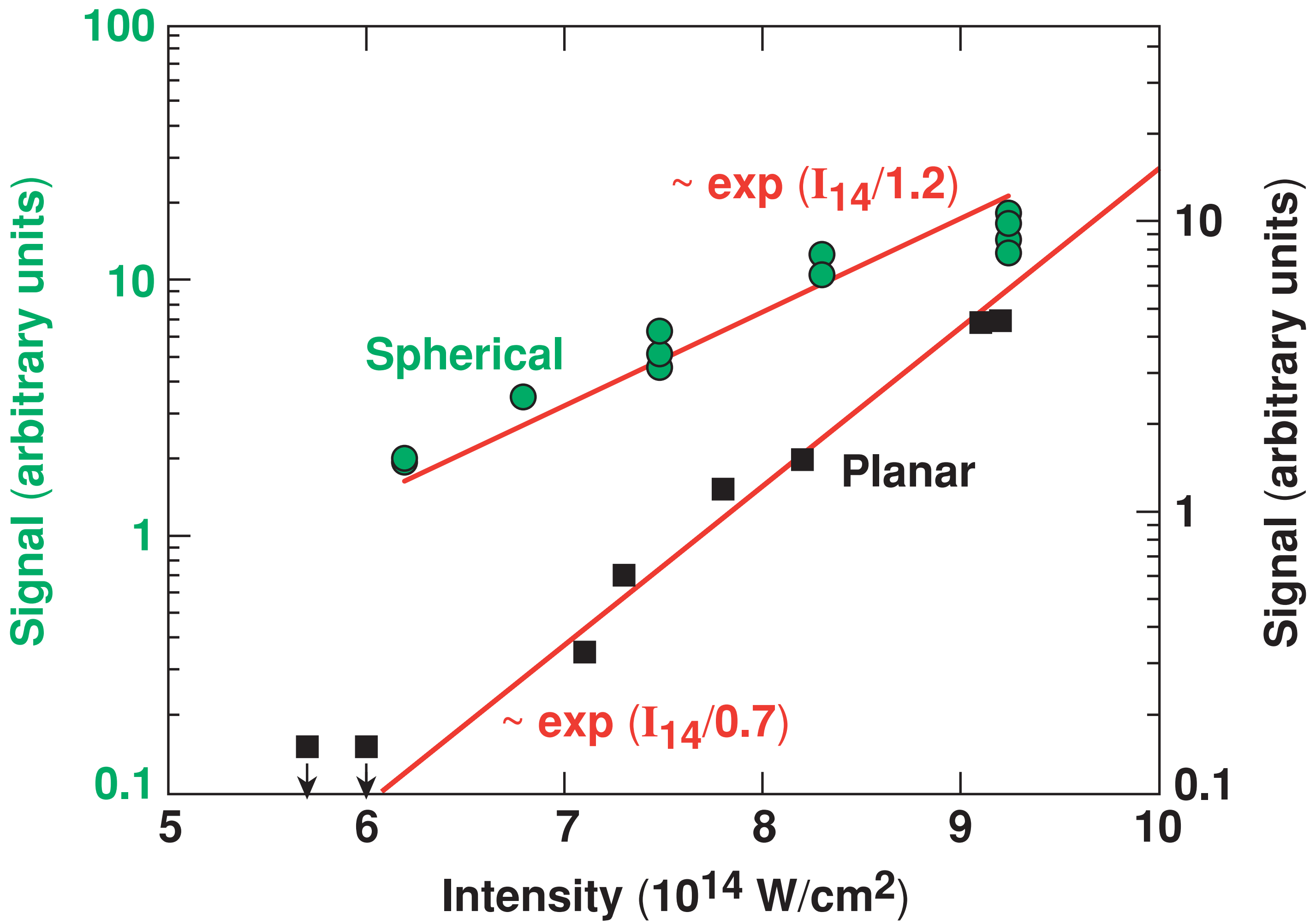
Simulations show that the density scale length is shorter for the high-Z targets

- $T_e \sim 2.5$ keV at $0.25\ n_c$



E12315

Long-scale-length planar and spherical experiments show different intensity scalings



E12316

Summary/Conclusions

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- The TPD instability appears to saturate above 10^{15} W/cm^2 for planar experiments with NIF-relevant scale length, at ~0.1% fractional preheat.
- Beam smoothing techniques affect the hot-electron production only moderately, polarization wedges decrease (by a factor of 2) the hard-x-ray signal, 1-THz SSD increases the signal by 20%.
- The density scale length at quarter-critical density has a strong effect on the TPD instability, both in magnitude and scaling with intensity.