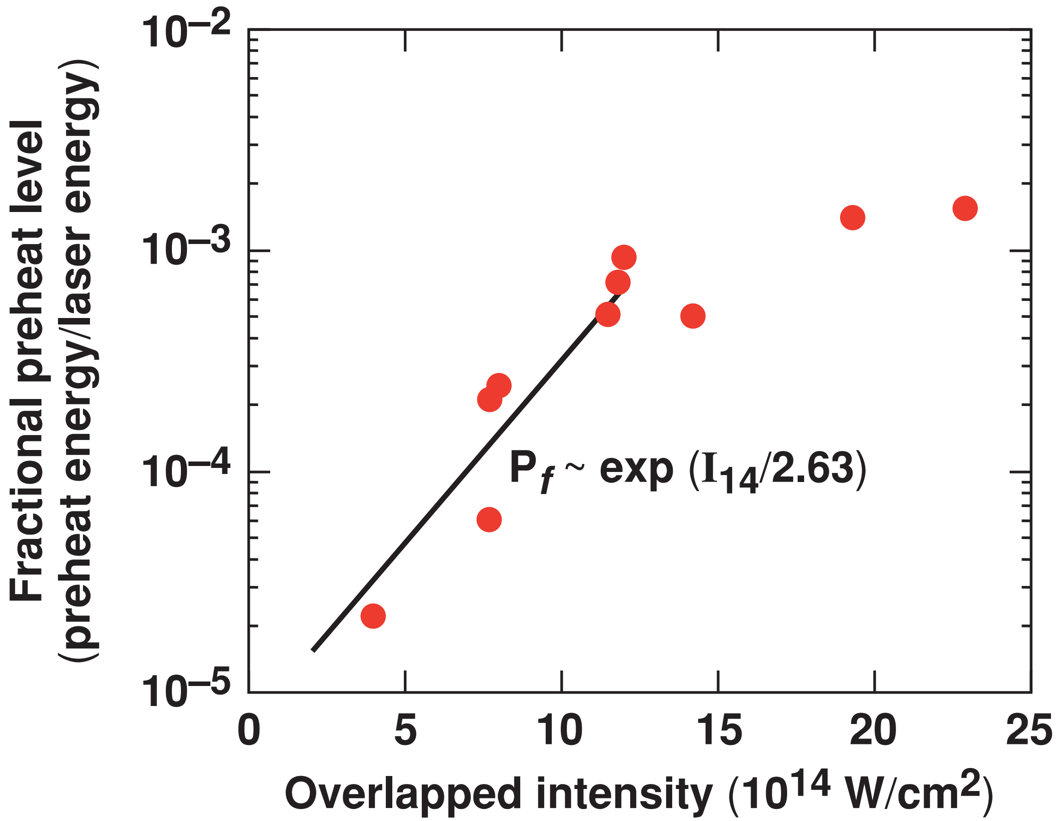
Multiple-Beam Effects on the Fast-Electron Generation due to the Two-Plasmon-Decay Instability



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Contributors

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Summary

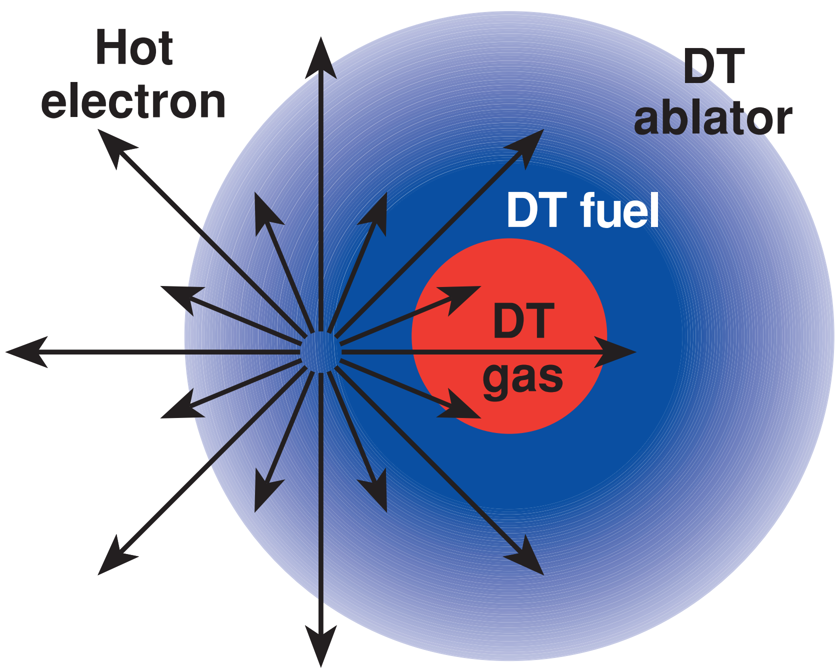
The two-plasmon-decay (TPD) instability appears to saturate around 10^{15} W/cm^2 under NIF direct-drive ICF conditions

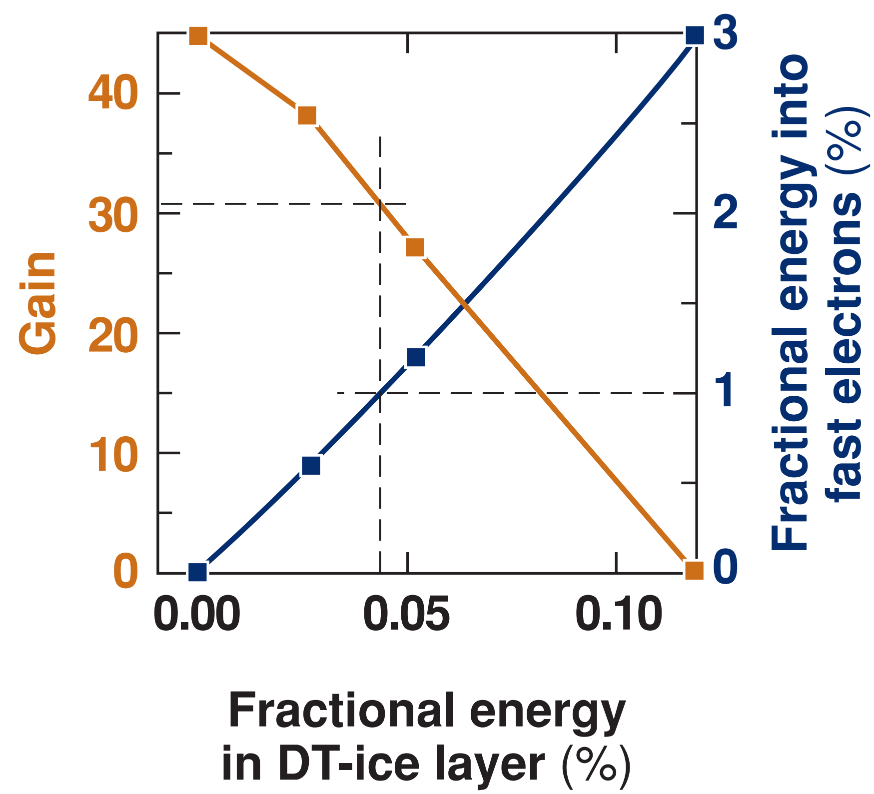
UR LLE

- Multibeam experiments showed the importance of total (overlapped) intensity for TPD-generated fast electrons
- Both spherical implosions on OMEGA and planar target experiments with NIF- relevant scale lengths show similar scalings.
- Target preheat by fast electrons due to TPD instability appears to saturate around 10^{15} W/cm^2
- Fractional energy preheat level of ~ 0.1% for illumination conditions relevant to direct-drive ICF is inferred.

Hot electrons can significantly reduce the target gain

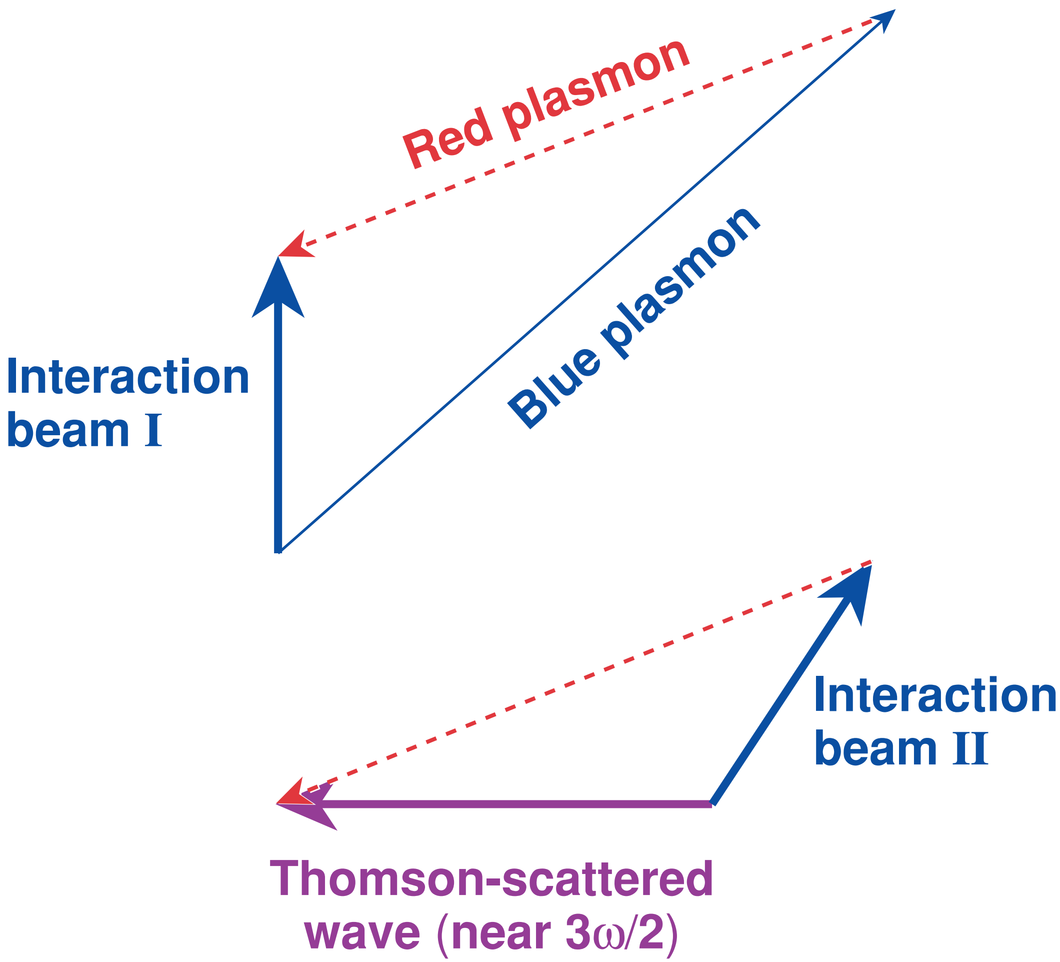
- The effect of an 80-keV hot-electron tail was simulated using the fast-electron package in *LILAC*.
- About 4% of the energy absorbed into fast electrons couples into the DT-ice fuel layer.





TC5003

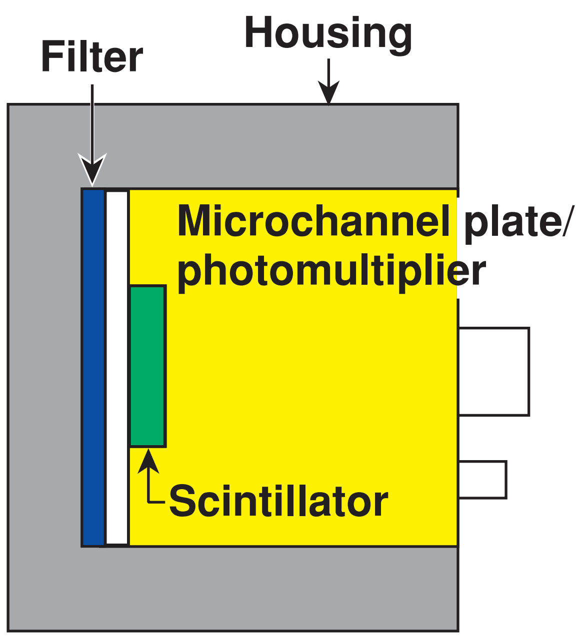
The 3ω/2 signature of the two-plasmon-decay instability is produced by Thomson scattering

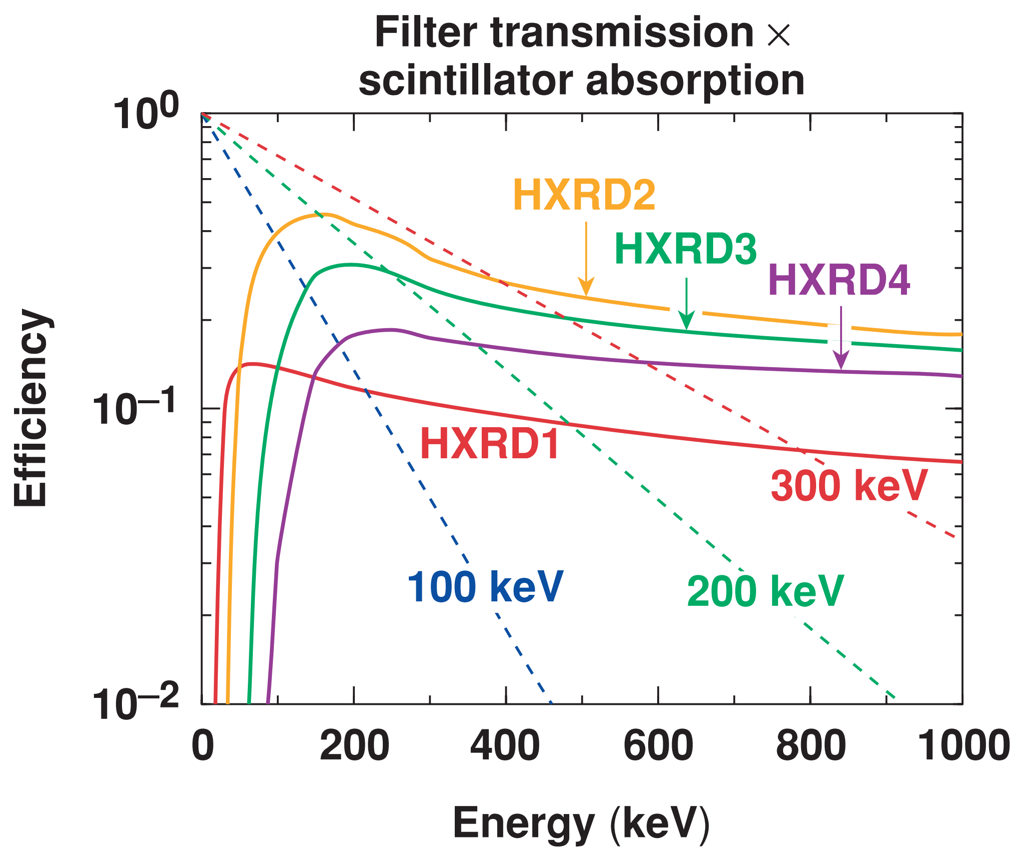


Two-plasmon decay (primary decay process)

Self-Thomson scattering (secondary scattering process)

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

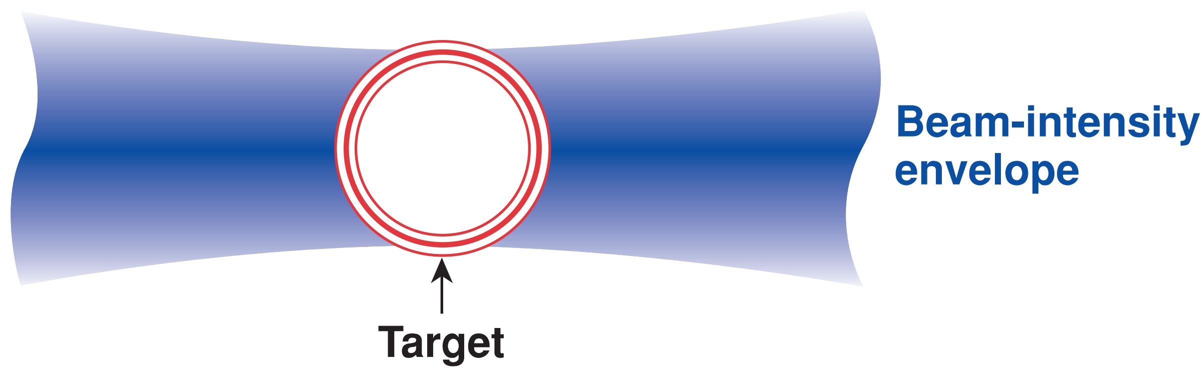


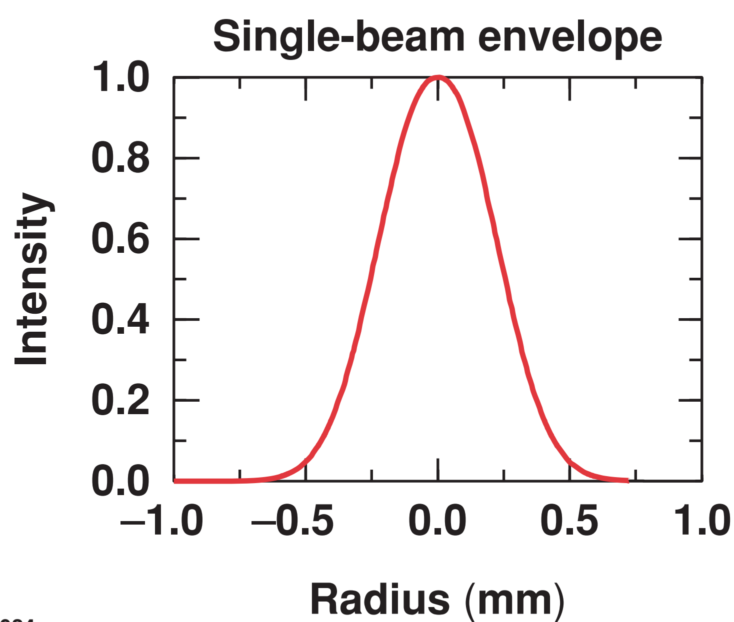


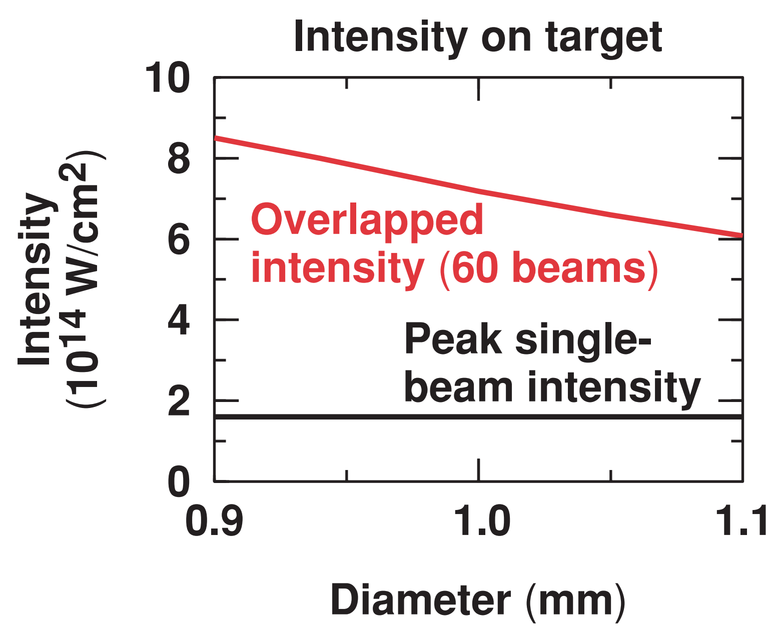
E10921

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

UR LLE



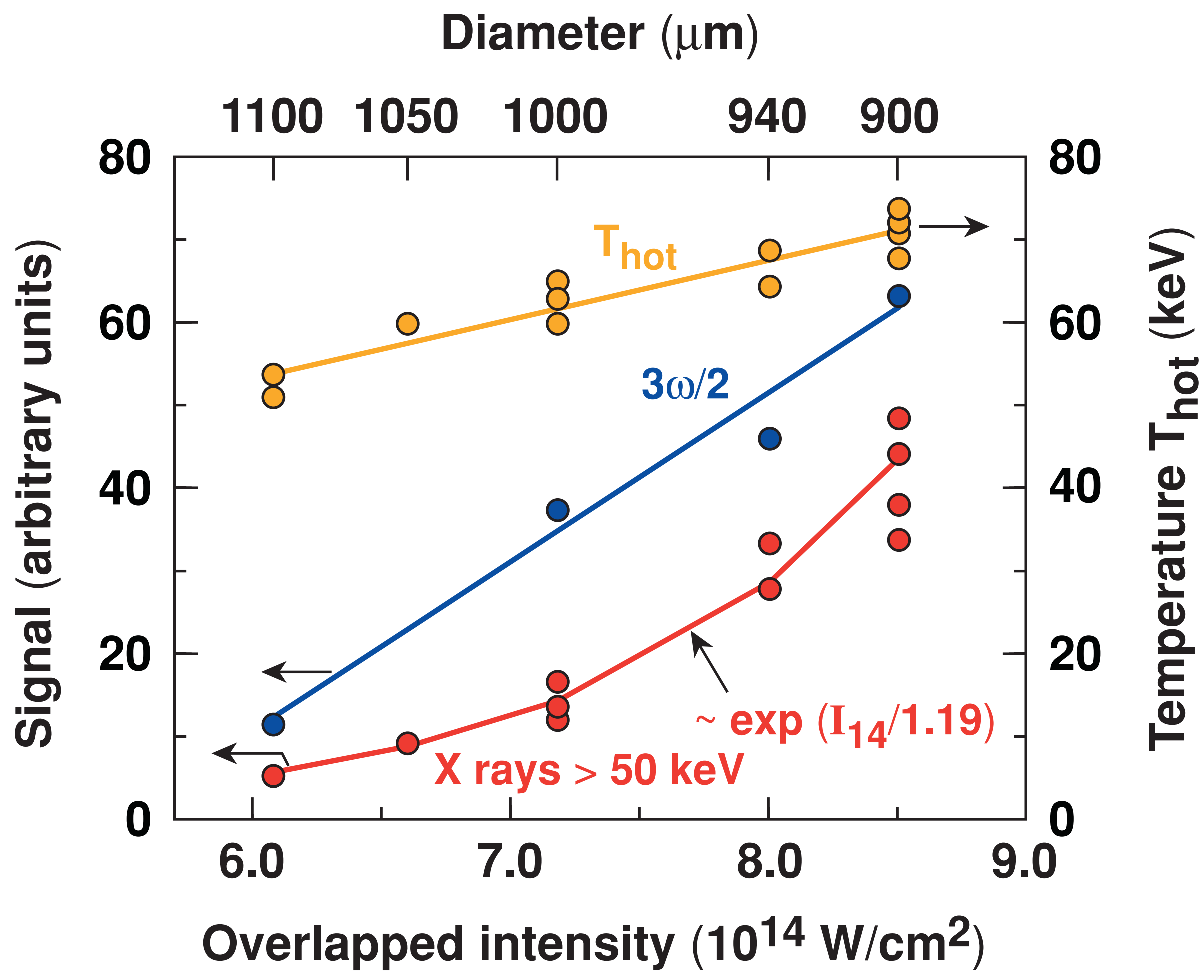




E10924

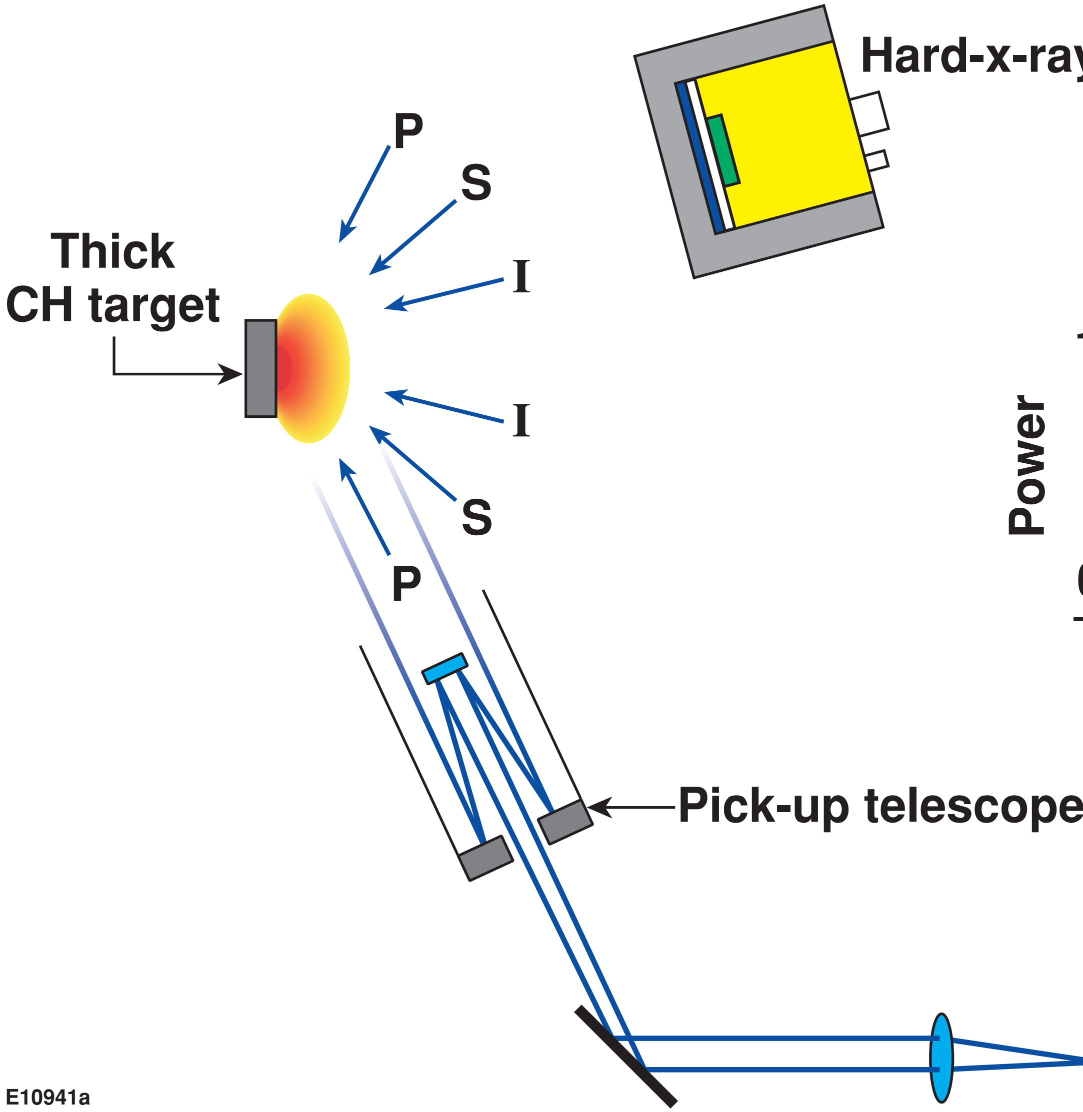
The TPD instability scales with overlapped intensity in spherical implosion experiments

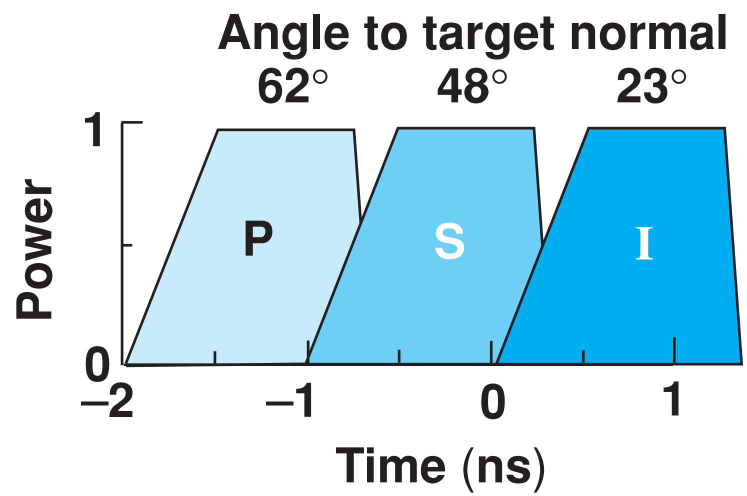
- Data taken on 60-beam OMEGA shots with CH shells varying from 900-μm to 1100-μm diameter



E11103

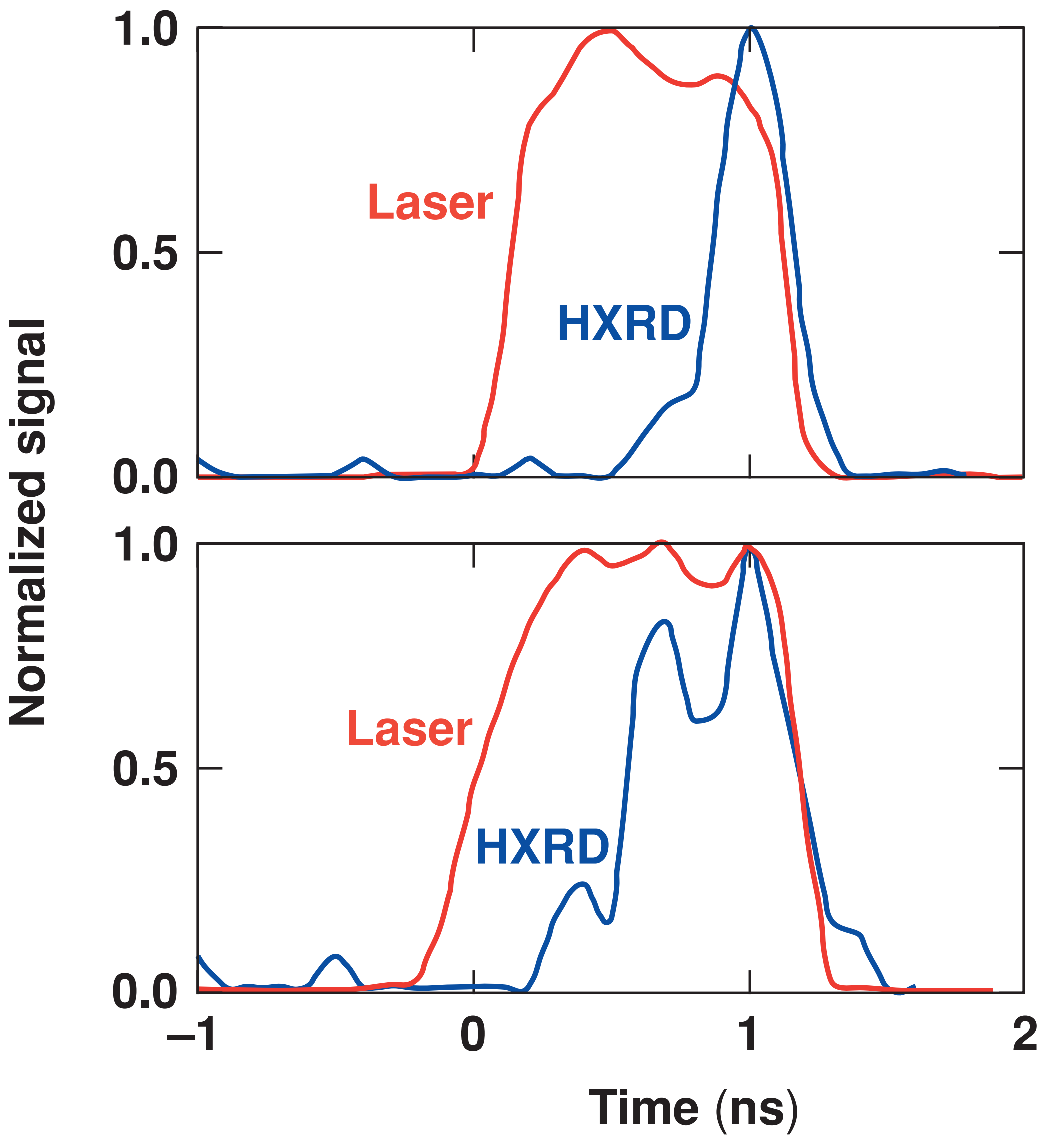
Planar-foil experiments use three sets of delayed beams, six of which are interaction beams





E10941a

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



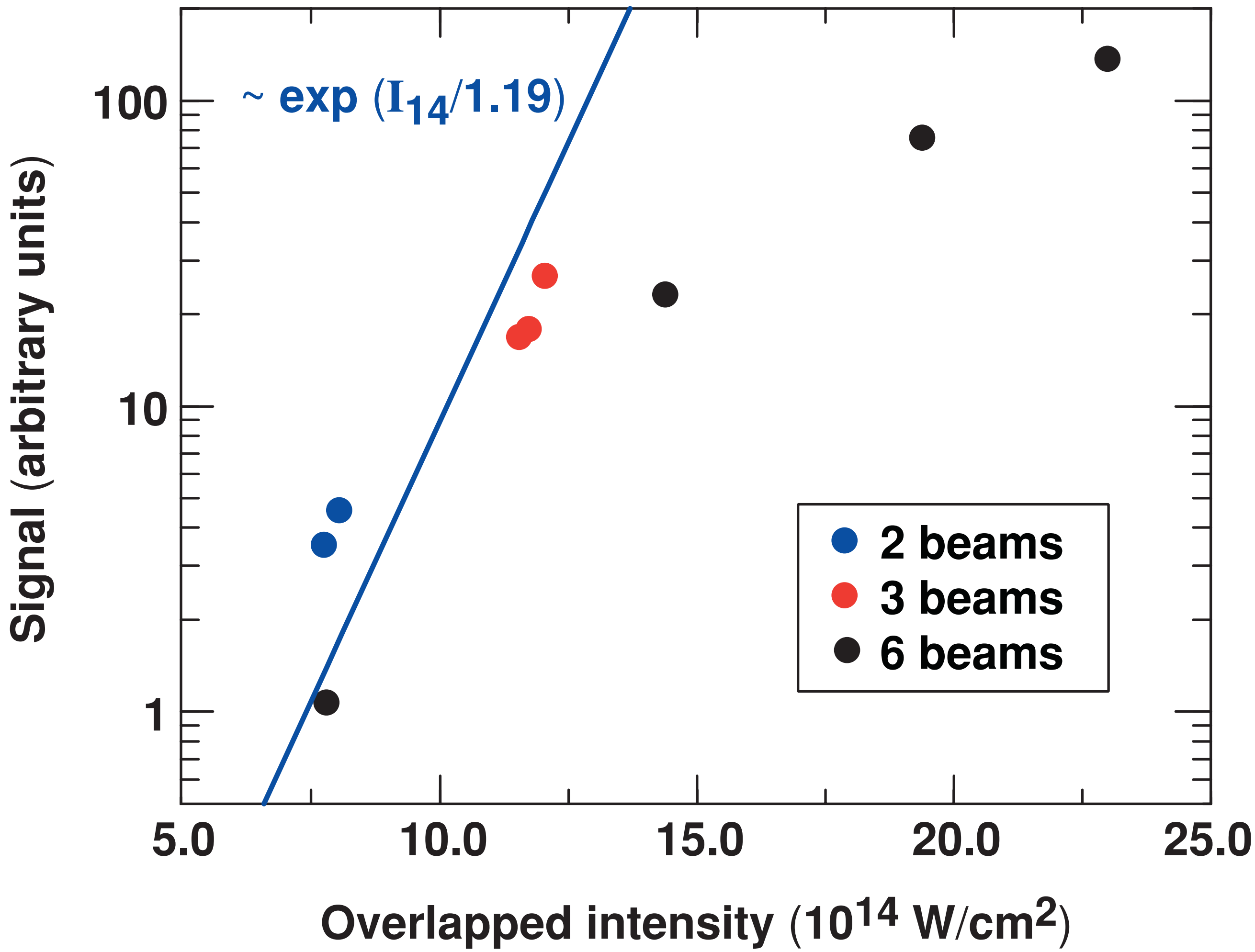
Current OMEGA implosion experiments

Multibeam, long-scale-length interaction experiments

E11760

The hard-x-ray (> 50-keV) signal depends only on the overlapped intensity and saturates above 10^{15} W/cm^2

NIF scale planar experiments



E11938

The hard-x-ray detectors (scintillator-PMT) are cross-calibrated with K_{α} emission from special targets

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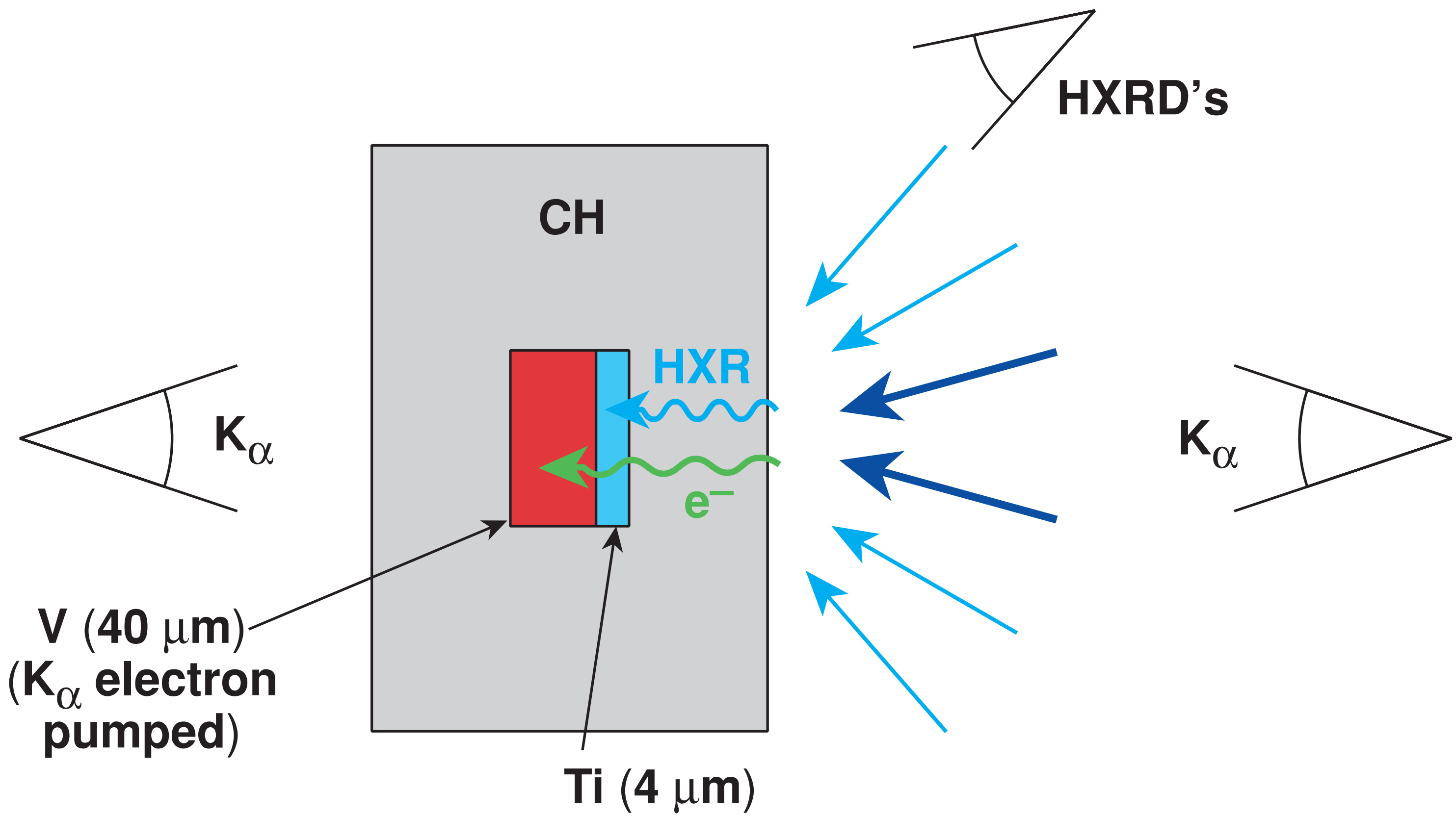
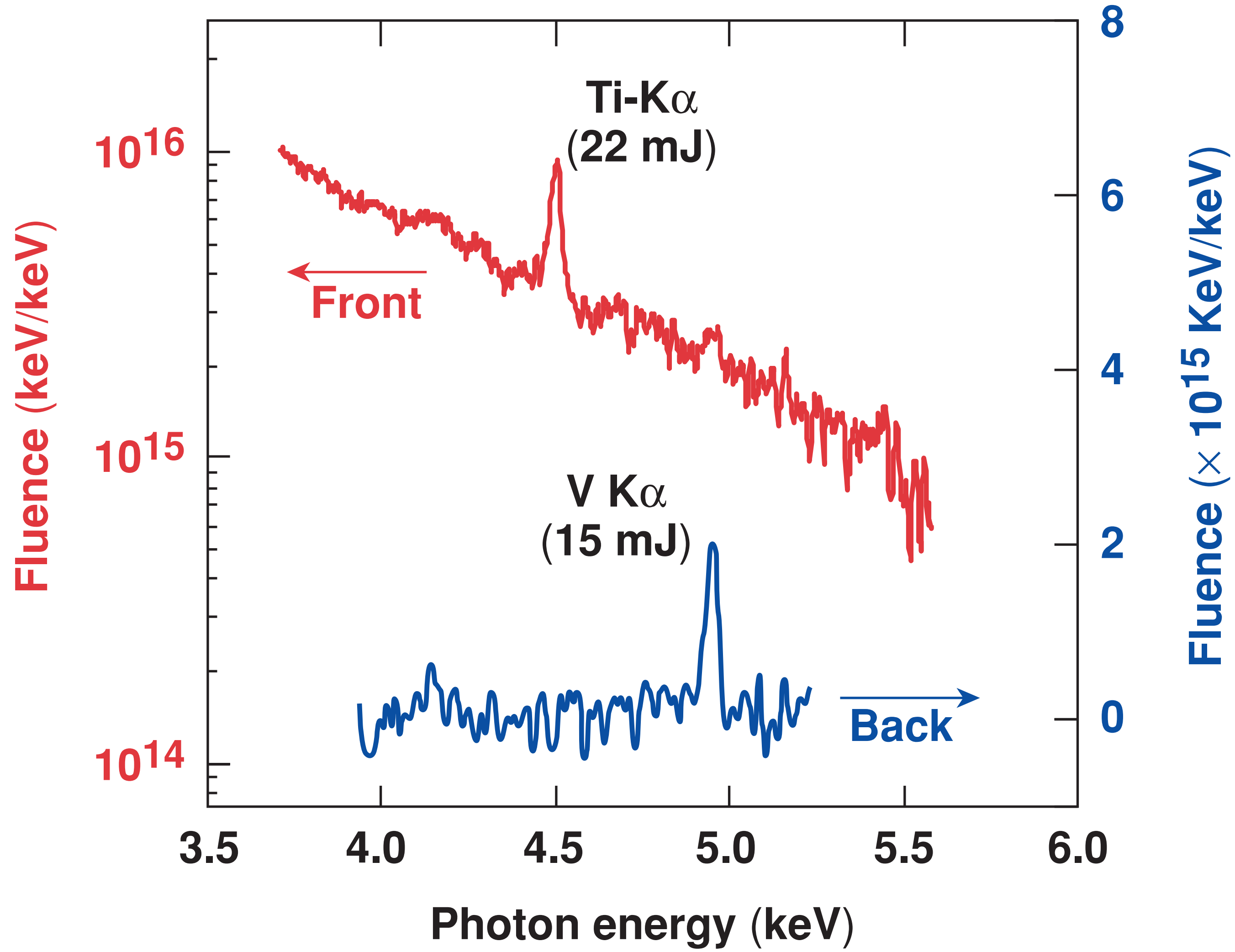
- Comparison of signals and some analysis allow HXRD's to be absolutely calibrated for pure-CH or D_2 targets.



→ absorbs x rays generated in the corona
→ passes energetic electrons

E11418

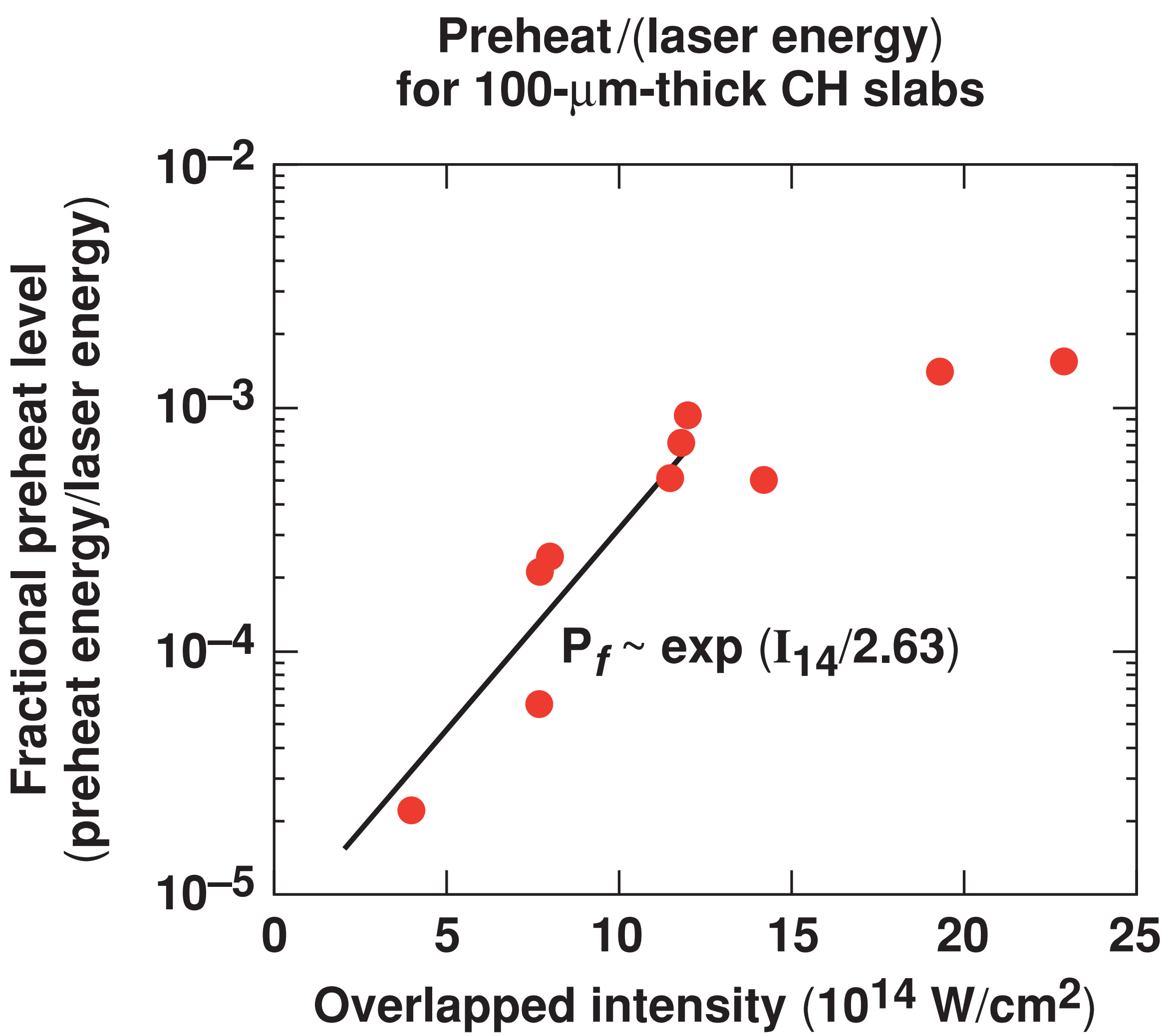
Using two different materials allows to separate the effects of radiation and hot electrons



E10223

The fractional preheat level caused by energetic electrons due to TPD appears to saturate above 10^{15} W/cm^2

UR LLE



E11757

Summary/Conclusions

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