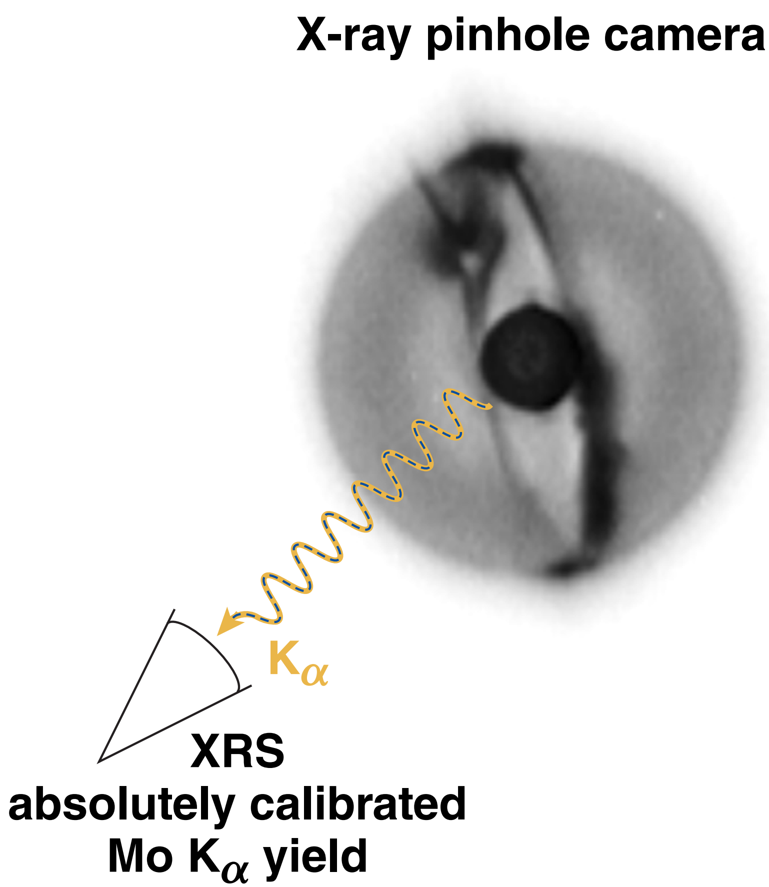
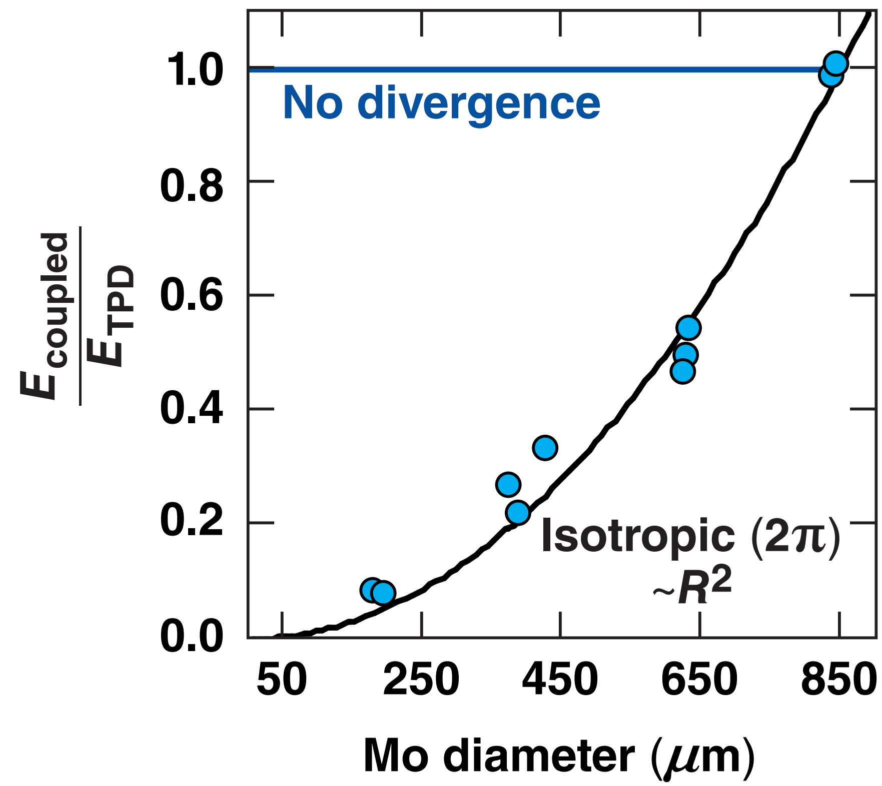
Two-Plasmon–Decay Electron-Divergence Measurements in Direct-Drive Implosions on OMEGA





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Summary

Measurements indicate that only 20% of the hot electrons produced by TPD are coupled to the fuel

- Calculations of the hot-electron preheat require knowledge of the two-plasmon decay (TPD) source and the angular divergence of the electrons
- Direct-drive ignition-relevant plasma conditions are created on OMEGA EP
- The fraction of laser energy converted to hot electrons saturates near ignition conditions
- Experiments indicate that the f_{hot} and T_{hot} are linked and independent of the target geometry
- The TPD-generated electrons are measured to be isotropic on OMEGA

Collaborators

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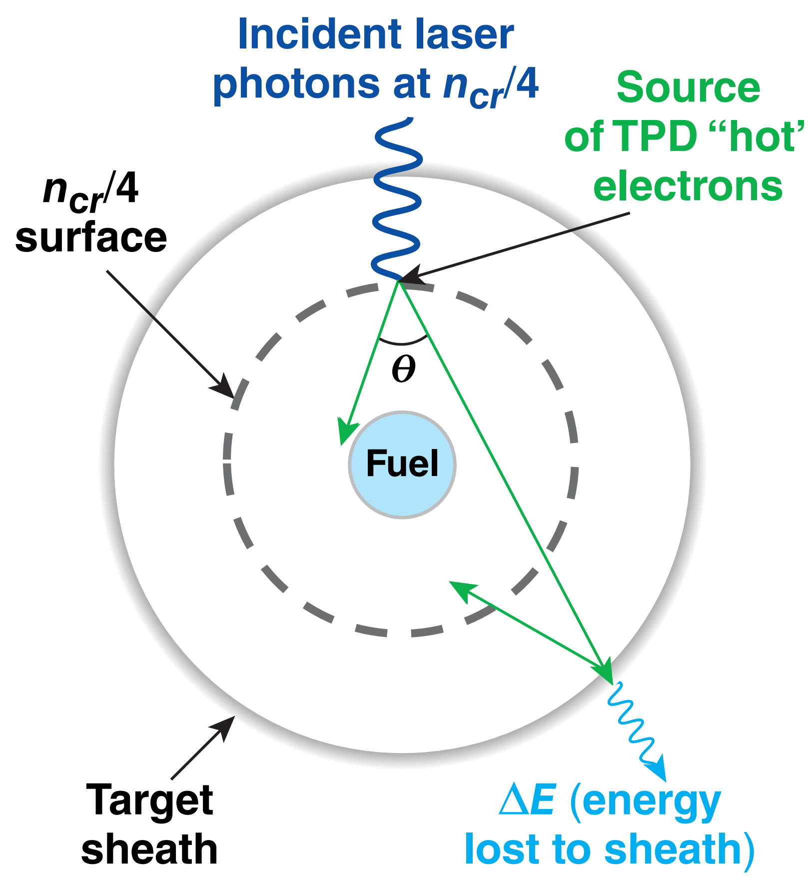
Two plasmon decay (TPD) generates hot electrons that can couple energy to the imploding, shell raising the adiabat and potentially quenching ignition

- **Calculating the energy coupled to the fuel (preheat) requires:**
  - **– electron source (T_{hot}, f_{hot})**
  - **– electron angular divergence (θ)**
  - **– energy lost to the sheath (ΔE)**

Direct-drive ignition requires that less than ~0.1% of the laser energy be coupled to the unablated fuel.



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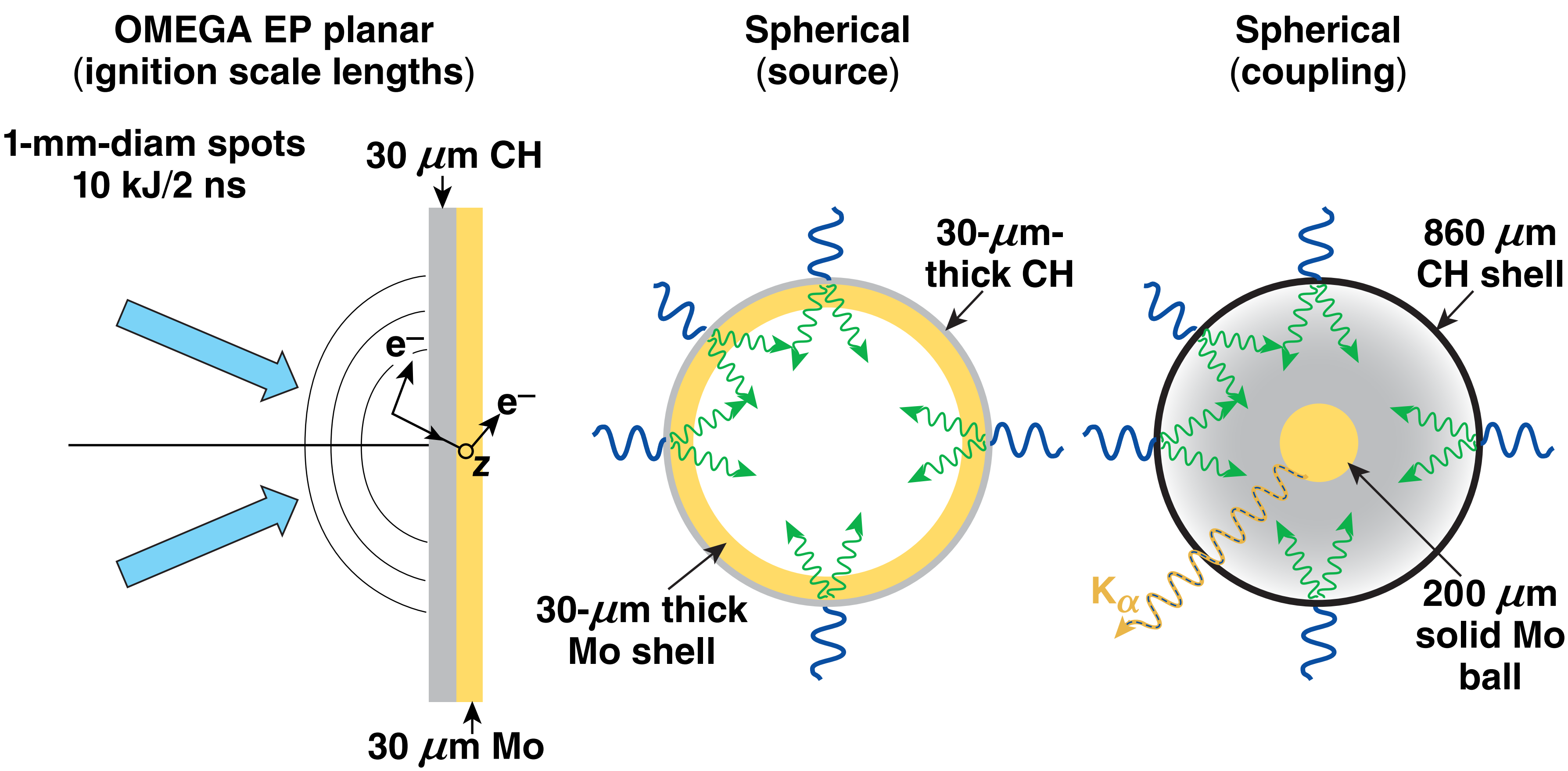
A series of targets were designed to study TPD in both planar and spherical geometries



Monte Carlo calculations are used to determine the total hot-electron energy given the K_α yield and hot-electron temperature.

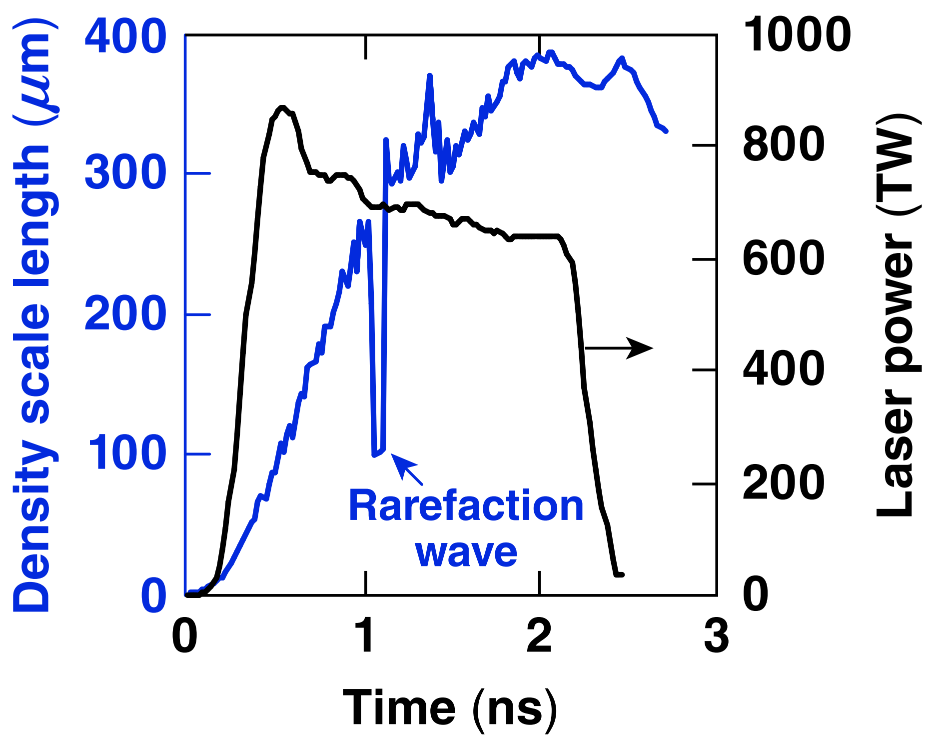
E19969c

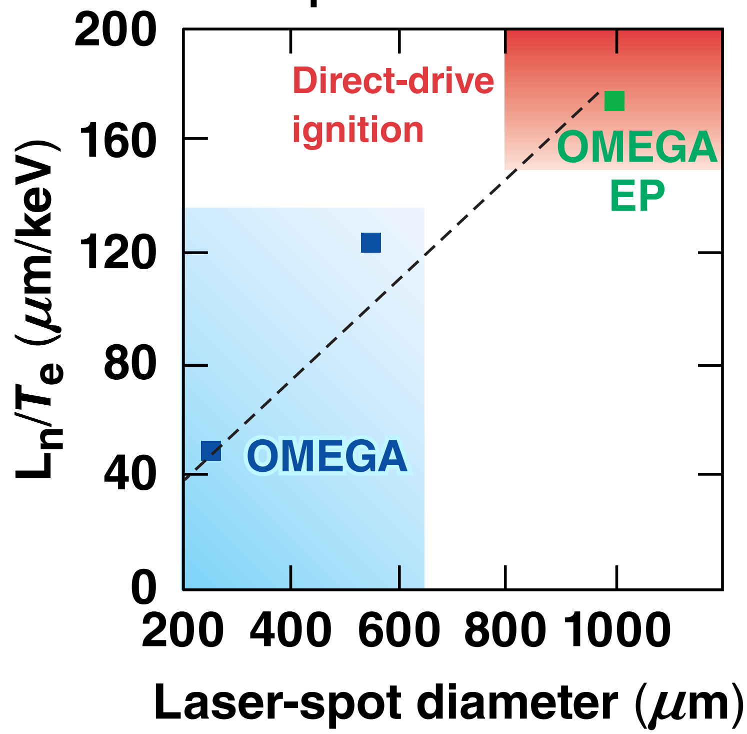
*B. Yaakobi *et al.*, Phys. Plasmas 19, 012704 (2012).

Direct-drive ignition-relevant plasma conditions are created in planar geometry on OMEGA EP

$$G_{TPD} \propto \left(\frac{I_0 L_n}{T_e}\right)$$

$$I_{overlap} = 7 \times 10^{14}\ \mathrm{W/cm^2}$$





The increased power available on OMEGA EP produces ignition-relevant longer-scale-length plasmas.

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Extending the intensity to ignition conditions indicates that ~1% of the laser energy is converted to hot electrons with a characteristic temperature of 85 keV

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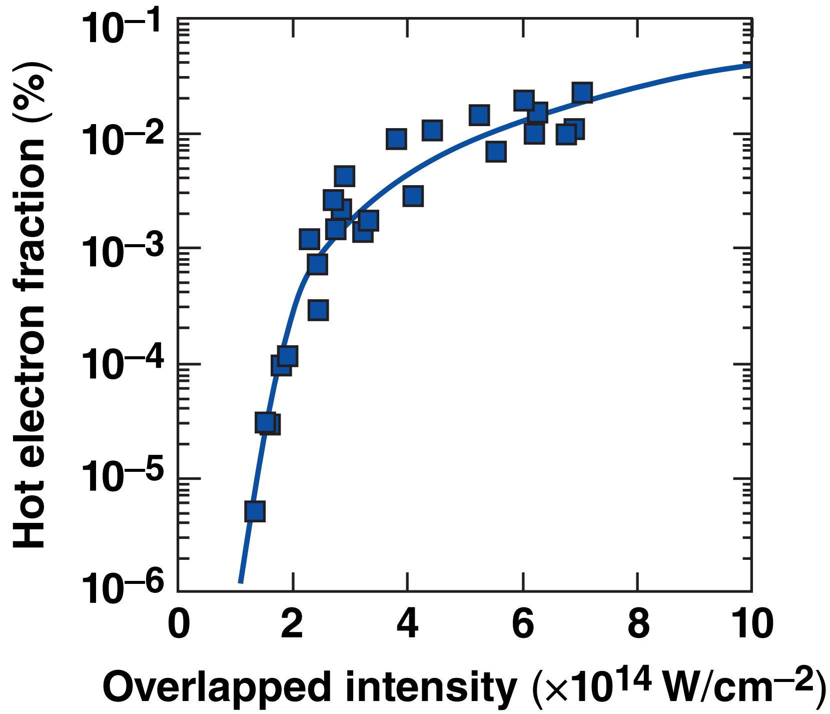
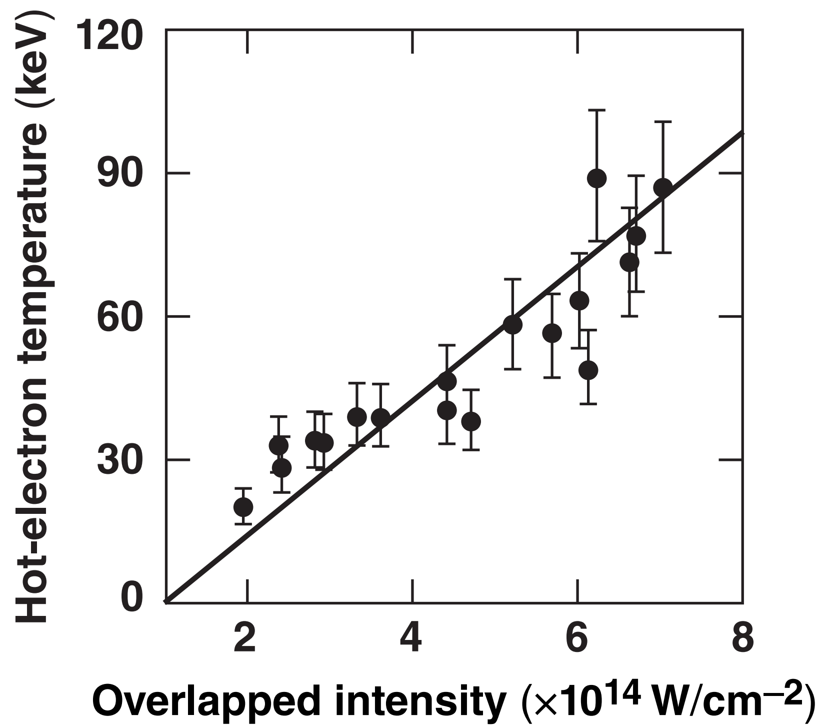
Planar targets, OMEGA EP



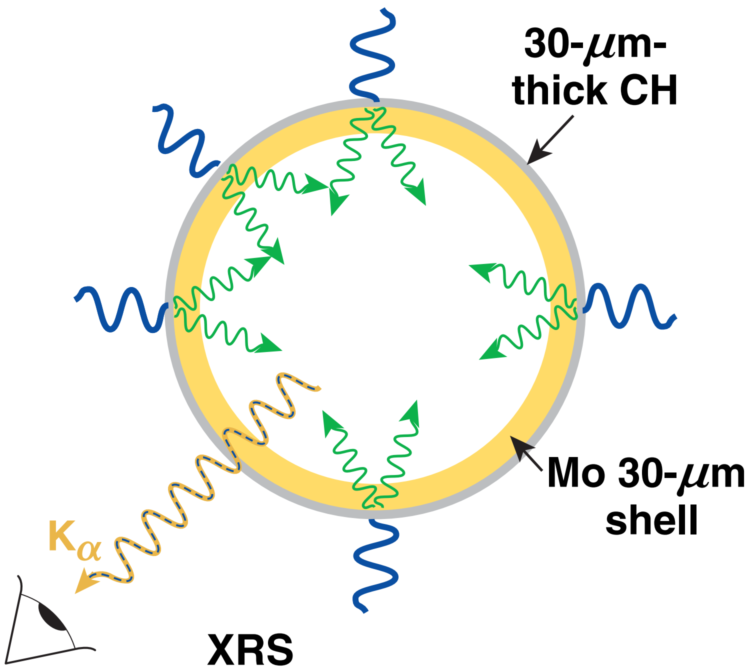


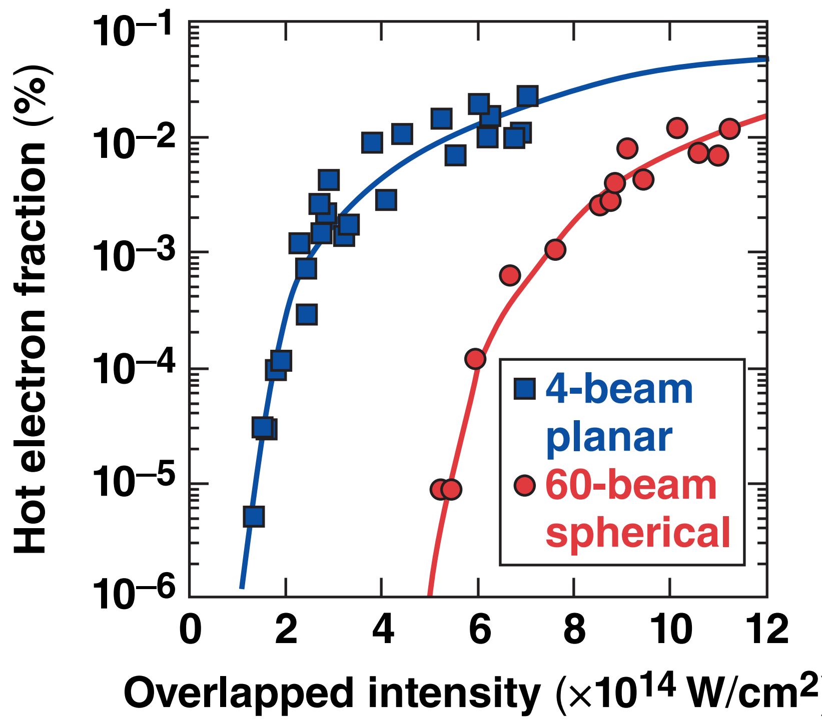
This target platform accounts for all electrons generated by TPD source; the energy coupled to the direct-drive shell ("preheat") will be reduced.

E21306d

*D. H. Froula *et. al*., Phys. Rev. Lett. 108, 165003 (2012).

The hot-electron fraction is reduced in spherical geometry for a given overlapped intensity

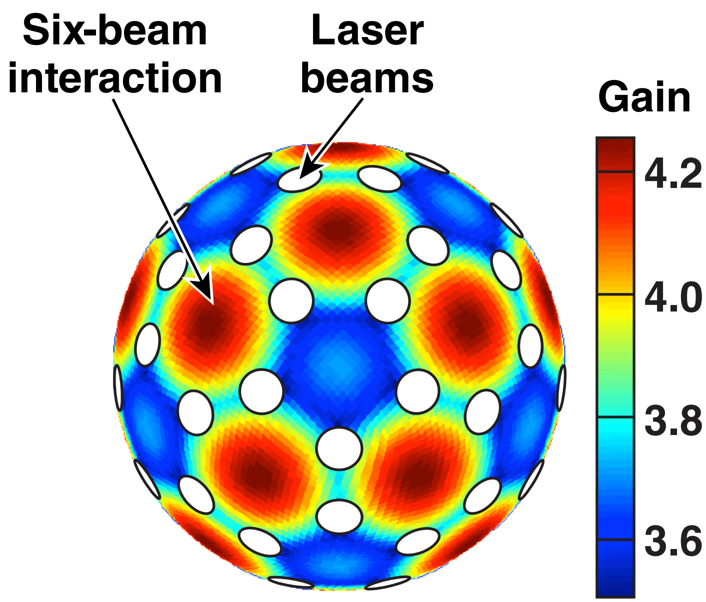


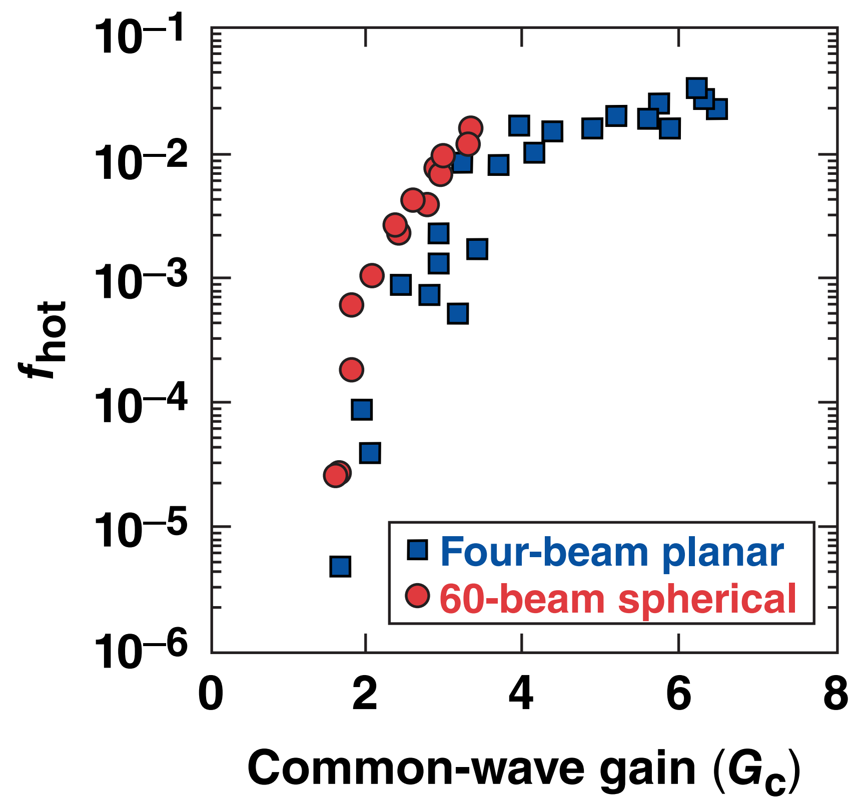


E21309c

A multibeam gain model shows that the laser-beam configuration must be taken into account

$$G_c = \left(f_g N_{\Sigma}^{sym}\right)\left(\frac{I_{14}^{SB} L_n\,(\mu m)}{47\, T_e\,(keV)}\right)$$



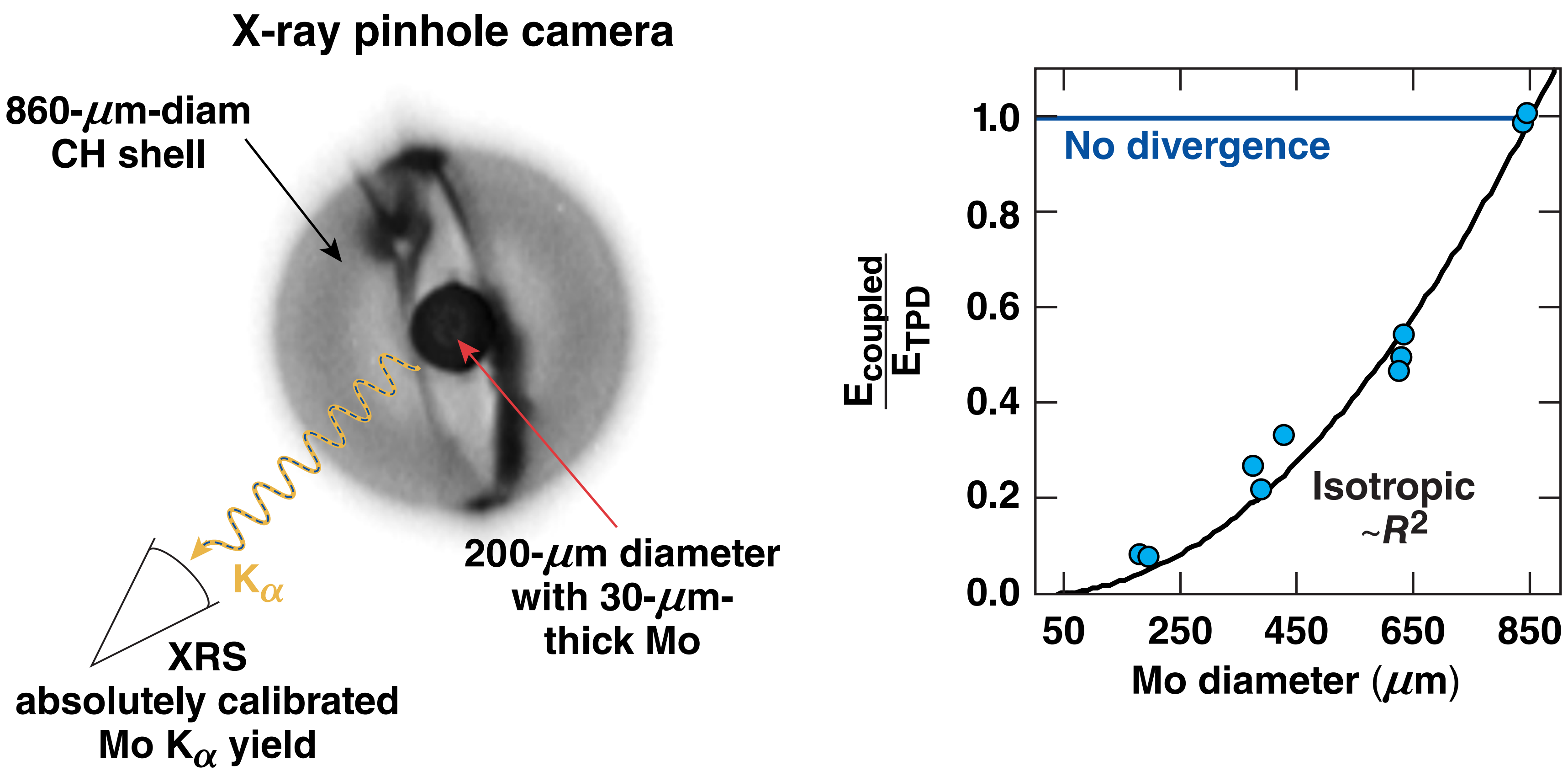


In polar drive, the gain is not driven by the overlapped intensity of all the beams.

E21771

D. T. Michel, YI2.00002, this conference.

The fraction of hot electrons reaching the cold shell is measured using small Mo balls

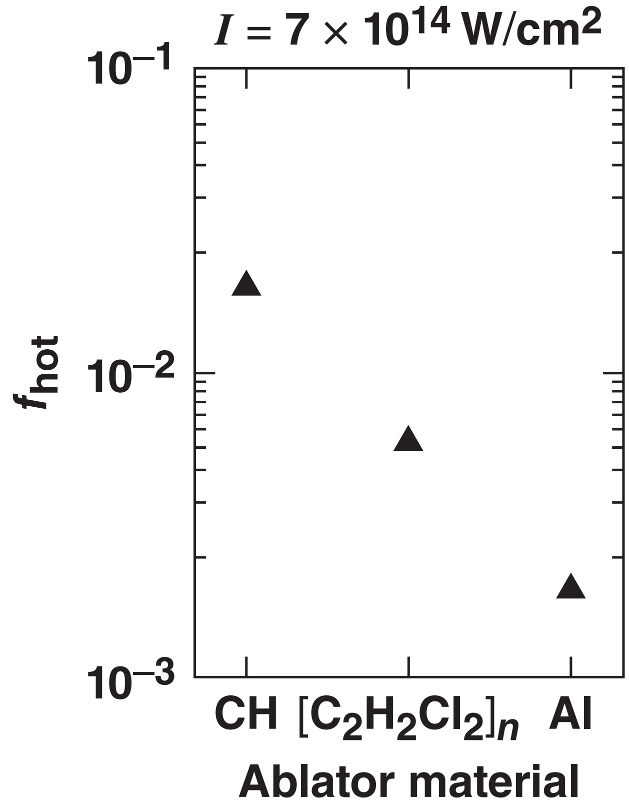


These results indicate that only 20% of the hot electrons generated by TPD will contribute to preheat on OMEGA.

E21184b

TPD can be reduced in direct-drive plasmas by changing the ablator material

- Part of this reduction is a result of hydrodynamics
  - increased electron temperature
  - reduced scale length
- TPD has been shown through simulations to be reduced by
  - increased electron–ion collisions*
  - reduced ion-acoustic wave damping**



*R. Yan *et al*., Phys. Rev. Lett. 108, 175002 (2012).
**J. F. Myatt, TO5.00005, this conference.

E21340a

Summary/Conclusions

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