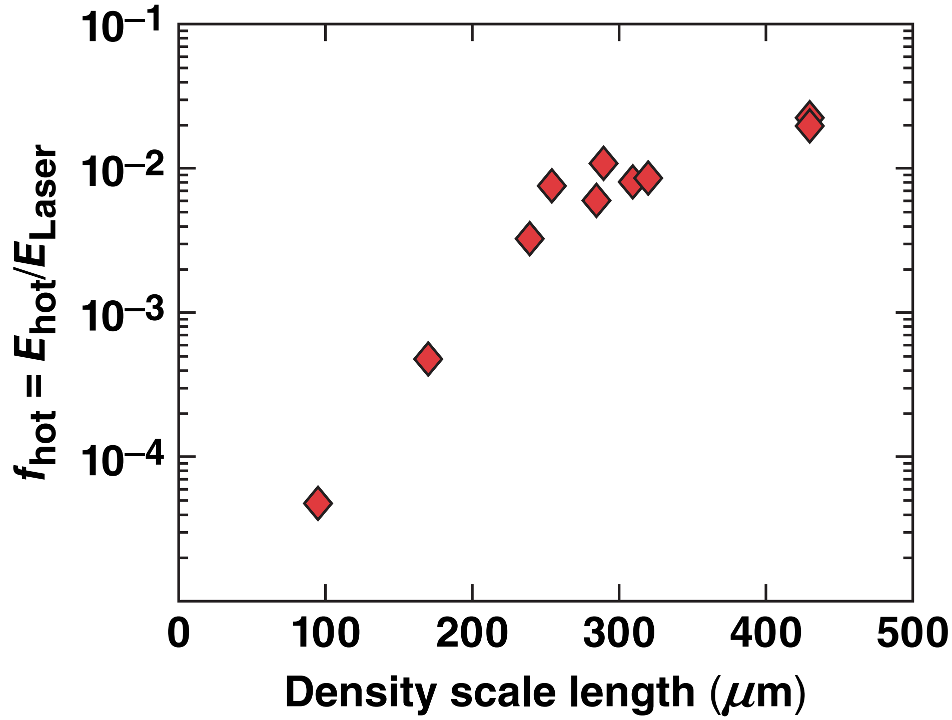
Measurements of the Two-Plasmon–Decay Generated Hot-Electron Fraction as a Function of the Quarter-Critical Density Scale Length



I_{qc} ~5 × 10^{14} W/cm^2

T_e ~2.5 keV

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55th Annual Meeting of the
American Physical Society
Division of Plasma Physics
Denver, CO
11–15 November 2013

Summary

The two-plasmon–decay (TPD) generated hot-electron fraction is measured to increase with the plasma density scale length

- The dependence of TPD on the plasma scale length is isolated by using targets of varying radii on OMEGA EP
- The TPD-generated hot-electron fraction is compared with the calculated 3-D common-wave gain
- The TPD gain threshold behavior when varying scale length appears to be different than when varying intensity

Collaborators

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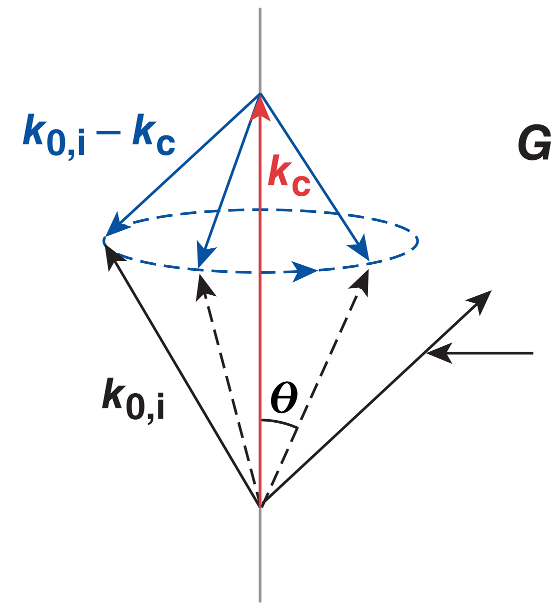
The maximum TPD growth rate is driven by only the beams with a common angle to the electron plasma wave (EPW)

Multibeam common-wave region



Intensity at n_c /4 that contributes to the dominant mode

$$G_c \approx \frac{I_\Sigma\left(10^{16}\ \mathrm{W/cm^2}\right)L_n\left(\mu\mathrm{m}\right)}{T_e\left(\mathrm{keV}\right)} \times 10^{-16}$$

This beam does not share a common EPW with the others

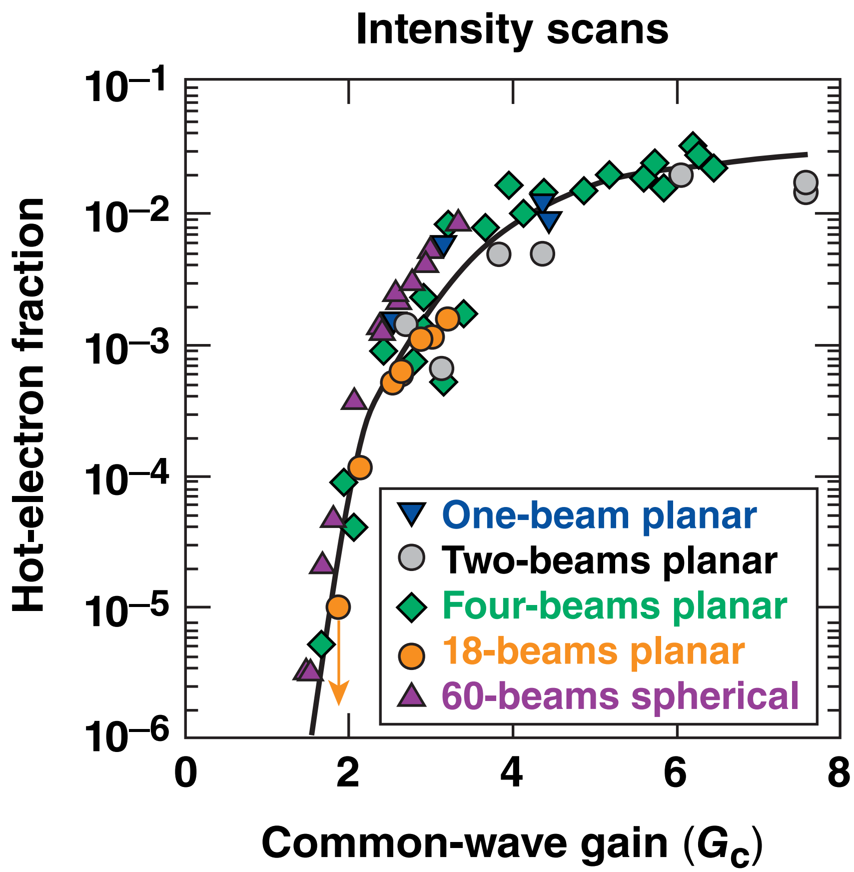
TPD scales similarly during intensity scans for a variety of experimental platforms

- TPD is diagnosed using the hard x rays produced by fast electrons from TPD

$$E_{hot}\,(\mathrm{J}) = 138\,\frac{K_\alpha\,(\mathrm{mJ/sr})}{\sqrt{T_{hot}}}$$

- During intensity scans, L_n/T_e was roughly constant during each study

We will now study the behavior when only the scale length is varied.



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The dependence of TPD on the plasma scale length is isolated by using targets of varying radii on OMEGA EP

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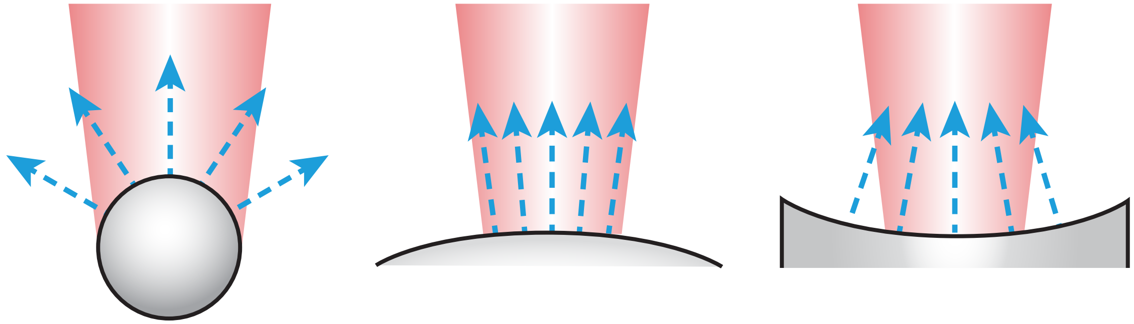
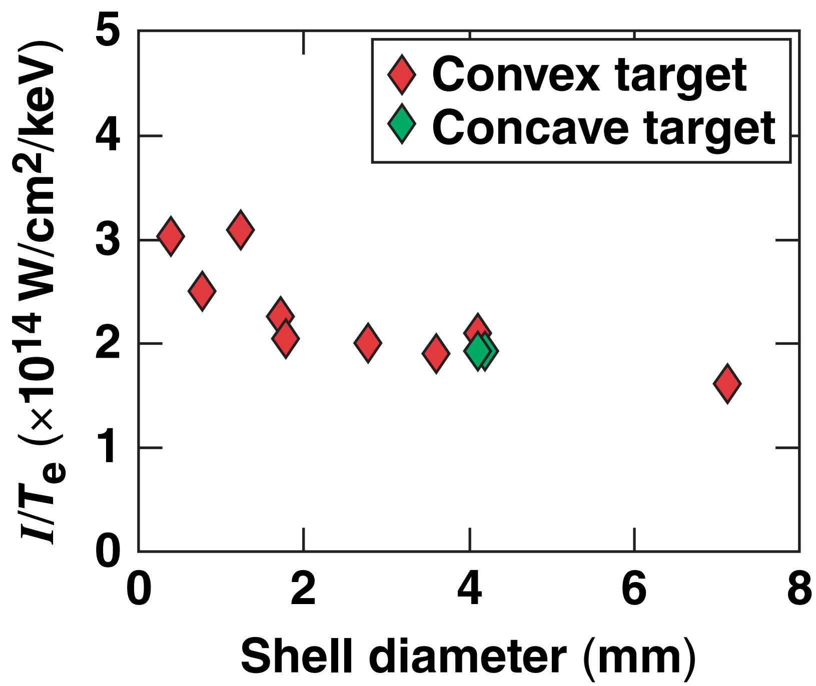
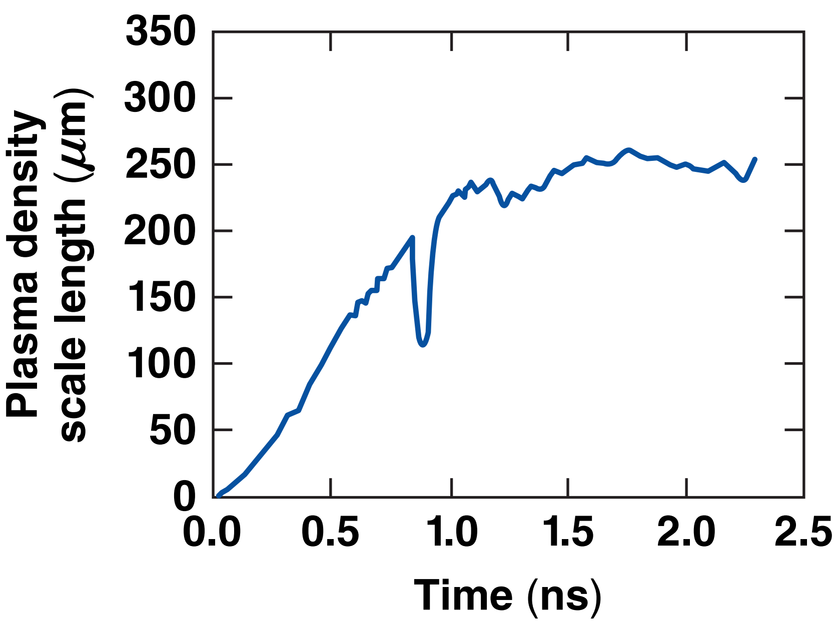


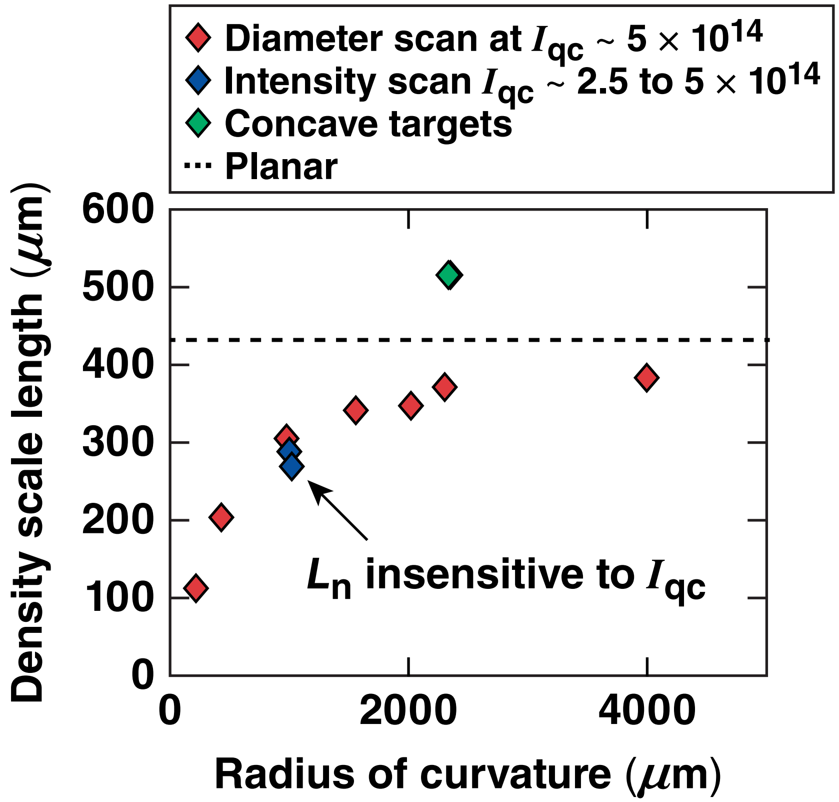
- By decreasing the radius of a spherical target, L_n decreases as the plasma expansion becomes more divergent
- Hydrodynamic simulations show that I/T_e is held approximately constant for these experiments



Hydrodynamic simulations show that the density scale length at $n_{cr}/4$ is dominated by the target radius of curvature, not laser intensity

- Two-dimensional flux-limited (f = 0.06) hydrodynamic simulations show that the density scale length at $n_{cr}/4$ saturates after about 1 ns





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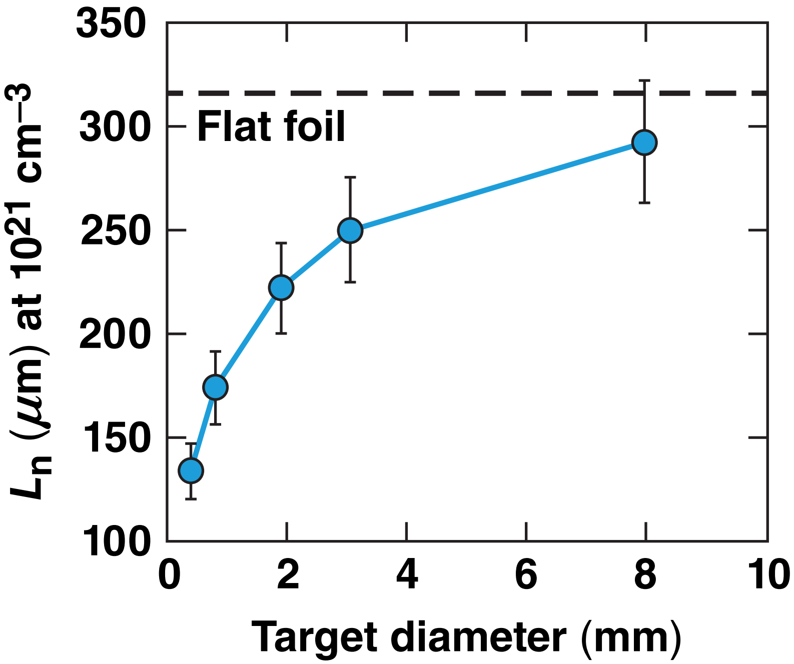
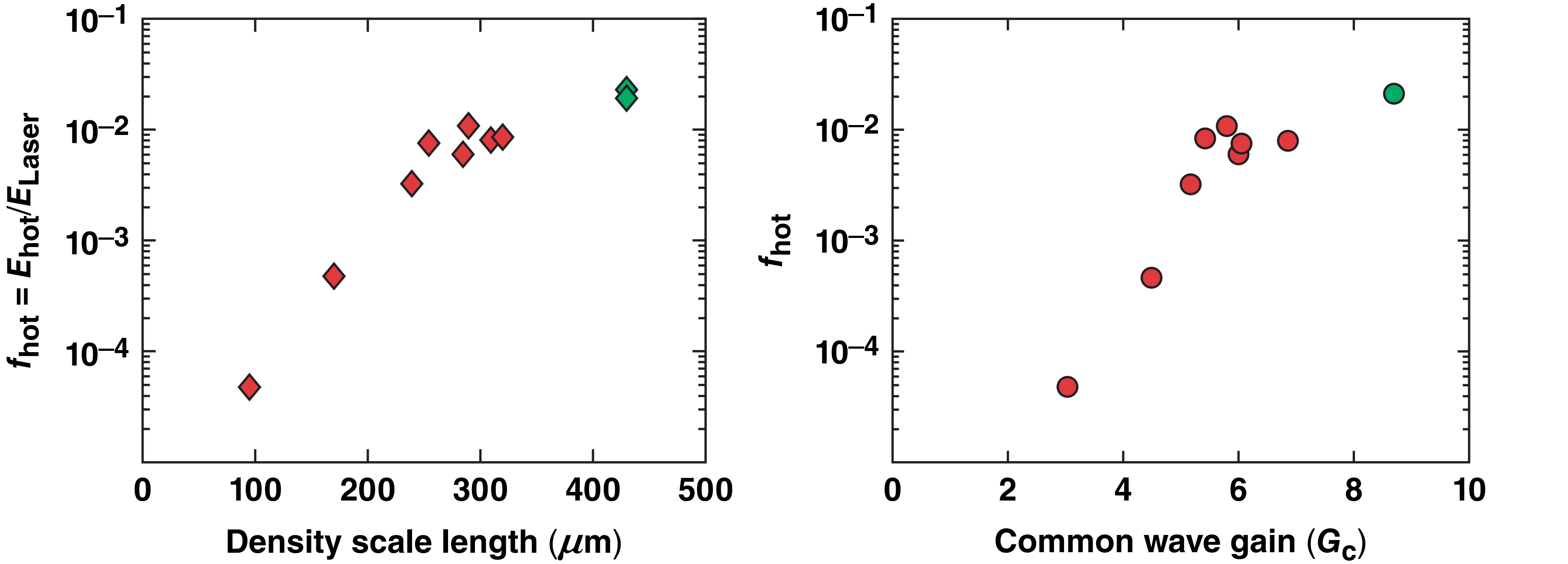
Density scale length measurements confirm the predicted trend with target radius of curvature

- Angular filter refractometry (AFR) measures the plasma density profile up to $n_e \sim 10^{21}$ cm^{-3} ($\sim$0.1 n_{cr})*
- The measurements confirm that the scale length increases as the target radius of curvature increases



*D. Haberberger, GI3.00003, this conference (invited).

The TPD-generated hot-electron fraction is measured to increase with the plasma density scale length



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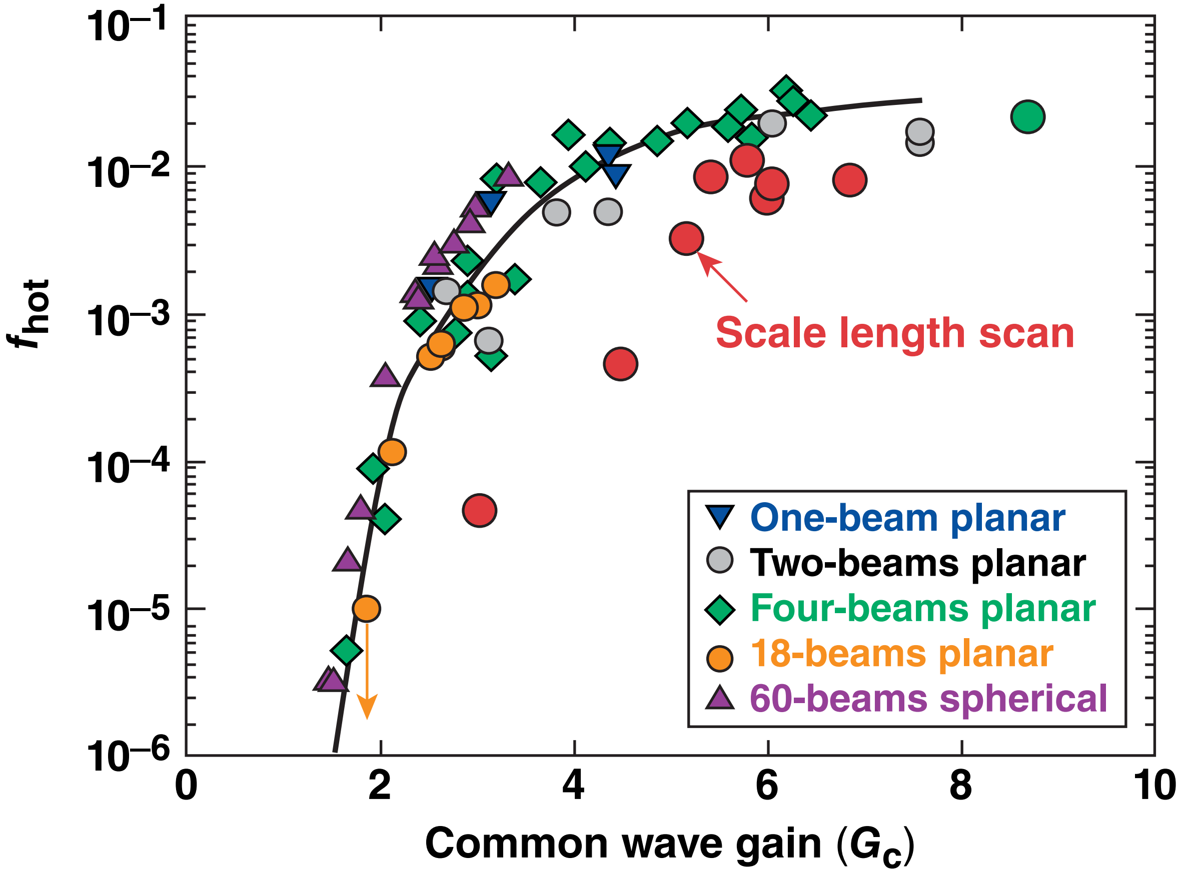
The TPD gain threshold behavior when varying scale length appears to be different than when varying intensity



Possible causes for the difference are being investigated.

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Summary/Conclusions

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