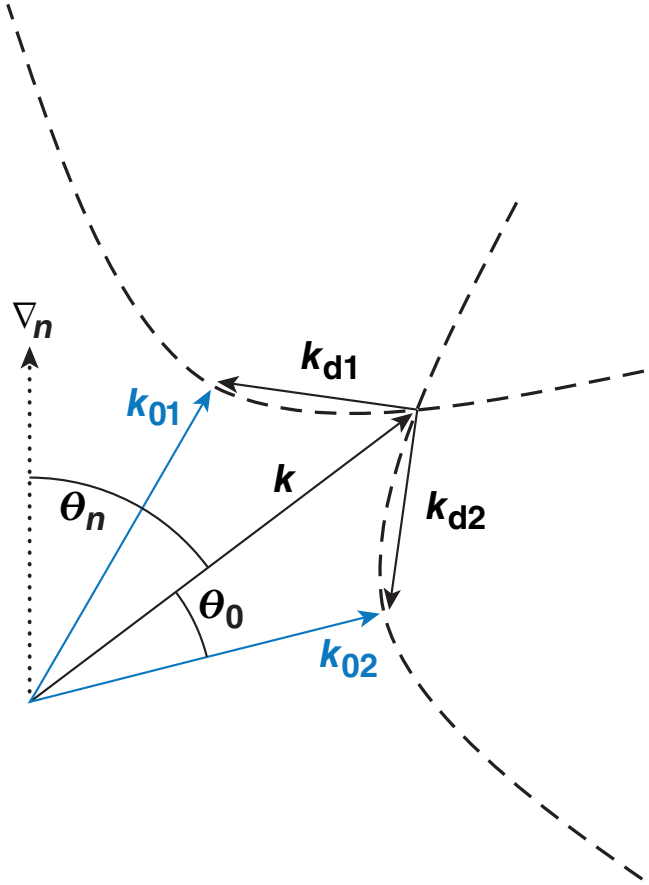
Convective Multibeam Two-Plasmon Decay for Spherical and Planar Irradiation Geometrics



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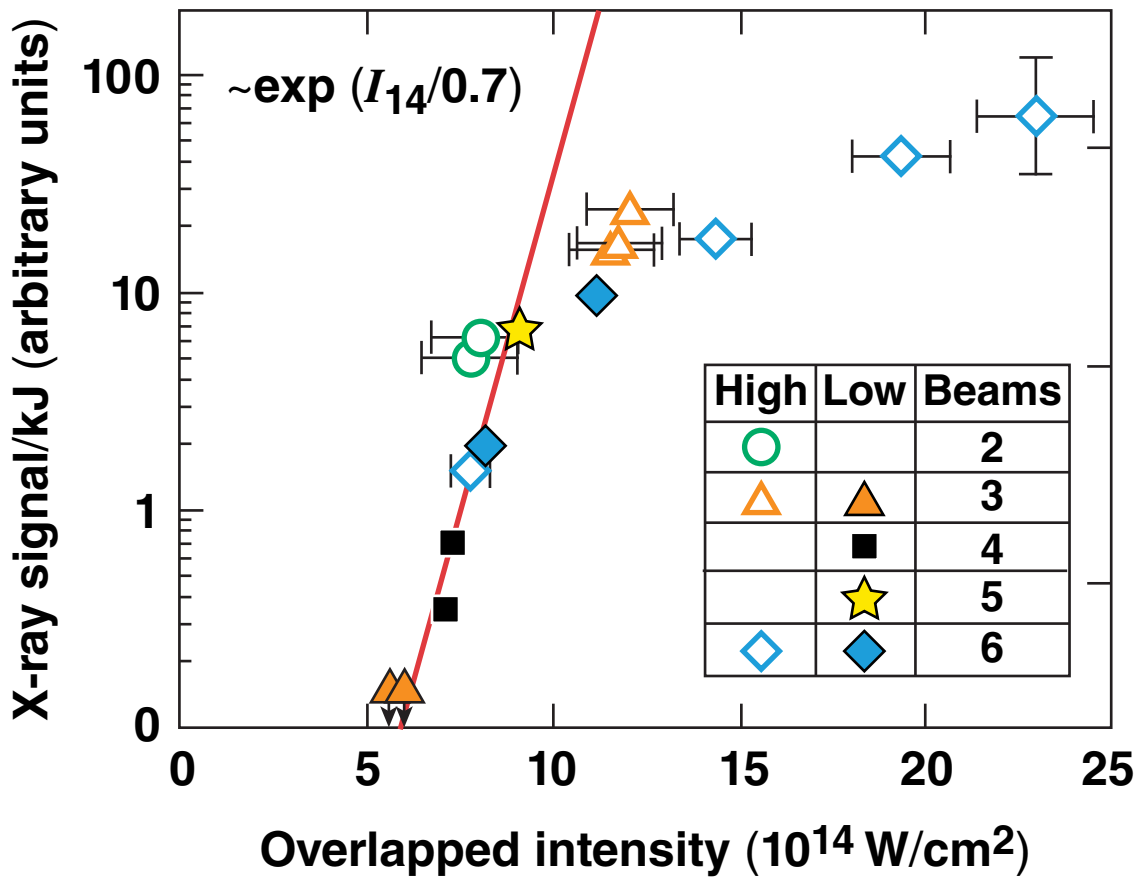
Summary

Two-plasmon decay appears to be collective near normal incidence, but less so at high incidence angles

UR LLE

- Experiments on OMEGA have shown that TPD appears to be driven by the collective intensity of several overlapping laser beams
- A group of beams can drive a common central plasma wave, which is expected to produce most of the hot electrons
- At small angles to the density gradient the common wave is driven by the collective intensity
- At larger angles, the most oblique beam predominates and integrated TPD gain increases

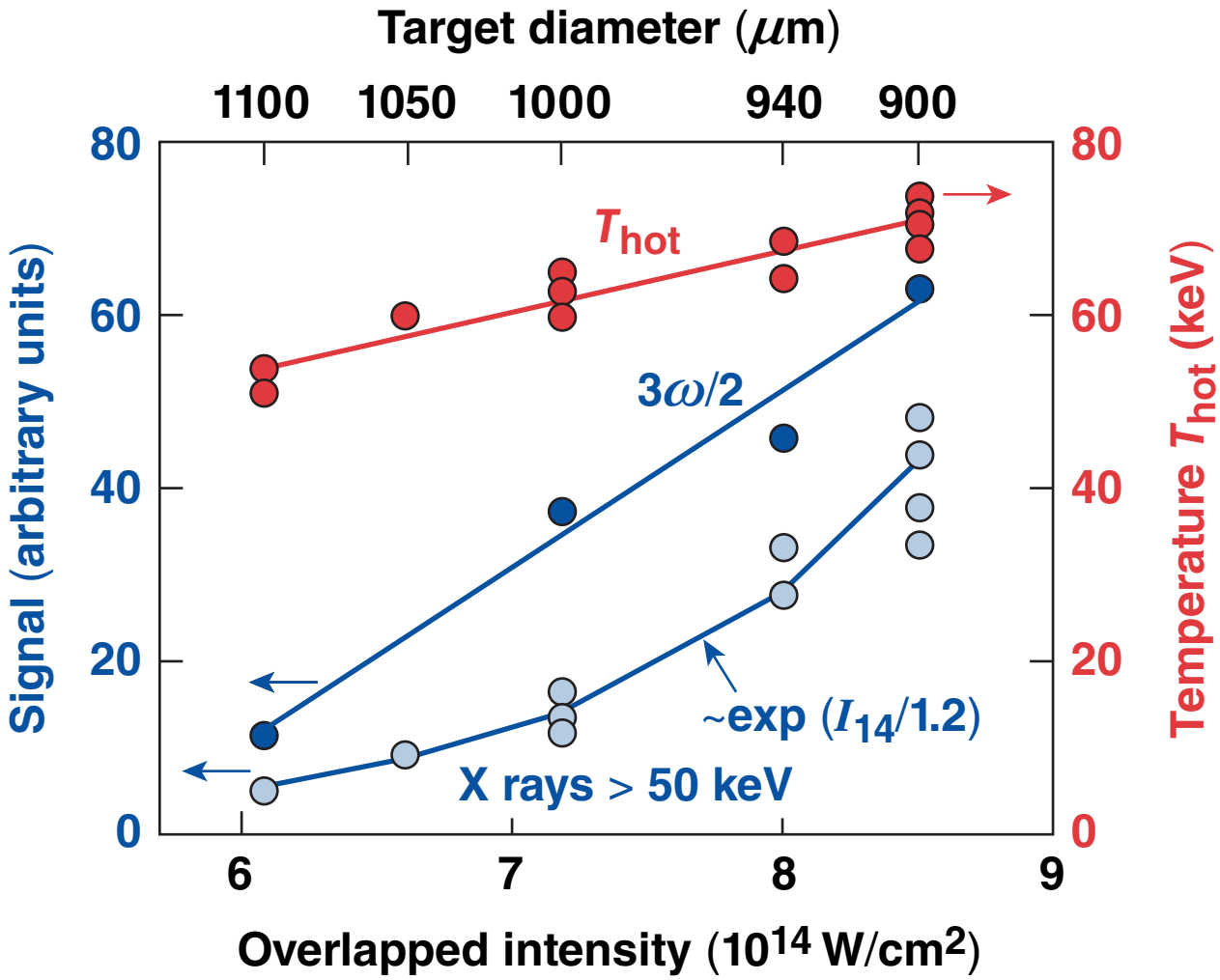
TPD appears to depend on the overlapped intensity for multibeam experiments (1)



TC8117d

Planar experiments [C. Stoeckl *et al.*, Phys. Rev. Lett. 90, 235002 (2003).]

TPD appears to depend on the overlapped intensity for multibeam experiments (2)

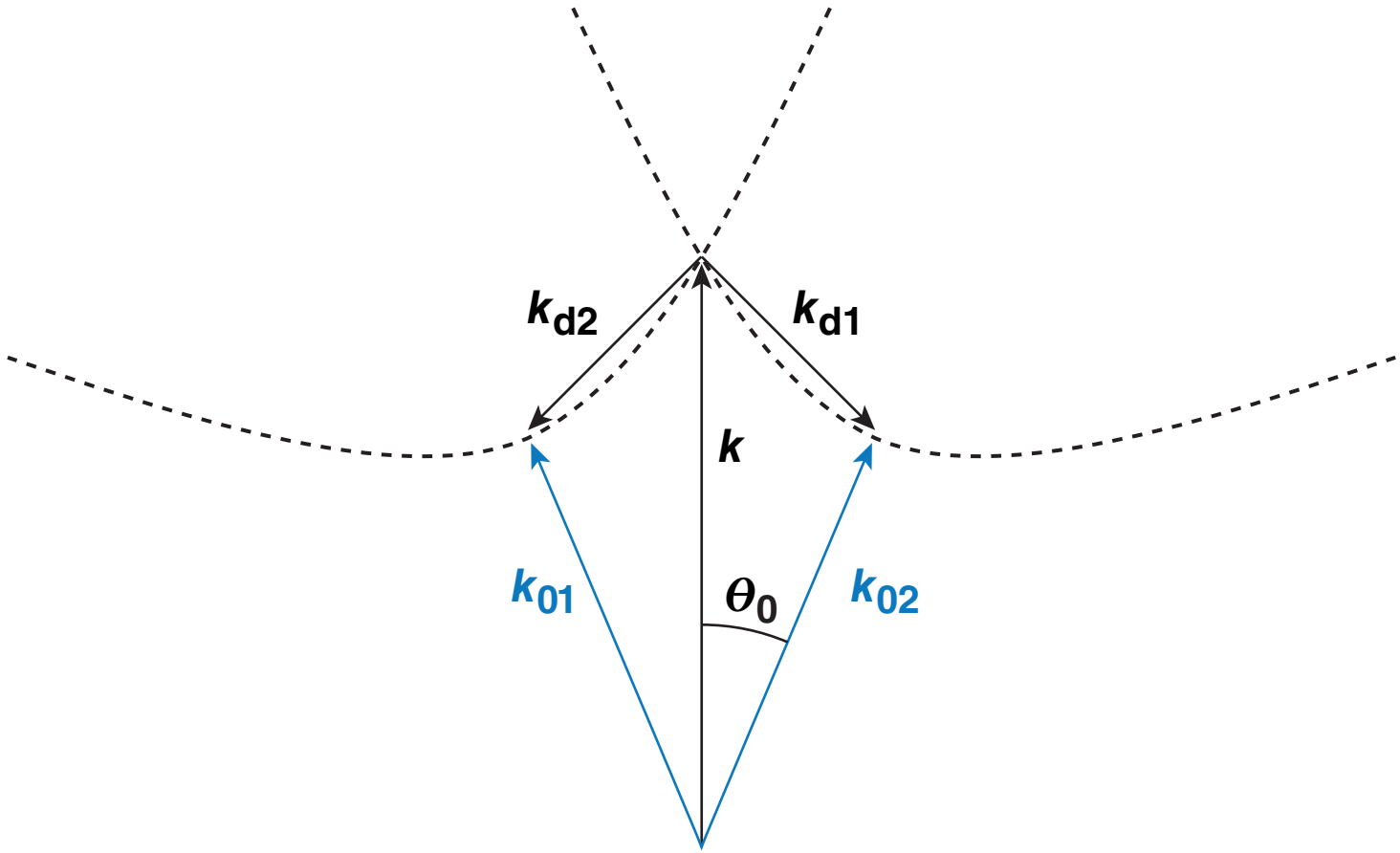


TC9432a

Spherical experiments [C. Stoeckl *et al.*, Phys. Rev. Lett. 90, 235002 (2003).]

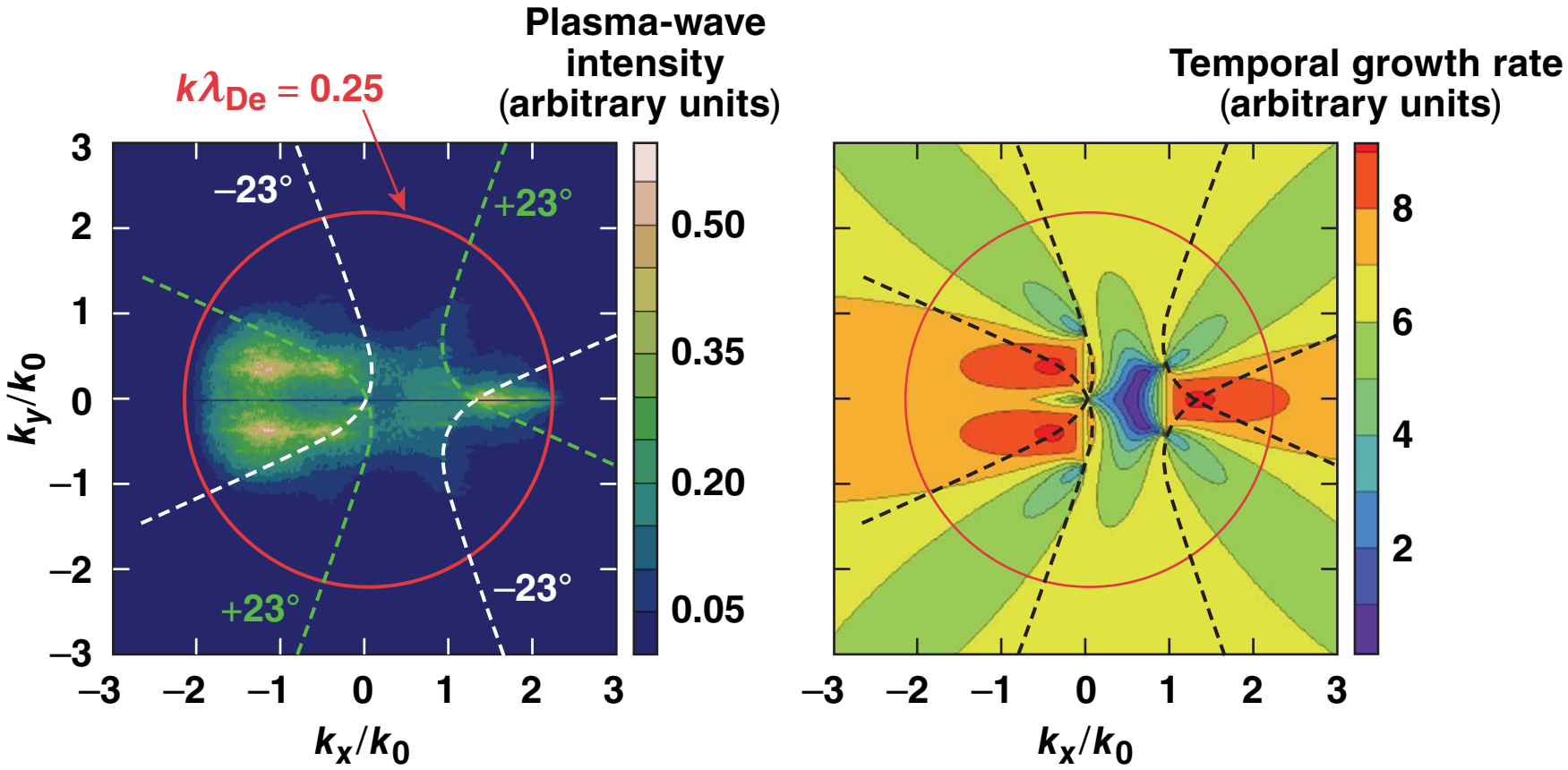
The anisotropy of multibeam TPD interaction can be studied using two beams

- Each pump wave drives a common plasma wave and a satellite—the common wave is of the greatest interest



TC9433

Zakharov simulations confirm linear theory—a common wave is driven at the intersection of the hyperbolas



TC8462a

Polar drive increases the importance of understanding the effects of beam-incidence angles on TPD

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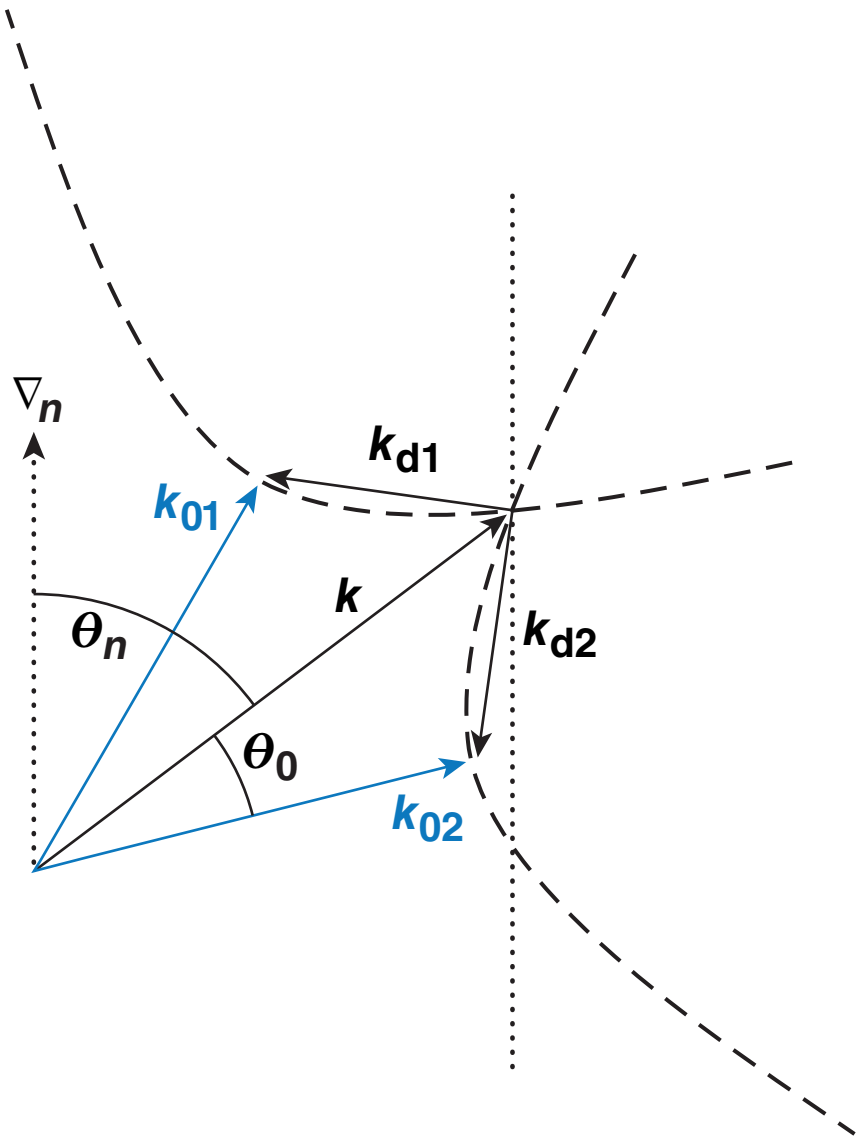
- In polar drive, more of the drive energy will impinge on the target at large angles
- Consequently, the common wave driven by groups of beams will deviate from the radial direction
- The angular distribution of this wave will determine the anisotropy of the hot electrons produced, and therefore their preheating efficiency
- For both theory and experiment, it is easiest to investigate the effects of oblique incidence in planar geometry first

The centroid of the beams can tilt from the density gradient in (θ_n) or out (ϕ_n) of the plane of the two beams



TC9434

Fourier analysis of the time-dependent TPD equations results in a set of first-order linear equations that can be integrated numerically

$$\frac{du}{dk_x} = \frac{1}{2} e^{i\alpha\beta^{1/2} k_{01x}(k_x - k_{xr})^2} \left(\frac{k^2 - k_{d1}^2}{k k_{d1}} \right) \alpha_1 (\hat{\varepsilon}_1 \cdot k) u_{d1}$$

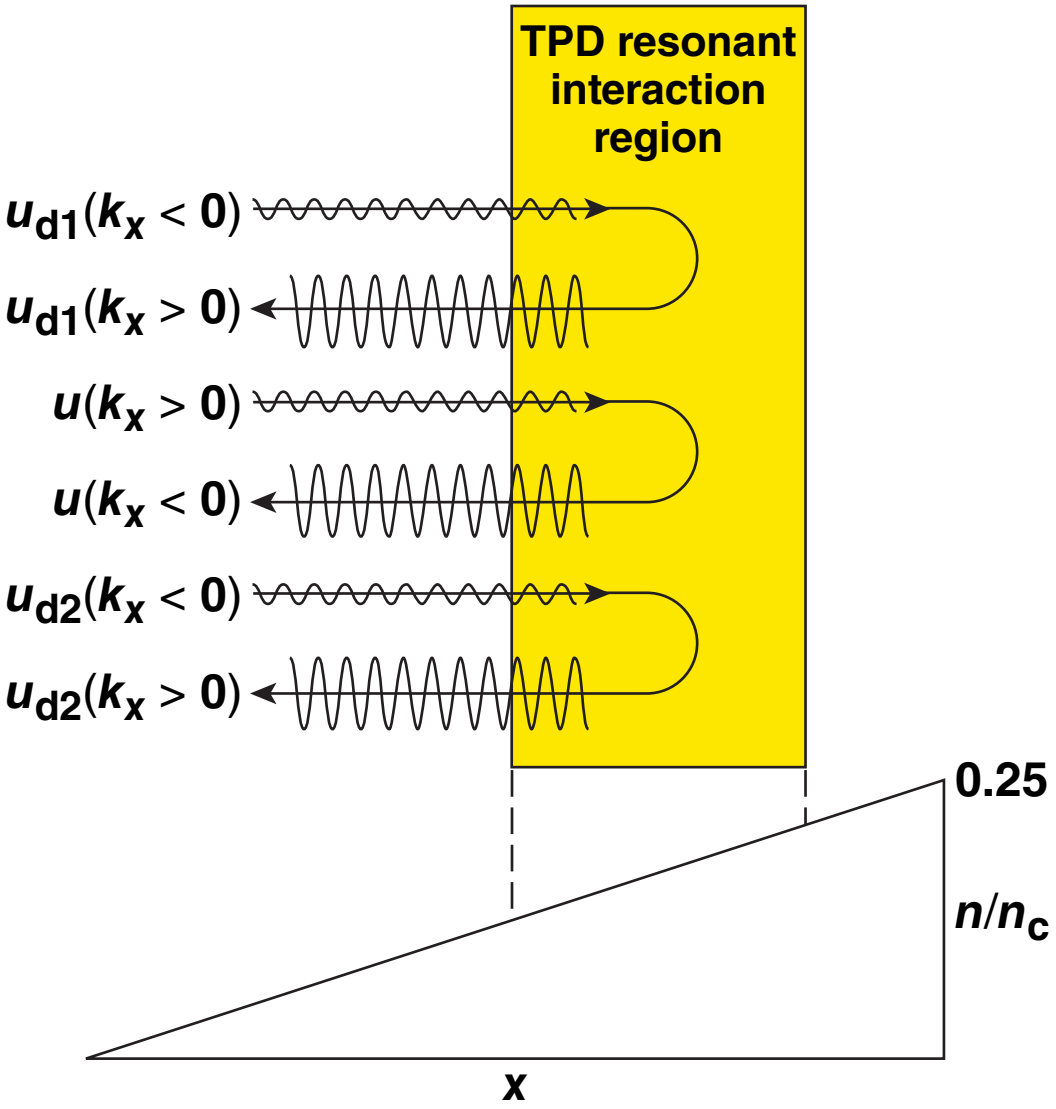
$$+ \frac{1}{2} e^{i\alpha\beta^{1/2} k_{02x}(k_x - k_{xr})^2} \left(\frac{k^2 - k_{d2}^2}{k k_{d2}} \right) \alpha_2 (\hat{\varepsilon}_2 \cdot k) u_{d2}$$

$$\frac{du_{d1}}{dk_x} = -\frac{1}{2} e^{-i\alpha\beta^{1/2} k_{01x}(k_x - k_{xr})^2} \left(\frac{k^2 - k_{d1}^2}{k k_{d1}} \right) \alpha_1 (\hat{\varepsilon}_1 \cdot k) u$$

$$\frac{du_{d2}}{dk_x} = -\frac{1}{2} e^{-i\alpha\beta^{1/2} k_{02x}(k_x - k_{xr})^2} \left(\frac{k^2 - k_{d2}^2}{k k_{d2}} \right) \alpha_2 (\hat{\varepsilon}_2 \cdot k) u$$

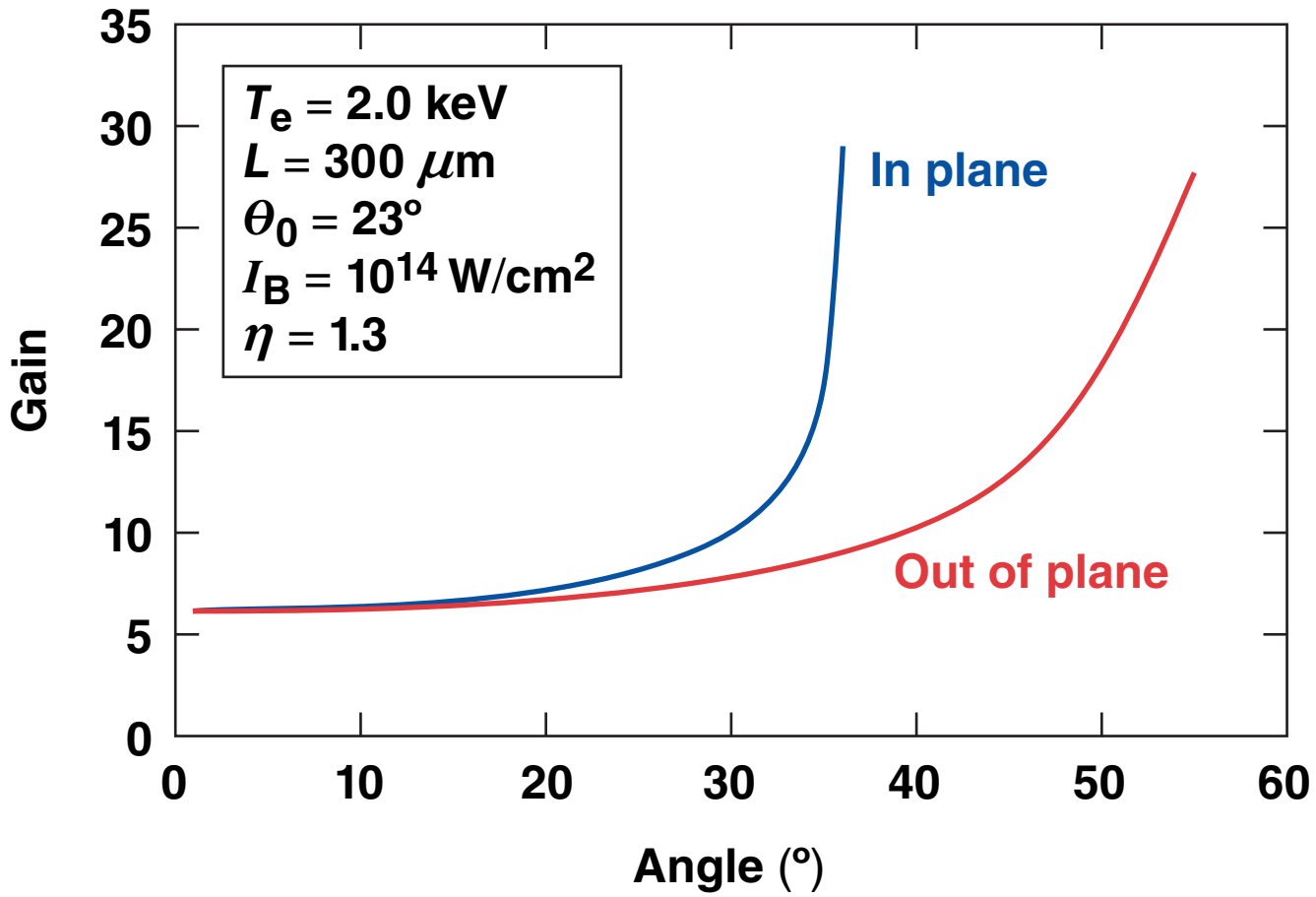
where $\alpha_i = \dfrac{4k_0 \left| v_{0i} \right|}{\omega_0} k_0 L$ and $\beta_i = \dfrac{9 v_e^4 k_0^2}{\left| v_{0i} \right|^2 \omega_0^2}$

Spatial growth can be obtained by numerical integration of the Fourier-transformed equations



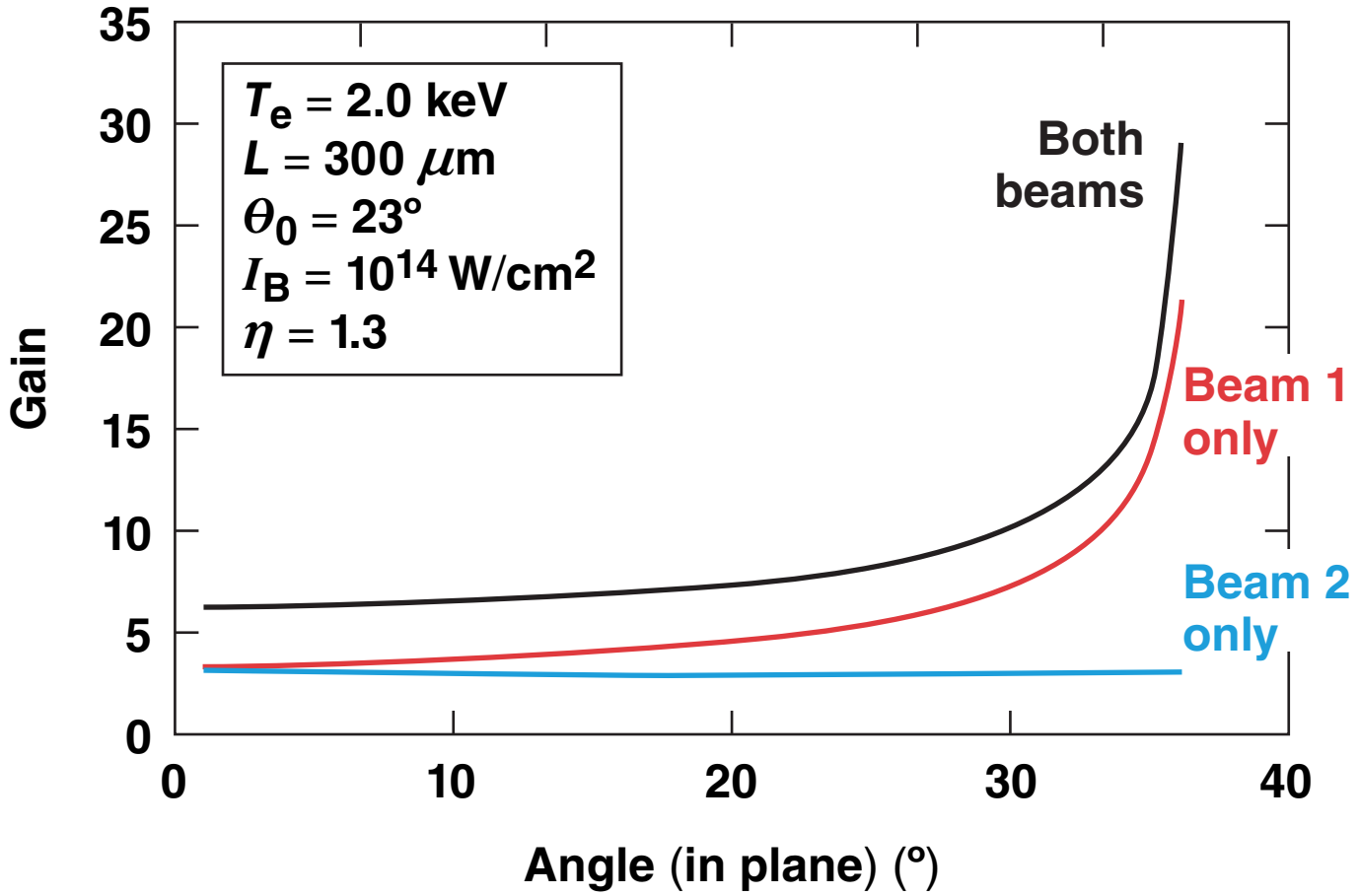
TC8470b

The integrated gain increases with tilt more rapidly in the beam plane than out



TC9435

At large angles the most-oblique beam provides most of the gain



TC9436

The linear theory suggests that incidence angle may play a significant role in TPD and resulting preheat

- Further experiments using multibeam irradiation of tilted flat targets are planned to investigate the effects of oblique incidence on TPD levels
- Simulations using J. Myatt's Zakharov code will be used to carry the theory into the nonlinear regime
- The theory breaks down when the incidence angles are large enough that the pump beams have turning points near the quarter-critical surface. Extending the theory to this regime is difficult; experiments should determine if it is worth pursuing

Summary/Conclusions

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