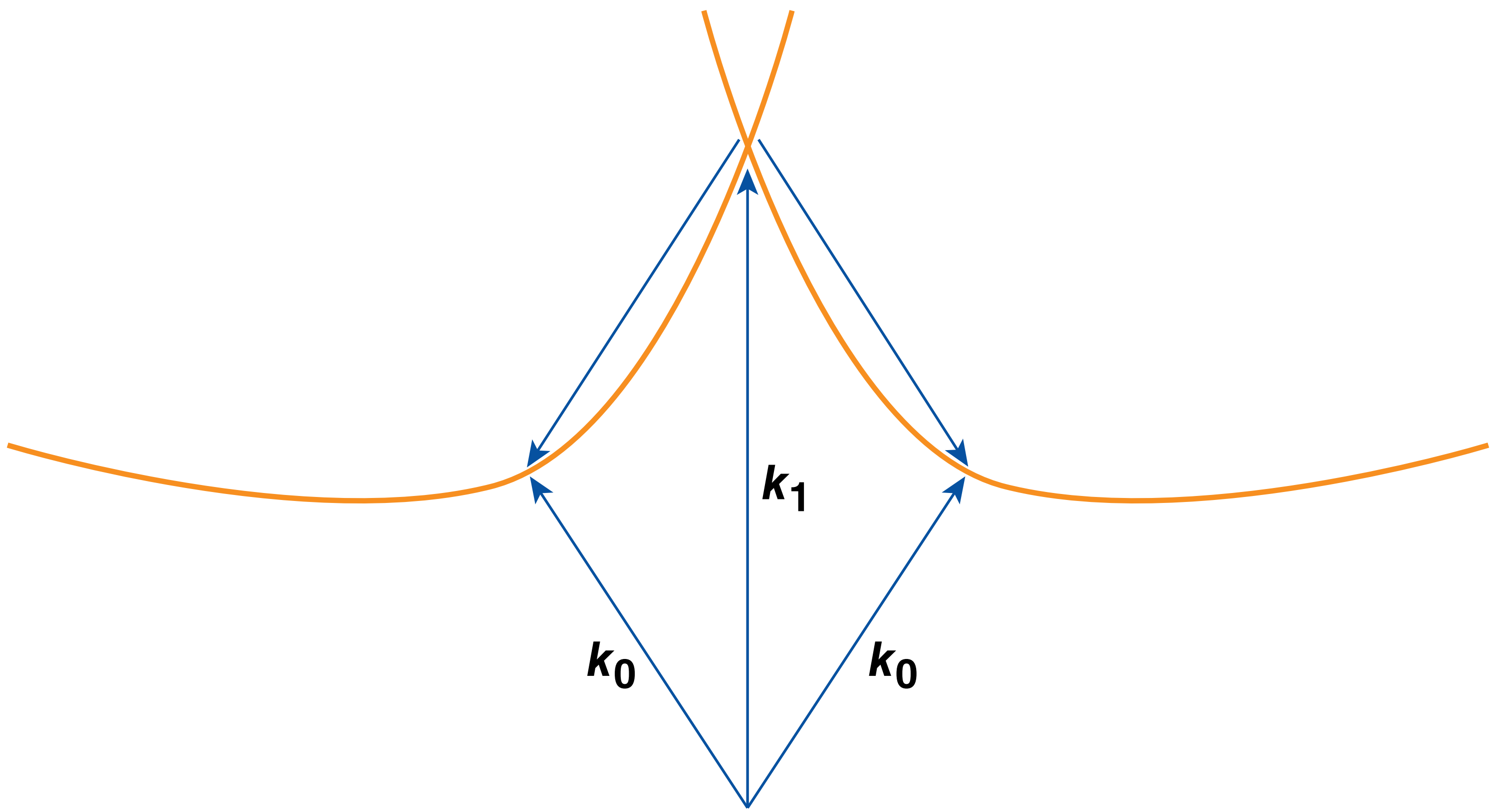
Anisotropy of Collectively Driven Two-Plasmon Decay in Direct-Drive Spherical Irradiation Geometry



R. W. Short
University of Rochester
Laboratory for Laser Energetics

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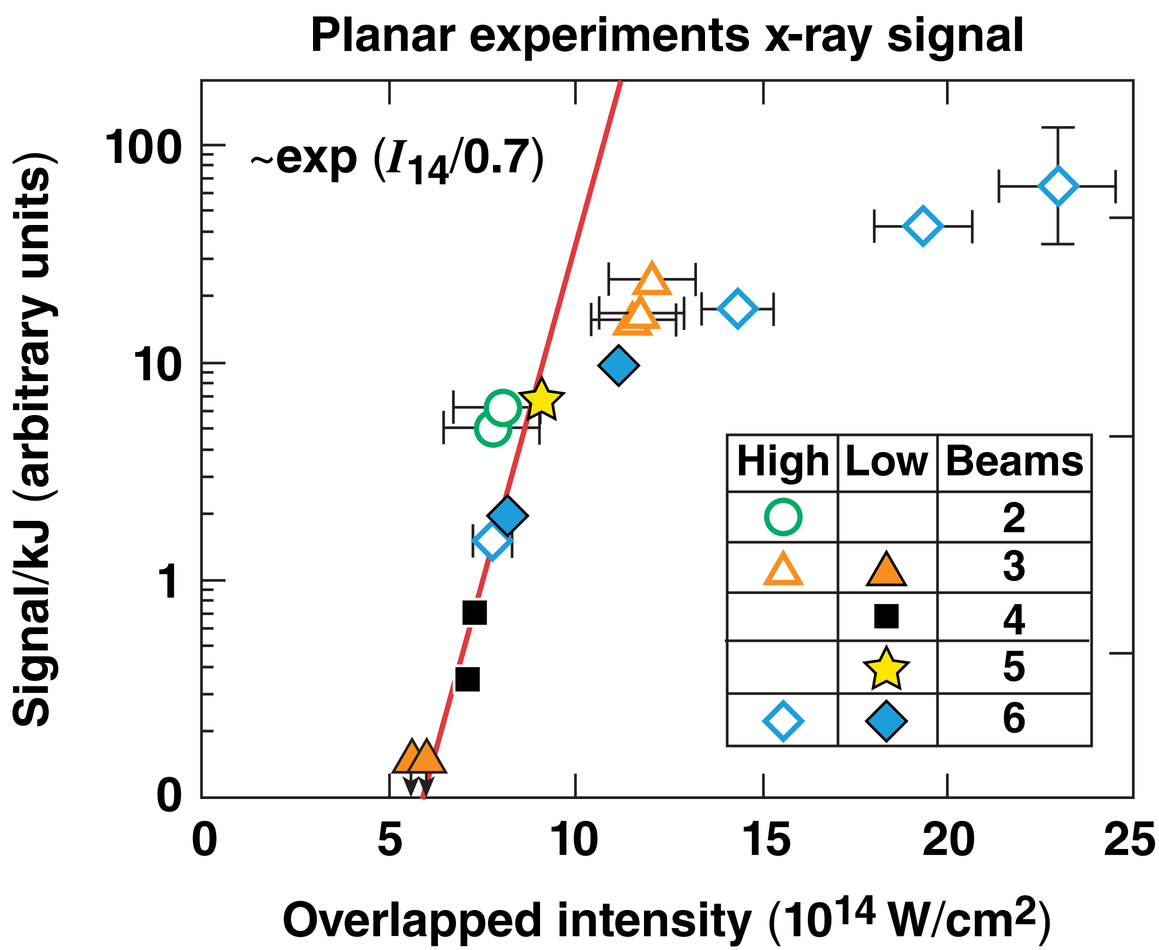
Summary

The transition of collectively driven TPD from convective to absolute occurs at very large gains, and is likely to be overshadowed by nonlinear effects

- Experiments on OMEGA have shown that TPD is driven by the collective intensity of several overlapping laser beams
- A group of beams can drive a common central plasma wave that is expected to produce most of the hot electrons
- The angular distribution of this wave will determine the anisotropy of the hot electrons produced, and therefore their preheating efficiency
- At small angles to the density gradient this decay exhibits a transition from convective to absolute at very large gains
- At larger angles gains are smaller and the transition to the absolute mode is not clear

TPD is observed to depend on the overlapped intensity for multiple-beam experiments

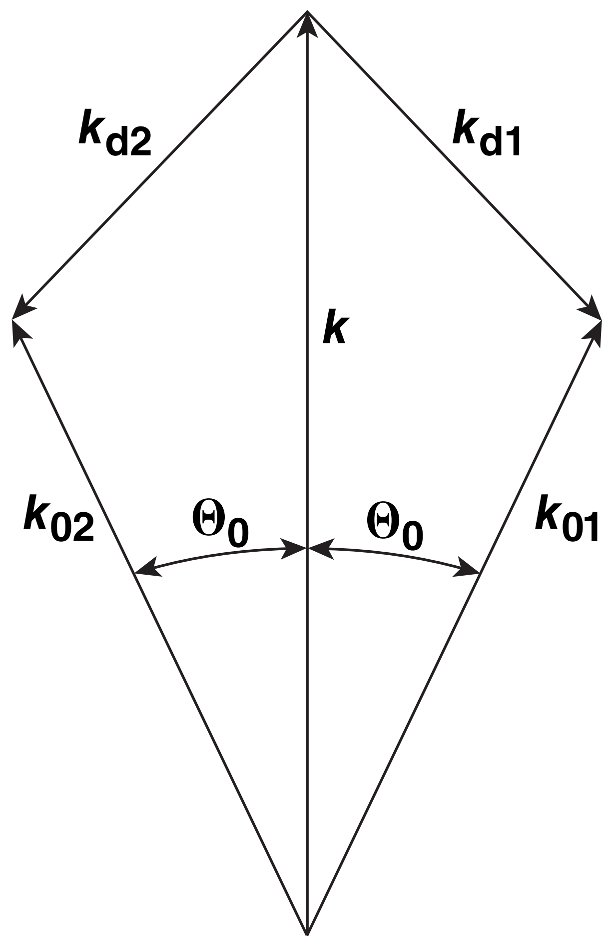


TC8117a

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 greatest interest



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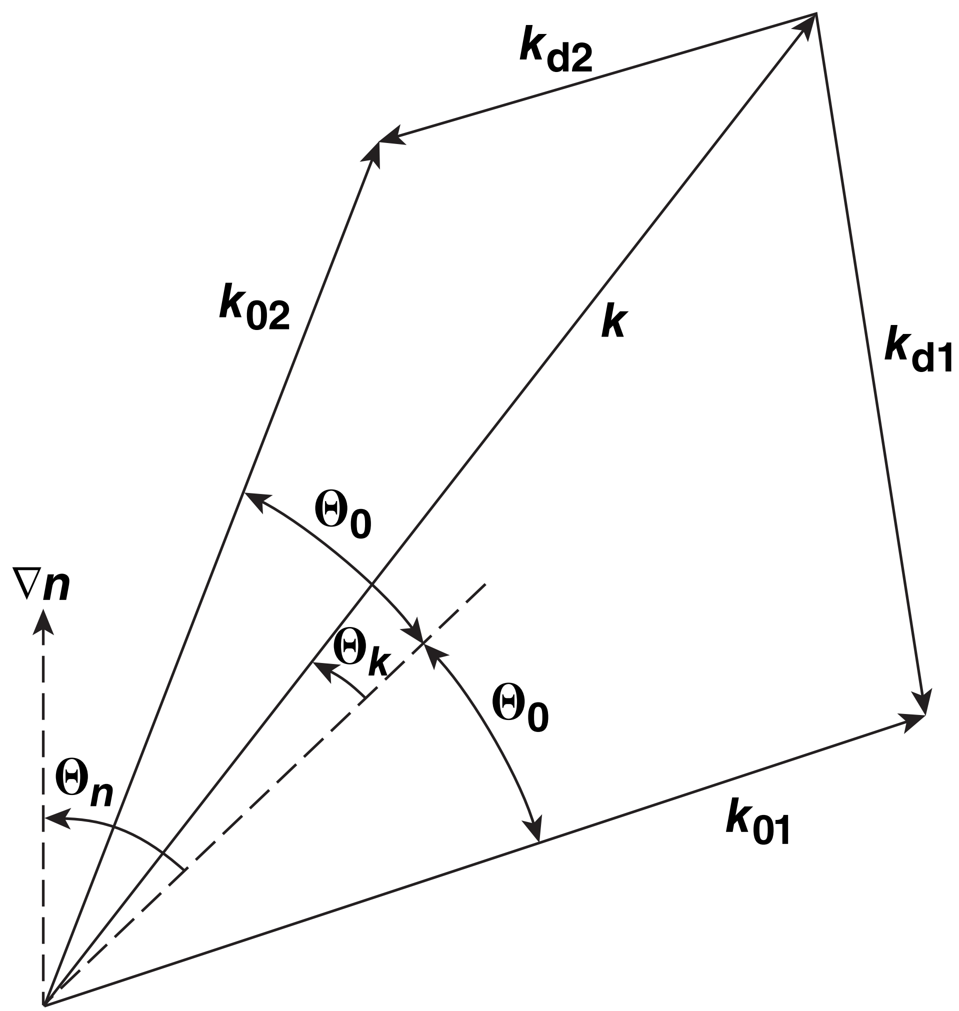
The common plasma wave can deviate from the centroid of the beams or from the density gradient



TC8467a

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

$$\frac{du}{dk_x} = e^{\frac{3i\upsilon_e^2 k_0 L}{\omega_p^2}\left\{\cos(\theta_0+\theta_n)k_x^2 + 2k_r[\cos(\theta_0+\theta_k) - \cos\theta_0]k_x\right\}} \frac{\left(\frac{k^2-k_{d1}^2}{kk_{d1}}\right)L}{\omega_p} |\upsilon_{01}|(\hat{\varepsilon}_1 \cdot k)u_{d1}$$

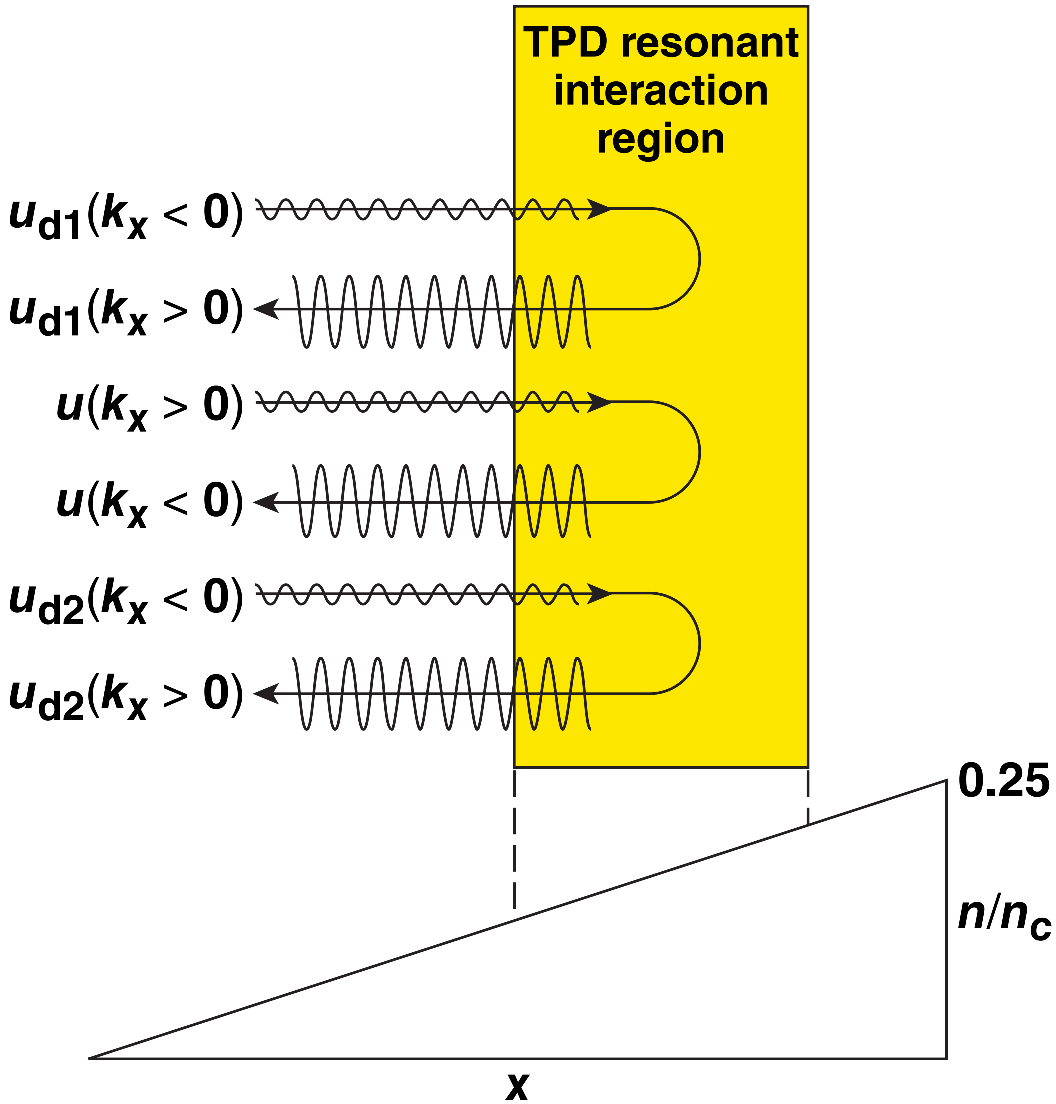
$$+ e^{\frac{3i\upsilon_e^2 k_0 L}{\omega_p^2}\left\{\cos(\theta_0-\theta_n)k_x^2 + 2k_r[\cos(\theta_0-\theta_k) - \cos\theta_0]k_x\right\}} \frac{\left(\frac{k^2-k_{d2}^2}{kk_{d2}}\right)L}{\omega_p} |\upsilon_{02}|(\hat{\varepsilon}_2 \cdot k)u_{d2}$$

$$\frac{du_{d1}}{dk_x} = -e^{-\frac{3i\upsilon_e^2 k_0 L}{\omega_p^2}\left\{\cos(\theta_0+\theta_n)k_x^2 + 2k_r[\cos(\theta_0+\theta_k) - \cos\theta_0]k_x\right\}} \frac{\left(\frac{k^2-k_{d1}^2}{kk_{d1}}\right)L}{\omega_p} |\upsilon_{01}|(\hat{\varepsilon}_1 \cdot k)u$$

$$\frac{du_{d2}}{dk_x} = -e^{-\frac{3i\upsilon_e^2 k_0 L}{\omega_p^2}\left\{\cos(\theta_0-\theta_n)k_x^2 + 2k_r[\cos(\theta_0-\theta_k) - \cos\theta_0]k_x\right\}} \frac{\left(\frac{k^2-k_{d2}^2}{kk_{d2}}\right)L}{\omega_p} |\upsilon_{02}|(\hat{\varepsilon}_2 \cdot k)u$$

TC8468b

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



TC8470b

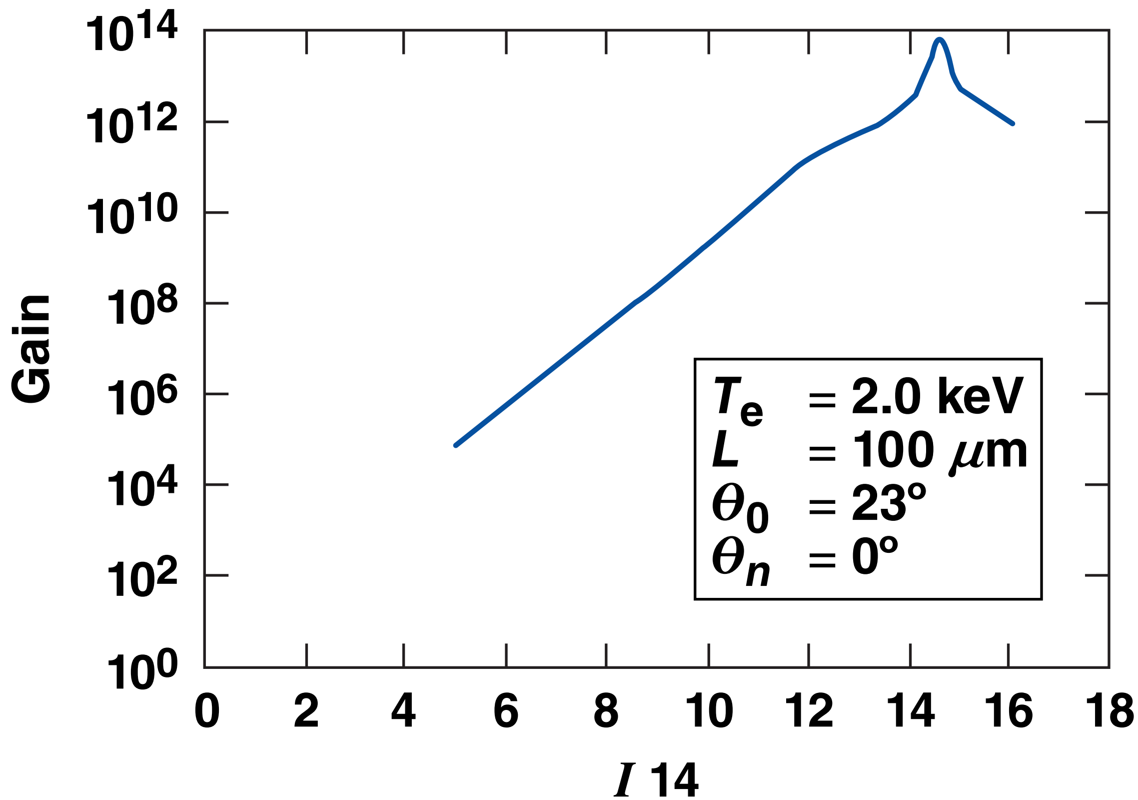
The absolute instability threshold can also be determined from the behavior of the spatial growth

- The convective gain can be found by integrating these equations over k_x from $-\infty$ to ∞

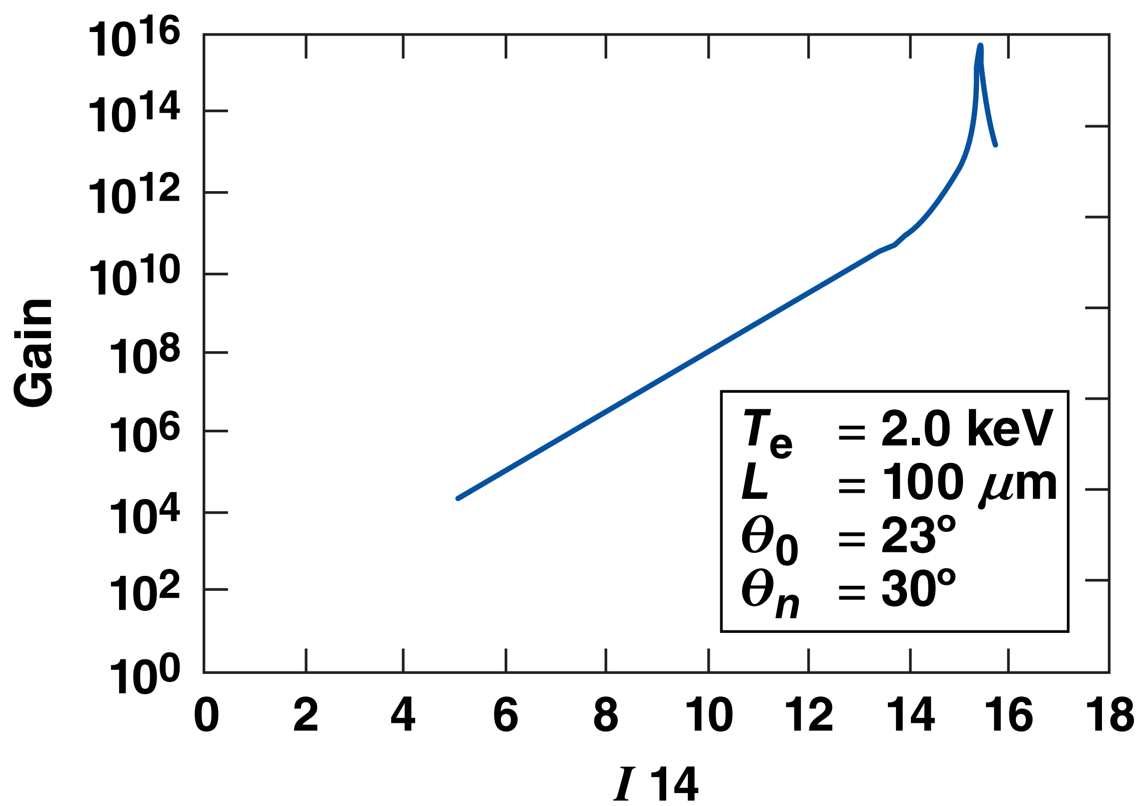
- The gain is represented as $\mathrm{Max}\left\{\dfrac{\left|u^{\mathrm{out}}\right|^2}{\left|u_{d1}^{\mathrm{in}}\right|^2+\left|u^{\mathrm{in}}\right|^2+\left|u_{d2}^{\mathrm{in}}\right|^2}\right\}$

- The spatial gain may diverge with increasing input intensity. This represents the onset of absolute instability

The instability transitions from convective to absolute at large gains

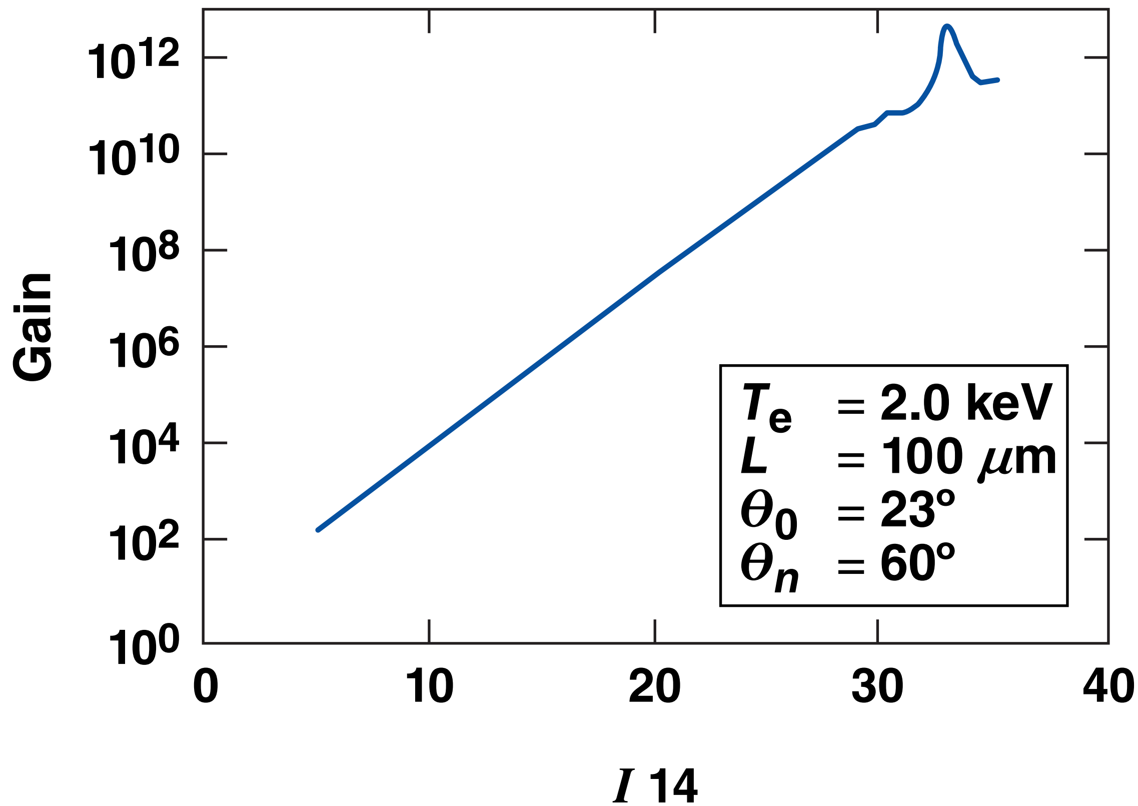


Small deviations from the density gradient have little effect



TC8860

At large angles the convective gain is reduced and the onset of absolute instability is not clear



Summary/Conclusions

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