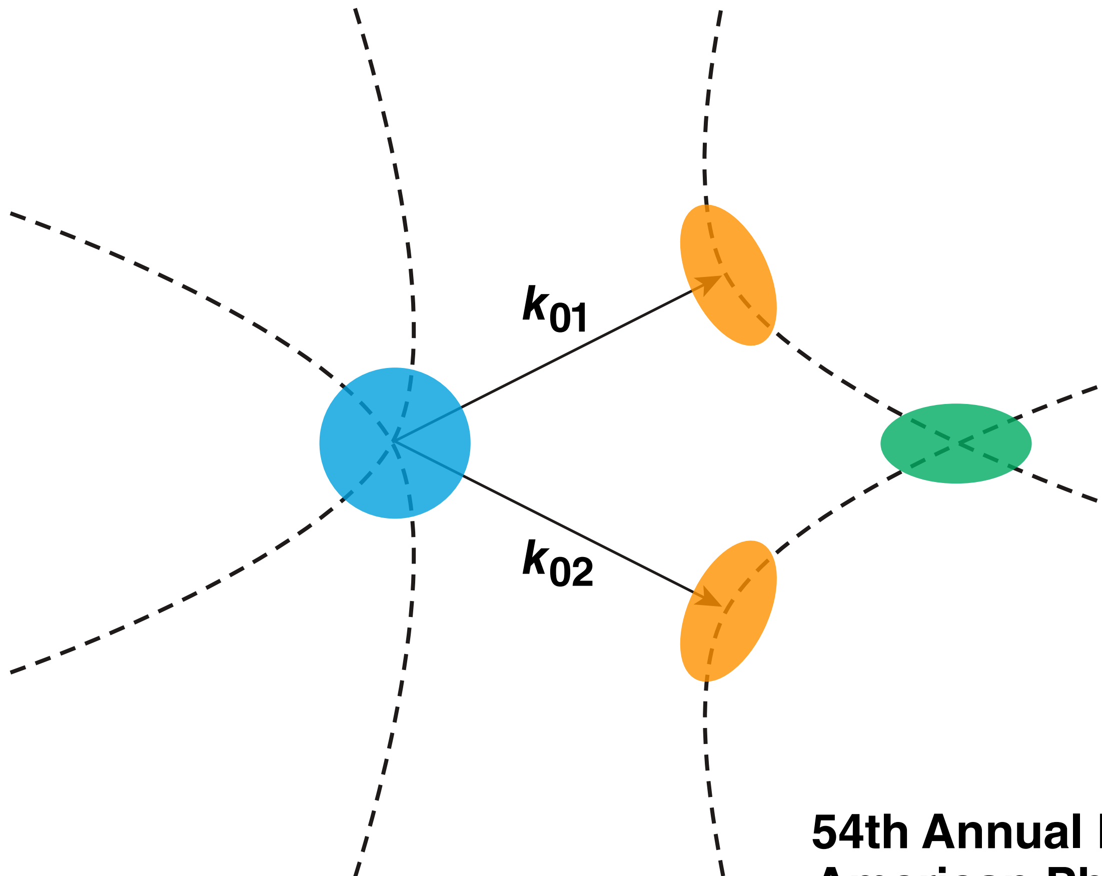
The Effects of Beam Polarization and Orientation on Convective and Absolute Two-Plasmon Decay (TPD) Driven by Multiple Laser Beams



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

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Summary

A small-*k* absolute mode is expected to dominate the linear stage of multibeam TPD growth

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- For multiple beams there are two regions in *k*-space where TPD can be collectively driven
- The small- and large-*k* modes have similar convective gains; however, the small-*k* modes are likely to be absolute and dominate the linear stage of the instability
  - These small-*k* modes appear to be responsible for a prominent feature in the $\omega_0/2$ spectra that is a useful temperature diagnostic*
- These results are consistent with Zakharov simulations**

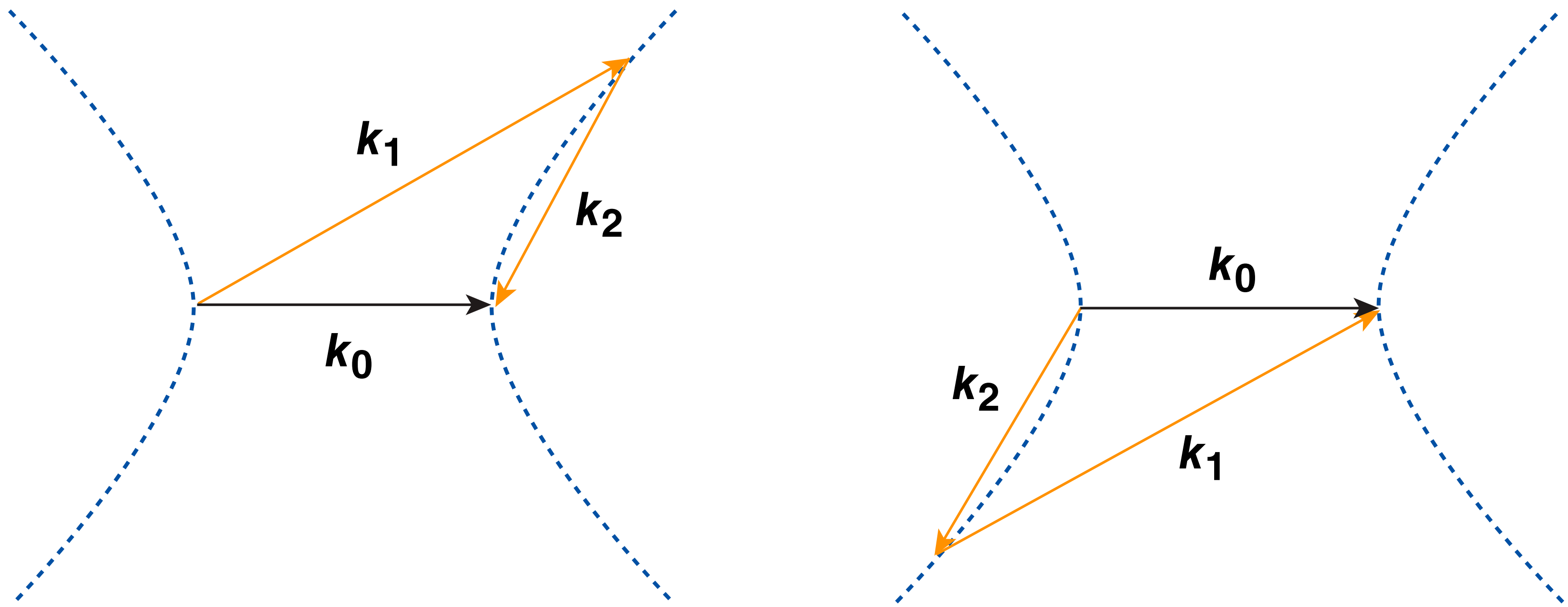
*W. Seka, TO5.00001, this conference.
**J. Zhang, TO5.00006, this conference.

Collaborators

J. F. Myatt, A. V. Maximov, D. T. Michel, D. H. Froula, and J. Zhang

Laboratory for Laser Energetics
University of Rochester

The temporal growth rate for single-beam TPD is maximized on a hyperbola in *k* space



- The hyperbola lies in the plane of polarization
- Different points on the hyperbola correspond to decays occurring at different densities; larger wave vectors → smaller densities

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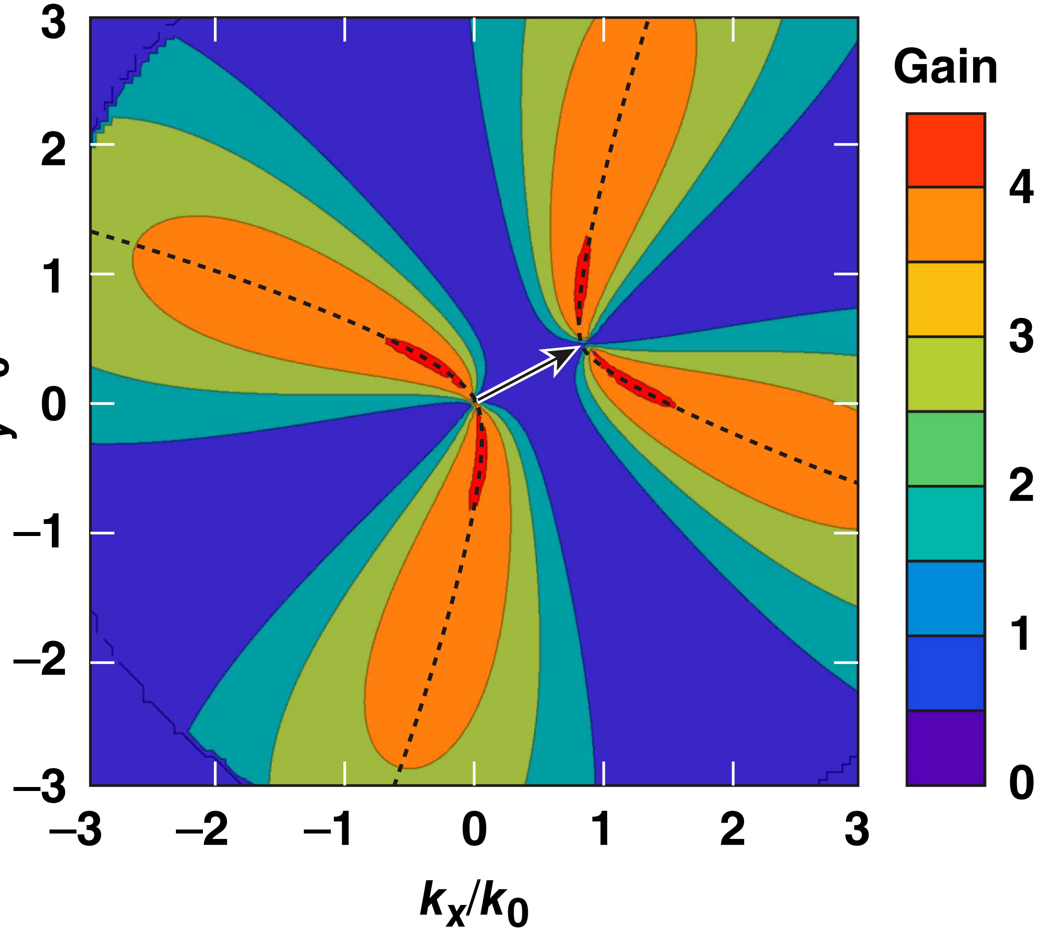
A single beam shows maximal gain along the hyperbola



I_{14} (single beam) = 1.0
L_μ = 300
T_{keV} = 1.5
In-plane polarization

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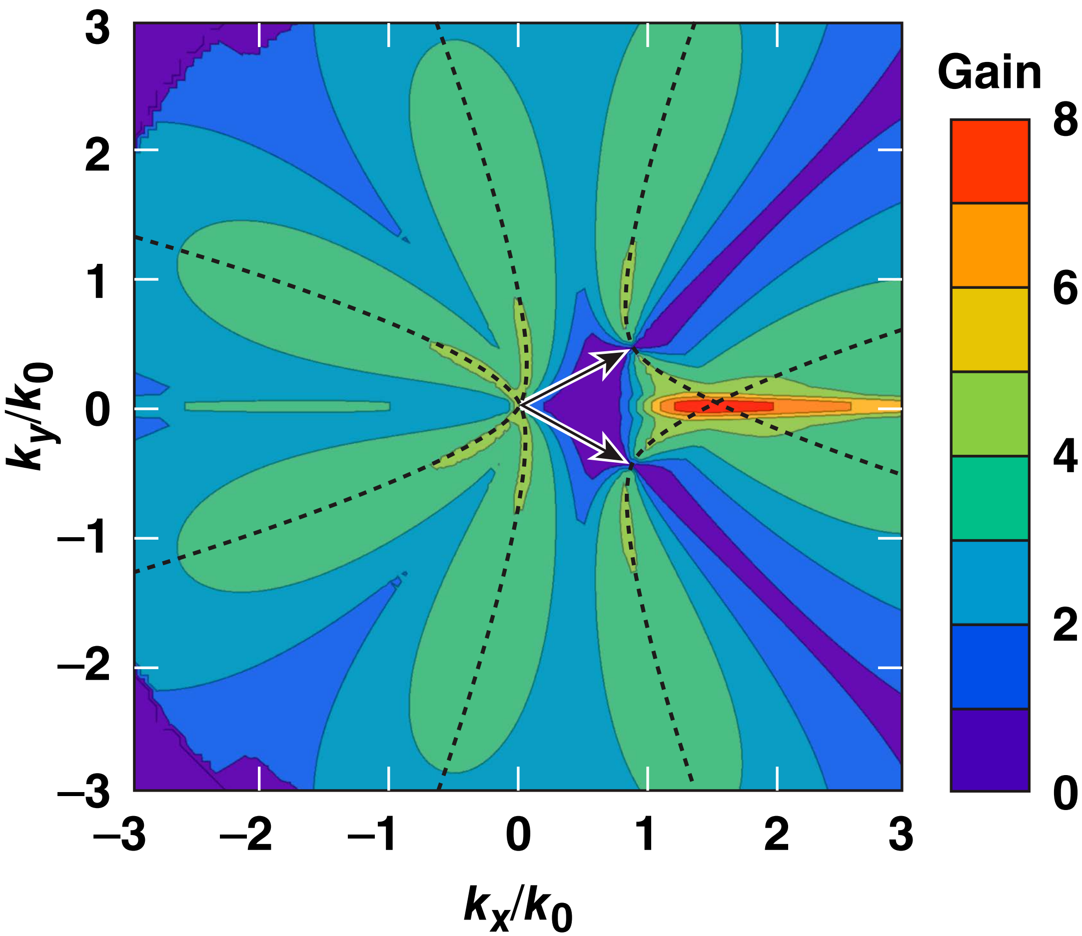
The expected gain enhancement is seen for two pump beams polarized in their common plane



I_{14} (single beam) = 1.0
L_μ = 300
T_{keV} = 1.5
In-plane polarization

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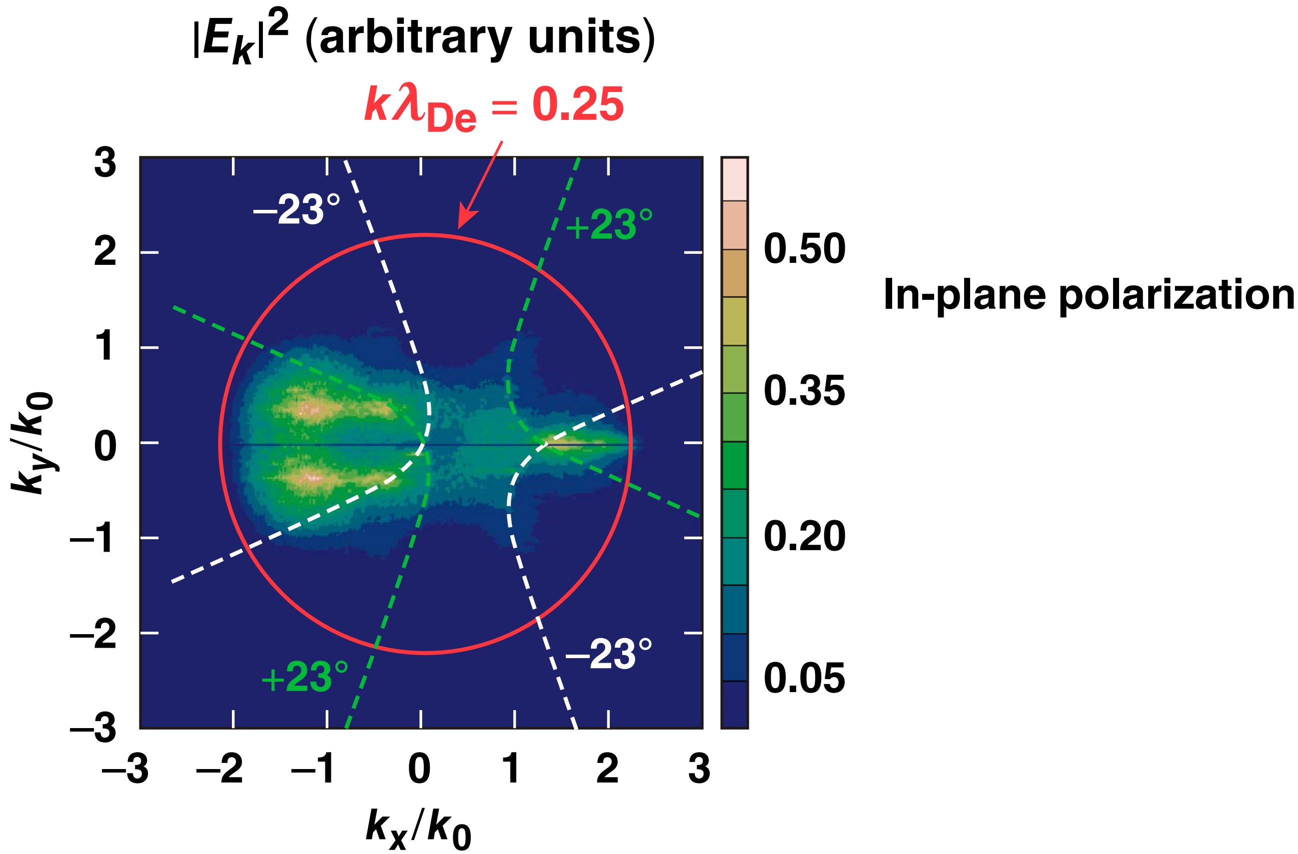
Similar features are seen in Zakharov simulations,* indicating that they persist in the nonlinear regime



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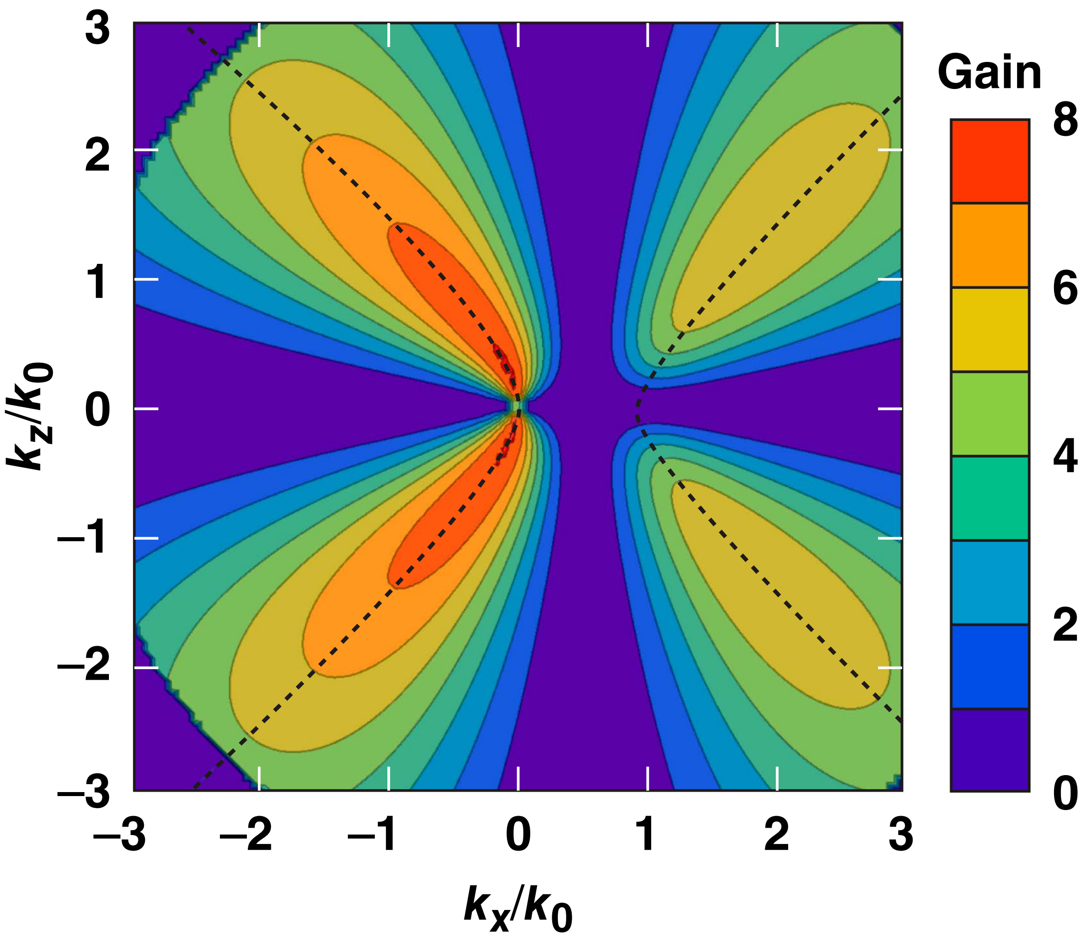
* J. F. Myatt *et al.*, Phys. Plasmas 19, 022707 (2012).

When the beams are polarized out of their common plane, enhanced gain is seen near the origin



I_{14} (single beam) = 1.0
L_μ = 300
T_{keV} = 1.5
Out-of-plane polarization

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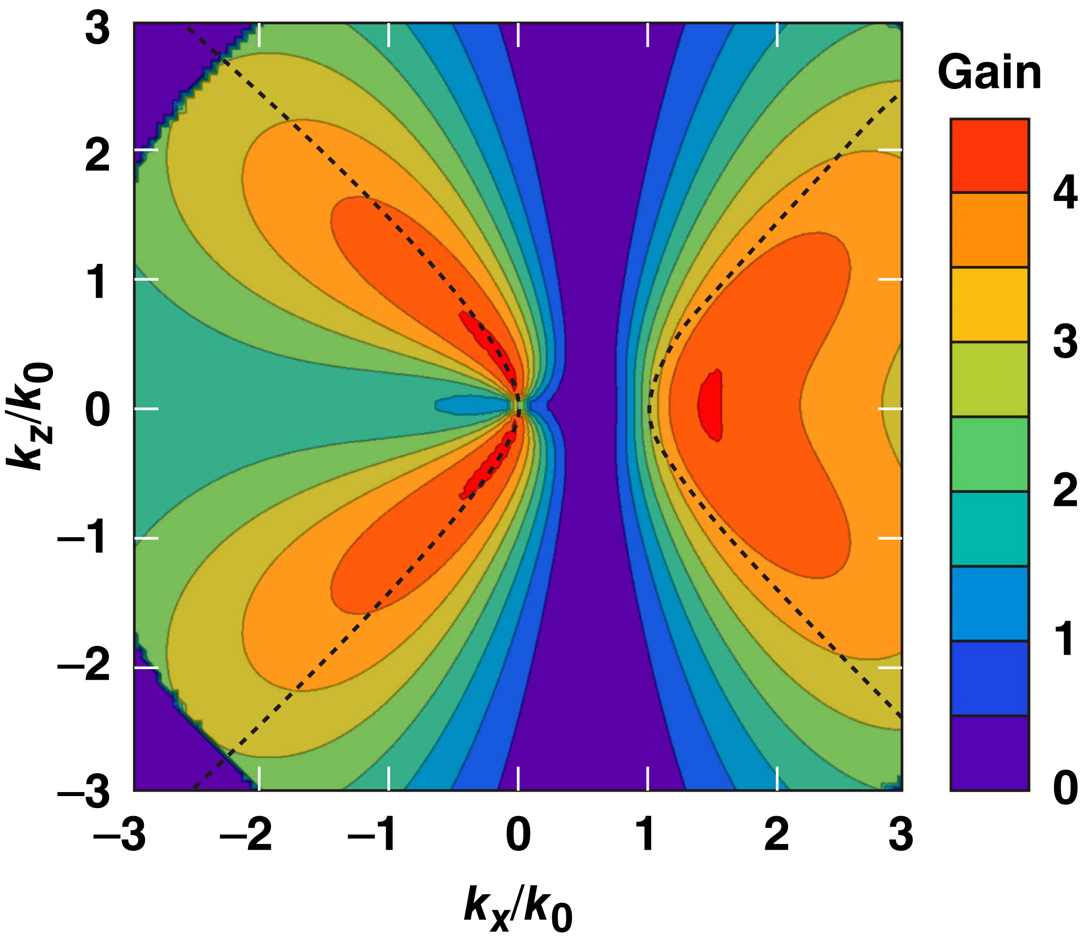
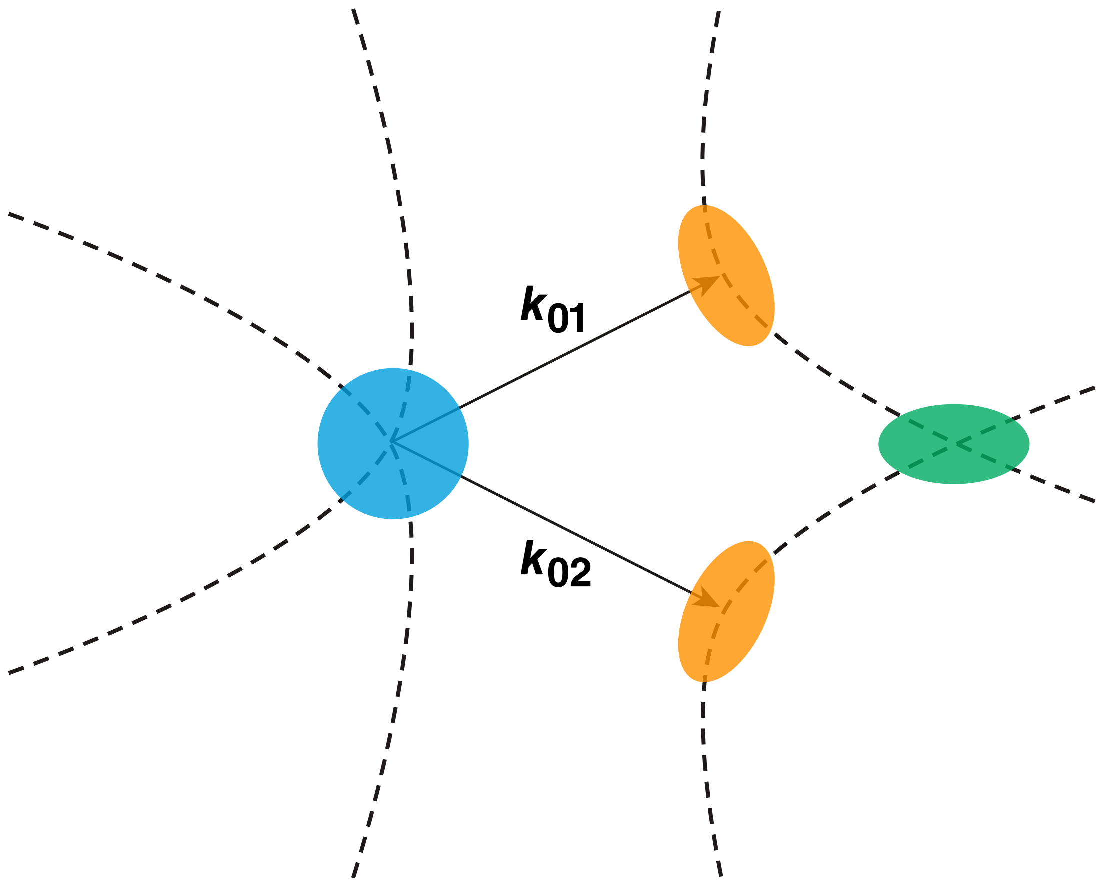
Polarization smoothing distributes the gain between the large- and small-*k* modes



I_{14} (single beam) = 1.0
L_μ = 300
T_{keV} = 1.5
Polarization smoothing

The presence of enhanced gain near the origin raises the possibility of absolute instability there



Two beams polarized in their common plane

Orange: region of absolute instability

Green: region of overlapped convective gain

Two beams polarized out of their common plane

Blue: region of overlapped absolute instability

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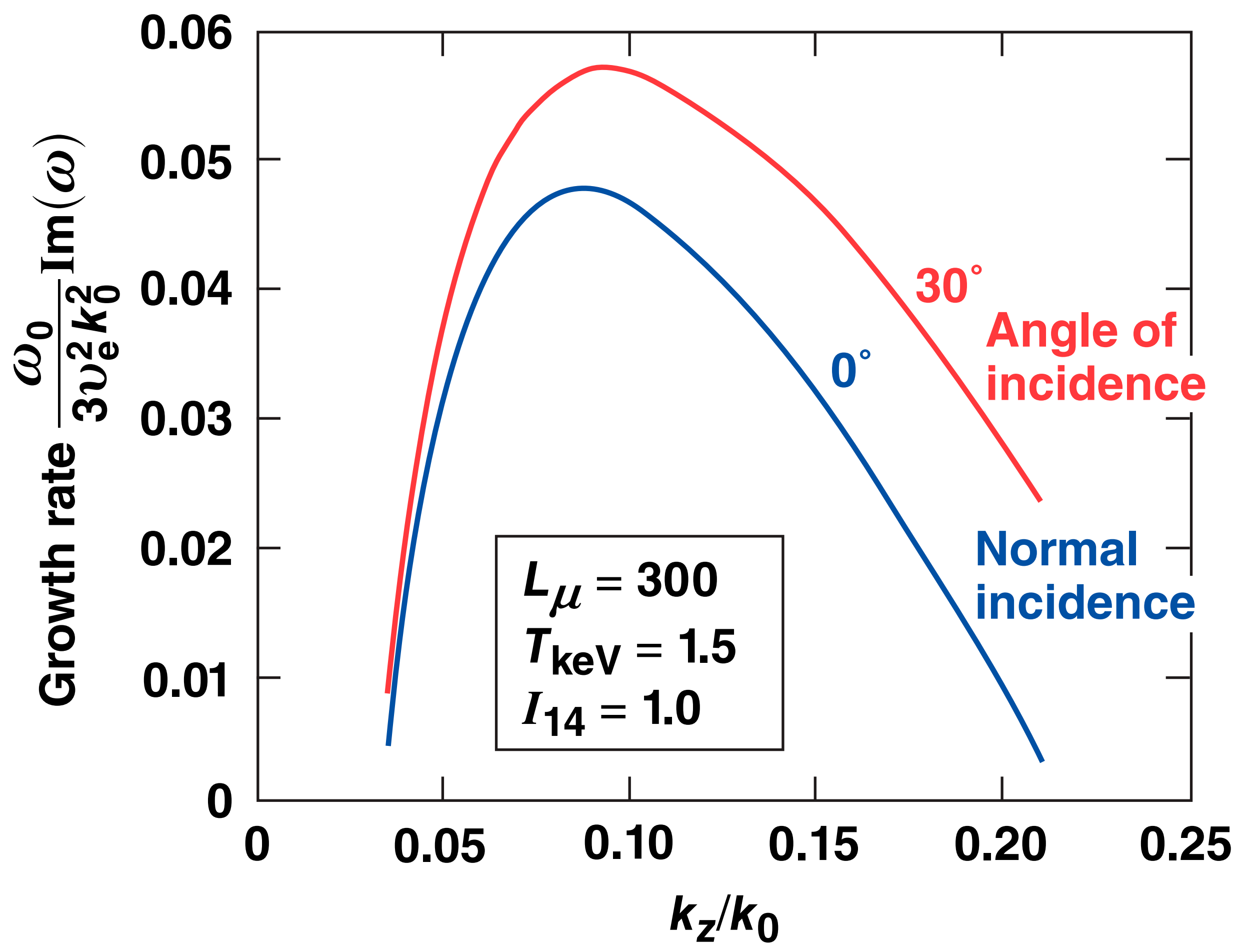
As in the normal incidence case, the absolute instability is localized at small *k*



The absolute TPD threshold is found to be comparable to the nominal convective threshold

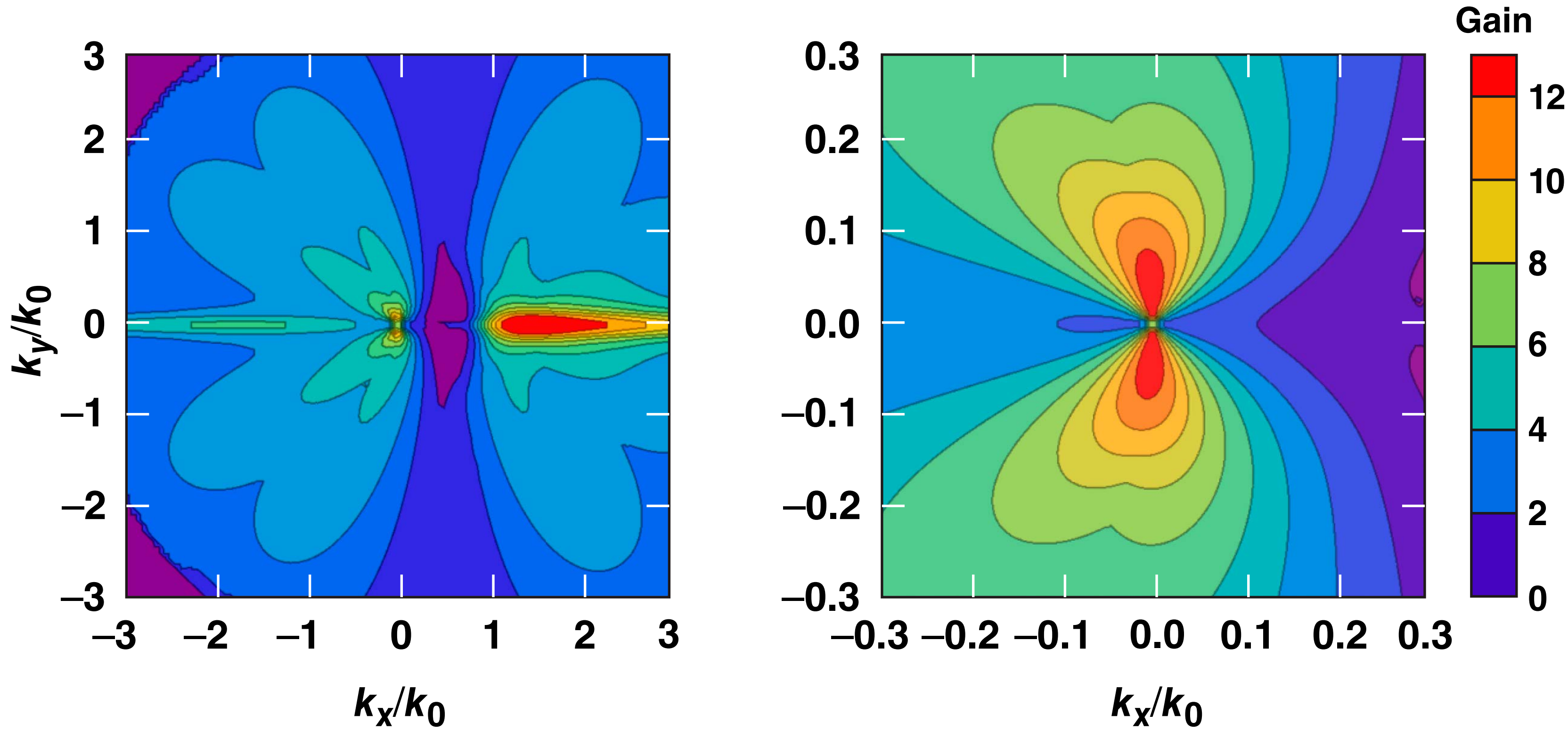
- Extending the 1983 results of Simon *et al.* to two beams at oblique incidence, the threshold is found to be well described by

$$\eta \equiv \frac{I_{14} L_{\mu}}{233\, T_{\mathrm{keV}} \cos\theta_0} > 1$$

- $\eta \cong \frac{1}{5} G_{\mathrm{R}}$, where G_{R} is the Rosenbluth gain factor and $G_{\mathrm{R}} > 2\pi$ is usually taken as the threshold for convective growth
- Therefore, the absolute small-*k* modes are expected to dominate the linear stage of the instability
- For more than two beams, the absolute instability analysis is more complicated, but a similar threshold is expected
- This seems to be borne out by simulations*

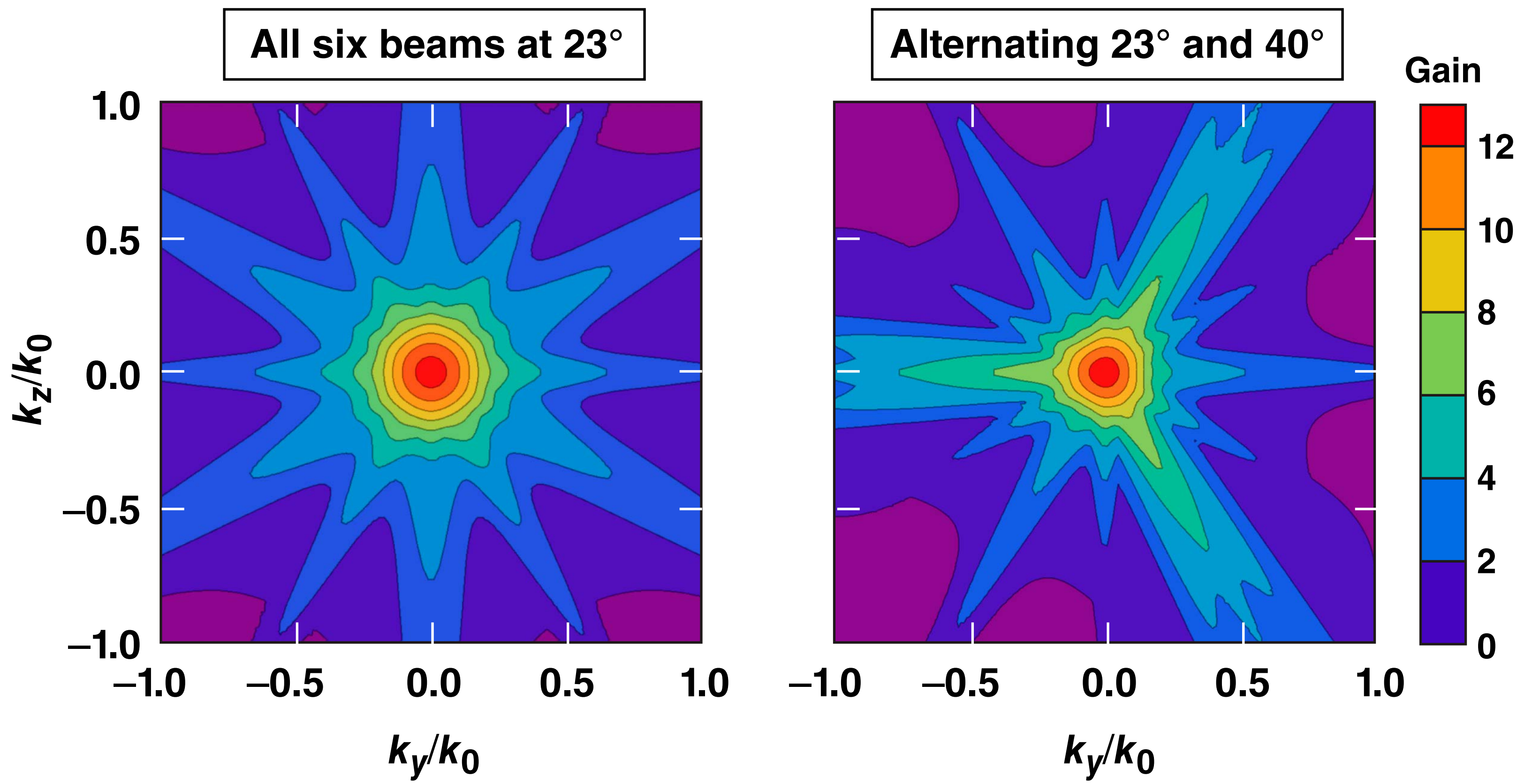
*J. Zhang, TO5.00006, this conference.

For six beams with polarization smoothing, the large- and small-*k* convective gains are comparable



- However, the small-*k* modes are likely to be absolute (infinite gain)

The small-*k* modes are insensitive to beam angle and orientation



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