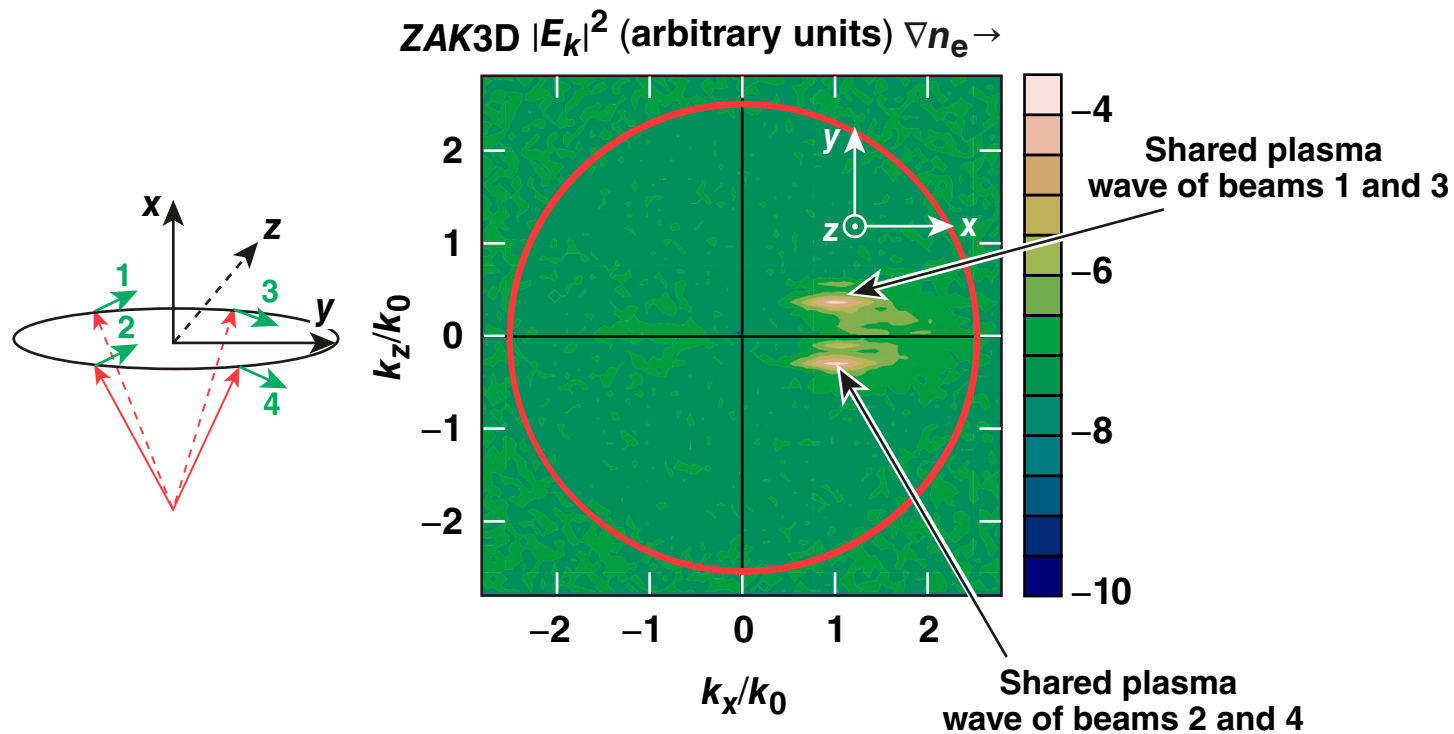


# Three-dimensional Zakharov Model of the Two-Plasmon–Decay Instability in Inhomogeneous Plasmas Driven by Multiple Laser Beams



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## Summary

# A 3-D Zakharov code called “ZAK3D” has been developed to study two-plasmon decay (TPD)



- Zakharov model is a time-enveloped fluid model, which describes the nonlinear coupling between Langmuir waves and ion-acoustic waves
- 3-D Zakharov simulations of TPD driven by two and four beams show shared Langmuir waves in both the large- and small- $k$  region, which are consistent with R. W. Short's linear gain theory\*
- The code is being used to model TPD in spherical implosion experiments on OMEGA

# Collaborators

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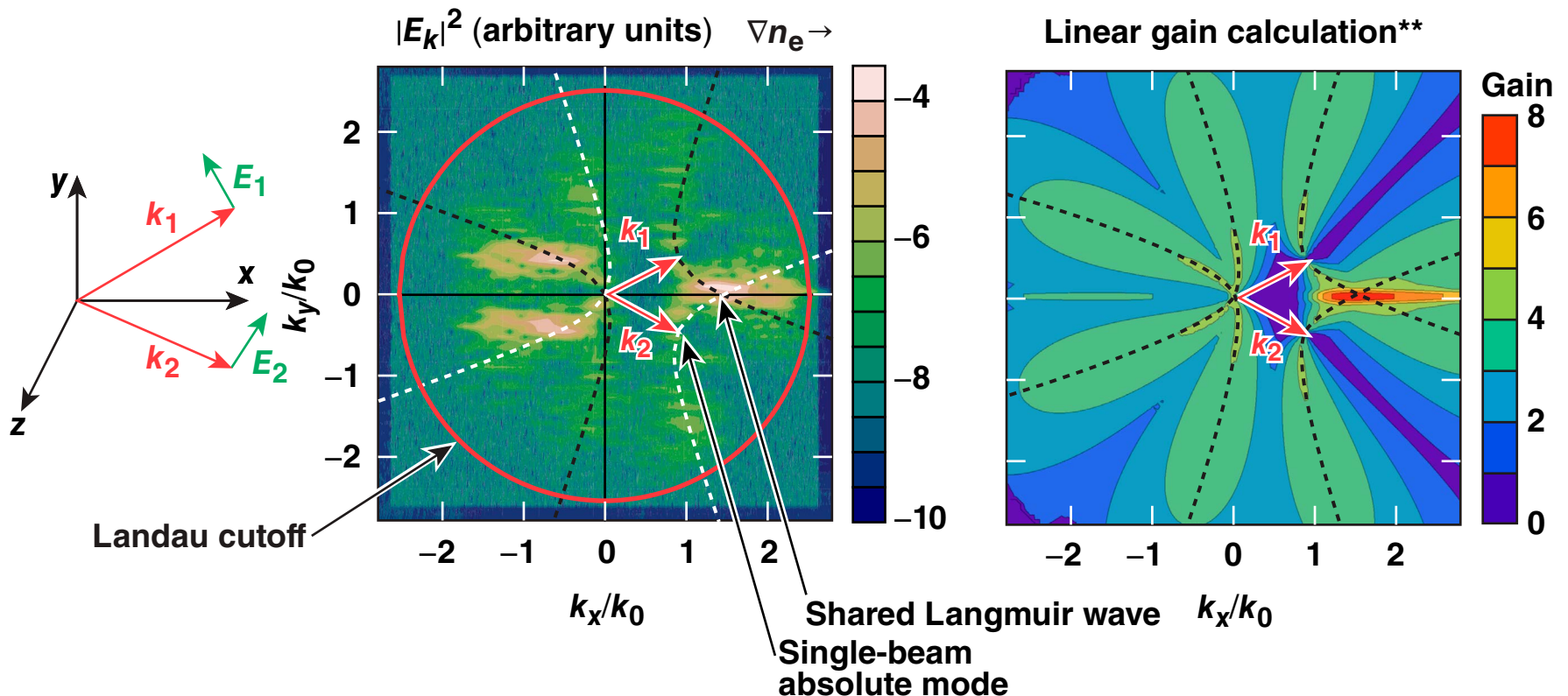
**Lodestar Research Corporation**

**D. F. DuBois**

**Los Alamos National Laboratory  
and Lodestar Research Corporation**

# Two-plane electromagnetic (EM) waves with in-plane polarization show shared plasma waves at the large- $k$ region

- These large- $k$  plasma waves are convectively unstable



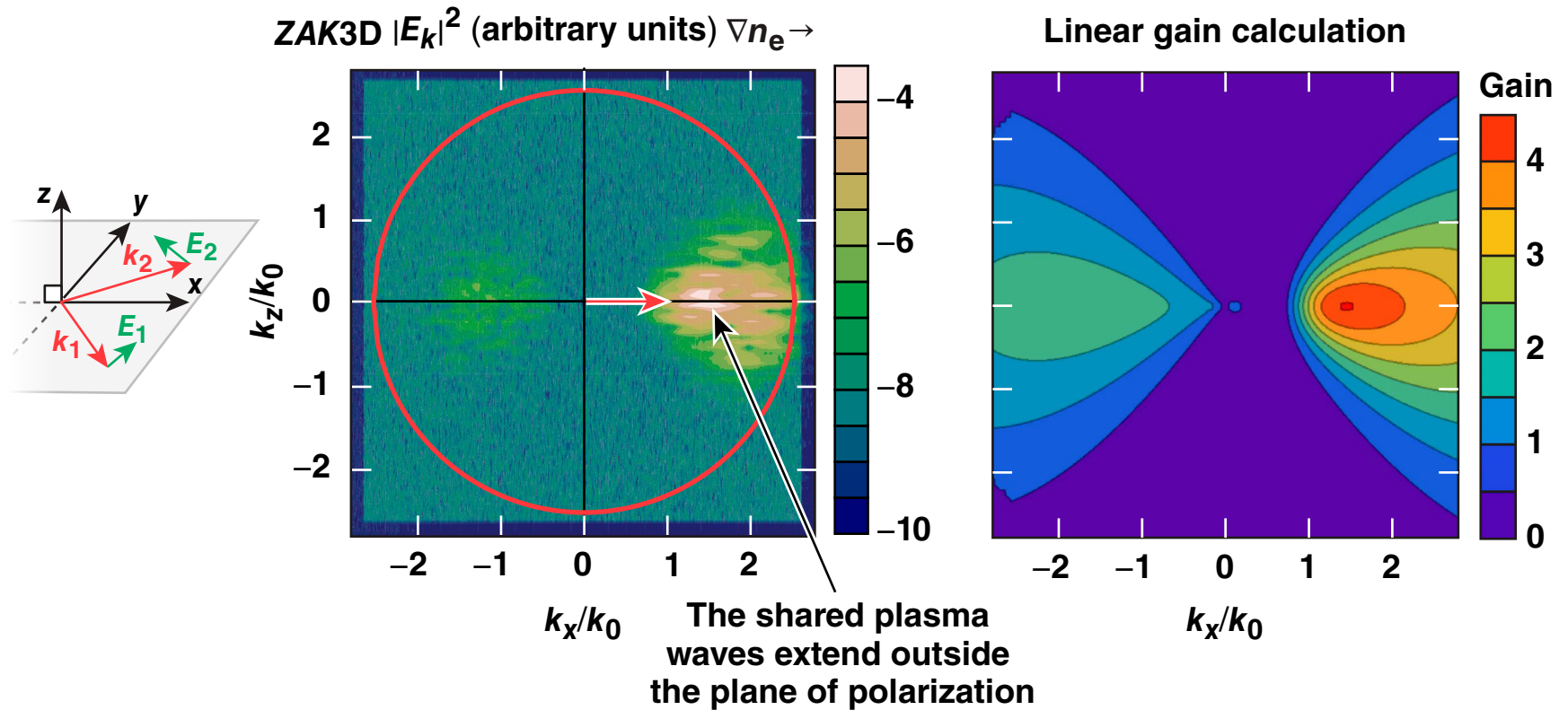
- In the regime of linear growth, two beams in-plane polarization is a 2-D problem\*

\*J. F. Myatt, TO5.00005, this conference.

\*\*R. W. Short, TO5.00006, this conference.

# The shared TPD modes also exist outside of the plane of polarization

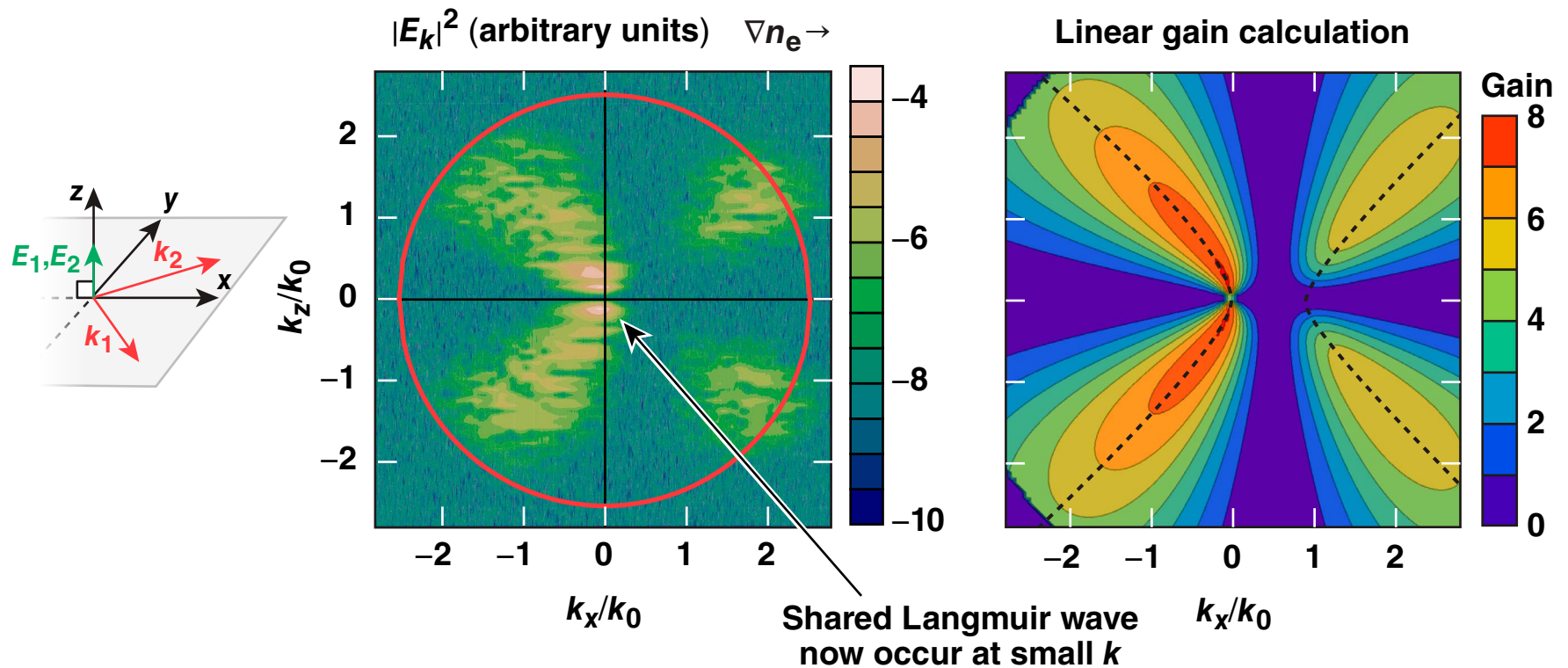
- Energy spectrum in the orthogonal plane of polarization ( $k_x$ - $k_z$  plane)



**This is a 3-D problem.**

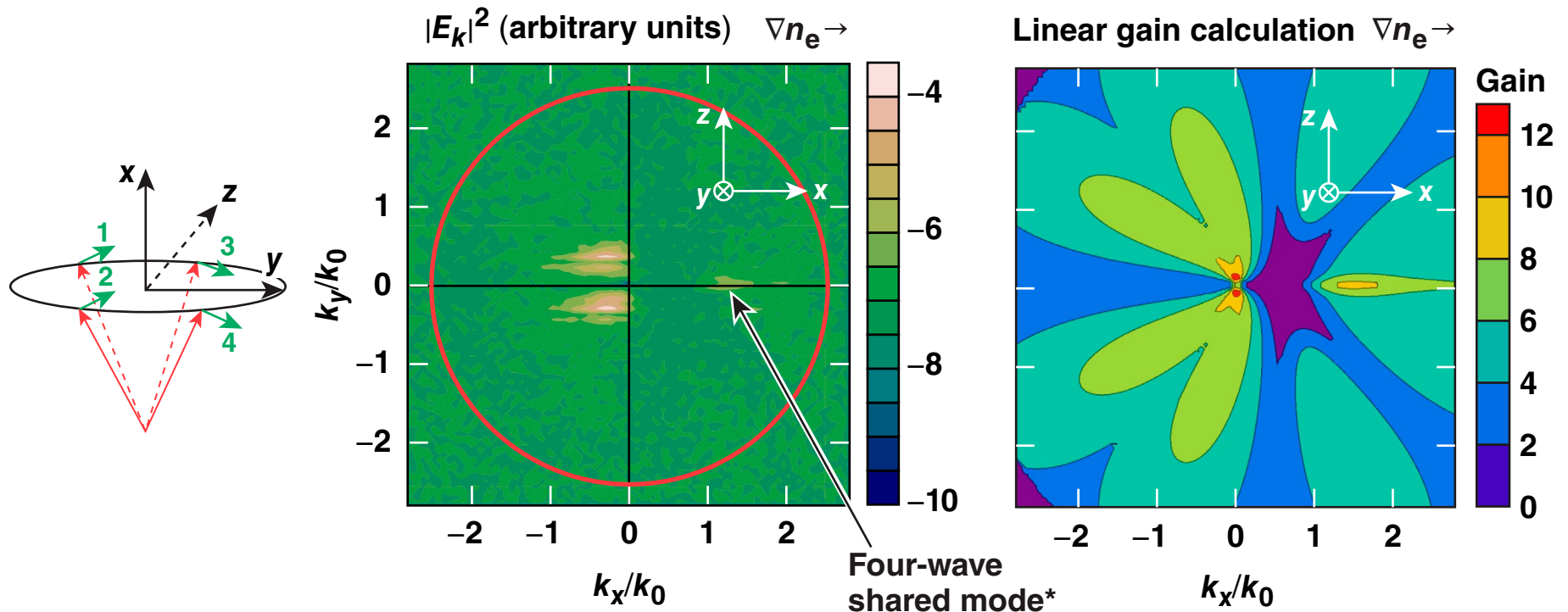
# Two-plane EM waves with out-of-plane polarization show that the shared plasma waves are in the small- $k$ region

- The small- $k$  waves are absolutely unstable\*

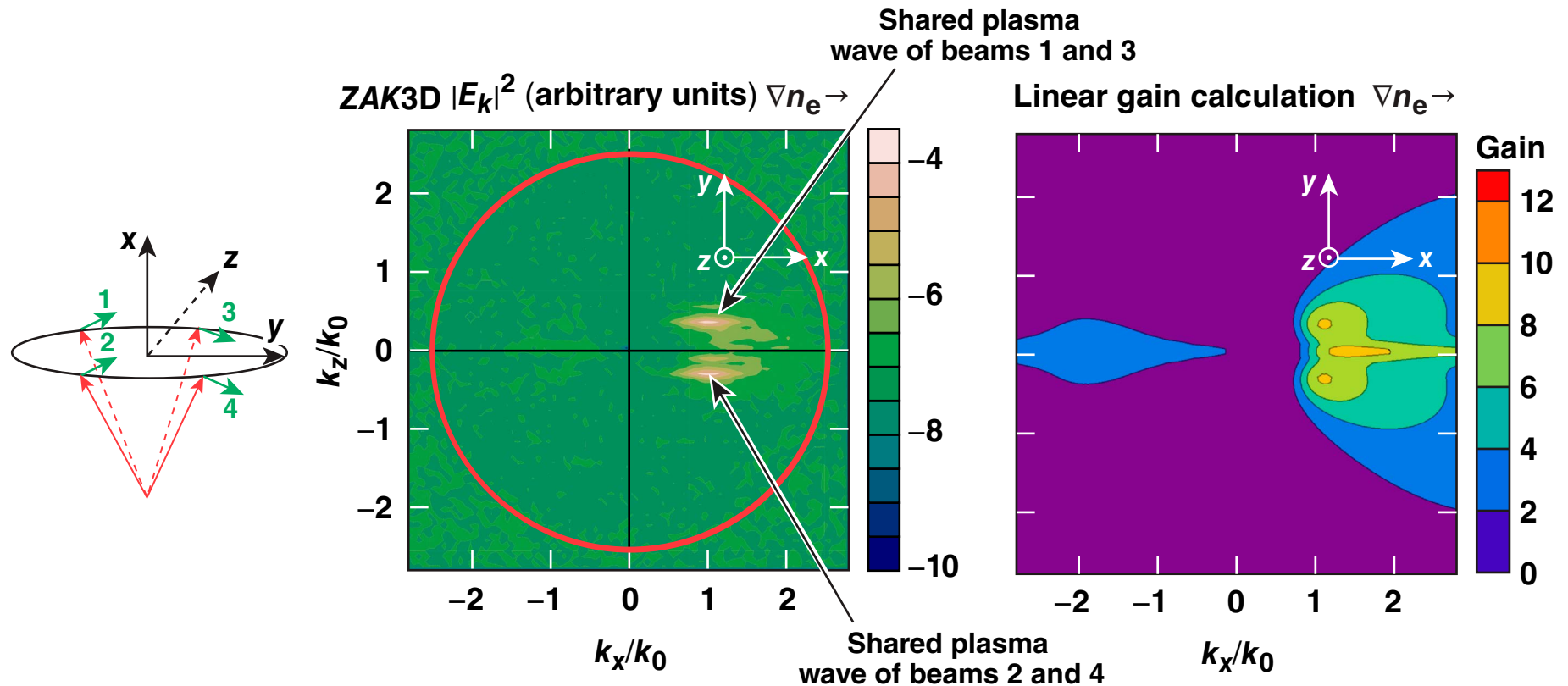


# Irradiation by four-plane EM waves is similar to the experimental configuration on OMEGA EP\*

- In  $k_x-k_y$  plane, beams 1 and 2 and beams 3 and 4 can be regarded as two pairs of beams with out-of-plane polarization



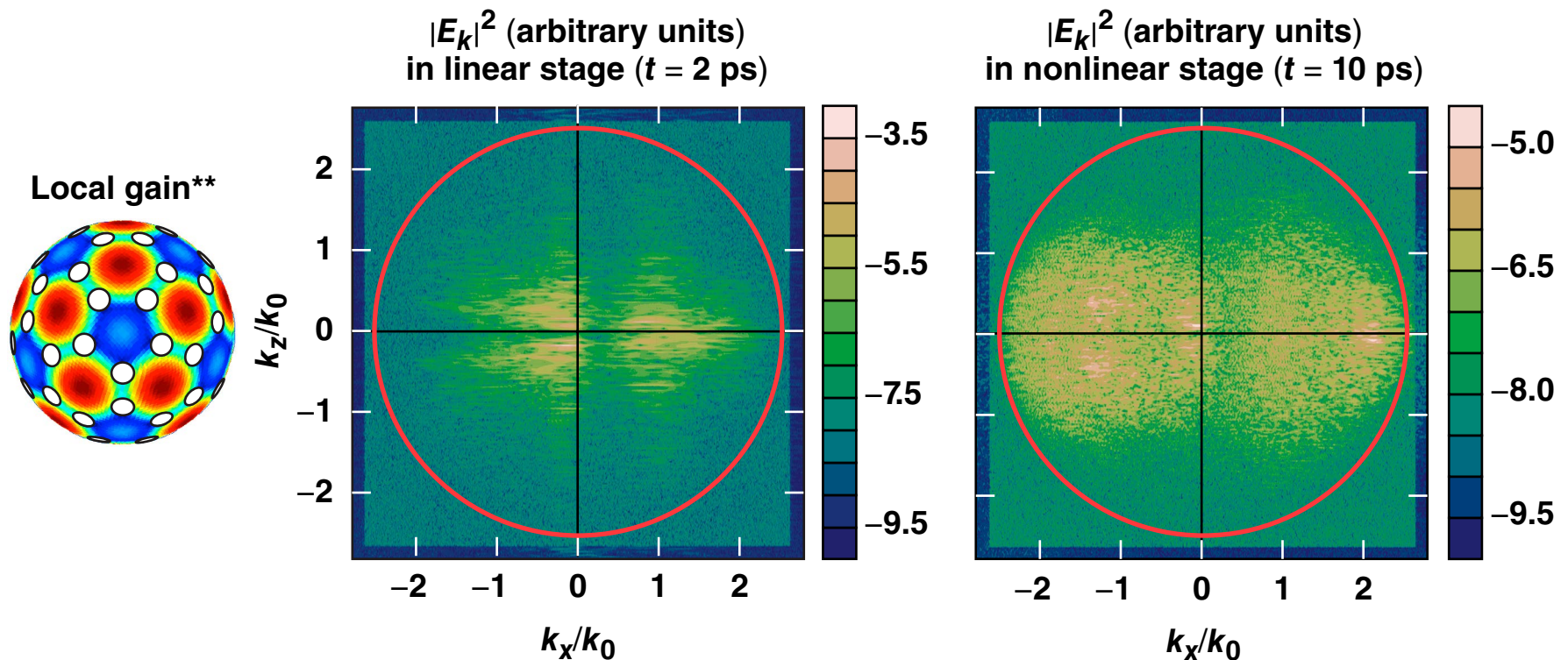
In the  $k_x-k_z$  plane, beams 1 and 3 and beams 2 and 4 can be regarded as two pairs of beams with in-plane polarization





# These calculations can be extended to spherical geometry with an arbitrary number of beams

- The linear growth is consistent with multiple beam theory
- TPD in the nonlinear stage is more important to help understand experiments



\*W. Seka, TO5.00001, this conference.

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

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