

Mitigation of the hose instability in plasma-wakefield accelerators

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The *hose instability* [1] is a long standing challenge for plasma-wakefield accelerators (PWFAs). It is seeded by initial transverse asymmetries of the beam or plasma spatial or momentum distributions. According to current models, the beam centroid displacement is amplified exponentially during the beam propagation in the plasma [2], resulting in an unstable acceleration process or in beam-breakup. However, these models overestimate the hosing growth rates as soon as the drive-beam energy change

becomes significant. This is shown in Fig. 1, which indicates that hosing can be far less pronounced than what has been reported so far. Yet unnoticed, this intriguing result suggests that the blowout regime in PWFA can provide saturation mechanisms for the hose instability, which strongly damp the beam centroid oscillations during propagation.

In this contribution, we present a model which describes the saturation mechanisms in excellent agreement with PIC simulations, thereby demonstrating for the first time the possibility of stable beam acceleration in PWFAs over long distances [3].

References

- [1] D.H. Whittum, W.M. Sharp, S.S. Yu, M. Lampe, and G. Joyce, *Phys. Rev. Lett.* **67**, 991 (1991)
- [2] C. Huang, W. Lu, M. Zhou, *et al.*, *Phys. Rev. Lett.* **99**, 255001 (2007)
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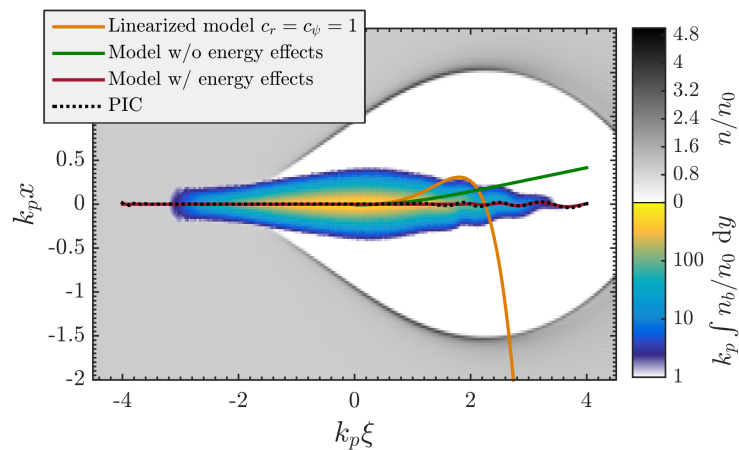


Figure 1: Plasma and beam charge densities from a 3D PIC simulation. The beam is subject to hosing. Lines depict beam centroid from the model in Ref. [1] (orange), from Ref. [2] (green), from a model presented in this contribution (red), and from the PIC simulation (black dashed).