Abstract Submitted
for the DPP14 Meeting of
The American Physical Society

Interplay between Weibel, two-stream and oblique-mode instabilities of the ultrarelativistic electron beam PANPAN RUAN, VLADIMIR KHUDIK, XI ZHANG, GENNADY SHVETS, Department of Physics, Institute for Fusion Studies, the University of Texas at Austin — Electromagnetic and electrostatic instabilities of ultrarelativistic electron beam propagating in dense plasma are studied analytically and through simulations. We develop a hybrid reduced-description code and show that it describes the beam evolution quite close to that reproduced by first-principle PIC VLPL code [1]. We demonstrate that when electromagnetic Weibel instability is suppressed by the large beam temperature, the electrostatic oblique modes quickly grow. The growth rates of the perturbations [2] from the simulations and theory match each other at different temperatures of the beam and plasma. During the non-linear stage, we study the saturation of the instabilities through simulations. The redistribution of the initial beam energy among the beam, plasma, electric and magnetic fields with time is analyzed. The nature of the final non-linear stage of the instability is explained.

[1] A. Pukhov, J. Plasma Phys. 61, 425-433 (1999).
[2] A. Bret et al., Phys. Plasmas 17, 120501 (2010)

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Date submitted: 11 Jul 2014 Electronic form version 1.4