Three-Dimensional Simulation Studies of the Temperature Anisotropy Instability in Intense Charged Particle Beams*

Edward A. Startsev, Ronald C. Davidson, Hong Qin, Princeton Plasma Physics Laboratory, Princeton, NJ 08536

In plasmas with strongly anisotropic distributions ($T_{||b}/T_{\perp b} \ll 1$) a Harris-type collective instability may develop if there is sufficient coupling between the transverse and longitudinal degrees of freedom. Such anisotropies develop naturally in accelerators and may lead to a detoriation of beam quality. The instability may also lead to an increase of longitudinal velocity spread, which would make the focusing of the beam difficult and impose a limit on the minimum spot size achievable in heavy ion fusion experiments. Our previous studies [1] clearly show that moderately intense beams with $s_b = \widehat{\omega}_{pb}^2/2\gamma_b^2\omega_{\beta\perp}^2 \geq 0.4$ are linearly unstable to short wavelength perturbations with $k_z^2 r_b^2 \geq 1$, provided the ratio of longitudinal and transverse temperatures is smaller than some threshold value. This paper reports the results of recent simulations of the temperature anisotropy instability using the Beam Equilibrium Stability Transport (BEST) code for space-charge-dominated, low-emittance beams with $s_b \to 1$. Such high-intensity beams are relevant to the Integrated Beam Experiment (IBX) which would serve as proof-of-principal experiment for heavy ion fusion.

*Research supported by the U. S. Department of Energy.

1. E. A. Startsev, R. C. Davidson and H. Qin, *Physical Review Special Topics on Accelerators and Beams* **6**, 084401 (2003).