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Condition for the onset of the current filamentation instability of ultra-relativistic fireball bunches in plasmas NITIN SHUKLA, JORGE VIEIRA, GoLP/Instituto de Plasma e Fusão Nuclear, Instituto Superior Técnico, Lisbon, Portugal, PATRIC MUGGLI, Max Planck Institute for Physics, Munich, Germany, RICARDO FONSECA, LUÍS SILVA, GoLP/Instituto de Plasma e Fusão Nuclear, Instituto Superior Técnico, Lisbon, Portugal — Current Filamentation Instability (CFI) is capable of generating strong magnetic fields relevant to explain radiation processes in astrophysical objects and lead to the on-set of particle acceleration in collisionless shocks. Probing such extreme scenarios in the laboratory is still an open challenge. It has been proposed that the available 20 GeV electron and positron bunches at the Stanford Linear Accelerator Center could be used to mimic these scenarios by exploring CFI associated with the propagation of a neutral e^-e^+ beam into a plasma [P. Muggli *et al.*, arXIV 1306.4380 (2013)]. In this work, we investigate this possibility by performing numerical 2D PIC simulations using Osiris [R. A. Fonseca *et al.*, Lect. Notes Comput. Sci. 2331, 342 (2002)]. We show that CFI can occur unless the rate at which the beam expands due to finite beam emittance, is larger than the CFI growth rate. We also explore the competition between CFI and the electrostatic two-stream instability (TSI) by changing the e^-e^+ bunch duration. We found that, by keeping the same number of particles, the CFI dominates over the TSI for shorter bunches with larger peak densities.

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