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**Exploring the onset of fireball filamentation in realistic laboratory conditions** NITIN SHUKLA, JORGE VIEIRA, Instituto Superior Tecnico, PATRIC MUGGLI, Max Planck Institute for Physics, GIANLUCA SARRI, Queens University of Belfast, RICARDO FONSECA, LUIS SILVA, Instituto Superior Tecnico — Relativistic high-density quasi-neutral electron-positron (fireball) beams have been recently generated in the laboratory [Sarri 2015] providing a platform to explore processes directly to address unsolved problems in astrophysics [Nakar 2011]. In this work, we present numerical studies [Fonseca 2008], complemented by theoretical estimates, of the interaction of fireball beams with non-zero emittance with plasmas using beam parameters currently available in labs around the world. We show that the ratio between the density of the fireball and background plasma controls a transition between the current filamentation instability (CFI) and the competing transverse two-stream instability. When the density ratio is higher than unity the CFI can grow as long as the beam expansion rate, caused by a finite emittance, is larger than the CFI growth rate. For wide beams, we show that the CFI can also grow as long as the transverse offsets between the beam centroids are smaller than a fraction of the beam transverse dimensions. We find that the longitudinal energy spread, typical of plasma-based accelerated electron-positron fireball beams, plays a minor role in the growth of CFI.

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