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Nonlinear Weibel Instability in collisonal and collisionless plasmas[1] VLADIMIR KHUDIK, CARL SIEMON, GENNADY SHVETS, University of Texas at Austin — The nonlinear stage of Weibel instability of a relativistic beam propagating through ambient plasma is studied analytically and supported by computationally efficient hybrid simulations. In our hybrid approach, beam electrons are modeled using numerical macroparticles while plasma electrons are modeled as a passive fluid instantaneously responding to the beam evolution. Assuming underdense beams, we find the self-similarity law for the nonlinear dynamics of the collisionless Weibel instability (WI). It is found that the electron energy distribution of the beam particles trapped in the filaments is close to Maxwellian. Using the Boltzmann distribution of the electron density in transverse plane, we derive a closed equation describing filament structure, yielding a modified Bennett pinch relation. Also, a theoretical model that utilizes the Bennett pinch relations is used to describe the nonlinear dynamics of the resistive WI and calculate the stopping time of the beam. It is found that the WI initially enhances beam deceleration but then reduces it when compared to a filamentation-suppressed beam (without WI), so that the overall stopping time of the beam is essentially unaffected by the instability.

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