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Gyrokinetic simulations of kink modes in astrophysical jets

JOSEPH MCCLENAGHAN, University of California, Irvine, KEN FOWLER, University of California, Berkeley, HUI LI, Los Alamos National Lab, ZHIHONG LIN, University of California, Irvine — With the prediction that powerful astrophysical jets that are formed around supermassive black holes maintain collimation by presence of a self generated magnetic field, linear MHD theory predicts that these magnetically confined jet plasmas would be unstable to kink modes. Kink modes have been studied extensively in tokamak experiments, theory, and MHD simulations, however, their dynamical evolution can depend on the nonlinear coupling of multiple physical processes. In this work, we have applied Gyrokinetic Toroidal Code (GTC) to study internal kink modes in a proposed jet equilibrium. Linear stability properties suggest that kink modes in astrophysical jets are linearly unstable with reasonable agreement to MHD. Nonlinear saturation amplitude and continued evolution of kink modes are examined to better understand how the jet can remain collimated in the presence of these modes without being disrupted. We also look at the generation of a mean parallel electric field by the nonlinear evolution of internal kink modes and the potential implication of this field on particle acceleration in jets.

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