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Electron temperature effects on plasmoids and Kelvin-Helmholtz vortices in collisionless turbulent plasmas

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In ideal magnetized plasmas, sheet-like field discontinuities, where current and vorticity peak, naturally form. According to the linear theory, these layers undergo fluid and magnetic instabilities whose strength depends on the amplitude of the local magnetic field and flow. In non-ideal plasmas, in presence of magnetic reconnection, the combined action of the sheared flow and the sheared magnetic field broadens the spectrum of the linearly unstable tearing modes and increases their growth rate compared to the static current layer case, both in collisional [1] and collisionless plasmas [2,3]. Recently [2], high resolution numerical simulations of a collisionless plasmas without electron temperature effects addressed the nonlinear dynamics of current and vorticity layers in a turbulent setup. They showed a complex situation in which, due to the presence of strong velocity shears, the typical plasmoid formation, observed to influence the energy cascade in the magnetohydrodynamic context, has to coexist with the Kelvin-Helmholtz instability. The competition among these instabilities affects not only the evolution of the current sheets, that may generate plasmoid chains or Kelvin-Helmholtz driven vortices, but also the energy cascade, that is different for the magnetic and kinetic spectra [2]. Here we present new results that extend the previous analysis by considering the the effect of the electron temperature which enters the plasma model equations via the ion sound Larmor radius.

1) Biskamp, D. 2000, Magnetic Reconnection in Plasmas (Cambridge University Press)
2) Borgno, D. et al. 2022, ApJ 929, 62
3) Grasso, D. and Borgogno, D. 2022, Fluid models for collisionless magnetic reconnection (IOP Publishing)

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