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Energy dissipation and particle acceleration in XRB jets: the potential role of the kink instability

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Previous observational and simulation work has explored the role the kink instability (KI) could play in explaining the phenomenology of active galactic nuclei jets and gamma ray bursts. Internal modes of this instability have been shown to drive conversion of magnetic energy into thermal energy without disrupting the overall flow of the jet. We suggest that these modes may therefore be able to explain the particle acceleration region required for persistent compact jets in X-ray binaries (XRBs). In contrast, external modes can lead to disruption of the overall flow and rapid bursts of magnetic reconnection, which may relate to flaring and the release of discrete ejecta.

We calculate the linear growth rates of the m=1 KI for a range of jet models and parameters. In this talk, I will show that there exist areas of parameter space where a perturbation will grow. Small perturbations on length scales 10^{-3} of the jet base radius grow to significant fractions of the radius of the jet within the expected jet size along the propagation axis ($\sim 10^{-5}$ parsecs). This growth exceeds the limits of the linear regime of this instability and therefore may lead to particle acceleration zones able to explain the observed compact jet's power law spectra. In relation to flaring, we investigate the ability of the KI to grow and dissipate energy on the necessary timescales. Our results suggest that the KI could be an important mechanism for energy dissipation and particle acceleration in XRB jets.

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