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Rotational Stabilization of Magnetically Collimated Jets

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— We investigate the launching and stability of extragalactic jets through nonlinear magnetohydrodynamic (MHD) simulation and linear eigenmode analysis. In the simulations of jet evolution, a small-scale equilibrium magnetic arcade is twisted by a differentially rotating accretion disk. These simulations produce a collimated outflow which is unstable to the current driven $m = 1$ kink mode for low rotational velocities of the accretion disk relative to the Alfvén speed of the coronal plasma. The growth rate of the kink mode in the jet is shown to be inversely related to the rotation rate of the disk, and the jet is stable for high rotation rates. The effect of rigid rotation on the kink mode in a cylindrical plasma is investigated via linear MHD initial value and eigenvalue calculations. The results from both treatments of the problem are shown to be in agreement. These calculations show that rigid-rotation distorts the $m = 1$ kink eigenmode reducing its growth rate and reducing the range of unstable non-resonant wave numbers. We surmise that the change in the linear spectrum explains the undistorted propagation in the nonlinear jet simulations in the large disk rotation regime. By removing individual terms in the momentum equation we show that kink stabilization is due to distortion of the eigenmode via the Coriolis force.

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