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An analytical theory for lateral Rayleigh-Taylor instability of a collimated MHD cylindrical plasma[1] XIANG ZHAI, PAUL BELLAN, Applied Physics, Caltech — A Rayleigh-Taylor (RT) instability is observed in the Caltech plasma jet experiment [1], when the current-carrying plasma tube undergoes kink instability and accelerates laterally from the original axis. This acceleration produces perpendicular to the cylindrical plasma an effective gravity that drives a fast, fine-scale RT which results in a fast magnetic reconnection. None of the existing RT theory considers the situation where a quasi-uniform (effective) gravity is perpendicular to a cylindrical magnetized plasma. We have developed an analytical RT model for this configuration. The effective gravity splits and couples an infinite set of azimuthal modes, leading to a dynamics that combines RT instability, current-driven instability, magnetic tension and cylindrical geometry. The theory successfully explains the RT wavelength and growth rate observed in the Caltech experiment.

[1] Moser, A. L. & Bellan, P. M. Magnetic reconnection from a multiscale instability Cascade. Nature. 482, 379 (2012)

[1]DOE, NSF

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