Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Combined Rayleigh-Taylor and Kelvin-Helmholtz instabilities on cylindrical interfaces VADIVUKKARASAN M, MAHESH V PANCHAGNULA, Indian Institute of Technology Madras — Hydrodynamic instabilities that occur on a fluid interface are of interest to a wide range of applications. We study the combined effect of Rayleigh-Taylor (R-T) and Kelvin-Helmholtz (K-H) mechanisms of instability simultaneously attempting to destabilize a cylindrical interface. Linear stability analysis is used to study the process by which relative velocity (characterized by a Weber number) and acceleration (characterized by a Bond number) induced effects distort the interface. We investigate the effect of three dimensional disturbances and study the effect of varying Bo and We. From the dispersion relation obtained in this study, we are able to recover the R-T and K-H mechanism dispersion relations as special cases. From this study, we observe the occurrence of two-dimensional Taylor and flute modes as well as three-dimensional helical modes. A regime chart is presented in the (Bo,We) space to demonstrate the energy budget in the acceleration and shear induced instability mechanisms. In addition, we show that the length scale associated with the distorted interface is minimum in the helical mode. Finally, we show that an optimal Weber number exists above which it is not beneficial to increase relative velocity based kinetic energy.

Mahesh V Panchagnula
Indian Institute of Technology Madras

Date submitted: 01 Aug 2014 Electronic form version 1.4