Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Gravity, surfactants and interfacial instabilities of shear flows
DAVID HALPERN, ALEXANDER FRENKEL, ADAM SCHWEIGER, University of Alabama — We study the linear-stability properties of slow two-fluid plane Couette-type flows in the presence of gravity and surfactants. If gravity is absent, the flow is unstable in certain regions of parameter space due to insoluble surfactants, while in other parametric regions, surfactants are stabilizing; in the absence of surfactants, gravity may lead to the Rayleigh-Taylor instability while it is stabilizing if the lighter liquid is the top layer. Due to the surfactant, there are two active normal modes, and thus two dispersion curves. For small enough Marangoni numbers Ma, the instability, if any, is longwave at its onset (reported earlier). At larger Ma, the instability close to its onset may be "midwave," where the growth rate is positive for a finite interval of nonzero wavenumbers. We present arbitrary-wavenumber results that involve the Bond number, Ma, the velocity-shear, the viscosity ratio and the aspect ratio of the two layers. We also present results for the special limit of infinite aspect ratio. There are dispersion curves with two maxima - a result of the crossing and reconnection of the dispersion curves as Ma or another parameter varies. Also, as Ma increases, for fixed values of the other parameters, the flow instability may switch on and off multiple times.

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Date submitted: 07 Aug 2012 Electronic form version 1.4