Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Suppression of the Rayleigh-Taylor instability in a confined geometry SAMAR ALQATARI, THOMAS VIDEBAEK, University of Chicago, PEKO HOSOI, IRMGARD BISCHOFBERGER, Massachusetts Institute of Technology —

We study the Rayleigh-Taylor instability of two miscible fluids in a Hele-Shaw geometry; confined in a thin gap, of size b, between two large flat plates. Using this geometry, we inject a fluid into another with a different density as to produce an unstable situation in which a heavy fluid initially resides above a layer of lighter fluid. Below a critical gap spacing, b_c, we find that no Rayleigh-Taylor fingers form despite the fluid density gradient that typically instigates the instability. We use simulations, validated by comparison with experiments, to determine b_c as a function of the difference of fluid densities $\Delta\rho$, the viscosities η, and diffusivities D. We argue that this critical confinement scale is set by a competition between destabilizing buoyancy forces and stabilizing effects of viscosity and diffusion. An argument based on dimensional analysis gives scaling exponents consistent with the observed results, $b_c \sim (D\eta/g\Delta\rho)^{1/3}$. In addition to the critical gap, we measure the characteristic wavelength and onset time in this confined geometry and compare it to the theoretical predictions for the Rayleigh-Taylor instability in open space.

Samar Alqatari
University of Chicago

Date submitted: 01 Aug 2019 Electronic form version 1.4