Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Two-layer fluid flows on inclined surfaces KASTURI SHAH, Massachusetts Institute of Technology, SAMUEL PEGLER, University of Leeds, BRENT MINCHEW, Massachusetts Institute of Technology — We present a theoretical and experimental study of the dynamics of two-layer viscous fluid flows on inclined surfaces, motivated by natural and industrial phenomena involving the interactions between two fluid layers. A general model describing the evolution of two fluids on an inclined substrate is developed and explored to reveal a rich variety of flow regimes for different modes of release. For the canonical example in which two fluids are introduced at a constant flux, the flow forms two regions: an upstream region containing both fluids, and a downstream region comprised purely of the lighter fluid, with a sharp intervening jump in thicknesses between the two. By constructing similarity solutions, we establish a full regime diagram of the possible configurations over all asymptotic limits of the viscosity, flux and density ratios. For the release of two fixed volumes of fluid, the layers separate completely into two disjoint but connected regions, contrasting in essential structure from the constant-flux case. Even a small volume of the heavier fluid is able to significantly accelerate the propagation of the lighter fluid in front of it. Excellent agreement is found between our theoretical predictions and the results of a series of laboratory experiments.

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Date submitted: 27 Jul 2020 Electronic form version 1.4