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Dispersive Hydrodynamics in Viscous Fluid Conduits NICHOLAS LOWMAN, MARK HOEFER, Department of Mathematics, North Carolina State University — The evolution of the interface separating a conduit of light, viscous fluid rising through a heavy, more viscous, exterior fluid at small Reynolds numbers is governed by the interplay between buoyancy and viscous stress. Perturbations about a state of vertically uniform, laminar conduit flow are considered in the context of the Navier-Stokes equations with appropriate boundary conditions, which lead systematically to a maximal balance between buoyancy driven, nonlinear self-steepening and viscous, interfacial stress induced, nonlinear dispersion. This results in a scalar, nonlinear partial differential equation describing large amplitude dynamics of the cross-sectional area of the intrusive fluid conduit. Unsteady perturbations of the uniform state have been shown in a laboratory setting to produce hallmark features of nonlinear, dispersive systems including solitary waves and nonlinear wave trains, i.e. dispersively regularized shock waves (DSWs). Shock waves solutions to the conduit equation for step-like initial data exhibit novel DSW behaviors, including backflow and DSW implosion. The asymptotic analysis shows that these fully nonlinear, dispersive hydrodynamic features of the reduced model are experimentally accessible in viscous fluid conduits.

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