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Wavebreaking of Interfacial Stokes Flows[1] MICHELLE MAIDEN, University of Colorado Boulder, NICHOLAS LOWMAN, North Carolina State University, DALTON ANDERSON, MARK HOEFER, University of Colorado Boulder
— Viscous fluid conduits provide a versatile system for the study of dissipationless, dispersive hydrodynamics. A dense, viscous fluid serves as the background media through which a less dense, less viscous fluid buoyantly rises. If fluid is continuously injected into the exterior fluid, an interface forms that behaves like a deformable pipe. Conservation of mass implies that the interfacial dynamics are conservative, i.e., they behave like a superfluid. Through buoyancy, high viscosity contrast, and a long wave assumption, conduit interfacial dynamics can be modeled by a scalar, nonlinear, dispersive wave equation with no assumption on amplitude. Experiments involving solitons, wavebreaking leading to dispersive shock waves (DSWs), and their interactions will be presented. The results include the refraction and absorption of a soliton by a DSW and the refraction of a DSW by a second DSW, resulting in two-phase behavior. Excellent agreement between nonlinear wave (Whitham) averaging, numerics, and laboratory experiments will be presented. The nonlinear wave dynamics observed in this model system have implications for a broad range of other conservative dispersive hydrodynamic systems.

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