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Confinement-induced stabilization of the Rayleigh-Taylor instability and transition to the unconfined limit SAMAR ALQATARI, THOMAS VIDEBAEK, SIDNEY NAGEL, University of Chicago, ANETTE HOSOI, IRMGARD BISCHOFBERGER, Massachusetts Institute of Technology — The Rayleigh-Taylor instability, which arises when a fluid sinks into and displaces a lighter one below it, is relevant in many situations: modeling type Ia supernovae in universal expansion, stabilizing ignition in inertial confinement fusion, and understanding the formation of salt fingers in the ocean. We prepare a density inversion between two miscible fluids in the thin gap between two plates, creating a clean initial stationary interface. Under these conditions, we find no Rayleigh-Taylor fingers are formed below a critical plate spacing. As we increase the plate separation, the system transitions from a stable regime where the diffusion of mass dominates the buoyant forces, through a regime where the gap sets the wavelength of the instability, and finally to the unconfined regime governed by the competition between buoyancy and momentum diffusion. We compare this miscible case to its immiscible counterpart, where diffusion is negligible and the effects of surface tension dominate. Our study, including experiment, simulation and linear-stability analysis, characterizes all regimes of confinement for the miscible and immiscible Rayleigh-Taylor instability.

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