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The stability of a rising droplet: an inertialess nonmodal growth mechanism[1] GIACOMO GALLINO, LAILAI ZHU, FRANCOIS GALLAIRE, Laboratory of Fluid Mechanics and Instabilities, EPFL — Past modal stability analysis (Kojima et al. 1984) predicted that a rising or sedimenting droplet in a viscous fluid is stable in the presence of surface tension no matter how small, in contrast with experimental and numerical results. By performing a non-modal stability analysis, we demonstrate the potential for transient growth of the interfacial energy of a rising droplet in the limit of inertialess Stokes equations. The predicted critical capillary numbers agree well with that from direct numerical simulations reported in the literature (Koh & Leal 1989). Boundary integral simulations are used to delineate the critical amplitude of the most destabilizing perturbations. The critical amplitude is negatively correlated with the linear optimal energy growth, implying that the transient growth is responsible for reducing the necessary perturbation amplitude required to escape the basin of attraction of the spherical solution.

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