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Non-linear state selection of axially confined viscous liquid jets[1] ALEJANDRO SEVILLA, ALEJANDRO MARTíNEZ-CALVO, MARIANO RUBIO-RUBIO, Fluid Mechanics Research Group, Universidad Carlos III de Madrid — Viscous liquid jets injected at a constant flow rate vertically downwards into a gaseous atmosphere become globally unstable when the flow rate becomes smaller than a certain critical value. Previous experiments are in good agreement with a global linear stability analysis based on the leading-order one-dimensional (1D) mass and momentum conservation equations, provided that the full curvature is retained in the computations. However, linear theory cannot predict the large-time dynamics of the jet under globally unstable conditions. To that end, here we report new experiments and numerical simulations of the 1D model, showing that the unstable jet may exhibit two markedly different non-linear states in the long term: either a limit cycle featuring self-sustained oscillations without break-up, or a fully-developed dripping regime emerging after the break-up of the liquid column. A bifurcation analysis demonstrates that the length of the jet is the key parameter that controls the selection of the final state. The dependence of the critical length on the liquid viscosity, the injector radius and the liquid flow rate are also characterized in detail.

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