Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Torricelli's curtain: morphology of horizontal laminar jets under gravity NEIL RIBE, GABRIEL PATERNOSTER, MARC RABAUD, Laboratoire FAST, Orsay — It has been "known" since the seventeenth century that a jet of water issuing horizontally from a hole in the side of a bucket describes a parabolic trajectory. However, this bit of canonical fluid mechanical lore is wrong in many cases. Our recent experiments performed on laminar jets issuing from a horizontal tube show that the initially round jet typically evolves into a thin vertical curtain bounded by bulbous rims at its upper and lower extremities. Moreover, injected dye reveals the presence of a recirculating flow with helical streamlines around the jet's axis. To understand this behavior, we formulate an analytical model for the near-orifice structure of the jet in the limit of large Froude number $Fr \equiv \epsilon^{-1} \gg 1$. We find that a recirculating flow is generated by the sinusoidal variation of the nonhydrostatic pressure around cross-sections of the jet at order ϵ, and that deformation of the cross-section occurs at order ϵ^2. We also use the volume-of-fluid code Gerris to study numerically the evolution of the jet's morphology as a function of the Reynolds, Froude and Ohnesorge numbers, and compare the results with our analytical theory and with laboratory experiments.

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Date submitted: 03 Aug 2012 Electronic form version 1.4