Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Steady Buckling of Viscous Capillary Jets NEIL RIBE, CNRS, University Paris-Saclay, Orsay, France, JINGXUAN TIAN, XIAOXIAO WU, ANDERSON SHUM, Dept. of Mechanical Engineering, University of Hong Kong — Steady buckling (coiling) of thin falling liquid jets plays an important role in instability-assisted high-resolution printing and ultra-fine liquid dispensing, situations in which the effects of surface tension are likely to be significant. To understand better these capillary effects, we have performed experiments with sub-millimetric jets and ultra-low flow rates ($\approx$ 10 ml/h) together with numerical simulations and linear stability analysis to study a hitherto unexplored coiling regime dominated by capillarity with negligible inertia. We find that the critical fall height H_c for coiling onset decreases with increasing flow rate, a tendency that is opposite to the zero surface-tension case and that has been previously documented only for inertia-dominated coiling. The enhanced resistance to buckling afforded by surface tension increases H_c by up to a factor of 10 relative to the surface tension-free case. A regime diagram in the space of capillary number and jet slenderness agrees closely with the prediction of the linear stability analysis, but differs significantly from the analogous diagram for unsteady buckling of a compressed liquid bridge constructed previously by other workers.

Neil Ribe
CNRS, University Paris-Saclay, Orsay, France

Date submitted: 20 Jul 2019 Electronic form version 1.4