

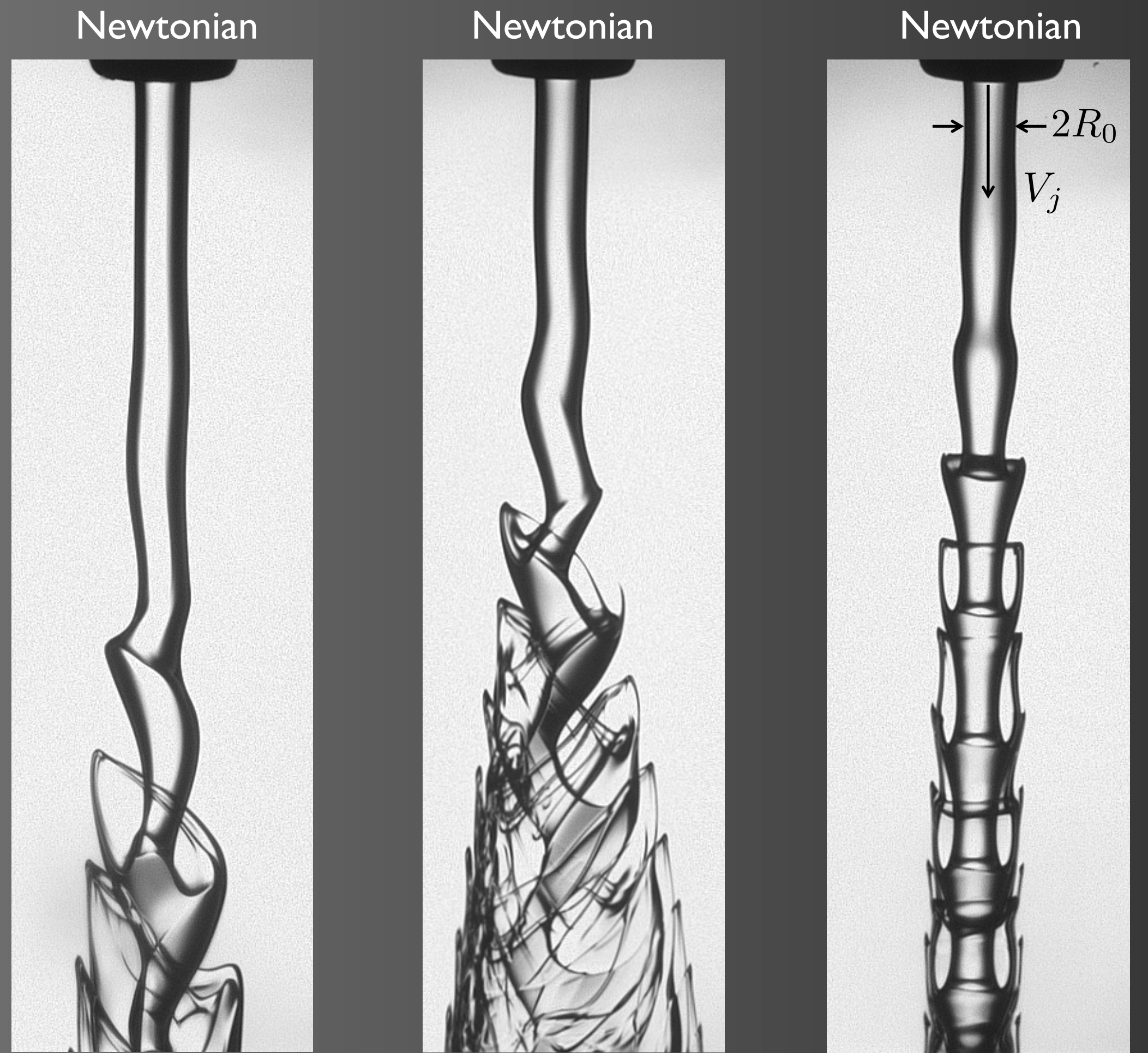
Chevron-like Waves of a Submerged Viscoelastic Jet

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Newtonian jet (water + glycerol) is discharged in the background liquid in the bath, water: $Re_j \equiv \rho V_j D / \mu \simeq 150$, $kR_0 = 0.5$
 $\rho / \rho_w = 1.1$, $\mu / \mu_w = 3$



$kR_0 = 0.52$

$kR_0 = 0.66$

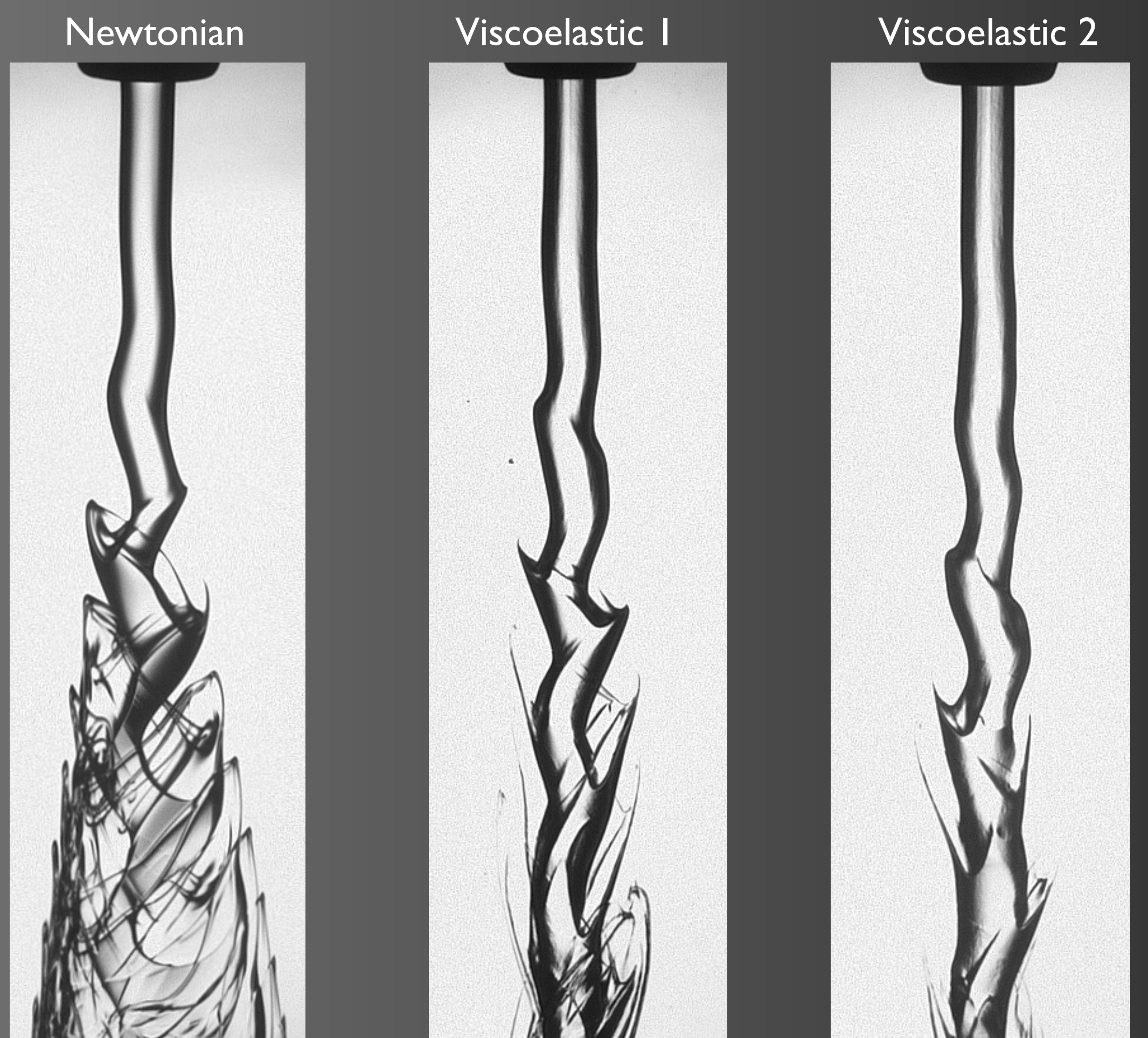
$kR_0 = 0.80$

$kR_0 \equiv 2\pi f R_0 / V_j$ Increasing Perturbation freq.

A novel experimental setup, equipped with strobe imaging, is used to study the instability patterns of a submerged liquid jet. Visualizations for Newtonian liquids show that the jet is unstable to linear perturbations. At low wave-numbers (kR_0), unstable varicose waves pile up into a continuously growing sinuous mode due to the difference in the corresponding wave speeds. This leads to some unique concertina or chevron-like patterns. For viscoelastic jets, the wave growth is substantially inhibited by the streamline tension due to the added elasticity.

References:

G. K. Batchelor and A. E. Gill, "Analysis of the stability of axisymmetric jets," J. Fluid Mech., 1962.
 J. M. Rallison and E. J. Hinch, "Instability of a high-speed submerged elastic jet," J. Fluid Mech., 1994.



$El = 0.00$

$El = 0.08$

$El = 0.10$

$El \equiv \tau \eta_p / \rho R_0^2$

Increasing Elasticity at fixed velocity and freq.

$Re_j \equiv \rho V_j D / \mu \simeq 150$, $kR_0 = 0.66$