Liquid Ligament Generation at a Free Surface

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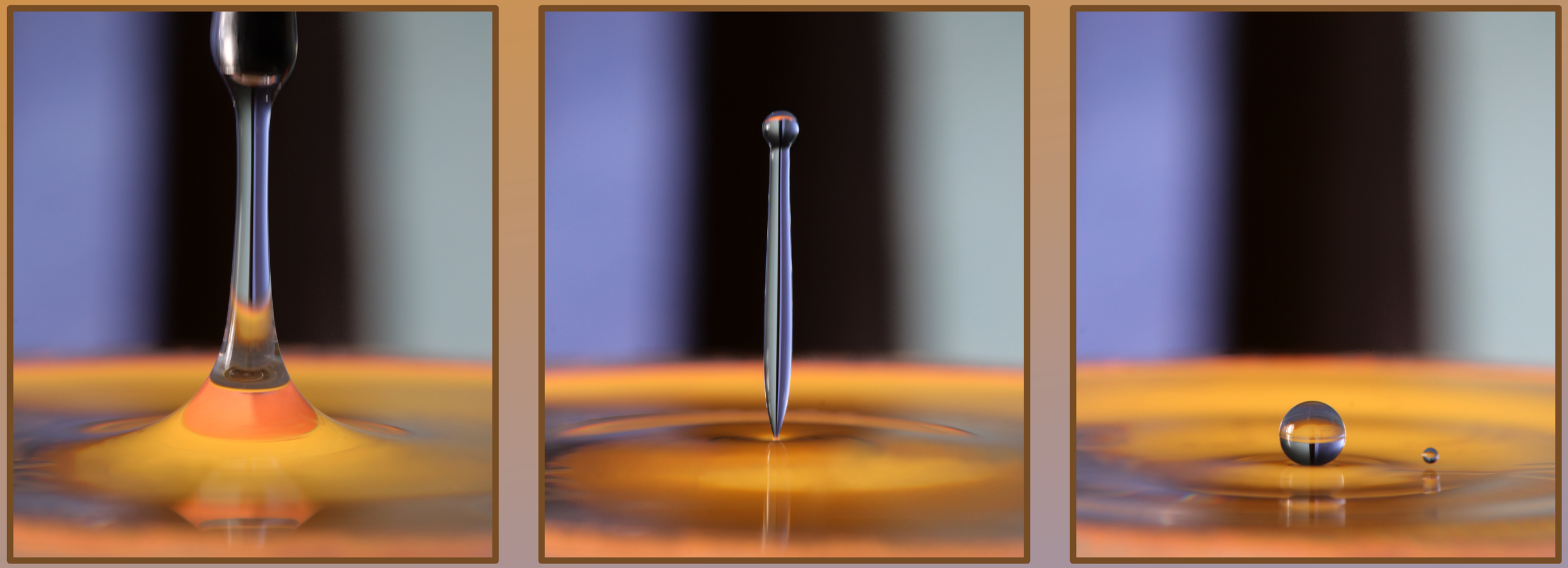

A small metal cylinder is rapidly extracted from a free surface resulting in the generation of a liquid ligament, which ultimately contracts to form a droplet.

A stainless steel cylinder of diameter 1.7 mm is partially submerged beneath an air-oil interface. The cylinder is connected to the shaft of an air piston actuated by a solenoid valve which rapidly retracts the partially submerged cylinder at approximately 400 mm/s. A liquid ligament forms at the free surface [1] which then contracts to form a droplet. This controlled extraction technique can be used to generate droplets of a repeatable size from a quiescent bath [2]. The size of the resulting droplet or droplets depends sensitively on the speed of retraction, the cylinder diameter, and the fluid properties [3] as well as on the initial immersion depth. In particular, larger droplets are created as the initial immersion depth is increased. For the experiments shown, a 10 cSt silicone oil is used.

[1] Marmottant, P., & Villermaux, E. (2004). Fragmentation of stretched liquid ligaments. *Physics of Fluids*, 16(8).
[2] Protière, S., Boudaoud, A., & Couder, Y. (2006). Particle–wave association on a fluid interface. *J. Fluid Mechanics*, 554.
[3] James, D. F., & Pouran, M. (2009). Droplet formation in quickly stretched liquid filaments. *Rheologica Acta*, 48(6).

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