

Liquid sheet & Periodic Atomization

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When two jets collide, a liquid sheet forms perpendicular to the jets' plane. Based on Reynolds number, different patterns are shaped including chain pattern, close rim, and open rim. Some asymmetrical perturbations make the liquid sheet to be unstable, consisting of misalignment in colliding of the two jets and the difference in two jets velocity. An unstable specified liquid sheet pattern found in abnormal conditions is the fishbone pattern, which resembles a planar fish skull and periodic ligaments ramifying droplets like fish ribs. Besides, these two asymmetrical conditions turns the liquid sheet, shown in the above figures in different side of views. The trend of shape variations were depicted for different Reynolds number in the following figure: where unstable waves are amplified, and the ligaments were ramified from the rim.



The working fluid was Water-Glycerol Mixture, with $\sigma=62\text{mN/m}^3$ and $\mu=15\text{mPa.s}$. The liquid emanates from two stainless steel hypodermic needle with square ends and internal diameter of 0.61 mm. The images were captured by a high-power pulsing LED-based shadowgraphy system, commercially called PhotoFreezer 2.70. The exposure time was limited to 125 ns, radiated up to 100 fps. A 7200-D Nikon camera equipped by 200mm micro Nikkor f/4 IF-ED was also used to record high-resolution (24 Megapixel) images.

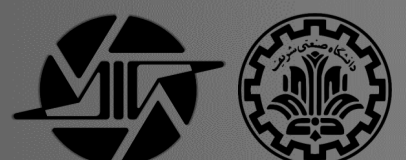
The non-dimensional parameters are defined as follows:

$Re = \rho u_j d_j / \mu$, $\lambda = |u_{j1} - u_{j2}| / u_{j1}$, $\varepsilon = y / d_j$
where y is the distance between jets center.

Ref:

A. Kebriaee, S. Kashanj, G. Oliaei, Atomization and Sprays, (Accepted Aug. 2018).

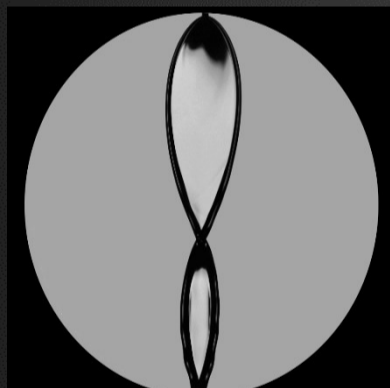
www.ae.sharif.ir
www.arsin.co



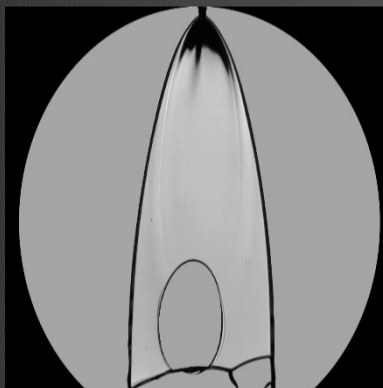
Identical colliding jets



Re= 150, Triple Chain

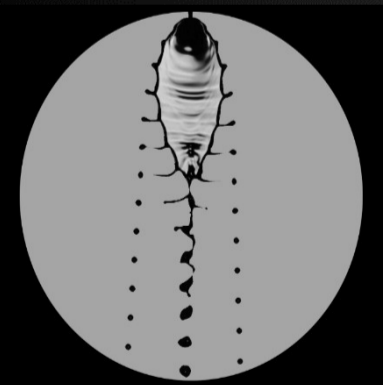


Re= 230, Double Chain

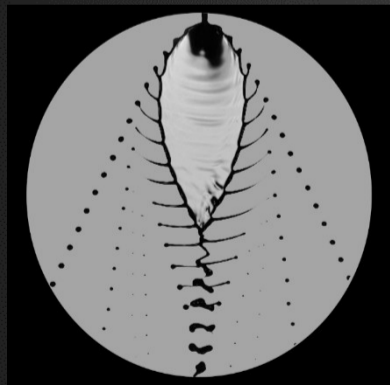


Re= 302, Open rim

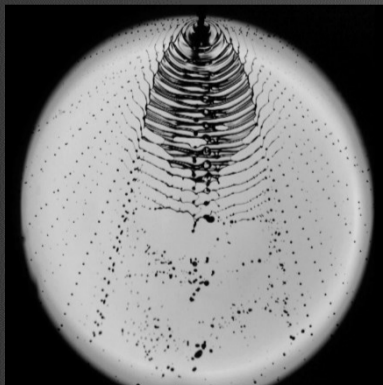
Different Jets Velocity



Re= 195, $\lambda=0.22$

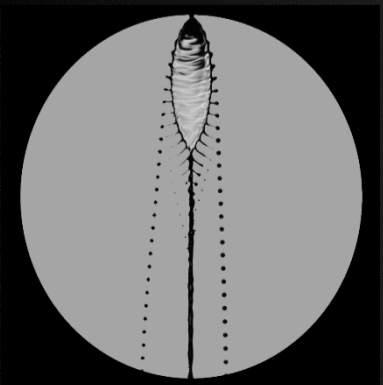


Re= 265, $\lambda=0.04$

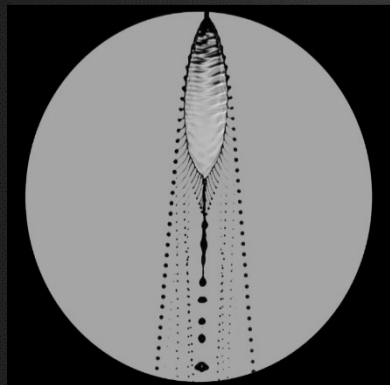


Re= 340, $\lambda=0.06$

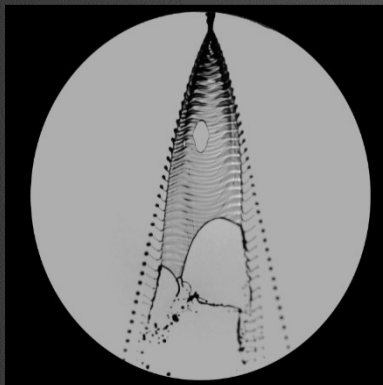
Misaligned Colliding Jets



Re= 192, $\varepsilon=0.43$



Re= 235, $\varepsilon=0.36$



Re= 345, $\varepsilon=0.62$