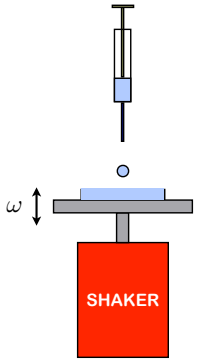
The lifetime of bouncing droplets

D. Terwagne, N. Vandewalle & S.Dorbolo

University of Liège, Belgium

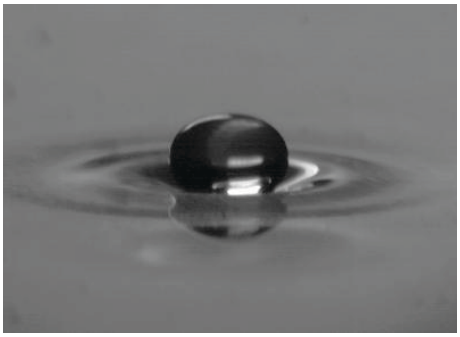
GRASP
Group for Research and Applications in Statistical Physics

Experimental setup



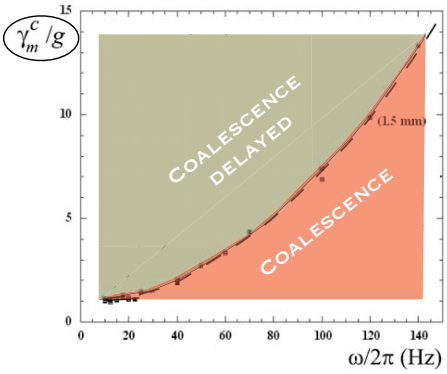
- 1.5 mm diameter
- viscosity 50cSt
- frequency 20-200 Hz
- Acceleration < 10g

The bouncing droplet



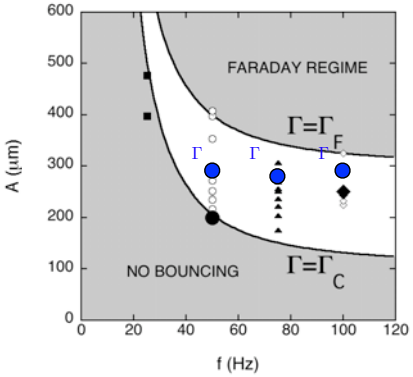
$\Gamma \quad \frac{\omega}{\quad}$

Bouncing threshold

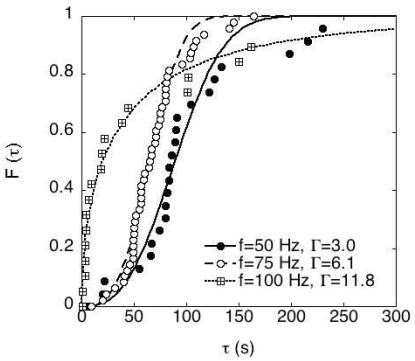


Y. Couder, E. Fort, A. Boudaoud, and H. Gautier, Phys. Rev. Lett. 94, 177801 (2005)

Phase diagram



Lifetime distribution

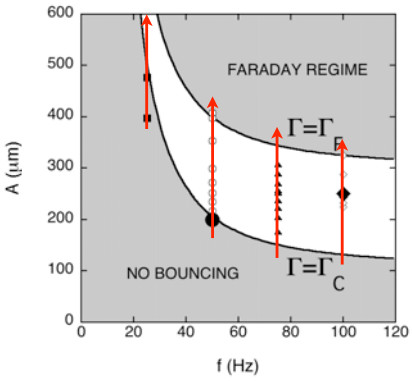


Γ	α	τ
2,	0,	6 -,
52	3 -	0 - 50
- ,	- - 6	, 3 07 -

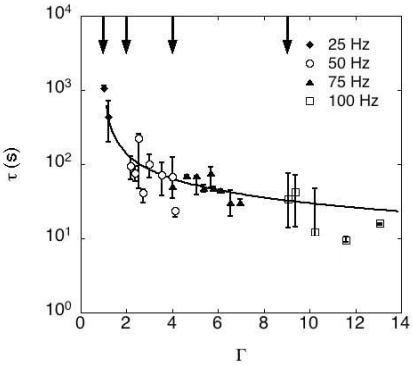
Weibull distribution →

$$F(\tau) = 1 - e^{-\tau^{\alpha}}$$

Phase diagram

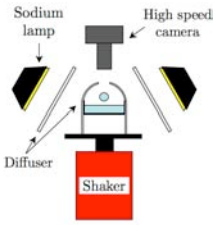


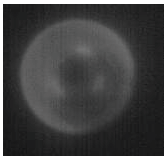
Lifetime

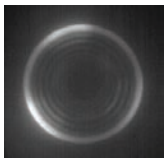


$$\tau \propto \frac{1}{\Gamma - \Gamma_F}$$

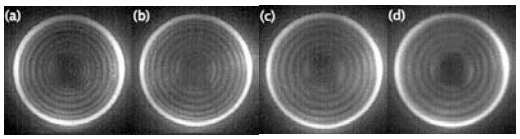
Interference fringes







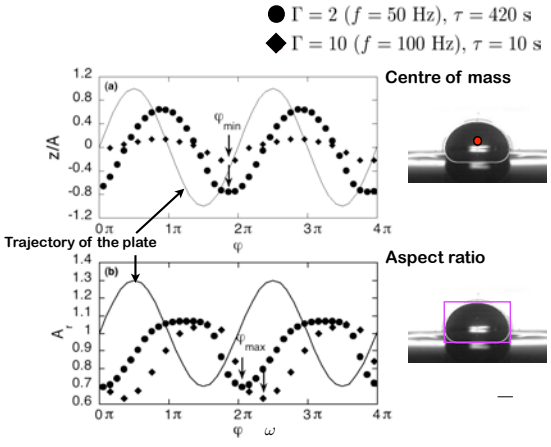
Interference fringes



- Decrease of the thickness for the minimum air film when frequency is increasing

  ⟶ Arrhenius law

Trajectories and deformations

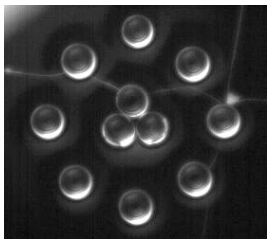


Conclusions

- Lifetime of bouncing droplets decreases with Γ and diverges for Γ=1 and f=25Hz.
  - Broad Weibull distribution for lifetimes
    - probabilistic mechanism
  - Interference fringes
    - periodic motion during the whole life
    - thickness of the minimum for the air film layer decreases with the frequency increasing

      → lifetime depends of thickness
  - Trajectory/deformation of the droplet
    - gives an explanation for the minimum of the air film

Thank you



D. Terwagne, N. Vandewalle & S. Dorbolo, Phys. Rev. E, in press (2007)