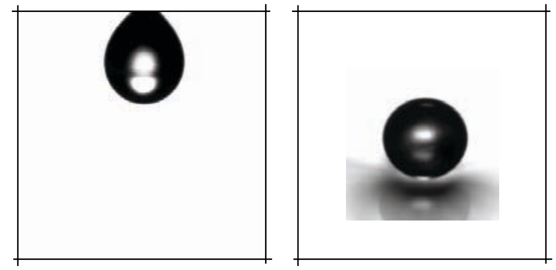
GRASP
Group for Research and Applications in Statistical Physics

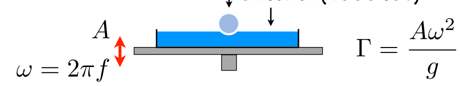
A drop of spectroscopy

D. Terwagne, T. Gilet, N.Vandewalle & S. Dorbolo
University of Liège - Belgium

The Phenomenon



How to avoid coalescence?



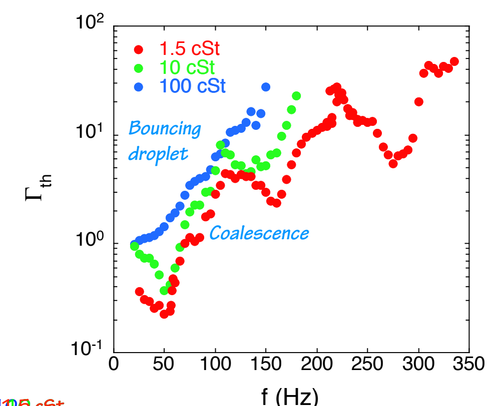
-> Vibrate the liquid surface

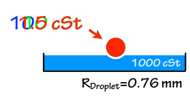
Y. Couder *et al.*, Phys. Rev. Lett. 94, 177801 (2005)

Plan

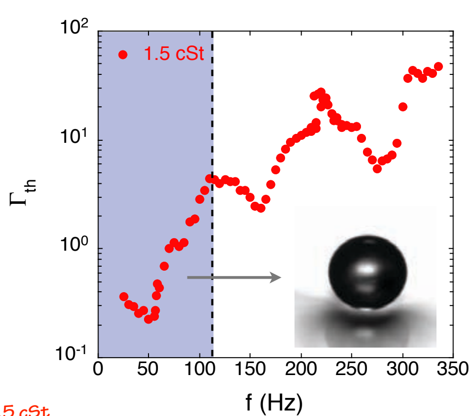
1. Bouncing droplet mechanism
2. Resonant and rolling droplet

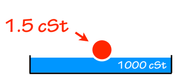
Bouncing Threshold





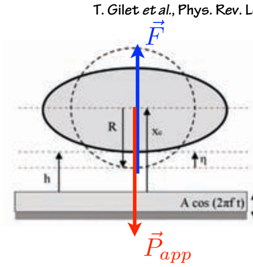
Bouncing Threshold





Bouncing droplet mechanism

T. Gilet *et al.*, Phys. Rev. Lett. 100, 167802 (2008)



Bouncing droplet $\vec{F} \leftrightarrow \vec{P}_{app}$

↑

Lubrication force

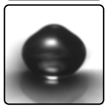
↑

Dynamic of the air film

↑

Droplet deformation NEW

Bouncing droplet mechanism



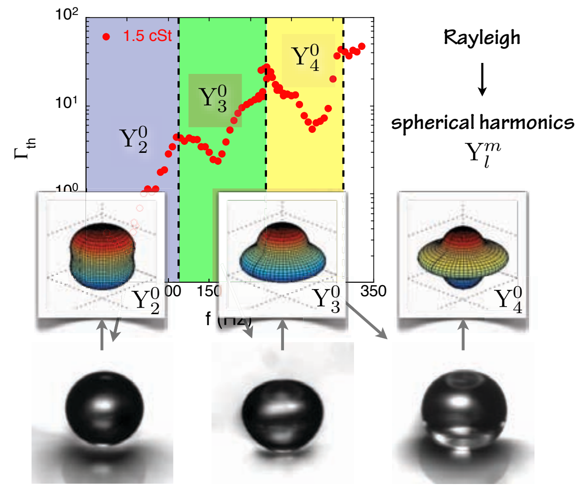
Bouncing droplet = Damped driven harmonic oscillator

- surface tension = restoring force
- viscosity = damping process

Threshold curve

- minimum : system resonance frequency ω_{res}
- divergence : droplet natural resonance ω_c

Bouncing Threshold



Rayleigh

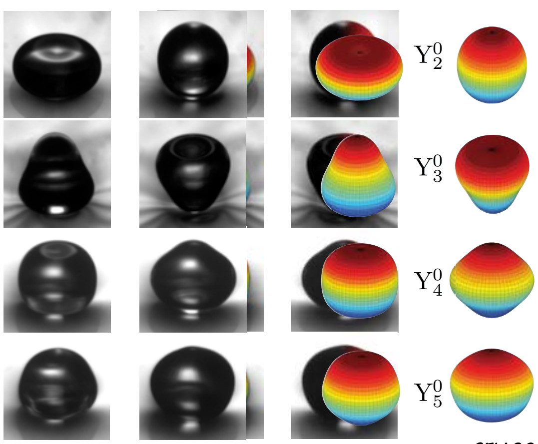
↓

spherical harmonics Y_l^m

see GFM 2008

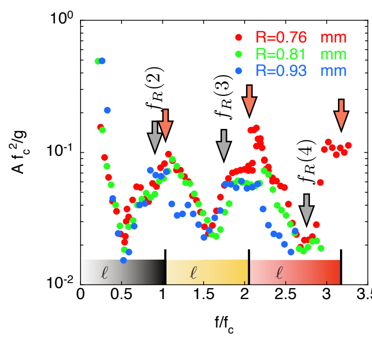
Spherical Harmonics

Experimen & Model



see GFM 2008

Resonant Modes



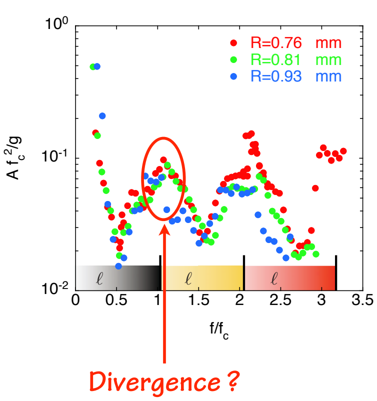
$\alpha = 1.15$

$$\left(\frac{f_R(\ell)}{f_c}\right)^2 = \frac{1}{3\pi}\ell(\ell-1)(\ell+2)$$

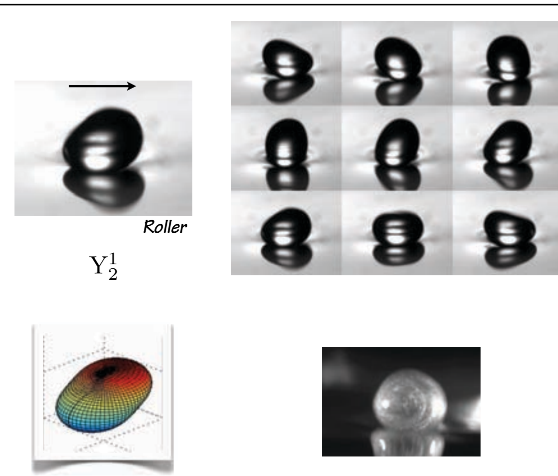
$f_c = \sqrt{\sigma/M}$ with $M = 4/3\pi\rho R^3$

Usually, $f_{Resonance}(\ell) = \alpha f_R(\ell)$ with $\alpha \rightarrow$ excitation geometry

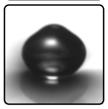
Roller Mode



Roller Mode



Conclusions & perspectives



Bouncing droplet mechanism

- Bouncing droplet = damped driven harmonic oscillator
- Threshold curve extrema -> resonance

Self-propelled droplet

- Roller

Mayonnaise droplet

see GFM 2008

S. Dorbolo *et al.*, New J. Phys. 10, 113021 (2008)
T. Gilet *et al.*, Phys. Rev. Lett. 100, 167802 (2008)