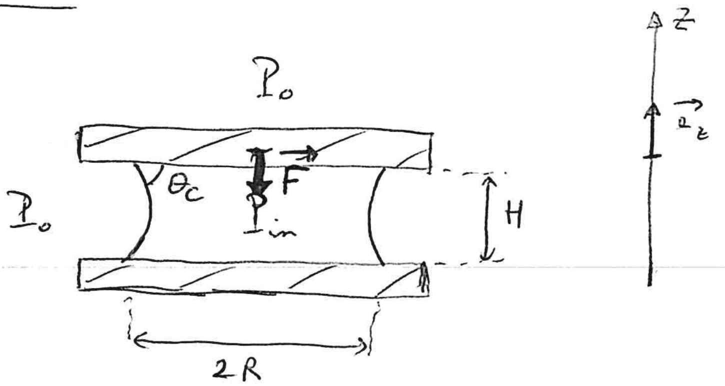
2/ Capillary adhesion



- $H << l_c \Rightarrow$ effects of gravity negligible.
- 2 contributions to the attractive force $\vec{F}$:
  - capillary action : $-2\pi\gamma R \sin\theta \, \vec{e_z}$
  - pressure difference $= -\gamma \mathcal{H} \pi R^2 \vec{e_z}$

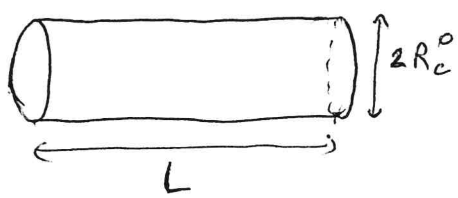
    when $\mathcal{H}$ = mean curvature $= \gamma\left(\frac{2\cos\theta}{H} - \frac{1}{R}\right)$.

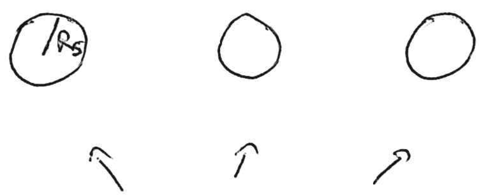
$$\Rightarrow \boxed{\vec{F} = -\left[2\pi\gamma R \sin\theta + \gamma\left(\frac{2\cos\theta}{H} - \frac{1}{R}\right)\pi R^2\right]\vec{e_z}}$$

when $H << R$: $\boxed{\vec{F} = -\frac{2\gamma\cos\theta}{H}\pi R^2 \vec{e_z}}$

4/ Rayleigh-Plateau instability

4.1 -





N spheres

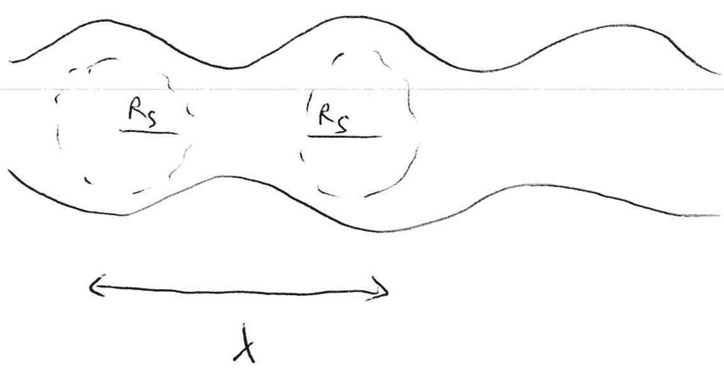
Volume : $V = L\pi R_c^{0\,2}$ $\qquad V = N\frac{4}{3}\pi R_s^3$

Surface : $S_{cyl} \simeq L \times 2\pi R_c^0$ $\qquad S_{sph} = N \cdot 4\pi R_s^2$

2,

$$S_{sph} < S_{cyl} \iff \boxed{R_s > \frac{3}{2} R_c^o}$$

2/ $\lambda \simeq 2 R_s \simeq 3 R_c^o$.



4.2 - $r_c(x) = R_c + \delta r_c \cos(kx)$ $\quad k = \frac{2\pi}{\lambda}$

1. Volume conservat° : $\displaystyle\int_0^\lambda \pi r_c^2(x)\, dx = \pi R_c^{o2} \lambda$

$$\iff \pi \left(R_c^2 + \frac{(\delta r_c)^2}{2} \right) \lambda = \pi R_c^{o\,2} \lambda$$

$$\iff \boxed{R_c = \left[R_c^{o\,2} - \frac{(\delta r_c)^2}{2} \right]^{1/2}}$$

2. $\delta r_c << R_c^o \Rightarrow \boxed{R_c \simeq R_c^o \left(1 - \left(\frac{\delta r_c}{2 R_c} \right)^2 \right)}$

3. Energy variation (per period) : $\displaystyle\Delta E = \gamma \int_0^\lambda 2\pi r_c(l)\, dl - \gamma \int_0^\lambda 2\pi R_c^o(x)\, dx$

(gravity neglected)

$$dl^2 = dx^2 + dr_c^2$$

$$\rightarrow dl \simeq dx \left(1 + \frac{1}{2} \left(\frac{dr_c}{dx} \right)^2 \right)$$

$$= dx \left(1 + \frac{(\delta r_c)^2}{2} k^2 \sin^2 kx \right)$$

$$\Longrightarrow \quad \Delta E = 2\pi\gamma \int_0^\lambda \left[-\frac{(\delta r_c)^2}{4R_c^0} + \delta r_c \cos kx + \frac{R_c^0 (\delta r_c)^2}{2} k^2 \sin^2 kx \right] dx$$

$$\boxed{\Delta E = 2\pi\gamma \, \frac{\lambda\,(\delta r_c)^2}{4R_c^0} \left[R_c^{0\,2} k^2 - 1 \right]}$$

4 - $\Delta E < 0 \iff \boxed{\lambda > 2\pi R_c^{0\,2}}$

<u>Note</u> : the mode that will have the largest ~~e~~ expanding factor is the one effectively selected among all the modes satisfying the above inequality.