

Antibubble collapse: Beyond the Taylor-Culick retraction

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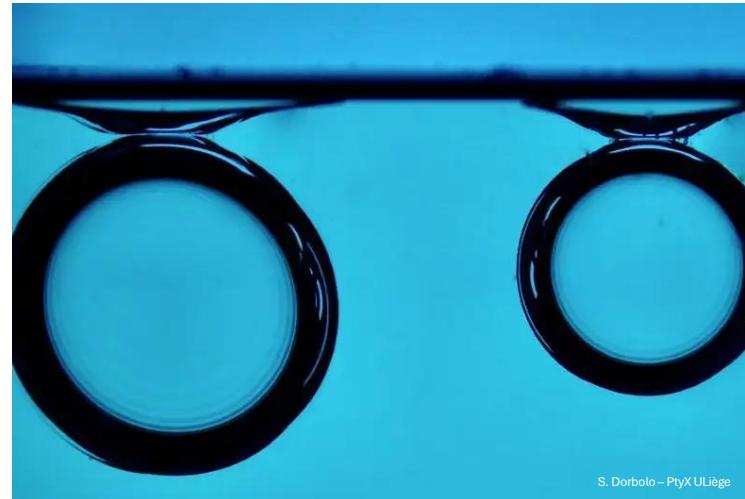
²Tips, Université libre de Bruxelles, Belgium

Bubble or antibubble?

Bubble

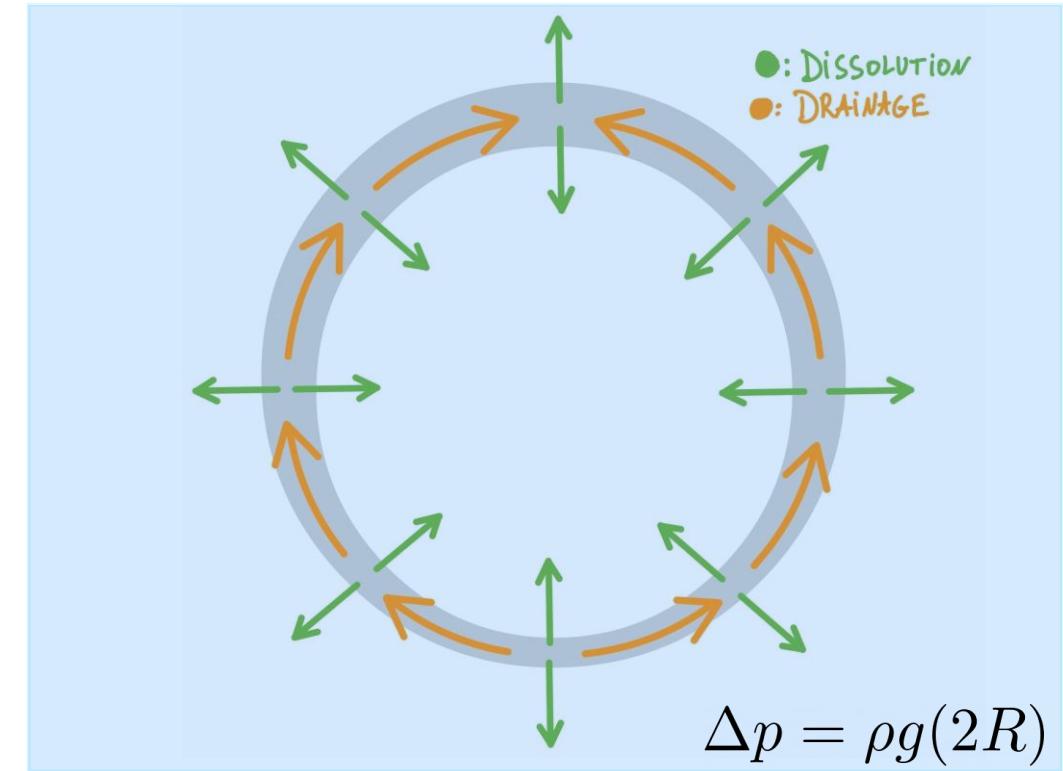


Antibubble



Ephémèritude

- Dissolution
- Drainage
 - Hydrostatic pressure
 - Thickening at the top
 - Thinning at the bottom: Van der Waals



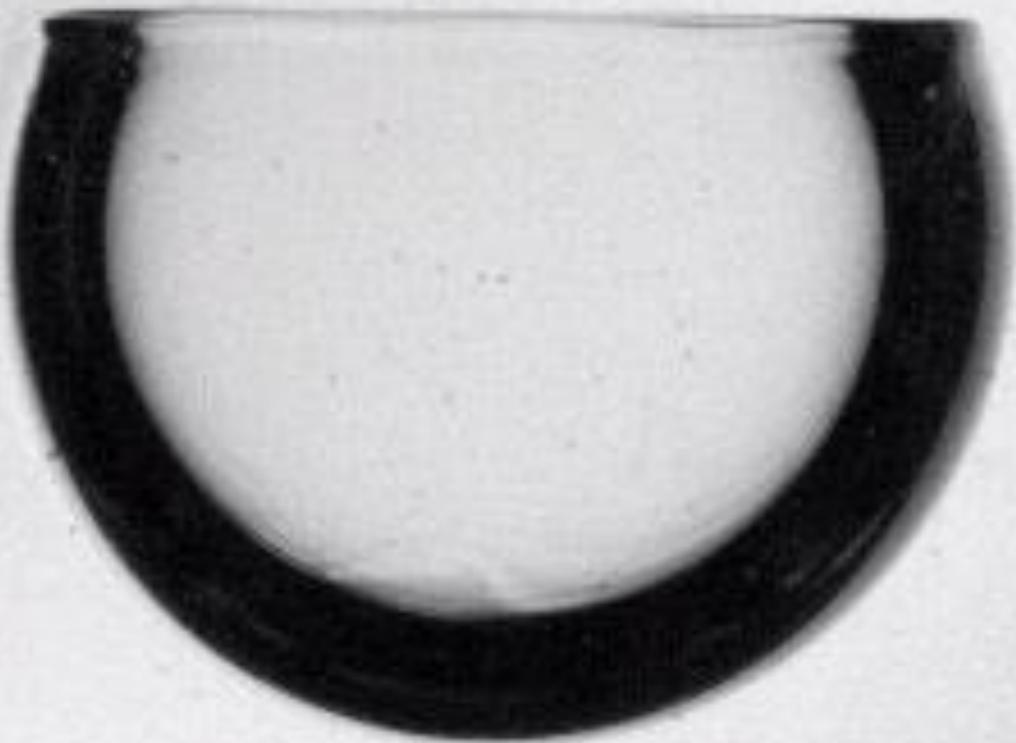
→ What happens when they die?

B. Scheid, J. Zawala and S. Dorbolo, *Gas dissolution in antibubble dynamics*, Soft Matter, 2014, **10**, 7096

Dreft 15 CMC

SLES + LDAO + FAE

10.0020 ms



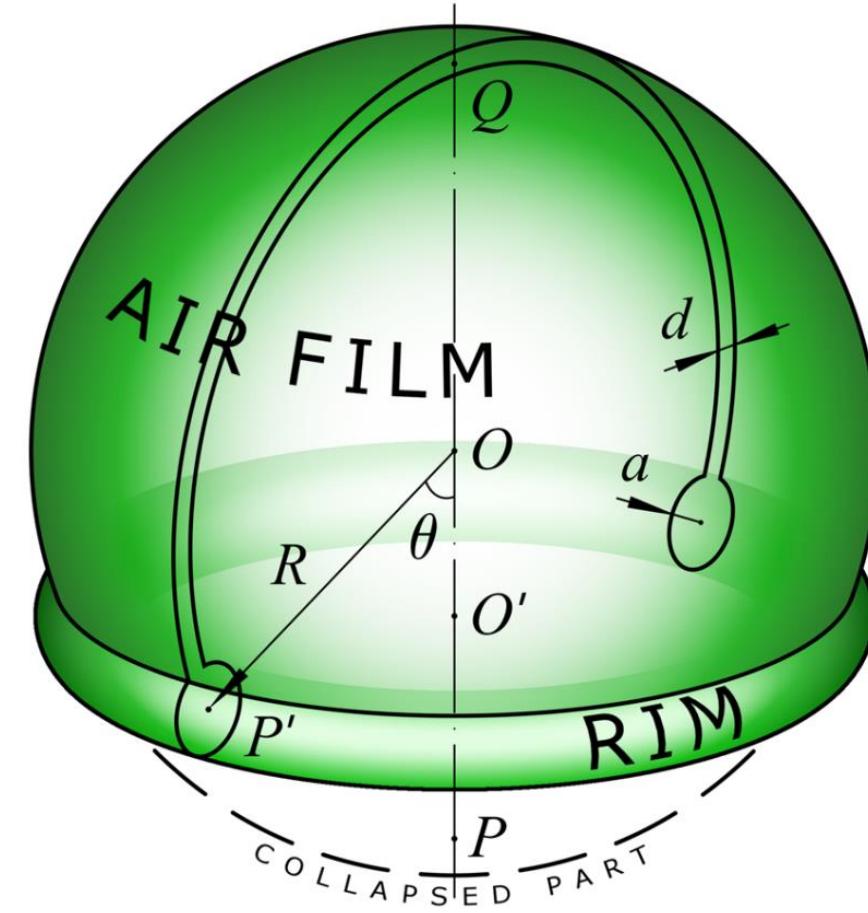
Collapse = Retraction

- Thin liquid film
 - Constant speed (Taylor-Culick)

$$v_{TC} = \sqrt{\frac{2\gamma_{af}}{\rho_f h_0}}$$

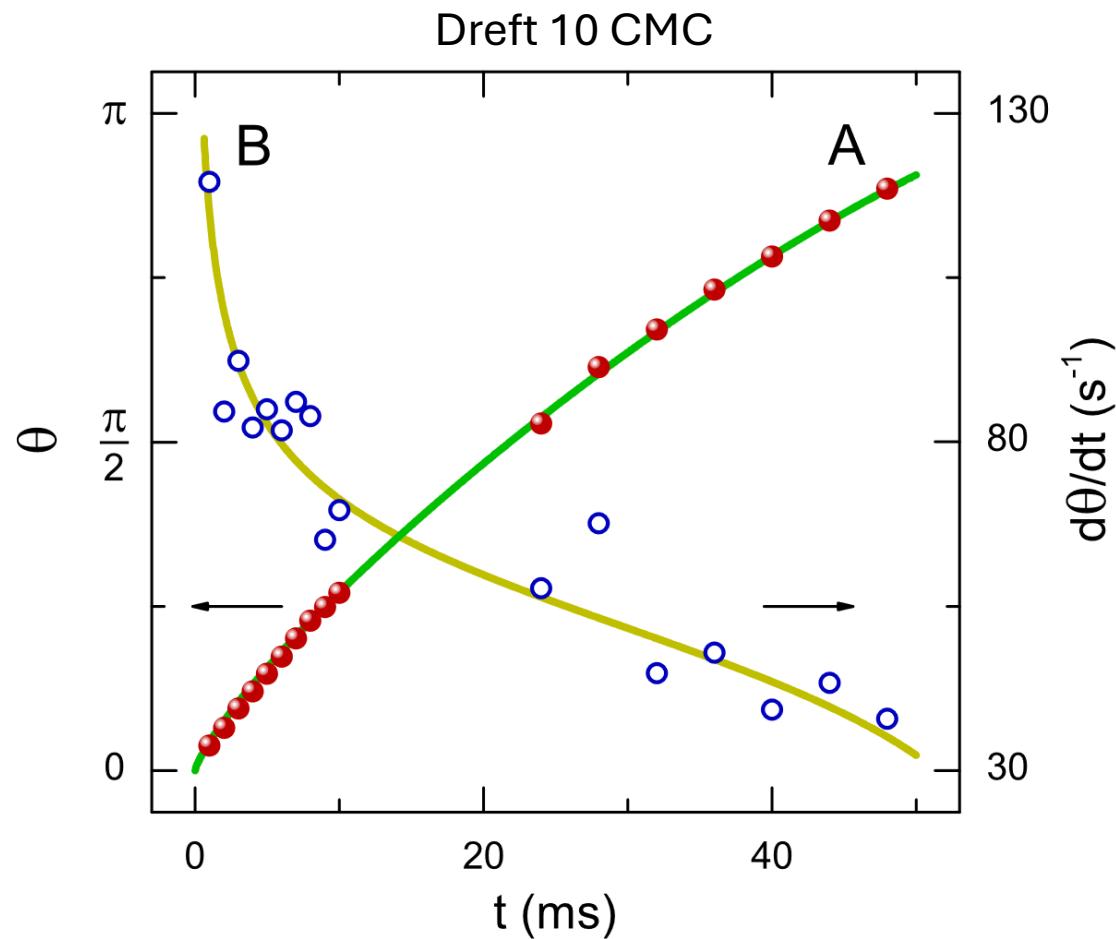
- Air film
 - Speed decreases (Sob'yanin)

$$v = \sqrt{\frac{2\gamma_{af}}{C_d \rho_f a_0}} \sqrt[4]{\cot\left(\frac{\theta}{2}\right)}$$



D. N. Sob'yanin, *Theory of Antibubble Collapse*, Physical Review Letters 114 (2015)

Collapse = Retraction

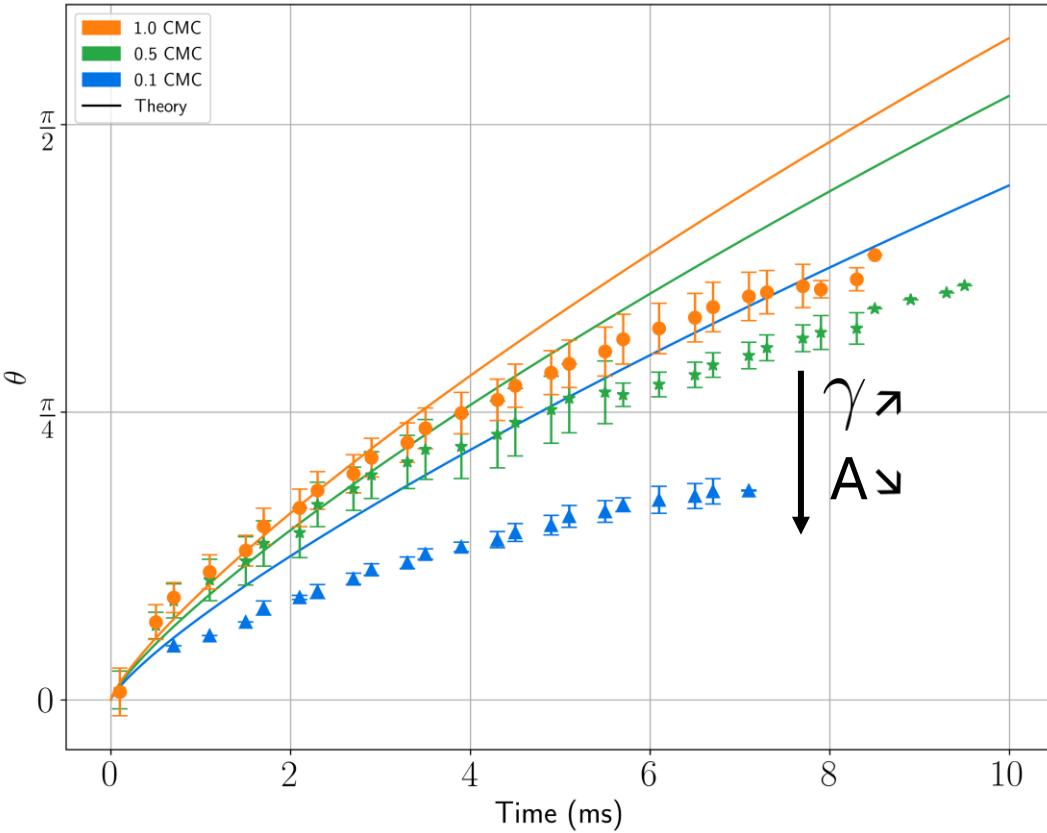


Surface rheology change with surfactant concentration
→ What happens when we change it?

D. N. Sob'yanin, *Theory of Antibubble Collapse*, Physical Review Letters **114** (2015)

S. Dorbolo, H. Caps, N. Vandewalle, *Fluid instabilities in the birth and death of antibubbles*, New Journal of Physics, **5** (2003)

Collapse = Retraction



Law acceptable for

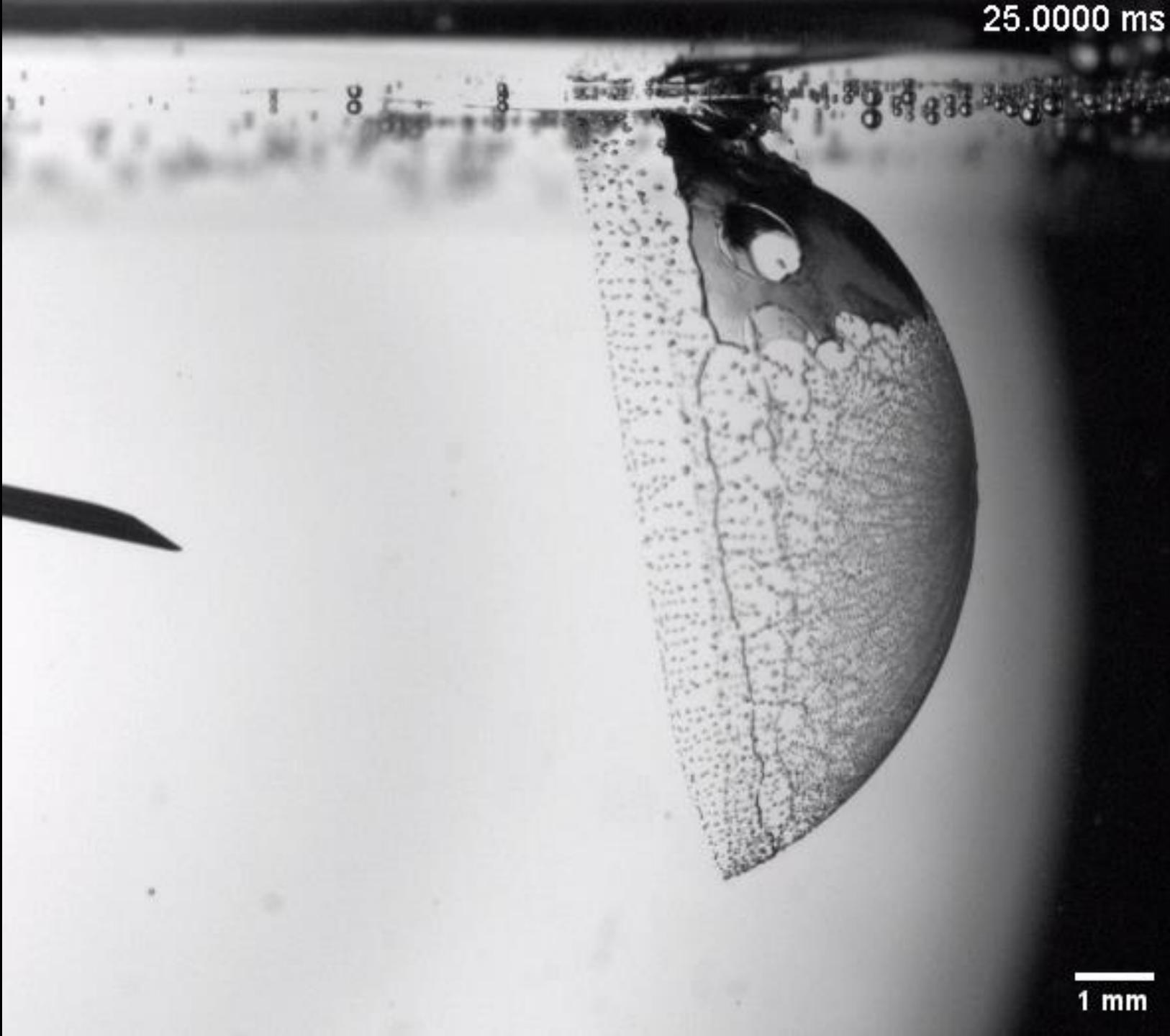
- Near CMC concentrations
- Angles smaller than $\pi/4$, i.e., for short times

→ What happens after $\pi/3$?

Denkov 1 CMC

SLES + CAPB

25.0000 ms

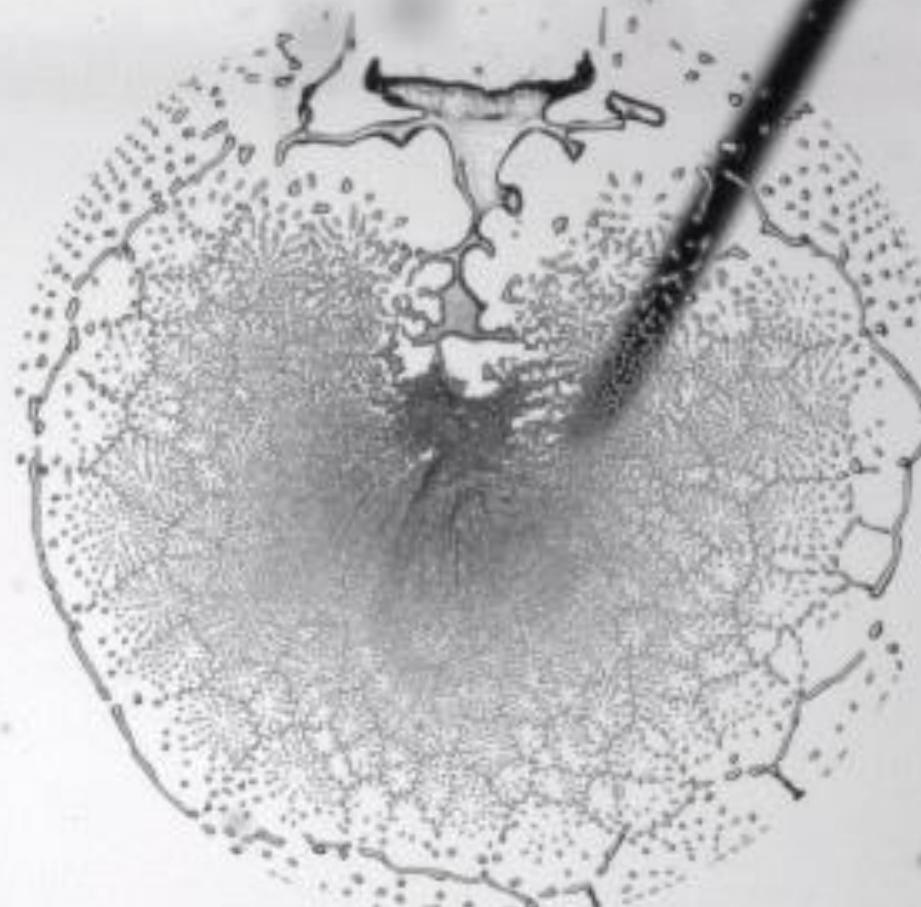


1 mm

Denkov 1 CMC

SLES + CAPB

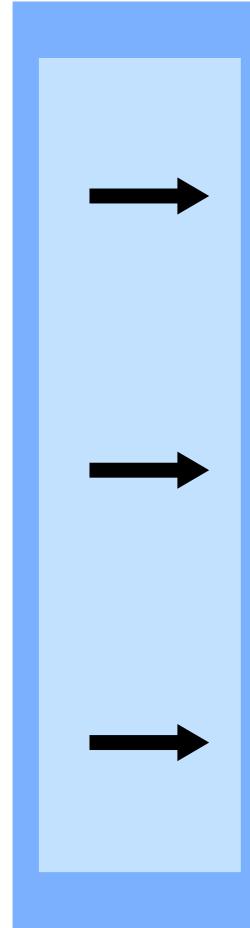
32.1875 ms



1 mm

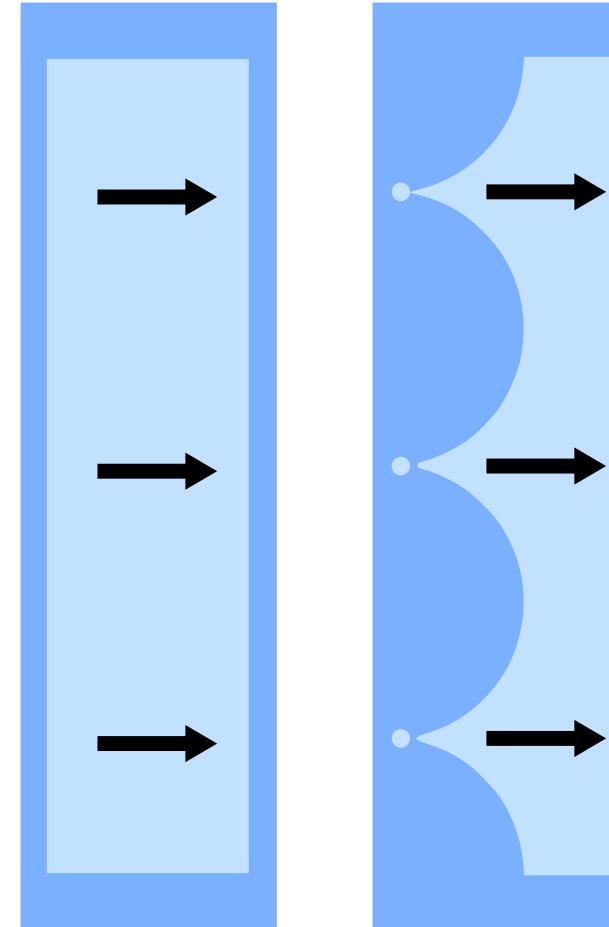
Some leads

- **Retraction**
- Rim instability
- Spinodal decomposition
 1. Topological change
 2. Wave



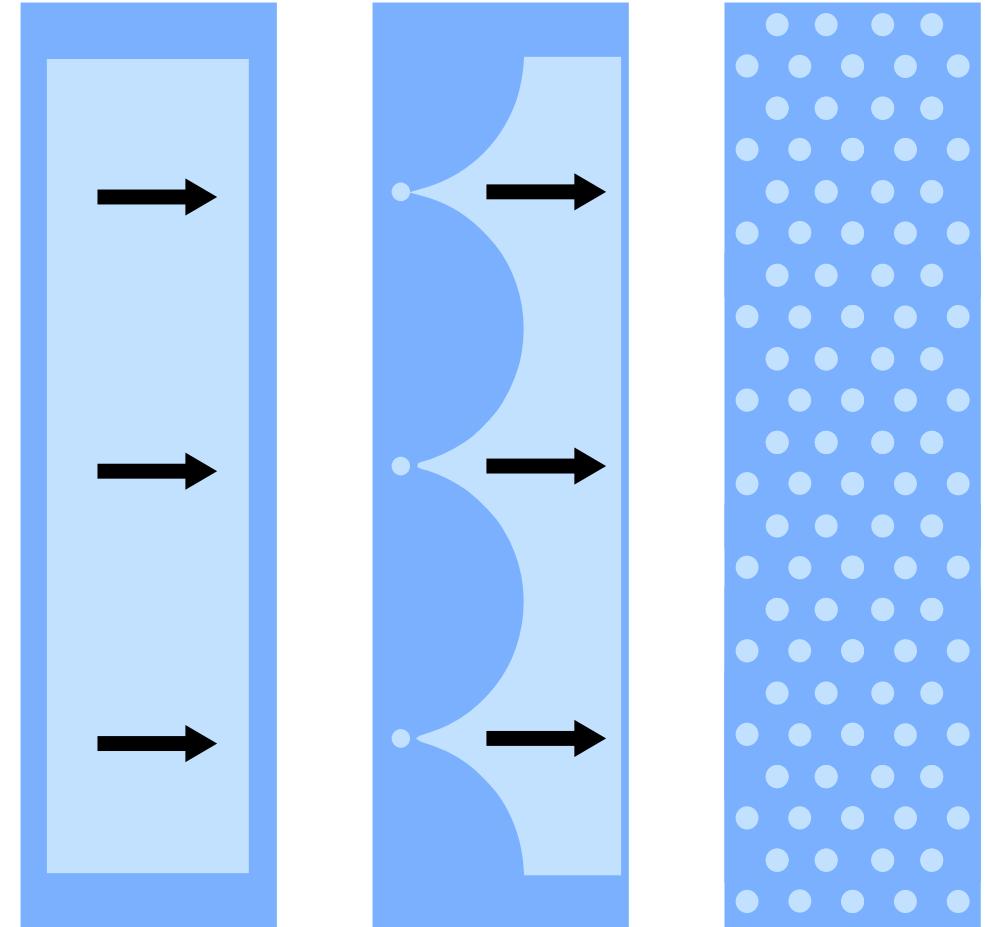
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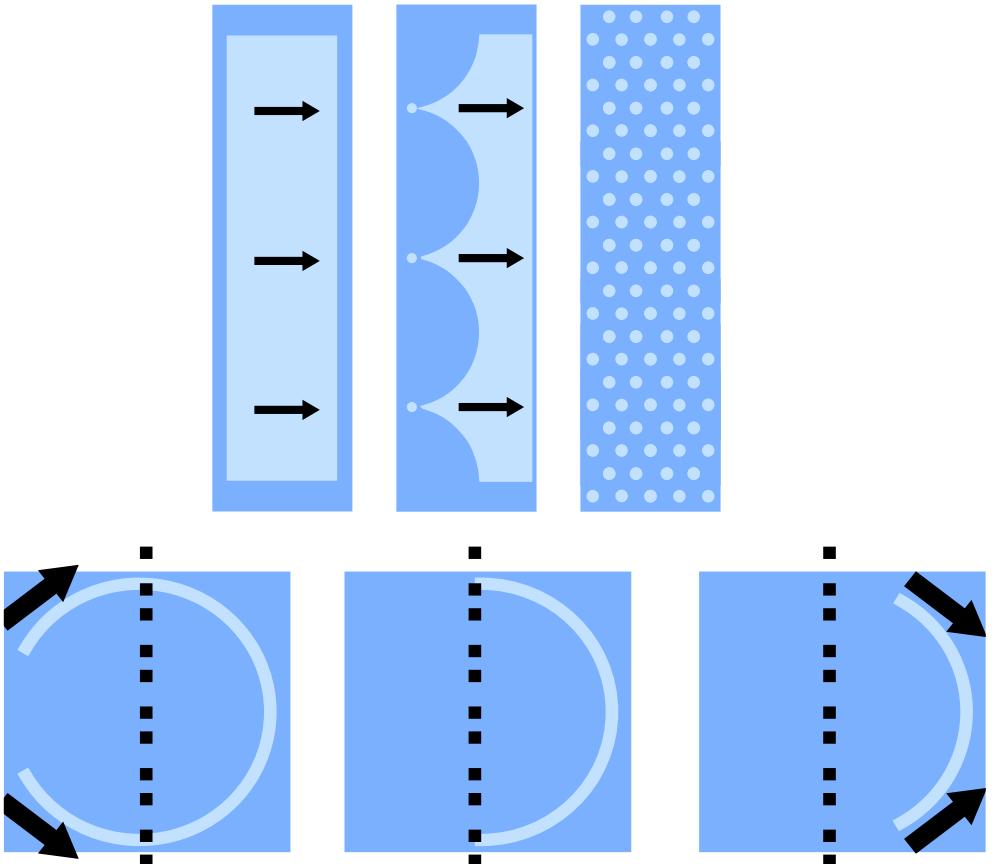
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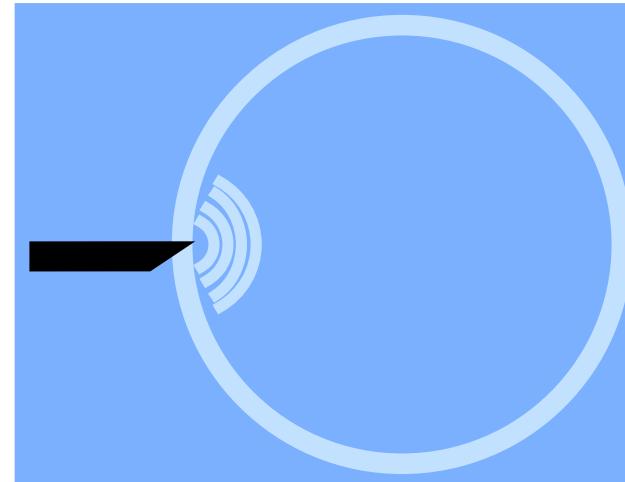
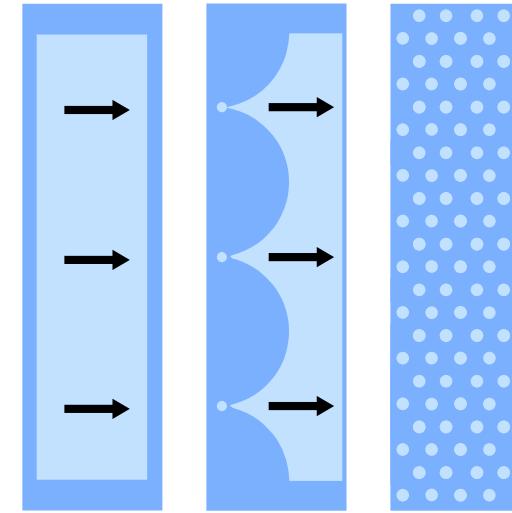
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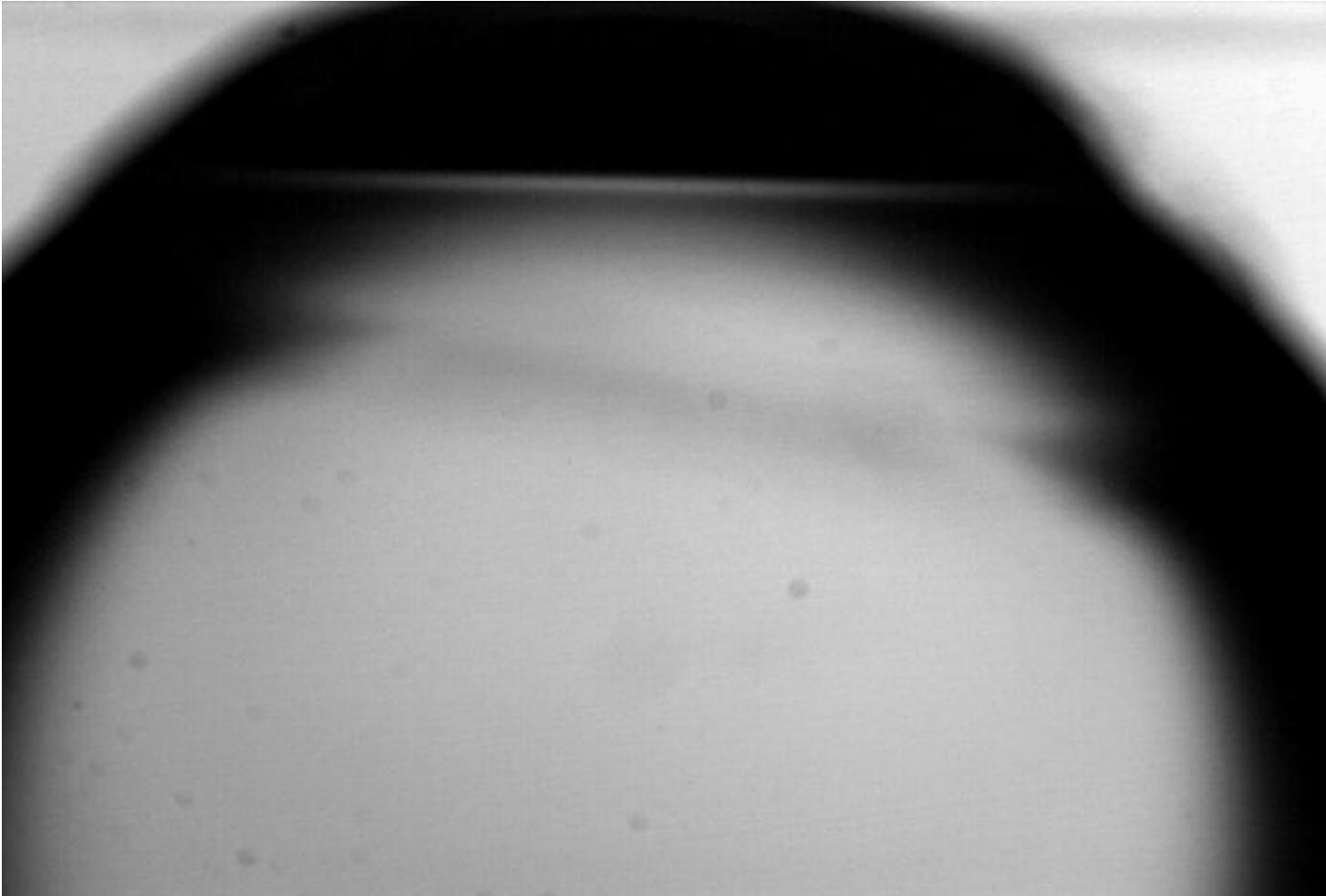


Some leads

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The journey continues



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Collapse ≠ Retraction

