Perspectives
(= Questions)

Eitan Grinspun

I am working
on Terminator 3

I approximate the
galaxy as a sphere...

Unexpected marriage?

Deux Français reçoivent l'IgNobel pour leurs travaux sur les spaghettis

DISTINCTION
Deux physiciens de l'université Paris-VI sont récompensés pour des études sur la résistance des pâtes !

Basile Audoly et Sébastien Neukirch ont reçu le prix IgNobel, récompense loufoque décernée par un comité de savants, dont d'anciens Nobel. *DR.*

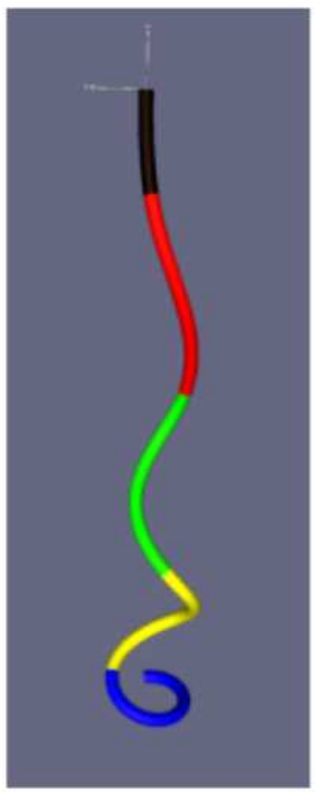
« C'EST DE LA SCIENCE *qui fait rire et réfléchir* », dit toujours Marc Abrahams, rédacteur en chef des *Annales de la Recherche Improbable*. Chaque année, à l'époque de l'attribution des vrais prix Nobel, un comité autoproclamé de journalistes, d'anciens Nobel, de savants, réunis à l'université d'Harvard dans le *« Conseil des gouverneurs des prix IgNobel »* décerne à des VRAIS chercheurs, pour des travaux publiés dans des VRAIS journaux savants, des prix loufoques.

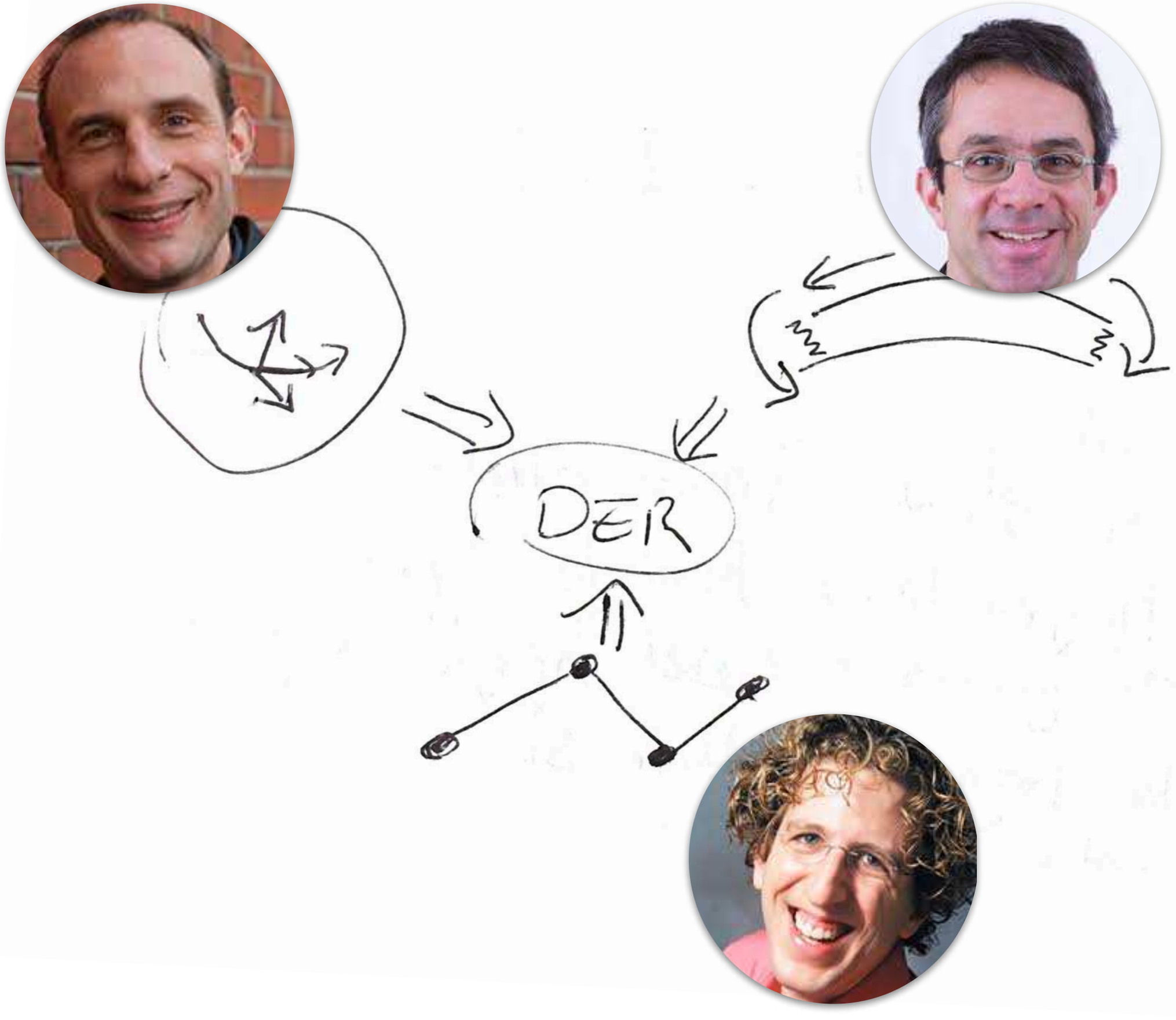
Cette année, l'IgNobel de physique récompense deux chercheurs français, Basile Audoly et Sébastien

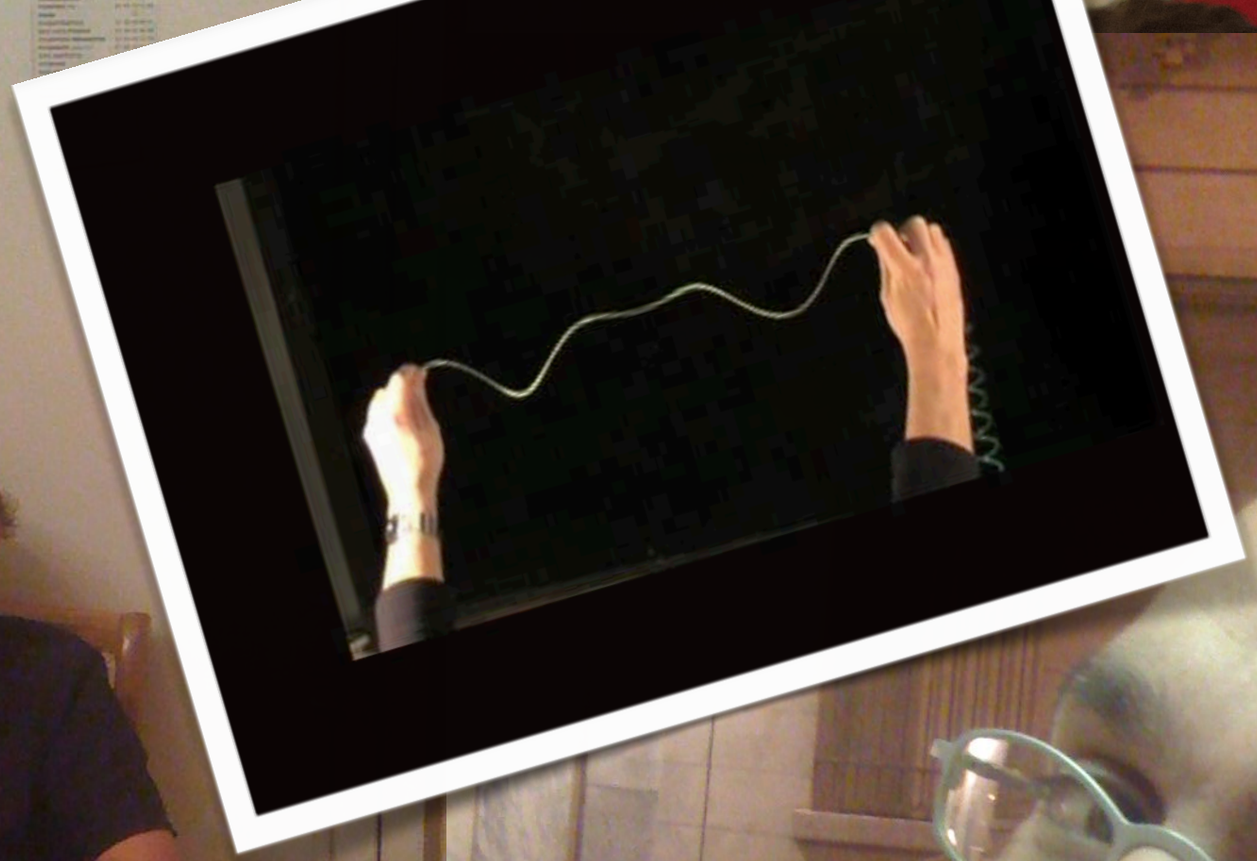
avant de le cuire, au-delà de sa résistance interne, il ne se casse pas en deux bouts nets et égaux. Pourquoi ?

C'est un problème de fragmentation et d'élasticité des matériaux. Alaudy et Neukirch ont maintenu

surcourbure et se recassent encore. Cette révélation dans le domaine de la fragmentation aura sans doute des conséquences pour les chercheurs, l'industrie de la défense, les sauteurs à la perche, et même pour

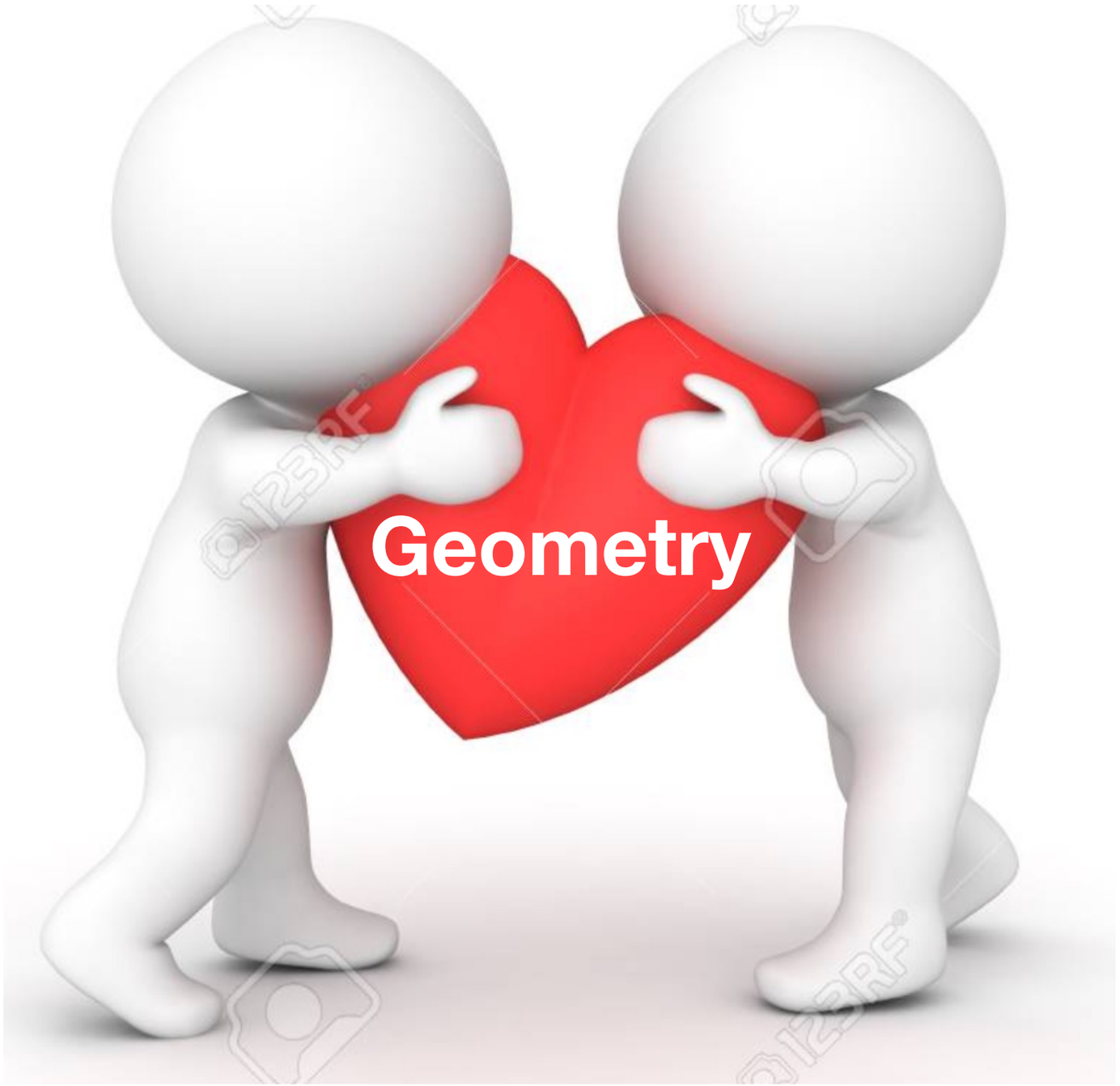



DER



Unexpected marriage?

..from a common love...



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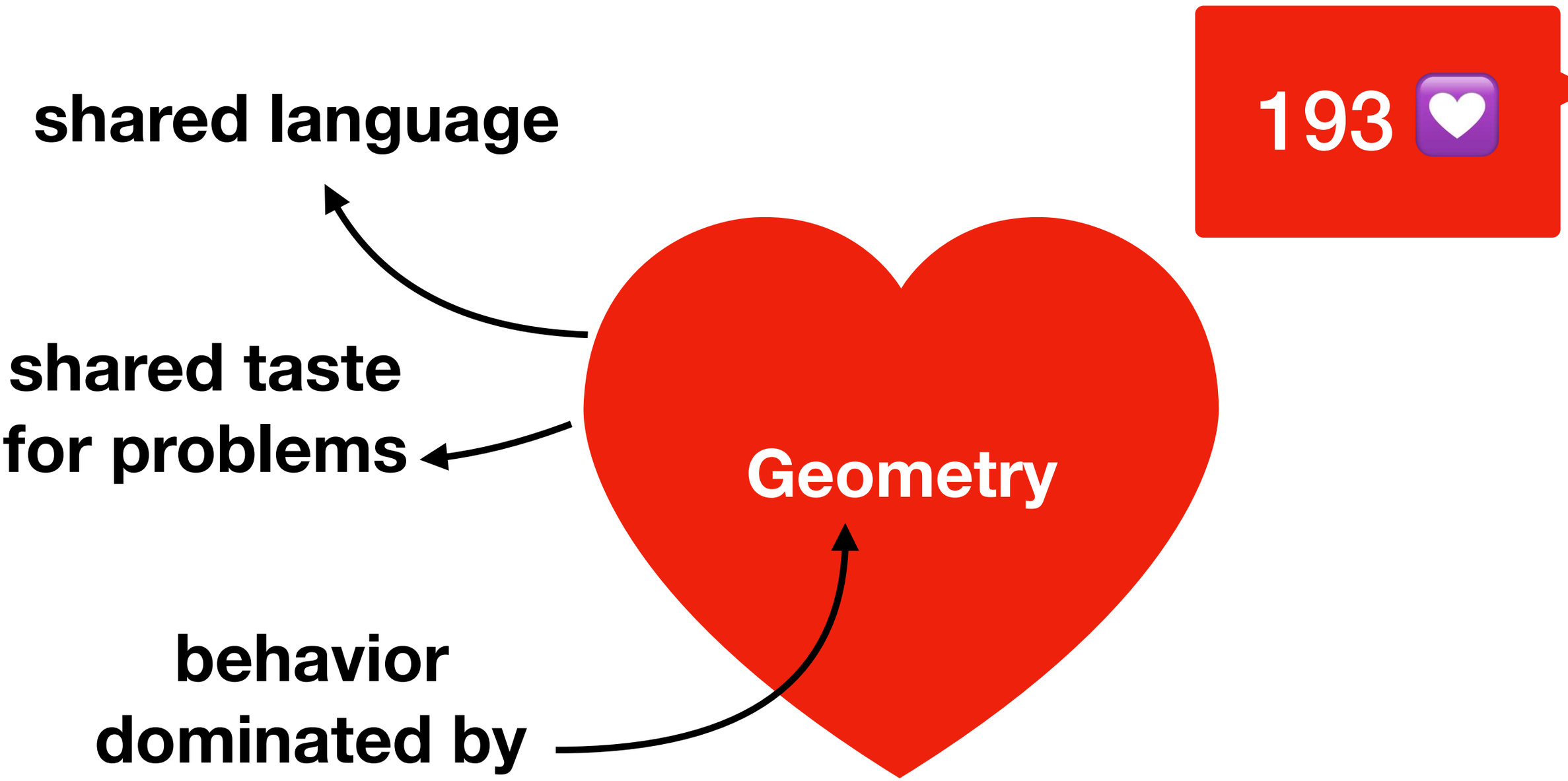
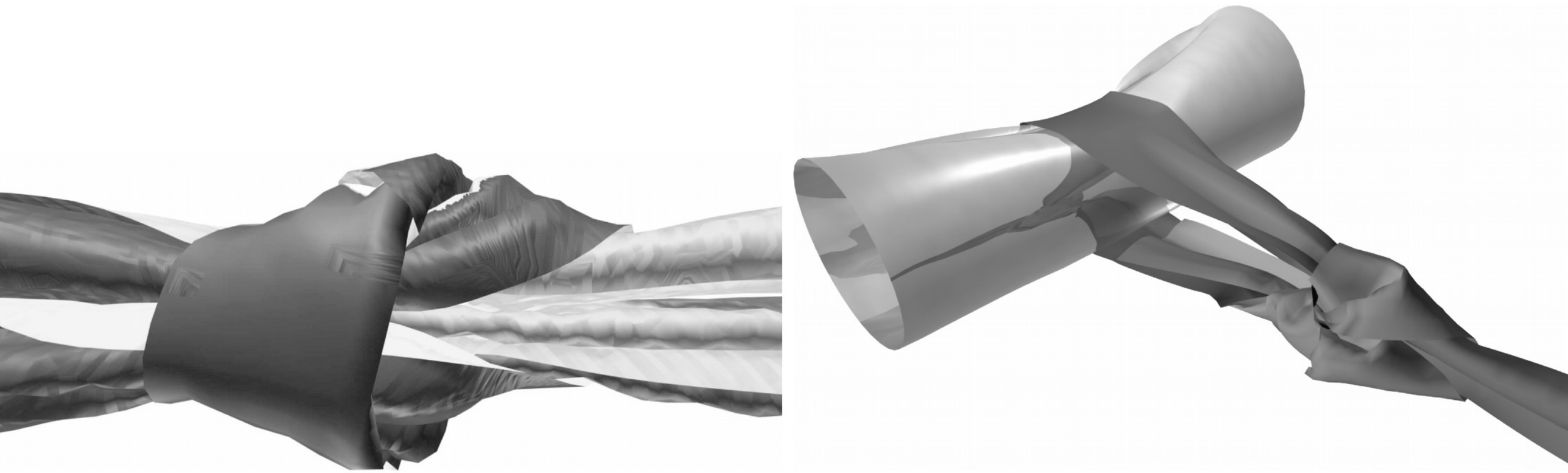


Bridge Culture & Language



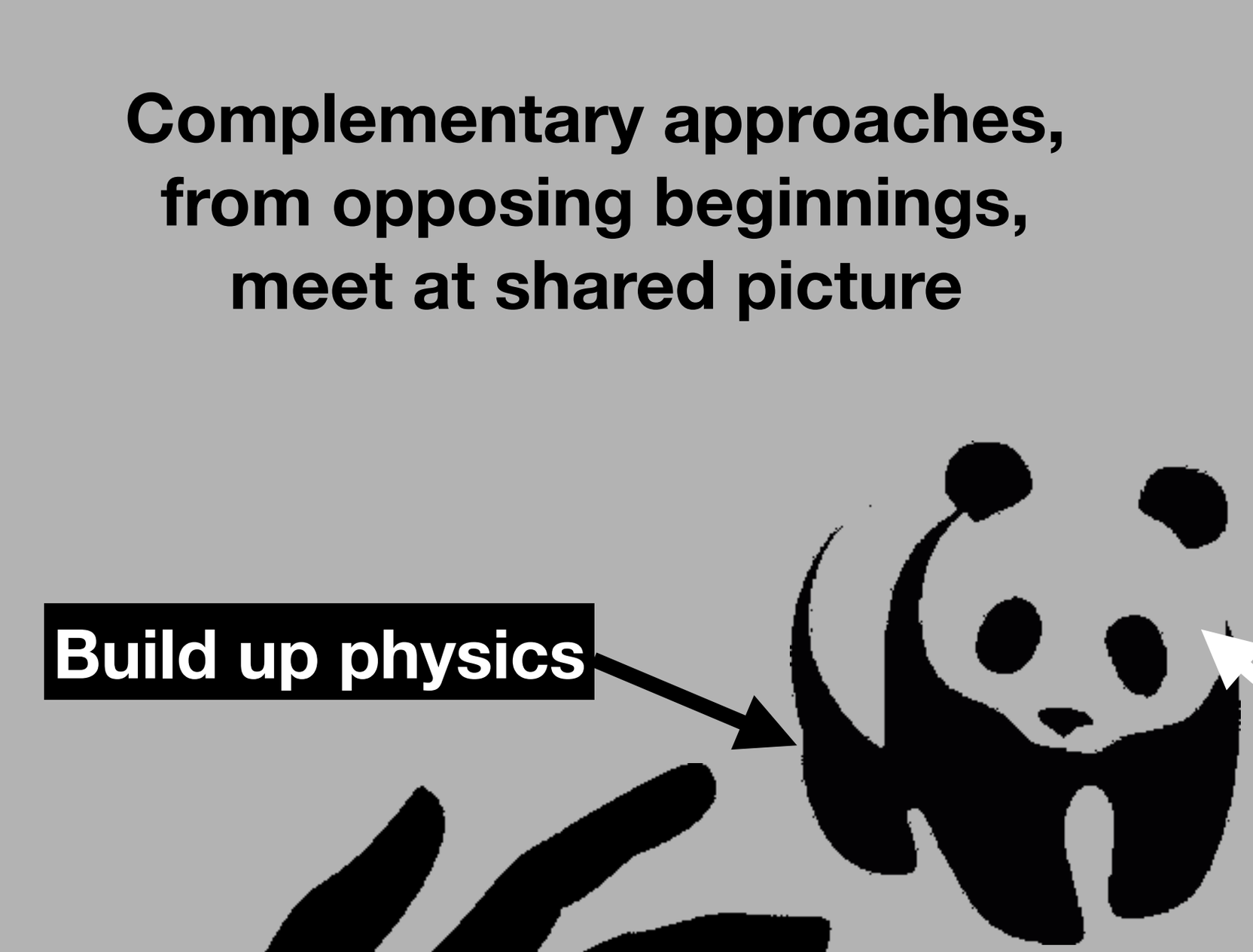
- know the audience
  “good visual rendering is even negative” - Emanuel

- small steps – deeper citations

Complementary approaches, from opposing beginnings, meet at shared picture

Experiments

Build up physics

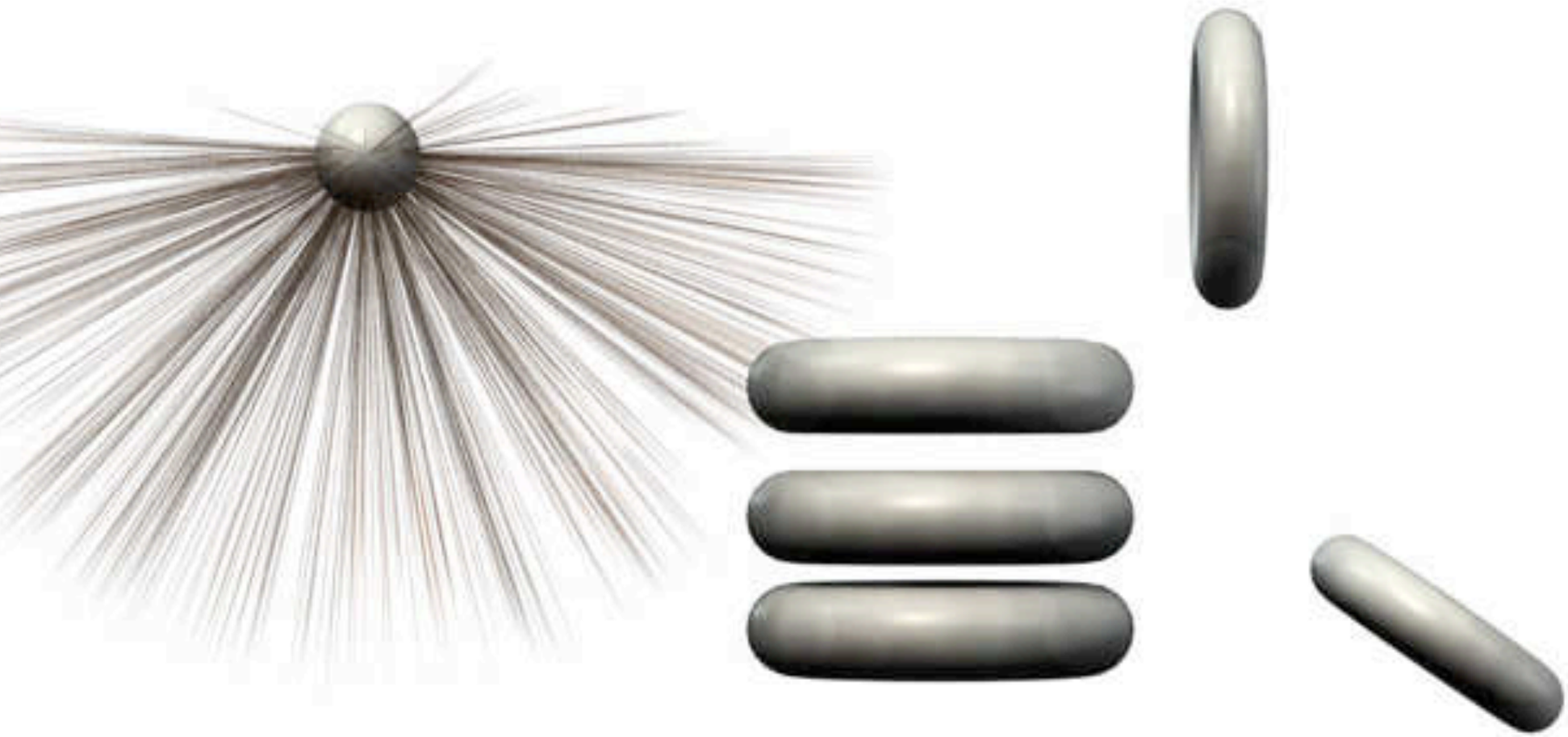


Factor out physics

Computation

(“capillarity is negligible” - Fabrice)

Hair in film:

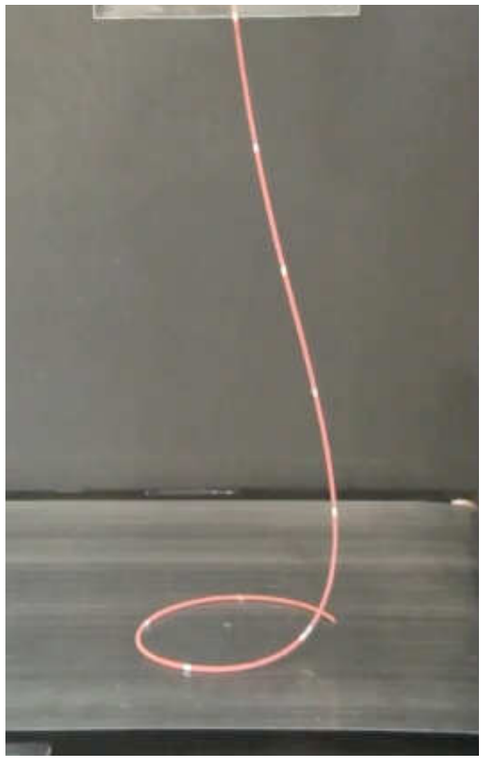


Steady coiling:

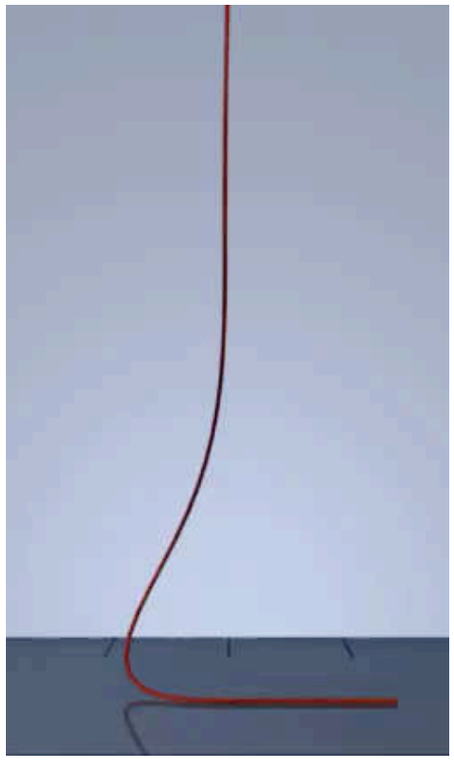
$$v_{belt} = 0$$
$$\epsilon = 1$$

Silicone rod
d=1.6mm

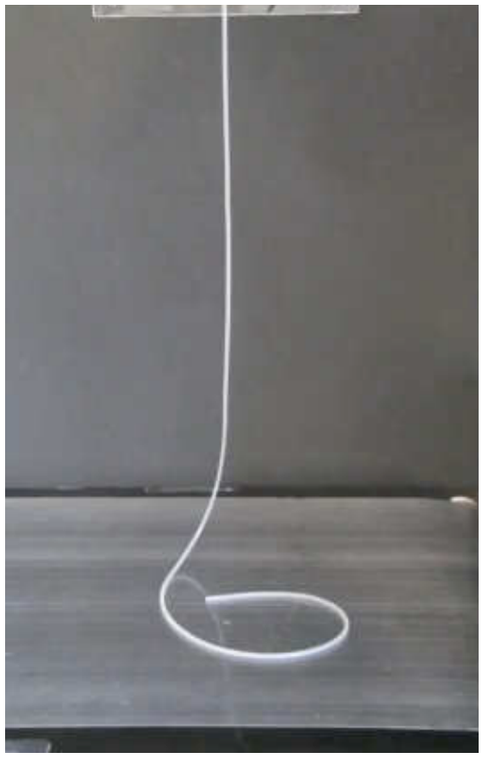
Experiments
k=0.25cm^{-1}

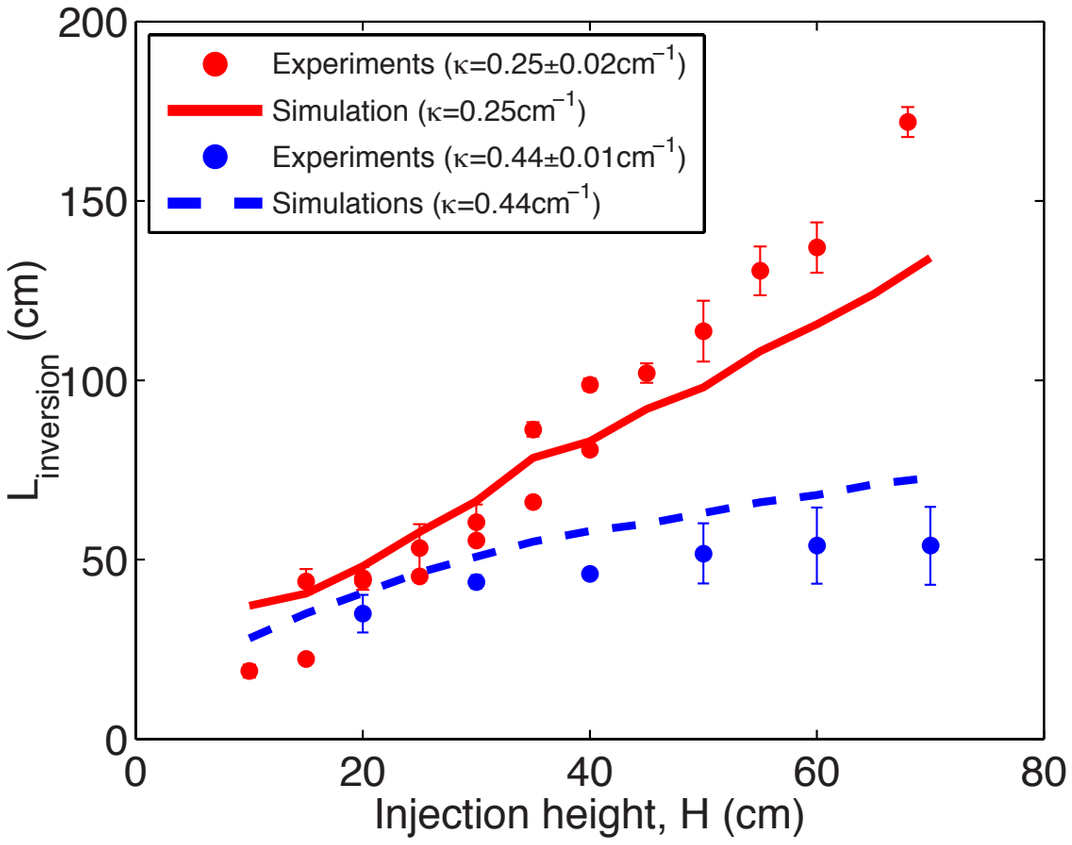


Simulations
k=0.25cm^{-1}



Experiments
k~0cm^{-1}





- Coiling inversion due to torsional buckling;
- Length of inversion scales with injection height;
- Excellent agreement with no fitting parameters.

Curvature Matters!

Steady coiling:

Experiments
k=0.25cm^{-1}

Simulations
k=0.25cm^{-1}

Experiments
k~0cm^{-1}

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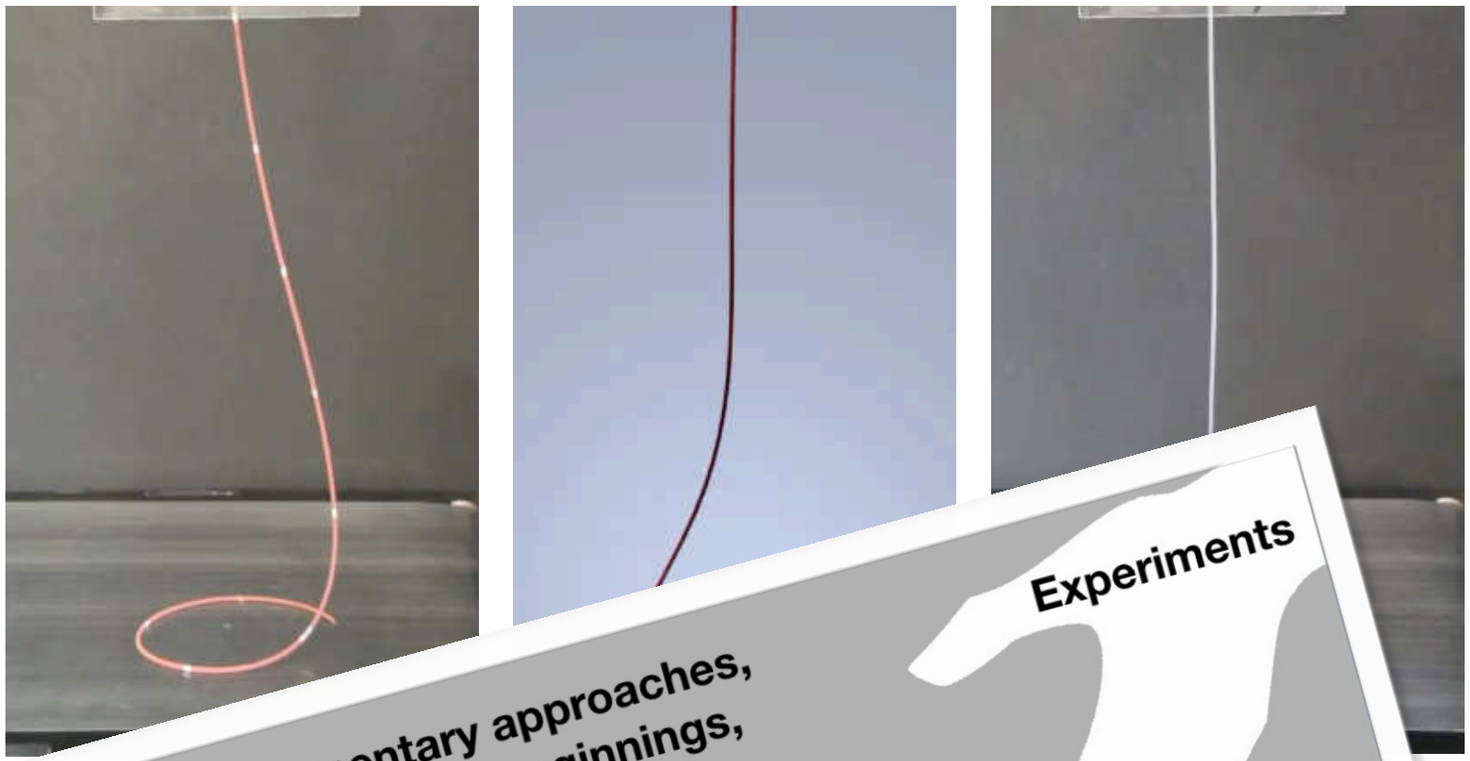

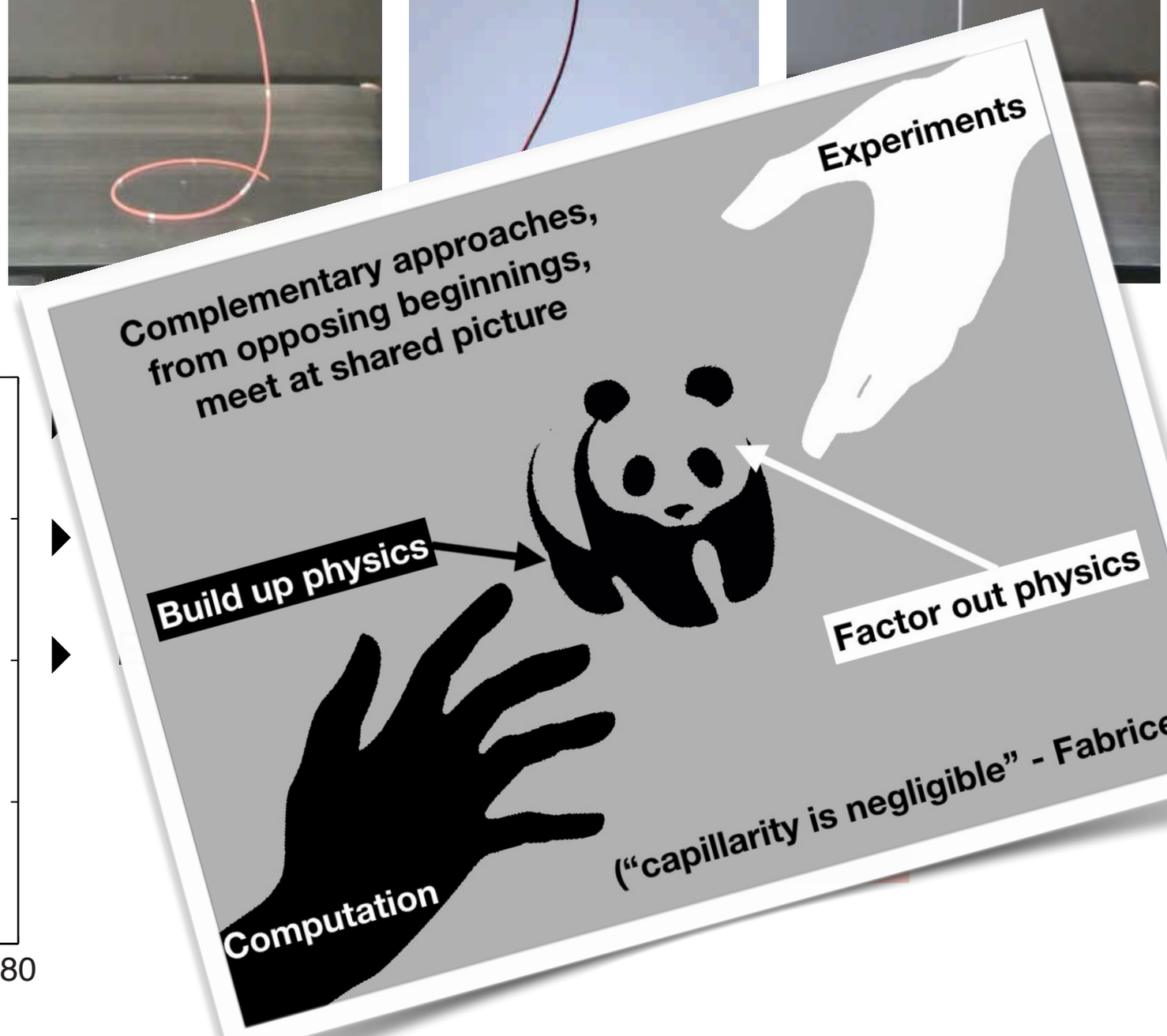

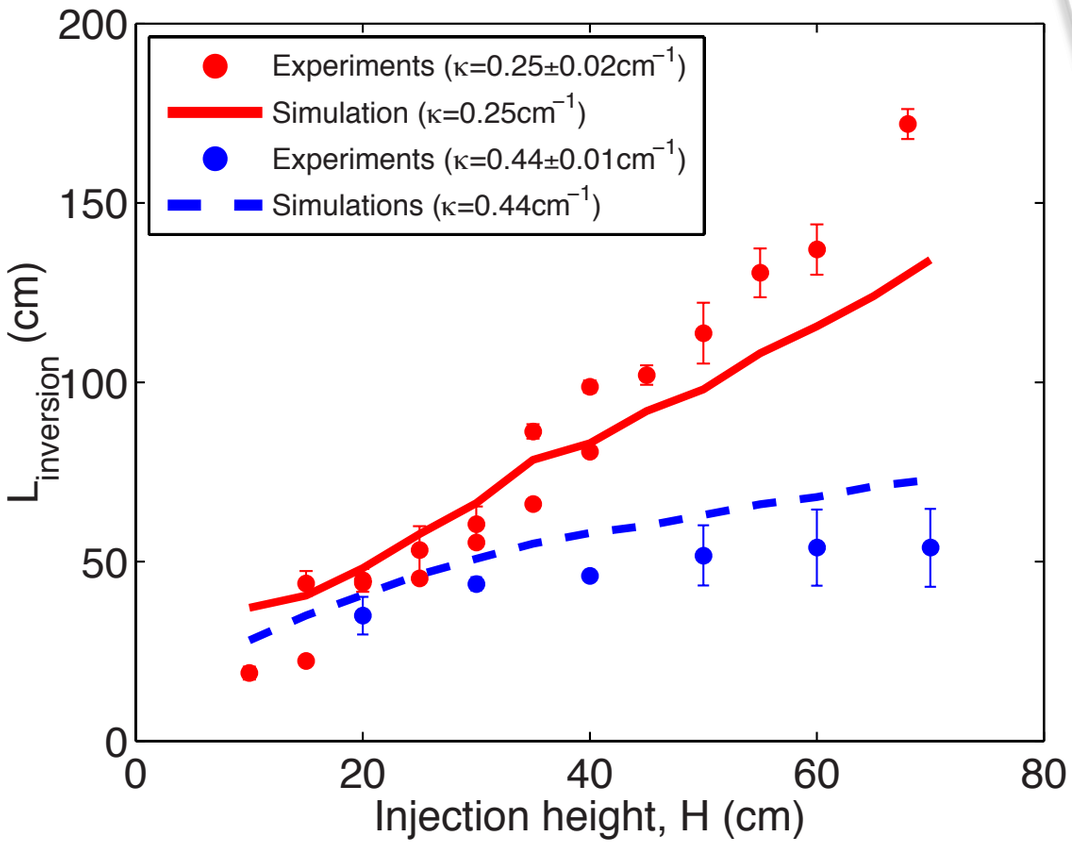

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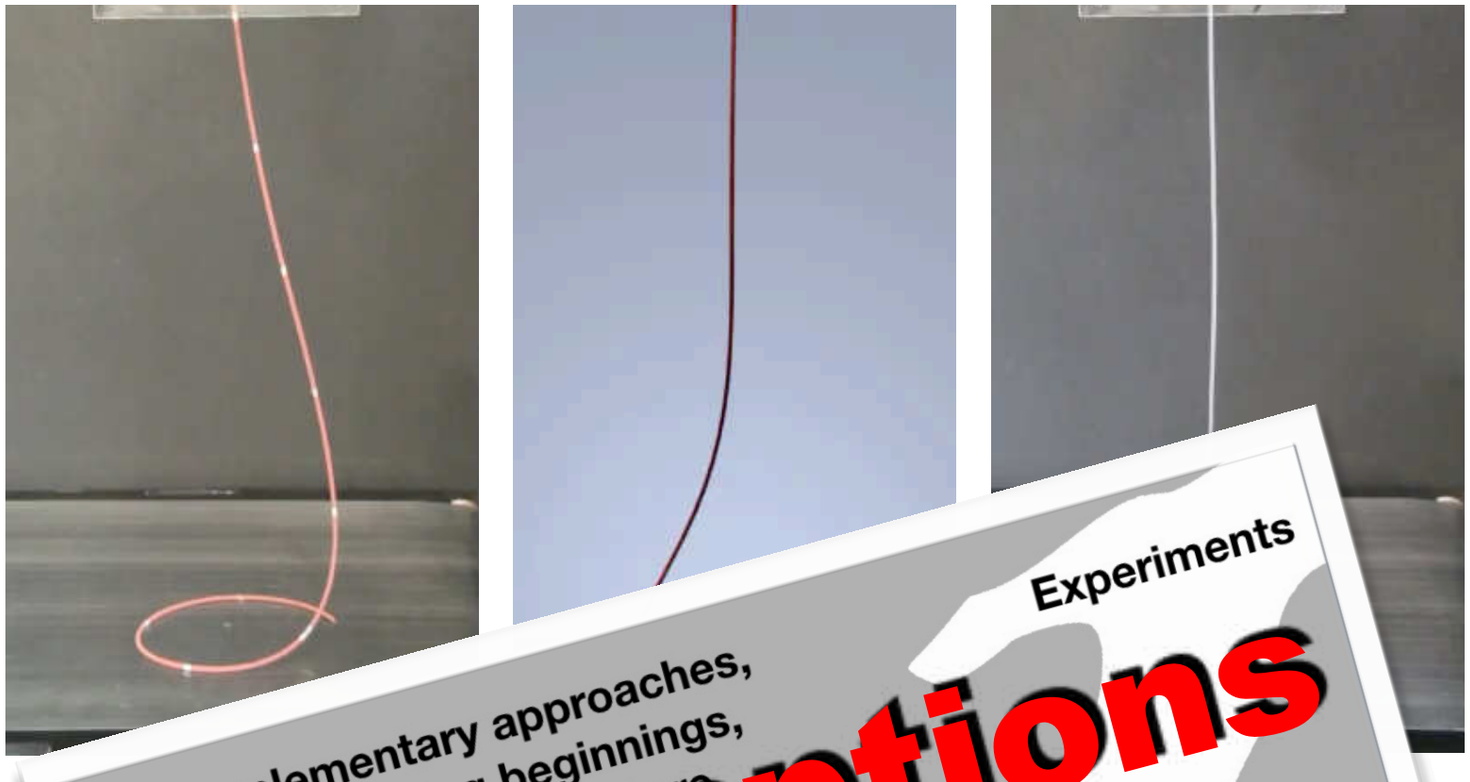
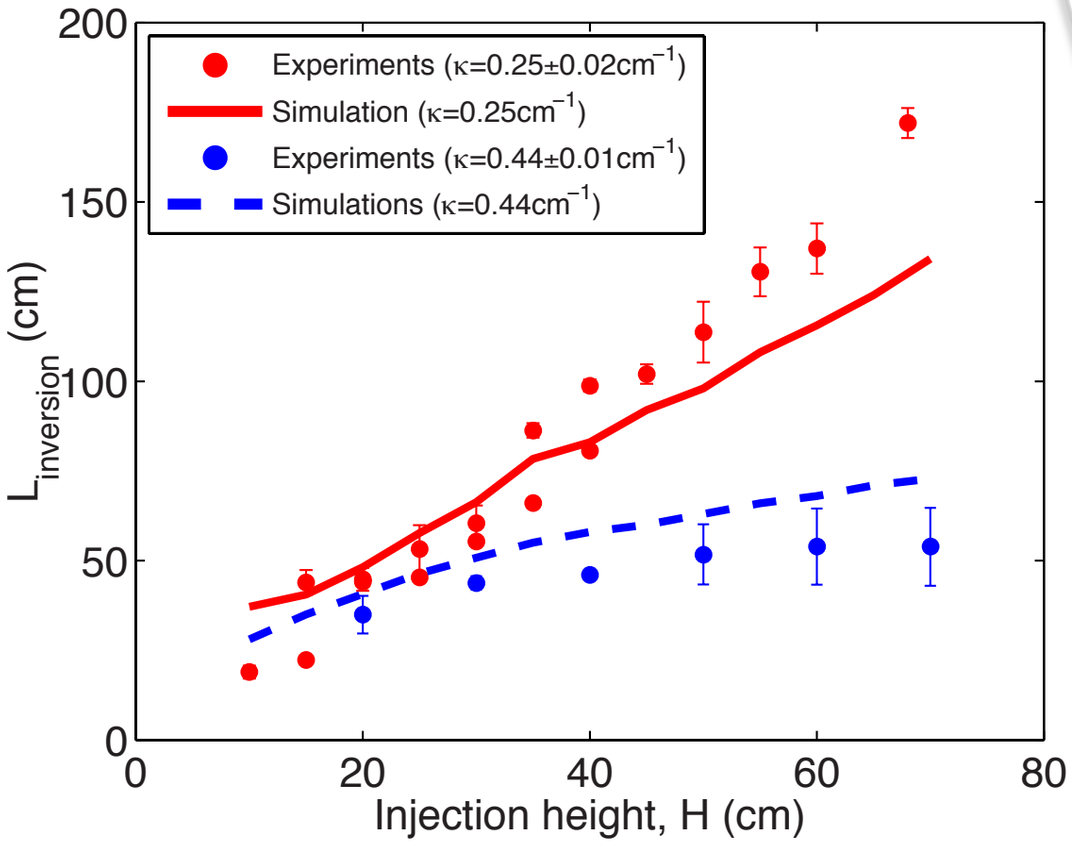
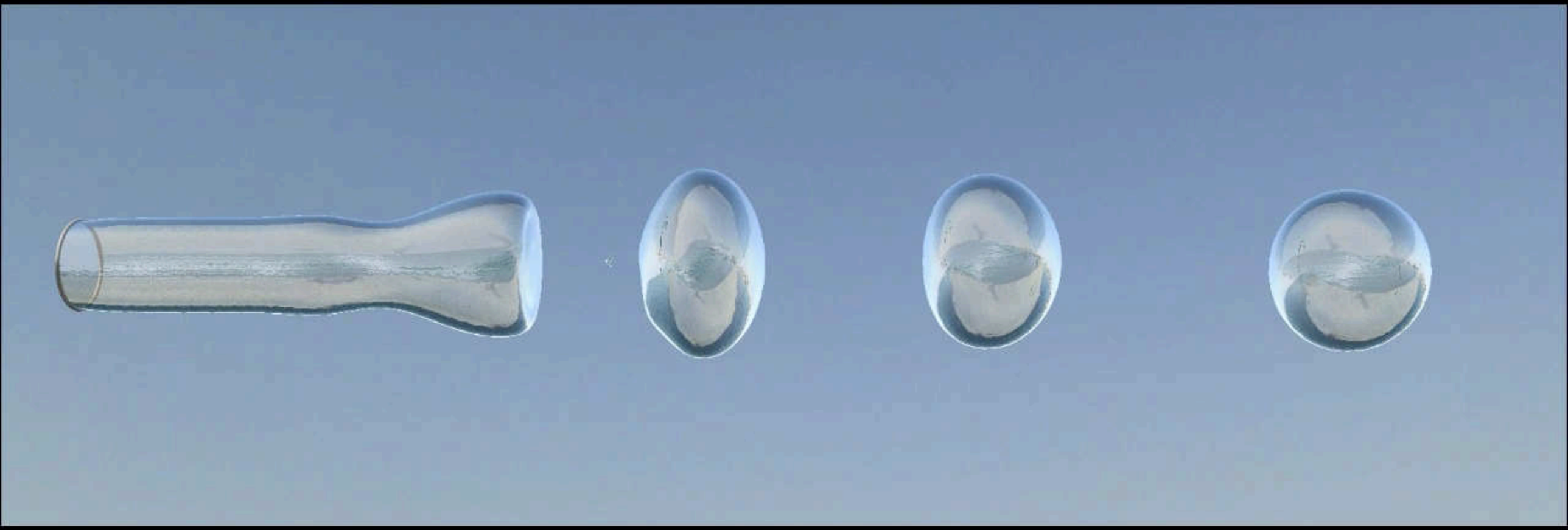
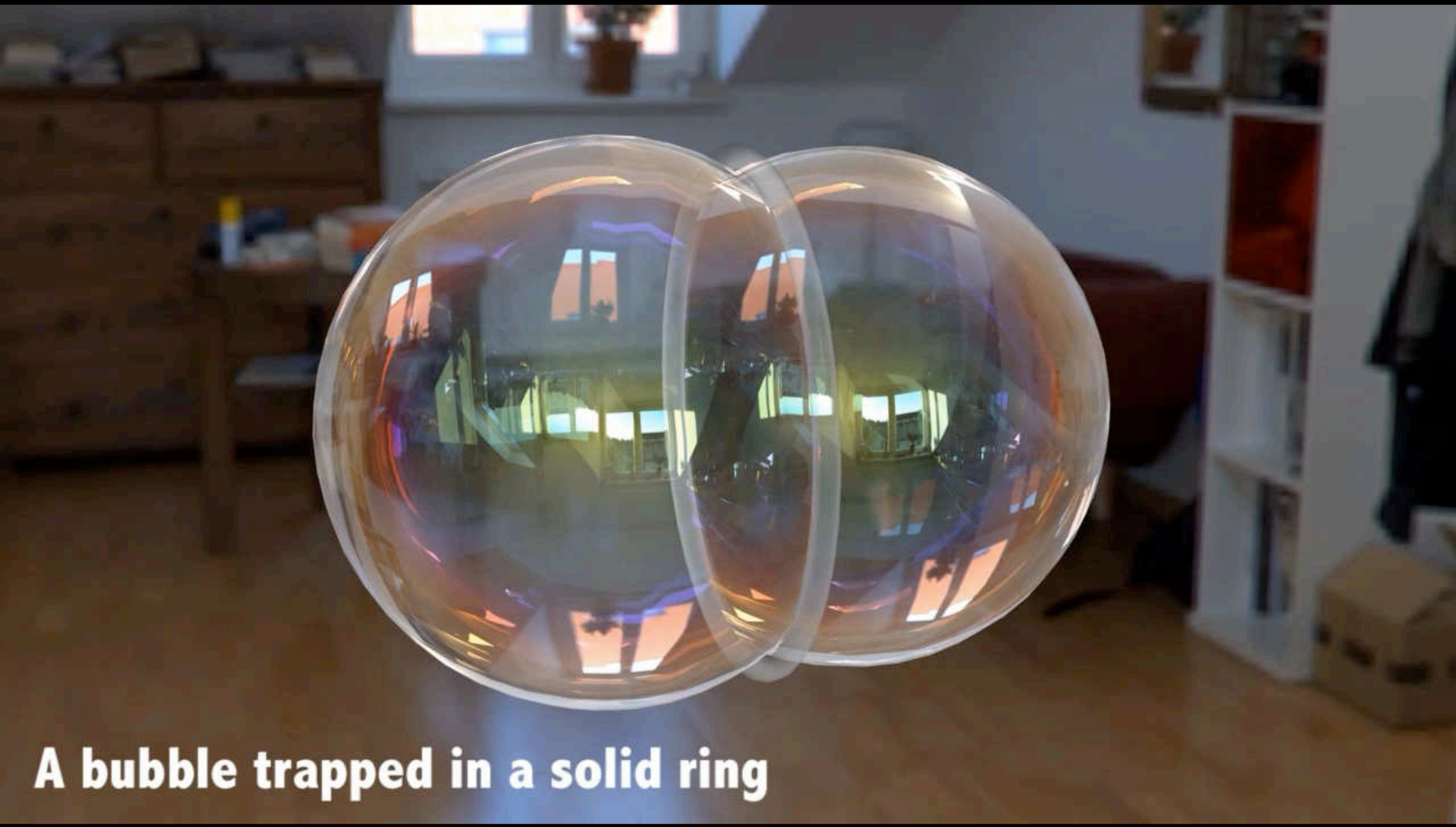


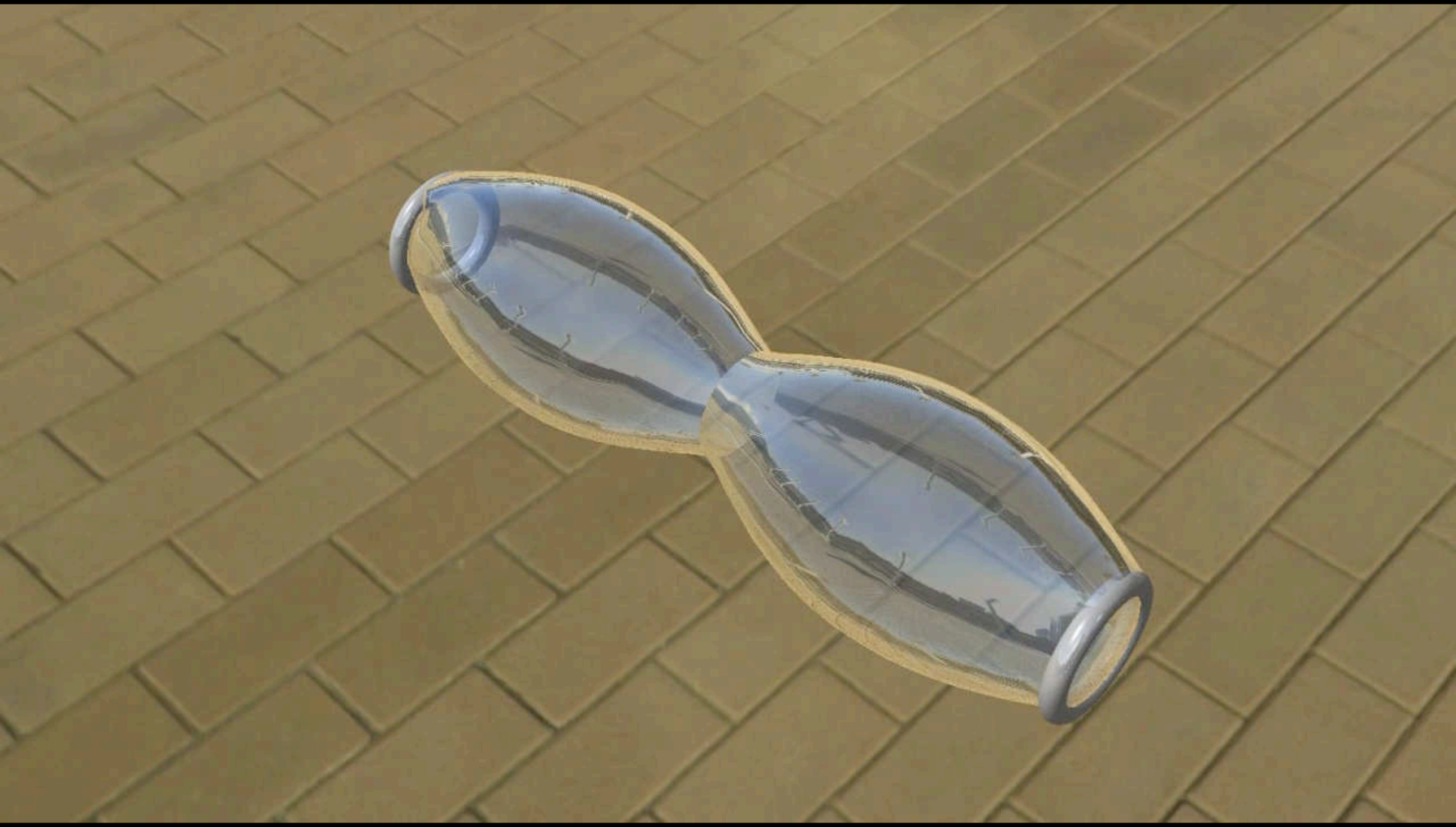


More assumptions looking for collaborators…





A bubble trapped in a solid ring




Popping bubbles in the cluster

Assumptions

Dynamics governed by

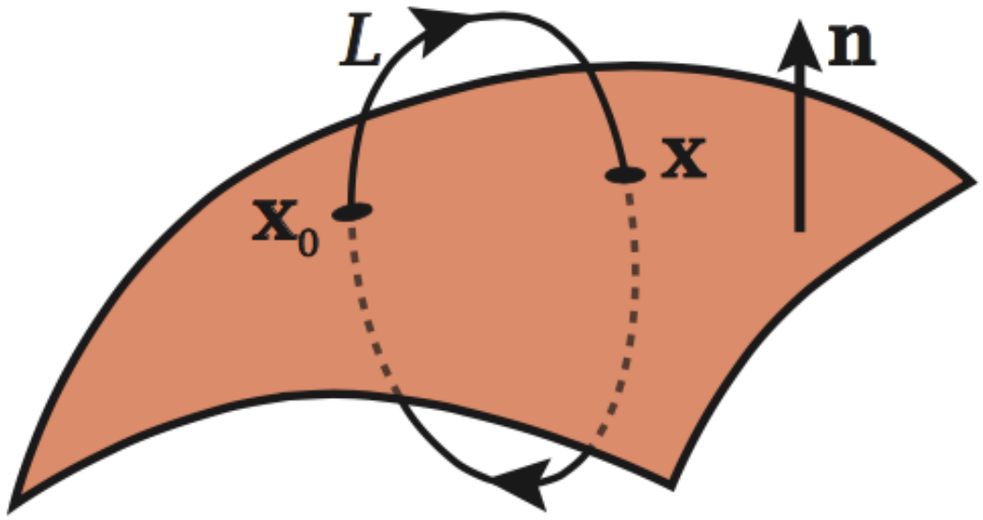
(a) surface tension

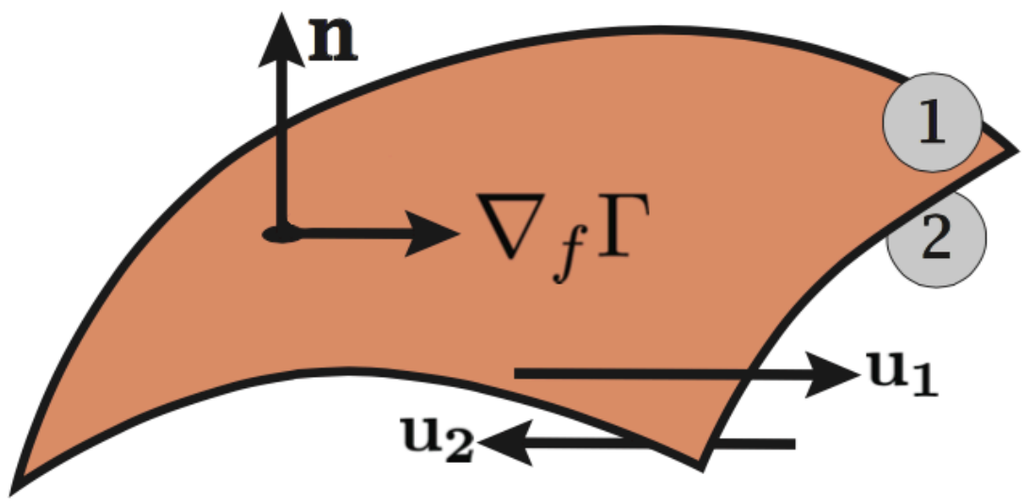
(b) inertia of air (neglect liquid inertia)

(c) incompressibility of air

(d) soap film advected in airflow

Vortex Sheet Representation





$$\Delta \mathbf{u} = \nabla_f \Gamma$$

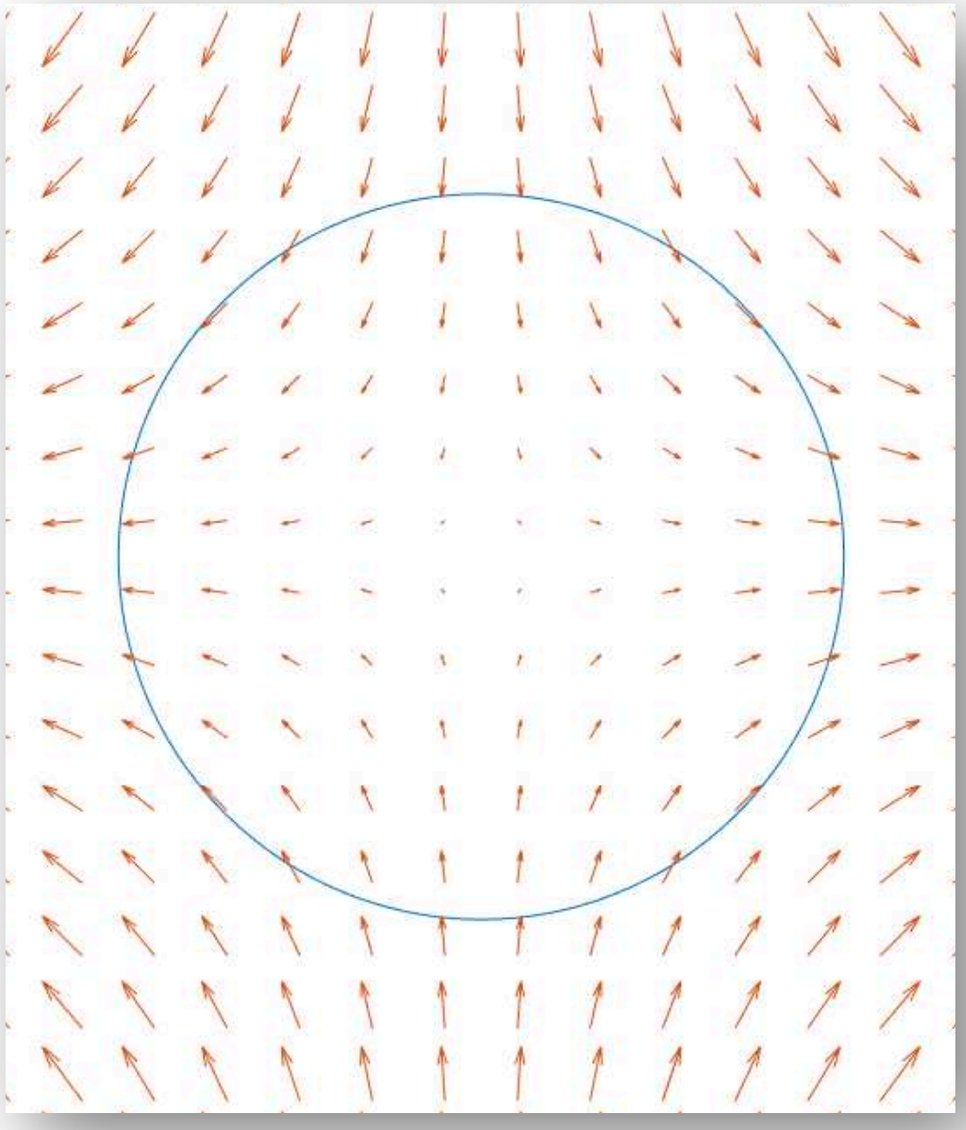
Circulation = $\Gamma(\mathbf{x}) = \oint_L \mathbf{u} \cdot d\mathbf{s}$

velocity (air)

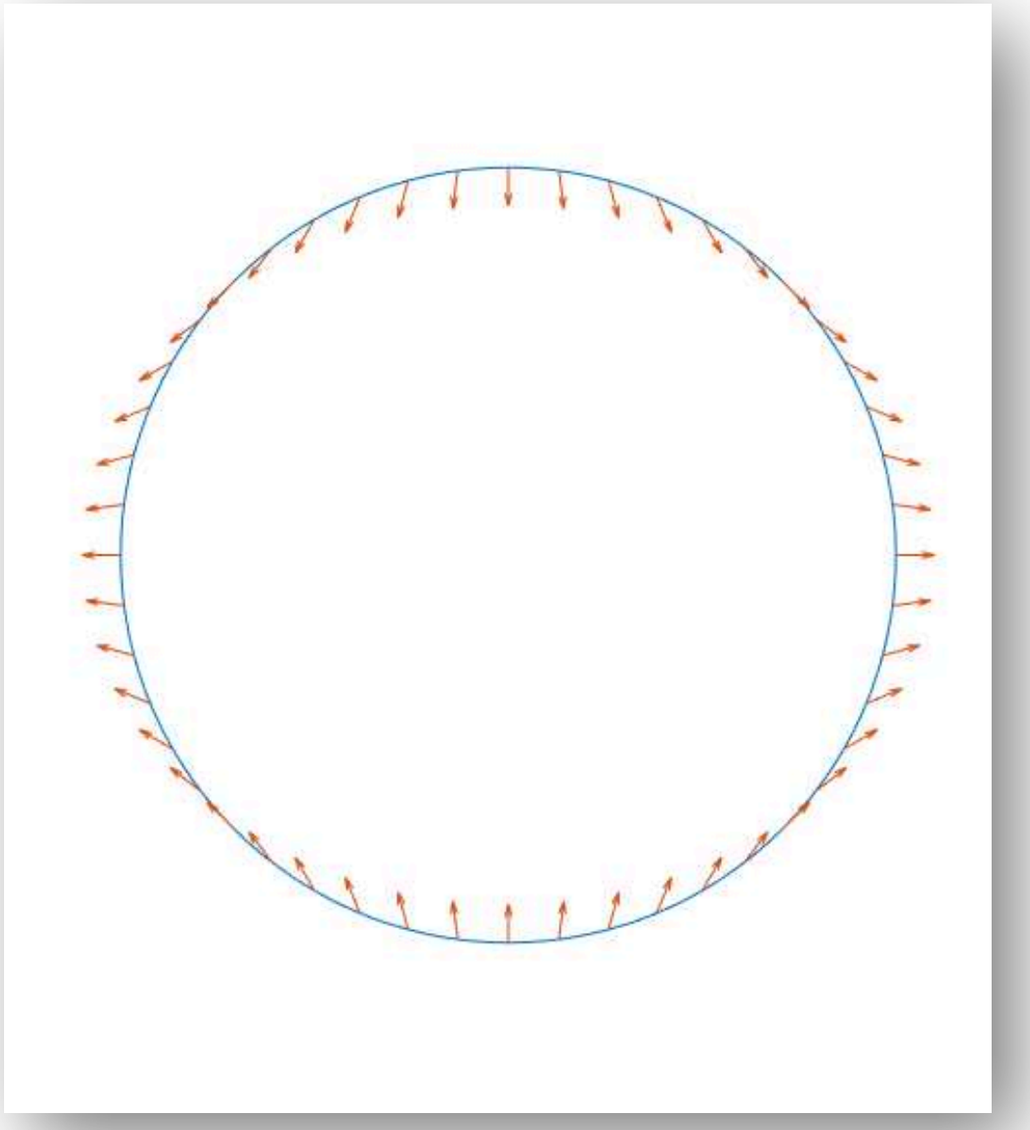
Temporal evolution $\frac{\mathrm{D}\Gamma}{\mathrm{D}t} = -\frac{\sigma}{\rho}(H_1 - H_2)$

surface tension (mean curvature)

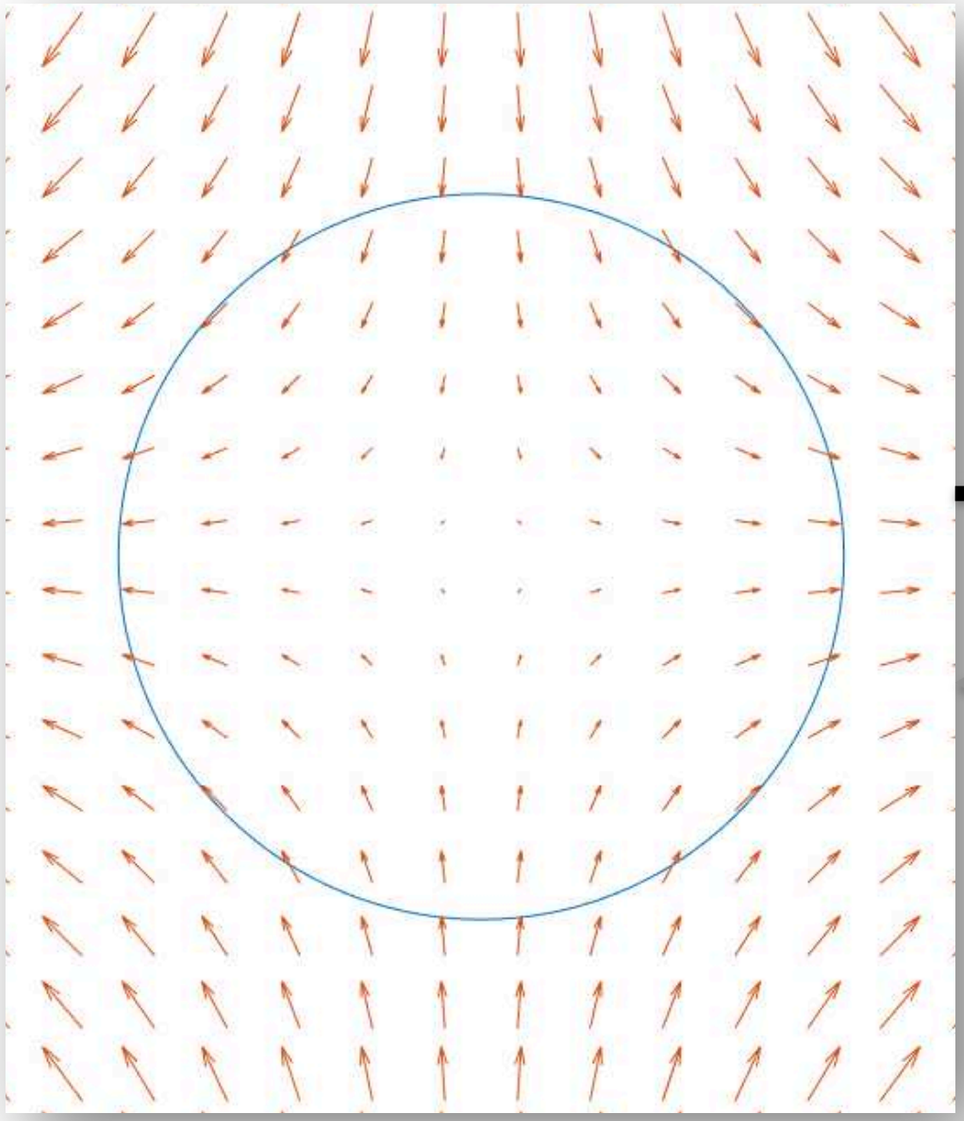
Can you see the flow **beneath** the surface?



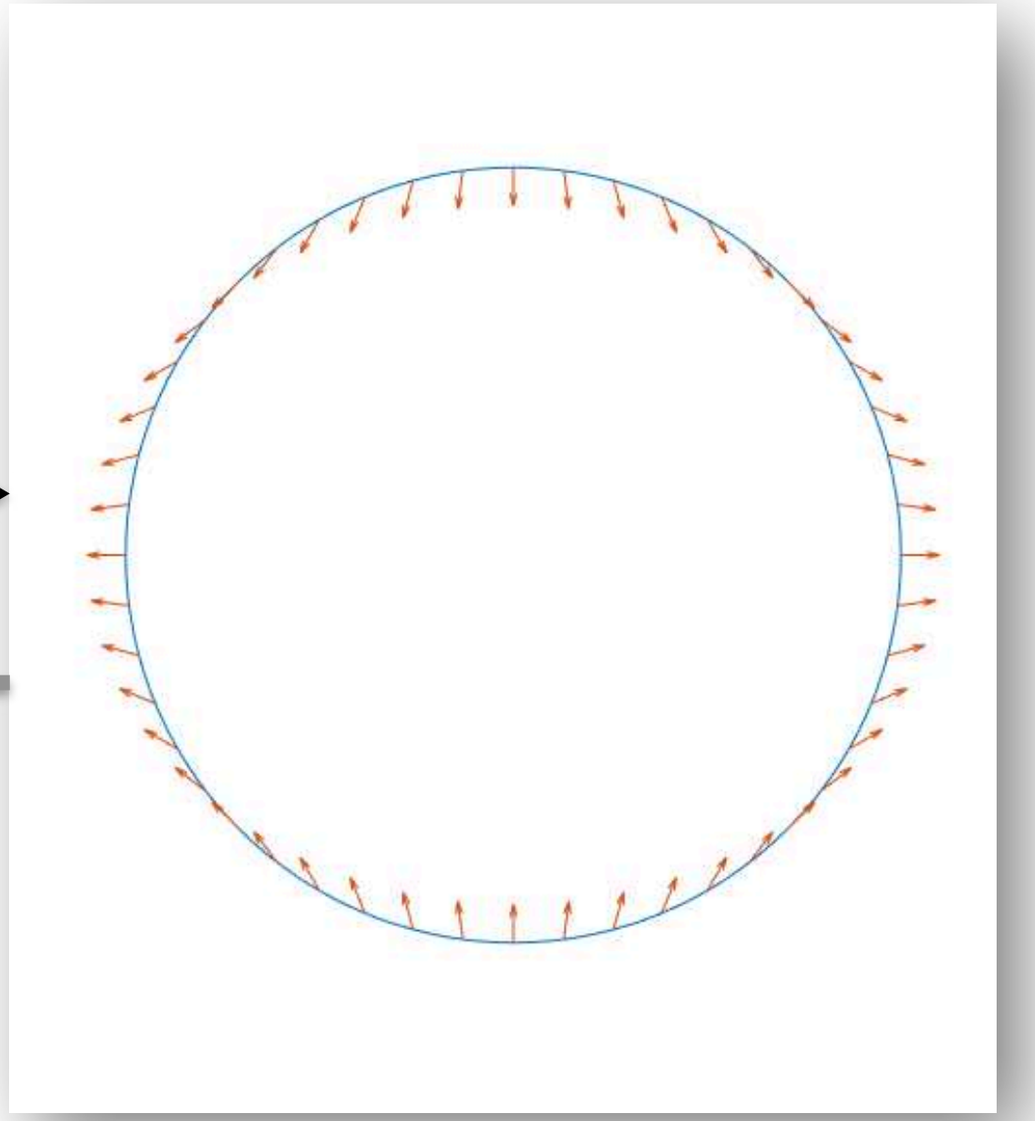
3D velocity field



Surface velocity field



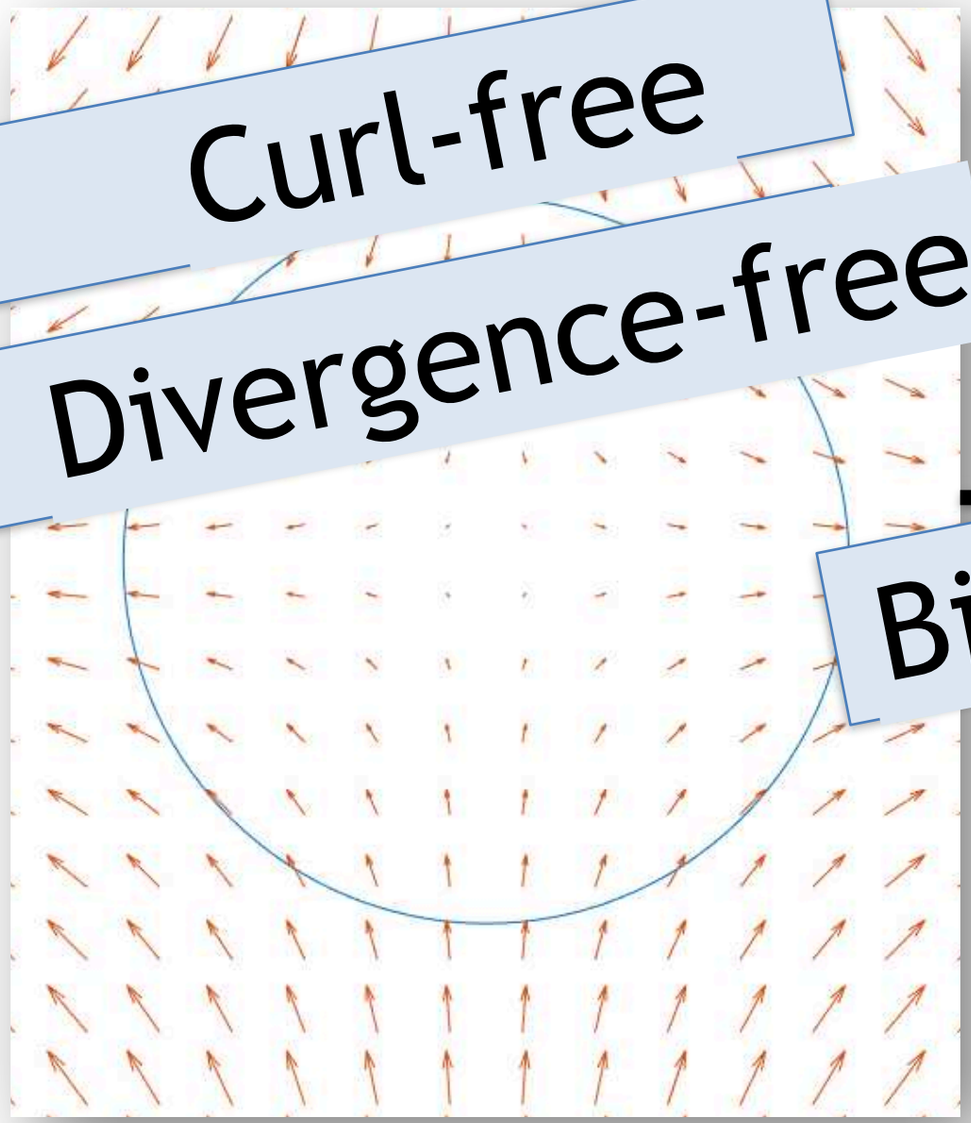
3D velocity field



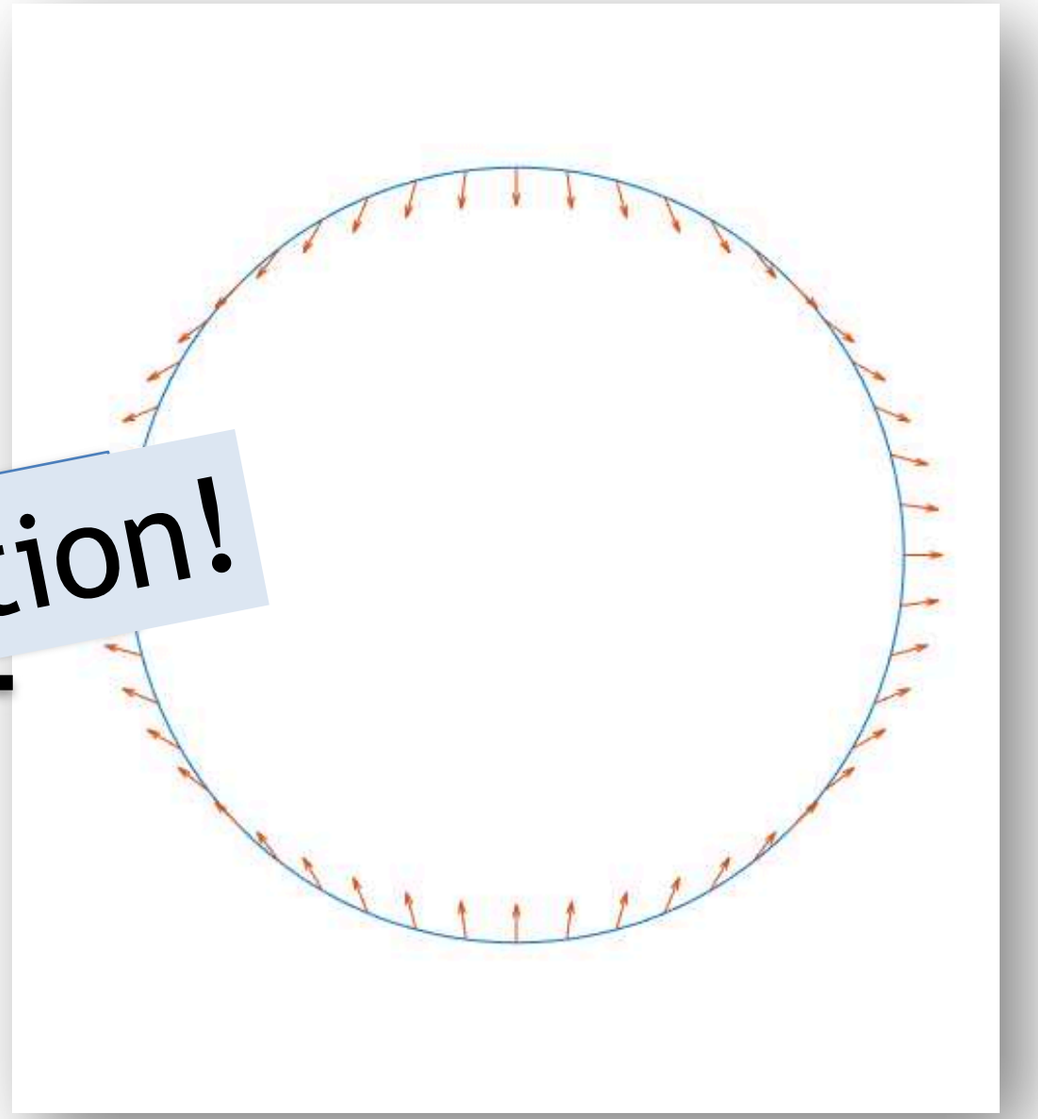
Surface velocity field

Curl-free

Divergence-free

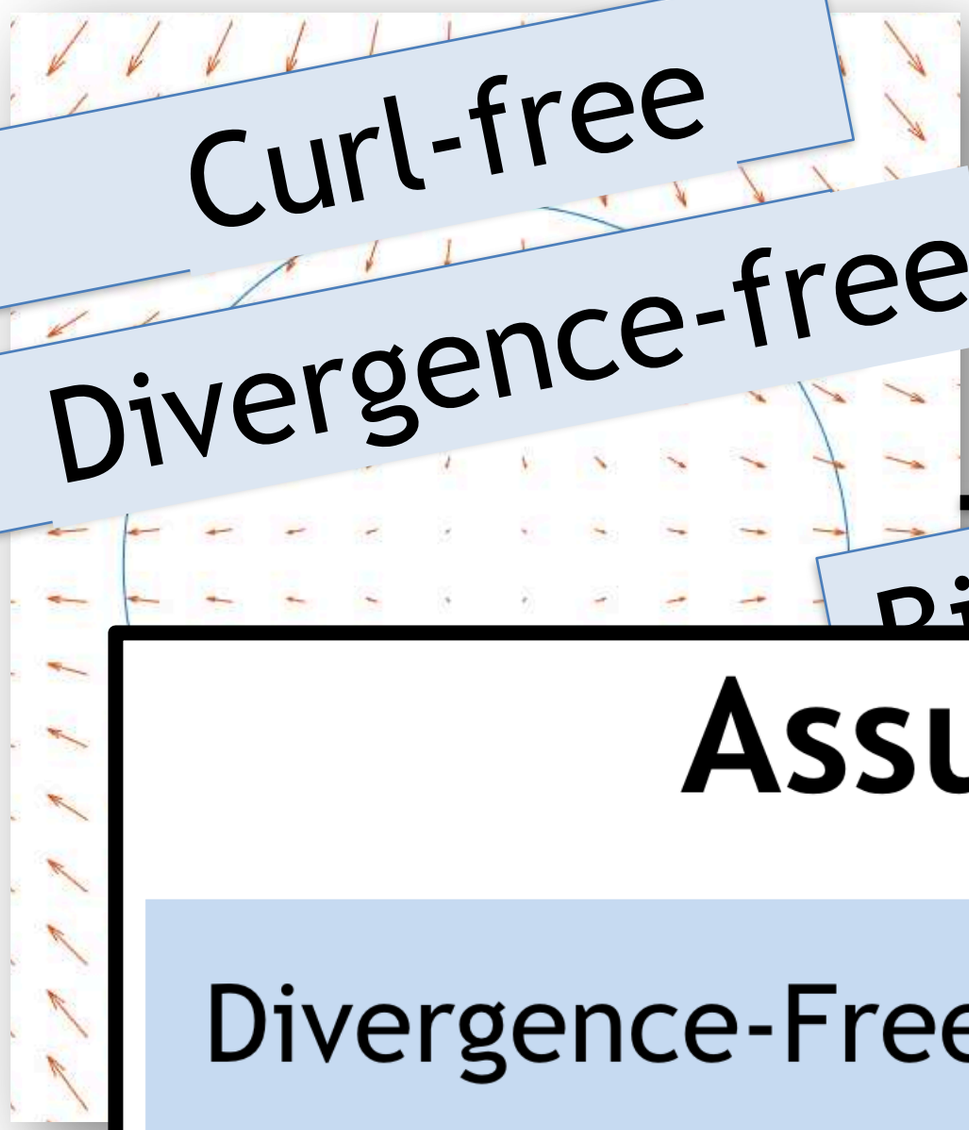


Bijection!



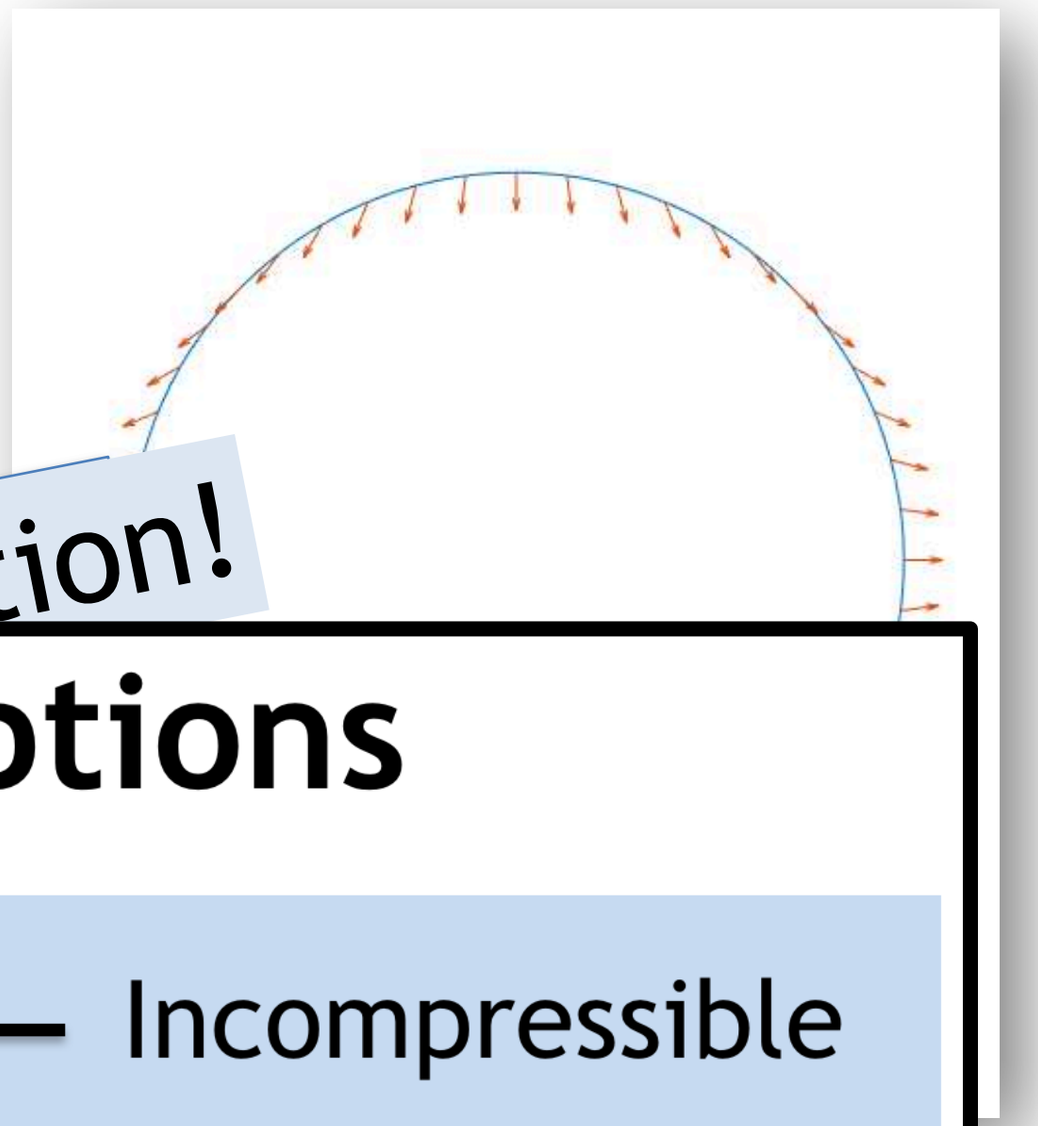
3D velocity field

Surface velocity field



Curl-free

Divergence-free

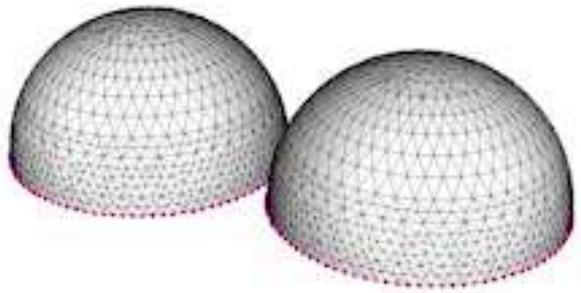


Bijection!

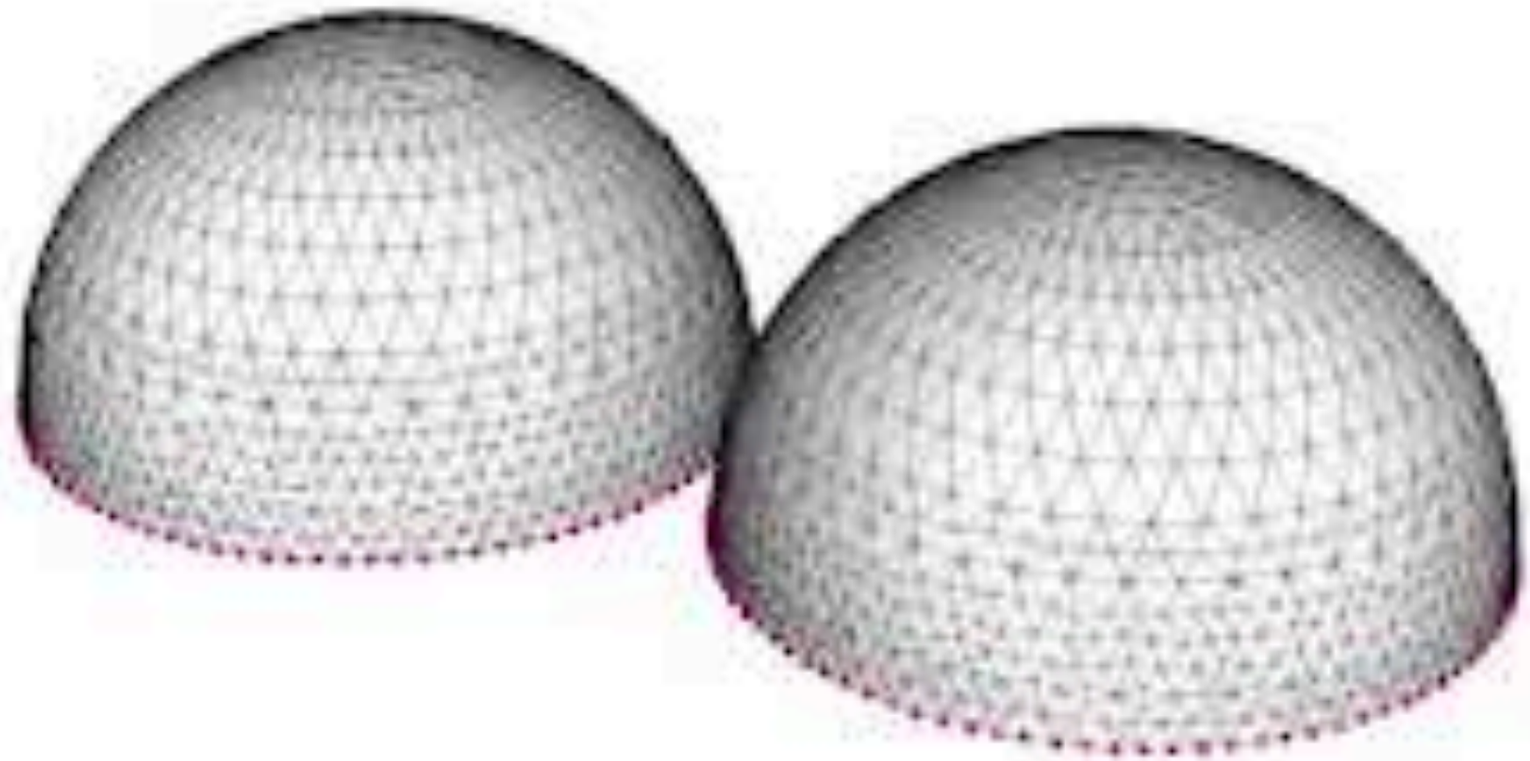
Assumptions

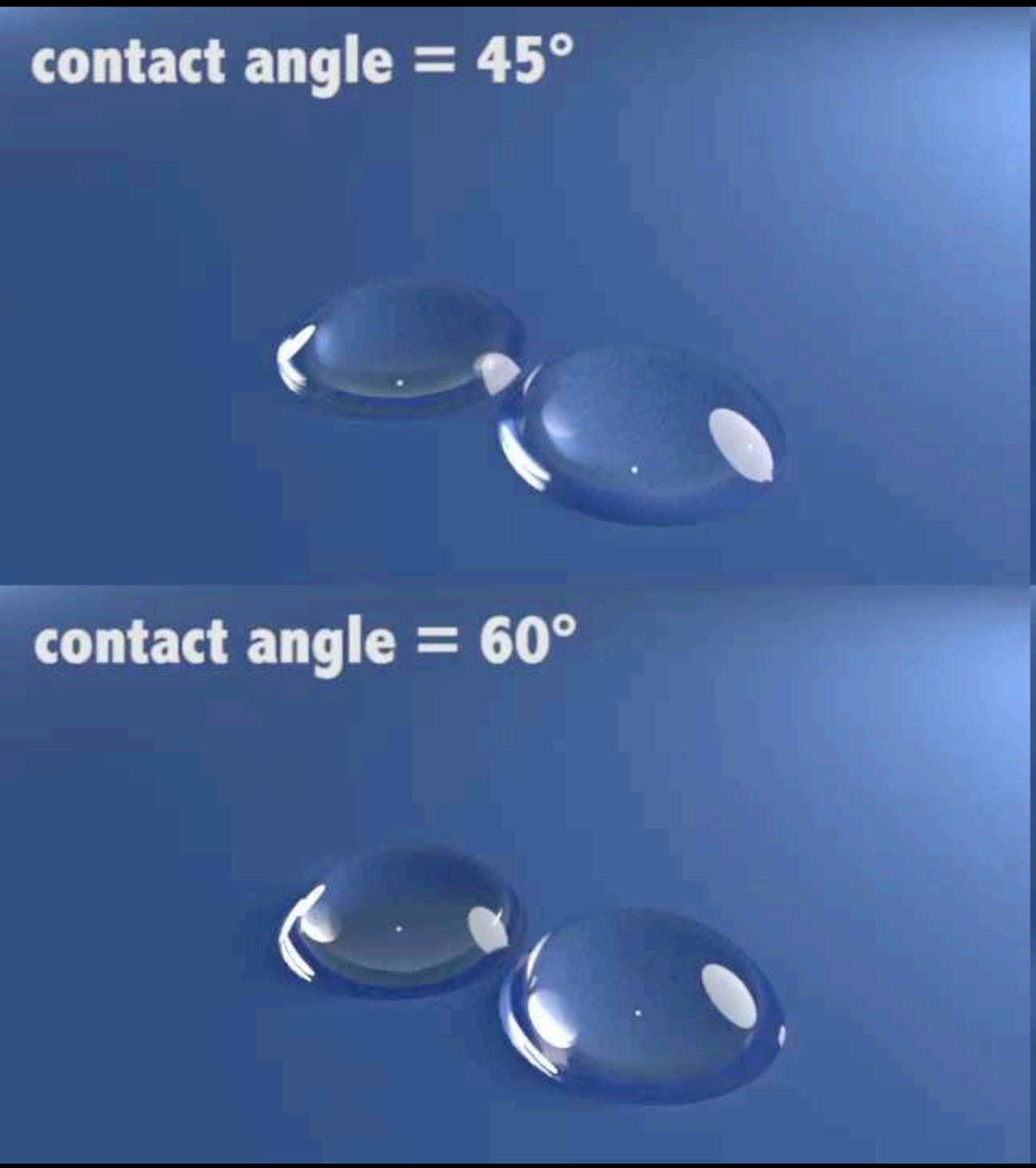
Divergence-Free	⟵	Incompressible
Curl-Free	⟵	Inviscid

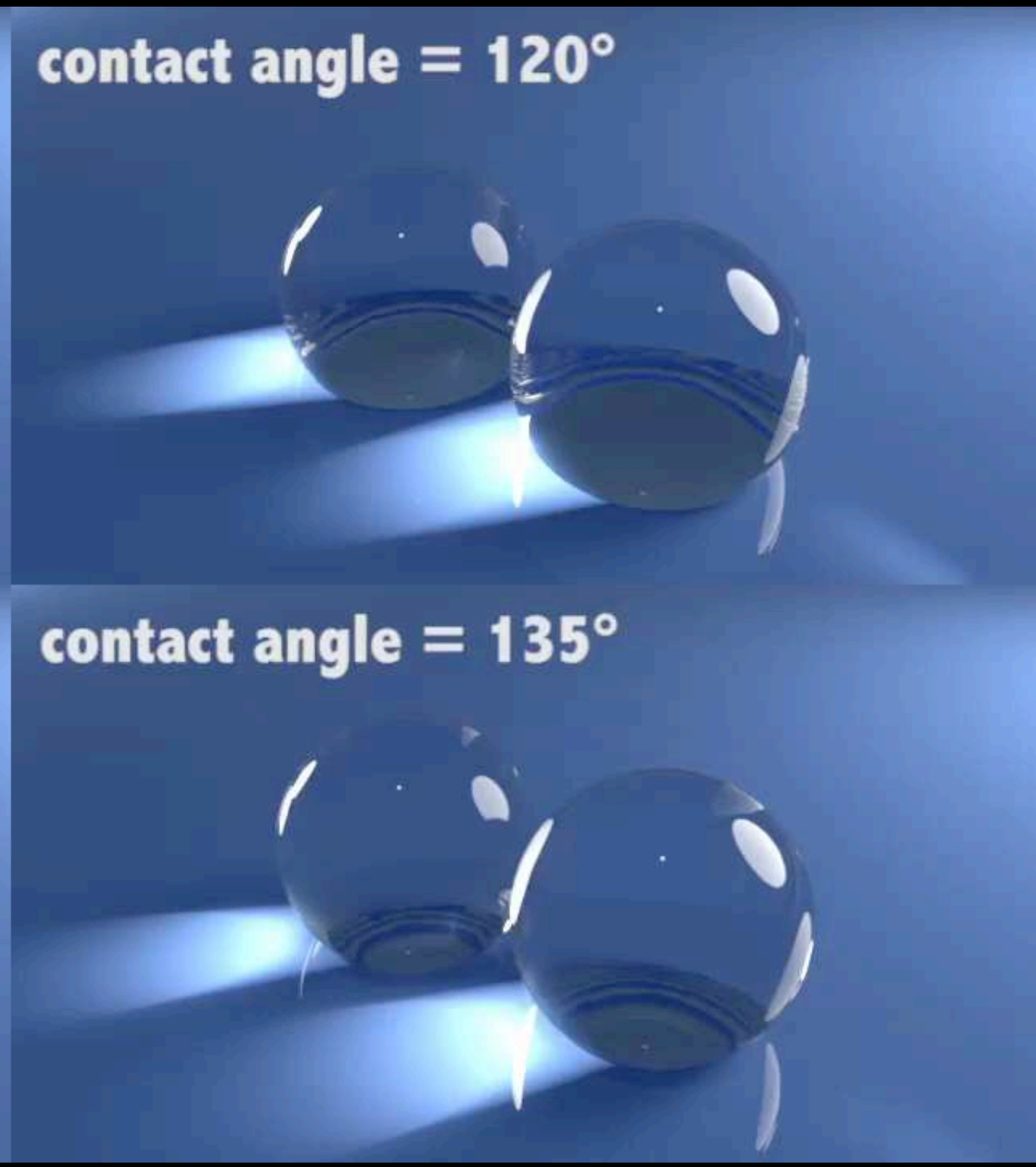
Surface mesh



Surface mesh

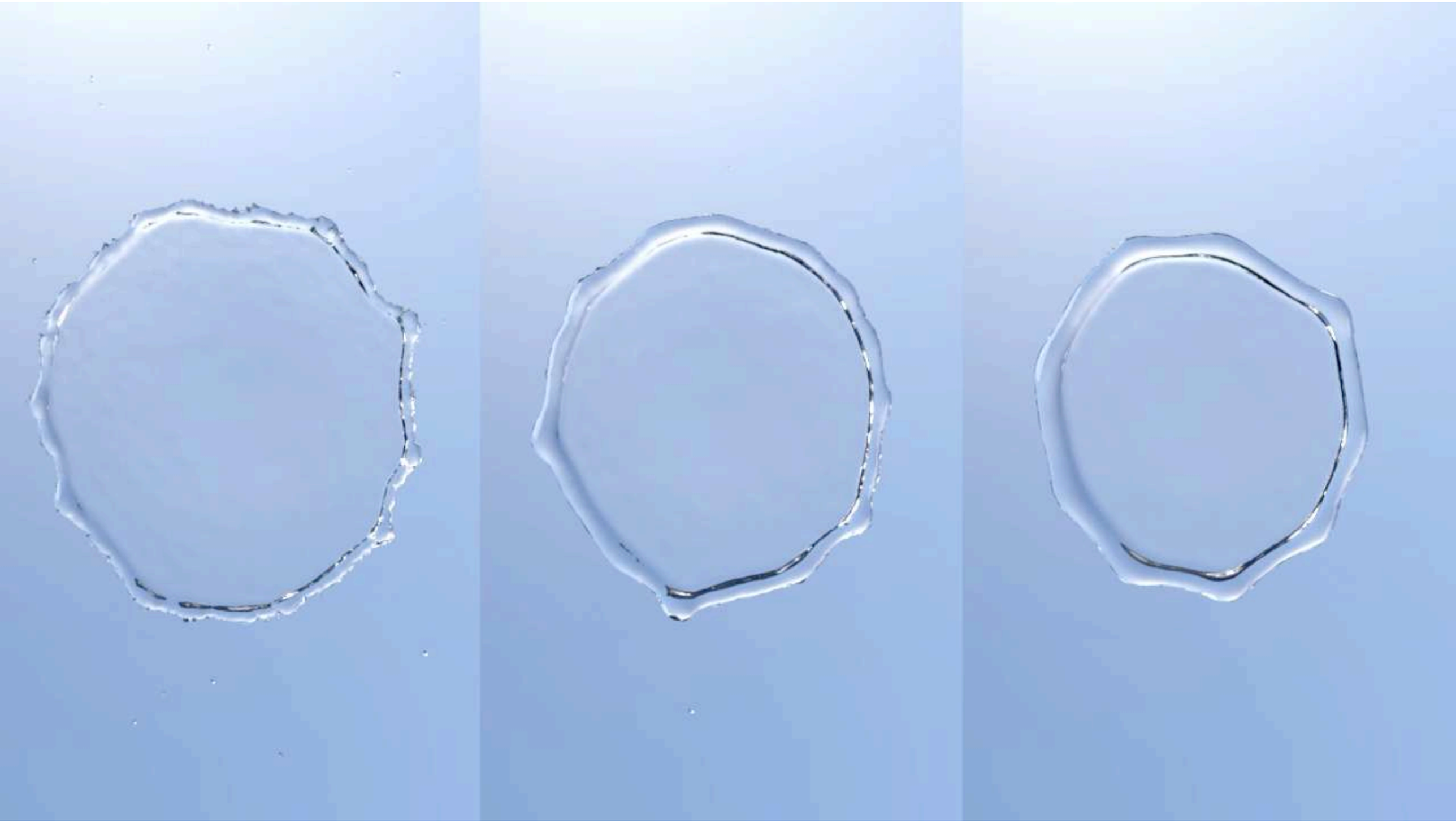



contact angle = 45°

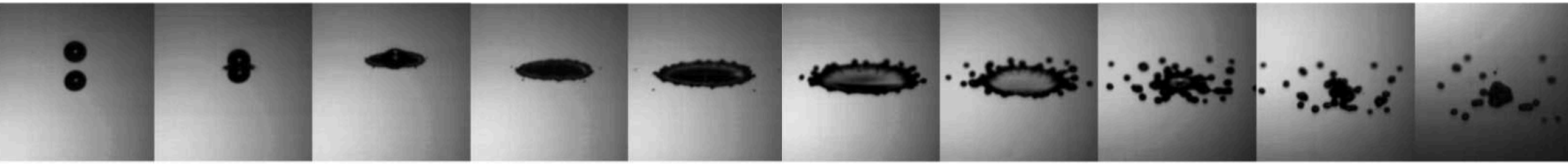

contact angle = 120°

contact angle = 60°

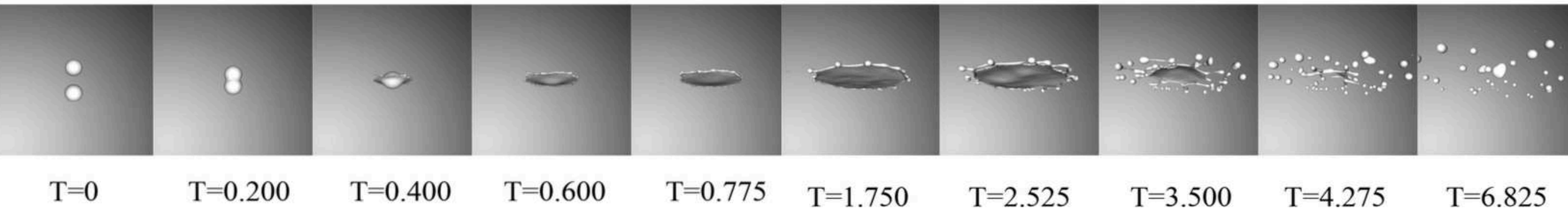
contact angle = 135°

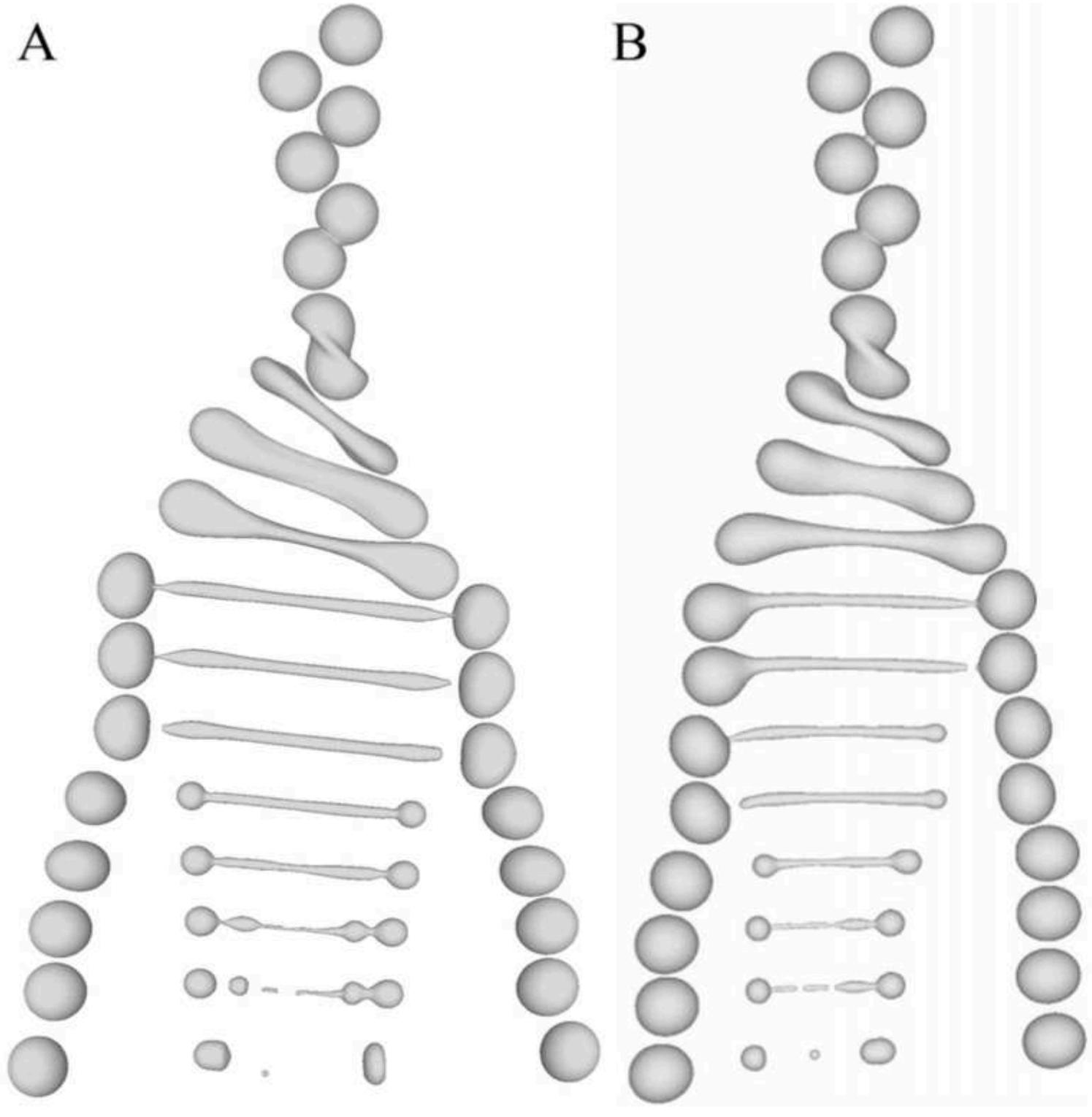


Physical experiment [Pan et al 2009]



Our approach





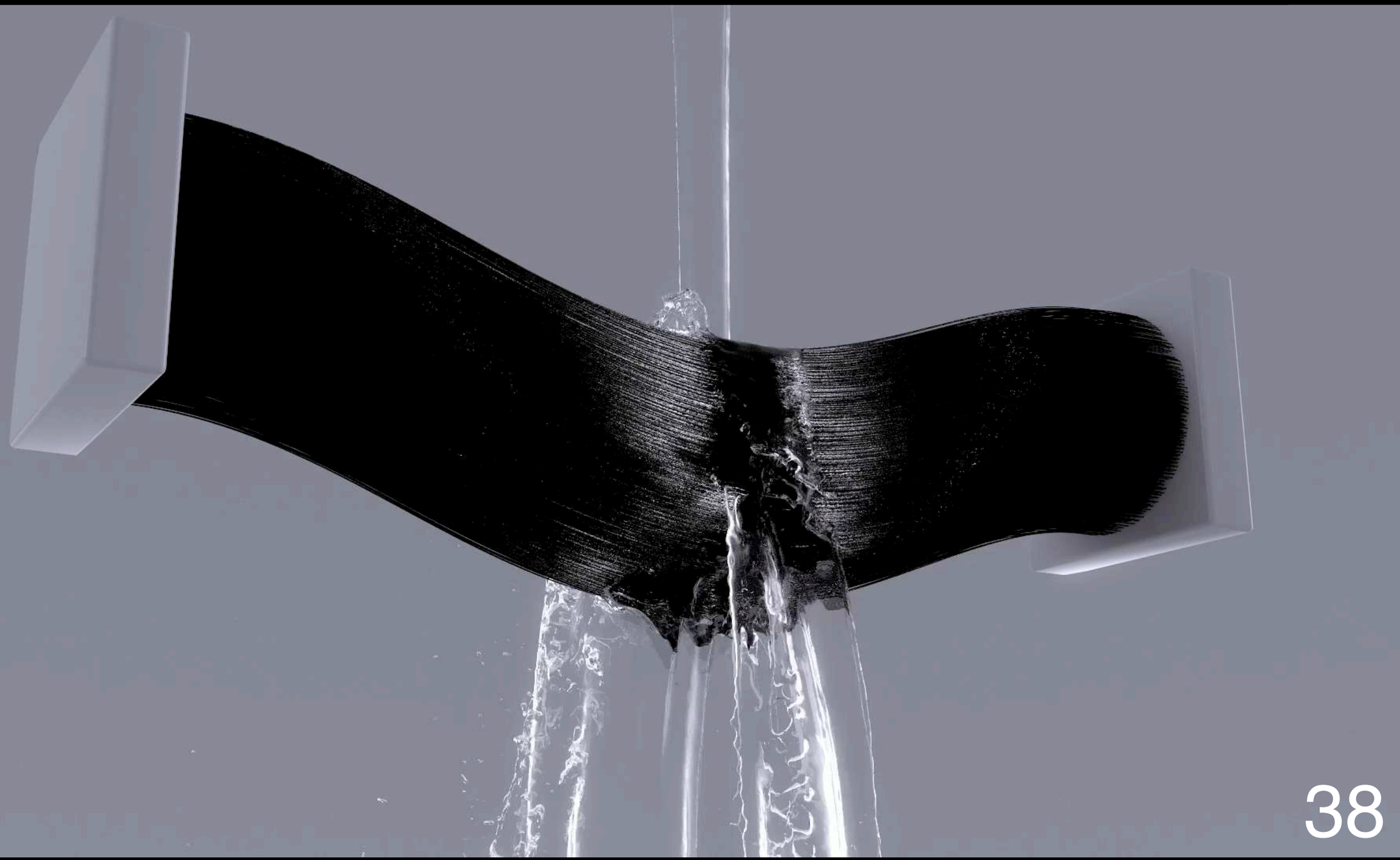
Our approach

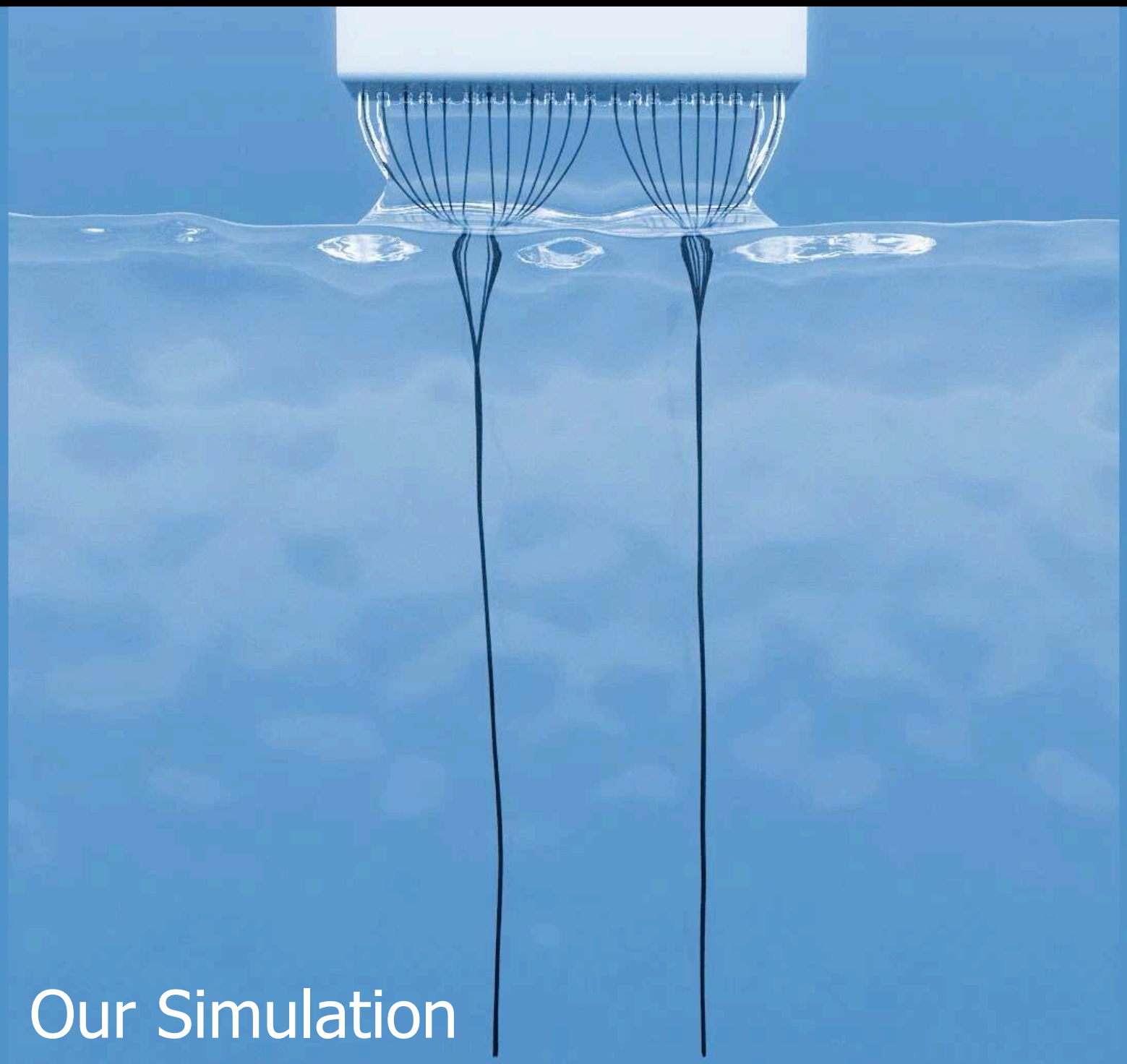
Unstructured tet mesh
[Quan et al 2009]

Flow r

2

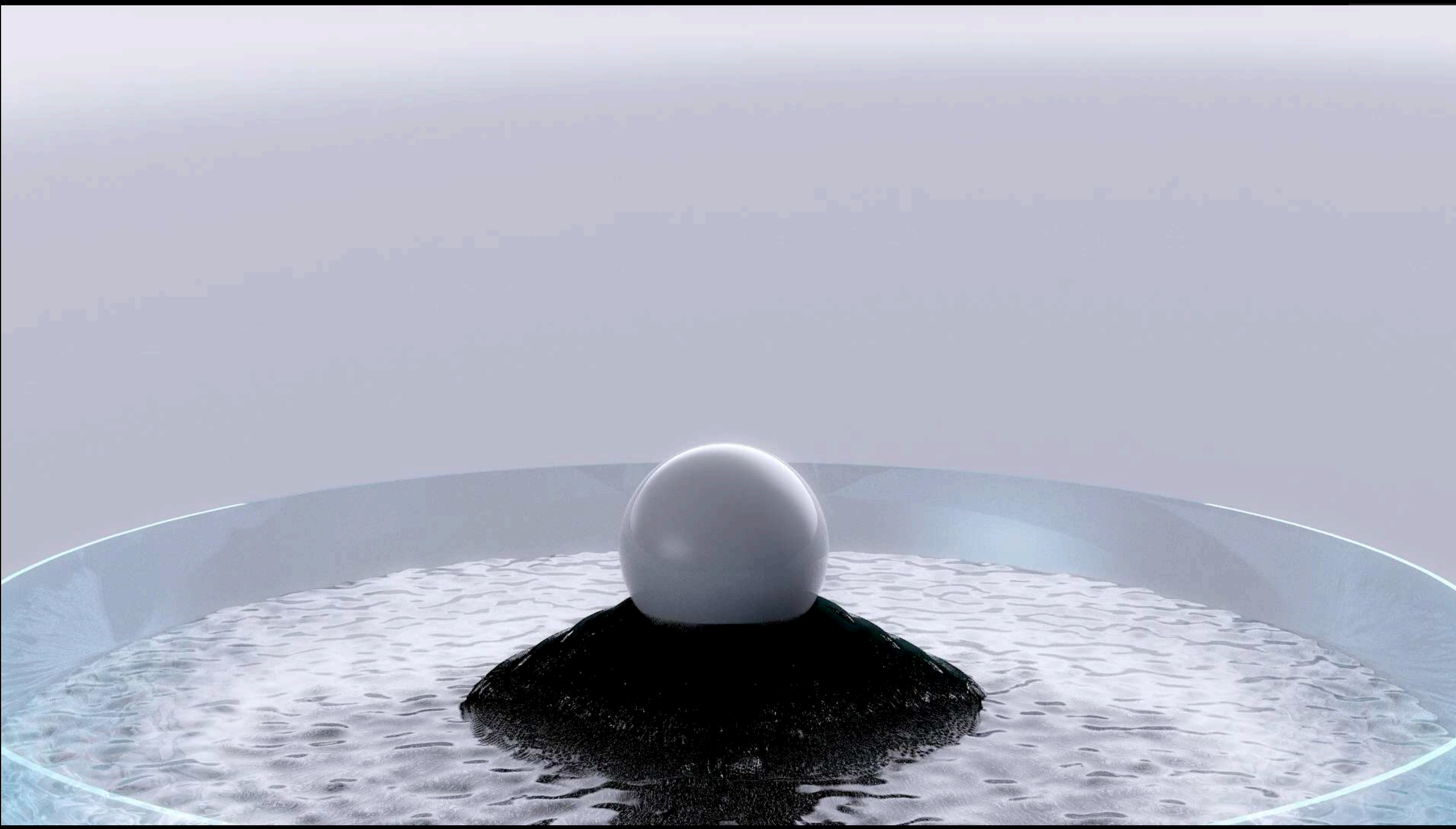
1





Our Simulation

Experiment [Bico et al. 2004]




cohesion
flow along
hairs
dripping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Thank you!

The first Graphics-Physics Workshop