Reducing contact time for a drop impacting on superhydrophobic surfaces

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Flowing Matter Across the Scales

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ETH
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European Research Council

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Centro Svizzero di Calcolo Scientifico
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Numerical Approach

- Multiphase Flows: Free Energy Approach
- Entropic Lattice Boltzmann Method
- Polynomial Equation of State

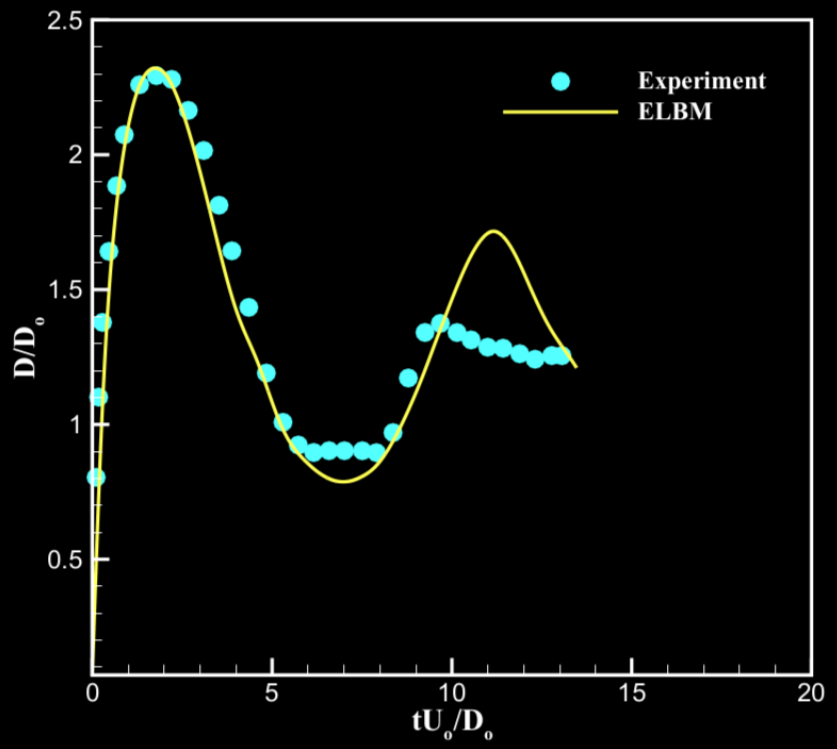
- ✓ Surface tension / contact-angle free to choose
- ✓ Thermodynamic consistency
- ✓ Large (enough) density ratios
- ✓ Low viscosity
- ✓ Dynamic and static droplet/bubble simulations

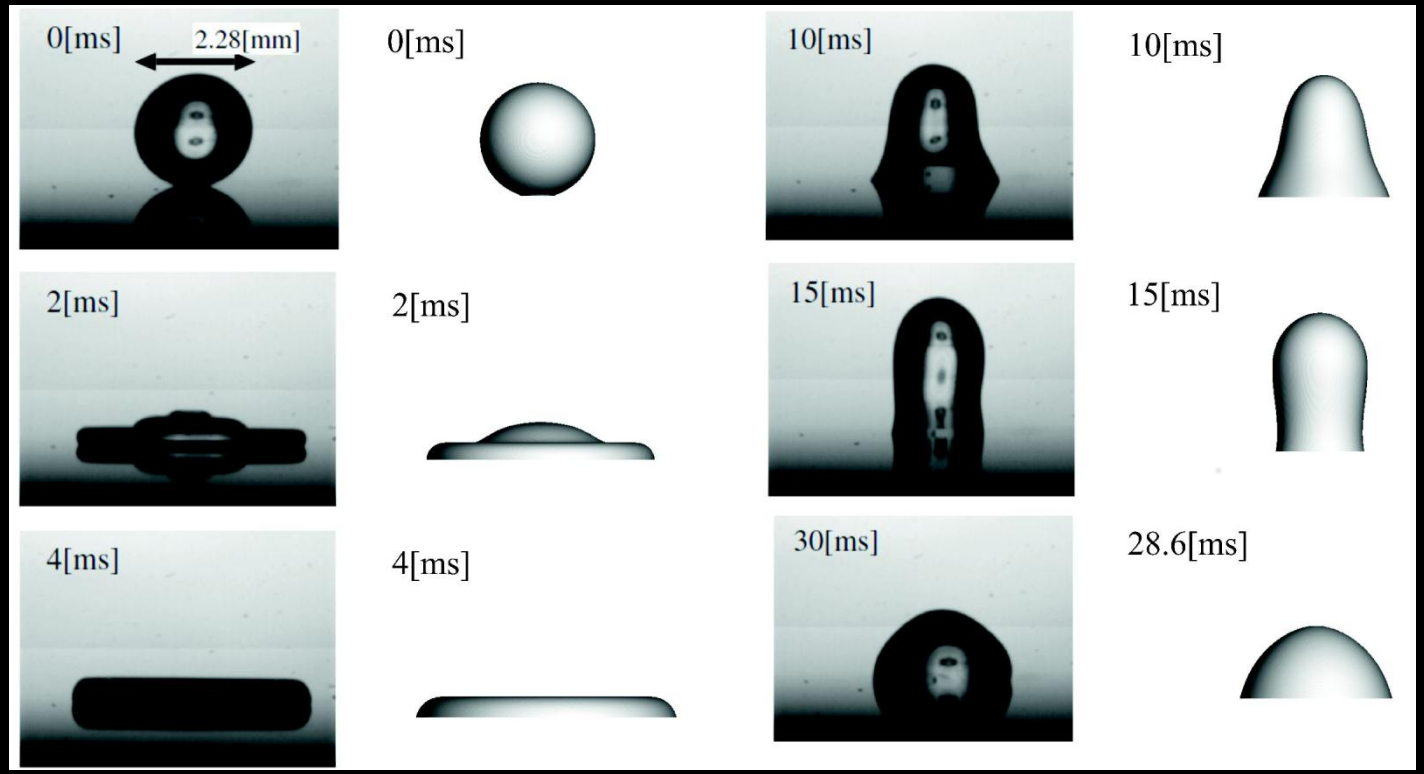
I Karlin, et. al. *Physical Review Letters*, (1998)

Simulations …

Hydrophilic surface

Time evolution of droplet diameter





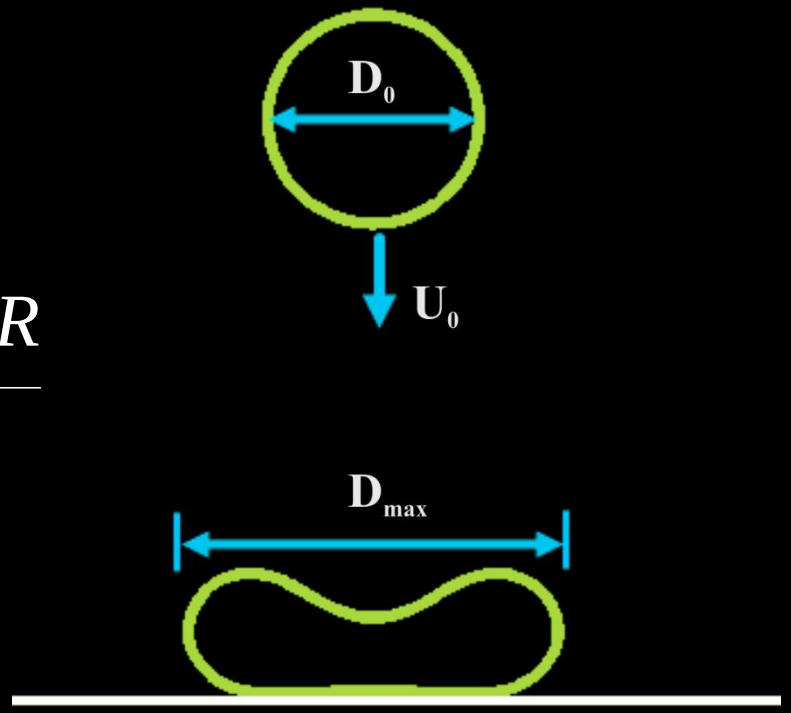
Yokoi, Kensuke, et al. *Physics of Fluids* 21.7 (2009).

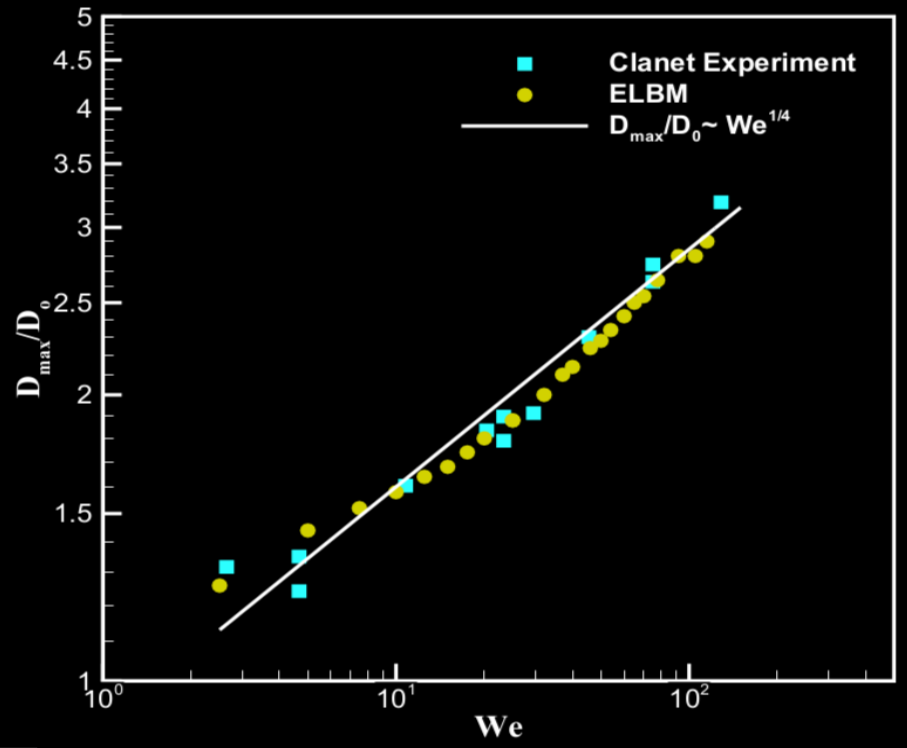
Simulations …

Super hydrophobic surfaces (SHS)

Maximum diameter of a drop impinging on a SHS

$$We = \frac{\rho_l U^2 R}{\sigma}$$



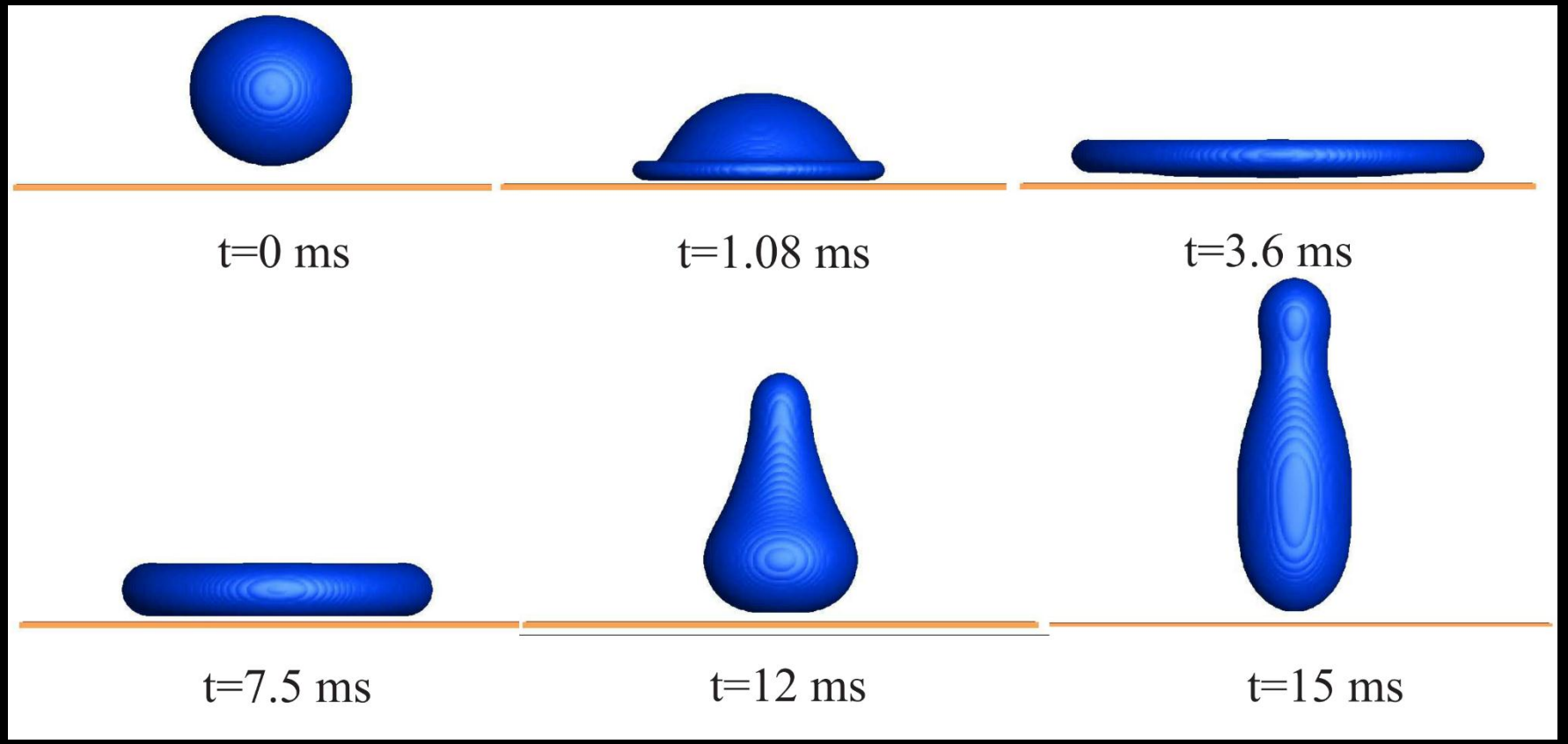


Clanet, Chr istophe, et al. *Journal of Fluid Mechanics* 517 (2004).

Simulations …

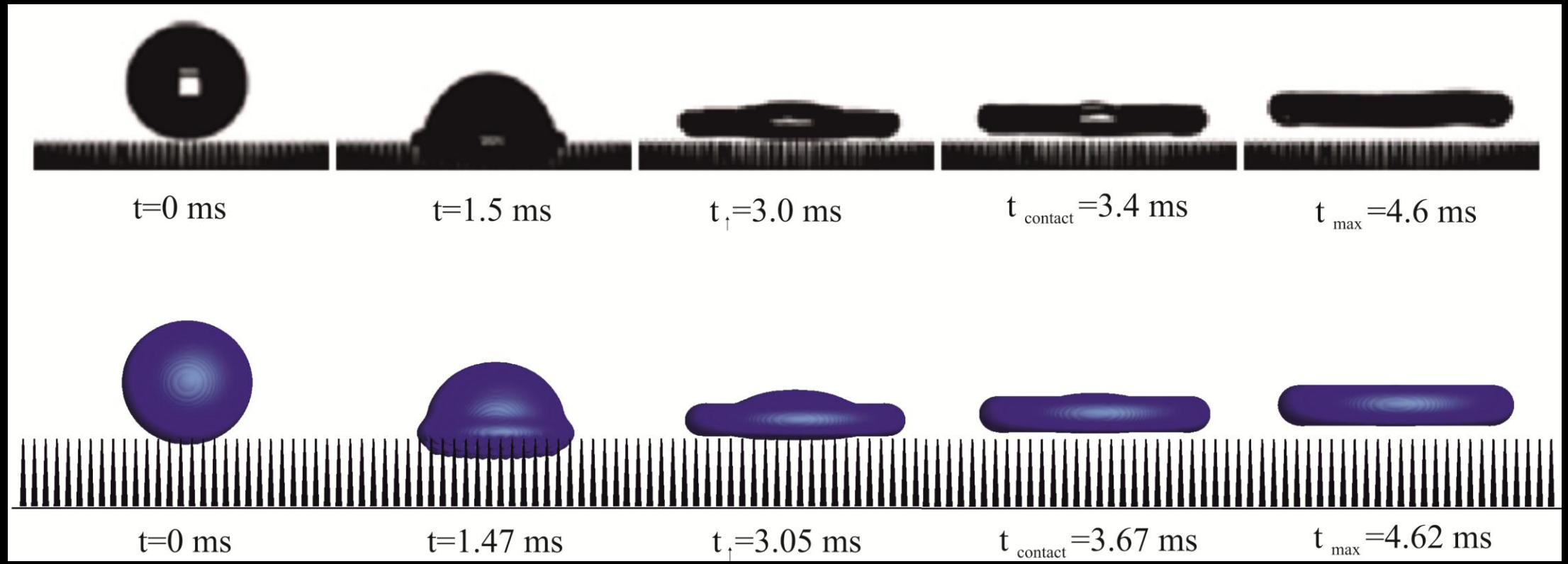
Reducing contact time

Conventional bouncing



Simulations …

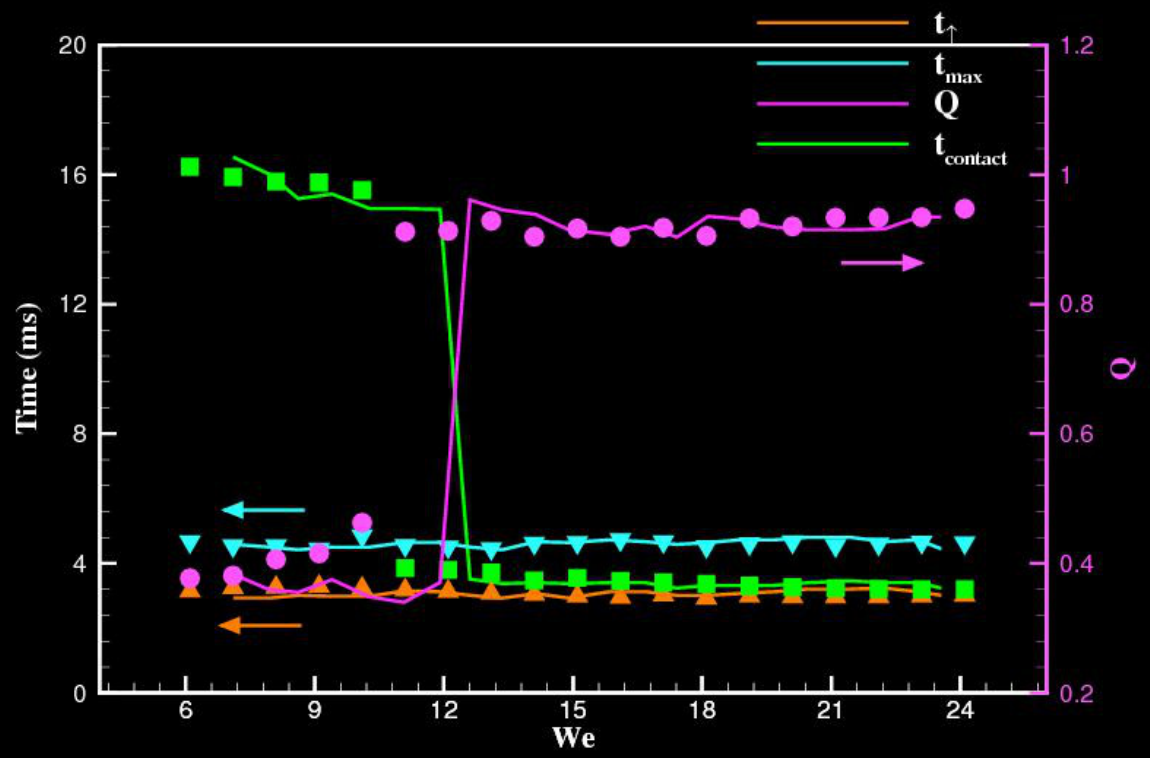
Reducing contact time: Tapered Posts



Liu et. al., Nature Physics 10, 515–519 (2014)

Simulations …

Reducing contact time: Tapered Posts

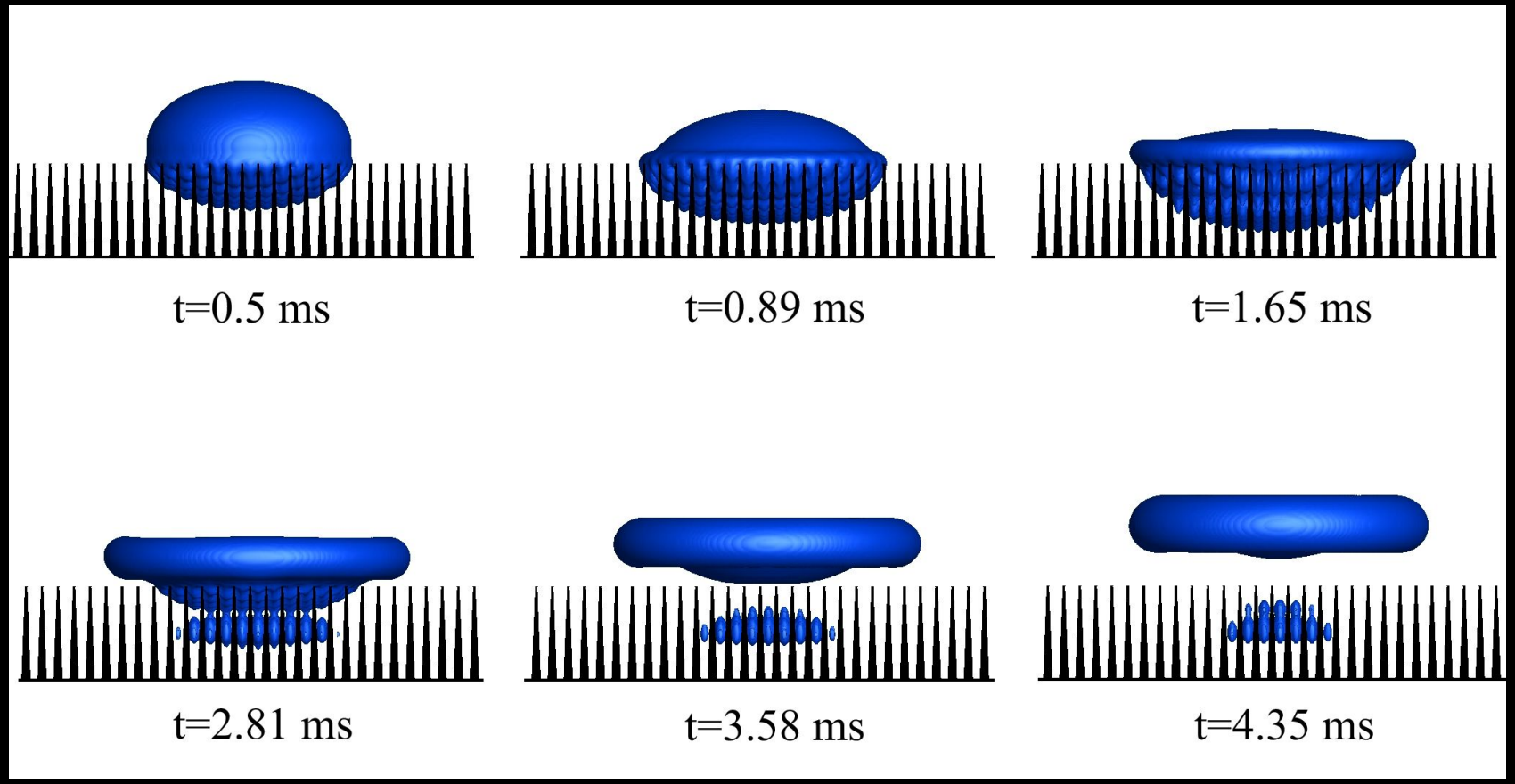


- Tested only for small We in the experiments !

Simulations …

Tapered Posts (Higher Weber Numbers)

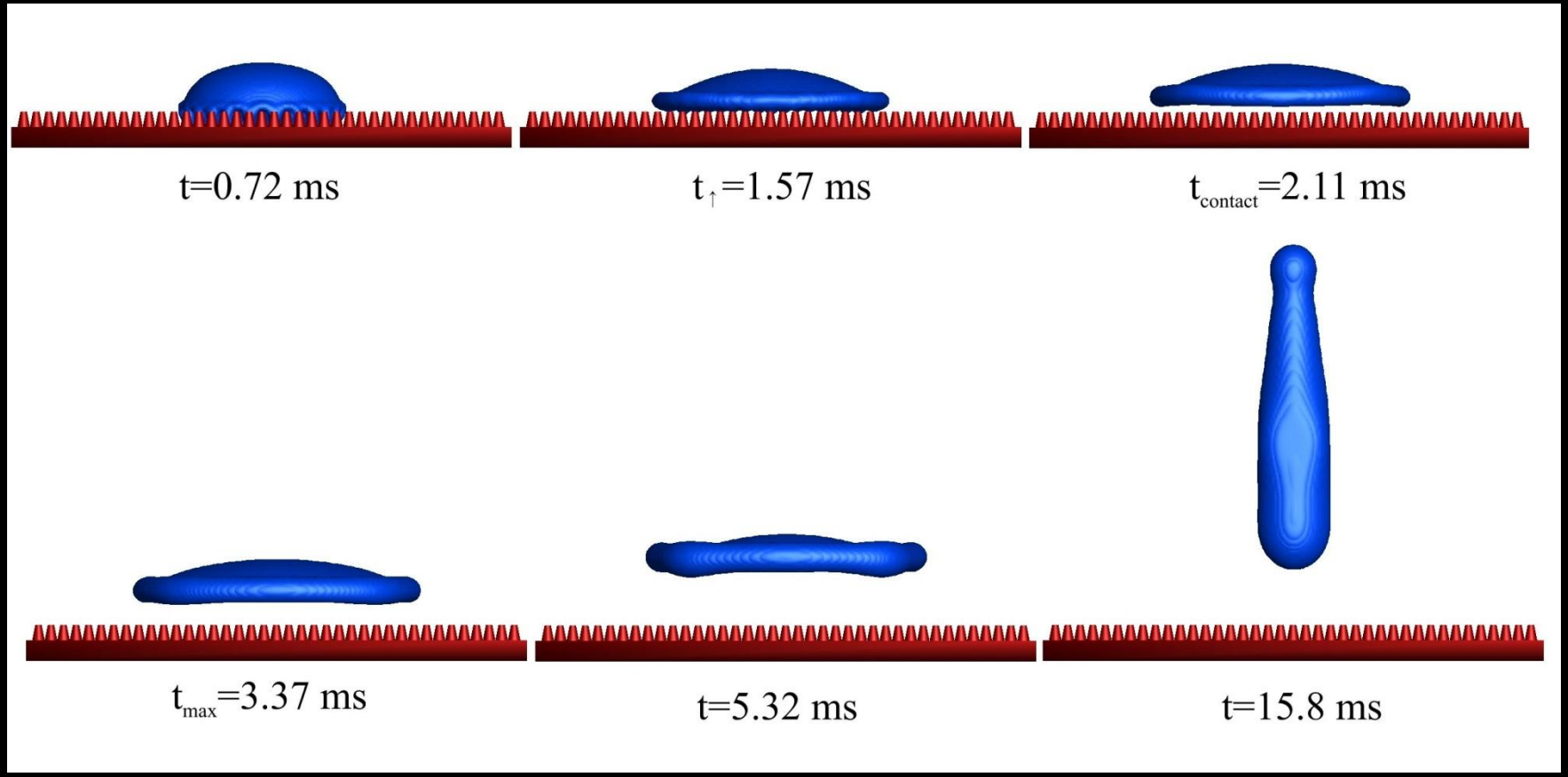
We=86.1



Simulations …

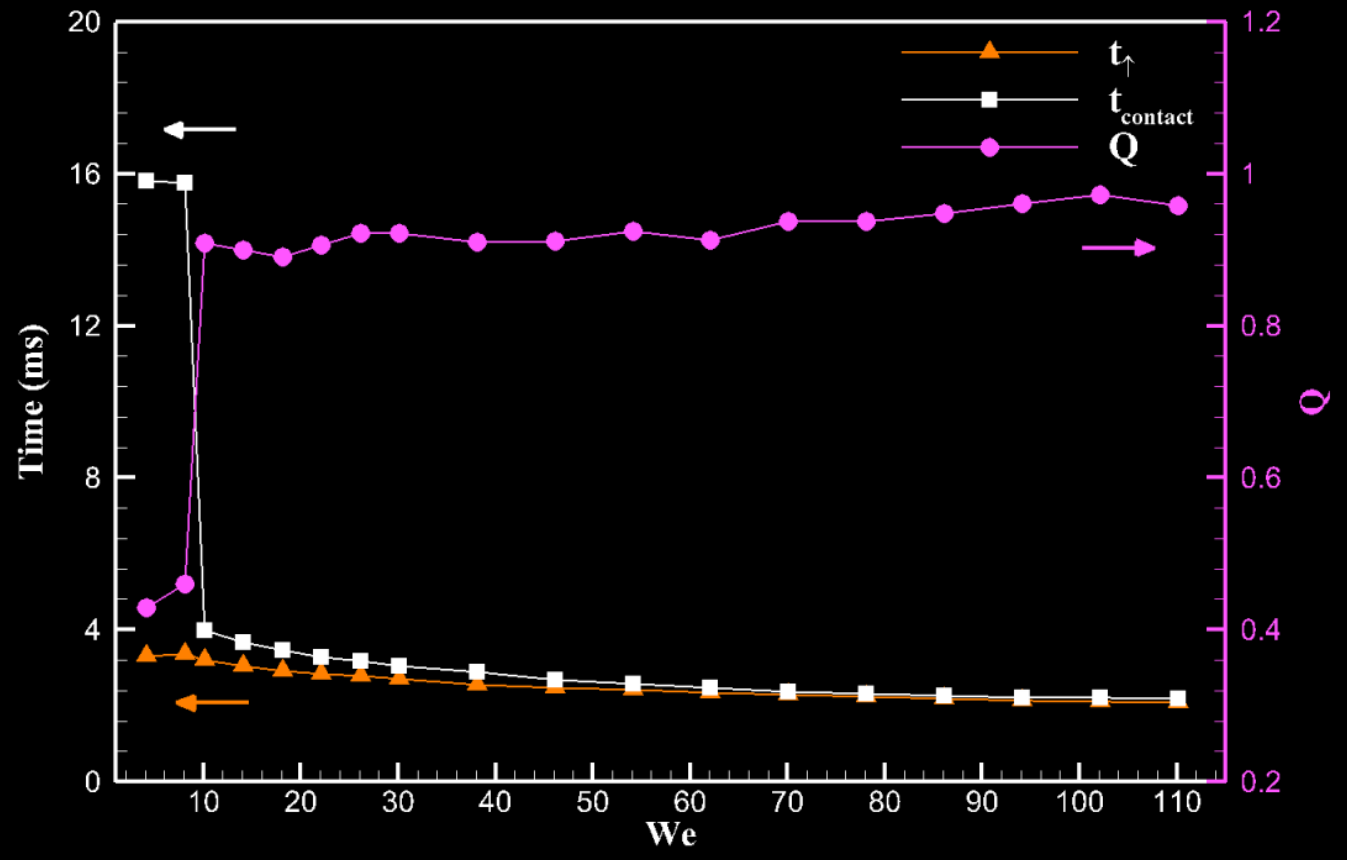
Reducing contact time: New geometry

We=86.1



Simulations …

Reducing contact time: New geometry



Conclusion

Advantages of new designed surface

- ✓Transition to pancake bouncing occurs earlier
- ✓No splitting of droplets
- ✓Larger We possible
- ✓Contact time reduces as We increases

Thank you for your attention