CFD in Microfluidics systems

ADVANCED MODELLING & SIMULATION – AMS –

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JUNE 2020

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Microfluidics systems

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Microchannel Heat Sink

- Bubbly flow: jG = 0.66, jL = 1.11 m/s; a = 0.205

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- Slug flow: jG = 0.66, jL = 1.11 m/s; a = 0.376

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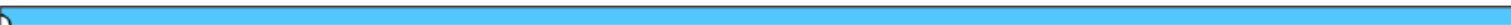- Slug train flow: jG = 1.57, jL = 1.11 m/s; a = 0.498
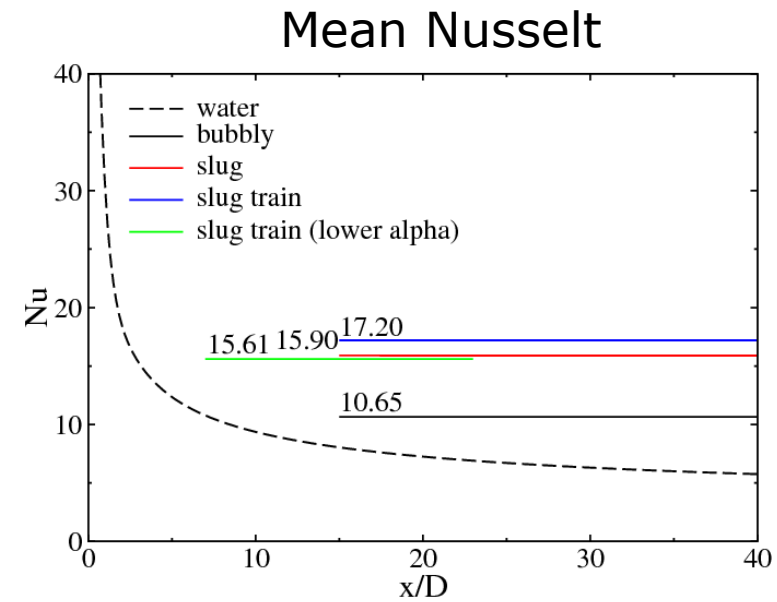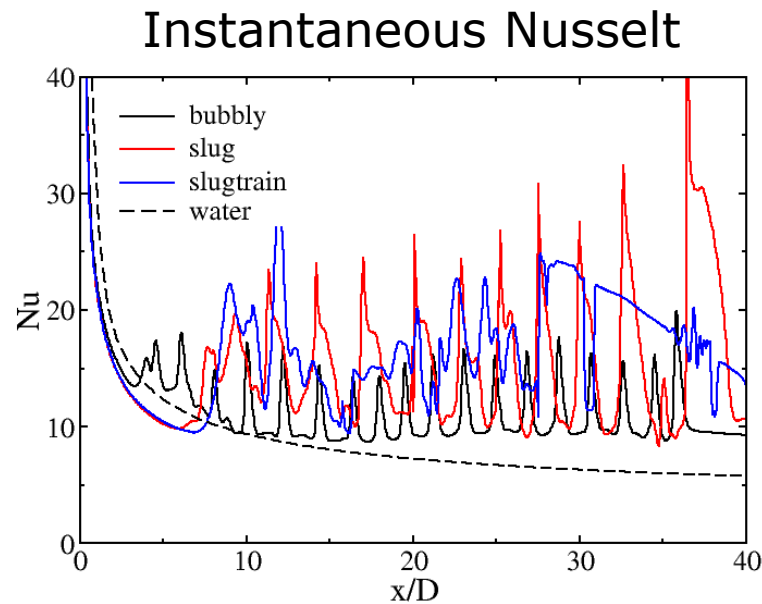
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- Churn flow: jG = 4.42, jL = 1.11 m/s; a =

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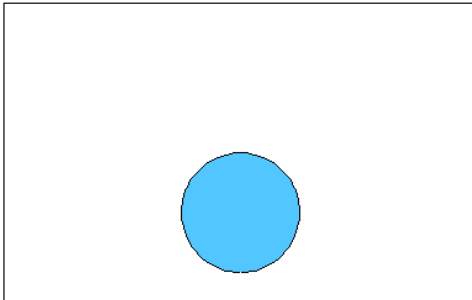... connecting Science and Technology

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Nusselt number

Five (5) times higher heat transfer for slug-train flow regime
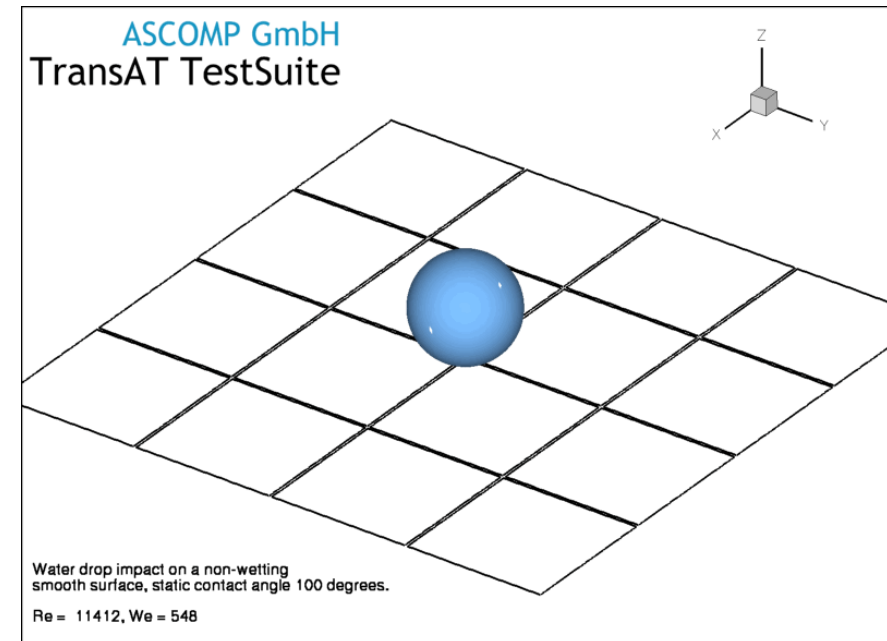
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Droplet impact – 2D & 3D examples
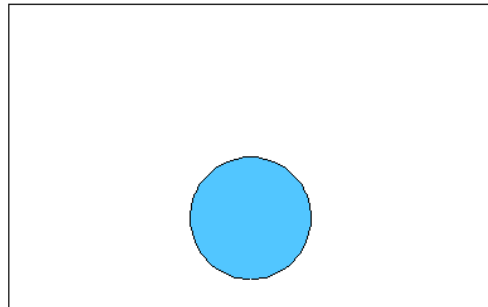
2D: adherence

2D: bouncing

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Water drop impact on a non-wetting
smooth surface, static contact angle 100 degrees.

Re = 11412, We = 548

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Bubble impact on dry surfaces

2D: CA = 100, We = 52 and Re = 3245
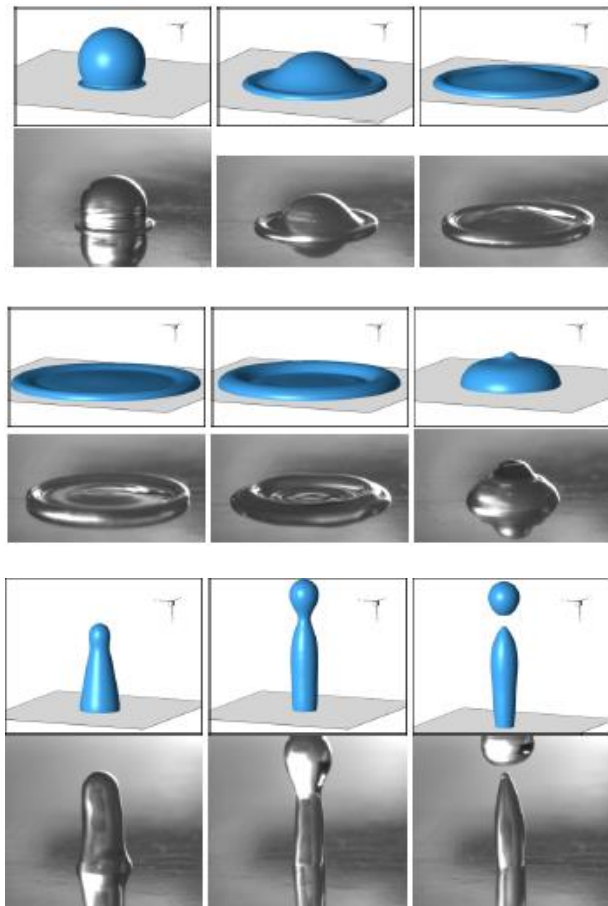
3D: CA = 100; We = 548 and Re = 11412

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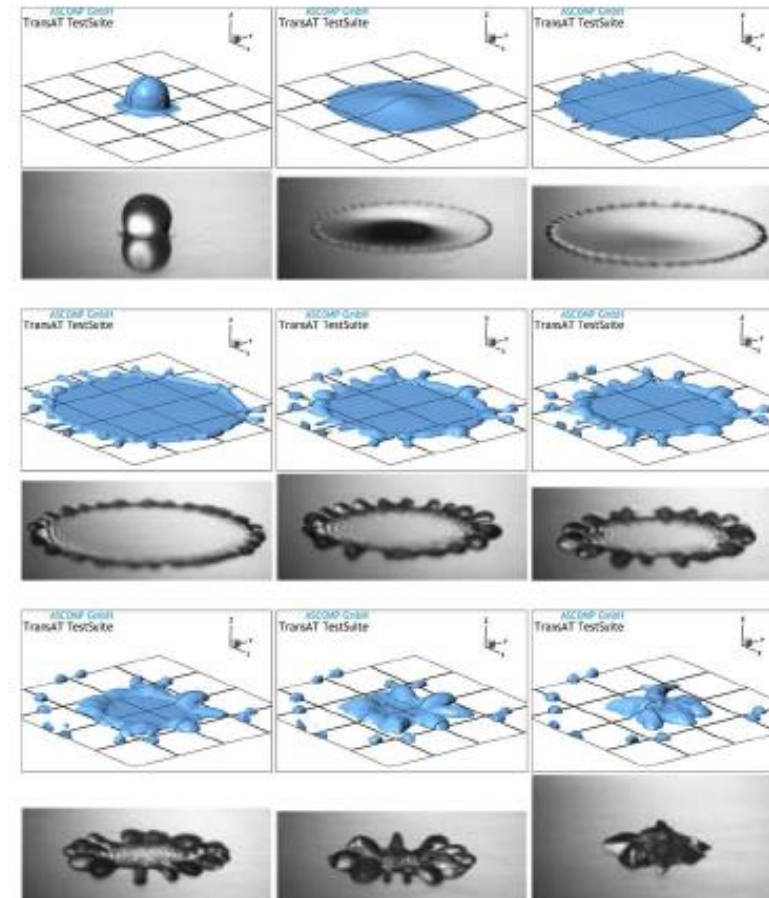
Droplet rebounding on a hot surface
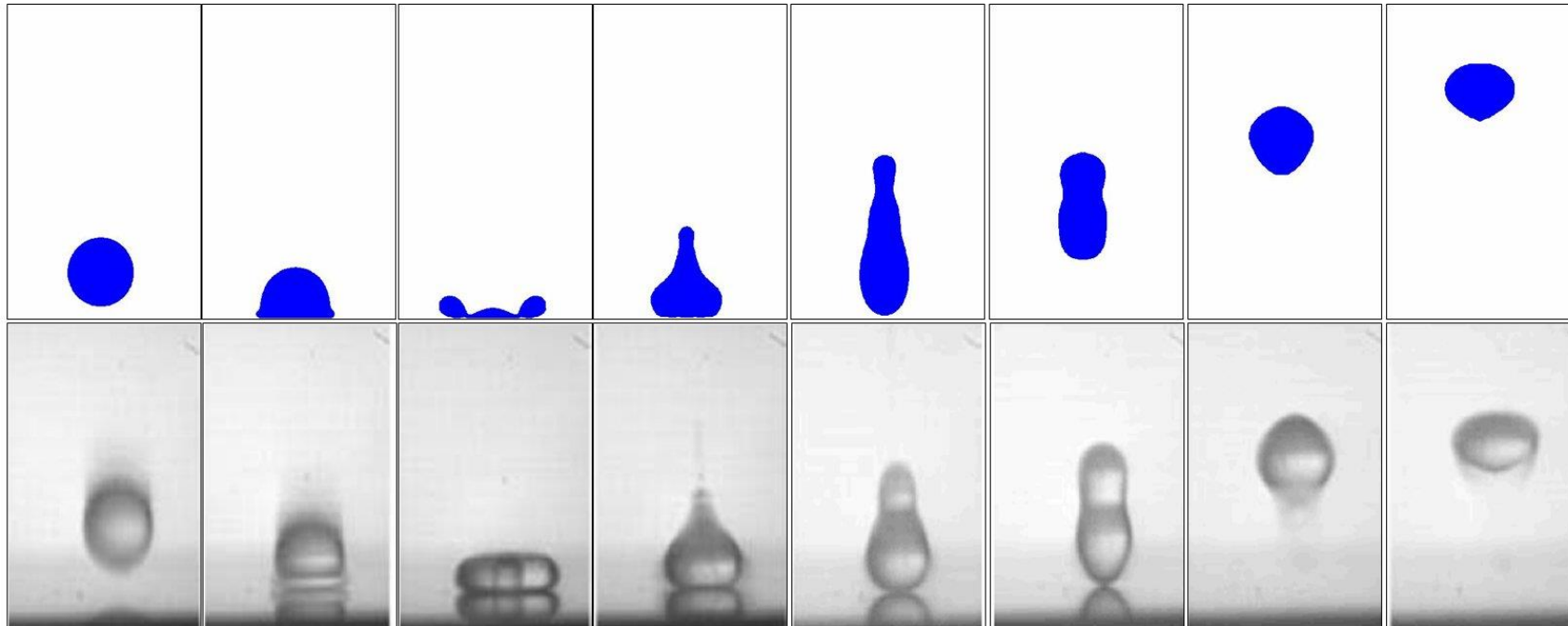
Exp: Wachters et al., Chem. Eng. Science, 1966 CFD: Chatzikyriakou et al., Appl. Therm Eng., 2009

Droplet returning to equlibrium

Narayanan & Lakehal, Proc. NSTI Boston, paper 770, 2006.

Bubble manipulation with Marangoni forces
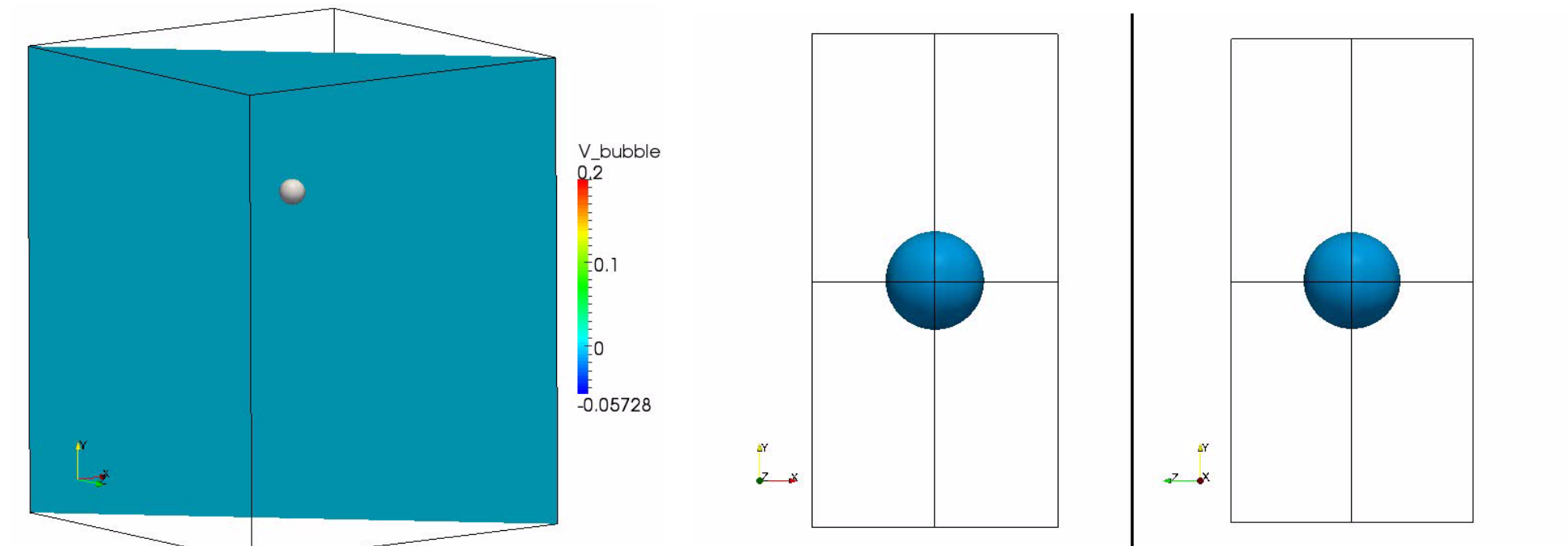
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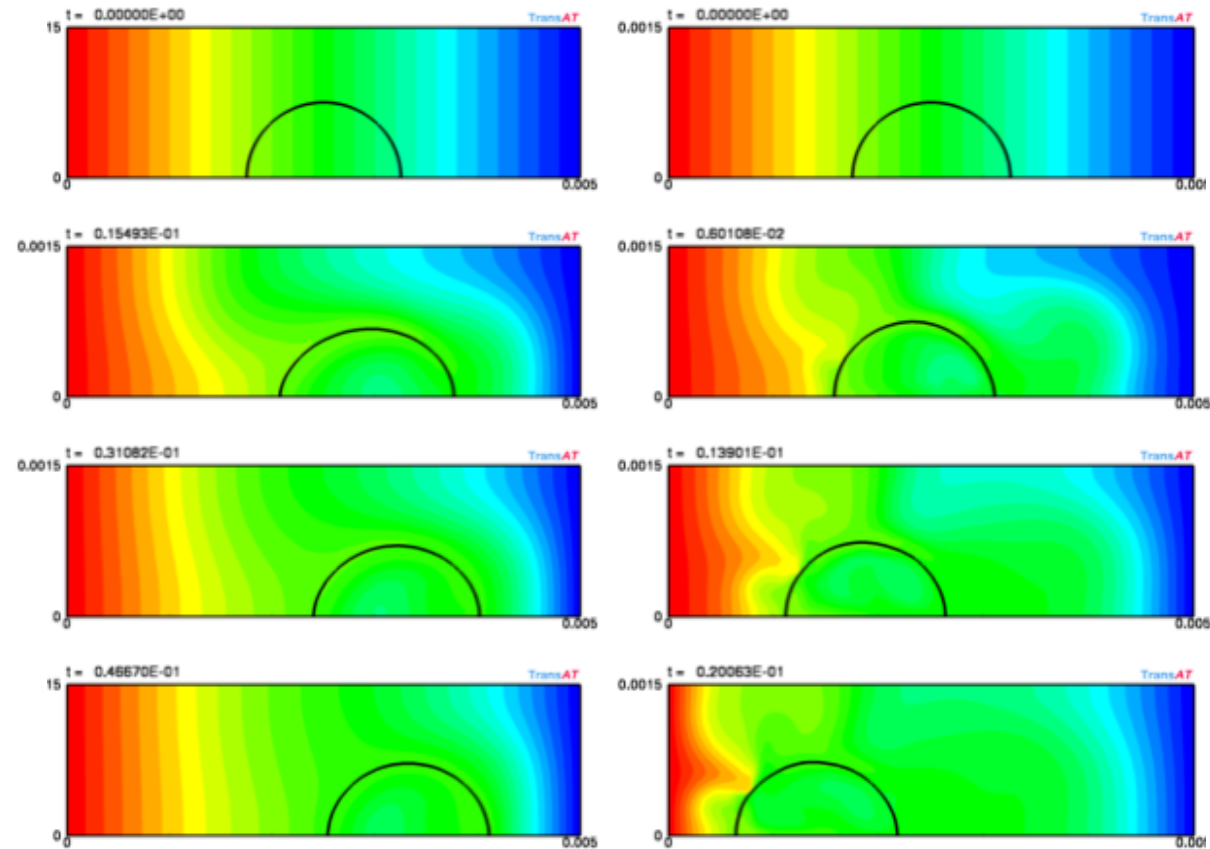
Bubble manipulation with Electrowetting effects

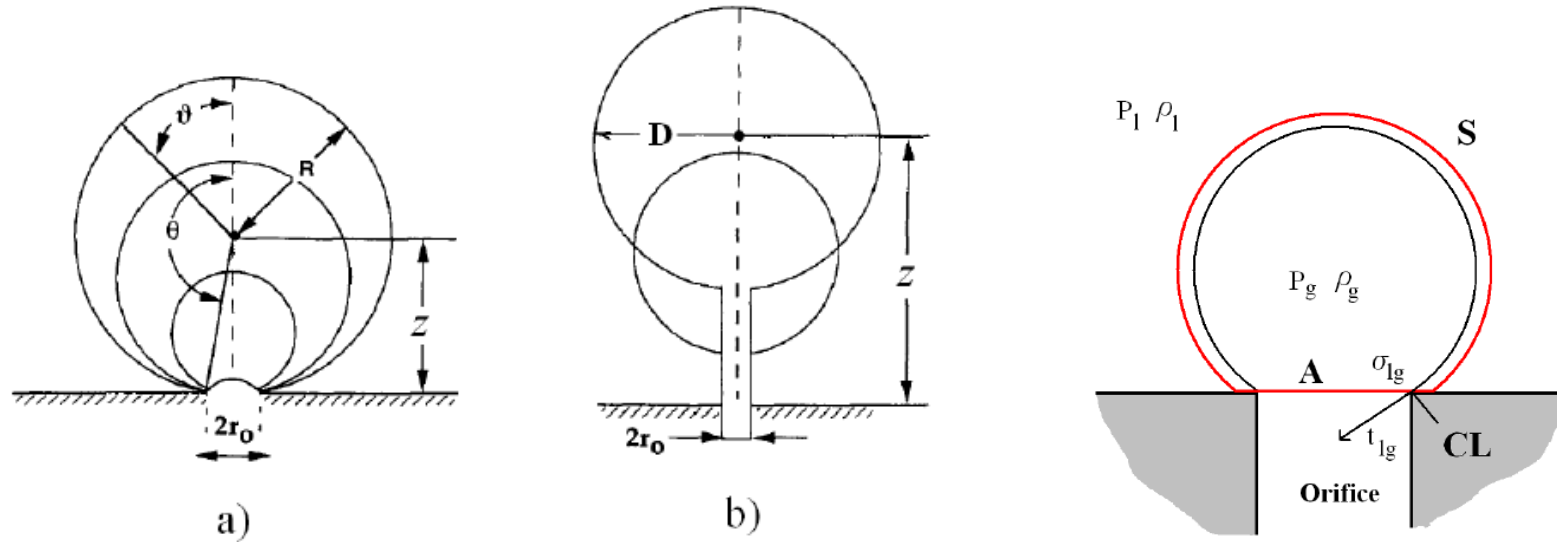$$\cos \theta(V) = \cos \theta(0) - \frac{\varepsilon_0 \varepsilon_r A . V^2}{\gamma_{LV} 2D}$$
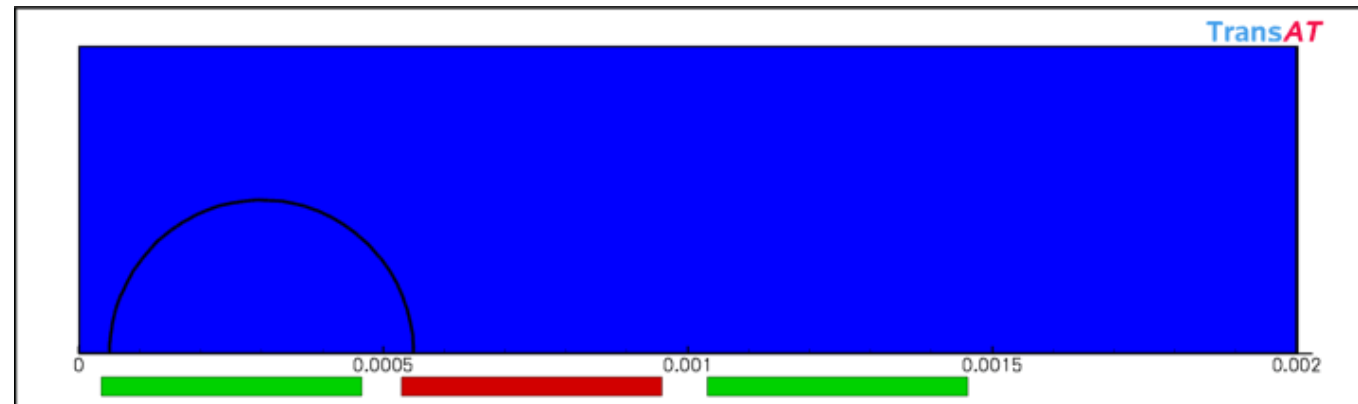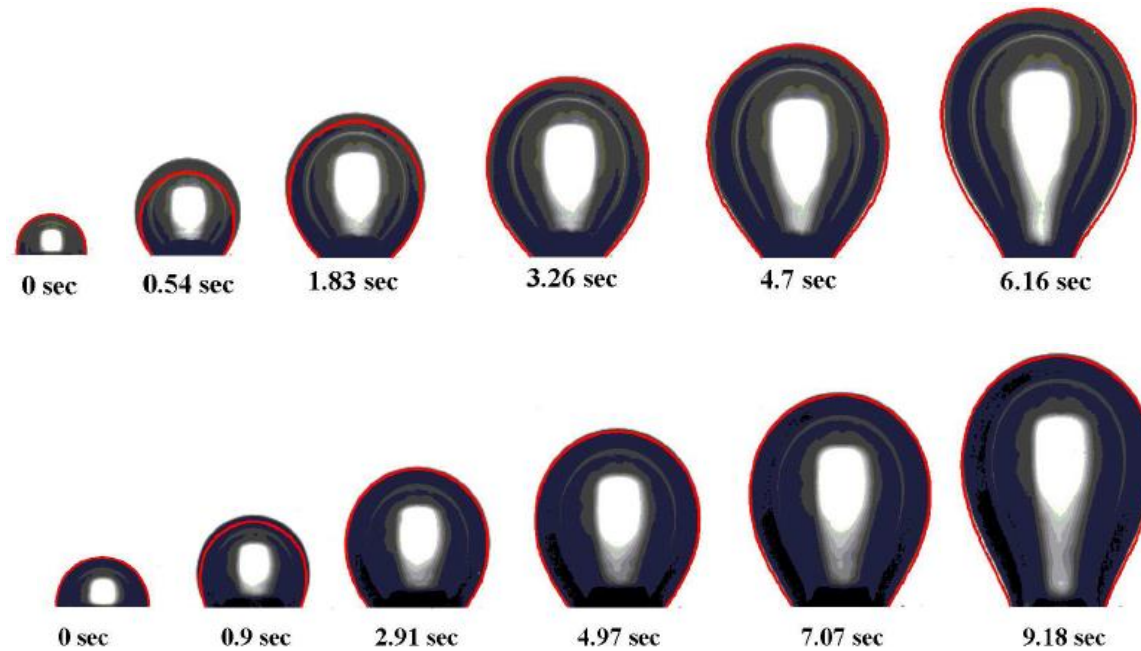
Bubble manipulation with external forcing

Bubble growth dynamics from orifices

S. Di-Bari and A. Robbins, Trinity College Dublin 2011.

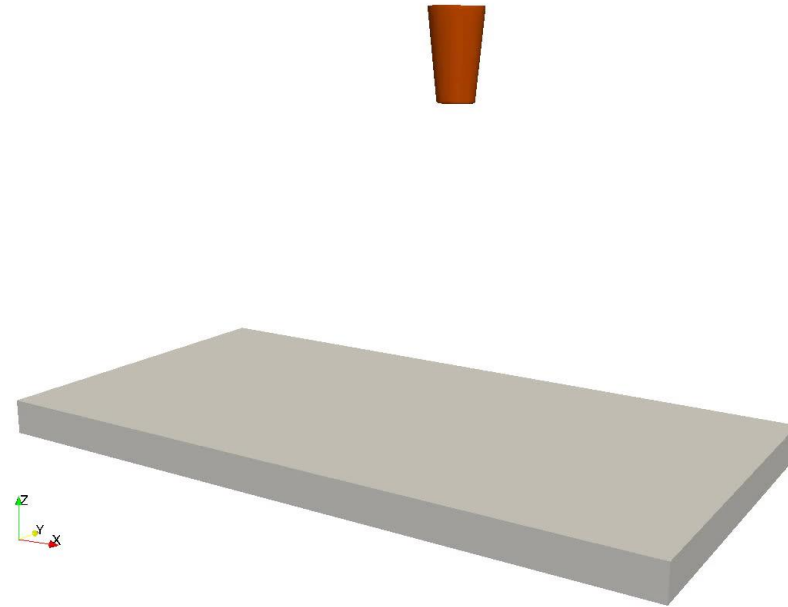# Bubble growth dynamics from orifices

S. Di-Bari and A. Robbins, Trinity College Dublin 2011.
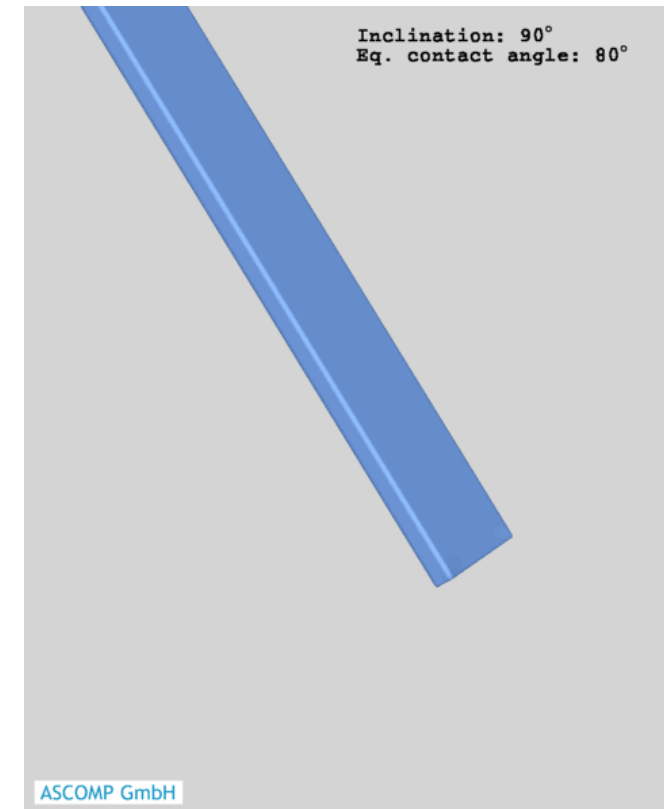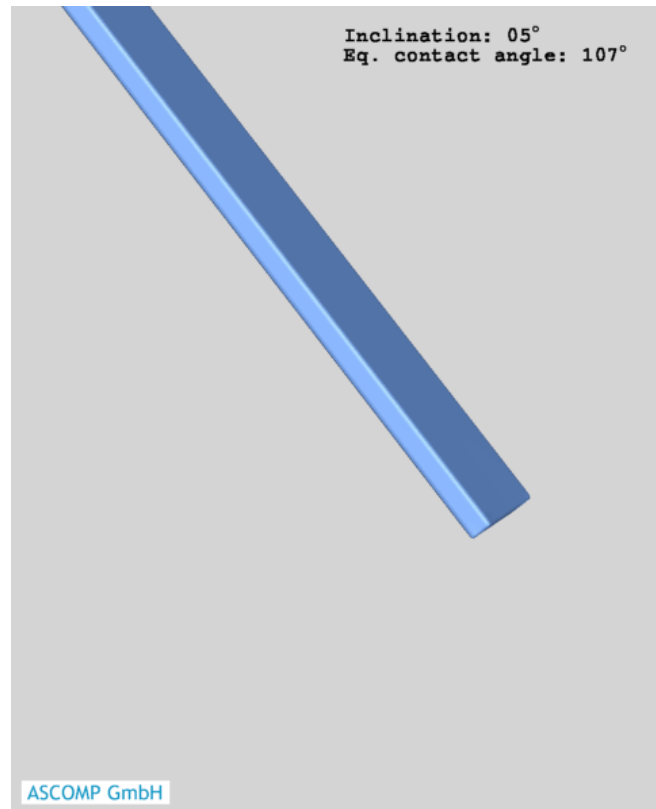
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Adhesive dispensing systems and coating

Rheology: Carreau model
Interface: Level sets
Wetting: Dynamic contact angle (Young's meniscus force partition)

Shear thinning is observed in the liquid only

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Dripping

Inclination: 05°
Eq. contact angle: 107°

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Inclination: 90°
Eq. contact angle: 80°

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