LIFE AND DEATH
OF SURFACTANT-LADEN DROPLETS

Alessio Roccon[a,b], Giovanni Soligo[c] & Alfredo Soldati[a,b]

[a]Institute of Fluid Mechanics and Heat Transfer, TU Wien, 1060 Vienna, AT
[b]Polytechnic Deparment, University of Udine, 33100 Udine, IT
[c]Complex Fluids and Flows units, 904-0495 Okinawa, JP

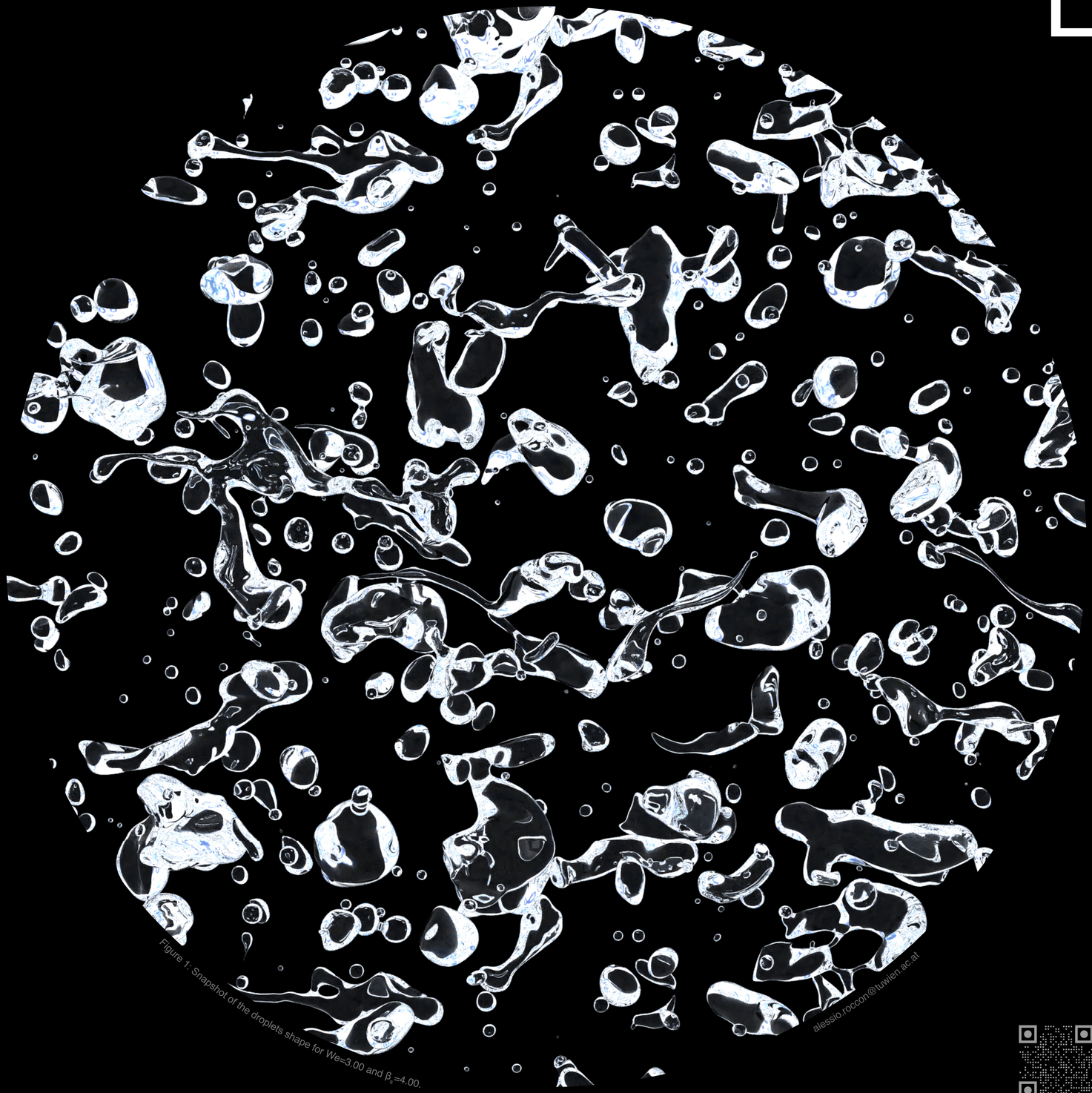

Figure 1: Snapshot of the droplets shape for We=3.00 and β_s=4.00.

alessio.roccon@tuwien.ac.at

The competition between two opposite phenomena, breakage events (**life**) and coalescence events (**death**), controls the population of surfactant-laden droplets:

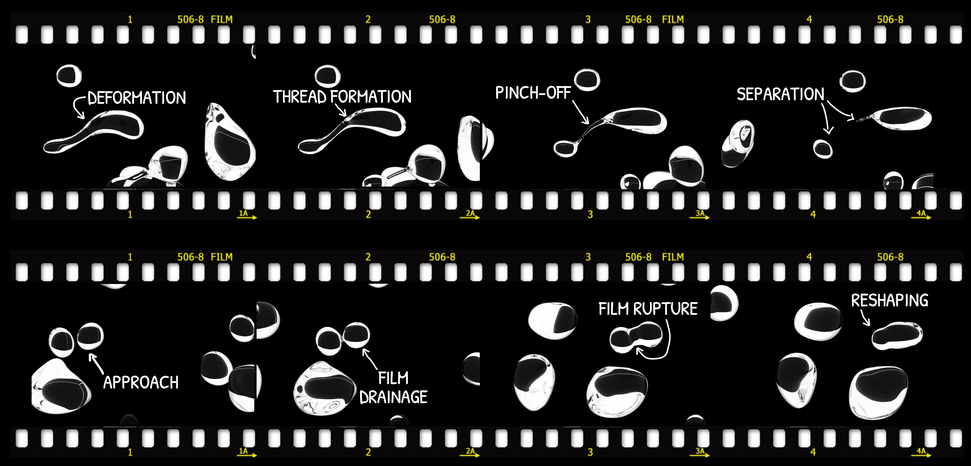

Figure 2: Time sequence of a breakage event (top film-strip): Deformation (1), thread formation (2), pinch-off (3) and separation (4) and of a coalescence event (bottom film-strip): Approach (1), film drainage (2), film rupture (3), reshaping (4).

We consider a turbulent channel flow laden with surfactant-laden droplets. The system is described by coupling direct numerical simulation of Navier-Stokes equations with a phase-field method. Two parameters characterize the system dynamics:

- Weber number (We): the ratio between inertial forces and surface tension forces. This parameter determines the interface deformability.
- Elasticity number (β_s); parameter that defines the surfactant strength. Larger values identify stronger surfactants actions.

Figure 3 shows the resulting droplet size distribution (DSD) obtained for different elasticity numbers. Present results are in good agreement with the theoretical scaling law, $d^{+*}\exp(-10/3)$, and with previous experimental and numerical results. The quality of the agreement increases for larger elasticity numbers (larger number of samples/droplets).

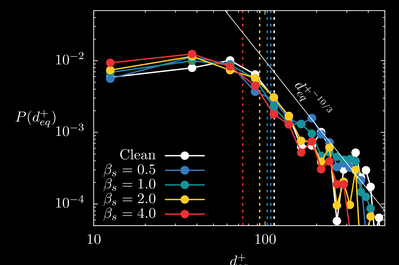

Figure 3: Droplet size distributions (DSD) reported in log-log scale. The results refer to We = 3.00 and the different cases are identified with different colors: white (clean), β_s = 0.50 (blue), β_s= 1.00 (green), β_s = 2.00 (yellow) and β_s = 4.00 (red). The theoretical scaling $d^{+*}\exp(-10/3)$ is shown with a thin continuous white line. The Hinze inviscid scale for each case is reported with vertical dashed lines.