Chair: Physics of Fluids group

Bursting Bubbles: from champagne to complex liquids

Description

Interaction of gas bubbles with the free liquid-gas interface is ubiquitous. For example, transporting aromatics from champagne and pathogens from contaminated water. Furthermore, the process is also responsible for the sea spray formation as a consequence of ejecting myriads of droplets.

First, the air bubble, generated in the liquid bulk, being lighter than the surrounding medium, rises because of buoyancy and reaches the liquid-air interface. It stays there as the thin film between the bubble and the free surface drains and ruptures to form film droplets (Lhuissier and Villermaux, 2012). The rupture results in the formation of a hole in the liquid meniscus. The unstable open cavity collapses leading to the interaction of the capillary waves and forms of an upward jet. Figure 1 illustrates a typical temporal sequence of the process. The phenomenon has been widely studied by Deike et al., 2018; Duchemin et al., 2002; Gordillo and Rodríguez-Rodríguez, 2019; Walls et al., 2015. Deike et al., 2018 has provided quantitative cross-validation of the numerical and experimental studies (Figure 2). Nonetheless, the literature lacks a comprehensive study on the influence of liquid pool properties on the bubble bursting process. Notably, the influence of rheological properties on the scaling laws can provide a close-up to the understanding of the phenomenon. This latter is highly related to several geophysical phenomena such as mudpots where viscoplasticity matters (see Sanjay et al. (2021) and https://www.youtube.com/watch?v=a9hUsVq9q7U), and spread of microbes where viscoelasticity is essential Bourouiba (2021) and Walls et al. (2017).

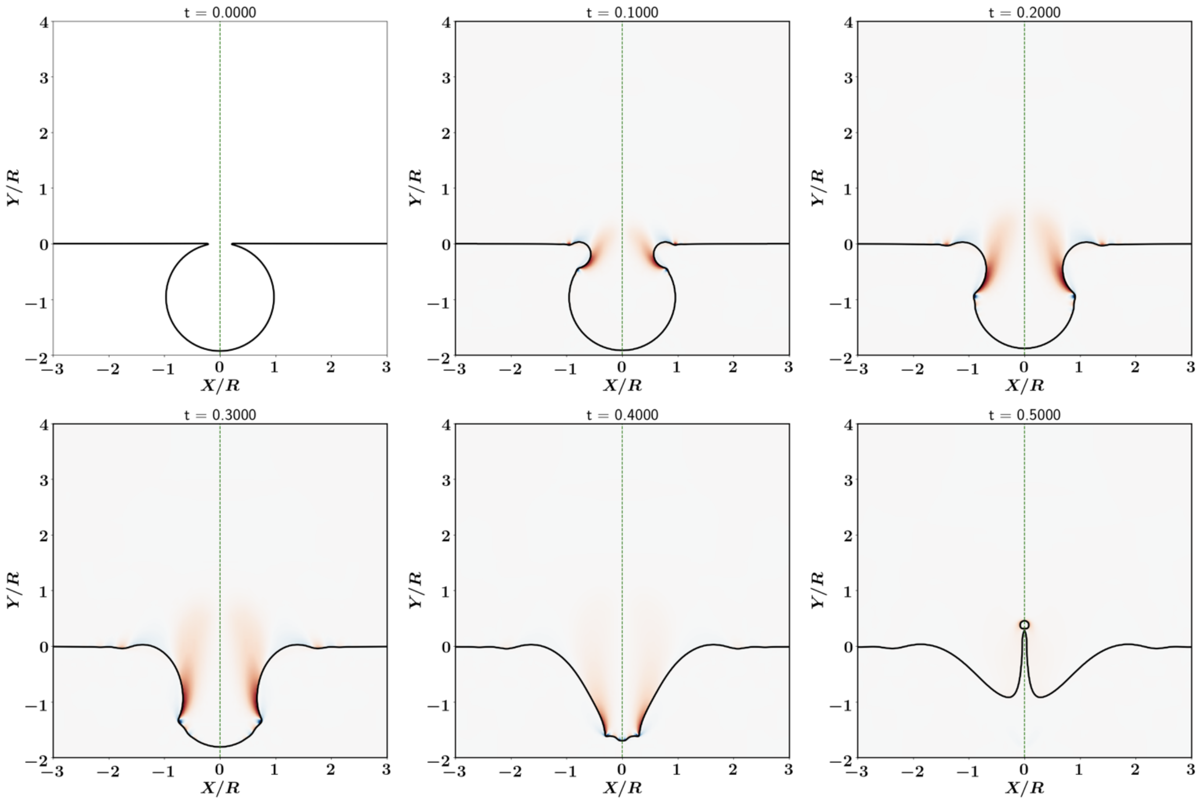

Figure 1: Time resolution of the process. The color shows the magnitude of non-dimensionalized vorticity, Γ (maximum Γ = 150 with red and minimum Γ = -150 with blue).

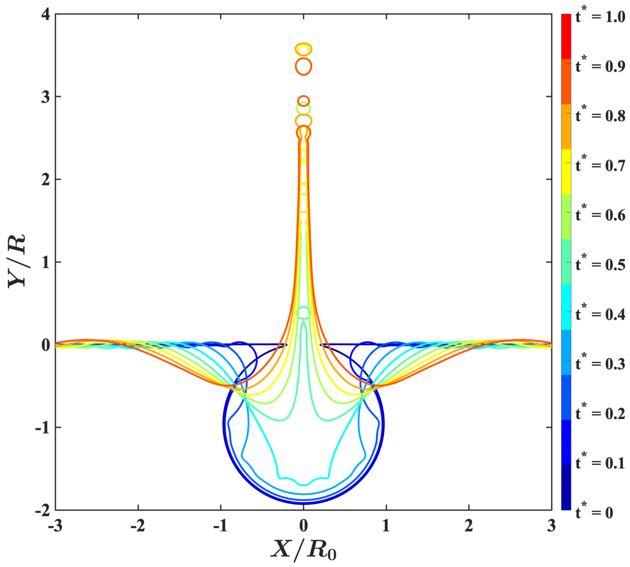

Figure 2: Collapse of the bubble cavity and interaction of capillary waves

What you will do and what you will learn?

1. You will learn about the fundamental fluid mechanics of two-phase flows.
2. You will learn the science of rheology.
3. You will learn the freeware code Basilisk C to simulate fluid dynamics problems.

If you have any questions, fell free to contact Vatsal or Ayush (details below).

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