Summary of the deliverable D2.8:
"Crown formation from a laser generated bubble close to a free surface"

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A cavitating bubble close to a free surface induces jetting: a central jet protruding outwards and a crown surrounding it at later stages. While the formation mechanism of the central jet is known and documented, that of the crown remains unsettled, specifically whether the compressibility of the surrounding liquid plays any role in its formation or not. We perform axisymmetric simulations of the problem using the free software program basilisk, where a finite-volume compressible solver has been implemented, that uses a geometric Volume-of-Fluid method (VoF) for the tracking of the interface. We show that the mechanism of crown formation is a combination of a pressure distortion over the curved interface, inducing flow focusing; and of a flow reversal, caused by the second expansion of the toroidal bubble that drives this crown. The work culminates in a parametric study with the Weber number, the Reynolds number, the pressure ratio and the dimensionless bubble distance to the free surface, as control parameters. Their effects on both the central jet and the crown are presented. For high Weber numbers, we observe the formation of weaker "secondary crowns", highly correlated with the third cycle of the bubble.

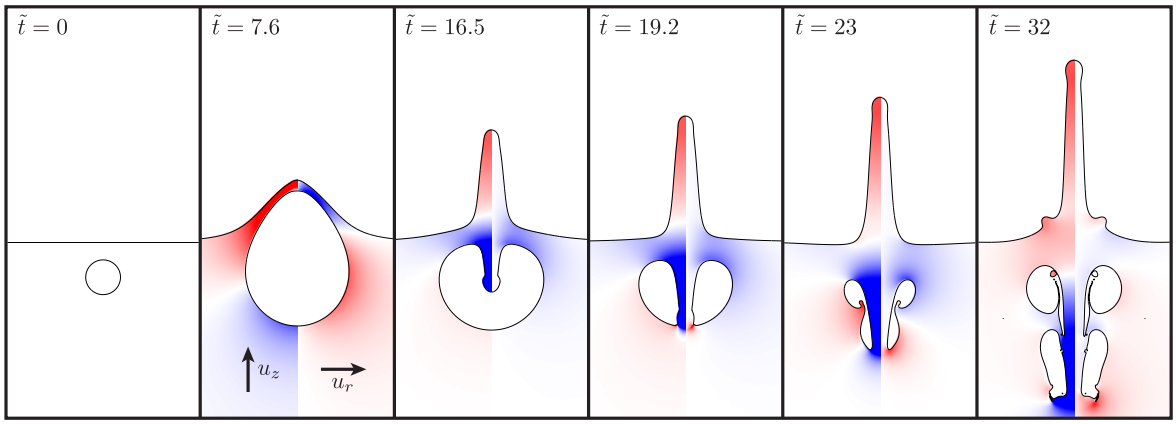

Figure 1 - At $\tilde{t}$ = 0, a highly pressurized bubble is initialized. The bubble then aspherically expands into an egg-shape, with the tip pointing upwards ($\tilde{t}$ = 7.6). This leads to an asymmetric collapse, where the bubble is pierced by an inner jet ($\tilde{t}$ = 16.5) which then breaks it into a toroid ($\tilde{t}$ = 19.2). At the same time, a jet protrudes upwards. The toroidal bubble further breaks into two toroids ($\tilde{t}$ = 23), and then expands again. The formation of an axisymmetric crown around the central jet is thus observed ($\tilde{t}$ = 32). The color code is for velocity: red means positive velocity, in the direction of the defined arrows, while blue stands for negative velocities, and stagnation points are shown in white.