**Bubble Collapse Near a Fiber: Broken Symmetry Conditions and a Planar Jet Formation**

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**Abstract**

The collapse of microbubbles near a fiber is an example often encountered in water treatment situations and cavitation fibrillation processes. However, due to the broken symmetry conditions, this process has not been studied in detail experimentally or numerically, making it difficult to precisely measure or simulate the rapid bubble evolution during collapse. In this work, we present a novel experimental method, allowing for precisely repeatable cavitation events observation, combined with numerical simulations offering insight into pressure and velocity fields distribution developments in time. Both experimental and numerical work focused on small distances between the bubble and the fiber, where physical interaction between the subjects is the strongest. Four different bubble offsets were considered within the scope of this work, and very good agreement of numerical simulations with experiments was found in all cases. Two modes of bubble collapse were identified, leading to mushroom-shaped bubbles at positions closest to the fiber and a pear-shaped bubble at the farthest position. It is noteworthy that in all four cases, a planar jet formation towards the fiber was observed. The formed jet initially assumes an elongated shape, whereas its stability depends on the mode of bubble collapse. Numerical analysis of the planar jet as the defining feature of the collapse defined lower bounds for the actual values of peak jet velocities, ranging between 250 m/s and 330 m/s, and the resulting impact pressures, which range from 100 MPa to 500 MPa.

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Experimental (left half) and numerical (right half) bubble shape progression for $γ=0.10$. Left: Frontal view along the fiber axis – y axis. Right: Side view along the z axis. Fiber diameter is 80 μm.

**References**

Jaka Mur, Vid Agrež, Jure Zevnik, Rok Petkovšek, and Matevž Dular, "Microbubble collapse near a fiber: Broken symmetry conditions and a planar jet formation", Physics of Fluids 35, 023305 (2023) https://doi.org/10.1063/5.0136353