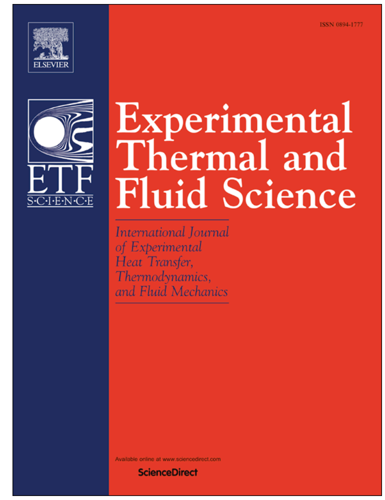

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Planar jets in collapsing cavitation bubbles

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ABSTRACT

The dynamics of a laser-induced cavitation bubble generated in the middle of two parallel horizontal rigid walls which are closed at one end with a vertical rigid wall is investigated experimentally using high-speed photography with 100000 frames s^{-1}. To gain a better understanding of the physical processes that underlie the bubble motion, numerical simulations are conducted by using a boundary element method with an incompressible formulation. We found a complex jetting behaviour which depends strongly on the relative size of the bubble with respect to the distance between the parallel walls and the initial location of the bubble from the vertical rigid wall. When the bubble is generated far from the vertical rigid wall, a radial jet is formed during bubble collapse leading, in some conditions, to bubble splitting. A bubble generated close to the vertical rigid wall develops a planar jet during its collapse phase, which is directed towards the vertical rigid wall. In the transition region, both a radial and a planar jet are generated. When the bubble diameter at its maximum expansion is much smaller than the distance between the parallel rigid walls, both the penetration of the planar jet on the opposite bubble surface and the formation of the secondary cavitation structure were observed during bubble oscillation. The height of the planar jet increases with increasing the bubble size with respect to the distance between the parallel rigid walls. The jet velocity decreases with increasing the relative bubble size with respect to the distance between the horizontal walls and decreasing the initial location of the bubble from the vertical wall. The complex jetting behaviour is attributed to a difference between the strength of the pressure gradients acting on the bubble motion during its collapse phase.

Keywords: bubble dynamics, cavitation, jets