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Numerical simulations of gas/vapor bubble oscillations

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In this work we numerically investigate the effect of heat and mass transfer on the dynamic response of gas-vapor bubbles. The numerical solution of the full non-linear 1D equations is compared with the analytical solution of the equations obtained for the oscillation of an spherical gas/vapor bubble in
response of a weak pressure perturbation (linear solution). For a system with known gas/vapor/liquid properties, we identify various oscillation regimes as a function of an nondimensional oscillation frequency (e.g. the bubble's Peclet number) and the vapor content. Even at very low frequencies, there exist regimes where transient diffusion effects arise due to heat diffusion in the surrounding liquid and also due to vapor mass diffusion inside the bubble. These phenomena restrict the applicability of the commonly-adopted assumption of full-equilibrium conditions inside the bubble. Simulations of the oscillation of bubbles for strong perturbations shows that non-linear effects restrict even further the range of applicability of the isothermal equilibrium model when the vapor content becomes larger than a critical value.

Presenter: Dr FUSTER, Daniel (Institut D'Alembert, UPMC-CNRS 75005 Paris)