THE INTERNAL FLOWS AND THE NONLINEAR DYNAMICS OF FREE DROPS AND BUBBLES

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The detailed experimental study of the stability and dynamics of free three dimensional liquid-gas interfaces is very difficult to rigorously carry out in 1 G. Two-dimensional surfaces are readily obtained on Earth, but the boundary conditions involve liquid-solid contact. The levitation of droplets and the trapping bubbles are also experimentally achievable on Earth, but the dynamics of those fluid particles are greatly influenced by the levitation fields. Our goals are to perform rigorous measurements relating to the stability and shape dynamics of isolated free drops in a gas and bubbles in a liquid with negligible perturbation arising from the positioning techniques, and to calibrate Earth-bound measurements using levitated drops and trapped bubbles. We are planning to carry out preliminary low-gravity experiments using the NASA Glovebox facility onboard the Space Shuttle in order to perform some fundamental measurements of the residual disturbances induced by a weak positioning acoustic field. The quantitative measurement of background internal flows and rotational motion in low gravity with very small acoustic positioning force is attempted as an assessment of the feasibility of performing measurements of thermocapillary flows in spot-heated free drops. In addition the characterization of the dynamics of large amplitude shape oscillations of free drops and bubbles will be carried out by acoustically exciting drop and bubble oscillations and by observing their nonlinear responses. The experimental apparatus is designed around a small-scale optical support rail with a diode laser source and a silicon photodetector. On this bench, two ultrasonic devices can be inserted, allowing the controlled positioning of droplets in air and air bubbles in water. The behavior of the droplets and bubbles are recorded by the Glovebox video cameras and by a Laptop computer directly interfaced to the photodetector. The investigations are currently scheduled for the S1'S-83 mission, and the performance and results of the experiments will be reported at this conference. | Work funded by NASA Office of Microgravity Science and Applications |