INTERNSHIP PROGRAM FOR INTERNATIONAL STUDENTS

INTERNSHIP SUBJECT FORM

Name of the Host Laboratory	LadHyX
Website of the Host Laboratory	www.ladhyx.polytechnique.fr
Internship Supervisor	Sébastien Michelin
Internship Subject	Unsteady growth and collapse of microscopic gas bubbles
Student's level	☐ Advanced Undergraduate Students (3rd or 4th year) ☐ Master's students (1st or 2nd year) ☒ PhD students
Proposed Duration	☒ 3 months ☒ 4 months ☒ 5 months ☒ 6 months
Prerequisites	Viscous flows, diffusion, partial differential equations, asymptotic analysis, Matlab/Python/… experience
Internship description (max. 15 lines)	During several industrial processes, such as glass manufacturing, small bubbles of dissolved gas can form (e.g. by chemical reactions with the container walls); their arrangement, density and size can have a significant if not critical impact on the quality and mechanical properties of the finished product. The growth (or collapse) dynamics of an isolated bubble, which is intimately linked with the (mostly diffusive) transport of the dissolved gas toward or away from the bubble can be modelled in detail (including confinement or unsteady effects), which is not the case for the collective dynamics of multiple bubbles, as a consequence of the geometric complexity of the fluid domain surrounding them. Yet, the growth/collapse dynamics of neighbouring bubbles can significantly influence the kinetics of the process and the final state of the system, and must therefore be taken into account accurately. We recently established a novel semi-analytic method to take into account such effects based on the Method of Reflections for diffusion and Stokes flow problems in the quasi-steady limit where diffusion is fast Unsteady effects can however profoundly alter the dynamics at the scale of a large number of bubbles, and is currently not taken into account into existing models (except for direct numerical simulations which are computationally costly). This project therefore aims to extend the method mentioned above to account for the finite diffusion time of the gas emitted/captured by the bubble in its collapse/growth, and evaluate the impact of these effects on the final arrangement and size of the bubbles. This would provide a simple yet efficient tool to predict the detailed unsteady growth/collapse dynamics as well as characterise the final state of the system.

The boxes marked with cross implies eligible