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	Acoustic propulsion of microparticles
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, slender body theory, asymptotic analysis, partial differential equations
Internship description (max. 15 lines)	In recent years, synthetic ''micro-swimmers" have fascinated many researchers for their potential biomedical applications (e.g. targeted drug delivery) or to understand self-organization and collective motion in small-scale physical systems (in contrast with crowds and fish school dynamics). An original example of such microswimmers consist in small rigid particles forced to oscillate by an externally-applied acoustic field. As a result of this forcing, the particles are observed to self-propel freely in the transverse pressure nodal plane. In experiments reported so far, an asymmetry of the particle (either in terms of geometry or density distribution) appears as an essential ingredient to generate a directional propulsion of the particle [2]. Yet, the origin of the self-propulsion itself is still highly debated, in particular regarding the role of fluid inertia in the emergence of a net propulsive force in comparison with other purely viscous mechanisms. Some recent progress were recently made in that regard through the theoretical work performed at LadHyX and in collaboration with F. Nadal (University of Loughborough) [3,4]. Furthermore, the mechanisms of interactions between neighbouring particles (in particular the nature and role of their hydrodynamic signature) remains to be understood and analysed fundamentally. The goal of this project will therefore be to characterise precisely the role and magnitude of the different effects (viscous or inertial) as well as the specificity of two geometric limits (near-sphere and elongated bodies) particularly relevant in experiments. The objective will be to quantify the relevant magnitude of

	self-propulsion expected from different mechanisms to conclude on their relevance to experimental systems and observations. The project will rely on theoretical analysis (matched asymptotics, slender body theory) of the coupled fluid-solid problem in the low-fluid inertia limit, possibly complemented with numerical simulations.

The boxes marked with cross implies eligible