INTERNSHIP PROGRAM FOR INTERNATIONAL STUDENTS

INTERNSHIP SUBJECT FORM

Name of the Host Laboratory	LadHyX
Website of the Host Laboratory	www.ladhyx.polytechnique.fr
Research Group	
Internship Supervisor	Sébastien Michelin
Internship Subject	Collective dynamics of chemically-active droplets
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, some Matlab/Python experience
Internship description (max. 15 lines)	Synthetic « micro-swimmers » fascinate many for their potential biomedical applications (e.g. targeted drug delivery) or to understand collective dynamics of small-scale physical systems (in contrast with crowds and fish school dynamics). Unlike miniaturized robots, chemically-active droplets have no moving parts, require no microscopic assembling, and draw their chemical energy directly from their immediate environment, thus allowing for much simpler and cheaper designs. They swim by combining a chemical *activity* (emission of large solute compounds) and a Marangoni *mobility* (i.e. the ability to generate surface flows and drift in response to chemical gradients). Because the chemical solutes released by the droplets are large, they diffuse slowly and their transport is primarily through convection by the Marangoni flows they generate, rendering their dynamics fundamentally non-linear and their modelling challenging. We have recent made significant advances in the understanding of binary collision and established a reduced model of chemically-active droplets that is able to capture their intrinsic dynamical features while remaining simple enough for analysing a large number of them. The goal of this project will be to characterise the dynamics of a large number of such droplets (e.g. from a statistical point of view) in order to obtain a better physical understanding of the fundamental features of such active fluids.