Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: LISN, Université Paris-Saclay
CNRS identification code: UMR 9015
Internship director'surname: Chibbaro, Semeraro
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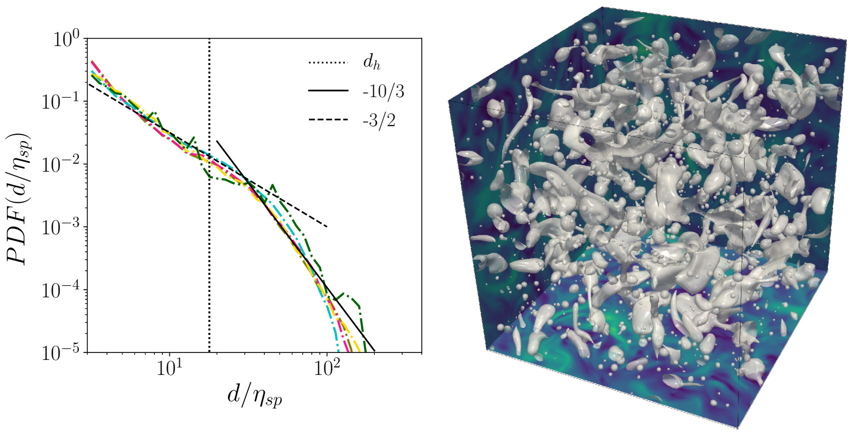
Web page: Scholar profiles
Detailed subjects at
Internship location: LISN, Saclay

Thesis possibility after internship: YES
Funding: NO (maybe) If YES, which type of funding:

Machine learning modelling of turbulent bubble breakup



Emulsions are a class of multiphase flows, crucial in industrial process and ubiquitous in envi- ronmental flows. In these flows, the dispersed phase interacts with the dynamics of the turbulent flow, generating a poly-dispersed droplet distribution while modulating turbulence already at small volume fractions. This dynamics has been the object of a recent study by Crialesi et al. (Comm. Phys. 2023), where direct numerical simulation of emulsions is analyzed in a turbulent homogeneous and isotropic flow by means of Volume of Fluid (VoF) method. This work has shed some light on the interaction between phases and the turbulent energy transport across scales (see Fig. 1a); in particular, this analysis, based on the spectral scale-by-scale analysis, revealed that energy is con- sistently transported from large to small scales by the interface and that the total surface is directly proportional to the amount of energy transported. Moreover, the energy transfer in the inertial range provides information about the droplet dynamics; interestingly the −10/3 and −3/2 scaling on droplet size distributions are found (see Fig. 1b). Leveraging the available high-fidelity dataset, the aim of the internship is to train and inform statistical population dynamics relations by use of machine learning tools. Methods of regression as well as linear Neural-Networks will be considered, in order to extract linear and quadratic kernels representing the dynamics of the droplets at the different scales.

Condensed Matter Physics: YES Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: YES