INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Lab. Interdisciplinaire des Sciences du Numérique,
CNRS identification code: UMR 9015 CNRS
Internship director : Anne Sergent (PR Sorbonne U) / Julien Salort (CR CNRS, ENS Lyon)
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Internship location: Campus universitaire, bât. 507, 91405 Orsay.
Map: https://maps.app.goo.gl/j6nGZB59hprBC9et5

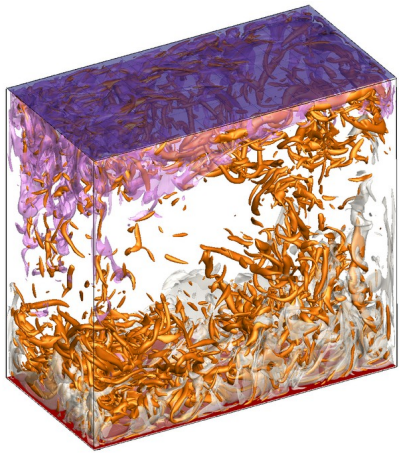
Thesis possibility after internship: YES
Funding: (to request: ED SMAER - SU) If YES, which type of funding:

Plume network in turbulent Rayleigh-Bénard convection

Thermal convective turbulent flows consist of a set of coherent structures (plumes) which are erratic and vary in intensity. The structure and statistical properties of these plumes are not yet fully understood or described. However, the most energetic plumes are associated with significant and even destructive phenomena, such as mantle convection hotspots and thermal fatigue of the melt corium retention vessel during a severe nuclear accident.

It has recently been shown that turbulent convection is organised hierarchically from the wall towards the centre of the domain by plumes that group together to form large-scale patterns through a continuous process of formation and aggregation. This raises once again the issue of the global heat transport modeling, linked to the local dynamics of thermal plumes in a highly fluctuating environment.

The aim of this internship is to apply the hierarchical description approach to plumes to data associated with two different turbulent transfer regimes. We have a 3D Direct Numerical Simulation (DNS) database of Rayleigh–Bénard convection simulations in water for a range of Rayleigh numbers (Ra) from 10^9 to 10^{12}. Using statistical analysis of instantaneous temperature fields, we will identify how changes in the overall behaviour of the flow affect the characteristics of the plume network. Additional DNS calculations may be performed after determining the planes of interest. In a second step, this methodology could be applied to DNS data with rough walls or to experimental measurements from Lyon.



Instantaneous kinetic and thermal coherent structures in turbulent RB convection.

DNS at Ra = 10^{10} in a water-filled tank

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES