Instrumentation towards small scales of turbulence in extreme conditions

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PhD may follow: Yes

Summary :

SBT is involved in the study of turbulent flows at high Reynolds number. This exciting research area has experienced steady progresses in the recent years through a combination of two technical advances: (i) mastering of laboratory flows at extreme Reynolds, through the technique of helium at low temperature; and (ii) the growing mastering of microfabrication techniques to achieve reliable micron-size sensors. This internship will take place at SBT, where both technologies are mastered. SBT works with leading research laboratories in France and Europe, for new advanced turbulence studies. This internship is a collaboration between SBT and LEGI (both laboratories are in Grenoble University).

Turbulent energy is injected at large spatial scales and is dissipated by viscosity at small scales. Between these two limits, inertial scales take place, where one can make the assumption of scale invariance. However, this scale invariance is no longer fulfilled, due to the phenomenon known as "intermittency", which is evidenced by measuring the velocity increments at scale r. As r decreases (ie as we move down towards dissipative scales), the statistics of velocity increments becomes farther and farther from a Gaussian distribution. This phenomenon (intermittencies at inertial scales) will be investigated in this internship, thanks to a new type of sensors micro-fabricated in the laboratory. Tests will be performed in a modest size experiment (the so-called Hejet experiment, which is already able to reach high Reynolds numbers), in order to compare the new results obtained with more conventional Wollastone hot wires, which have already been used in this experiment. The “conventional” hot wires have a length of 160 Âµ (already a world record in the field!), while we hope to manufacture new sensors with a length so small as 30 Âµ. If the results are positive, we will put these new sensors in the SHREK experiment, also available at SBT, which is the largest Von Karman device in the world, capable to reach Reynolds up to 10^8.

Requested skills :

fluid mechanics; instrumentation