POSTDOC : SIMULATIONS OF THE TURBULENT RAYLEIGH-TAYLOR INSTABILITY USING A DIFFUSE INTERFACE MODEL

Duration : 2 years starting autumn 2022.

Institution : LRC Centre Borelli ENS Paris-Saclay, France.

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The project :

The Rayleigh-Taylor instability (RTI)[1], appearing at accelerated interfaces between variable density fluids, is ubiquitous in nature with numerous astrophysics or geophysics applications. It is also a crucial mechanism in inertial confinement fusion as the mixing produced by the hydrodynamics instabilities determine the neutron yield of the capsule[2]. Still, many fundamental questions remain concerning the development of RTI, in particular in the late time self-similar regime where the turbulent mixing zone (TMZ) appears particularly sensitive to the structure of turbulence at large scales.

Hence, whether the miscibility or non-miscibility of the fluids influences the TMZ growth rate is an ongoing debate. For very turbulent flows, one would expect that surface tension impacts only the small scales but weakly the TMZ dynamics. However, different results show that the self-similar growth rate coefficient is directly correlated to how the fluids mix together. In addition, the experimental and numerical data exhibit large discrepancies preventing definitive conclusions[3,4].

In this project, we will study the importance of the fluid miscibility on the RTI dynamics using highly resolved simulations with the pseudo-spectral code STRATOSPEC already used in the group (see Figure 1 and[5]). A diffuse interface method relying on the Cahn-Hilliart equations will be coupled to the Navier-Stokes solver[6]. To this aim, we propose to assess the efficiency of various semi- or fully implicit numerical methods. Computational resources for the simulations will be

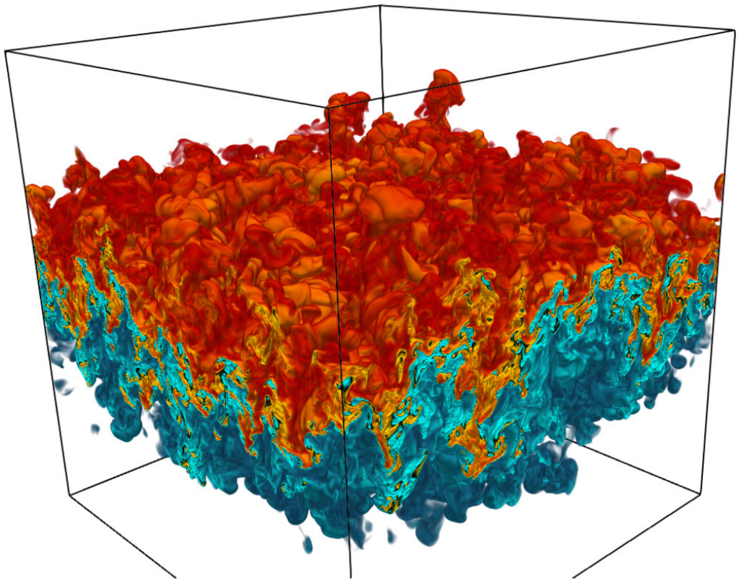

FIGURE 1. Visualization of a RTI turbulent mixing zone from a STRATOSPEC direct numerical simulation.

provided through the TGCC supercomputers. Different theories and models will be proposed to interpret the results.

Applicant profile : PhD in fluid mechanics with experience in numerical simulations. A good knowledge in HPC pseudo-spectral Navier-Stokes solver is a plus.

RÉFÉRENCES

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