Proposal for a M2 internship (spring 2025) and a PhD thesis starting in October 2025

Achieving the internal wave turbulence regime in the lab

Fluid stratification in density together with the Earth rotation is a central ingredient of the dynamics of the oceans and atmosphere. It deeply modifies turbulence by allowing internal waves to propagate in the bulk of the fluid. Turbulent dynamics at atmospheric and oceanic "small scales" is known to be dominated by these internal waves. In global climate simulations, these small scales are however generally not resolved because of prohibitive computation times and their action is accounted for by parameterizations. Improvement of these parameterizations based on physical theories is an important current challenge. In this framework, the so-called Wave Turbulence Theory is a major avenue which however faces analytical difficulties. The predictions remain uncertain and have not been validated yet in laboratory experiments where a genuine wave turbulence regime in a stratified fluid has not yet been reached.

The M2 internship and the following PhD thesis will consist in running a new experimental setup (fluid domain of 2.5 m high and 2.3 m large, 8000 L of stratified salt water) aiming at reaching this wave turbulence regime in a stratified fluid to test the theoretical predictions. In a first stage, the student will run this setup at FAST lab in Orsay to study internal wave turbulence in a density stratified fluid. In a second stage, the setup will be transferred to Grenoble to be used on the 13m diameter rotating Coriolis platform to add a global rotation to the stratification of the fluid in order to approach more closely the geophysical conditions.

Candidates should have received a high-level academic training in non-linear physics and/or in fluid dynamics.

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Recent papers of the team on this topic:

N. Lanchon, P.-P. Cortet, *Energy Spectra of Nonlocal Internal Gravity Wave Turbulence*, Physical Review Letters, **131** 264001 (2023), https://hal.science/hal-04367105/document

N. Lanchon, D.O. Mora, E. Monsalve, P.-P. Cortet, *Internal wave turbulence in a stratified fluid with and without eigenmodes of the experimental domain*, Physical Review Fluids, **8** 054802 (2023), https://hal.science/hal-04097778/document