Energy Cascade in Internal Wave Attractors

Christophe Brouzet*[1]

[1]Laboratoire de Physique de l'ENS Lyon (Phys-ENS) – CNRS : UMR5672, École Normale Supérieure - Lyon – 46 allée d'Italie 69007 Lyon, France

Abstract

A question of paramount importance in the dynamics of the oceans is related to the cascade of mechanical energy in the abyss and its contribution to mixing. Here, we propose a unique self-consistent experimental setup that models a cascade of triadic interactions transferring energy from large-scale monochromatic input to multi-scale internal wave motion. This setup is based on internal wave attractors. Experiments are here carried out in a trapezoidal test tank filled with linearly stratified fluid. Energy is injected into the system via the oscillatory motion of a vertical wall and internal wave velocity fields are measured with a standard PIV technique. Internal wave attractors are prone to parametric subharmonic instability (PSI), which transfers energy from the attractor to a pair of secondary waves.

As the forcing amplitude increases, PSI produces several pairs of secondary waves, creating a cascade of triadic interactions which produces internal-wave motion with a rich multi-peak discrete frequency spectrum embedded into a continuous spectrum of weaker magnitude. We show, for the first time, experimental explicit evidence of a wave turbulence framework for internal waves using energy spectra.
Finally, we show how beyond this regime, we have a clear transition to a cascade of small-scale overturning events which induces significant mixing.

*Speaker