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Titles and Abstracts

Charlotte DIETZE, LMU München, Germany

TBA

Résumé/Riassunto: TBA

Michele DOLCE, EPFL, Lausanne, Switzerland

Long-time behaviour in the 2D inhomogeneous incompressible fluids near a stably stratified Couette flow

Riassunto/Résumé : Fluids in the ocean are often inhomogeneous and incompressible and, in relevant physical regimes, can be described by the 2D Euler-Boussinesq system. Equilibrium states are then commonly observed to be stably stratified, namely the density increases with depth. We are interested in considering the case when also a background shear flow is present. In the talk, I will describe quantitative results for small perturbations around a stably stratified Couette flow. The density variation and velocity undergo an $O(1/(t^{1/2}))$ inviscid damping while the vorticity and density gradient grow as $O(t^{1/2})$ in L^2. This is precisely quantified at the linear level. For the nonlinear problem, the result holds on the optimal time-scale on which a perturbative regime can be considered. Namely, given an initial perturbation of size $O(\varepsilon)$, it can be heuristically expected that the linear regime is observed up to a time-scale $O(\varepsilon^{-1})$. However, we are able to control the dynamics all the way up to $O(\varepsilon^{-2})$, where the perturbation become of size $O(1)$ due to the linear instability. This is based on joint works with R. Bianchini, M. Coti Zelati and J. Bedrossian.

David GÉRARD-VARET, IMJ-PRG, Paris, France

Recent mathematical results on boundary layer theory

Résumé/Riassunto: The concept of boundary layer, introduced by Ludwig Prandtl in 1904, aims at providing an asymptotic description of viscous flows at high Reynolds number near rigid walls. Due to various instability phenomena, its range of application is however limited. Over the last 15 years, much has been done mathematically to clarify this range of application : questions around well-posedness of boundary layer models, or stability of boundary layer expansions have been at least partially answered. The goal of these lectures is to review these advances.

Sylvain JOUBAUD, LPENSL, Lyon, France

Instabilities of internal gravity wave beams

Résumé/Riassunto: Internal gravity waves propagate in stratified fluid and are ubiquitous in the geophysical context. In the ocean, they play an essential role in the transport of energy and mixing and they redistribute energy and momentum in the middle atmosphere. Such waves are also an interesting object of study thanks to the unusual dispersion relation of internal waves linking frequency and propagation.). Internal wave beam with a confined profile are important for the linearized dynamics but, strikingly, important in the nonlinear regime since they happens to be solutions of the nonlinear governing equations. In this lecture, I will discuss the stabilities properties of these waves in light of the recent experimental and analytical studies of those internal gravity wave beam. In particular, I will focus on the classic triadic resonant instability (TRI) that corresponds to the destabilization of a primary wave with the spontaneous emission of two secondary waves of lower frequencies and with different wave vectors.

Stéphane LE DIZES, IRPHE, Marseille, France

Critical slope singularities of gravito-inertial waves

Résumé/Riassunto: A singularity generically forms in the structure of gravito-inertial waves at the critical boundary points where the (convex) boundary is tangent to the direction of propagation of the wave. Using a local analysis of such a critical point, I determine the form of this inviscid singularity. This singularity is responsible of a thin and intense beam that propagates within the fluid. I show that both the structure and the scaling amplitude of this beam can be obtained by smoothing the singularity by viscous effects. Results are compared to numerical results obtained for the wave structure in a librating spherical shell.

Riccardo MONTALTO, Dip. di Mat. F. Enriques, Milano, Italy

Nonlinear quasi-periodic oscillations in Fluid Mechanics

Riassunto/Résumé : In this talk I shall discuss some recent results about the construction of quasi-periodic waves in Euler equations and other hydro-dynamical models in dimension greater or equal than two. I shall discuss quasi-peridic solutions and vanishing viscosity limit for forced Euler and Navier-Stokes equations and the problem of constructing quasi-periodic traveling waves bifurcating from Couette flow (and connections with inviscid damping). Time permitting, I also discuss some results concerning the construction of large amplitude quasi-periodic waves in MHD system and rotating fluids. The techniques are of several kinds: Nash-Moser iterations, micro-local analysis, analysis of resonances in higher dimension, normal form constructions and spectral theory.

Miguel ONORATO, Dipartimento di Fisica, Torino, Italy

Wave Turbulence and thermalization in the Fermi-Pasta-Ulam-Tsingou chain

Riassunto/Résumé : One-dimensional chains are used as a fundamental model of condensed matter, and have constituted the starting point for key developments in nonlinear physics and complex systems. The pioneering work in this field was proposed by Fermi, Pasta, Ulam and Tsingou in the 50s in Los Alamos. An intense and fruitful mathematical and physical research followed during these last 70 years. Recently, a fresh look at the mechanisms at the route of thermalization of such systems has been provided through the lens of the Wave Turbulence approach. In this review, we give a critical summary of the results obtained in this framework. We also present a series of open problems and challenges that future work needs to address.

Costanza RODDA, Imperial College London, UK

The baroclinic instability in laboratory experiments: from atmospheric dynamics to climate change

Riassunto/Résumé : Baroclinic instability is a fluid dynamics instability that arises in rotating, stably-stratified fluids subjected to a horizontal temperature gradient. This instability is at the core of the atmosphere's mid-latitude variability.

In the early 1950's Raymond Hide introduced a laboratory experiment–the differentially heated rotating annulus–which captured the baroclinic instability and modelled the fundamental dynamics of the mid-latitude atmospheric circulation. In this talk, we will discuss recent applications of this laboratory experiment to understand different aspects of the atmosphere dynamics, such as multiscale interactions and the effects of global warming on mid-latitude extreme temperature events.