ICMAT
INSTITUTO DE CIENCIAS MATEMÁTICAS

Workshop
Mathematical Analysis of Fluid Dynamics

4 July 2023

Aula Gris 1, ICMAT

10:00-10:45. "Regularity and Structure Functions", Peter Constantin (Princeton University)

I will discuss some aspects of the relationship between singularity formation and the multiscale nature of solutions of incompressible Navier-Stokes and Euler equations.

11:00-11:45. "On the 2d Boussinesq equations around a stable density profile", Roberta Bianchini (CNR-IAC)

We will be interested in the analysis of the 2d Boussinesq equations modeling continuously stratified fluids under the influence of gravity. The system is obtained by a linearization of the equations of non-homogeneous incompressible flows around a background density profile that increases with depth (spectrally stable density profile).
I will present some results related to well/ill-posedness, stability and long-time dynamics.

11:45-12:30. "On the finite-time singularity formation for sharp-crested water waves", Nastasia Grubic (ICMAT)

The water-waves problem is one of the classical free boundary problems arising in the context of incompressible fluid flows. It describes an inviscid, irrotational, incompressible fluid flow in a time-dependent domain governed by Euler equations. The free boundary moves with the fluid, separating fluid region from vacuum region and can be characterized as the set of discontinuities in the fluid density. We will first discuss how to suitably reformulate the problem as a system of contour equations for boundary velocity and parametrization of the interface. We will then discuss local well-posedness in a class of weighted Sobolev spaces which allow propagation of sharp crests on the interface. Finally, as a corollary of our approach, we will show there exist initial data for which the fluid becomes singular in finite-time.

15:00-15:45. “Singularity formation of the De Gregorio equation”, Fan Zheng (ICMAT)

I will talk about two blow-up scenarios of the (generalized) De Gregorio equation. The first is exactly self-similar blow-up solutions for all alpha < 1 and a*alpha being small, where alpha is the Holder exponent and a is the strength of the convection. It generalizes a result of Elgindi. The second is a non-asymptotically self-similar blow-up for the De Gregorio equation (with a=1), which uses a completely different construction.

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