NAVIER-STOKES EQUATIONS IN THE ZERO VISCOSITY LIMIT: BOUNDARY LAYERS, SEPARATION AND BLOW UPS

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The appearance of a boundary layer (BL) is a ubiquitous phenomenon in applied mathematics: a BL occurs when the presence of a small parameter causes a sharp transition between the perturbed and the unperturbed regime. The concept of BL was introduced by Ludwig Prandtl to give an explanation to D'Alembert's paradox; Prandtl's 1904 paper would prove to be one of the most important fluid dynamics paper ever written.
However, despite more than a century of investigations, many problems raised by Prandtl's BL theory still remain unsolved. Among them we mention the lack of a fully satisfactory mathematical theory of Prandtl's equations and the problem of the convergence, in the zero viscosity limit, of the Navier-Stokes solutions to the Euler solutions.

In this talk we shall review some of the rigorous results that have been recently obtained in this area. We will see that, when the initial data are analytic, one is able to control the phenomenon of the separation of the BL, at least for a short time, and prove the convergence of Navier-Stokes solutions to Euler solutions.
We intend also to present some of the numerical simulations through which one gets a better understanding of the separation and of the break-up of the Prandtl scenario.