FIM Nachdiplomvorlesung

François Golse (Ecole Polytechnique, Palaiseau)

Velocity averaging and hydrodynamic limits of kinetic models

February 26 - May 28, 2014
Wednesdays, 10.15 - 12.00h
HG G 43, ETH Zürich, Rämistrasse 101

Abstract

The dynamics of neutral gases can be described either by the equations of fluid mechanics with appropriate equations of state, or by the more complex kinetic theory of gases. The problem of deriving the fundamental models of fluid mechanics from the Boltzmann equation of the kinetic theory of gases by some mathematical limiting procedure was formulated by Hilbert in 1900. These lectures will review recent progress on this and other related issues. The core result discussed in this course is the connection between the Leray theory of global solutions of the Navier-Stokes equations (1934) and the DiPena-Lions theory of renormalized solutions of the Boltzmann equation (1990). The mathematical structure common to these hydrodynamic limits will be the main focus in these lectures. Velocity averaging results, corresponding to a kind of smoothing effect of the transport operator, are key to the mathematical analysis of nonlinear kinetic models and will be discussed in detail.

The lectures only assume familiarity with the fundamental functional analytic tools used in the theory of partial differential equations. Although the course deals with mathematical models coming from statistical mechanics or fluid mechanics, it does not require any prior knowledge in physics.

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