Course: Mathematical methods in the kinetic gas theory

Teacher(s): dr Milana Čolić, dr Srboljub Simić

Course status: elective

Број ЕСПБ:

ECTS: 12

Goal

To introduce basic concepts of the mathematical analysis of the Boltzmann equation as the central equation in the collisional kinetic theory of rarefied gases, together with some perspectives.

Outcomes

To study applications of mathematical analysis in the kinetic gas theory, which is an active research area, and to consider possibilities of further contributions in this area.

Contents

Theoretical teaching

Rarefied gases, distribution function, Boltzmann equation. Interaction between molecules, collision integral operator and its properties, weak form of the collision operator and collisional invariants, H-theorem, equilibrium distribution. Macroscopic equations. Hydrodynamic approximations of the Boltzmann equation. Space homogeneous problem, Povzner lemma, Cauchy problem, L^1 theory and generation and propagation of moments, L^p theory and propagation of moments. Modelling in the case of polyatomic gases and gas mixtures.

Practical teaching

Practical instructions will follow the theoretical part. Application of theoretical results will be illustrated through problem solving and numerical simulations.

Recommended bibliography

1. C. Cercignani: Rarefied Gas Dynamics, Cambridge University Press, Cambridge, 2000.
2. C. Villani: A review of mathematical topics in collisional kinetic theory, in Handbook of Mathematical Fluid Dynamics, vol. 1, North-Holland, Amsterdam, 2002.
3. F. Golse, The Boltzmann Equation and Its Hydrodynamic Limits, in Handbook of Differential Equations, Evolutionary Equations, vol. 2, Elsevier, Amsterdam, 2005.
4. L. Saint-Raymond, Hydrodynamic Limits of the Boltzmann Equation, Springer-Verlag, Berlin, 2009.
5. C. Cercignani, R. Illner, M. Pulvirenti, The Mathematical Theory of Dilute Gases, Springer-Verlag, New York, 1994.

Active teaching hours:	Theoretical:	Practical:

Methods of teaching

Classical lectures accompanied with presentations and numerical simulations. Discussion with students.

Knowledge estimation: (max 100 points)