Karlstad Applied Analysis Seminar

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Consistent BGK models for gas mixtures and hydrodynamic equations

Abstract

Kinetic BGK models are often used in various applications in rarefied gas dynamics and plasma physics, because of the complexity of nonlinear Boltzmann-type kinetic equations describing the dynamics of multi-component gases. In this talk, some consistent relaxation time-approximation models of BGK-type for inert gas mixtures are presented and their main properties are discussed [1, 2]. Consistency means three basic properties: correct reproduction of conservation laws, H-theorem and uniqueness of equilibrium solution. The main peculiarities of the presented BGK models will be highlighted with reference to their continuum limits obtained by Chapman-Enskog expansions [3]. In particular, it will be shown that a recent BGK model [2], reproducing the structure of the Boltzmann collision operator for mixtures and well suited to deal with various intermolecular collisional potentials, can lead in the hydrodynamic limit, in a proper collision dominated regime, to multi-temperature and multi-velocity Euler and Navier Stokes closures.

(Joint work with M. Bisi, G. Martalò, and G. Spiga, Department of Mathematical, Physical and Computer Sciences, University of Parma).

References:

[1] M. Groppi, G. Russo, G. Stracquadanio, Semi-Lagrangian approximation of BGK models for inert and reactive gas mixtures, in "From Particle Systems to Partial Differential Equations V", Springer Proceedings in Mathematics and Statistics 258, Patricia Goncalves and Ana Jacinta Soares (Eds.) (2018), 53-80.

[2] A.V. Bobylev, M. Bisi, M. Groppi, G. Spiga, I.F. Potapenko, A general consistent BGK model for gas mixtures, Kinet. Relat. Models 11 (2018), 1377-1393.

[3] M. Bisi, A.V. Bobylev, M. Groppi, G. Spiga, Hydrodynamic Equations from a BGK Model for Inert Gas Mixtures, AIP Conference Proceedings, RGD 31 2018, in press.