FAKULTÄT FÜR MATHEMATIK

Univ.-Prof. Dr. Radu Ioan Bot, Dekan

Einladung zur öffentlichen Defensio von Herrn

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Thema der Dissertation:

Hypocoercivity for linear and nonlinear kinetic systems

Abstract: Since 2006 different approaches to hypocoercivity have been proposed. The first part of this thesis gives an overview. The second part is devoted to new results.
The first of the four works presented is about the study of a linear kinetic-reaction system. We consider a weakly reversible reaction network and kinetic transport of the different species. For this system we are able to compute the exponential convergence rate to the global equilibrium, and to obtain the rigorous fast reaction limit to a diffusion equation for the mass distribution of the gases. The main results rely on proving the microscopic coercivity of the system exploiting the properties of the reaction network.
The second work deals with the thermalization of a gas towards a Maxwellian velocity distribution with the background temperature described by a kinetic relaxation model. The sum of the kinetic energy of the gas and the thermal energy of the background are conserved, and the heat flow in the background is governed by the Fourier law. For the coupled nonlinear system of the kinetic and the heat equation, existence of solutions is proved on the one-dimensional torus. Spectral stability of the equilibrium is shown on the torus in arbitrary dimensions by hypocoercivity methods. The macroscopic limit towards a nonlinear cross-diffusion problem is carried out formally. An existence result for the cross-diffusion problem is the subject of the third work.
In the fourth contribution a reaction-kinetic model for a two-species gas mixture undergoing pair generation and recombination reactions is considered on a torus. For dominant scattering with a non-moving constant-temperature background the macroscopic limit to a reaction-diffusion system is carried out. Exponential decay to equilibrium is proven for the kinetic model by hypocoercivity estimates. This seems to be the first rigorous derivation of a nonlinear reaction-diffusion system from a kinetic model as well as the first hypocoercivity result for a nonlinear kinetic problem without smallness assumptions. The analysis profits from uniform bounds of the solution in terms of the equilibrium velocity distribution.

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