

## MACROSCOPIC TRANSPORT EQUATIONS FOR RAREFIED GAS FLOWS STRUCHTRUP HENNING

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The well known transport laws of Navier-Stokes and Fourier fail for the simulation of processes on lengthscales in the order of the mean free path of a particle that is when the Knudsen number is not small enough. Thus, the proper simulation of flows in rarefied gases requires a more detailed

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Henning Struchtrup University of Victoria, Canada

Macroscopic Transport Equations for Rare ed Gas Flows

All interesting macroscopic quantities are moments,  $f(x,t,c)$  is determined through the Boltzmann equation.

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Thus, the proper simulation of flows in rarefied gases requires a more detailed description. This book discusses classical and modern methods to derive macroscopic transport equations for rarefied gases from the Boltzmann equation, for small and moderate Knudsen numbers, i.e. at and above the Navier-Stokes-Fourier level.

Macroscopic transport equations for rarefied gas flows ...

Struchtrup H. (2005) Macroscopic transport equations for rarefied gas flows. In: Macroscopic Transport Equations

for Rarefied Gas Flows, Interaction of Mechanics and Mathematics.

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The rational derivation of transport models for microscale gasflows is based on the Boltzmann equation, which describes the gas as a set of statistical particles. Equations for macroscopic quantities like temperature or velocity, follow by proper averaging of the Boltzmann equation, and a careful discussion of the order of magnitude of quantities involved.

#### Macroscopic Transport Equations for Rarefied Gas Flows

Henning Struchtrup Macroscopic Transport Equations for Rarefied Gas Flows Approximation Methods in Kinetic Theory With 35 Figures [v] Springer Contents

Introduction 1 1.1 Contents and scope 1 1.2 What is an ideal gas? 6 1.3 Length scales 7 1.4 Pressure and energy 9 1.5 Estimates for viscosity and heat conductivity 10 9 Macroscopic

#### Macroscopic transport models for rarefied gas flows: a ...

macroscopic transport models for rarefied gas flows 3 of 26 Since 2003 we are involved in the development and evaluation of the regularized 13 moment (R13) equations which are of third order in the Knudsen number  $Kn$ , i.e., of super-Burnett order (Grad,

#### Macroscopic Modelling of Rare ed and Vacuum Gas Flows

Macroscopic Modelling of Rare ed and Vacuum Gas Flows Henning Struchtrup Peyman Taheri Anirudh Rana University of Victoria, Canada Macroscopic transport equations Regularized 13 moment equations [Struchtrup&Torrilhon, since2003] derived from Boltzmann equation (order of magnitude method)

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A robust numerical method for the R13 equations of rarefied gas dynamics: Application to lid driven cavity A Rana, M Torrilhon, H Struchtrup Journal of Computational Physics 236, 169-186 , 2013

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Entropic boundary conditions for 13 moment equations  
in ...

Struchtrup, Macroscopic Transport Equations for Rarefied Gas Flows (Springer, 2005). This approach is motivated by the simple argument that, since the bulk equations are derived from the Boltzmann equation, the accompanying boundary conditions should similarly be motivated by a statistical description of particle collisions with the wall.

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The regularized 13 moment (R13) equations are a macroscopic model for the description of rarefied gas flows in the transition regime.