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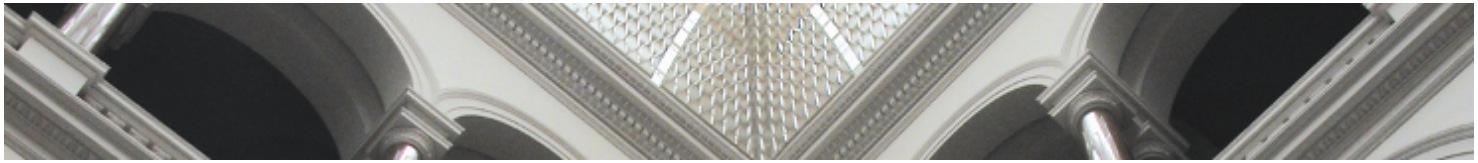
Model Order Reduction of Rarefied Gases Using Neural Networks

Zachary Schellin | Technische Universität Berlin | Institut für Numerische Fluiddynamik



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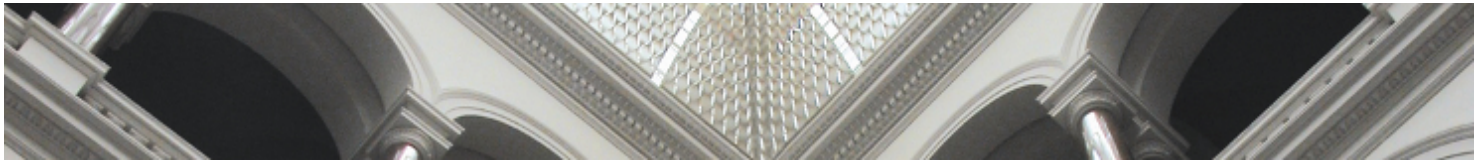

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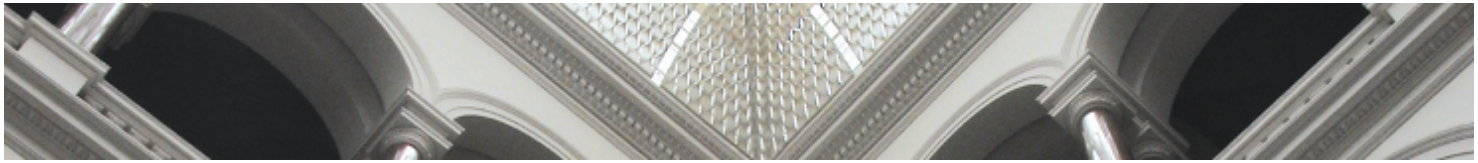
Introduction

hallo



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The BGK-Model

– The Boltzmann equation approximated by $\boldsymbol{Q}$ the BGK operator as a source term with

$$\partial_t f + v\partial_x f = \overbrace{\frac{1}{\tau}(M_f - f)}^{Q} \tag{1}$$

– The equilibrium solution is a Maxwellian distribution $\boldsymbol{M_f}$ with

$$M_f = \frac{\rho(x,t)}{(2\pi RT(x,t))^{\frac{3}{2}}} \exp\left(-\frac{(v-u(x,t))^2}{2RT(x,t)}\right) \tag{2}$$

– The duration to evolve into equilibrium is given by the relaxation time $\boldsymbol{\tau}$ with

$$\tau^{-1} = \frac{\rho(x,t)T^{1-\nu}(x,t)}{Kn} \tag{3}$$

– The rarefaction level is defined over the Knudsen number $\boldsymbol{Kn}$ with

$$Kn = \frac{\lambda}{l} \tag{4}$$

[1]

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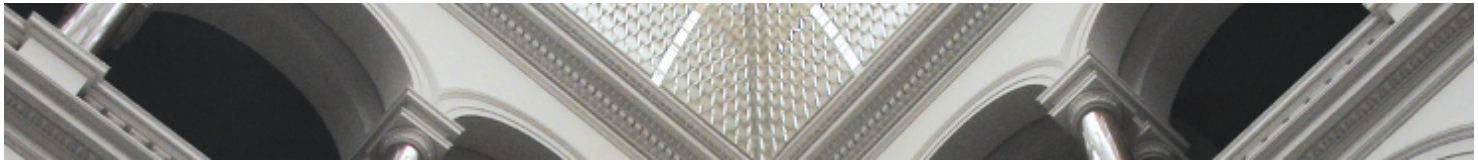


The BGK-Model

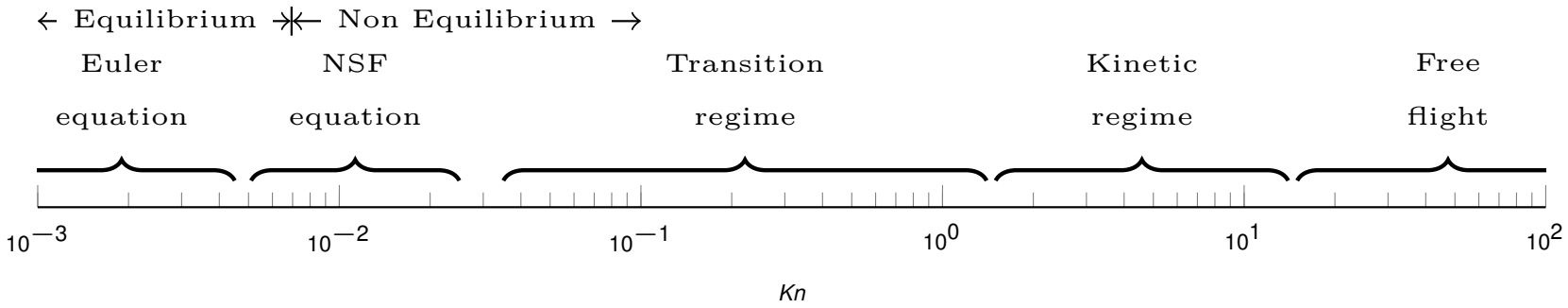
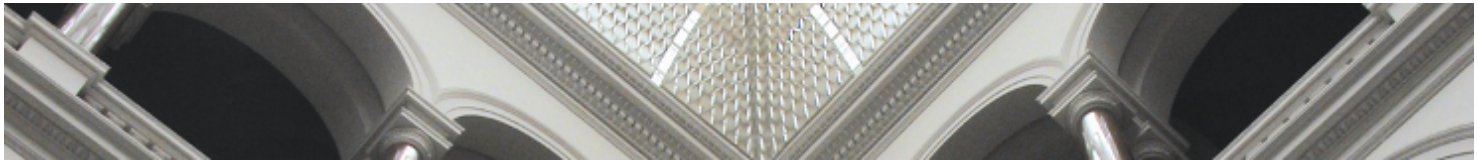


Figure: Partitioning of Kn, the Knudsen number, into levels of rarefaction.



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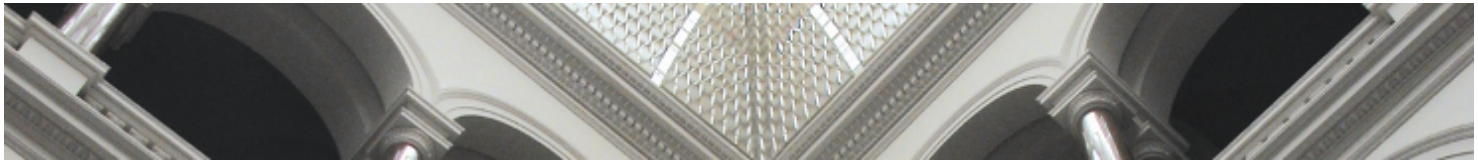
Verwendung der `tuberlinbeamer`-Klasse

Es folgen demnächst ein paar Folien zur Verwendung dieser Dokumentklasse.

- Kenntnis der beamer-Klasse ist von Vorteil



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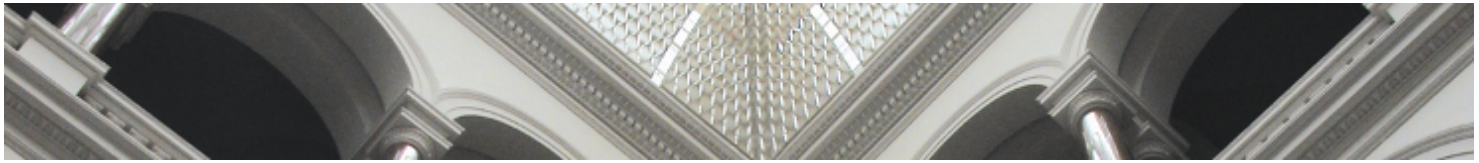
ToDo

- ToDo schreiben
- ToDo abarbeiten



P. L. Bhatnagar, E. P. Gross, and M. Krook. “A Model for Collision Processes in Gases. I. Small Amplitude Processes in Charged and Neutral One-Component Systems”. In: Phys. Rev. 94 (3 1954), pp. 511–525. DOI: 10.1103/PhysRev.94.511. URL: https://link.aps.org/doi/10.1103/PhysRev.94.511.