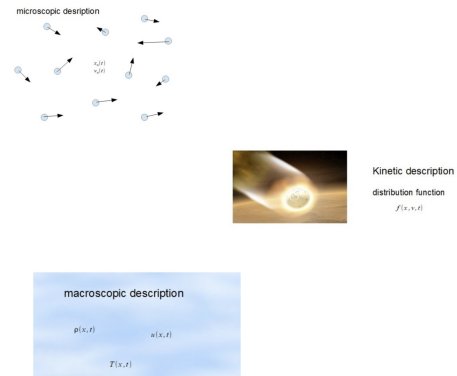


'Kinetic Transport Theory of dilute gases'

Lecture SS 2023

In physics, if we want to describe the time evolution of a gas, there are different possibilities to do this. One is to imagine that the gas consists of a lot of particles and describe the time evolution of the position and velocity of each particle by Newton's law (microscopic description). This ansatz has the advantage that it is very exact. But it has the disadvantage that in a gas we have of the order 10^{13} particles. These are too many equations to solve with a computer. But in many cases, it is even not necessary to know the exact position and velocity of every particle. Therefore another ansatz is to describe the gas by macroscopic averaged quantities as density, mean velocity and temperature (macroscopic description). This ansatz has the advantage that now we have less equations, only equations for the density, the mean velocity and the temperature. But it is only an averaged equation. So it does not take into account the individual effect of the particles. So if really something happens on the level of particles which influences the macroscopic behaviour, like for example a space vehicle re-entering the atmosphere, this is not a good description anymore. Therefore there is also a third possibility introduced by Boltzmann. Here, one still uses an averaged description, so it is not necessary to follow each single particle, but where it is still possible to take into account the effect of the type interactions of the particles (kinetic description). This description, for example, is used in a plasma.



Some aspects we will consider in this lecture:

- connection of the microscopic, the kinetic and the macroscopic description and basic mathematical concepts for how to get from one to another
- Examples of models in the kinetic description for different applications (hard-spheres, plasma, aerosols)
- notions of solutions in the kinetic description and basic concepts so study existence of solutions in the kinetic description
- basic concepts to study the qualitative behavior and the convergence to equilibrium in the kinetic description

The lecture is intended for master students who want to specialize in the field of analysis and partial differential equations. A background on partial differential equations is useful, but not mandatory.