Abstract:

We will address two different questions:

1) An important aspect of constructing discrete velocity models (DVMs) for the Boltzmann equation is to obtain the right number of collision invariants. It is a well-known fact that DVMs can also have extra collision invariants, so called spurious collision invariants, in plus to the physical ones. A DVM with only physical collision invariants, and so without spurious ones, is called normal. The construction of such normal DVMs has been studied a lot in the literature for single species, but there are also several works where normal DVMs for binary mixtures are constructed. In this talk we will address ways of constructing DVMs for multi-component mixtures and for polyatomic molecules (here in the meaning that each molecule has one of a finite number of different internal energies, which can be changed, or not, during a collision). We present some general algorithms for constructing such models, but we also give some concrete examples of such constructions.

The two different approaches above can be combined to obtain multi-component mixtures with a finite number of different internal energies, and then be applied for DVMs for chemical reactions.

2) We also consider some problems related to the nonlinear half-space problem of condensation and evaporation for the discrete Boltzmann equation (DBE; the general discrete velocity model) for mixtures, polyatomic molecules, and chemical reactions, and for the discrete quantum Boltzmann equation. We assume that the flow tends to a stationary point (Maxwellian for the DBE) at infinity and that the outgoing flow is known at the wall (complete absorption at the wall). The number of conditions on the assigned data at the wall needed for existence of a unique solution is found. The number of parameters to be specified in the boundary conditions depends on if we have subsonic or supersonic condensation or evaporation. We obtain similar results for more general boundary conditions at the wall.

All our results are valid for any finite number of velocities.