Propagation of initial correlations and effective equations in collisional kinetic theory

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In the talk we consider a new approach to the problem of the rigorous description of kinetic evolution of large hard sphere systems within the framework of the marginal observables governed by the dual BBGKY hierarchy. The relations of the hierarchy of evolution equations for marginal observables and the nonlinear kinetic equations for states described by means of a one-particle marginal distribution function are established.

The Boltzmann-Grad asymptotic behavior of a nonperturbative solution of the Cauchy problem of the dual BBGKY hierarchy for systems with hard sphere collisions is considered. In case of initial states specified by means of a one-particle distribution function the interplay between the Boltzmann–Grad asymptotic behavior of marginal observables and a solution of the Boltzmann kinetic equation is established.

One of the advantages of the stated approach to the derivation of kinetic equations from underlying hard sphere dynamics consists in an opportunity to construct the Boltzmann-like kinetic equation with initial correlations and it gives to describe the process of the propagation of initial correlations in the Boltzmann-Grad scaling limit.

Moreover, using suggested approach, we derive the non-Markovian Enskog kinetic equation with initial correlations and construct the marginal functionals of states, describing the creation of all possible correlations of particles with hard sphere collisions in terms of a one-particle distribution function governed by the Enskog equation. The Boltzmann–Grad asymptotic behavior of a non-perturbative solution of the derived Enskog equation and the marginal functionals of states are also established.

The obtained results we extend on systems of hard spheres with inelastic collisions. In particular, we established that in a one-dimensional space the kinetic evolution of a large system of hard rods with inelastic collisions is governed by the certain generalization of the known Boltzmann equation for one-dimensional granular gases.

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