MODEL KINETIC DESCRIPTION FOR MANY-COMPONENT PLASMA

V.V. Belyi

IZMIRAN, Russian Academy of Sciences, Troitsk, Moscow, Russia

The most widely used kinetic model equation especially in the discrete simulation of plasma and gas dynamics is Bhatnagar, Gross & Krook (BGK) model [1]. The advantage of the BGK model is that the solution of the kinetic equation reduces to that of a system of algebraic equations. A weak point is that the model implies that the Prandtl number equals 1. A graver situation arises in the case of many-component systems [2, 3]. A new form of the collision operator for a Coulomb plasma is derived. One-component and many-component systems are considered. The proposed collision operator properly takes into account the relaxation of the first 13 hydrodynamic moments. Besides this, it accounts for the non-diagonal component contribution in the quadratic approximation in the expansion of the linearized collision operator with respect to the complete system of Hermite polynomials. It is shown that for a system of charged particles with the Coulomb interaction potential, these contributions are essential and lead to Spitzer corrections to the transport coefficients [4]. A consistent derivation of the model linearized collision operator for a many-component system is presented. In these results an ambiguity in the choice of coefficients is eliminated, in contrast to the BGK type models [2, 3]. A technique for reconstruction of the non-linear model collision integral form based on a known expression for the model linearized operator is proposed [5]. It is shown that the model collision integral in the local (not complete) equilibrium approximation does not contain a complicated exponential, that is common for the BGK type integrals. Boltzmann's H-theorem is proved for our model.

References

1. P.L. Bhatnagar, E.P. Gross, and M. Krook, *Phys. Rev.* **94,** 511 (1954)
2. Gross E.P., Krook *M. Phys. Rev.* 1956, V. 103, N. 3, p.593
3. Green J.M. *Phys. Fluids.* 1973, V.16. N. 11,p.2023
4. Belyi V.V. *J. Stat. Mech.* (2009) P06001
5. Belyi V.V. Proceeding of 28th International Symposium on Rarefied Gas Dynamics, AIP vol. 1501, p. 75-82, 2012.