Continual approximate solution with acceleration and condensation mode

Olena Sazonova
(V.N. Karazin Kharkiv National University, Ukraine)
E-mail: olena.s.sazonova@karazin.ua

The kinetic equation Boltzmann is the main instrument to study the complicated phenomena in the multiple-particle systems, in particular, rarefied gas. This kinetic integro-differential equation for the model of hard spheres has a form [1, 2]:

$$D(f) = Q(f, f), \tag{1}$$

$$D(f) = \frac{\partial f}{\partial t} + v\frac{\partial f}{\partial x}, \tag{2}$$

$$\begin{aligned} Q(f, f) = \frac{d^2}{2}\int\limits_{\mathbb{R}^3} dv_1 \int\limits_{\Sigma} d\alpha |(v - v_1, \alpha)|[f(t, v_1', x)f(t, v', x) - \\ - f(t, v_1, x)f(t, v, x)], \end{aligned} \tag{3}$$

We will consider the continual distribution [3]:

$$f = \int\limits_{\mathbb{R}^3} \varphi(t, x, u)M(v, u, x, t)du, \tag{4}$$

which contains the local Maxwellian of special form describing the acceleration and condensation flows of a gas (is an analogue of vortices) [4]. They have the form:

$$M(v, u, x, t) = \rho_0 e^{\beta\left((u-[\omega\times t])^2+2[\omega\times x]\right)} \left(\frac{\beta}{\pi}\right)^{\frac{3}{2}} e^{-\beta(v-u-[\omega\times t])^2}. \tag{5}$$

The purpose is to find such a form of the function $\varphi(t, x, u)$ and such a behavior of all hydrodynamical parameters so that the uniform-integral remainder [3, 4]

$$\Delta = \sup_{(t,x)\in\mathbb{R}^4} \int\limits_{\mathbb{R}^3} |D(f) - Q(f, f)|dv, \tag{6}$$

or its modification "with a weight":

$$\widetilde{\Delta} = \sup_{(t,x)\in\mathbb{R}^4} \frac{1}{1 + |t|} \int\limits_{\mathbb{R}^3} |D(f) - Q(f, f)|dv, \tag{7}$$

tends to zero.

Also some sufficient conditions to minimization of remainder Δ or $\widetilde{\Delta}$ are found. The obtained results are new and may be used with the study of evolution of screw and whirlwind streams.

References

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