THE FEATURES OF THE NON-EQUILIBRIUM EQUATION OF STATE IN HEAVY-ION COLLISIONS AT INTERMEDIATE ENERGIES

D'yachenko A.T.[1], Gridnev K.A.[2], Mitropolsky I.A.[3]
[1]Petersburg State Transport University, Russia; [2]Saint Petersburg State University, Russia; [3]Russian Research Center "Kurchatov Institute", B.P.Konstantinov Petersburg Nuclear Physics Institute, Gatchina, Russia
E-mail: dyachenko_a@mail.ru

In the development of the approach in [1] for the description of heavy–ion collisions, we proposed to use the method of moments for solving the kinetic equation, which gives, for the first moments with weights $1, \vec{p}, p^2$, equations of the hydrodynamic type, allowing us to find the distribution function of the nucleons, $f(\vec{r},\vec{p},t)$ (where $\vec{r}$ is the spatial coordinate , $\vec{p}$ is the momentum , and t is the time). At the same time, we used a non–equilibrium equation of state to describe the hydrodynamic evolution of a system of the «hot spot» type, according to which $f(\vec{r},\vec{p},t)$ is associated with an equilibrium component, $f_0(\vec{r},\vec{p},t)$, and a non–equilibrium component $f_1(\vec{r},\vec{p},t)$:

$$f(\vec{r},\vec{p},t) = f_1 \cdot q + f_0 \cdot (1-q),$$

where q is the relaxation factor. Here, $f_1(\vec{r},\vec{p},t)$ is given in the form of a Fermi–ellipsoid in the momentum space, which is a convenient parameterization of the excitations in the Fermi–liquid theory, and $f_0(\vec{r},\vec{p},t)$ is given as the equilibrium Fermi–sphere. In this approach, the account of the non–equilibrium component has led to a successful description of the heavy–ion collision dynamics, in particular to the description of the energy spectra of protons emitted at various angles [1–4].

In the present paper we develop a method for the calculation of the factor q by taking the moment from a kinetic equation with weight $p_x^2 - (p_y^2 + p_z^2)/2$ that determines the degree of anisotropy of the distribution function, $f(\vec{r},\vec{p},t)$. We found that $q = 1$ on the shock wave during the compression stage in the energy range ~10–100 MeV/nucleon and that q decreases with increasing energy, which results in an increase of the isotropy of the function $f(\vec{r},\vec{p},t)$ at higher intermediate energies, in accordance with experimental data on the proton spectra.

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