On the temperature evolution of a dissipative randomly driven system

V. Gorev[a] and A. Sokolovsky[b]

[a] *Dnipro University of Technology, 19 Dmytra Yavornytskoho Ave., 49005 Dnipro, Ukraine, E–mail: lordjainor@gmail.com*

[b] *Oles Honchar Dnipro National University, 72 Gagarina Ave., 49010 Dnipro, Ukraine, E–mail: Alexander.I.Sokolovsky@gmail.com*

We investigate a kinetic equation for a dissipative system placed in a random field. It is assumed that the potential interaction in the system is small (small parameter λ). The dissipative interaction and the correlation functions of the random field are also assumed to be small and are estimated by one small parameter μ. A kinetic equation for the system under consideration up to the first order in λ and μ was obtained in [1] on the basis of the Bogolyubov reduced description method.

In our work the corresponding kinetic equation is obtained up to the second order of smallness in λ and μ. In fact, a generalization of the Landau–Vlasov kinetic equation to the systems under consideration is derived. A general nonlocal collision integral is obtained, and its local approximation is investigated in the case where the dissipation force between two particles is proportional to their veocity difference. In the absence of dissipation and an external field the kinetic equation coincides with the well-known Landau–Vlasov kinetic equation.

The evolution of a spatially uniform system is investigated. In order to solve the kinetic equation analytically, we consider the case where $\lambda \gg \mu$. In this situation the evolution of the system is described by the Landau–Vlasov kinetic equation with small corrections that are due to the dissipative and random forces. It is shown that after the mean free time the system is approximately described by the Maxwellian distribution function. Corrections to the Maxwellian distribution function are found on the basis of a generalized Chapman–Enskog method and evaluated with the help of a truncated Sonine polynomial expansion.

The corresponding time evolution equation for the temperature is derived, and it is shown that the spatially uniform system reaches a steady state. Corrections to the result [1] for the steady-state temperature of the system are obtained.

[1] O.Yu. Sliusarenko, A.V. Chechkin and Yu.V. Slyusarenko, Journal of Mathematical Physics, 56, 043302 (2015).