Towards rigorous derivation of kinetic equations of hard spheres

V. Gerasimenko[a] and I. Gapyak[b]

[a] *Institute of Mathematics of NAS of Ukraine, 3, Tereshchenkivs'ka Str., 01601 Kyiv-4, Ukraine, E–mail: gerasym@imath.kiev.ua*

[b] *Taras Shevchenko National University of Kyiv, Department of Mechanics and Mathematics, 2, Academician Glushkov Av., 03187, Kyiv, Ukraine, E–mail: gapjak@ukr.net*

We develop a rigorous formalism for the description of the kinetic evolution of infinitely many hard spheres. On the basis of the kinetic cluster expansions of cumulants of groups of operators of finitely many hard spheres which are the generating operators of a nonperturbative solution of the Cauchy problem of the BBGKY hierarchy the nonlinear kinetic Enskog equation is derived. We also consider the Markovian approximation of the collision integral of the generalized Enskog equation and discuss its link with the collision integral of the Enskog-type kinetic equations.

Moreover, the generalized Fokker – Planck kinetic equation for the trace particle, interacting as hard spheres with infinite particle surrounding, is constructed. Using the developed method of kinetic cluster expansions of the cumulants of groups of the operators of finitely many hard spheres, we establish an equivalence of the description of the evolution of states by the generalized Fokker – Planck kinetic equation and constructed marginal functionals of its solution and by the Cauchy problem of the BBGKY hierarchy of hard spheres.

Gapyak I.V., Gerasimenko V.I. On rigorous derivation of the Enskog kinetic equation // arXiv:1107.5572. – 2011. – 28 p.