ENERGY EXCHANGE PROCESSES IN TWO-FRACTION SYSTEMS OF CHARGED DUST PARTICLES

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The energy exchange processes in dissipative systems of non-identical interacting particles with inhomogeneous distribution of heat sources and/or any other sources of stochastic kinetic energy are studied. A theoretical model for analyzing the energy balance in such systems is considered, based on the mechanism of heat transfer, which occurs due to the transfer of stochastic oscillations of individual charged particles near their equilibrium position, due to the interaction between them. Within the framework of this mechanism, simple equations for the energy balance in a system of non-identical particles (with different masses, charges, coefficients of friction and temperature) for plane and chained clusters are presented. The influence of the gravity field on the energy redistribution between two particles is investigated.

The conditions of energy exchange in extended two-fraction ensembles of charged particles of various sizes with Coulomb interaction are studied numerically. The simulation was carried out for two-layer ensembles and bulk clouds of charged particles in the gravity field, as well as for two-dimensional structures formed in the external electric fields under the influence of forces proportional to the square of the dust radius. The study of the processes of redistribution of stochastic kinetic energy between fractions of particles having different temperatures, as well as the redistribution of stochastic energy by degrees of freedom, is carried out. The influence of high temperatures (leading to significant deviations of the particles from their equilibrium position) on the energy balance in the analyzed systems is considered.

A semiempirical approximation is proposed, depending on the temperature of the heat sources and the characteristic frequencies of the system, which well describes the energy exchange processes in systems of various configurations.

The results of this work can be adapted for systems with any type of reciprocal interactions and can be useful for analyzing energy exchange in inhomogeneous systems that are of interest in dusty plasmas.

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