Energy exchange in extended systems of various configurations consisting of non-identical dust particles in plasma

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Most theoretical and numerical studies of the properties of dusty plasmas deal with identical dust particles, since such systems are easier to describe mathematically and easier to understand. However, under real conditions, plasma-dust structures rarely contain the similar particles. The study of the conditions of energy exchange in systems of non-identical particles (of different sizes, charges, and temperatures) is of considerable interest in various fields of science and technology.

In this paper, we study the processes of redistribution of stochastic kinetic energy between the fractions of dust particles with different sizes and temperatures, as well as its redistribution by degrees of freedom, is presented. The numerical simulation was carried out for two- and three-layers ensembles and bulk clouds of charged particles in the gravity field, and for two-dimensional structures formed in the external electric fields under the influence of forces proportional to the square of dust radius. A semiempirical approximation is proposed, which well describes the energy exchange in all considered cases.

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.