CHARGING OF DUSTY PLASMA MICROPARTICLES BY ION AND ELECTRON FLUXES WITH KAPPA DISTRIBUTION IN A COLLISIONAL REGIME

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A dusty plasma is a complex system composed of ionized gases, including electrons, ions, and charged dust particles, usually of micrometer or submicrometer size. Such plasmas occur in diverse settings, including certain industrial applications, space environments, and laboratory experiments. Observations of spacecraft near some astrophysical objects have shown deviations from the Maxwellian distribution, especially in the high-energy spectrum [1]. Empirical findings suggest that particle distributions often display a "suprathermal" tail at high energies, which can be represented mathematically using Î° (kappa) distributions. The kappa distribution has been widely applied in both space and laboratory plasmas. For example, in our earlier work [2], the charging process of dust particles based on the kappa distribution was examined through the orbital motion limited (OML) approximation, which neglects collisions between plasma particles. In this study, however, we investigate the charging of dust particles while taking plasma particle collisions into account. This approach contrasts with previous studies that did not include such collisions. For this purpose, we utilize the analytical model from reference [3], which characterizes the dust particle environment as a collisionless layer while applying the drift-diffusion approximation for ions and electrons beyond this layer. By including plasma particle collisions in the analysis, this study aims to provide a more thorough understanding of the mechanisms behind dust particle charging. This research is supported by the Science Committee of the Ministry of Science and Higher Education of the Republic of Kazakhstan (Grant No. AP19676689).

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