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Grain charging rate in high ion concentrated dusty plasma using Langevin-dynamic simulations[1] VIKRAM SURESH, ZHIBO LIU, RANGANATHAN GOPALAKRISHNAN, Univ of Memphis — Grain charging is modeled in instances wherein the ions are dense and strongly coupled: $\Gamma_i \equiv \frac{e^2}{4\pi\varepsilon_o n_i^{-\frac{1}{3}} k_B T_i} > 1$. Langevin Dynamics is used to simulate the motion of multiple ions around a negatively charged grain in a periodic domain for $\sim 10^1 - 10^5$ Pa. The ion flux coefficient is calculated using the grain-ion collision time distribution and the grain-ion pair correlation function $g^{(2)}(r)$ is used to deduce the influence of the ion space charge on the collision of individual ions with the grain during charging. In addition to Γ_i, the ion flux coefficient is influenced by the diffusive Knudsen number $Kn_D \equiv \frac{\sqrt{m_i k_B T_i}}{f_i n_i^{-\frac{1}{3}}}$ (an ion-neutral gas interaction parameter) and $\chi_p \equiv \frac{a_p}{n_i^{-\frac{1}{3}}}$ (that compares the size of the grain to the mean inter-ion spacing). We also demonstrate that an effective grain-ion potential computed using $g^{(2)}(r)$ according to the effective potential theory accurately describes the grain-ion dynamics in a binary framework for $\Gamma_i <\sim 20$, without the need to simulate multiple ions. Ion concentration has a significant effect across different ion coupling regimes and the analysis of the pair-correlation functions reveals the perturbation of ion structure in the plasma by the presence of grains. We hope our model development will spark experimental validation efforts.

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