

# Accelerated self-consistent charge calculations for simulating the dynamics of complex plasma structures

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The consideration of charges on dust particles is essential for accurately modeling various dust systems, including the simulation of chain structures formed by these particles. However, direct self-consistent simulations of dust particle charges alongside their dynamics demand substantial computational resources, even with the aid of modern supercomputers and optimization techniques. This challenge becomes particularly pronounced when attempting to obtain dynamic characteristics of dust structures, such as vibration spectra. In this study, we introduce a novel method that significantly accelerates the self-consistent calculation of dust particle charges during the simulation of their dynamics. Our approach relies on a pre-computed relationship between the charge of a dust particle and the positions and charges of neighboring particles. The charge calculations are carried out using our developed software, OpenDust [1, 2], which facilitates efficient and accurate simulations in multi-level dust dynamics.

- [1] Kolotinskii D and Timofeev A 2023 *Computer Physics Communications* **288** 108746
- [2] Kolotinskii D and Timofeev A 2022 Performance analysis of gpu-based code for complex plasma simulation *Russian Supercomputing Days* (Springer) pp 276–289