SELF-CONSISTENT CALCULATION OF DUST PARTICLES CHARGES IN MULTI-SCALE SIMULATION OF DUST DYNAMICS

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The consideration of dust particle charges is essential for accurately describing a wide range of dust systems, such as in the modeling of chain structures formed by dust particles. However, direct self-consistent simulations of dust particle charges alongside their dynamics require significant computational resources, even with modern supercomputing capabilities and optimization techniques. This is particularly challenging when aiming to obtain dynamic properties of dust structures, such as vibration spectra. In this work, we present a novel method that significantly accelerates the self-consistent calculation of dust particle charges during the simulation of particle dynamics. Our approach is based on a pre-calculation of the charge dependence of a dust particle relative to the position and charge of neighboring particles. The charge calculations are performed using our developed software code, OpenDust, which facilitates efficient and accurate simulations in multi-scale dust dynamics.