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Screened interaction potentials between compound particles for simulation of complex plasmas

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Effective interaction potentials are widely used in computer modeling in such areas as plasma physics, condensed matter physics, physics of colloidal systems, as well as nanotechnology. Usually, one of the plasma components is ideal or weakly coupled, whereas the other component (consisting of relatively inert particles) creates a strongly coupled subsystem on the background of mobile weakly coupled particles. In this case strongly correlated relatively inert particles can be investigated via effective interparticle interaction potentials, where initially screening provided by mobile weakly coupled particles (electrons), whereas many-body effects due to strongly coupled species included naturally in simulations such as molecular dynamics or Monte-Carlo. In this work it is shown that the method of multipole expansion allows to easily find interaction potentials between compound particles screened by weakly coupled component of plasma even without spherical symmetry, if we know the effect of the medium on the potential of individual particles comprising compound particles [1]. Obtained screened potential was used for molecular dynamics simulation of a 2D charged dust system taking into account the effect of the induced dipole moment of a dust particle [2, 3]. As it is known, in gas discharge the dust particle and ions focused by the dust grain can be considered as a one compound particle with non-zero dipole moment. Elongated dust particles can also have an induced dipole moment due to charge separation in the external electric field.

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[3] T.S. Ramazanov, A.Zh. Gabdulin, and Zh.A. Moldabekov, Contrib.Plasma.Phys. Doi: 10.1002/ctpp.201500125, (2016).

Primary author: Mr MOLDABEKOV, Zhandos (IETP, Al Farabi Kazakh National University)

Co-authors: Mr GABDULIN, Ayatola (IETP, Al Farabi Kazakh National University); Dr GABDULLIN, Maratbek (IETP, Al Farabi Kazakh National University); Prof. RAMAZANOV, Tlekkabul (IETP, Al Farabi Kazakh National University)

Presenter: Mr MOLDABEKOV, Zhandos (IETP, Al Farabi Kazakh National University)

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