

Study of plasma distribution around various dust particle structures

Kolotinskii D A^{1,2,@} and Timofeev A V^{1,2,3}

¹ Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia

² Moscow Institute of Physics and Technology, Institutskiy Pereulok 9, Dolgoprudny, Moscow Region 141701, Russia

³ National Research University Higher School of Economics, Myasnitskaya 20, Moscow 101000, Russia

@ kolotinskiy.da@phystech.edu

Dusty plasma is a weakly ionized gas, which contains particles of a condensed state of micron and submicron sizes. Such particles, being in a plasma environment, are charged negatively due to the difference in the mobility of the ionic and electronic components of the plasma. Dusty plasma is observed in outer space, in comet tails and in planetary rings, and it is actively studied in laboratories. The reason why the dusty plasma attracts researchers' attention is the unusualness of the observed phenomena. For example, dust particles can self-organize into complex ordered structures, such as chains or crystal-like structures. Moreover, the transfer of energy from the plasma subsystem to the energy of dust particles is observed in dusty plasma systems, that makes it an example of active matter. In addition, dusty plasma is used in practical application. In the method of spraying surfaces in a high electric field, dusty plasma is generated to produce varnish drops which cover the sprayed surface. In the present work, we theoretically study the distribution of the gas discharge plasma around different structures of dust particles for various plasma parameters. We obtain the charge density and the electric potential distribution around the dust particles, and calculate dust particle charges and forces, acting on dust particles. For theoretical research, we use numerical simulation of the ion dynamics according to [1]. It is assumed that electrons have a Boltzmann distribution, ions undergo pair collisions with neutral gas molecules by the mechanism of resonant charge exchange.