ANALYSIS OF THE PHASE STATE OF SMALL-SIZED MONOLAYER DUSTY PLASMA SYSTEMS USING GLOBAL ORIENTATIONAL ORDER PARAMETER

Vasilieva E.V.,*1  Vaulina O.S.,1  Tun Y.,2  Vasiliev M.M.,1  Petrov O.F.,1  Fortov V.E.1

1 JIHT RAS, Moscow, Russia, 2 MIPT, Dolgoprudny, Russia
*elen_vasilieva@mail.ru

To study the melting processes in monolayer dusty plasma structures, standard methods are typically used, such as analysis of the shape of pair and bond-angular correlation functions, which has strict limitations on the number of observed particles and the degree of uniformity of the studied systems. Often in laboratory experiments with dusty plasma, the formation of various irregularities, in particular the so-called domains, is observed, which can significantly affect the melting process in the two-dimensional non-ideal structures. In this regard, the study of global order parameters (translational and orientational) seems promising, since these parameters will vary appreciably even in the real experiments with dusty plasma structures with different structural pertubations, and they are suitable not only for extended monolayer structures, but also for systems with a small number of particles.

In our work we present the results of a numerical and experimental study of the global orientational order parameter as a function of coupling parameter of two-dimensional system, as well as of the number of particles in the small-sized (cluster) systems. The calculations were performed for non-ideal two-dimensional system of particles interacting via Yukawa potential in a wide range of parameters corresponding to the experimental conditions in the laboratory dusty plasmas. The global orientational order parameter measured from experiments with monolayer dusty plasma structures of small sizes, formed in the near electrode area of RF gas discharge, was also analyzed.

This work was supported by the Russian Scientific Foundation (Grant No. 14-12-01440)