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Substrate dynamics of two-dimensional dusty plasmas

Yan Feng, Wei Li, Liang Gu, Kang Wang, Dong Huang
School of Physical Science and Technology, Soochow University, China
e-mail (speaker): fengyan@suda.edu.cn

The collective behaviors of dusty plasmas without external fields, or substrates, have been widely investigated in the past two decades. In colloidal systems, substrates are often introduced to manipulate their dynamics, and quite a few new dynamical behaviors have been discovered. Here, using computer simulations, we systematically study the dynamics of two-dimensional dusty plasmas on one-dimensional periodic substrates [1-4]. First, for the propagation of waves, we find that the propagation of the waves across the potential wells of the substrate is inhibited and the longitudinal motion of an individual chain dominates the propagation of waves along the potential wells of the substrate [1]. Increasing the width or decreasing the depth of the substrate minima allows the particles to buckle into a zigzag structure, and the resulting spectra develop two branches, one for the sloshing motion and one for the breathing motion [1]. Second, as the substrate strength increases from zero, the structural order of two-dimensional dusty plasma along each potential well of one-dimensional periodic substrates first increases and then decreases gradually [2]. From the mean squared displacement of the diffusive behavior along the potential wells, between the initial ballistic and final diffusive motion, there is the subdiffusion at the intermediate time scale, which may result from the substrate-induced distortion of the caging dynamics [2]. Third, we focus on the depinning dynamics of this system. When the applied spatially uniform and temporally constant external driving force increases gradually from zero, quite a few structural and dynamical diagnostics all suggest that there are three different states, which are the pinned, the disordered plastic flow, and the moving ordered states [3]. Finally, we study the newly-discovered oscillation-like diffusive motion of 2D liquid dusty plasmas on one-dimensional periodic substrates with varied widths [4].

References

[1] W. Li et al., PHYS. REV. E, 98, 063203 (2018).
[2] K. Wang et al., PHYS. REV. E, 98, 063204 (2018).
[3] W. Li et al. PHYS. REV. E, 100, 033207 (2019).
[4] W. Li et al. PHYS. PLASMAS, 27, 033702 (2020).