The study of spatial distribution of vibrational properties in a harmonically confined Yukawa system

Voronov I V[1,2,@], Nikolaev V S[1,2] and Timofeev A V[2,1,3]

[1] Moscow Institute of Physics and Technology, Institutskiy Pereulok 9, Dolgoprudny, Moscow Region 141701, Russia

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

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

[@] ilya.v.voronov@gmail.com

There is the highest available frequency which bounds the oscillation spectrum of particles in a spatially homogeneous crystalline system. The effect of spatial localization of high-frequency particle vibrations is that particles in different quasi-homogeneous regions of the spatially inhomogeneous system have different highest available frequency of oscillations [1]. It is shown that in a system of harmonically confined screened charges, which is spatially inhomogeneous, the highest available frequency of oscillations drops monotonically from the center to the periphery. This effect leads to the corresponding compression of the oscillation spectrum. Since the oscillation spectrum determines properties of vibrations, such as the characteristic frequency as weighted average and amplitude in low-temperature approximation, we demonstrate that these properties monotonically change from the center to the periphery. These results can be useful for the study of wave instabilities [2] and phase transitions [3] in dusty plasmas [4].

[1] Voronov I, Nikolaev V and Timofeev A 2022 *Journal of Experimental and Theoretical Physics* **135** 940–950

[2] Couëdel L, Nosenko V, Zhdanov S, Ivlev A V, Laut I, Yakovlev E V, Kryuchkov N P, Ovcharov P V, Lipaev A M and Yurchenko S O 2019 *Physics-Uspekhi* **62** 1000

[3] Petrov O, Vasiliev M, Tun Y, Statsenko K, Vaulina O, Vasilieva E and Fortov V 2015 *Journal of Experimental and Theoretical Physics* **120** 327–332

[4] Fortov V E and Morfill G E 2009 *Complex and dusty plasmas: from laboratory to space* (CRC Press)