Statistical Theory of Many-body Systems / 7

Towards understanding of condensed matter via study granular systems

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Granular materials under the external perturbations show a diversity of structural transformations which characterized by different symmetries. Their rigorous classification in terms of phase transitions seems very attractable (nevertheless, still questionable). Intriguing question is: can we use the information extracted from studying of structural transformations characters in granular materials to describe any details about the local symmetry of the condensed matter, which displayed during the typical phase–transformations? Here, there are several analogies as well as discrepancies are waiting for us: Local structure, Phase transitions, Landau-Ginzburg kinetics, Lindeman criteria for crystallization, Equation of state.

We would like to outline some results of our research directed to study of structurization, which occurs during packing processes in gently agitated granular (micro-mechanical) systems [1-5]. The focus will be done on developing and investigation of hard-spheres (discs) packing models. The results of this research, in our opinion, in principle can provide an understanding of some characters of the local structure and bulk properties not only of granular matter, but also a regular phases of condensed matter (e.g., molecular liquids and solutions, colloids, glasses). The problem of densest packing are formally belong to pure mathematical area. But inspite of this objectives to study structural and physical properties of perturbed granular systems a variety of physical theoretical models which are partially based on phenomenological information (direct observation) have been developed. The packing of hard-particles can be described by geometric approach, which provides a practical and universal methods of quantitative characterization of the local (as well as global) packing via symmetry categories.

We will consider a packing of a large conglomeration of hard particles confined by a finite-sized container. Boundaries as well as exclusion-volume effects (under the negligible dissipation) would be described by simple packing parameters (like compactivity). Properties of the states of such systems (for instance 2D hard discs) will be studied theoretically and after then compared with the results of direct observations. Obtained results will be analyzed with

respect to reminiscences with some properties of the typical phases of condensed matter.

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