Phase transitions in quasi-two-dimensional dusty plasma structure in RF discharge

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At present time there are two theories of the melting process in two-dimensional systems. The first model is a Grain-Boundary-Induced melting (GBI) theory, which describes the melting process as a phase transition from crystal to liquid without the formation of an intermediate phase [1]. The second one is a Kosterlitz-Thouless-Halperin-Nelson-Young (KTHNY) theory, which predicts the transition from solid to liquid through the formation of the intermediate, the so-called hexatic phase [2].

In our work we present an experimental study of melting processes in quasi-2D dusty plasma structures, formed in a weakly ionized plasma of high capacitive discharge. On the basis of obtained data about the spatial distribution of dust particles and their velocity profile, we analyzed pair and orientational correlation functions, as well as the number of topological defects. A nature of the change of orientational correlation functions confirms the existence of a "solid – to hexatic – to liquid" phase transition, that is fully consistent with the KTHNY - theory, and the obtained excess entropy of dusty plasma system shows an abrupt jump in the transition region.

[1] S. T. Chui, *Phys. Rev. B: Condens. Matter* **28**, 178 (1983)
[2] J. M. Kosterlitz and D. J. Thouless, *J. Phys. C: Solid State Phys*. **6**, 1181 (1973).