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Melting scenario for two-dimensional plasma crystals V. NOSENKO, S.K. ZHDANOV, A.V. IVLEV, C.A. KNAPEK, G.E. MORFILL, Max-Planck Institute for extraterrestrial Physics, Garching, Germany — The solid-liquid phase transition in two-dimensional (2D) systems is not completely understood. Two most important (and competing) models of 2D melting are the dislocation theory of melting - the Kosterlitz-Thouless-Halperin-Nelson-Young (KTHNY) theory and the theory of grain-boundary-induced melting. We performed experimental study of melting in 2D crystalline lattices using complex plasma as a model system. Complex (dusty) plasmas consist of fine solid particles suspended in a weakly ionized gas. At our experimental conditions, the suspension forms a highly ordered 2D triangular lattice, where all particles can be traced using video microscopy. This lattice is very soft and can be readily melted using e.g. the radiation of a focused laser beam. We found an Arrhenius dependence of the defect concentration on the kinetic temperature in steady-state experiments, and show the evidence of metastable quenching in unsteady experiments, where the defect concentration follows a power-law temperature scaling. In all experiments, independent indicators suggest a grain-boundary-induced melting scenario.

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