Monte- Carlo Simulation of Solid State and Melting of 2D Confined Magnetic Particles

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9.7 cm

Numerous systems correspond to confined magnetic particles interacting through dipolar interactions : magnetic particles, flux lines in superconductors, charged colloids. Because of the long range dipolar interaction, the ground state and excited states of such 2 D system are not simply found. Here from careful extended Monte-Carlo simulations the ground state is obtained and shown to be derived from a triangular lattice with a few layers stuck to the confinement boundary. The most common solid state obtained by relaxation from a random configuration is found to be an excited state composed of many triangular crystallites separated by lines of alternate topological defects with five and seven nearest neighbors. The melting of these two solid phases gives finally a common liquid phase as expected. But the melting of the ground state happens as a sharp first order transition while the melting of the excited state happens as a continuous vitreous transition which starts at low temperature with the motion of topological defects on their defect lines, while the rest of the sample remains solid, as a two component medium. These results are compared to experimental and numerical results of corresponding experiments with such Wigner glass and Wigner crystal. The elastic properties of these solid states are also considered.

13.4 cm

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