The Fluctuation-Dissipation Theorem of Topological Defect Colloidal Particles's energy on 2D Periodic Substrates: A Monte Carlo Study of thermal noise-like fluctuation and diffusion-like Brownian motion

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By Monte Carlo simulations, we have calculated mean-square fluctuations in statistical mechanics, such as those for colloids energy configuration are set on square 2D periodic substrates interacting via a long range screened Coulomb potential on any specific and fixed substrate when the system is in thermal equilibrium . These random fluctuations with small deviations from the state of thermodynamic equilibrium arise from the granular structure of them and appear as thermal diffusion with Gaussian distribution structure, are showing linear form of the Fluctuation-Dissipation Theorem on energy of particles constitutive a canonical ensemble. The noise-like variation of the energy per particle and order parameter versus the Brownian displacement of sum of large number of random steps of particles at low temperatures phase are presenting a markovian process on colloidal particles as well too.