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A Long-Lived Oscillatory Space-Time Correlation Function of Two Dimensional Colloids JEONGMIN KIM, Research Institute for Basic Science, Sogang University, BONG JUNE SUNG, Department of Chemistry, Sogang University — Diffusion of a colloid in solution has drawn significant attention for a century. A well-known behavior of the colloid is called Brownian motion : the particle displacement probability distribution (PDPD) is Gaussian and the mean-square displacement (MSD) is linear with time. However, recent simulation and experimental studies revealed the heterogeneous dynamics of colloids near glass transitions or in complex environments such as entangled actin, PDPD exhibited the exponential tail at a large length instead of being Gaussian at all length scales. More interestingly, PDPD is still exponential even when MSD was still linear with time. It requires a refreshing insight on the colloidal diffusion in the complex environments. In this work, we study heterogeneous dynamics of two dimensional (2D) colloids using molecular dynamics simulations. Unlike in three dimensions, 2D solids do not follow the Lindemann melting criterion. The Kosterlitz-Thouless-Halperin-Nelson-Young theory predicts two-step phase transitions with an intermediate phase, *the hexatic phase* between isotropic liquids and solids. Near solid-hexatic transition, PDPD shows interesting oscillatory behavior between a central Gaussian part and an exponential tail. Until 12 times longer than translational relaxation time, the oscillatory behavior still persists even after entering the Fickian regime. We also show that multi-layered kinetic clusters account for heterogeneous dynamics of 2D colloids with the long-lived anomalous oscillatory PDPD.

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