



Library Indian Institute of Science Education and Research Mohali



DSpace@IISERMohali / Thesis & Dissertation / Doctor of Philosophy (PhD) / PhD-2013

Please use this identifier to cite or link to this item: <http://hdl.handle.net/123456789/1566>

Title:	A Study of Equilibrium and Non-Equilibrium Phase Transition In Two Dimensional Colloidal Suspension
Authors:	Khali, Shubhendu Shekhar
Keywords:	XY model Solid and hexatic melting Thermodynamic Pressure Hexatic melting
Issue Date:	Jul-2020
Publisher:	IISER Mohali
Abstract:	<p>A flashing ratchet refers to an overall directed motion of particles in a thermal environment under the influence of an asymmetric potential, switching on and off stochastically. This model has been studied in the context of active dynamics of molecular motors, as a mechanism of particle segregation, transport of cold atoms in optical lattice, in motion of flux quanta and in describing the collective dynamics of elastically coupled motor proteins. While a large body of work has been concentrated on the ratcheting effect of non-interacting systems in one spatial dimension, there has been fewer studies that focuses on the effects of interaction in one or higher dimensions. Despite moderate efforts, the collective dynamics of interacting system of particles under ratcheting drives remains largely unexplored. It is also worth noting that in most of such studies the focus had been on the transport properties of the system and its dependence on the external control parameter. In the first part of the thesis, we present our results on the study of equilibrium phase transition in a two dimensional system of interacting colloidal suspension and compare it with that of the predictions from KTHNY theory and grain boundary melting. The melting transition is identified from the translational and the orientational order parameter and their correlation functions. The nature of the phase transition is determined from the distribution of the order parameters and the local density fluctuations. In the second part of the thesis, we look at such a two dimensional colloidal dispersion of soft-core particles driven by a one dimensional stochastic flashing ratchet that induces a time averaged directed particle current through the system. It undergoes a non-equilibrium melting transition as the directed current approaches a maximum associated with a resonance of the ratcheting frequency with the relaxation frequency of the system. We use extensive molecular dynamics simulations to present a detailed phase diagram in the ratcheting rate-mean density plane. With the help of numerically calculated structure factor, solid and hexatic order parameters, and pair correlation functions, we show that the non-equilibrium melting is a continuous transition from a quasi-long ranged ordered solid to a hexatic phase. The transition is mediated by the unbinding of dislocations, and formation of compact and string-like defect clusters.</p>
URI:	http://hdl.handle.net/123456789/1566
Appears in Collections:	PhD-2013

Files in This Item:

File	Description	Size	Format	
PH13018.pdf		49.06 MB	Adobe PDF	View/Open

Show full item record



Items in DSpace are protected by copyright, with all rights reserved, unless otherwise indicated.

Admin Tools

Edit...

Export Item

Export (migrate) Item

Export metadata

