

RICE QUANTUM GROUP MEETING SEMINAR SERIES



<u>Presenter:</u>	Sohail Dasgupta
Research Group:	Prof. Kaden Hazzard's group
Date:	March 31, 2023, Friday
Time:	4PM - 5PM
Venue:	SST 300

Dipolar Interacting Quantum Matter in Synthetic Dimensions

Abstract:

Synthetic dimension platforms offer unique ways of exploring quantum matter. These highly tunable platforms can be used to mimic solid-state phenomena, as well as to realize novel Hamiltonians beyond the realms of usual solid-state materials or even optical lattices.

In this talk, I will present the many-body physics of atoms and molecules combining internal synthetic lattices with real-space microtrap arrays. In this setup, the atoms/molecules interact via dipole-dipole angular-momentum-exchange interactions, and I focus on the case of uniform synthetic tunneling rates. Through a combination of mean-field theory and quantum Monte Carlo results, I will show that the interplay between the interaction and synthetic tunneling gives rise to several different phases, symmetry-breaking and otherwise.

One particularly interesting phase is one where the system is localized along the synthetic dimension, forming a quantum string or membrane that fluctuates in a higher dimensional space. We find tri-critical points on the phase boundaries between this string phase and a disordered gas when the finite size of the synthetic dimension is six sites or larger. I will conclude with some open questions and motivate other systems that can be engineered with synthetic dimension platforms in general that are hard to build elsewhere.

Short Bio:

Sohail Dasgupta is a 4th year PhD student at Rice in Prof. Kaden Hazzard's group. His broad research interest includes understanding exotic quantum many-body phenomena in different ultracold atoms and molecules platforms with numerical and analytical techniques. He is presently interested in the set of platforms known as Synthetic Dimensions that use d -Dimensional real systems to simulate $(d+1)$ -Dimensional physics. These systems seem to host exotic quantum phases that do not have any solid state or optical lattice analogue. Before joining Rice, he did his BS and MS at the Indian Institute of Science Education and Research (IISER) Kolkata.

Note: Snacks and Coffee will be served during the event Wine & cheese will be served after the talk. Everyone is welcome to stay around after the seminar for further informal discussions.