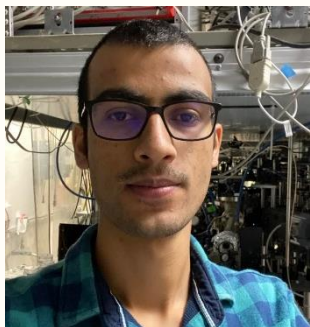


RICE QUANTUM GROUP MEETING SEMINAR SERIES



Presenter: Aashish Kafle
Research Group: Prof. Randy Hulet's group
Date: April 28, 2023, Friday
Time: 4PM - 5PM
Venue: SST 300

Spin-charge separation in a 1D Fermi Gas with tunable interactions

Abstract:

Ultracold atoms confined in optical lattices are a powerful tool for the quantum simulation of complex many-body systems. We confine spin-1/2 atomic fermions (^6Li) to one dimension and realize the Yang-Gaudin model, the low-energy behavior of which is expected to be that of a Tomonaga-Luttinger liquid. Such liquids exhibit bosonic collective low-energy excitations and spin-charge separation. Using Bragg spectroscopy and a Feshbach resonance, we directly excite either the spin or charge wave with a tunable repulsive interaction strength. We observe the onset of spin-charge separation as interactions are increased from zero [1]. The spin and charge excitation velocities are equal for the non-interacting case, while the charge-mode velocity increases and the spin-mode velocity decreases with increasing repulsive interaction, a hallmark of spin-charge separation. The excitation spectra provide access to the dynamic structure factors of each mode, which are in quantitative agreement with the Tomonaga-Luttinger liquid theory, including nonlinear corrections due to band curvature and back-scattering. Furthermore, we realize a spin-incoherent Luttinger liquid that features a suppression of the spin-charge separation owing to the thermal energy of the system surpassing the spin energy [2]. In addition, we observe an inversion of the spin-charge separation on the attractive interaction regime, where we expect unlike spins to pair and the spin mode to be gapped.

- [1] Ruwan Senaratne, Danyel Cavazos-Cavazos, Sheng Wang, Feng He, Ya-Ting Chang, Aashish Kafle, Han Pu, Xi-Wen Guan and Randall G. Hulet, *Science* 376, 6599 (2022).
[2] Danyel Cavazos-Cavazos, Ruwan Senaratne, Aashish Kafle and Randall G. Hulet, arXiv:2210.06306 (2022).

Short Bio:

Aashish Kafle is a 3rd year Ph.D. student at Rice in Prof. Randall Hulet's group. Before joining Rice, he was involved with building a Quantum Gas Microscope at the University of Virginia. His broad research interest includes quantum simulation of fermions and experimental techniques therein. He is currently interested in the physics of low-dimensional fermions that host exotic quantum behaviors.

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.