ICFO

SEMINAR: Universal Internal Correlations of One-Dimensional Anyons: Momentum Tails and Reduced Density-Matrix Structure

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15:00 to 16:00
Seminar Room

We study one-dimensional anyons as a platform to explore the interplay between generalized exchange statistics and many-body correlations, with a view toward experimentally relevant implementations in engineered ultracold atomic systems.
We first analyze the momentum distribution of N-identical Lieb-Liniger anyons with mixed pseudopotential descriptions and derive their asymptotic high-momentum behavior, identifying universal coefficients governing the large-momentum tails relevant for time-of-flight measurements.
We then investigate internal correlations encoded in the one-body density matrix. Using the mapping between anyonic states and bosonic mean-field bright-soliton solutions as an analytical tool, we study the structure of the one-body density matrix and its natural orbitals. We show that the corresponding occupation numbers display a universal behavior, independent of the specific choice of underlying non interacting bosonic state. We further analyze the occupation spectrum and identify signatures consistent with odd-parity fractional fermionic pairing.
Finally, we connect these results to experimentally relevant implementations based on spin-orbit coupled ultracold atoms realizing two distinguishable bosons in one dimension in the Tonks Girardeau regime, where effective one-dimensional geometries and engineered interactions can be used to emulate anyonic physics. In particular, the anyonization mechanism can be understood as arising from a spin-dependent anyonic gauge field acting on the triplet sector, leading to controlled
exchange-statistics effects.
Overall, our results show how generalized exchange statistics govern universal correlation properties in both momentum-space and reduced-density-matrix observables, linking anyonic statistics, many-body coherence, and experimentally accessible signatures in one-dimensional quantum systems

Hosted by: Prof. Dr. Leticia Tarruell