SEMINAR: A journey through Flatland: What does the antiflatness of a spectrum teach us?

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11:30 to 12:00
Seminar Room

The first layer of quantumness in a many-body quantum state is embodied by entanglement, the resource for quantum correlations. However, when addressing quantum complexity, entanglement alone is not sufficient. One must go beyond, and consider the so-called non-stabilizerness (or magic). It is well known that a state can be maximally entangled yet classically simulable, as shown by the Gottesman-Knill theorem. On the other hand, states with low entanglement but high magic can still be simulated efficiently using tensor network techniques. Hence, the interplay between entanglement and non-stabilizerness is crucial to understand the emergence of quantum complexity.
In this talk, we will explore the concept of antiflatness to characterize the structural fluctuations within the entanglement spectrum of a quantum state (i.e., the spectrum of its reduced density operator). As a measure of the interplay between entanglement and magic, antiflatness provides second-order information about quantum correlations that standard average measures fail to capture. Standard majorization theory orders states by purity and is structurally blind to spectral fluctuations, So we introduce a novel partial ordering known as antiflat-majorization and define Flatness-Preserving Operations, obtaining new necessary conditions for quantum-state convertibility. We also unify several antiflatness measures through escort distributions and Bregman divergences, connecting the Capacity of Entanglement to Quantum Fisher Information. Finally, we demonstrate that absolute maximal antiflatness is not achieved by a single universal state, but rather by a continuous Pareto frontier of extremal states with jump spectra, and we analyze the typicality of these spectral fluctuations using Haar, Bures-Hall and t-doped Clifford random state ensembles.
Hosted by: Prof. Dr. Antonio Acin