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Dr. Alessandro Romito
Lancaster University, Department: Physics

Entanglement and topology in measurement-induced phase transistions.

Measurements are inherently probabilistic processes with an unavoidable back-action on any quantum system. This back-action makes the system evolve along stochastic quantum trajectories and generally competes with unitary dynamics, leading to localisation phenomena like the Zeno effect. In many-body systems, this interplay leads to measurement-induced phase transitions (MiPTs) between out-of-equilibrium steady states. A remarkable one is a MiPT between volume and area-law entanglement scaling phases, which is not detectable in the averaged state of knowledge of the system but only accessing the statistical distribution of the entanglement along quantum trajectories. MiPTs are being investigated and characterised in a variety of systems.In this talk, I will review quantum measurements and their back action in their discrete and continuous framework. I will first revisit the Zeno effect along individual trajectories from continuous measurements and identify topological properties of the trajectories in the Zeno regime. I will then extend the considerations to many-body fermionic systems. Focusing on Gaussian fermions, I will discuss MiPTs from competing measurements and unitary dynamics in terms of entanglement scaling and topological order. I will finally introduce a theory of partial post-selection that allows us to characterise MiPTs of subsets of quantum trajectories from the entire ensemble to individual (post-selected) trajectories.