

The Hubbard model is a minimal model describing interacting particles on lattices. In the case of fermions, it captures a wide range of phenomena associated with strong electron-electron correlations, and captures the essential physics of cuprate (high- T_c) superconductors. For bosons, it features a well-known quantum phase transition between a superfluid (BEC) state for weak interactions and a Mott insulating state at larger interactions.

In this talk, I will discuss two recent sets of experiments exploring strongly correlated states emerging in Hubbard models. First, I will focus on the Fermi-Hubbard model, explored over a wide range of dopings and temperatures using a quantum gas microscope [\[arxiv:2412.17801\]](#). We specifically probe a regime where a pseudogap is known to develop, and, through measurements of multi-point correlation functions up to 5th order, we provide evidence that the pseudogap regime is associated with the emergence of strong correlations at all order.

In the second part, I will briefly discuss the Mott transition, explored using a Bose-Hubbard quantum simulator with single particle resolution in momentum space [\[arxiv:2508.21623\]](#). Notably, we measure the full distribution function of the BEC order parameter, recovering the intuitive aspects of Landau's theory on phase transitions. At the same time, we reveal universal, non-Gaussian statistics at the transition point.