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Quench dynamics in long-range interacting quantum systems

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A distinctive feature of atomic, molecular, and optical systems is that interactions between particles are often long-ranged. Control techniques from quantum optics often allow one to tune the pattern of these long-range interactions, creating an entirely new degree of freedom, absent in typical condensed matter systems. These tunable long-range interactions can result in very different far-from-equilibrium dynamics compared to systems with only short-range interactions. In the first half of the talk, I will describe how very general types of long-range interactions can qualitatively change the entanglement and correlation growth shortly after a quantum quench. In the second half of the talk I will show that, at longer times, long-range interactions can lead to exotic quasi-stationary states and dynamical phase transitions. These theoretical ideas have been explored in recent trapped-ion experiments, and connections to these experiments will be emphasized in both parts of the talk.