

Webinar

Non-equilibrium Dynamics of Synthetic Quantum Matter

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In recent years, rapid advances in the development of quantum technologies have led to the possibility of creating and manipulating large-scale “synthetic quantum matter”. These unique many-body platforms synthesised from ultracold atoms, molecules, ions, and photons provide a powerful and versatile route to elucidate quantum phenomena that may be difficult (or even impossible) to realise elsewhere in nature. In this seminar, I will present some of our recent work on understanding the non-equilibrium properties of these systems. In the first part of the talk, I will propose a route to realise a discrete time crystal in a periodically driven quantum system. A time crystal is a fascinating non-equilibrium phase of matter that exhibits spontaneous time-translation-symmetry breaking. I will demonstrate that a many-body interference mechanism can be harnessed to create an eternal time crystal with global "all-to-all" interactions. In the second part of the talk, I will describe quantum information scrambling in a chaotic spin-chain with competing short and long-range interactions. I will argue that this system can exhibit fast scrambling, thereby providing a route to probe aspects of quantum gravity in near-term experiments. I will then briefly describe the kaleidoscope of quantum phases that emerge in this system and conclude with a brief overview of future research directions.

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