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Title: A one dimensional, long-range interacting, prethermal time crystal

Abstract: Driven quantum systems provide an intriguing landscape for studying novel phases of non-equilibrium matter. However, a generic strongly-interacting Floquet system will continuously absorb energy from the drive until it approaches an infinite temperature state. One approach to overcoming this challenge is to work in the so-called many-body localized regime; unfortunately, the dual constraints of strong disorder and low dimensionality significantly limit the types of experimental platforms that one can consider. In this talk, I will describe an alternate strategy based on Floquet prethermalization. In this case, even in the absence of disorder, one can observe an extremely slow heating time scale with an exponential dependence on the frequency of the drive, resulting in a long-lived intermediate "prethermal" regime where non-equilibrium phases can be stabilized. In this context, I will report on the recent observation of a 1D prethermal time crystal in a long-range interacting chain of trapped atomic ions. Finally, time permitting, I will end by describing our recent efforts at proving the existence of a 1D classical time crystal with true long-range order, where time-translation symmetry is broken out to infinite times.