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Quantum Stat Mech in a Programmable Spin Chain of Trapped Ions[1]

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Trapped atomic ions are a versatile and very clean platform for the quantum programming of interacting spin models and the study of quantum nonequilibrium phenomena. When spin-dependent optical dipole forces are applied to a collection of trapped ions, an effective long-range quantum magnetic interaction arises, with reconfigurable and tunable graphs. Following earlier work on many-body spectroscopy[2] and quench dynamics[3], we have recently studied many body non-thermalization processes in this system. Frustrated Hamiltonian dynamics can lead to prethermalization[4], and by adding programmable disorder between the sites, we have observed the phenomenon of many body localization (MBL)[5]. Finally, by applying a periodically driven Floquet Hamiltonian tempered by MBL, we report the observation of a discrete "time crystal in the stable appearance of a subharmonic response of the system to the periodic drive[6]

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[3]P. Richerme, et al., **Nature 511**, 198 (2014).
[4]B. Neyenhuis, et al., **arXiv 1608.00681** (2016).
[5]J. Smith, et al., **Nature Physics 12**, 907 (2016).
[6]J. Zhang, et al., **arXiv 1609.08684** (2016).