Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

Probing many-body dynamics on a 51-atom quantum simulator[1]

HARRY LEVINE, HANNES BERNIEN, ALEXANDER KEESLING, AHMED OMRAN, HANNES PICHLER, SOONWON CHOI, Harvard University, SYLVAIN SCHWARTZ, Laboratoire Kastler Brossel, ALEXANDER ZIBROV, Harvard University, MANUEL ENDRES, California Institute of Technology, MARKUS GREINER, Harvard University, VLADAN VULETIC, Massachusetts Institute of Technology, MIKHAIL LUKIN, Harvard University — Controllable, coherent many-body quantum systems can provide insights into fundamental properties of quantum matter, enable the realization of exotic quantum phases, and ultimately offer a platform for computation that may surpass classical computing. Here we demonstrate a method for deterministically creating large, reconfigurable arrays of up to 51 individual cold atoms. We engineer strong, coherent interactions among the atoms by coupling them to highly excited Rydberg states. This allows us to realize a programmable Ising-type quantum spin model with a tunable range of interactions. Within this model, we experimentally study phase transitions into various spatially ordered states, and we observe universal scaling properties of these transitions as revealed by the Kibble-Zurek mechanism. Finally, we study many-body dynamics far from equilibrium, induced by a rapid change in system parameters. Our platform offers an opportunity to explore many-body physics on a programmable quantum simulator in a regime where exact classical simulation is intractable.

[1]NSF, Center for Ultracold Atoms, NSSEFF, AFOSR MURI, NWO, DFG, NDSEG

Harry Levine
Harvard University

Date submitted: 26 Jan 2018 Electronic form version 1.4