Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Observation of Domain Wall Confinement and Dynamics in a Quantum Simulator[1] P. BECKER, W. L. TAN, F. LIU, G. PAGANO, K. S. COLLINS, A. DE, L. FENG, H. B. KAPLAN, A. KYPRIANIDIS, R. LUNDGREN, W. MORONG, S. WHITSITT, A. V. GORSHKOV, C. MONROE, Joint Quantum Institute and Joint Center for Quantum Information and Computer Science, University of Maryland and NIST — Confinement is a ubiquitous mechanism in nature, whereby particles feel an attractive force that increases without bound as they separate. A prominent example is color confinement in particle physics, in which baryons and mesons are produced by quark confinement. Analogously, confinement can also occur in low-energy quantum many-body systems when elementary excitations are confined into bound quasiparticles [1]. Here, we report the first observation of magnetic domain wall confinement in interacting spin chains with a trapped-ion quantum simulator [2]. By measuring how correlations spread, we show that confinement can dramatically suppress information propagation and thermalization in such many-body systems. We determine the excitation energy of domain wall bound states from non-equilibrium quench dynamics. Furthermore, we study the number of domain wall excitations created for different quench parameters, in a regime that is difficult to model with classical computers. This work demonstrates the capability of quantum simulators for investigating exotic high-energy physics phenomena, such as quark collision and string breaking. [1] F. Liu, et al., Phys. Rev. Lett. 122, 150601 (2019). [2] W. L. Tan, P. Becker, et al., arXiv: 1912.11117 (2019).

[1]This work is supported by the NSF STAQ program, the NSF QIS and Physics Frontier Center at JQI, AFOSR and ARO MURI programs, the DARPA DRINQS program, and the DOE BES and HEP programs.

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Date submitted: 03 Feb 2020 Electronic form version 1.4