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Multi-qubit adiabatic evolutions by parameter jumping in Rydberg-atom programmable quantum simulators YUNHEUNG SONG, ANDREW BYUN, JAEWOOK AHN, KAIST — Adiabatic evolutions of a multi-qubit system to the many-body ground states of a targeted Hamiltonian allow various tasks for quantum information processing. However, the very nature of energy gap closing near critical points requires slow ramps of control parameters, while dephasing due to experimental imperfections limits coherence time, making it hard to get the targeted states adiabatically. Shortcuts to adiabaticity [1] could resolve this problem by speeding up the adiabatic evolutions, but require nonlocal interactions that are hard to implement in currently available quantum simulators. In this work, we adopt a recently proposed scheme utilizing discrete changes of a control parameter [2] to achieve the many-body ground states of our Rydberg-atom quantum simulator [3], adiabatically despite zero energy gaps along the evolution pathways. We have observed that the scheme not only works for atoms all within blockade radius, which are effectively described as a two-level system, but also improves the final ordered state probability of 1D atom chains simulating Ising quantum magnets.
[1] A. del Campo, and K. Sengupta, Eur. Phys. J. Spec. Top. 224, 189 (2015). [2] K. Xu et al., Sci. Adv. 5, eaax3800 (2019). [3] H. Kim et al., Phys. Rev. Lett. 120, 180502 (2018).

Yunheung Song
KAIST

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