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Shadow Lattice Stabilization Program for Strongly Correlated States of Light ELIOT KAPIT, University of Oxford, MOHAMMAD HAFEZI, Joint Quantum Institute, University of Maryland College Park, STEVEN SIMON, University of Oxford — Recent progress in nanoscale quantum optics and superconducting qubits has made the creation and quantum simulation of strongly correlated, and even topologically ordered, states of photons a real possibility. Many of these states are gapped and exhibit anyon excitations, which could be used for quantum information processing. However, the question of how to stabilize the many-body ground states of photonic quantum simulators against decays remains largely unanswered. We here propose a simple mechanism which achieves this goal. Our construction uses a uniform two-photon drive field to entangle the qubits of the primary lattice with an auxiliary "shadow" lattice of qubits with a much faster loss rate than the primary qubits. This entanglement raidly refills hole states created by photon losses, and a many-body gap prevents further photons from being added once the strongly correlated ground state is reached. We present a set of general guidelines for designing the shadow lattice and coupling Hamiltonians to stabilize the ground state of a given primary Hamiltonian. We then provide an explicit construction which stabilizes abelian and non-abelian fractional quantum Hall states of light. The device parameters needed for our scheme to work are within reach of current technology.

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