

Abstract Submitted  
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**Optical Lattice with Torus Topology**<sup>1</sup> HWANMUN KIM, GUANYU ZHU, J. V. PORTO, MOHAMMAD HAFEZI, Joint Quantum Institute, NIST/University of Maryland, College Park — We propose an experimental scheme to construct an optical lattice where the atoms are confined to the surface of a torus. This construction can be realized with spatially shaped laser beams which could be realized with recently developed high resolution imaging techniques. We numerically study the feasibility of this proposal by calculating the tunneling strengths for atoms in the torus lattice. To illustrate the nontrivial role of topology in atomic dynamics on the torus, we study the quantized superfluid currents and fractional quantum Hall (FQH) states on such a structure. For FQH states, we numerically investigate the robustness of the topological degeneracy and propose an experimental way to detect such a degeneracy. Our scheme for torus construction can be generalized to surfaces with higher genus for exploration of richer topological physics.

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