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Observing the Quantum Spin Hall Effect with Ultracold Atoms
J.Y. VAISHNAV, Joint Quantum Institute, National Institute of Standards and Technology, Gaithersburg MD 20899, TUDOR D. STANESCU, Condensed Matter Theory Center, Department of Physics, University of Maryland, College Park, Maryland 20742, CHARLES W. CLARK, Joint Quantum Institute, National Institute of Standards and Technology, Gaithersburg MD 20899, VICTOR GALITSKI, Condensed Matter Theory Center, Department of Physics, University of Maryland, College Park, Maryland 20742 — The quantum spin Hall (QSH) state is a topologically nontrivial state of matter proposed to exist in certain 2-D systems with spin-orbit coupling. While the electronic states of a QSH insulator are gapped in the bulk, a QSH insulator is characterized by gapless edge states of different spins which counterpropagate at a given edge; the spin is correlated with the direction of propagation. Recent proposals [1] suggest that synthetic spin-orbit couplings can be created for cold atoms moving in spatially varying light fields. Here, we identify an optical lattice setup which generates an effective QSH effect for cold, multilevel atoms. We also discuss methods for experimental detection of the atomic QSH effect.

[1]T. D. Stanescu, C. Zhang, V. Galitski, *Physical Review Letters* **99**, 110403 (2007), J. Y. Vaishnav, Charles W. Clark, *Physical Review Letters* **100**, 153002 (2008).

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