

Time-Reversal Invariant Topological Insulators With Ultra-Cold Atoms in Optical Lattices

Indu Satija

Department of Physics, George Mason University, Fairfax, Virginia 22030, USA and
National Institute of Standards and Technology, Gaithersburg, Maryland 20899, USA

Systems exhibiting Quantum spin Hall effect represent a fascinating new state of matter rooted in time reversal symmetry and exhibiting non-trivial topological properties, or features which cannot be defined locally. A spin related version of quantum Hall systems, these topological insulators carry spin current and are commonly expected in spin-orbit coupled systems. Here we propose a possible realization of this topological state using ultra-cold gasses subjected to $SU(2)$ gauge fields. We analyze in detail the model relevant for this experimental system, and demonstrate the existence of series of quantum phase transitions between topological and normal insulating phases. Underlying these profound properties of the system is a vast landscape of Dirac points and Z_2 topology encoded in the multi-band spectrum of the system.