Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

A 3D topological insulator quantum dot for optically controlled quantum memory and quantum computing HARI PAUDEL, MICHAEL LEUENBERGER, Dept.of Physics and NanoScience Technology Center, University of Central Florida — We present the model of a quantum dot (QD) consisting of a spherical core-bulk heterostructure made of 3D topological insulator (TI) materials with bound massless and helical Weyl states existing at the interface. The number of bound states can be controlled by tuning the size of the QD and the magnitude of the core and bulk energy gaps in QD sizes of few nanometers. The confined massless Weyl states in 3D TI QDs are localized at the interface of the QD and exhibit a mirror symmetry in the energy spectrum. The strict optical selection rules give rise to the Faraday effect due to Pauli exclusion principle. We show that the semi-classical Faraday effect can be used to read out spin quantum memory. When a 3D TI QD is embedded inside a cavity, the single-photon Faraday rotation provides the possibility to implement optically mediated quantum teleportation and quantum information processing with 3D TI QDs. Remarkably, the combination of inter- and intraband transition gives rise to a large dipole moment of up to 450 Debye. The strong-coupling regime can be reached for a cavity quality factor of $Q \approx 10^4$ in the infrared wavelength regime.

Hari Paudel
Dept.of Physics and NanoScience Technology Center,
University of Central Florida

Date submitted: 15 Nov 2013 Electronic form version 1.4