# HL 119: Invited Talk Michael Leuenberger

Time: Friday 11:00–11:30 Location: POT 006

**Invited Talk** HL 119.1 Fri 11:00 POT 006

**A 3D topological insulator quantum dot for optically controlled quantum memory and quantum computing** — Hari P. Paudel and •Michael N. Leuenberger — NanoScience Technology Center, University of Central Florida, Orlando, FL 32826, USA

We present the model of a quantum dot (QD) consisting of a spherical core-bulk heterostructure made of 3D topological insulator (TI) materials, such as the narrow-bandgap semiconductor $Pb_{1-x}Sn_xTe$, with bound massless and helical Weyl states existing at the interface and being confined in all three dimensions. 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, which determine the confining potential. We demonstrate that such bound Weyl states can be realized for QD sizes of few nanometers. In contrast to topologically trivial semiconductor QDs, 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. We find that 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 information processing.