

Kirtimaan Mohan – HEP Seminar – September 28, 2026
MSU

Title: Quantum Tomography of Top Quarks as a Probe of Charge-Parity Violation in Higgs boson interactions.

Measurements at the LHC now reconstruct all fifteen parameters of the top-antitop two-qubit spin density matrix, amounting to a complete quantum tomography of top-quark pairs. In this talk, I will show how quantum tomography can be used to probe Charge-Parity (CP) violation in the interaction between the Higgs boson and the top quark.

Additional sources of CP violation are required to explain the observed matter-antimatter asymmetry of the Universe, motivating searches for CP-violating interactions beyond those present in the Standard Model. A particularly well-motivated possibility is a CP-violating component of the top-Yukawa coupling, which can modify the spin structure of top-quark pair production. These effects enter the density matrix at one loop through virtual Higgs exchange and generate CP-odd spin correlations and polarization of the top quarks. I will present the one-loop calculation of the top-antitop spin density matrix in the presence of a CP-violating top-Higgs interaction and show how these predictions can be directly compared with experiment. Using recently reported CMS measurements, we obtain constraints on the CP-even and CP-odd components of the top-Yukawa coupling that are complementary to those derived from direct $t\bar{t}H$ and tH production.