

Zhite Yu – HEP Seminar – October 18, 2022
MSU

Title: Azimuthal Angular Correlation as a New Boosted Top Jet
Substructure

Abstract: We propose a novel jet substructure observable of boosted tops that is related to the linear polarization of the W boson in boosted top quark decay, which results in a $\cos 2\phi$ angular correlation between the $t \rightarrow bW$ and W decay planes. We discuss in detail the origin of such linear polarization by applying Wigner's little group transformation. We show that the unique $\cos 2\phi$ angular correlation only exists in the boosted regime but not in the top quark rest frame. We construct an experimental observable for such correlation based on the transverse energy deposition asymmetry in the top jet that does not require the reconstruction of W decay products. The degree of this asymmetry can be used to measure the longitudinal polarization of the top quark, which is an important probe of new physics that couples to the top sector, and can discriminate a boosted top quark jet from its background events, such as QCD jets. A numerical simulation is also performed and found to agree well with the analytic prediction of the standard model.