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Atmospheric neutrinos in DUNE

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The Deep Underground Neutrino Experiment (DUNE) is a pioneering long-baseline neutrino experiment that will feature multi-kiloton scale Liquid Argon Time Projection Chambers (LArTPCs). Beyond its primary beam neutrino objectives, DUNE's cutting-edge technology offers a unique opportunity to investigate atmospheric neutrinos with unprecedented precision. Atmospheric neutrinos, spanning a wide range of energies and path lengths, provide a rich dataset for probing diverse L/E regimes, offering invaluable insights into the PMNS oscillation parameters. This natural neutrino source provides a highly complementary dataset to DUNE's beam program, helping to break parameter degeneracies and enabling a comprehensive view of neutrino oscillations.

This talk will focus on the latest reconstruction performance and the comprehensive analysis framework for atmospheric neutrinos within the DUNE experiment. Building upon the full simulation and reconstruction chain, which includes detailed evaluations of the hadronic system, energy estimation, and directional reconstruction capabilities, we present the critical next steps toward full oscillation analyses. Specifically, we will discuss the recent, extensive implementation of systematic uncertainties, covering atmospheric flux variations, cross-section models, Earth density profiles, and detector effects. The integration of these systematic constraints demonstrates the high-precision capabilities of DUNE's LArTPC technology and directly sets the stage for upcoming sensitivity studies to standard neutrino oscillations and physics beyond the Standard Model.

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