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Compatibility of neutrino DIS data and its impact on nuclear parton distribution functions

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In global analyses of nuclear parton distribution functions (nPDFs), neutrino deep-inelastic scattering (DIS) data is well-known to exhibit tensions with the data from charged-lepton DIS. Using the nCTEQ framework, we investigate these tensions both internally and with the data sets used in our recent nPDF analysis nCTEQ15WZSIH. We properly take into account nuclear effects in the calculation of the deuteron structure function F_2^D using the CJ15 analysis. The resulting nPDF fit, nCTEQ15WZSIHdeut, serves as the basis for our comparison with inclusive neutrino DIS and charm dimuon production data. Using χ^2 hypothesis testing, we study the tensions with these data and the impact of the proton PDF baseline as well as the treatment of data correlation and normalization uncertainties. We identify the experimental data and kinematic regions that generate the tensions and present several possible approaches how a consistent global analysis with neutrino data can be performed. We show that the tension can be relieved using a kinematic cut at low x ($x > 0.1$) and also investigate a possibility of managing the tensions by using uncorrelated systematic errors. Finally, we present a different approach identifying a subset of neutrino data which leads to a consistent global analysis without any additional cuts. Understanding the long-standing tensions between the neutrino and charged-lepton DIS data is important not only for a better flavor separation in global analyses of nuclear and proton PDFs, but also for neutrino physics and for searches for physics beyond the Standard Model.

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I. INTRODUCTION AND REVIEW OF PREVIOUS ANALYSES

Charged-current (CC) deep-inelastic scattering (DIS) of neutrinos off nuclei has long been recognized to have