

# First measurement of differential cross sections for muon neutrino charged current interactions on Argon with a two-proton final state with the MicroBooNE detector



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## 1. Analysis Overview

**Goal:** Target charged-current two-proton final state interactions with MicroBooNE

- First differential cross-section measurement
- Utilize largest neutrino-argon data sets

**Motivation:** Require good understanding of two-proton final state interactions essential for future neutrino precision experiments, e.g., DUNE

## 2. Signal Definition

- Single muon with  $100 < P_\mu < 1200$  MeV/c
- Two protons with  $300 < P_p < 1000$  MeV/c
- No neutral mesons, photons, or electrons
- No charged pions with  $P_\pi > 65$  MeV/c

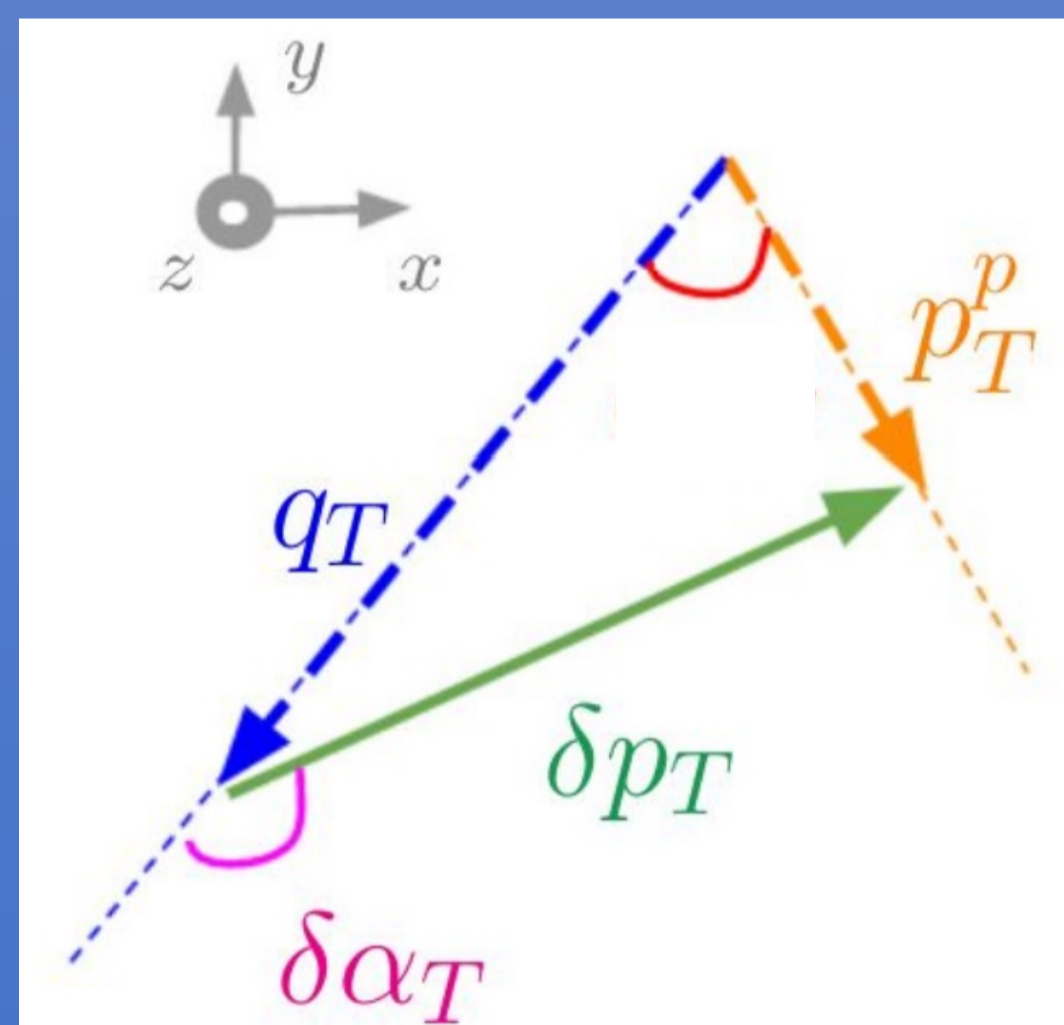
Achieve efficiency and purity of 14% and 65%, respectively

## 3. Variables of Interest

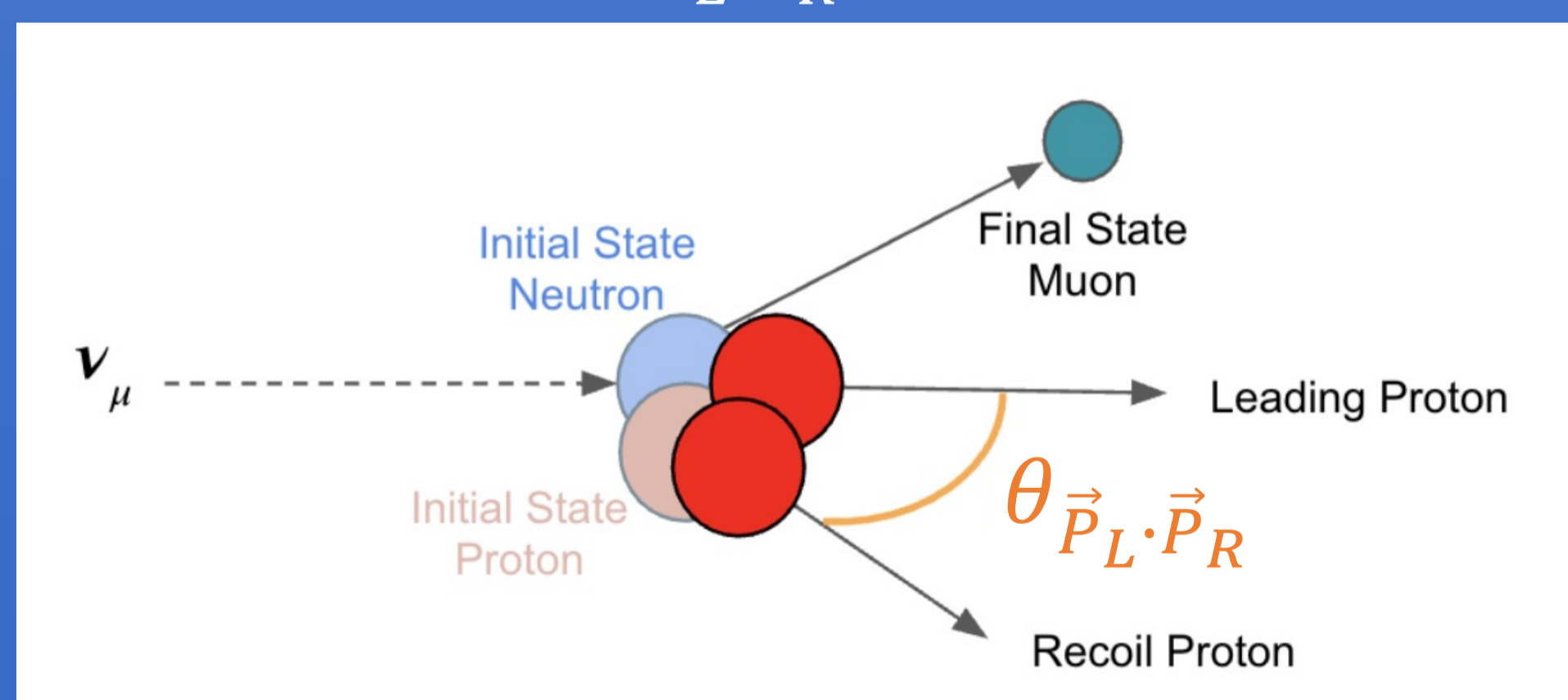
Three variables defined which all have sensitivity to initial nucleon state and final state interactions

A. Transverse missing momentum ( $\delta P_T$ ):

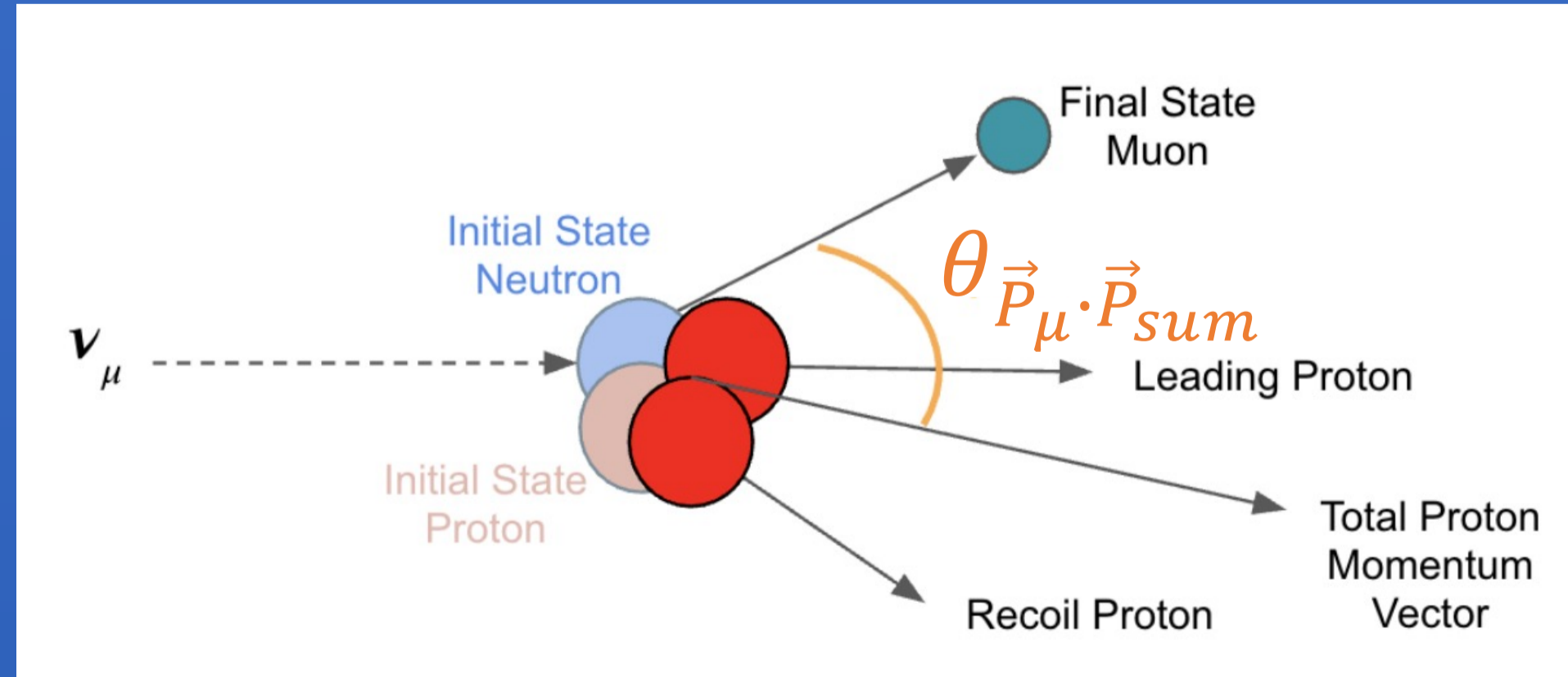
- Defined using momentum transfer vector and particle kinematics



B. Proton opening angle ( $\theta_{\vec{P}_L \cdot \vec{P}_R}$ ):

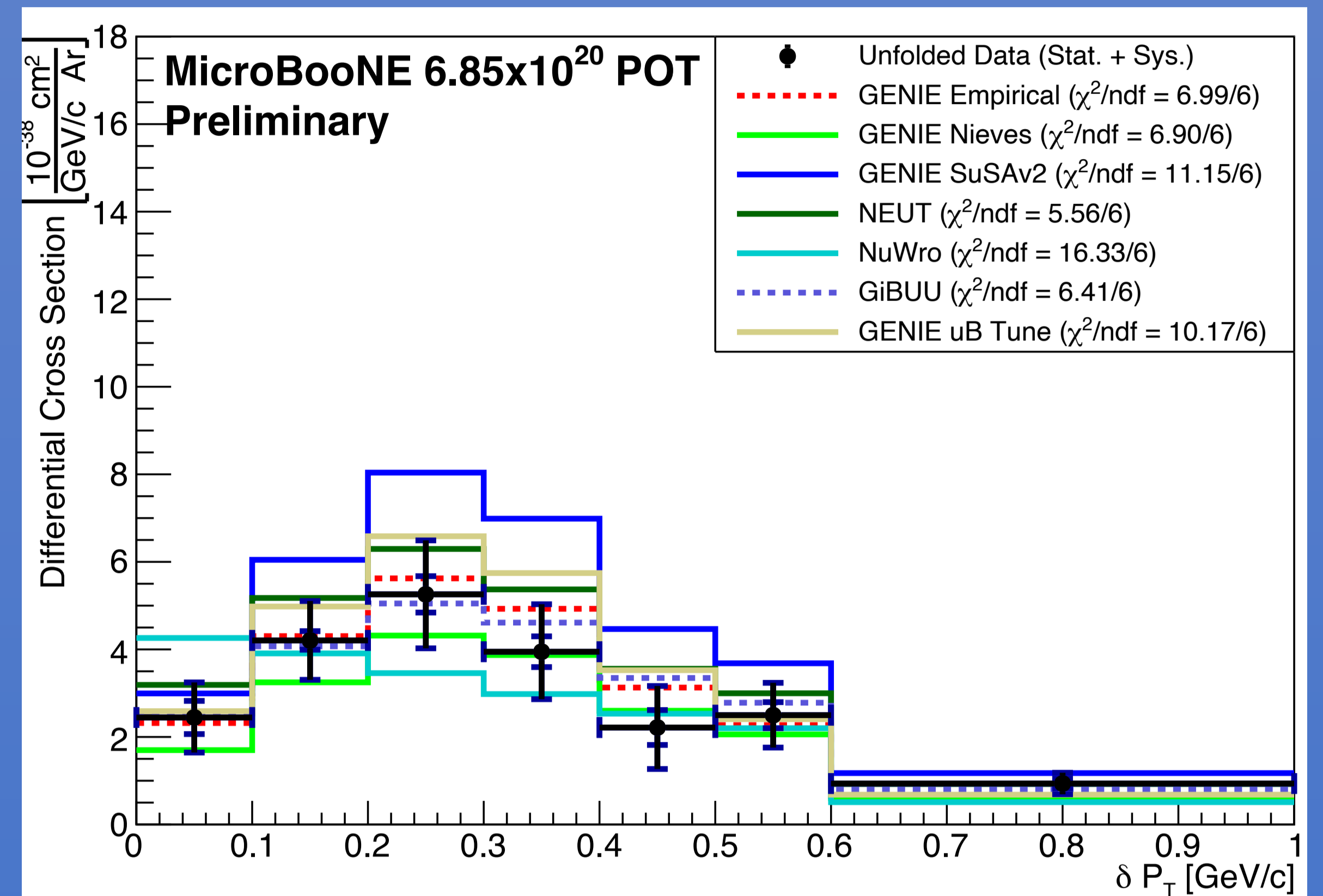


C. Opening angle between muon and proton sum ( $\theta_{\vec{P}_\mu \cdot \vec{P}_{sum}}$ ):

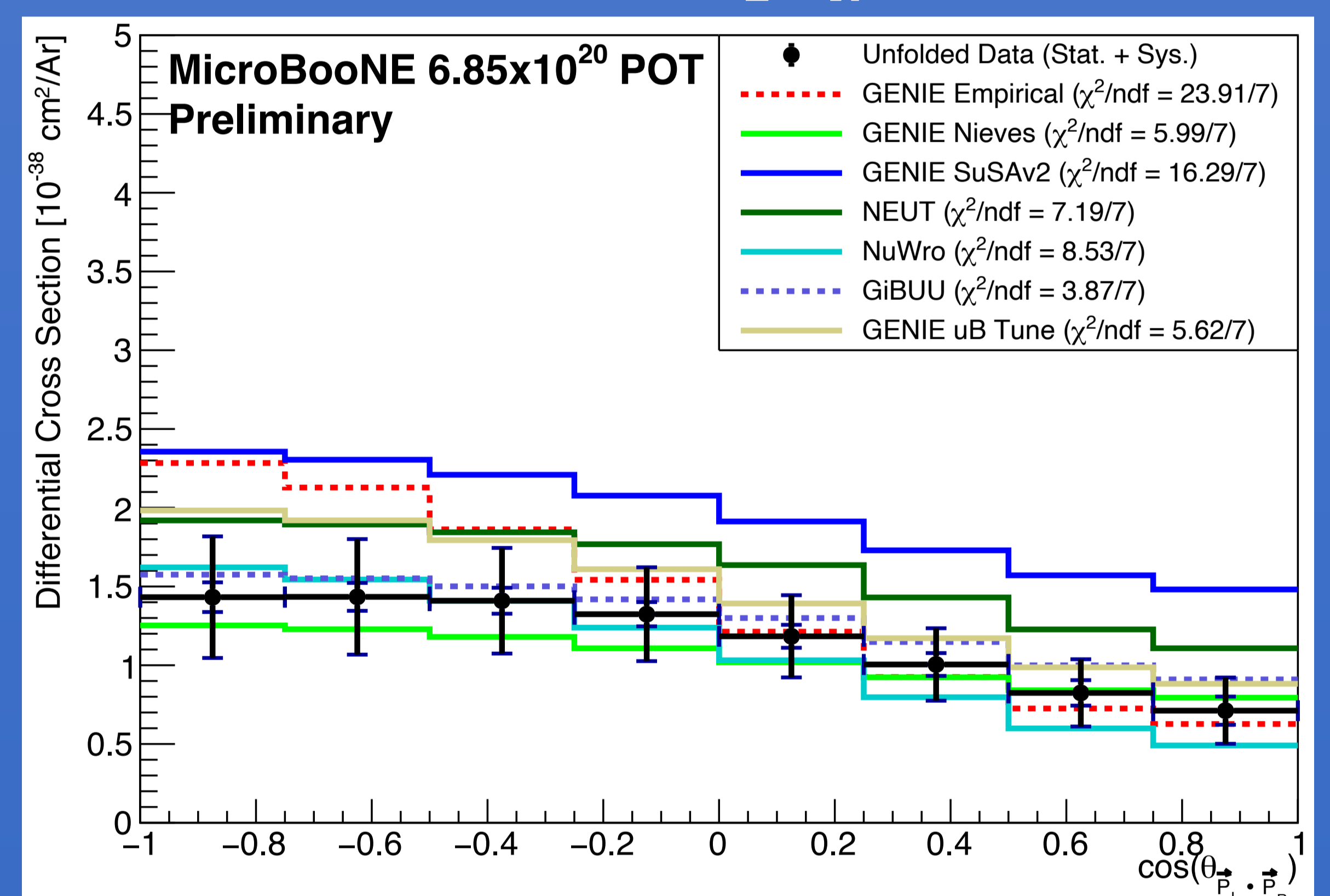


## 4. Measurement

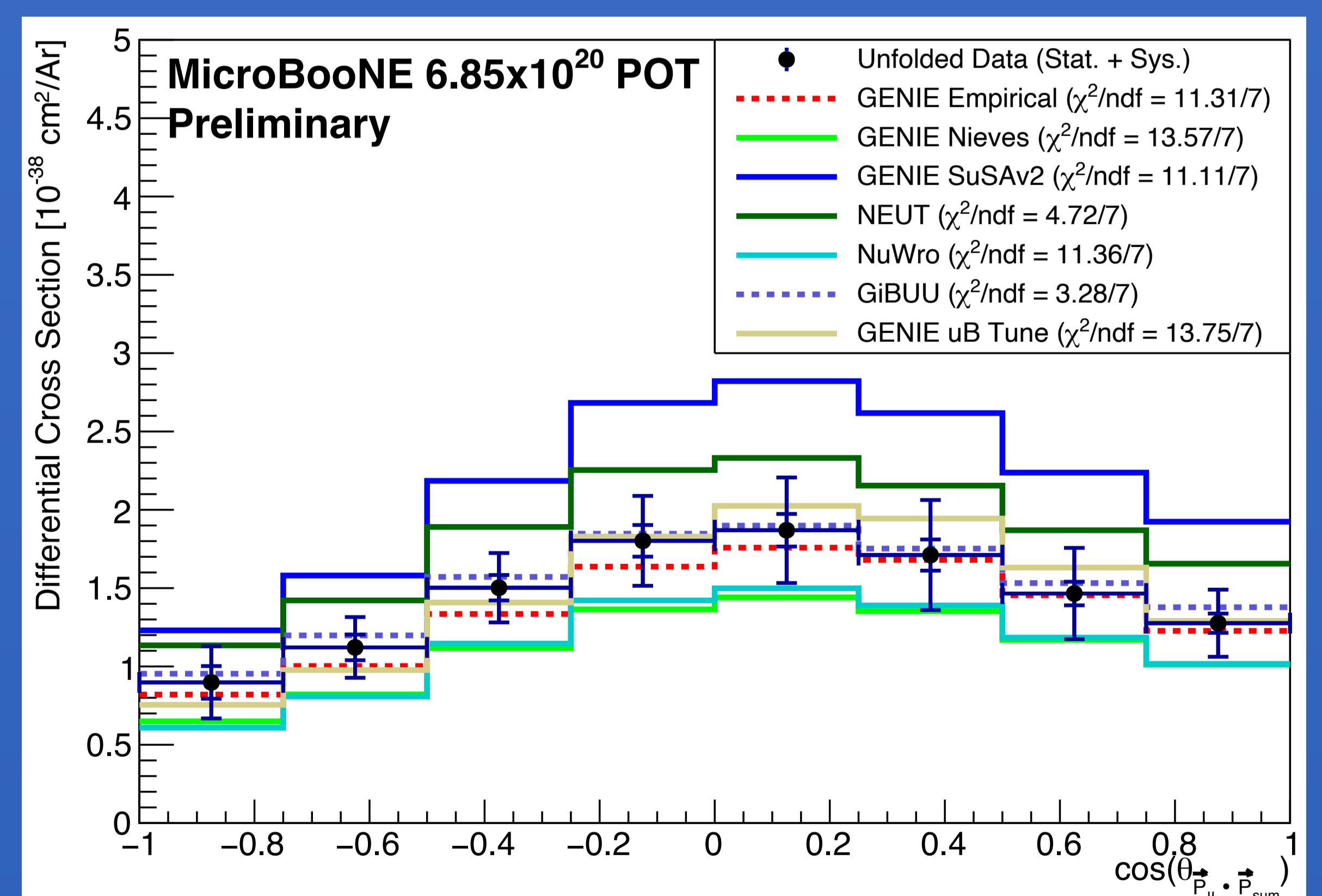
A. Transverse missing momentum ( $\delta P_T$ ):



B. Proton opening angle ( $\theta_{\vec{P}_L \cdot \vec{P}_R}$ ):



C. Opening angle between muon and proton sum ( $\theta_{\vec{P}_\mu \cdot \vec{P}_{sum}}$ ):



Results from [MicroBooNE Public Note: 1133](#)

Run 3493 Event 27435, October 23rd, 2015

