CC1π^+ Selection for 4π Geometry

Objectives, progress and problems

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Universitat Autònoma
de Barcelona

What are the objectives?

Objective: Development of ν_μ CC multiple π exclusive interactions selection for a 4π geometry.

Universitat Autònoma de Barcelona

Doctoral Thesis

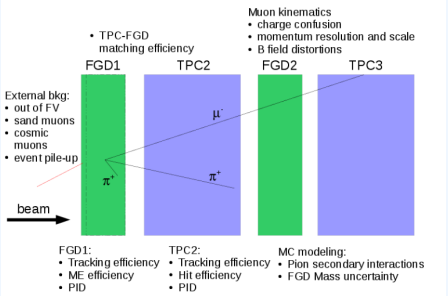
Measurement of the Muon Neutrino Charged Current Interactions and the Muon Neutrino Single Pion Cross Section on CH Using the T2K Near Detector

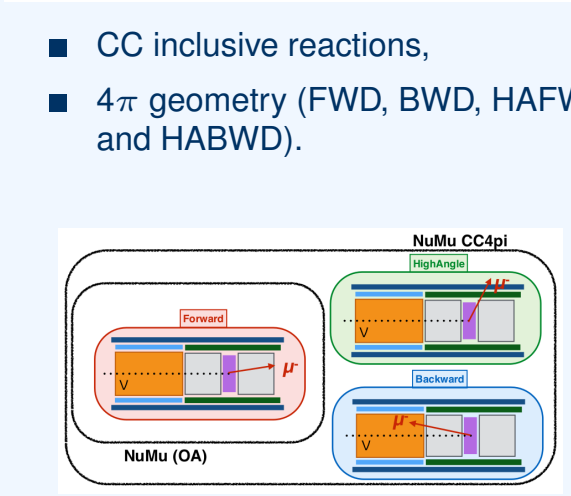
Author: Raquel Castillo Fernández

Supervisor: Dr. Federico Sánchez Nieto

Tutor: Dr. Enrique Fernández Sánchez

- CC multiπ exclusive reactions,
- forward direction.





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Study of the ν_μ interactions via charged current in the T2K near detector

Alfonso Andrés García Soto

Tesis presentada para optar al grado de DOCTOR EN FÍSICA

- CC inclusive reactions,
- 4π geometry (FWD, BWD, HAFWD and HABWD).

Objective: Study of 4π CC1π interactions.

Studies

- The relationship between the pion and the muon parameters,
- The case in which the π are in the backward direction on the Δ system of reference,
- The Adler angle with high transfer momentum.

What are the objectives?

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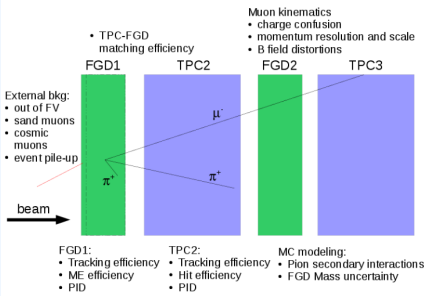

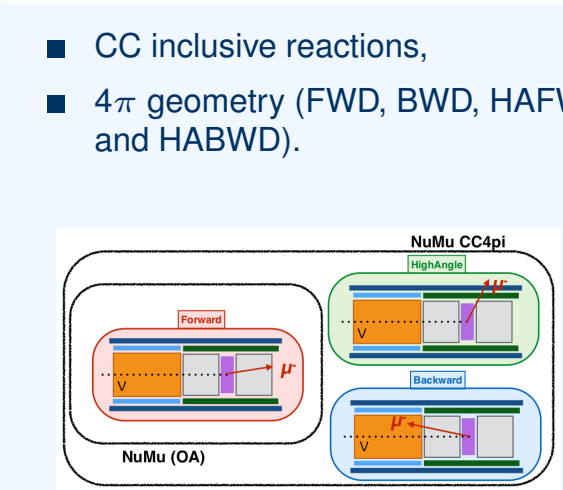

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SELECTION CRITERIA

numuCCMultiPi

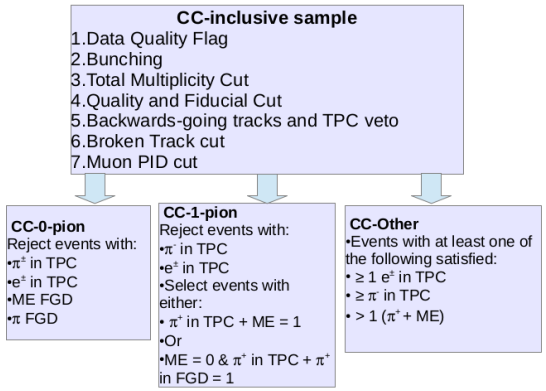


Figure 1: Selection flowchart. First a CC-inclusive sample is selected, then it is split into three different samples: CC-0-pion, CC-1-pion and CC-Other. The corresponding selection cuts are shown in each box.

numuCC4pi

- event quality,
- > 0 tracks,
- Sort TPC tracks,
- quality+fiducial,
- veto Action,
- muon PID Action,
- find vertex,
- fill summary,
- find_pions,
- **FWD and BWD:** the muon candidate -> long TPCs segments,
- **HAFWD and HABWD:** the muon candidate -> short or no TPC segment.

numuCC4piMultiPi

Using the two selection:

- Include the numuCCMultiPi selection in numuCC4pi,
- Include the **(FWD, BWD, HAFWD and HABWD)** for the pion candidate.

Software and samples

1. nd280Highland2 v2r27 (the TOF inverter isn't working)
2. Production 6B

Run No.	files
run6b_mag_neut.root run6b_data.root	air(2,3 and 4) + water (2 and 4) from 00004000 to 00009999

Table 1: File used for test.

Results obtained so far

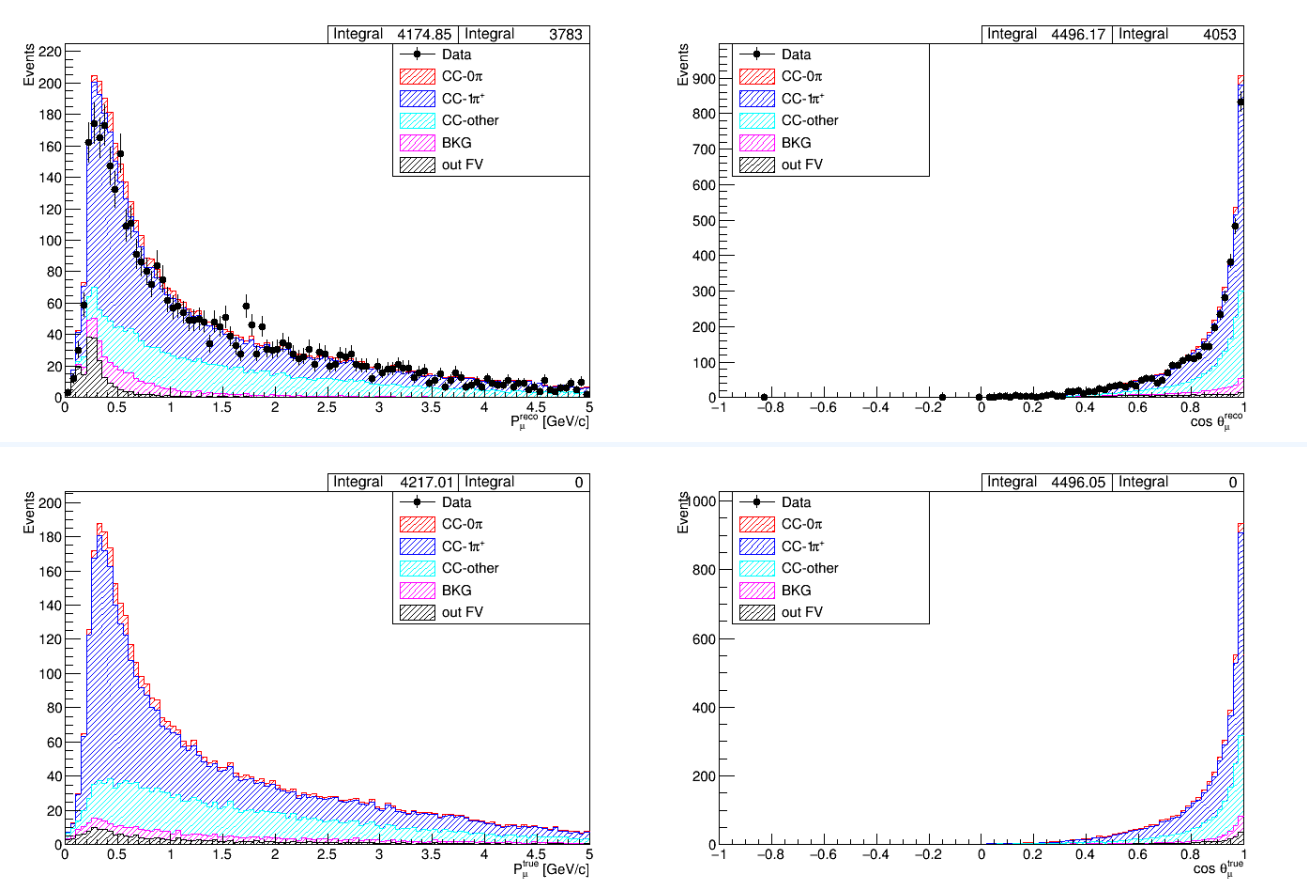


Figure 1: Distribution of the reconstructed muon momentum (top left), reconstructed cosine of muon angle (top right), true muon momentum (bottom left) and true cosine of muon angle (bottom right).

Results obtained so far

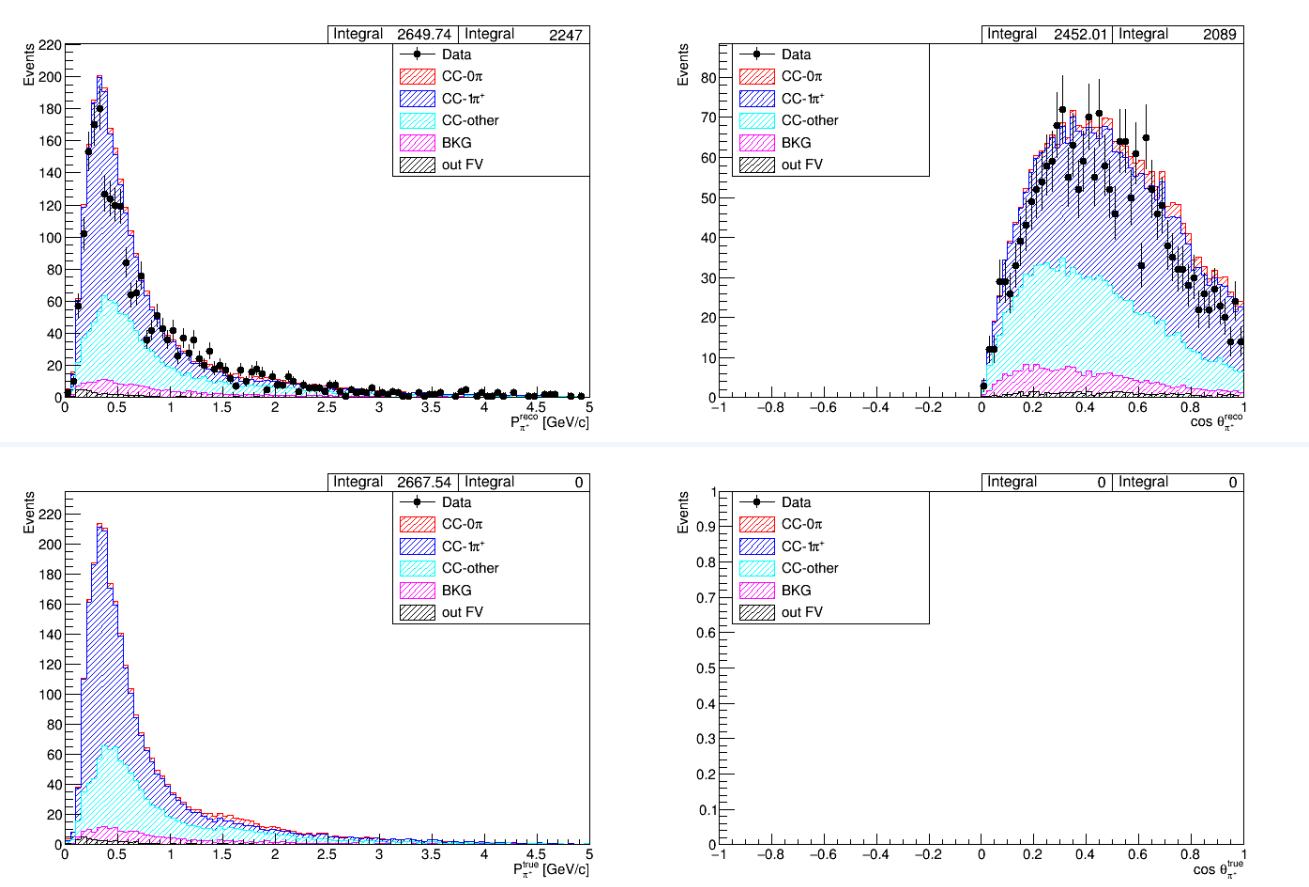


Figure 2: Distribution of the reconstructed pion momentum (top left), reconstructed cosine of pion angle (top right), true pion momentum (bottom left) and true cosine of pion angle (bottom right).

Results obtained so far

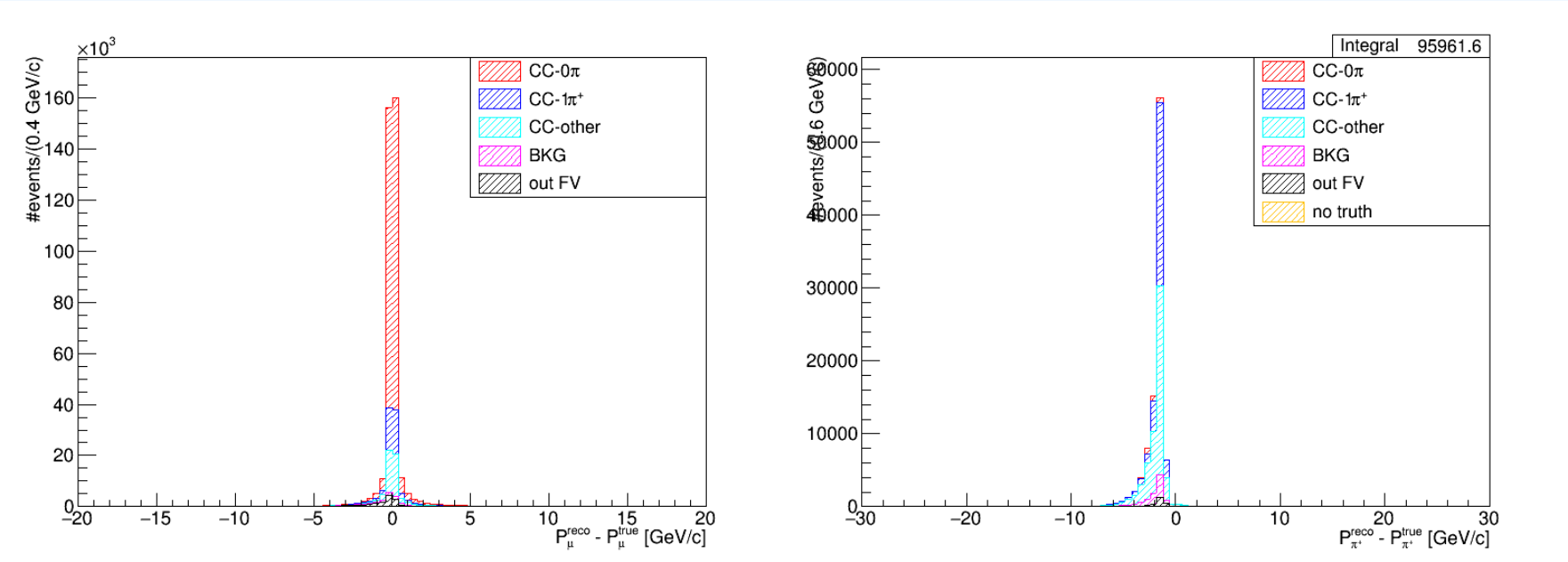


Figure 3: Reconstructed minus true momentum for muon (left) and pion (right).

Results obtained so far

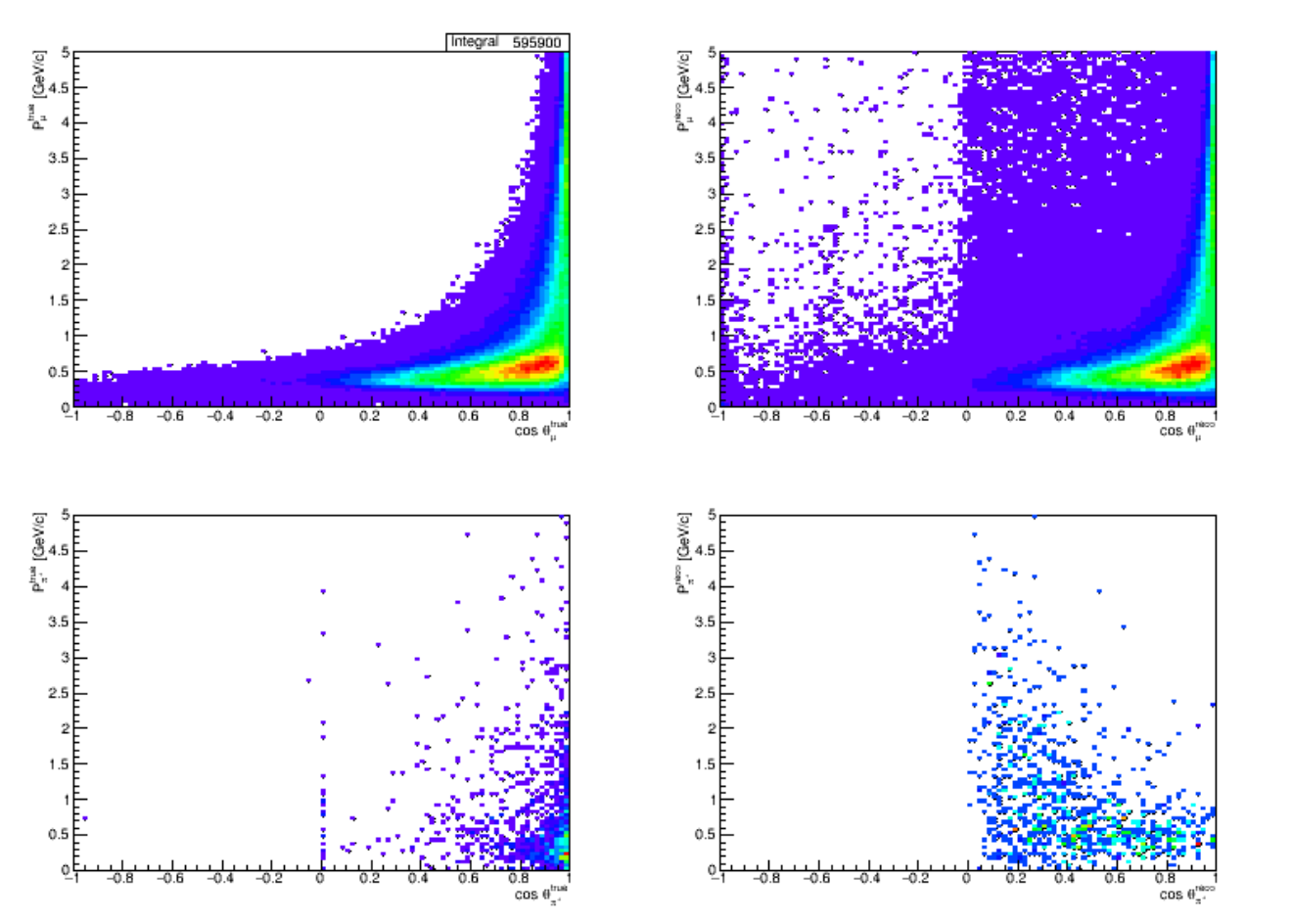


Figure 4: Distribution of ... (top left), ... (top right), ... (bottom left) and ... (bottom right).

Results obtained so far

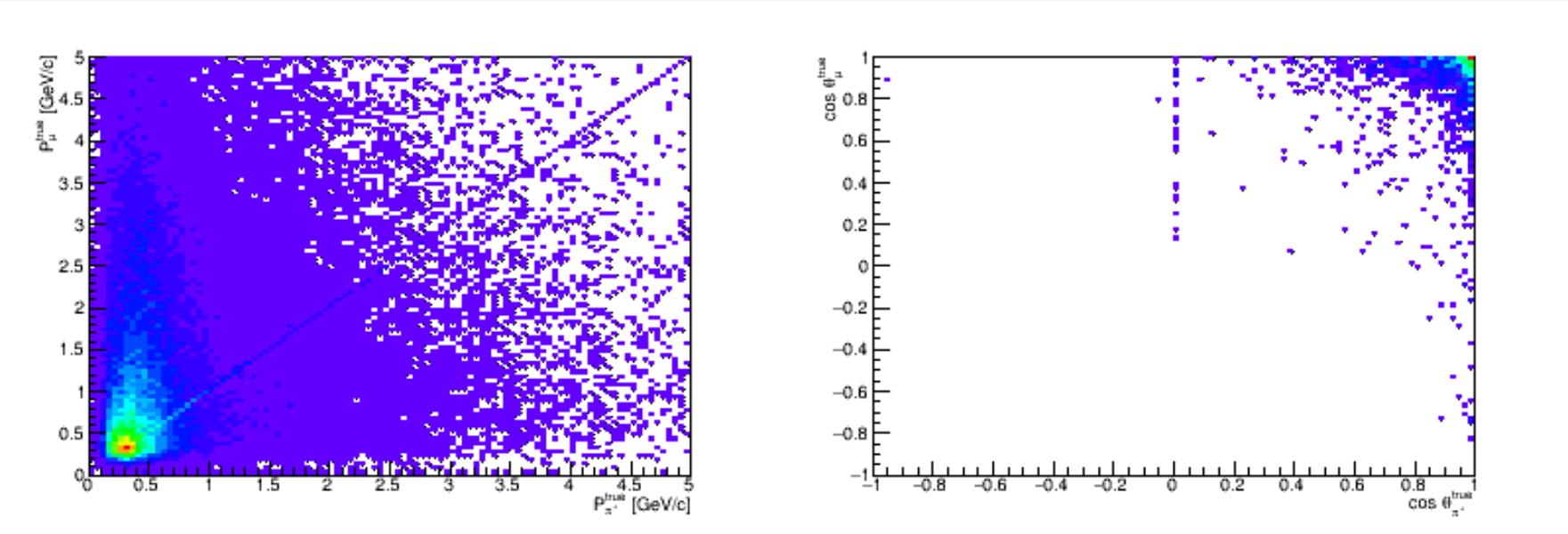


Figure 5: Relationship between muon and pion momentum (left) and muon and pion cosine of the angle (right).

Purity and efficiency

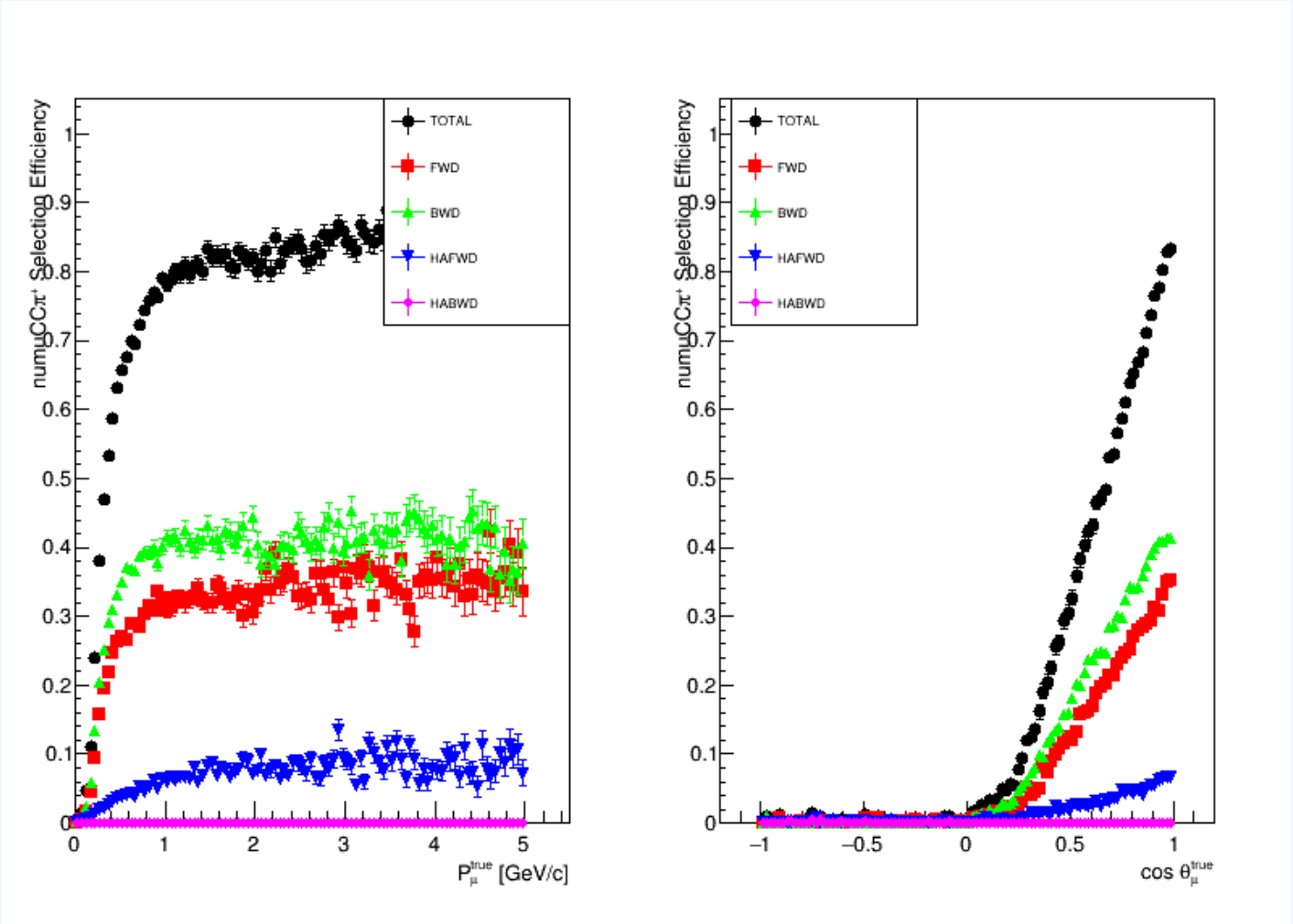


Figure 6: True muon momentum (left) and cosine of the emission muon angle (right) efficiency for $\nu_\mu CC1\pi+$ with its vertex in FGD1 FV. Colors indicate contribution from different directions: forward (red), backward (green), high angle forward (blue), high angle backward (pink) and total (black).

Purity and efficiency

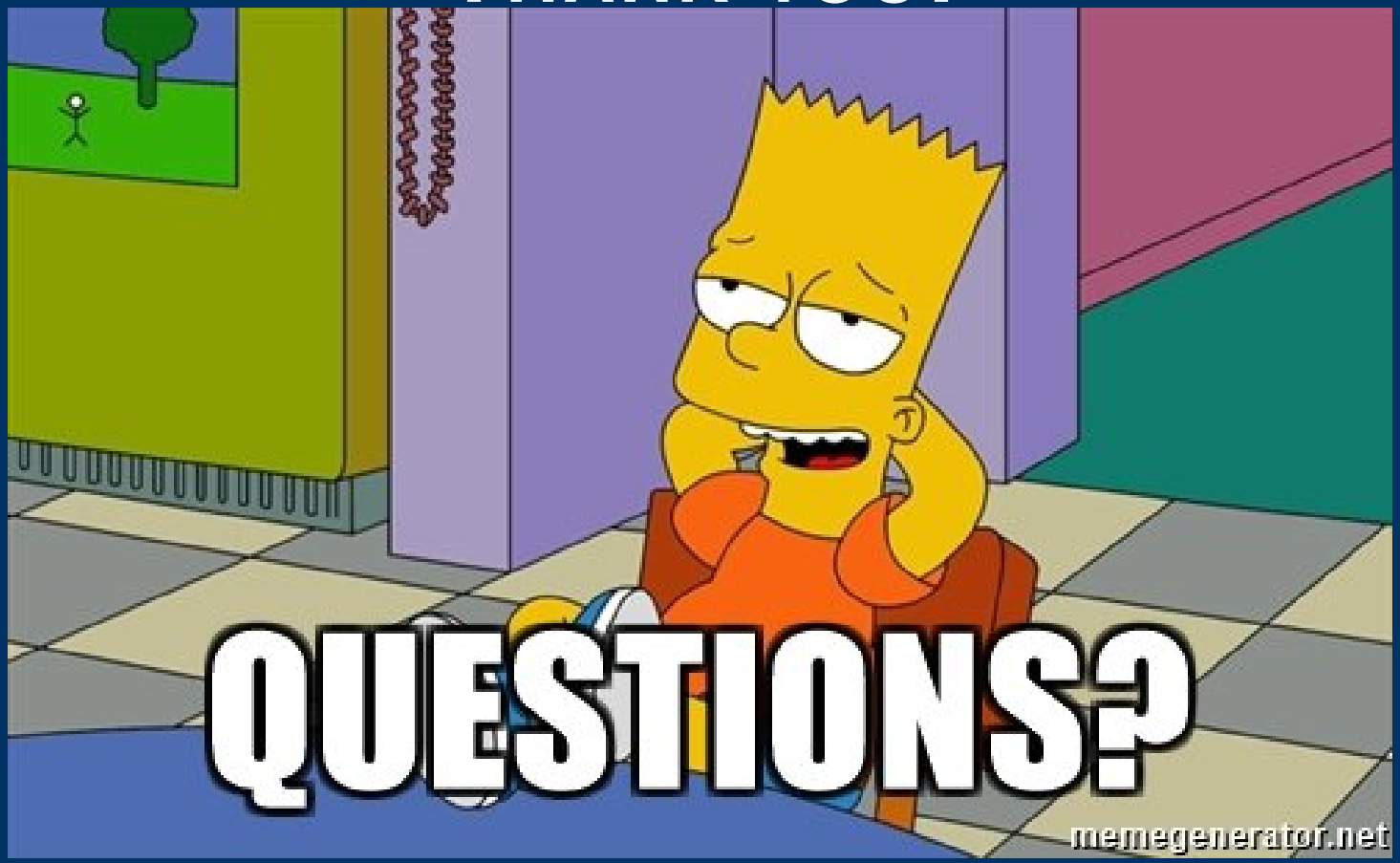
Reaction	CC-0π	CC-1π^+	CC-Other
CCQE	80.555804	0.96669139	0.87819256
2p2h	12.778574	0.15125105	0.15862126
RES	6.2993036	79.455851	28.342972
DIS	0.36631802	7.747303	70.620215
COH	0	11.678904	0
NC	0	0	0
CC$-\bar{\nu}_\mu$	0	0	0
CC$-\nu_e$, $CC-\bar{\nu}_e$	0	0	0
other	0	0	0
out FV	0	0	0
no truth	0	0	0
sand μ	0	0	0

Table 2: Purity (in %) of the reaction for different topologies

Summary

1.
2.
3.
4.

Thank you!



and Suggestions.