CCQE IN THE POD

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March 20, 2009
charged-current – quasi-elastic interactions

W-boson exchange between the incident neutrino and a quark in the nucleon

Flavor of outgoing lepton “tags” neutrino flavor

Dominant process (38% of interactions)
P0D Events

CCQE events

NC $1\pi^0$ event

275 MeV/c $\mu$
690 MeV/c $p$

480 MeV/c $\mu$
696 MeV/c $p$

473 MeV/c $\pi^0$
accompanied by $n$
Backgrounds

CC $1\pi^\pm$
- dominant in terms of size of contribution
- use event topology to reduce
- ah, but in case where pion absorbed into nucleus topology doesn’t help – this will require clever use of kinematics
- worse case, since the final state contains these events we can account for them with branching ratio (theory uncertainty introduced)

CC $1\pi^0$
- use event topology to reduce, caveat as above

NC $1\pi$
- small contribution – need to study kinematics and topology

CC multi - $\pi$
- small contribution but need to be addressed

Variety of small contributors
Using neut MC files (thanks Trung)

- 40 GeV protons incident on graphite target
- Water target placed at 280 m 2.5 degrees off-axis?

h2o.neut4.5.1.flux04b_40GeV_2.5deg.nd5.004.nfsi.nt

Quick sanity check: fraction of CCQE events in sample (Mode=1)
I expect 38% - I get 35% in each of 2 50k samples

From CDR (neut)

Files I am using (neut)
selected CCQE (Mode=1)
CCQE Events

\[ p_\mu \]
\[ P_{prot} \]
\[ \theta_\mu \]

CC1\(^\pi\) Events

\[ p_\mu \]
\[ P_{prot} \]
\[ \theta_\mu \]
CCQE Events

CC$1\pi$ Events ($\pi$ absorbed)
Correlations with $\nu$ Energy

- $p_\mu$ vs $p_\nu$
- $p_{prot}$ vs $p_\nu$
- CC QE
- CC 1π (absorbed)
Next Steps

• Look at reconstructed MC
  • Generation with latest ND280 version here
  • Get my hands on samples generated elsewhere

• Study reco’d kinematics and topologies
• Look at $Q^2$, $E/p$, etc…

• Account for detector efficiencies

• Much later – things like energy scale…

• Like to have an update in about a month

To Do ASAP

• Grid access for CSU
  • Access to MDC0 and flux files