# NC-Elastic Events in the 2x2

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# NC Elastic Events

Why NC Elastic?

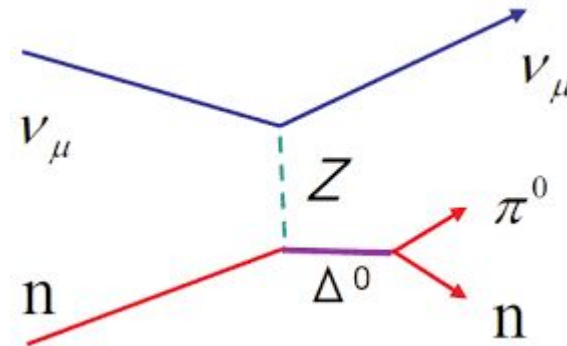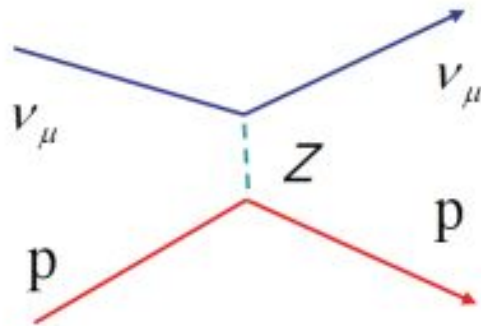    Clear signal- proton knocked out

    Lower energy- proton likely to stop making it a good candidate for dE/dx PID

    Interesting Physics- Strange Axial FF

Background:

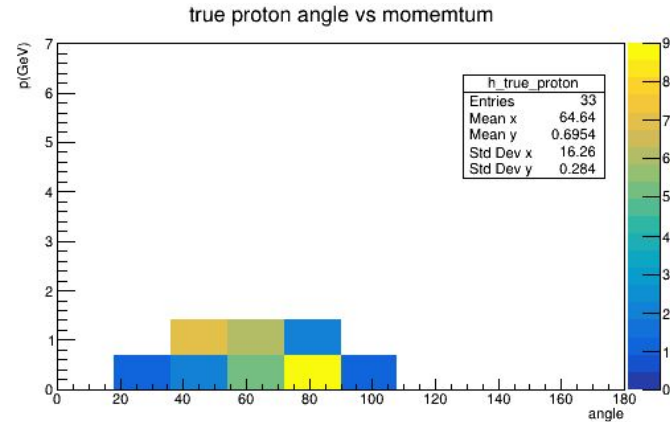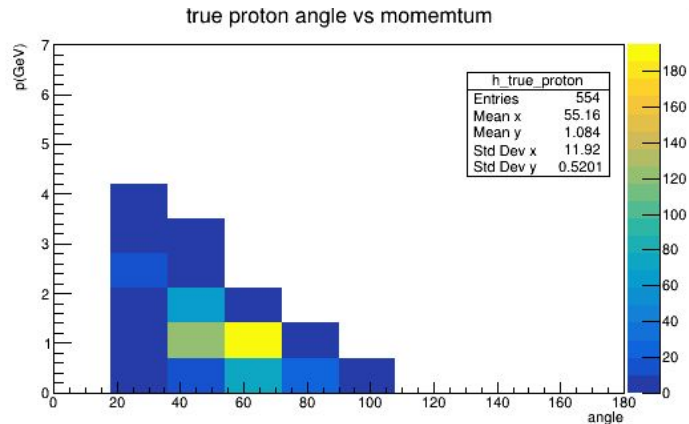    NC pi0 prod with no shower

    Neutron scattering off proton- neutrons hard to detect, but also proposed

# Truth Level

Event Cuts

      Inside FV, 8cm away from walls, truth cut on argon interaction

      1E19 POT, corresponds to about 3 days of data taking

      198058 spills, 554 nc-elastic interactions, 33 after cuts

      (44 at 6cm,

# Reco Events

814 reconstructed NC elastic events (Less confident on this number as of 11pm last night )
0 of them matched the truth
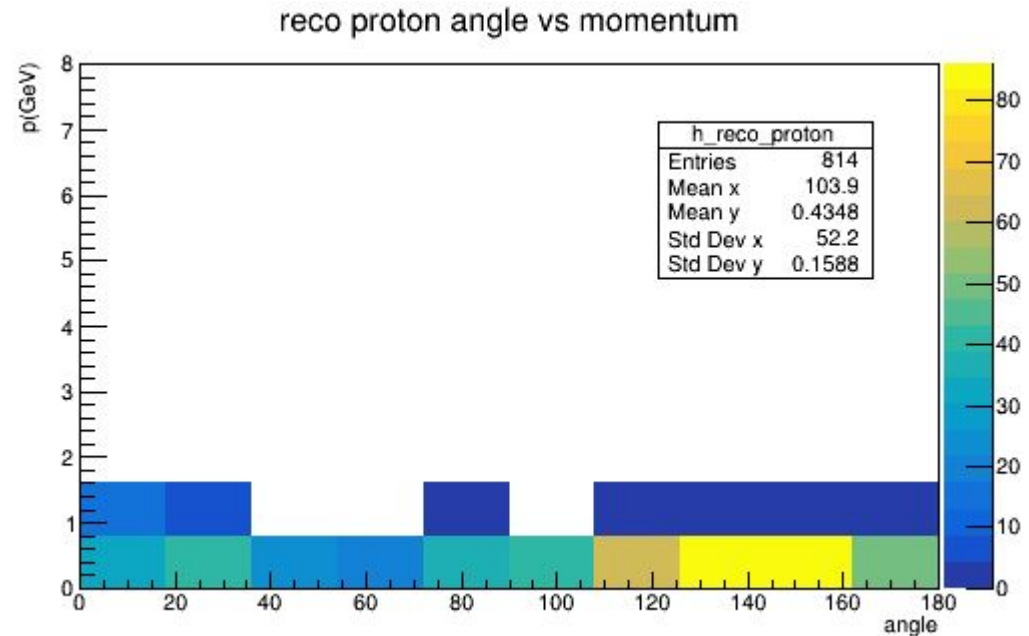
reco proton angle vs momentum

| h_reco_proton | |
|---|---|
| Entries | 814 |
| Mean x | 103.9 |
| Mean y | 0.4348 |
| Std Dev x | 52.2 |
| Std Dev y | 0.1588 |

# Truth Matching

So what are these reconstructed protons?



h_true_pdg

| h_true_pdg | |
| --- | --- |
| Entries | 814 |
| Mean | 374 |
| Std Dev | 832.3 |

Muons, photons, electrons

Protons

Pions

PDG Code
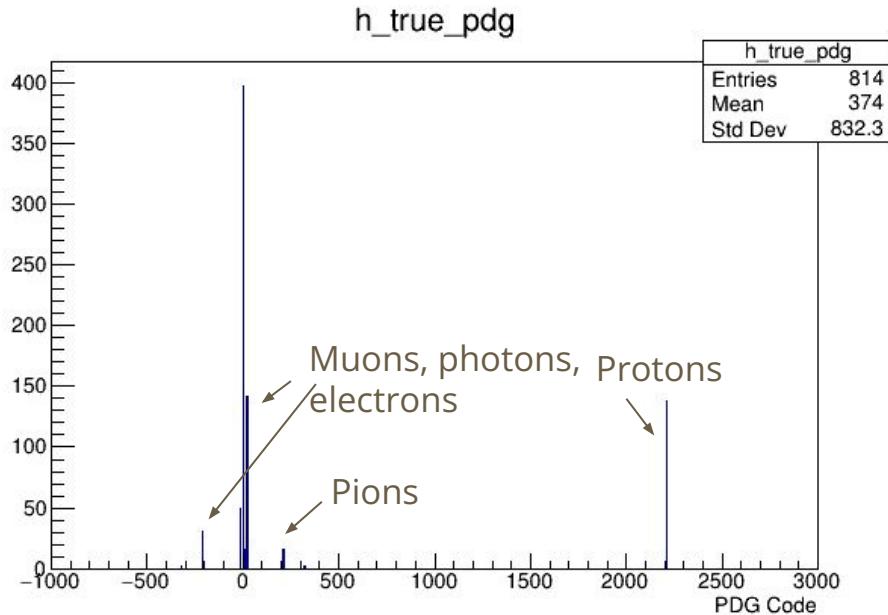
# Truth Matching

So what are these reconstructed protons?
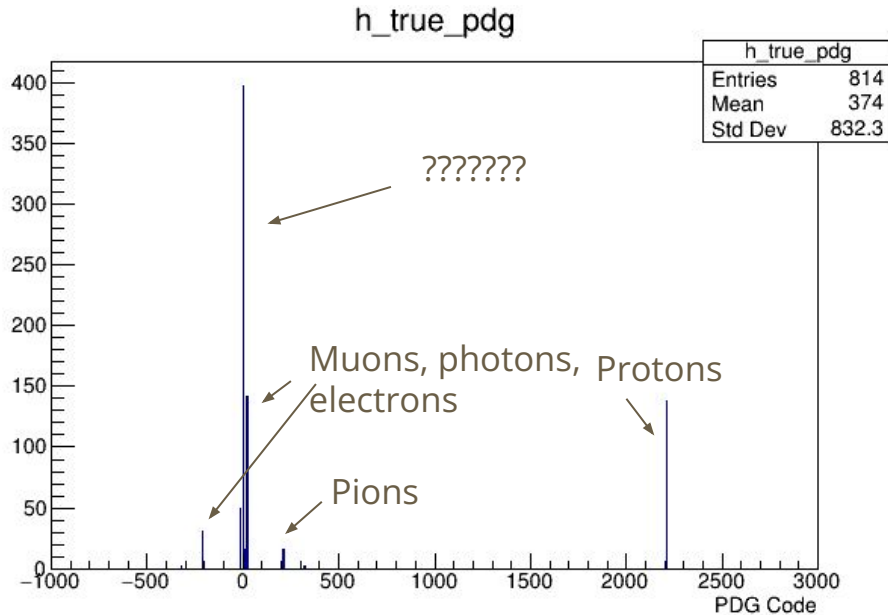


Who Knows?
No truth information

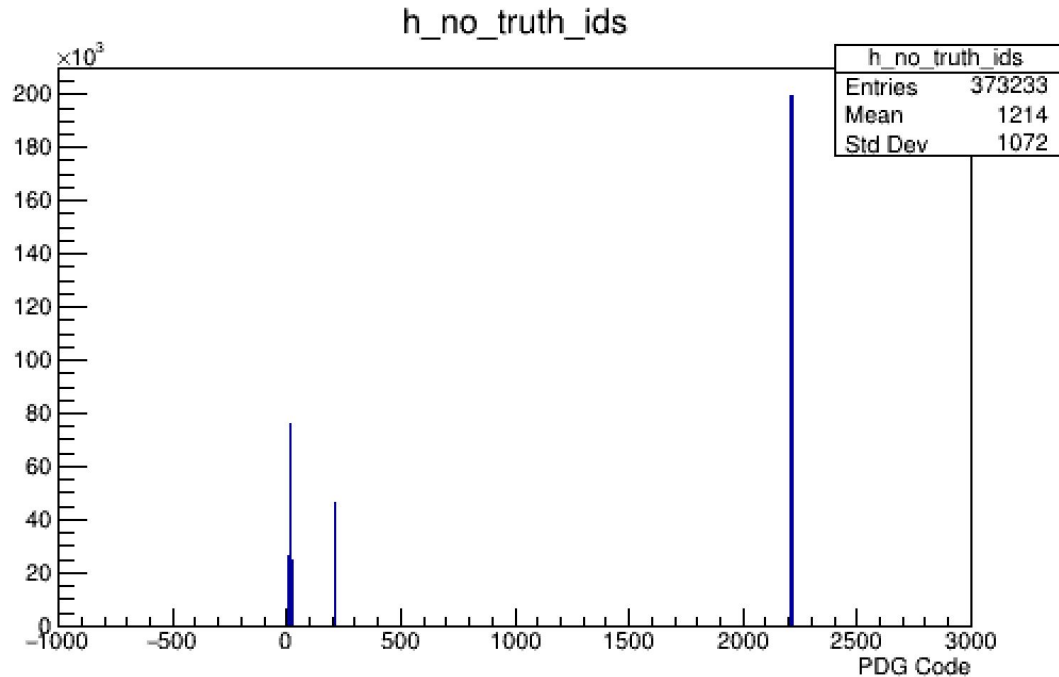Ones that are protons mostly coming from interactions with multiple protons or protons with other particles like pions, neutrons, ect.

Also photons

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# Truth Matching

So what are these reconstructed protons?



This problem very common for protons

Truth Info for a single spill: No NC Elastic

Can't match it to a truth event

Tagged as NC Elastic

Reco Info for same spill

```
TRUTH EVENTS*********************
new_truth_event 203000005 ------------------------
primary truth interactions [-13, 2212, 2112, 111, -211, 2212]
secondary truth interactions [22, 22]
new_truth_event 1000000202025989 ------------------------
primary truth interactions [13, -211, 2212, 2112, 211]
secondary truth interactions [11]
new_truth_event 202000099 ------------------------
primary truth interactions [13, 111, 2212, 211, -211, 2212, 2212, 2212, 2212, 21
12, 2112, 2112, 2112, 2112, 2112, -211, 111]
secondary truth interactions []
new_truth_event 203000003 ------------------------
primary truth interactions [-13, 2112, 211, -211]
secondary truth interactions [-11]
RECO EVENTS*****************************
new reco event 0 ---------------------
secondary
truth_matched event id 203000005
primary reco interaction []
secondary reco interaction [11]
new reco event 1 ---------------------
primary
no truth info
primary reco interaction [2212]
secondary reco interaction []
new reco event 2 ---------------------
primary
no truth info
primary reco interaction [13]
secondary reco interaction []
new reco event 3 ---------------------
primary
truth_matched event id 203000005
primary
no truth info
primary reco interaction [22, 2212]
secondary reco interaction []
new reco event 4 ---------------------
secondary
truth_matched event id 203000005
primary
truth_matched event id 203000005
```

Truth Info for a single spill: No NC Elastic

```
TRUTH EVENTS**********************
new_truth_event 203000005 -----------------------
primary truth interactions [-13, 2212, 2112, 111, -211, 2212]
secondary truth interactions [22, 22]
new_truth_event 1000000202025989 -----------------------
primary truth interactions [13, -211, 2212, 2112, 211]
secondary truth interactions [11]
new_truth_event 202000099 -----------------------
primary truth interactions [13, 111, 2212, 211, -211, 2212, 2212, 2212, 2212, 21
12, 2112, 2112, 2112, 2112, 2112, -211, 111]
secondary truth interactions []
new_truth_event 203000003 -----------------------
primary truth interactions [-13, 2112, 211, -211]
secondary truth interactions [-11]
RECO EVENTS******************************
new reco event 0 --
secon
```

Can't match it to a truth e...

Tagge... Elastic...

Have filed a bug report
More to come, hopefully

```
...ction []
...reco event 2 -----------------------
primary
no truth info
primary reco interaction [13]
secondary reco interaction []
new reco event 3 -----------------------
primary
truth_matched event id 203000005
primary
no truth info
primary reco interaction [22, 2212]
secondary reco interaction []
new reco event 4 -----------------------
secondary
truth_matched event id 203000005
primary
truth_matched event id 203000005
```

Reco Info for same spill

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