LPNHE neutrino group meeting

Physics Studies for ND280 Upgrade, t0 calculation

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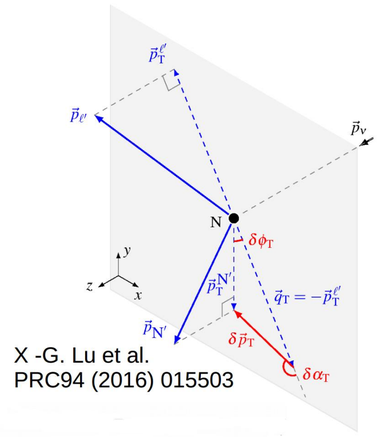
Introduction

Input

- 2D histograms of Single Transverse Variables
  $\delta_{\alpha T}$ and dpT or
  $\delta_{\alpha T}$ and nucleon fermi momentum (pn)

Fitter code



X -G. Lu et al.
PRC94 (2016) 015503

Output
Value and precision of

- 2p2h
- CCQE
- pion FSI norm
- norm syst
- proton FSI
- Eb/25 (for easy plot since other parameter values are 1)

$\delta_{\alpha T}$ together with pn and δ_{pT} turn out to be suitable observables to have good precision for key parameters.

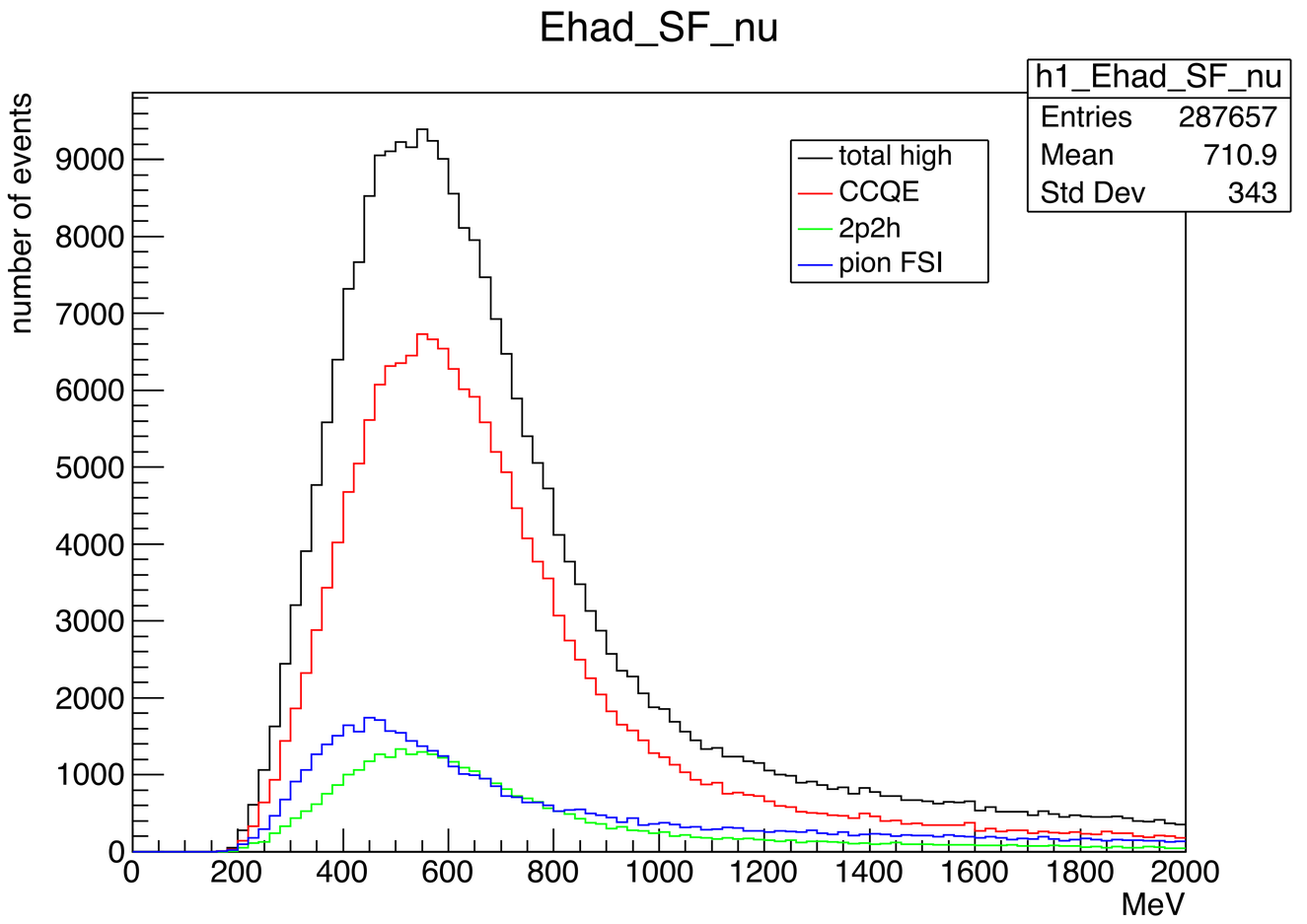
How about the other observables?

Ehad distribution for nu

Another kind of variable that we can use for the fitter is Ehad

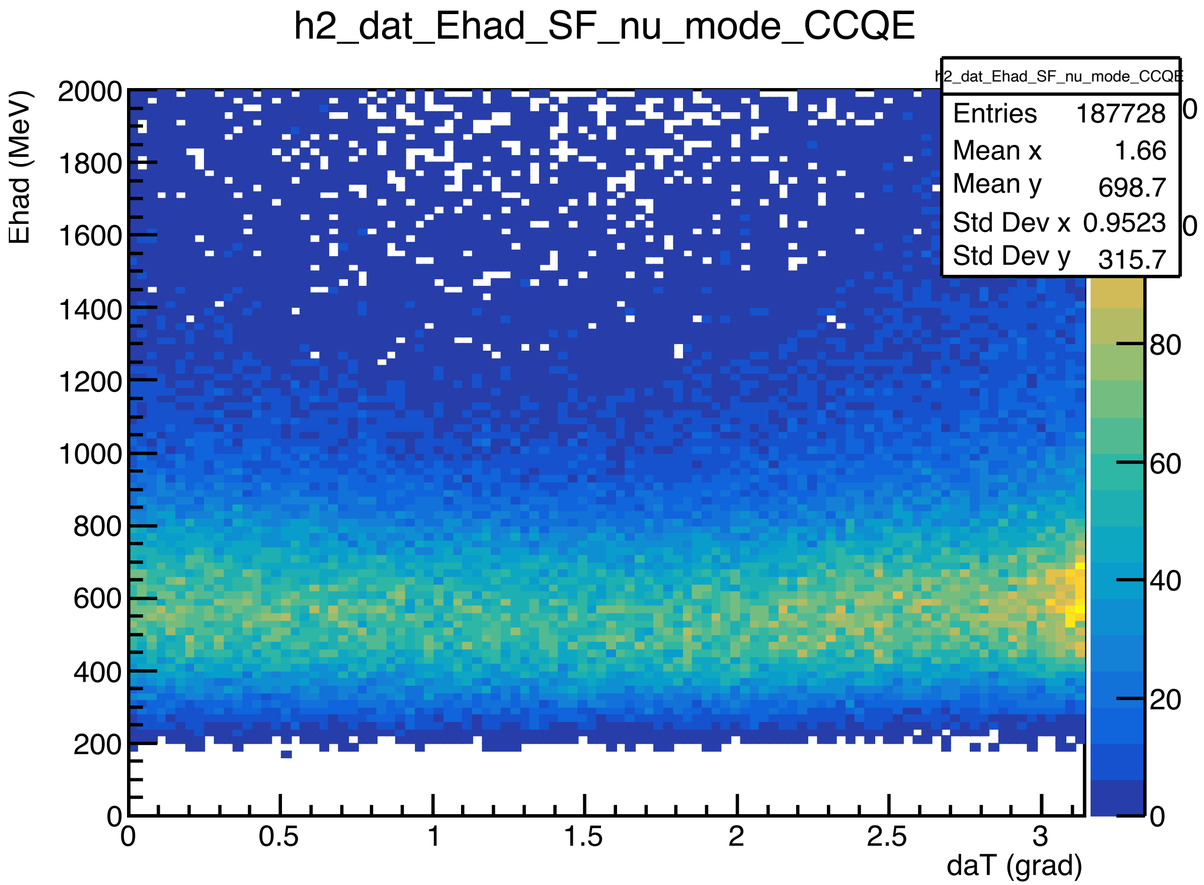
Ehad = E_muon + kinetic E of proton
kinetic E of neutron for anti-nu

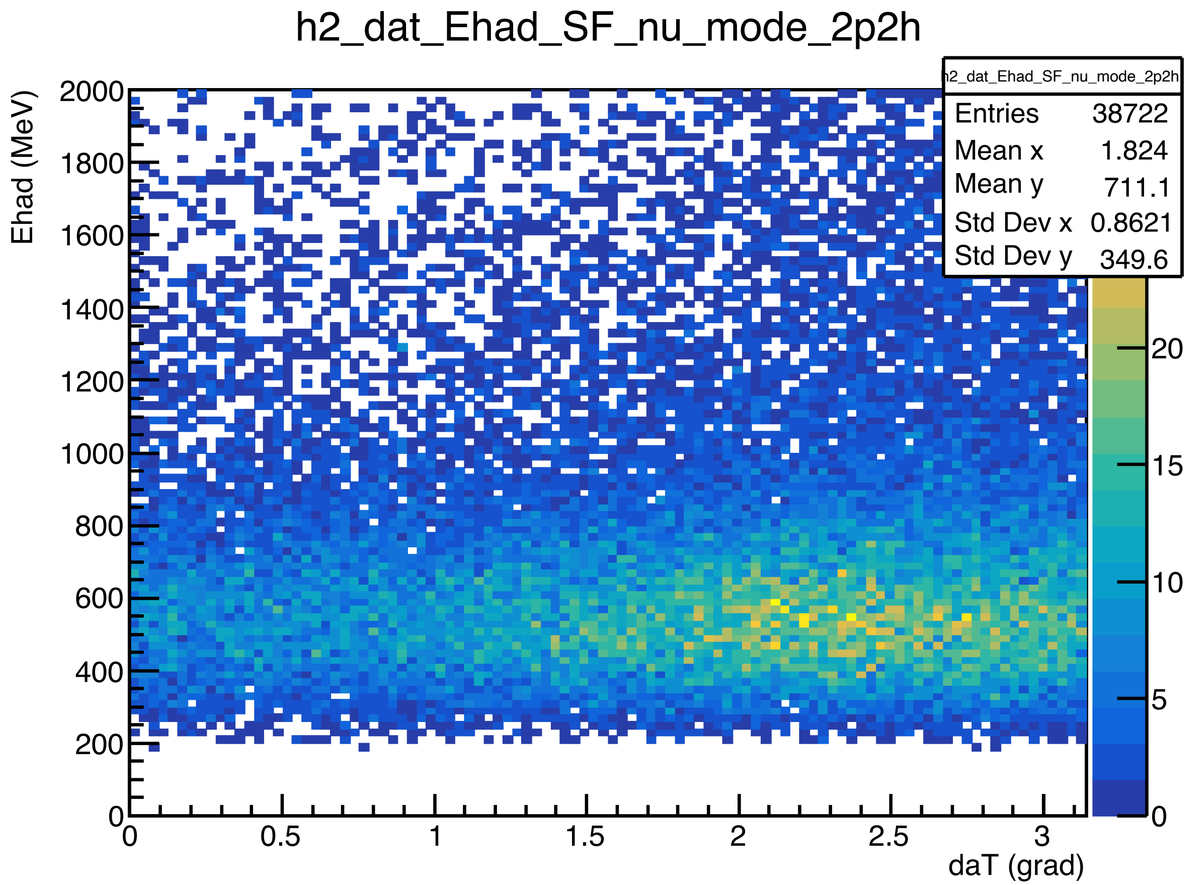
Peaks around 600MeV
which is neutrino energy



Anti-nu case in back up

$\delta_{\alpha T}$ and Ehad 2D distribution



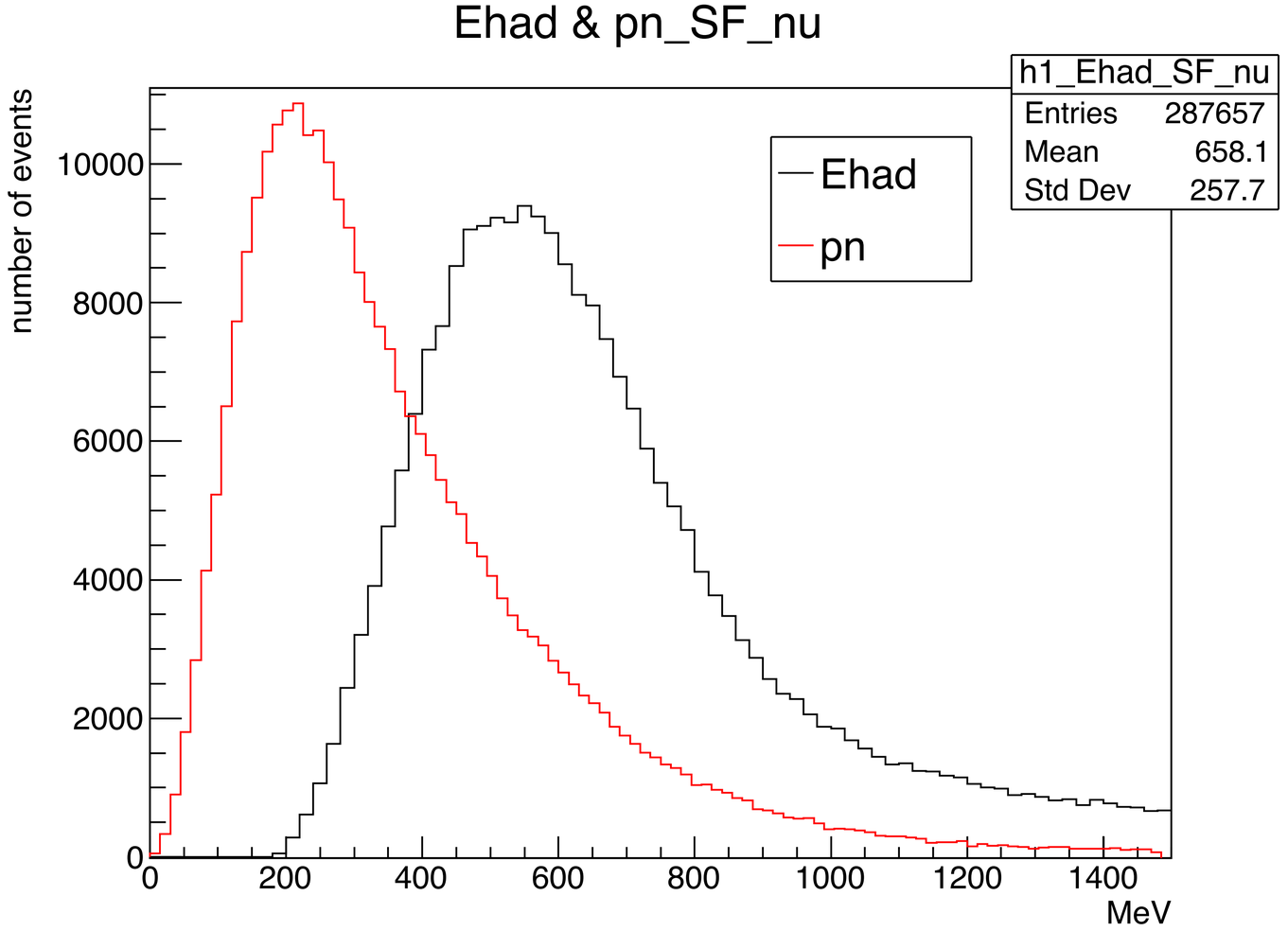


No point under 200MeV, the CCQE focus on 600 MeV while the 2p2h spreads in the area which is below 600MeV (agree with our expectation).

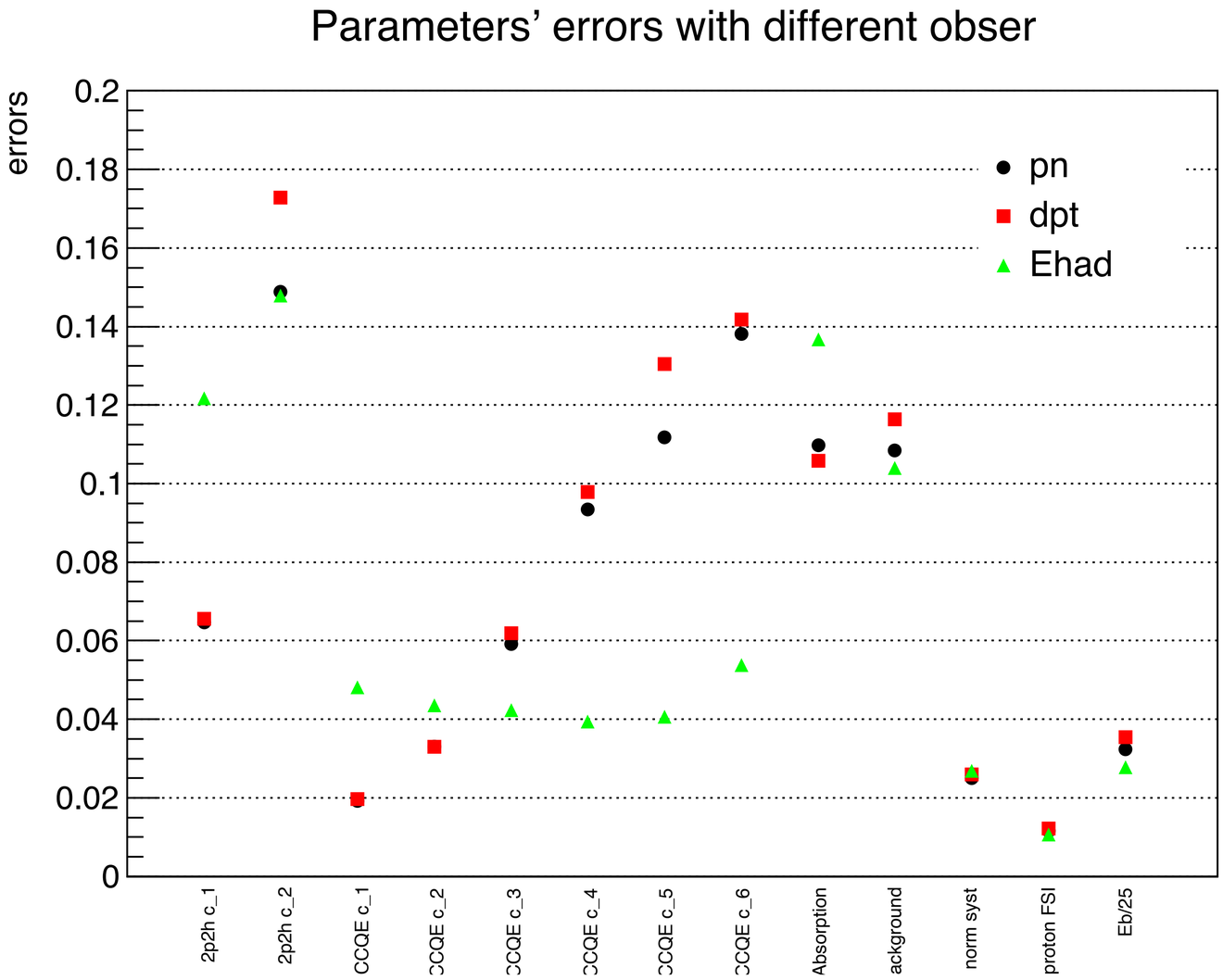
Ehad vs pn distribution for nu

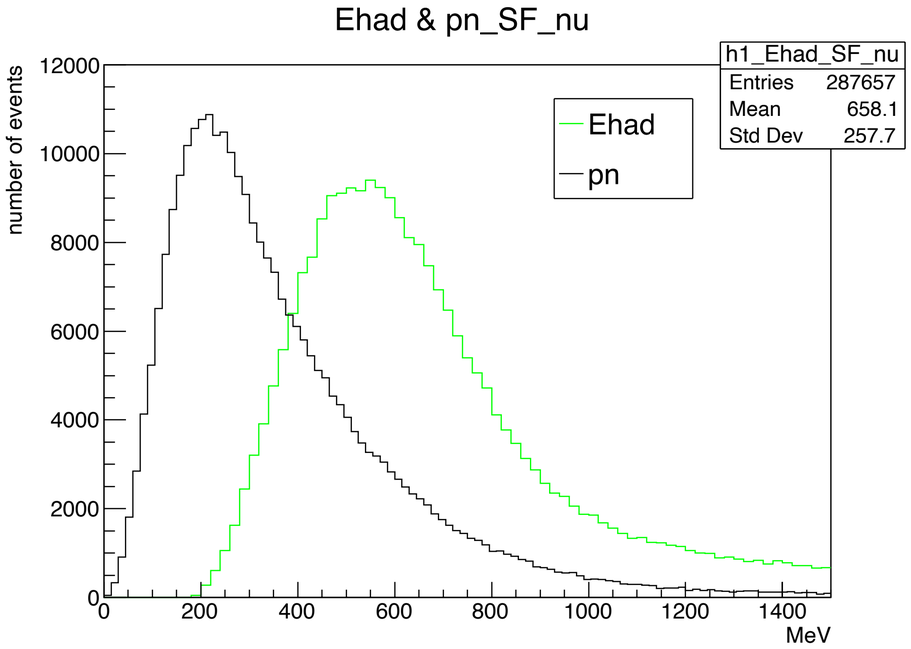
Due to the differences in Ehad and nucleon momentum (pn) distribution, we need to change the range of CCQE parameters.

Old		New	
CCQE_c1	0-100MeV	CCQE_c1	200-400MeV
CCQE_c2	100-200MeV	CCQE_c2	400-600MeV
CCQE_c3	200-300MeV	CCQE_c3	600-800MeV
CCQE_c4	300-500MeV	CCQE_c4	800-1000MeV
CCQE_c5	500-700MeV	CCQE_c5	1000-1200MeV
CCQE_c6	700-1000MeV	CCQE_c6	1200-1400MeV



Different observables

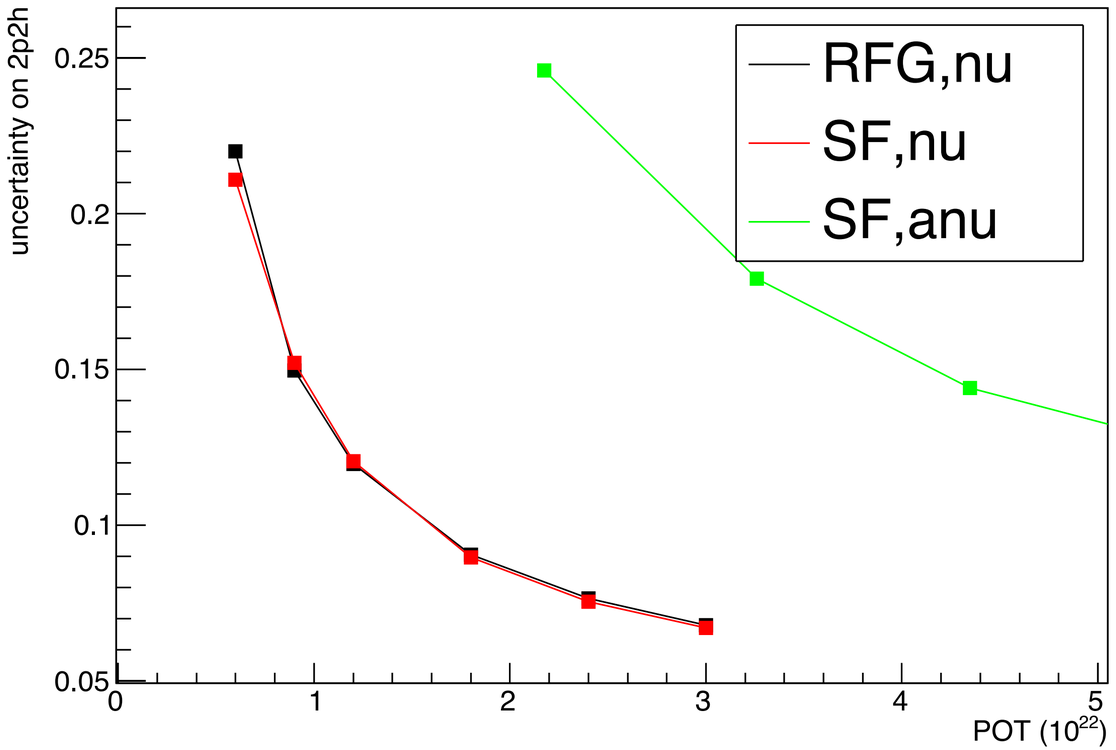


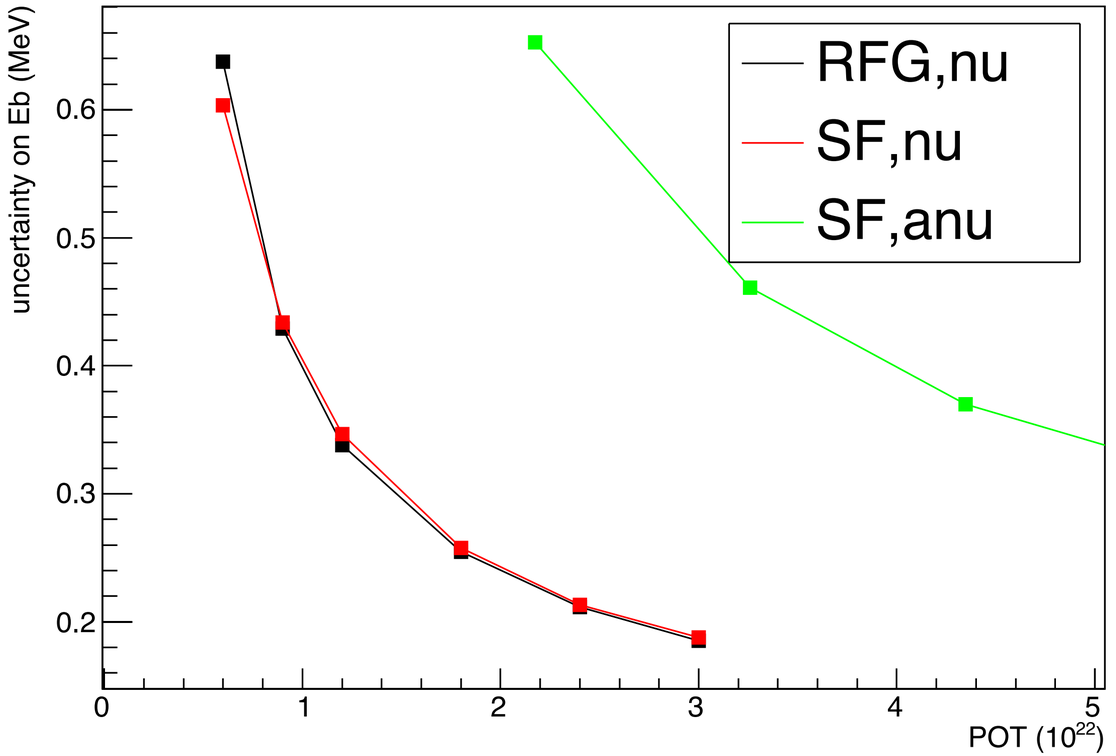


The CCQE parameters range: 200-1400MeV
CCQE errors with Ehad are stably good while it increases in pn and dpt case since we are moving to its tail

First 2p2h <800MeV
second 2p2h>800MeV
=>The first one is better since 2p2h bias our reconstructed Enu at low energy.

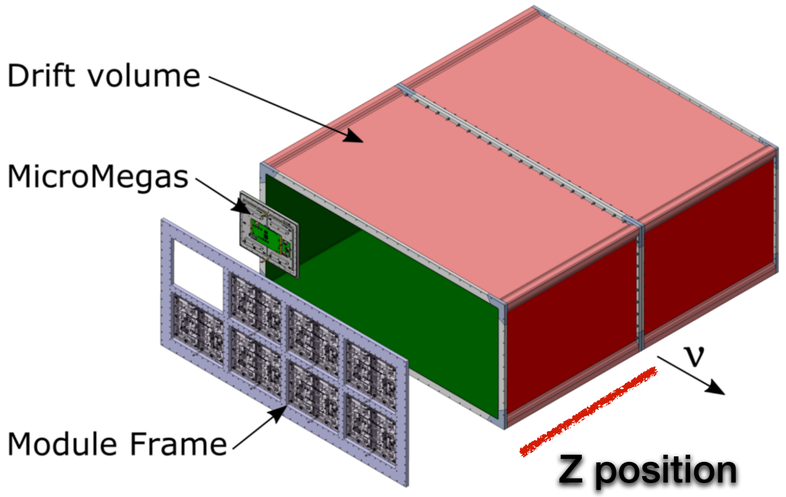
2p2h and Eb precision (Ehad as input) for more POT





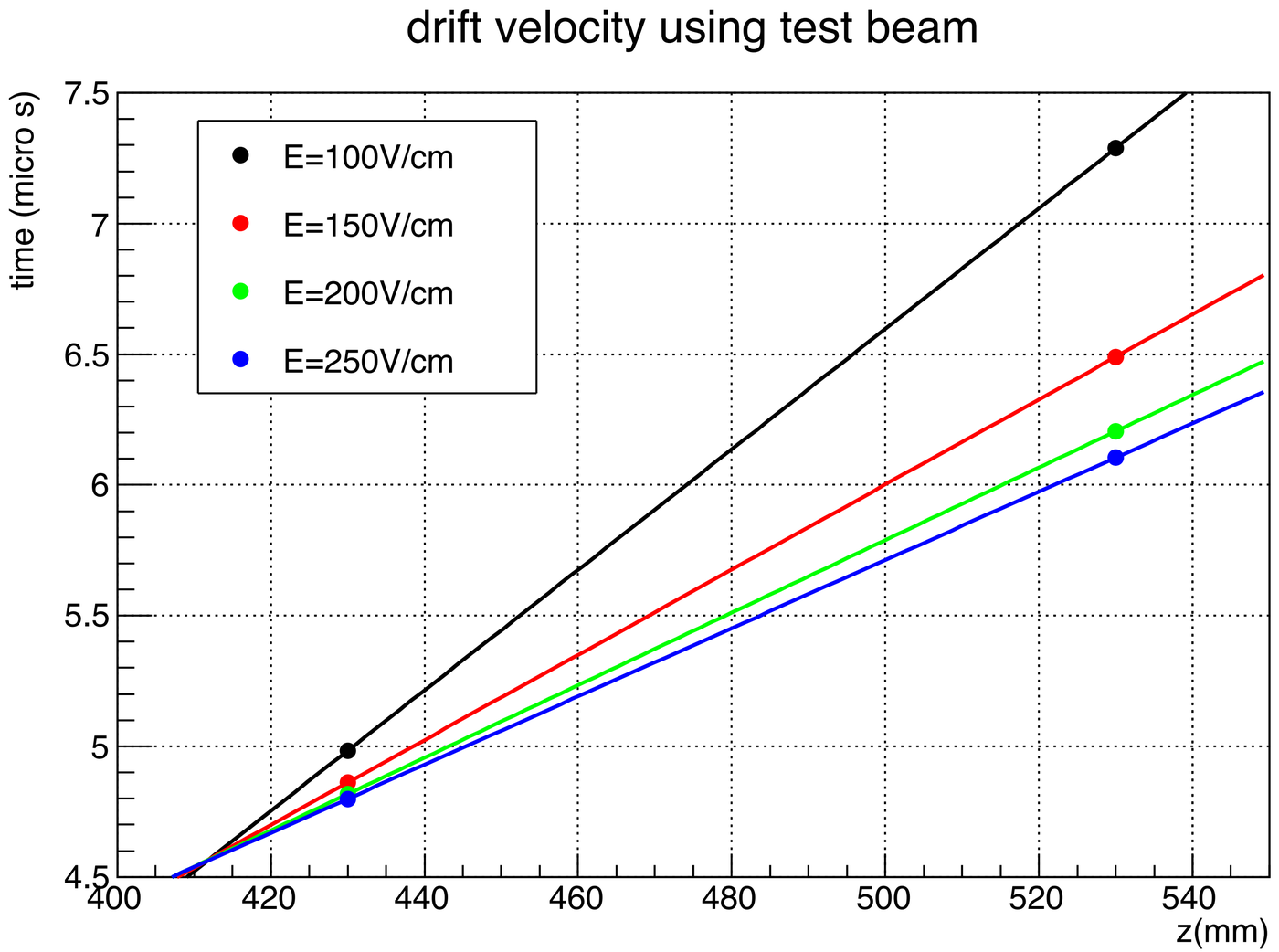
The input Ehad can be a good observable to have a good precision in both 2p2h and binding energy Eb

T0 calculation for resistive Micromegas of High Angle TPC



I calculated the average time of leading pads for all clusters (except for the first and last clusters due to its low charged-gain)

t0: from 4.55-4.57(micro second)

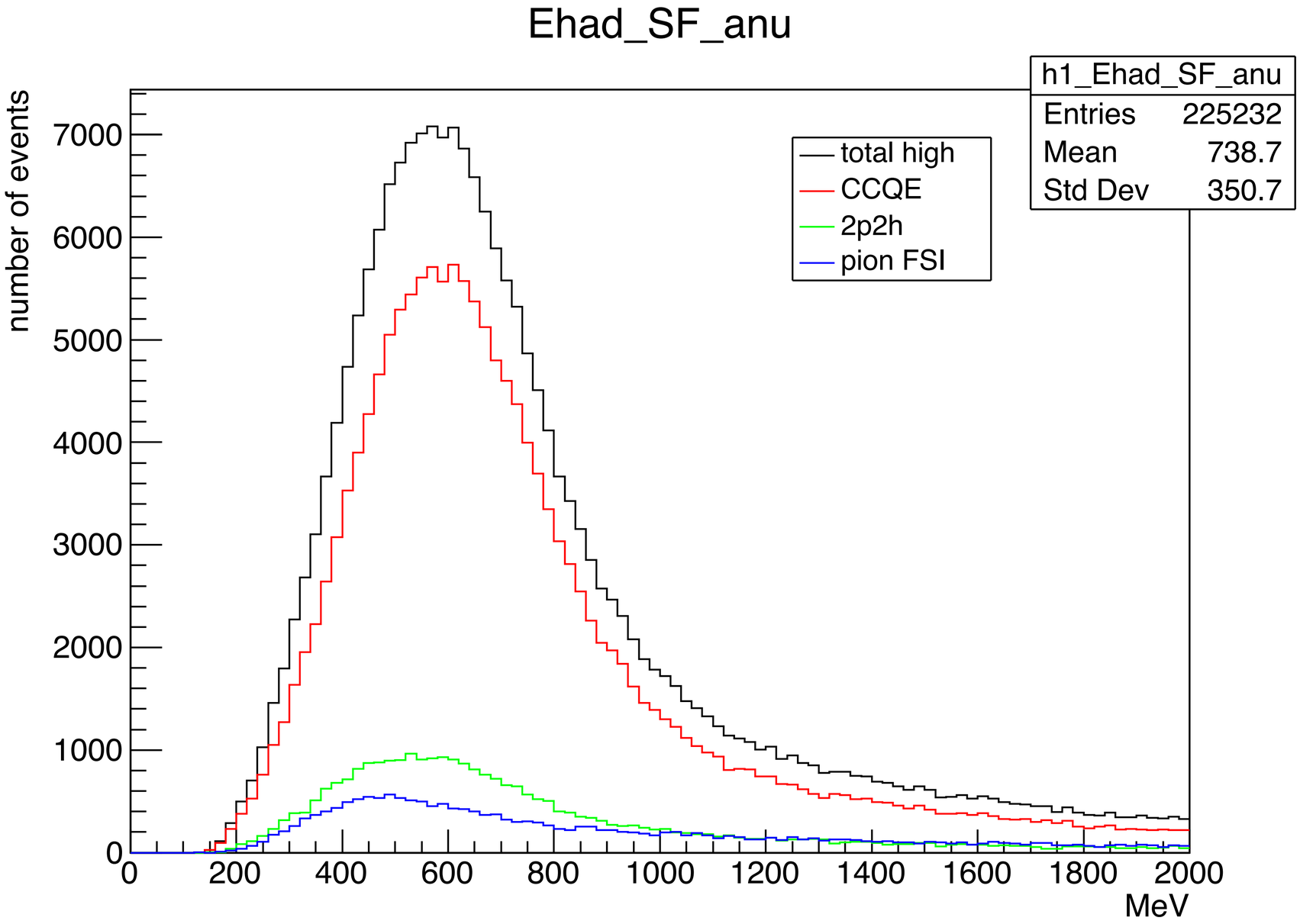


Summary

- We need to use the range of parameters flexibly with different observables.
- The Ehad turn out to be a promising observable to provide a good precision in 2p2h and Eb eventually.
- Next step:
  - adding flux covariance matrix to the fitter.
  - look at the correlation between parameters after fit.
  - Use Ehad and dpt for fitter input.
  - Compare Ehad and pn as input for different POT.

Back up

Ehad distribution for anti-nu



Results after fit for Ehad as input