

# Problems in $\pi^0$ Reconstruction

September 5, 2017 | Albrecht Gillitzer, IKP Forschungszentrum Jülich

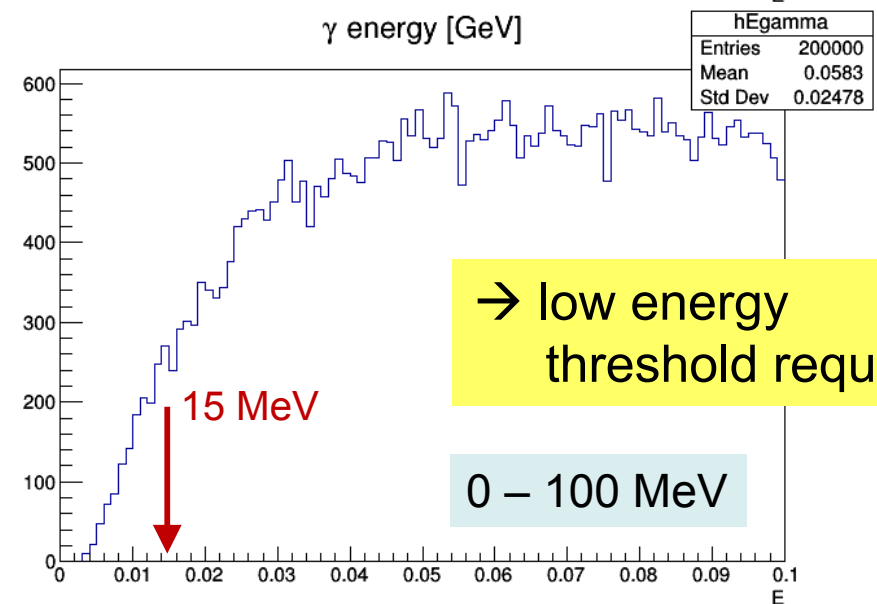
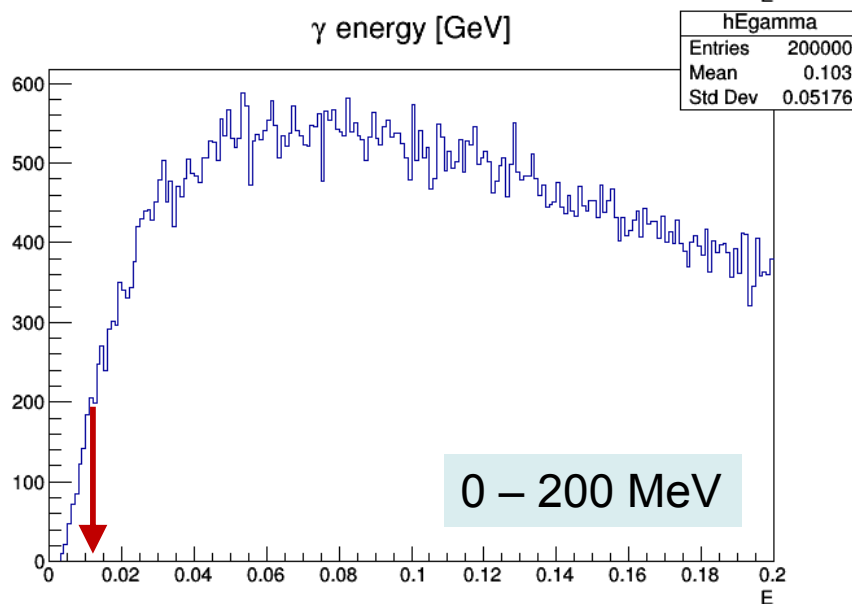
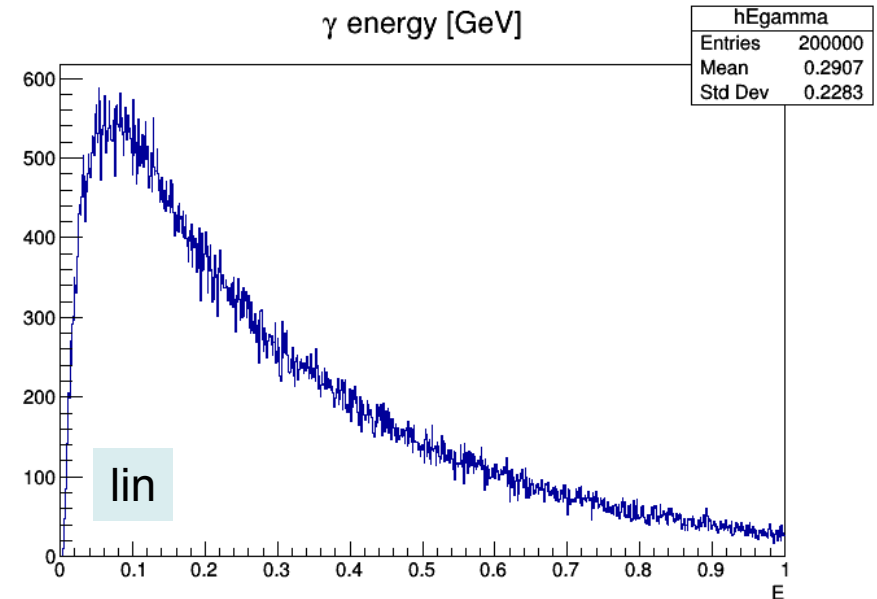
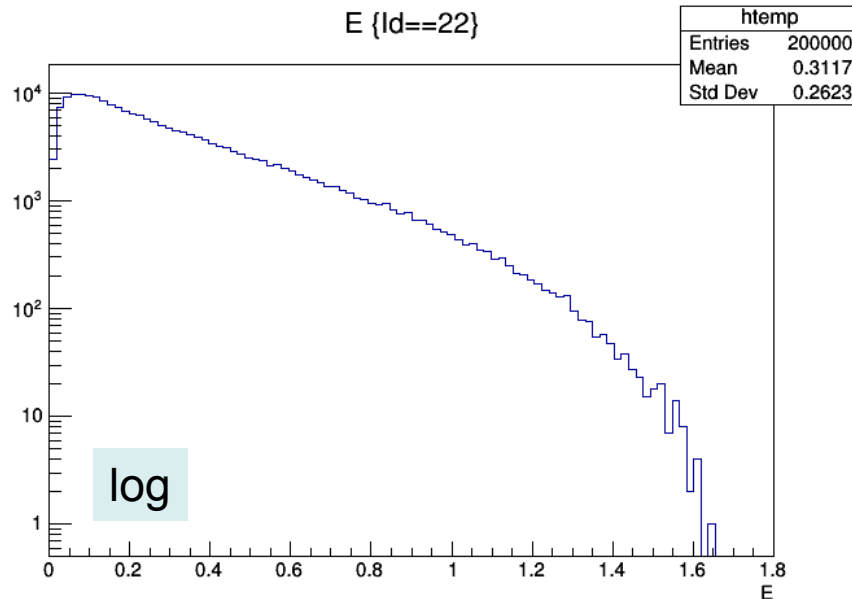
PANDA Collaboration Meeting 17/3, Novosibirsk, Russia

## Neutral Pion Modes in $\Xi^*$ Decays

- studied channel:  $4.6 \text{ GeV}/c \bar{p}p \rightarrow \bar{\Xi}^+ \Xi^- \pi^0$
- PandaRoot release feb17p1  $\rightarrow$  trunk 30122, all Geant4
- simulated 2.4 M events (feb17p1), 2.7 M events (trunk 30122)
- **this talk: analyzed 0.2 M events (trunk 30122)**
- analysis task based on Xinying's code
- focus in analysis on  $\pi^0$  reconstruction
- found very low MC truth matching in rel. feb17p1  $\rightarrow$  trunk
- high combinatorial background also induced by secondary particles other than photons

# MC Truth Photon Energy Spectrum

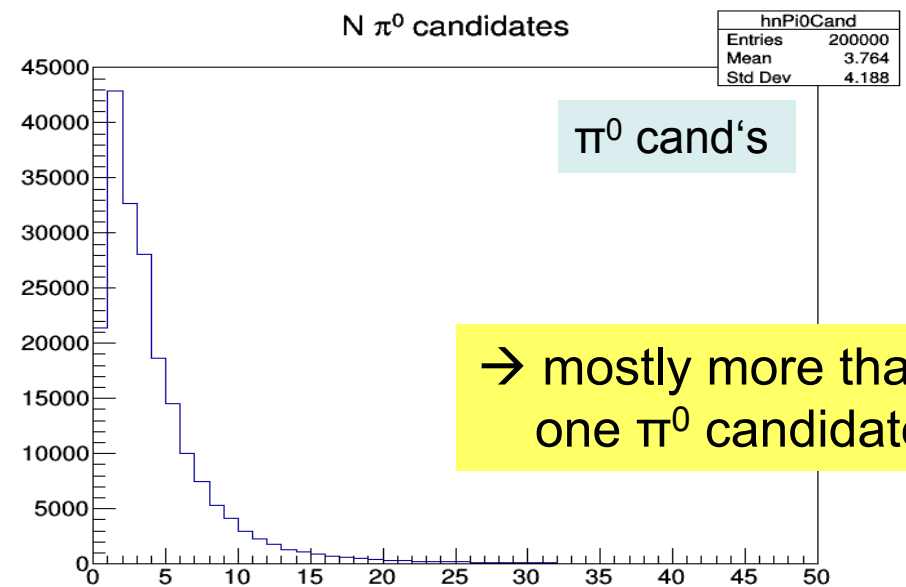
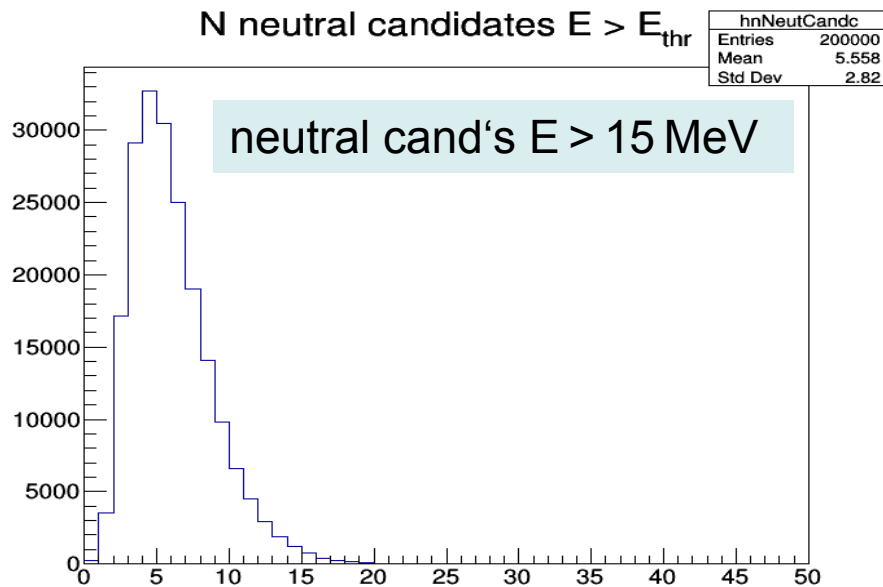
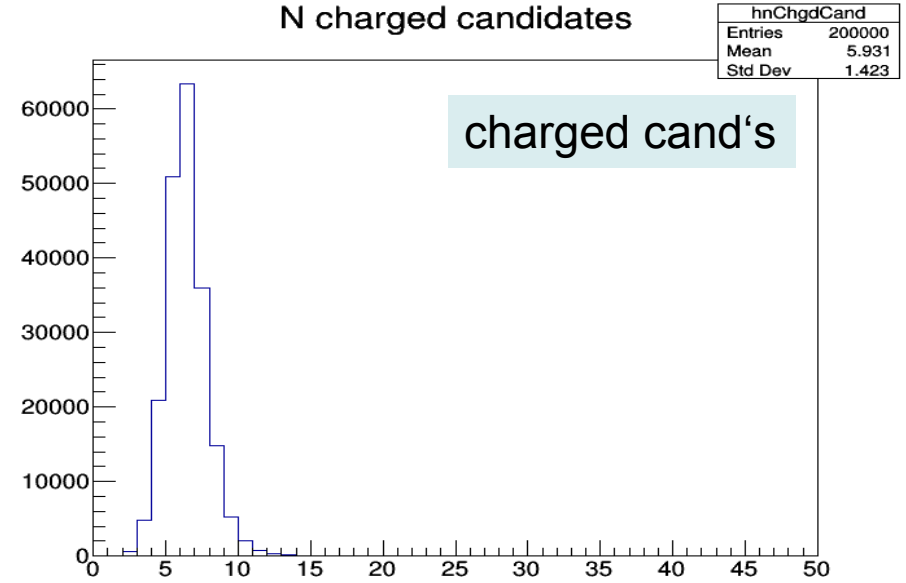
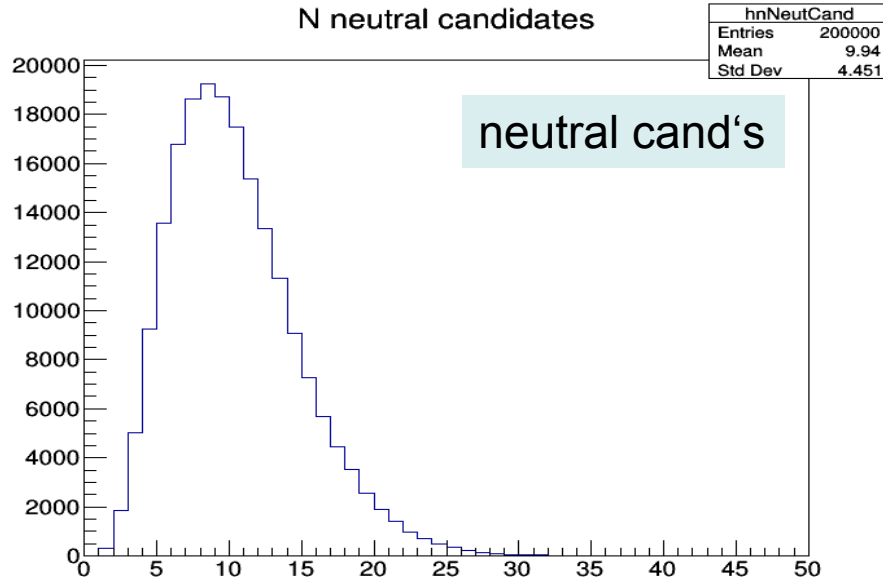
100000 events



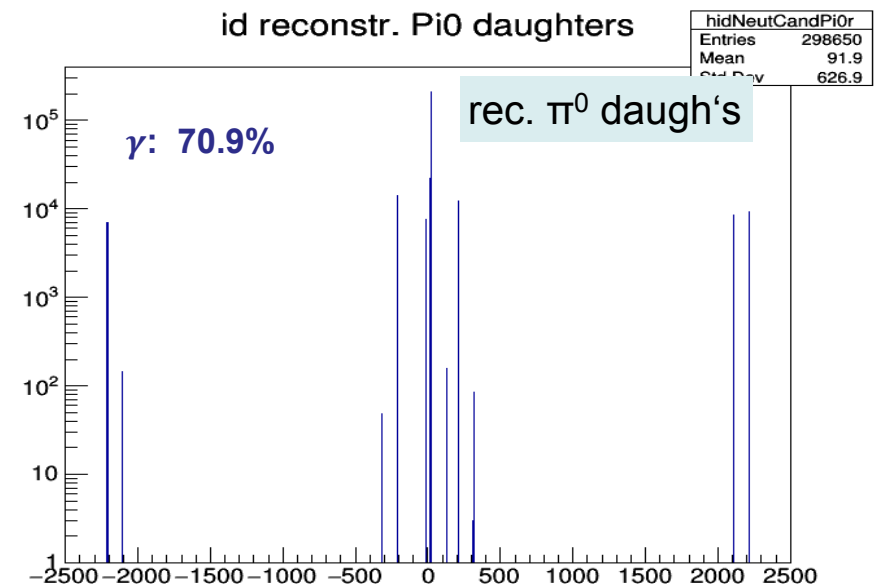
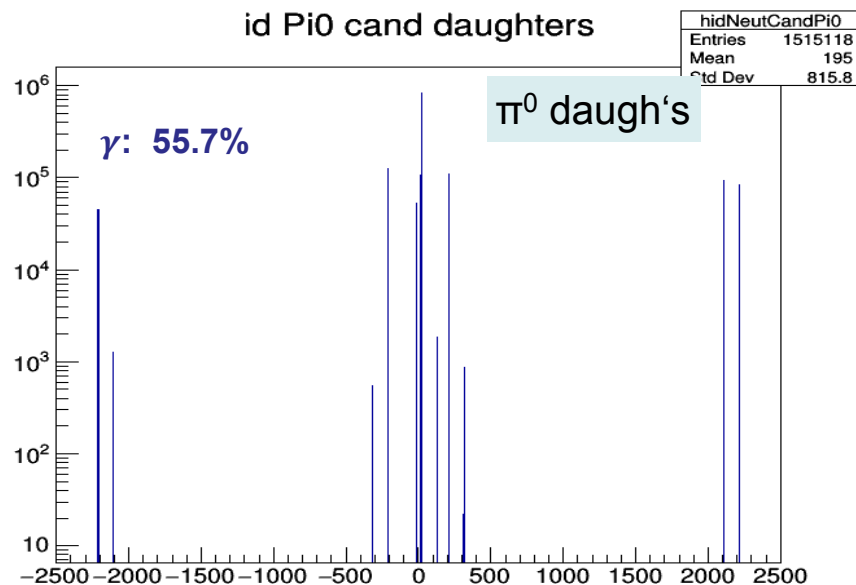
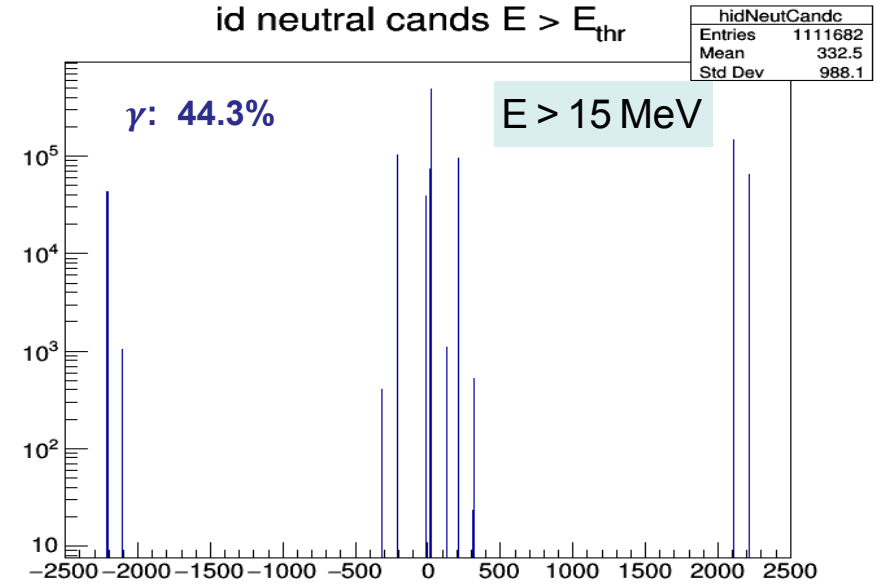
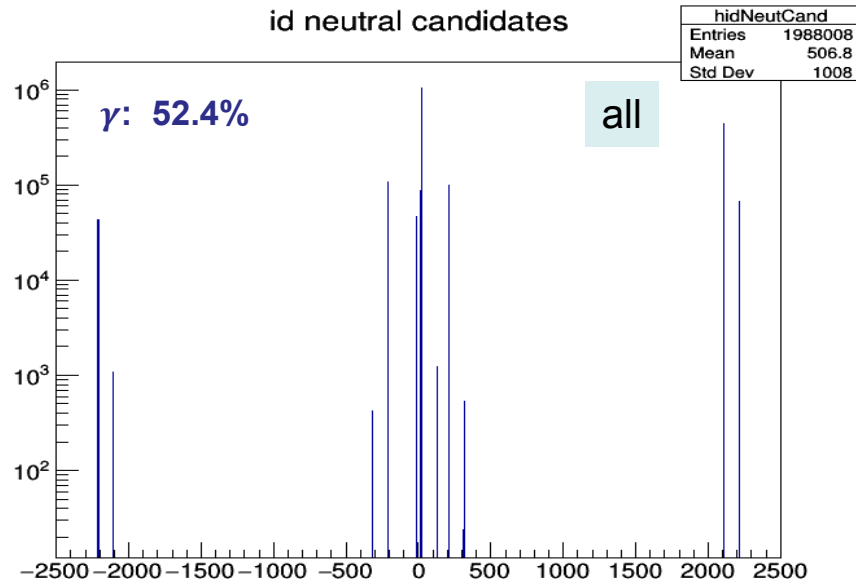
→ low energy threshold required

# Multiplicity of Candidates

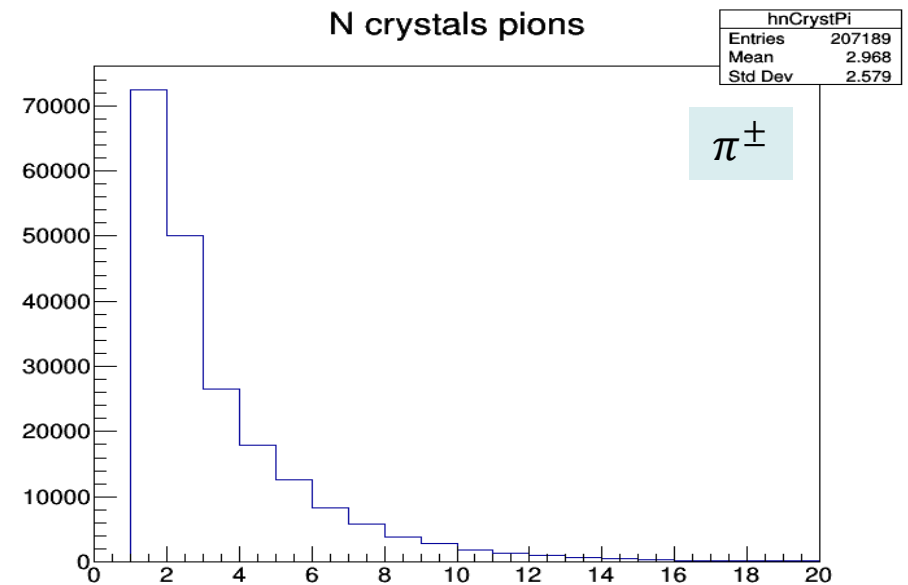
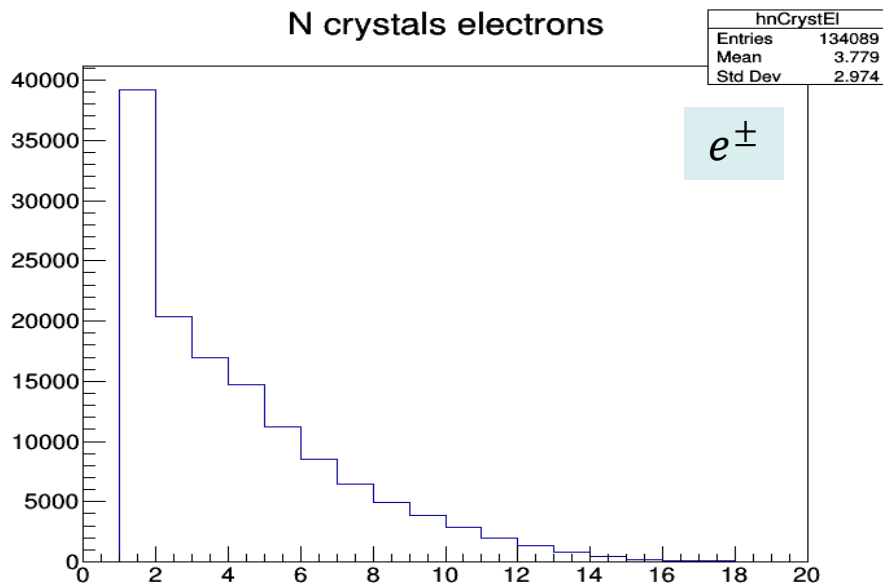
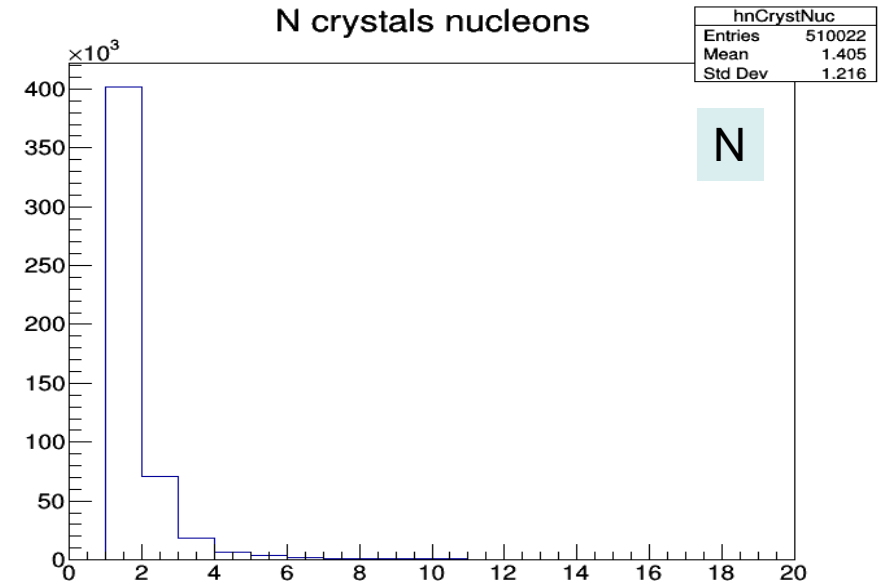
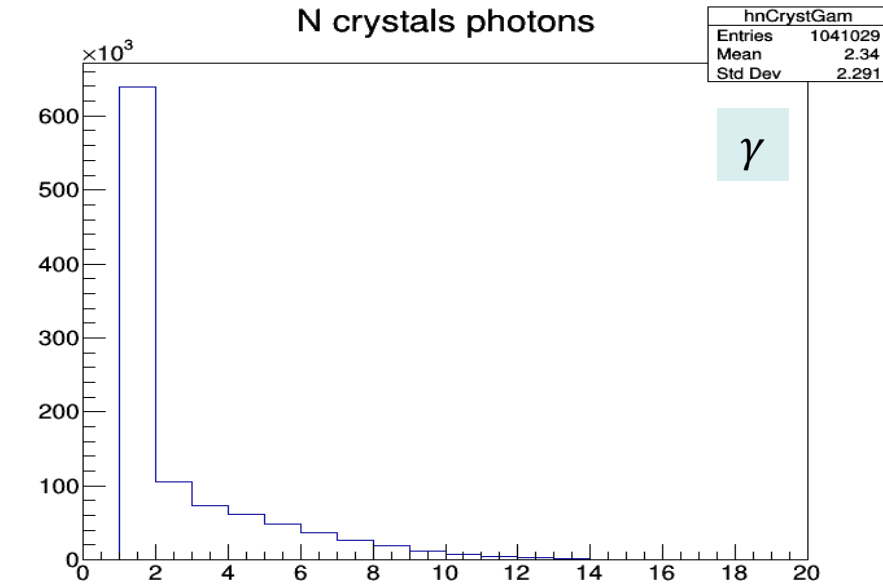
200000 events



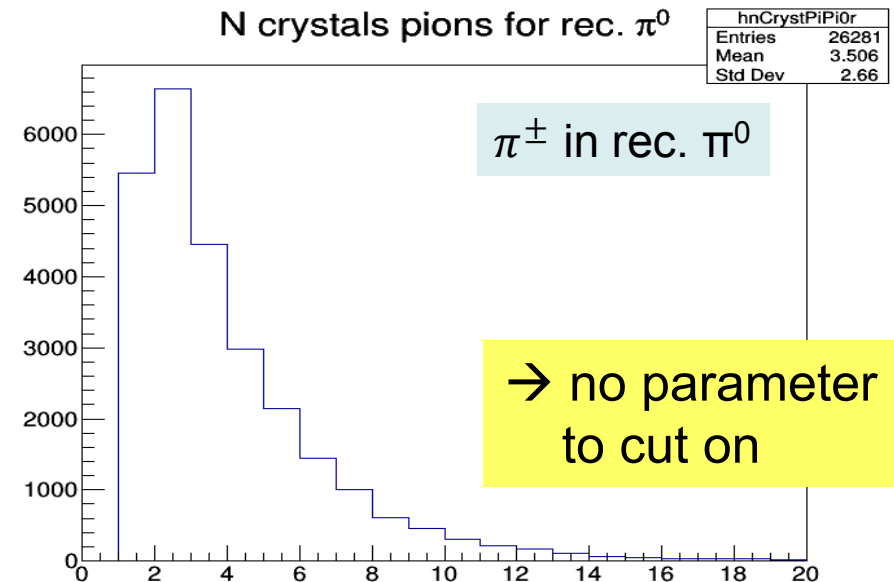
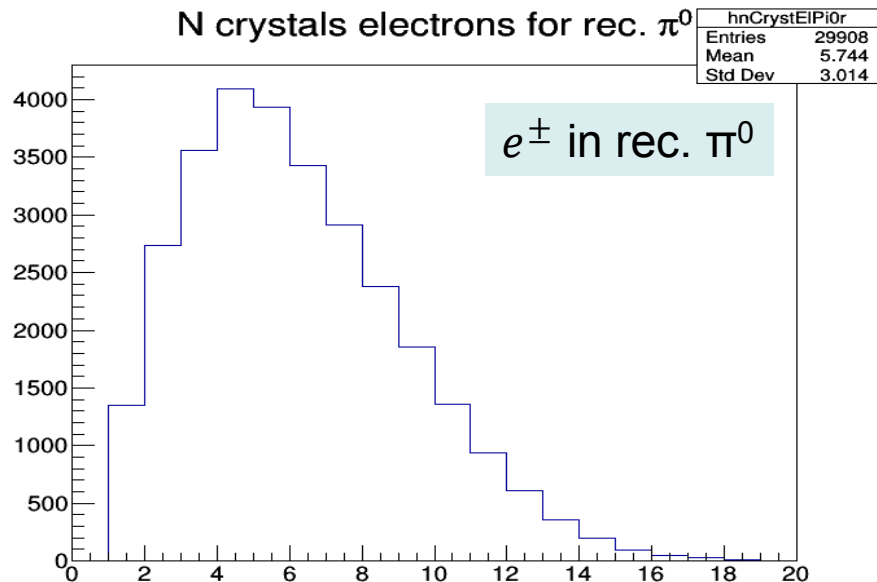
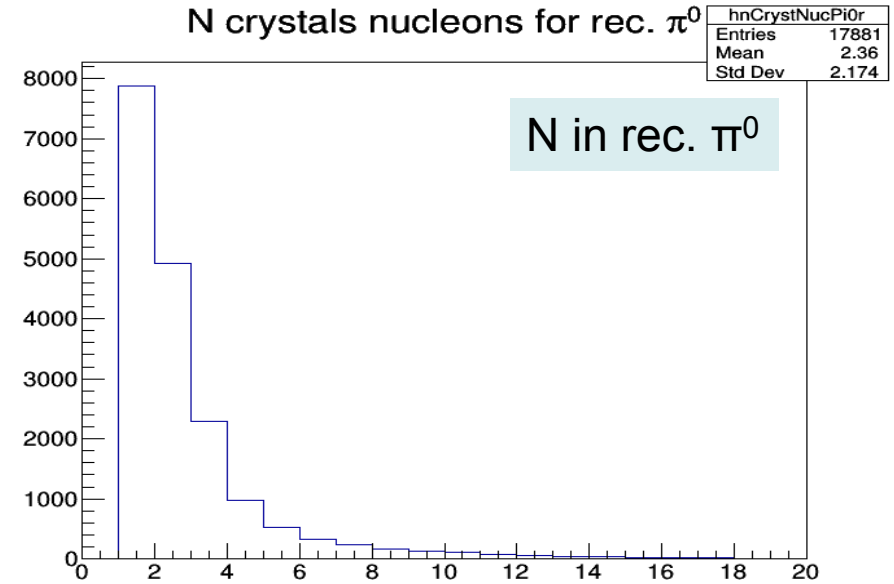
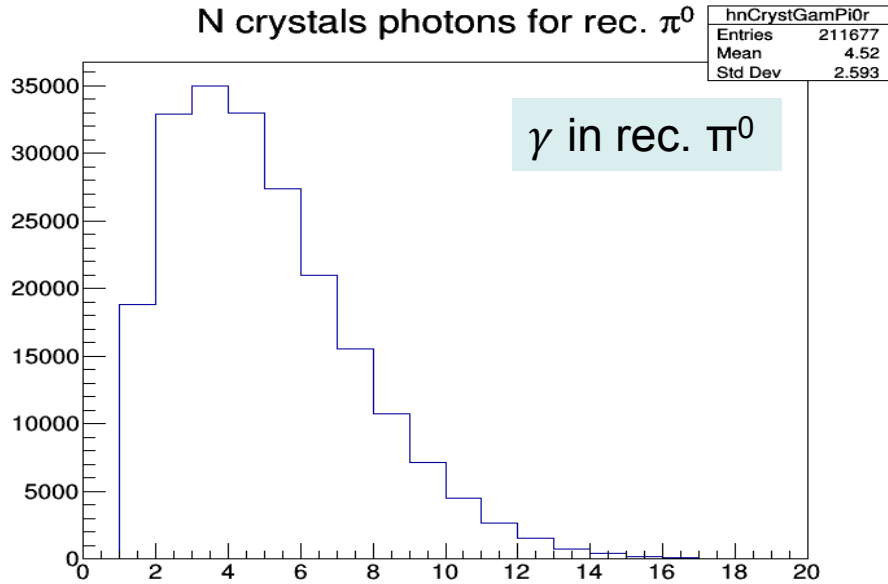
# Id of Neutral Candidates: all types of particles (incl. $\nu$ !)



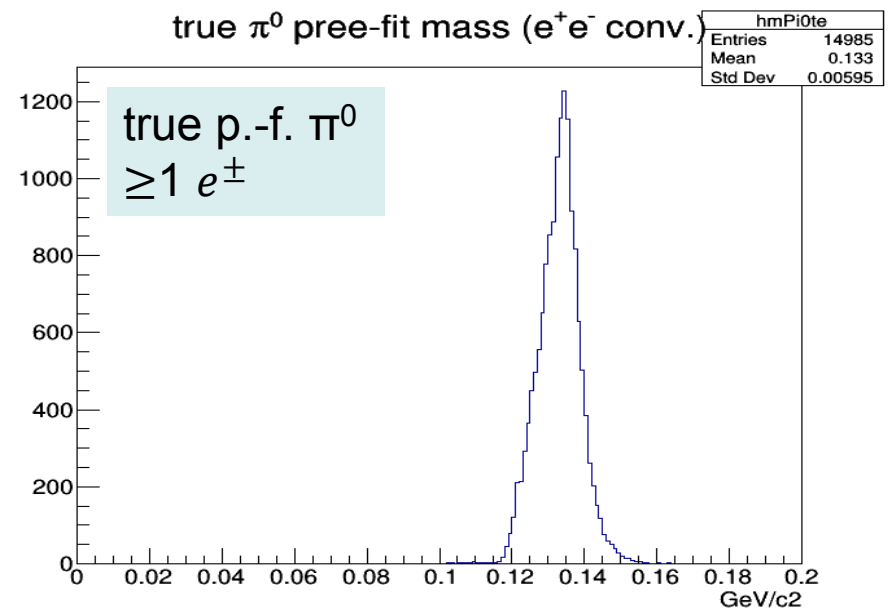
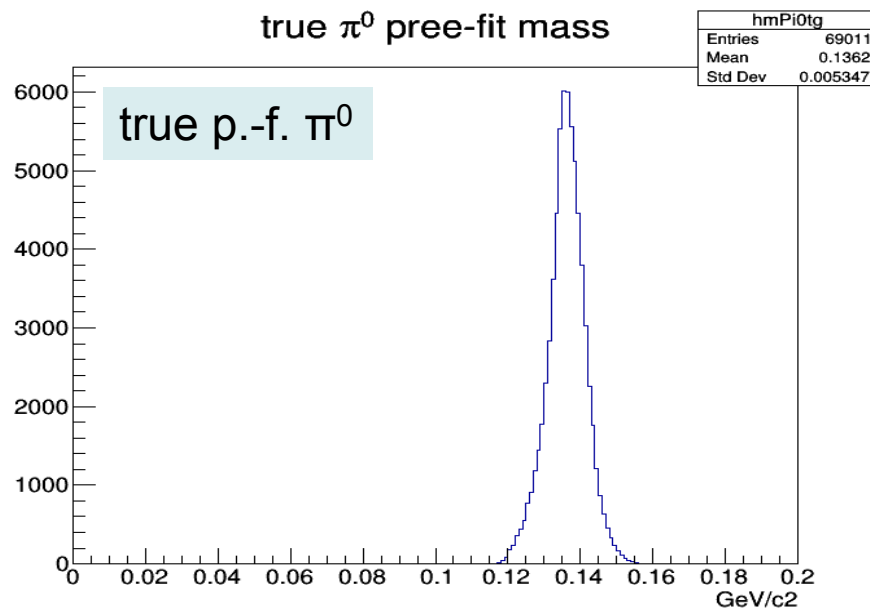
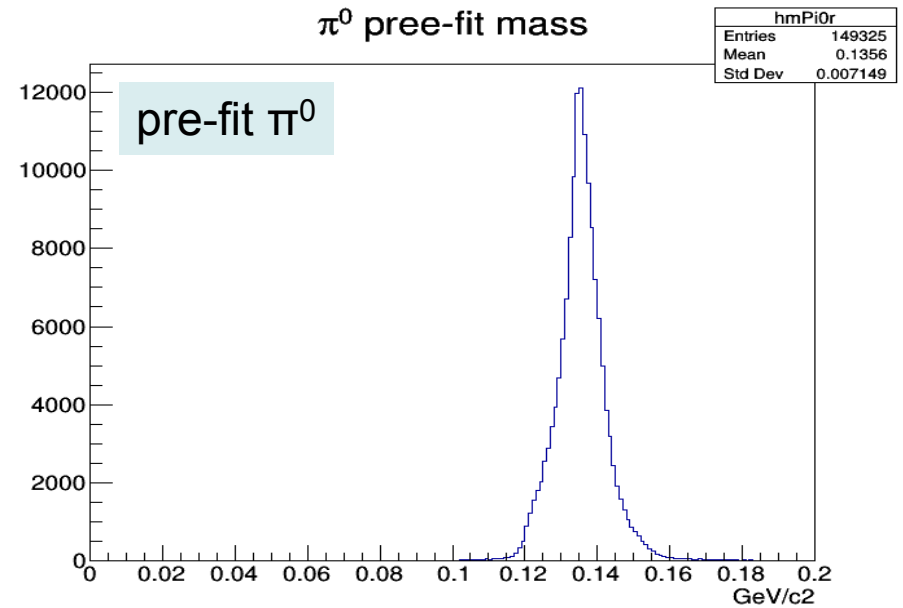
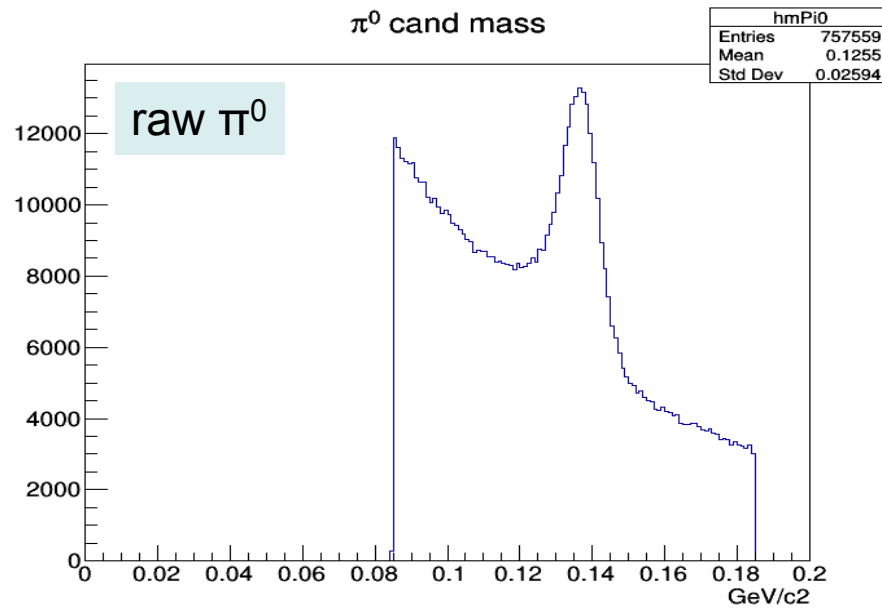
# # Hit EMC Crystals of Neutral Candidates



# # Hit EMC Crystals of Neutral Candidates (Rec. $\pi^0$ )

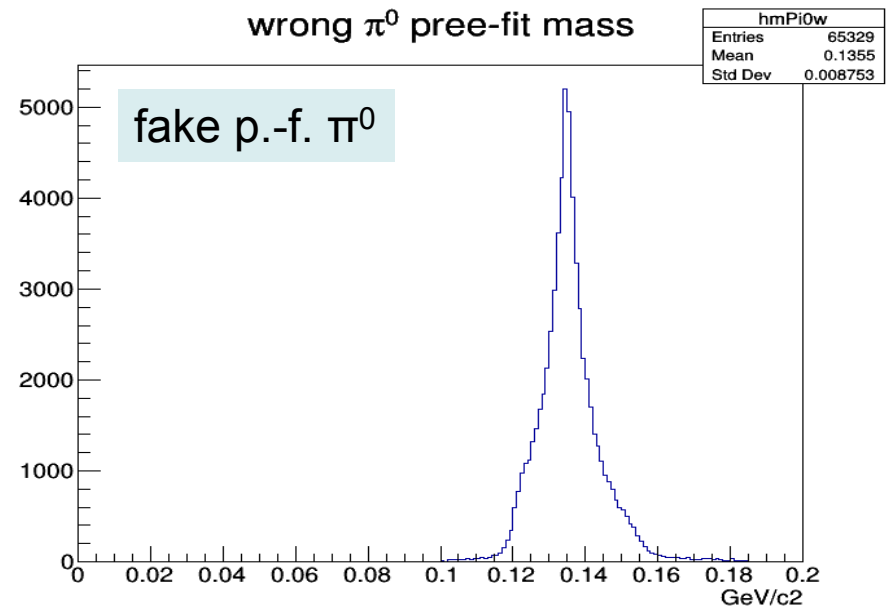
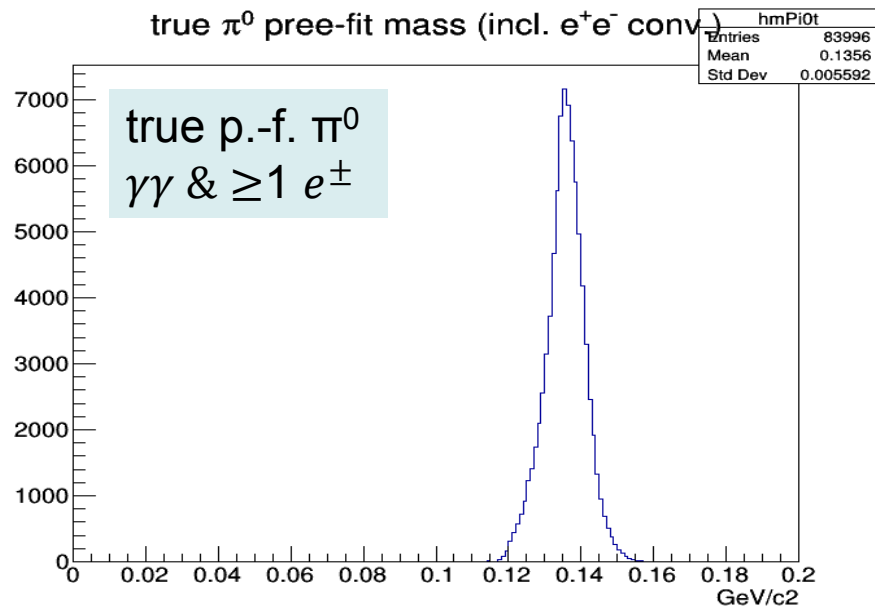
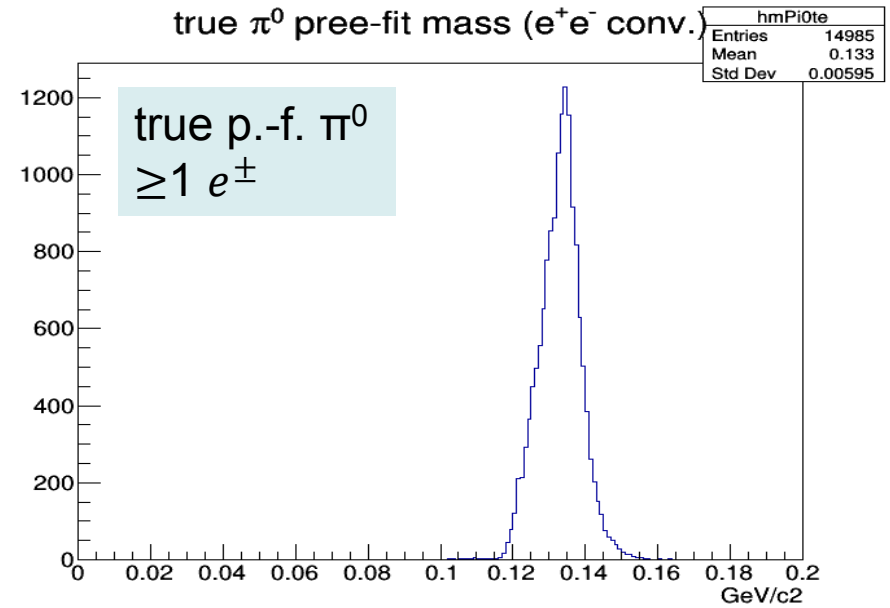
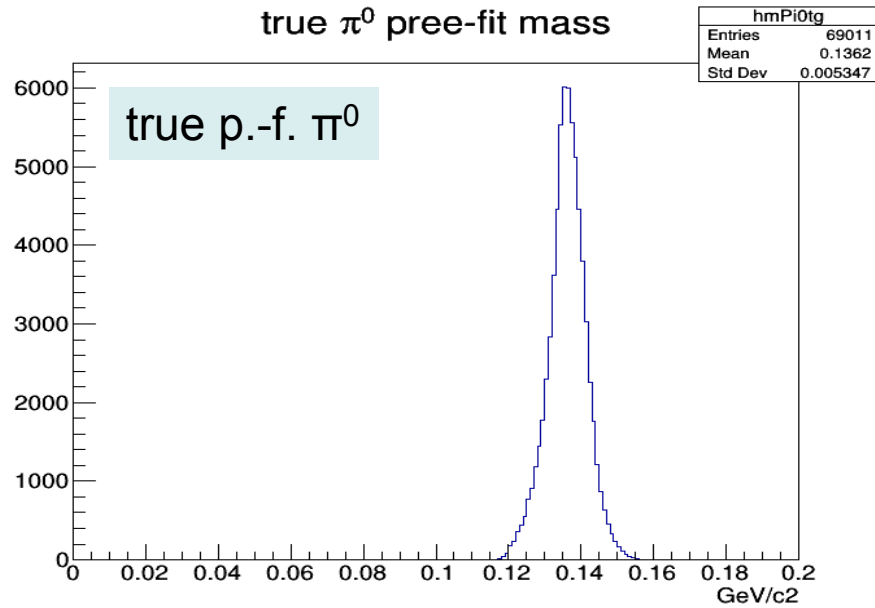


# Masses of $\pi^0$ Candidates

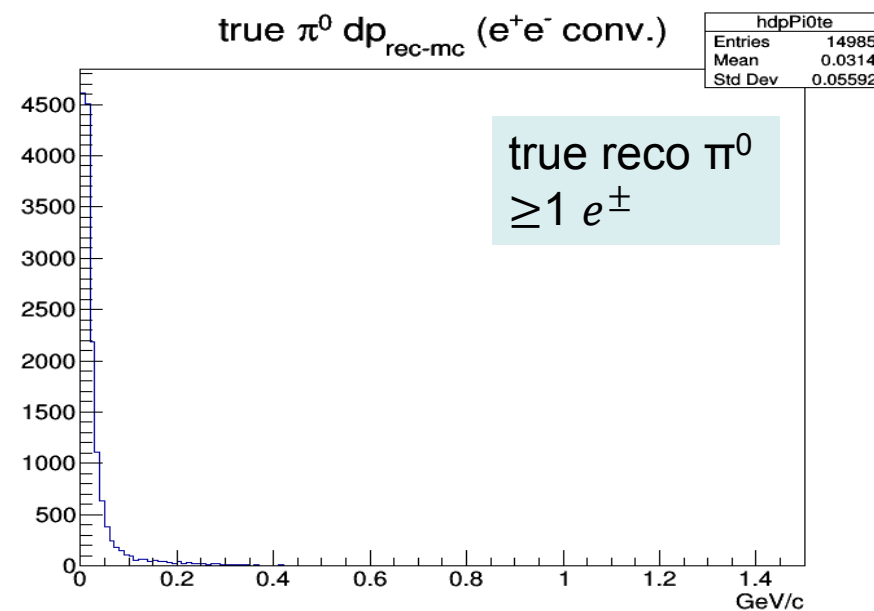
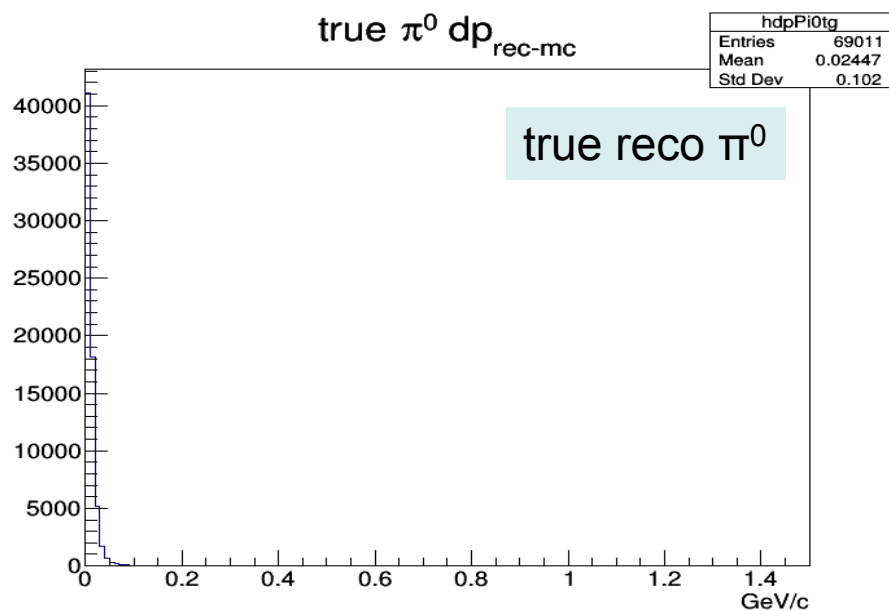
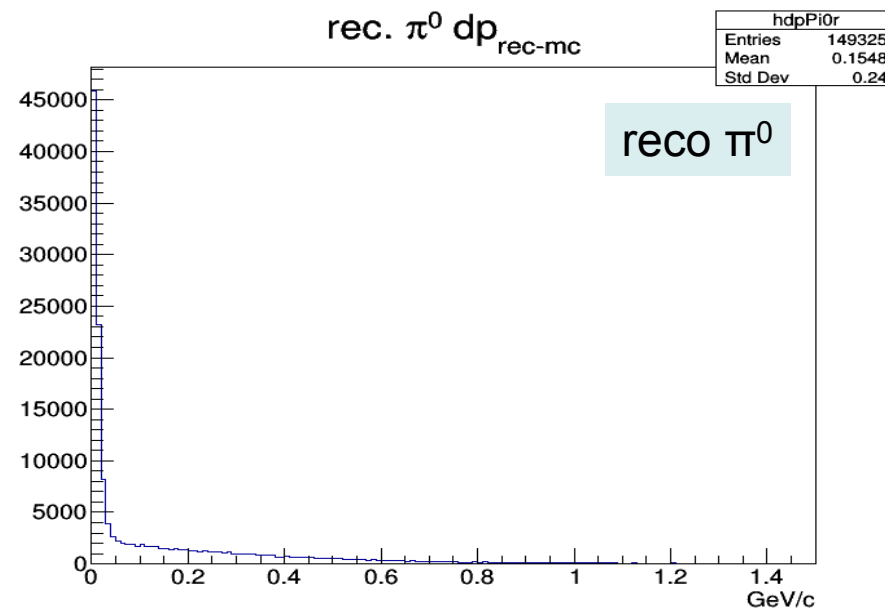
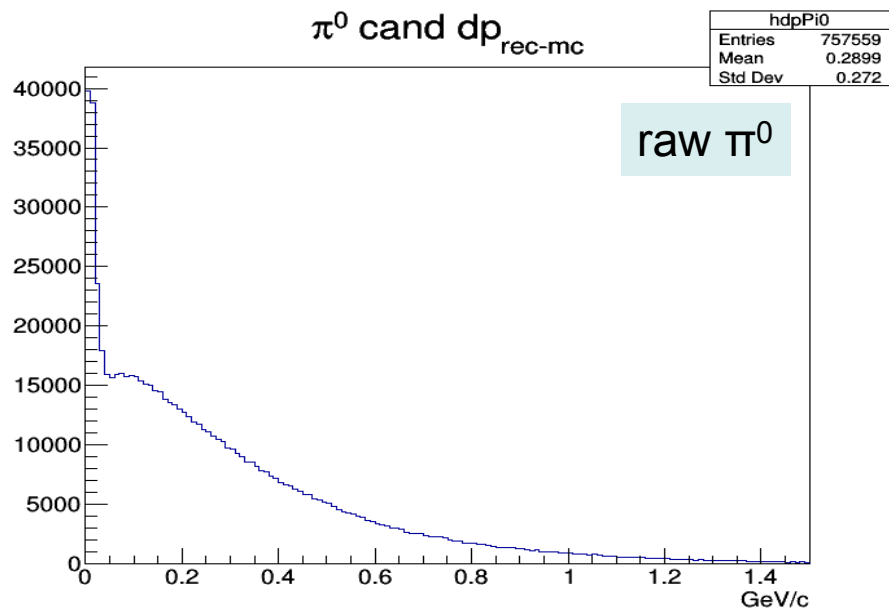




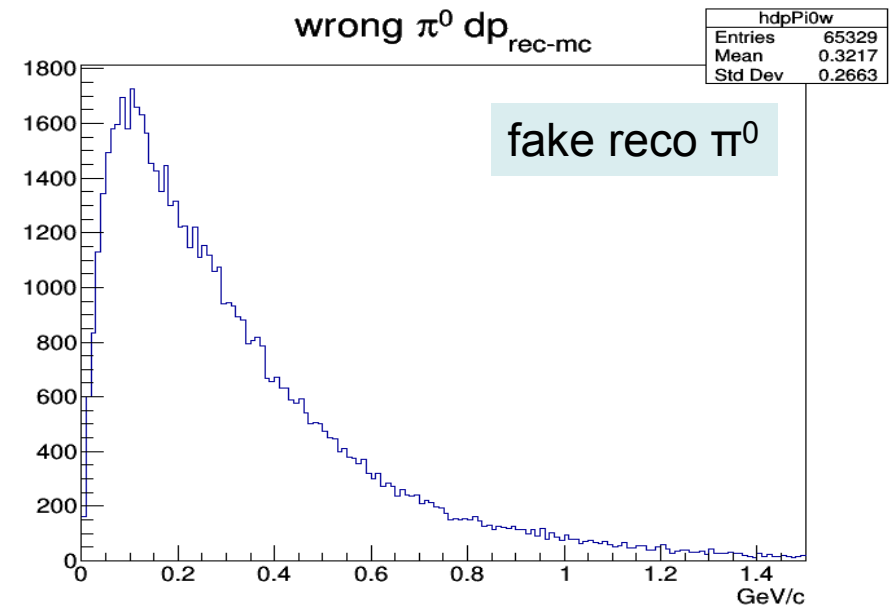
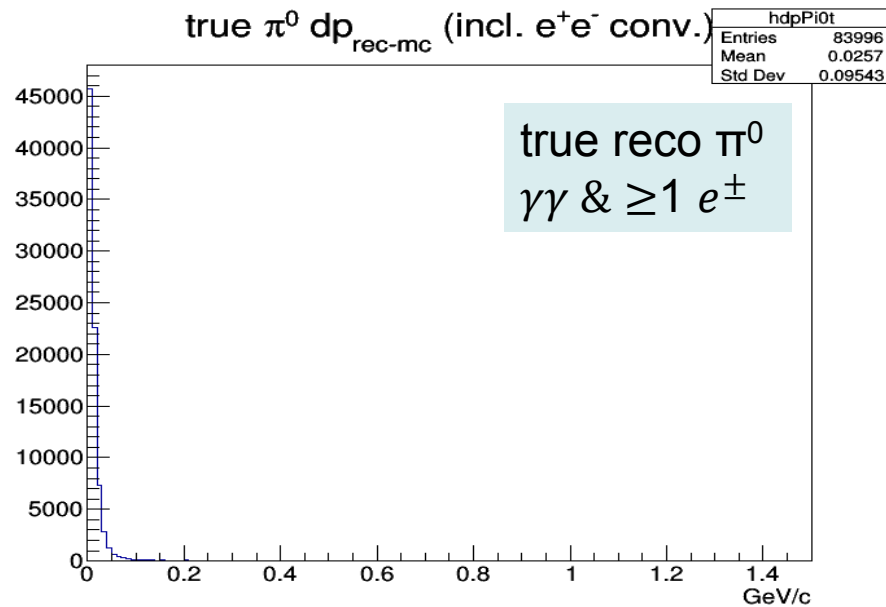
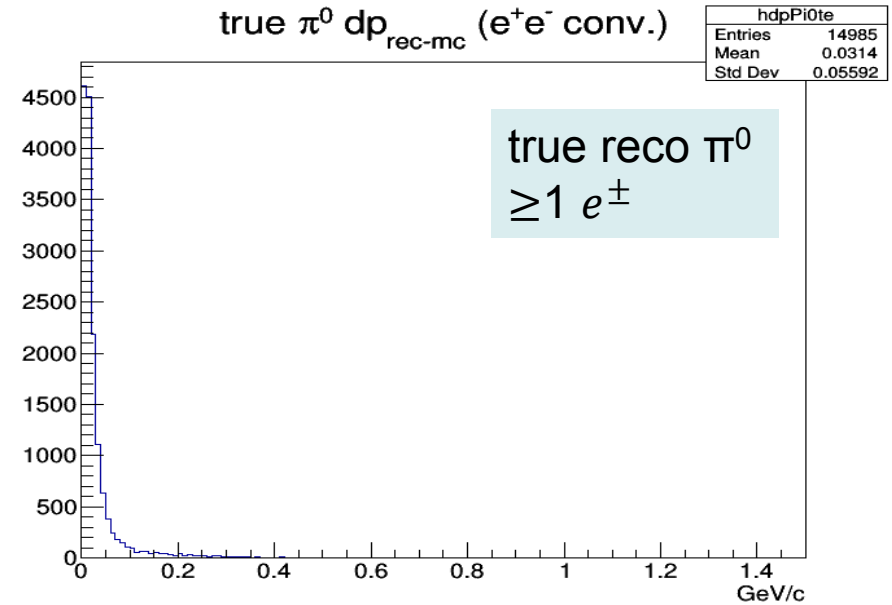
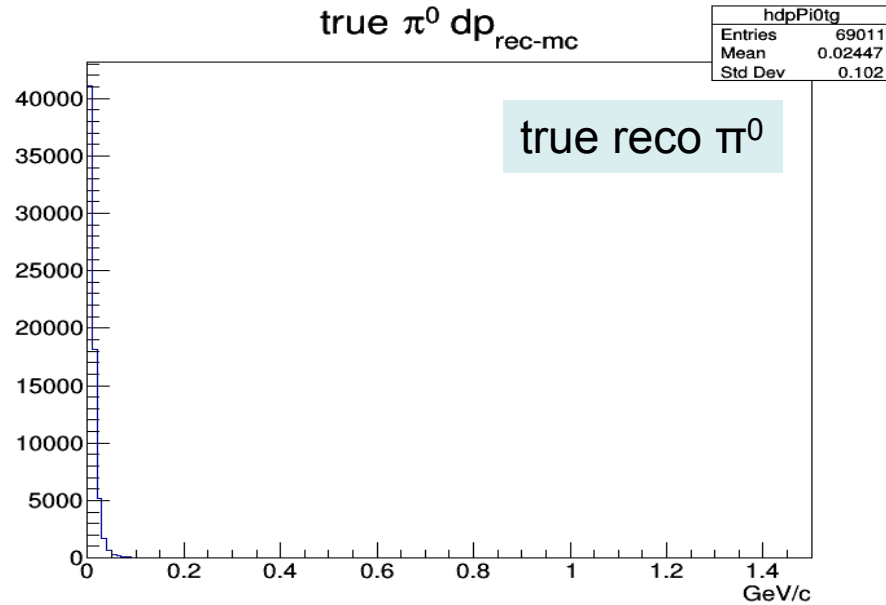
# Masses of $\pi^0$ Candidates



# $|\vec{P}_{\text{rec}} - \vec{P}_{\text{MC}}|$ of $\pi^0$ Candidates

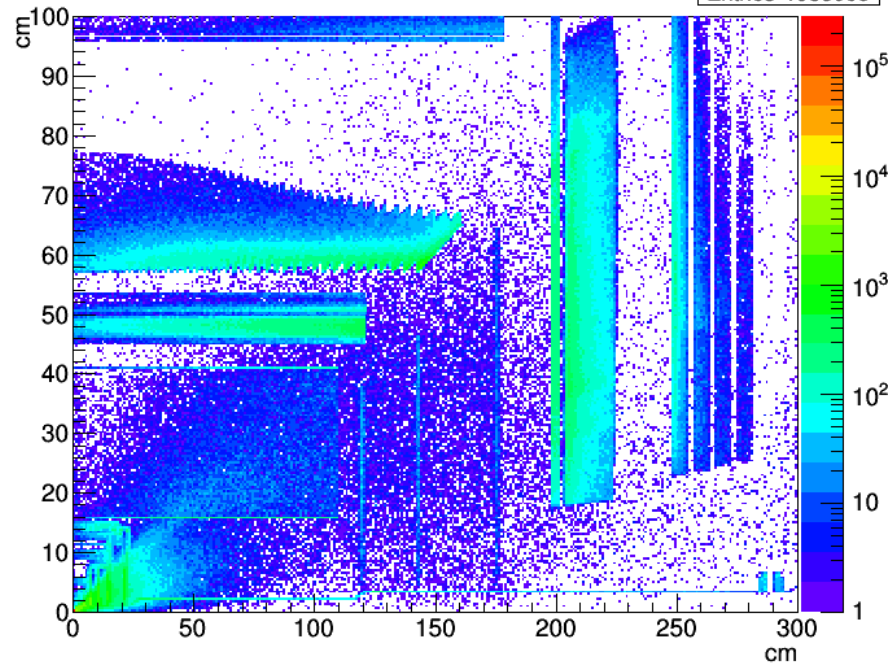
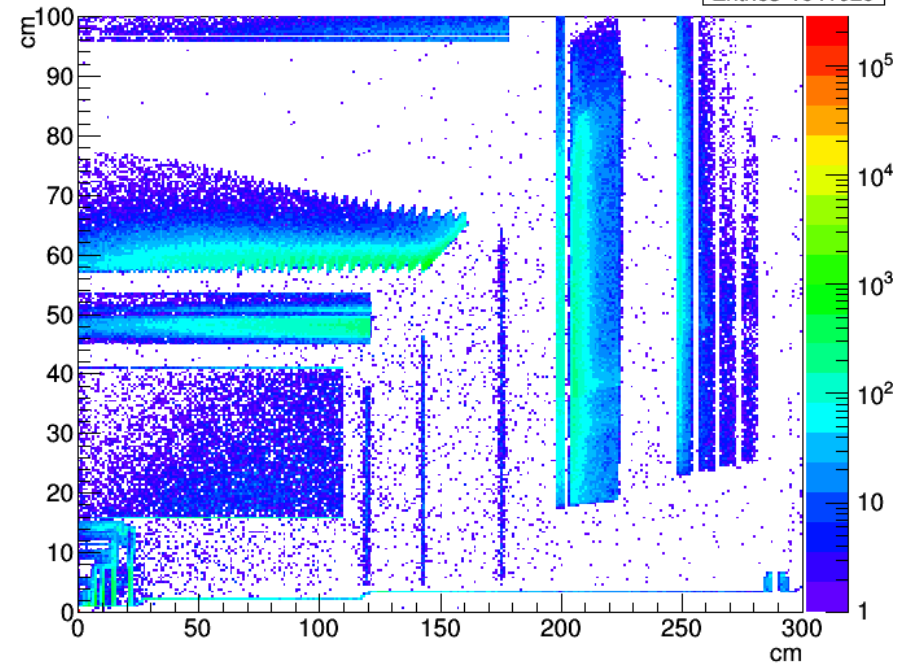
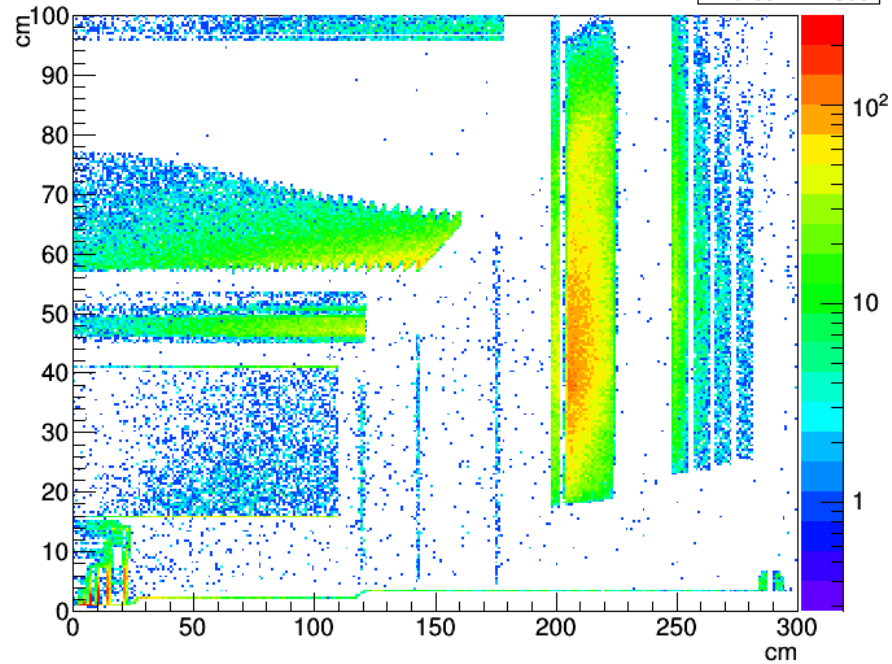
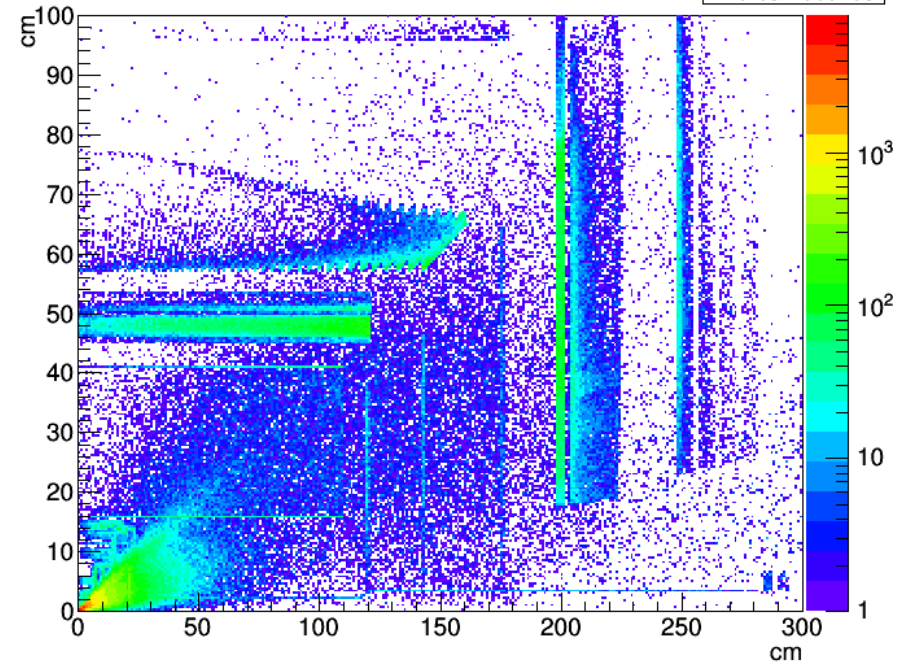


# $|\vec{P}_{\text{rec}} - \vec{P}_{\text{MC}}|$ of $\pi^0$ Candidates



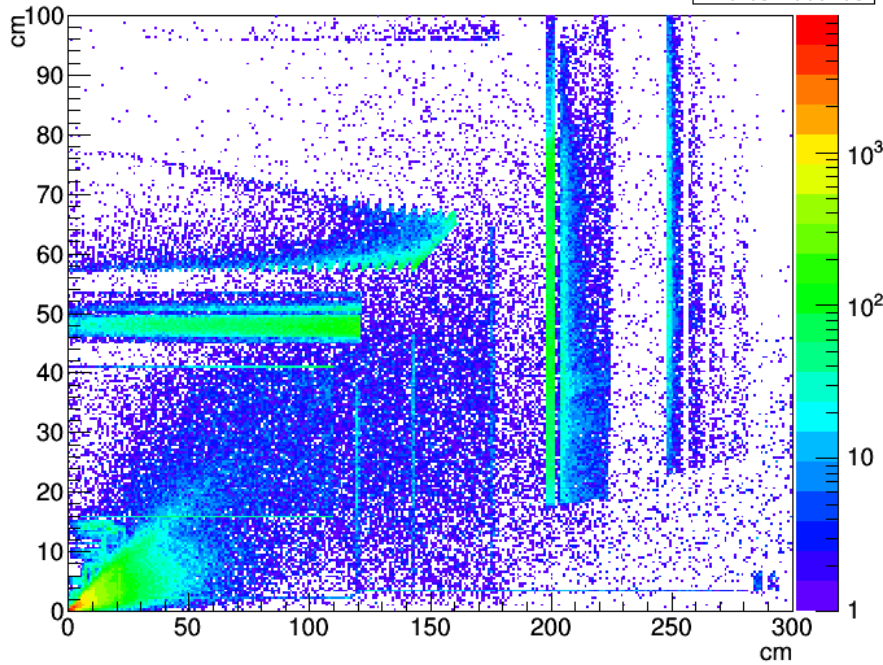
## Origin of Neutral Candidates

- Where do the neutral candidates come from?
- Why are there so many charged particles in the list?
- The following slides show the start points of neutral candidate tracks:
  - all neutral candidates
  - photons
  - neutrons
  - all charged
  - electrons ( $e^{\pm}$ )
  - pions ( $\pi^{\pm}$ )
  - protons ( $p, \bar{p}$ )

neutral cand  $R_{\text{start}}$  vs  $Z_{\text{start}}$ h zrNeutCand  
Entries 1988008neutral cand  $R_{\text{start}}$  vs  $Z_{\text{start}}$  ( $\gamma$ )h zrNeutCandGam  
Entries 1041029neutral cand  $R_{\text{start}}$  vs  $Z_{\text{start}}$  (n)h zrNeutCandNeut  
Entries 442953neutral cand  $R_{\text{start}}$  vs  $Z_{\text{start}}$  (chg)h zrNeutCandChgd  
Entries 500195

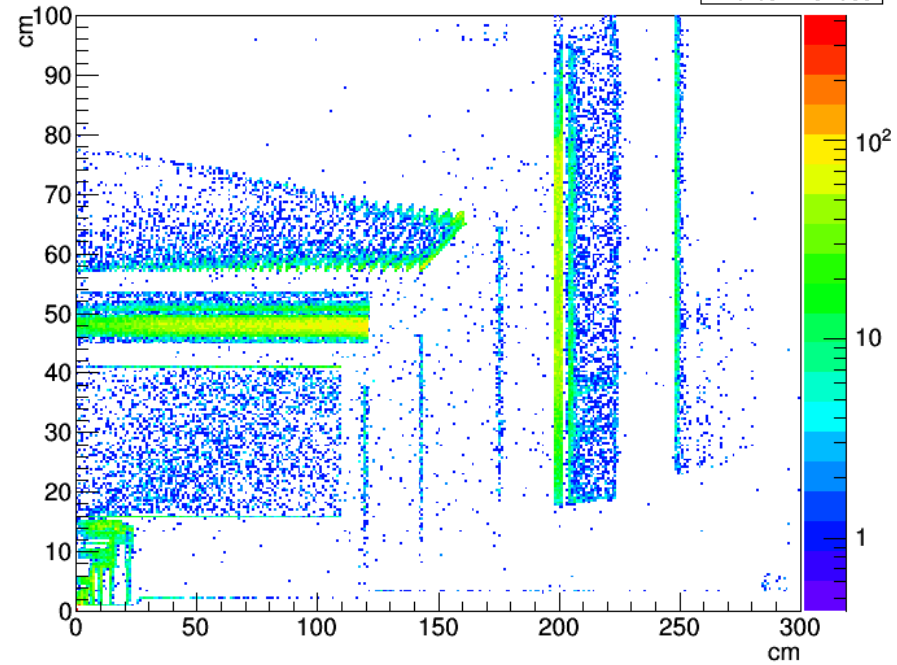
neutral cand  $R_{\text{start}}$  vs  $Z_{\text{start}}$  (chg $d$ )

h zrNeutCandChgd  
Entries 500195



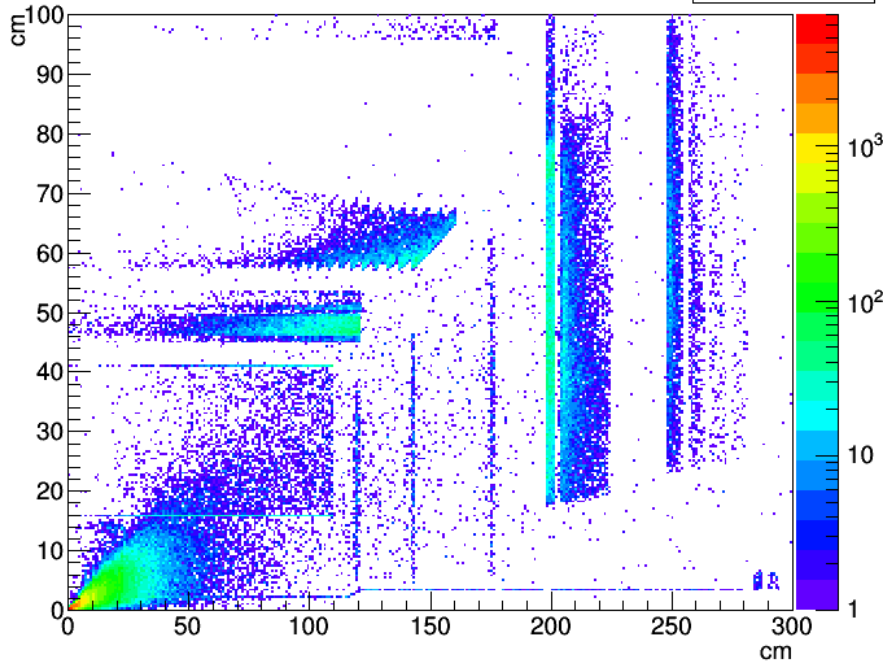
neutral cand  $R_{\text{start}}$  vs  $Z_{\text{start}}$  ( $e^+$ )

h zrNeutCandEI  
Entries 134089



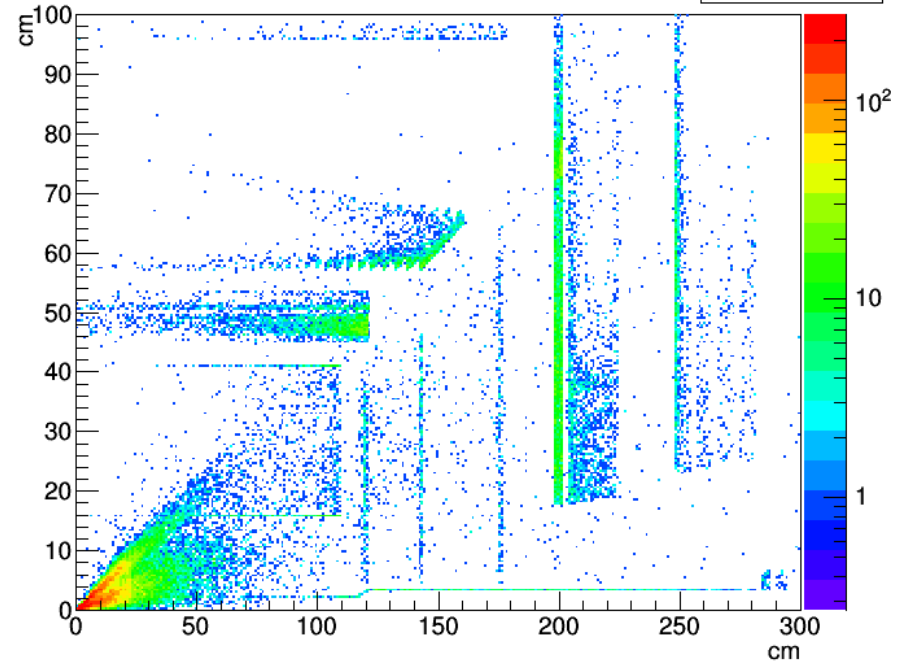
neutral cand  $R_{\text{start}}$  vs  $Z_{\text{start}}$  ( $\pi$ )

h zrNeutCandPi  
Entries 207189



neutral cand  $R_{\text{start}}$  vs  $Z_{\text{start}}$  (p)

h zrNeutCandProt  
Entries 67069





## Status Summary

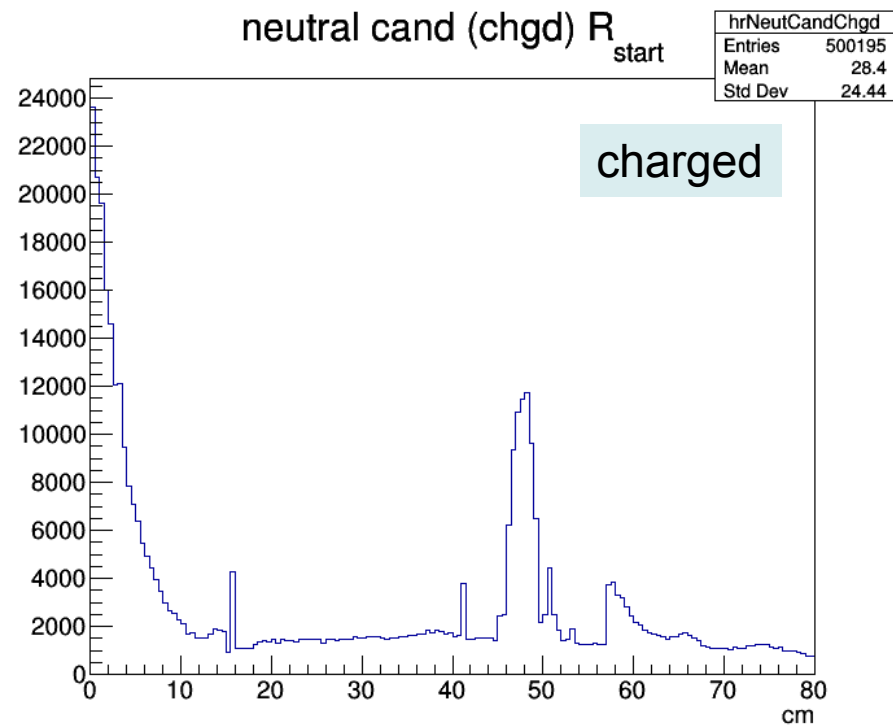
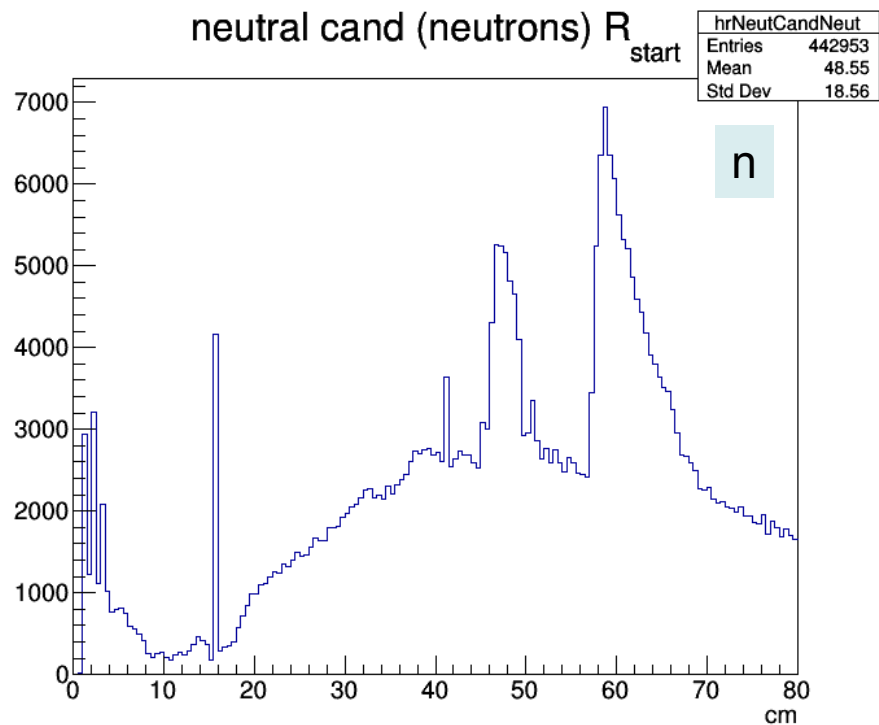
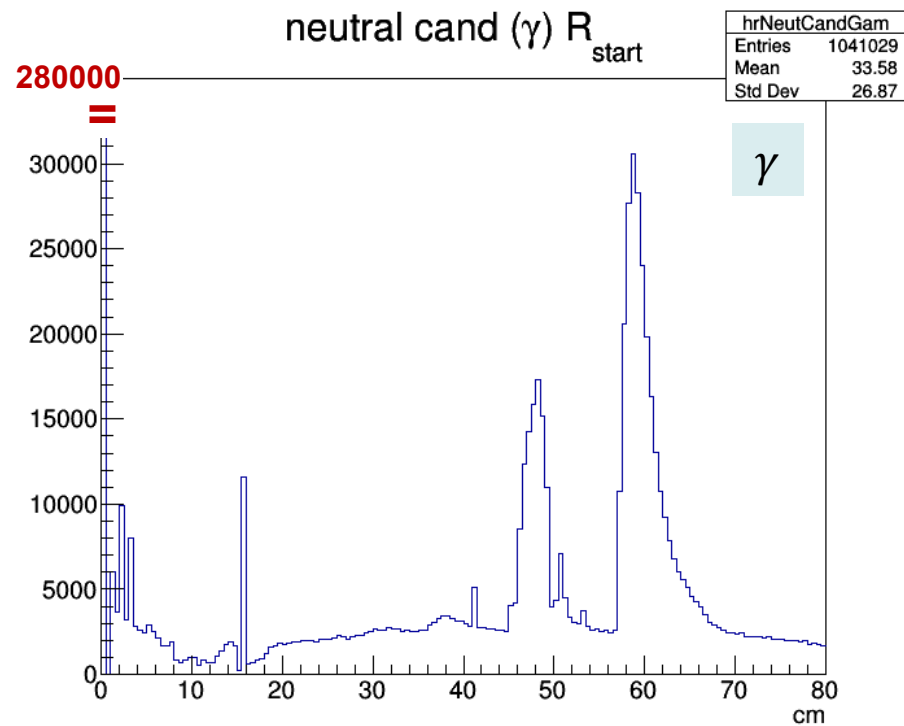
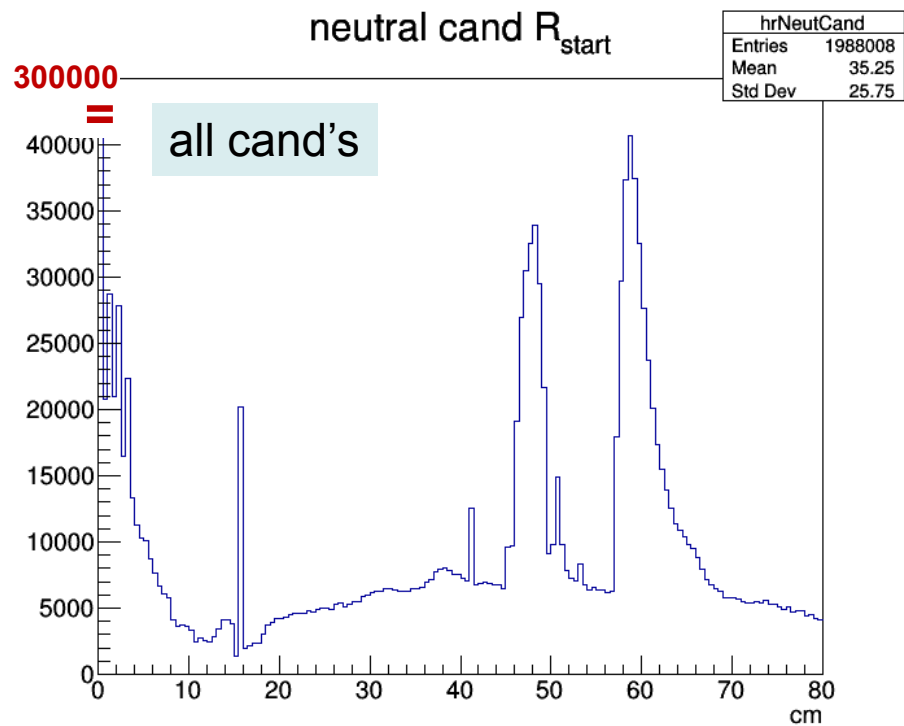
- $\pi^0$  reco efficiency too low:  $\sim 42\%$  true  $\pi^0$  found (rel. to generated)
- Ratio of signal to combinatorial background too low: S/B  $\sim 1.3$
- MC truth match fraction improved in trunk 30122 compared to release feb17p1 ( $\sim 30\%$ )
- options to separate photons from other particles currently insufficient
- 4C fit removes part of the background but result is unsatisfactory (not discussed here)
- $\rightarrow$  need further effort to improve neutral particle reconstruction e.g. time information to suppress slow particles

# Thank You for Your Attention !

spare

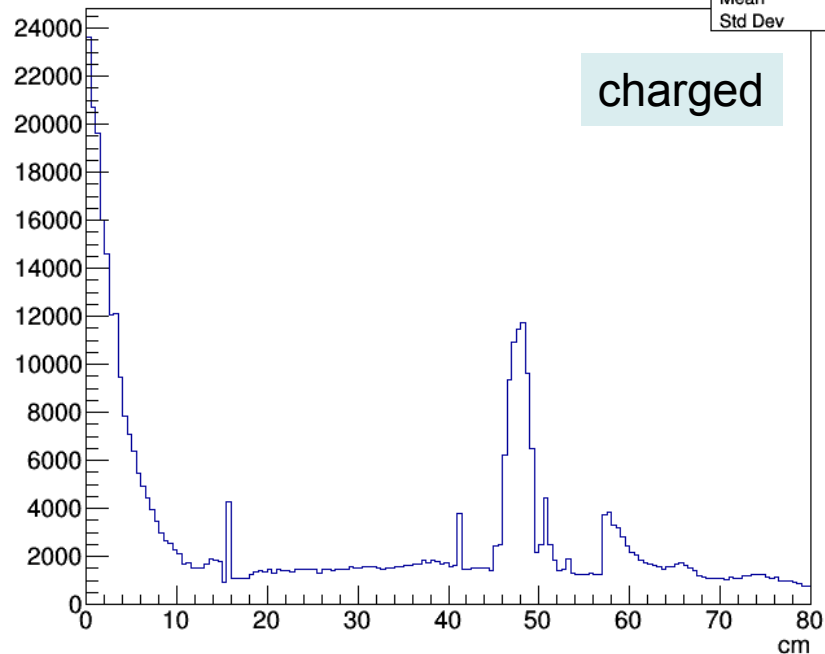






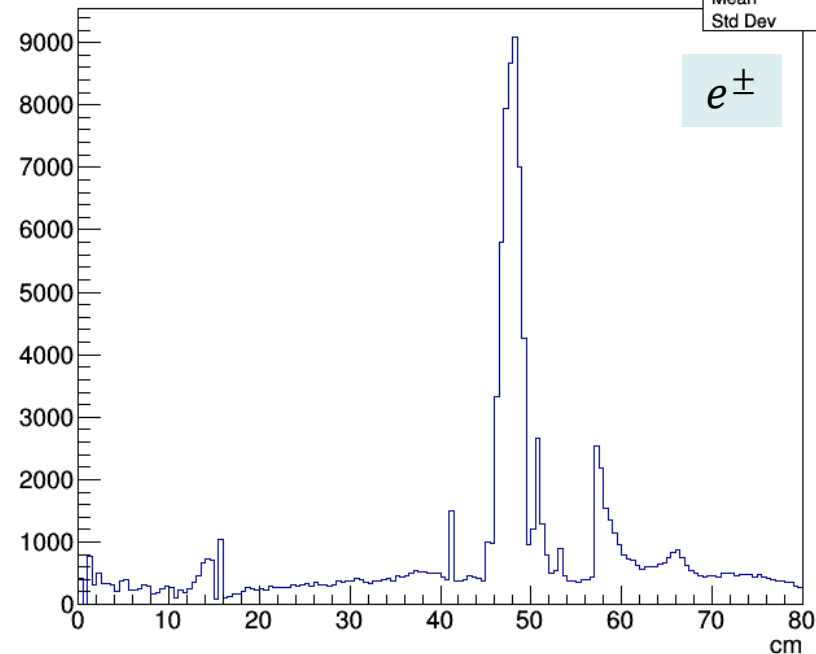
neutral cand (chgd) R

hrNeutCandChgd	
Entries	500195
Mean	28.4
Std Dev	24.44



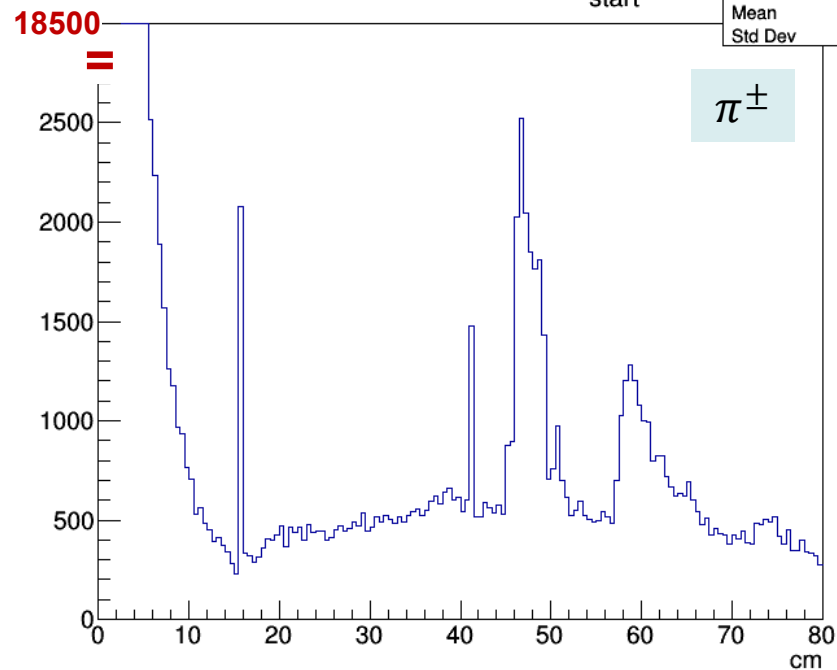
neutral cand (electrons) R

hrNeutCandEl	
Entries	134089
Mean	46.44
Std Dev	16.77



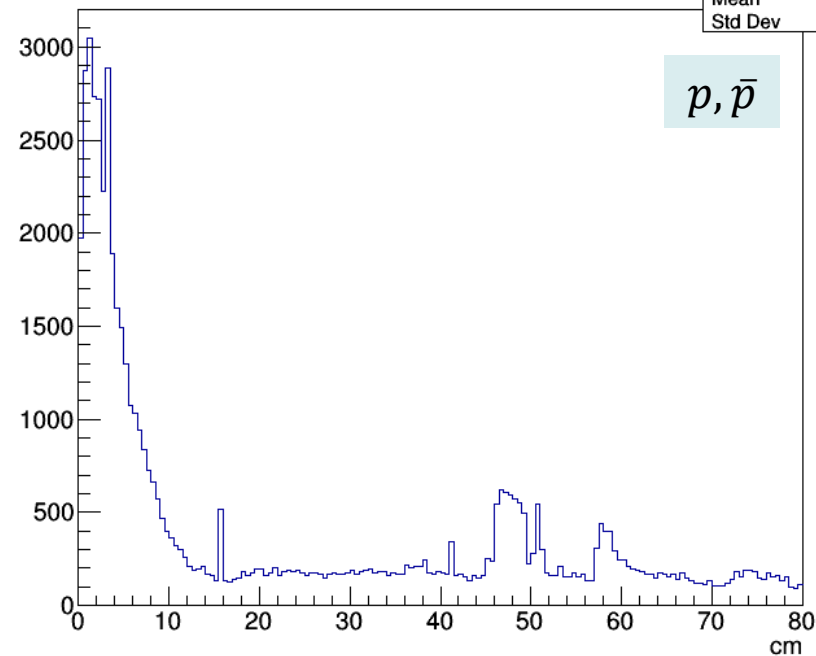
neutral cand ( $\pi$ ) R

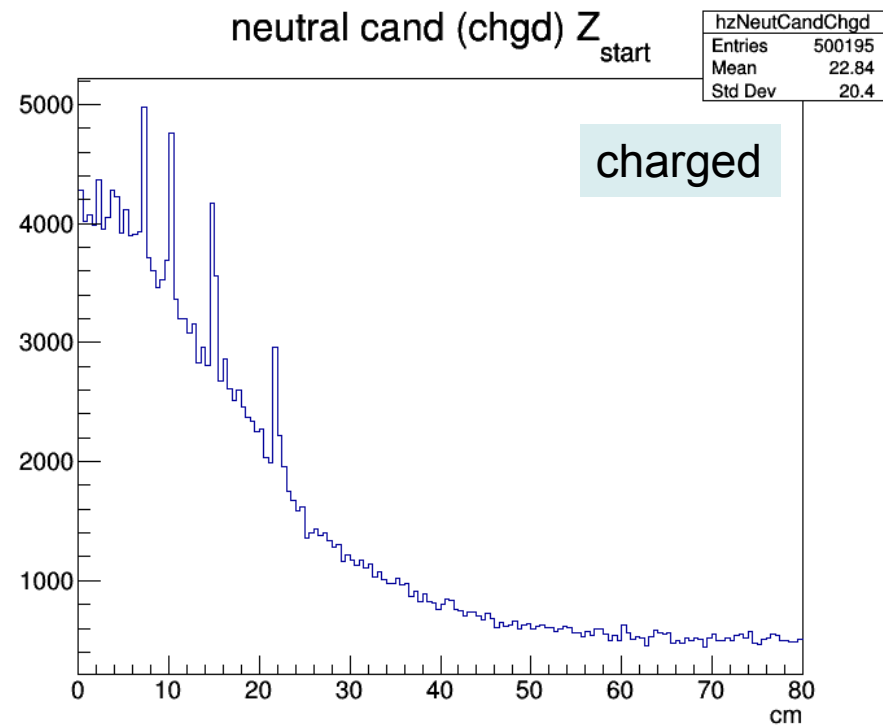
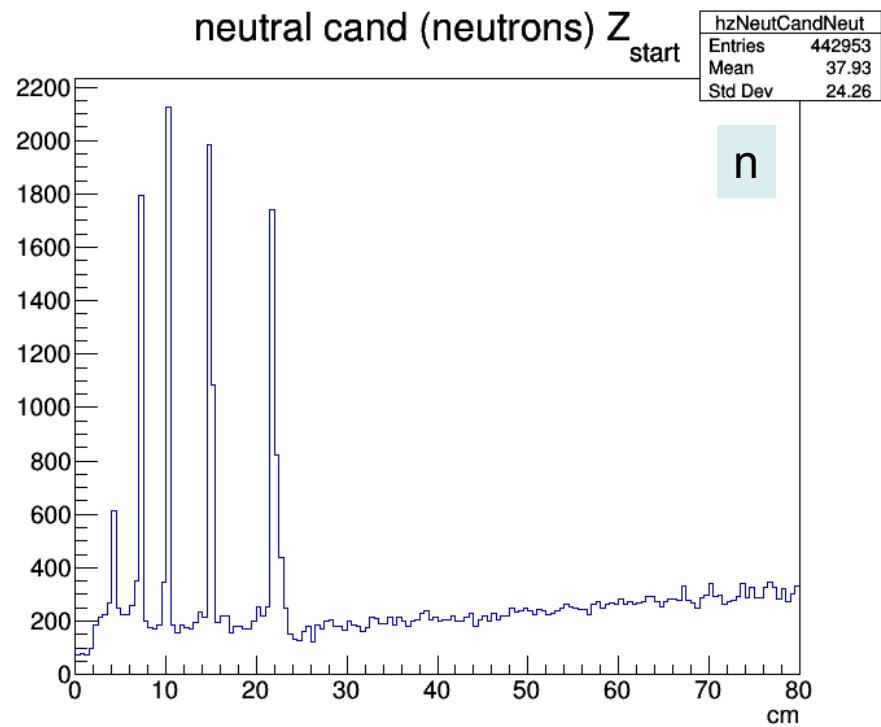
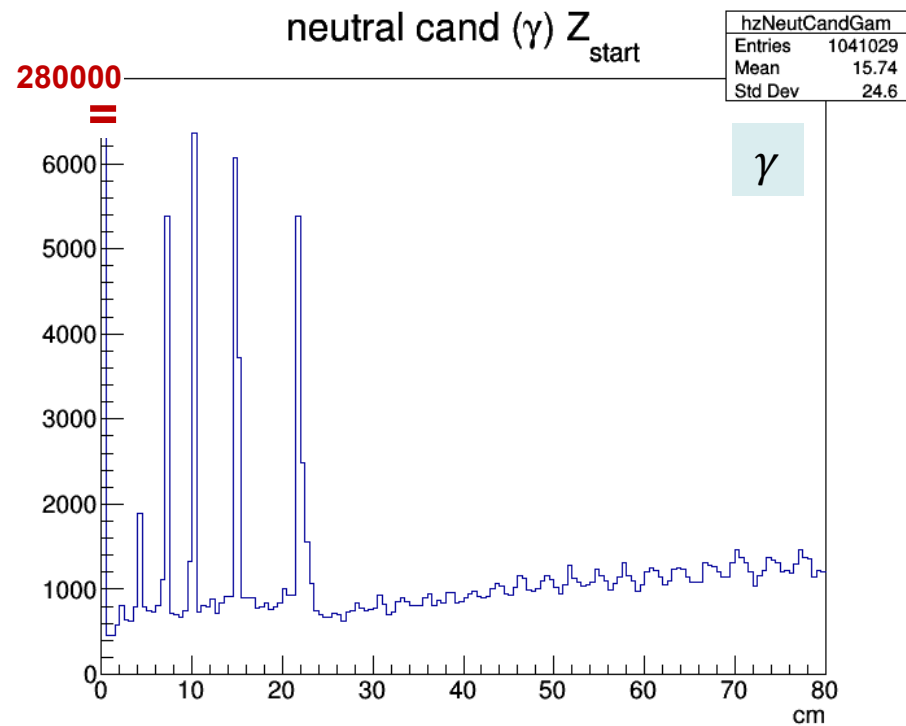
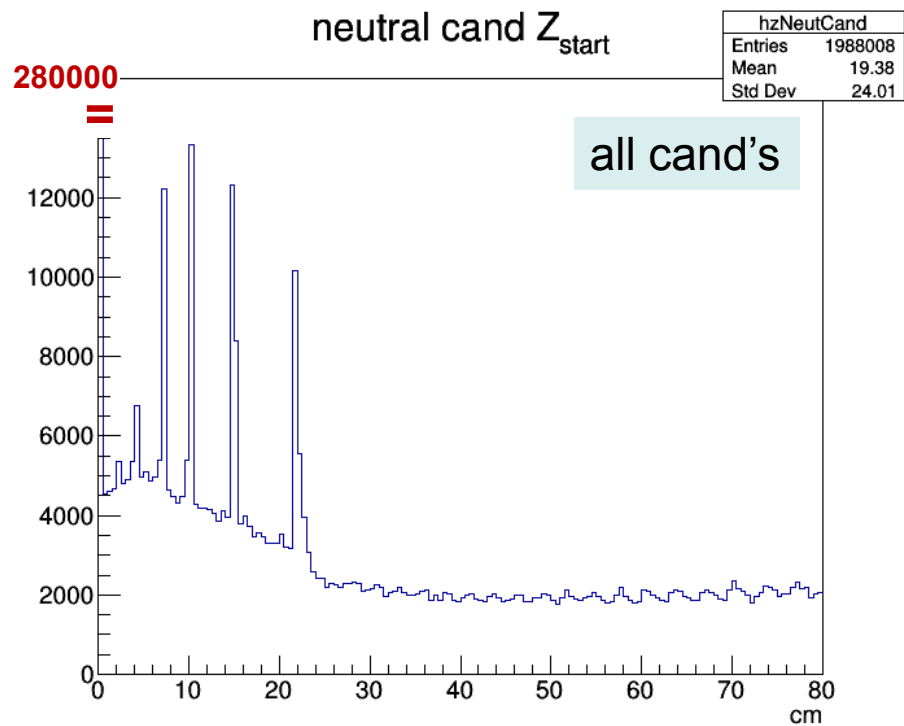
hrNeutCandPi	
Entries	207189
Mean	22.57
Std Dev	24.82



neutral cand (protons) R

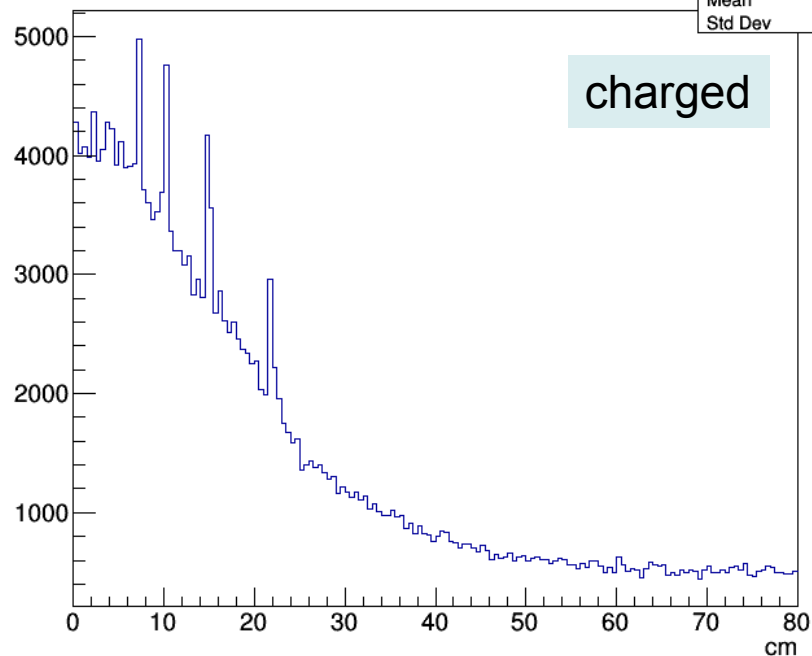
hrNeutCandProt	
Entries	67069
Mean	22.9
Std Dev	24.1



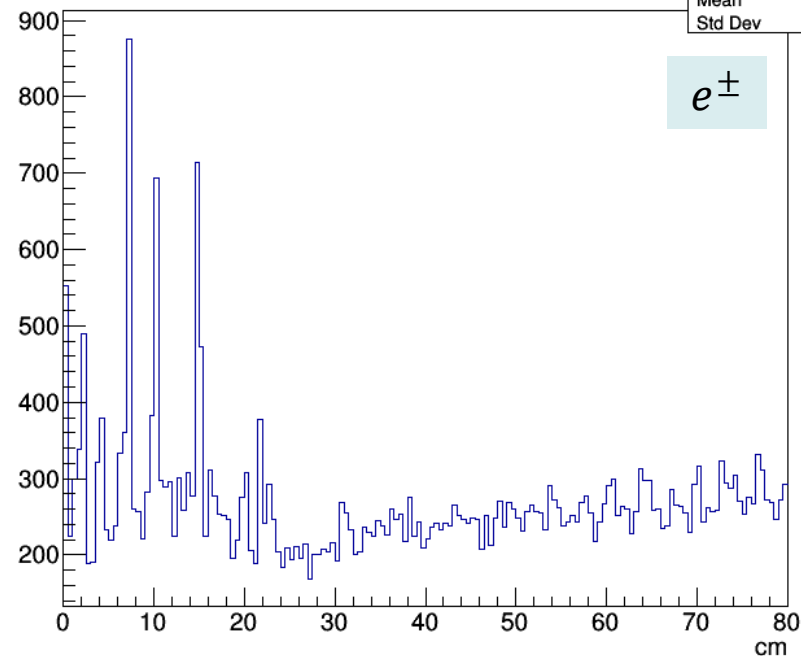


neutral cand (chg'd) Z<sub>start</sub>

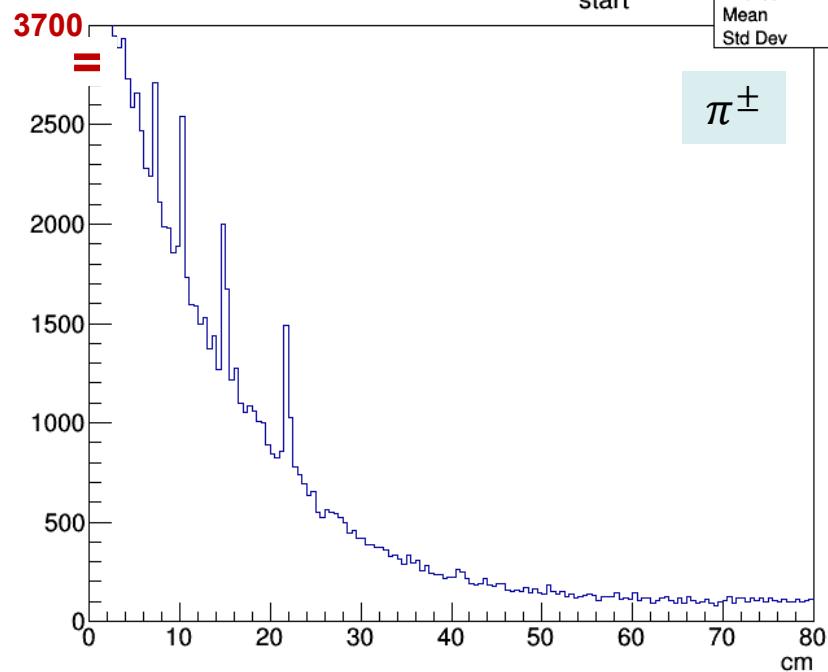
hzNeutCandChgd	
Entries	500195
Mean	22.84
Std Dev	20.4

neutral cand (electrons) Z<sub>start</sub>

hzNeutCandEl	
Entries	134089
Mean	38.68
Std Dev	24.18

neutral cand ( $\pi$ ) Z<sub>start</sub>

hzNeutCandPi	
Entries	207189
Mean	16.08
Std Dev	16.6

neutral cand (protons) Z<sub>start</sub>

hzNeutCandProt	
Entries	67069
Mean	21.06
Std Dev	16.17

