e+D Full Simulations with BeAGLE Events

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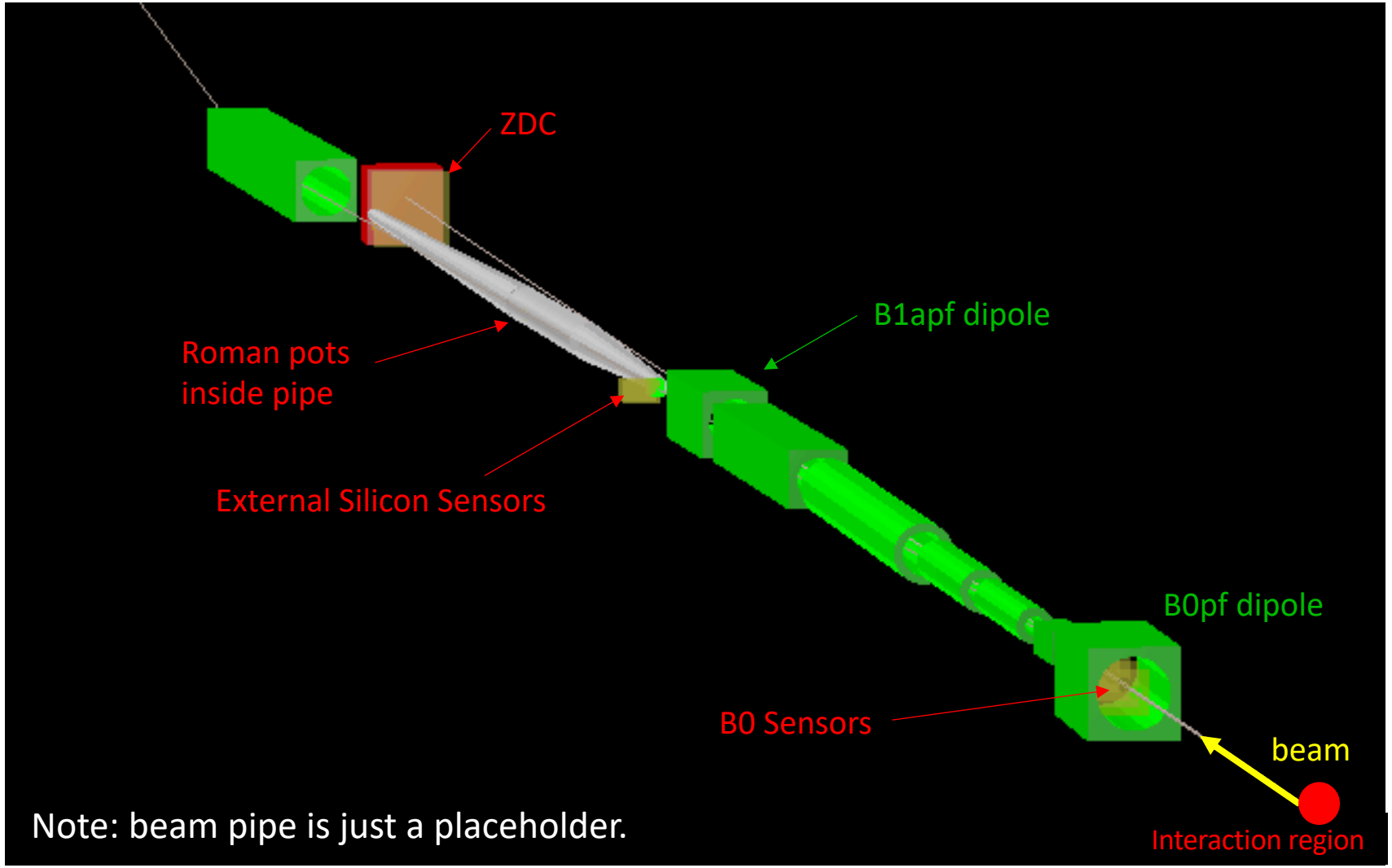
4/16/2020

Preliminaries

- 18 (GeV) x 135 (GeV/n) e+D events with BeAGLE.
- Results for neutron spectator and proton spectator shown separately.
- ZDC: $\sigma_E \sim \frac{50\%}{\sqrt{E}} + 5\%, \sigma_\theta \sim \frac{3\ mrad}{\sqrt{E}}$
- External Silicon Sensors: $500um\ x\ 500um$ pixels
- B0: $50um\ x\ 50um$ pixels
- Angular divergence numbers from “high acceptance – 18x275 GeV – full scope” portion of “eRHIC parameters v6.0” table.
- Beam energy spread $\sim 10^{-4}$
- Vertex smearing (to simulate the crab cavity effect)

Simulation Apparatus

- EicRoot with GEANT4
- Includes ZDC, B0 sensors, Roman Pots, and External Silicon Sensors for particles with different rigidity.



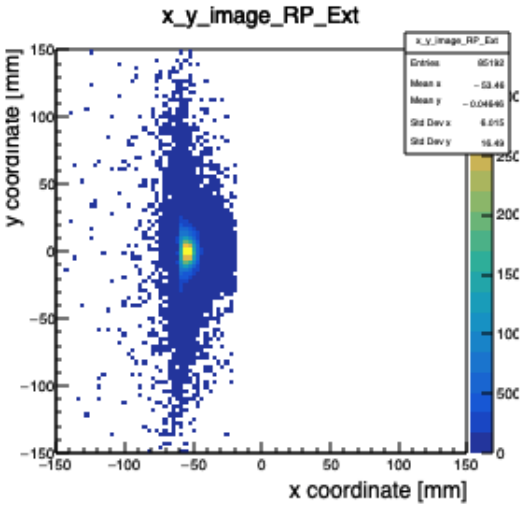
Proton Spectator

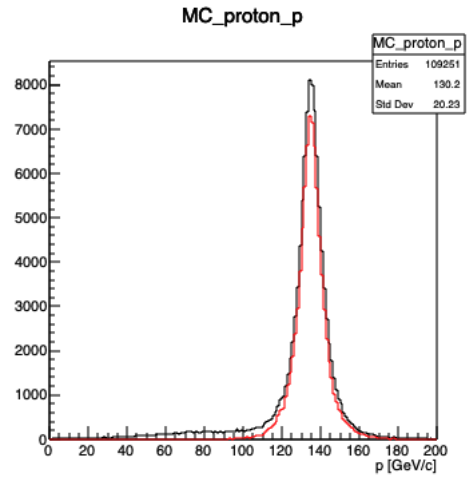
Proton Spectator

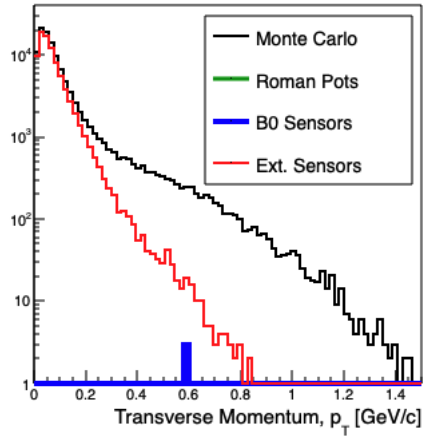
Monte-Carlo Gen.

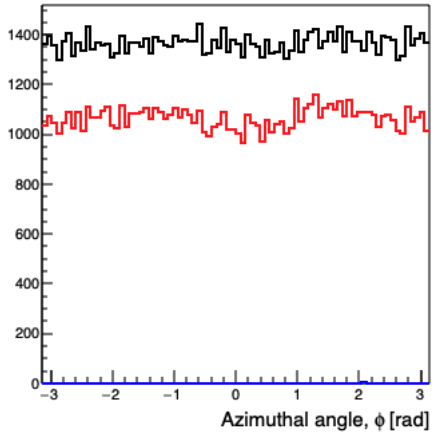
Reconstructed

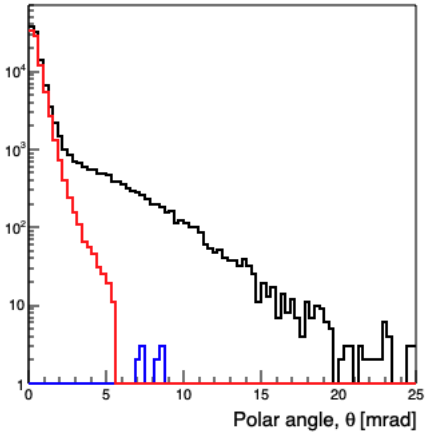
Protons



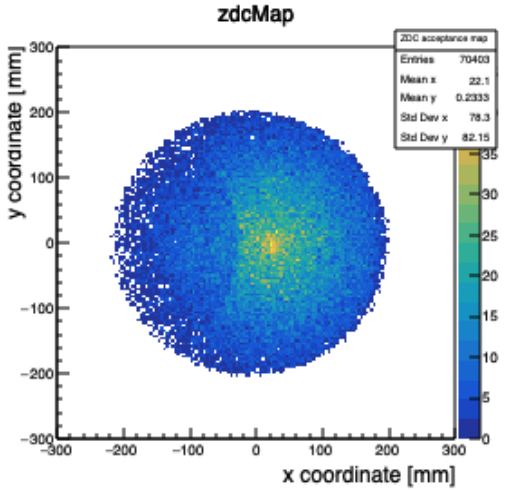


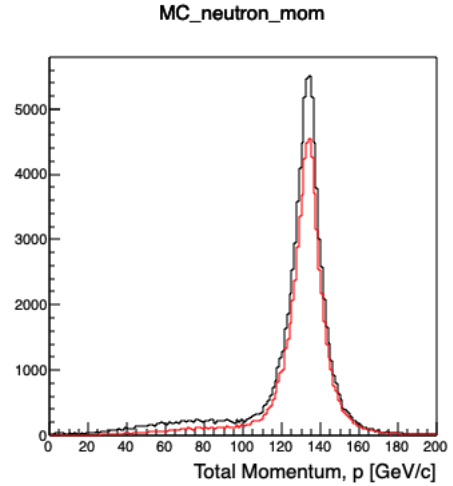


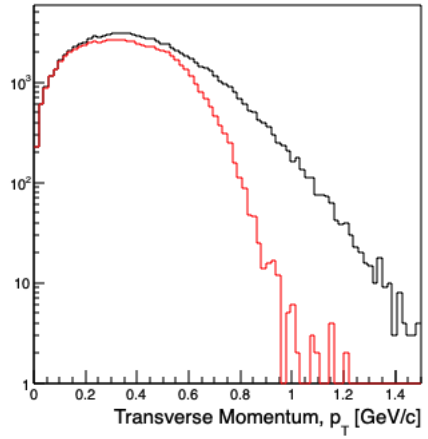


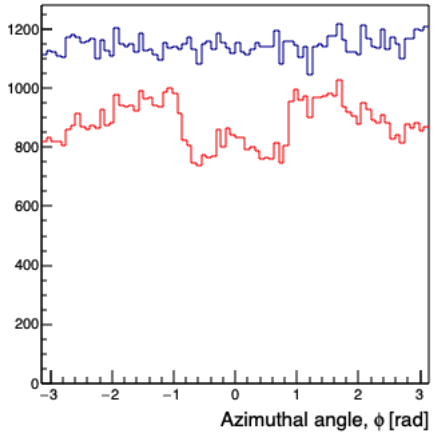


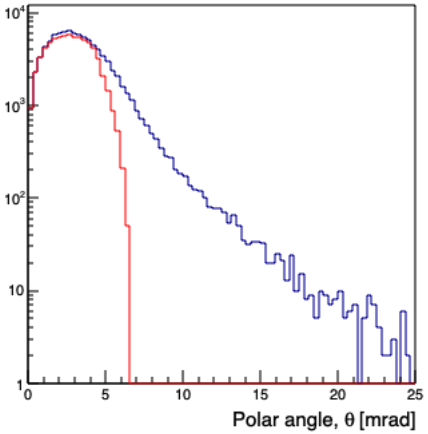
Neutrons



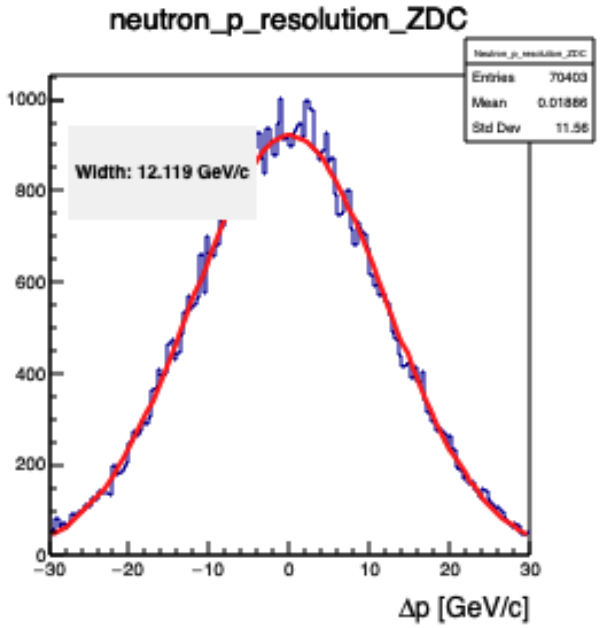


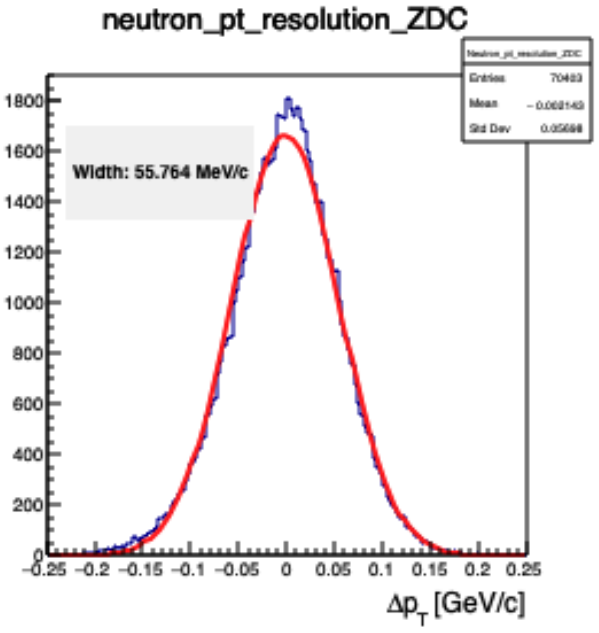


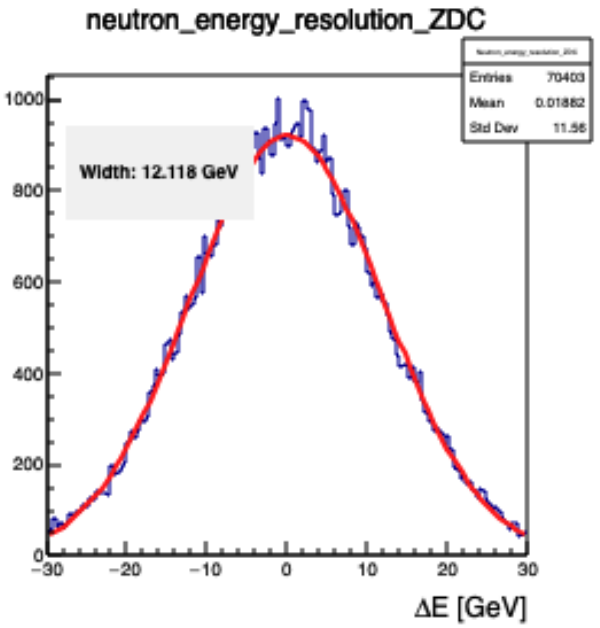


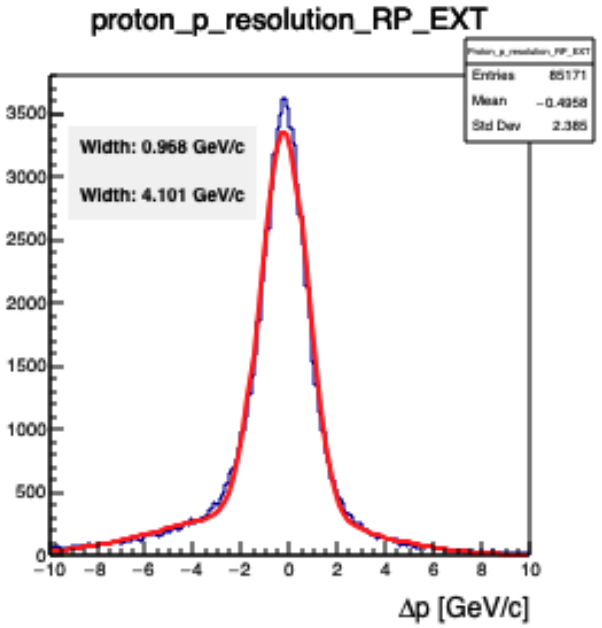


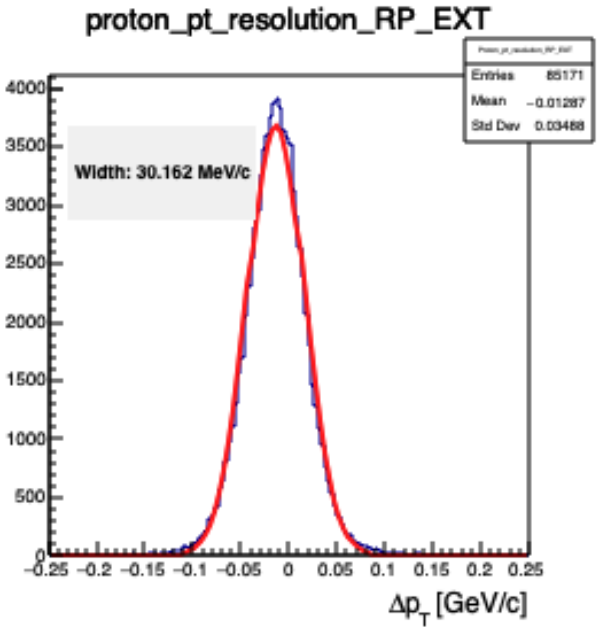
Proton Spectator











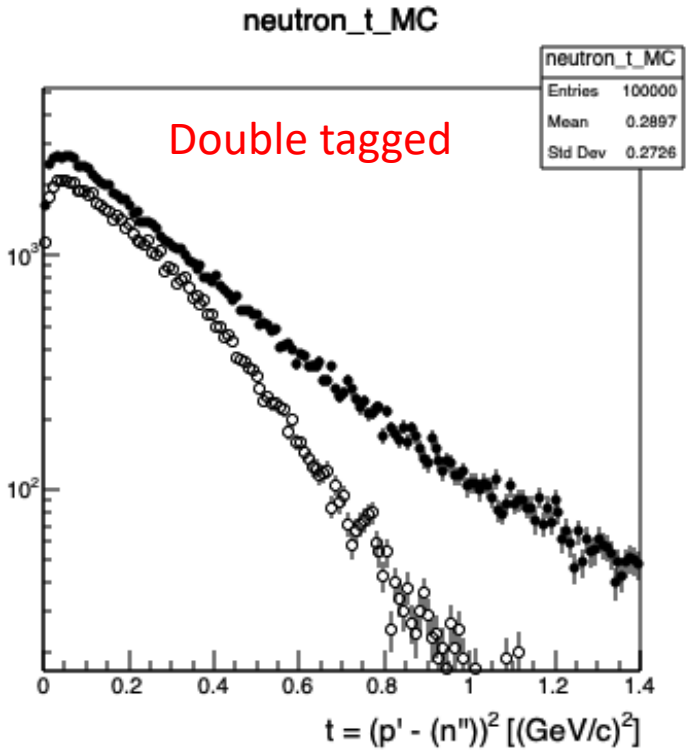
The widths calculated here include all of the smearing contributions mentioned earlier.

The percent resolution vs. pt will be shown later, as well as a table summarizing the individual contributions.

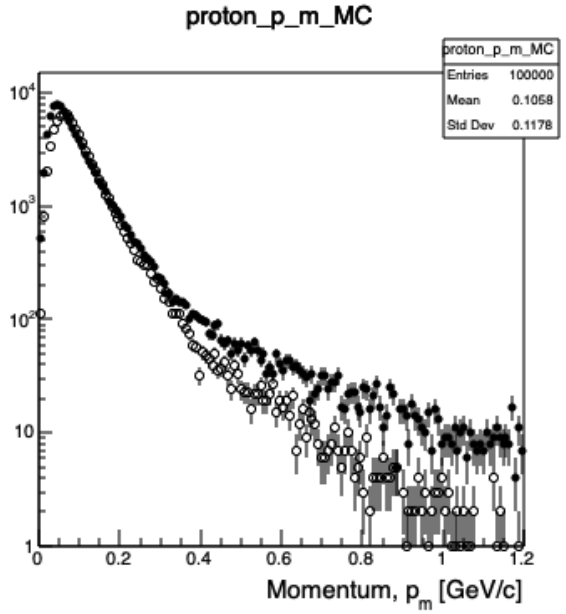
Proton Spectator

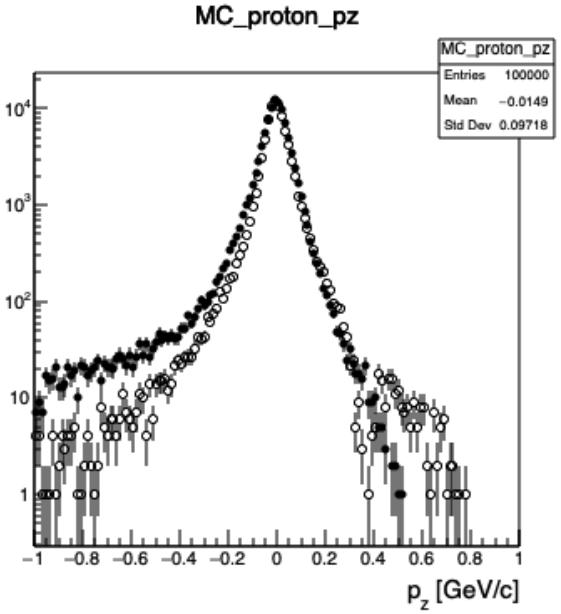
- Monte-Carlo Gen.
- Reconstructed

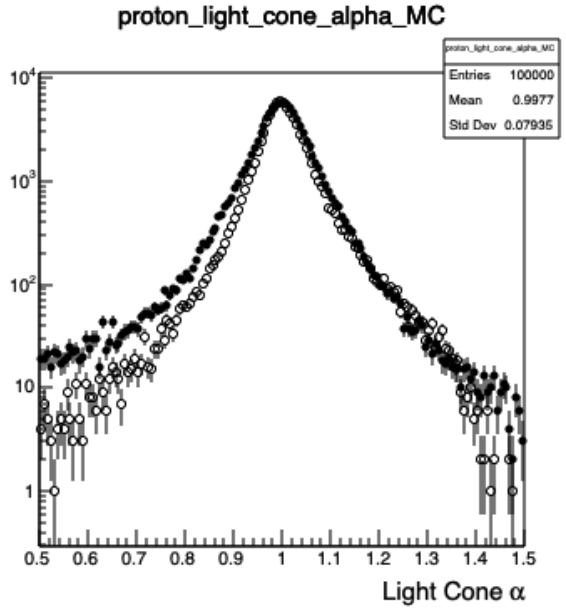
- Acceptance for double-tagging could be *slightly* improved when the Roman Pots are included, and when the detector solenoid are included.
- Effects of smearing can be seen by inspection in many plots, but quantifying the effect on physics depends on what you are extracting.

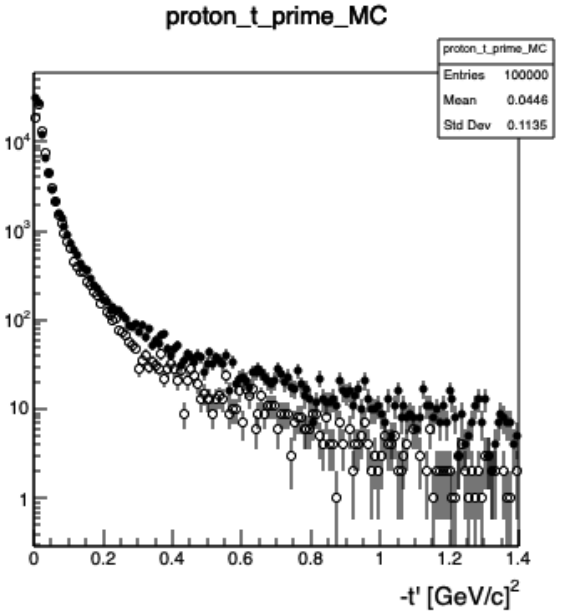


Proton tagged

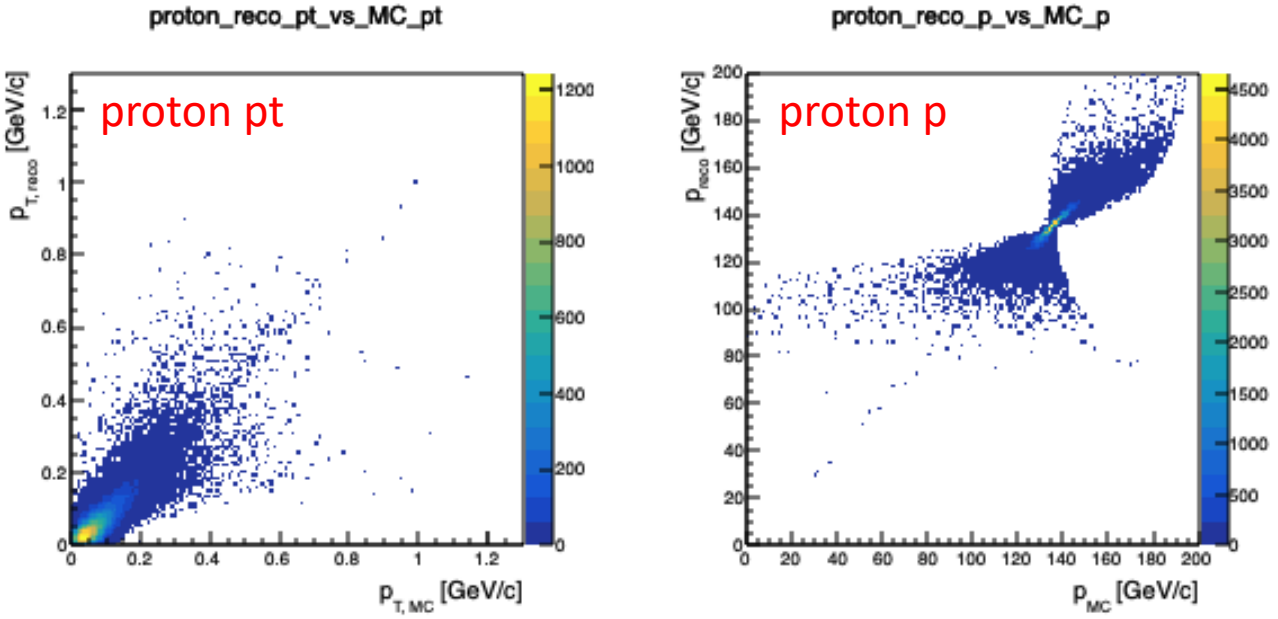


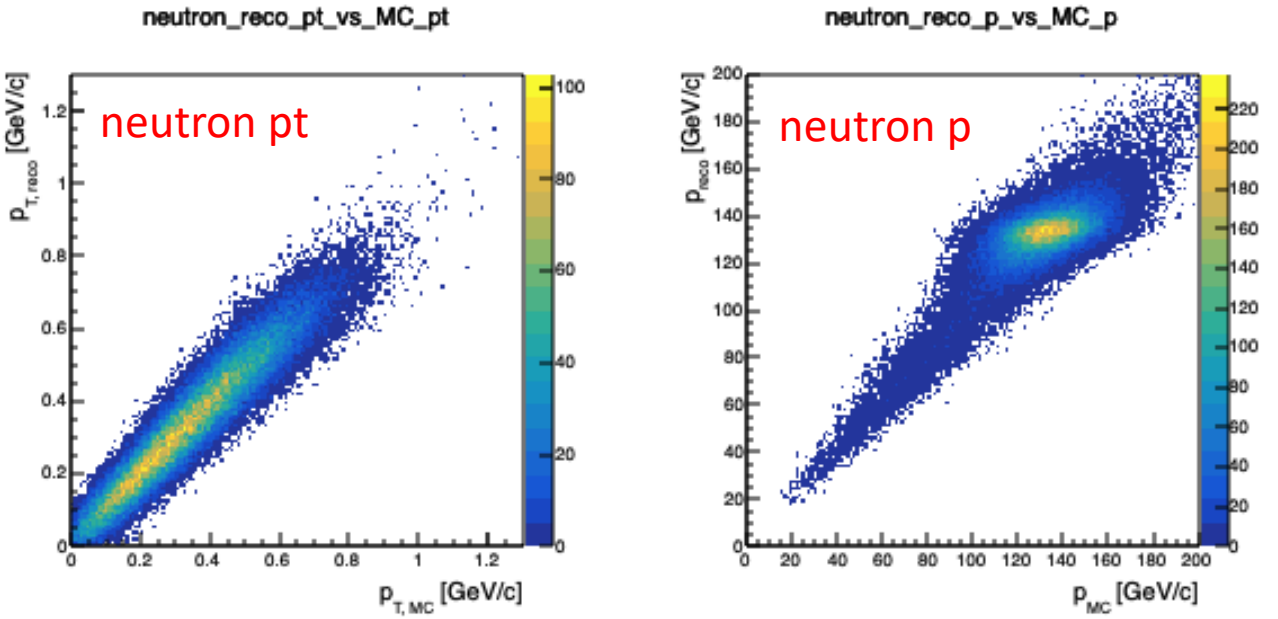






Proton Spectator





- The protons that are significantly off energy start to have issue with the tracking since they are more strongly affected by the edge of quadrupole fields.
- Neutrons fall nicely on a straight line, with the width driven by the detector smearing.

Neutron Spectator

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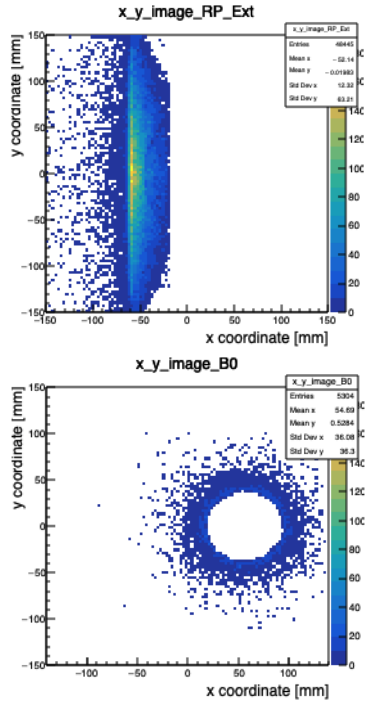
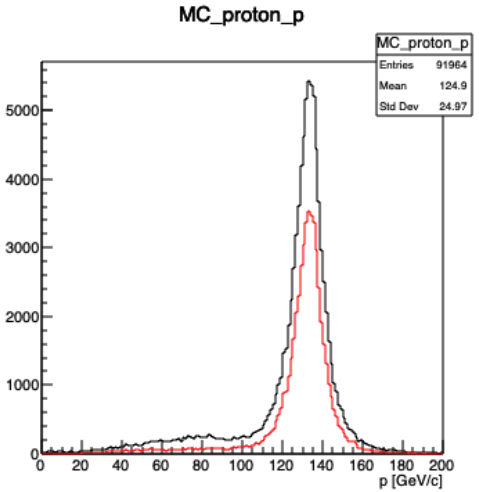
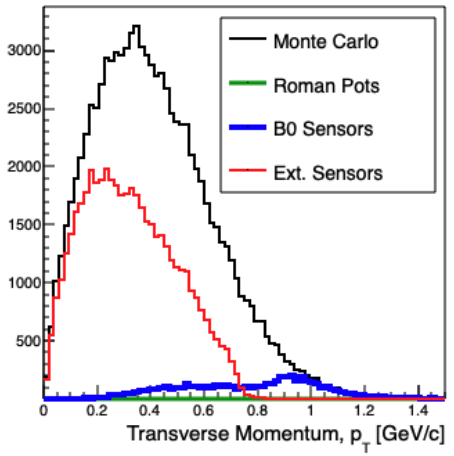
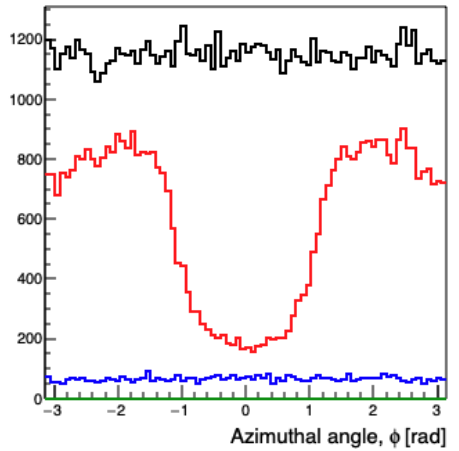
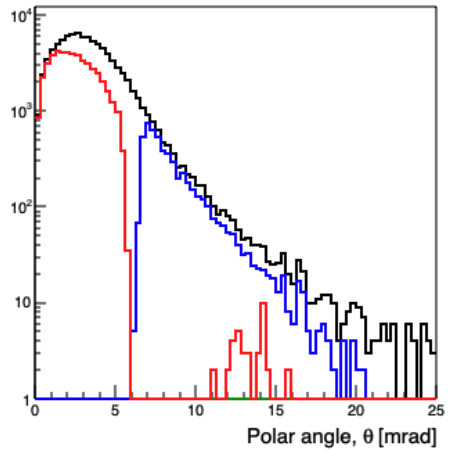


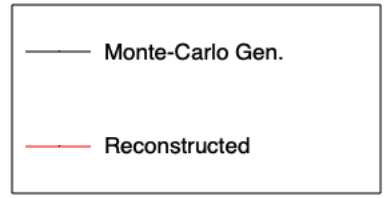
Protons



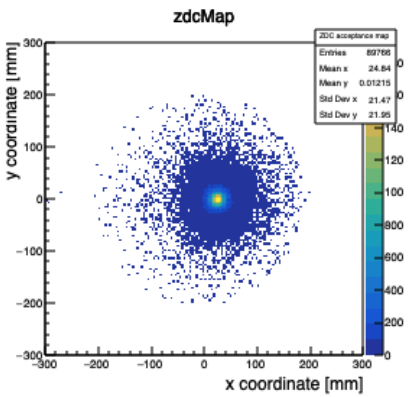


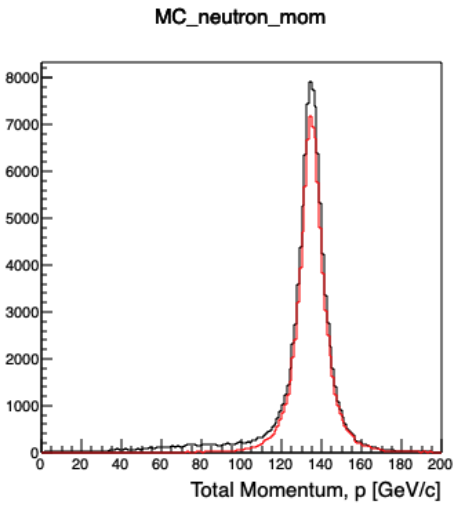


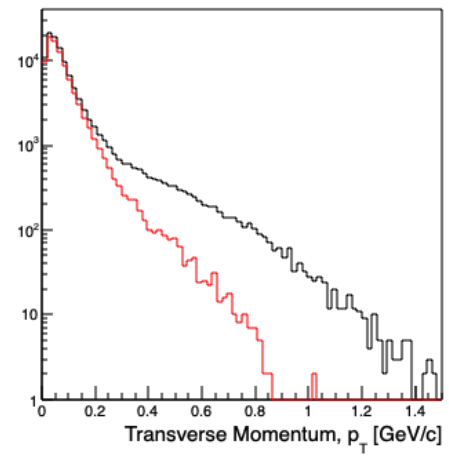


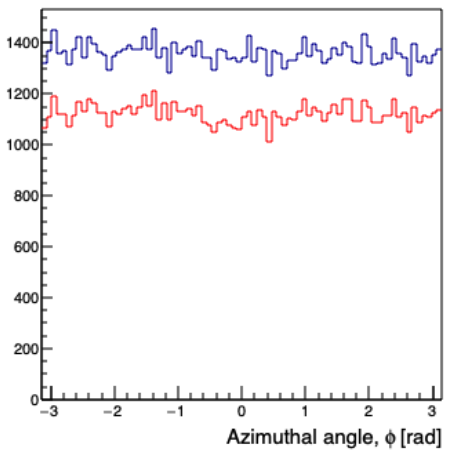


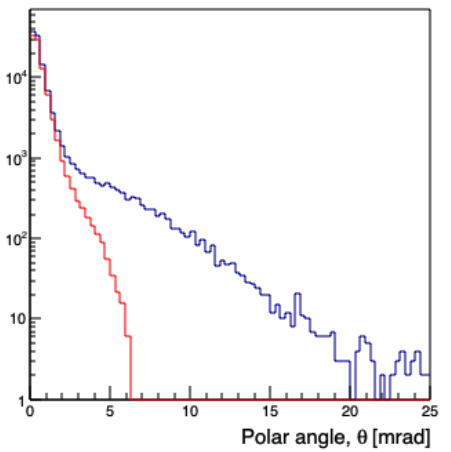
Neutrons



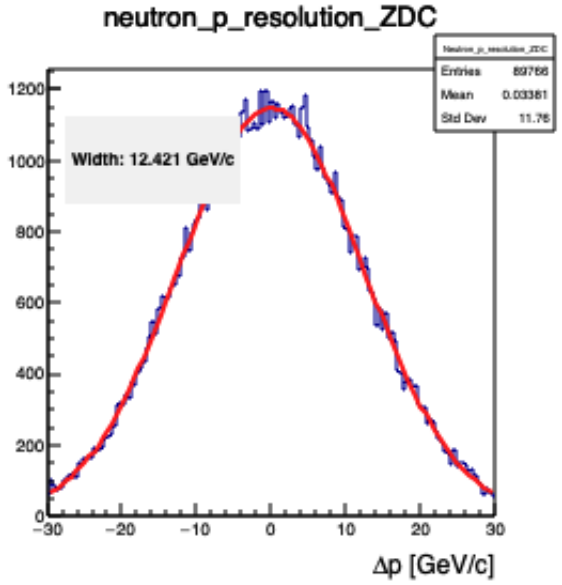


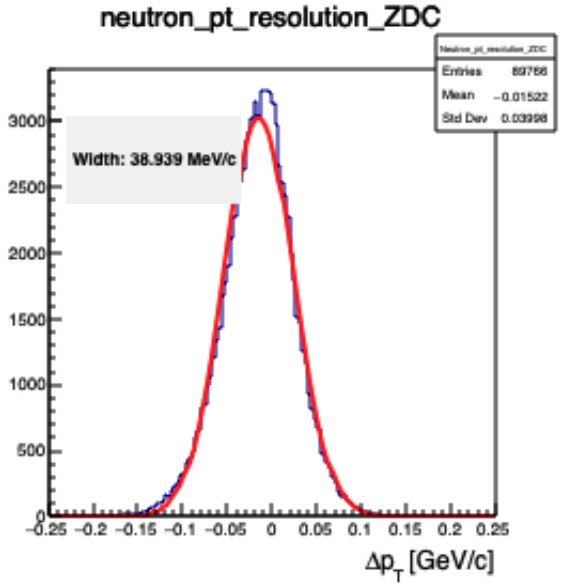


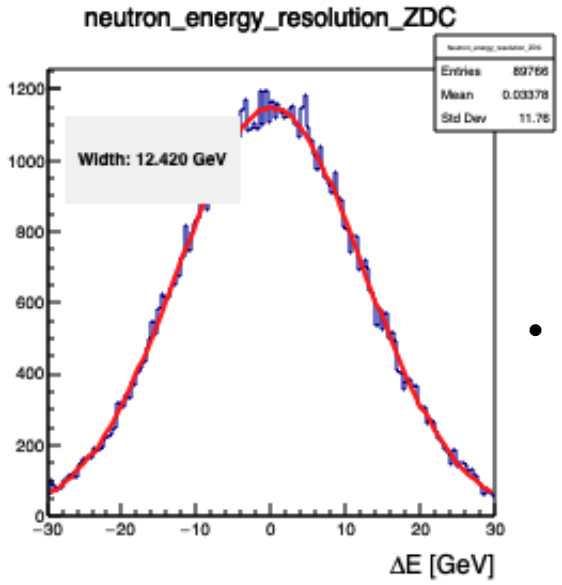




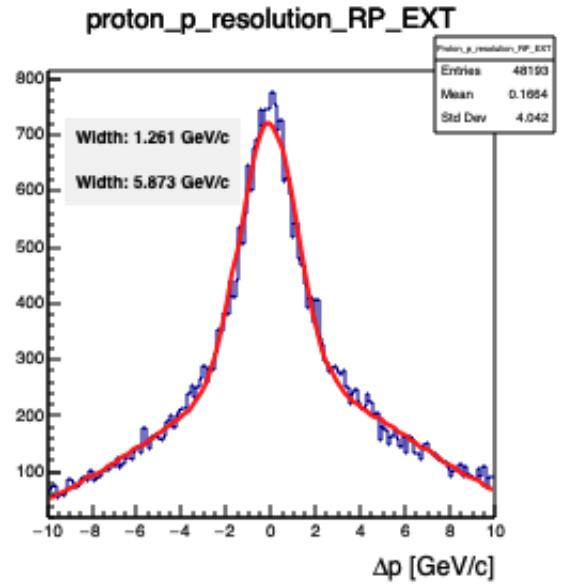
Neutron Spectator

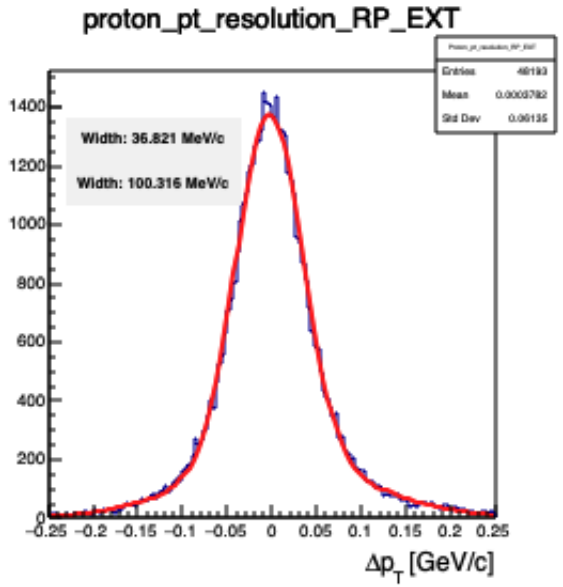


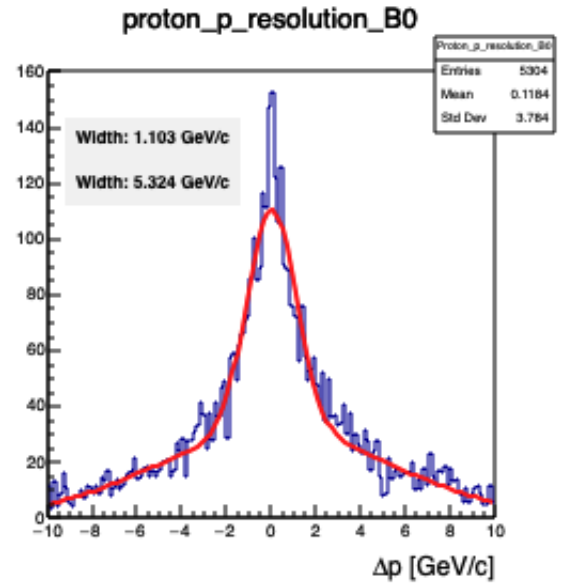


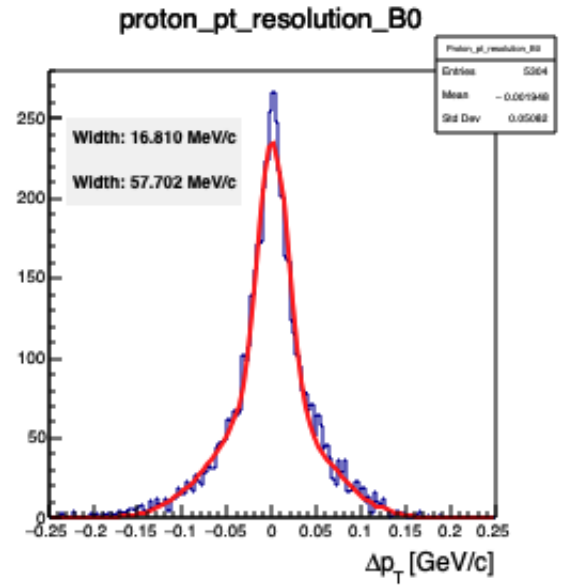


- More off-energy protons adds some different effects in the proton smearing. I have used two Gaussians to fit these distributions.









Neutron Spectator

- Monte-Carlo Gen.
- Reconstructed

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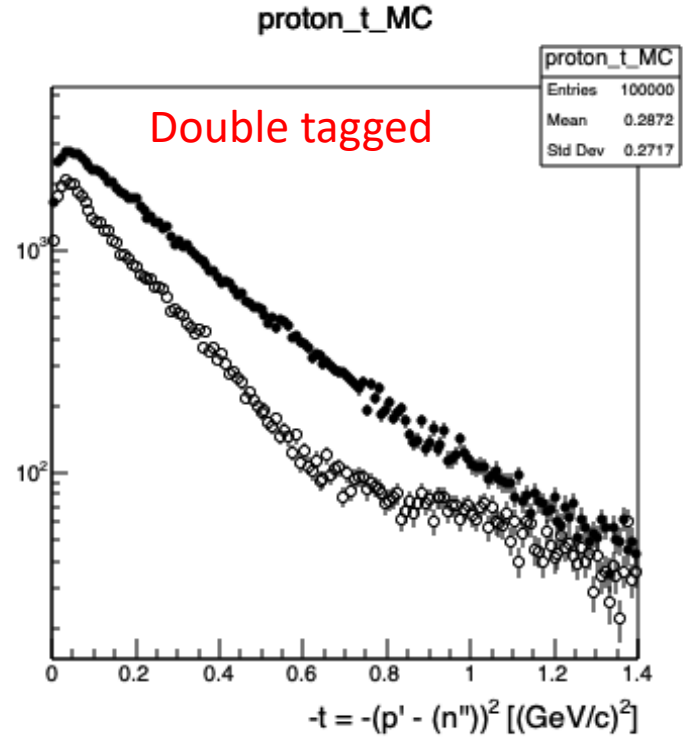
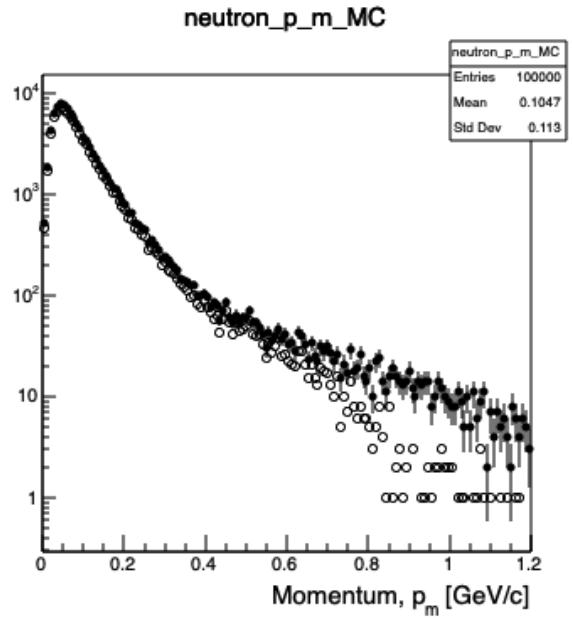
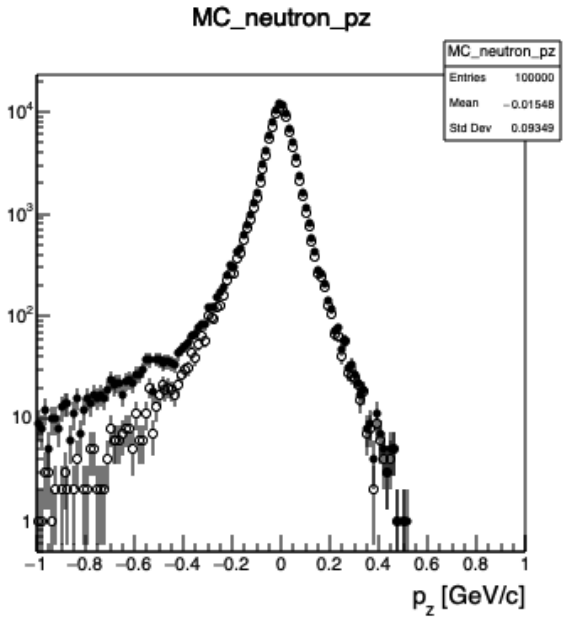
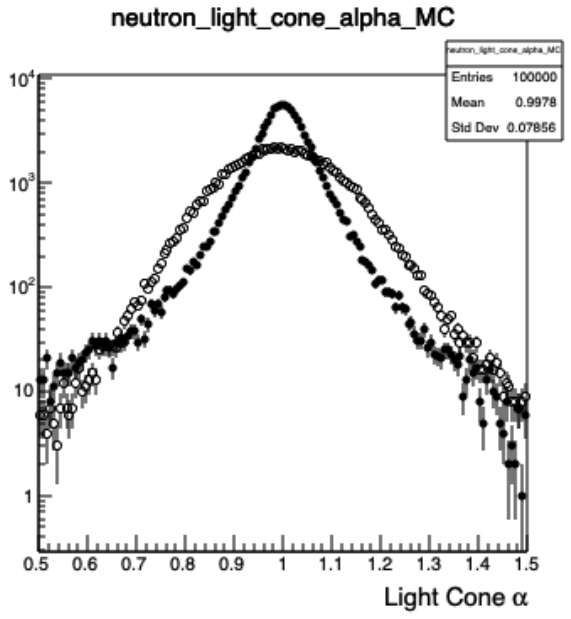
- Effects of smearing can be seen by inspection in many plots, but quantifying the effect on physics depends on what you are extracting.

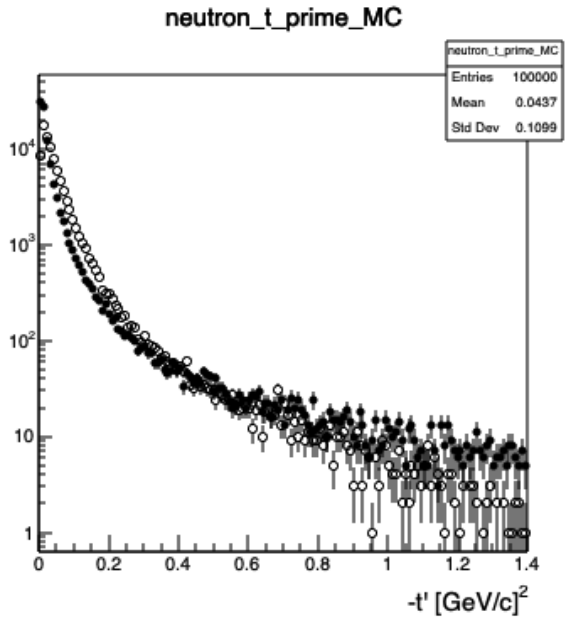


Neutron tagged

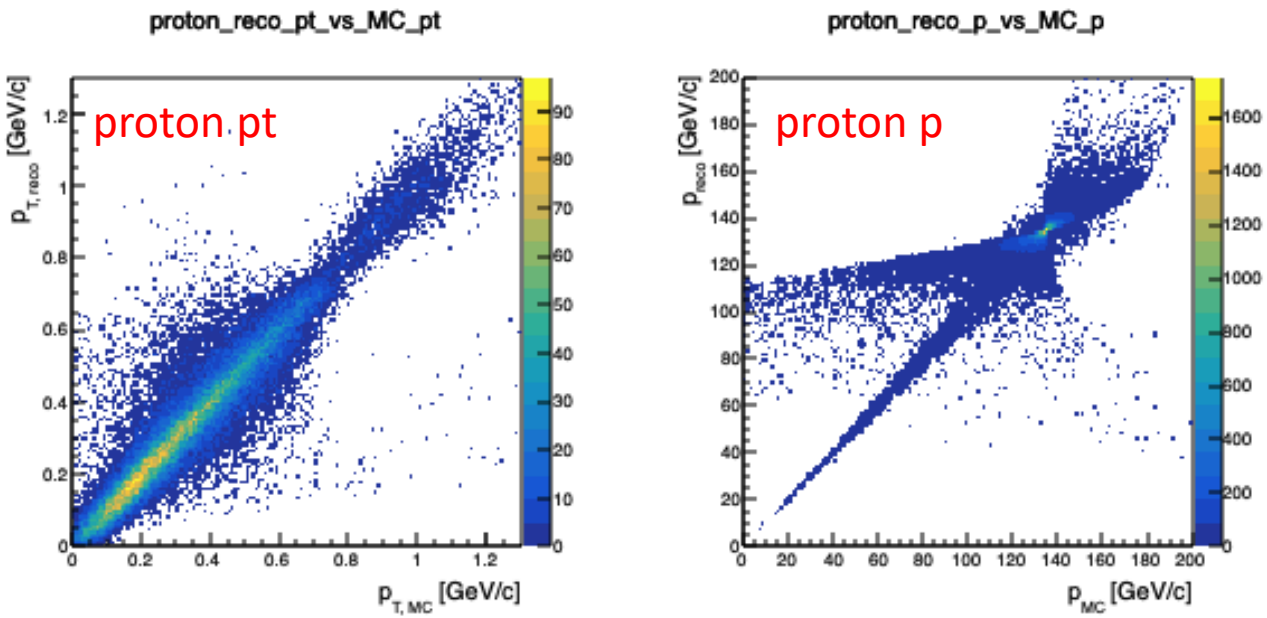


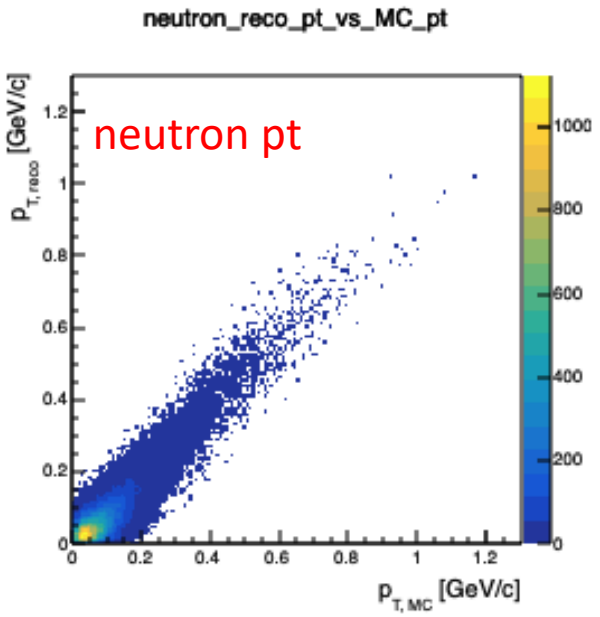


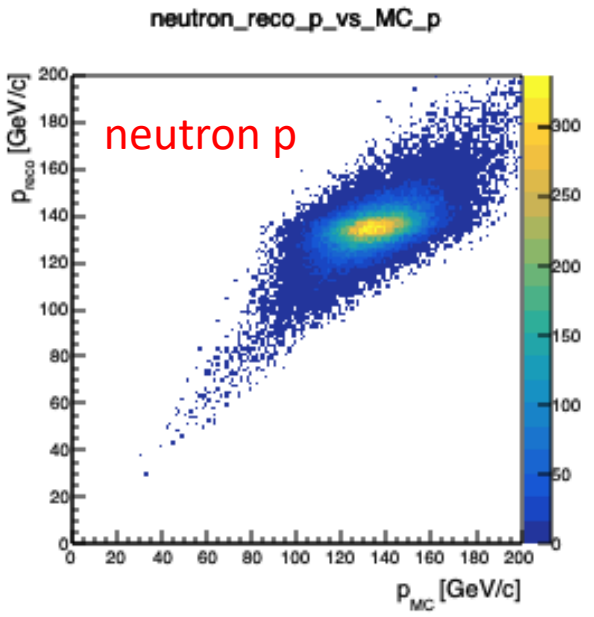




Neutron Spectator

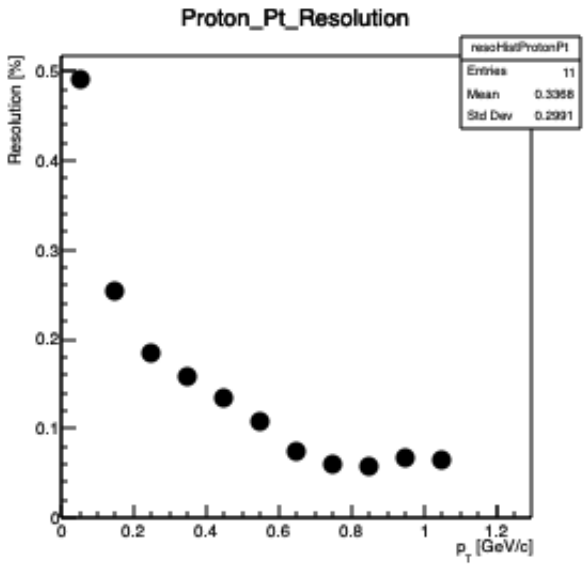


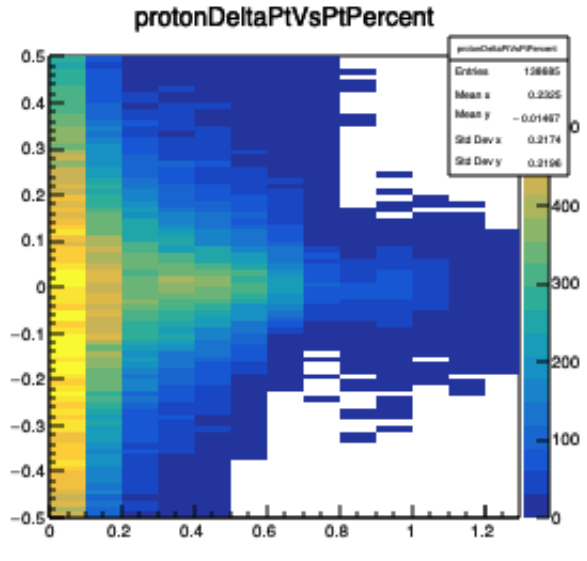




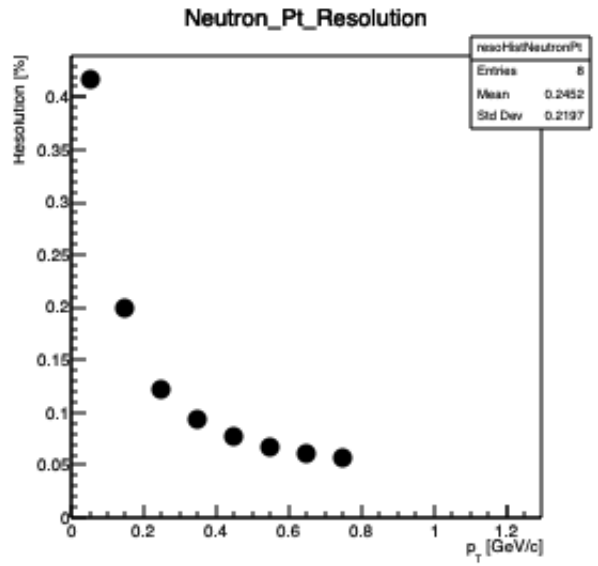
- The protons that are significantly off energy start to have issue with the tracking since they are more strongly affected by the edge of quadrupole fields.
- Neutrons fall nicely on a straight line, with the width driven by the detector smearing.

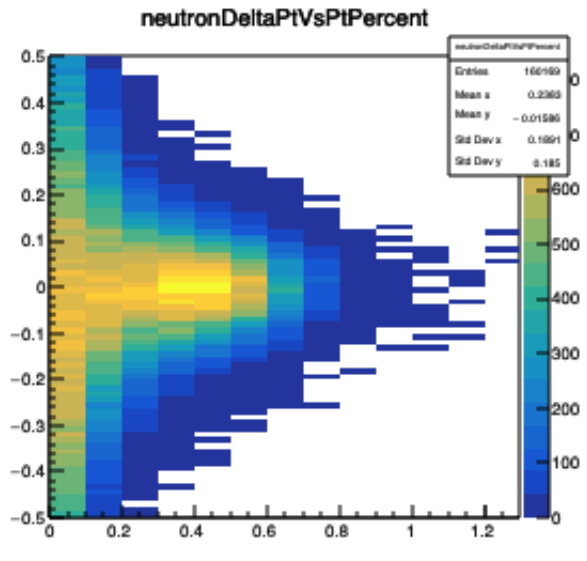
Total Resolutions





protons (both cases combined)





neutrons (both cases combined)

Table of smearing contributions

[MeV/c]	Angular Divergence	Crab Cavity (vtx. smearing)	Beam Energy Spread	Pixel Size	E Res./Ang.Res.	Reco. Smearing (transport matrix)	Notes
Proton (external sensors)	~30	~13	< nominal smearing*	~10	N/A	~7	Severely off energy particles have worse smearing overall.
Neutron	~30	~13	< nominal smearing*	N/A	35-50	N/A	In the struck case, we have more lower-p neutrons, which will provide a larger contribution from E res. smearing.

Total for protons in ESS ~30 MeV/c with proton spectators, ~48 MeV/c for struck protons.
Total for neutrons is ~38 MeV/c for spectators, ~ 55 MeV/c for struck neutrons.

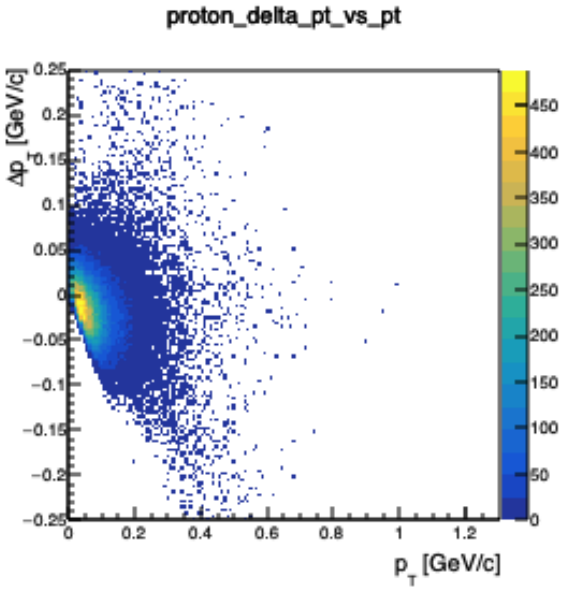
*Nominal smearing: smearing without any effects included. ~0 for neutrons, ~3 MeV/c for protons in ESS.

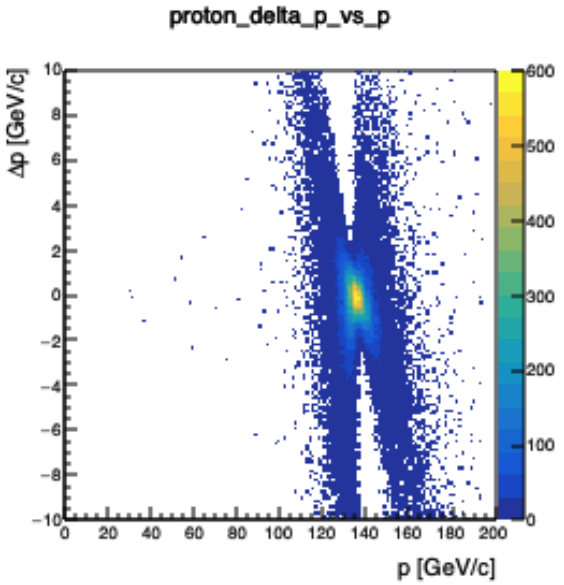
Summary

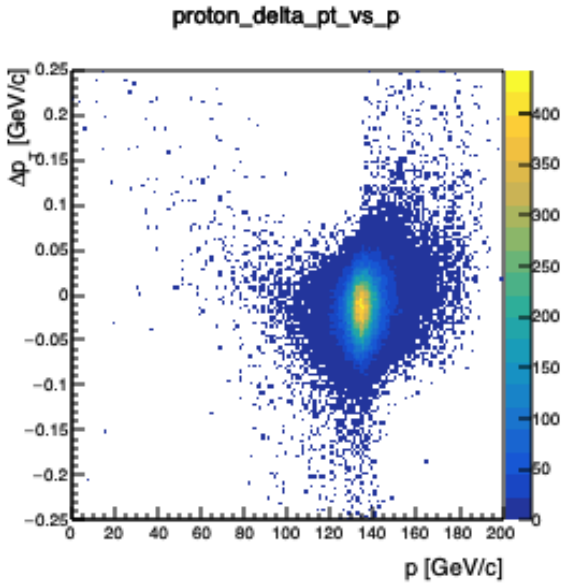
- A comprehensive study of the acceptance and resolution of protons and neutrons from e+D nuclear breakup events in BeAGLE is now very mature.
  - Beam effects included, magnets/yokes included, etc.
- Need a few more days to do final checks, clean up plots, etc.
- Outlook
  - Energy dependence (i.e. lower energy configuration) could be studied.
  - e+He3 also needs a similar treatment.
  - What else?

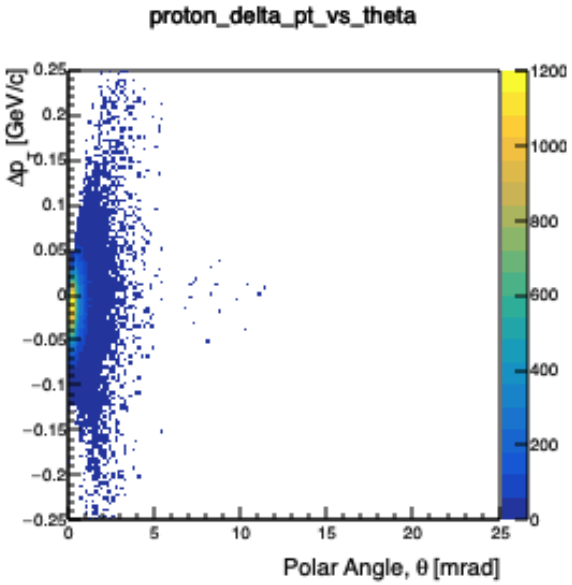
Backup

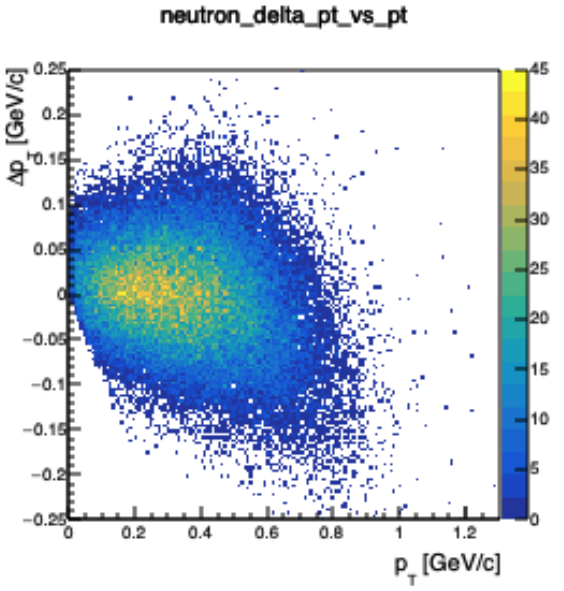
Proton Spectator

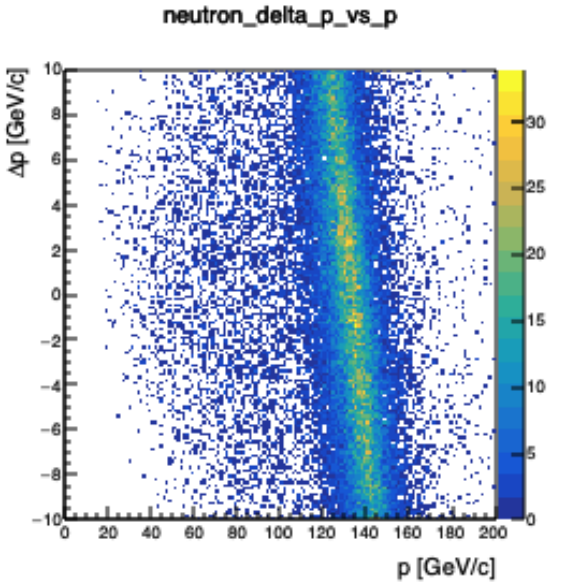


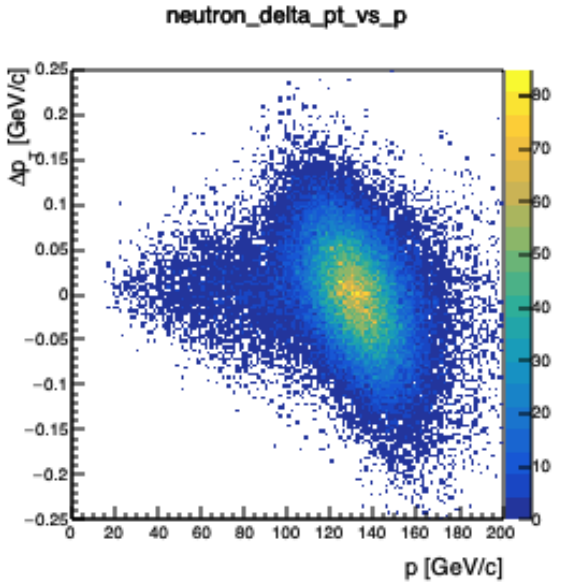


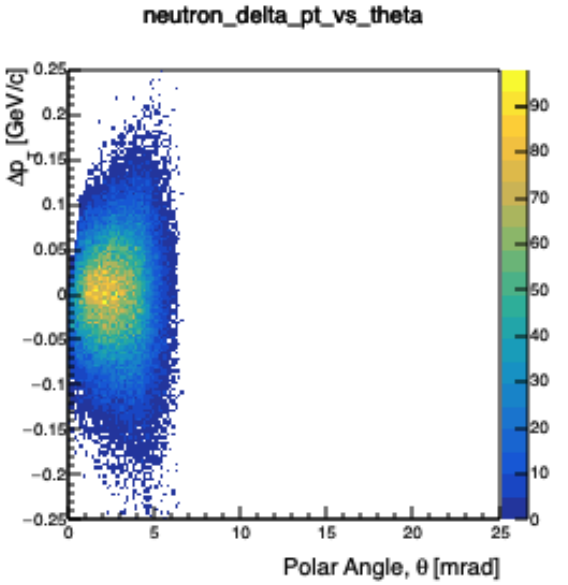












Neutron Spectator