

Effect of 50cm Lattice Shift on FF Acceptances

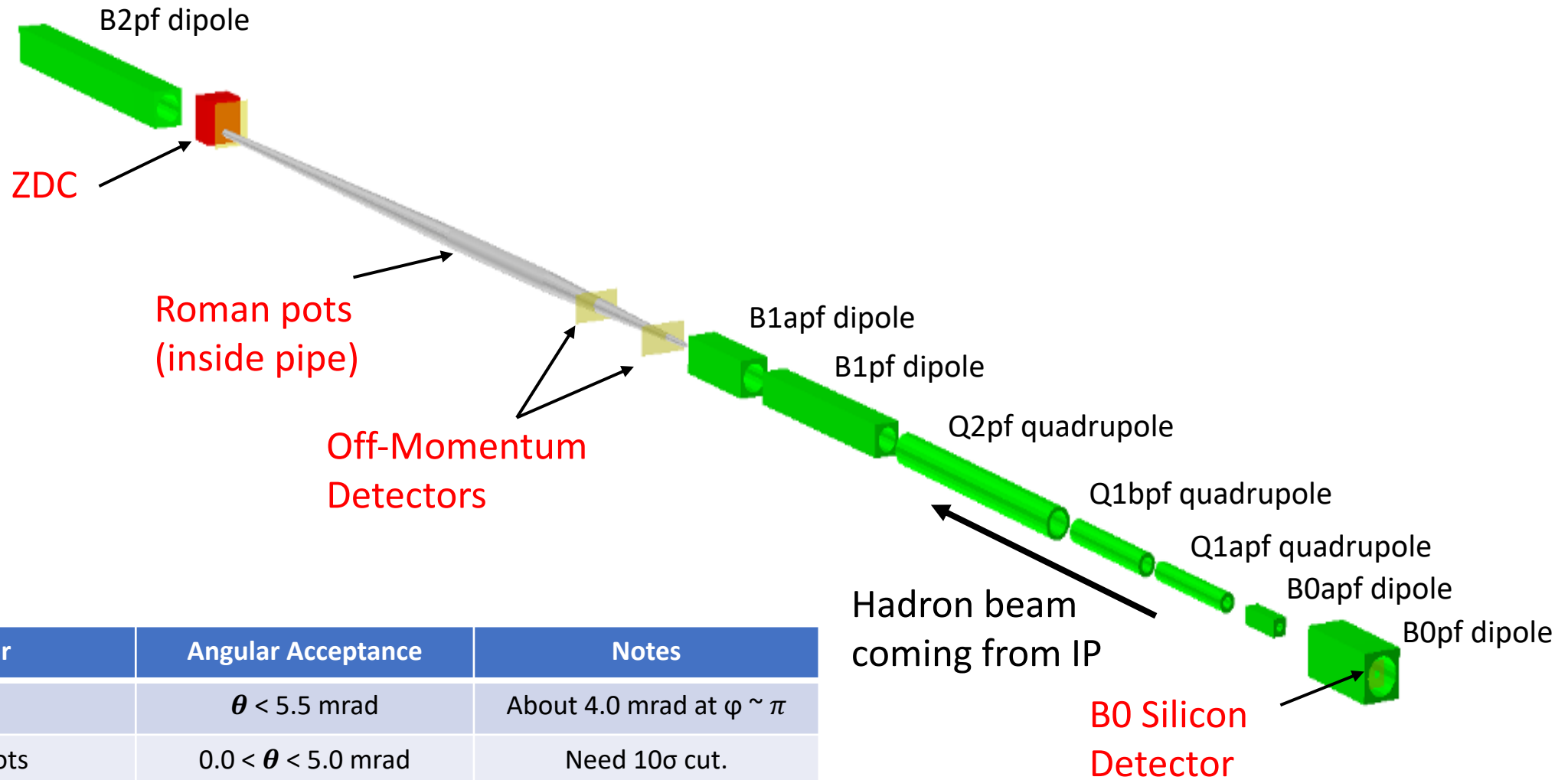
Alex Jentsch

9/10/2020

Preliminaries

- I will compare the particle scan done for the Yellow Report to study the overall acceptances in the FF IR region.
 - Particle gun using protons (neutrons not shown).
 - Magnets set to top proton energy setting (275 GeV).
 - Proton momentum sampled in $0 < p < 275 \text{ GeV}/c$
 - Particles sampled symmetric in phi, and polar angle $0 < \theta < 20 \text{ mrad}$.
- Three proton detectors for capturing protons with different scattering angles and momenta.
- I have NOT yet shifted detectors.

IR & Detector Layout

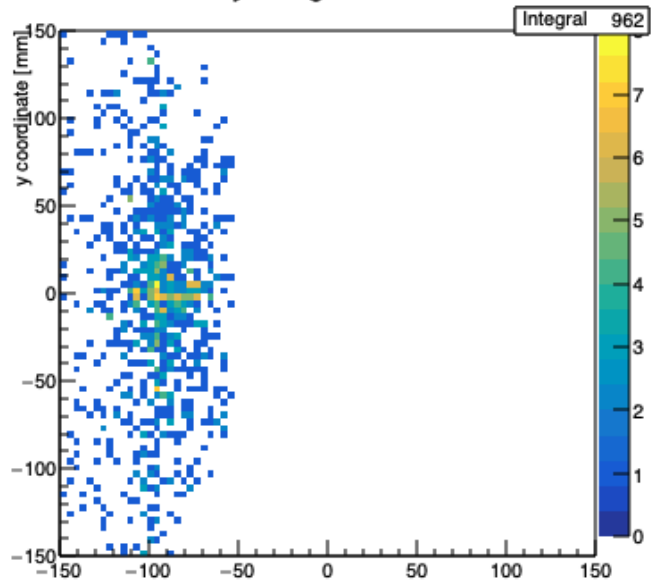


| Detector | Angular Acceptance | Notes |
|------------------------|-----------------------------------|--------------------------------------|
| ZDC | $\theta < 5.5$ mrad | About 4.0 mrad at $\varphi \sim \pi$ |
| Roman Pots | $0.0 < \theta < 5.0$ mrad | Need 10σ cut. |
| Off-Momentum Detectors | $0.0 < \theta < 5.0$ mrad | Roughly $.4 < x_L < .6$ |
| B0 Sensors | $5.5 < \theta < 13.0 - 20.0$ mrad | Still need to optimize. |

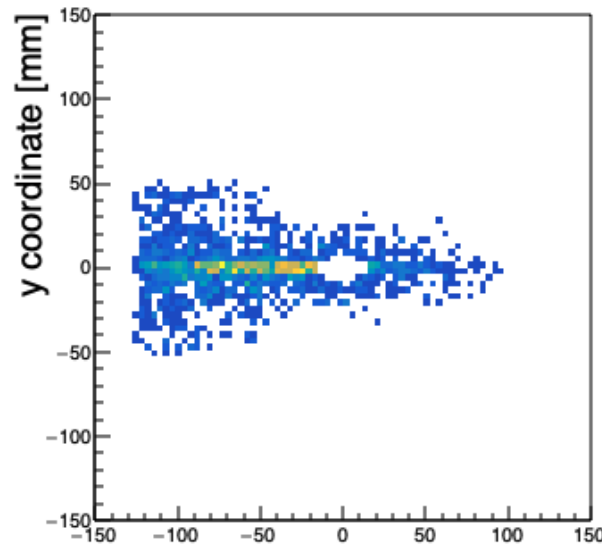
$$x_L = \frac{p_{z,nucleon}}{p_{z,beam}}$$

Comparisons – detector acceptance images

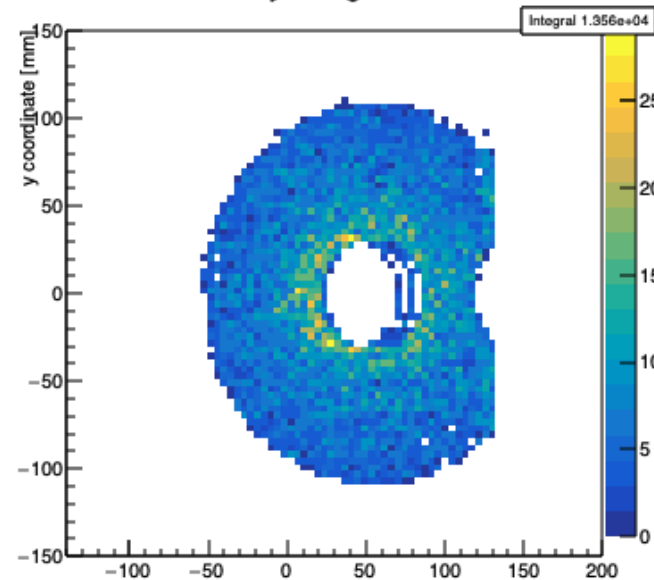
x_y_image_RP_Ext



x_y_image_RP

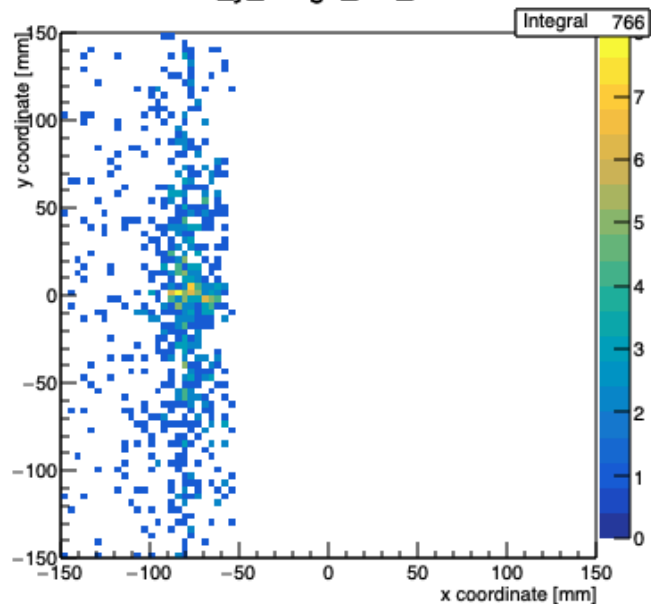


x_y_image_B0

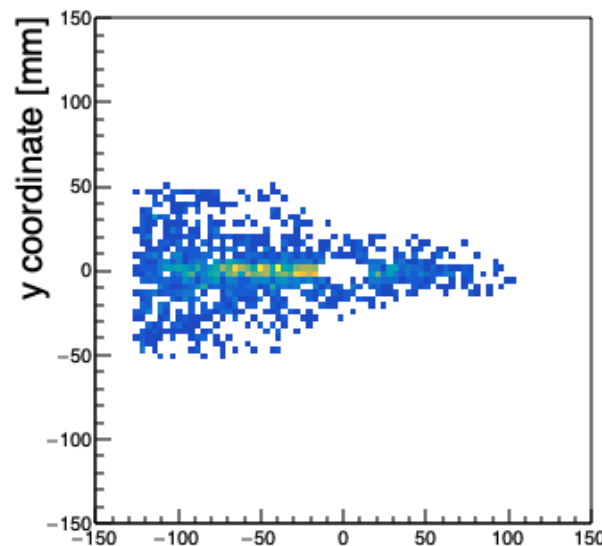


Original IR

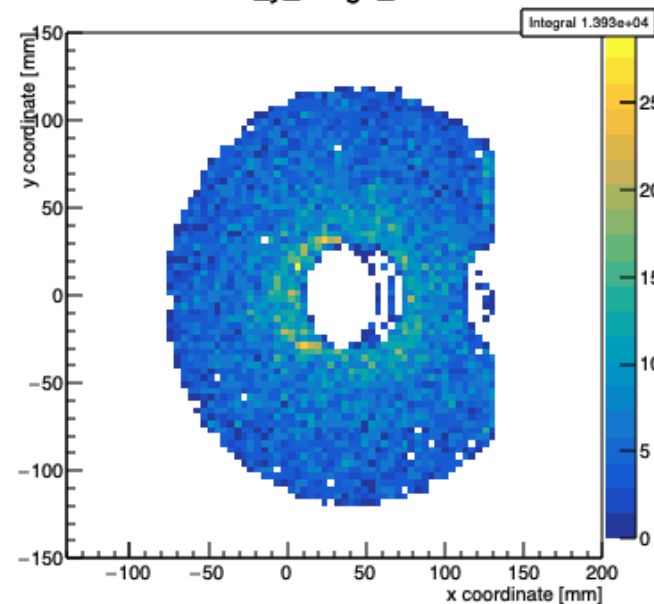
x_y_image_RP_Ext



x_y_image_RP

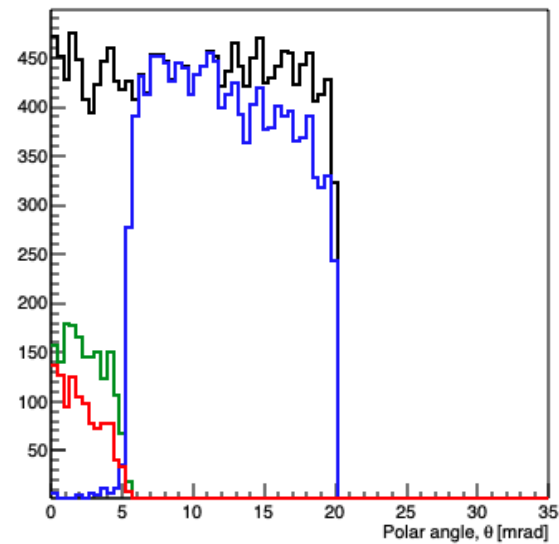
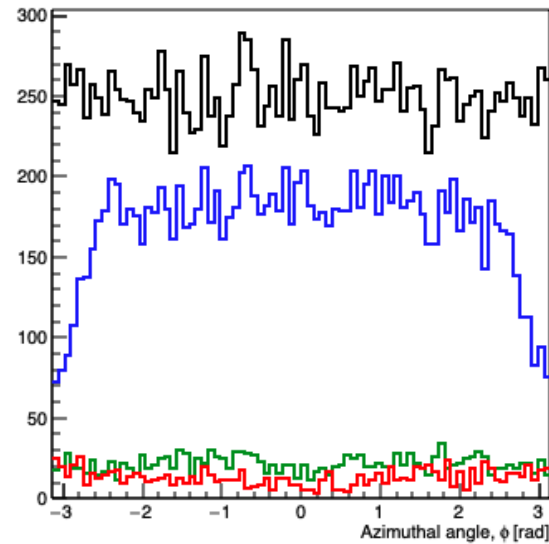
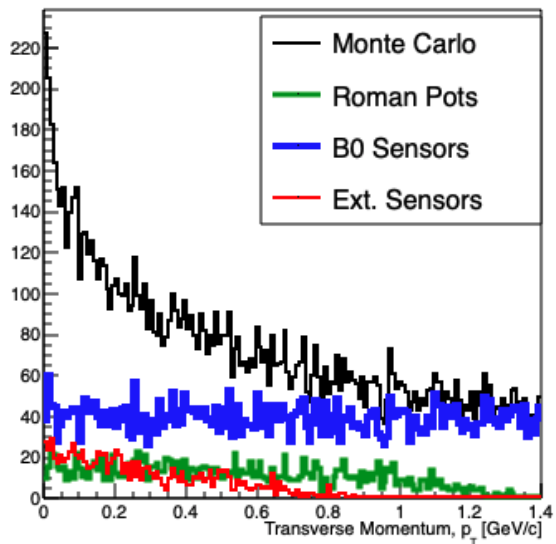


x_y_image_B0

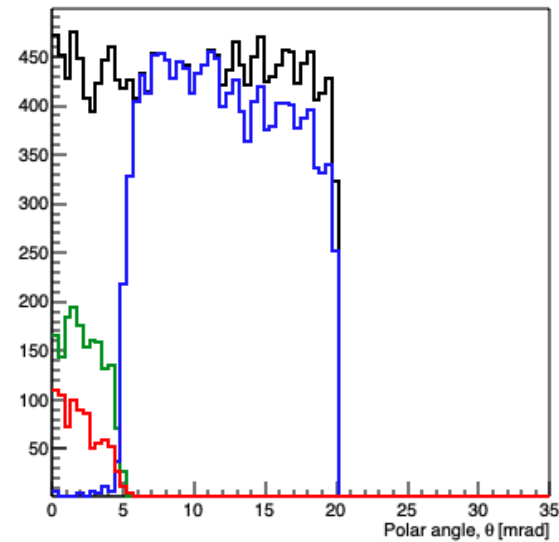
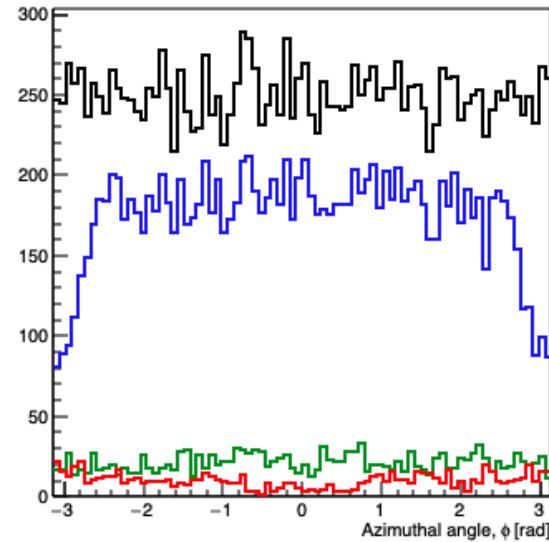
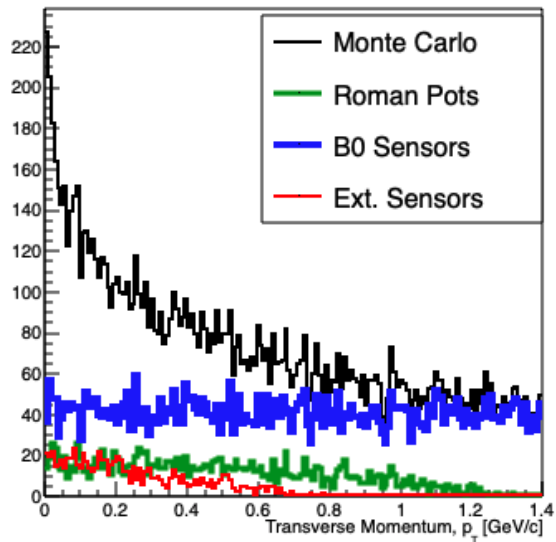


50 cm shift

Comparisons - p_T , ϕ , θ



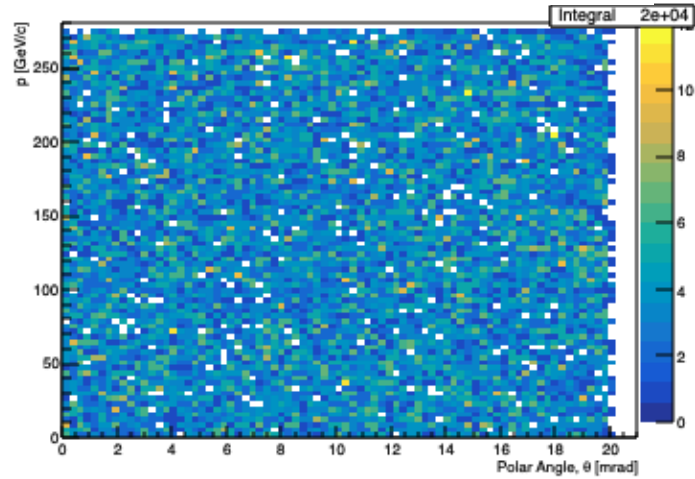
Original IR



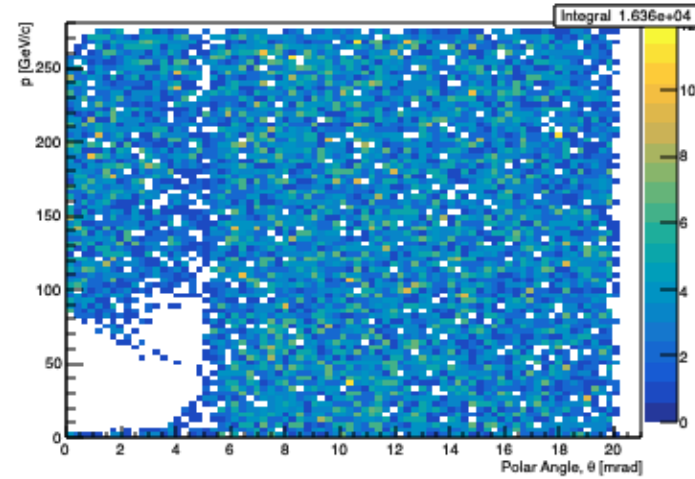
50 cm shift

Comparisons - p vs. θ

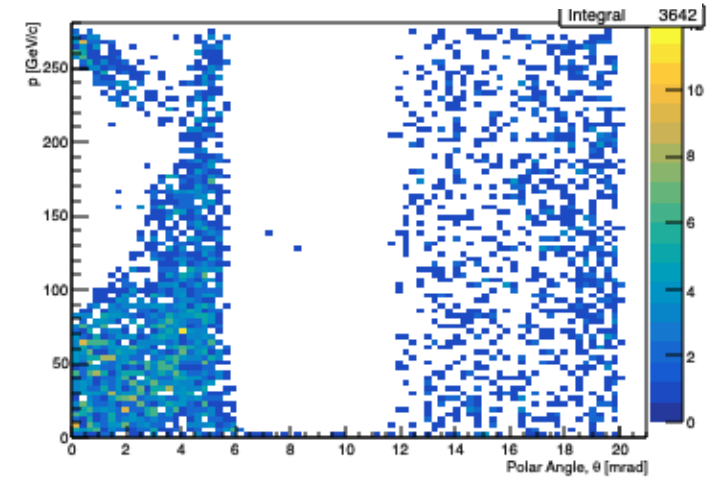
Particle Gun Generated



Accepted

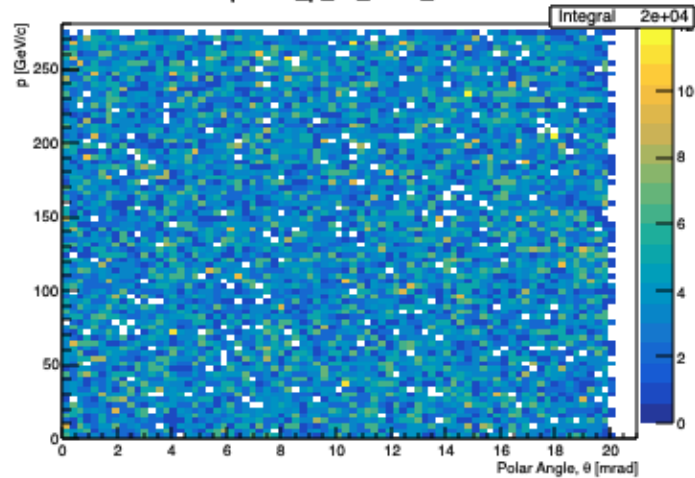


Generated minus Accepted

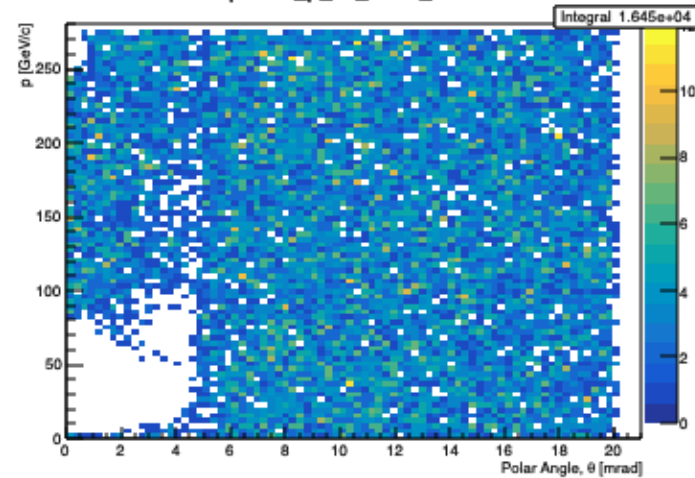


Original IR

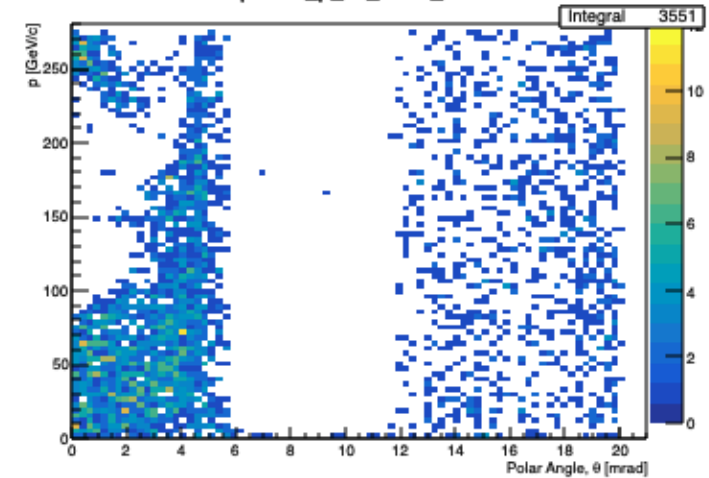
proton_p_vs_theta_MC



proton_p_vs_theta_reco



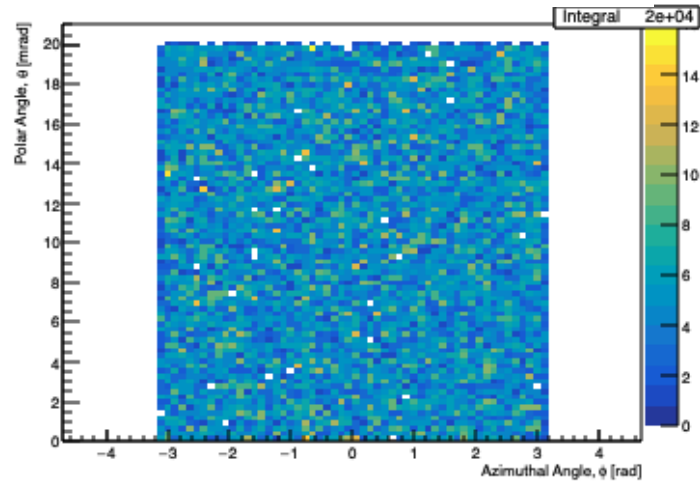
proton_p_vs_theta_Diff



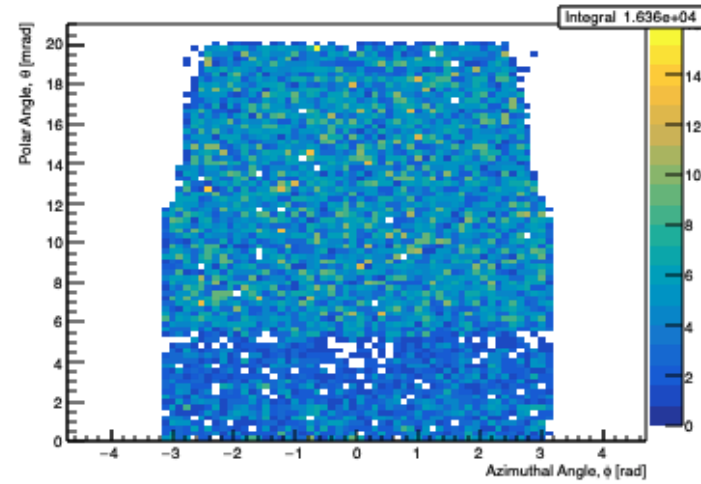
50 cm shift

Comparisons - θ vs. ϕ

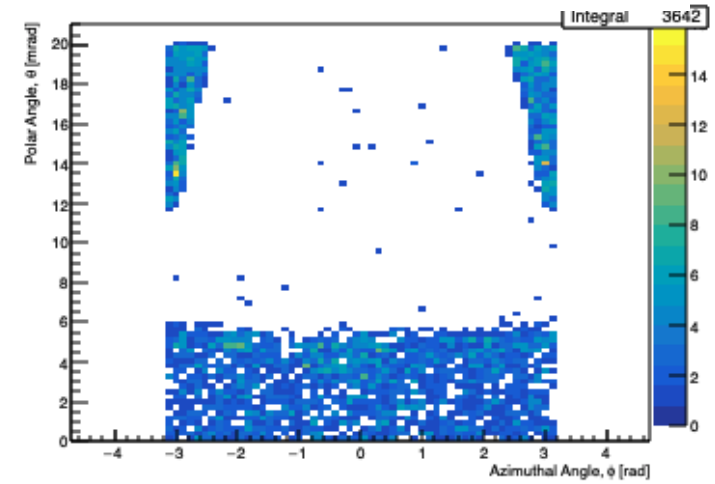
Particle Gun Generated



Accepted

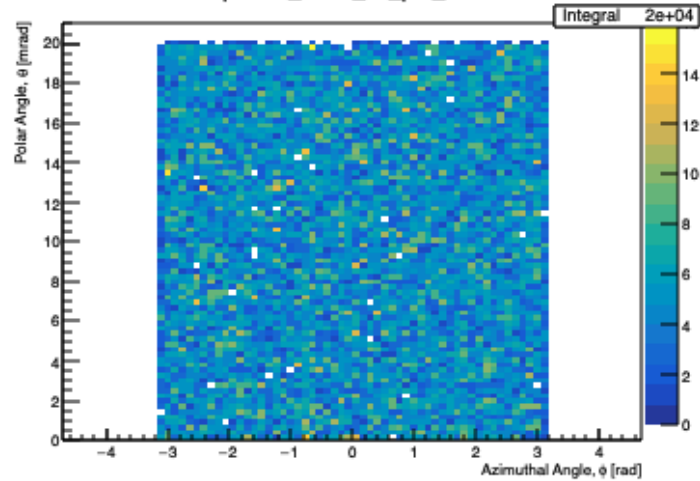


Generated minus Accepted

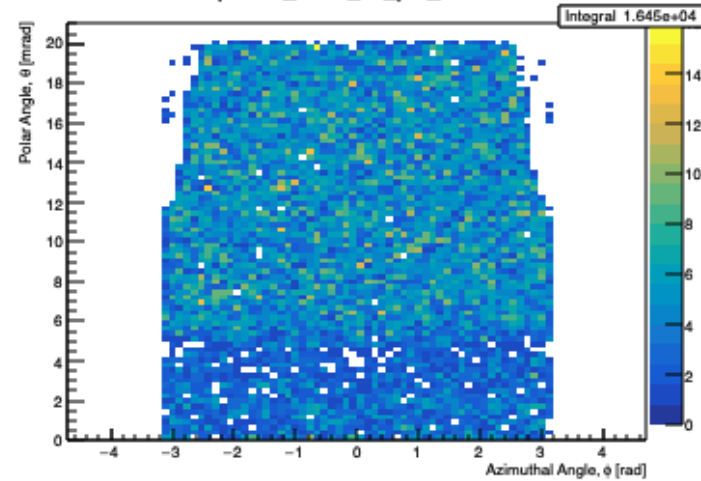


Original IR

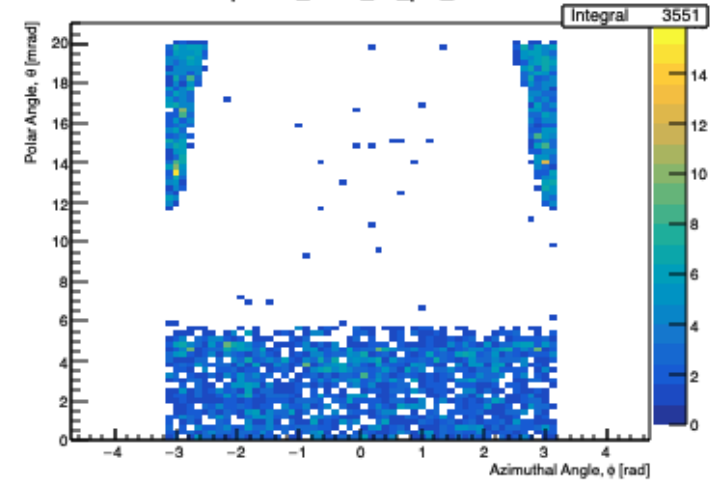
proton_theta_vs_phi_MC



proton_theta_vs_phi_Reco

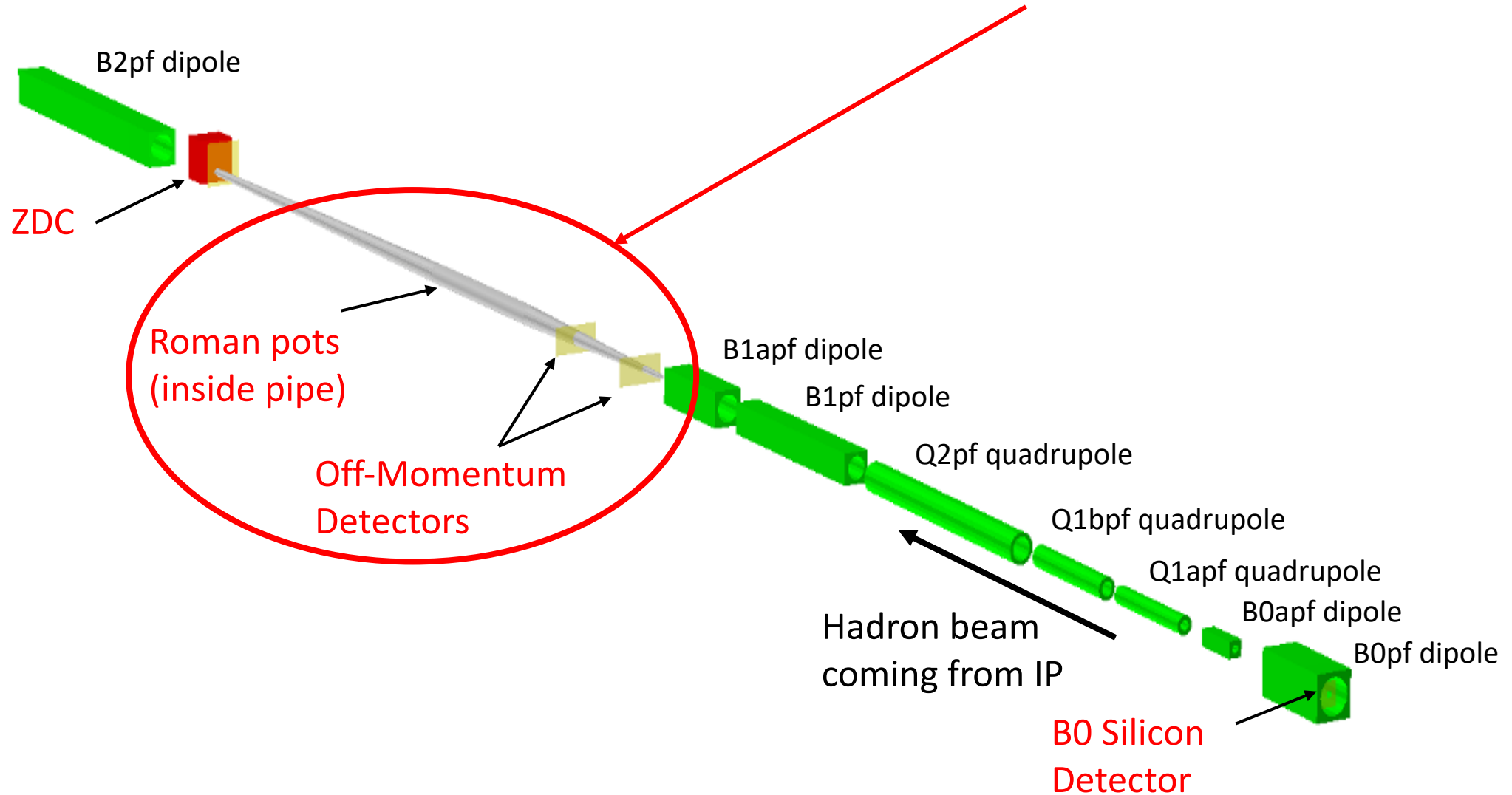


proton_theta_vs_phi_Diff



50 cm shift

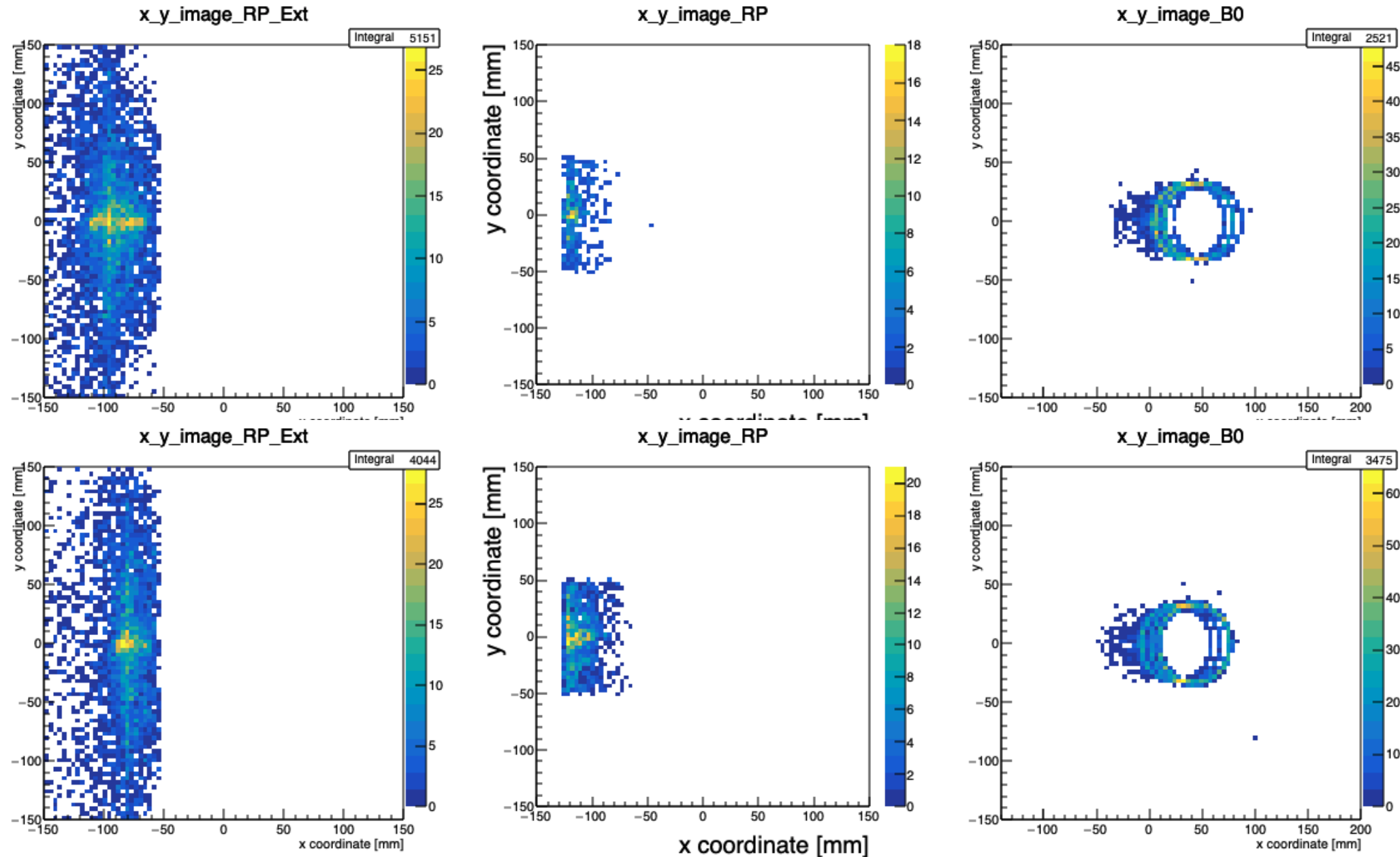
Zoom into region of $x_L \leq 0.6$ and $0 < \theta < 6$ mrad



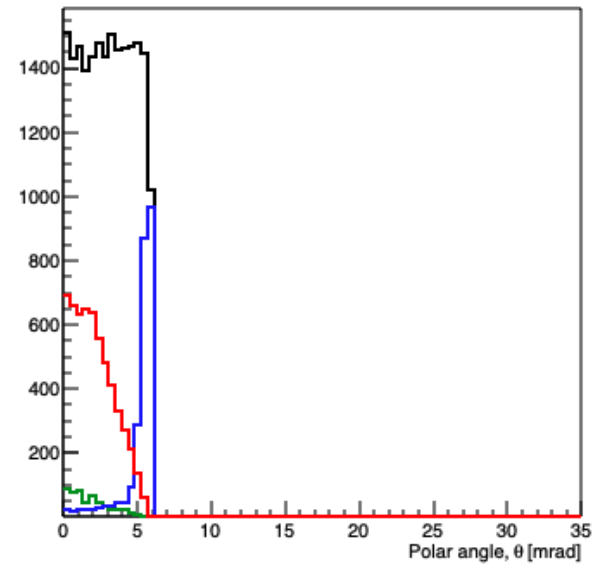
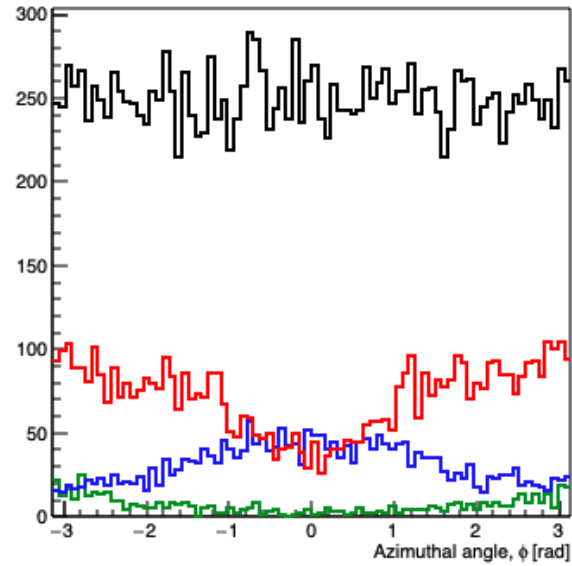
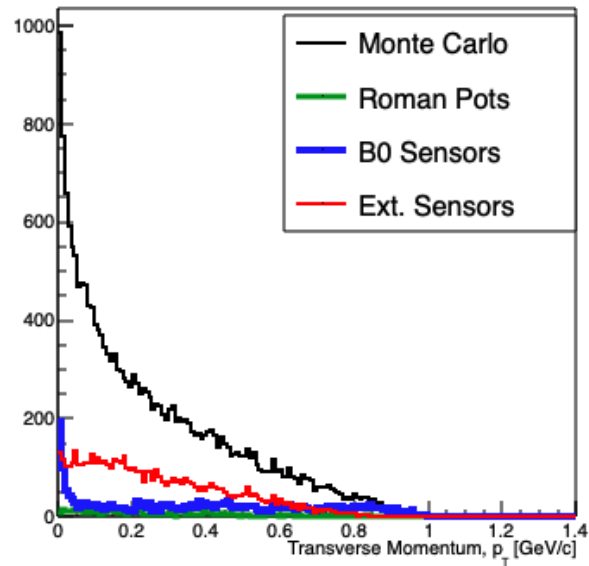
Comparisons – detector acceptance images

Original IR

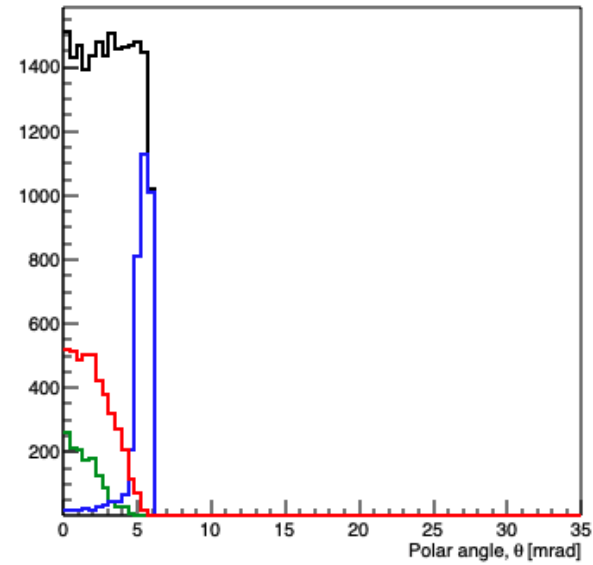
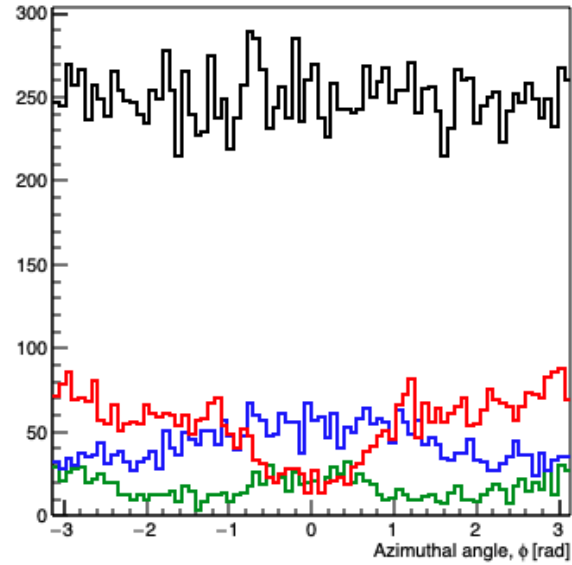
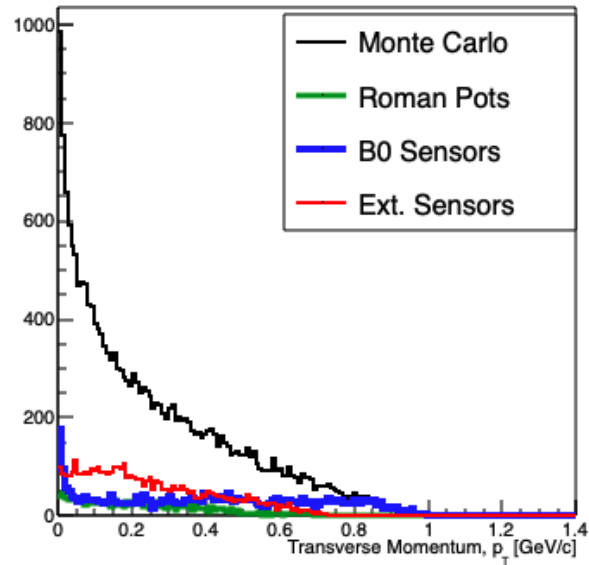
50 cm shift



Comparisons - p_T , ϕ , θ



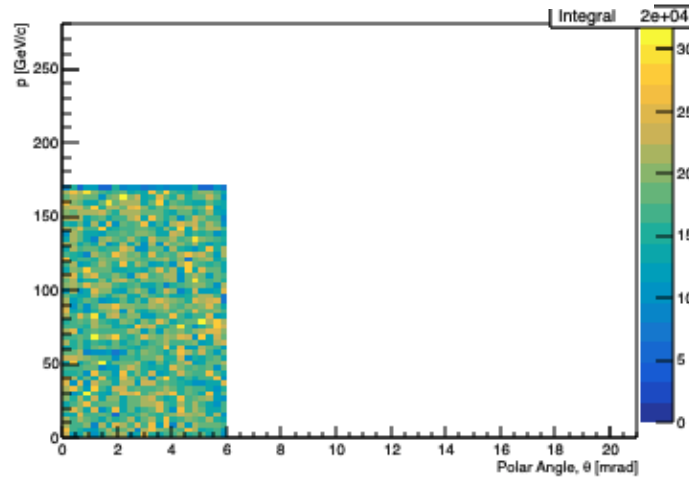
Original IR



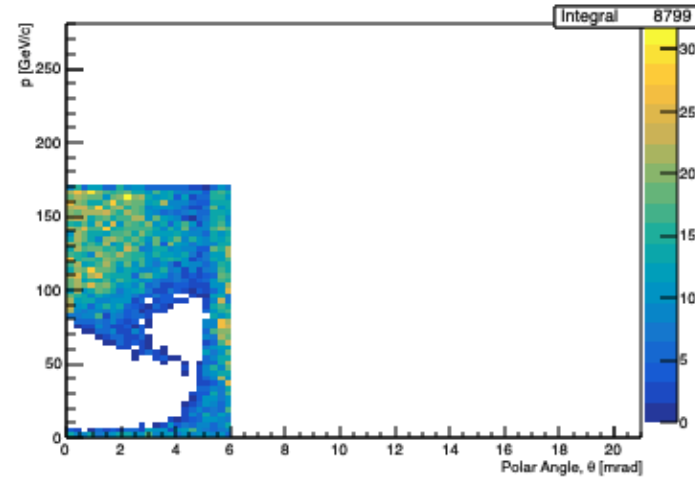
50 cm shift

Comparisons - p vs. θ

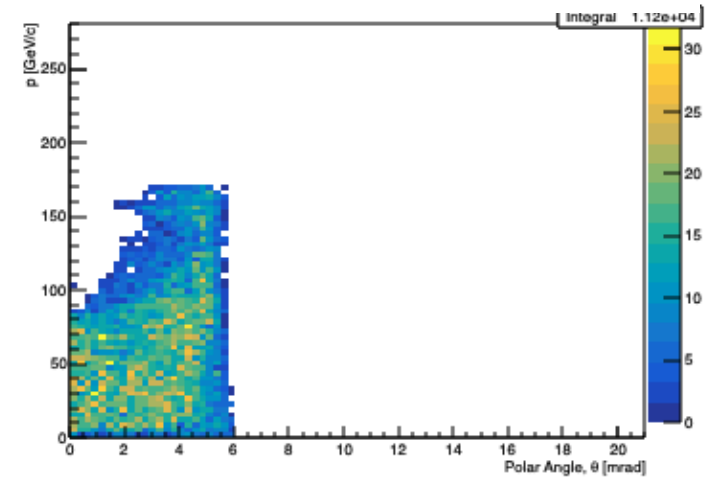
Particle Gun Generated



Accepted

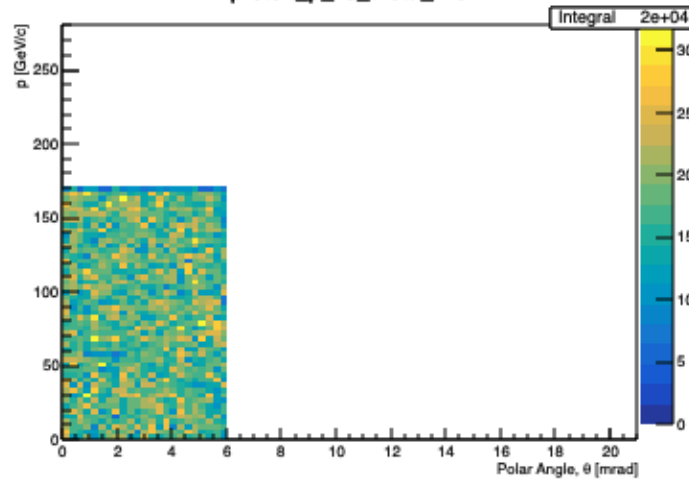


Generated minus Accepted

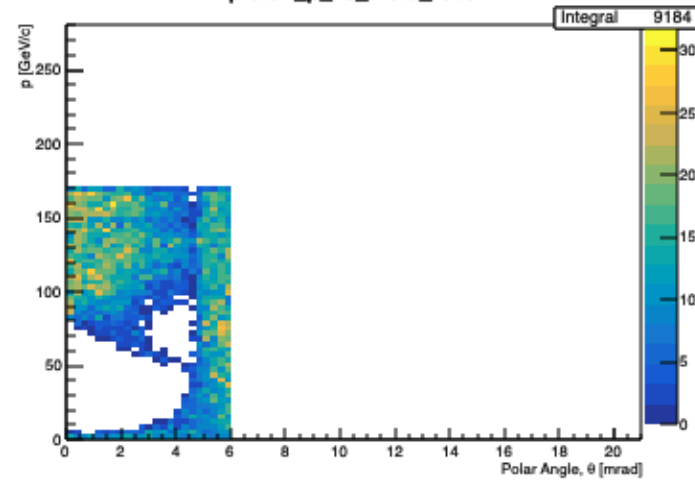


Original IR

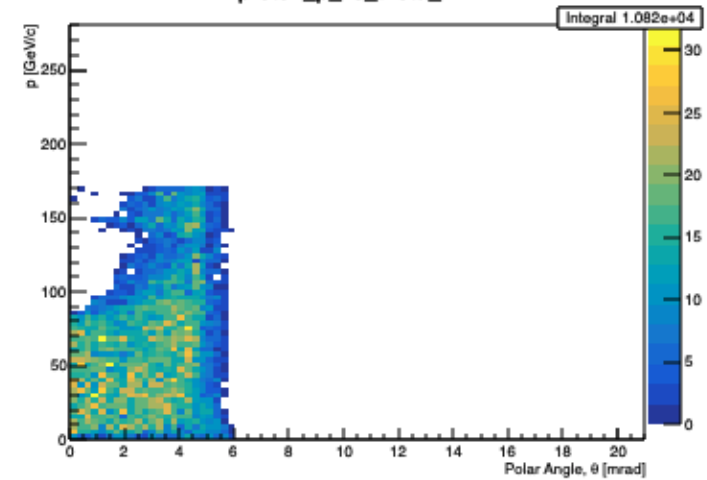
proton_p_vs_theta_MC



proton_p_vs_theta_reco



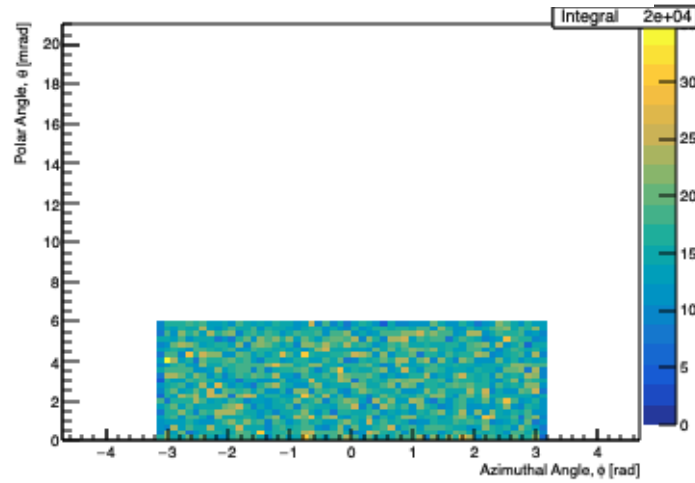
proton_p_vs_theta_Diff



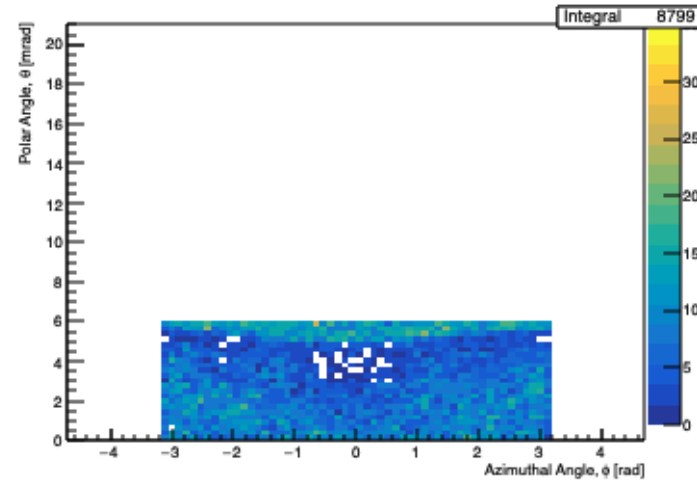
50 cm shift

Comparisons - θ vs. ϕ

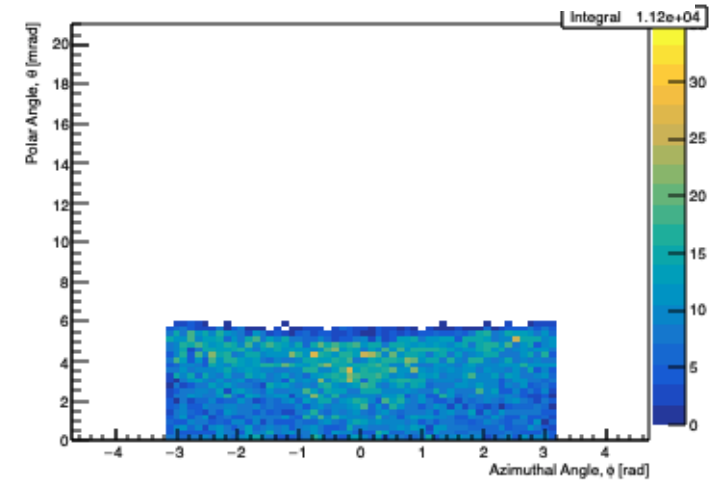
Particle Gun Generated



Accepted

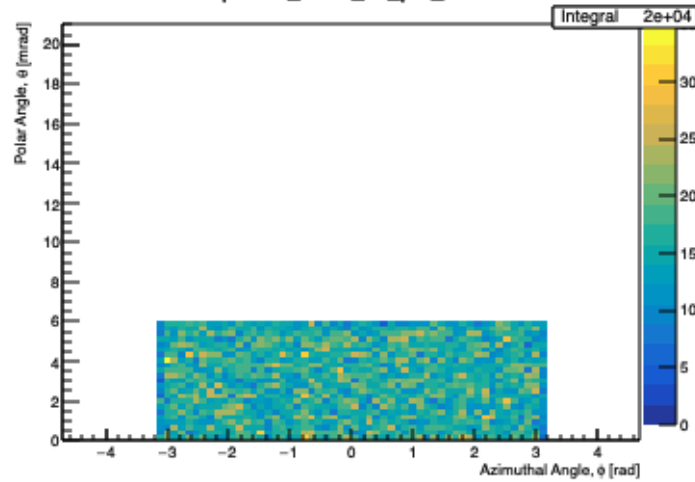


Generated minus Accepted

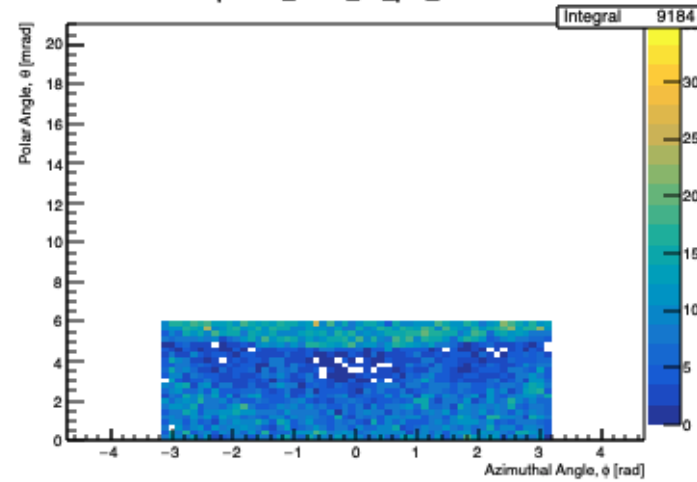


Original IR

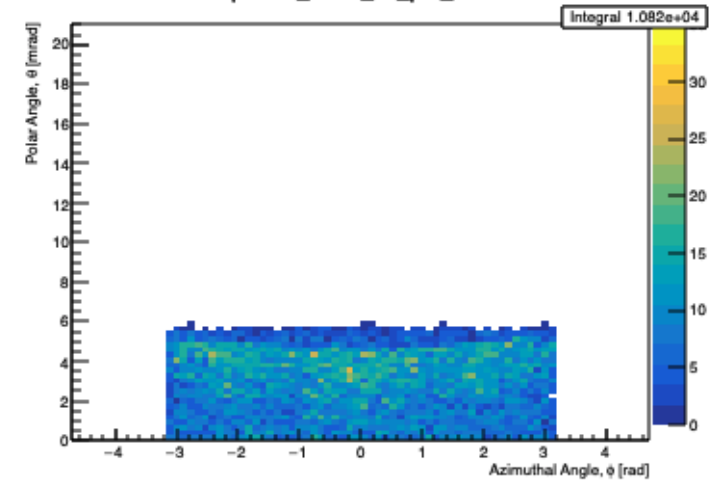
proton_theta_vs_phi_MC



proton_theta_vs_phi_Reco



proton_theta_vs_phi_Diff



50 cm shift

Takeaways

- The 50cm shift has only a small impact on the proton acceptance, particularly at the highest pt.
 - I can study this more carefully by isolating regions of phase space relevant to a particular subsystem.
- Neutrons (not shown here) see almost no change (marginal decrease in acceptance on one side of the aperture).
- It would be helpful to have an **official** BMAD version of the layout in my coordinate system (because of the physics event generators).
 - Hadron going in the positive z-direction, 25mrad crossing angle all in the hadron beam.
 - Feel free to email me for more details.