Particle Scan of EIC Far-Forward Region

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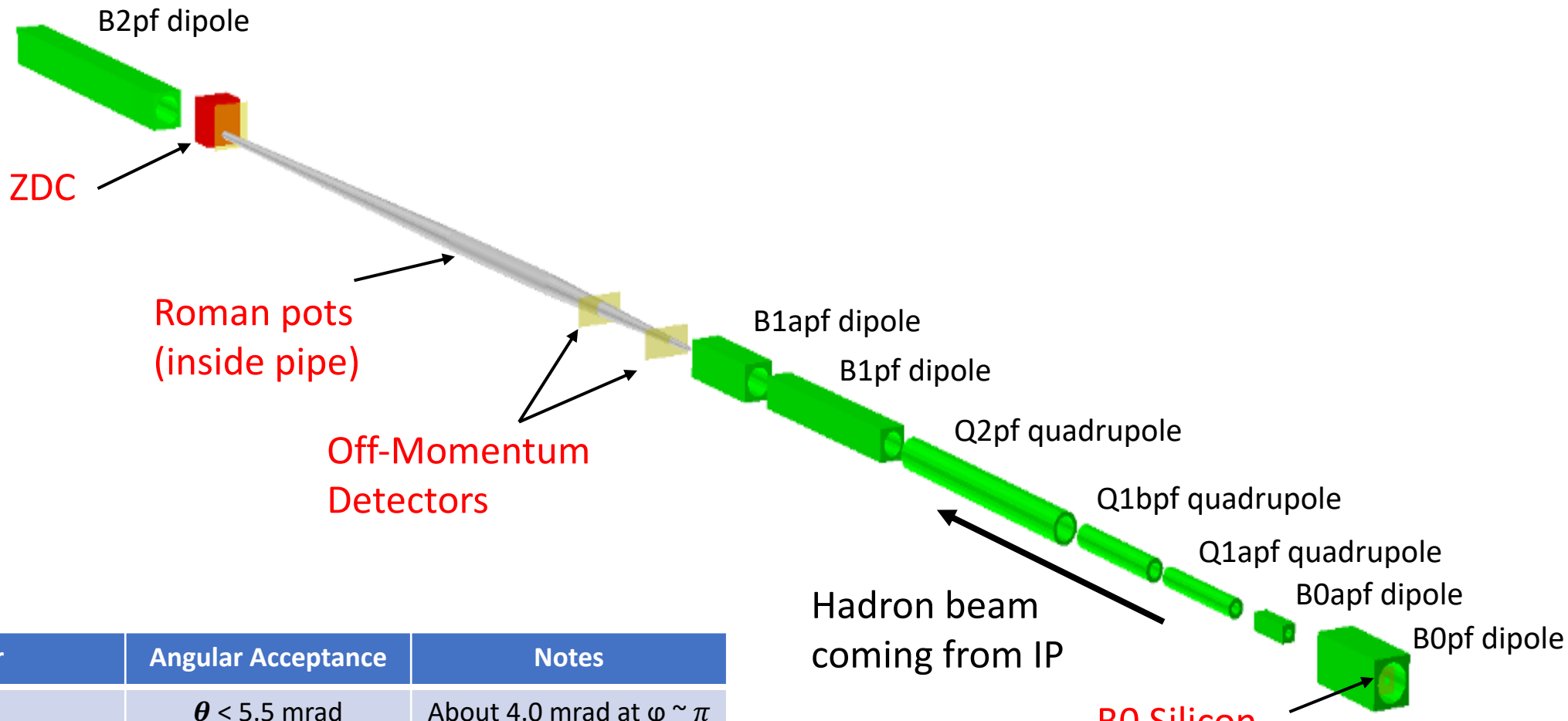
Preliminaries

- Only protons used for this scan.
  - Will repeat for a few other particles, especially pions.
- Used particle gun and sampled the following ranges.
  - $0 < p < 275\ GeV, 0 < \varphi < 2\pi, 0 < \theta < 27\ mrad$
- Magnets set to the maximum field settings (i.e. the settings for the 275 GeV proton beam).
- All current FF detectors included.
  - Roman Pots
  - Off-Momentum Detectors
  - B0 Spectrometer
  - ZDC (not relevant for protons, but perhaps for pions**)

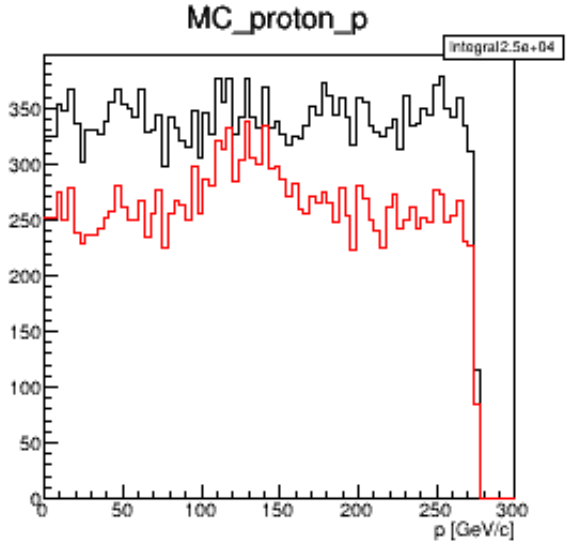
Preliminaries

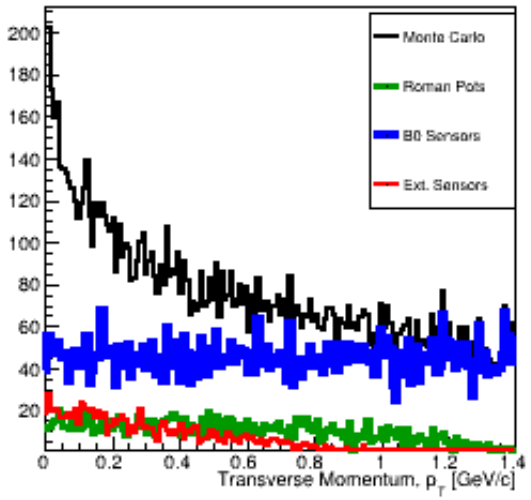


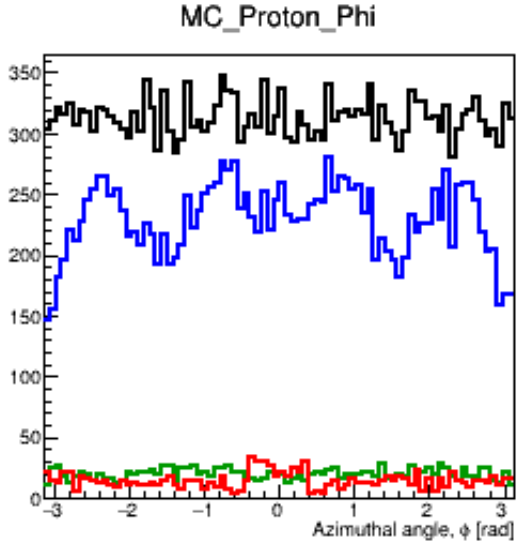
Detector	Angular Acceptance	Notes
ZDC	$\boldsymbol{\theta}$ < 5.5 mrad	About 4.0 mrad at φ ~ π
Roman Pots	0.0 < $\boldsymbol{\theta}$ < 5.0 mrad	Need 10σ cut.
Off-Momentum Detectors	0.0 < $\boldsymbol{\theta}$ < 5.0 mrad	Roughly .4 < x_L < .6
B0 Sensors	5.5 < $\boldsymbol{\theta}$ < 20.0 mrad	Still need to optimize.

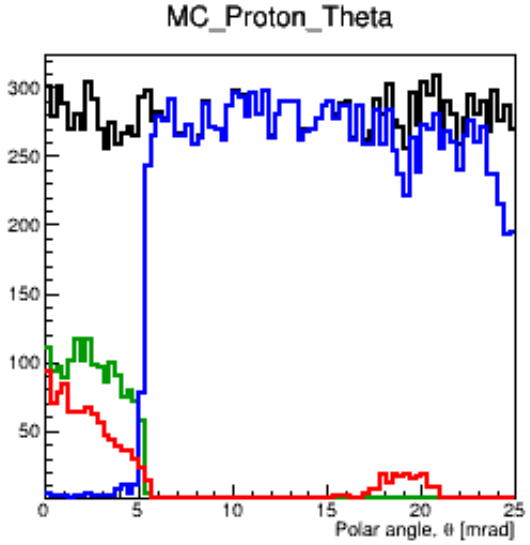
$$x_L = \frac{p_{z,nucleon}}{p_{z,beam}}$$

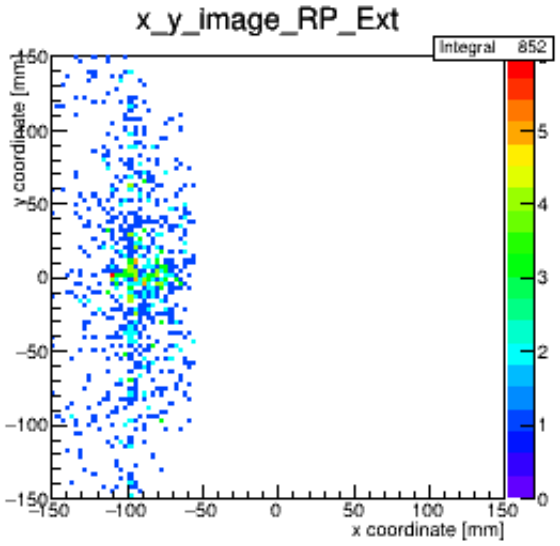
Results

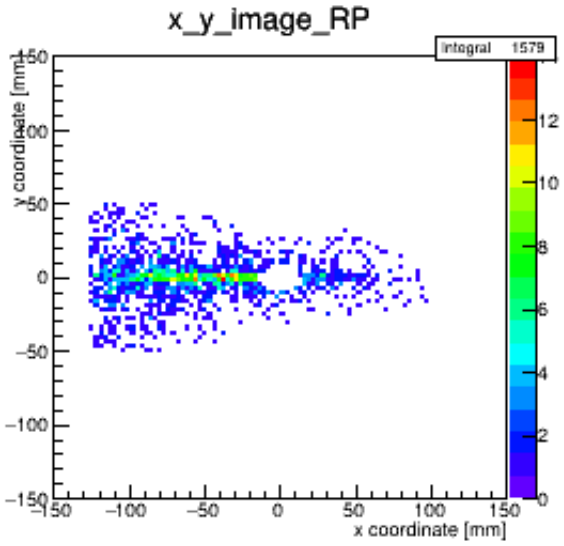

MC_proton_p
Integral 2.5e+04
p [GeV/c]


Monte Carlo
Roman Pots
B0 Sensors
Ext. Sensors
Transverse Momentum, p_T [GeV/c]


MC_Proton_Phi
Azimuthal angle, ϕ [rad]


MC_Proton_Theta
Polar angle, θ [mrad]


x_y_image_RP_Ext
Integral 852
x coordinate [mm]
y coordinate [mm]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Integral 1579
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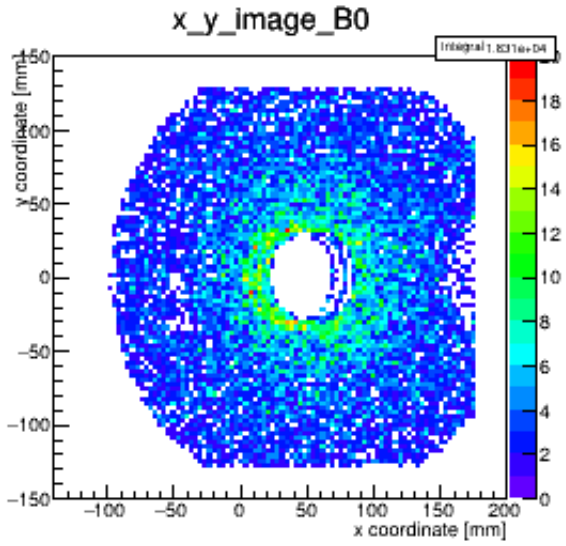
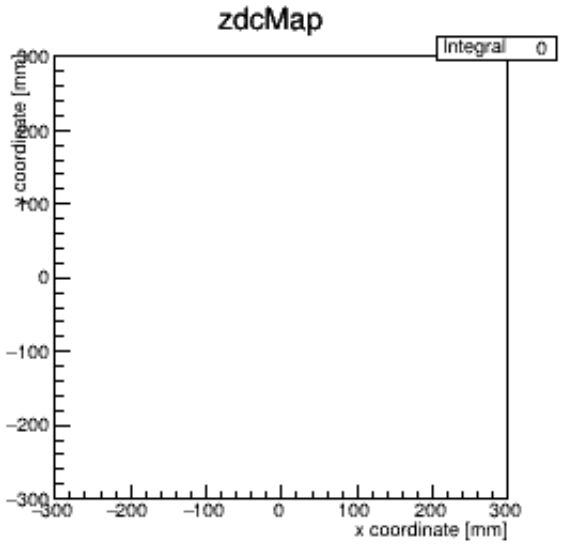
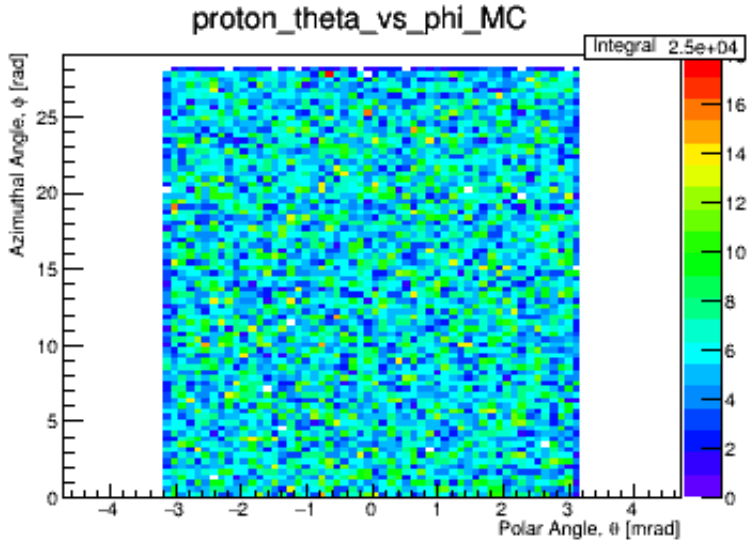
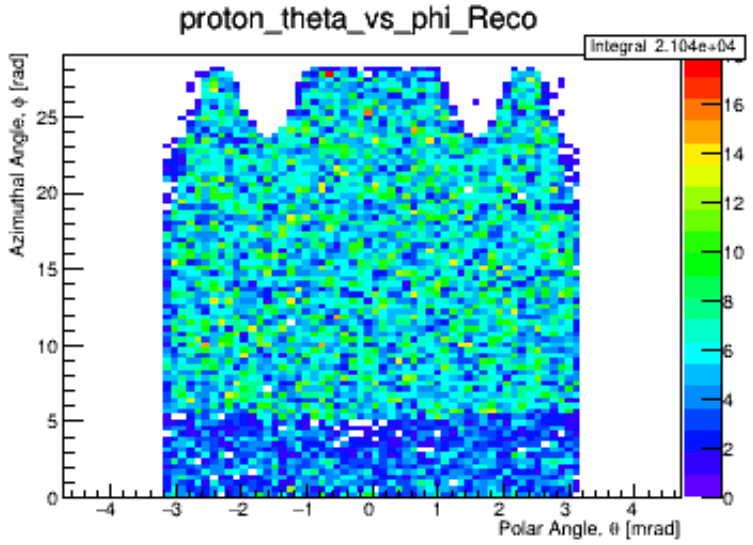
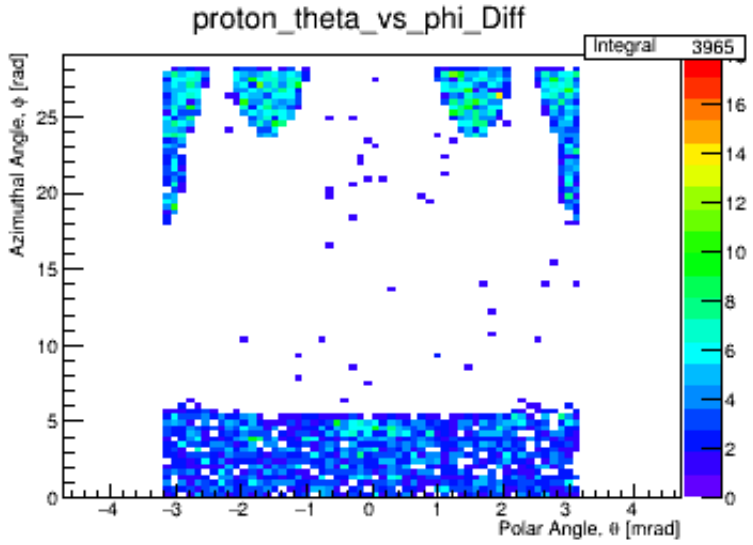

x_y_image_B0
x coordinate [mm]
y coordinate [mm]

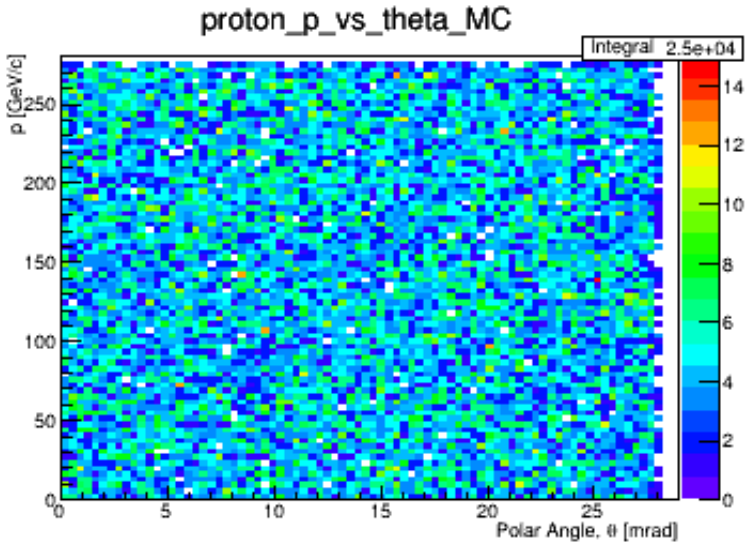

zdcMap
Integral 0
x coordinate [mm]
y coordinate [mm]

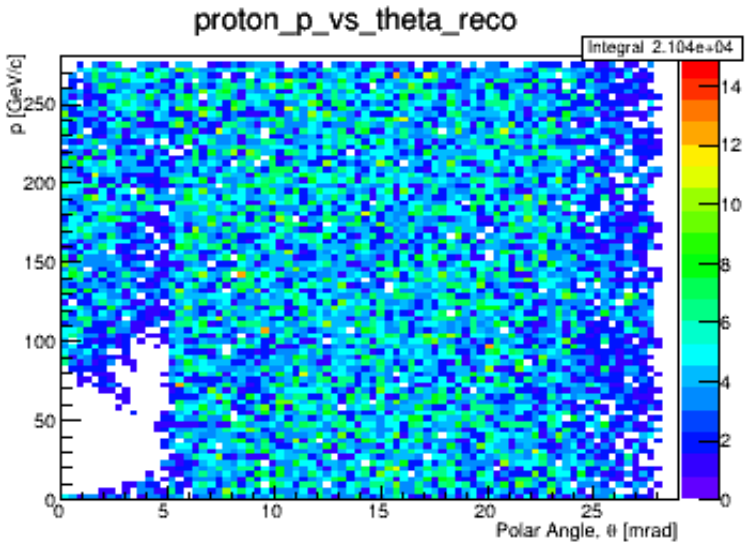
Results

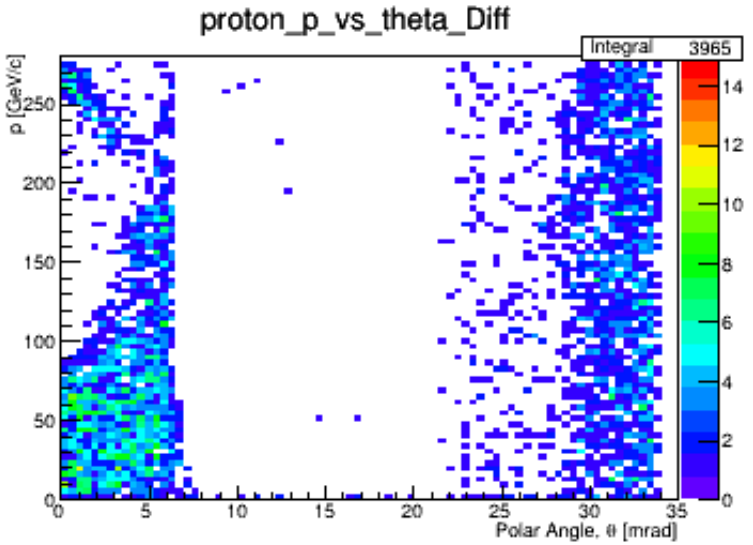

proton_theta_vs_phi_MC
Integral 2.5e+04
Azimuthal Angle, ϕ [rad]
Polar Angle, θ [mrad]


proton_theta_vs_phi_Reco
Integral 2.104e+04
Azimuthal Angle, ϕ [rad]
Polar Angle, θ [mrad]

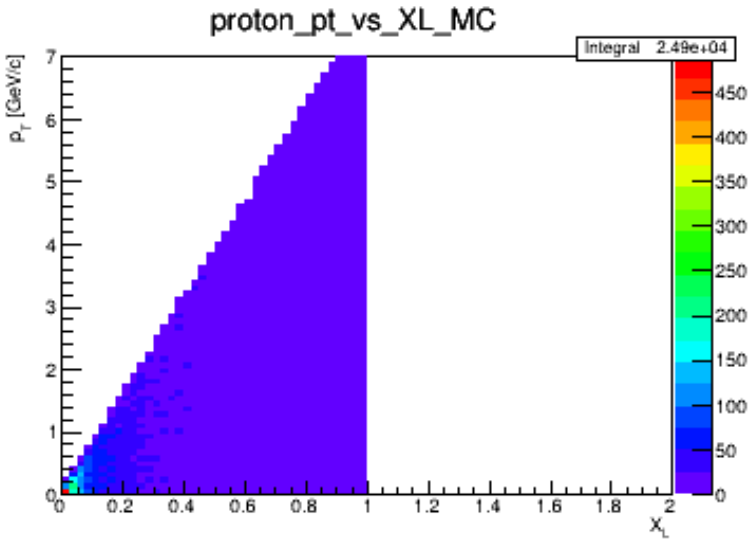

proton_theta_vs_phi_Diff
Integral 3965
Azimuthal Angle, ϕ [rad]
Polar Angle, θ [mrad]

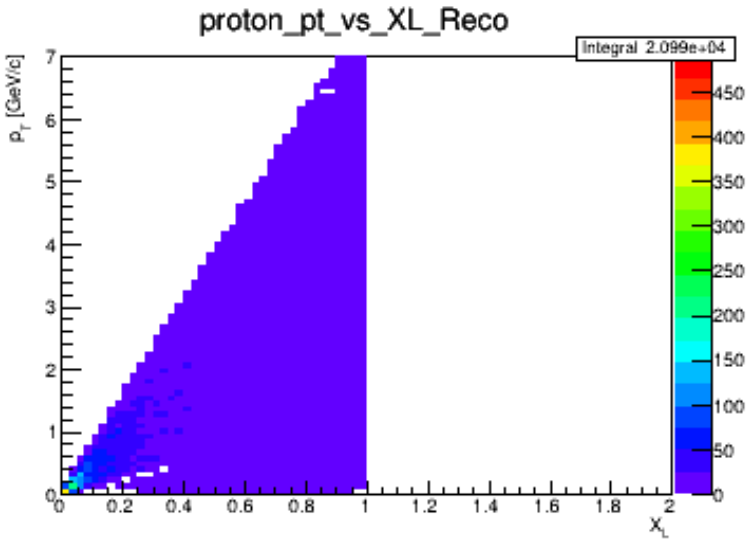

proton_p_vs_theta_MC
Integral 2.5e+04
p [GeV/c]
Polar Angle, θ [mrad]

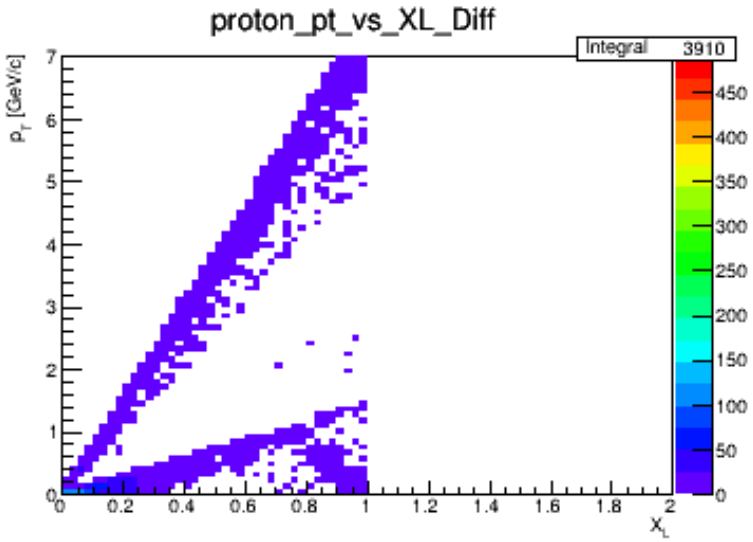

proton_p_vs_theta_reco
Integral 2.104e+04
p [GeV/c]
Polar Angle, θ [mrad]

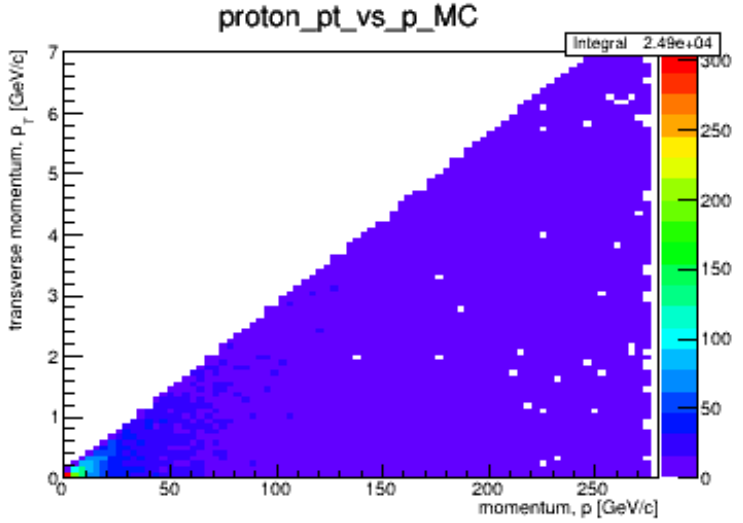

proton_p_vs_theta_Diff
Integral 3965
p [GeV/c]
Polar Angle, θ [mrad]

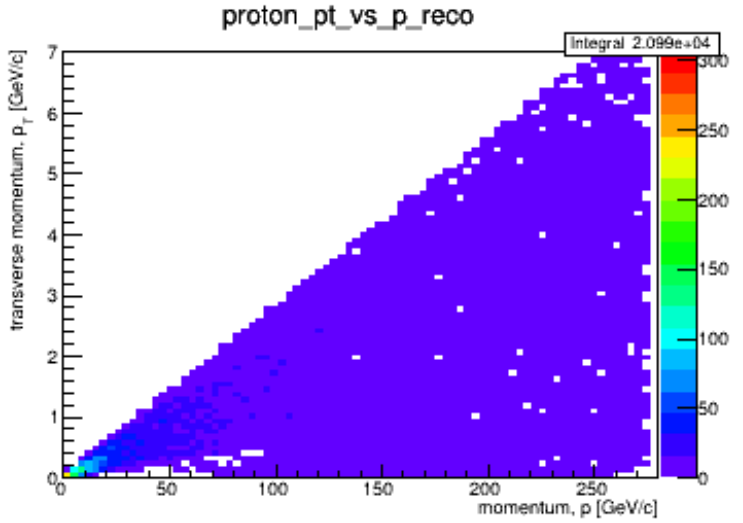
Results

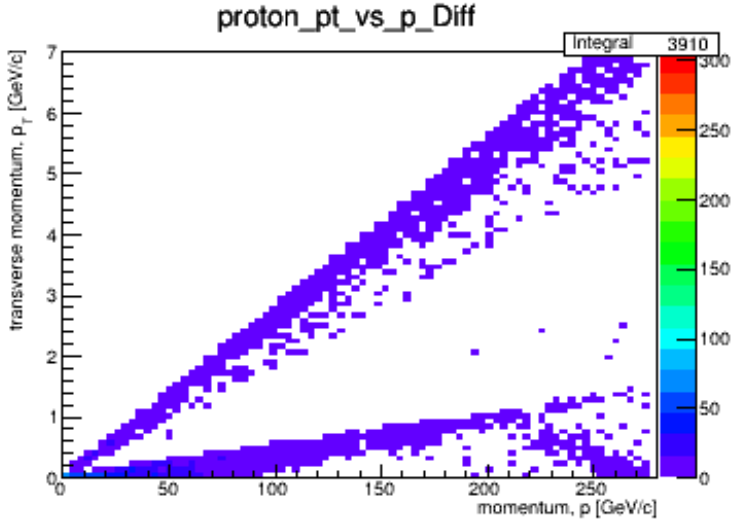

proton_pt_vs_XL_MC
Integral 2.49e+04
p_T [GeV/c]
X_L


proton_pt_vs_XL_Reco
Integral 2.099e+04
p_T [GeV/c]
X_L


proton_pt_vs_XL_Diff
Integral 3910
p_T [GeV/c]
X_L


proton_pt_vs_p_MC
Integral 2.49e+04
transverse momentum, p_T [GeV/c]
momentum, p [GeV/c]


proton_pt_vs_p_reco
Integral 2.099e+04
transverse momentum, p_T [GeV/c]
momentum, p [GeV/c]


proton_pt_vs_p_Diff
Integral 3910
transverse momentum, p_T [GeV/c]
momentum, p [GeV/c]

Takeaways

- Acceptance looks more or less uniform for $5.5 < \theta < 18\ mrad$
  - This is where the protons fall nicely into the B0 sensors symmetric in phi.
- For $0 < \theta < 5.5\ mrad$ things are complicated. The acceptance depends a lot on the longitudinal momentum of the proton compared to the magnet setting.
  - Not sure what the best way to parameterize this is.
  - Still DO NOT recommend doing fast smearing for accurate acceptance in this region.
  - For x_L > .9, should be okay – but need to be aware of $10\boldsymbol{\sigma}$ cut.
- For $18 < \theta < 27\ mrad$, acceptance not symmetric in phi.
  - Almost certainly will not have great acceptance past 25 or 26 mrad when the true engineering components for the magnet are there.