IP8 Secondary Focus xL Coverage

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Preliminaries

- Using the same IP8 lattice shown at the FF cross-collaboration meeting (https://indico.bnl.gov/event/12068/).
  - Results of my previous comprehensive acceptance studies are on the Indico, as well as details for the detector assumptions I used.
- There are some notable changes when using the correct IP8 optics numbers (compared to the IP6 ones).
  - Larger dispersion @ RPSF: Causes the 10σ to be larger.
  - Now using the correct beta-functions at the RPSF – also causes the 10σ to be larger (the beta-functions are a bit larger at the SF than at the IP, using IP6 numbers for comparison).
  - Beta functions at the drift RP are very different in x and y, with that difference getting smaller further downstream -> causes anisotropic acceptance in phi. Could re-think placement (in z) of drift RP to try and find optimal spot.

10σ Calculation

- We have normally quoted the transverse beam size as $\sigma_{x,y} = \sqrt{\beta(z)_{x,y}\epsilon_{x,y}}$, but this is only approximately true if the dispersion is very small, or if the beta-function times emittance is very large in comparison.
  - Correct formula, $\sigma_{x,y} = \sqrt{\beta(z)_{x,y}\epsilon_{x,y} + \left(D_{x,y}\frac{\Delta p}{p}\right)^2}$.
  - The second term is very small compared to the first in the case of the normal RP, so $\sigma_{x,y} = \sqrt{\beta(z)_{x,y}\epsilon_{x,y}}$ is a perfectly fine approximation to quote in that case.
  - However, at the RPSF, this second term is large enough to affect the total transverse beam size.
- The previous preliminary study used the IP6 beta-functions and dispersion values at both the RP drift location, and the RPSF locations (the optics numbers were not yet available for IP8 at the time of that study).
  - The results presented here use the IP8 numbers with the present IP8 lattice.

Drift Roman Pots (z = 26m)

protons (275 GeV settings)
$0 < \theta < 5$ mrad
$0.95 < x_L < 1.0$

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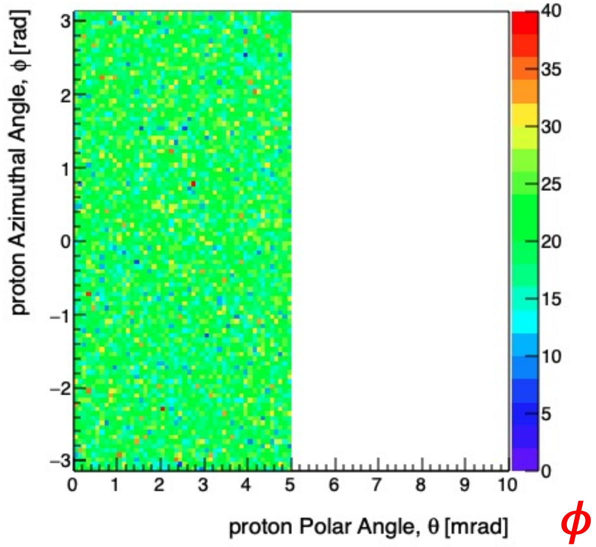

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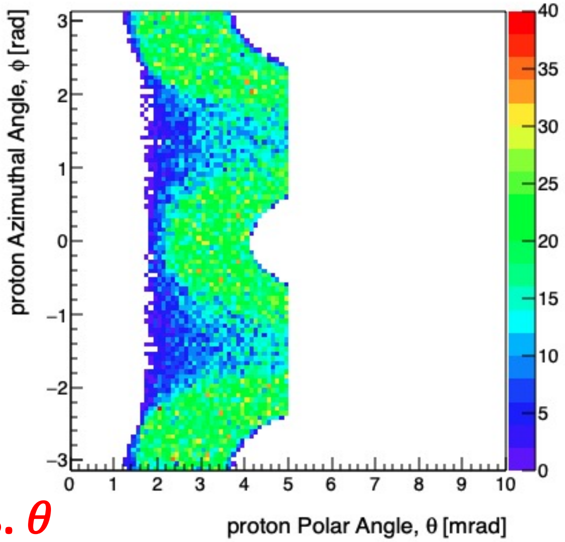
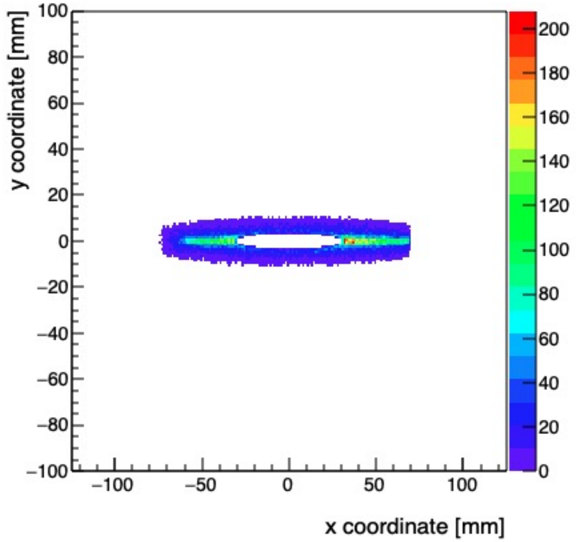


ϕ vs. θ

RP Occupancy



$\beta_x\ (z = 25.7m)$ = 548 m
β_y (z = 25.7m) = 87 m
$D_x = 0.126$

σ_x @ RP = 3.10607 mm
σ_y @ RP = 0.372664 mm

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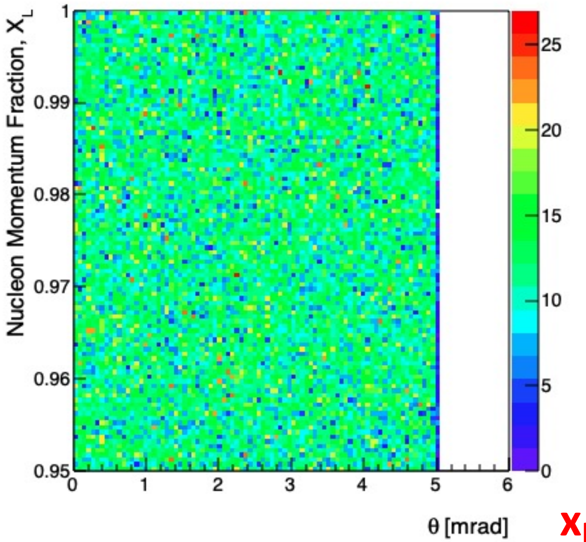

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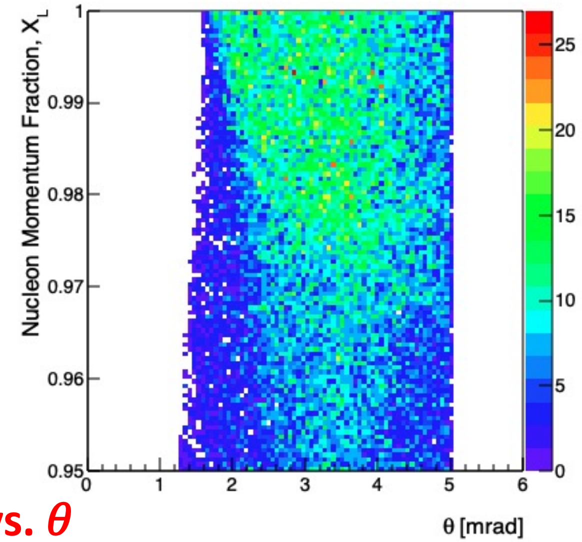

x_L vs. θ

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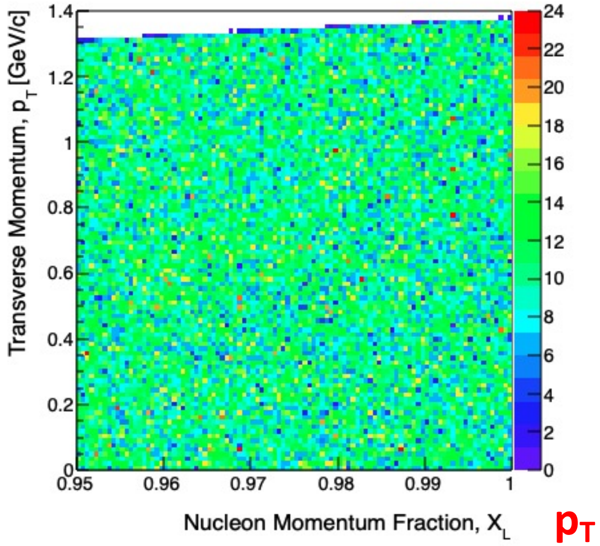

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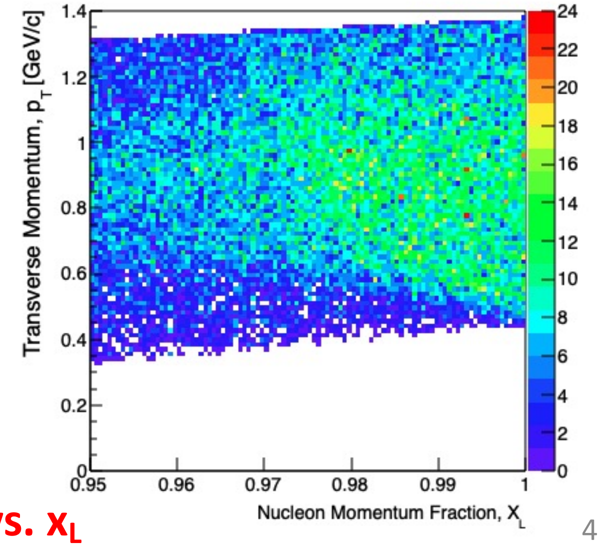

p_T vs. x_L

Drift Roman Pots (z = 30m)

protons (275 GeV settings)
$0 < \theta < 5$ mrad
$0.95 < x_L < 1.0$

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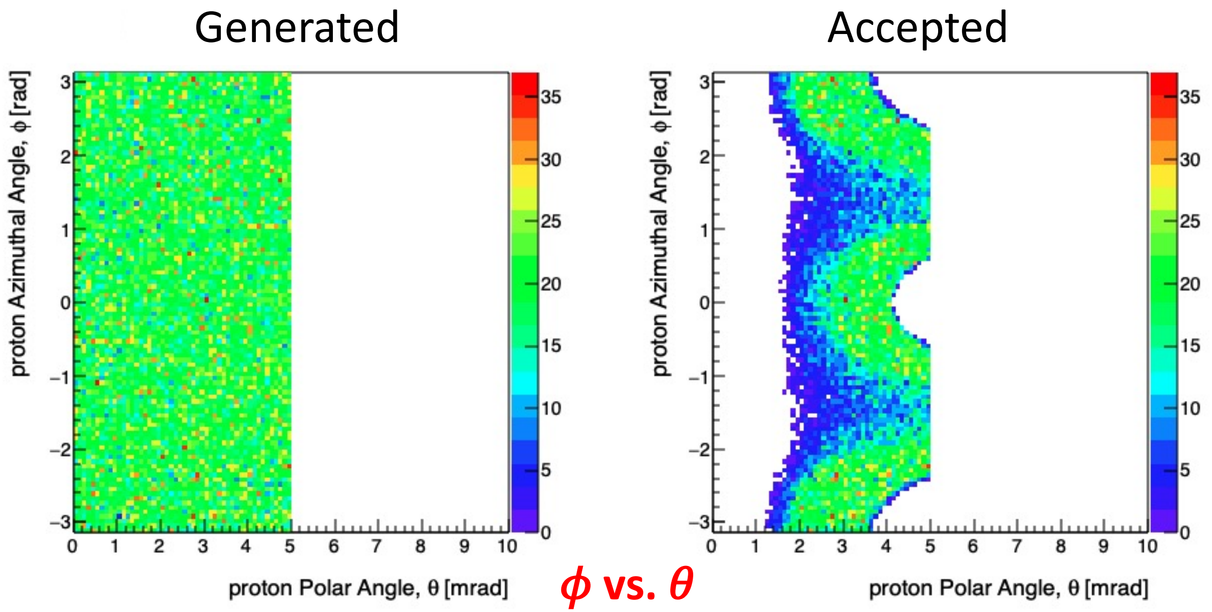
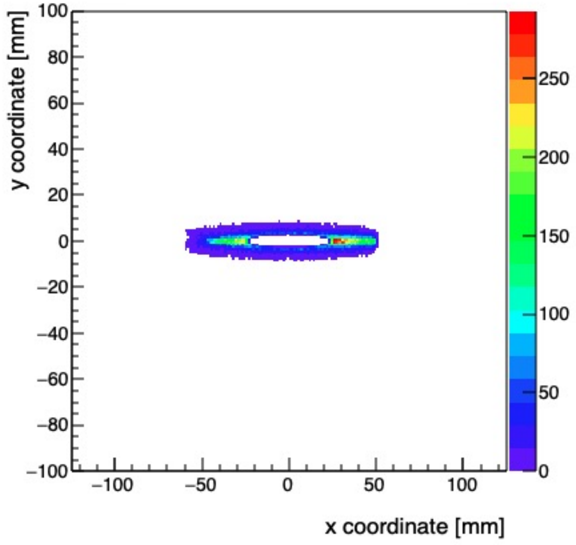


ϕ vs. θ

RP Occupancy



$\beta_x\,(z = 29.7m)$ = 338 m
β_y (z = 29.7m) = 55 m
$D_x = 0.204$

σ_x @ RP = 2.44373 mm
σ_y @ RP = 0.297106 mm

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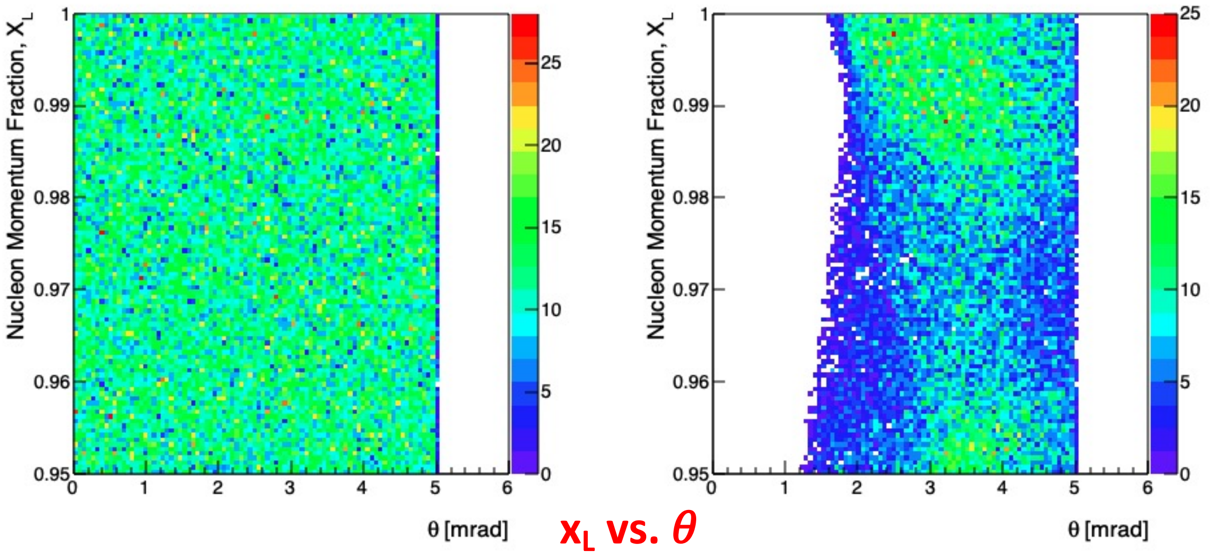

x_L vs. θ

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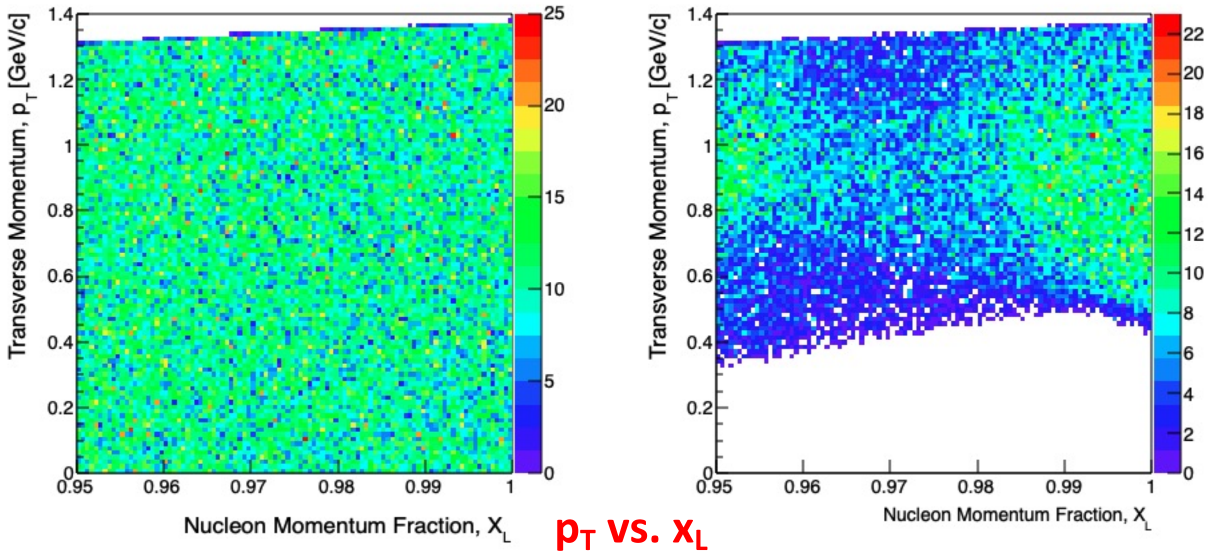

p_T vs. x_L

Roman Pots @ SF

σ_x @ RPSF = 0.328283 mm.
σ_y @ RPSF = 0.085217 mm.

protons (275 GeV settings)
$0 < \theta < 5$ mrad
$0.95 < x_L < 1.0$

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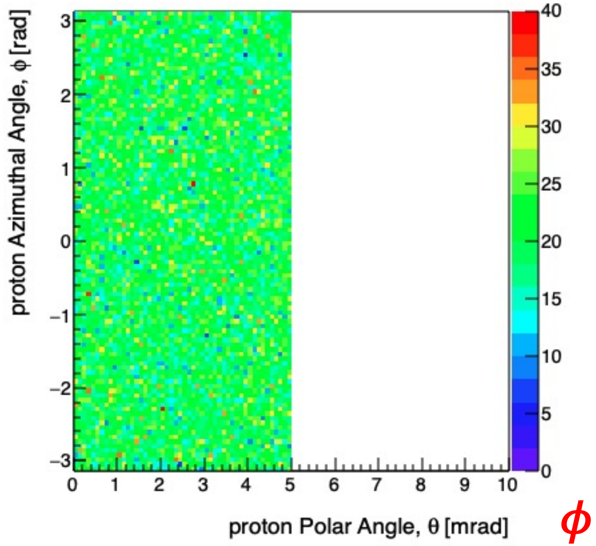

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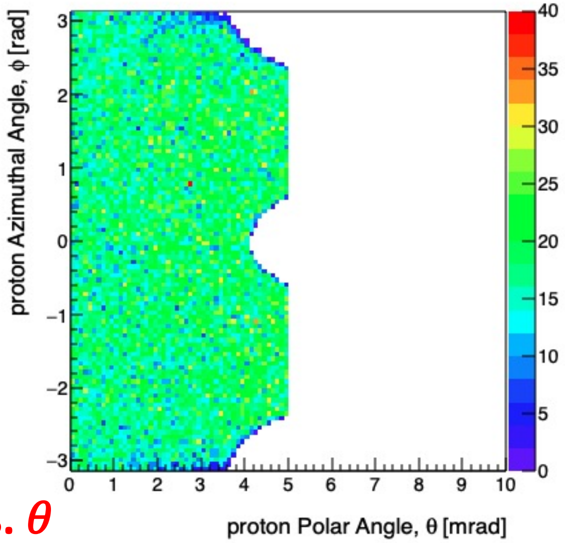

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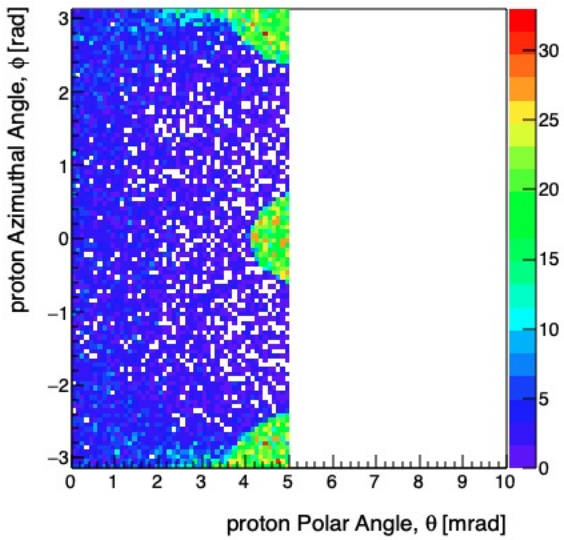
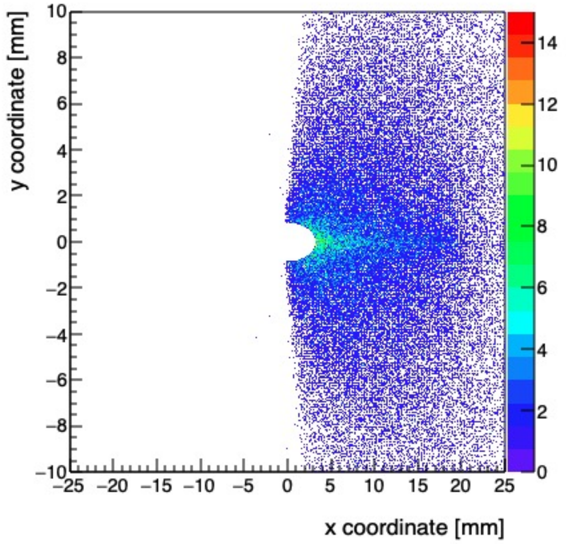


ϕ vs. θ

RPSF Occupancy



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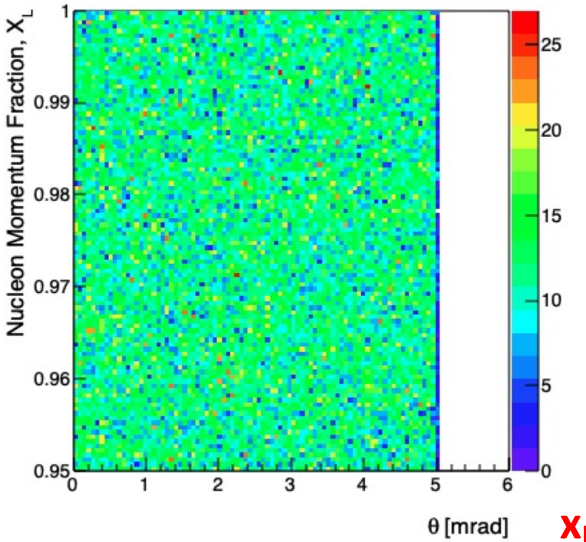

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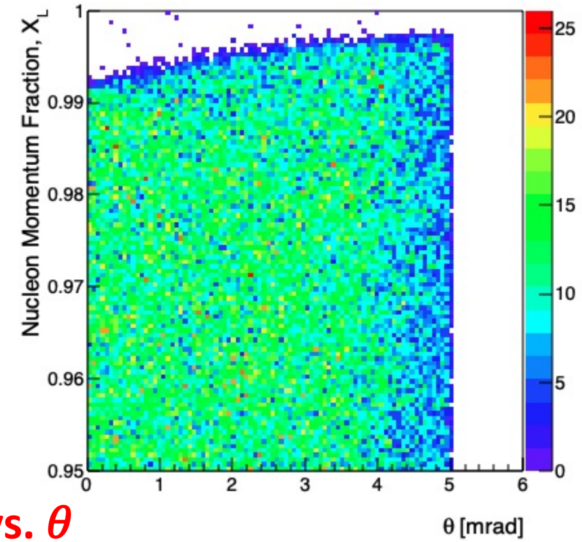

x_L vs. θ

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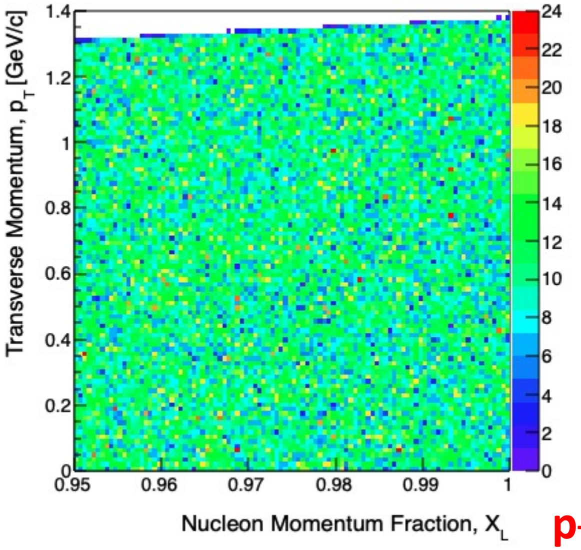

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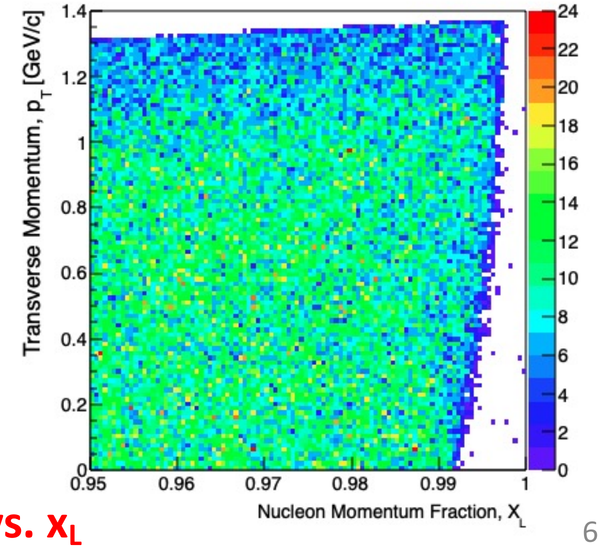


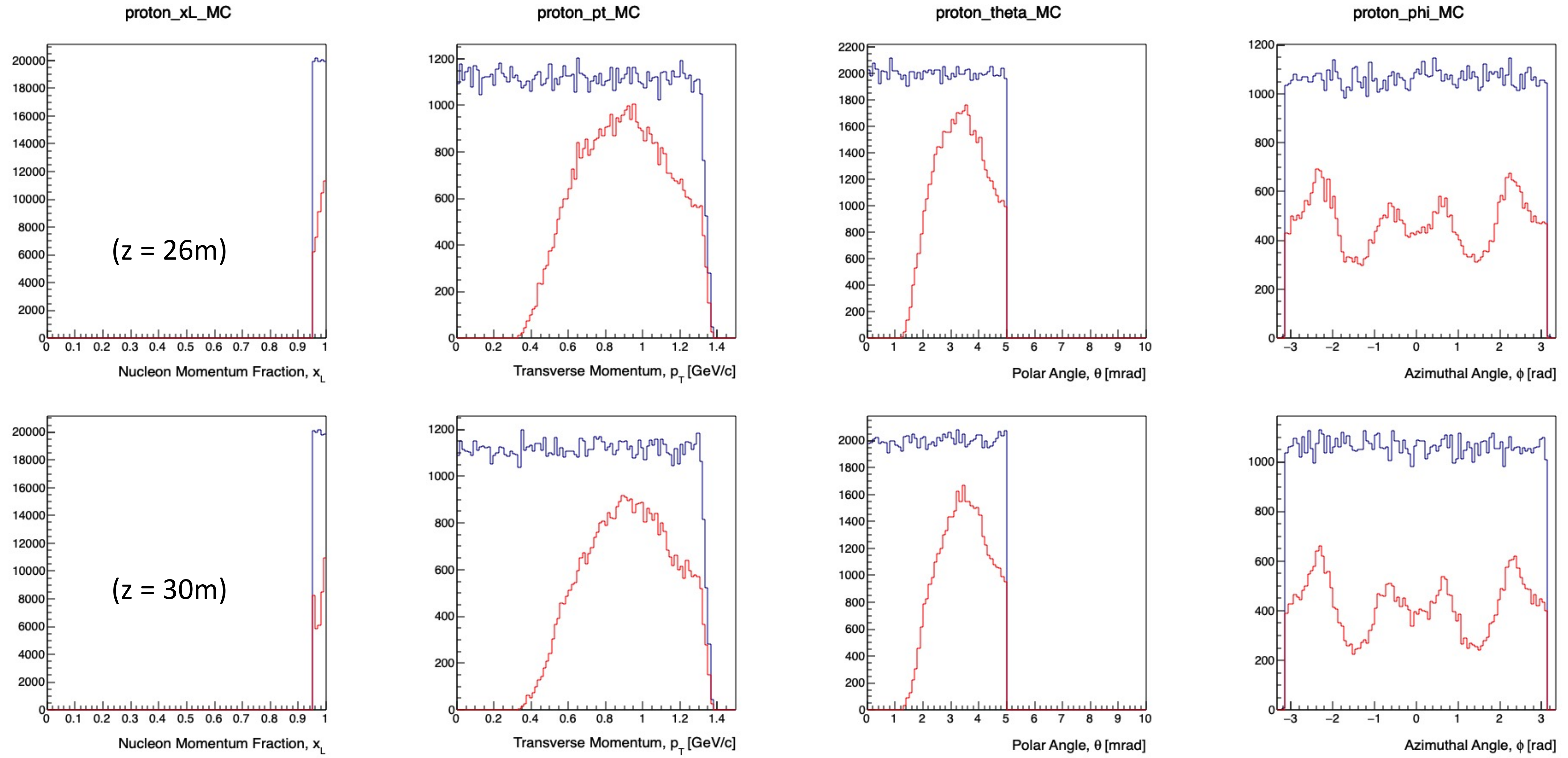
p_T vs. x_L

Summary

- The secondary focus provides a significant improvement in coverage of xL for protons.
- Finding a “sweet spot” for the RP drift detectors will require optimization.
  - In general, closer to the last dipole before the drift seems a bit better.
- It would still be wise to have both detectors working together to maximize total phase space coverage in xL and pT.

Backup

1D Kinematic Plots – RP Drift



1D Kinematic Plots – RPSF