

# PC update 3-19-21

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Goals for this update:

- Do some Data/MC comparison with Minimum Bias
- Show Data/MC efficiencies and purity with  $p_T$ ,  $X_+$ ,  $R_{xy}$
- Show  $1/X_0$  as a function of  $R$

Datasets:

There are many Minimum Bias data samples

Here are the options I considered ( samples I processed on UNL :✓):

- /L1MinimumBias/Run2018B-PromptReco-v2/AOD ✓
  - On tape
  - small  $O(10)$ GB
  - Low PU
- /H1MinimumBias0/HIRun2018A-PromptReco-v1/AOD
  - On disk
  - HI = Heavy Ion?
- /MinimumBias/Run2018A-12Nov2019\_UL2018-v1/AOD ✓
  - On disk
  - UL data?
  - standard PU, so not compatible with this RecoSIM
- /MinimumBias0/Run2018B-PromptReco-v2/AOD ✓ (tape recall/ run in progress)
  - On tape
  - Low PU
  - includes lumi mask
  - found it here: <https://twiki.cern.ch/twiki/bin/view/Main/VertexCompositeTrees2019>

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NOTE:

Results shown here will use /L1MinimumBias/Run2018B-PromptReco-v2/AOD. There is significant discrepancy between MC and Data. Maybe this dataset is L1 trigger only and lacks additional processing that is applied in MC or other refined datasets.

The /MinimumBias0/Run2018B-PromptReco-v2/AOD dataset looks more promising in terms of the correct sample to look at. If it turns out bad, probably need to ask Suvankar for appropriate dataset.

Also, new trick -- If you submit a crab job with dataset on tape, crab will already submit a tape recall request and then automatically run over the sample when it has been transferred off tape.

We define radial regions

BPIX1 + BP [1,5) cm

BPIX2 [5,9) cm

BPIX3 [9,13) cm

BPIX4 [13,18) cm

OUTER [18,20) cm

These serve as bins of efficiencies for later computation

Efficiency and purity (note efficiency errors are from Divide and not properly propagated)

Efficiency is defined as:

$$\frac{N \text{ Reconstructed Conv. matched to a Sim Vertex}}{N \text{ Sim Conversion Vertices}}$$

Purity is defined as:

$$\frac{N \text{ Reconstructed Conv. matched to a Sim Vertex}}{N \text{ Reconstructed Conv.}}$$

The cuts/acceptance applied are

**The standard Reco. selection criteria**

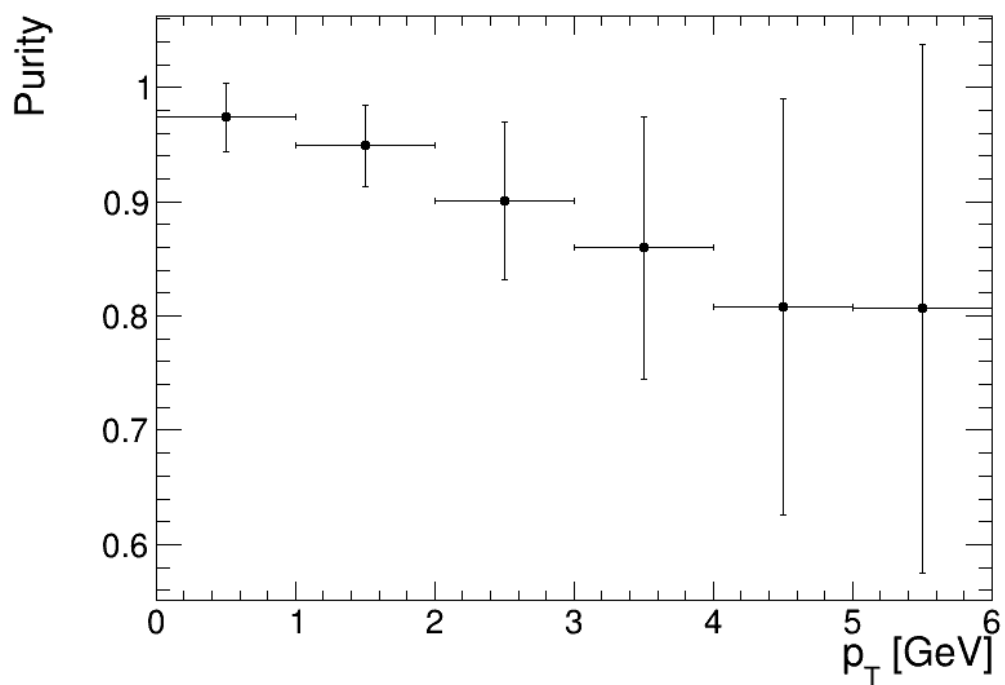
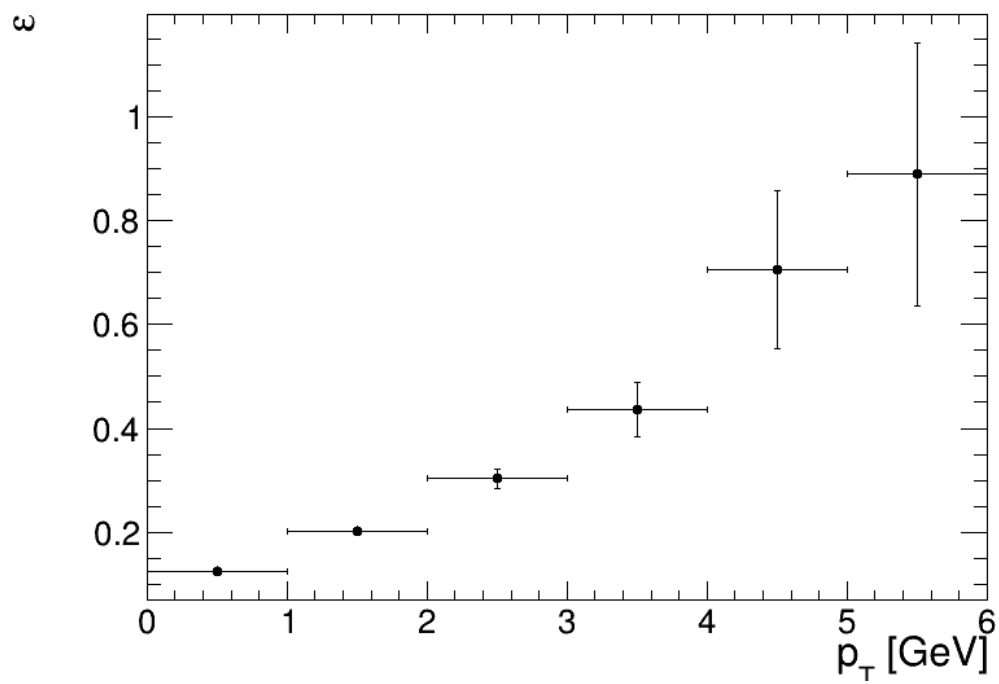
$$\sigma_R < 0.25\text{cm} \quad |z_{pc}| < 25\text{cm} \quad |\cos \theta_\gamma| < 0.85 \quad P_{\text{fit}} > 0.01 \quad 0 \text{ Hits before Vtx.} \\ \min(p_{T1}, p_{T2}) > 0.2\text{GeV}$$

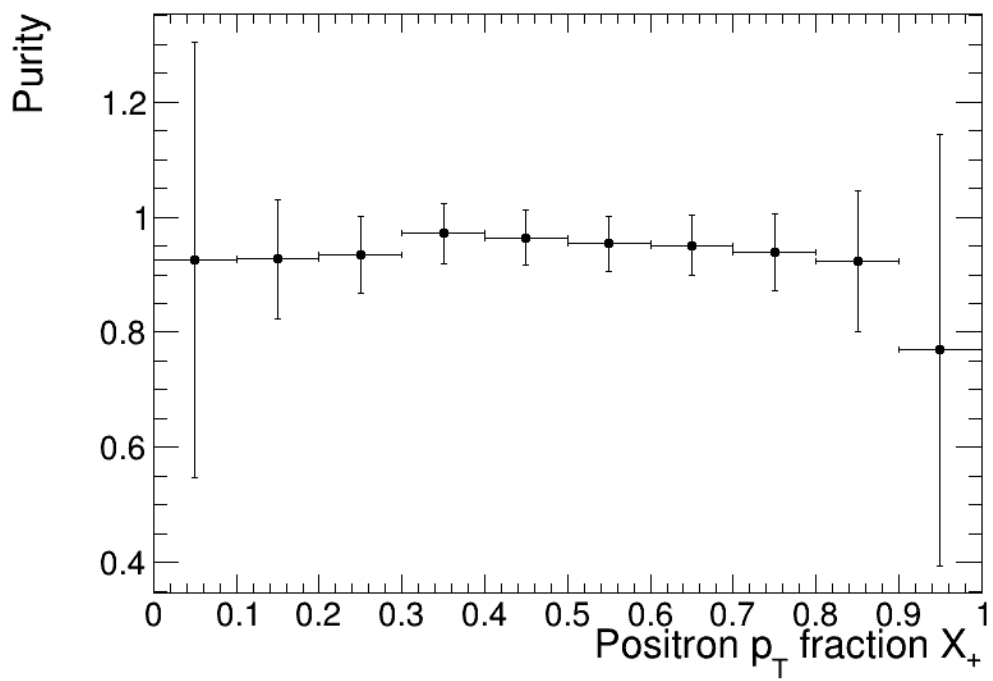
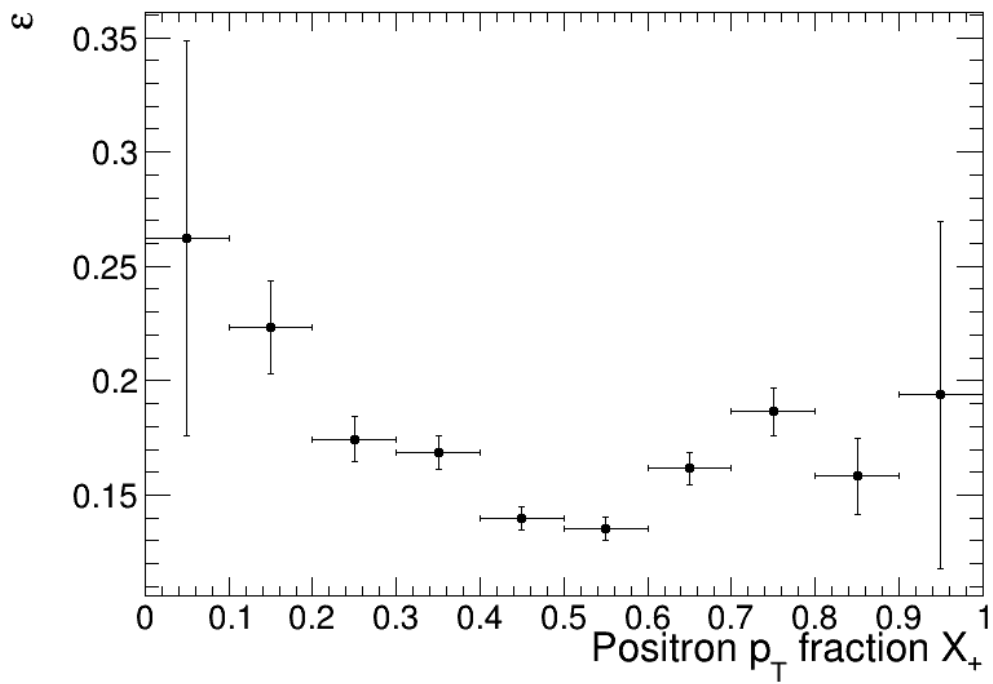
**Gen. acceptance criteria:**

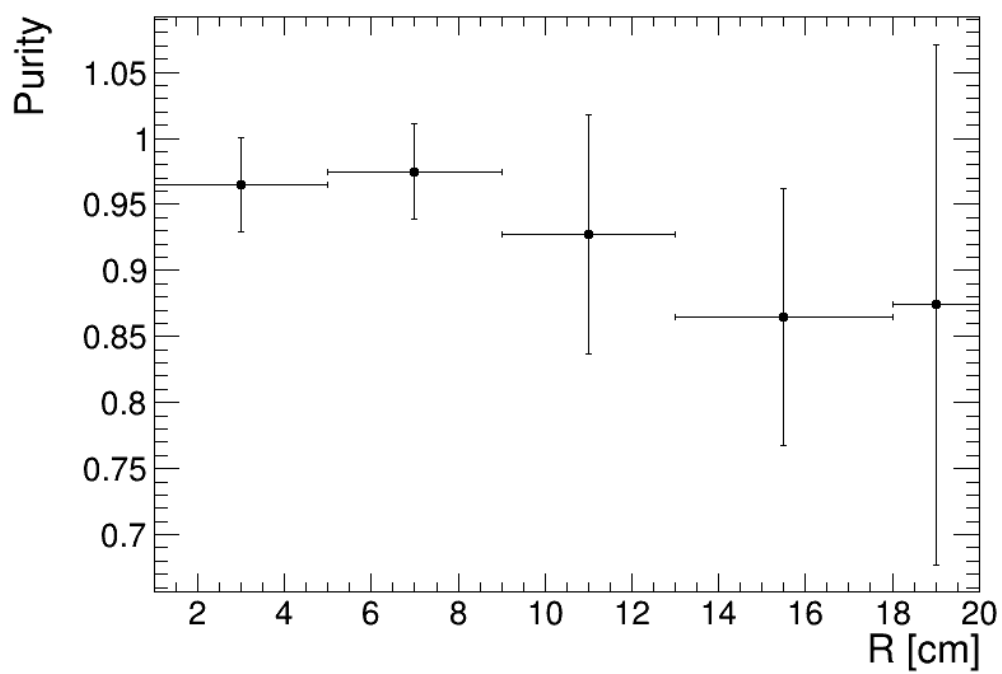
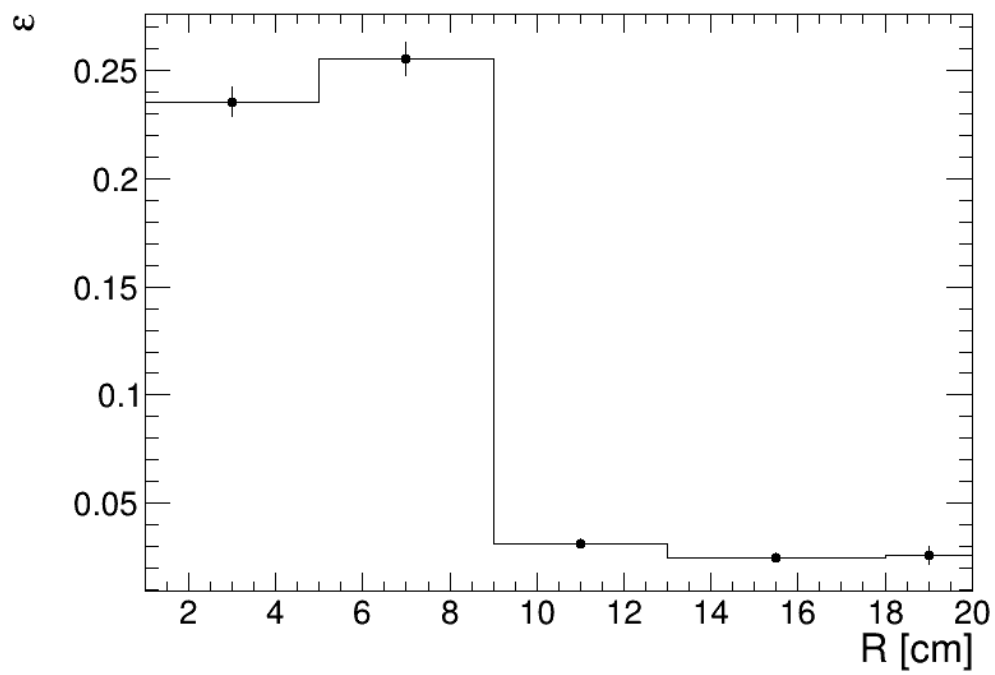
$$|z_{pc}| < 25\text{cm} \quad |\cos \theta| < 0.85 \quad \min(p_{T1}, p_{T2}) > 0.2\text{GeV}$$

For more details refer to DPG talk :Photon\_Conversions\_Update\_Nov2-20.pdf

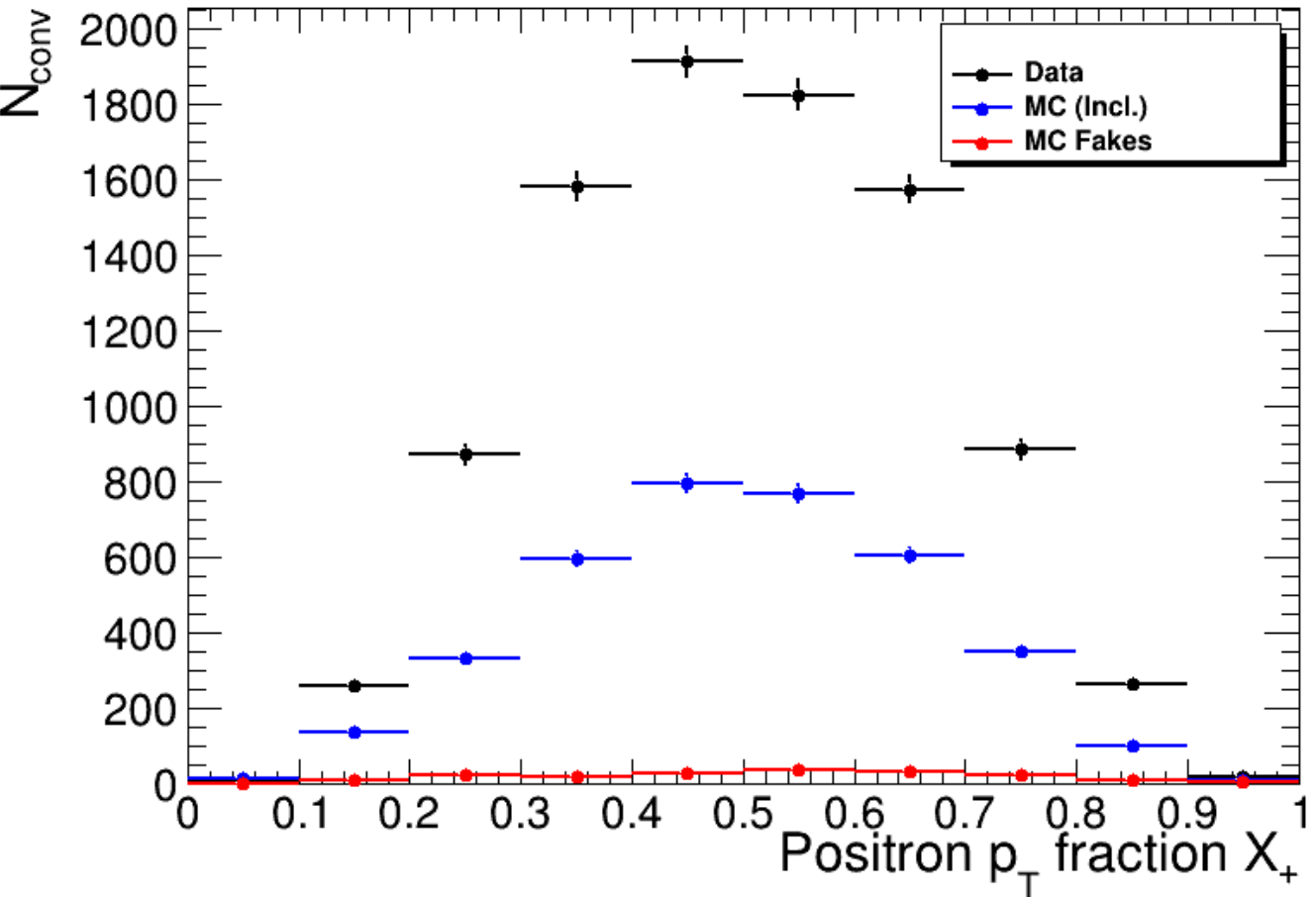
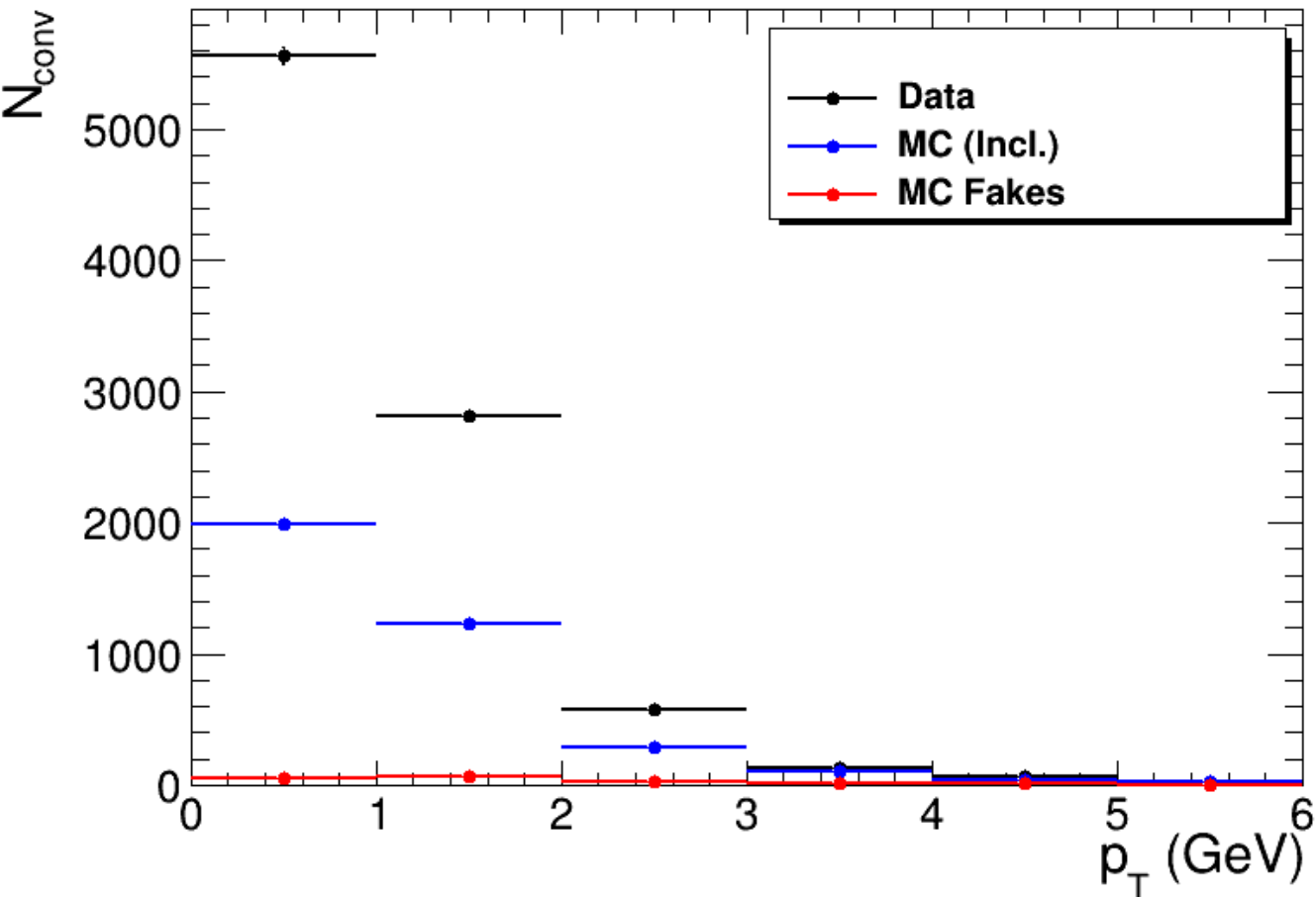
[https://indico.cern.ch/event/934826/contributions/4088970/attachments/2134433/3596215/Photon\\_Conversions\\_Update\\_Nov2-20.pdf](https://indico.cern.ch/event/934826/contributions/4088970/attachments/2134433/3596215/Photon_Conversions_Update_Nov2-20.pdf)

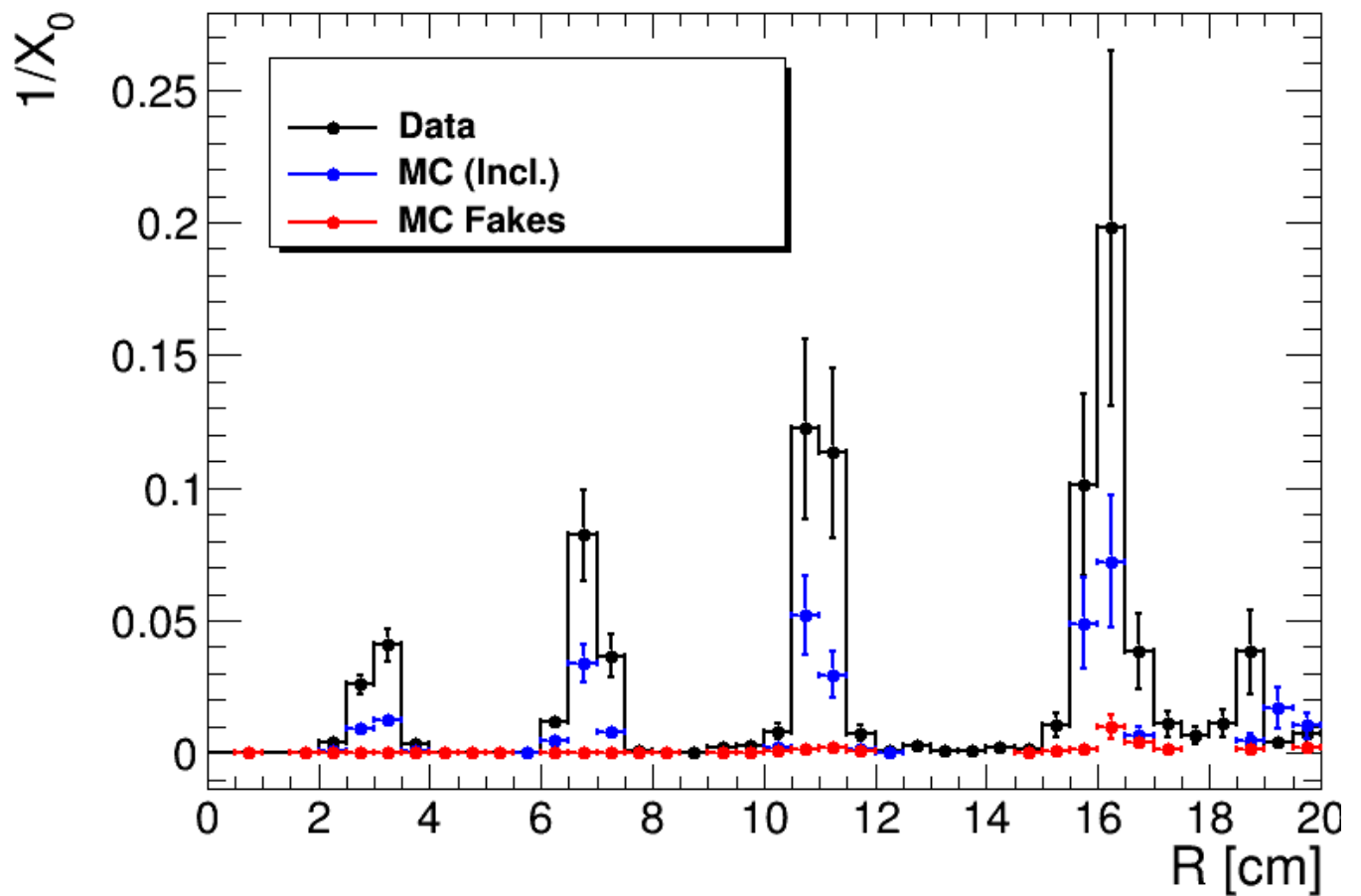
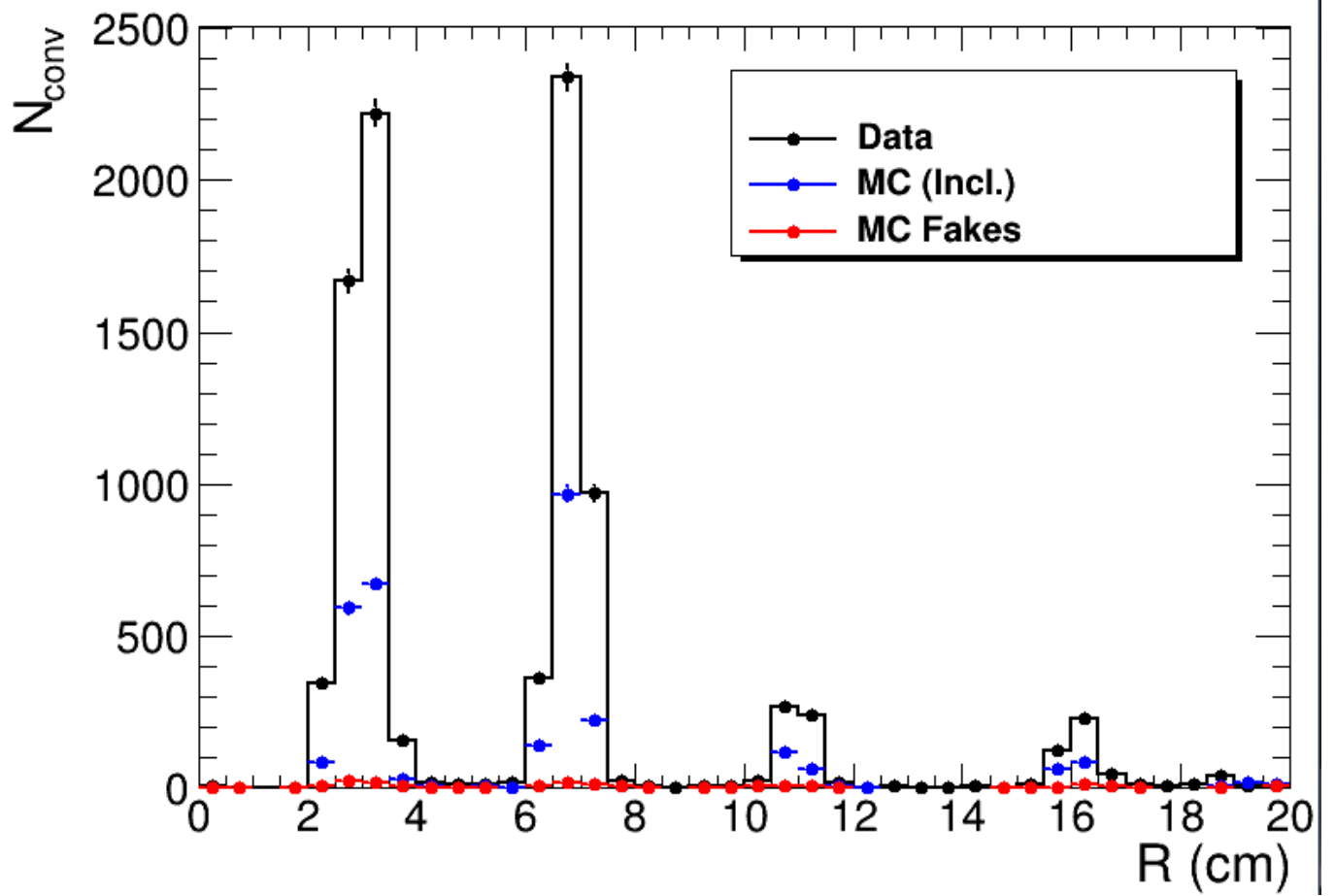






Data MC Comparison





For the  $1/X_0$  measurement I used the  $N_\gamma = 6159$  from my previous talk and  $f_{\text{geom}} = 2\pi(z_2 - z_1) \ln(r_2/r_1)$ . Bin size is 0.2 cm and data uses the BP centered radius ( $\rho$ )

## Flux of Prompt Gen. Photons through the barrel

Region	Prompt Photons ( $\times 10^4$ )	Converted ( $\times 10^4$ )	Converted & can Reco. ( $\times 10^4$ )	Fraction Converted	Fraction converted can Reco.
$S_1$	6159	385	15	6.2%	4.0%
$S_2$	5718	93	14	1.6%	15.0%
$S_3$	5551	62	14	1.1%	23.1%
$S_4$	5337	44	14	0.82%	31.8%
$S_5$	5096	65	21	1.3%	33.1%
Totals					
$S_{1 \rightarrow 5}$	6159	649	79	2.3%	12.2%

- Prompt photons defined by production in  $R < 1\text{cm}$ ,  $|z| < 15\text{cm}$ , with  $p_T > 0.4\text{GeV}$  and  $|\cos\theta| < 0.85$
- Converted represents total conversions without acceptance criteria applied
- Converted & can reco is the number of conversions that pass acceptance pair min.  $p_T > 0.2\text{GeV}$

Sanity Checks:

Can predict number of conversions in  $S_2$ :

$$5718 \times (7/9) \times (0.0074 + 0.011) = 81(93)$$

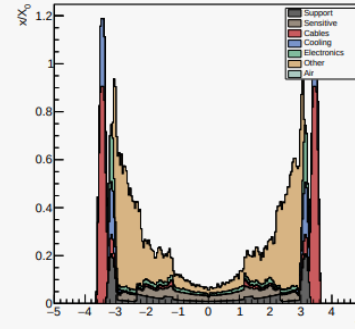
Total  $x/X_0$  in  $R < 25$  observed by prompt photon:

$$x/X_0 = 649/(6159 \times 7/9) = 13.5\%$$

$$x/X_0 = 0.74\% \text{ for layer 1}$$

$$x/X_0 = 1.1\% \text{ for layer 2,3,4}$$

Material Budget PixBar



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The  $1/X_0$  is overestimated from data because there is significantly more conversions at low  $p_T$ . However looking at MC we find reasonable agreement in BPIX1 and BPIX 2 of  $1/X_0 \approx 1\%$ . BPIX3, BPIX4, and OUTER look a bit high.