



# Mono-photon study barrel-endcap

Jets & Clusters

---

Mohamed Reda Mekouar

January 22, 2025

Institute of High Energy Physics, Chinese Academy of Sciences

We chose to do a  $\theta$  scan with a step of  $\Delta\theta = 1^\circ$  to check our resolution over the range  $8^\circ \leq \theta \leq 54^\circ$  which is approximately  $0.6 \leq \cos(\theta) \leq 0.99$ :

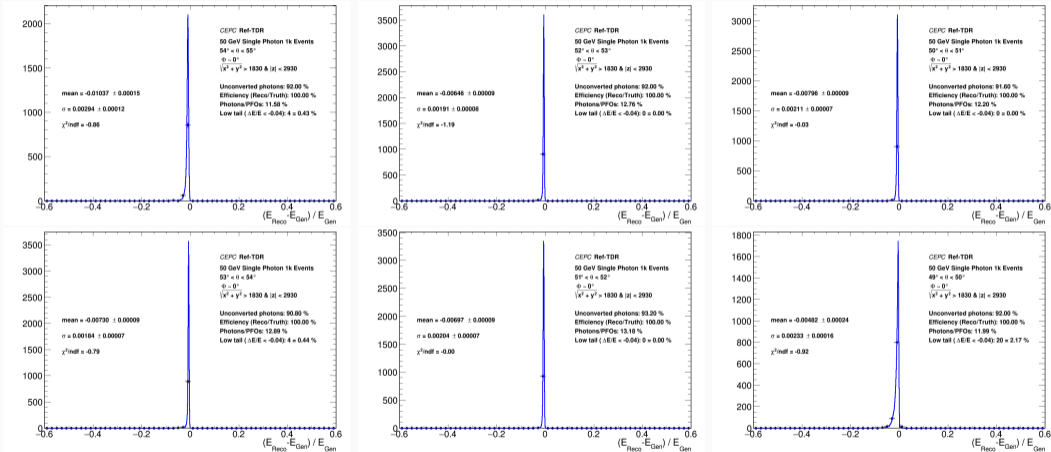
-From  $35^\circ \leq \theta \leq 54^\circ \approx (0.6 \leq \cos(\theta) \leq 0.82)$ : barrel region

-From  $33^\circ \leq \theta \leq 35^\circ \approx (0.82 \leq \cos(\theta) \leq 0.84)$ : big crack between barrel and endcap

-From  $8^\circ \leq \theta \leq 33^\circ \approx (0.84 \leq \cos(\theta) \leq 0.99)$ : endcap region

# Barrel region

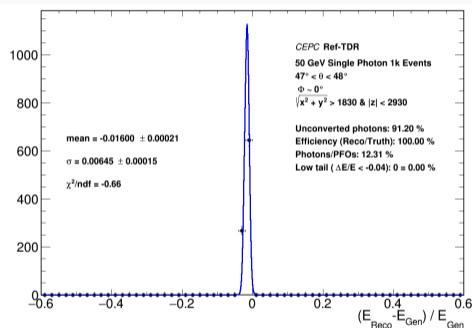
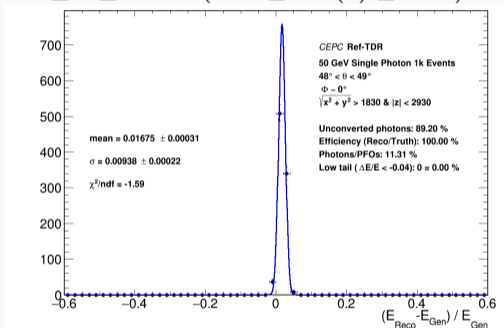
First module in barrel region: From  $49^\circ \leq \theta \leq 55^\circ \approx (0.57 \leq \cos(\theta) \leq 0.66)$



The resolution is around 0.2% and the scale less than 1%  
 -> Good reconstruction in the first module (bare dead material)

# Barrel region

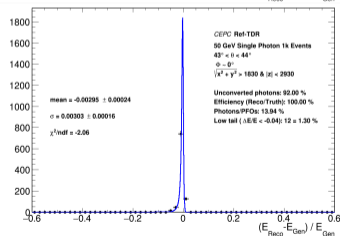
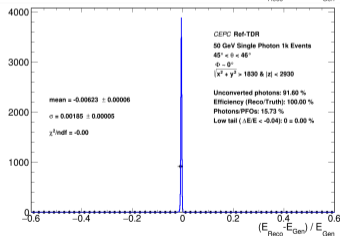
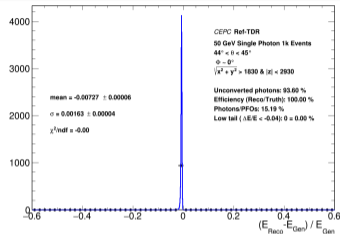
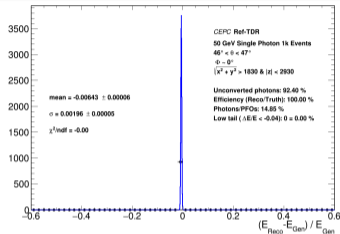
Dead material/crack between first and second module in barrel region: From  $47^\circ \leq \theta \leq 49^\circ \approx (0.66 \leq \cos(\theta) \leq 0.68)$



Resolution decreasing in the  $2^\circ$  range covering the dead material/crack between two modules

# Barrel region

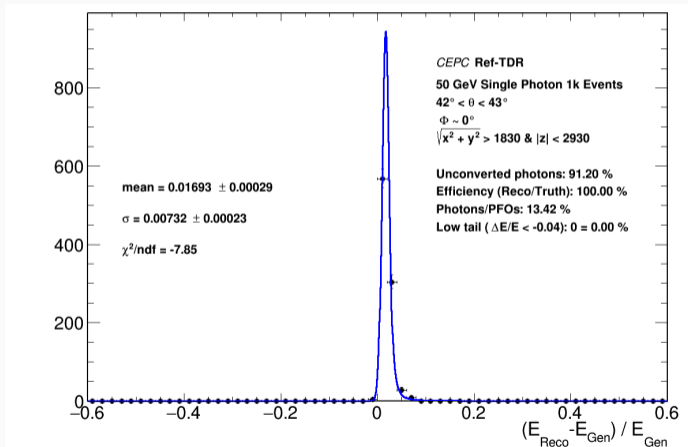
Second module of the barrel: From  $43^\circ \leq \theta \leq 47^\circ \approx (0.68 \leq \cos(\theta) \leq 0.73)$



Good reconstruction within the module (small increase in resolution when approaching  $43^\circ$  -> shifting to dead material) -  $\gamma$  conversion rate still around 8% (as expected in barrel)

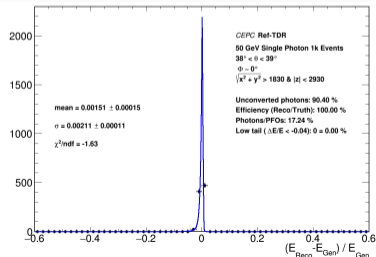
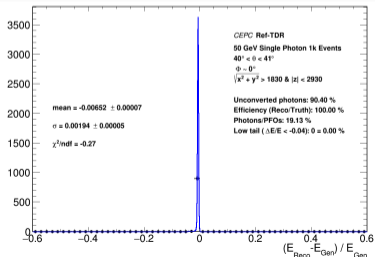
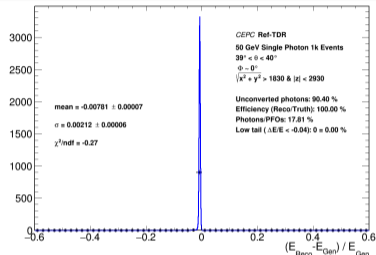
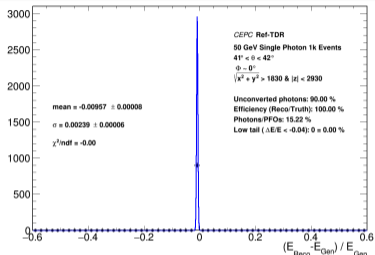
# Barrel region

Dead material/crack between second and third module in barrel region: From  $42^\circ \leq \theta \leq 43^\circ \approx (0.73 \leq \cos(\theta) \leq 0.74)$



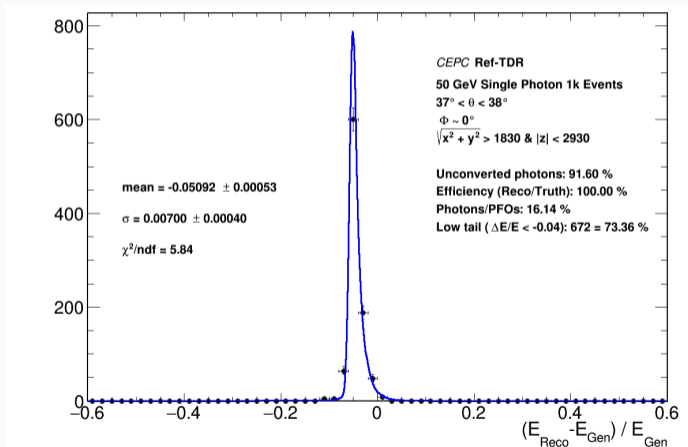
# Barrel region

Third module: From  $38^\circ \leq \theta \leq 42^\circ \approx (0.74 \leq \cos(\theta) \leq 0.79)$



# Barrel region

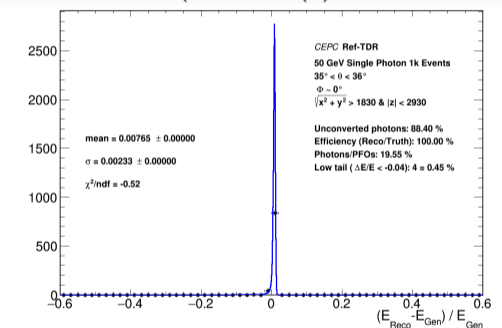
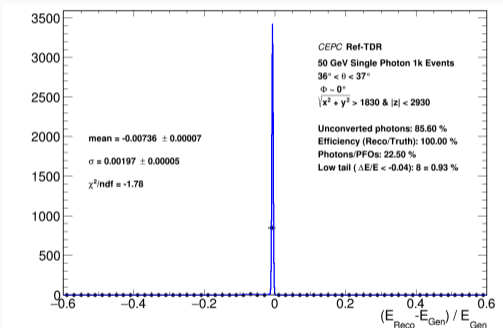
Dead material/crack between 3<sup>rd</sup> and 4<sup>th</sup> module in barrel region: From  $37^\circ \leq \theta \leq 38^\circ$   
 $\approx (0.79 \leq \cos(\theta) \leq 0.8)$





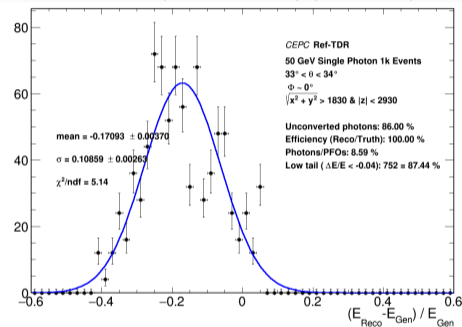
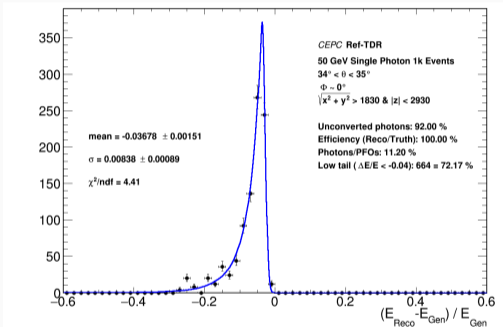
# Barrel region

Fourth and last module in the barrel: From  $35^\circ \leq \theta \leq 37^\circ \approx (0.8 \leq \cos(\theta) \leq 0.82)$



# Crack region

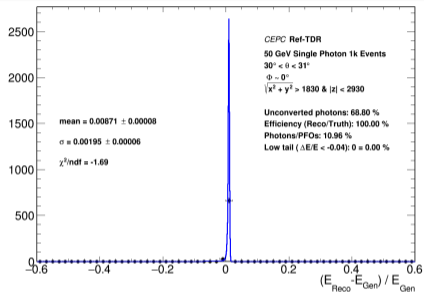
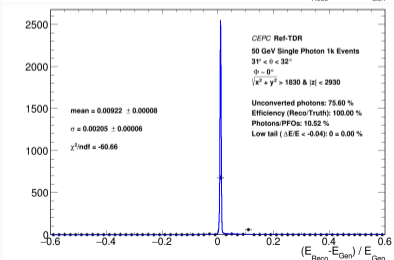
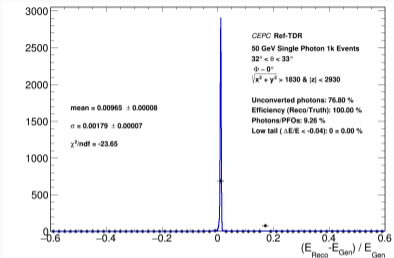
Big crack between barrel and endcap: From  $33^\circ \leq \theta \leq 35^\circ \approx (0.82 \leq \cos(\theta) \leq 0.84)$



The resolution reasonably gets much worse because we have an empty gap between the barrel and endcap

# Endcap region

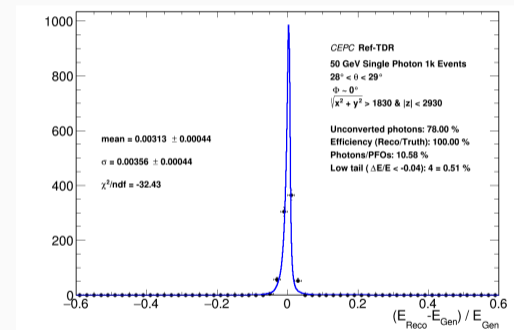
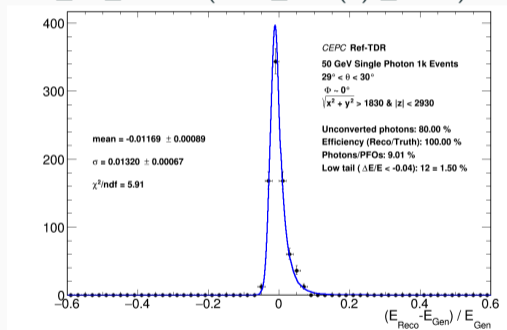
First module of the endcap: From  $30^\circ \leq \theta \leq 33^\circ \approx (0.84 \leq \cos(\theta) \leq 0.87)$



Resolution in endcap is as good as barrel (0.2%) but with much higher  $\gamma$  conversion rate (25-30%) - Mean/Scale shifted to positive side (to be calibrated)  
Small bump in the higher tail (around  $0.1 < \Delta E/E < 0.2$ ) (bug in Digi/Reco?)

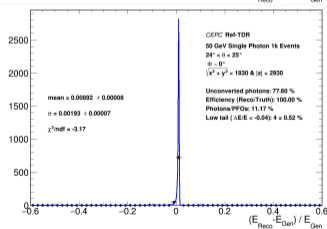
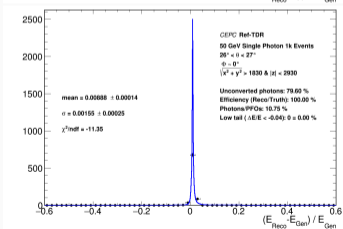
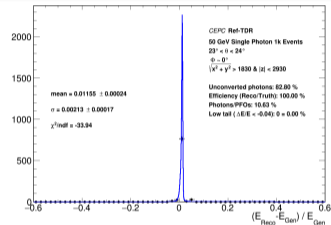
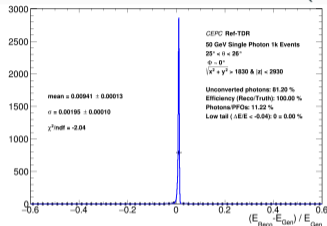
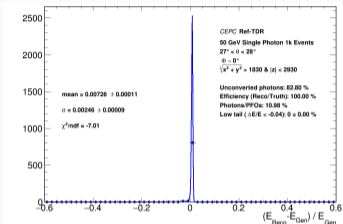
# Endcap region

Dead material/crack between first and second module in endcap region: From  $28^\circ \leq \theta \leq 30^\circ \approx (0.87 \leq \cos(\theta) \leq 0.88)$



Resolution goes as high as 1.3% in the first crack between endcap modules

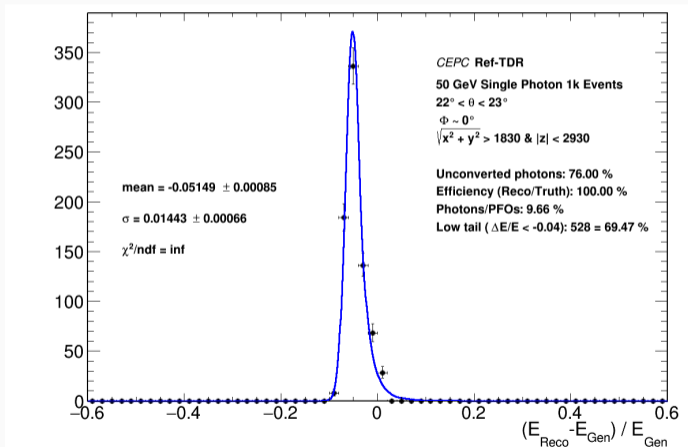
Second module in endcap region: From  $23^\circ \leq \theta \leq 28^\circ \approx (0.88 \leq \cos(\theta) \leq 0.92)$



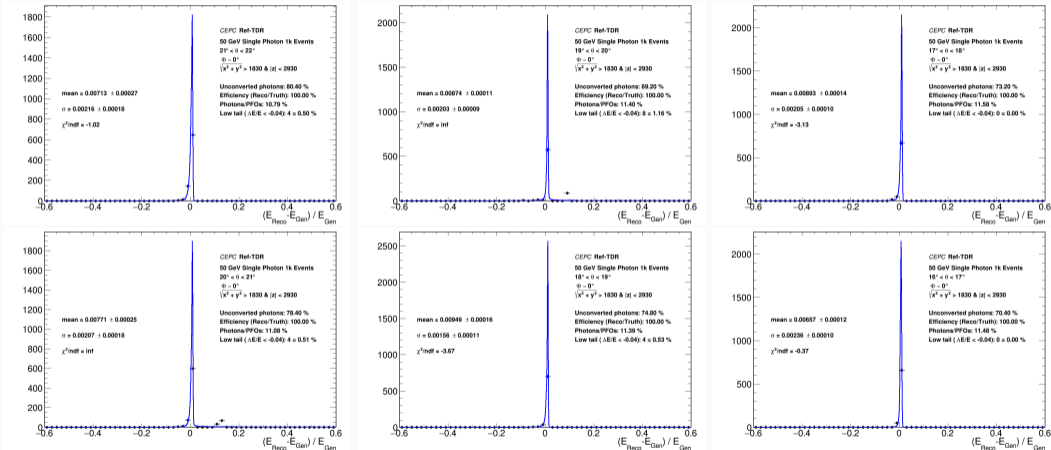
Resolution still at 0.2% and  
Scale almost at 1% -  
Conversion rate at around  
20%

# Endcap region

Dead material/crack between second and third module in endcap region: From  $21^\circ \leq \theta \leq 22^\circ \approx (0.92 \leq \cos(\theta) \leq 0.93)$

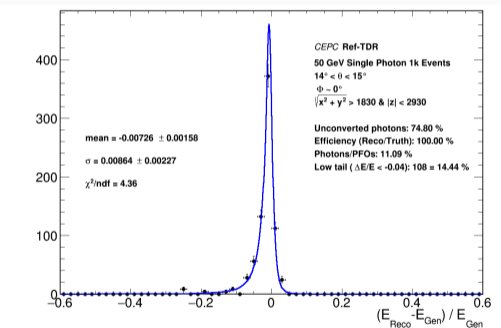
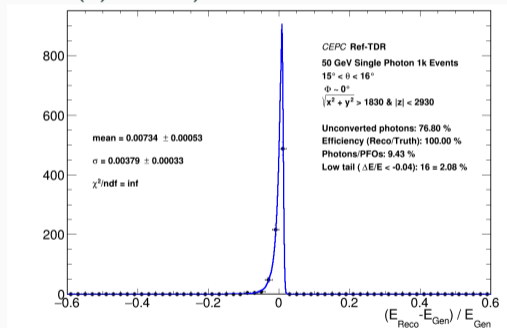


Third module: From  $16^\circ \leq \theta \leq 21^\circ \approx (0.93 \leq \cos(\theta) \leq 0.96)$



Small bump appearing again in higher tail

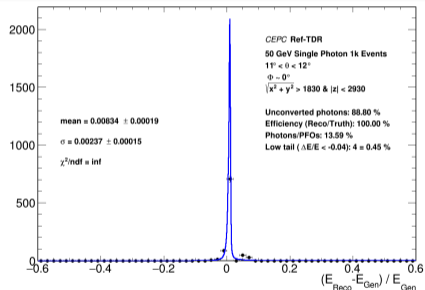
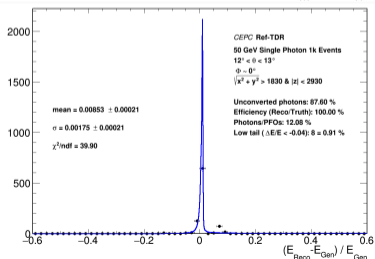
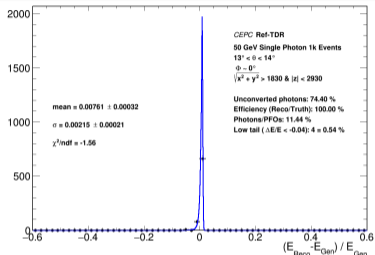
Dead material/crack for the third module in endcap region: From  $14^\circ \leq \theta \leq 16^\circ \approx (0.96 \leq \cos(\theta) \leq 0.97)$





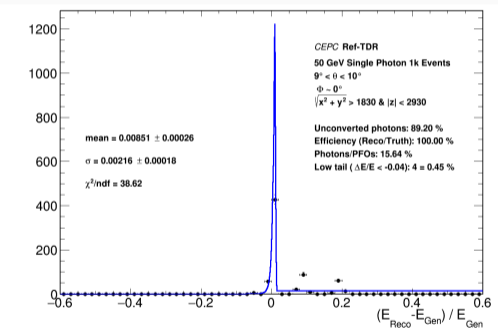
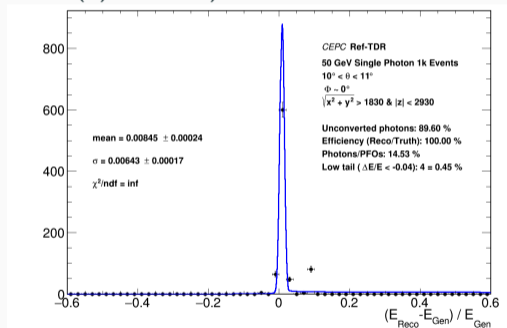
# Endcap region

Last module: From  $11^\circ \leq \theta \leq 14^\circ \approx (0.97 \leq \cos(\theta) \leq 0.98)$



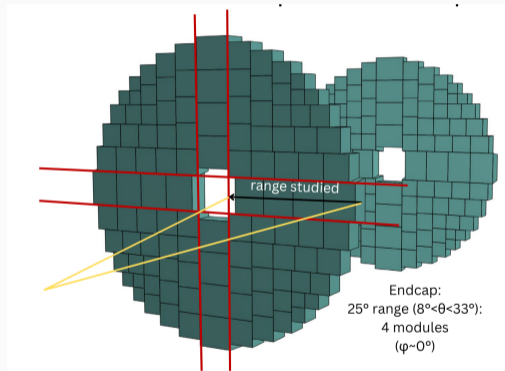
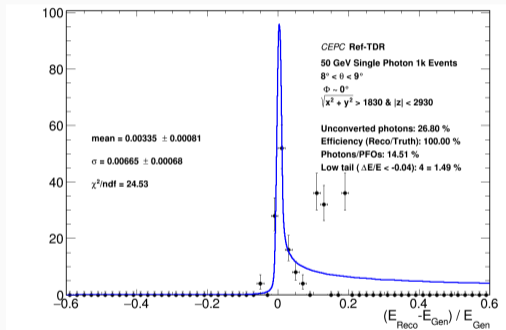
# Endcap region

Dead material for last module in endcap region: From  $9^\circ \leq \theta \leq 11^\circ \approx (0.98 \leq \cos(\theta) \leq 0.988)$



# Endcap region

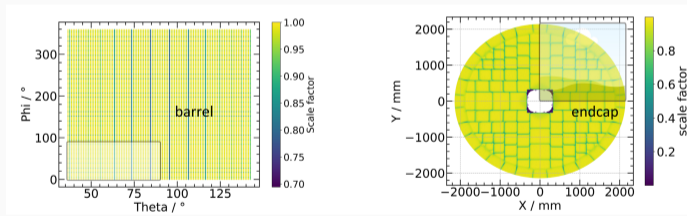
Limit of endcap region (big hole in the center of the endcap): From  $8^\circ \leq \theta \leq 9^\circ \approx (0.988 \leq \cos(\theta) \leq 0.99)$



Lots of converted photons (75% not reconstructed in endcap because, almost no material in this range for endcap)

# Perspectives

- Using these results to scale/calibrate and shift the mean values of our reconstructed photons
- Fixing the bump in the higher tail
- 2D scans for resolution ( $\varphi, \theta$ ) to mitigate effects/impact of different crack regions (within barrel, between barrel & endcap, within endcap, according to  $\varphi$  and those according to  $\theta$ )



Define zones for 2D scan to scale over rest of subdetectors according to symmetries  
( $0^\circ < \varphi < 90^\circ$ ,  $8^\circ < \theta < 89^\circ$ )?

- Upcoming important geometry update in CEPCSW according to decision on granularity (10mm v. 15mm)?

Thank you!