V0.8 Photon Samples -First Look

<mark>1/30/25</mark>



New Samples, European Strategy Goals



- Federico produced new photonGun samples with the v0.8 lattice BIB overlaid
- We aim to remake the photon (and neutral hadron) plots from the paper for input to European strategy
- I have generated ntuples with the photonGun samples and made some preliminary gen/reco-level plots to begin the validation process
- Samples:

/ospool/ucshared/project/futurecolliders/data/fmeloni/DataMuC_MAIA_v0/v0/recoBIB/photonGun_E*



0-50 GeV Slice - E, theta

- Everything looks sane at gen Level
- As expected, efficiency looks low for the 0-50 slice
- Concerning drop-off in efficiency as E grows, though
 – worth further inspection
- We see the expected shape in the theta distribution
- Cutoff at 20 GeV is manually imposed in selection process
- (also recall the -1 peak is the unmatched photons)





0-50 GeV Slice - Npfo, PFO Type

- All events have less than 5 PFOs reconstructed
- PFOs are either photons

 (22) or neutrons (2112) –
 nice sanity check





50-250 GeV Slice - E, theta

- Again, gen Looks good
- Theta dependency not apparent anymore—consistent with previous samples (see fig. 17 in paper)
- Overall matching efficiency also improves as expected





50-250 GeV Slice - Npfo, PFO Type

- Small fraction of events have 1000s of PFOs – BIB junk
- Vast majority still in the reasonable 1-5 range (note log-log scale)
- Still mostly photons and neutrons, but now we have some electrons (pdg 11) and pions (pdg 211) sneaking in as well





250-1000 GeV Slice - E, theta

- Gen distributions remain reasonable
- Efficiency a lot better
- No theta-dependence (as we expect)
- Energy underestimation visible in shift of Edistribution





250-1000 GeV Slice - Npfo, PFO Type

- Similar fraction of events with O(1000) PFOs
- Relative rates of neutrons, photons, electrons, and pions relatively stable
- From these plots, nothing super alarming





Resolution Study – Bimodal Behavior

- Tried to run the resolution study out of the box
- Distributions of (E_rec-E_true)/E_true are distinctly bimodal
- True for all three energy slices
- Here are 3 examples; see backup for more plots
- These plots are for the endcap region; barrel displays same bimodality









Resolution Study – Bimodal Behavior

- Interestingly, the transition region does **not** display the same bimodality
- Motivates a closer inspection of theta dependence
- First: the same resolution study, binned in theta







Theta-binned resolution



- Binning by theta reveals the same trend: bimodality in the barrel and endcap regions, not in the transition region
- (See backups for plots)
- In the endcaps, the two peaks are at ~-0.15 and -0.1; in the barrel, they are at -0.2 and -0.1
- In the transition region, the peak is at about -0.15
- Two peaks \rightarrow are we choosing a spurious photon candidate half the time?
 - And why is this not affecting the transition region?

NPhotons vs Theta, E



- Wanted to look for any theta or E-dependences in the number of photonidentified PFOs per event
- No visible theta dependence; no E dependence beyond what we expect from statistics





BIB Energy Distribution



- Do we need to re-optimize the E (pT) cut to exclude the BIB?
- Plotted E of all MC particles (BIB included)
- Our cut of 20 GeV still seems reasonable to cut out the BIB spike without losing signal



Backup: Gaussian Fits (Endcaps)





































Backup: Gaussian Fits (Barrel)





Backup: Gaussian Fits (Transition)







Backup: Gaussian Fits (Theta binning)



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Endcap