Reconstruction of photons and neutral mesons with MPD

Yonghong Wang
Shandong University
MPD collaboration

Outline

1、Dataset

2、Photon selection in ECal

3、Photon selection in PCM(Photon Conversion Method)

4、Meson reconstruction via invariant mass

5、Comparison of reconstructed and generated

6、Summary

Dataset

- Collision system: Bi+Bi @9.2GeV
- Event generator: UrQMD
- Production: 50M events https://mpdforum.jinr.ru/t/request-8-input-request-25/622
- Analysis Train (wagon - pairGG): https://mpdforum.jinr.ru/t/request-25-general-purpose-50m-urqmd-bibi-9-2-second-collaboration-paper/455

Event cut:

Primary vertex of event reconstructed and vertex_z cut < |100| cm

Photon selection in ECAL

Photon cluster selection in ECAL：

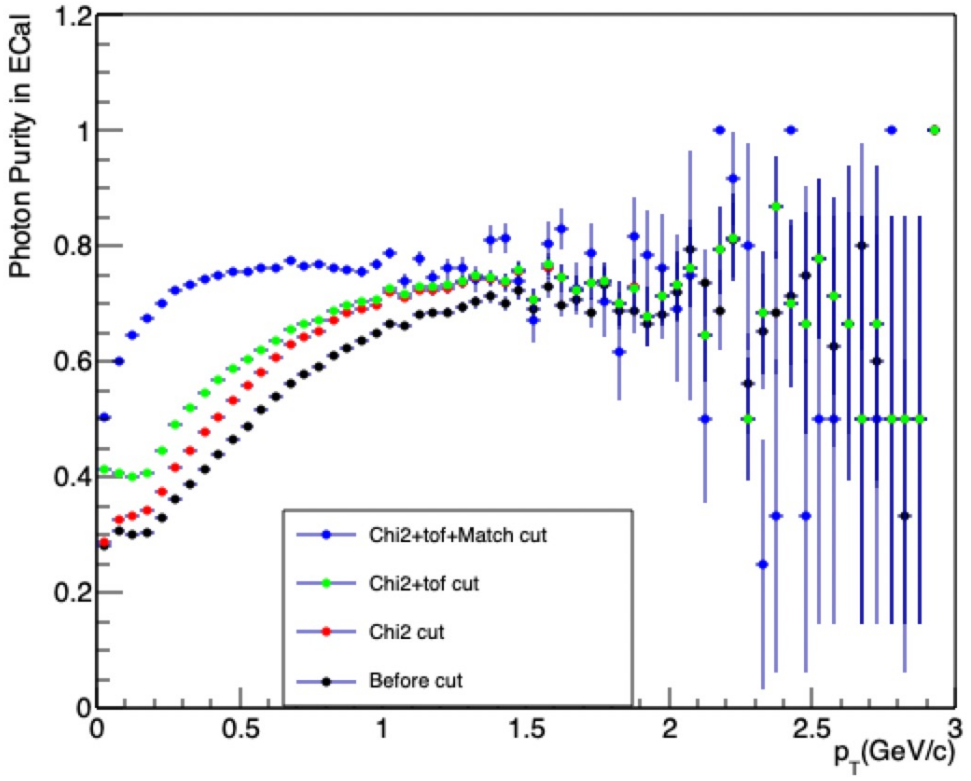
1、N_hit_tower>=2

2、reconstructed energy>=75MeV

3、Chi2<=4(This variable says how close the cluster shape to the one expected for electromagnetic shower.)

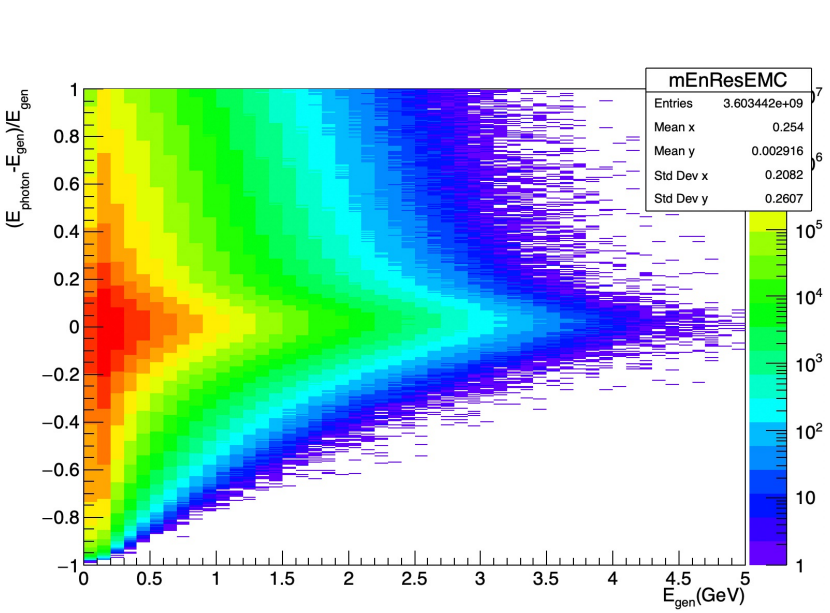
4、tof<2ns(tof of the cluster, assumed ECAL time resolution dt = 0.5 ns)

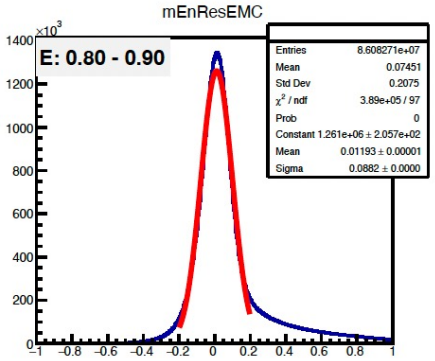
5、charged particle veto cut (no matching to tracks reconstructed in the TPC and extrapolated to the ECAL)

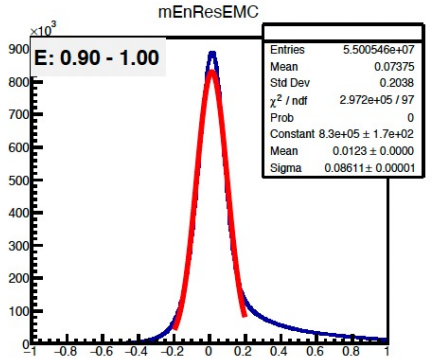


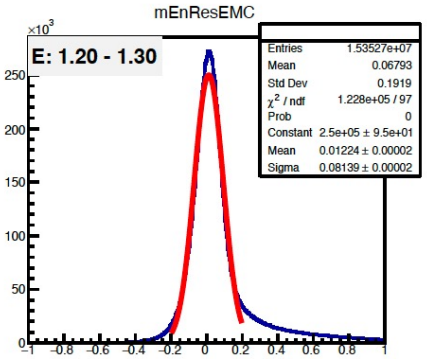
Purity: The photon purity is the ratio of the photon after the cut to all the particles after the cut

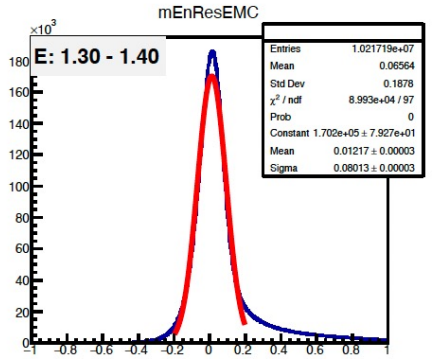
Photon energy resolution in ECAL

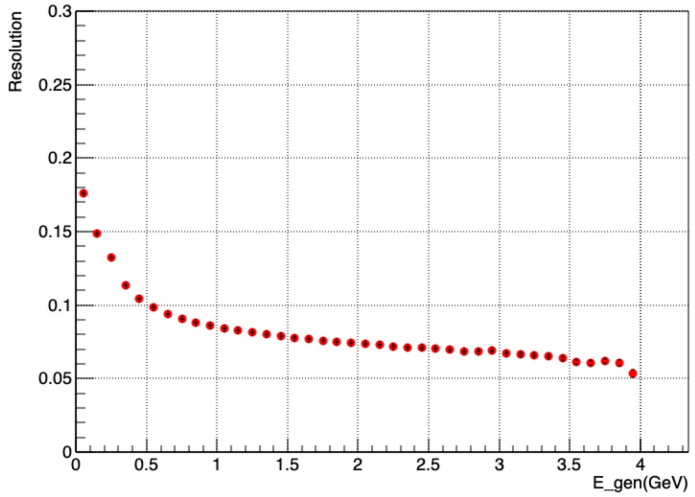












The (E_rec-E_gen)/E_gen vs. E_gen distribution is projected onto the Y-axis at intervals of 0.1GeV on E_gen, and the distribution of its projection is fitted with a Gaussian function, the Gaussian fitted sigma as a resolution of energy.

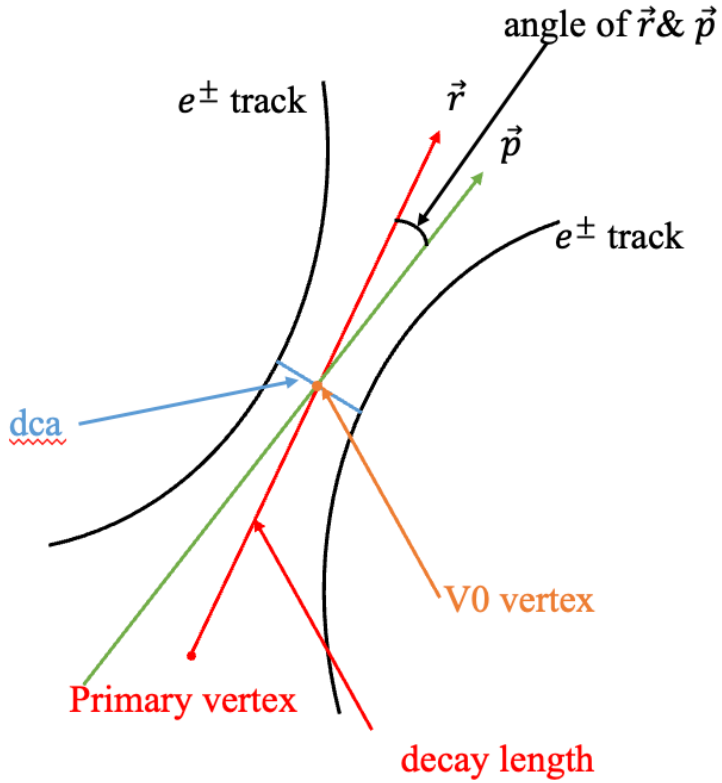
Photon selection in PCM

The cuts of single $e^+(e^-)$ track for PCM:

1、nhit>10 in TPC

2、p_T > 50 MeV/c

3、TPC 2-sigma e-ID or TPC 2-sigma eID + 3-sigma TOF e-ID in case of track matching to the TOF



e^+e^- pair's variables for PCM:

1、dca: distance of closest approach for e^+e^- tracks

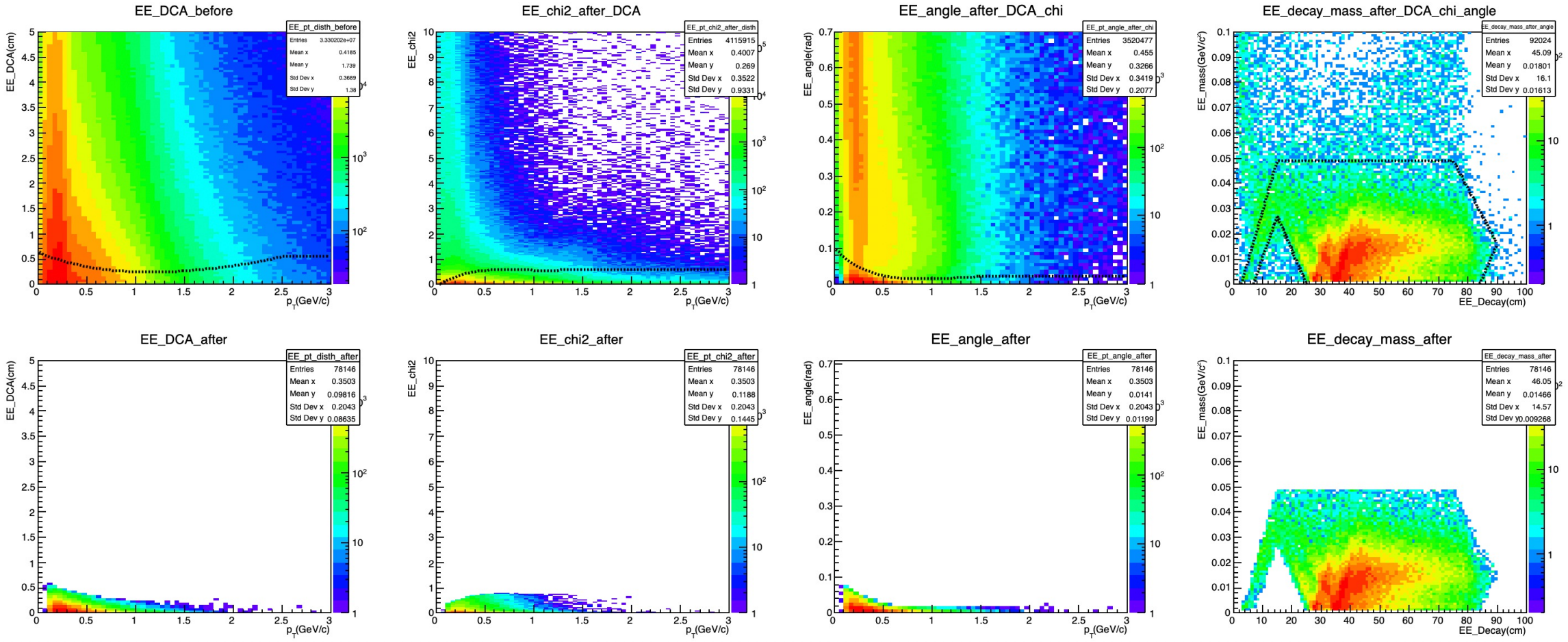
2、Chi2: quality of the secondary vertex reconstruction

3、angle: between $\vec{r}$ & $\vec{p}$

4、decay length: the distance from primary vertex to V0 vertex

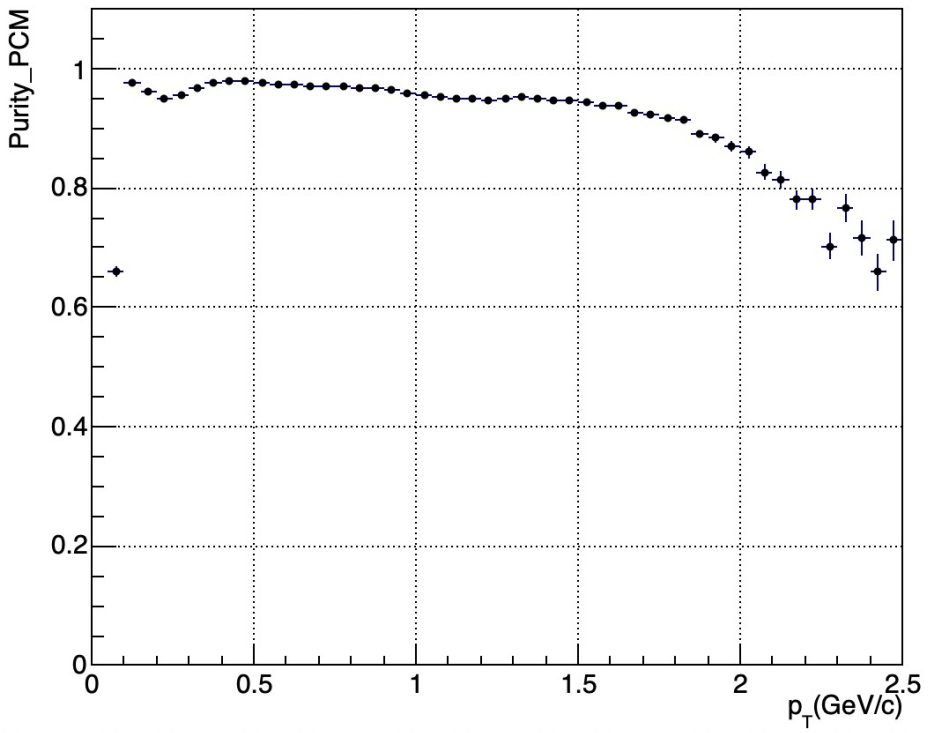
5、mass: the mass of mother particle of e^+e^- pair

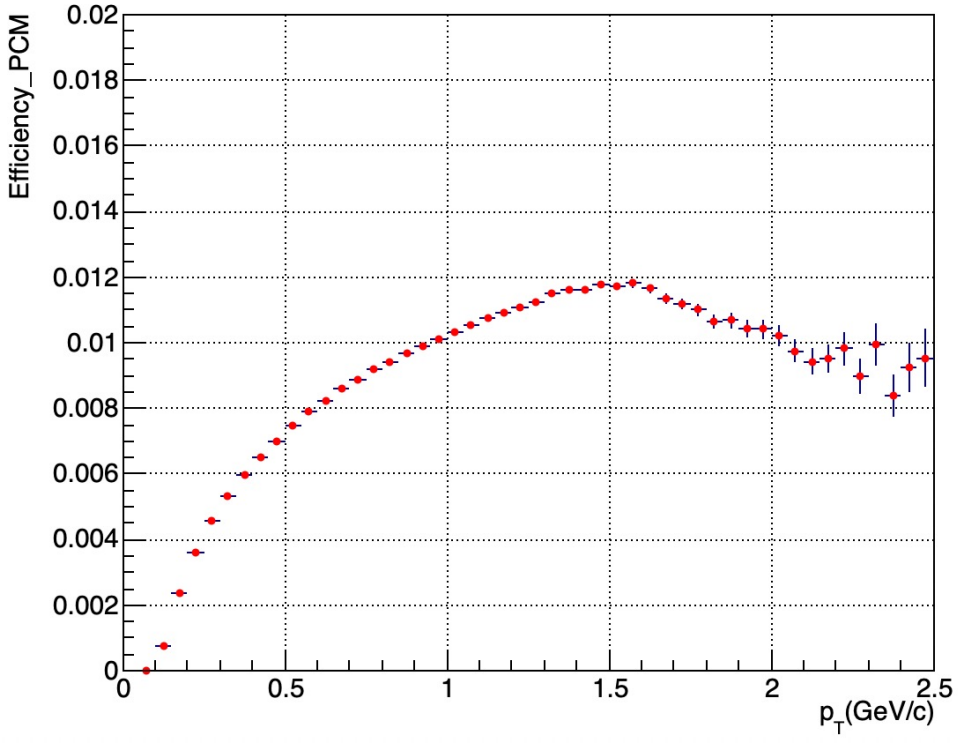
e^+e^- pairs selection for PCM



The upper are distributions of true conversion e^+e^- pairs.
The black dotted curves as 2*sigma selection, where sigma is either a Gaussian width (for distributions with Gaussian shape) or a range, which accounts for 65% of the total signal (2*sigma accounts for ~ 95% of the total signal).

Photon purity and efficiency in PCM



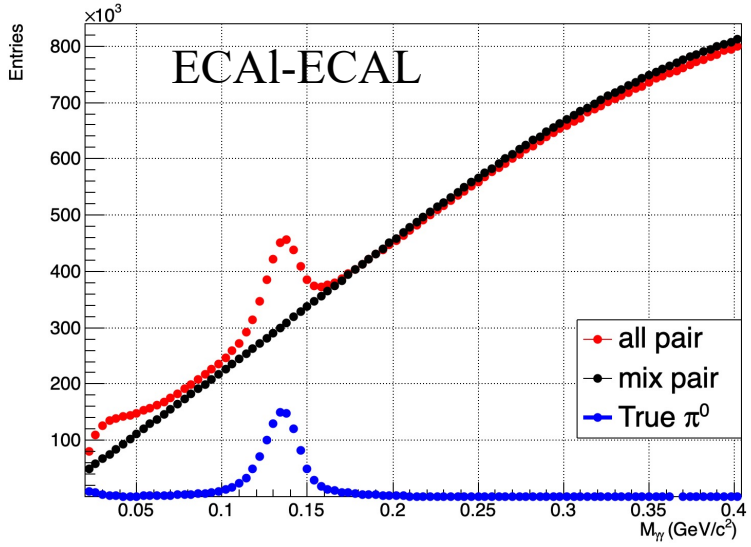


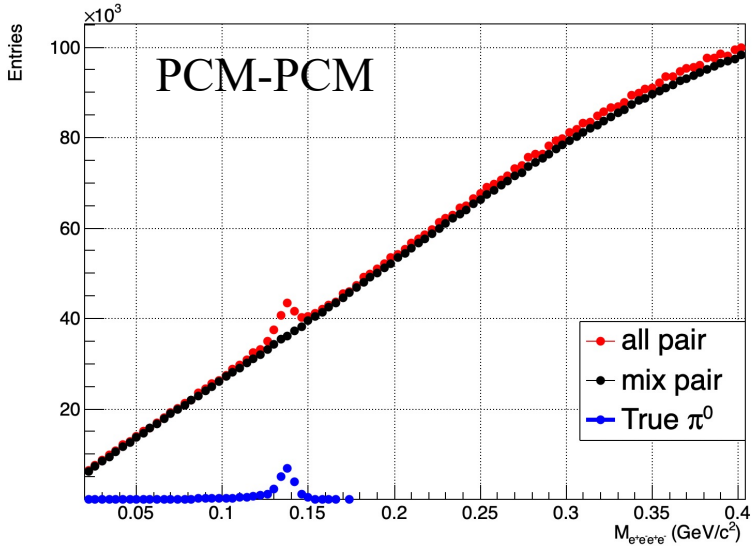
$$\text{Purity} = \frac{\text{The number of } e^+e^- \text{pairs from photons after cut}}{\text{The number of } e^+e^- \text{pairs after cut}}$$

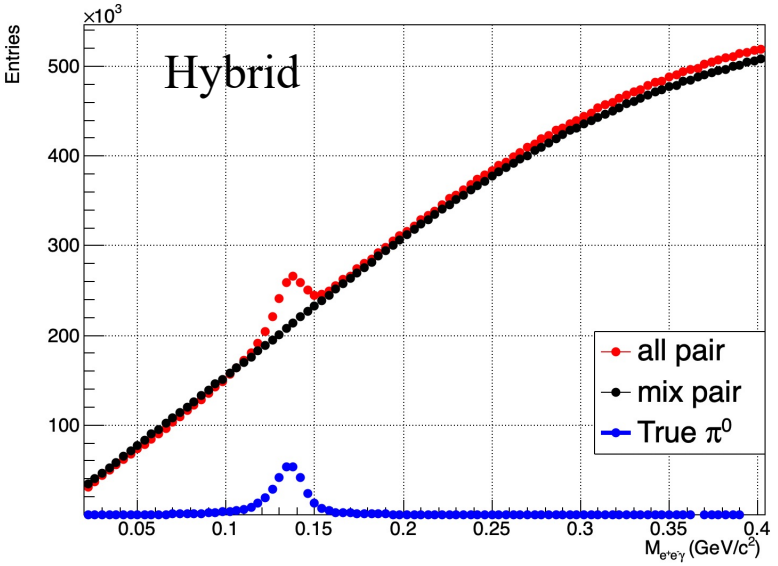
$$\text{Efficiency} = \frac{\text{The number of } e^+e^- \text{pairs from photons after cut}}{\text{The number of true photon(MC photon)}}$$

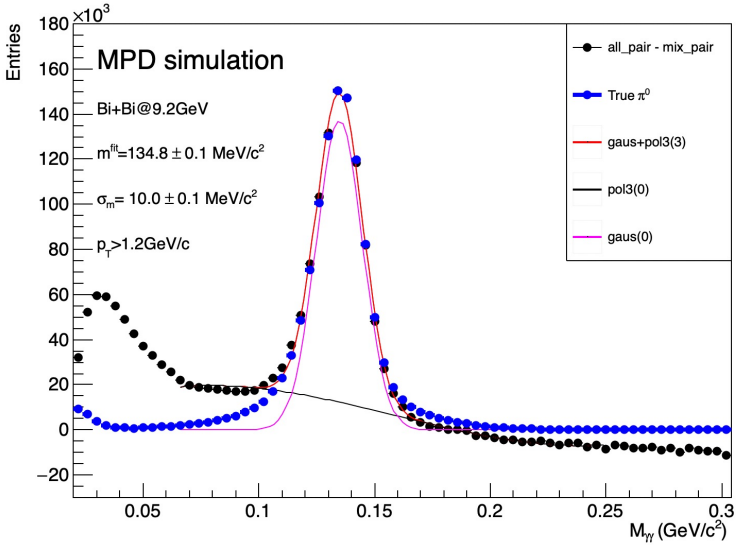
The photon purity obtained by PCM is higher than 80% at p_T < 2GeV/c.

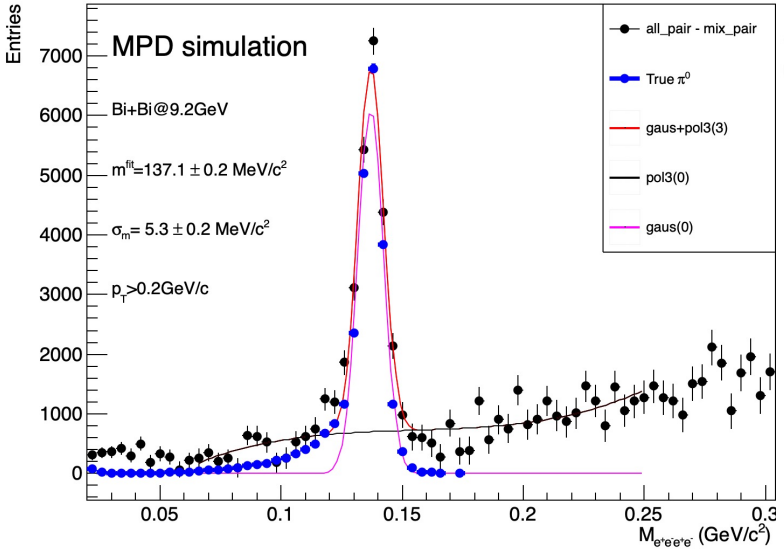
Reconstruction via invariant mass

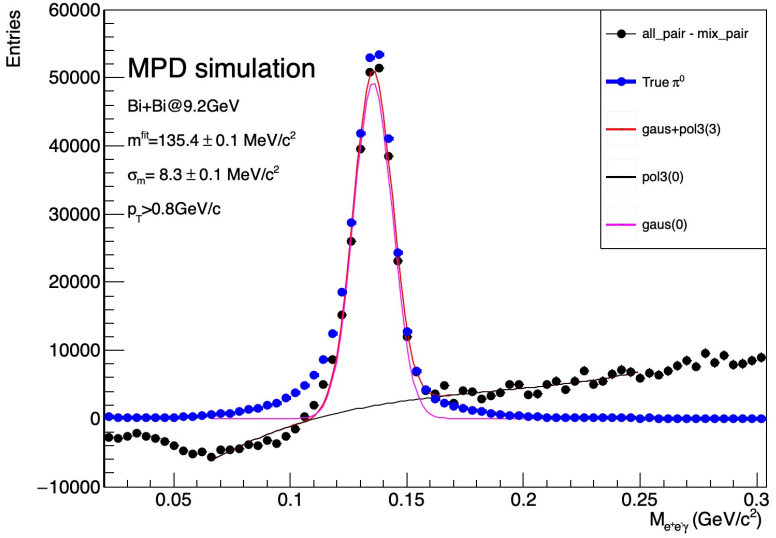






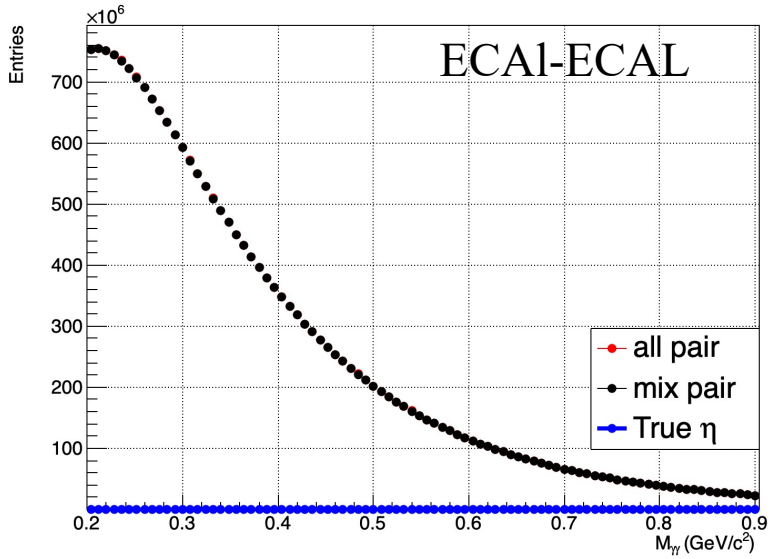


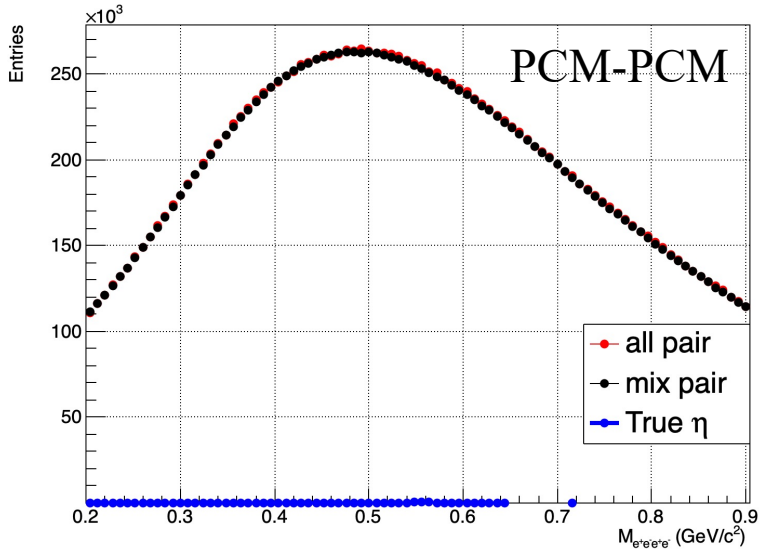


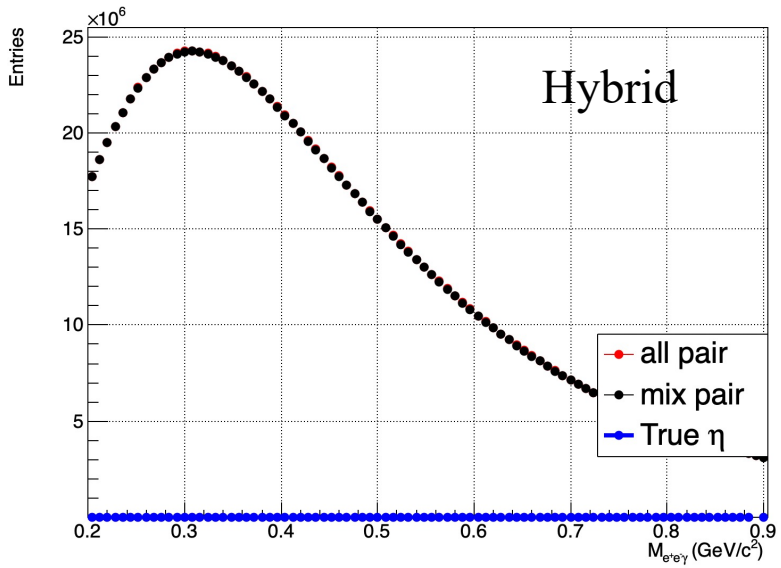


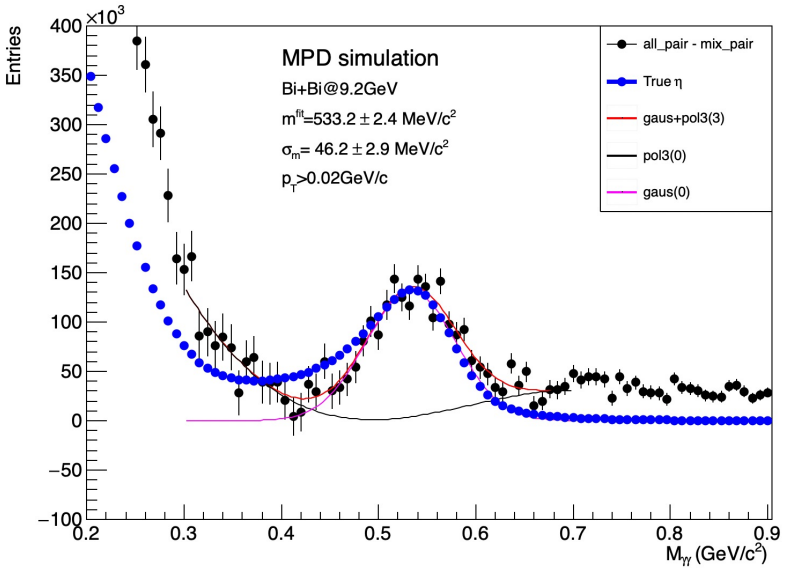
A clear excess is visible in distributions close to the nominal meson mass of 135 MeV/c² for the π^0.

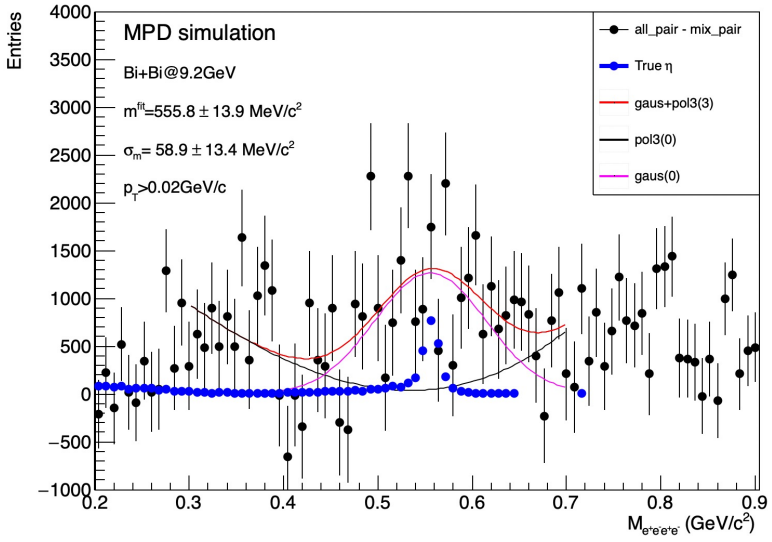
Reconstruction via invariant mass

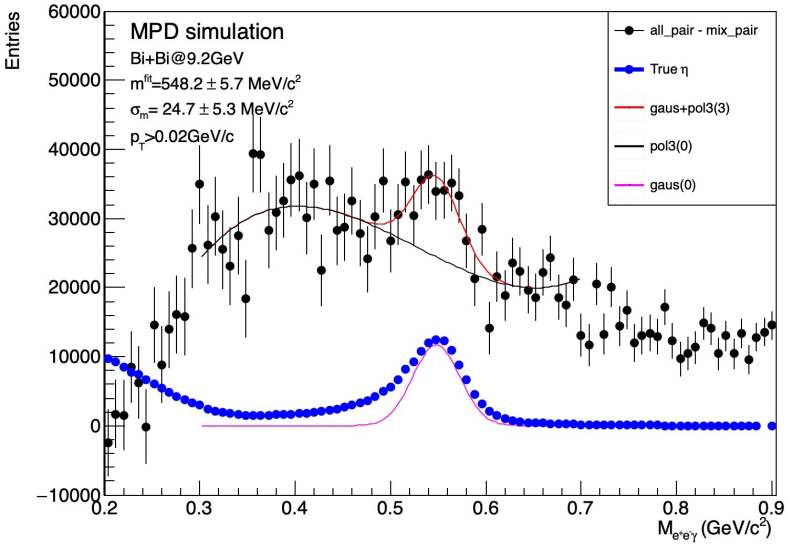






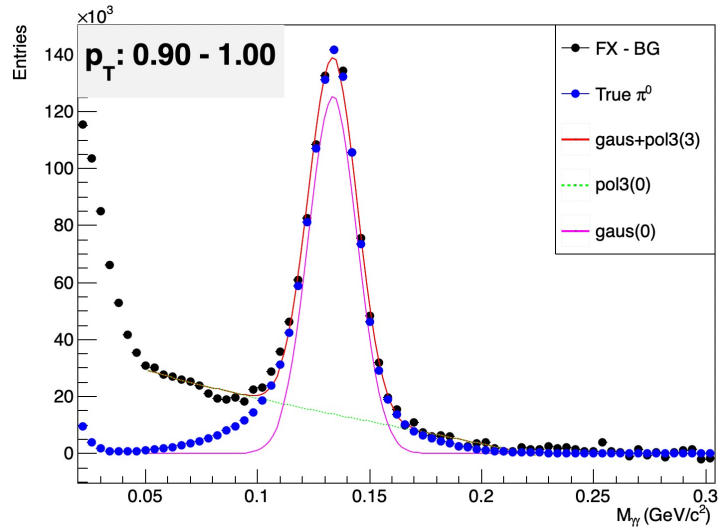


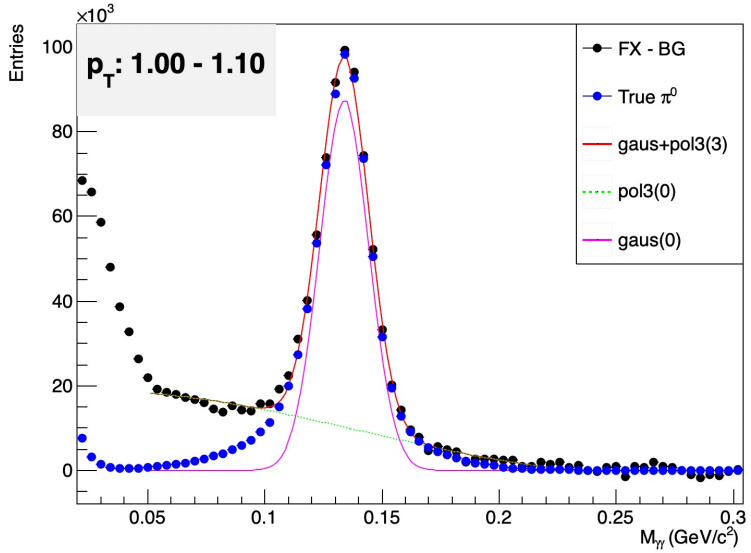


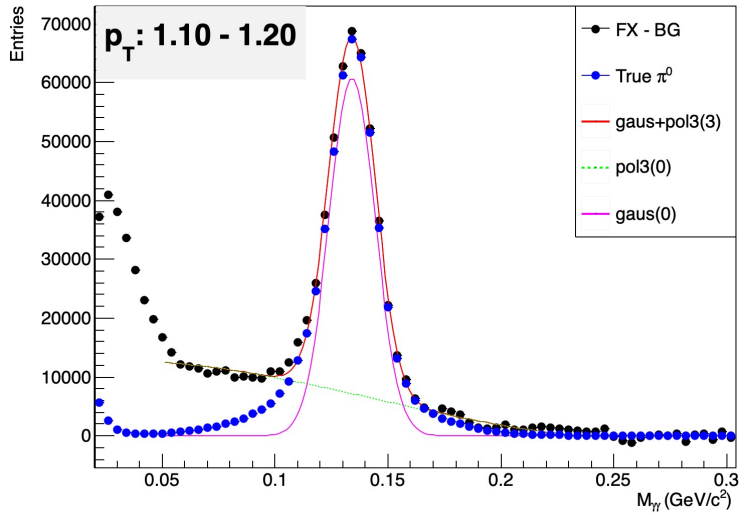


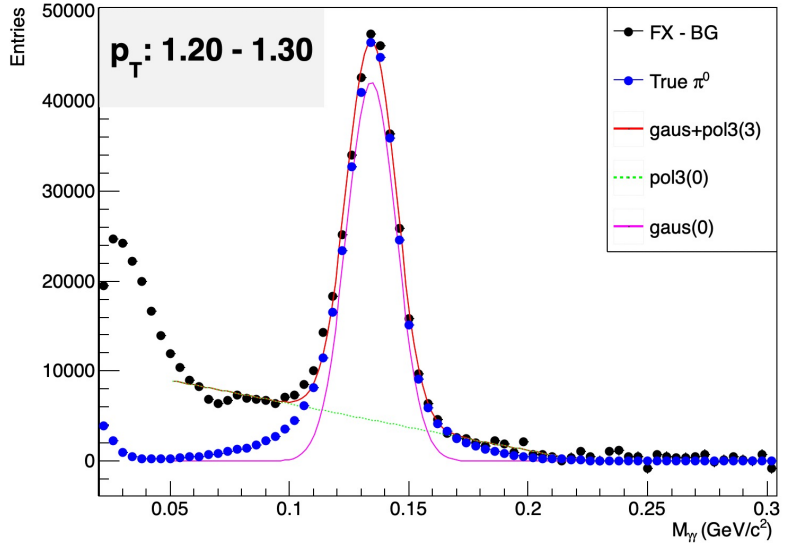
A clear excess is visible in distributions close to the 548 MeV/c^2 for the η meson.

$M_{\gamma\gamma}$ distributions for different p_T bins(ECAL)



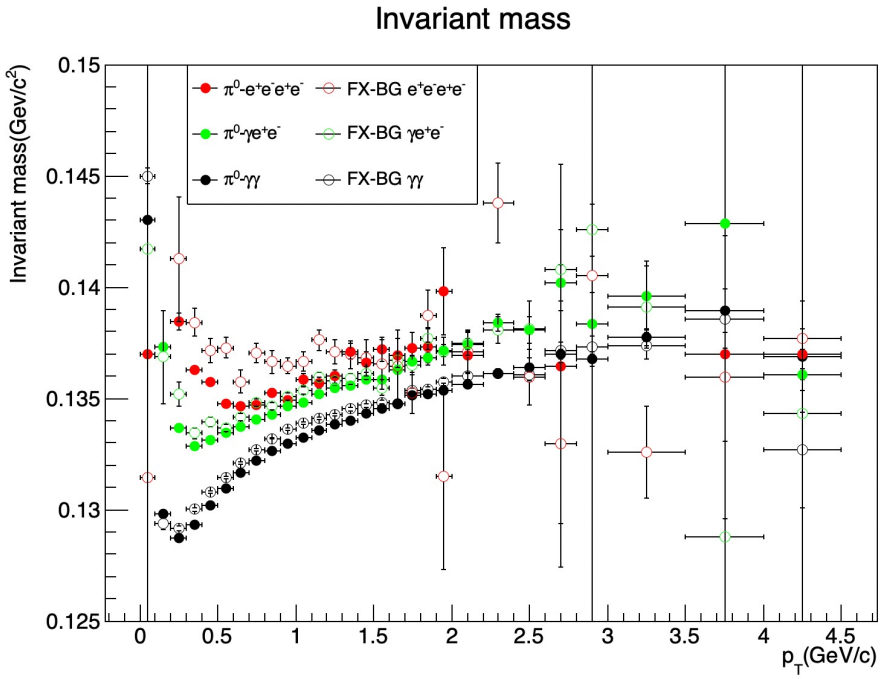


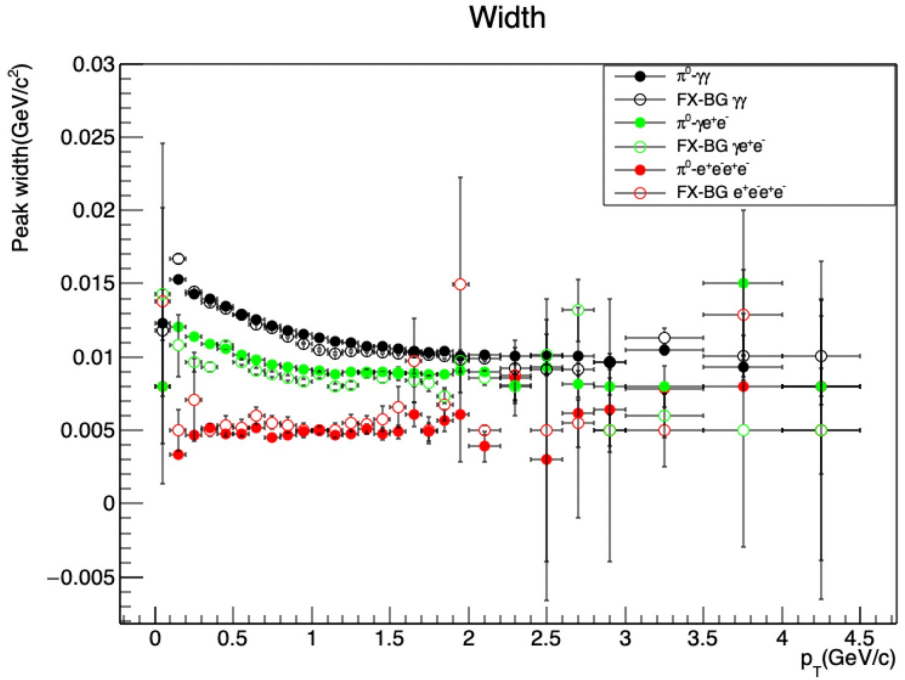


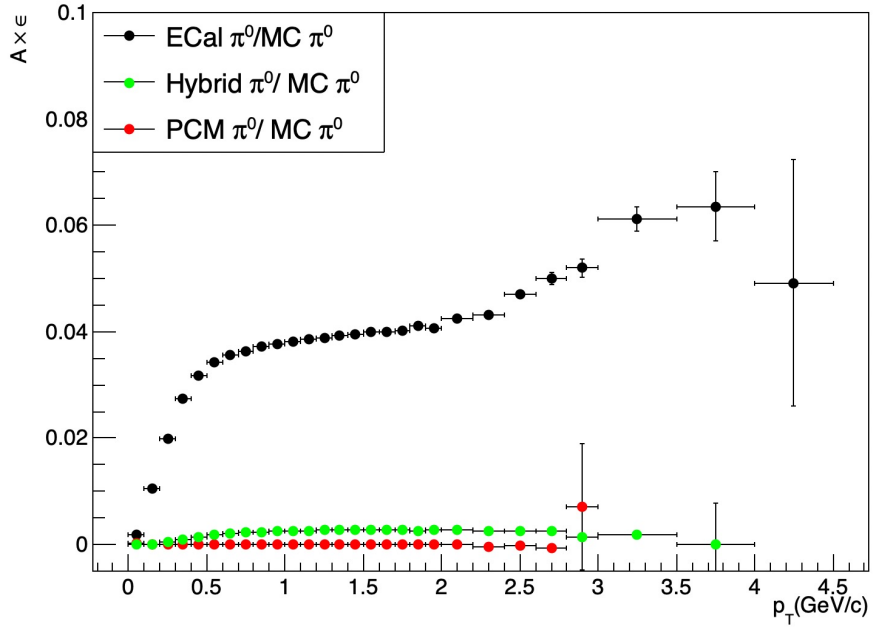


A clear excess is visible in distribution at different p_T bins close to the meson mass of 135 MeV/c^2 for the π^0.

Comparison of π^0 reconstructed and generated

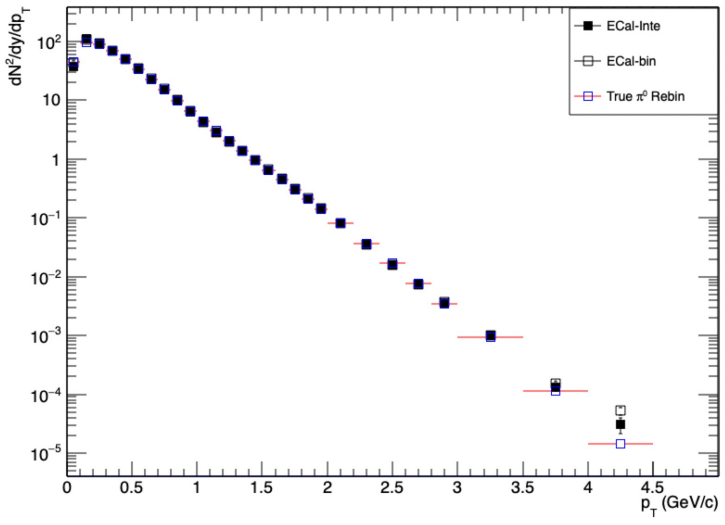


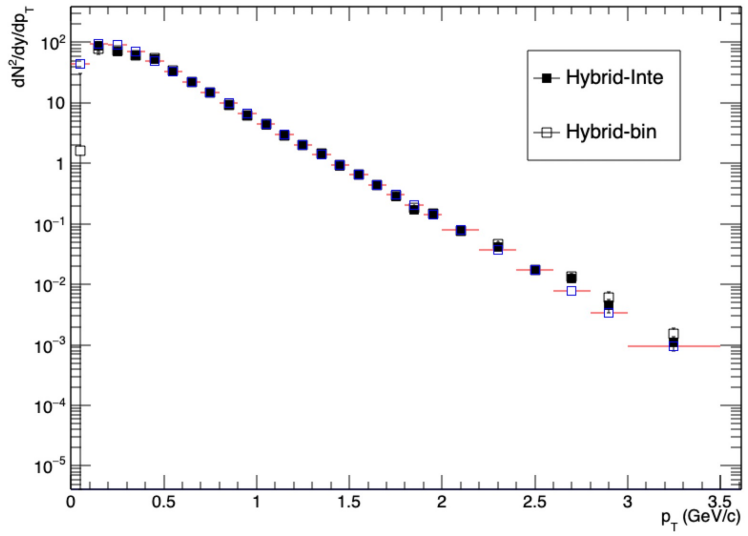


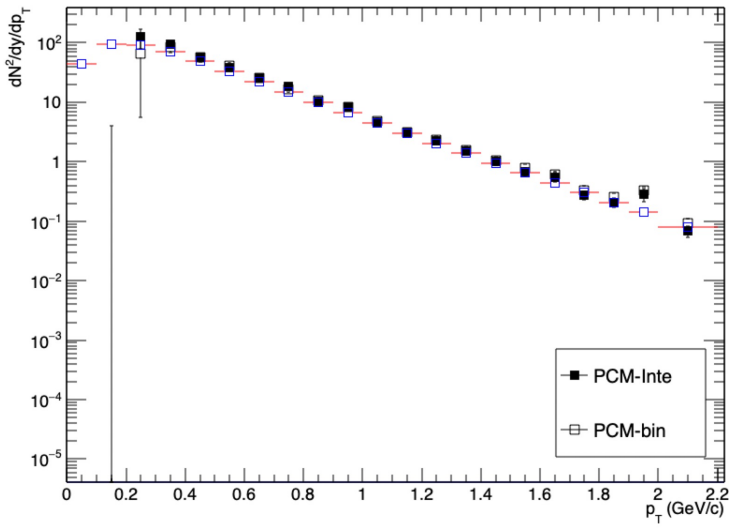


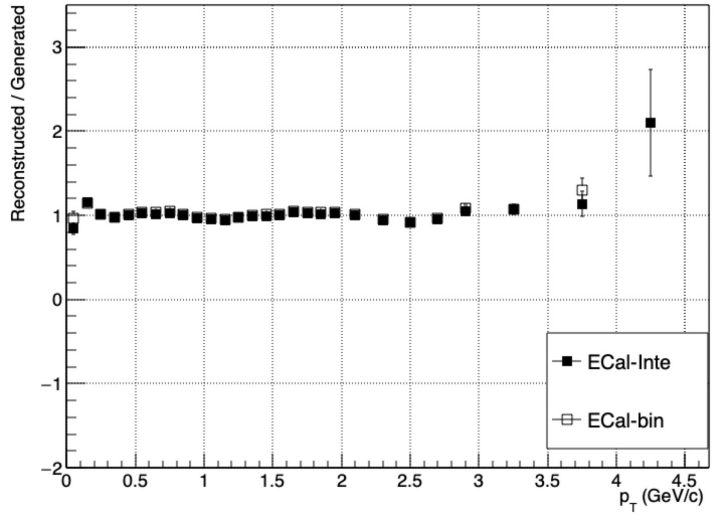
The fit_mean and fit_sigma obtained from the FX-BG are close to the photons come from true π^0.

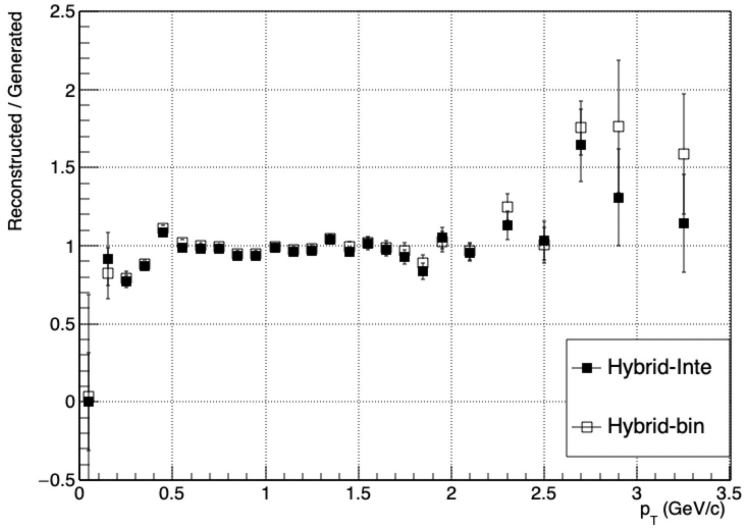
Comparison of π^0 reconstructed and generated

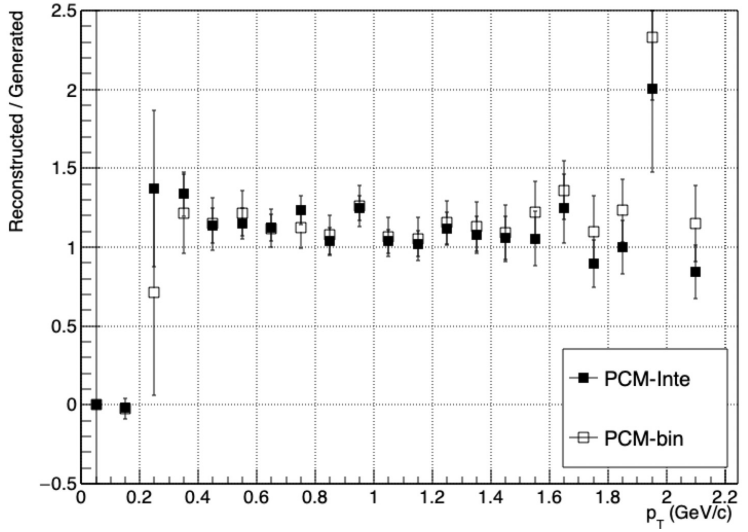






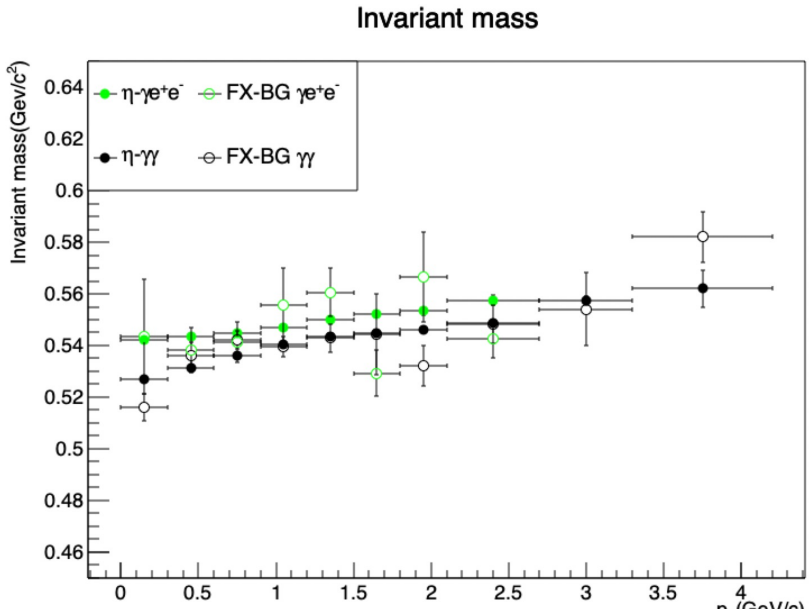


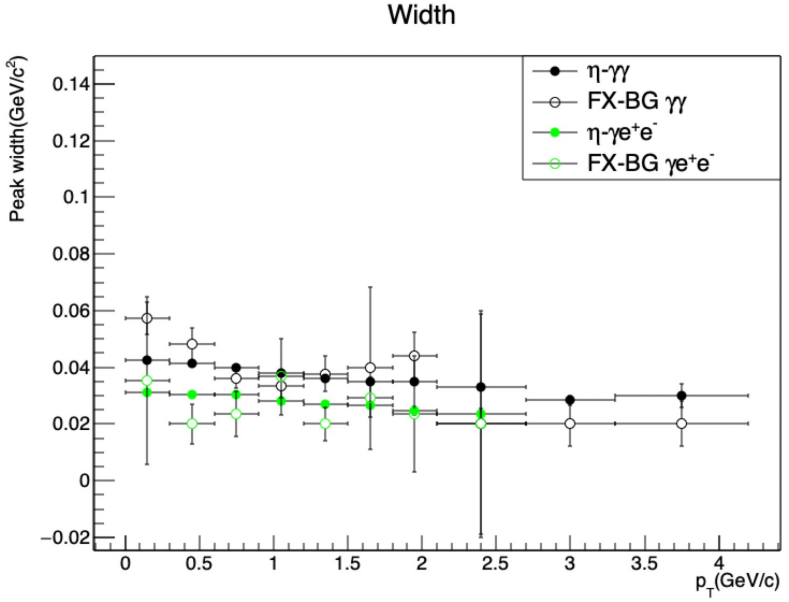


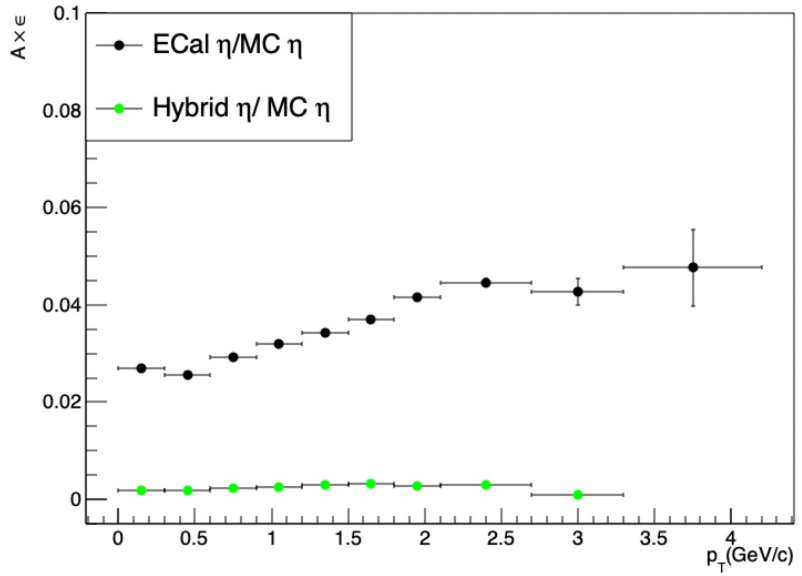


The reconstructed is relatively close to generated for π^0 in certain p_T ranges.

Comparison of η reconstructed and generated

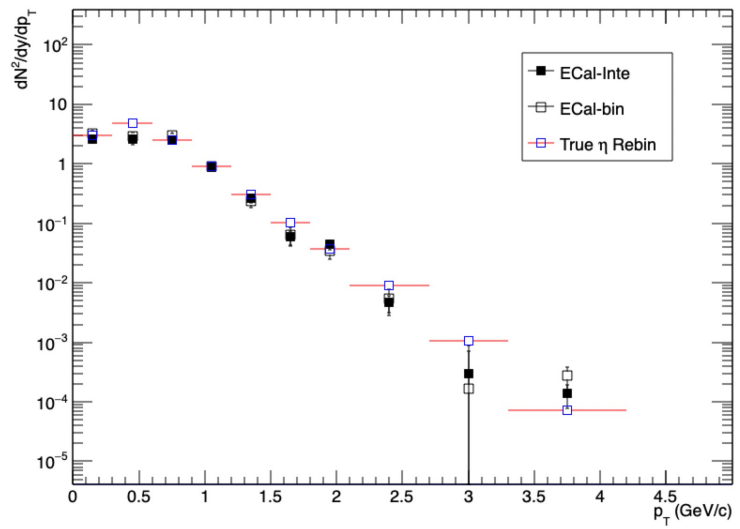


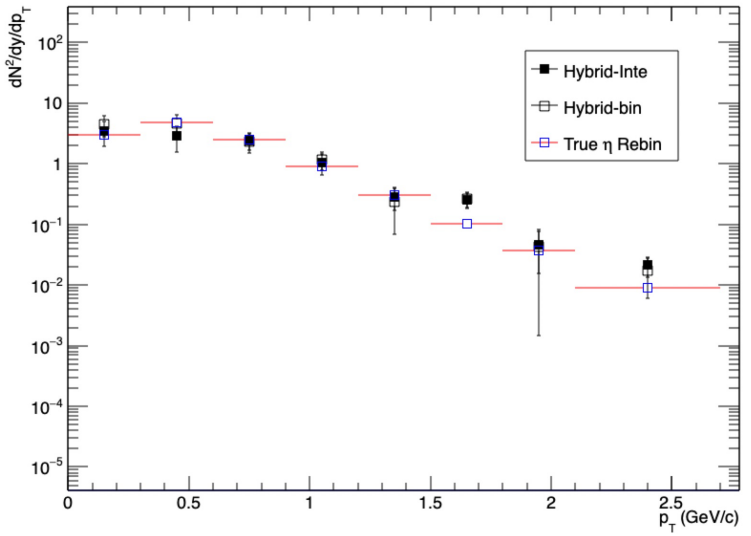


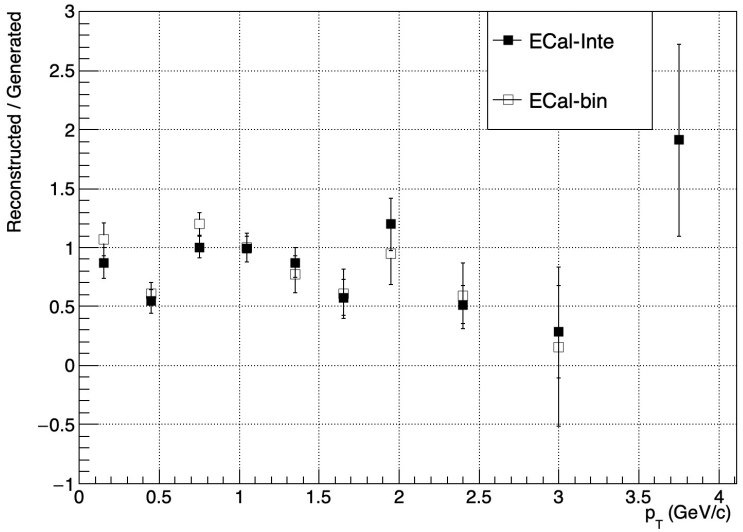


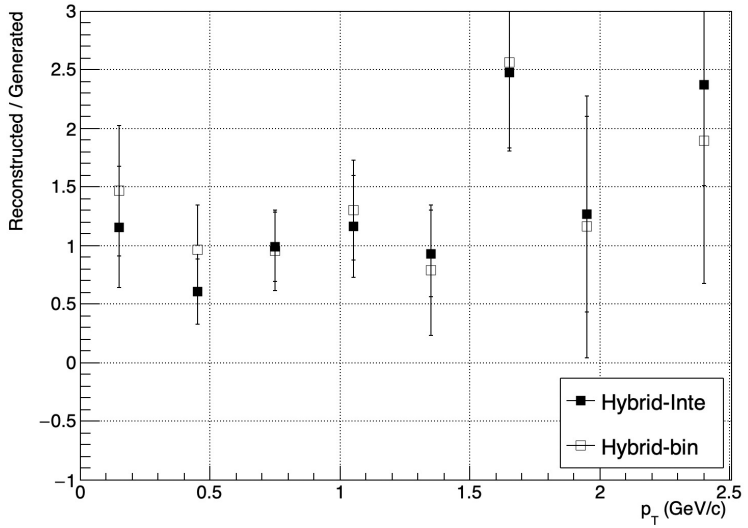
The fit_mean and fit_sigma obtained from the FX-BG in certain p_T ranges are close to the photons come from true η.

Comparison of η reconstructed and generated









The eta reconstructed results are consistent with generated, and need to optimize.

Summary

1、 Signals for π^0 are observed in 0.1<pT <4 GeV/c.

2、 A hint of signals for η is observed (need extra work and cut optimization).

3、 The first-look results for reconstructed π^0/η are consistent with the generated spectra, fine tuning of fits is still required.

4、The centrality dependent study is ongoing.

Summary

1、 Signals for π^0 are observed in 0.1<pT <4 GeV/c.

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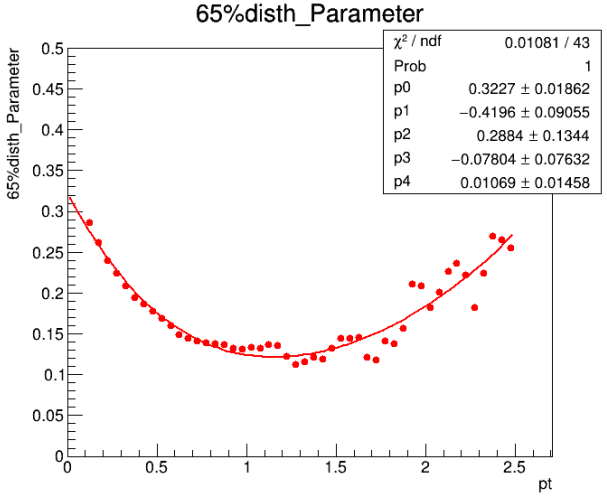
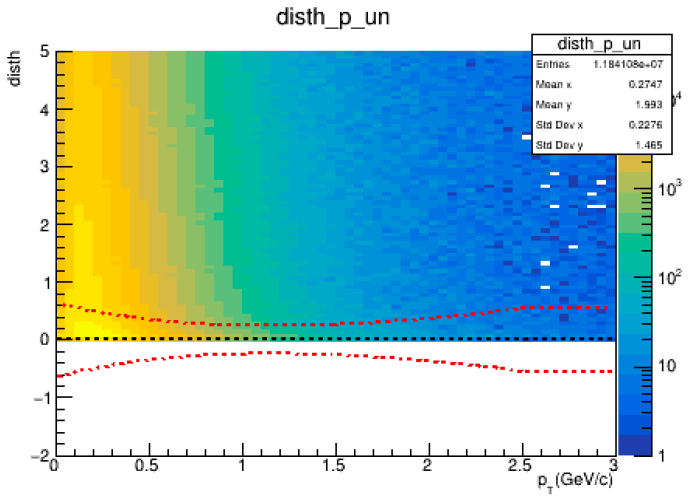
Thanks!

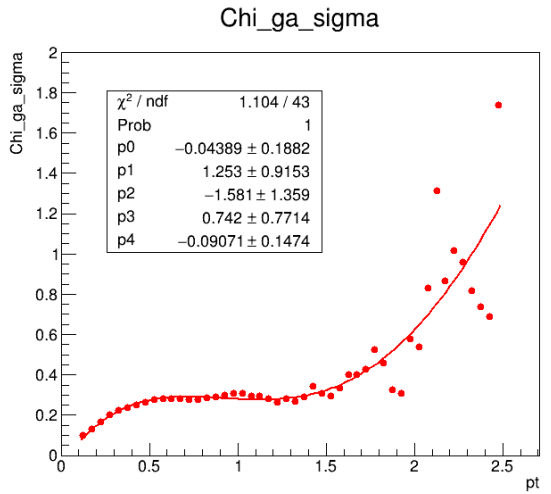
Backup

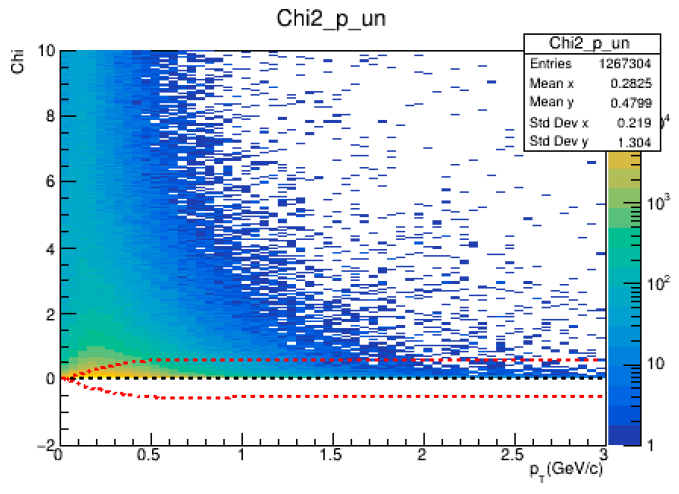
e^+e^- pairs cuts for PCM



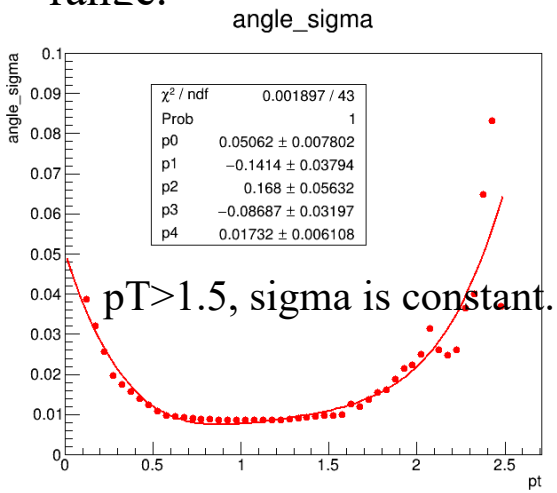


Use 65% parameterization, mean=0, and the red line in the UN pairs diagram is 2*σ. The sigma is calculated by calculate the counts account for 65% of all disth (0-1.5) range.

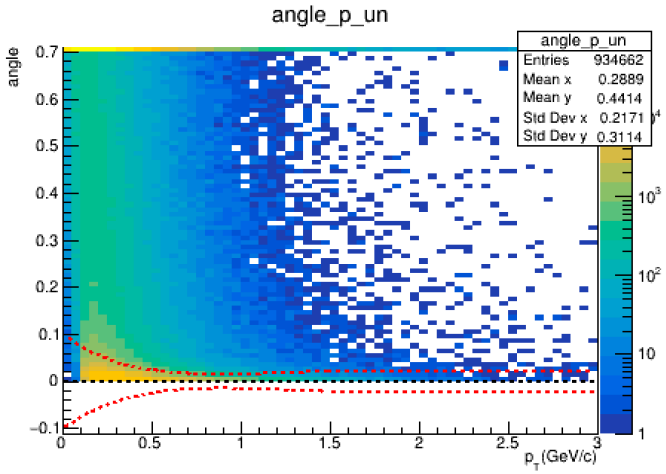


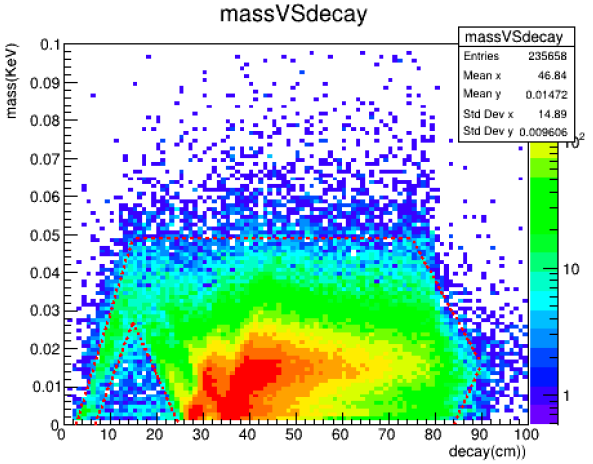


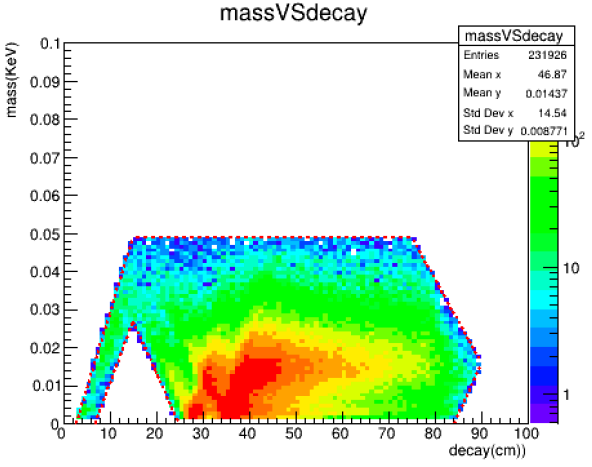
After disth(DCA) cut, using (Chi2 0-4 range) integral* 65% parameterization, mean=0, and the red line in the UN pairs diagram is 2*σ. I choose pT>1.25, sigma is constant.



pT>1.5, sigma is constant.

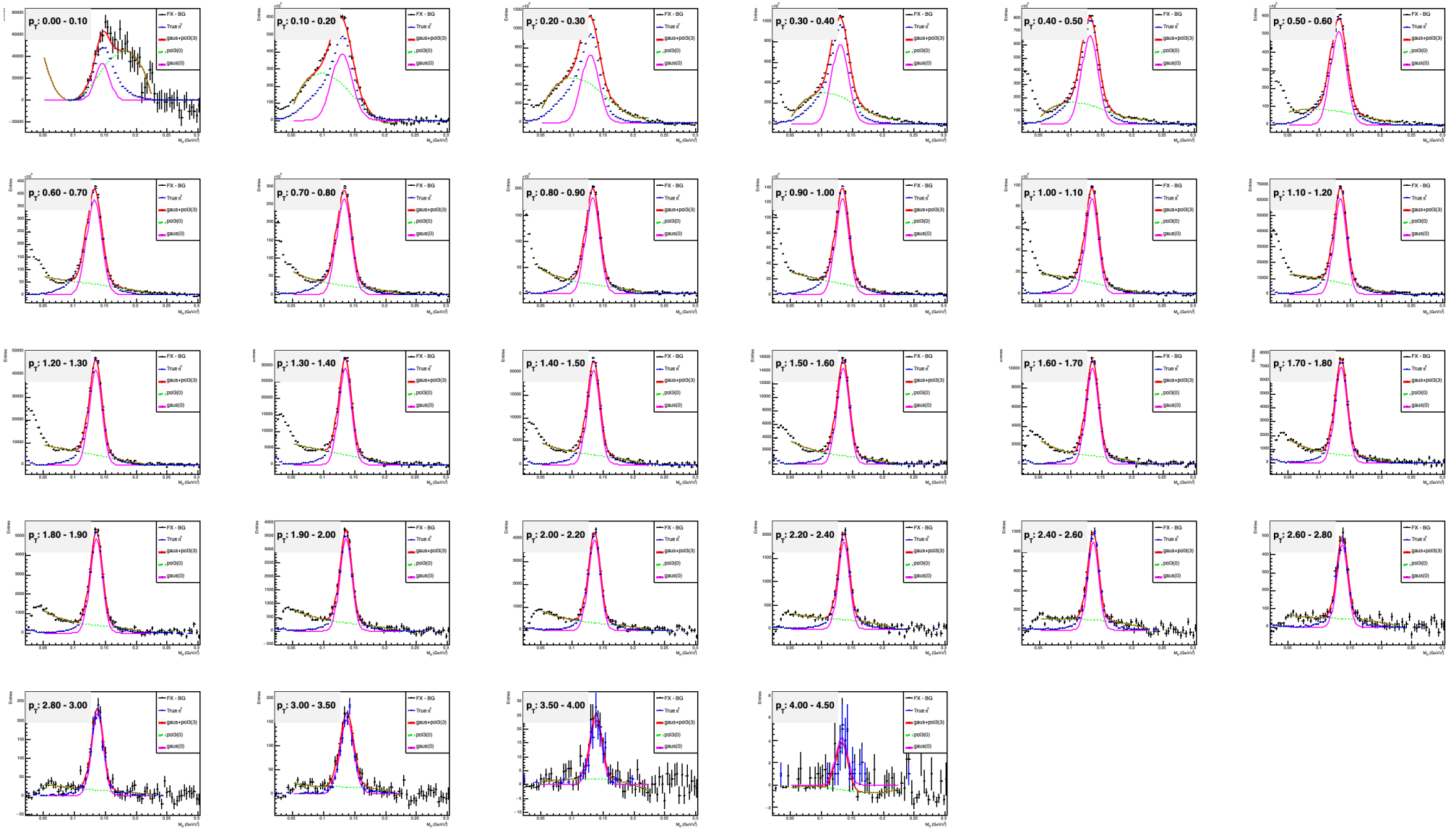






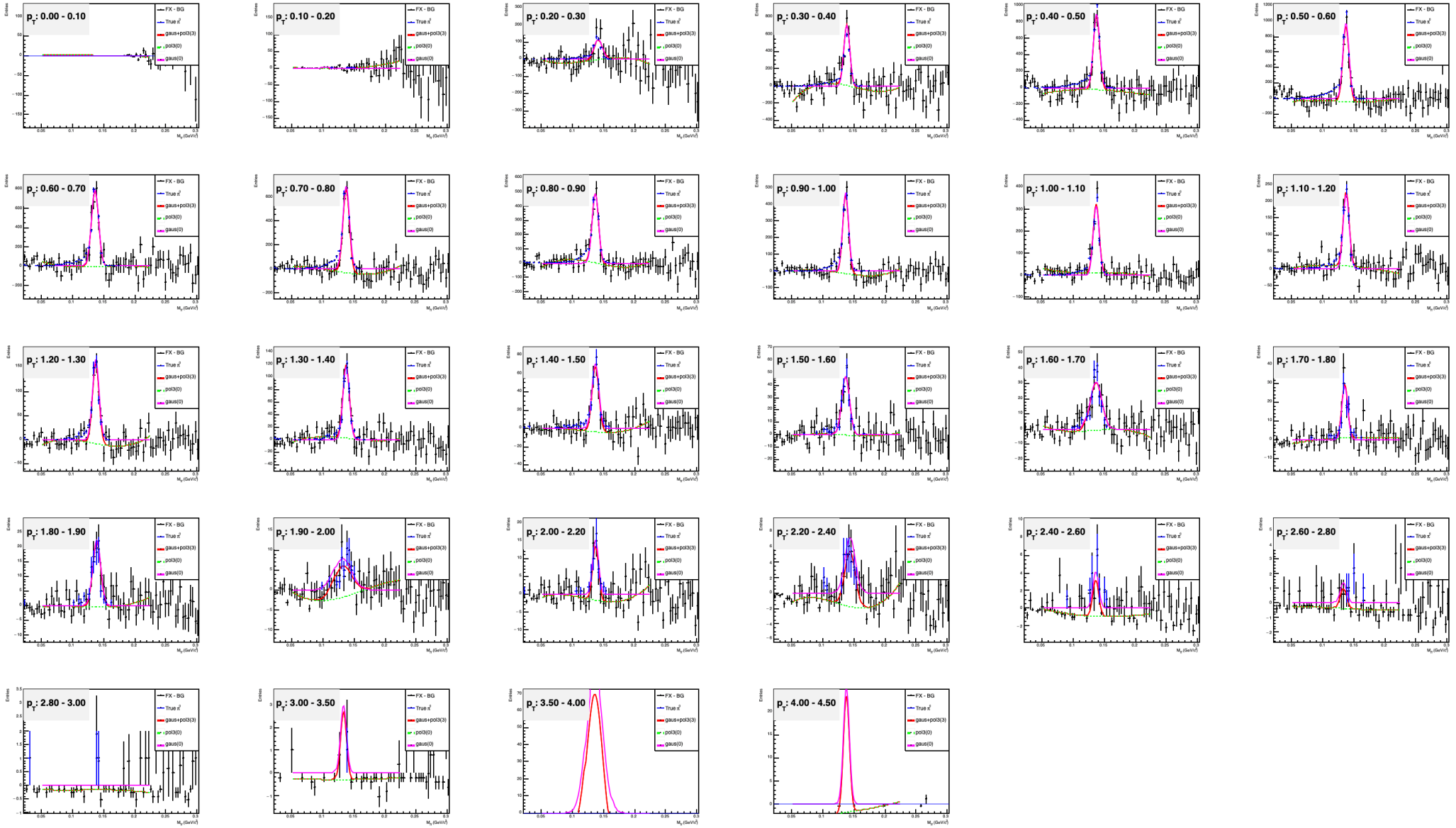
The DCA, Chi2, angle and decay_mass cuts are added in a specific order to select e^+e^- pairs for PCM.

$M_{\gamma\gamma}$ distributions for different p_T bins(ECAL)



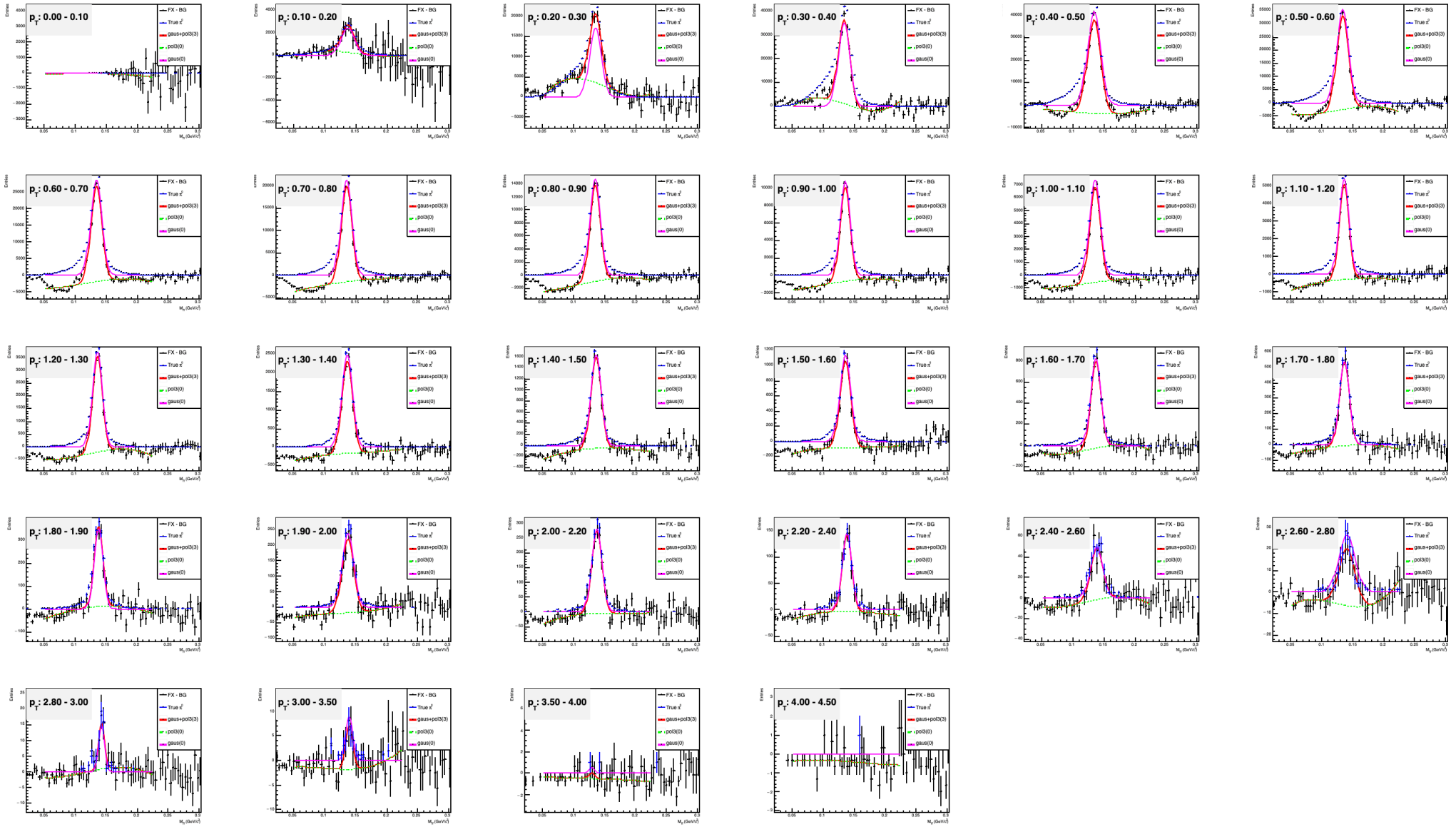
A clear excess is visible in all distributions close to the meson mass of 135 MeV/c^2 for the π^0.

$M_{\gamma\gamma}$ distributions for all pT bins(PCM)



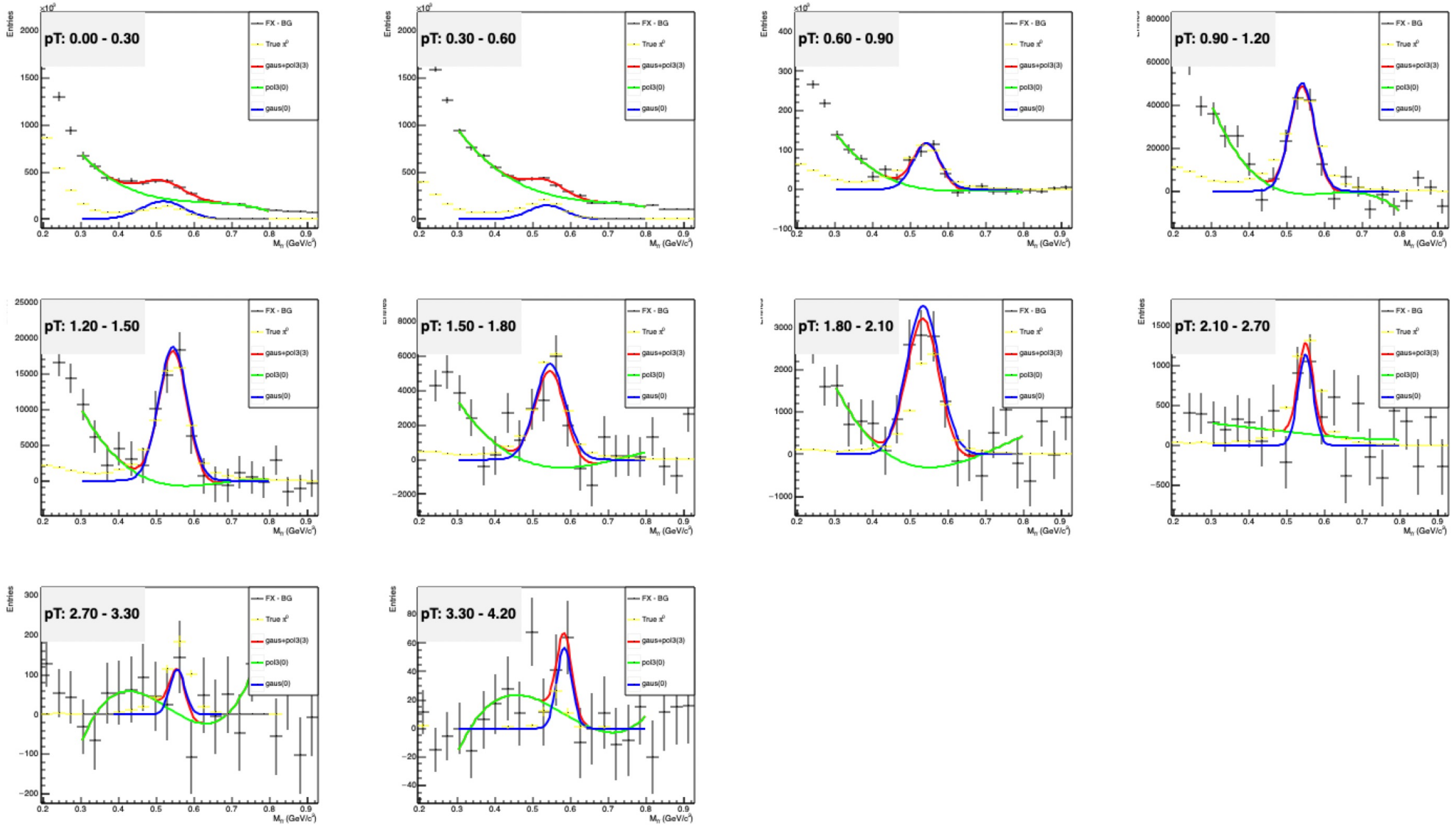
A clear excess is visible in $0.3<p_T<2.4$GeV/c close to the meson mass of 135 MeV/c^2 for the π^0.

$M_{\gamma\gamma}$ distributions for all pT bins(Hybrid)



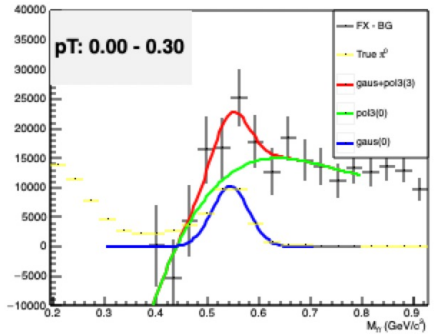
A clear excess is visible in $0.1<p_T<3$GeV/c close to the meson mass of 135 MeV/c^2 for the π^0.

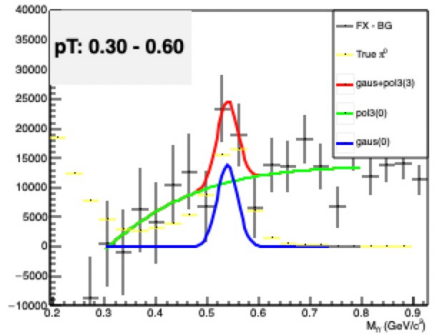
$M_{\gamma\gamma}$ distributions for all pT bins(ECAL)

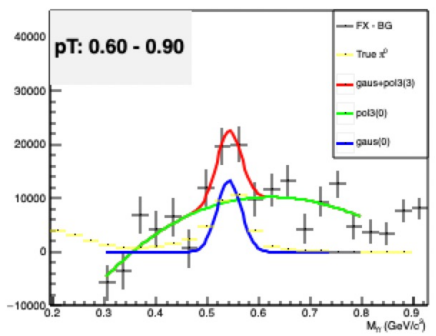


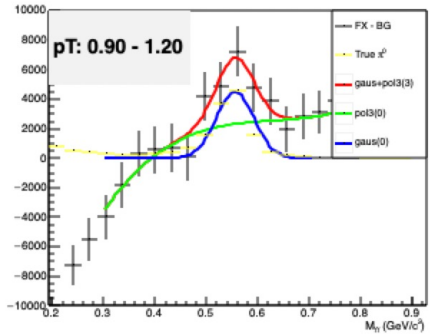
A clear excess is visible in p_T<2.7GeV/c close to the meson mass of 548 MeV/c^2 for the η.

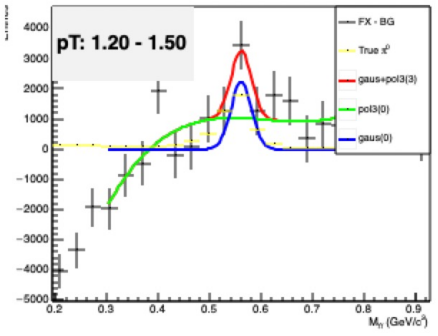
$M_{\gamma\gamma}$ distributions for all pT bins(Hybrid)

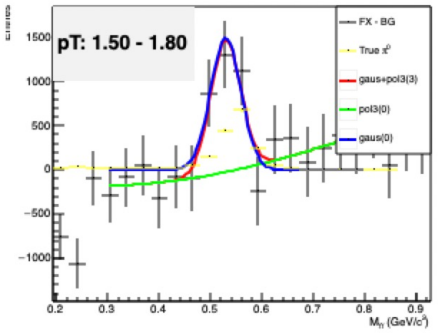


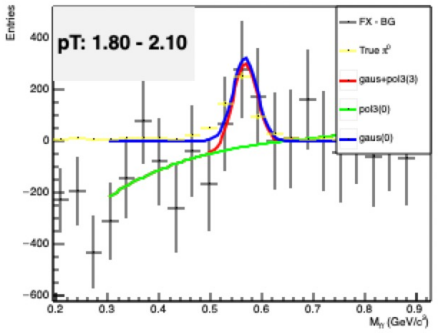


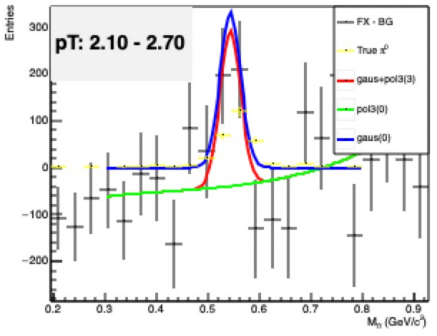


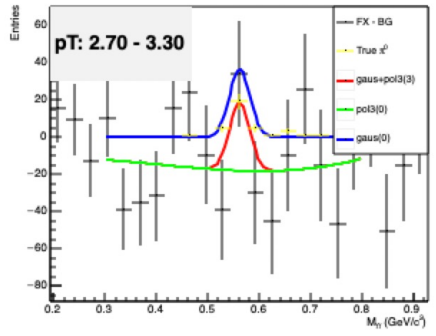


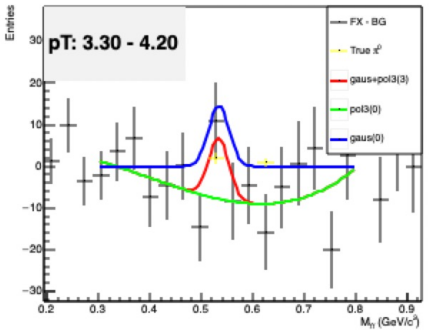












A excess is visible in 0.3< p_T<2.7GeV/c close to the meson mass of 548 MeV/c^2 for the η in hybrid method.