Reco-Data and ZDC Response Matrix

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Biweekly Meeting

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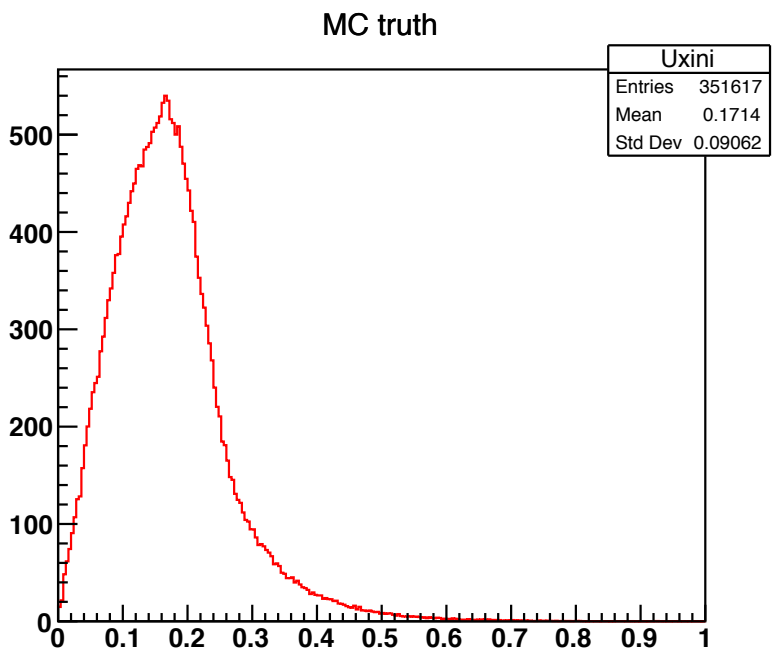
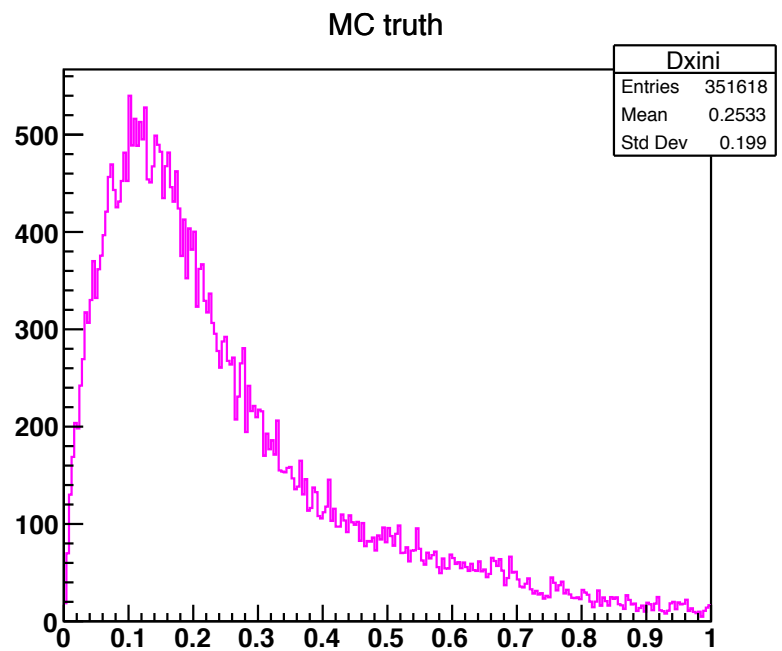
UPC vs DPMJET Pt Comparison Before Cuts

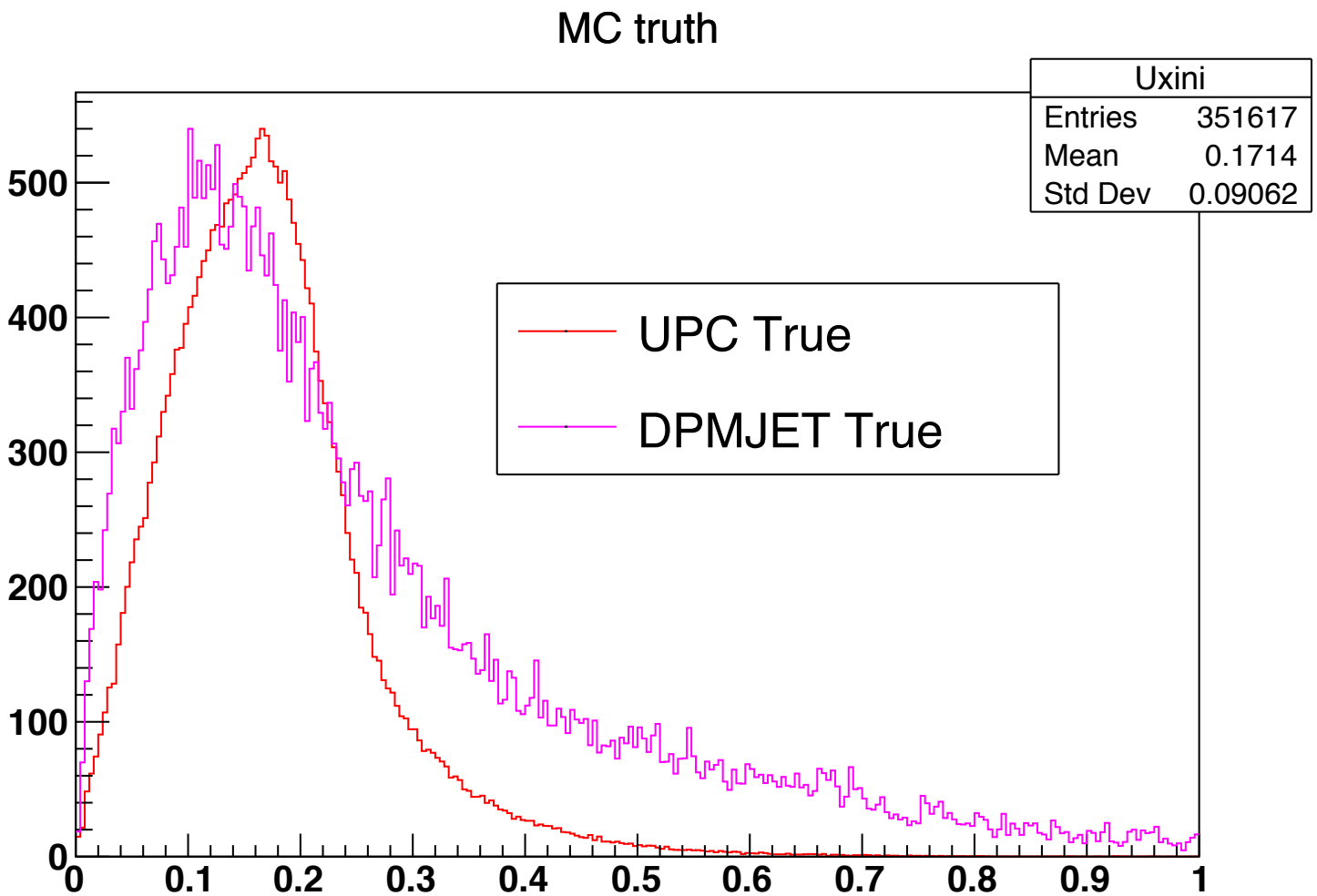
[Last meeting comment]: Show plots for UPC and DPMJET True Pt distributions without cuts. DPMJET Pt spectrum is expected to be broader than UPC.

Left panel is UPC (electromagnetic) narrower and right panel is DPMJET (hadronic) far wider than UPC as expected.

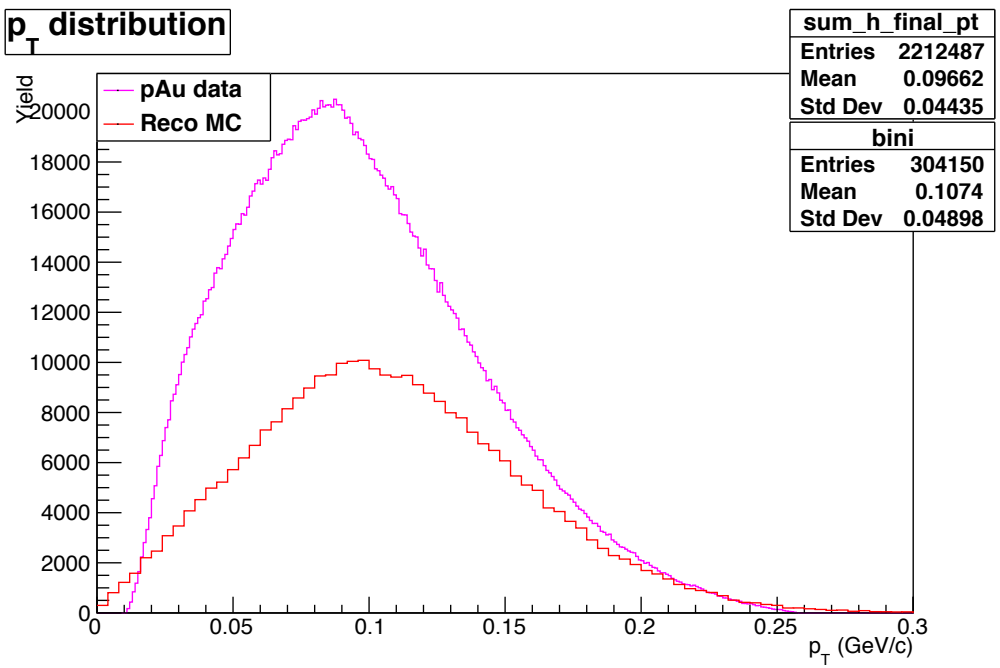




Superposed UPC vs DPMJET Pt Before Cuts



Previous Reco Pt vs pAu Data – Last Meeting



Some Homework and Comments from Last Meeting:

① Check inner radius cut

② Check why reco tail is longer than data. Check energy.

③ Compare energy histograms for reco and data

④ Normalize number of entries to compare with UPC + DPMJET histograms vs. experimental data.

⑤ Show some detector response matrix plots from UPC+DPMJET MC sample

Analysis Process – Cuts Applied to Reco Pt

Eta, Energy and Radius Cuts

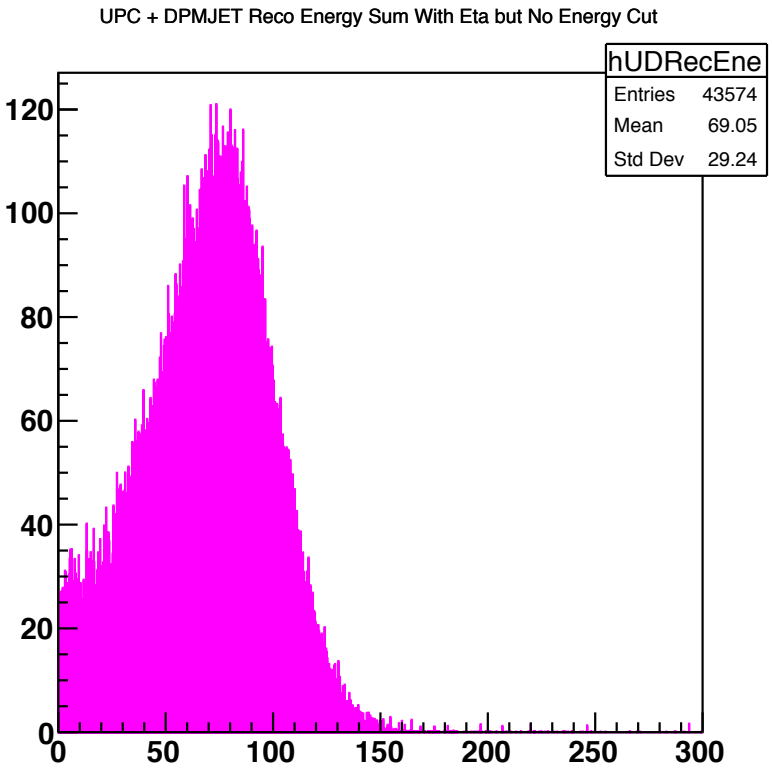
Following steps have been applied to arrive at the draft reco pt spectrum: Energy spectra have been scanned alongside corresponding pt spectra according to cuts below :

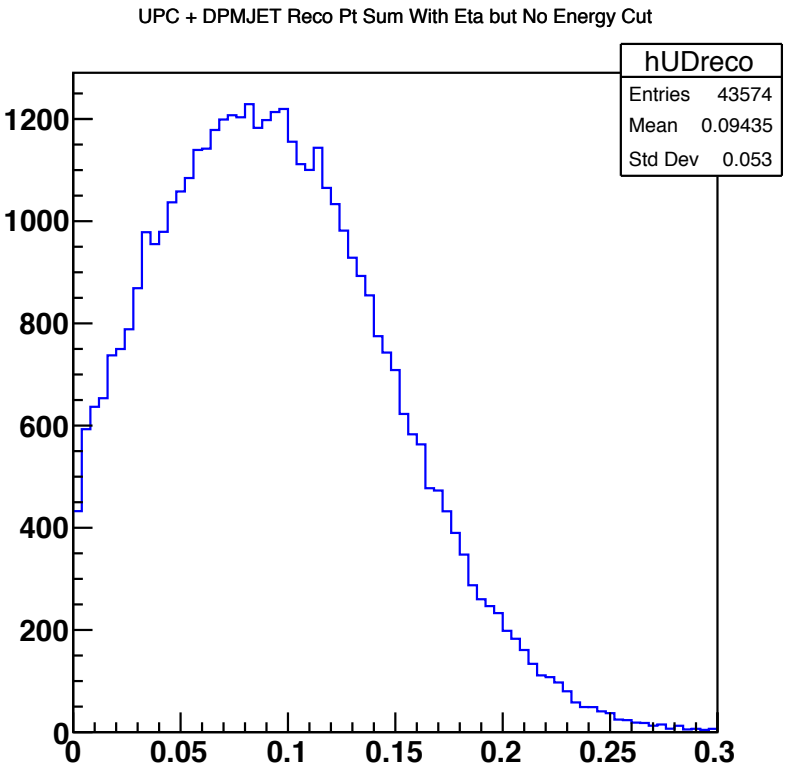
- ⌘ Eta > 6.8 cut only
- ⌘ Eta > 6.8 and energy > 40 GeV cuts
- ⌘ Eta > 6.8 and 40 < E < 120 GeV cuts.
- ⌘ Eta > 6.8 and 40 < E < 120 GeV and r > 0.5 cm cuts.
- ⌘ Eta > 6.8 and 40 < E < 120 GeV and 0.5 < r < 4.0 cm cuts.

Corresponding energy and pt plots for each of the scanned cuts are following on the next slides.

Analysis Process – Eta > 6.8 Cut Only

Eta > 6.8 Cut

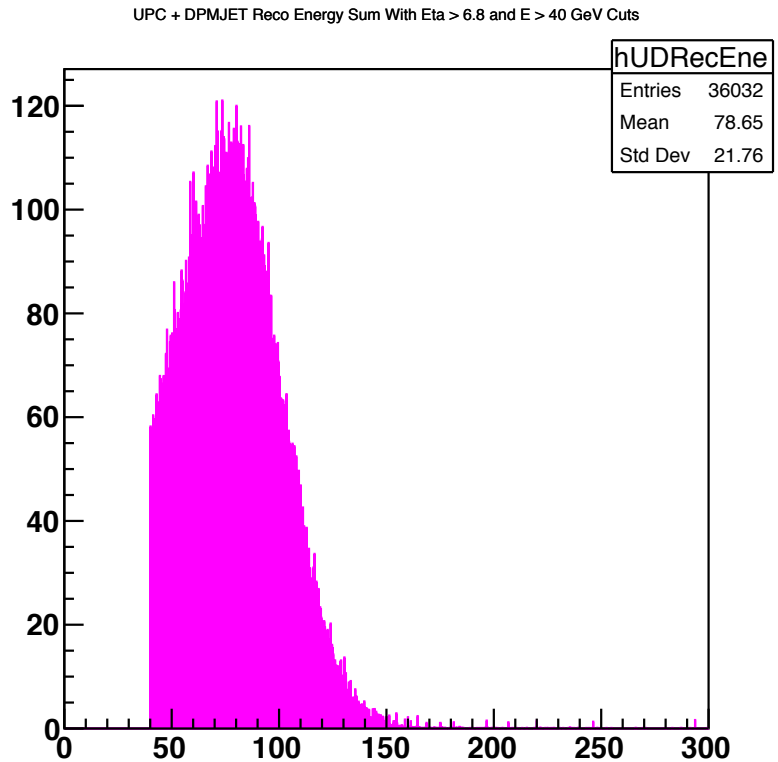


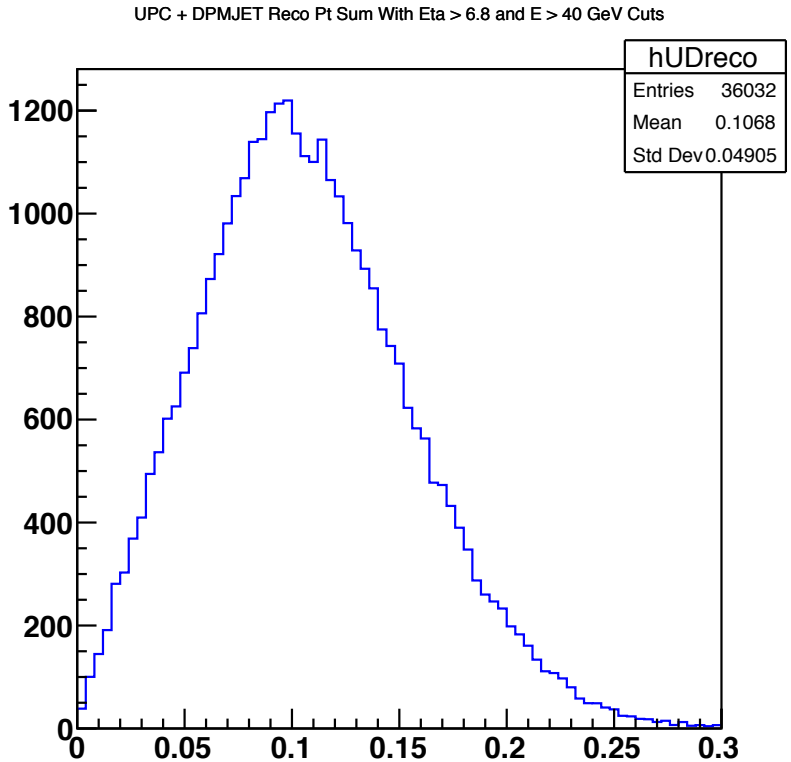


ZDC Energy distribution (left panel) and pT distribution (right panel)

Analysis Process – Eta > 6.8 and E > 40 GeV

Eta > 6.8 and ZDC Energy > 40.0 GeV Cuts

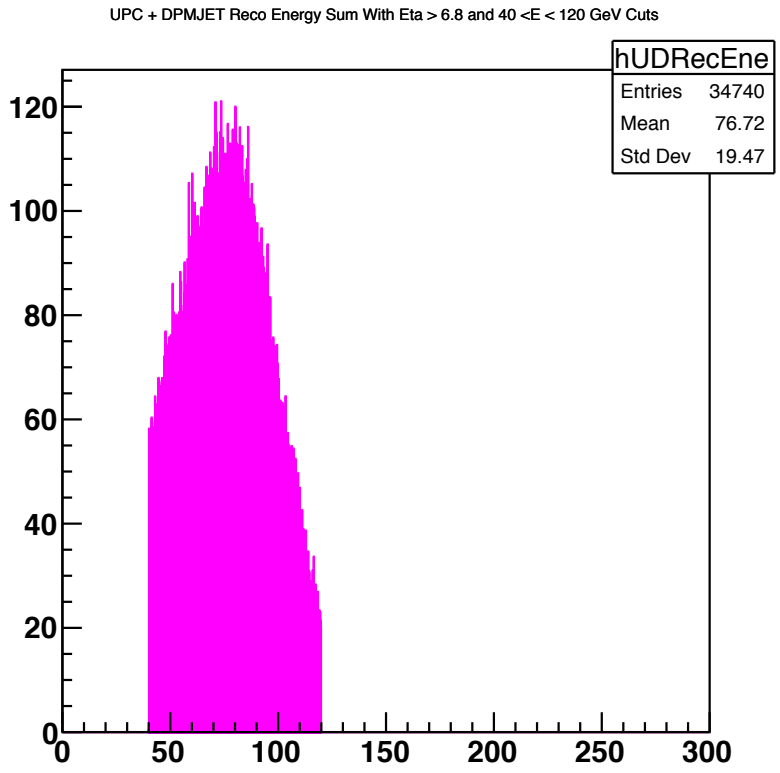


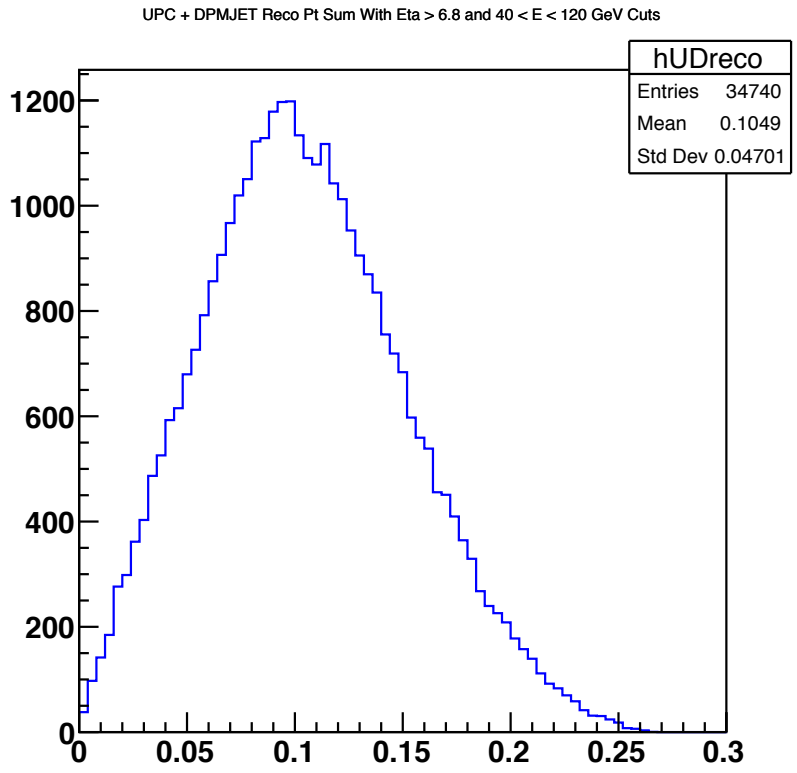


ZDC Energy distribution (left panel) and pT distribution (right panel)

Analysis Process – Eta > 6.8 : 40<E<120 GeV

Eta > 6.8 and ZDC Energy: 40 < E < 120 GeV Cuts

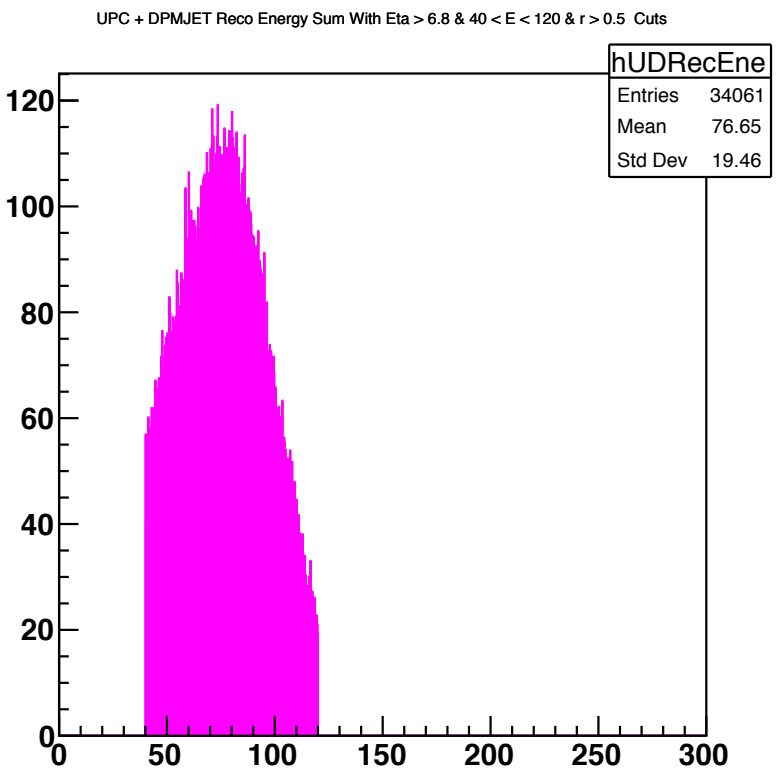


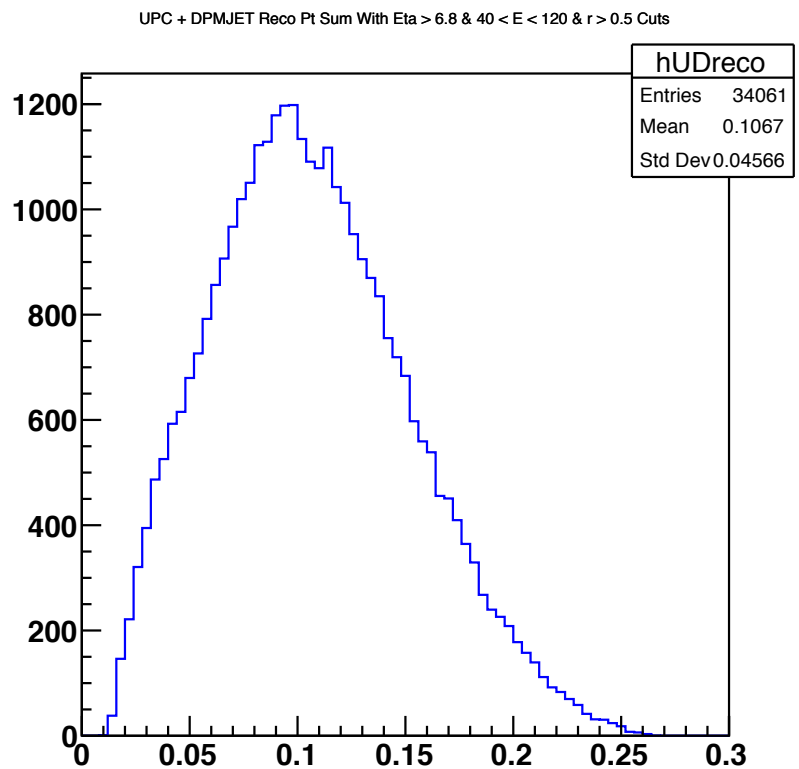


ZDC Energy distribution (left panel) and pT distribution (right panel)

Analysis Process - Eta>6.8, 40<E<120, r>0.5 cm

Eta > 6.8 and ZDC Energy: 40 < E < 120 GeV and Inner radius: r > 0.5 cm Cuts

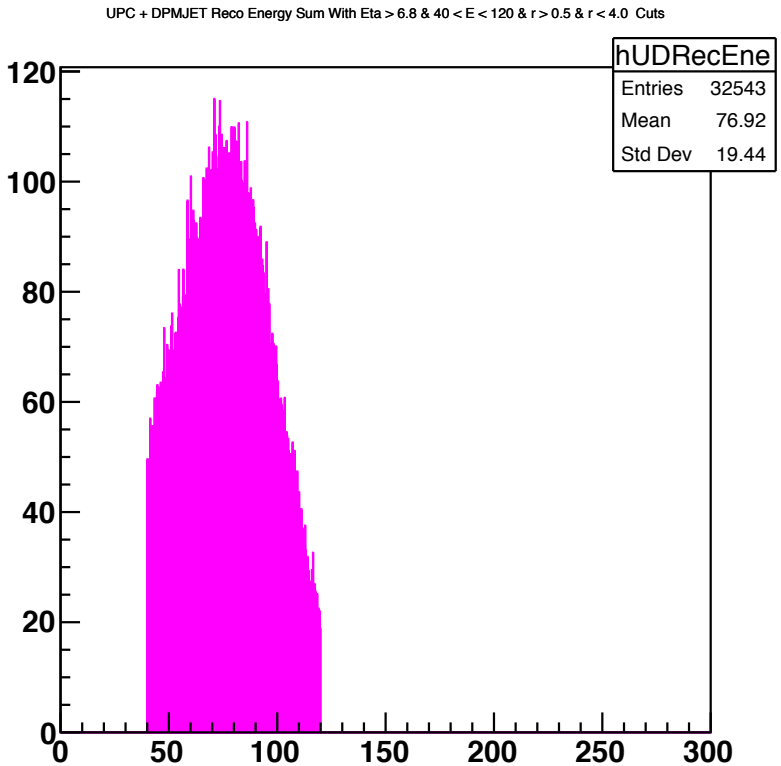


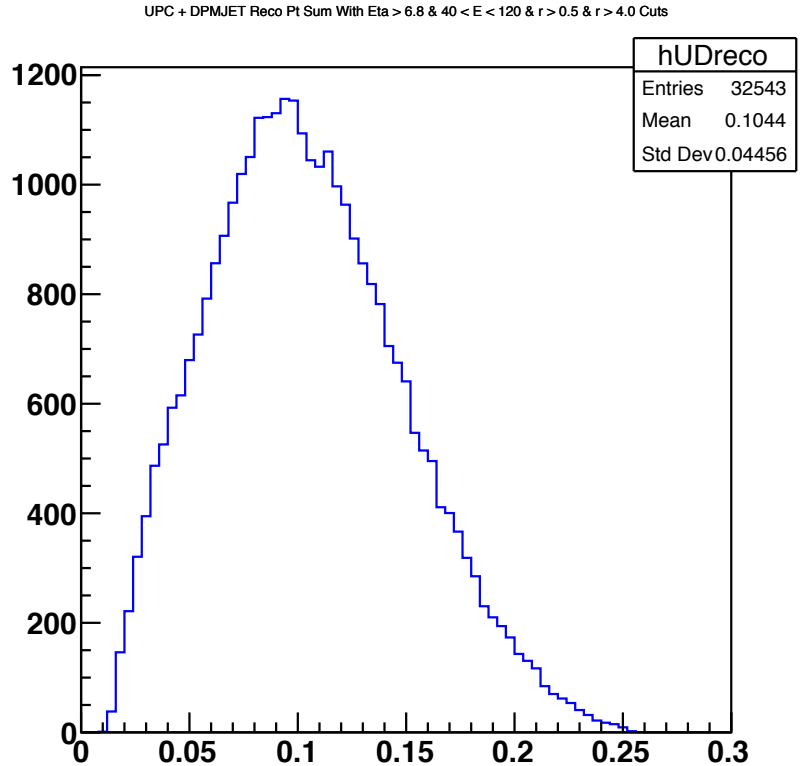


ZDC Energy distribution (left panel) and pT distribution (right panel)

Analysis Process- Eta>6.8, 40<E120, 0.5<r4.0cm

Eta > 6.8 and ZDC Energy: 40 < E < 120 GeV and radius : 0.5 < r < 4.0 cm Cuts

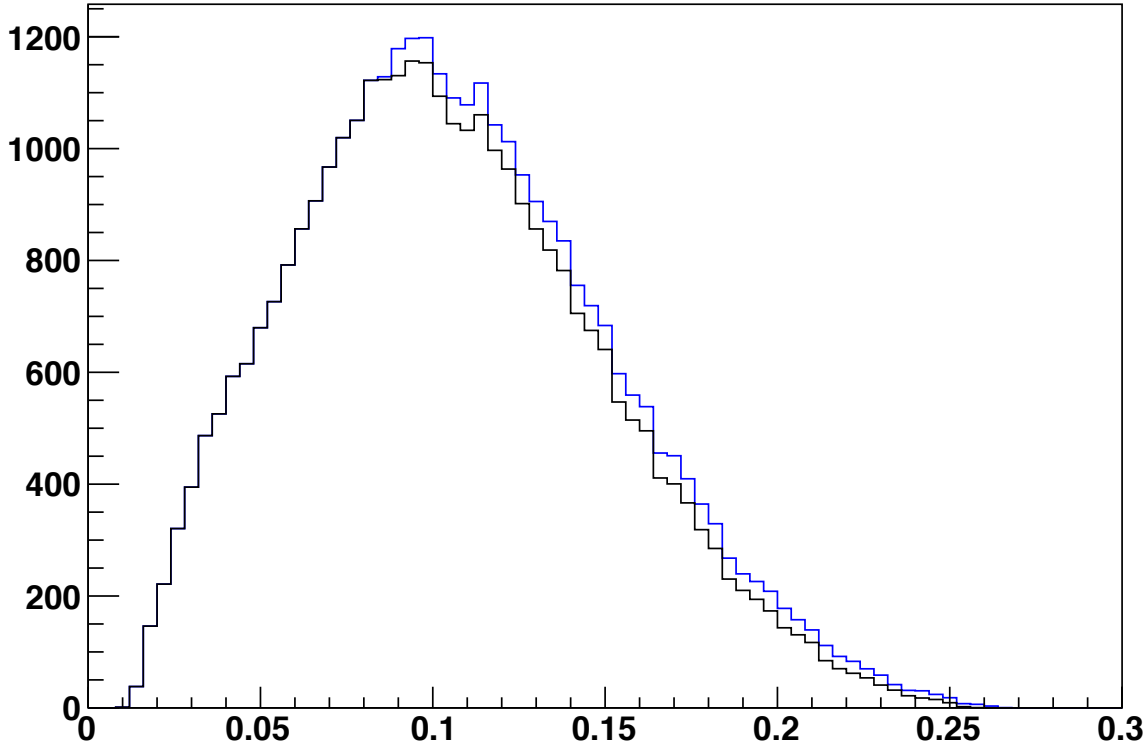




These are the final energy (left) and pT (right) spectra after all cuts

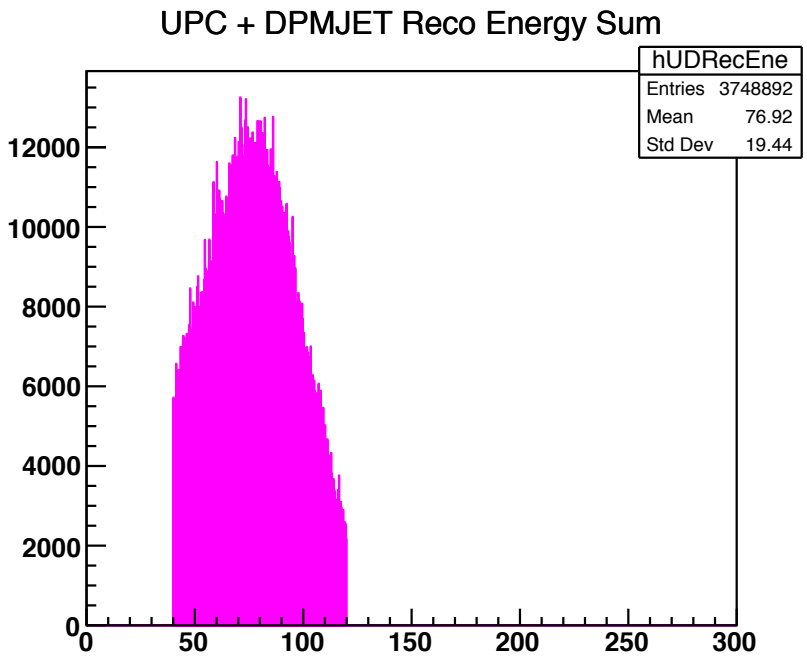
Analysis Process - Pt Comparison With/Without r < 4.0 cm Cut

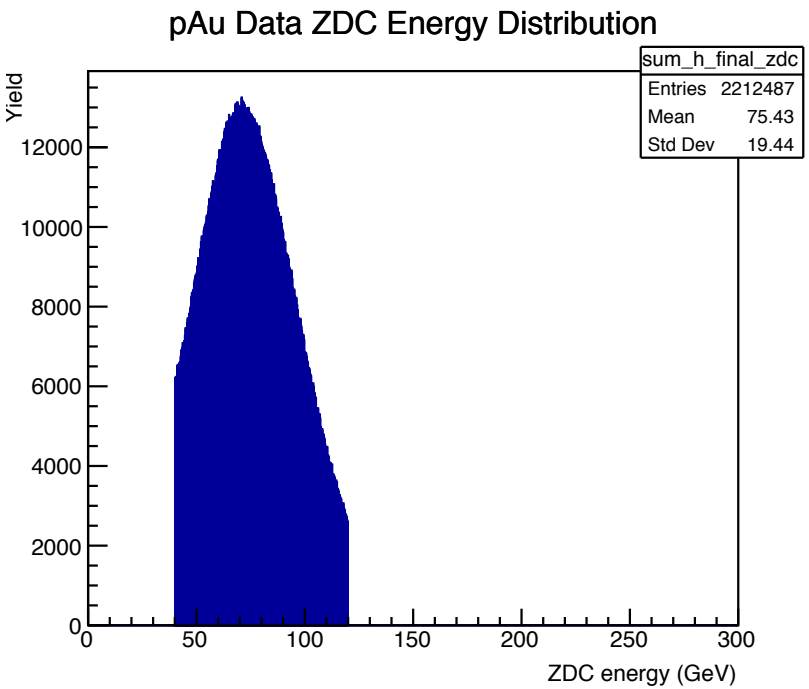
- Eta > 6.8 and 40 < E < 120 GeV and r < 0.5 cm cuts → BLUE LINE
- Eta > 6.8 and 40 < E < 120 GeV and 0.5 <r<4.0 cm cuts →BLACK LINE



Analysis Process – Final E for Reco and Data

Final reco energy (left) and pAu data energy (right) distributions)

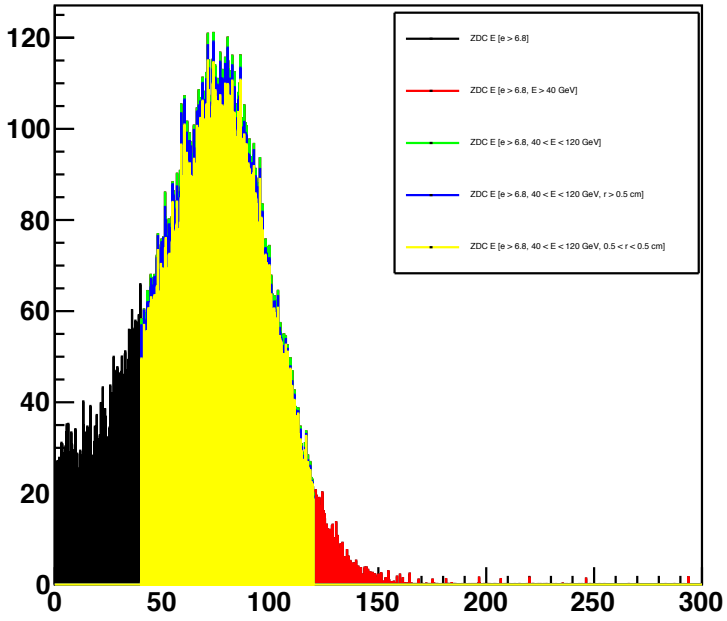


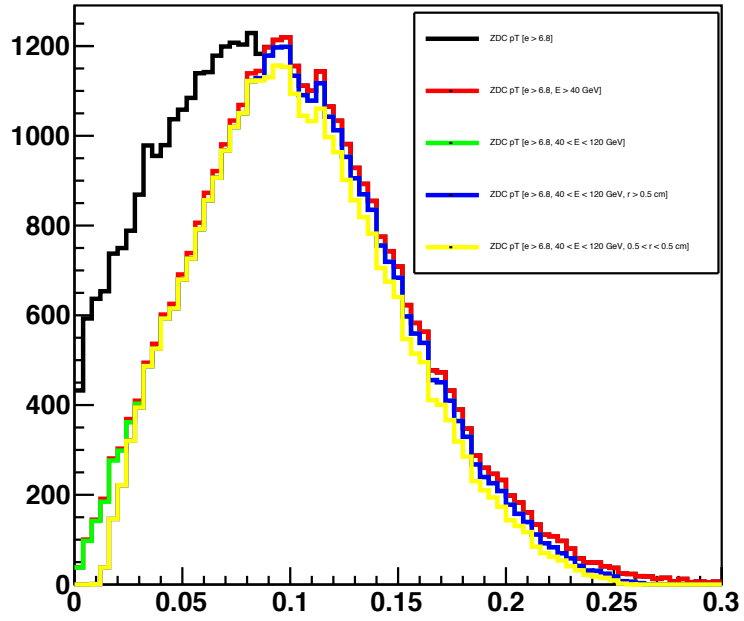


With eta > 6.8 and ZDC Energy: 40 < E < 120 GeV and radius : 0.5 < r < 4.0 cm cuts

Analysis Process – Cut Effect on Reco E & pT

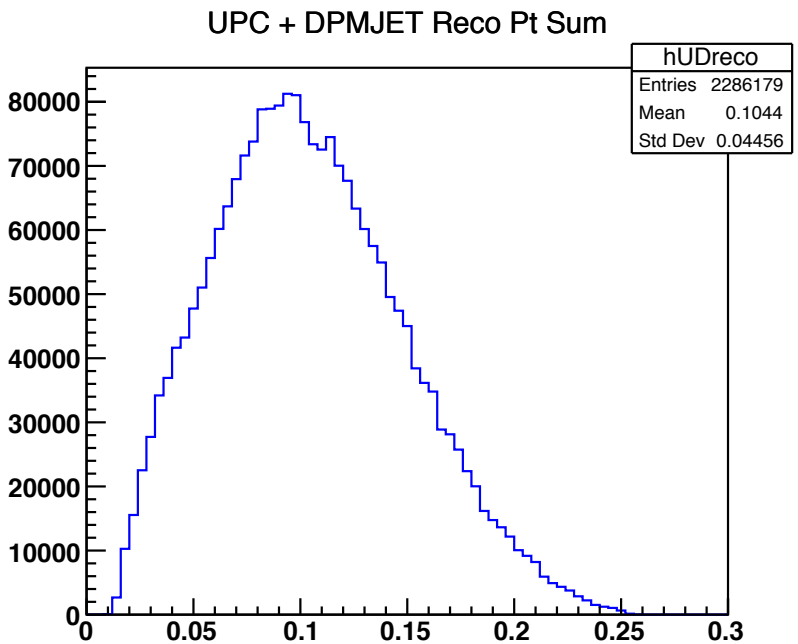
Effect of all introduced cuts on the ZDC energy and the corresponding reco pT

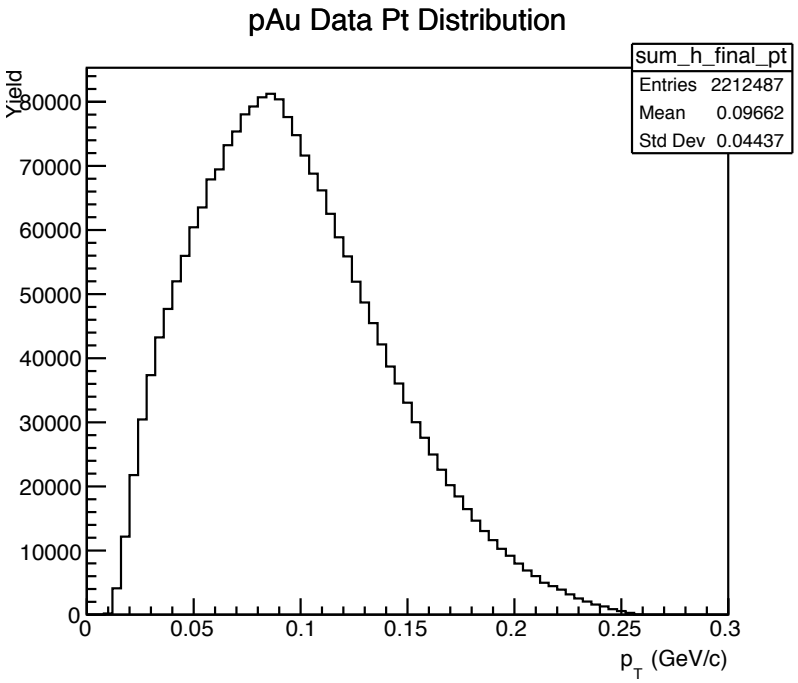




Superposed reco energy distributions (left panel) and pT distributions (right panel)

UPC + DPMJET Reco Pt Distribution

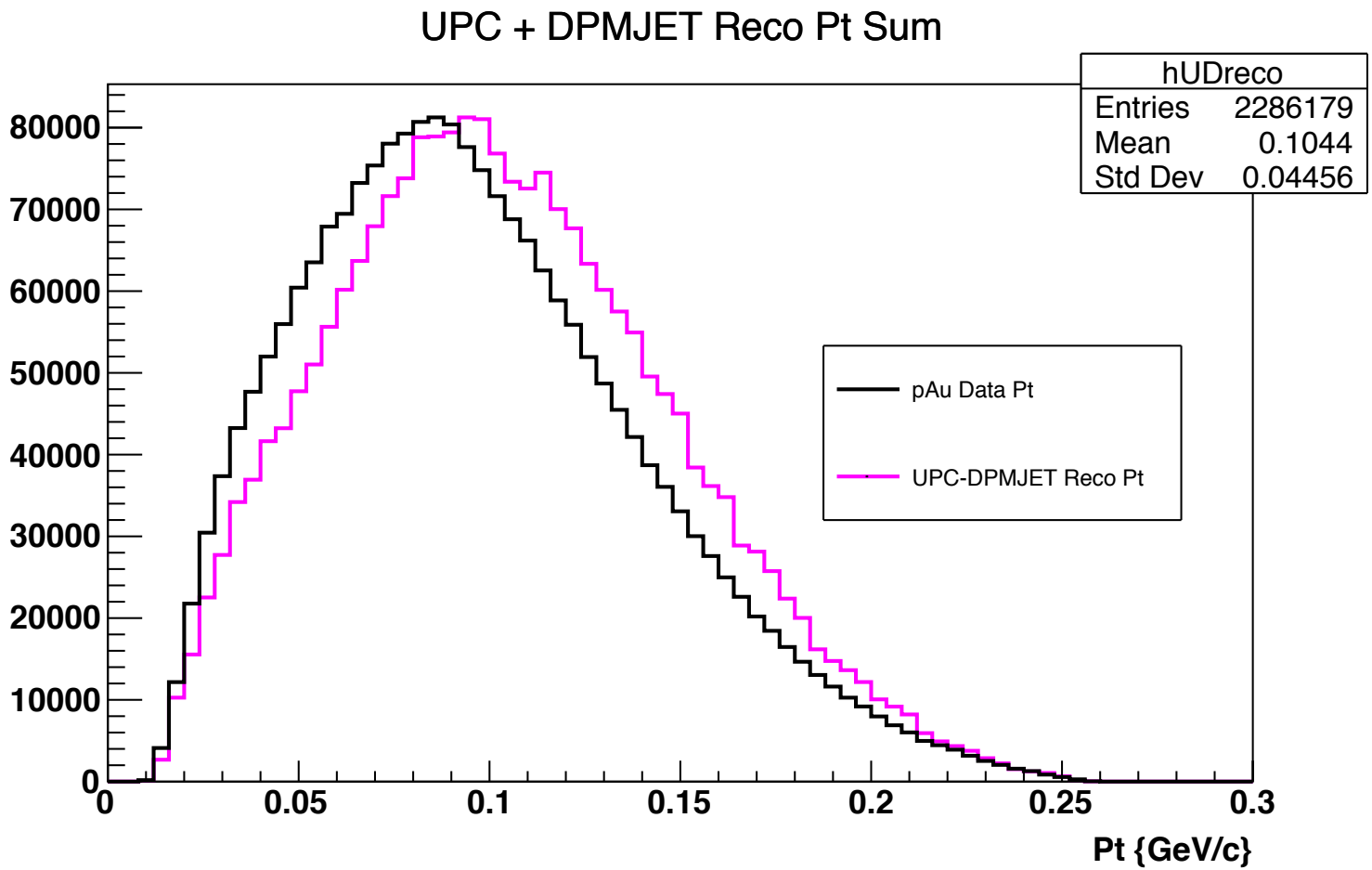




Reco Pt (left panel) and pAu Pt (right panel) with Reco Pt normalized to pAu Pt data entries for comparison. Following cuts have been applied to the Reco Pt.

- ⌘ Eta > 6.8 for very forward region
- ⌘ Minimum and maximum energy cuts: 40.0 < E < 120.0 GeV
- ⌘ Inner and outer radii cuts: 0.5 < r < 4.0 cm

UPC + DPMJET Reco Vs. pAu Data Pt



Normalized UPC+DPMJET Reco Pt (Magenta) and pAu data Pt (black) superimposed.

UPC + DPMJET Reco Vs. pAu Data Pt

Percentage Error for Mean and Standard Deviation for Reco pT and Data

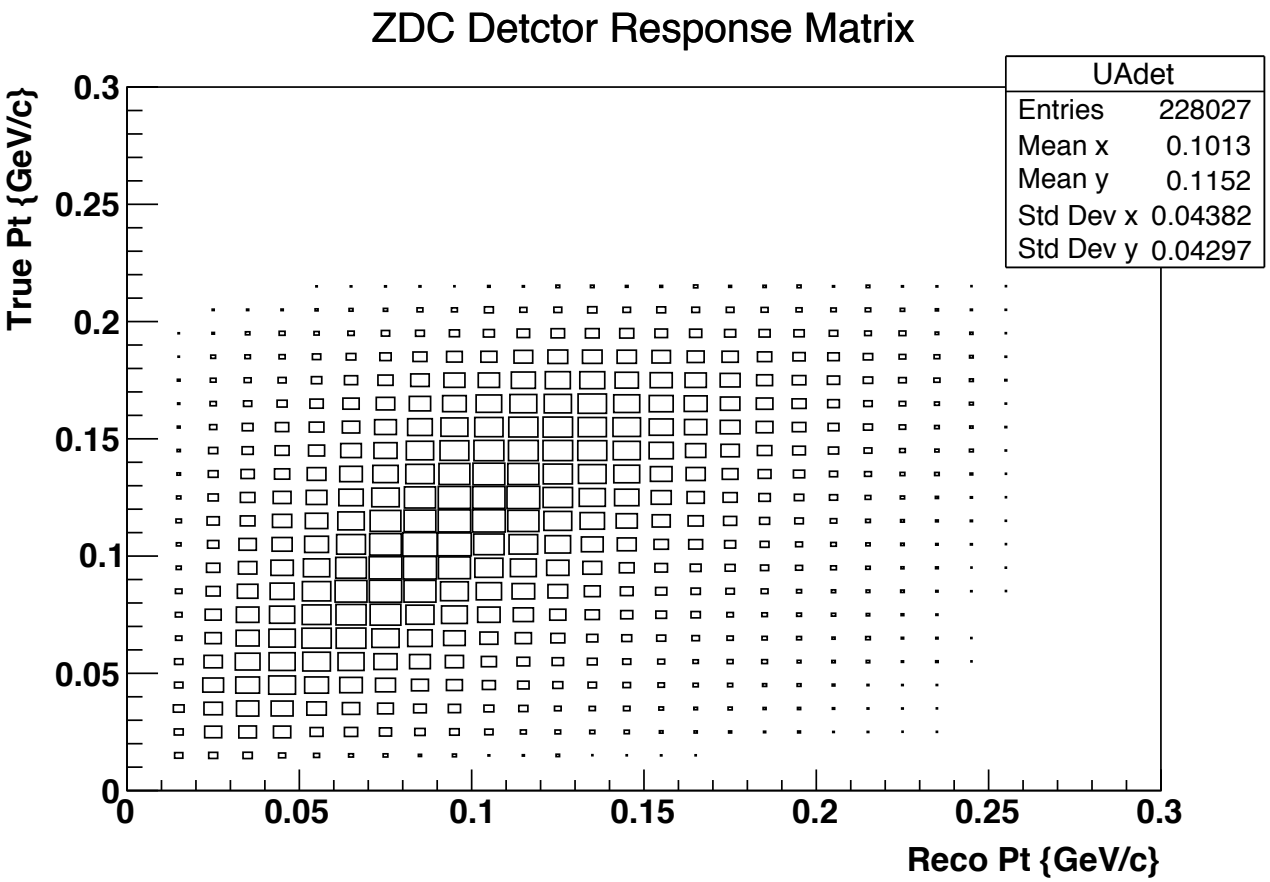
- Mean: Reco and pAu means are slightly off. They are not merged precisely. From slide 12, Reco mean = 0.1044 and pAu mean = 0.0966. The mean percentage error ≈ 8%,

$$\%error = \frac{|reco - data|}{data} \times 100 = \frac{|0.1044 - 0.0966|}{0.0966} \times 100 \approx 8\%$$

- Sigma: Reco and pAu are also slightly off.

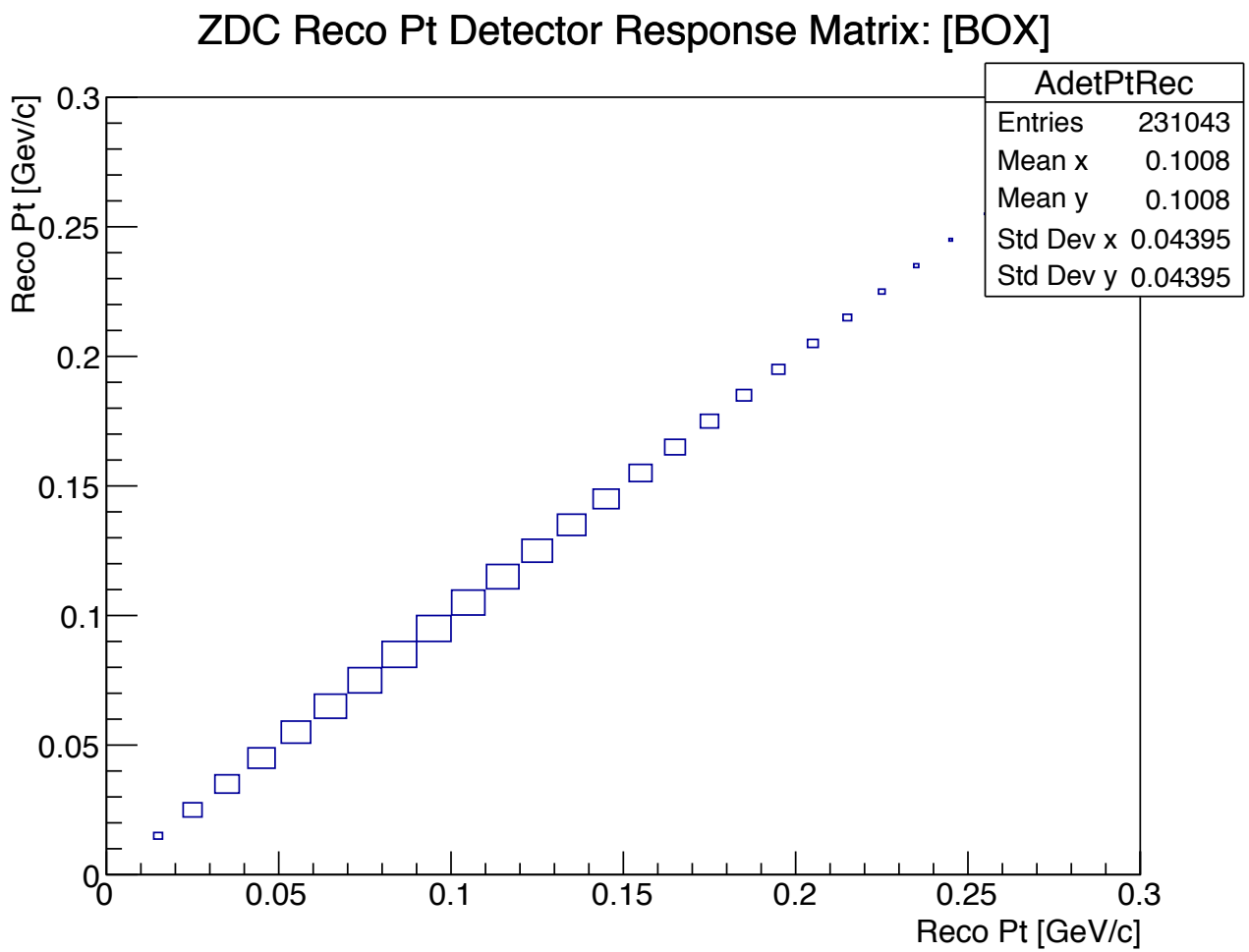
$$\%Sigma_{error} = \frac{|Sigma_{reco} - Sigma_{data}|}{Sigma_{data}} \times 100 = \frac{|0.04456 - 0.04437|}{0.04437} \times 100 \approx 0.4\%$$

ZDC P_T Detector Response Matrix

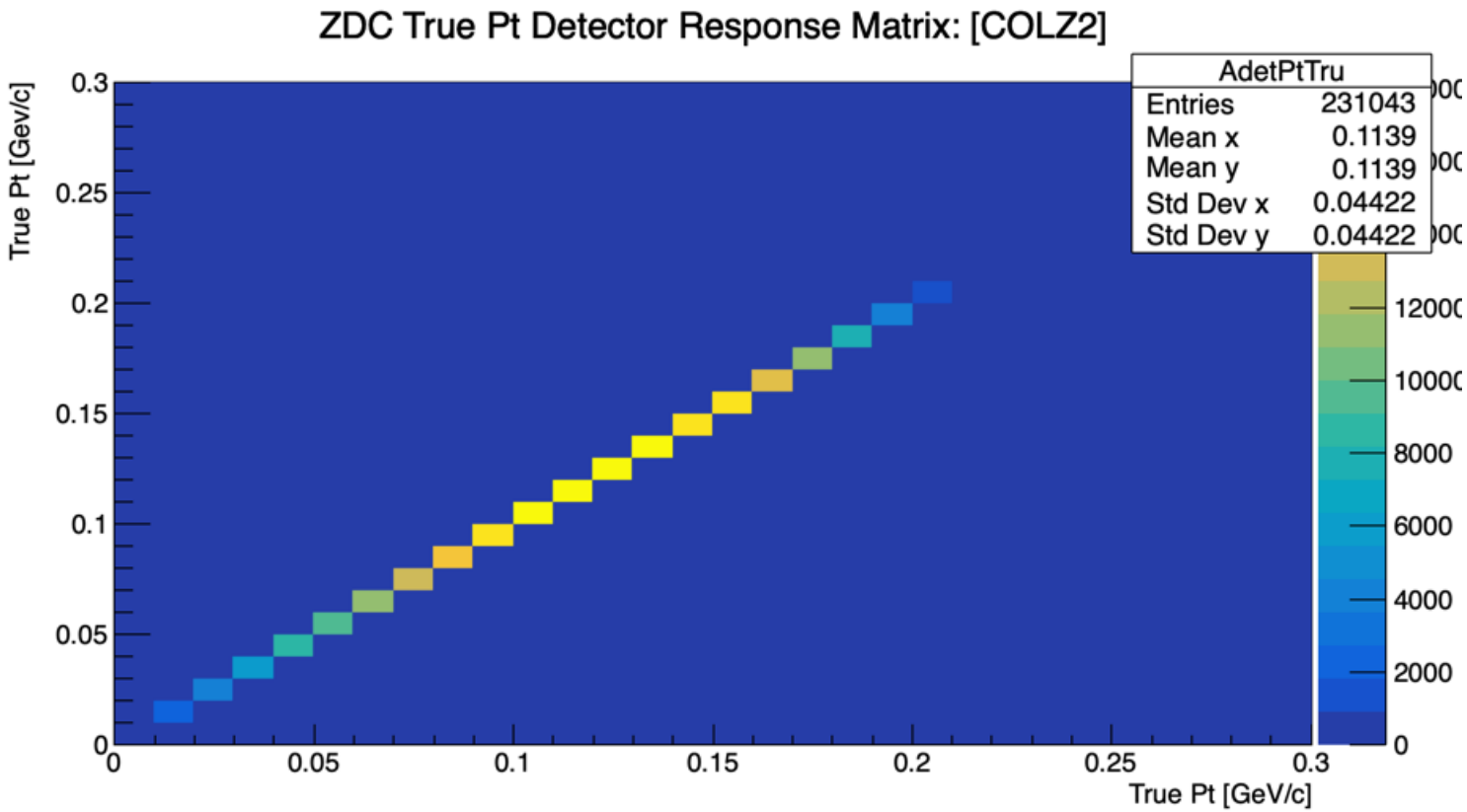


◎ Need to do some correction by applying some regularization parameter to obtain a response matrix like the ones on the next slides 18 and 19.

ZDC P_T Detector Response Matrix - Ideal Case



ZDC P_T Detector Response Matrix – Ideal Case



Next Task

- Discrepancy between current reconstructed P_T from MC and data may need some tweak.

- Tweak cross section parameter for MC. Used cross section values of 9.6 mb and 9.2 mb for UPC and DPMJET do not have possible error associated with them in the previous study.

BACKUP1: UPC and DPMJET Cross-sections

PHYSICAL REVIEW C **95**, 044908 (2017)

TABLE I. Cross sections for neutron production in ultraperipheral collisions and hadronic interactions at $\sqrt{s_{NN}} = 200$ GeV. Cross sections in parentheses are calculated without η and x_F limits.

UPCs		Hadronic interactions	
$p^{\uparrow}$Al	$p^{\uparrow}$Au	$p^{\uparrow}$Al	$p^{\uparrow}$Au
0.7 mb (2.2 mb)	19.6 mb (41.7 mb)	8.3 mb	19.2 mb

BACKUP2: ZDC P_T Detector Response Matrix