Update for Acceptance systematics

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Scheme for acceptance systematics

- **Premise**
  - Difference of the p_T or y distribution from between data and MC reflects the acceptance from MC
- **Weighting to denominator and numerator respectively**
  - Weighting function is continuous (not binned)
  - Variation of acceptance with weighting can be considered as systematics for acceptance

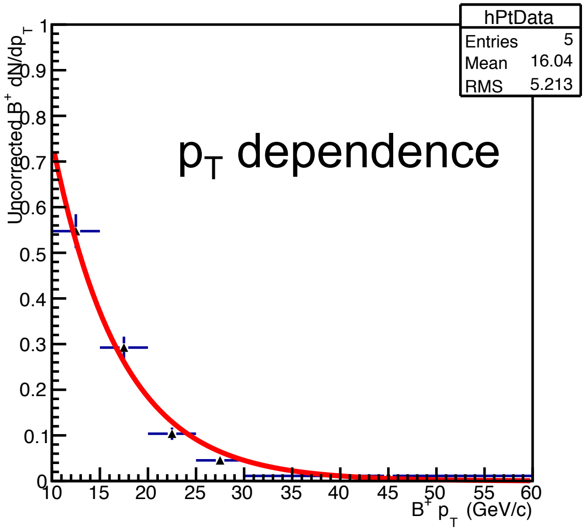
$$\alpha = \frac{N^{B^{signal}}_{reconstructable,M}(p_{\mathrm{T}}, y)}{N^{B^{signal}}_{-2.40<y^{triplet}<2.40}(p_{\mathrm{T}}, y)}$$

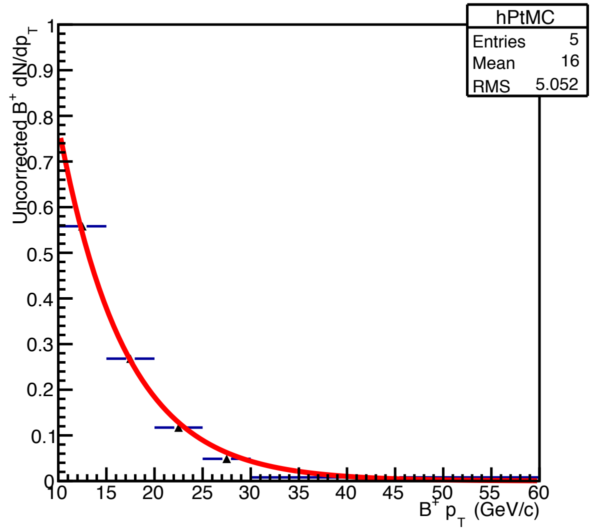
Data/MC ratio

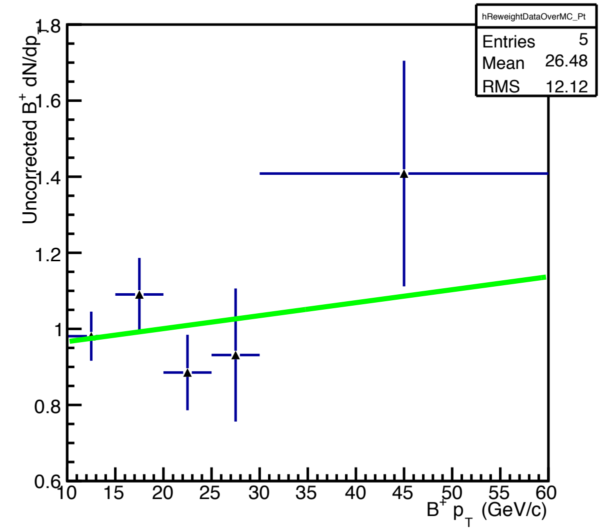
Normalized uncorrected yield from data

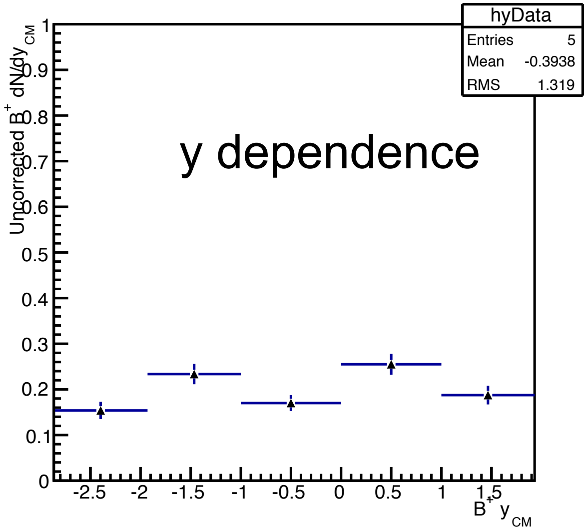
Normalized uncorrected yield from MC

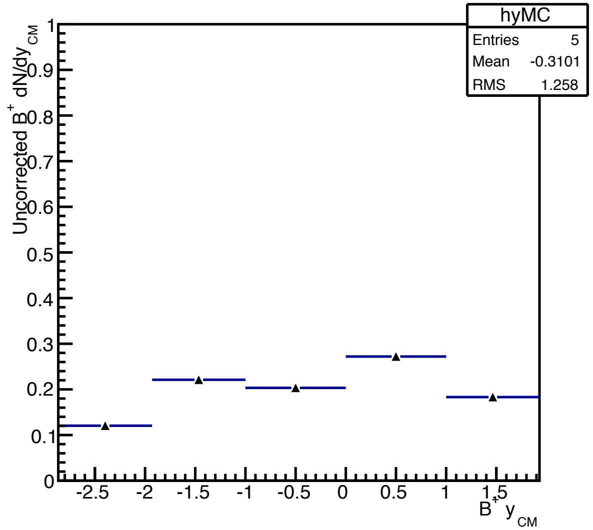
Data/MC ratio of normalized uncorrected yield

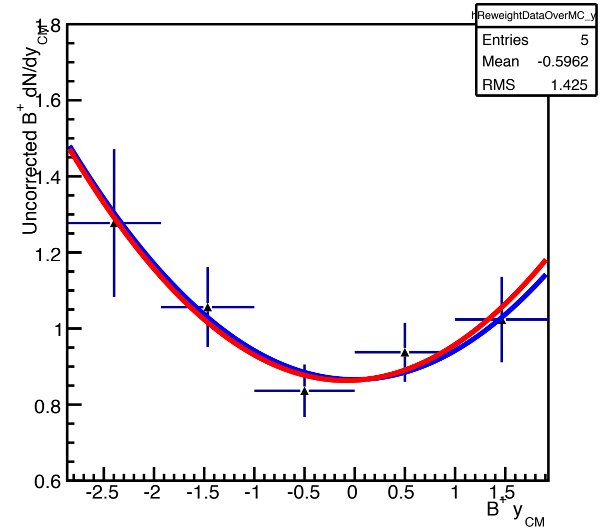




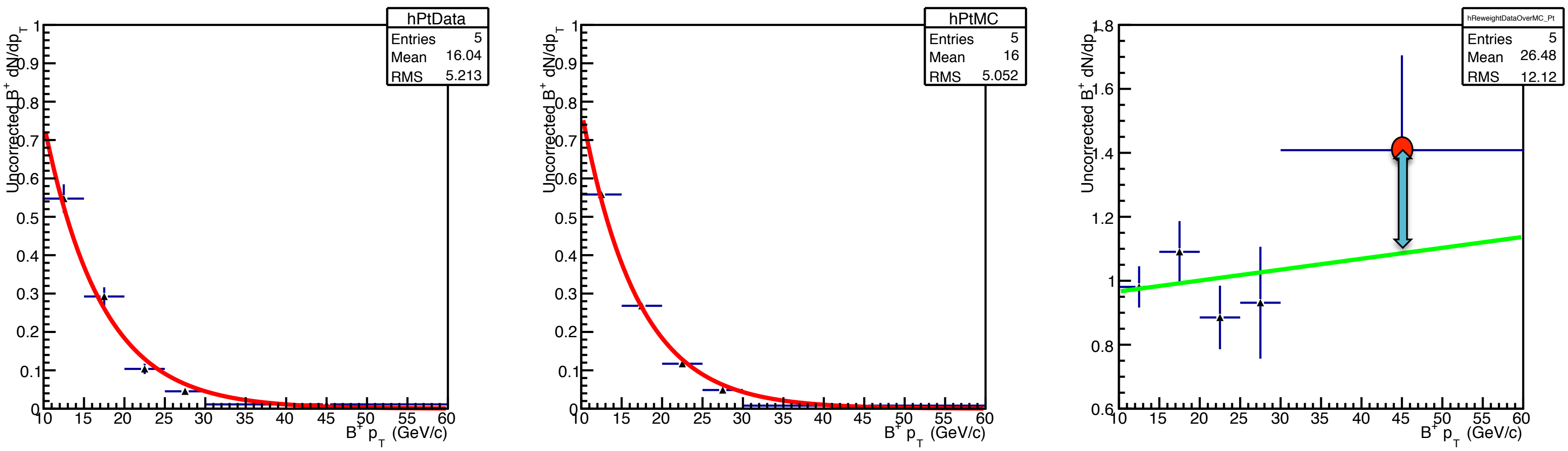








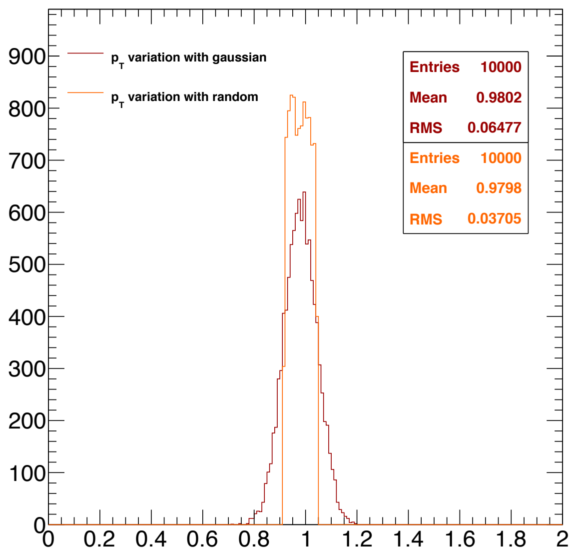
Estimate acceptance systematics

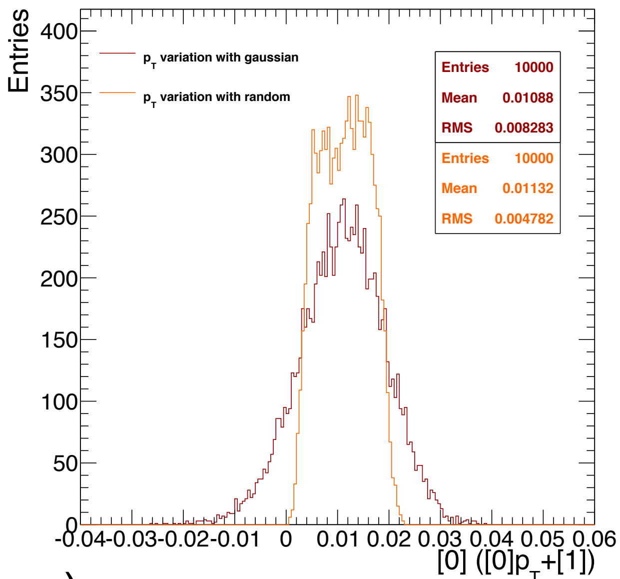


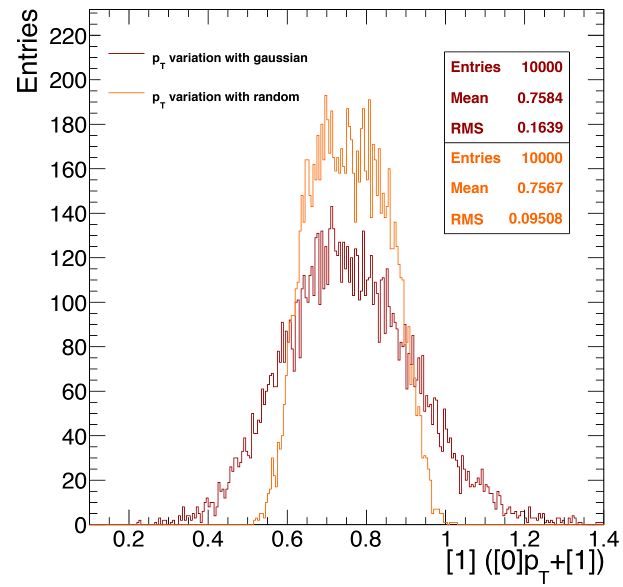
- **Run random generator and vary the Data/MC ratio in each bin**
  - Mean = Data/MC ratio, Sigma = error of the Data/MC
  - Run the random generator 10k times
  - Get parameters of 1st order polynomial
  - Test with flat and gaussian distribution

Ratio variation

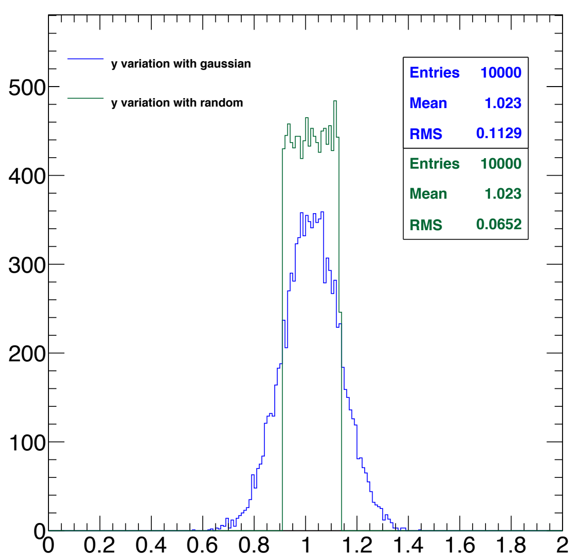
- pT dependence

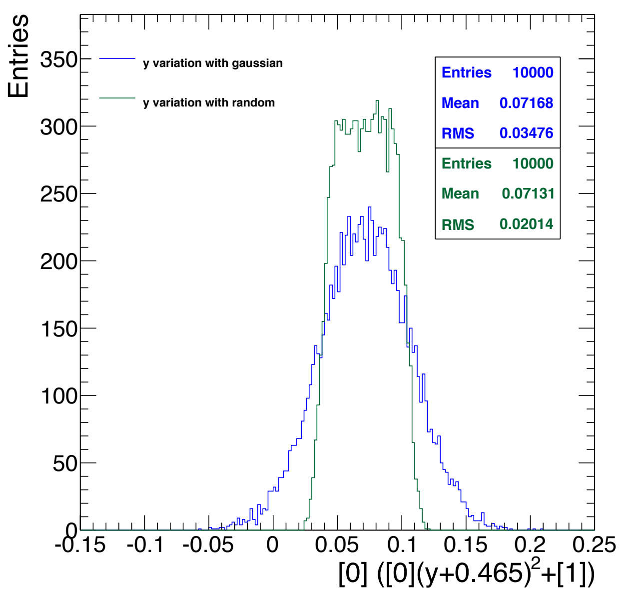


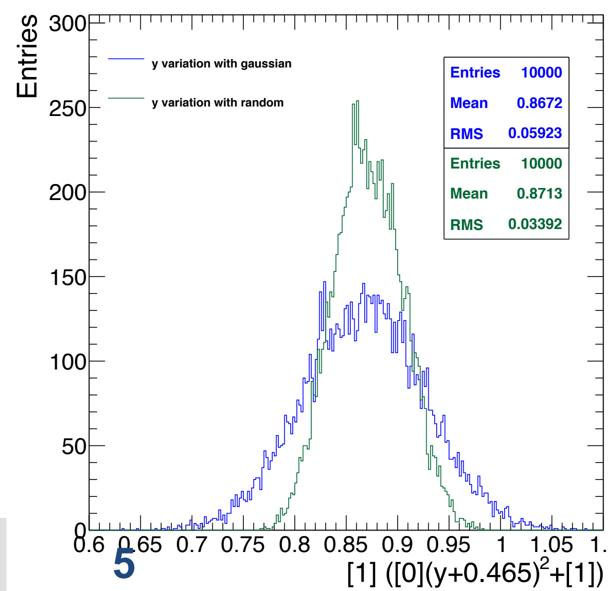




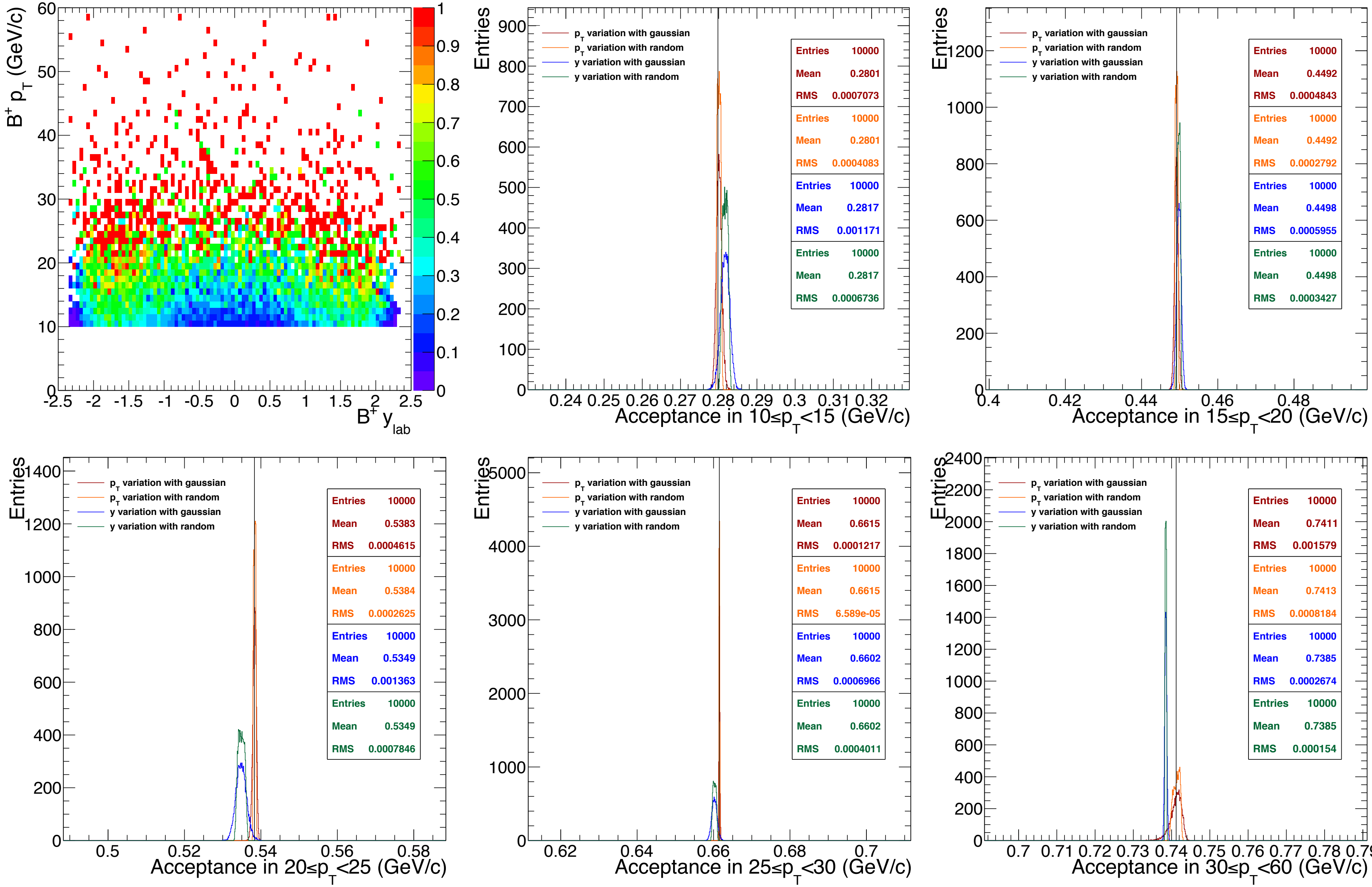
- y dependence (in lab frame)



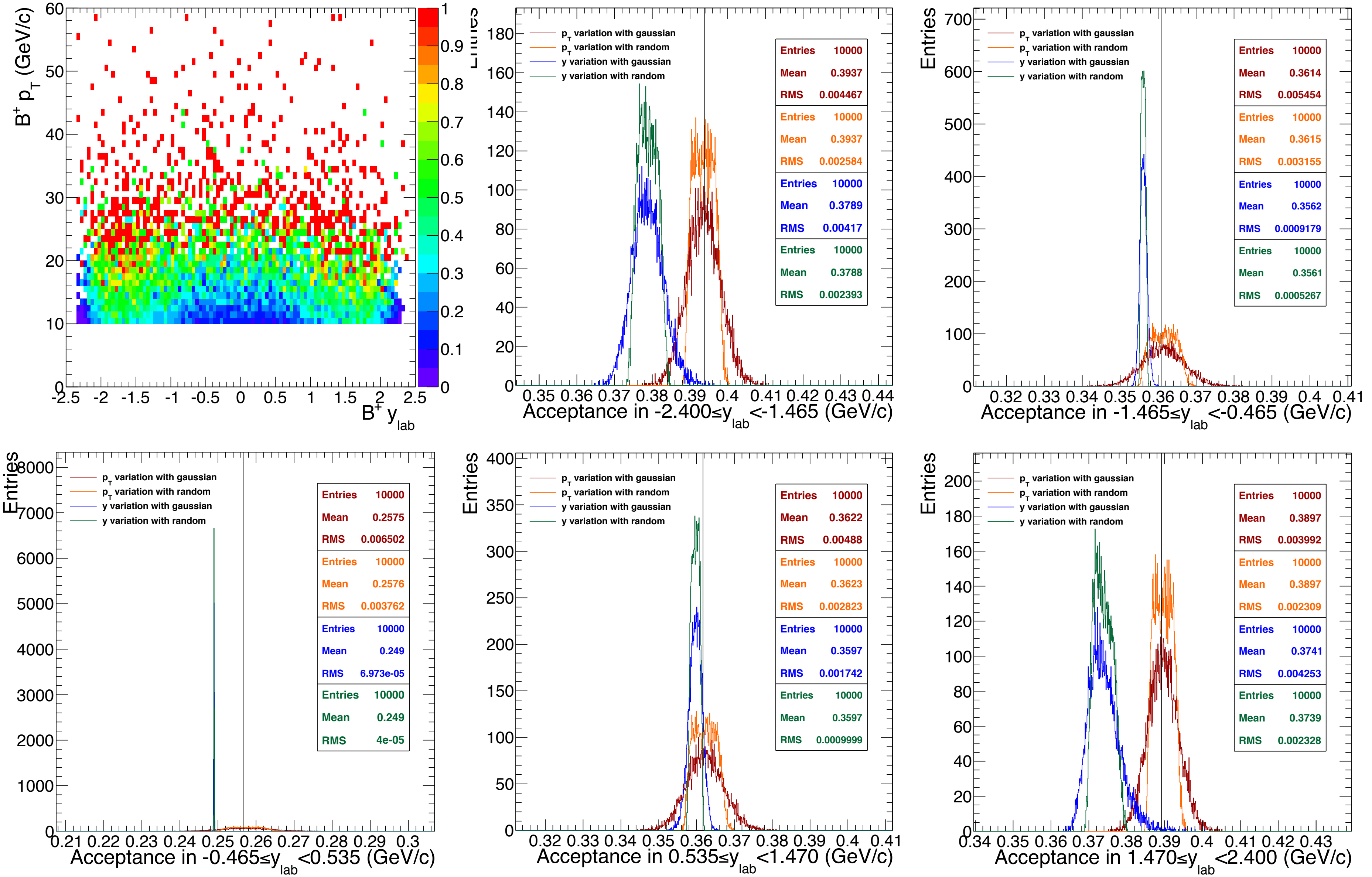




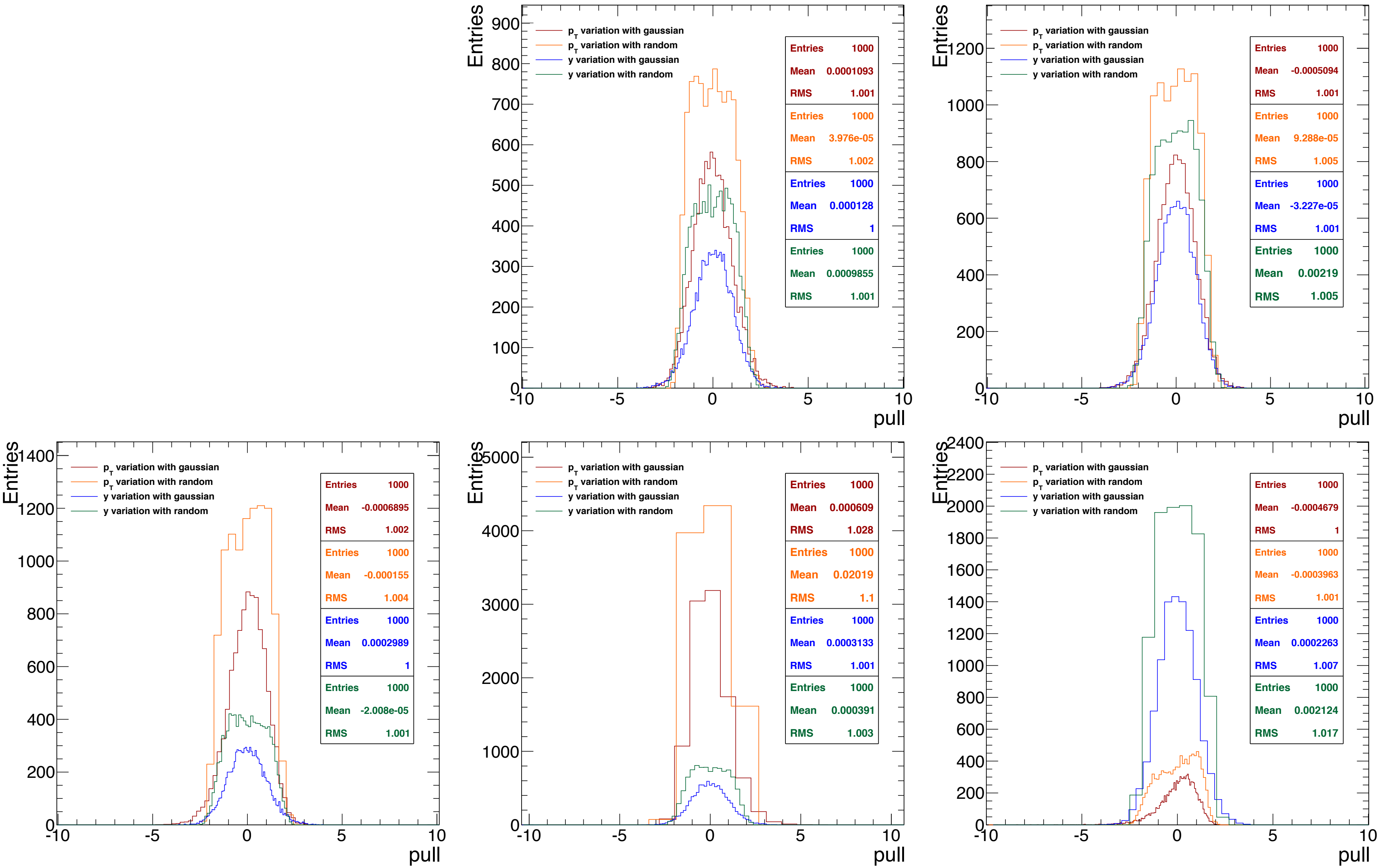
p_T dependence



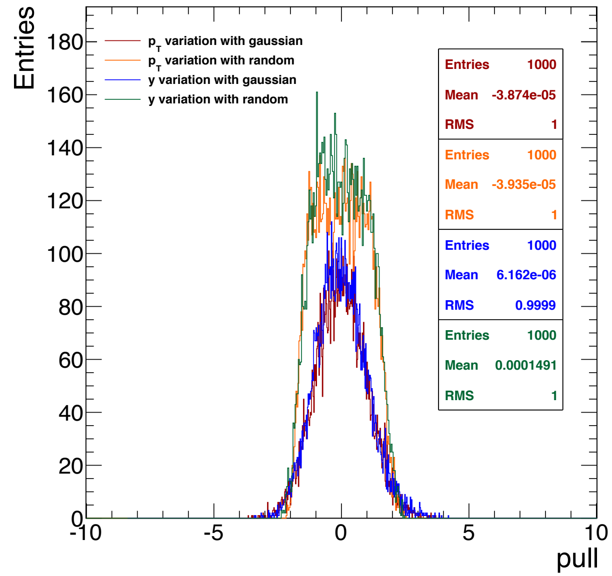
y dependence

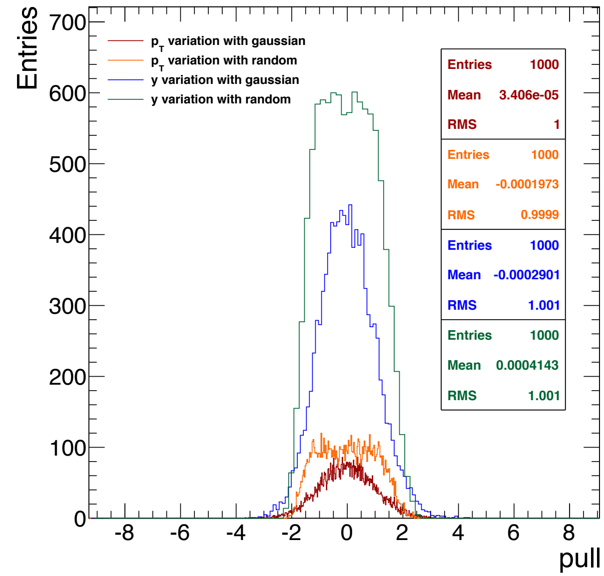


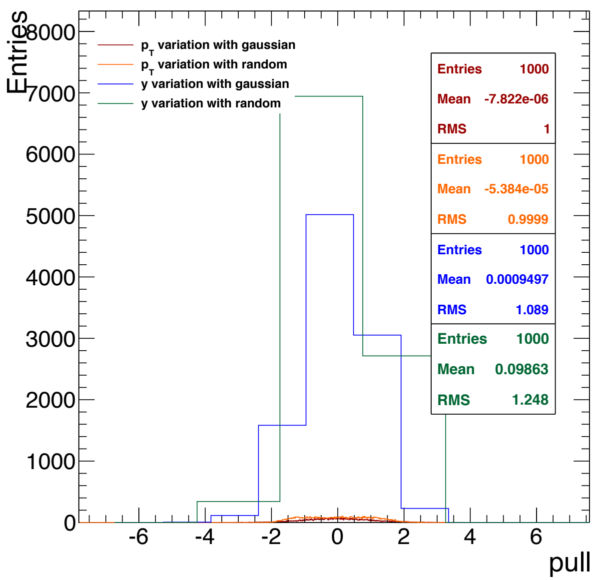
Pull distribution, p_T dependence

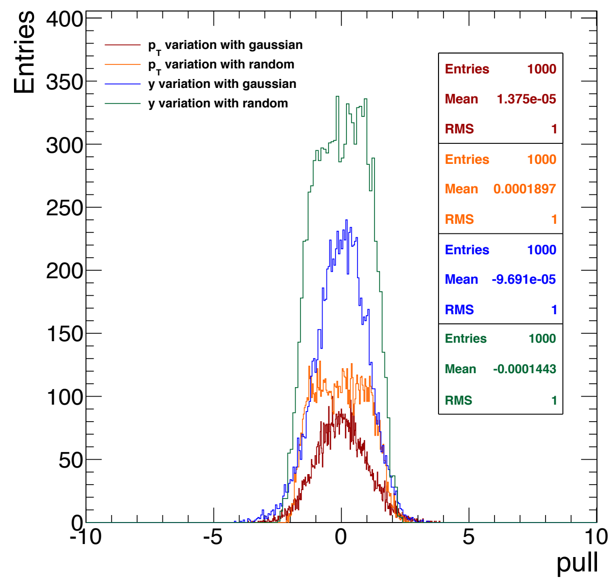


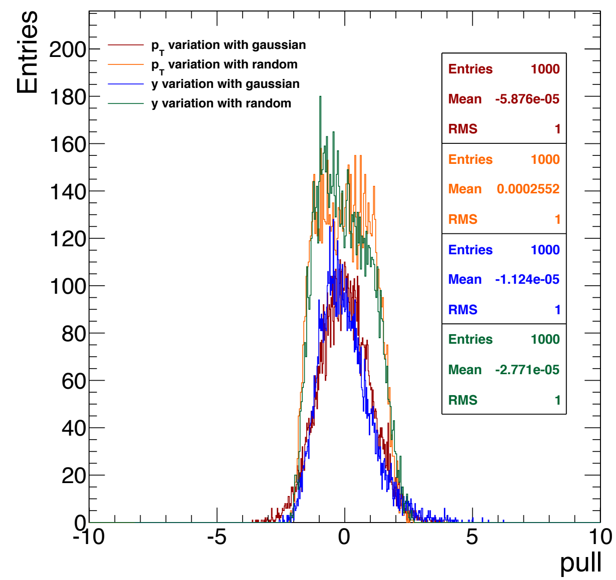
Pull distribution, y dependence











Discussion

- **Acceptance by 10k variation with gaussian or flat distribution**

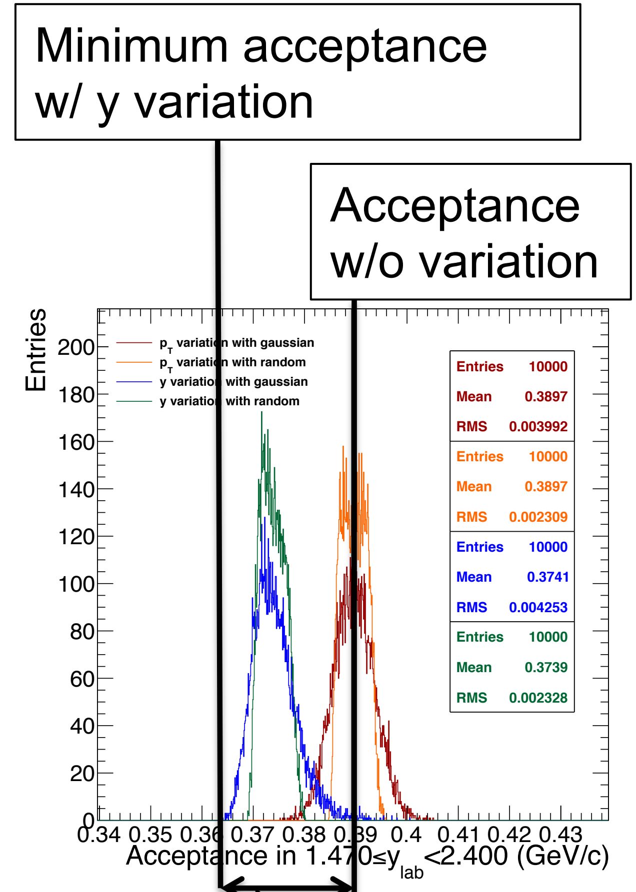
- **Variation is affected by acceptance trends versus pT or y, so varied acceptance value have complicated trends**

- **How we should choose the difference from that?**
  - Mean value from toy study – Acceptance value without variation
  - Difference between max and min from toy study
  - Max or min from toy study – Acceptance value without variation
    - shown table in next slide

Acceptance variation

p_T bin	Acceptance	p_T variation Delta Acc.	y variation Delta Acc.
1 (10,15)	0.2798	0.33%	0.61%
2 (15,20)	0.4492	0.20%	0.28%
3 (20,25)	0.5383	0.22%	0.84%
4 (25,30)	0.6615	0.08%	0.39%
5 (30,60)	0.7412	1.34%	0.38%

y bin (lab)	Acceptance	p_T variation Delta Acc.	y variation Delta Acc.
1 (-2.4,-1.465)	0.3939	1.70%	2.93%
2 (-1.465,-0.465)	0.3608	2.15%	0.78%
3 (-0.465,0.535)	0.2568	2.56%	0.93%
4 (0.535, 1.470)	0.3617	1.94%	0.93%
5 (1.470, 2.4)	0.3892	1.60%	2.60%



- Red : Select maximum in two cases, use as systematics?

Backup

Reminder of strategy for weight calculation for the acceptance

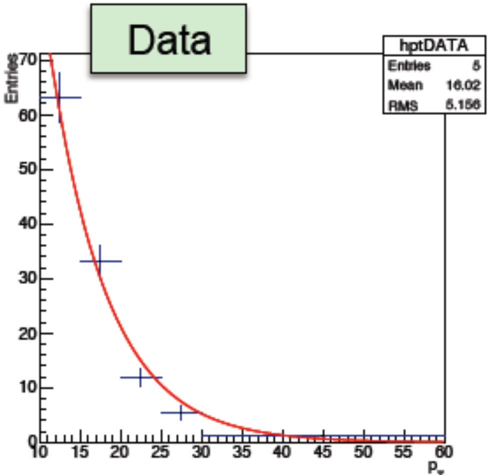
Last decision

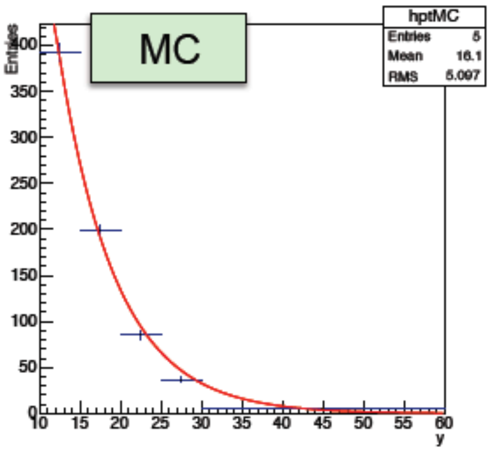
- QM2014 methods : rule out with problems
- Fit and divide methods : proper for pT dependence
- Divide and fit methods : rule out because of failing fit

New proposal after collection of y

- QM2014 methods : rule out with problems
- Fit and divide methods : proper for pT dependence
- Divide and fit methods : proper for y dependence – find the candidate fitting function

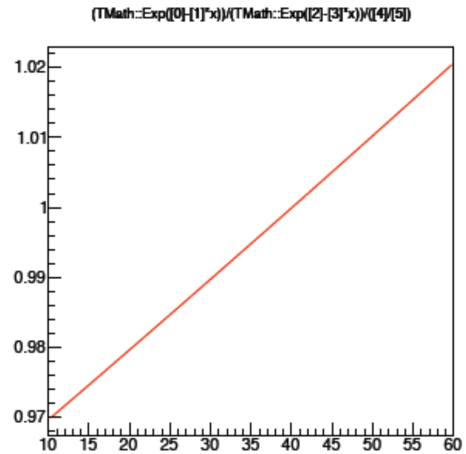
Method 2 : Fit and divide methods



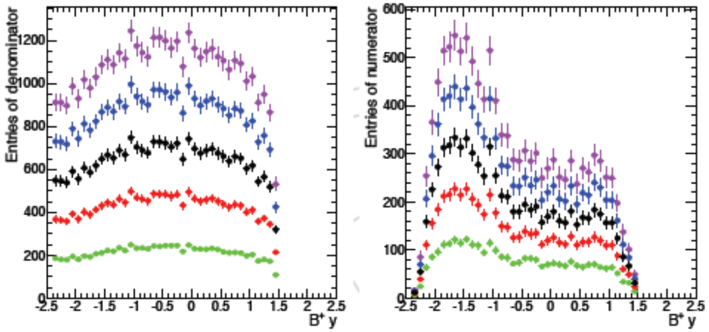


With the raw yields from MC and data, fit by exponential function

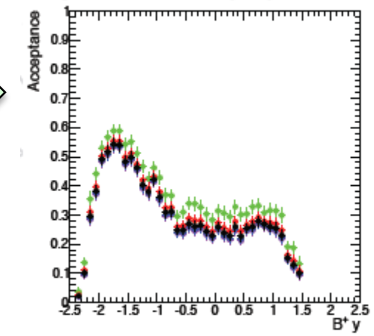
$$\frac{\dfrac{e^{p0-xp1}|_{data}}{Total\ \ B\ \ cand.|_{data}}}{\dfrac{e^{p0-xp1}|_{MC}}{Total\ \ B\ \ cand.|_{MC}}}$$



Divide fitting functions from MC and data, then get the weighting function W
Consider the errors from each parameters

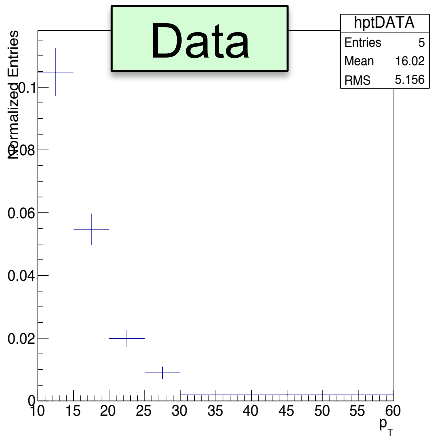


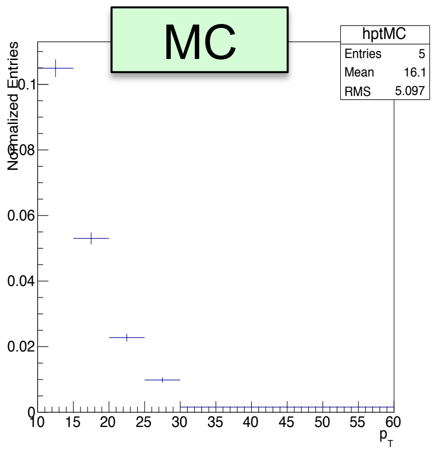
Weight the denominator and numerator : Fill(y,W)



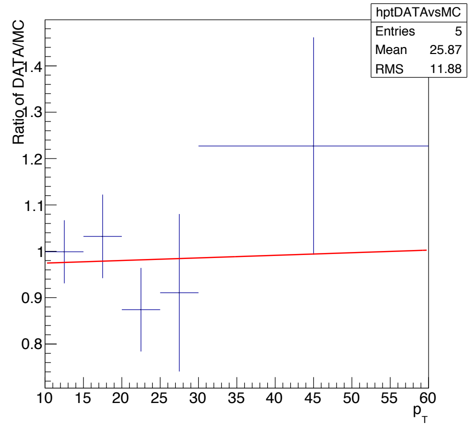
Calculate the acceptance from dividing the numerator by the denominator, and redo with the varying the parameters consideration with errors, then compare the difference and set the systematics

Method 3 : Divide and fit methods

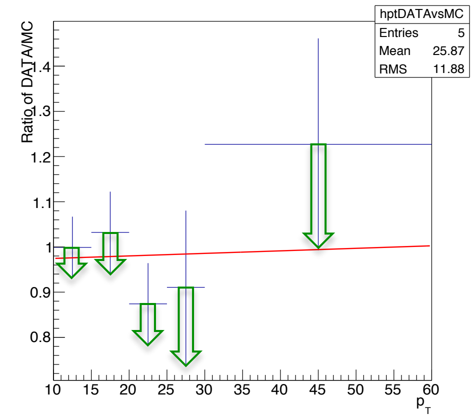




Get the normalized raw yields from MC and data

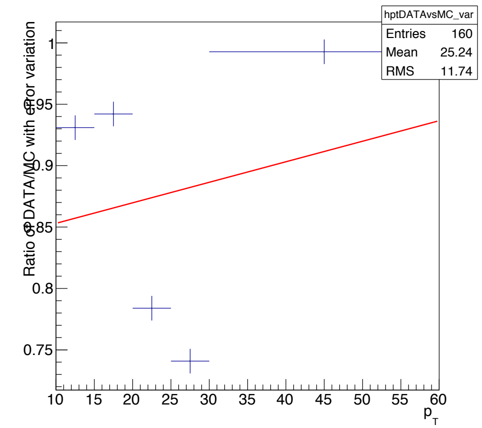


Divide the normalized raw yields then fit points by 1st order polynomial function(like method 1), that is weighting function W



With up or down variation of error in each points, get the fitting function again

(ex. down, down, down, down)

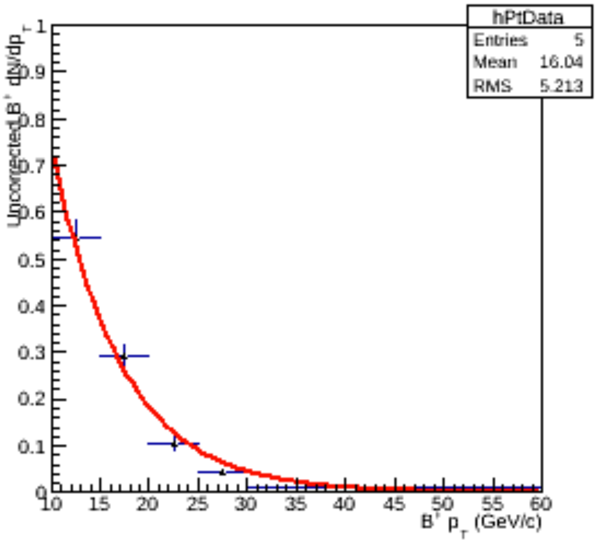


Get the acceptance with various weighting function and check the difference between maximum and minimum, set as the systematics

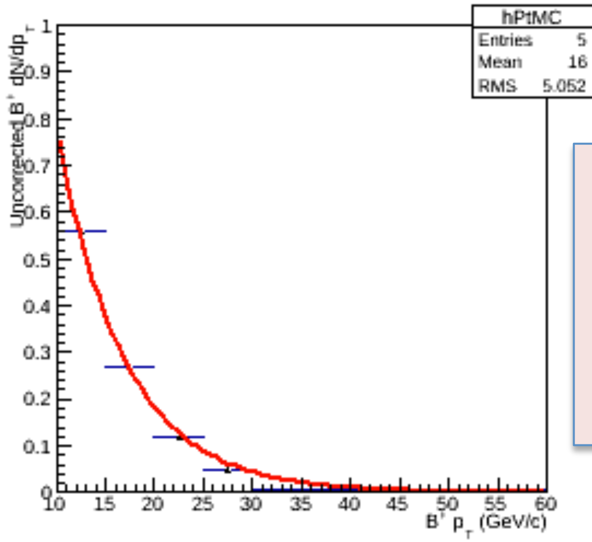
p_T dependence

exp/exp without fitting
exp/exp with fitting
1^{st} order polynomial with fitting

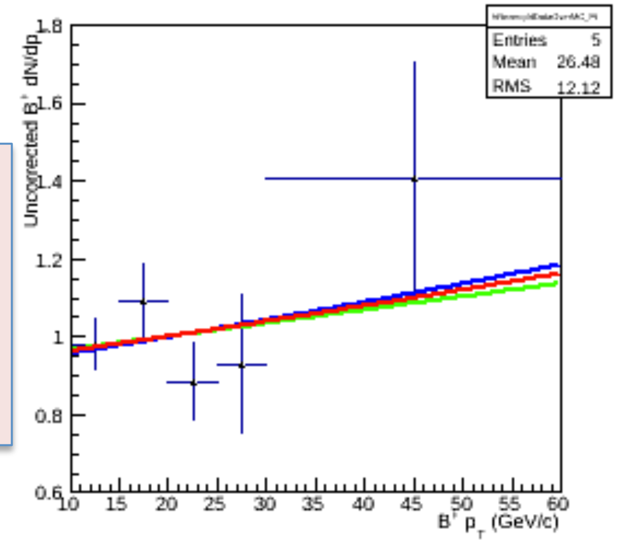
Reco. B+ in Data



Reco. B+ in MC



Data/MC

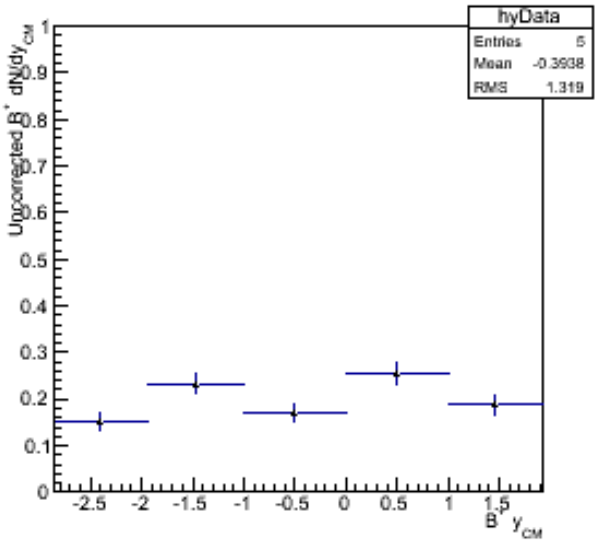


Divide with "B" option

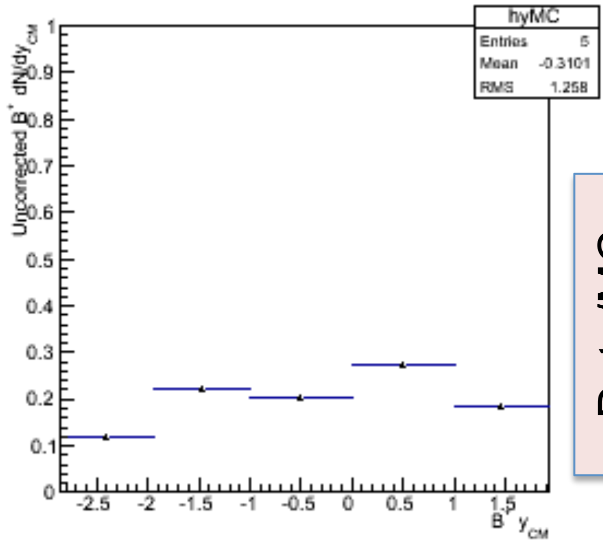
- Apply method 2 (fit and divide)

y dependence

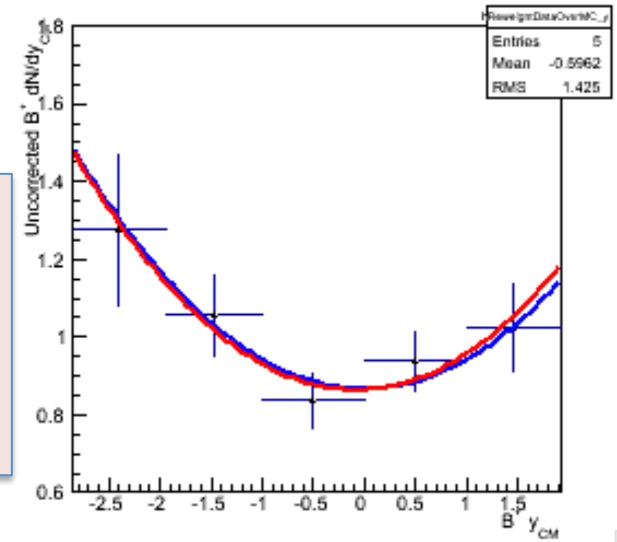
Reco. B+ in Data



Reco. B+ in MC



Data/MC



2^{nd} order polynomial with fixed y shift (minimum is at y=0)

2^{nd} order polynomial without fixed y shift (minimum y is conrolled by fitting

Divide with “B” option

- Apply method 3 (divide and fit)
- Find proper fitting function, revive method 3

Rapidity conversion in between lab and CM frame

- **General**
  - Proton going direction have plus rapidity in CM frame
  - Merge bins with same rapidity in CM frame(same color in tables)
- **1st run**
  - proton going to minus eta $$y_{CM} = -y_{lab} - 0.465$$

yLAB	-2.4	-1.465	-0.465	+0.535	+1.470	+2.4
yCM	1.935	1.0	0.0	-1.0	-1.935	-2.865

← proton going direction

- **2nd run**
  - proton going to plus eta $$y_{CM} = y_{lab} - 0.465$$

yLAB	-2.4	-1.470	-0.535	+0.465	+1.465	+2.4
yCM	-2.865	-1.935	-1.0	0.0	1.0	1.935

proton going direction →