UF | UNIVERSITY of FLORIDA

The Foundation for The Gator Nation

pt LUT assignment for CSCTF

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- Introduction
- Method
- Monte Carlo sample
- Threshold efficiency
- Conclusion

Introduction

- The previous study was done in 2001 (CMS Note 2001/033)
- Main features of the paper for 3 Station method:
  - Δφ12 and Δφ23 are calculated and parameterize with the function $\mu_{ij}(pt) = A_{ij}/pt$ (ij = 12 or 23) (1) for each η bin likelihood function is plotted for them:

$$L_{3\ Station} = \frac{1}{2\pi\sigma_{12}\sigma_{23}\sqrt{1-\rho^2}} \times \exp\left\{-\frac{1}{2(1-\rho^2)}\left[\frac{(\Delta\phi_{12}-\mu_{12})^2}{\sigma_{12}^2} - \frac{2\rho(\Delta\phi_{12}-\mu_{12})(\Delta\phi_{23}-\mu_{23})}{\sigma_{12}\sigma_{23}} + \frac{(\Delta\phi_{23}-\mu_{23})^2}{\sigma_{23}^2}\right]\right\}$$

- pt is found solving equation: ∂ln(L)/∂pt = 0 in assumptions:
  1. ρ = 0.6 = constant (2)
  2. $c_{ij} = \sigma_{ij}/\mu_{ij}$ = constant (pt) (3)

=> Quadratic equation => pt = maximum solution of this equation

✓ Code of this study is not available

✓ values μ_{12} and μ_{23} and there sigma σ_{12} and σ_{23} are failed to parameterize in low PT region (~ 5 GeV)

New study is needed to have possibility to improve ptLUTs and make tune to the DATA

New study: Likelihood for 2 and 3 Station Methods

$$L_{2\ Station} = \frac{1}{\sqrt{2\pi}\sigma_{12}} \times \exp\left\{-\frac{(\Delta\phi_{12}-\mu_{12})^2}{2\sigma_{12}^2}\right\}$$

$$L_{3\ Station} = \frac{1}{2\pi\sigma_{12}\sigma_{23}\sqrt{1-\rho^2}} \times \exp\left\{-\frac{1}{2(1-\rho^2)}\left[\frac{(\Delta\phi_{12}-\mu_{12})^2}{\sigma_{12}^2} - \frac{2\rho(\Delta\phi_{12}-\mu_{12})(\Delta\phi_{23}-\mu_{23})}{\sigma_{12}\sigma_{23}} + \frac{(\Delta\phi_{23}-\mu_{23})^2}{\sigma_{23}^2}\right]\right\}$$

- Mean values μ_{12} and μ_{23} and there sigma σ_{12} and σ_{23}, extracted from the Gauss fit of the $\Delta\phi_{12}$ and $\Delta\phi_{23}$ distributions correspondingly, are parameterized with smooth functions:

$$\mu = \frac{a_0}{(pt-a_3)} + \frac{a_1}{(pt-a_3)^2} + a_2; \quad \sigma = \frac{b_0}{pt} + \frac{b_1}{pt^2} + b_3$$

- Correlation ρ between $\Delta\phi_{12}$ and $\Delta\phi_{23}$ is calculated and parameterized with smooth function:

$$\rho = (c_0 + c_1 \log pt + c_2 \log^2 pt + c_3 \log^3 pt) \times \exp\{-c_4 \log pt\}$$

- pt is found solving equation: $\partial \ln(L)/\partial pt = 0$ numerically and $\partial^2 \ln(L)/\partial^2 pt > 0$.

- pt = (maximum solution of this equation)*1.2
  1.2 (20%) correction is taking to have efficiency > 90% in CSCTF triggering

Monte Carlo Data

- Official sample is used in this analysis:

  /SingleMuonPlusOneOverPt_NewField/Summer09-MC_31X_V8-v1/
  GEN-SIM-DIGI-RAW-RECO

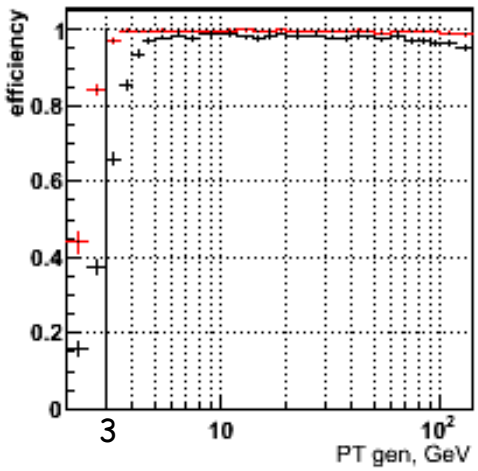
- Some definition:

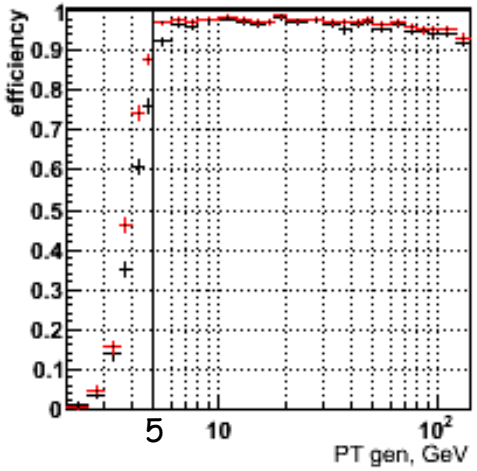
  Quality = 3:
  track has 3 Stations including ME1 for |η| <2.1
  track has 3 Stations for |η| > 2.1
  Quality = 2:
  track has 2 Stations including ME1
  Quality = 1:
  track has 2 Stations without ME1

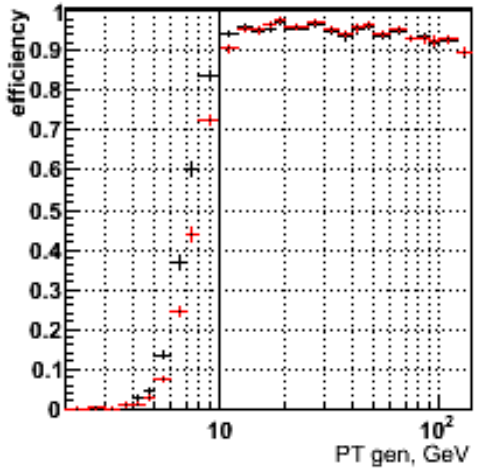
$$\varepsilon_{threshold}(pt_{gen},\eta_{gen}) = \frac{N^{gen\&\&rec}(\eta_{gen\&\&rec}, pt_{gen} with\ pt^{rec} \geq pt_{threshold})}{Ngen(\eta_{gen}, pt_{gen})}$$

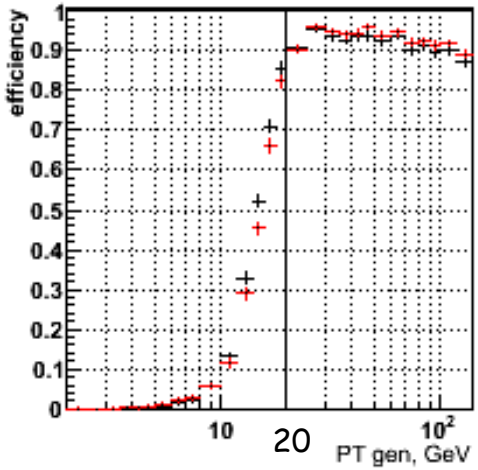
Efficiency is calculated for the following thresholds:3, 5, 10, 20 and 40 GeV

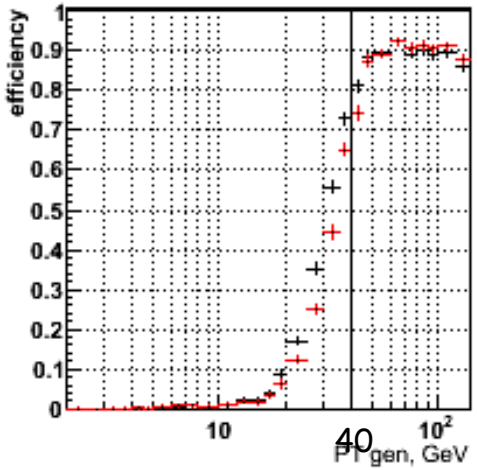
Pt efficiency for Quality = 3 and 1.2 < |η| < 2.1







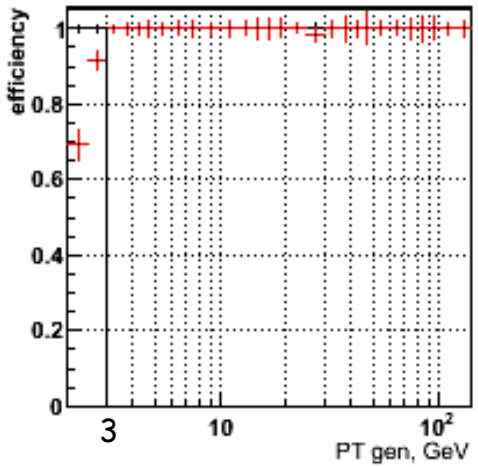


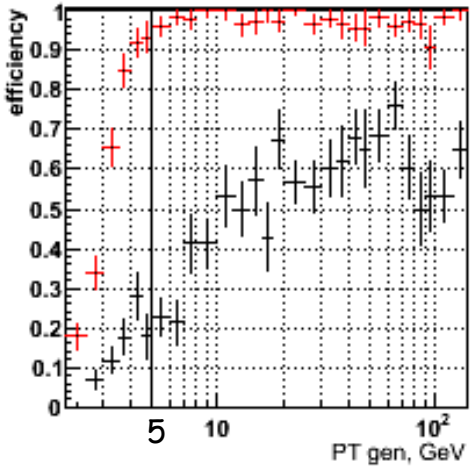


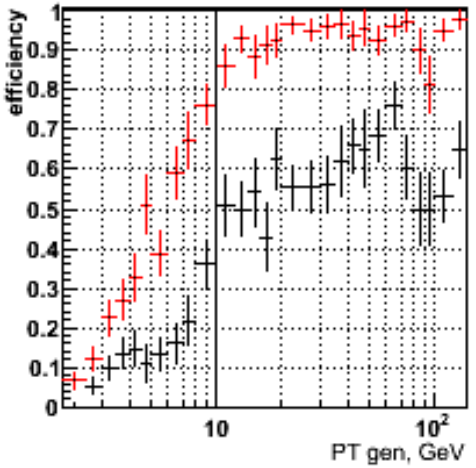
- old method
- new method

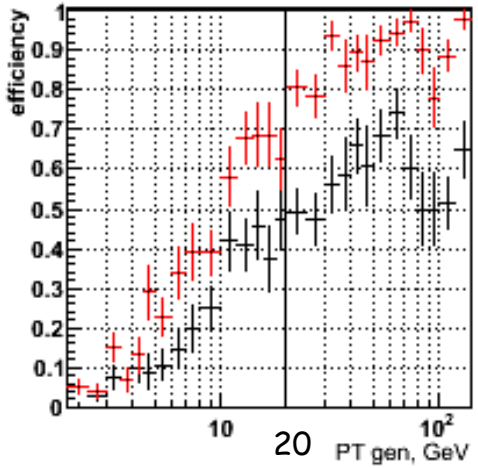
✓ Significant improvement for Quality = 3 muons for low pt region (< 5 GeV)
✓ At high pt region results almost the same

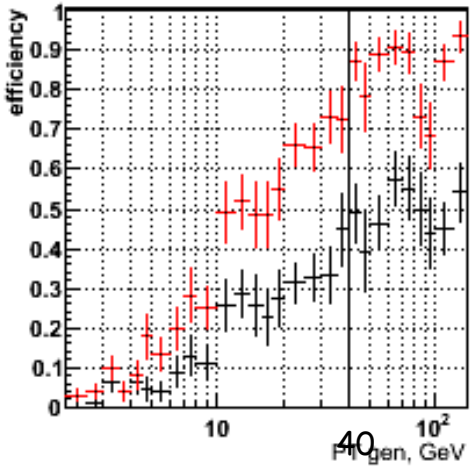
Pt efficiency for Quality = 1 and 1.2 < |η| < 2.1







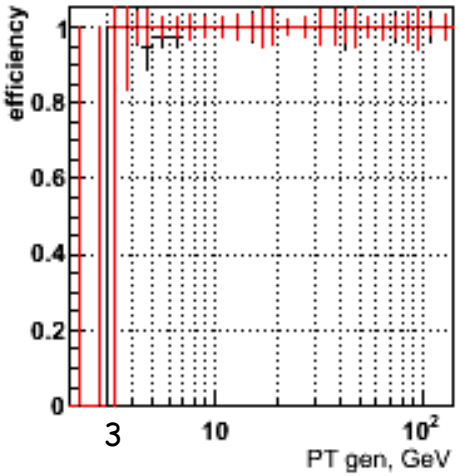


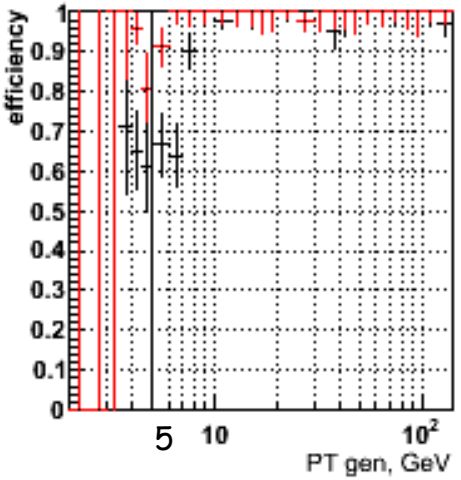


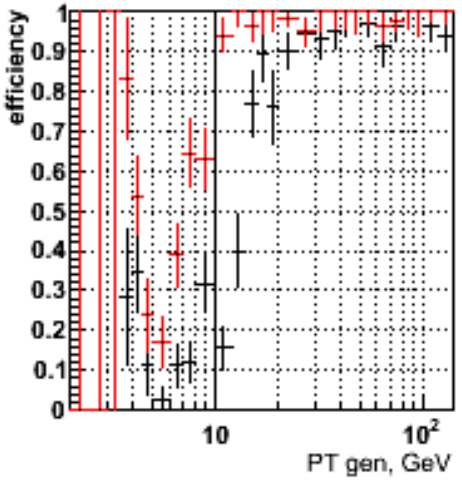
- old method
- new method

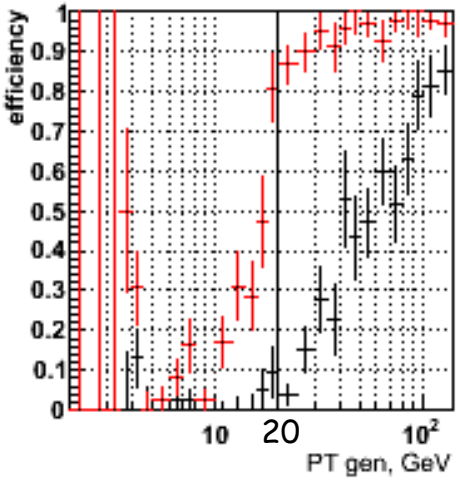
✓ Significant improvement for Quality = 1 muons for all η bins

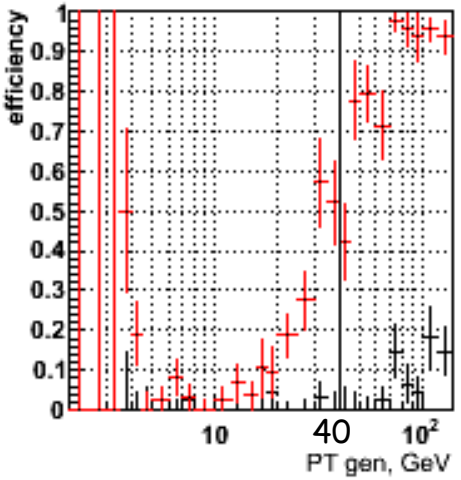
Pt efficiency for Quality = 3 and |η| < 1.2







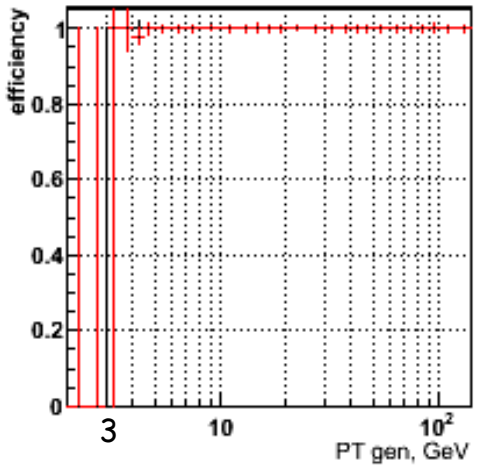


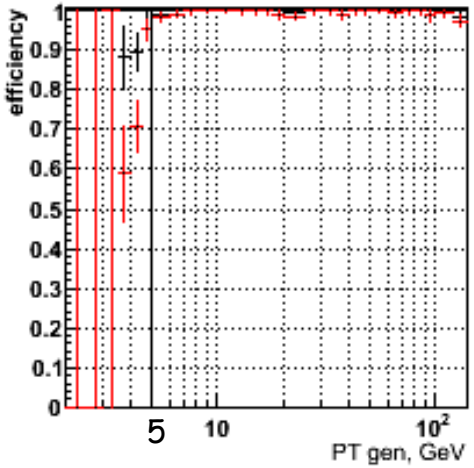


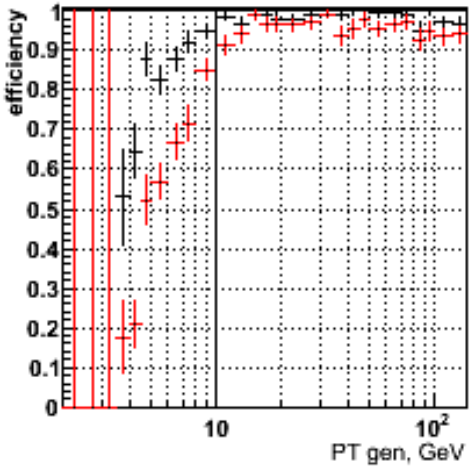
- old method
- new method

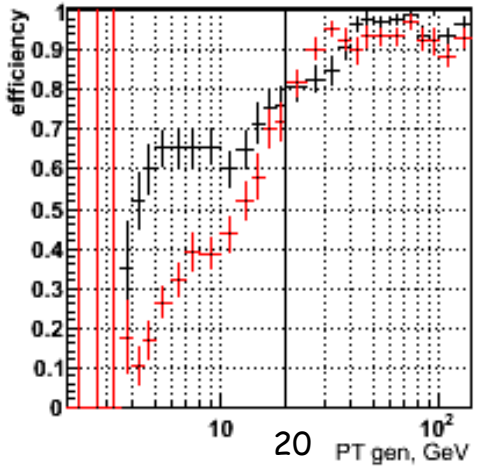
✓ Significant improvement for all Quality muons in overlap region (DT-ME)

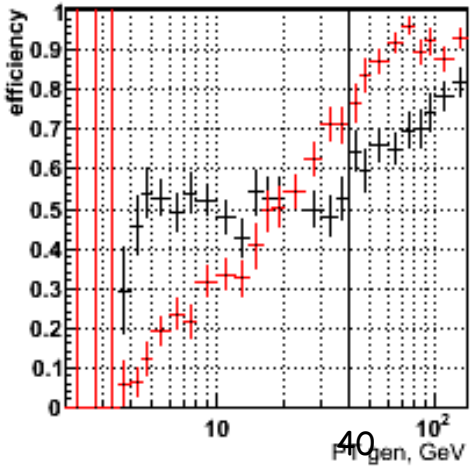
Pt efficiency for Quality = 1 and |η| < 1.2











- old method
- new method

✓ Significant improvement for all Quality muons in overlap region (DT-ME)

Conclusion

What was done:

- new ptLUT is generated:
  to generate new ptLUT (~15 min.)
  is much longer than old ptLUT (< 1 min.)
- comparison between new ptLUT and old ptLUT
  => significant improvements for Quality 1 muons and overlap region (DT-ME) are observed

To do list:

✓ try investigate other improvements

Backup slides

Possible track combinations

All mean values and sigmas are described for following Δϕ combinations:

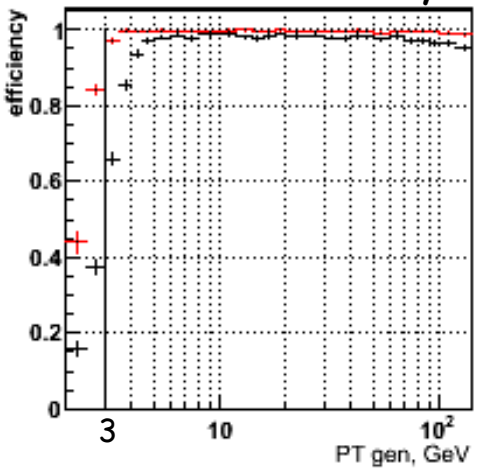
iQ	LCT in Station	Possible |η| range η_{low} - η_{high}
1	1-2	1.0 – 2.1
2	1-3	1.1 – 2.1
3	1-4	1.8 – 2.1
4	2-3	1.1 – 2.4
5	2-4	1.8 – 2.4
6	3-4	1.8 – 2.4
7	DT-1	0.9 – 1.2
8	DT-2	1.0 – 1.2
9	DT-3	1.1 – 1.2
11	1-2-3	1.1 – 2.1
12	1-2-4	1.8 – 2.1
13	1-3-4	1.8 – 2.1
14	2-3-4	1.8 – 2.4
22	DT-1-2	1.0 – 1.2
23	DT-1-3	1.1 – 1.2
24	DT-2-3	1.1 – 1.2

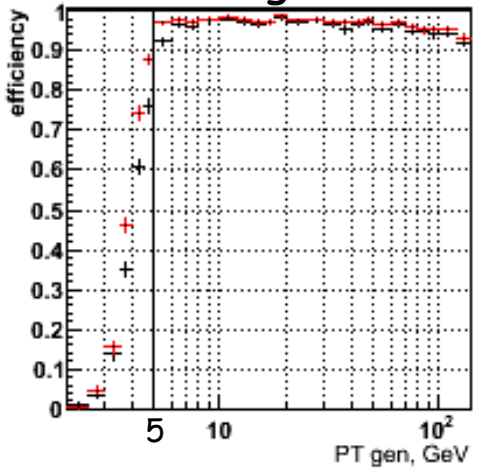
If ($\eta < \eta_{low}$) take parameterization of μ and σ from η_{low} bin for ptLUTs
If ($\eta > \eta_{high}$) take parameterization of μ and σ from η_{high} bin for ptLUTs

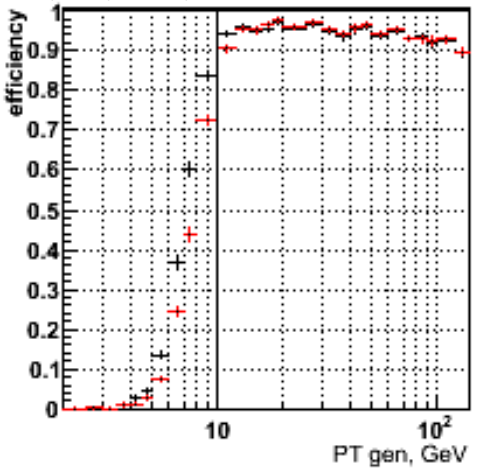
Pt efficiency for Quality = 3 and 1.2 < |η| < 2.1

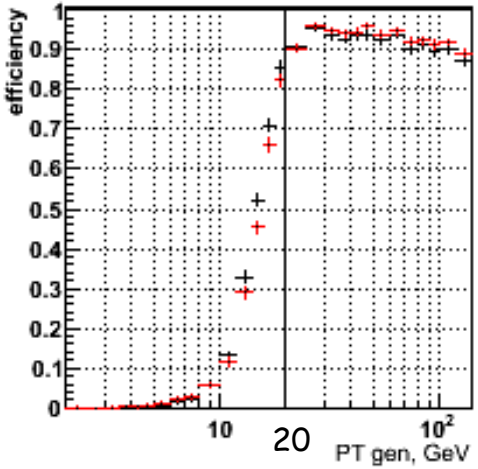
$$\varepsilon_{threshold}(pt_{gen},\eta_{gen}) = \frac{N^{gen\&\&rec}(\eta_{gen\&\&rec}, pt_{gen} with\ pt^{rec} \geq pt_{threshold})}{Ngen(\eta_{gen}, pt_{gen})}$$

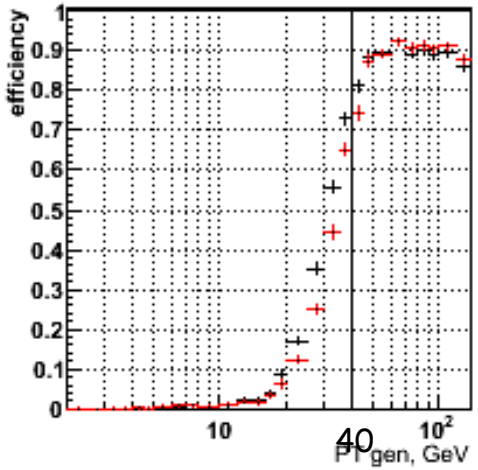
Calculate efficiency for the following thresholds:3, 5, 10, 20 and 40 GeV





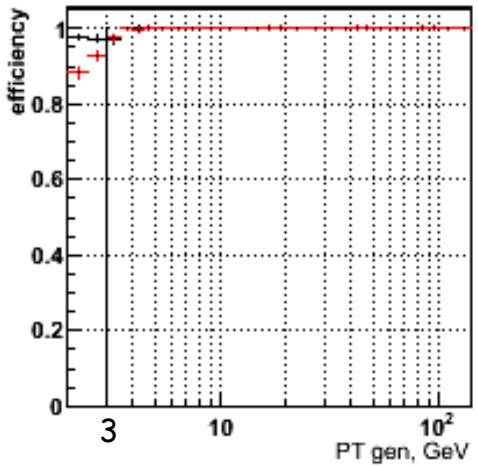


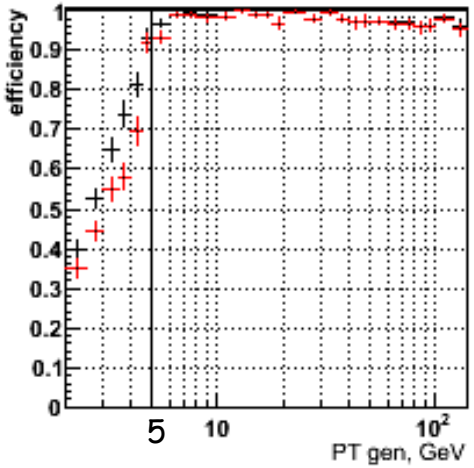


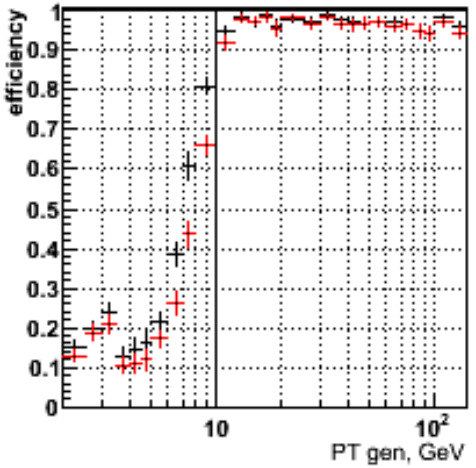


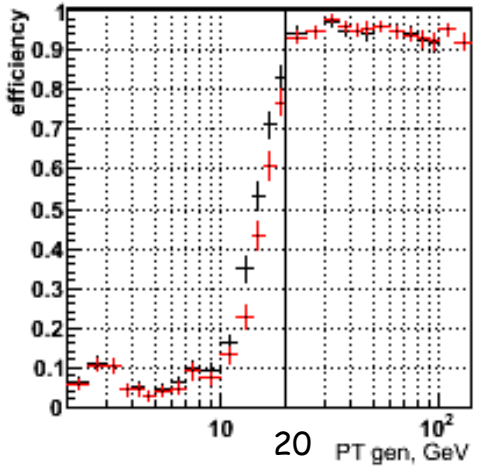
- old method
- new method

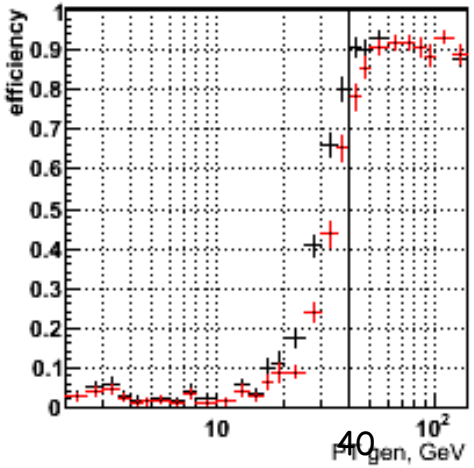
Pt efficiency for Quality = 2 and 1.2 < |η| < 2.1





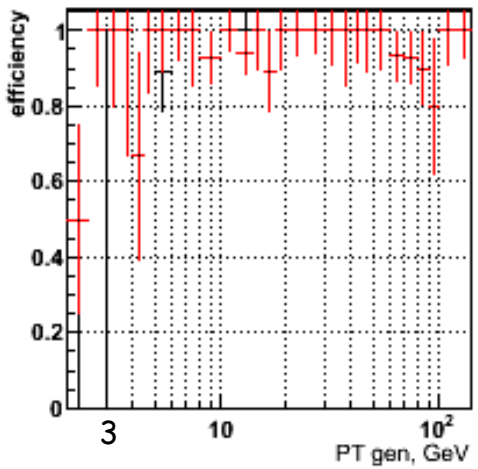


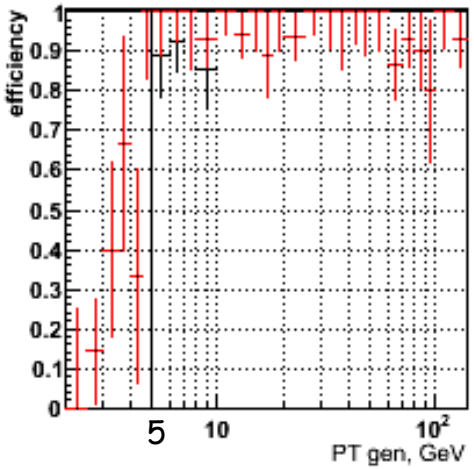


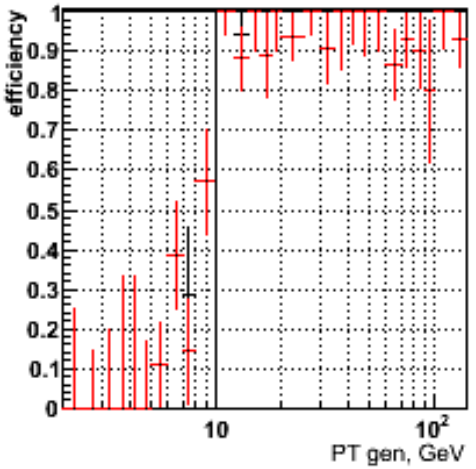


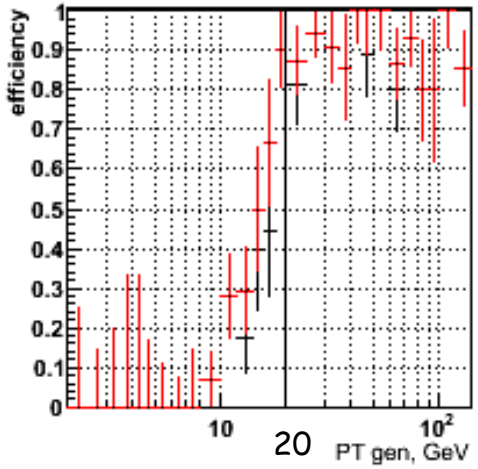
- old method
- new method

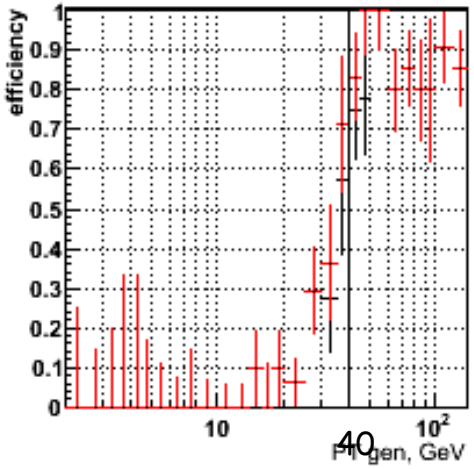
Pt efficiency for Quality = 3 and |η| > 2.1







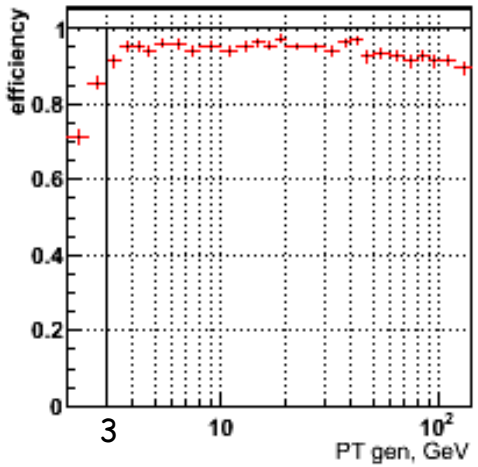


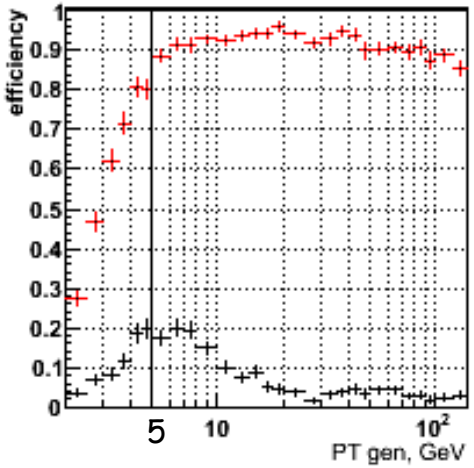


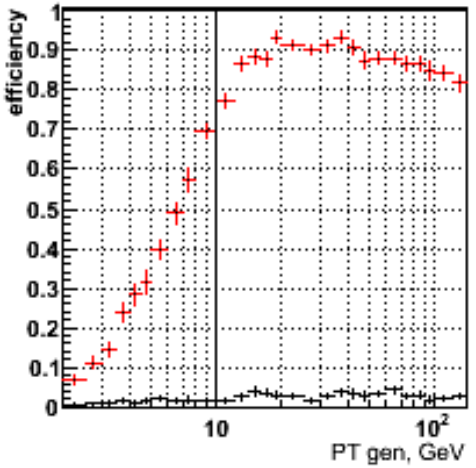
- old method
- new method

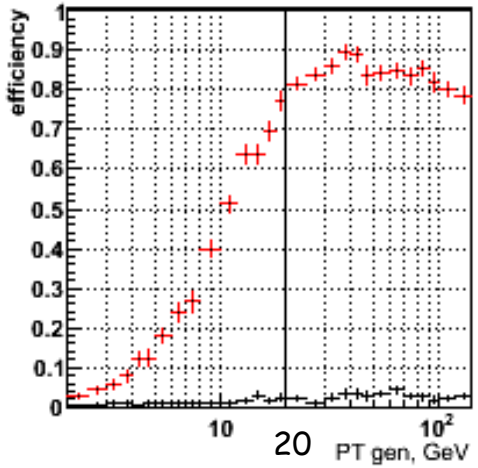
No entries for Quality =2 and |η| > 2.1

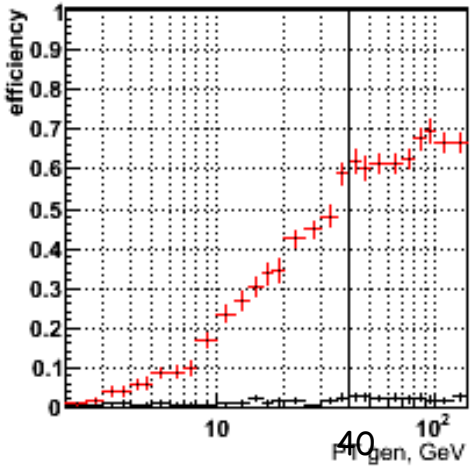
Pt efficiency for Quality = 1 and |η| > 2.1





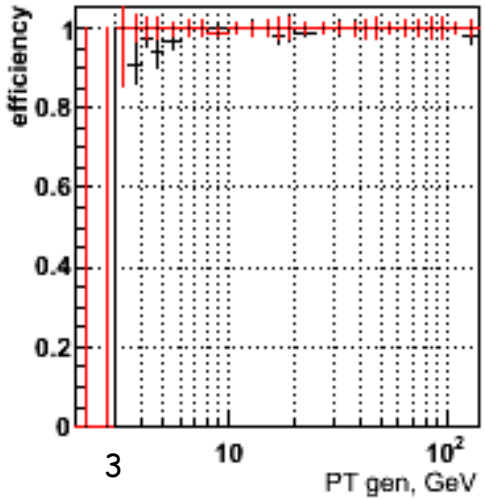


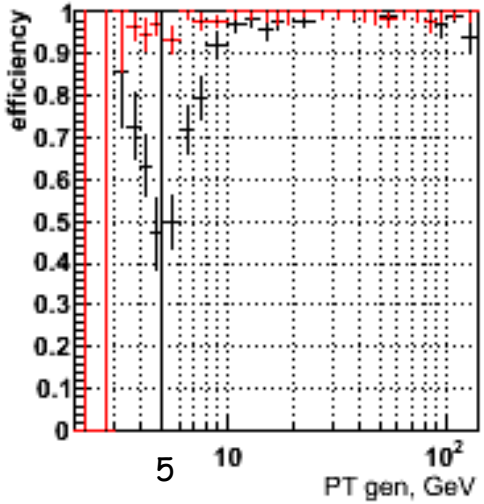


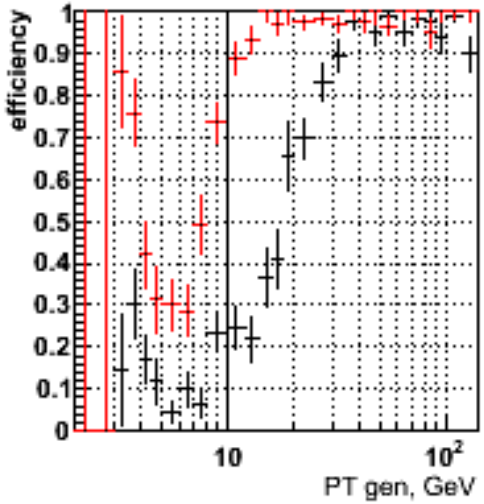


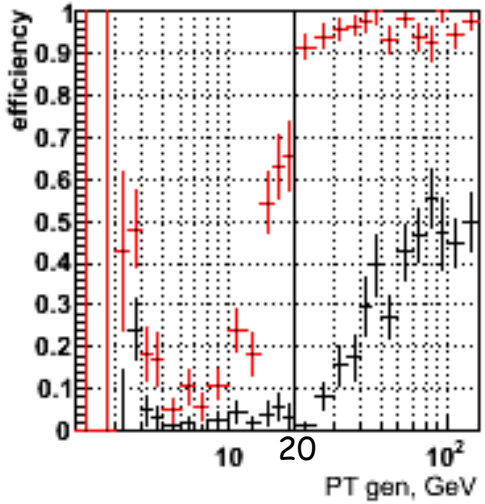
- old method
- new method

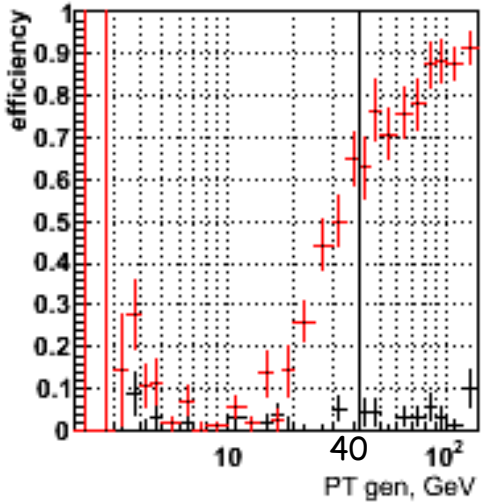
Pt efficiency for Quality = 2 and |η| < 1.2









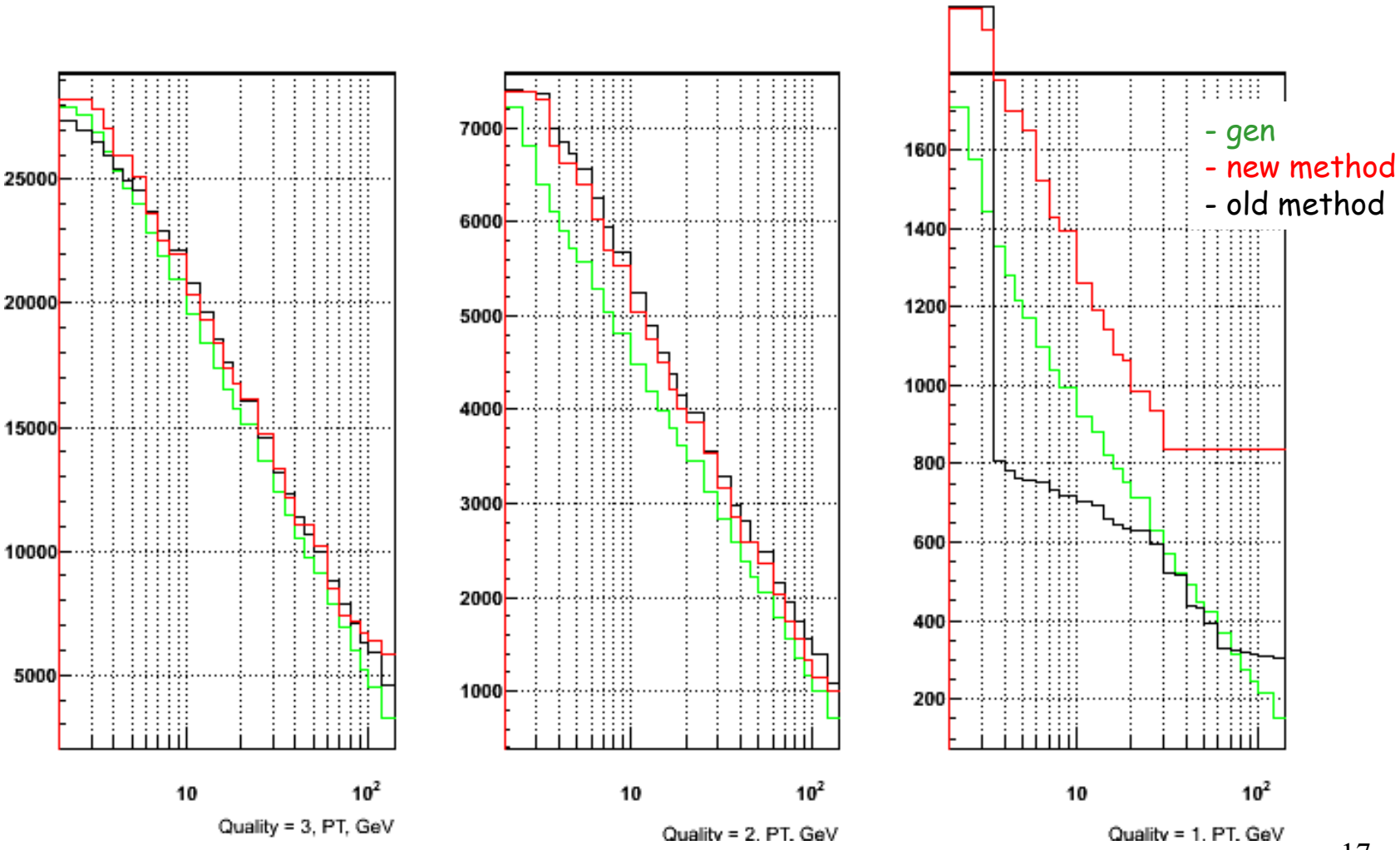


- old method
- new method

Pt Rate for Gen and Rec Muons

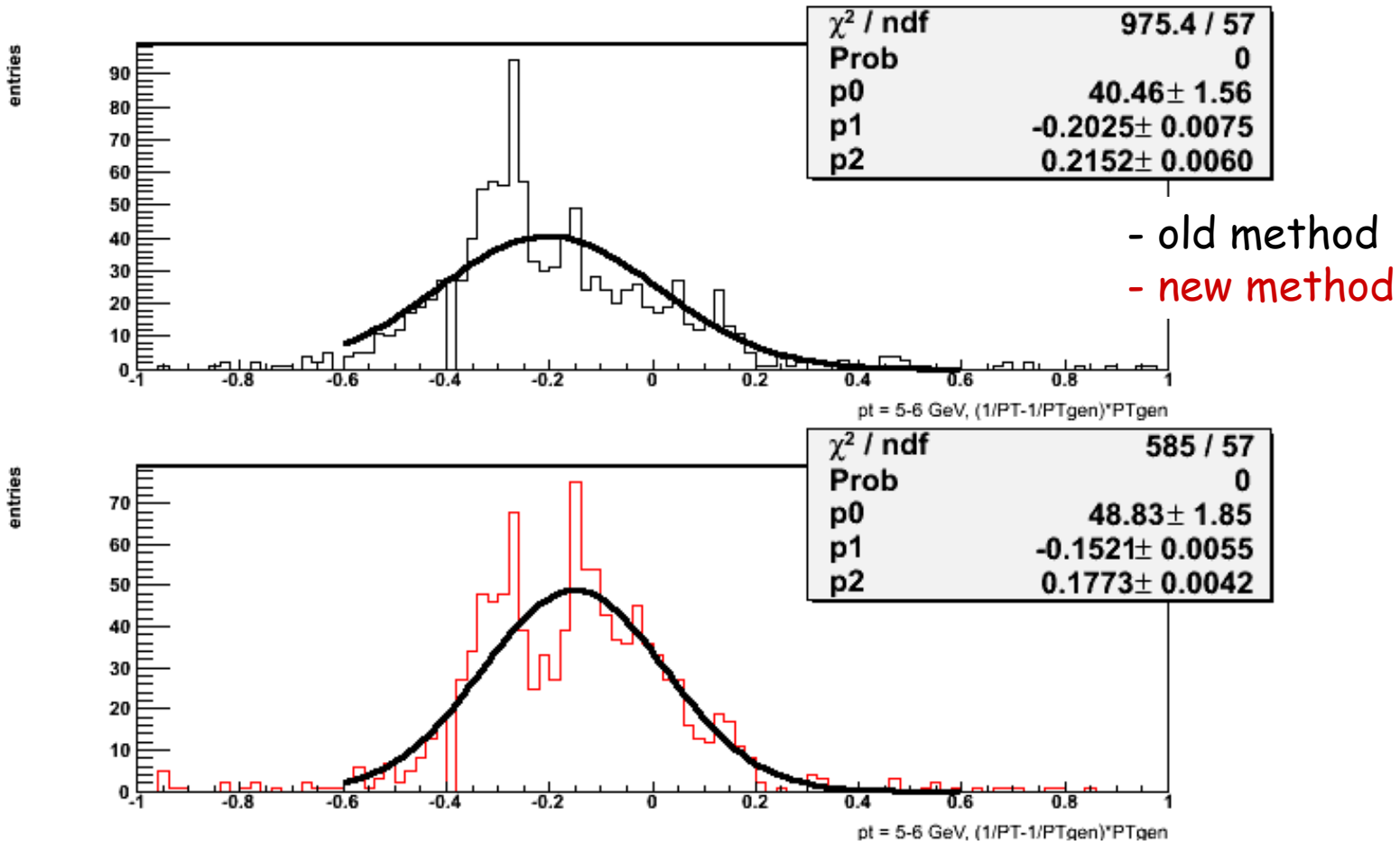
This rate is plotted only for **1.2 < |η| < 2.1**

Quality = 3 Quality = 2 Quality = 1



Resolution (1/pT – 1/pTgen)*pTgen for 1.2 < |η| < 2.1, 1-2-3

5 < PTgen < 6 GeV

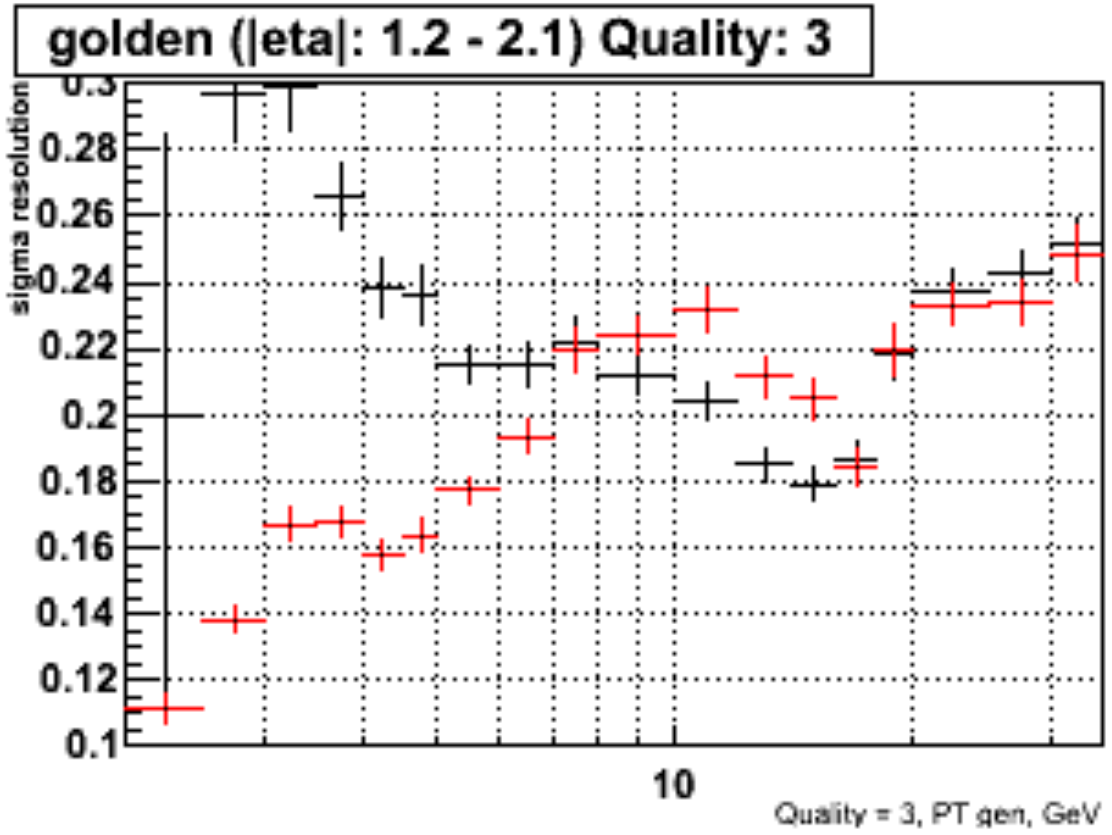


- old method
- new method

In new method low pt muons assign to the low pt muons with better resolution

Sigma of Resolution (1/pT – 1/pTgen)*pTgen

Quality = 3 and 1.2 < |η| < 2.1



- old method
- new method