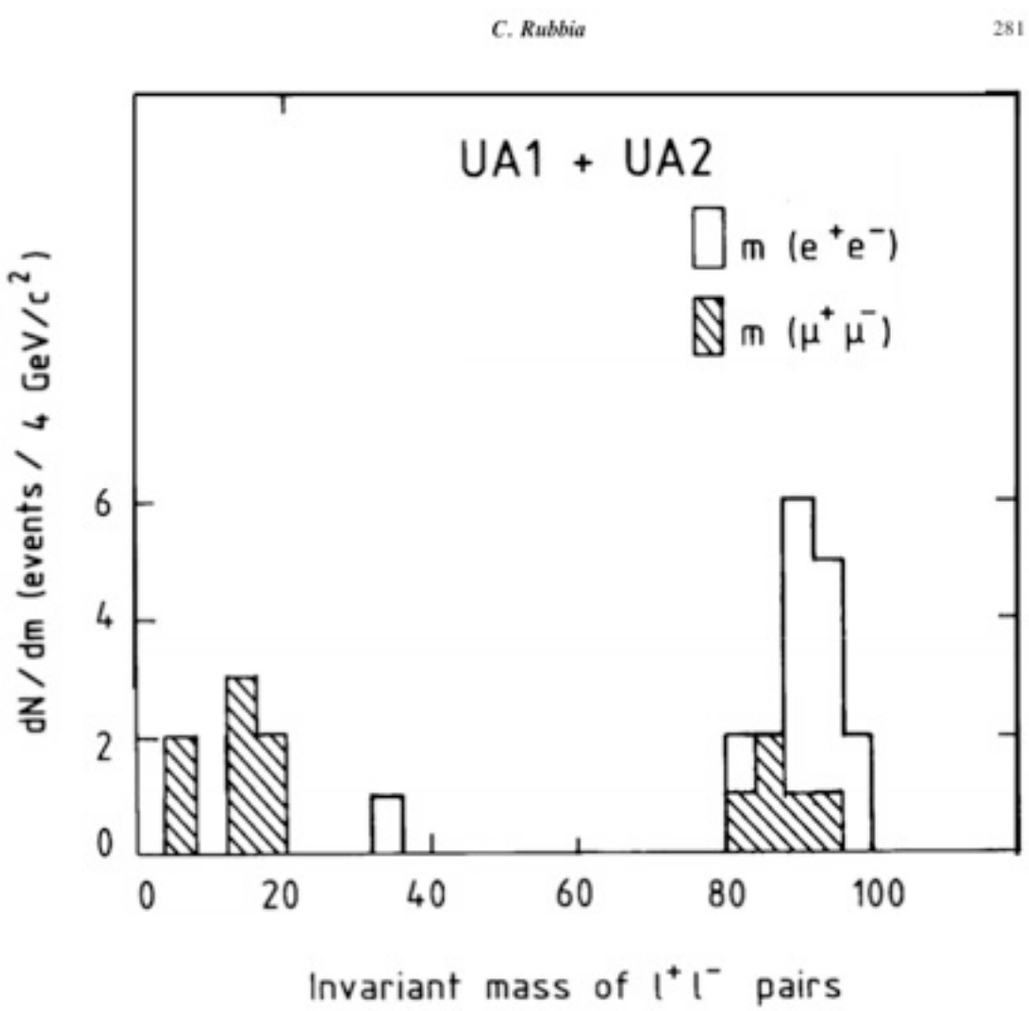
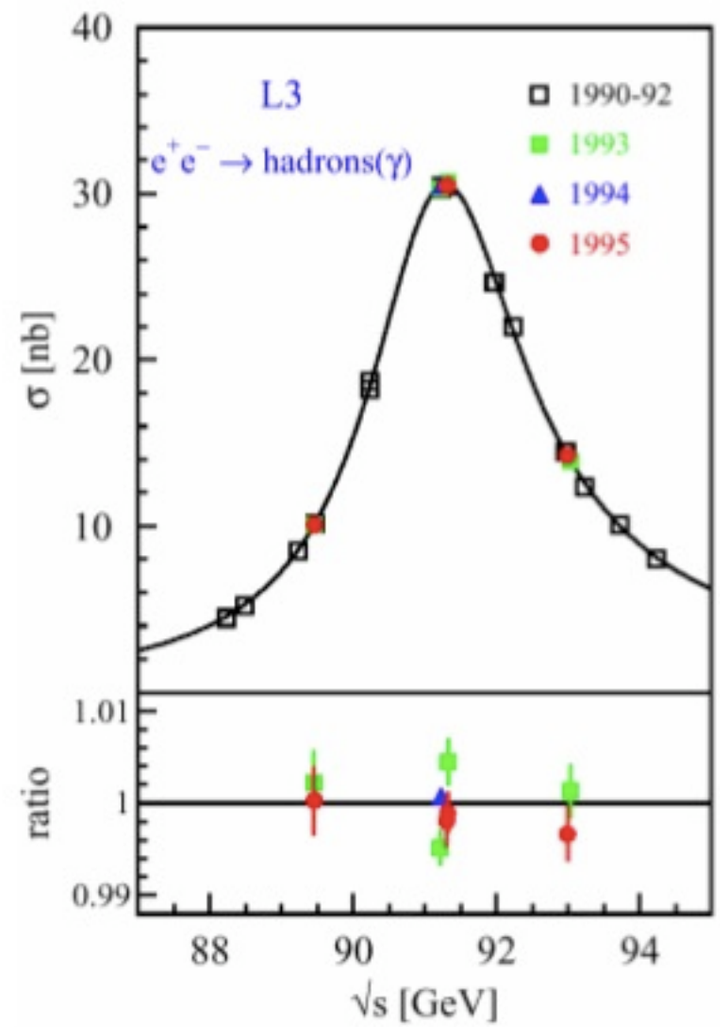
Z lineshape for the absolute scale





Santiago Folgueras

Supervisor: Emanuele Di Marco & Chiara Rovelli

Motivation

Z boson = “candle” for physics at startup

- ECAL calibration
- measure cross section of inclusive ($Z \rightarrow ee$, $Z \rightarrow \mu\mu$)
- measure Z+jets → QCD studies and New Physics searches

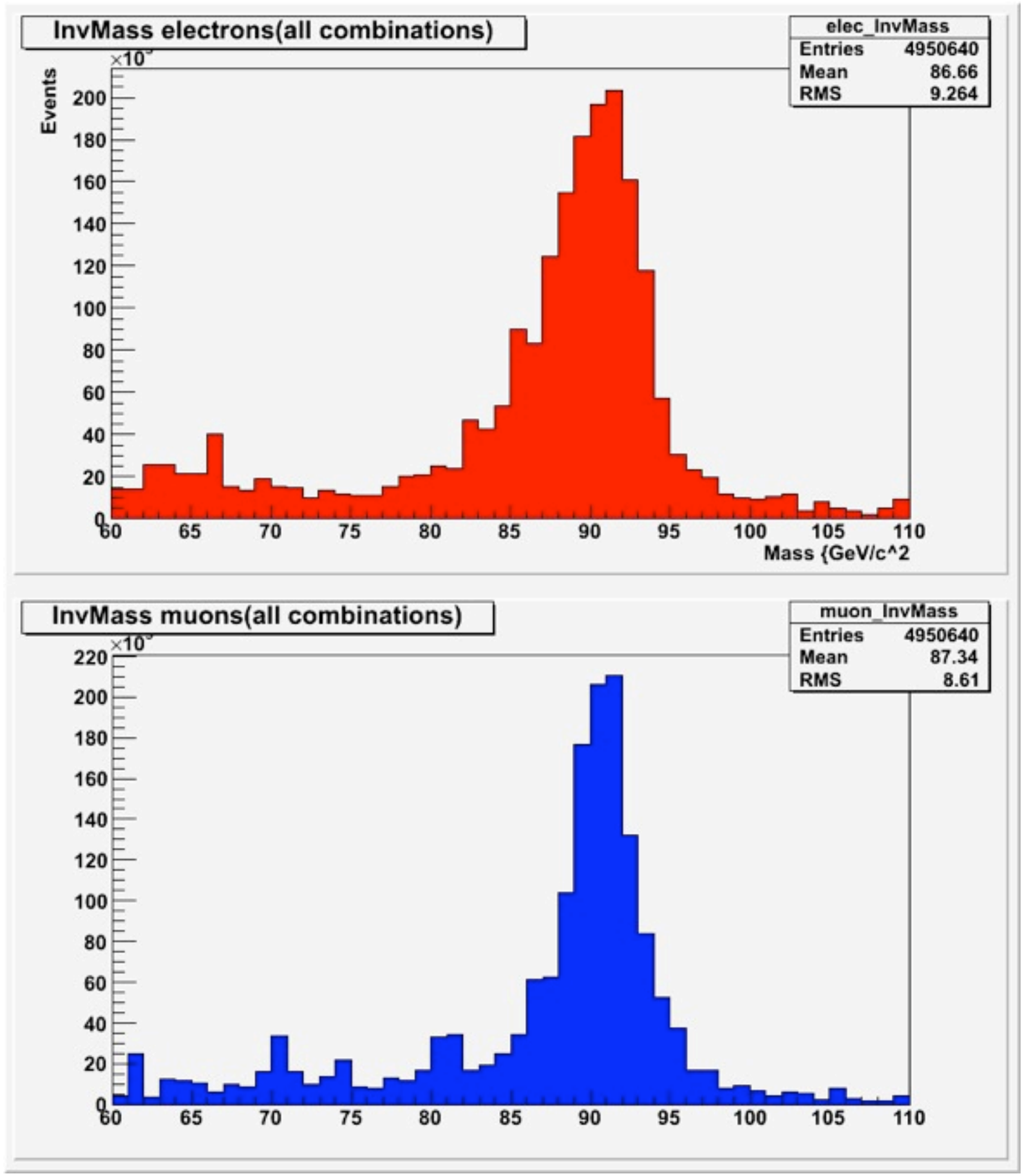
Z lineshape for the absolute scale

Sample: Z+jets using MADGRAPH generator +PYTHIA for the full hadronization

Reconstructing Z with 2 leptons (muons & electrons)

2 reconstructed leptons (NO isolation & Id)

Full lepton combinatorial

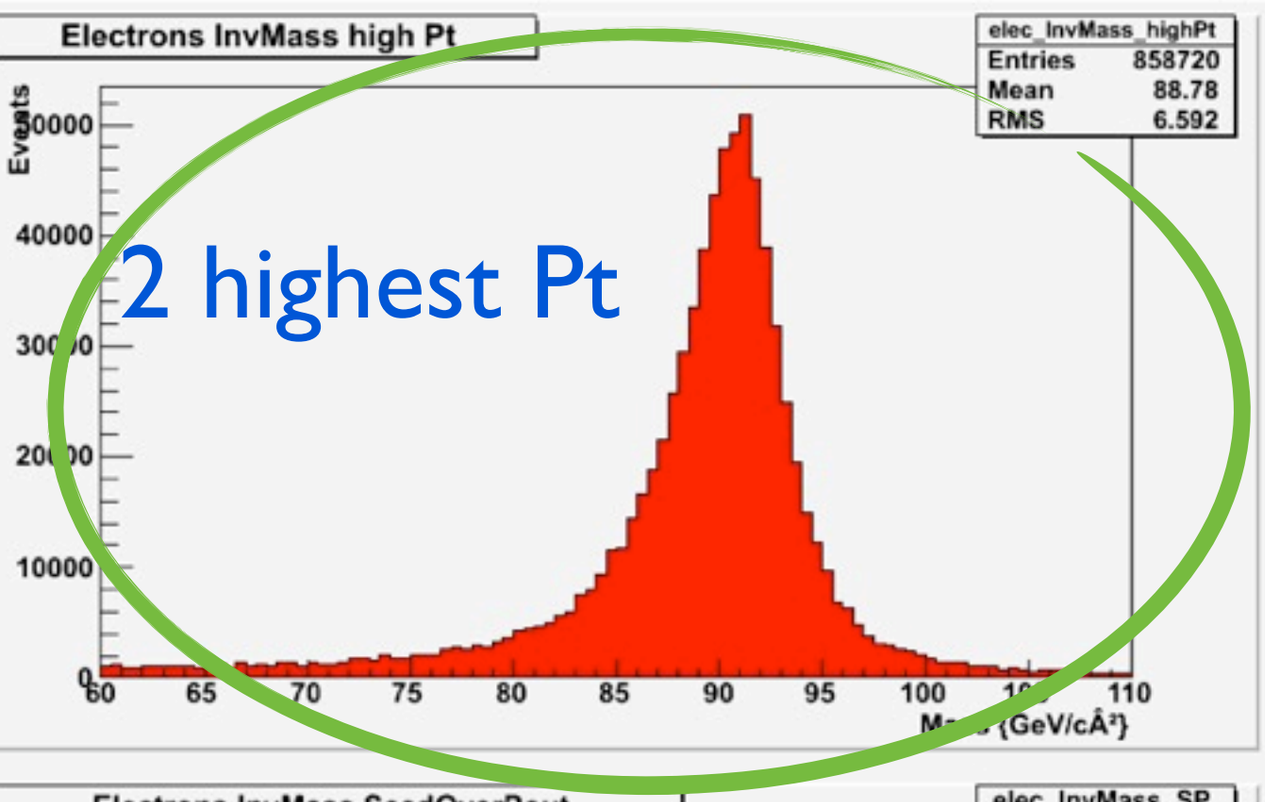


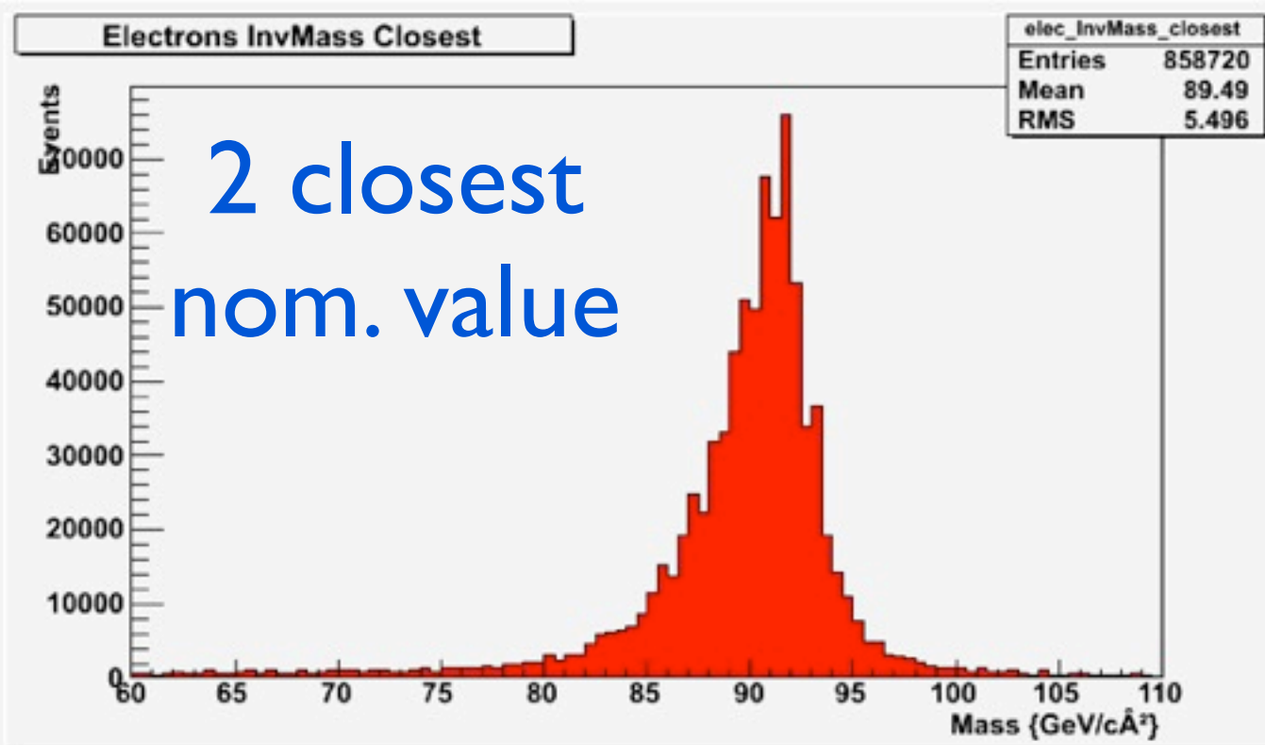
Pt > 15 GeV
-2.5 < η < 2.5

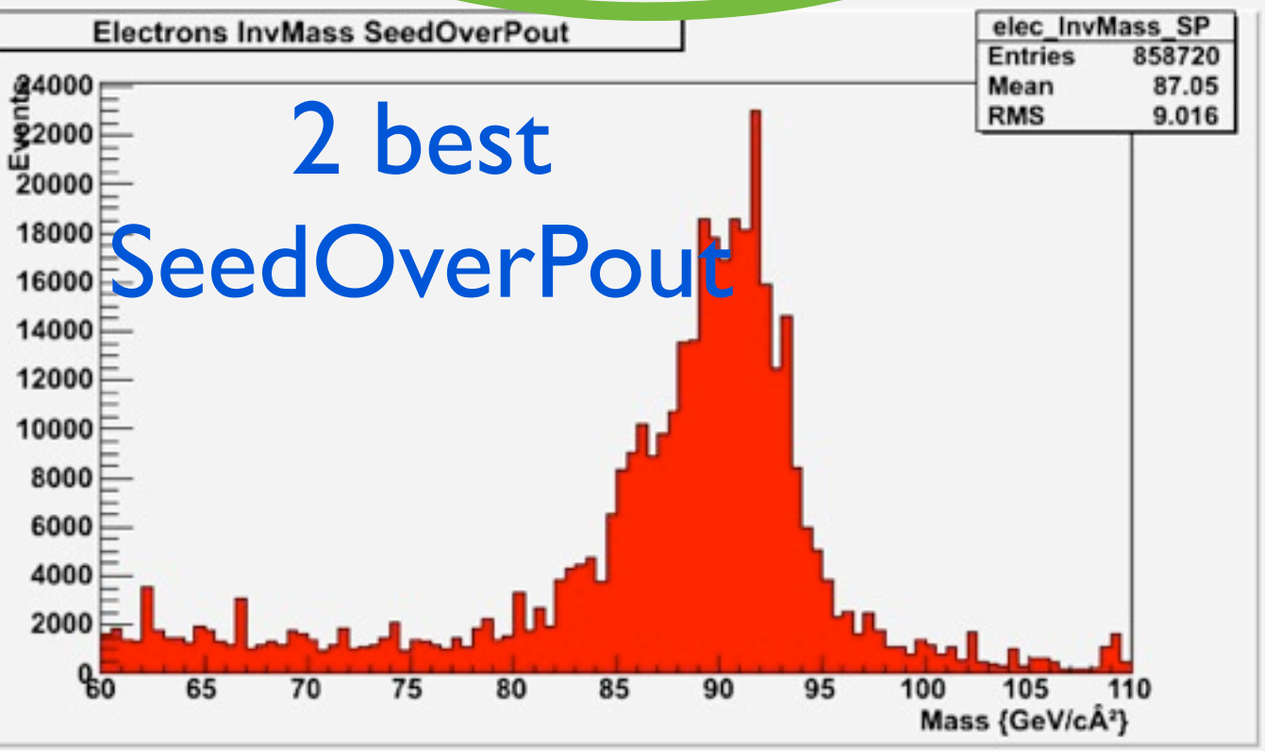
Pt > 15 GeV
-2.4 < η < 2.4

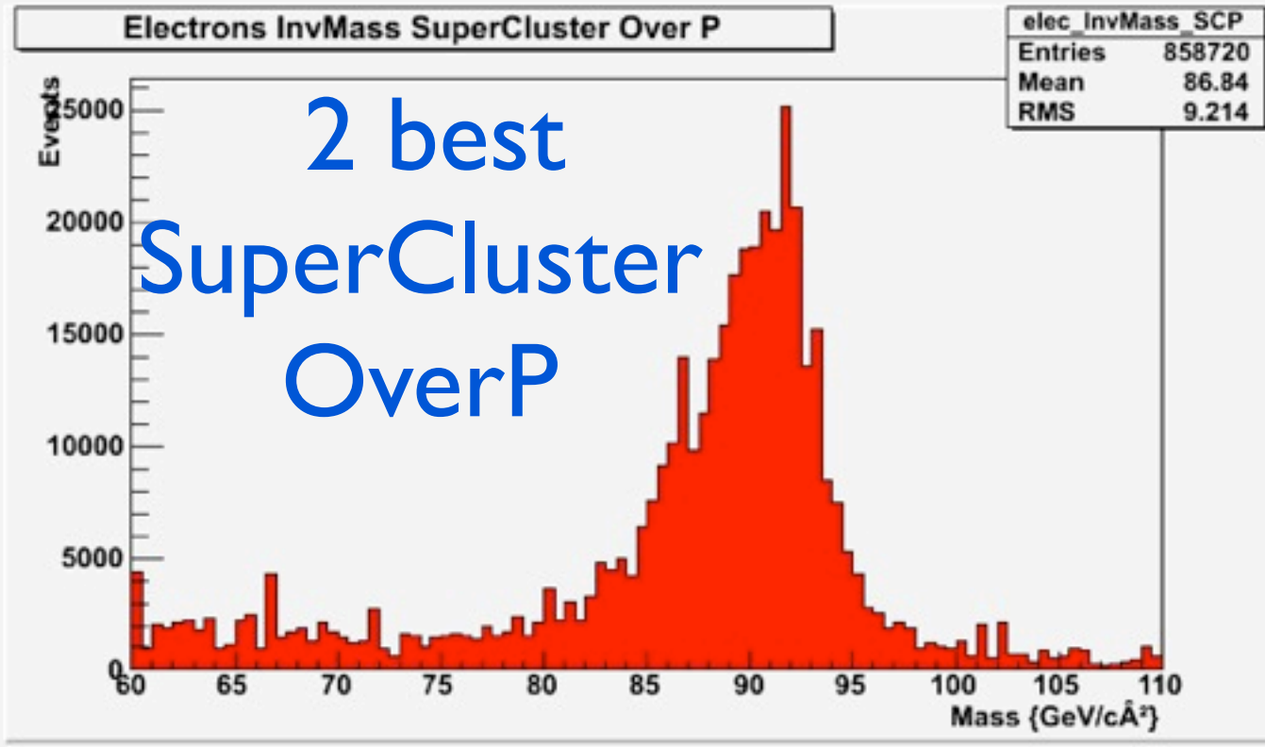
Santiago Folgueras

Best candidate selection (Electrons)

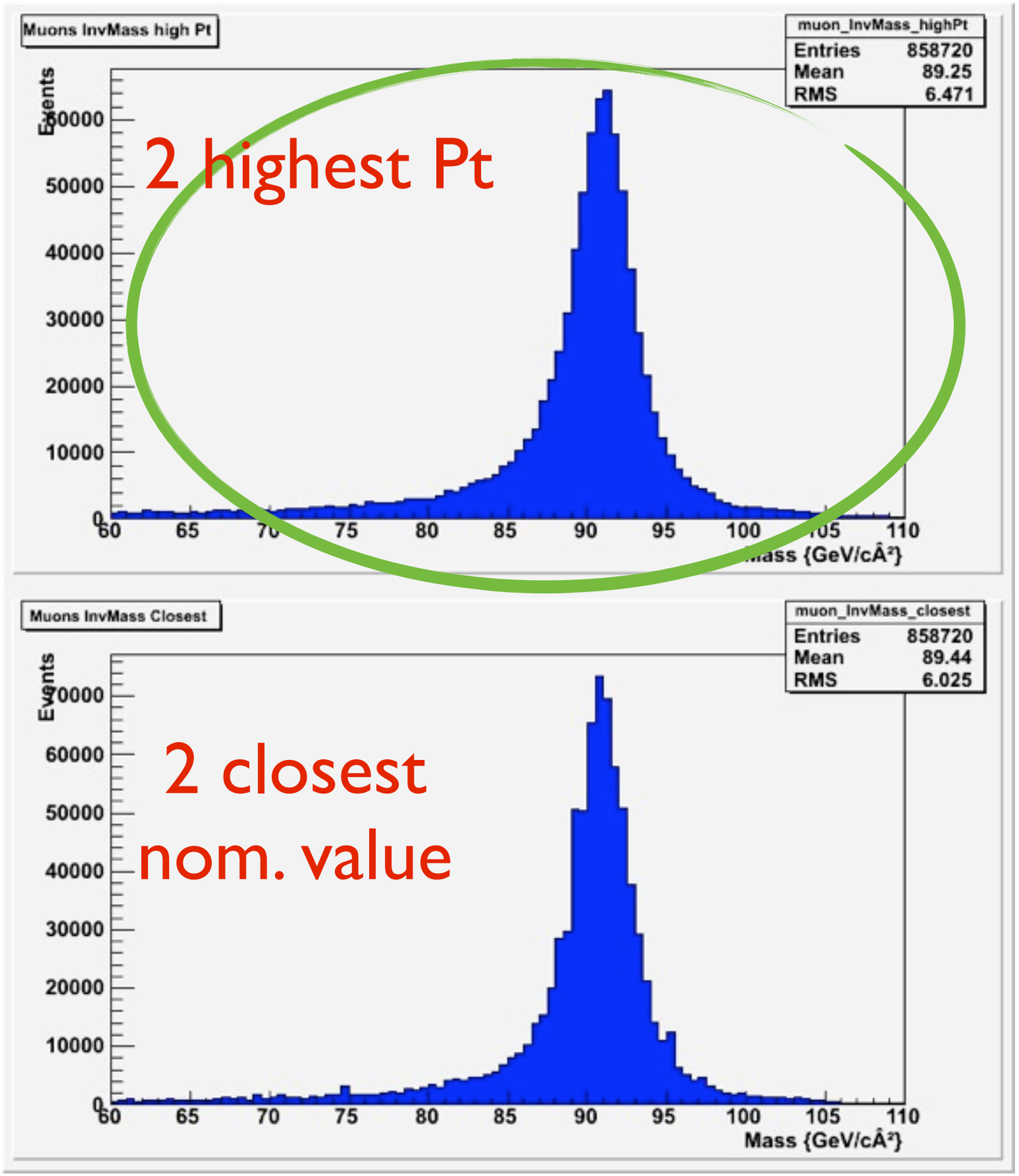








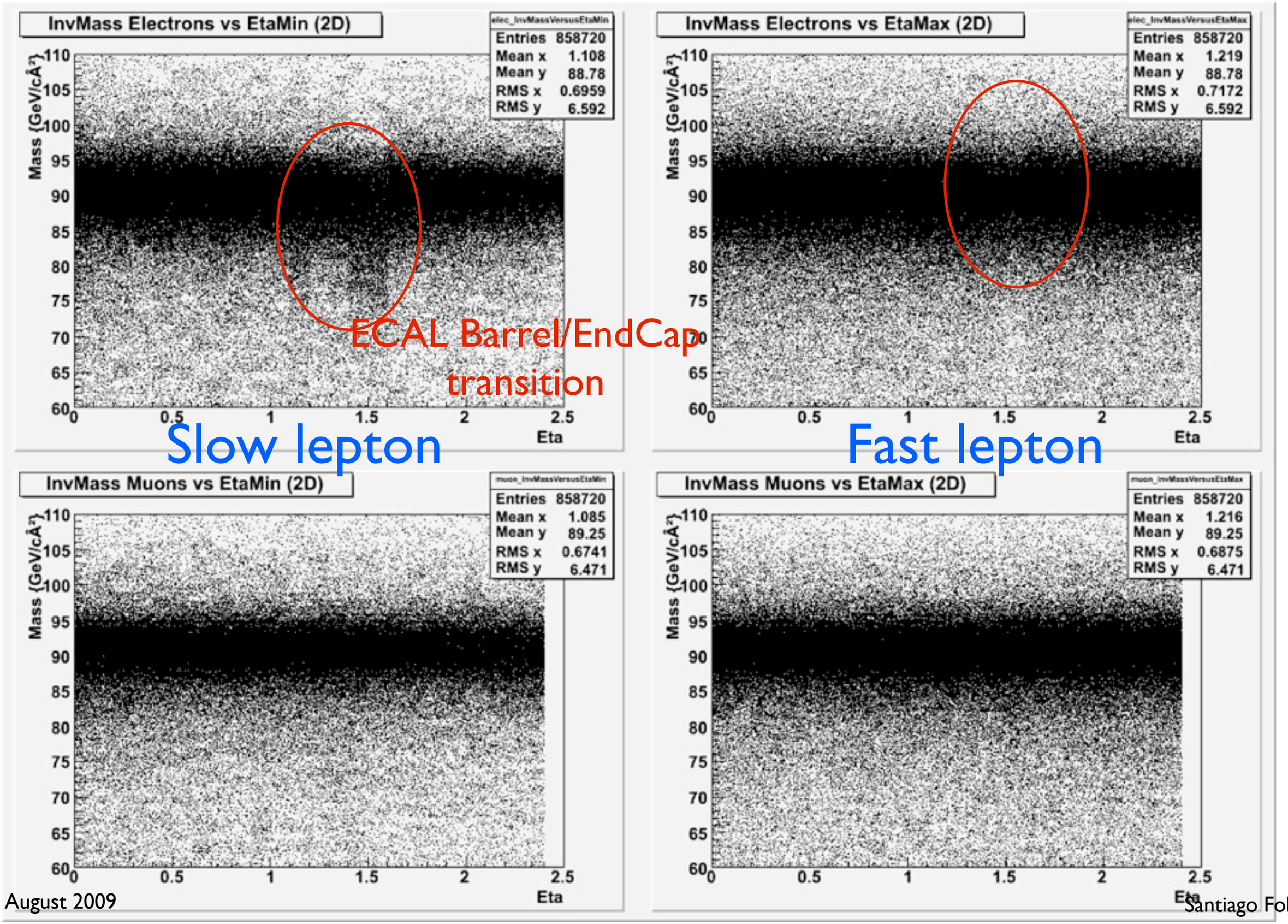
Best candidate selection (muons)



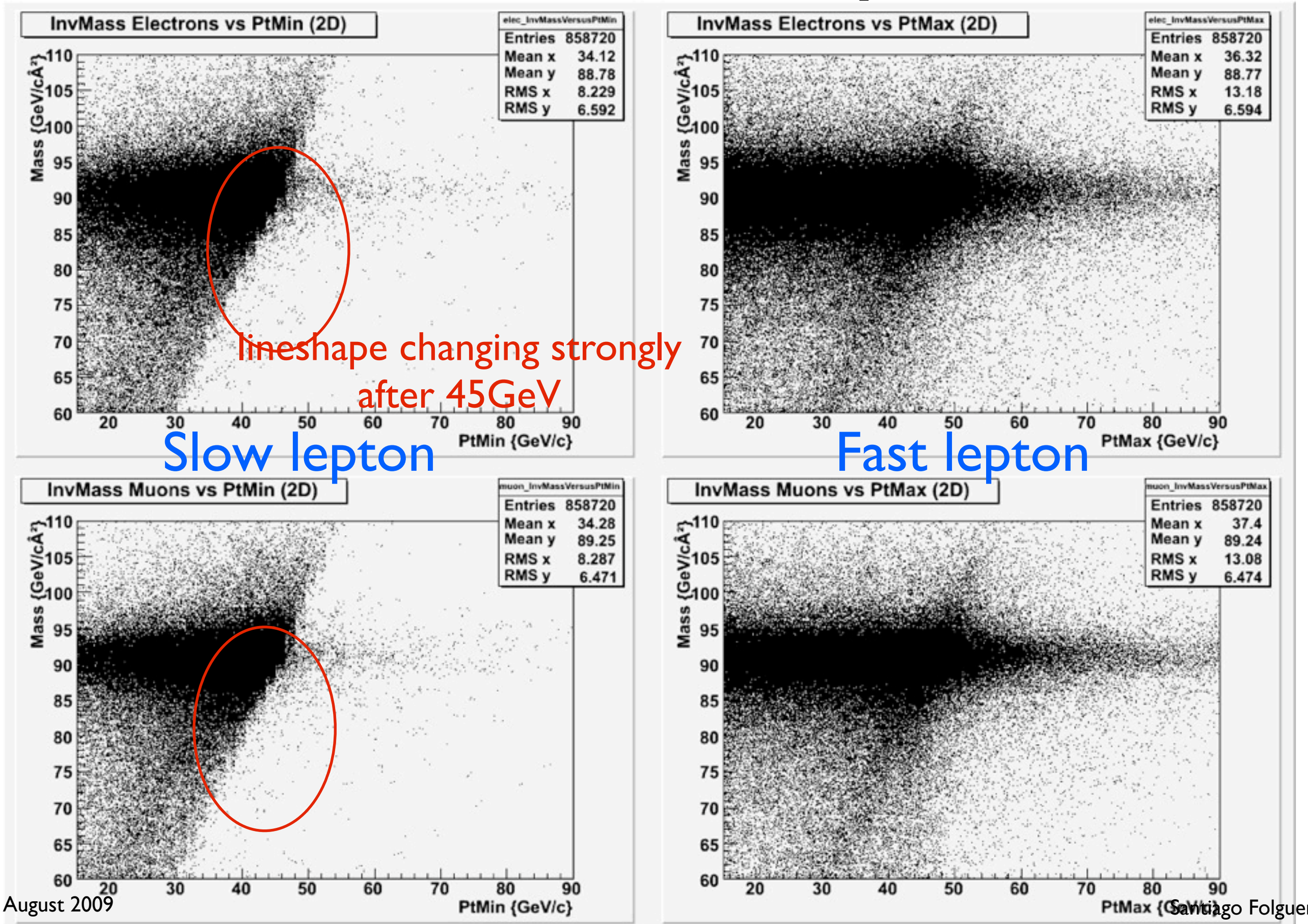
Pt > 15 GeV

$-2.4 < \eta < 2.4$

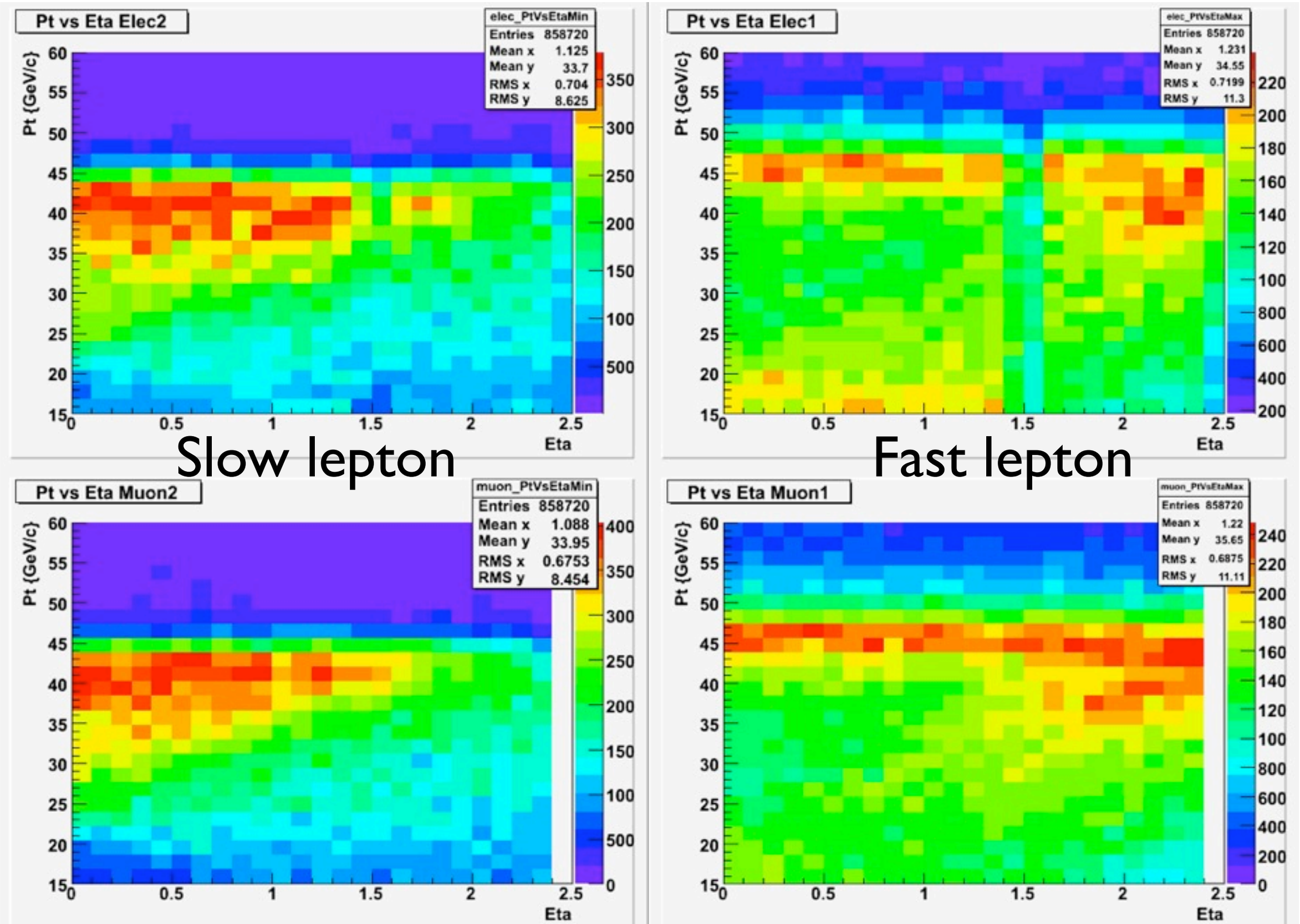
InvMass vs |η| leptons



InvMass vs Pt leptons



Pt vs Eta leptons



Z peak fits

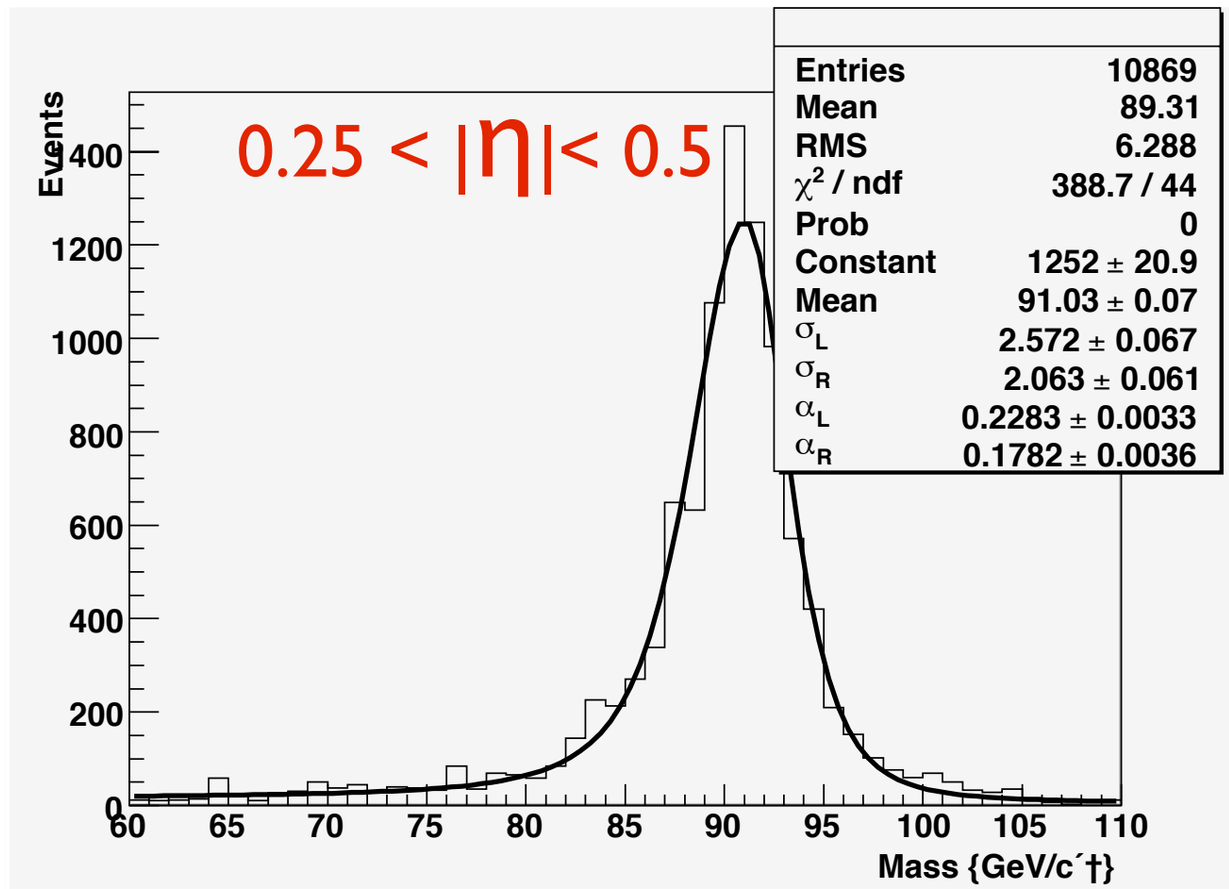
A bin chi^2 fit used to extract an estimation of the mean and the resolution

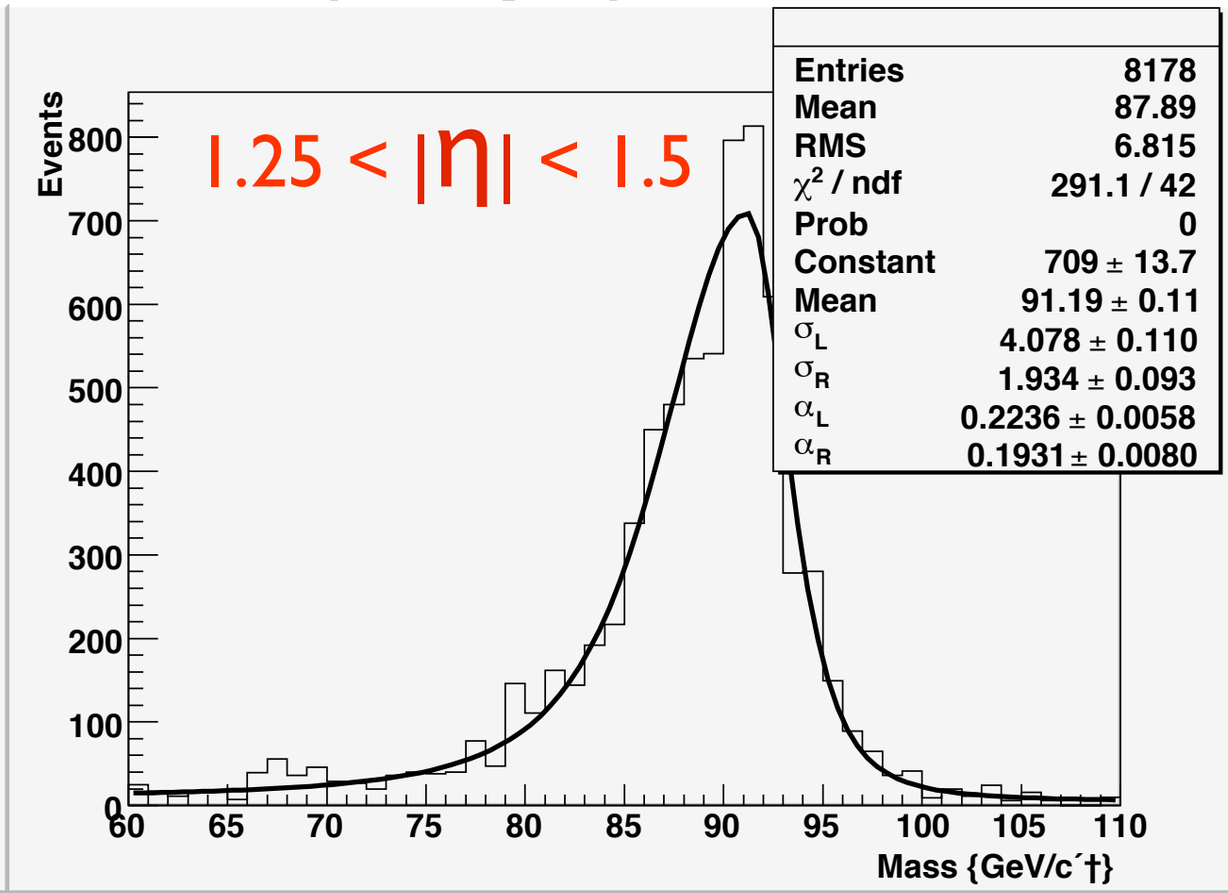
$$f(x) = N \times \exp\left[-\frac{(x-m)^2}{2(\sigma^2_{L/R} + \alpha_{L/R}(x-m)^2)}\right]$$

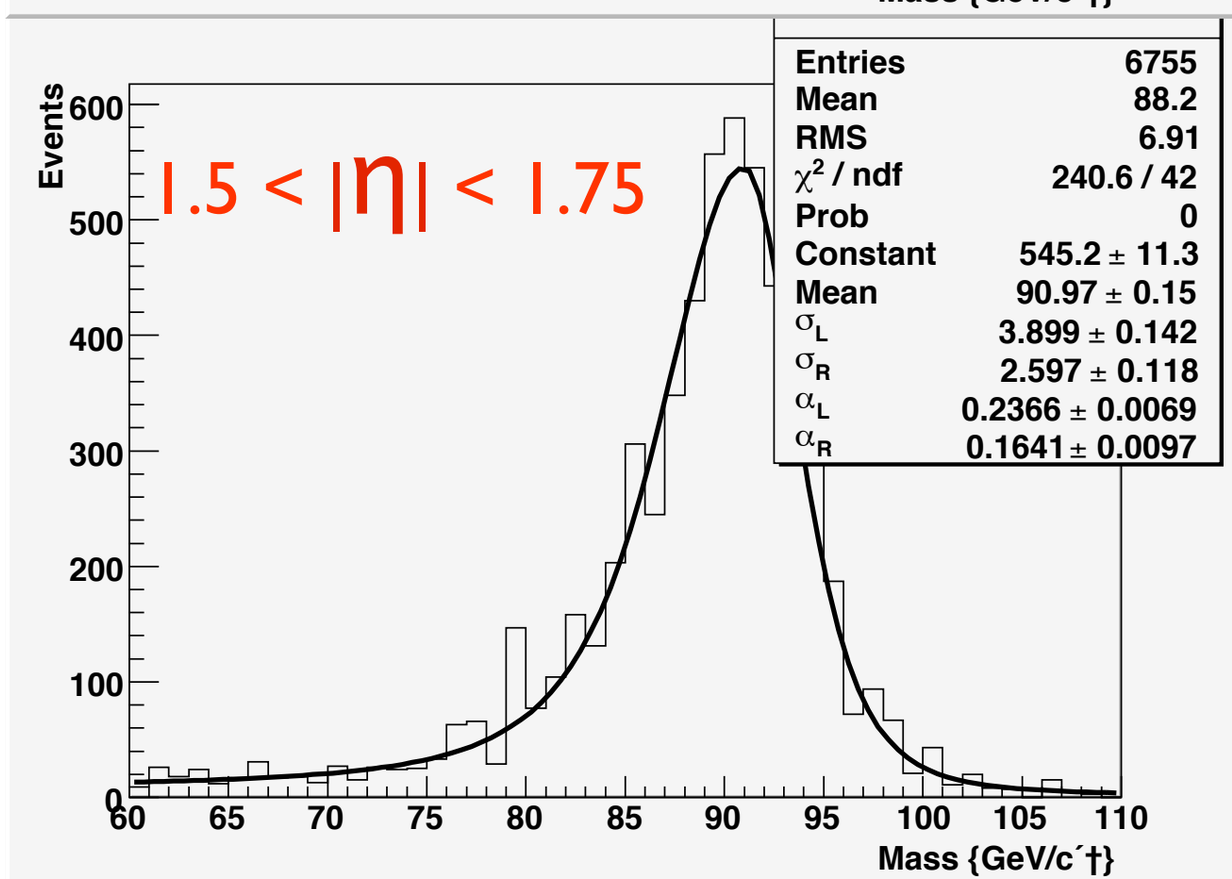
σ_L : resolution
m : mean value

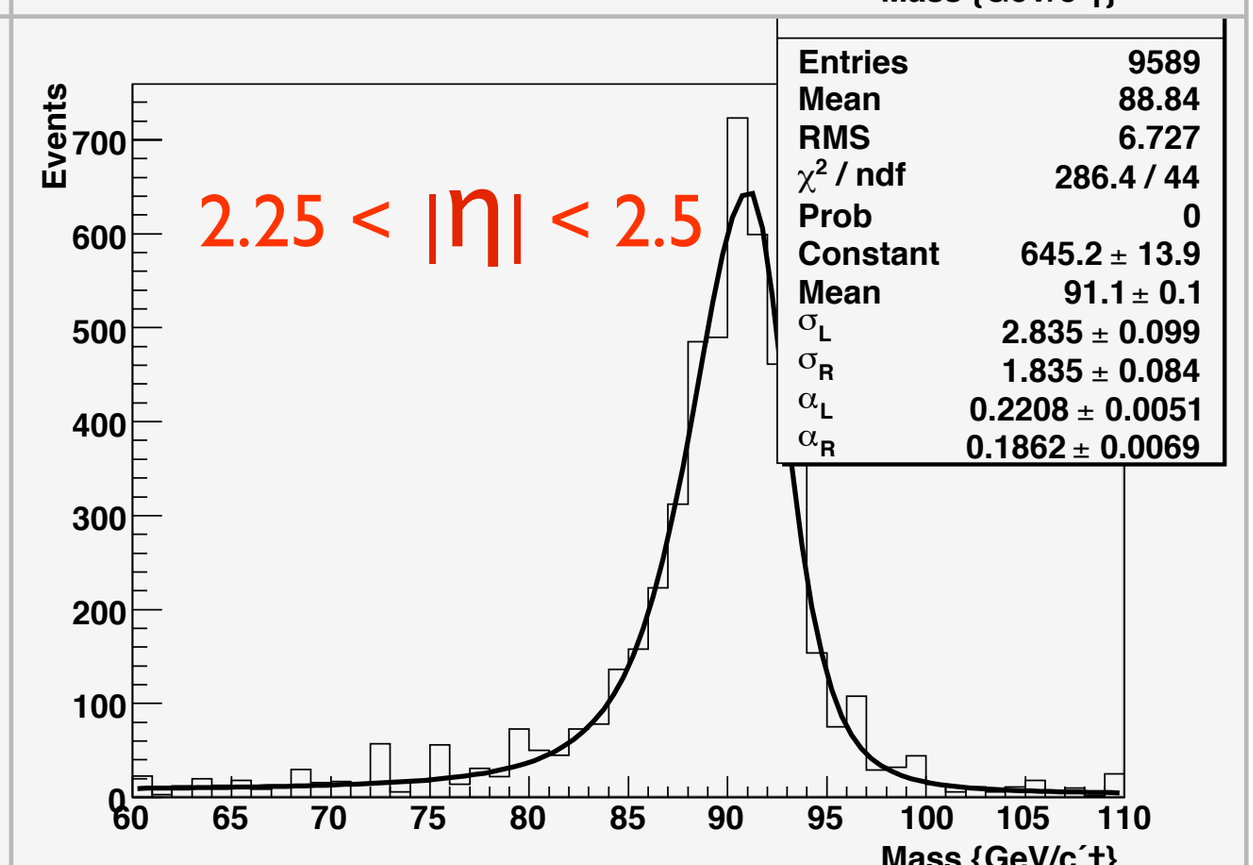
Require:
- 2 leptons in the same |η| bin
- 2 leptons in the same Pt bin

Eta 2 Electrons (all pt)

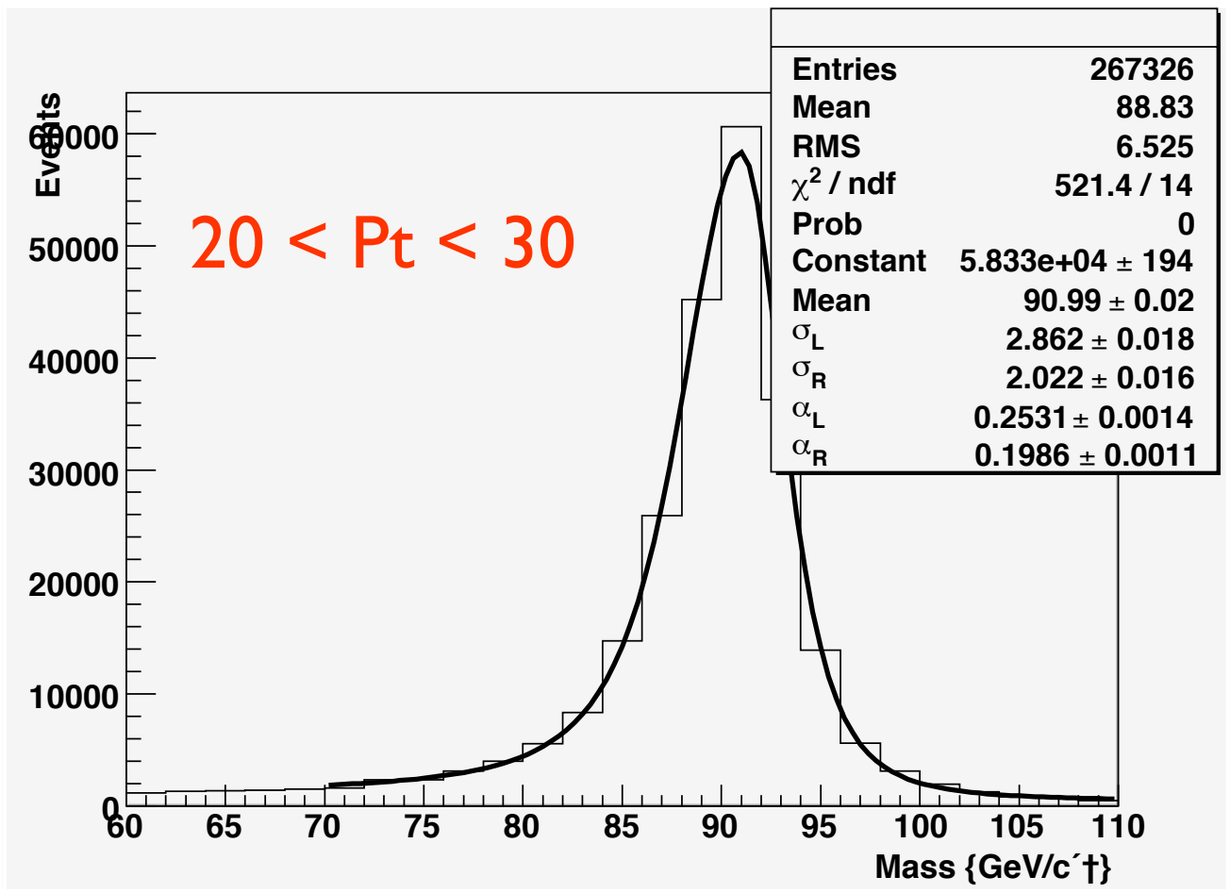


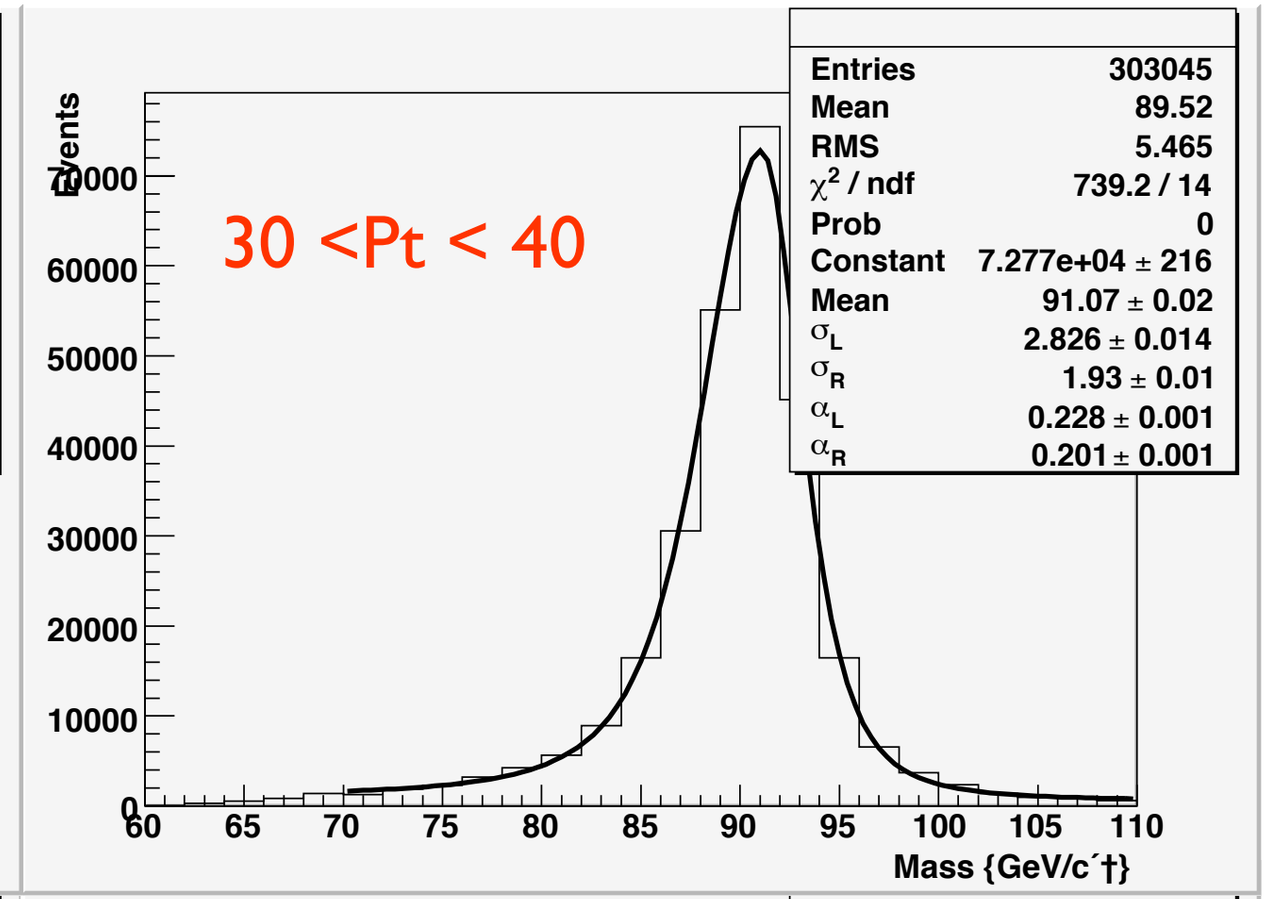


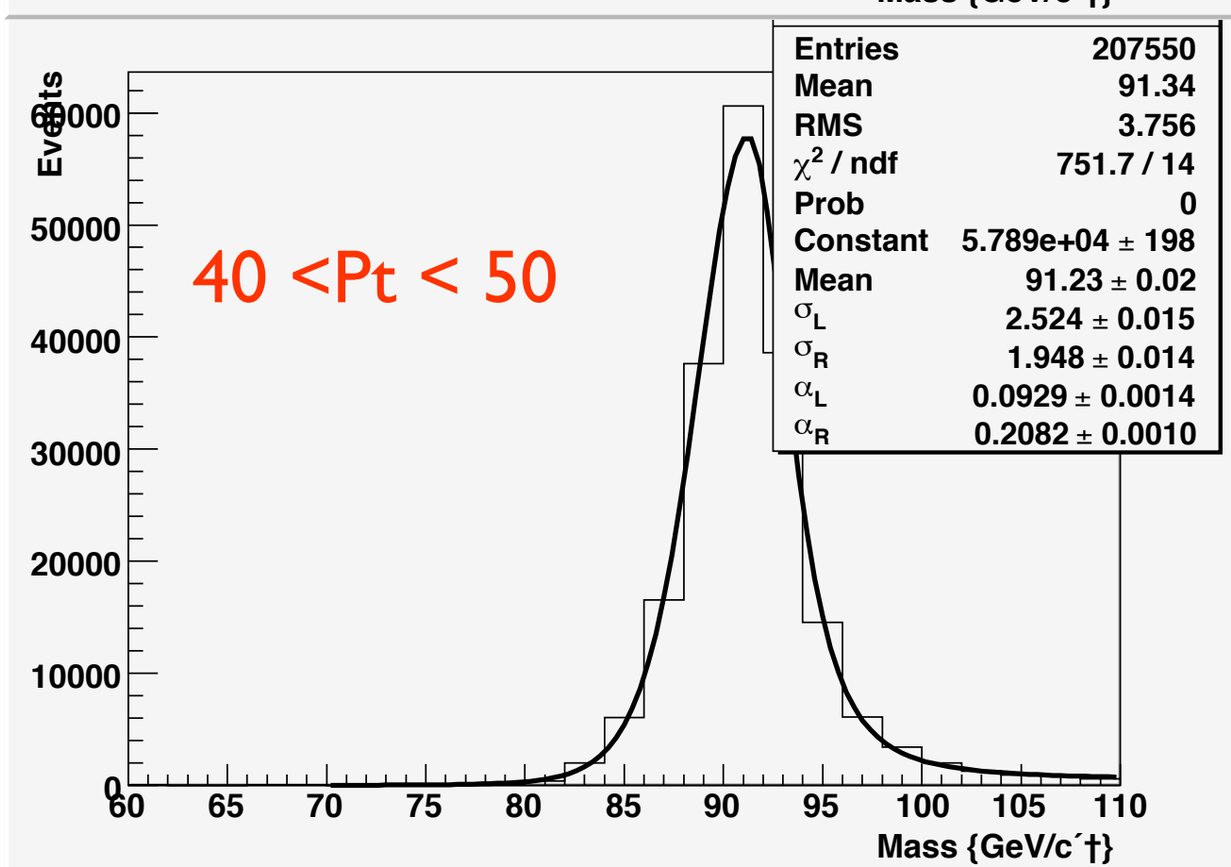


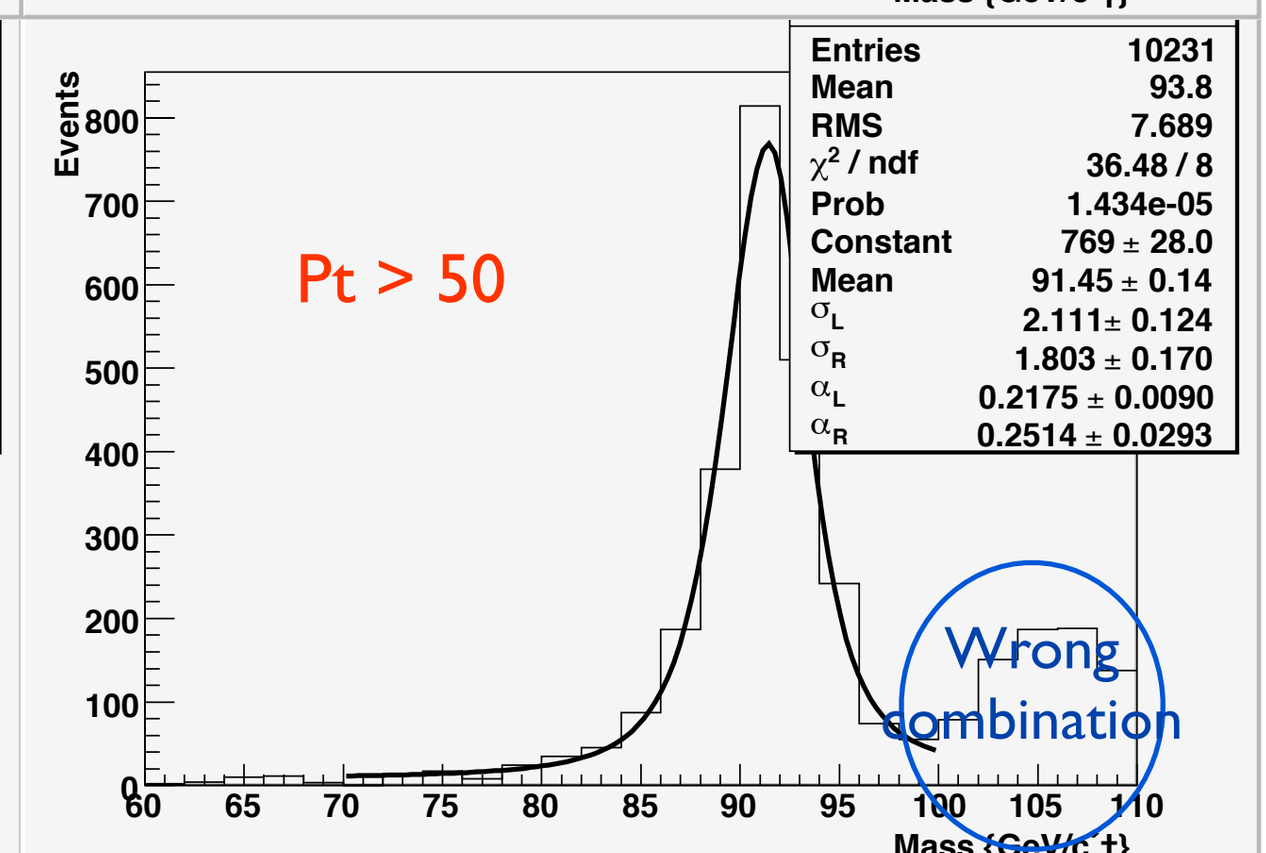


Pt Electrons (all eta)

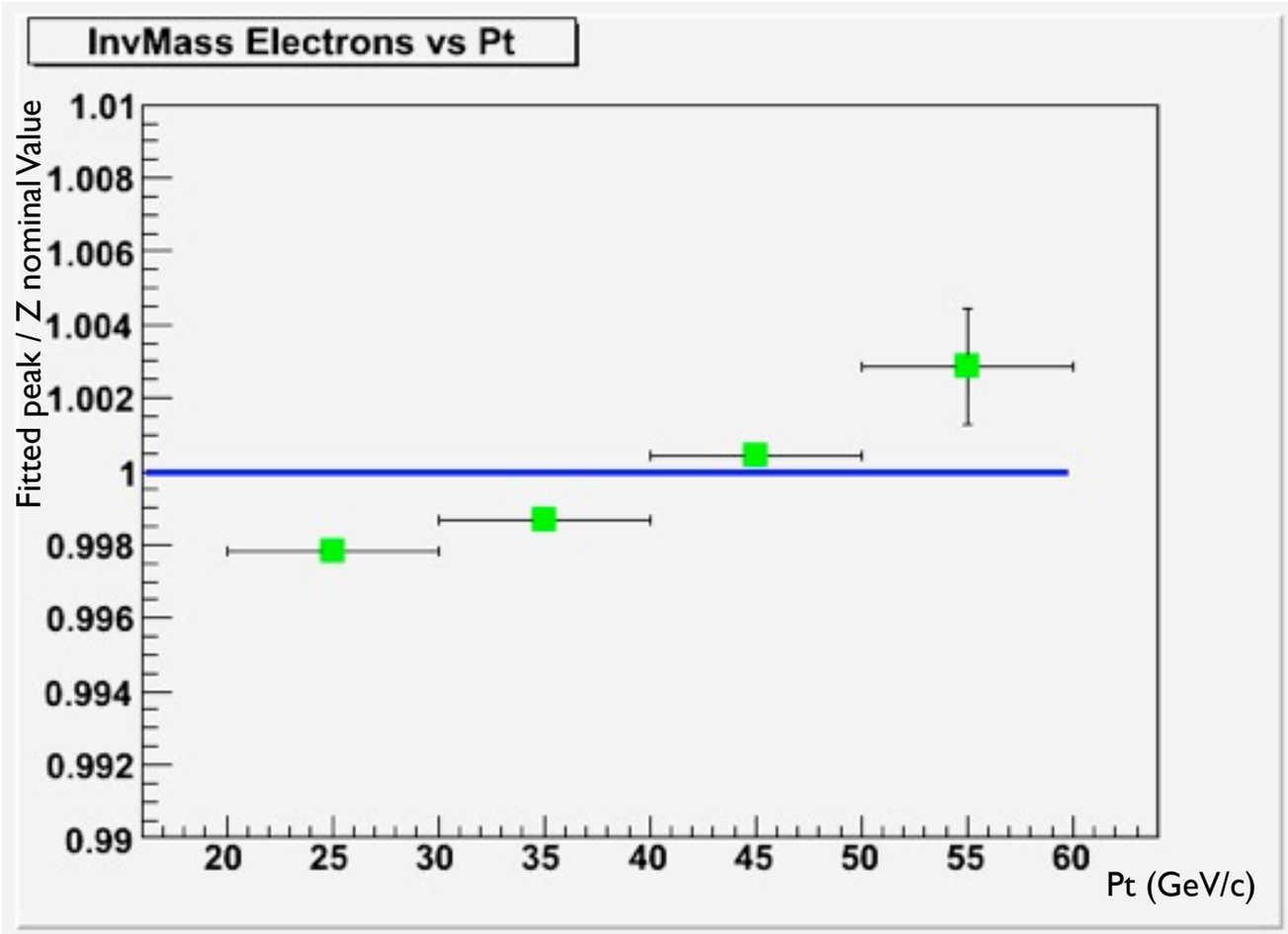






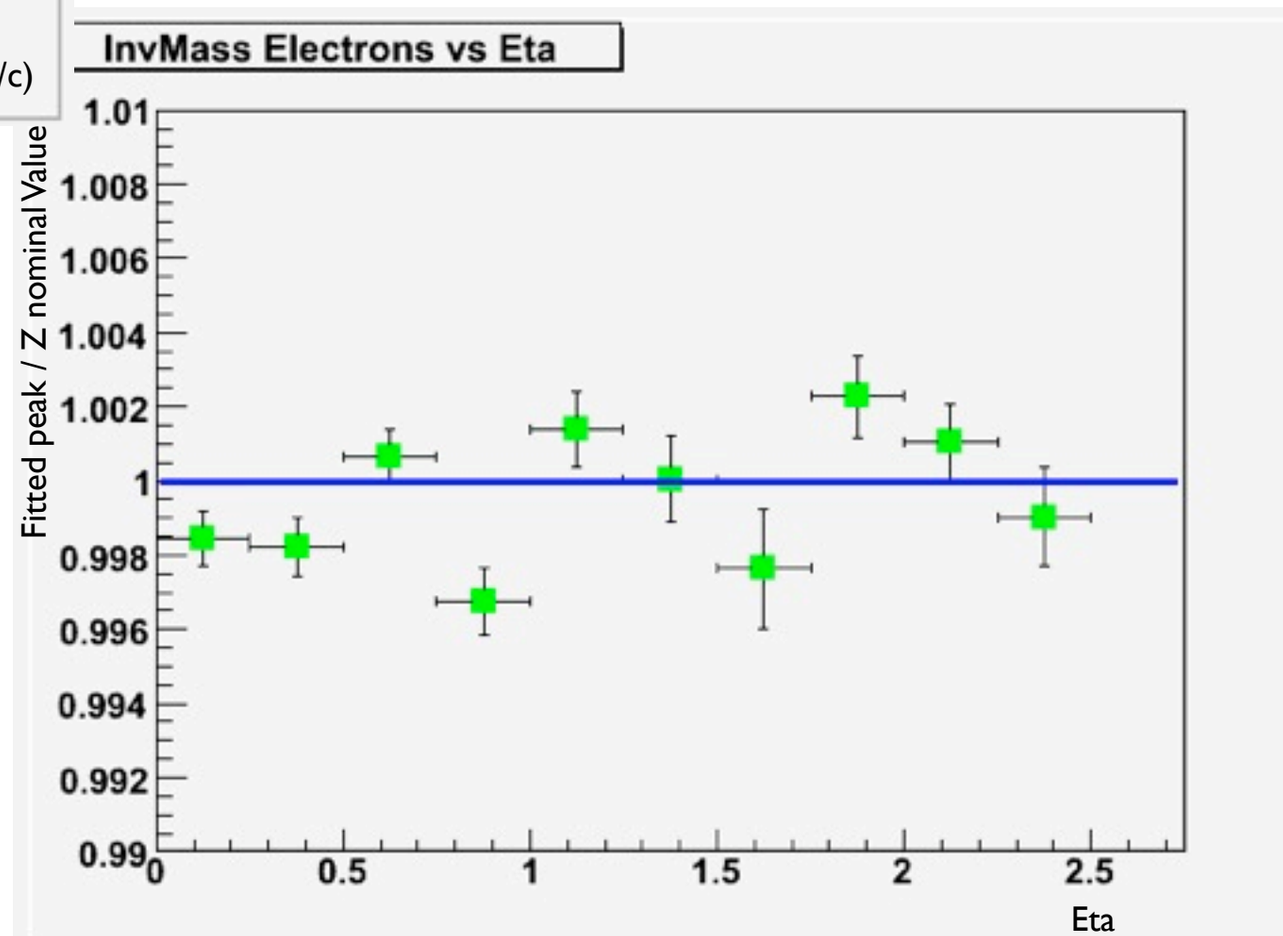


Mean Value Electrons(RATIO)

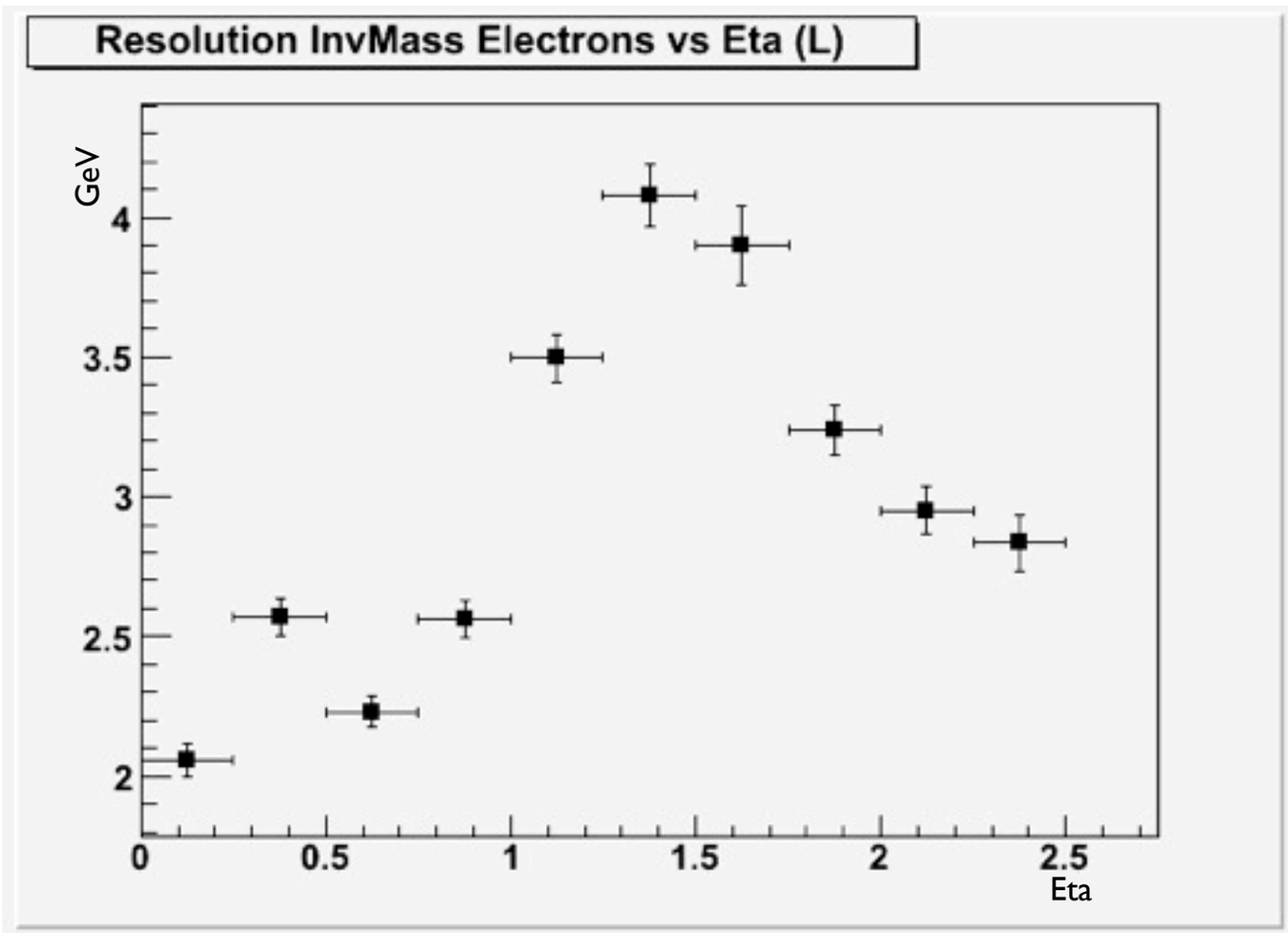


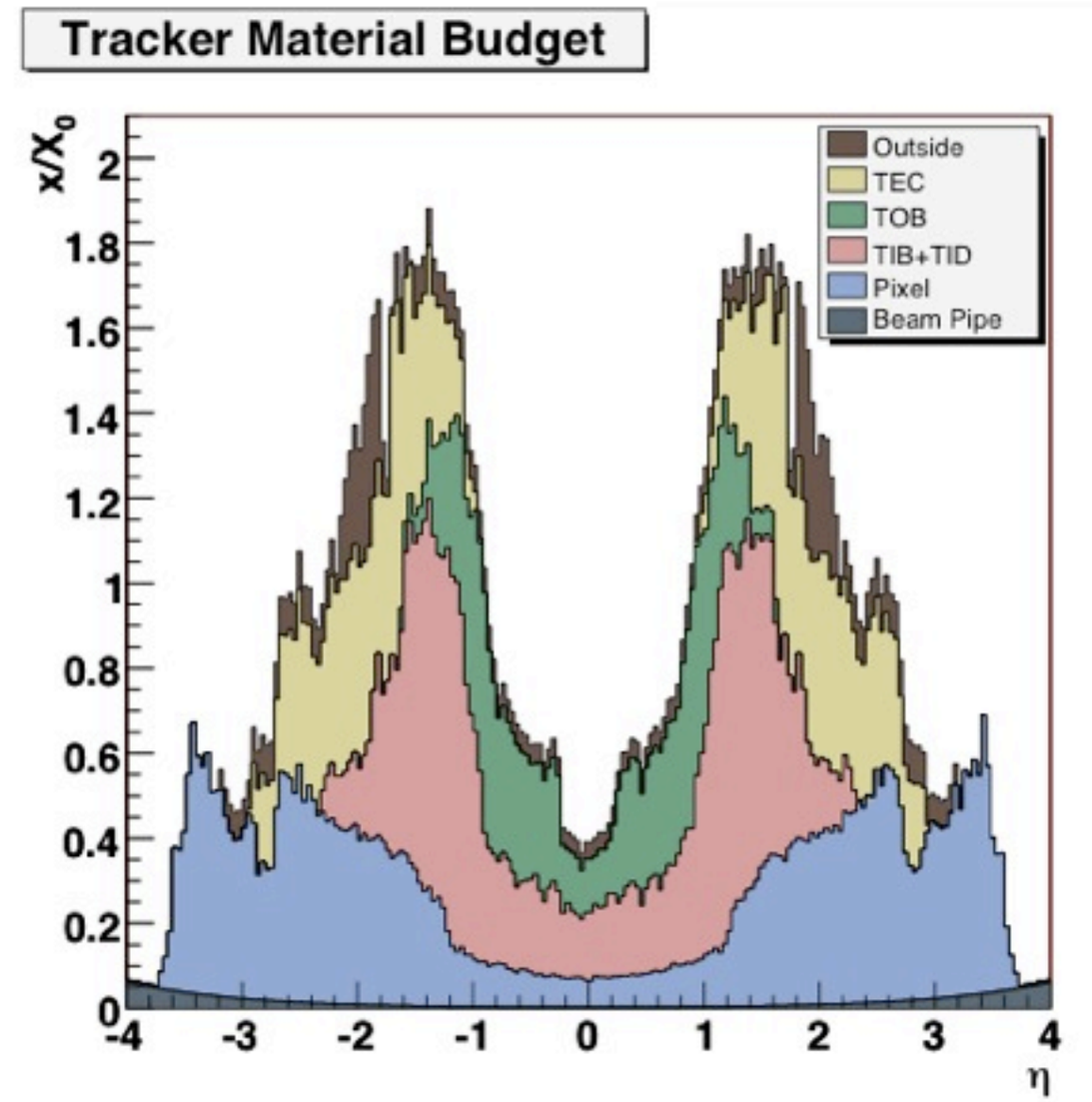
Increase with Pt within 0.3 %

Constant within 0.3 % for |η|



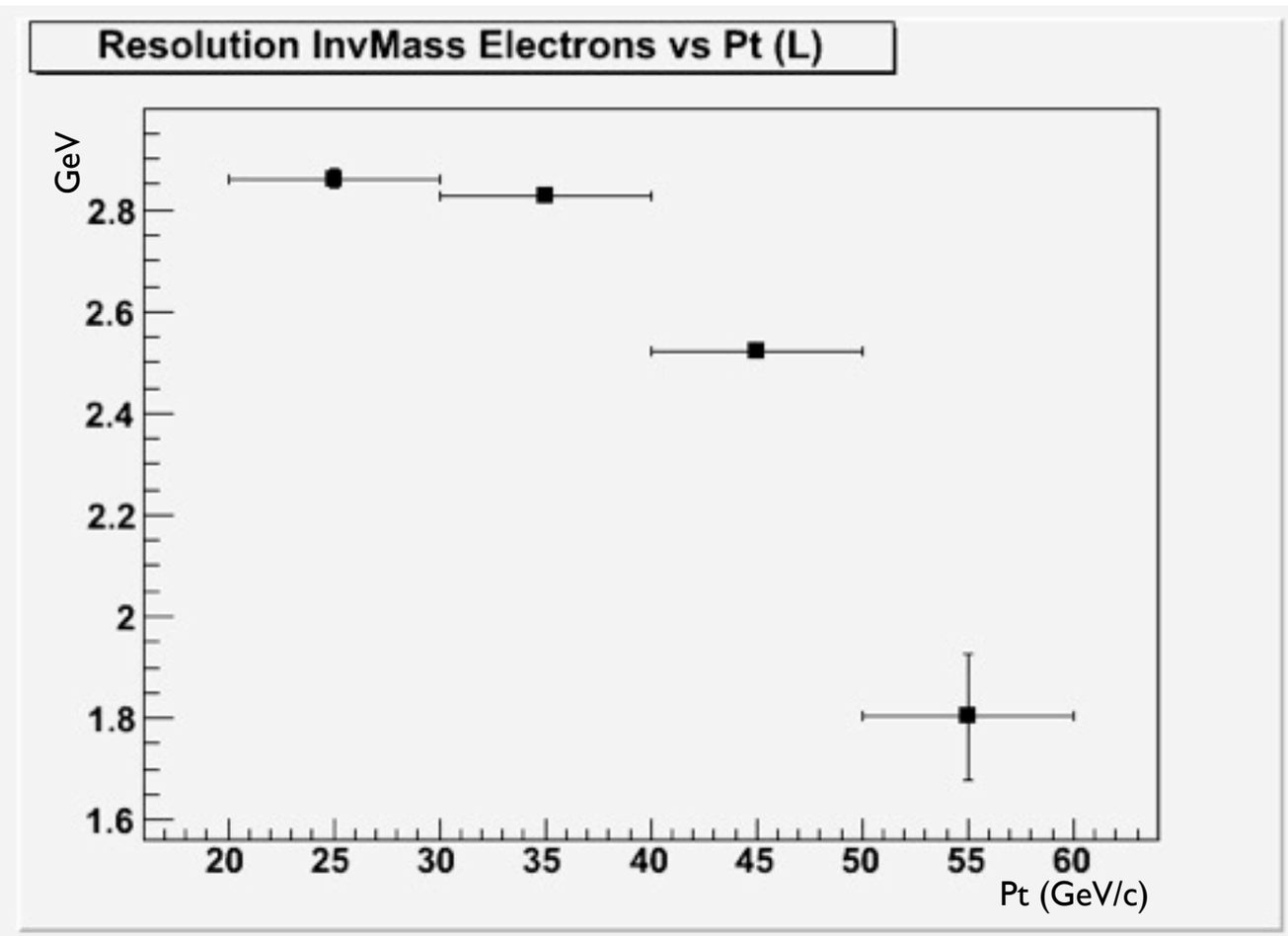
Resolution Eta





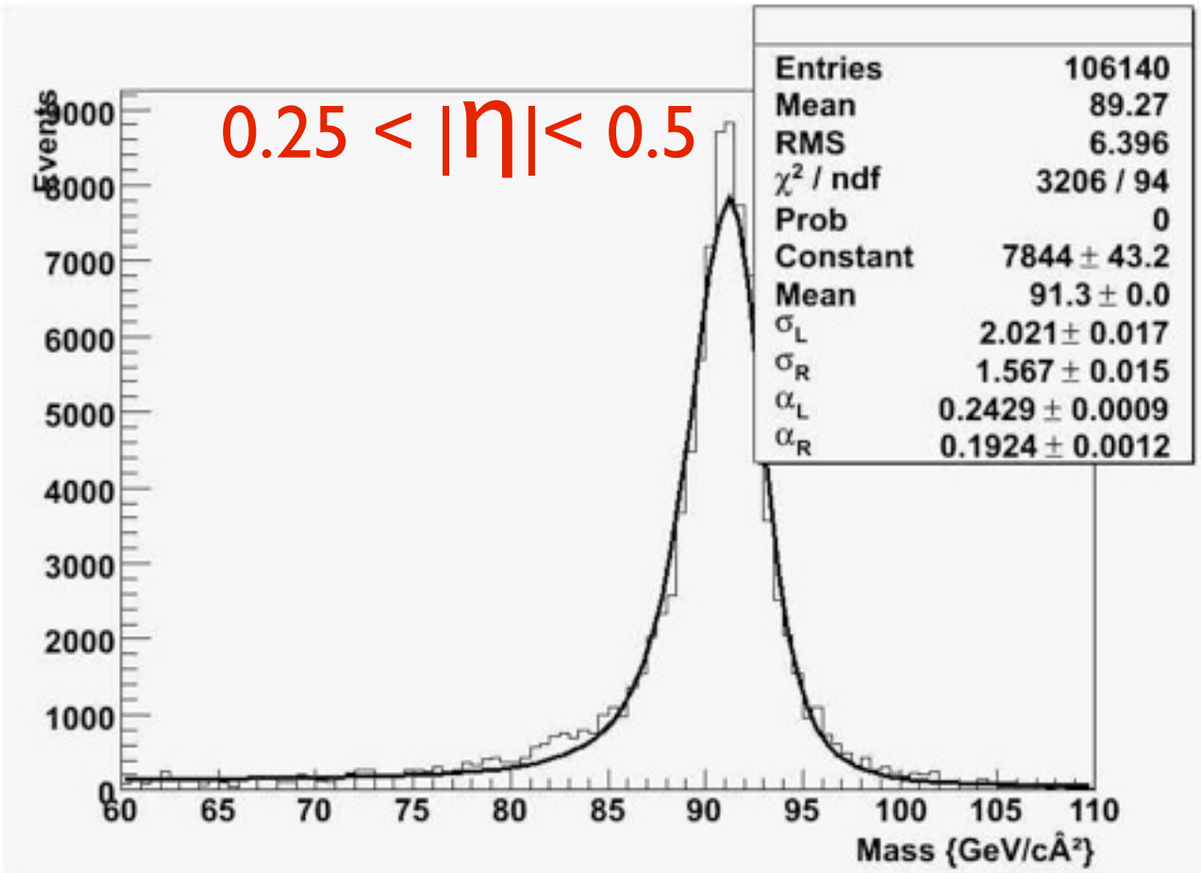
Fractional radiation length before ECAL

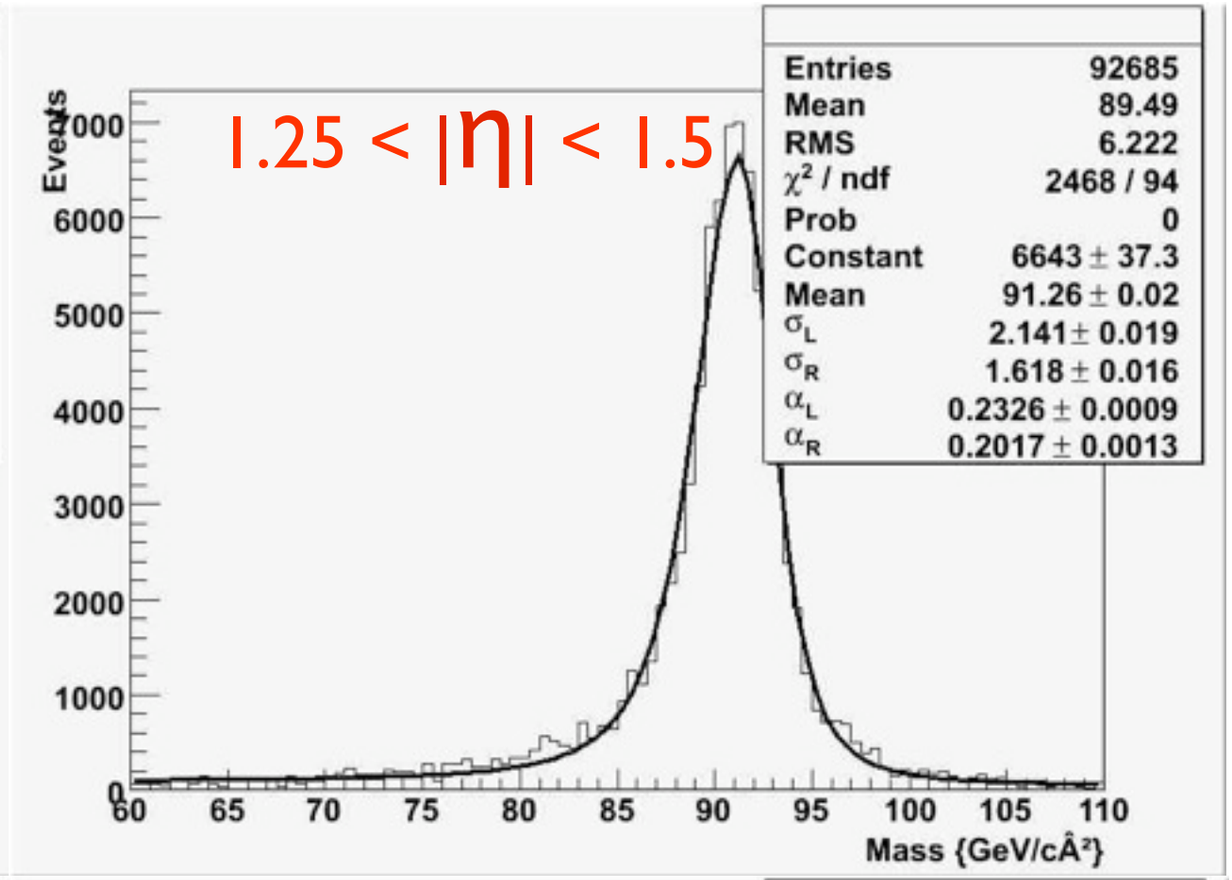
Resolution Pt Electrons

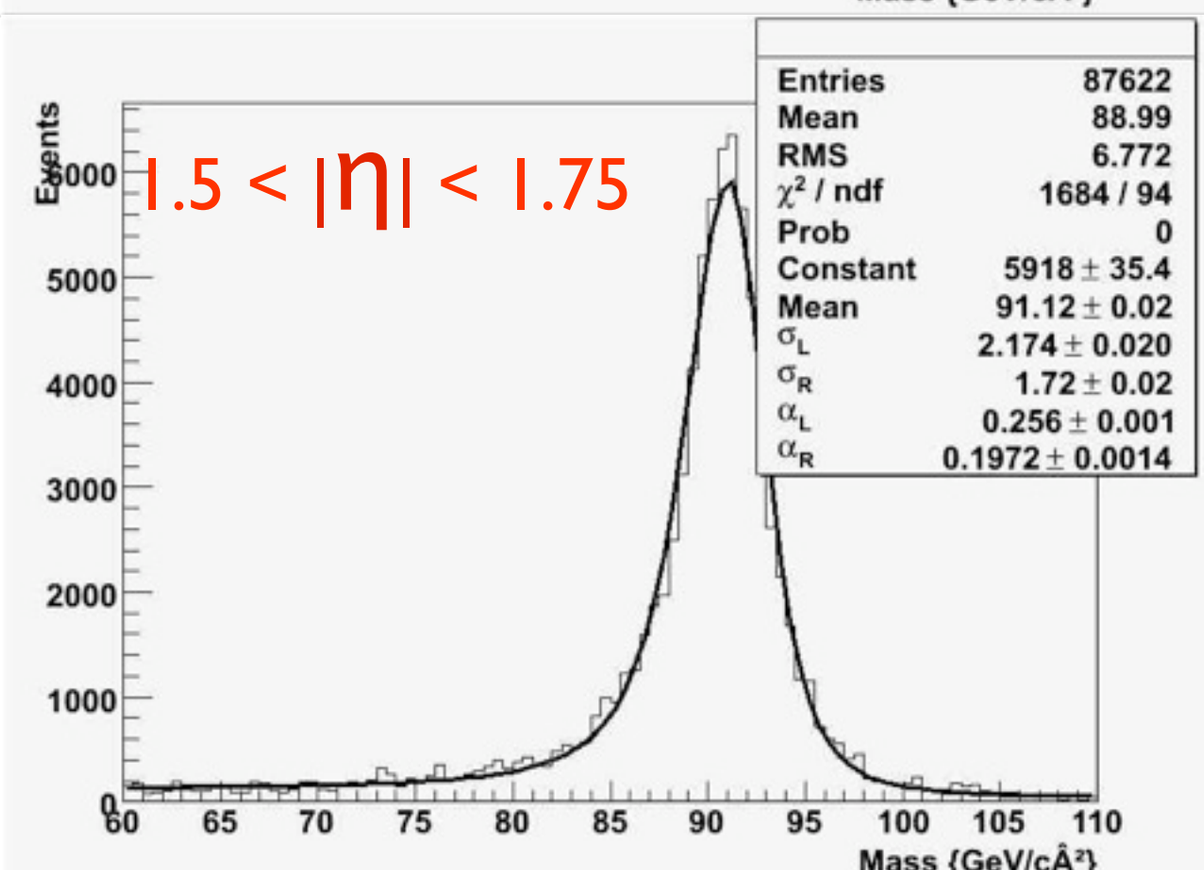


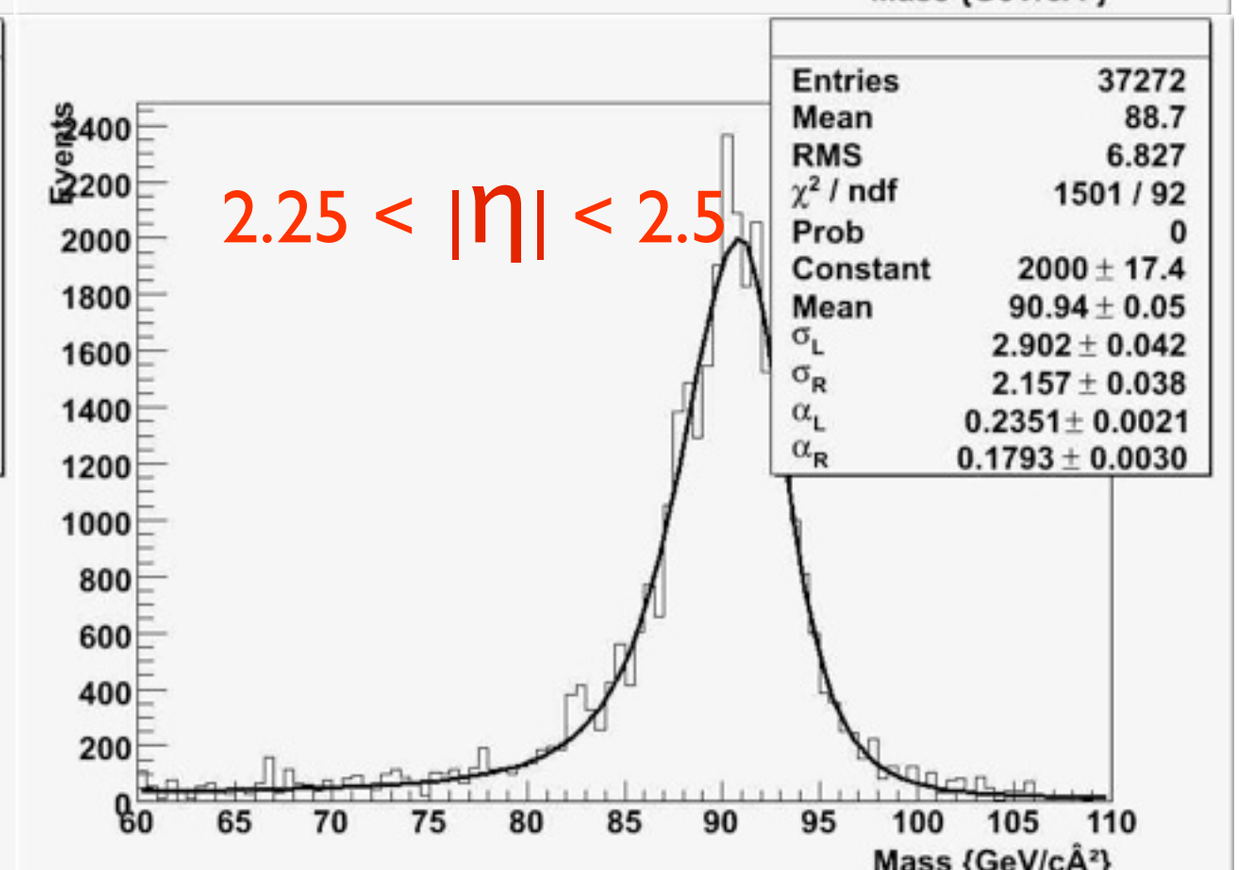
Expected behaviour as far as the electron becomes harder

Eta 2 Muons (all pt)

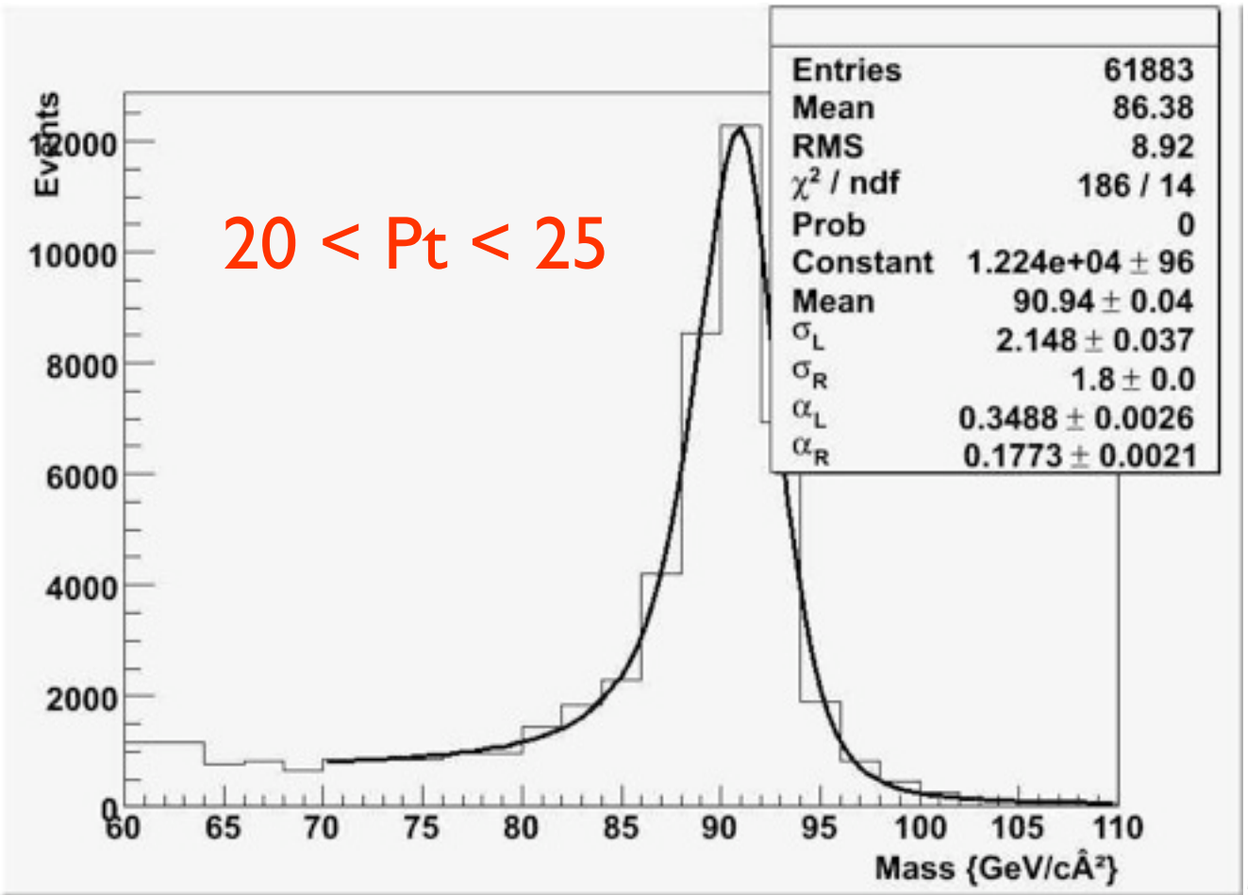


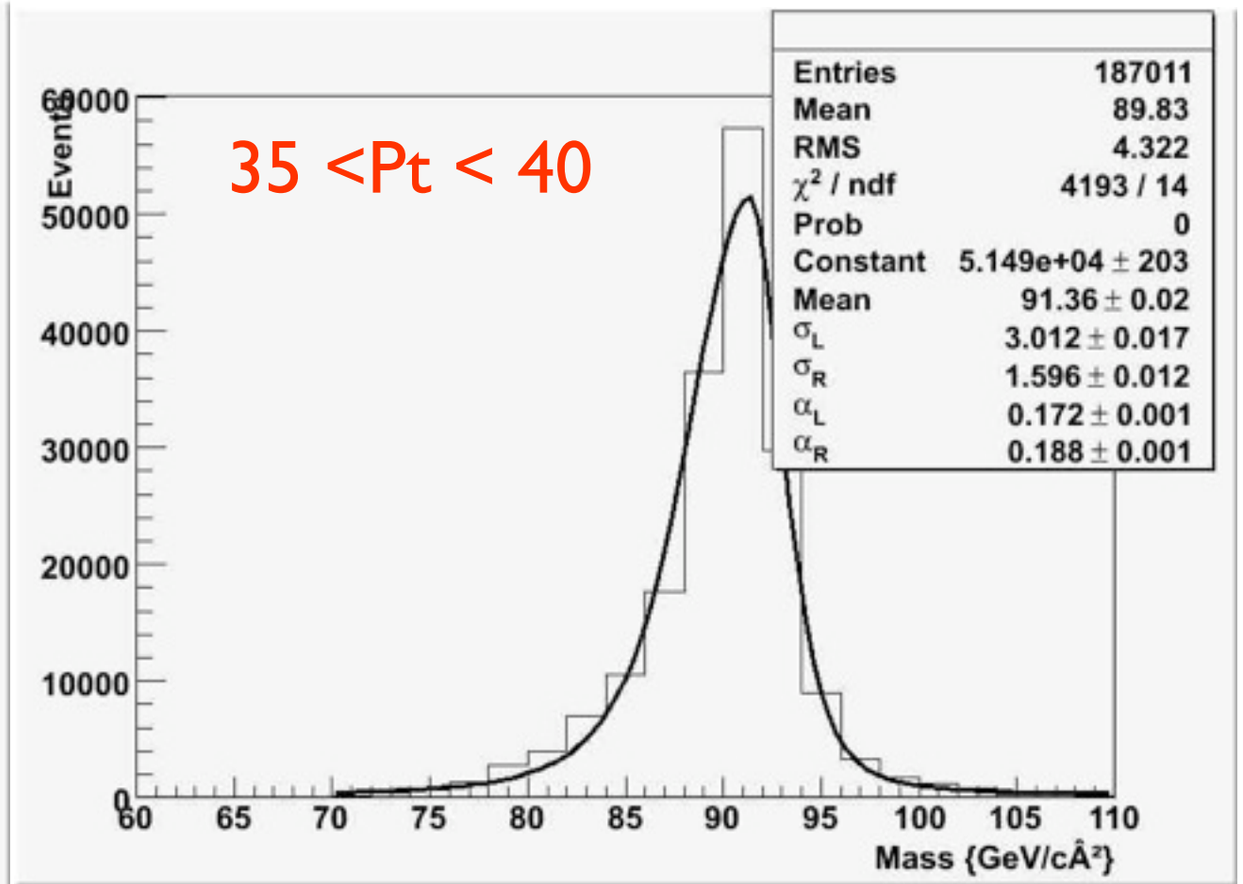


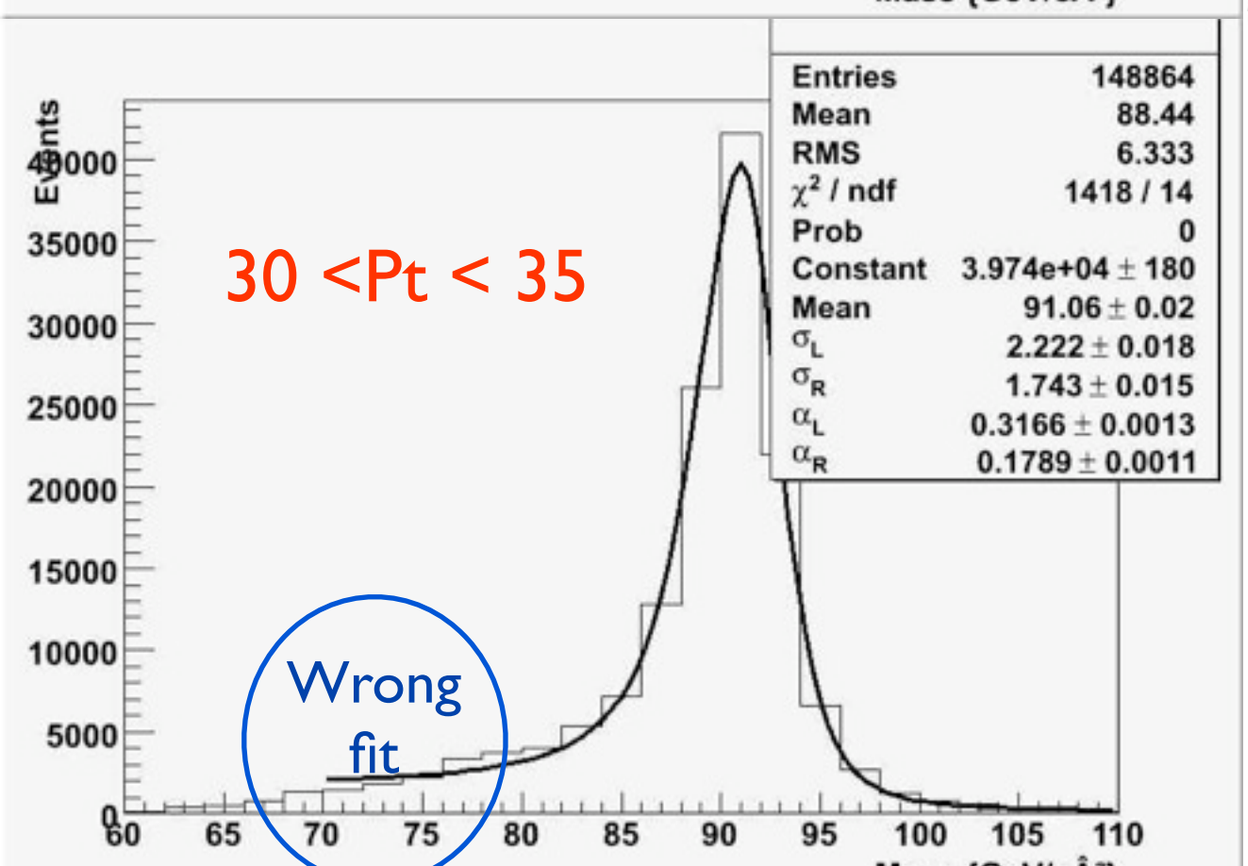


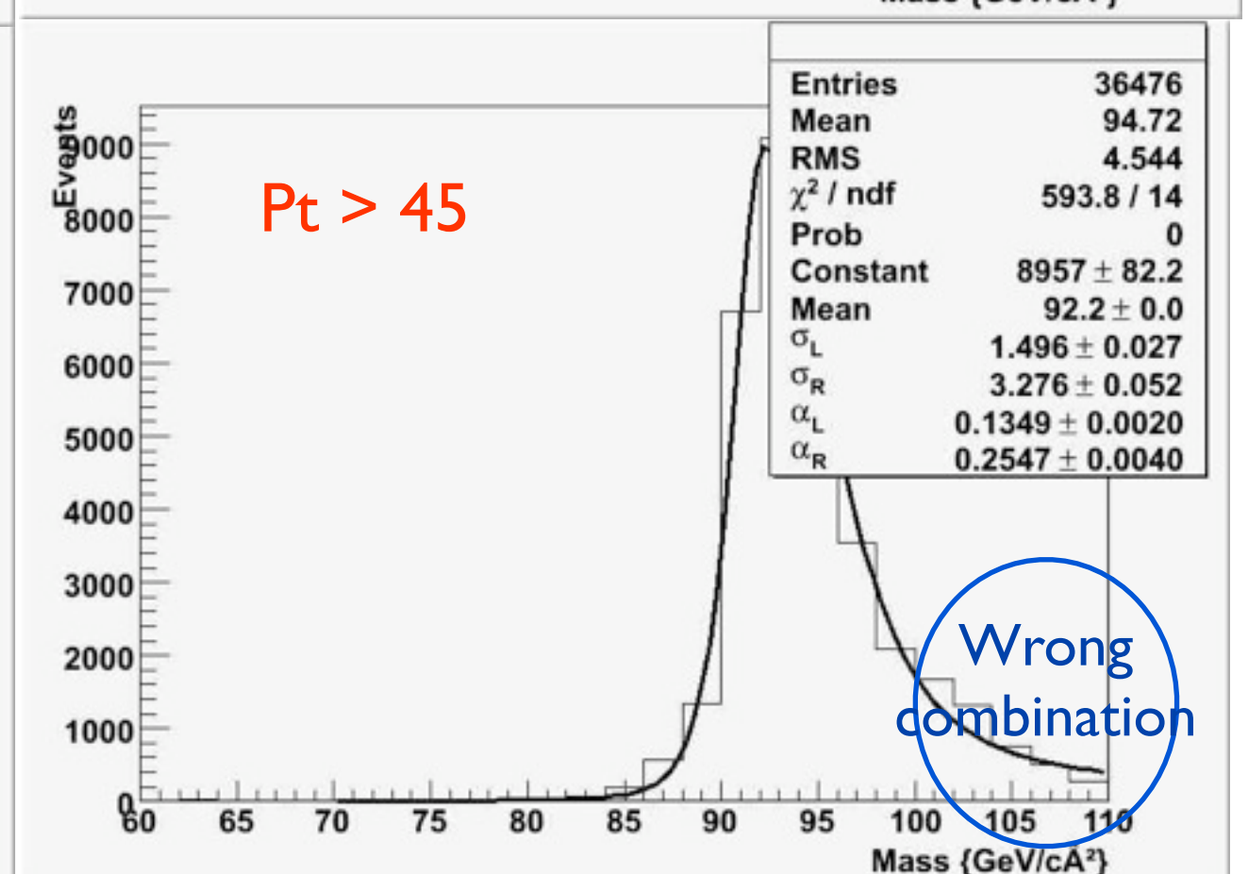


Pt Muons (all eta)

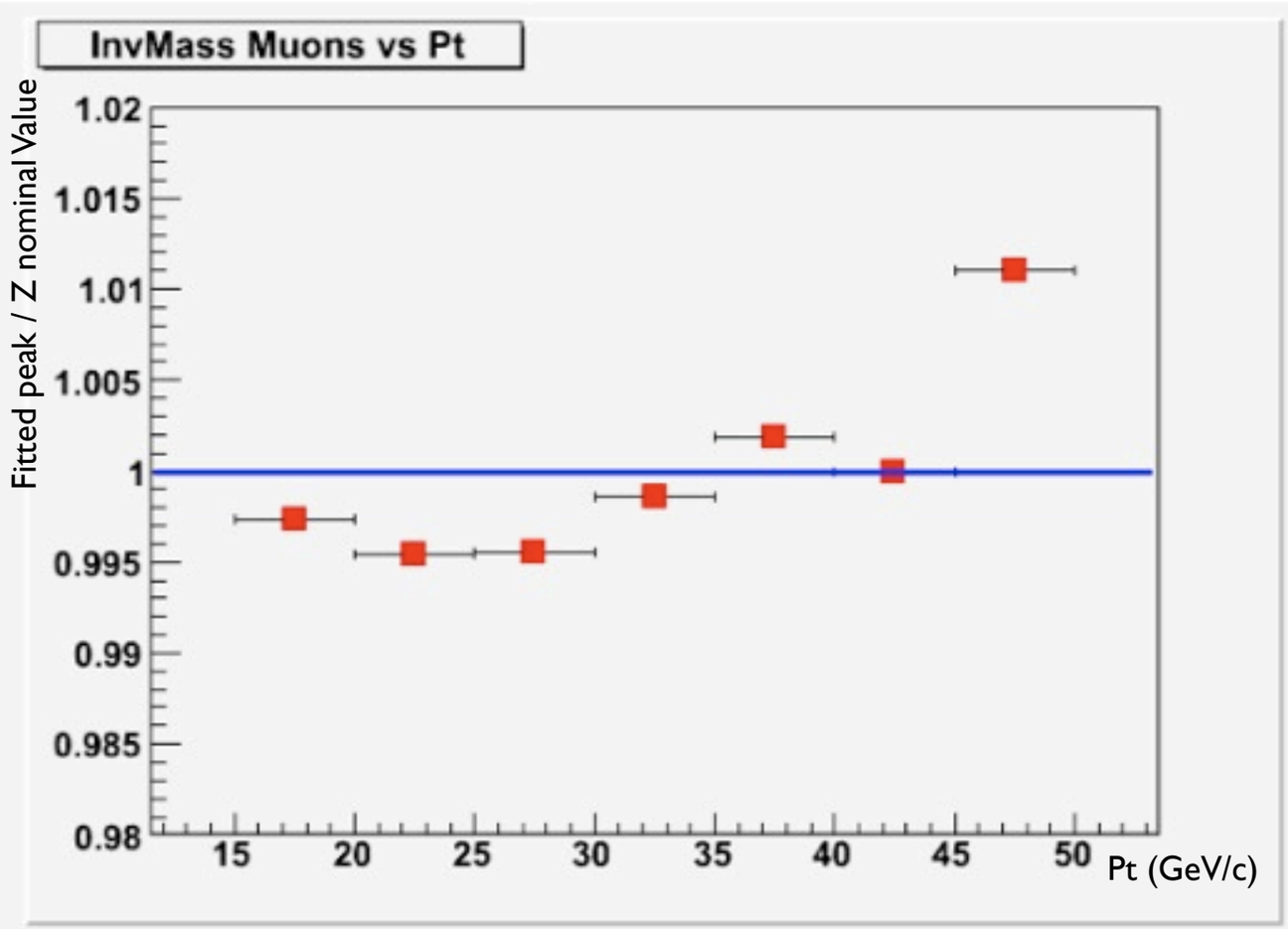






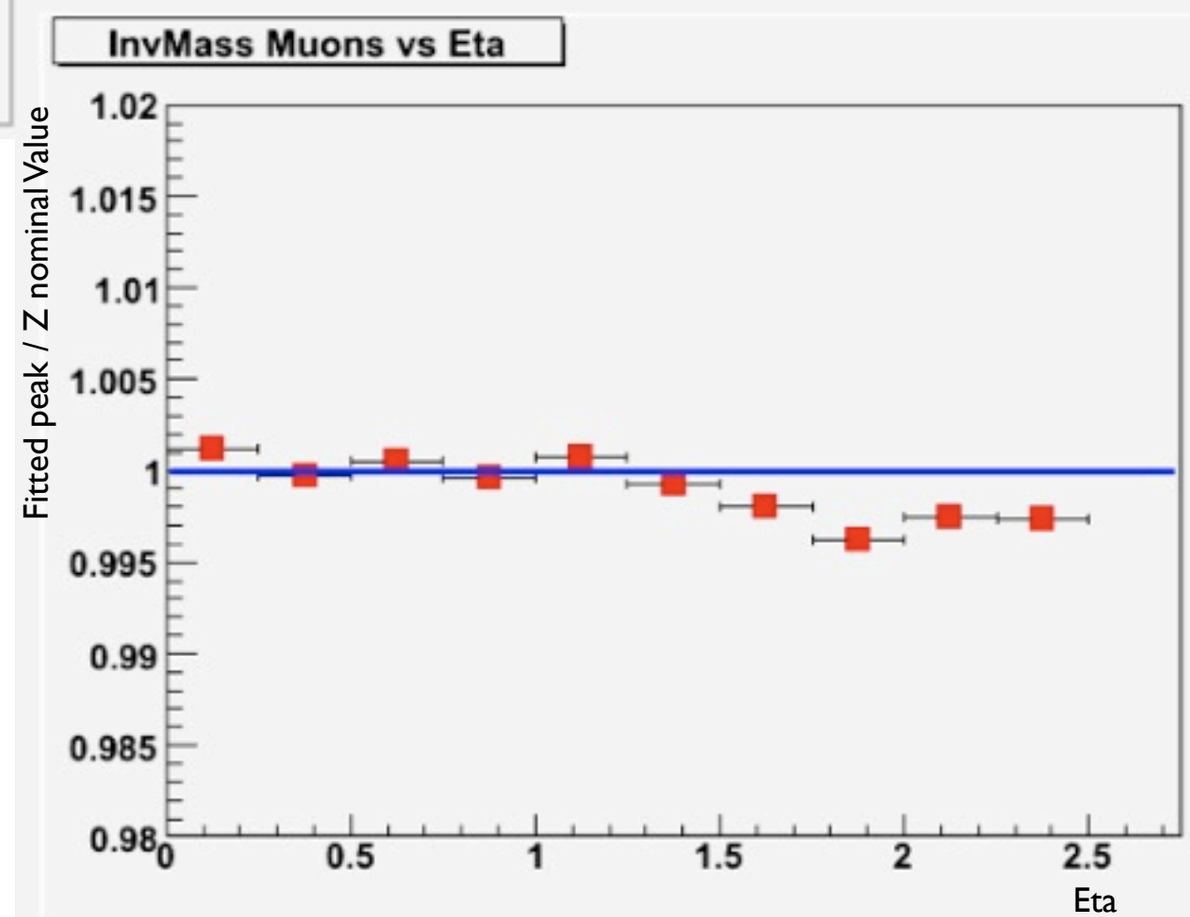


Mean Value Muons (RATIO)

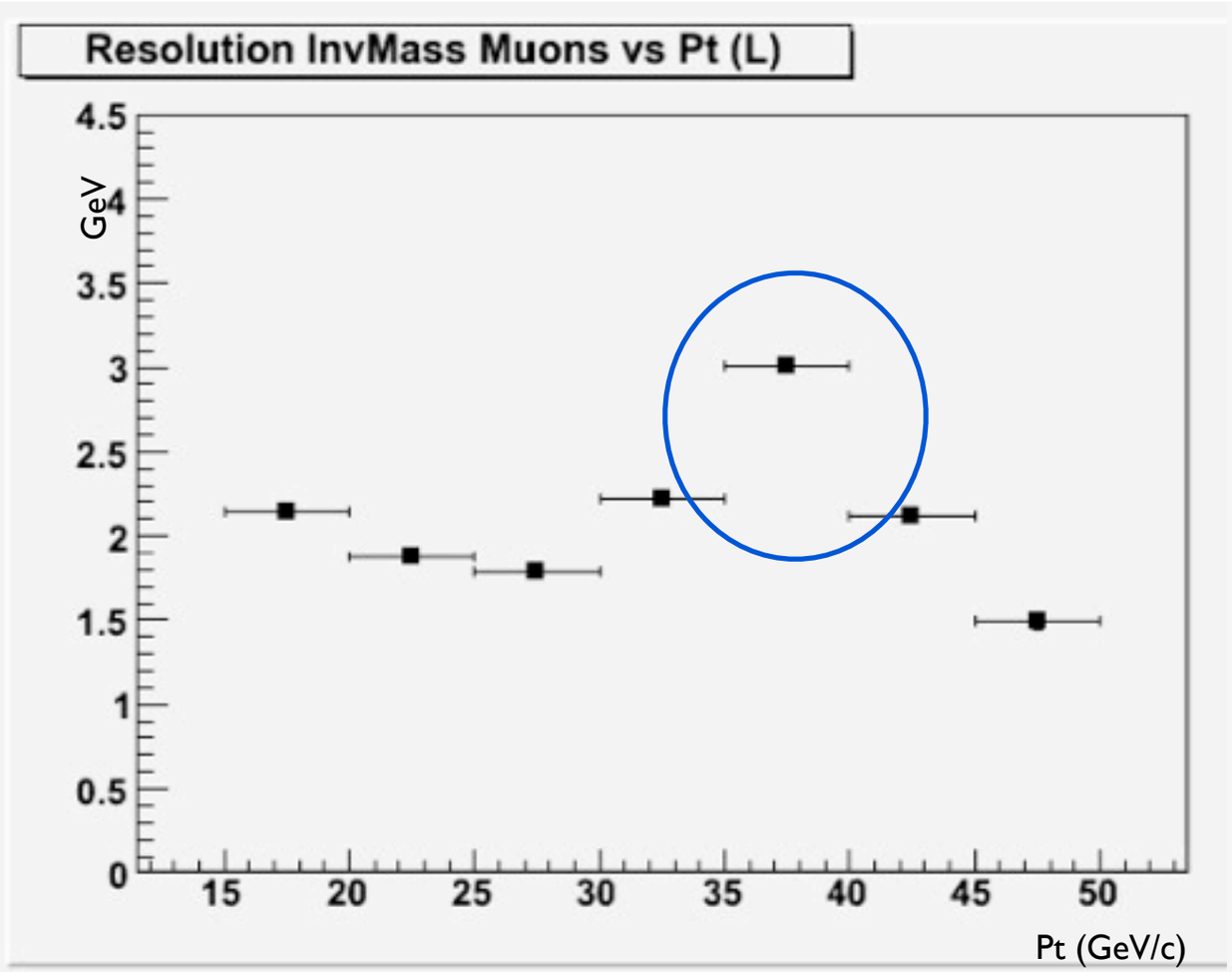


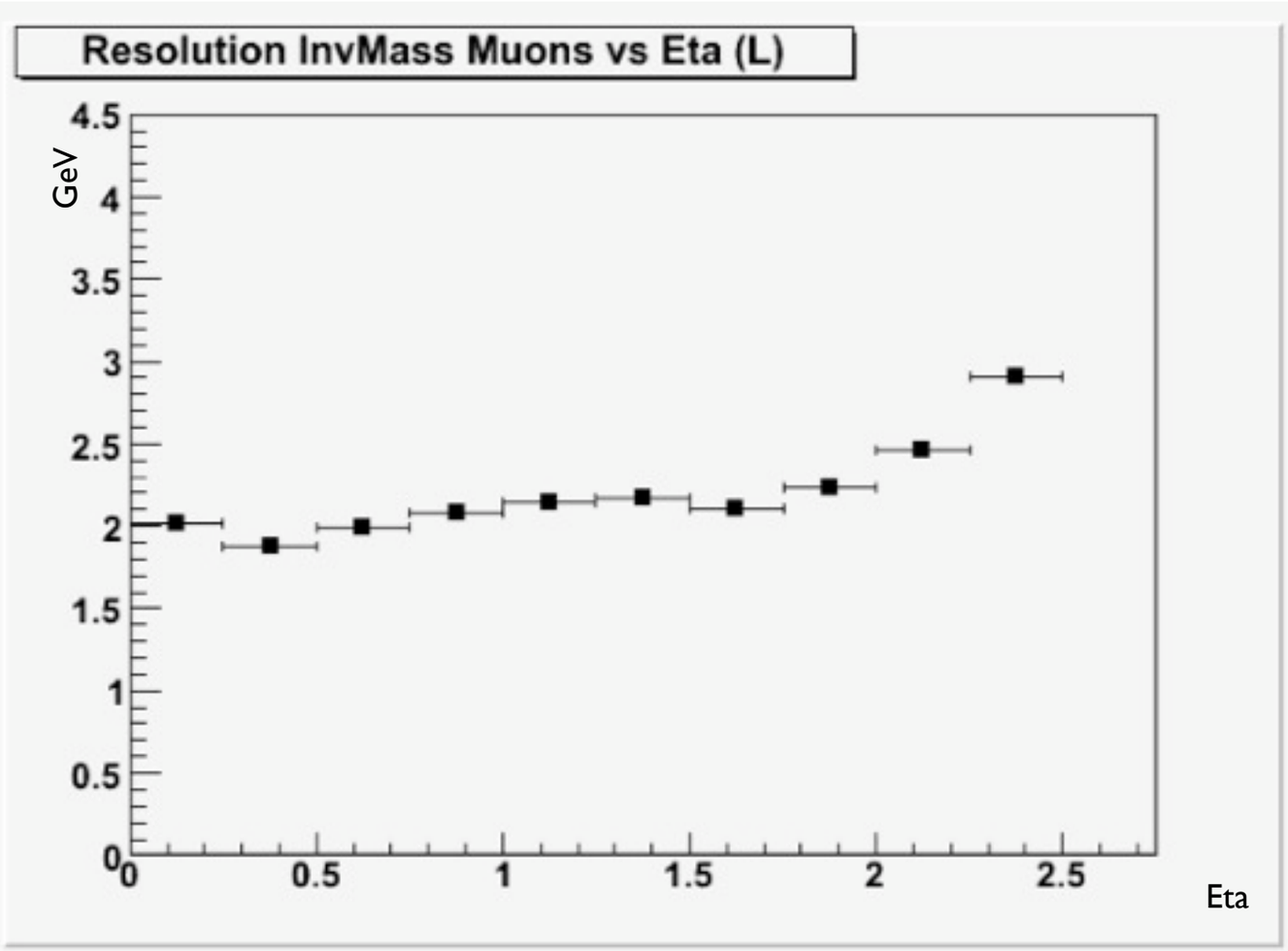
Increase with Pt within 0.5 %

Constant within 0.3 % for |η|



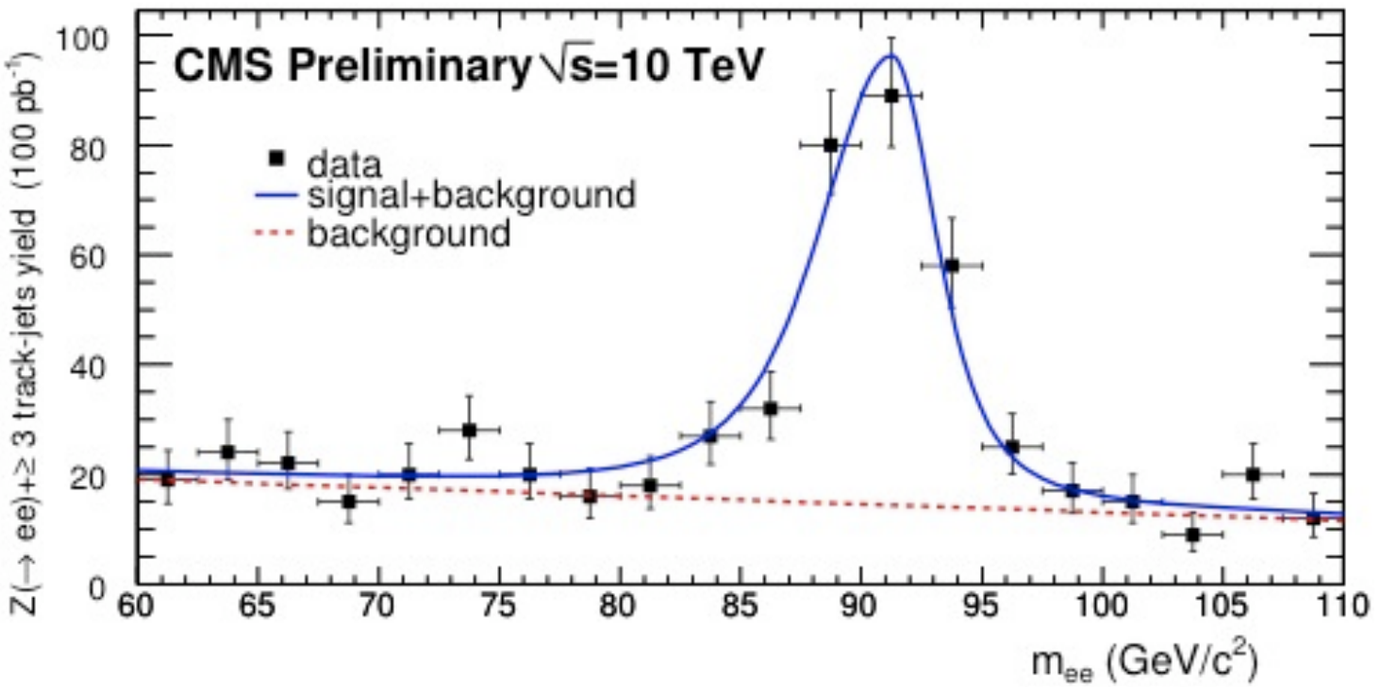
Resolution Muons





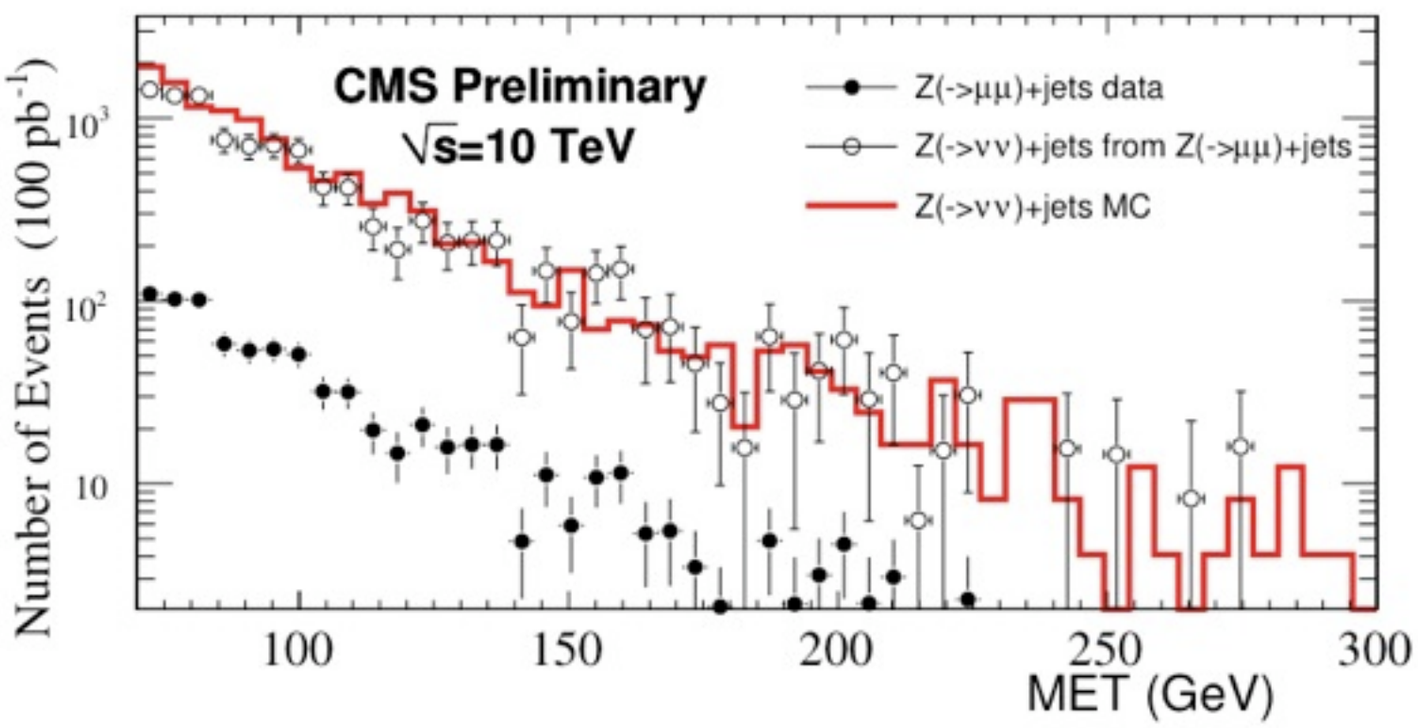
Almost flat up to the acceptance of the tracker

For the future...



Use realistic Z selection (trigger, lepton, InvMass...) incl. background

Study the effect of the non-perfect knowledge of the tracker material and of different amount of brem with a modified simulation



Study the effect of different amount of brem with a modified simulation

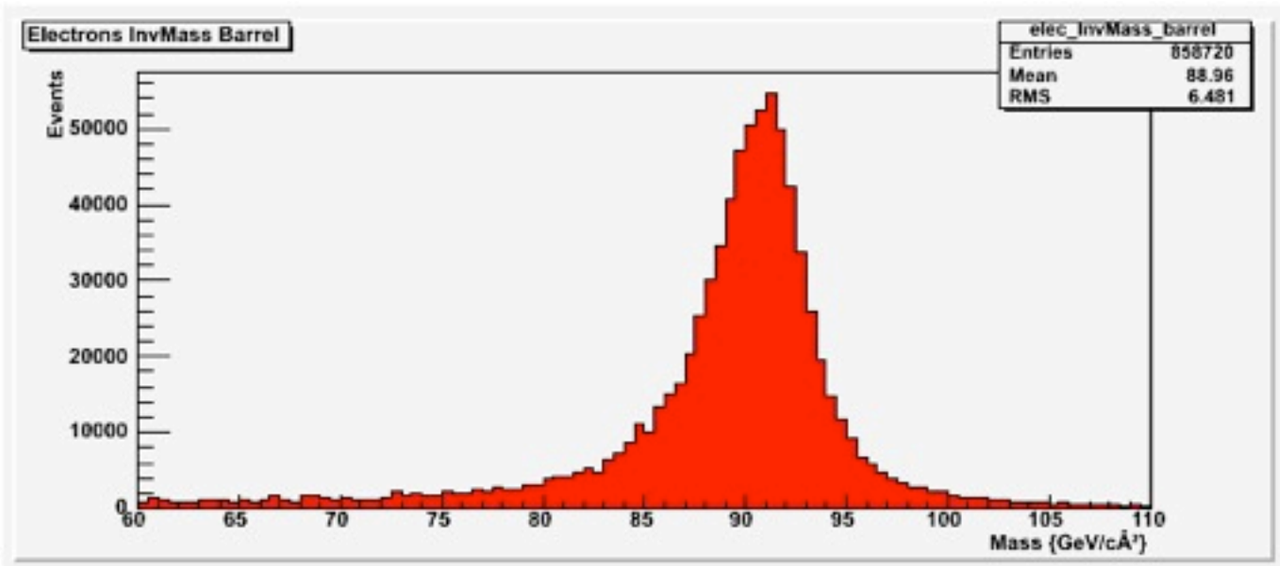
Calorimeter absolute scale calibration

¿ ... ?

Backup slides

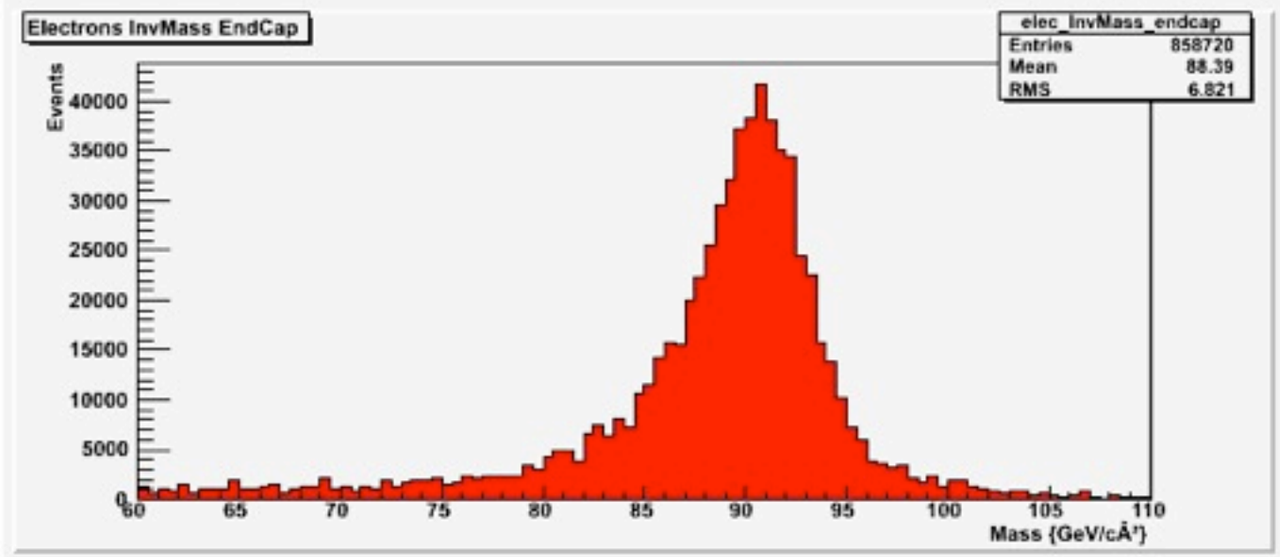
Eta dependence

barrel & barrel



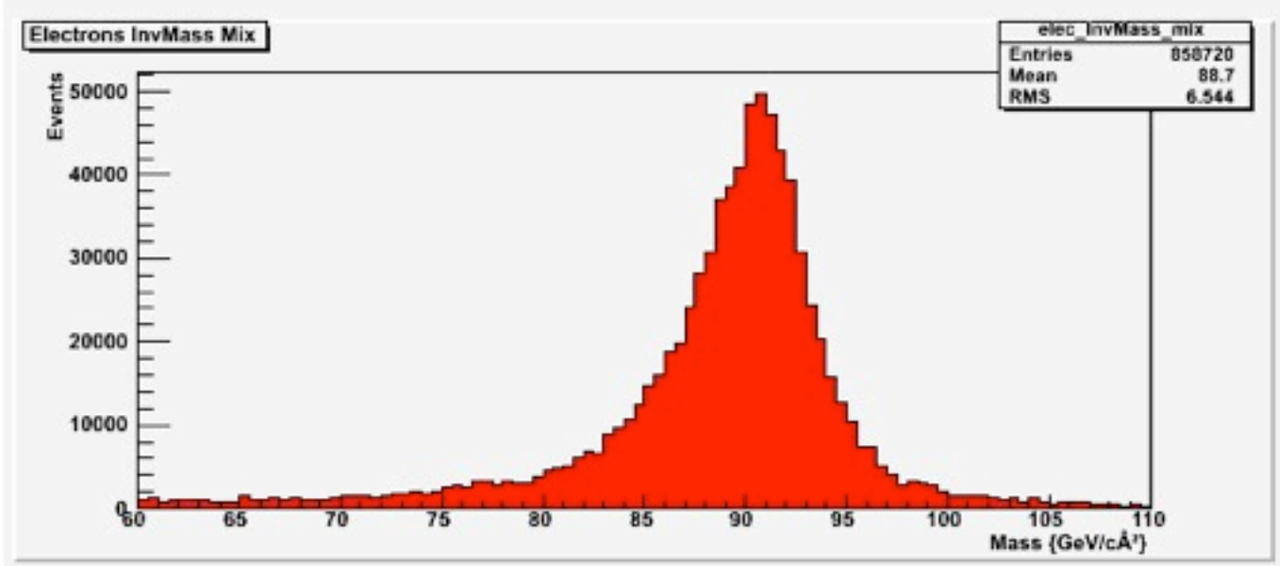
RMS 6.681

endcap & endcap



RMS 6.821

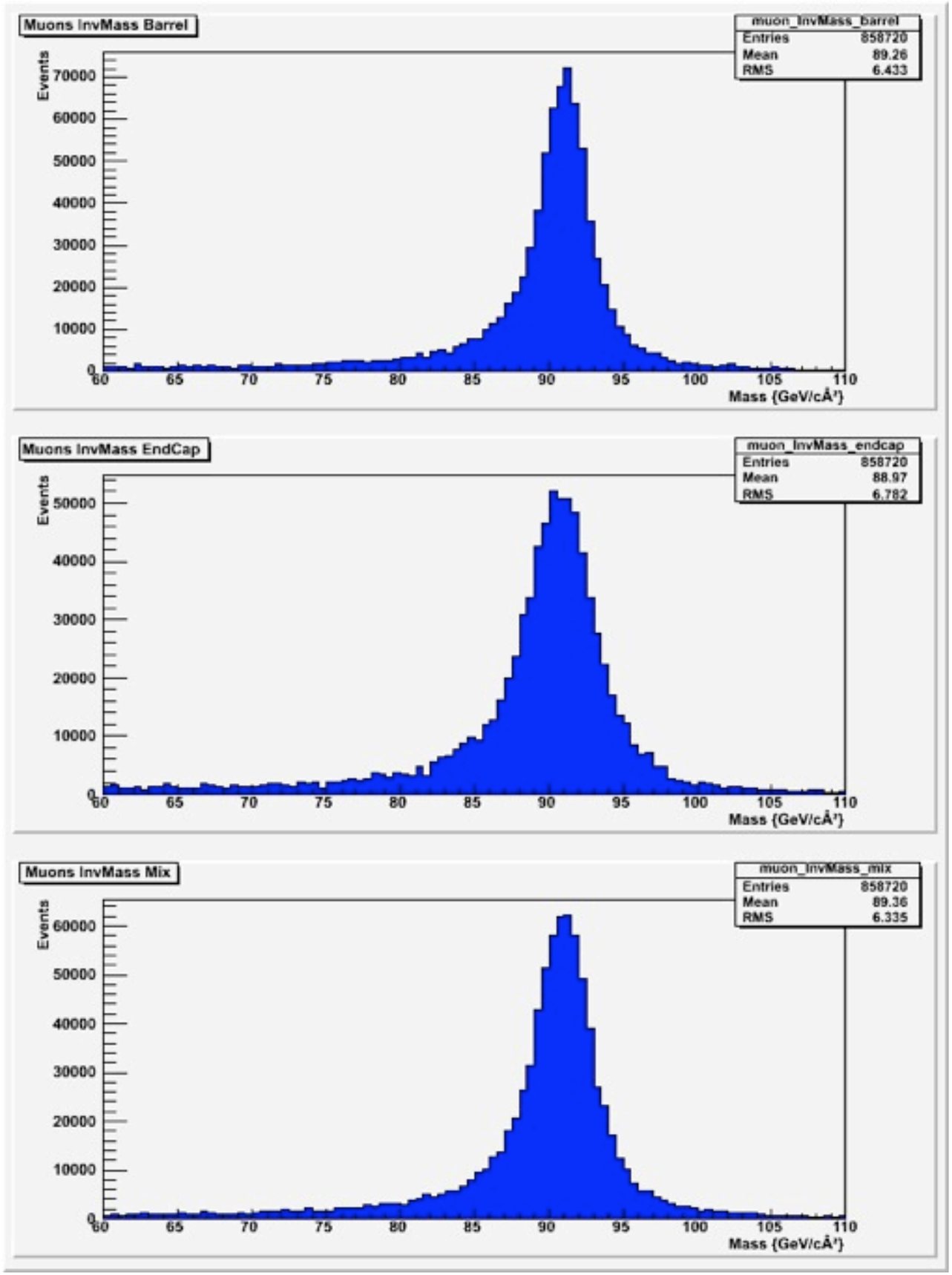
barrel & endcap



RMS 6.544

Eta dependence

barrel & barrel



RMS 6.433

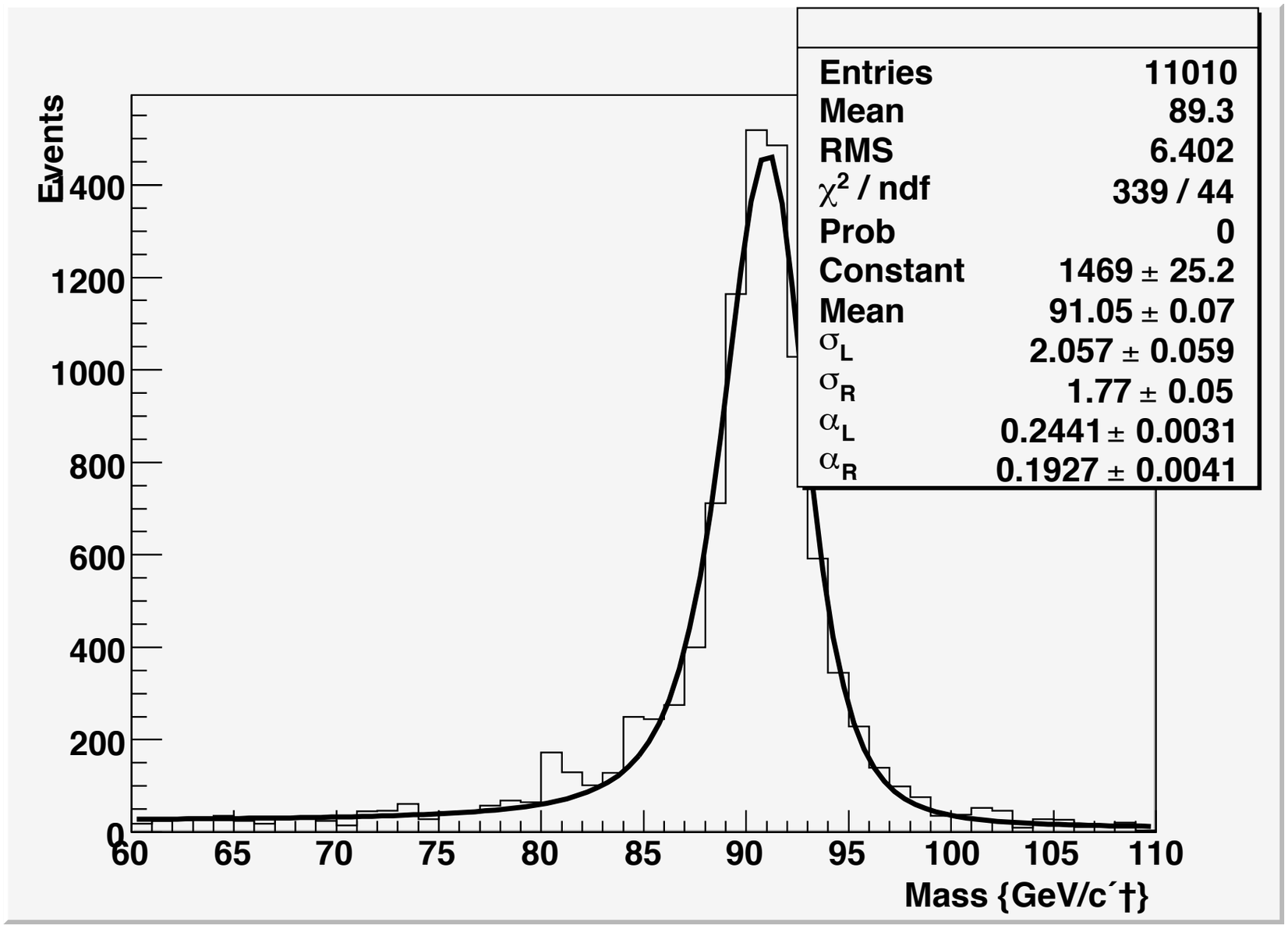
endcap & endcap

RMS 6.782

barrel & endcap

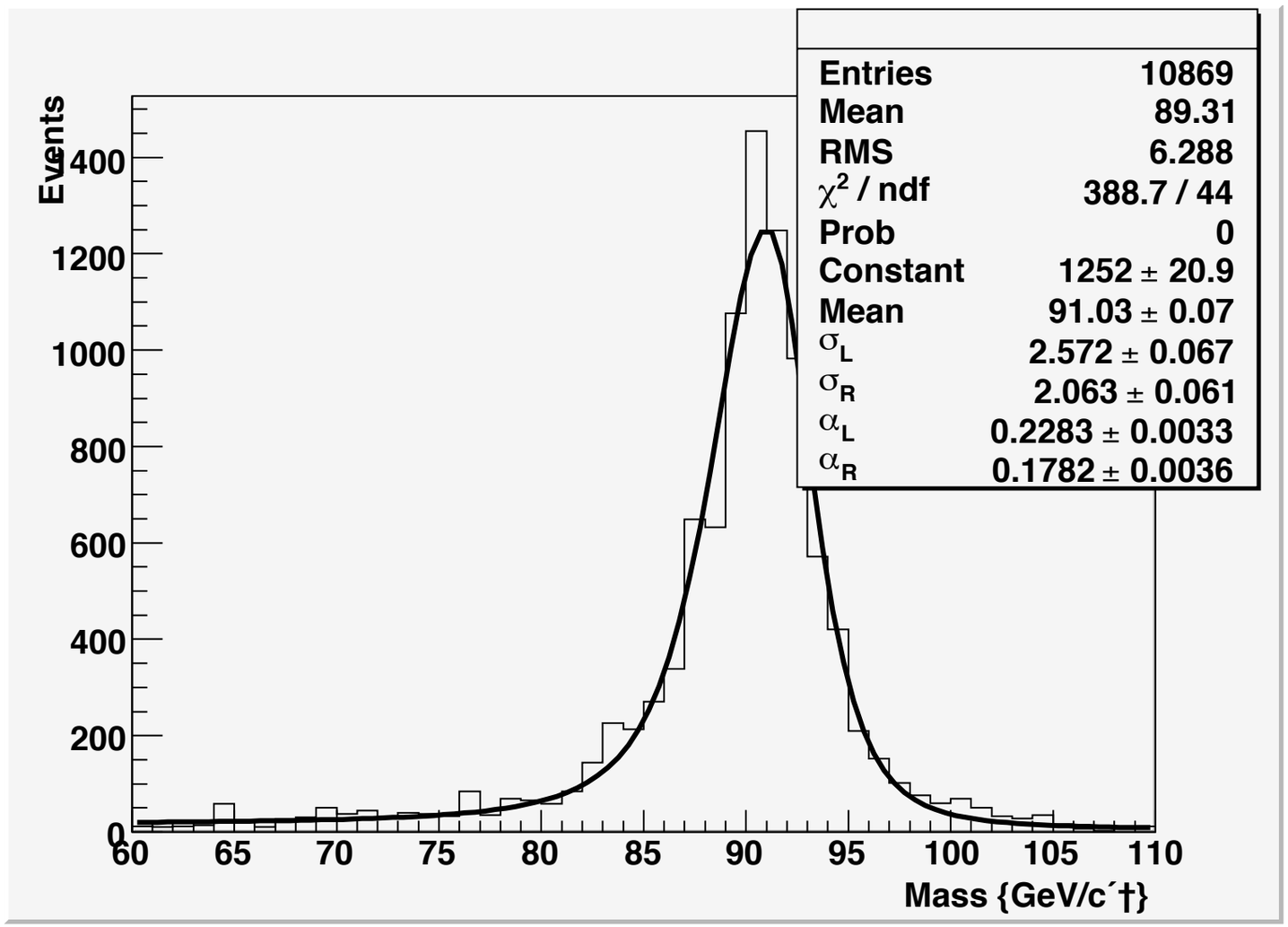
RMS 6.335

Fits


Entries 11010
Mean 89.3
RMS 6.402
χ² / ndf 339 / 44
Prob 0
Constant 1469 ± 25.2
Mean 91.05 ± 0.07
σL 2.057 ± 0.059
σR 1.77 ± 0.05
αL 0.2441 ± 0.0031
αR 0.1927 ± 0.0041
Events
0
200
400
600
800
1000
1200
1400
60
65
70
75
80
85
90
95
100
105
110
Mass {GeV/c´†}

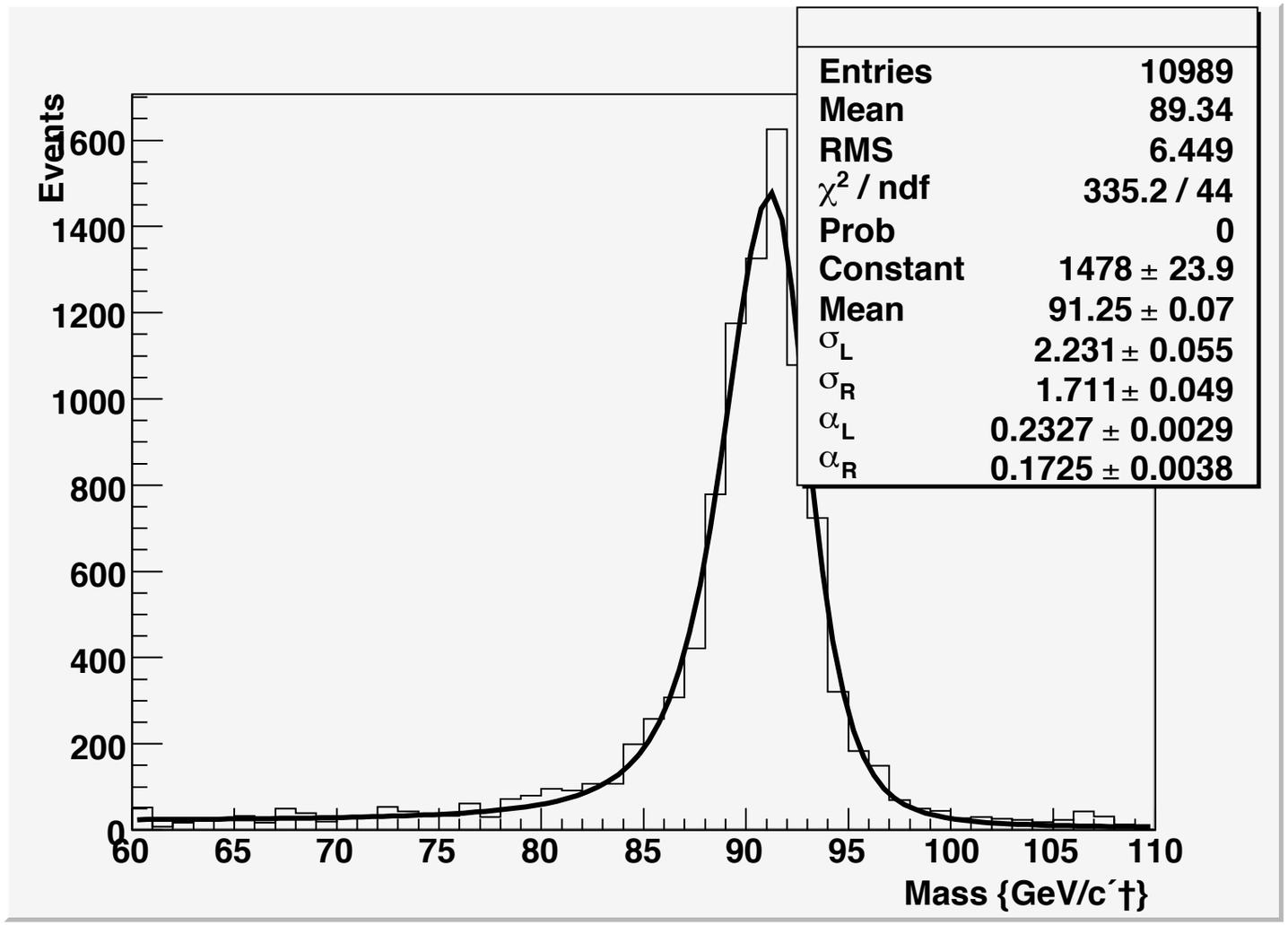
$|\eta| < 0.25$

Fits



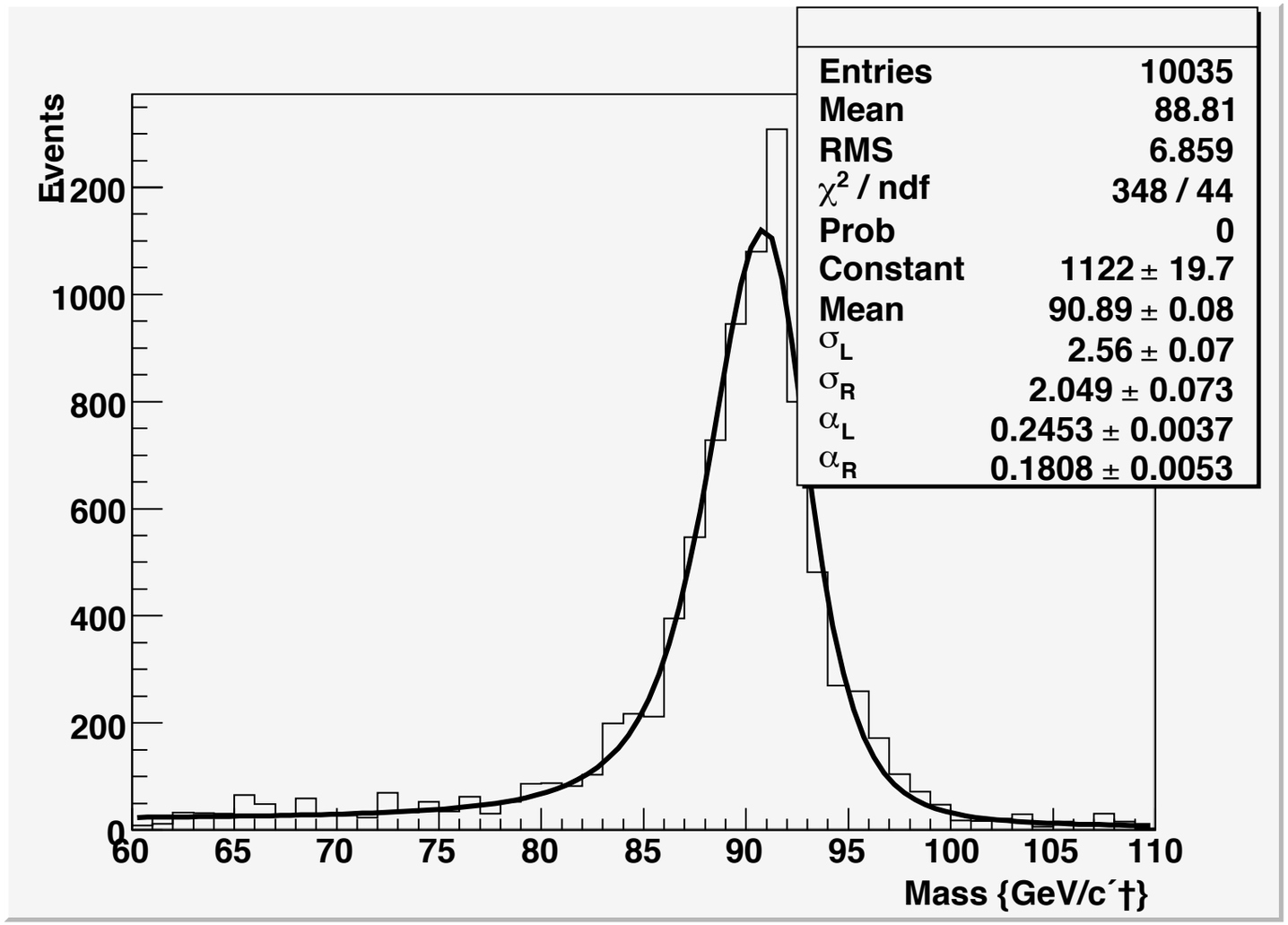
$0.25 < |\eta| < 0.5$

Fits



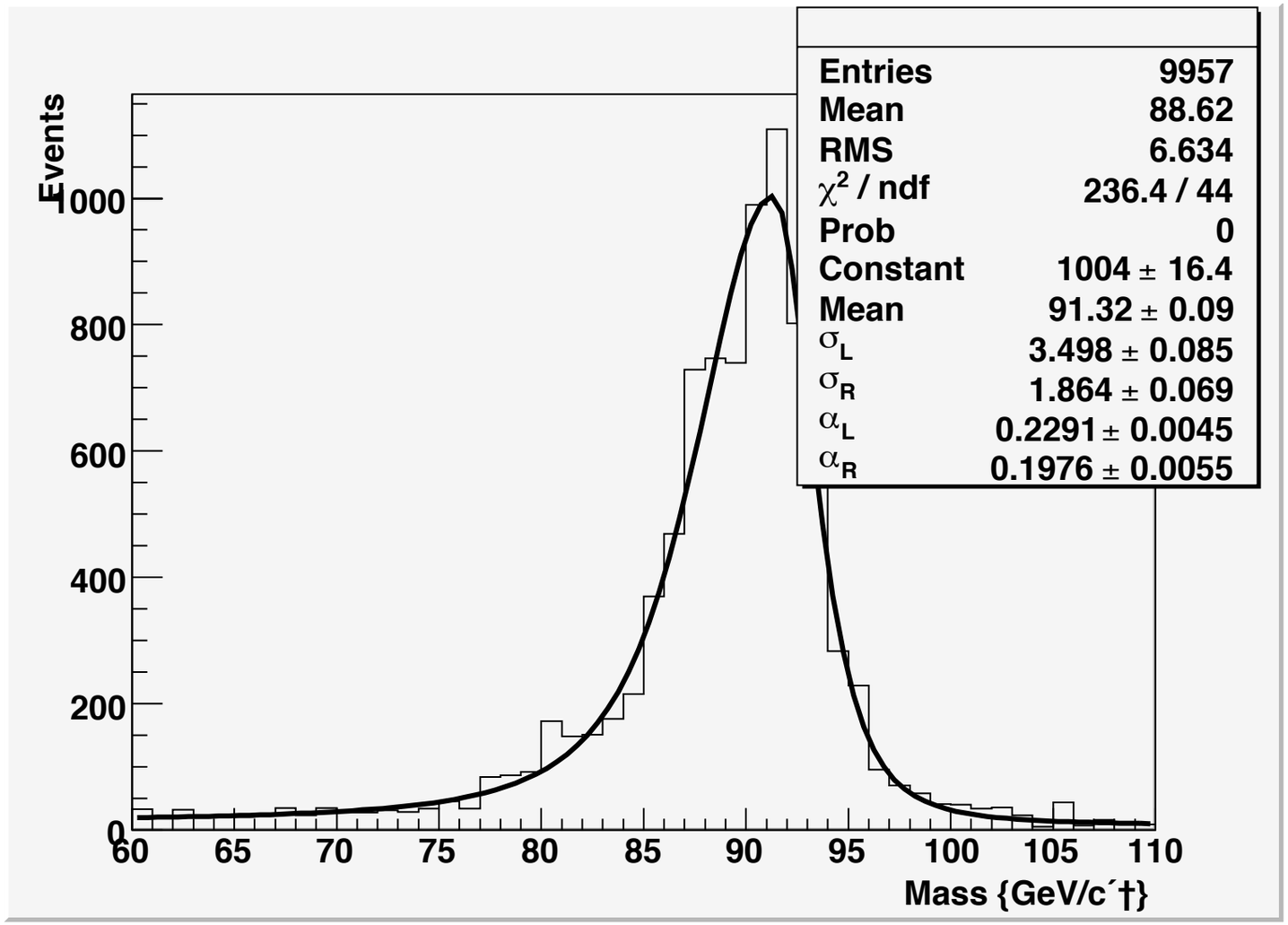
$0.5 < |\eta| < 0.75$

Fits



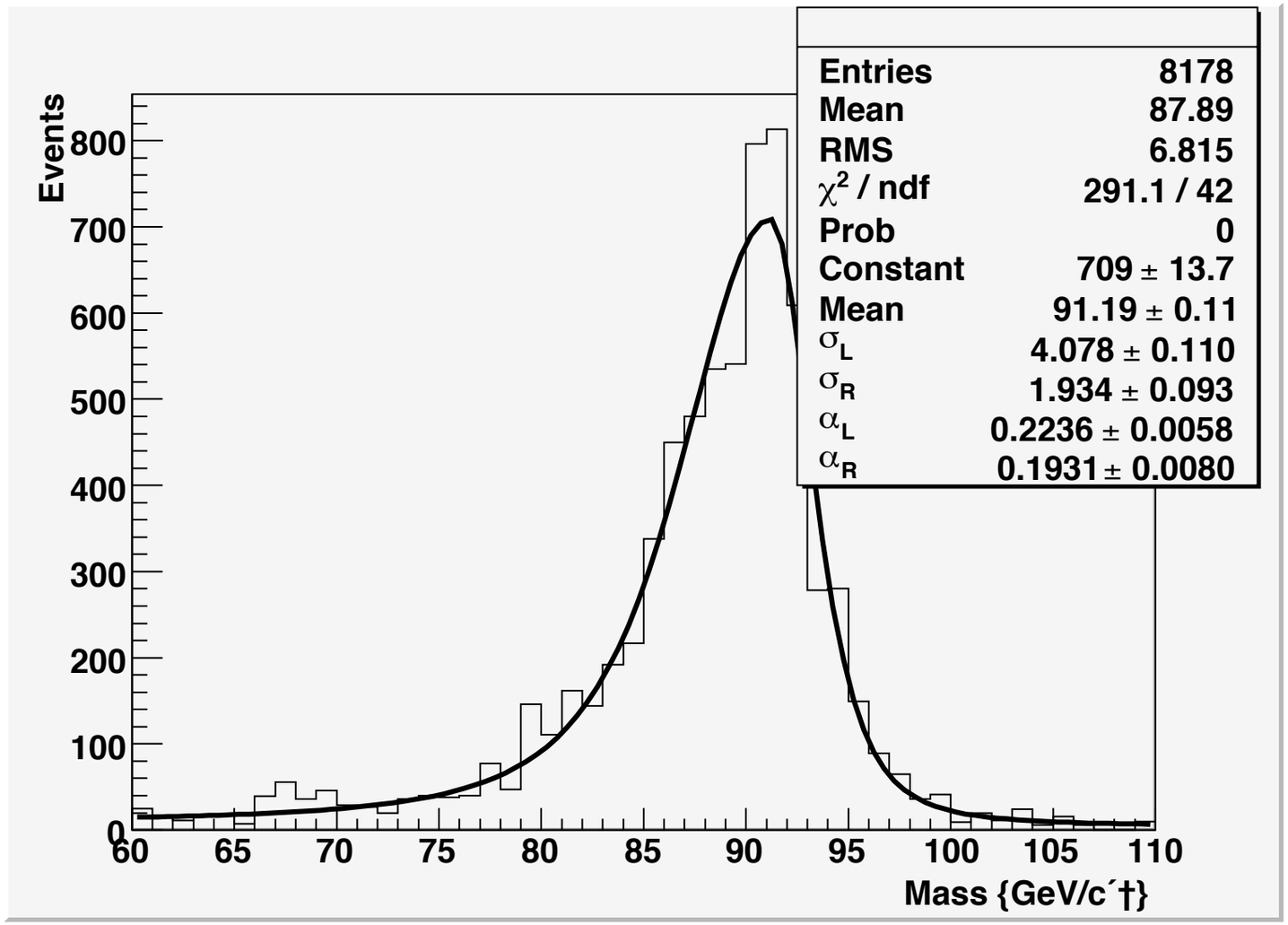
$0.75 < |\eta| < 1$

Fits



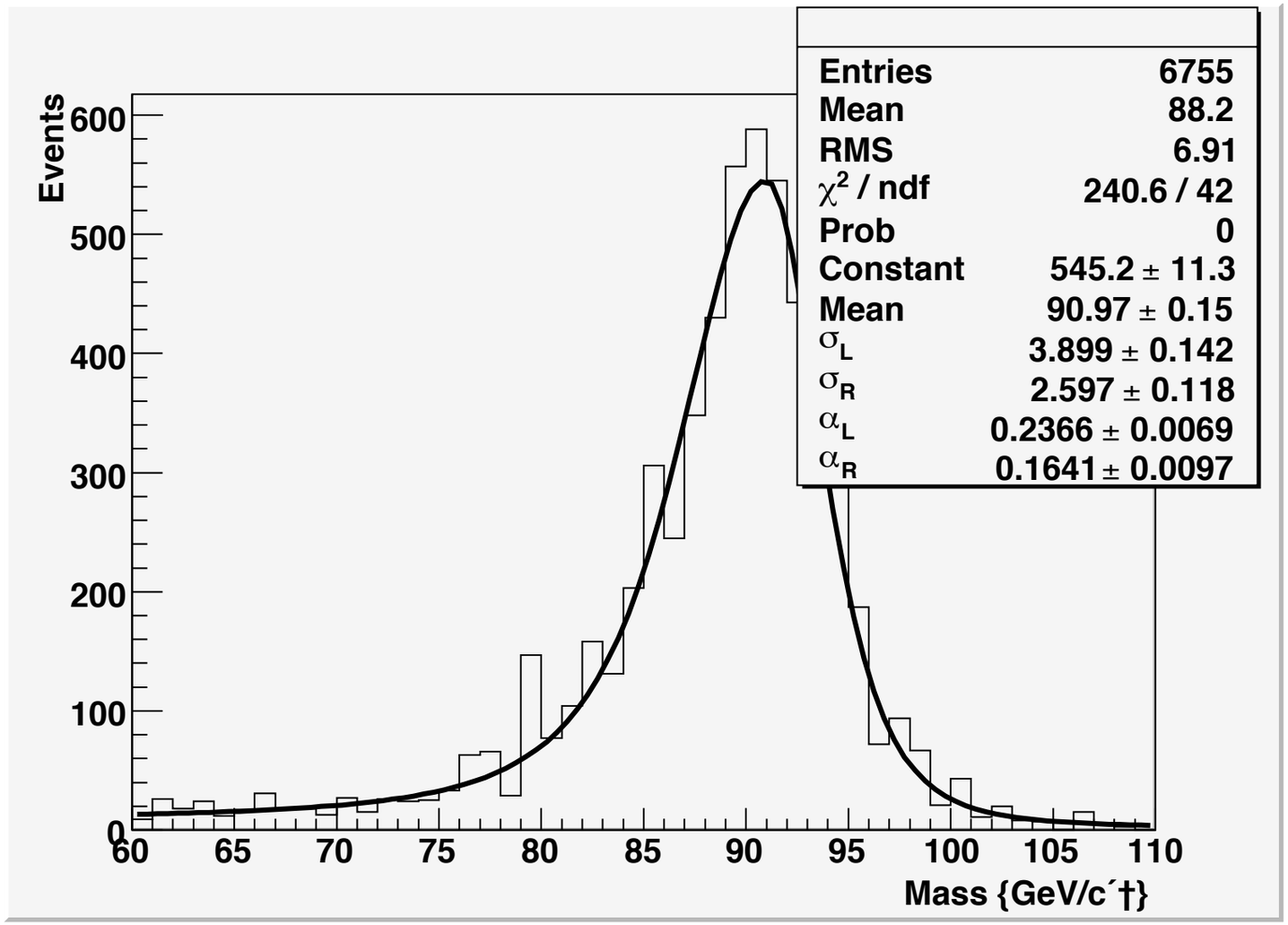
$1 < |\eta| < 1.25$

Fits



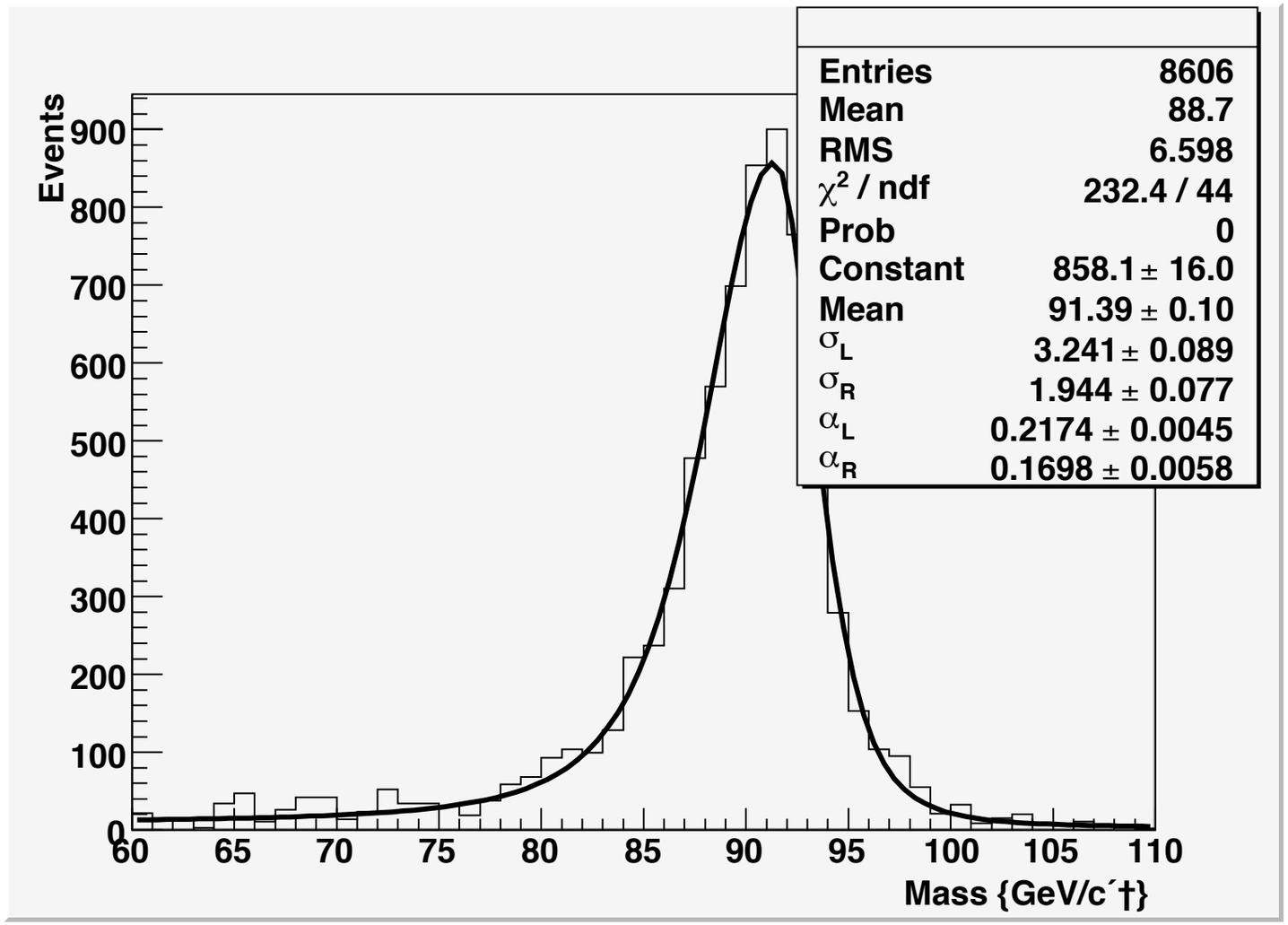
$1.25 < |\eta| < 1.5$

Fits



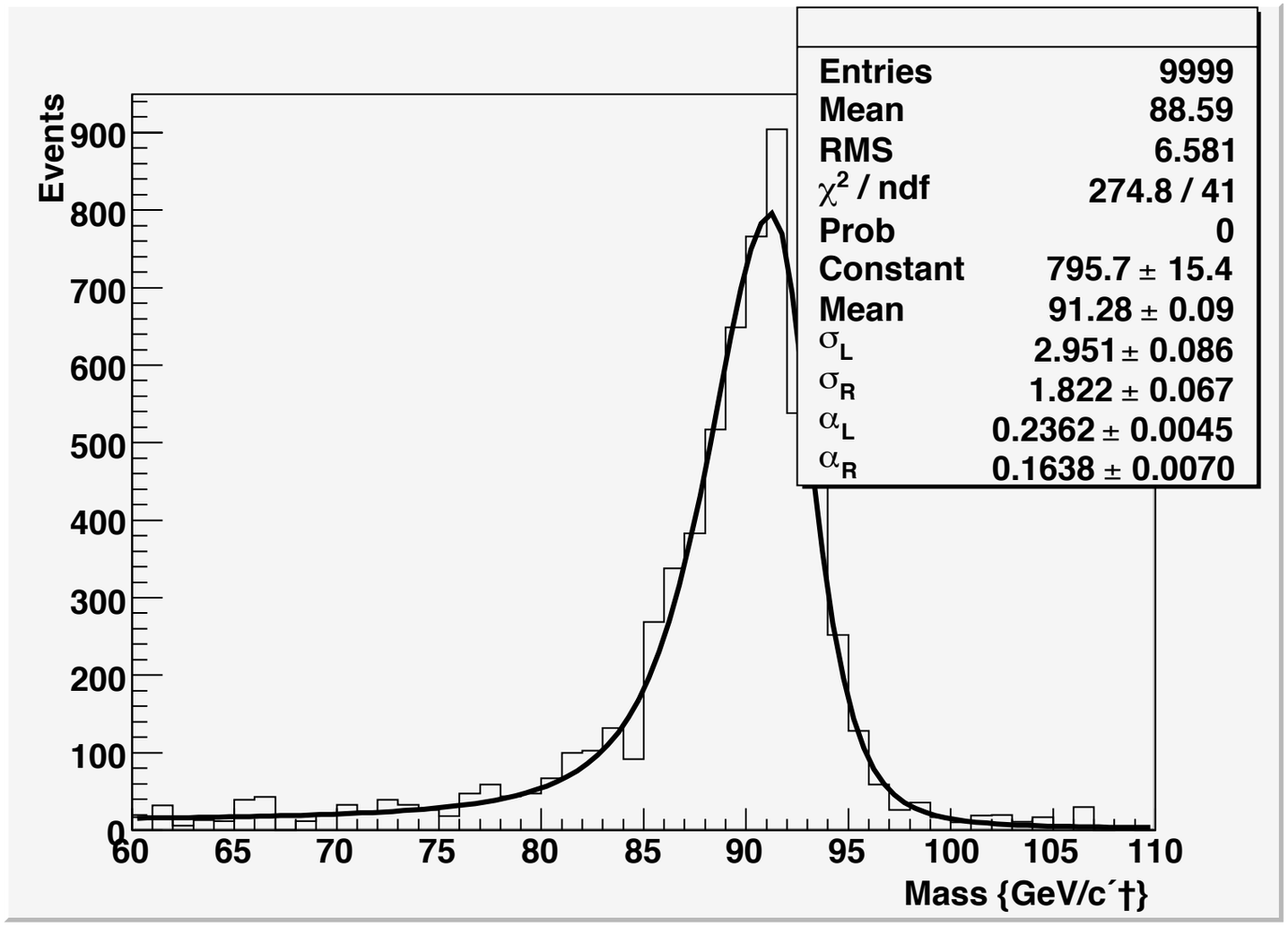
$1.5 < |\eta| < 1.75$

Fits



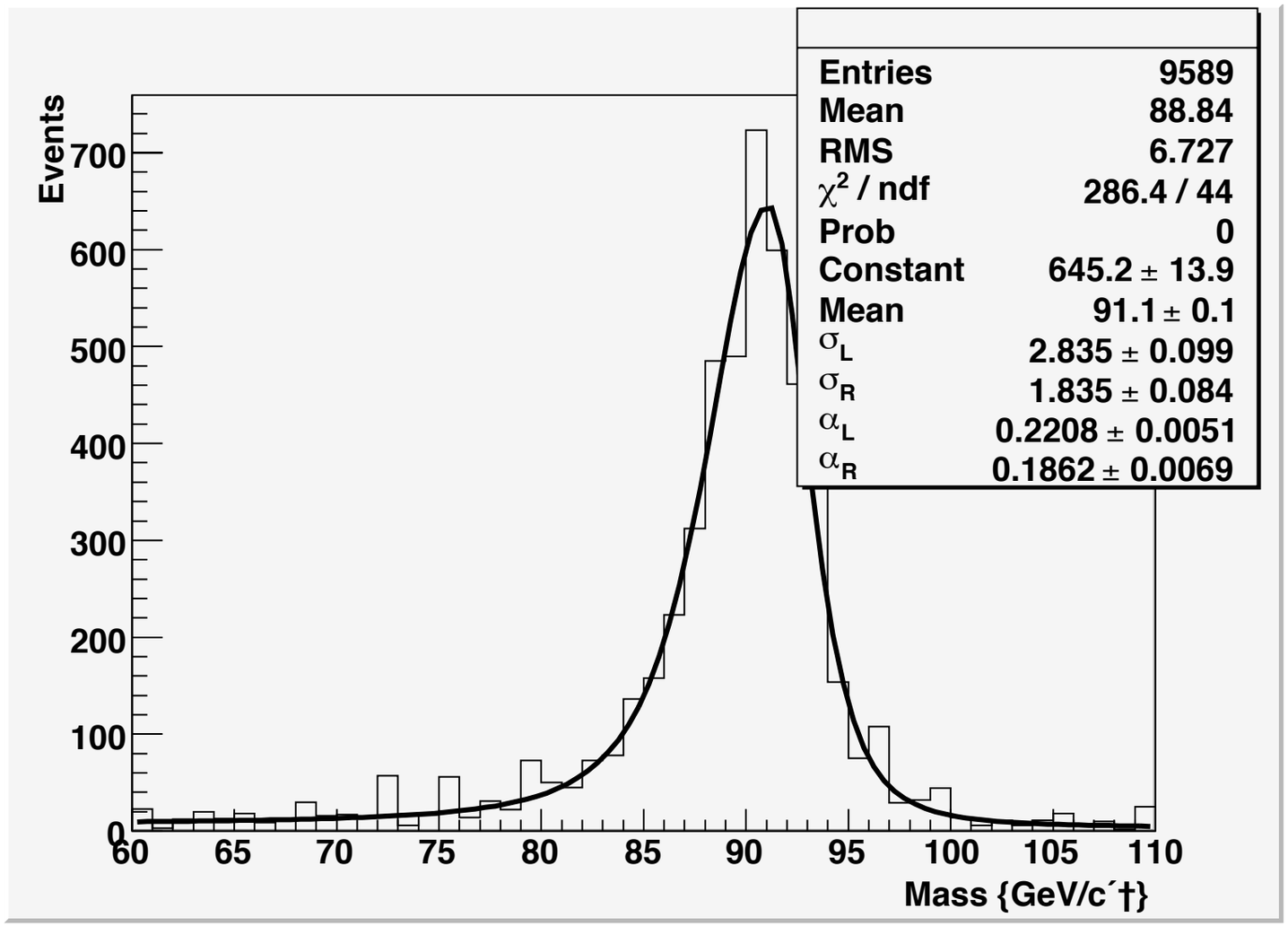
$1.75 < |\eta| < 2$

Fits


Entries 9999
Mean 88.59
RMS 6.581
χ^2 / ndf 274.8 / 41
Prob 0
Constant 795.7 ± 15.4
Mean 91.28 ± 0.09
σ_L 2.951 ± 0.086
σ_R 1.822 ± 0.067
α_L 0.2362 ± 0.0045
α_R 0.1638 ± 0.0070
Events
0
100
200
300
400
500
600
700
800
900
60
65
70
75
80
85
90
95
100
105
110
Mass {GeV/c´†}

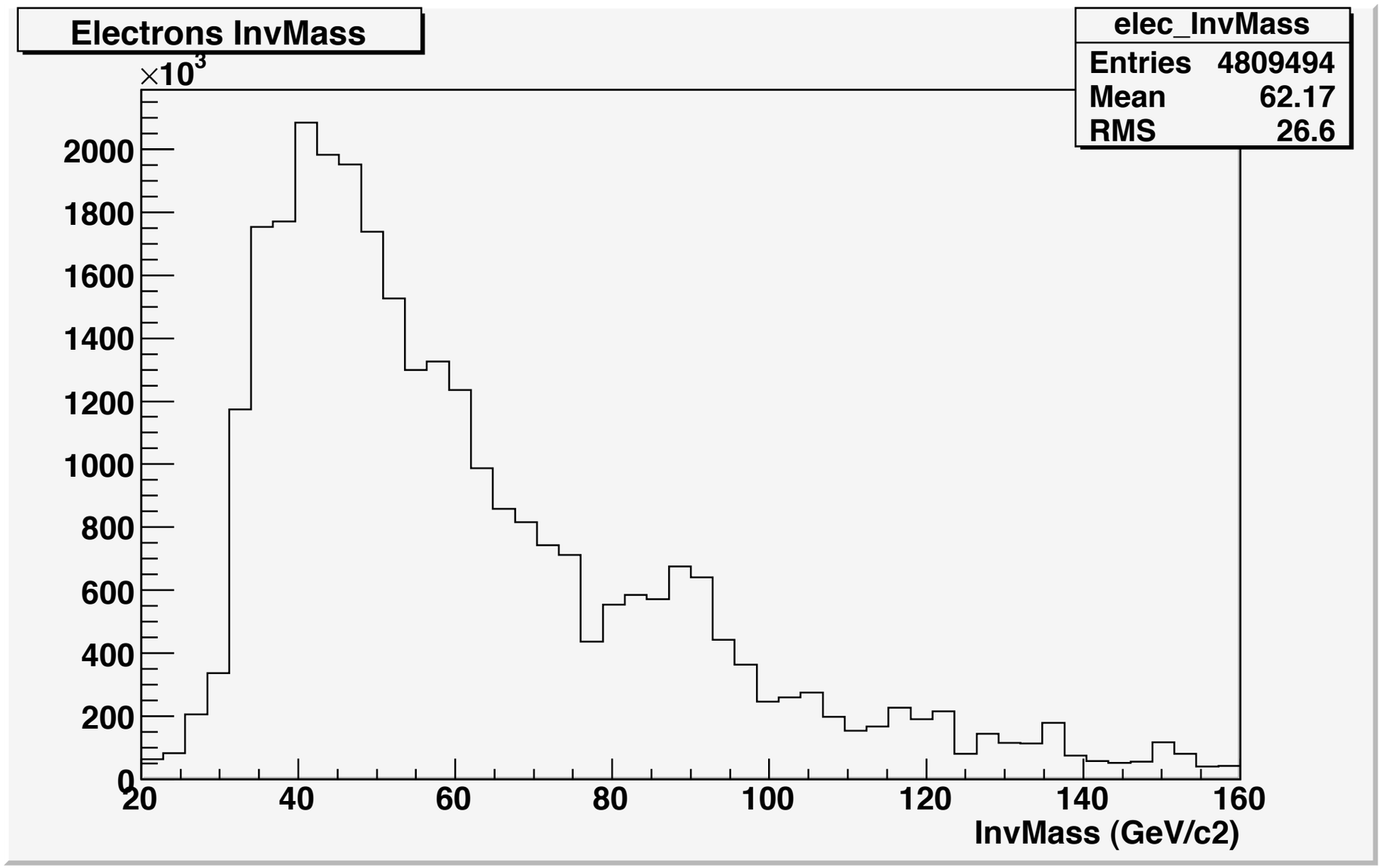
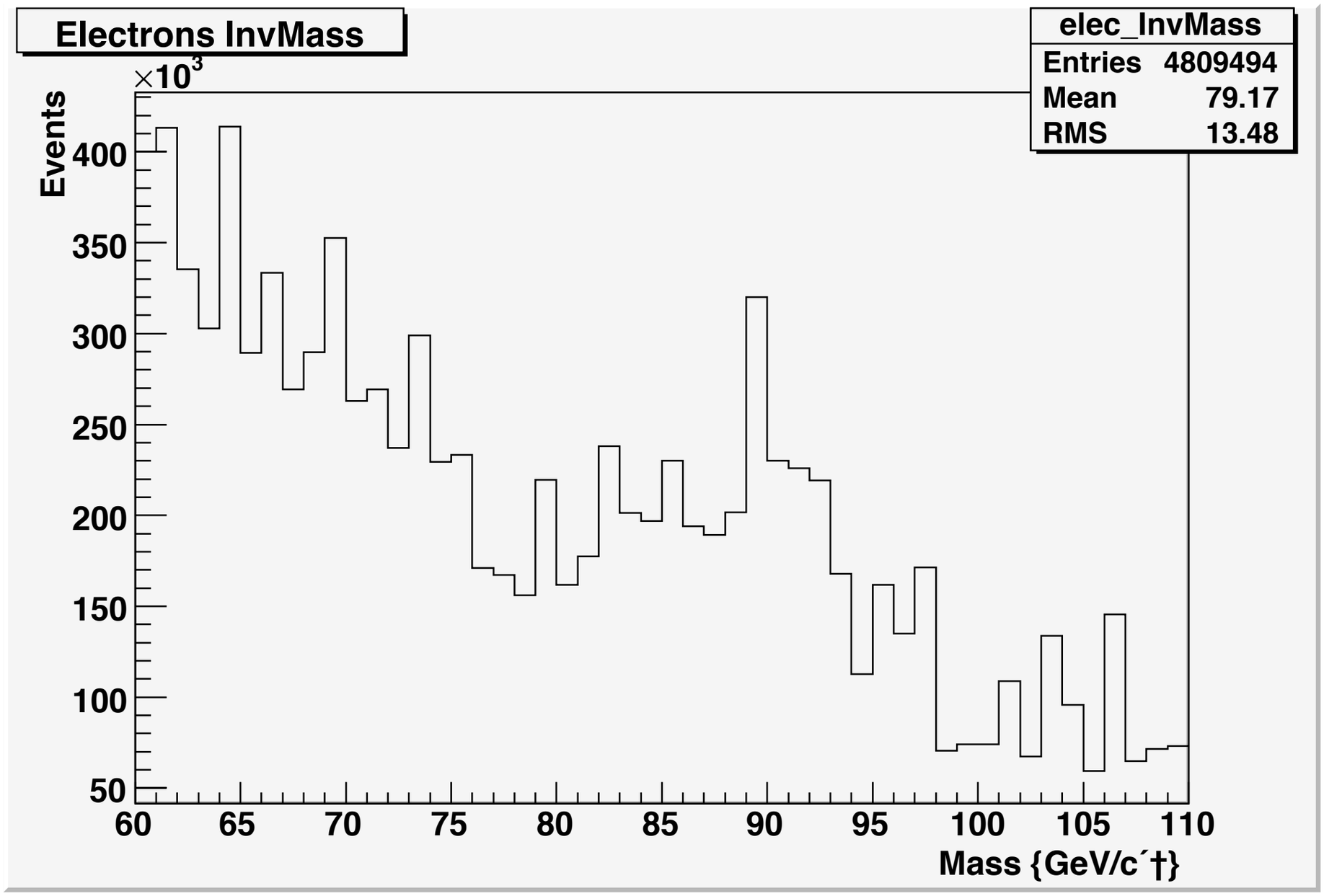
2. <|η|< 2.25

Fits


Entries 9589
Mean 88.84
RMS 6.727
χ^2 / ndf 286.4 / 44
Prob 0
Constant 645.2 ± 13.9
Mean 91.1 ± 0.1
σ_L 2.835 ± 0.099
σ_R 1.835 ± 0.084
α_L 0.2208 ± 0.0051
α_R 0.1862 ± 0.0069
Events
0
100
200
300
400
500
600
700
60
65
70
75
80
85
90
95
100
105
110
Mass {GeV/c´†}

2. 25 <|η|< 2.5

Background + signal



Background + signal