Z(ee)+n Jets Analysis

- Samples and selection criteria
- Data & MC tuning
- Data vs MC
- Plans

Samples and selection criteria

Samples

- **Data:**
  - EM1TRK skim
  - Single EM triggers
  - Run range: 20 April 2002 - 28 June 2004 (Runs 151,817 - 194,566)
  - Rejecting bad runs (CAL, SMT, CFT, Jet/Met, Lumi)
  - $323 pb^{-1}$
  - No T42 applied
  - Jetcorr v5.1
  - Processed with ATHENA (v01-05-02)
- **MC:**
  - Z/Gamma* > e^+e^- +X: 400k Pythia
  - Zj -> eej: 150k Alpgen + Pythia
  - Zjj -> eejj: 180k Alpgen + Pythia
  - Zjjj -> eejjj: 15k Alpgen + Pythia
  - Processed with ATHENA (v01-05-02)

Selection Criteria

- Removing bad runs/LBNs & dupli events
- PVX cut: |z|<60cm
- Using unprescaled single EM triggers
- Electron selection:
  - |ID|=10,11
  - EMF>0.9
  - Iso<0.15
  - HMx(7)<12
  - p_T>25GeV
  - |det_eta|<1.1
  - Including phi cracks
- Z selection:
  - 75GeV < M_{ee} < 105GeV
  - At least one trackmatched electron
  - At least one electron needs to fire the trigger
- Jet selection:
  - 0.05 < EMF < 0.95
  - HotF < 10
  - N90>1
  - CHF<0.4
  - L1conf
  - JES corrected p_T>20GeV
  - |det_eta|<2.5
  - Removal of jets overlapping with electrons from Z within dR of 0.4

Data & MC tuning

Z(ee)+n Jets (n=0,1,2,...): corrections

	Electrons	Jets
Data	- Correct for data EM inefficiencies - Correct for trigger inefficiencies - Correct for data tracking inefficiencies - Background subtraction	- JES 5.1
MC	- Electron smearing - Correct for MC EM inefficiencies - Correct for MC tracking inefficiencies - Correct for difference in Z pT between data and MC	- JES 5.1 - Jet smearing - Jet reco scaling factor

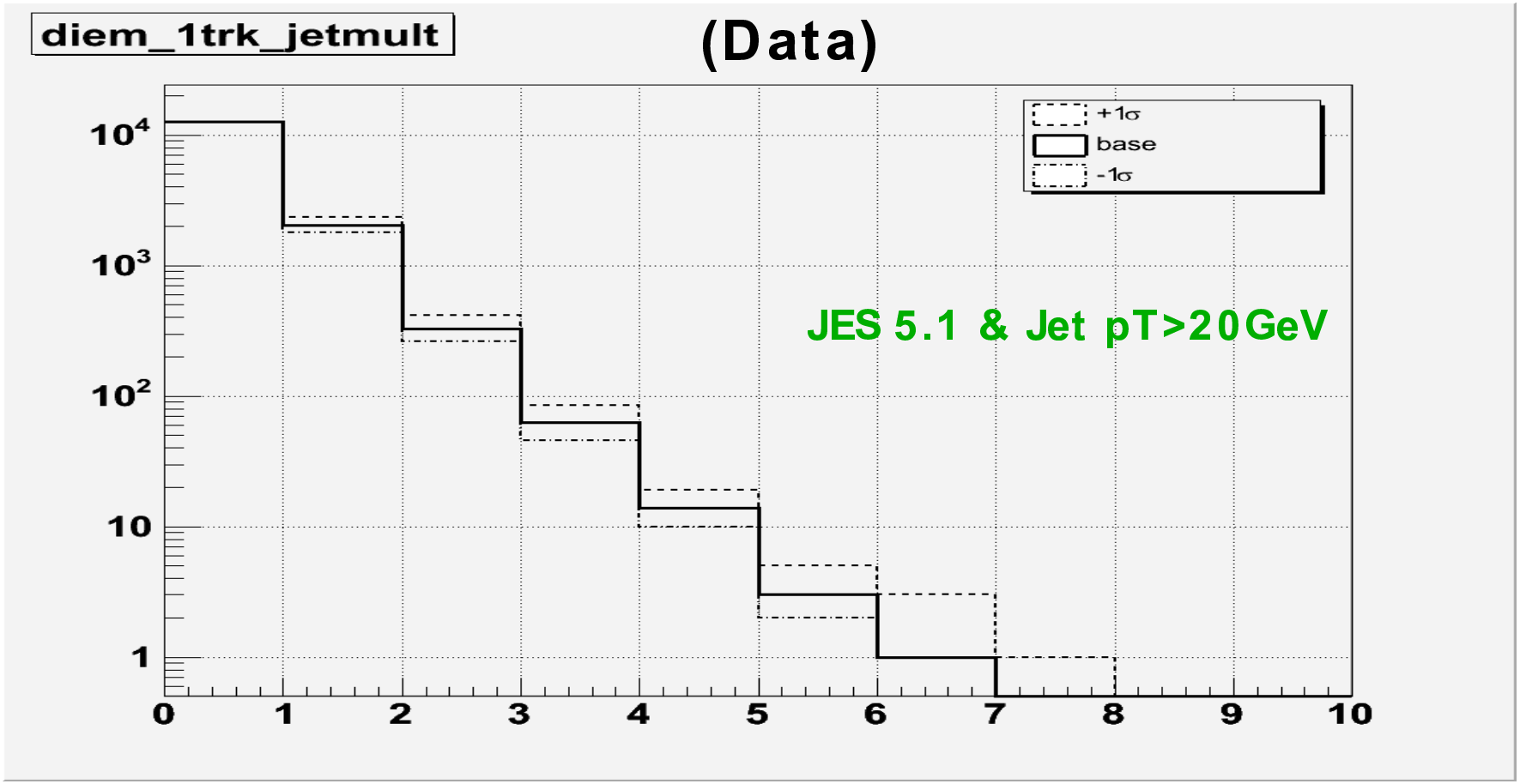
Data vs MC

- Normalization between data and MC is wrt area (shape comparisons)
- 2 versions of plots:

1trk	2trk
20GeV jets	25GeV jets

1trk
20GeV jets

Jet Multiplicities



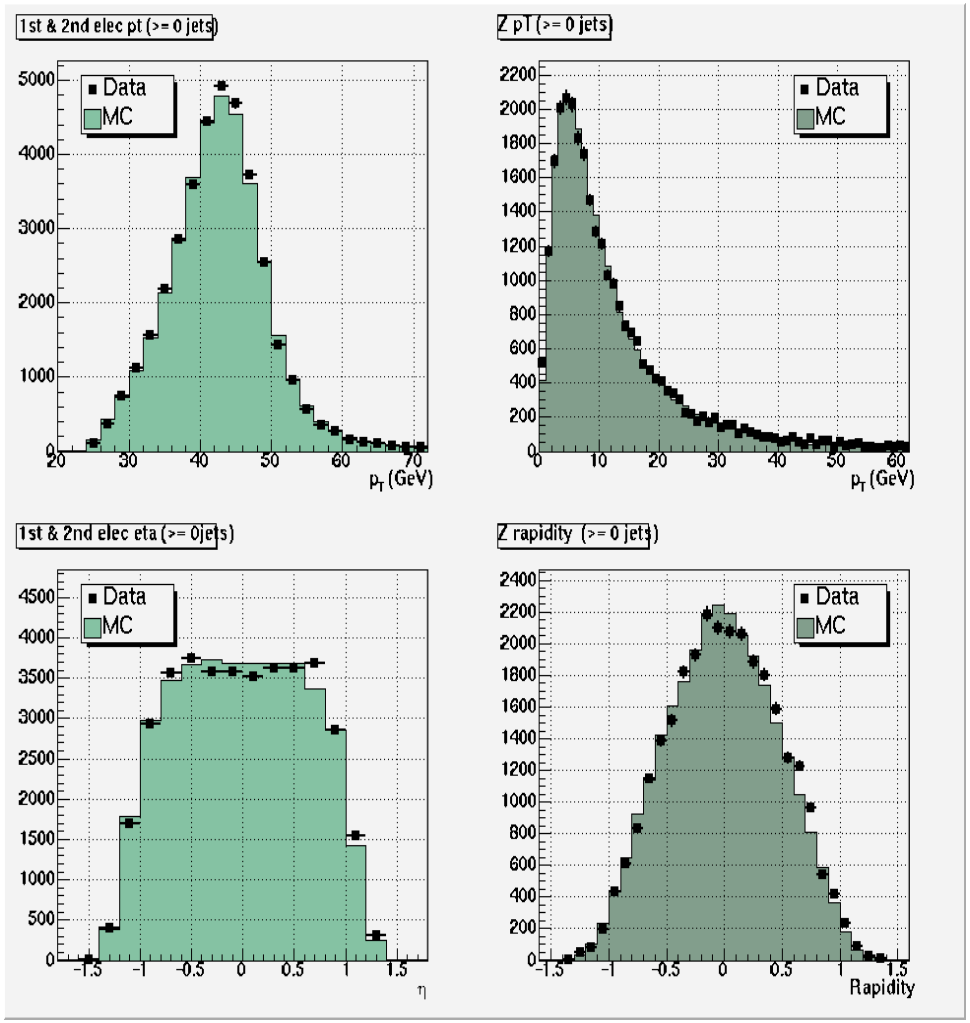
Inclusive # of jets	0	1	2	3	4	5	6
# events	12,718	2,033	327	63	14	3	1

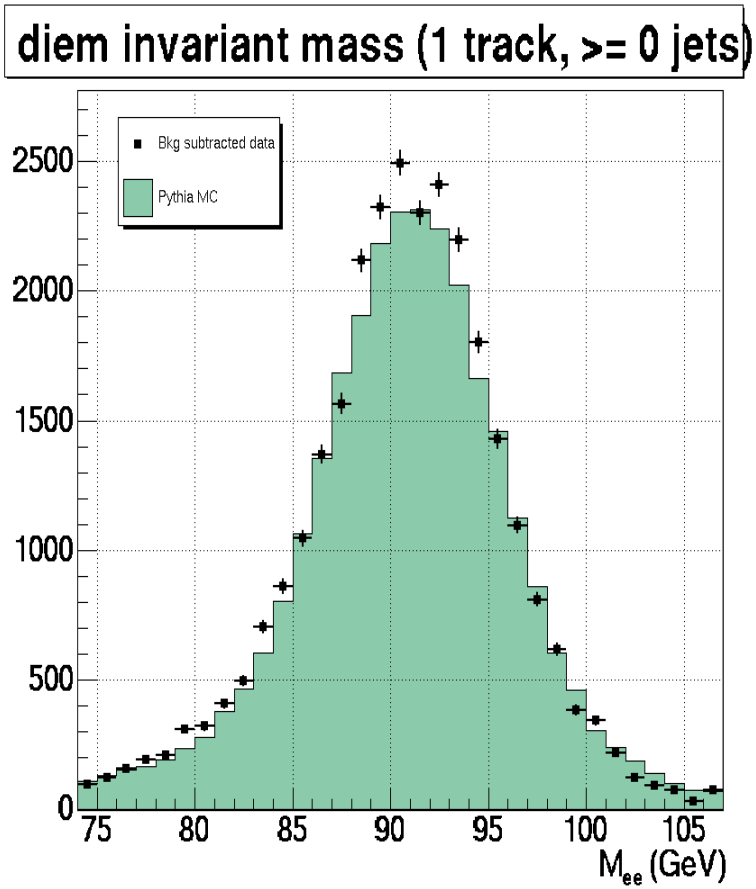
1trk
20GeV jets

Z(ee)+X: Electrons and Zs

Sample size ≈ 12k events

MC = Pythia





Mass = 90.92 GeV

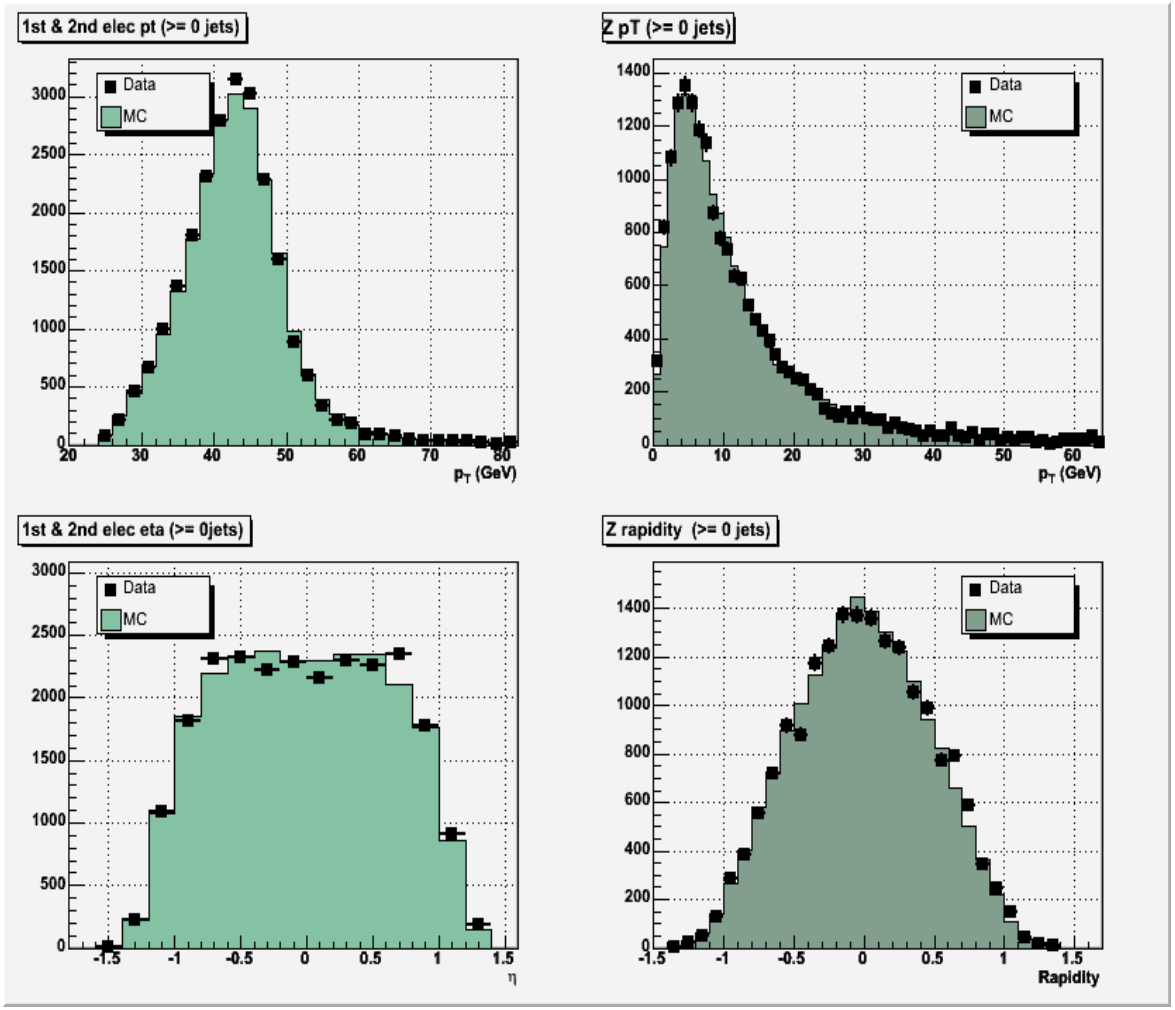
Width = 3.98 GeV

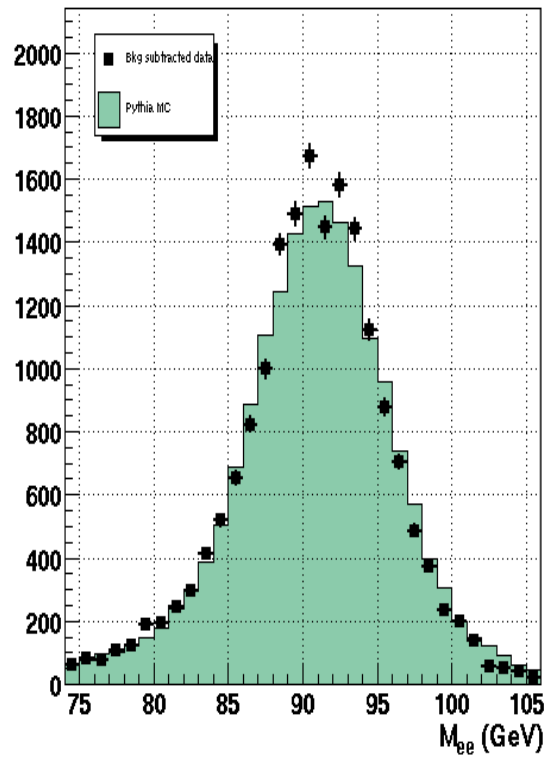
2trk
25GeV jets

Z(ee)+X: Electrons and Zs

Sample size ≈ 8k events

MC = Pythia





Mass = 90.96 GeV

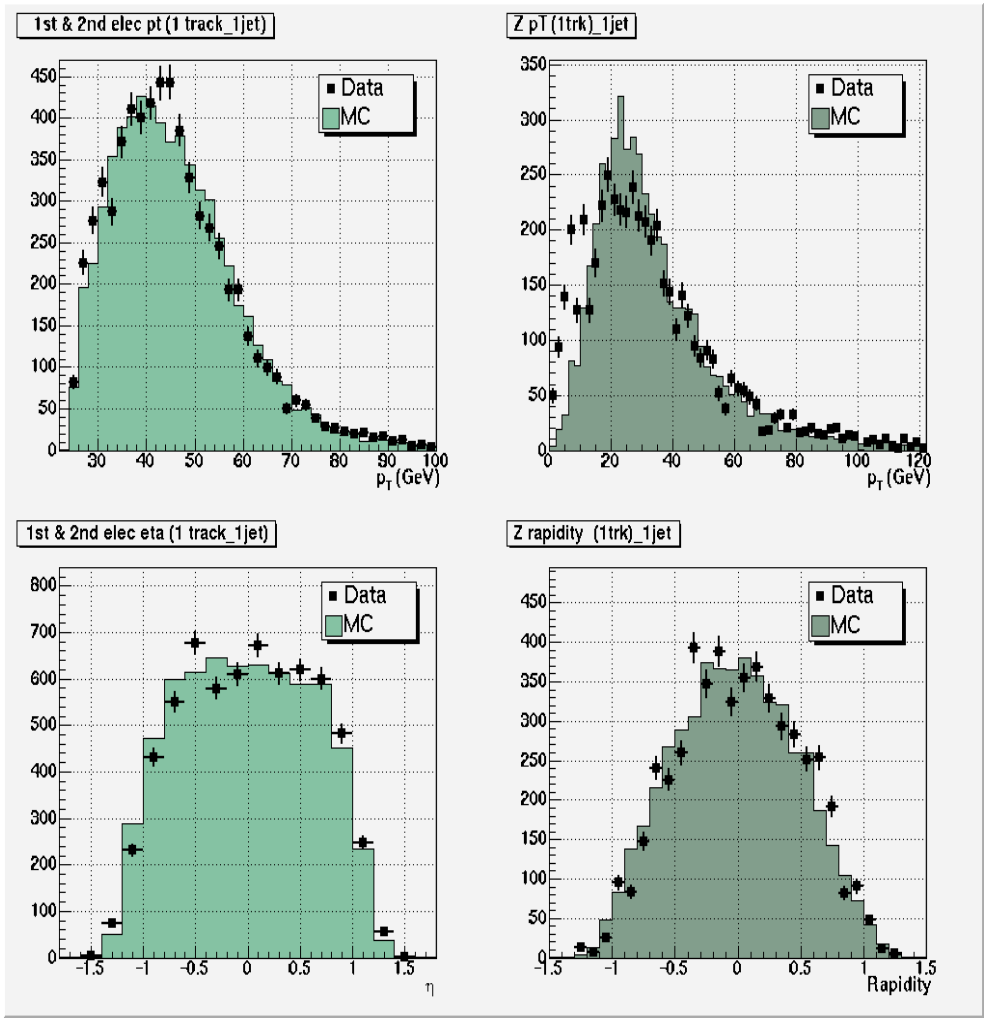
Width = 3.79 GeV

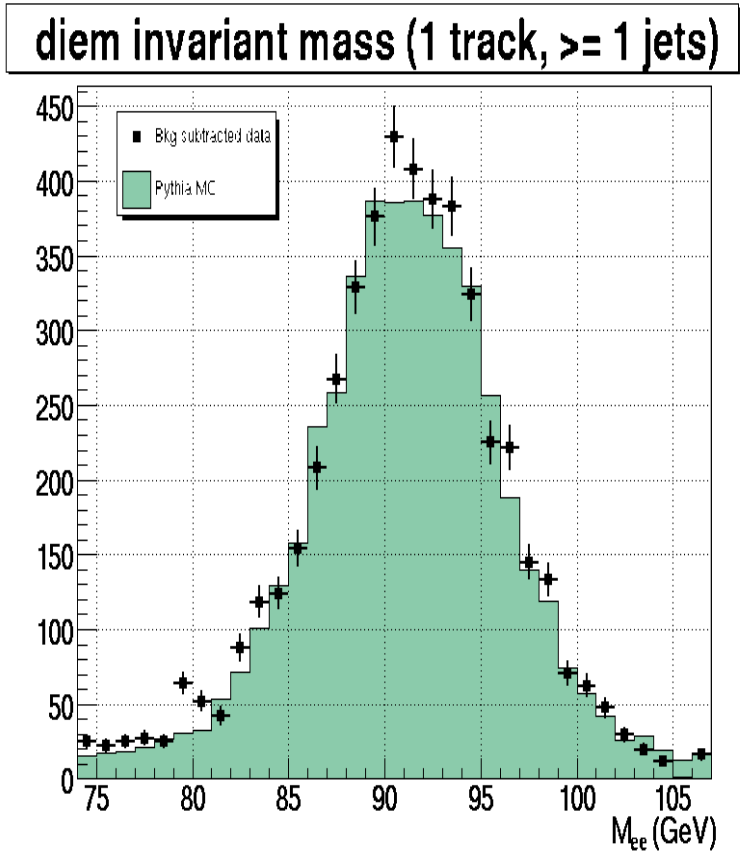
1trk
20GeV jets

Z(ee) + ≥1jet(s): Electrons and Zs

Sample size ≈ 2k events

MC = Zj Alpgen





Mass = 91.27 GeV

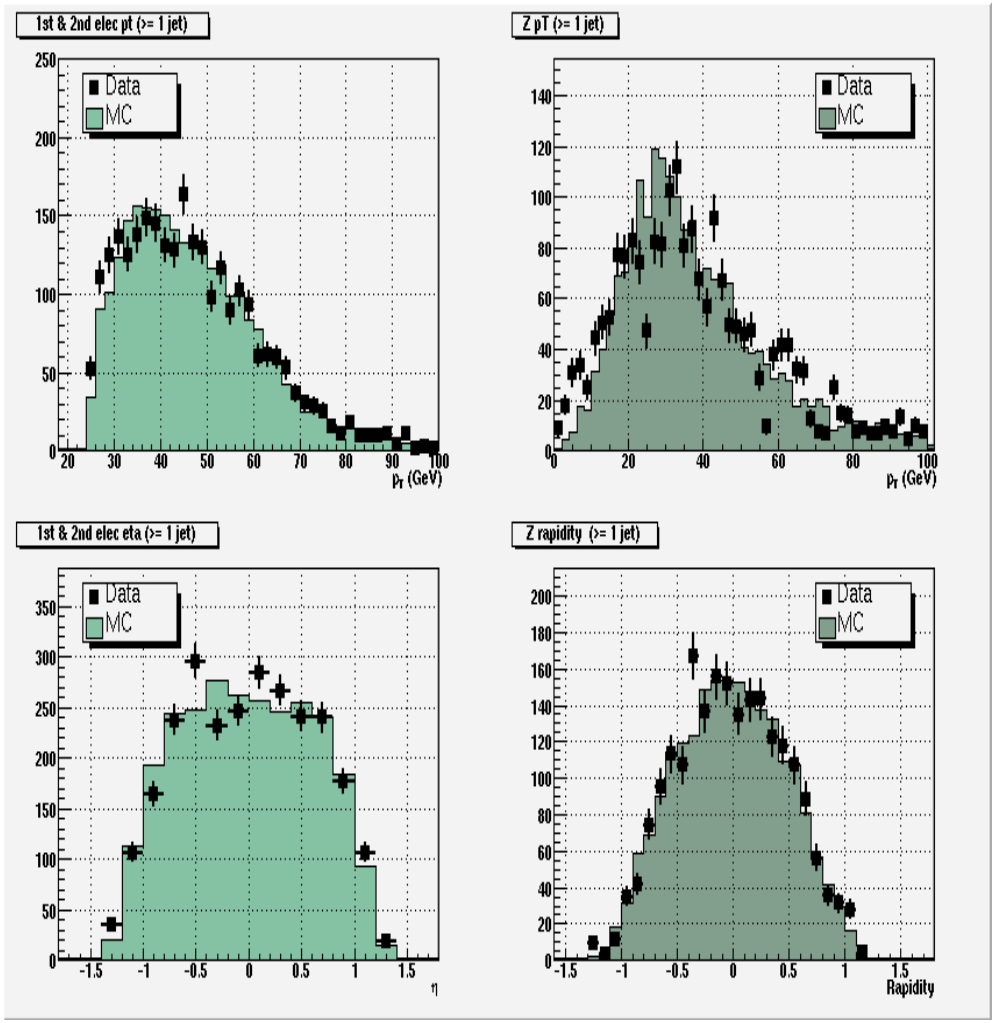
Width = 4.00 GeV

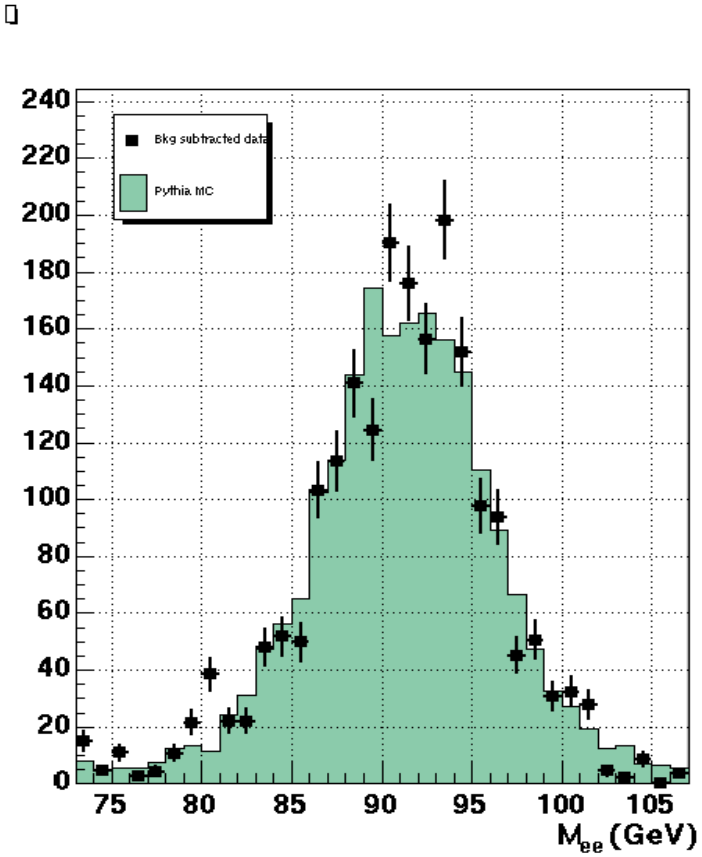
2trk
25GeV jets

Z(ee) + ≥1jet(s): Electrons and Zs

Sample size ≈ 800 events

MC = Zj Alpgen





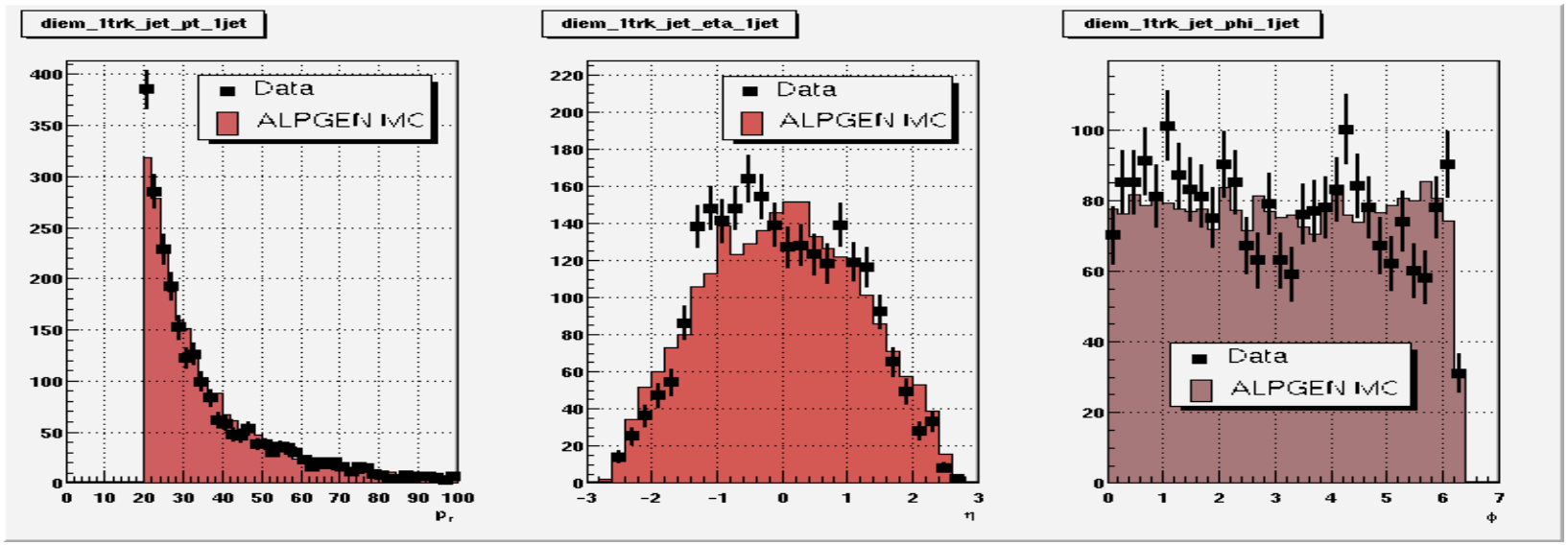
Mass = 91.38 GeV

Width = 3.84 GeV

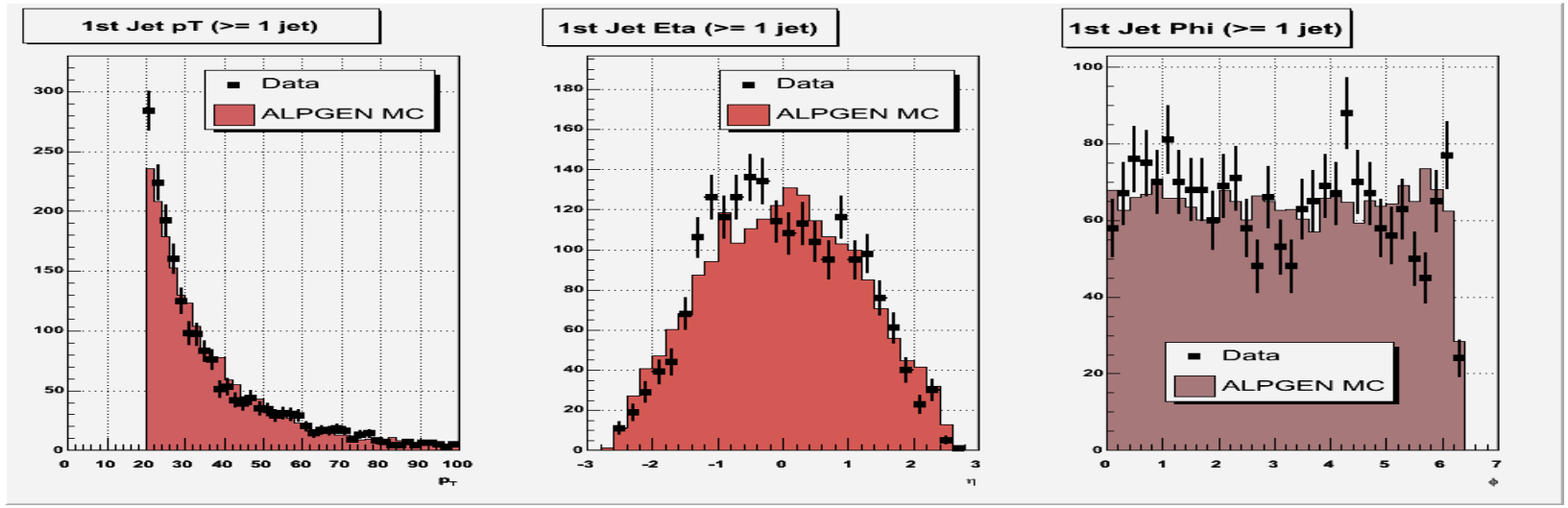
1trk
20GeV jets

Z(ee) + ≥1jet(s): Jets

All Jets



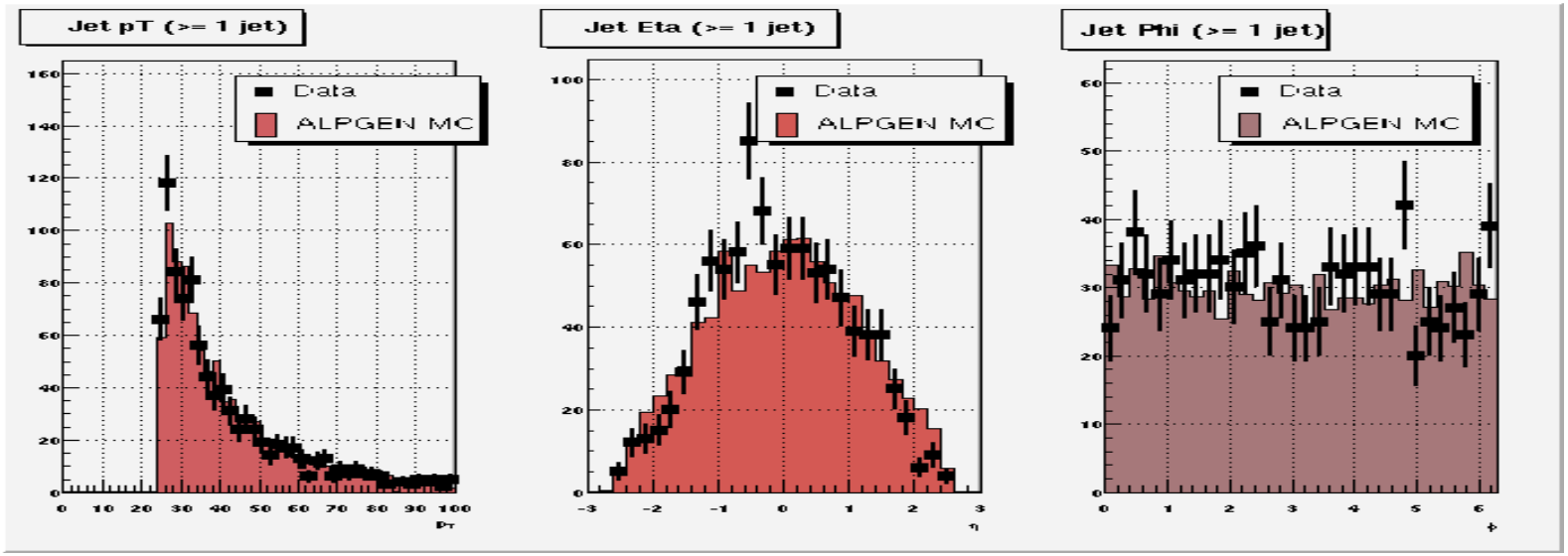
Lead Jet



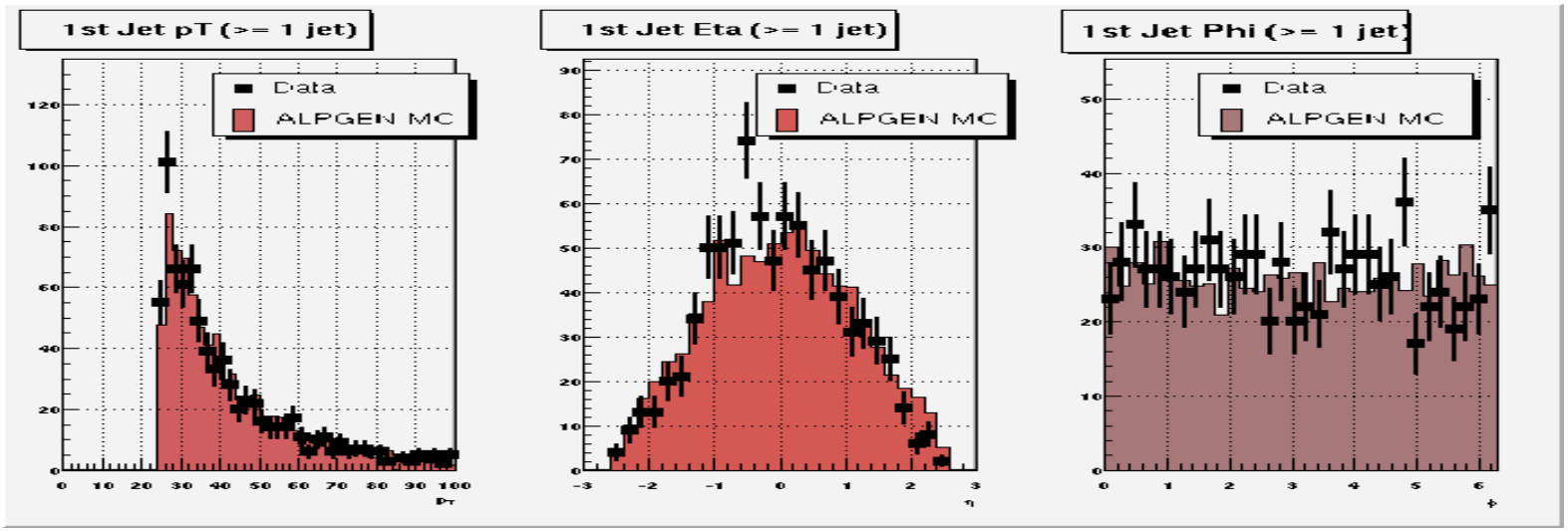
2trk
25GeV jets

Z(ee) + ≥1jet(s): Jets

All Jets



Lead Jet

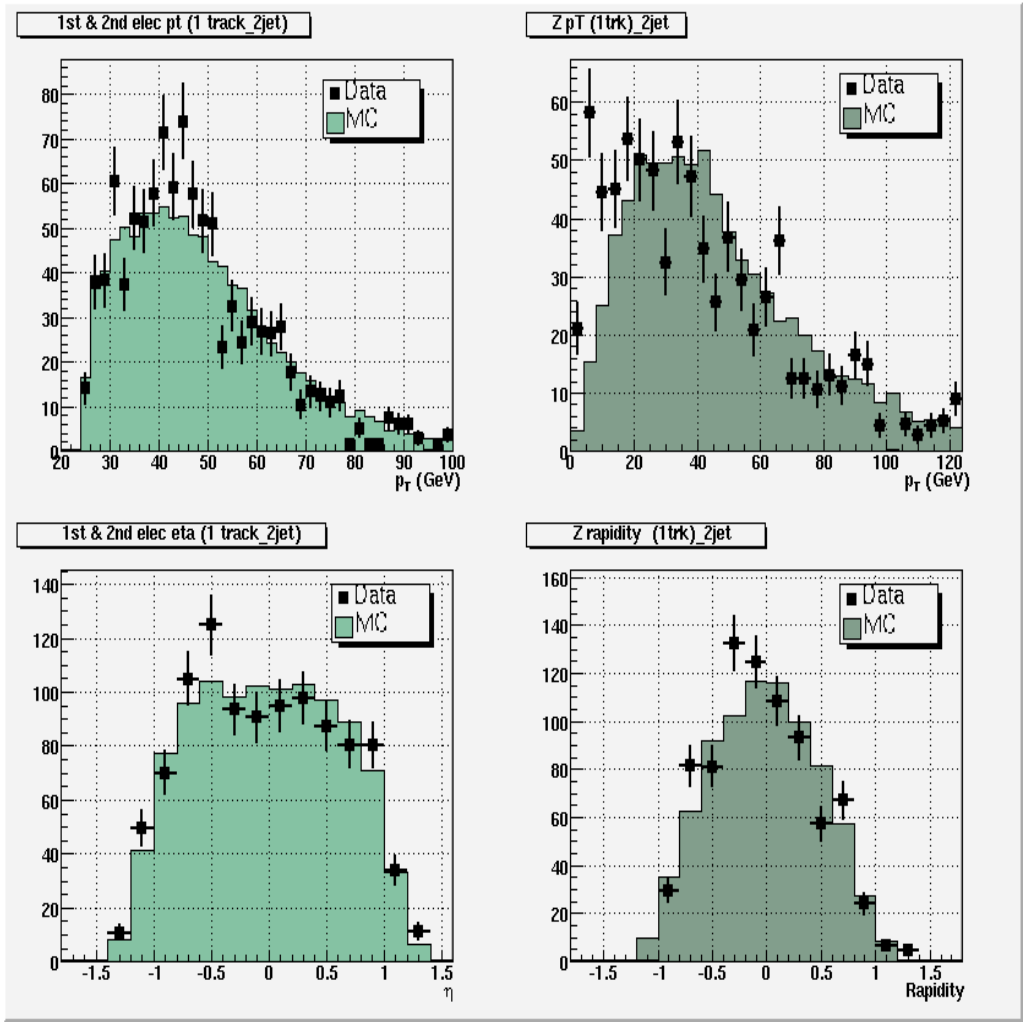


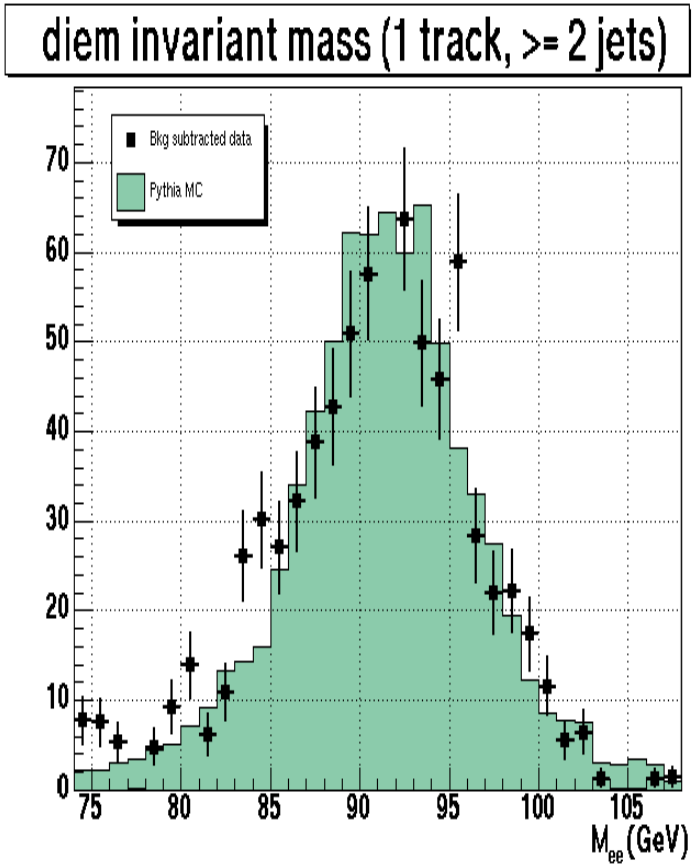
1trk
20GeV jets

Z(ee) + ≥ 2 jet(s): Electrons and Zs

Sample size ≈ 300 events

MC = Zjj Alpgen





Mass = 91.22 GeV

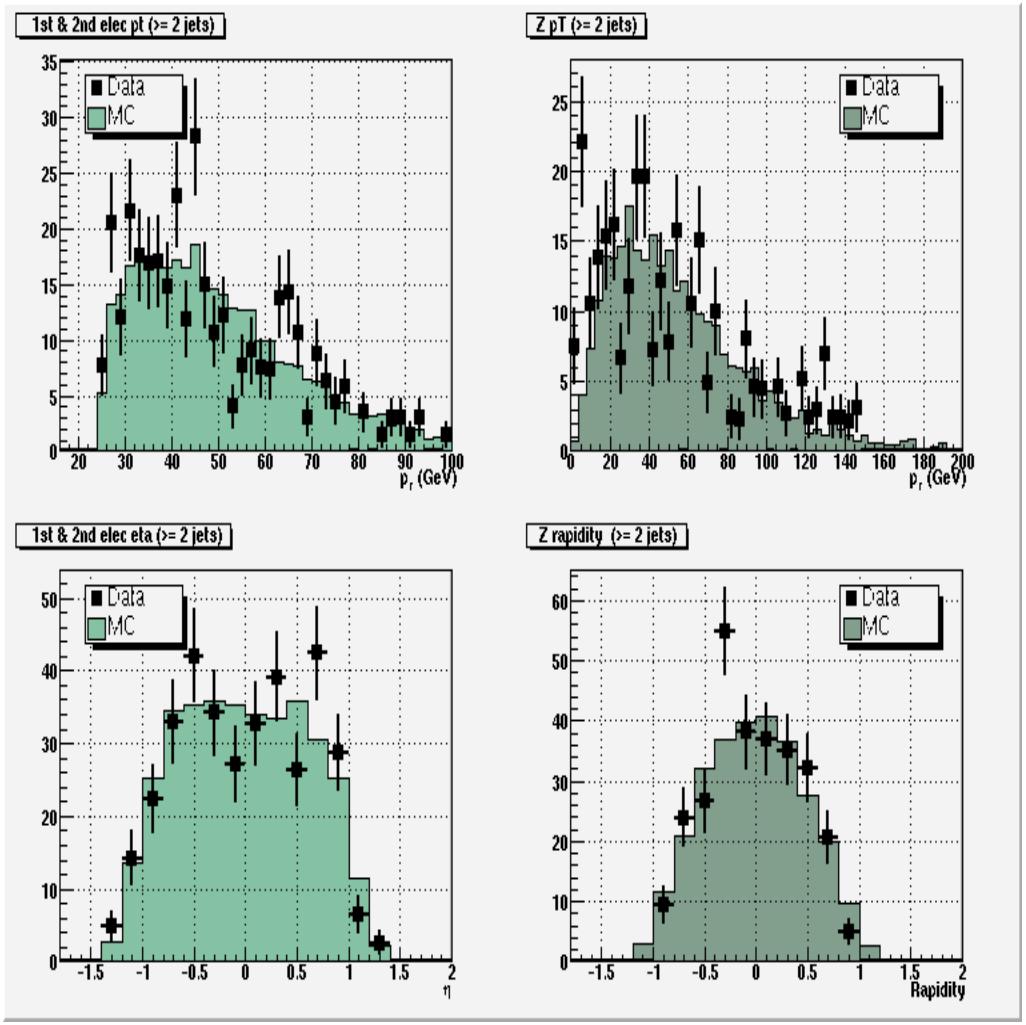
Width = 4.21 GeV

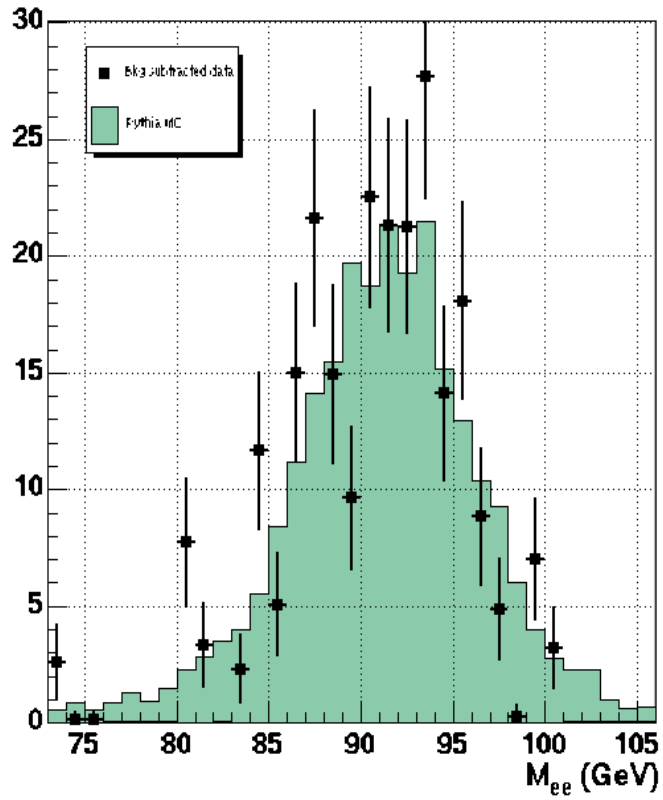
2trk
25GeV jets

Z(ee) + ≥ 2 jet(s): Electrons and Zs

Sample size ≈ 100 events

MC = Zjj Alpgen





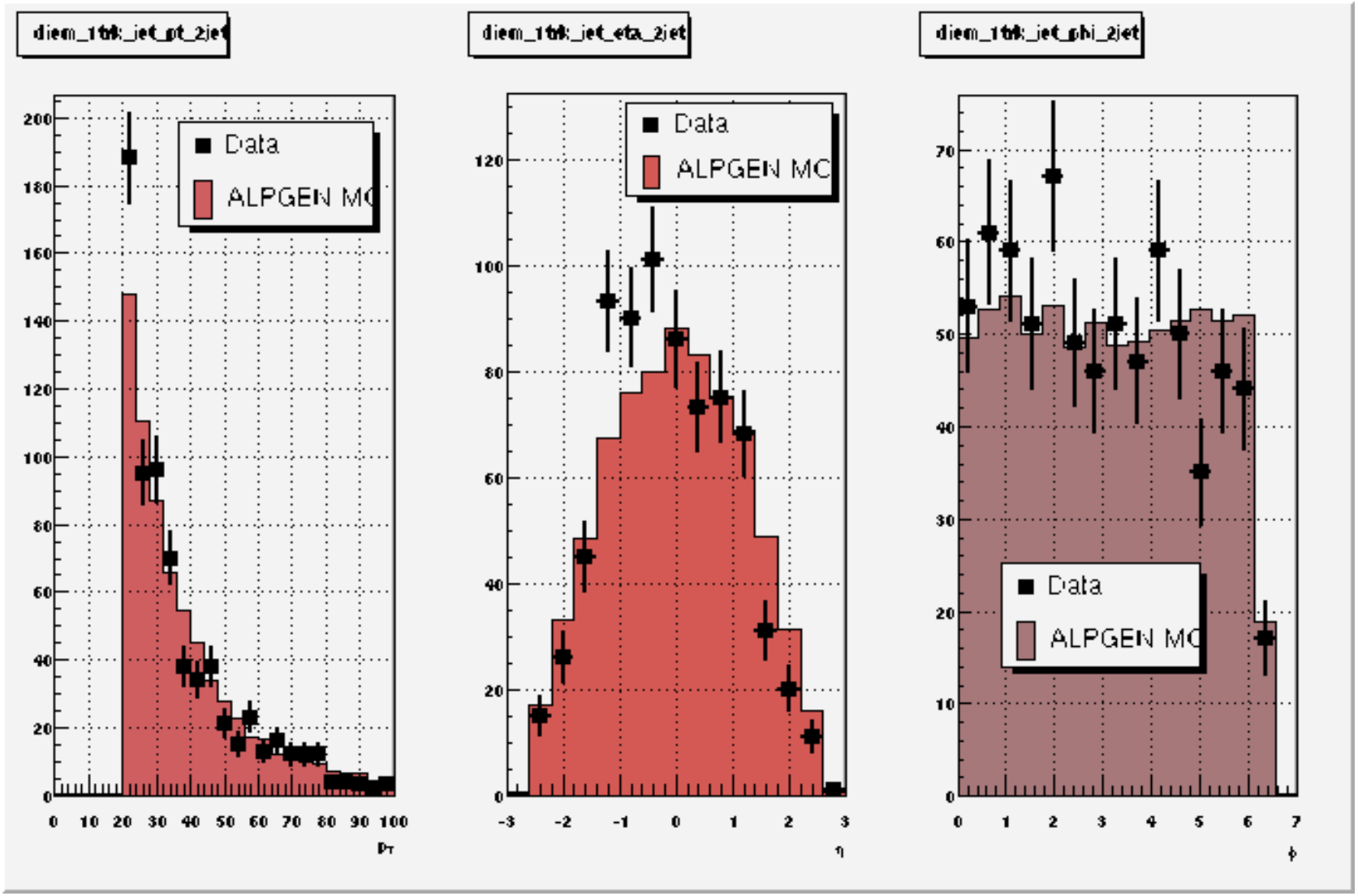
Mass = 91.25 GeV

Width = 3.21 GeV

1trk
20GeV jets

Z(ee) + ≥2 jet(s): Jets

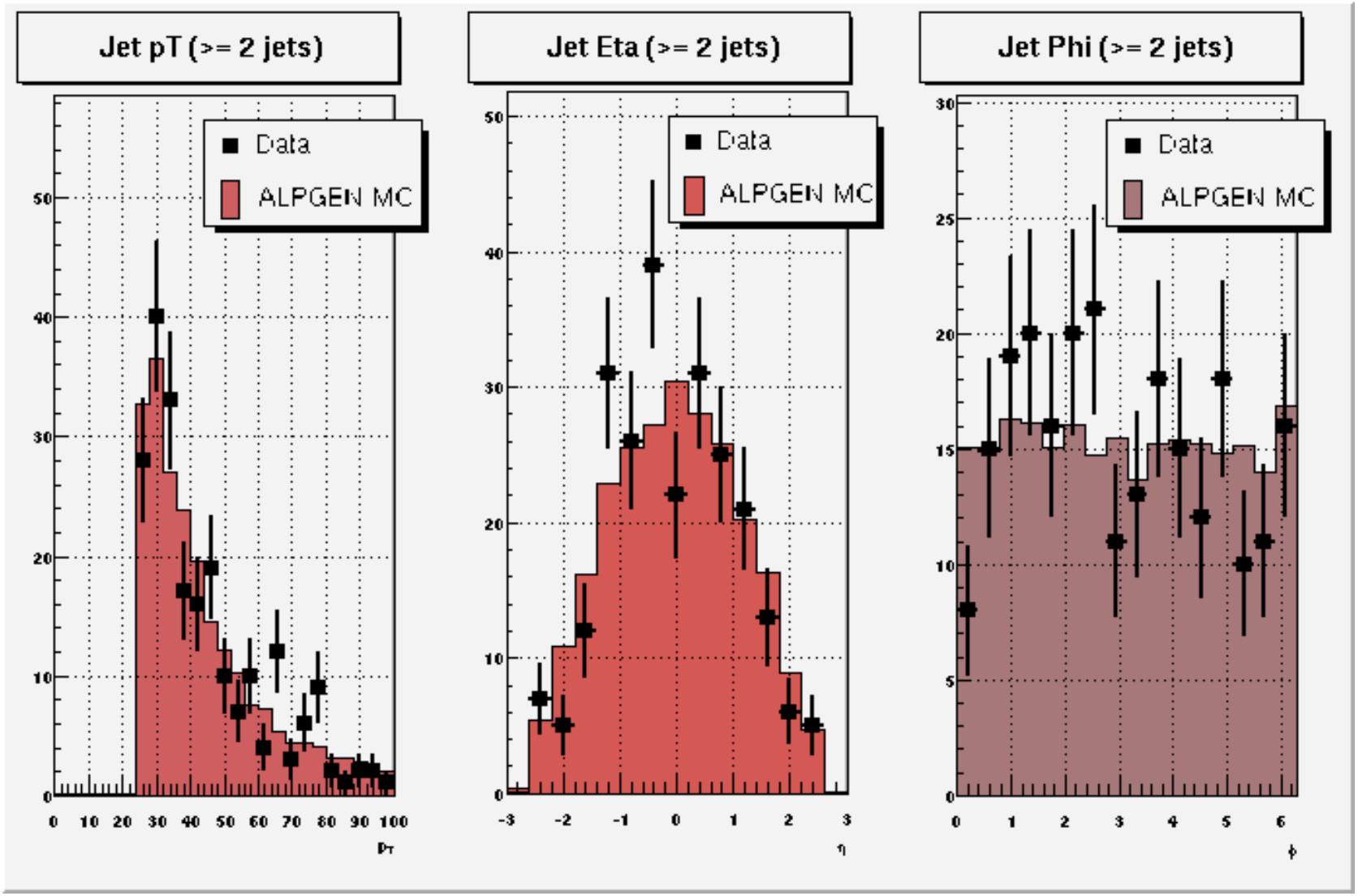
All Jets



2trk
25GeV jets

Z(ee) + ≥2 jet(s): Jets

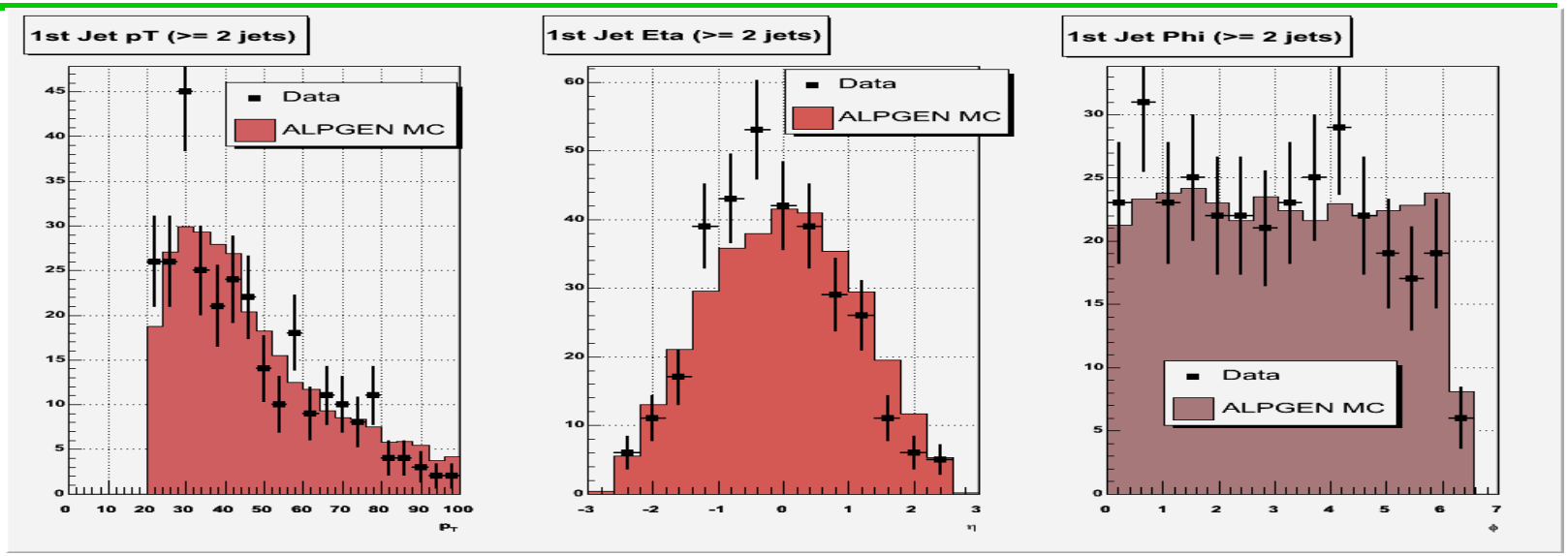
All Jets



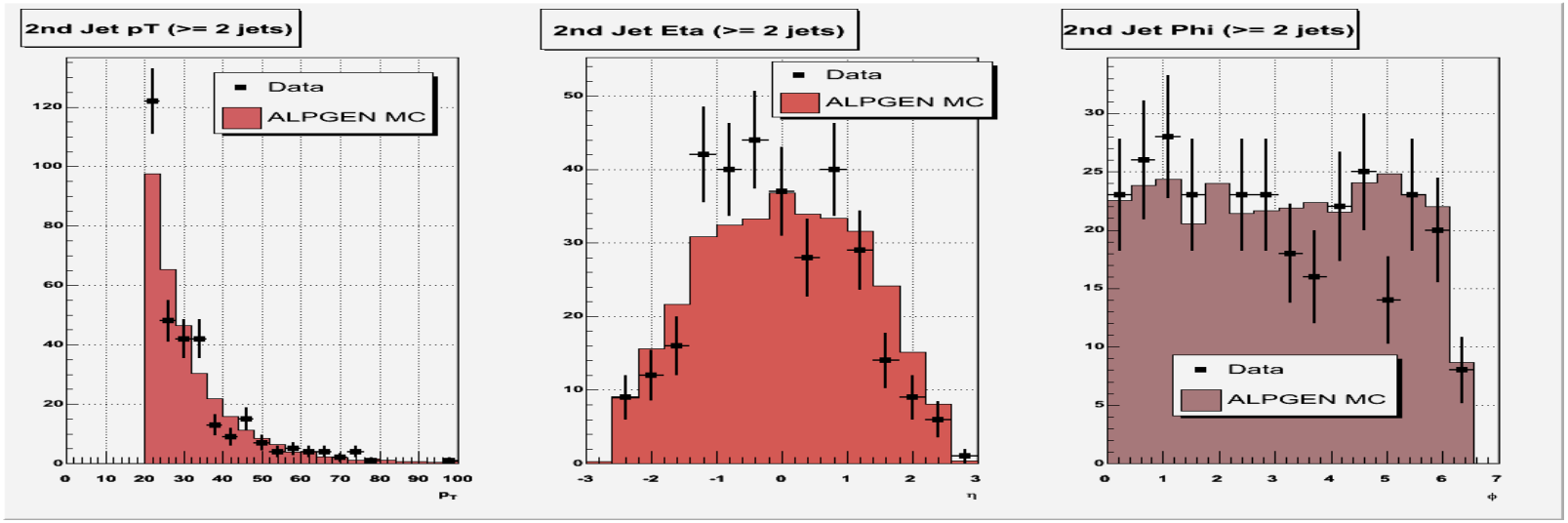
1trk
20GeV jets

Z(ee) + ≥2 jet(s): Jets

Lead Jet



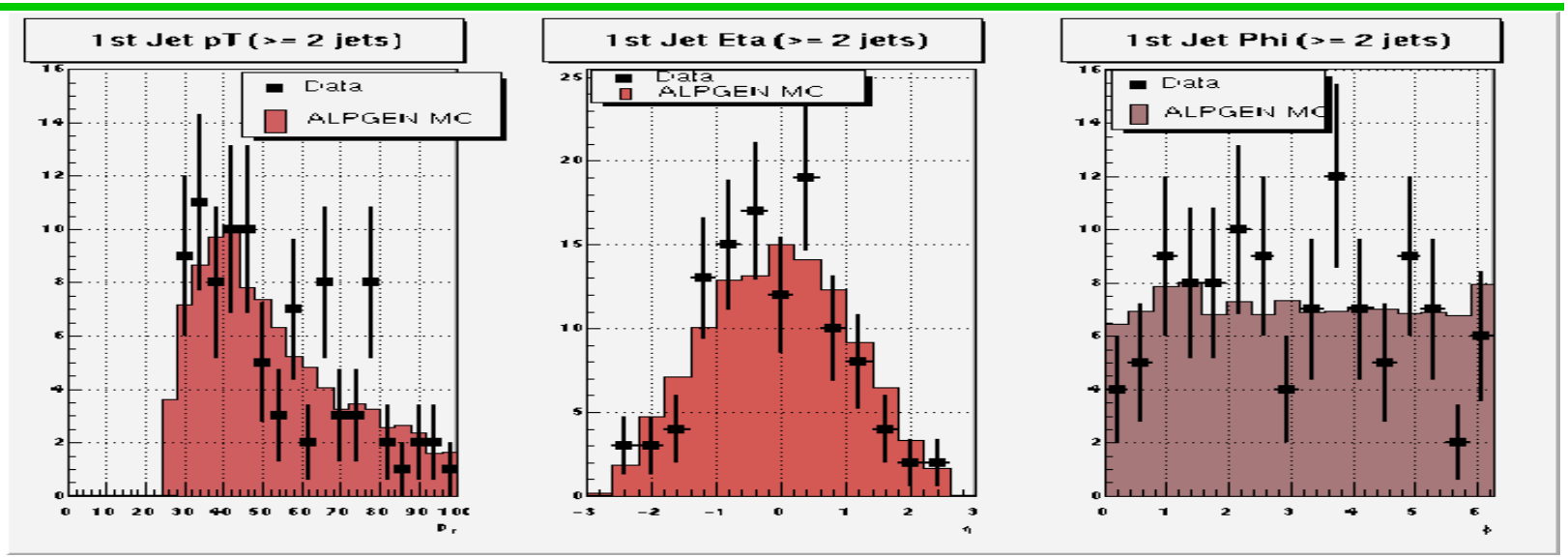
Next-to-lead Jet



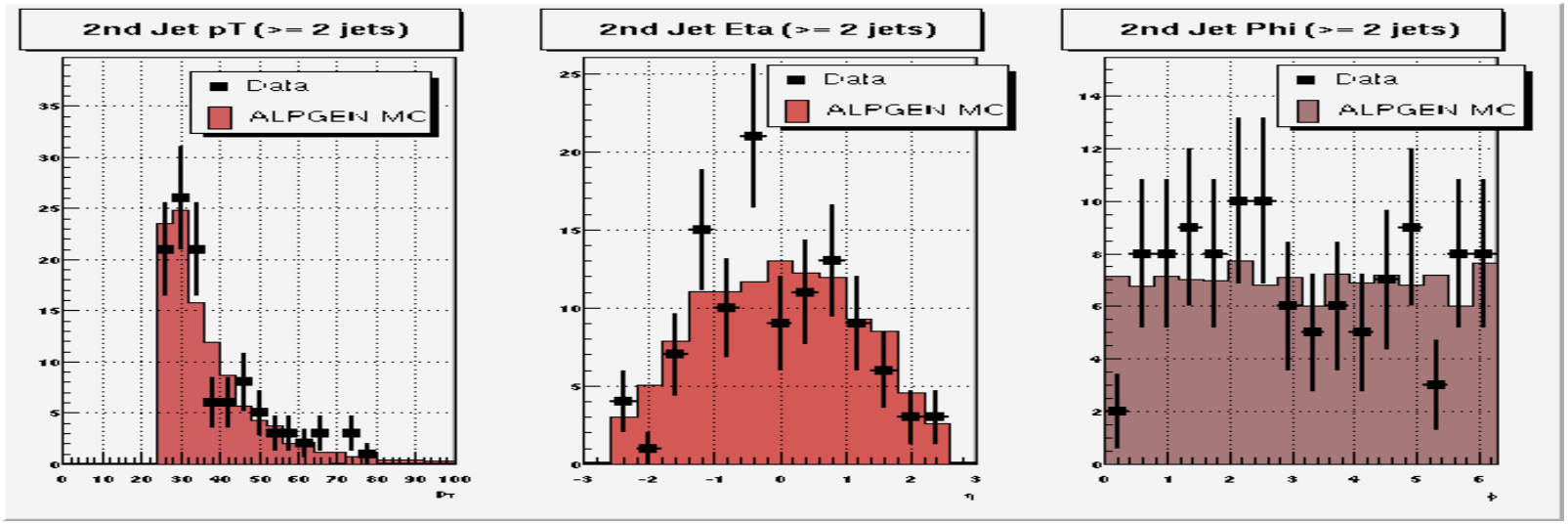
2trk
25GeV jets

Z(ee) + ≥2 jet(s): Jets

Lead Jet



Next-to-lead Jet



Plans

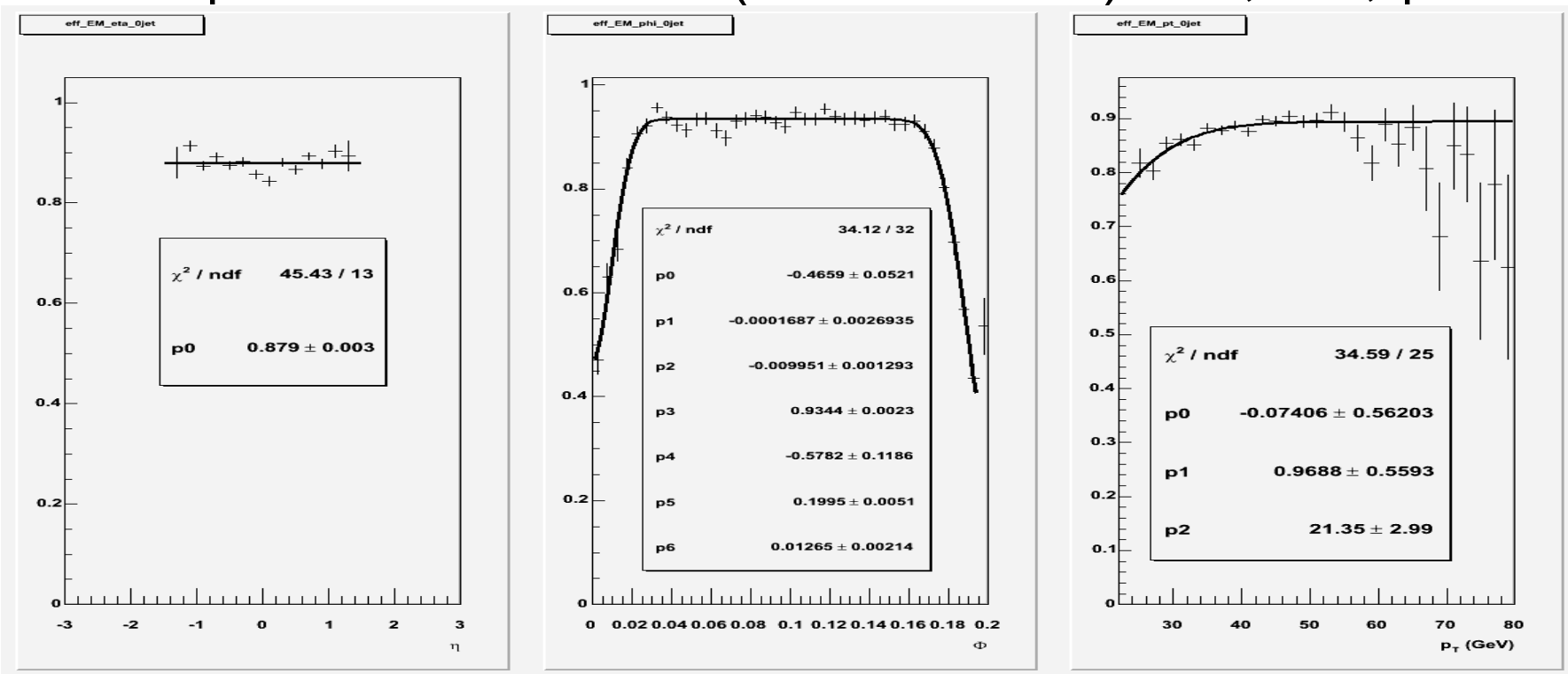
- Switch from JES5.1 to JES5.3
- Data vs MC:
  - need to understand all data features
  - Normalize wrt xsection
- Acceptance for different jet multiplicities
- Xsections
- Analysis note is in preparation

Z(ee)+X: EM (data)

Averaged EM efficiency **w/ o** SB subtraction = **88.0%** +- 0.3

Averaged EM efficiency **with** SB subtraction = **88.6%** +- 0.3

1D parameterizations (w/o SB subtr): Eta, Phi, pT



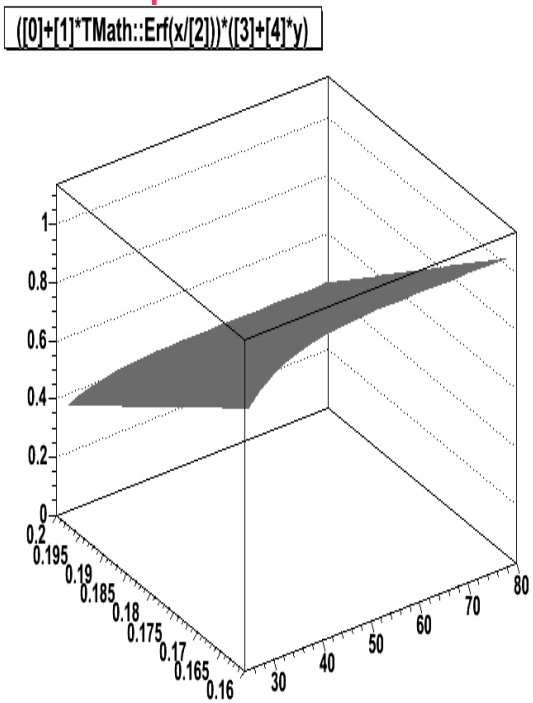
Flat eta

2D parameterization for pT and phi needed (next slide)

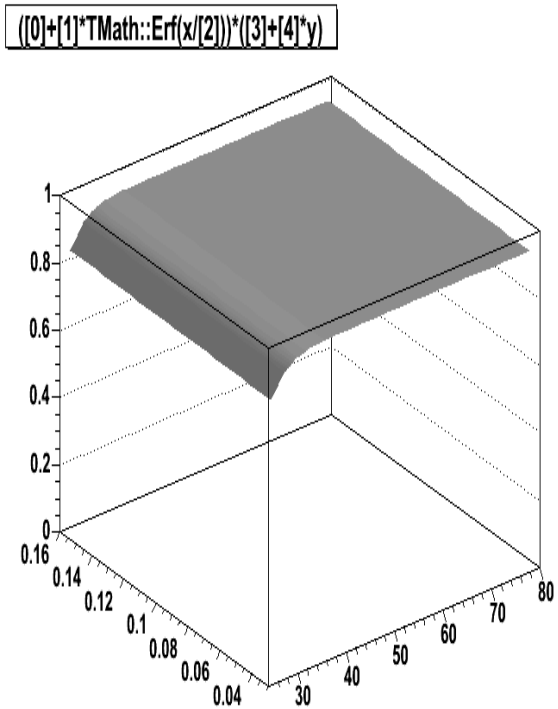
Z(ee)+X: EM (data)

2D parameterization (w/o SB subtr): pT vs Phi

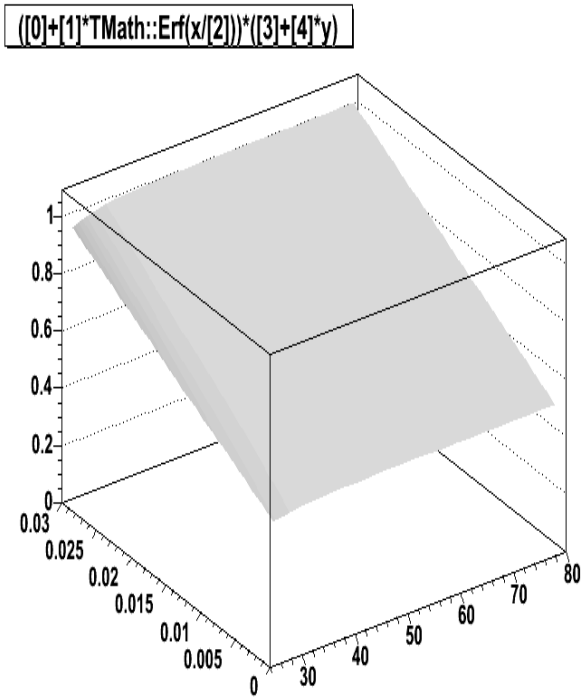
These plots are used to correct for EM inefficiencies for all jet multiplicities!



p0= -2.34953e-02
p1= 1.39917e-01
p2= 2.37790e+01
p3= 3.06092e+01
p4= -1.34375e+02



p0= -3.61703e+00
p1= 3.89949e+00
p2= 1.36172e+01
p3= 3.33038e+00
p4= 1.77957e-01



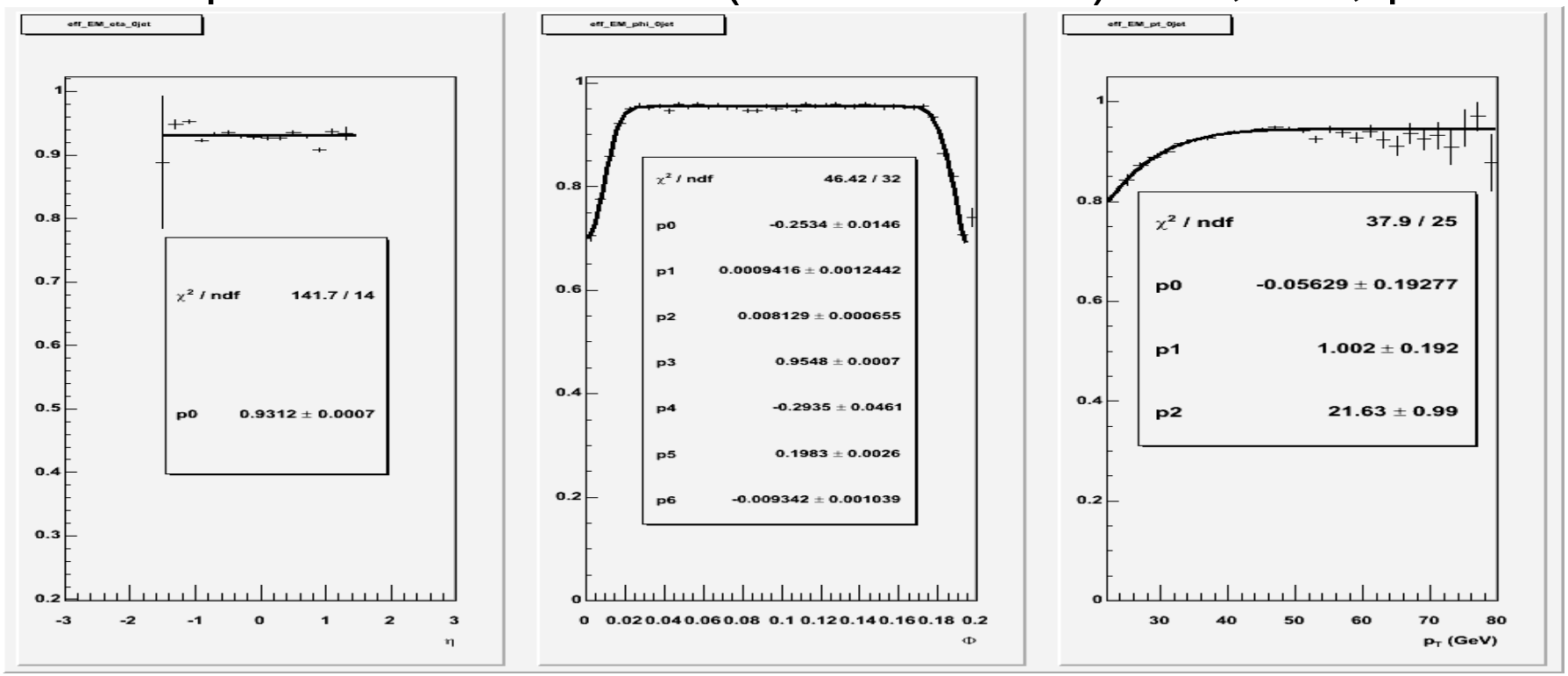
p0= -8.69193e-02
p1= 9.54774e-01
p2= 1.79537e+01
p3= 5.80844e-01
p4= 1.98381e+01

Z(ee)+X: EM (MC)

Averaged EM efficiency **w/ o** SB subtraction = **93.2%** +- 0.1

Averaged EM efficiency **with** SB subtraction = **93.3%** +- 0.1

1D parameterizations (w/o SB subtr): Eta, Phi, pT



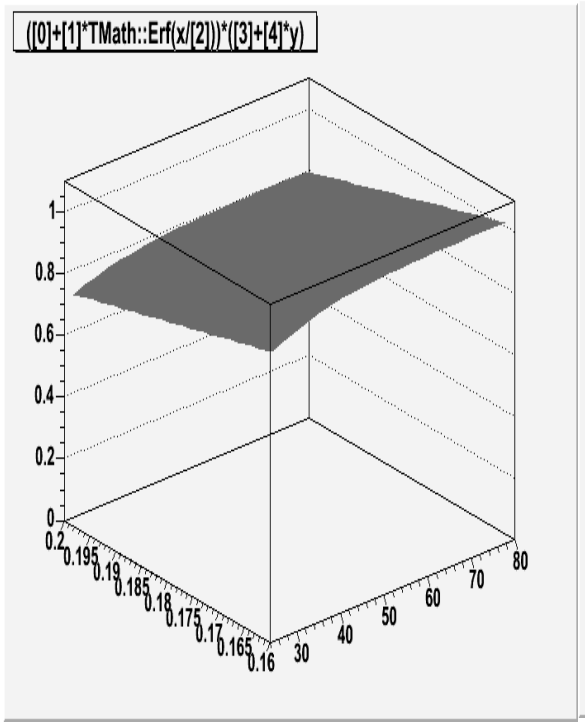
Flat eta

2D parameterization for pT and phi needed (next slide)

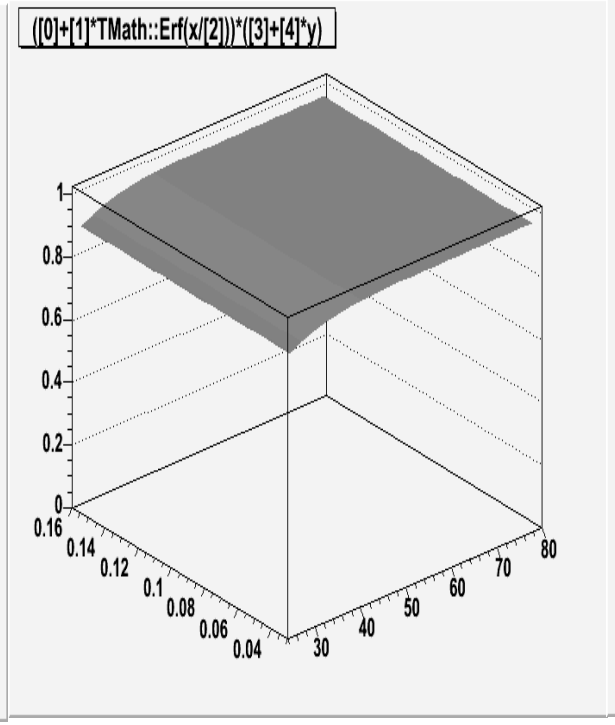
Z(ee)+X: EM (MC)

2D parameterization (w/o SB subtr): pT vs Phi

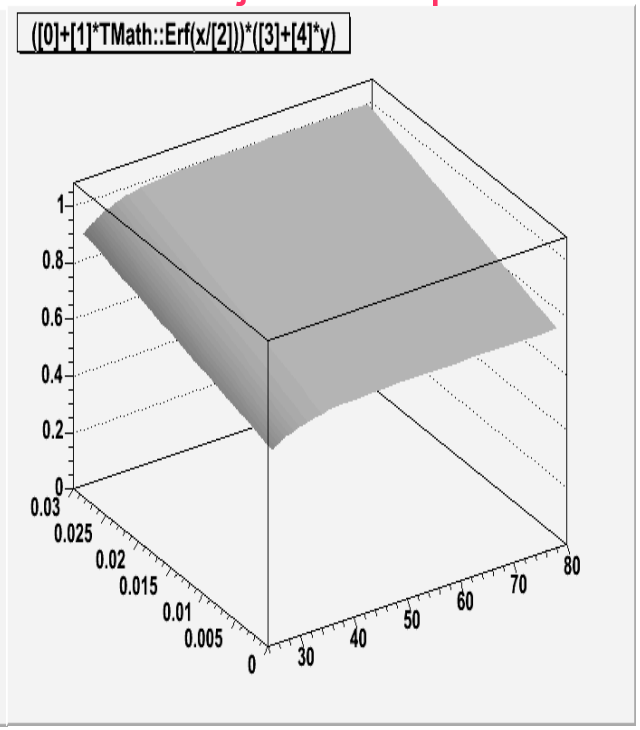
These plots are used to correct for EM inefficiencies for all jet multiplicities!



p0= 6.14594e-02
p1= 4.05125e-02
p2= 3.12857e+01
p3= 1.89872e+01
p4= -5.52882e+01

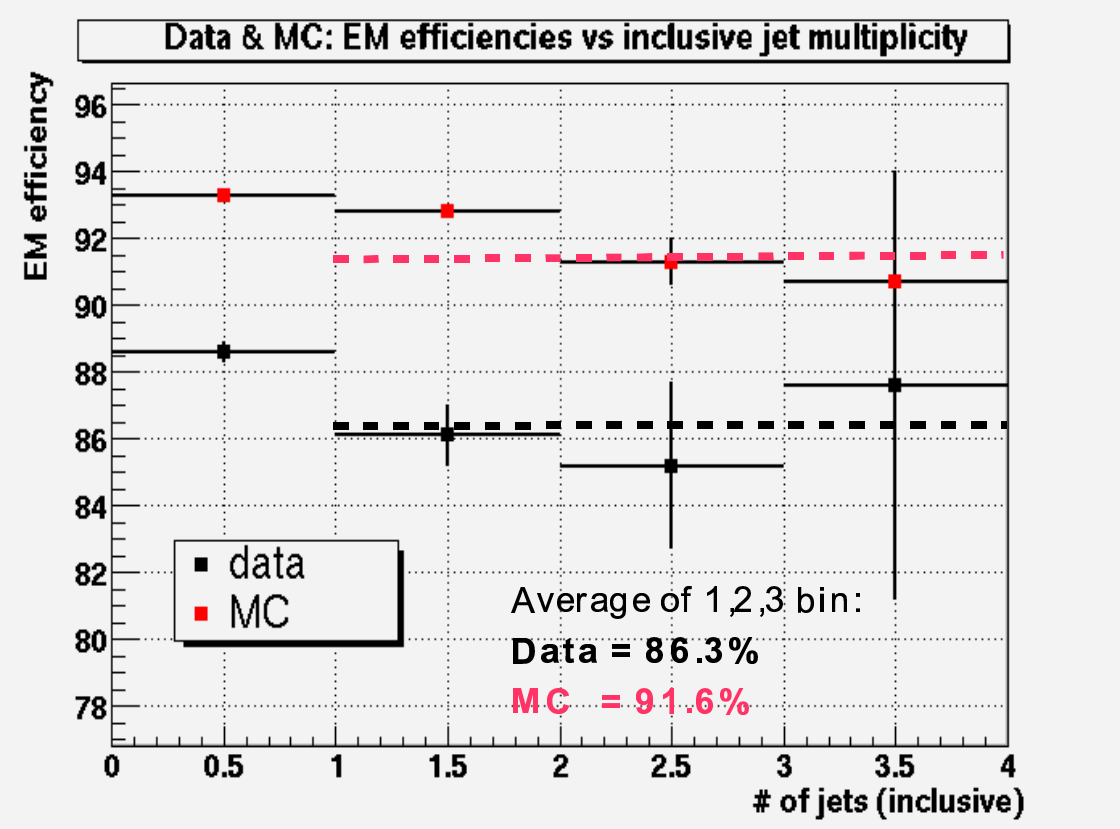


p0= 4.42093e-01
p1= 8.43046e-01
p2= 2.30857e+01
p3= 7.57404e-01
p4= -3.30983e-03



p0= -3.17203e-01
p1= 1.12591e+00
p2= 2.02681e+01
p3= 9.33264e-01
p4= 1.08388e+01

Z(ee)+n Jets: EM (data & MC)



After applying the pt/phi parameterized efficiency correction to all samples the following ratio is supposed to take care of the residual inefficiencies due to jet activity:

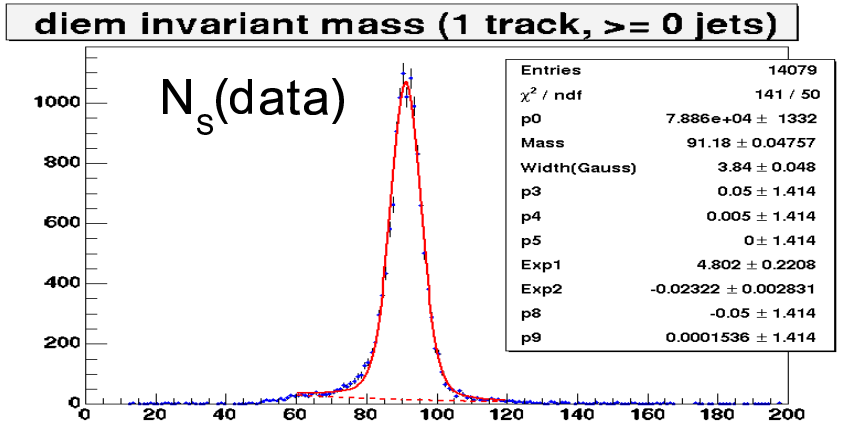
EM_jet_corr (data) = 88.6%/86.3%
= 1.03

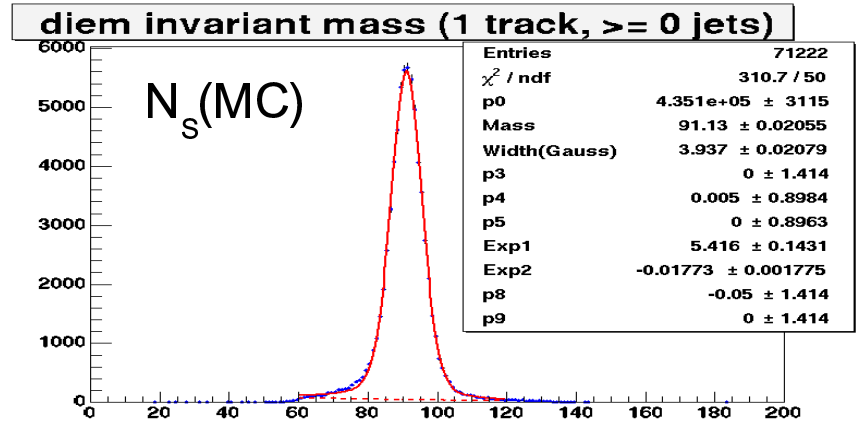
EM_jet_corr (MC) = 93.3%/91.6%
= 1.02

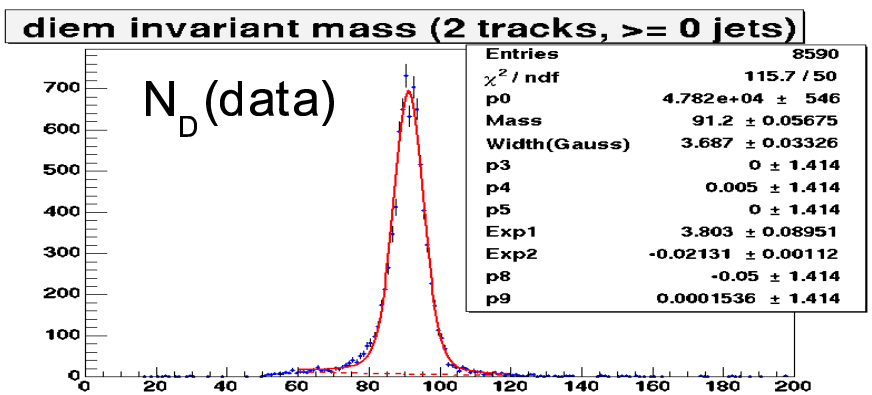
Jet mult	0	1	2	3	4
Data	88.6+-0.3	86.1+-0.9	85.2+-2.5	87.6+-6.4	-
MC	93.3+-0.1	92.8+-0.2	91.3+-2.3	90.7+-2.3	(88.5+-10.8)

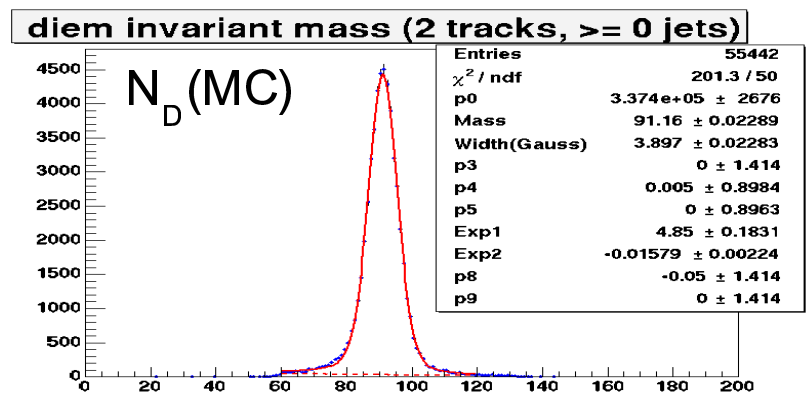
Z(ee)+X: Track (data & MC)

$$Eff = 2N_D / (N_D + N_S)$$





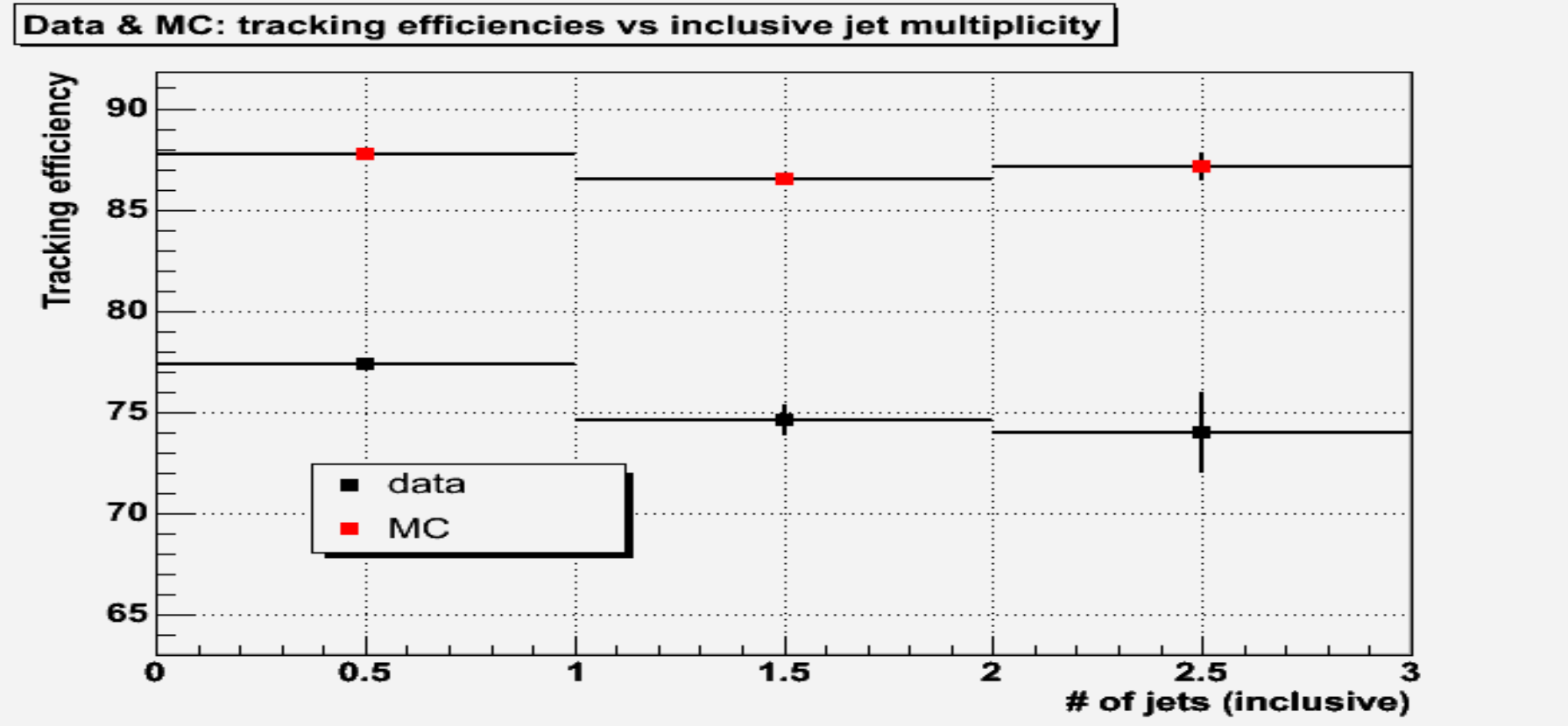




Eff(data) = **77.4%** +- 0.3

Eff(MC) = **87.7%** +- 0.1

Z(ee)+n Jets: Track (data & MC)



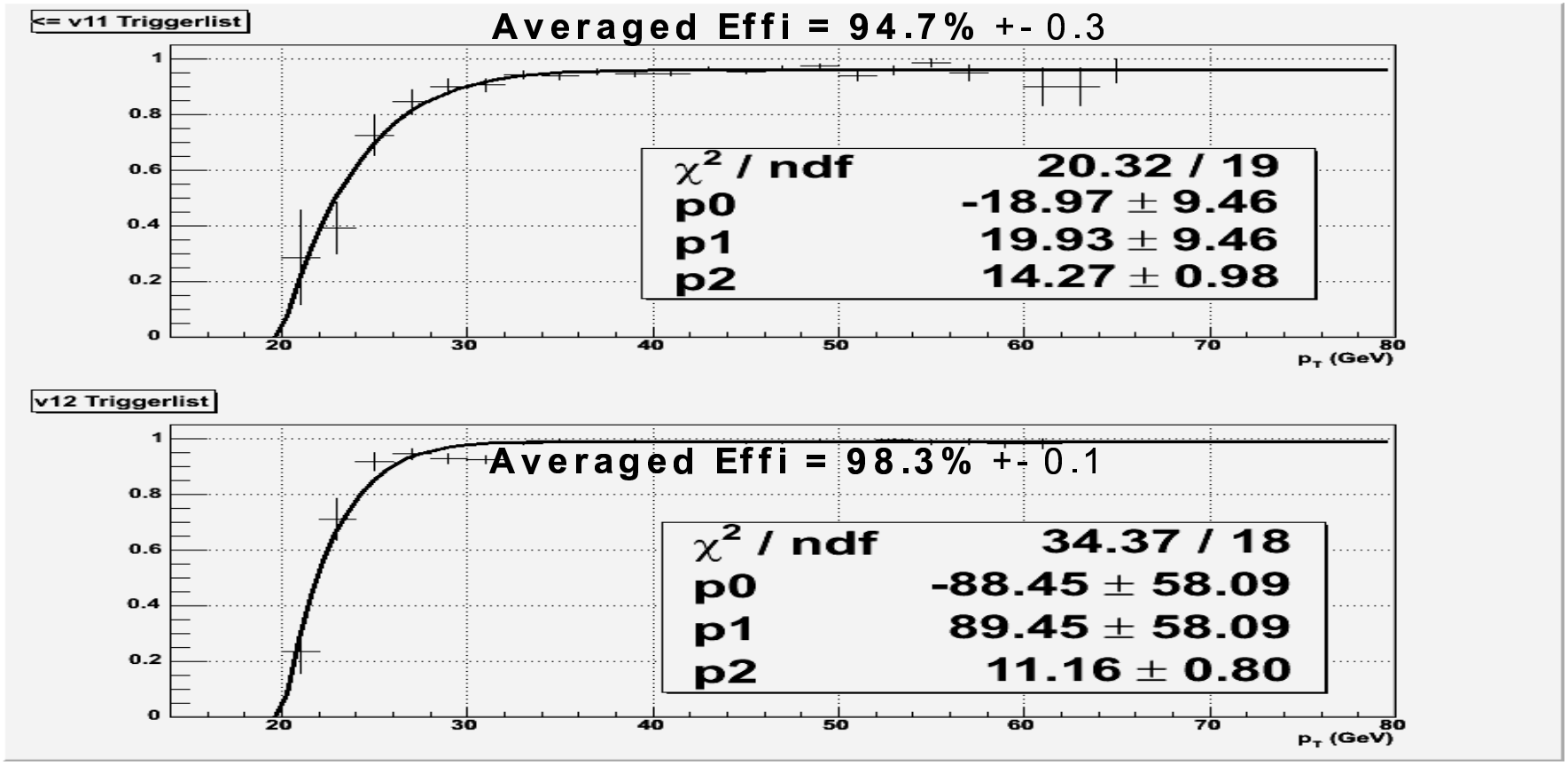
Jet mult	0	1	2
data	77.4+-0.3	74.6+-0.8	74.0+-2.0
MC	87.7+-0.1	86.5+-0.3	87.1+-0.7

Average (data) = 75.3%

Average (MC) = 87.1%

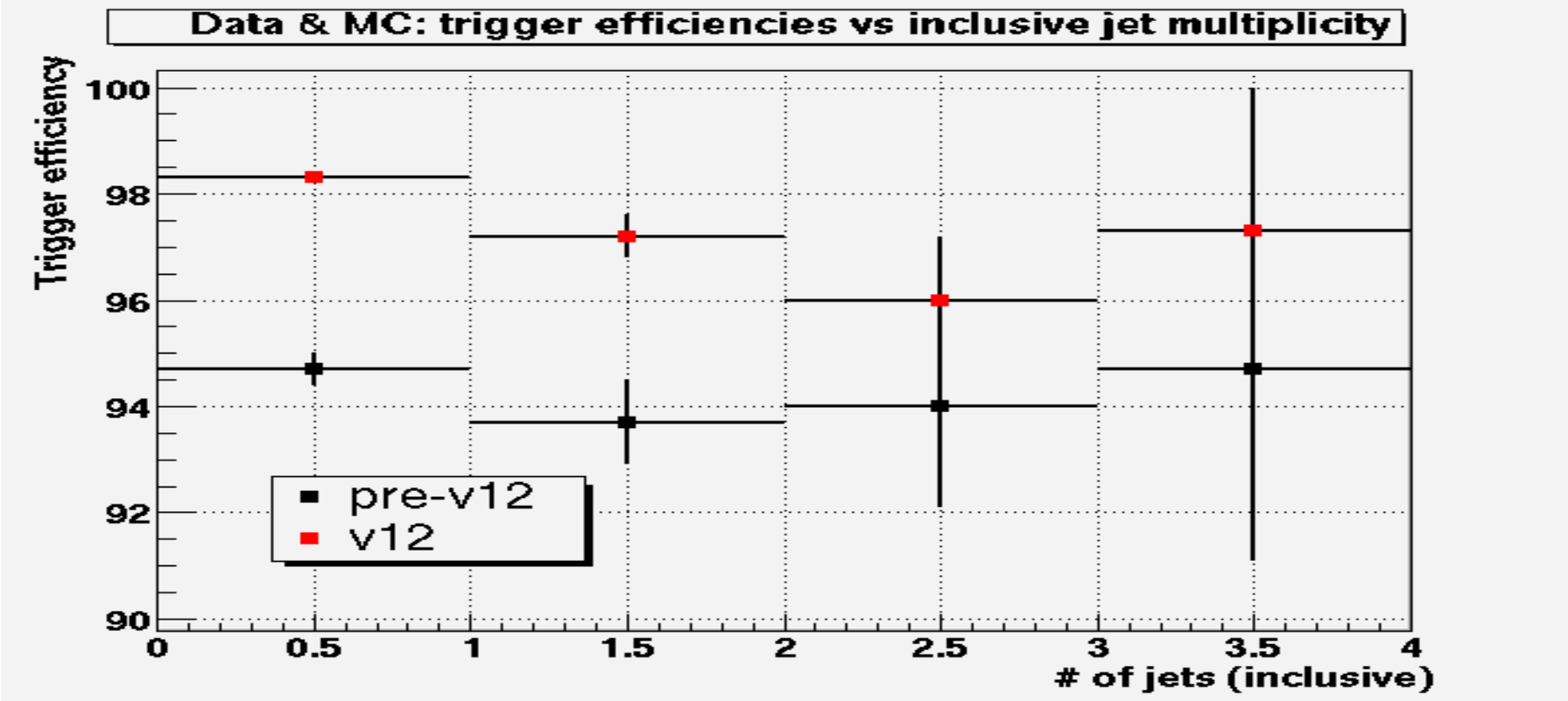
Z(ee)+X: Trigger

Eff(pt) = p0 + p1 * Erf(pt/ p2)



Assuming no dependence of trigger efficiency wrt jet multiplicity (next slide), these curves are used for all jet multiplicities to correct for trigger inefficiencies.

Trigger

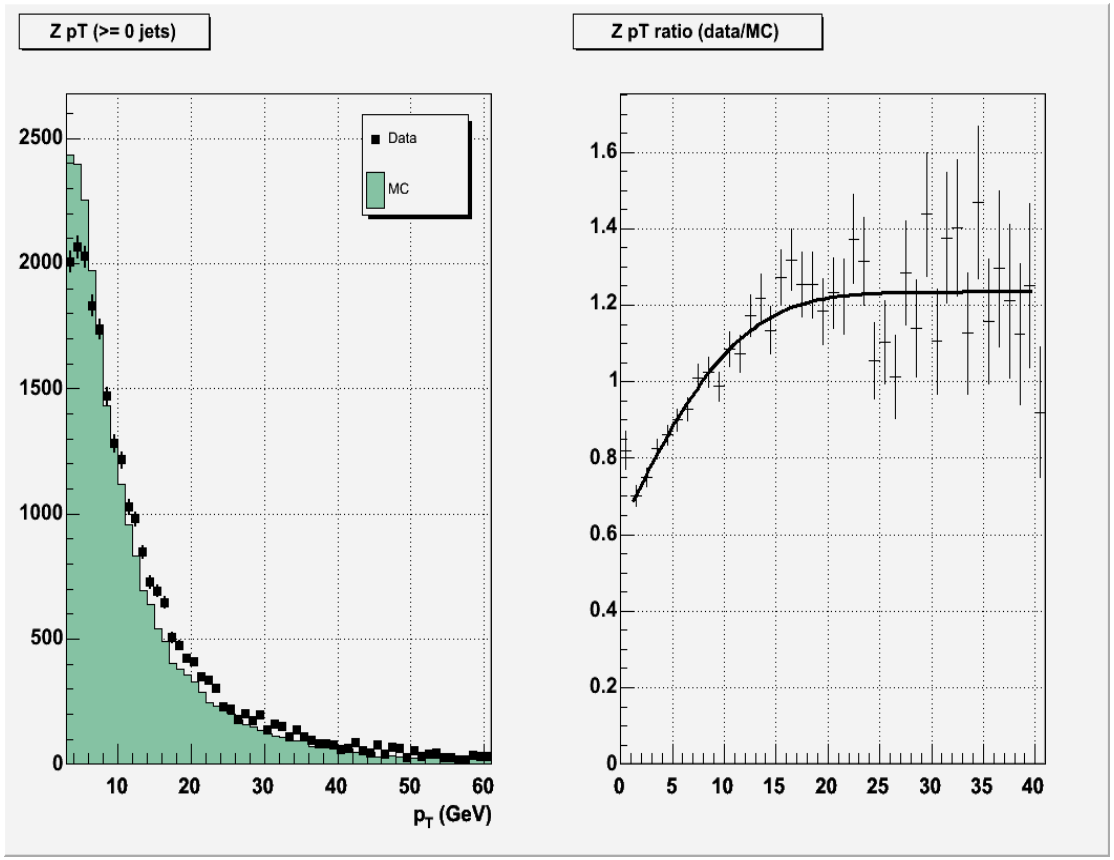


Jet mult	0	1	2	3
pre-v12	94.7+-0.3	93.7+-0.8	94.0+-1.9	94.7+-3.6
v12	98.3+-0.1	97.2+-0.4	96.0+-1.2	97.3+-2.7

Z(ee)+X: Z pt correction

After applying all of the corrections from the previous slides we compare the Z pT distribution between data and MC and derive an additional Z pT correction. This correction is then applied to the MC to take care of residual kinematic differences between data and MC.

We use this correction for all jetmultiplicity samples!



Error function parameterization for Z pT ratio:

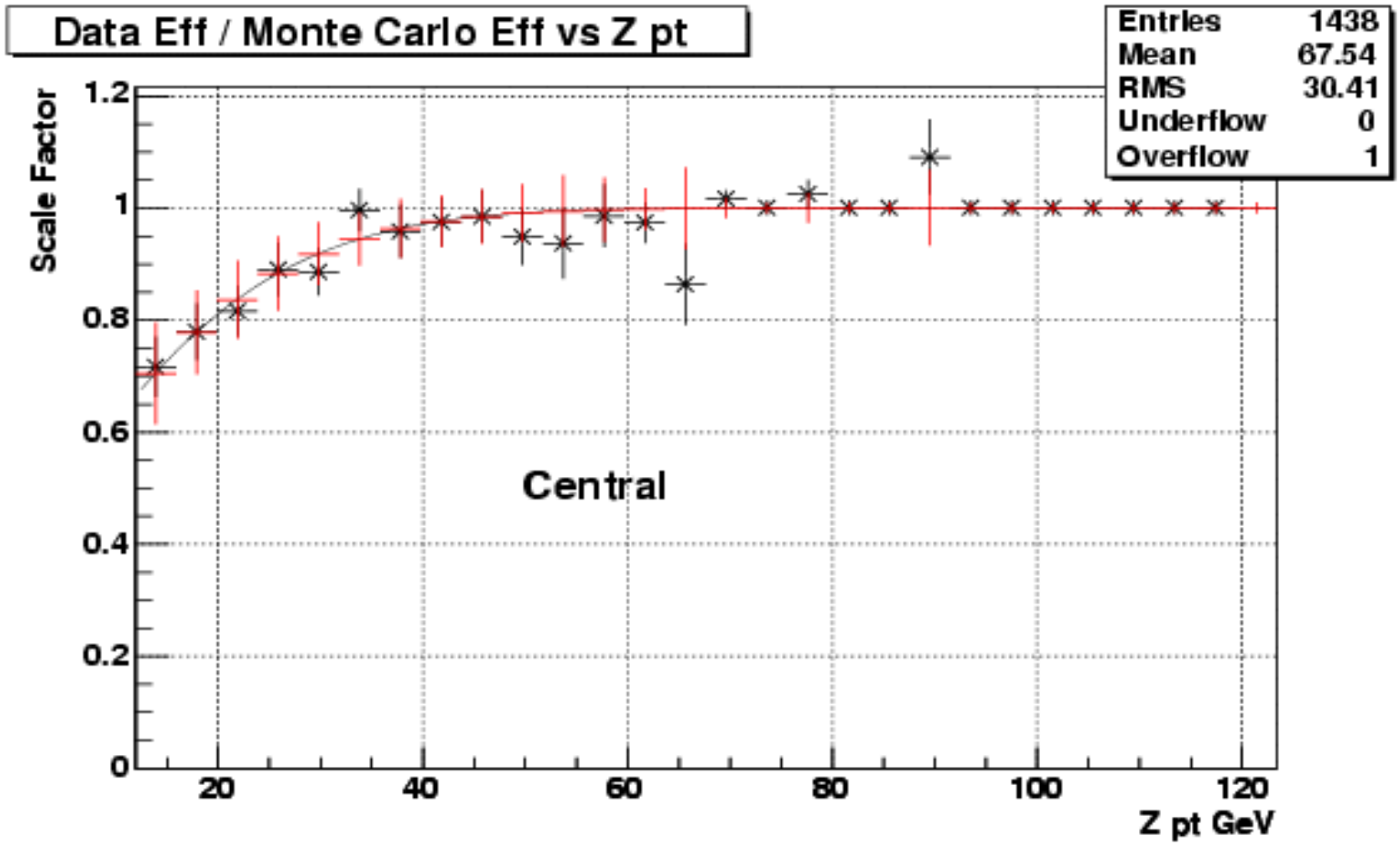
Ratio(Z pt) = p0 + p1 * Erf(pt/ p2)

p0 = 6.22963e-01

p1 = -6.11939e-01

p2 = -1.27720e+01

MC Jet reco scaling factor (J.Heinmiller)



To compensate for the difference between the jet reco efficiency in data and MC.