Jet energy calibration with gamma+jet events

A progress report
(DZero collaboration meeting)

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Method overview

- Idea: Balance p_t of photons against jets
  - Relies on good em-scale
- Start with fixed algorithm (cone 0.7)
- Objects:
  - em clusters 1.0
  - jets α_{jet}
  - out-of-cone α_{ue}
    (underlying event, pile-up etc.)

- Goals:
  - jet energy scale from p_t-balance (α_{jet})
  - optimize $p_{t,miss}$ resolution (α_{ue})

Projections

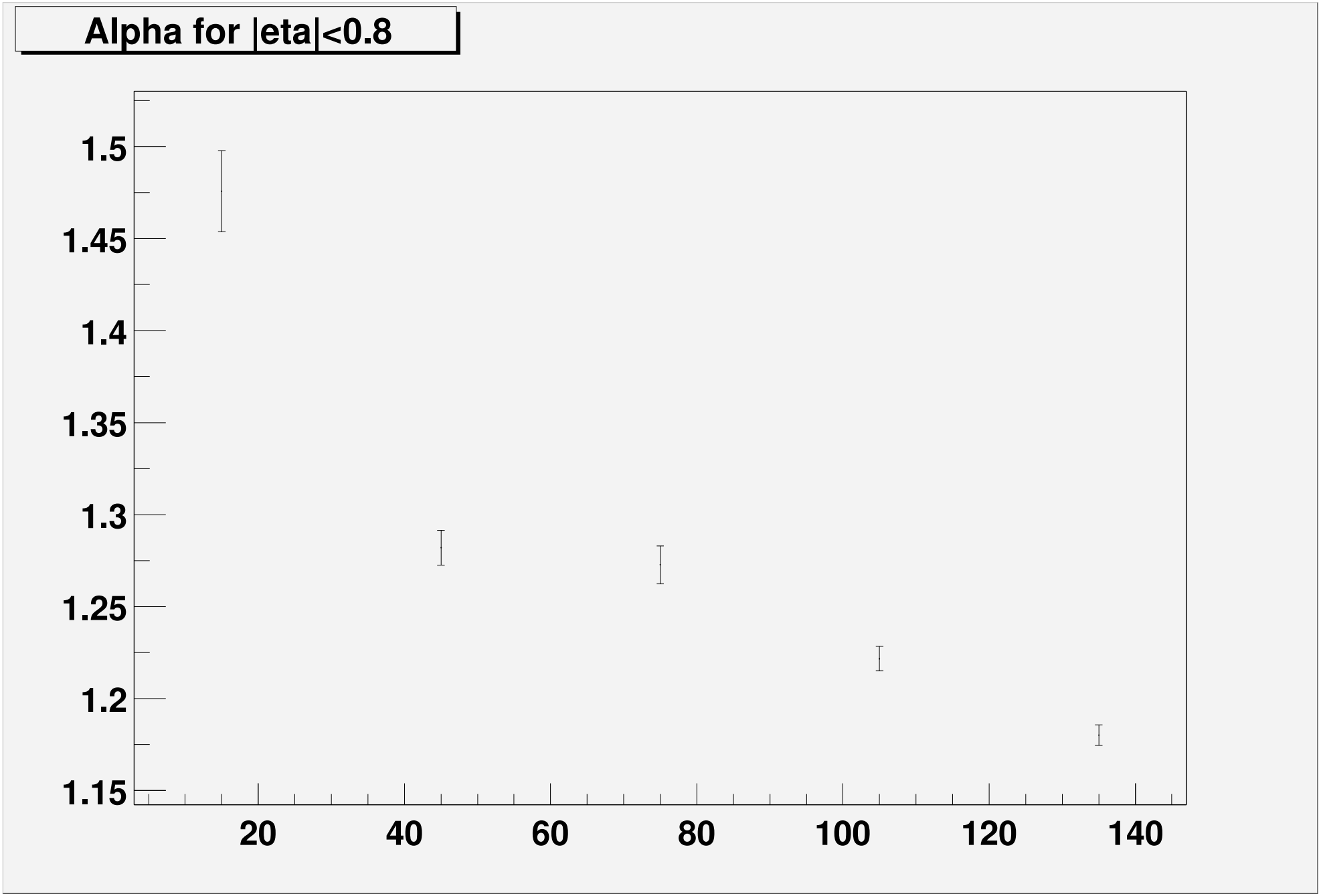
- View everything in the transverse plane
- Project all jets on the photon direction and transverse to it
- Minimize:

$$\chi^2 = \sum_{i=1}^{N_{event}} \left(E_\gamma - \sum_{k=1}^{N_{jet}} \alpha_{jet}(E,\eta) E_\xi(jet_k) \right)^2 / \sigma^2_{jet}$$

- Nest step: Include α_{ue} and fit transverse component

Strategy

1. Determine $\alpha_{jet}(E_t,\eta)$
   $\alpha_{UE}=1$
2. Release layer weights
3. Release α_{UE}


Alpha for |eta|<0.8
1.5
1.45
1.4
1.35
1.3
1.25
1.2
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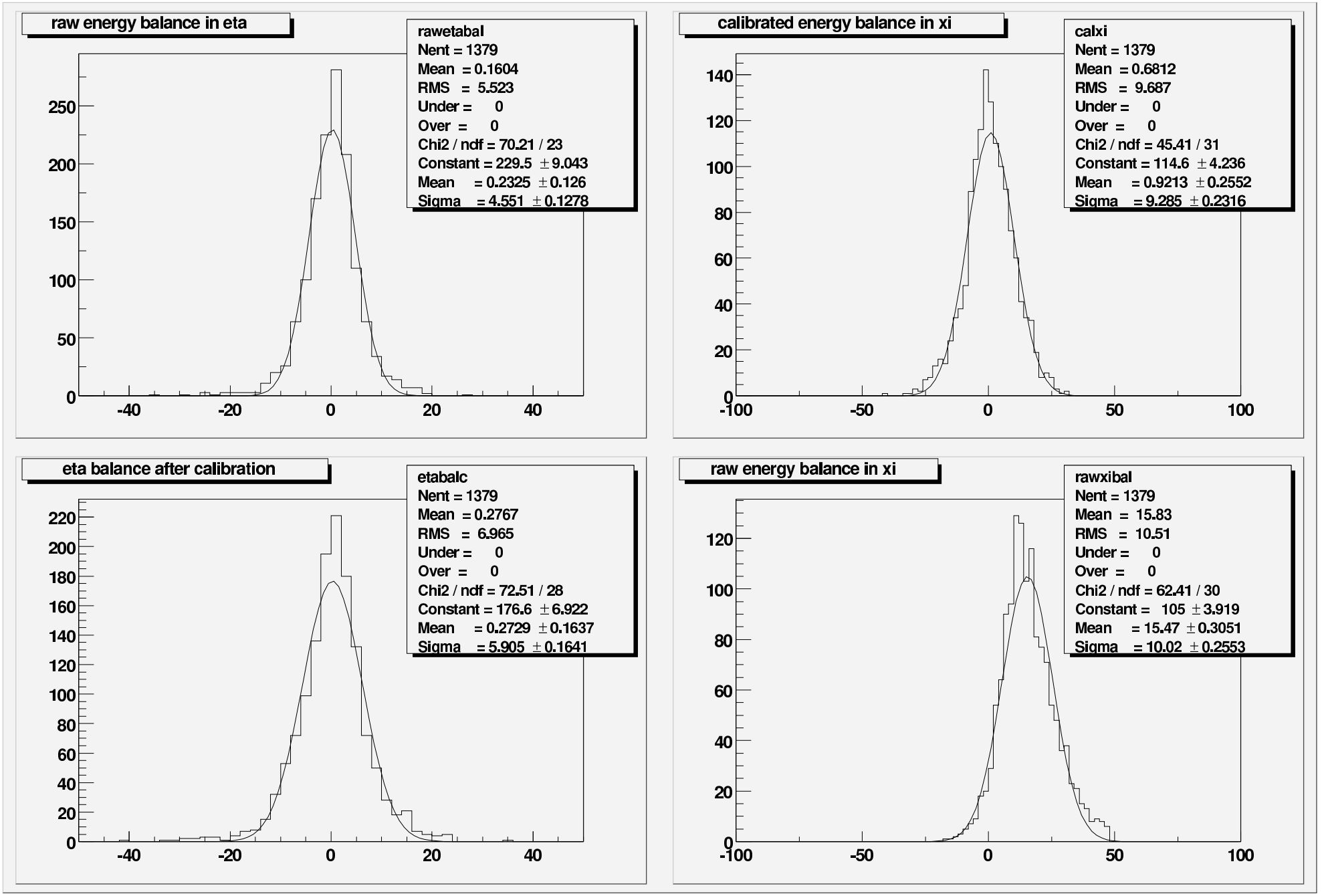
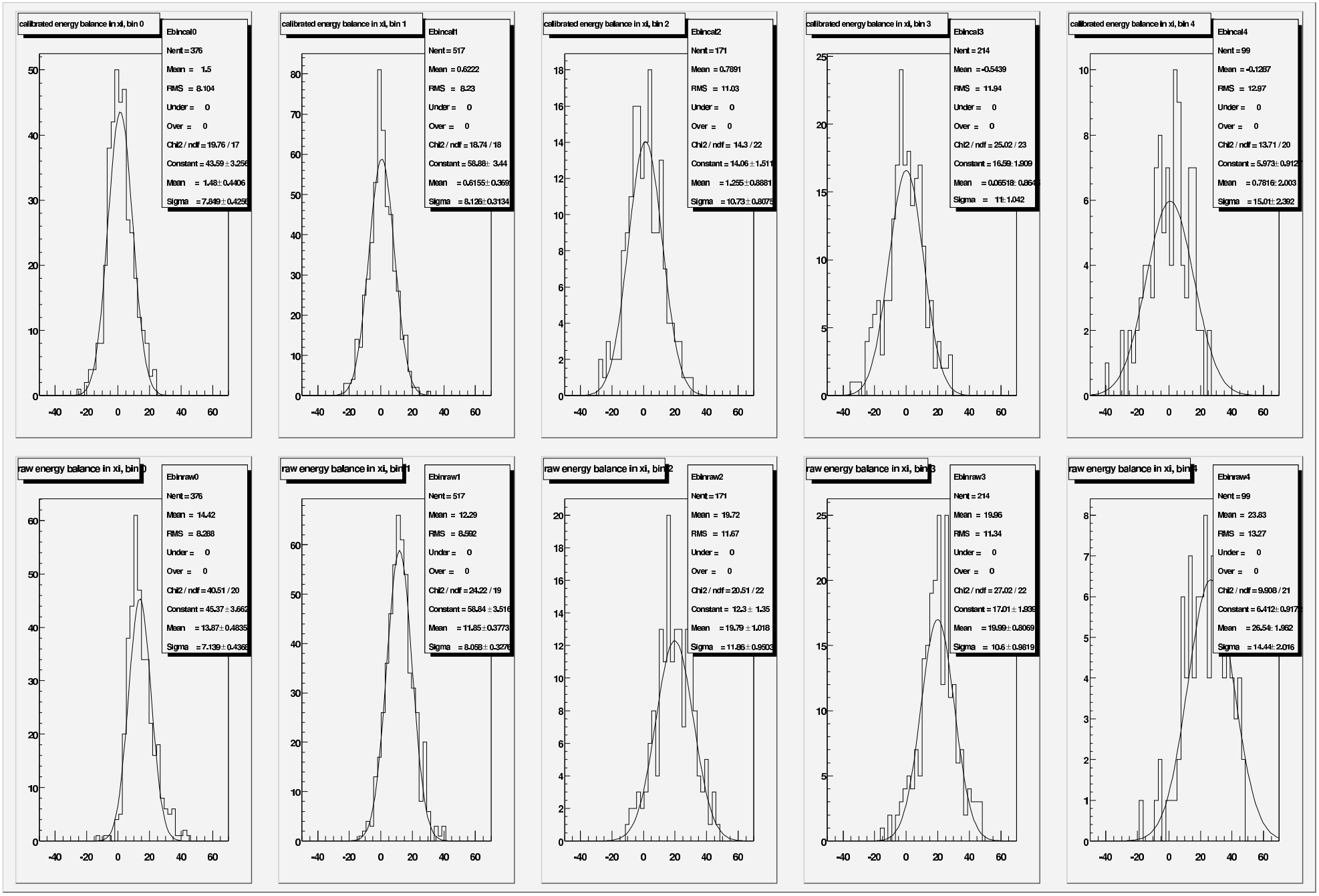
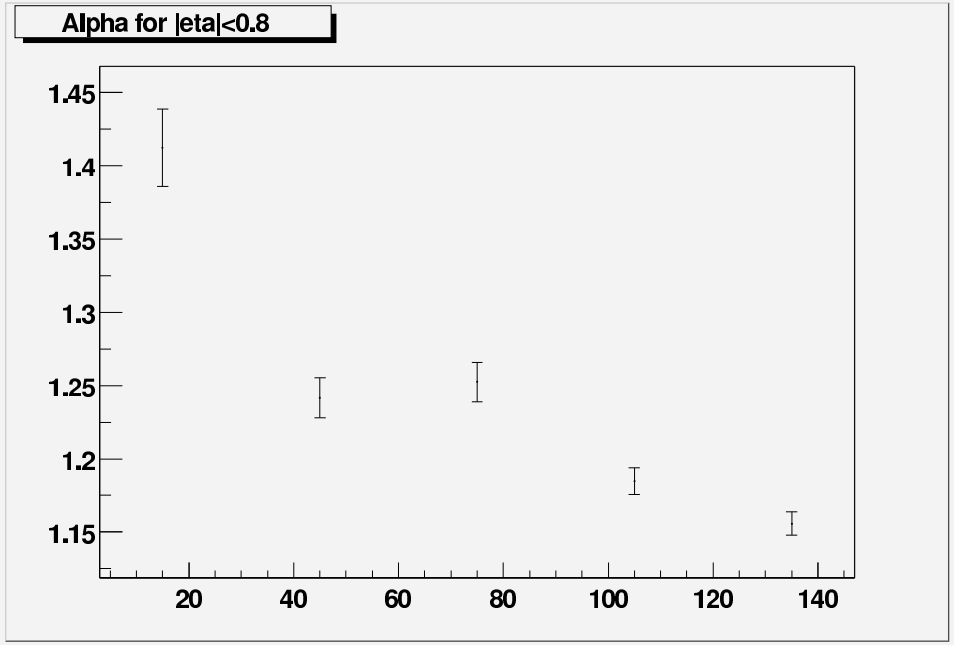

raw energy balance in eta
rawetabal
Nent = 1379
Mean = 0.1604
RMS = 5.523
Under = 0
Over = 0
Chi2 / ndf = 70.21 / 23
Constant = 229.5 ±9.043
Mean = 0.2325 ±0.126
Sigma = 4.551 ±0.1278
calibrated energy balance in xi
calxi
Nent = 1379
Mean = 0.6812
RMS = 9.687
Under = 0
Over = 0
Chi2 / ndf = 45.41 / 31
Constant = 114.6 ±4.236
Mean = 0.9213 ±0.2552
Sigma = 9.285 ±0.2316
eta balance after calibration
etabalc
Nent = 1379
Mean = 0.2767
RMS = 6.965
Under = 0
Over = 0
Chi2 / ndf = 72.51 / 28
Constant = 176.6 ±6.922
Mean = 0.2729 ±0.1637
Sigma = 5.905 ±0.1641
raw energy balance in xi
rawxibal
Nent = 1379
Mean = 15.83
RMS = 10.51
Under = 0
Over = 0
Chi2 / ndf = 62.41 / 30
Constant = 105 ±3.919
Mean = 15.47 ±0.3051
Sigma = 10.02 ±0.2553


calibrated energy balance in xi, bin 0
Ebincal0
Nent = 376
Mean = 1.5
RMS = 8.104
Under = 0
Over = 0
Chi2 / ndf = 19.76 / 17
Constant = 43.59 ± 3.256
Mean = 1.48 ± 0.4406
Sigma = 7.849 ± 0.4256
calibrated energy balance in xi, bin 1
Ebincal1
Nent = 517
Mean = 0.6222
RMS = 8.23
Under = 0
Over = 0
Chi2 / ndf = 18.74 / 18
Constant = 58.88 ± 3.44
Mean = 0.6155 ± 0.369
Sigma = 8.126 ± 0.3134
calibrated energy balance in xi, bin 2
Ebincal2
Nent = 171
Mean = 0.7891
RMS = 11.03
Under = 0
Over = 0
Chi2 / ndf = 14.3 / 22
Constant = 14.06 ± 1.511
Mean = 1.255 ± 0.8881
Sigma = 10.73 ± 0.8075
calibrated energy balance in xi, bin 3
Ebincal3
Nent = 214
Mean = -0.5439
RMS = 11.94
Under = 0
Over = 0
Chi2 / ndf = 25.02 / 23
Constant = 16.59 ± 1.909
Mean = 0.06518 ± 0.864
Sigma = 11 ± 1.042
calibrated energy balance in xi, bin 4
Ebincal4
Nent = 99
Mean = -0.1287
RMS = 12.97
Under = 0
Over = 0
Chi2 / ndf = 13.71 / 20
Constant = 5.973 ± 0.912
Mean = 0.7816 ± 2.003
Sigma = 15.01 ± 2.392
raw energy balance in xi, bin 0
Ebinraw0
Nent = 376
Mean = 14.42
RMS = 8.288
Under = 0
Over = 0
Chi2 / ndf = 40.51 / 20
Constant = 45.37 ± 3.662
Mean = 13.87 ± 0.4835
Sigma = 7.139 ± 0.4368
raw energy balance in xi, bin 1
Ebinraw1
Nent = 517
Mean = 12.29
RMS = 8.592
Under = 0
Over = 0
Chi2 / ndf = 24.22 / 19
Constant = 58.84 ± 3.516
Mean = 11.85 ± 0.3773
Sigma = 8.058 ± 0.3276
raw energy balance in xi, bin 2
Ebinraw2
Nent = 171
Mean = 19.72
RMS = 11.67
Under = 0
Over = 0
Chi2 / ndf = 20.51 / 22
Constant = 12.3 ± 1.35
Mean = 19.79 ± 1.018
Sigma = 11.86 ± 0.9503
raw energy balance in xi, bin 3
Ebinraw3
Nent = 214
Mean = 19.96
RMS = 11.34
Under = 0
Over = 0
Chi2 / ndf = 27.02 / 22
Constant = 17.01 ± 1.939
Mean = 19.99 ± 0.8069
Sigma = 10.6 ± 0.9819
raw energy balance in xi, bin 4
Ebinraw4
Nent = 99
Mean = 23.83
RMS = 13.27
Under = 0
Over = 0
Chi2 / ndf = 9.908 / 21
Constant = 6.412 ± 0.917
Mean = 26.54 ± 1.962
Sigma = 14.44 ± 2.016


Alpha for |eta|<0.8
1.45
1.4
1.35
1.3
1.25
1.2
1.15
20
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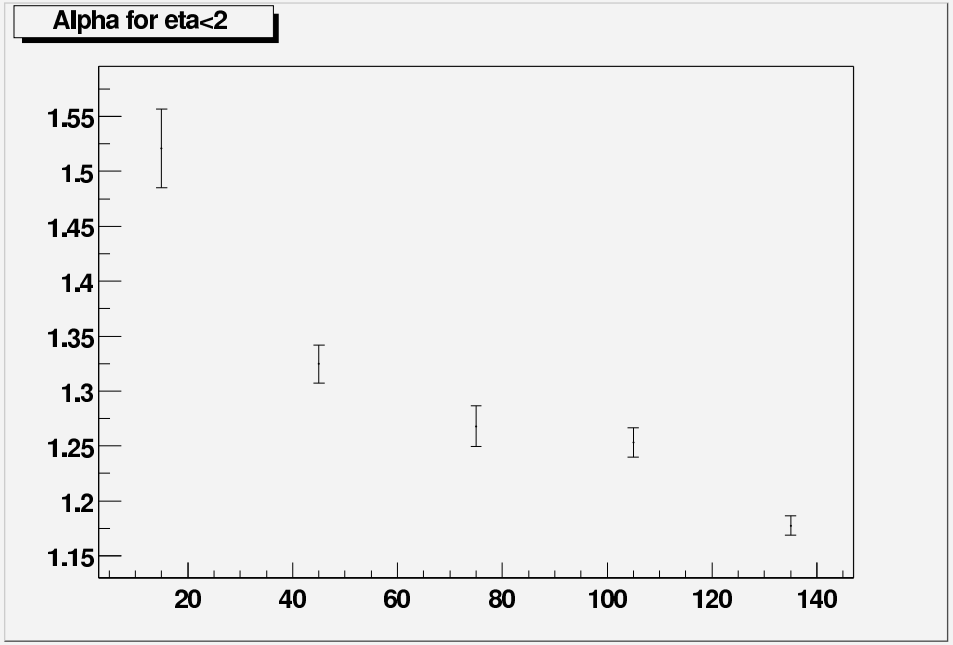
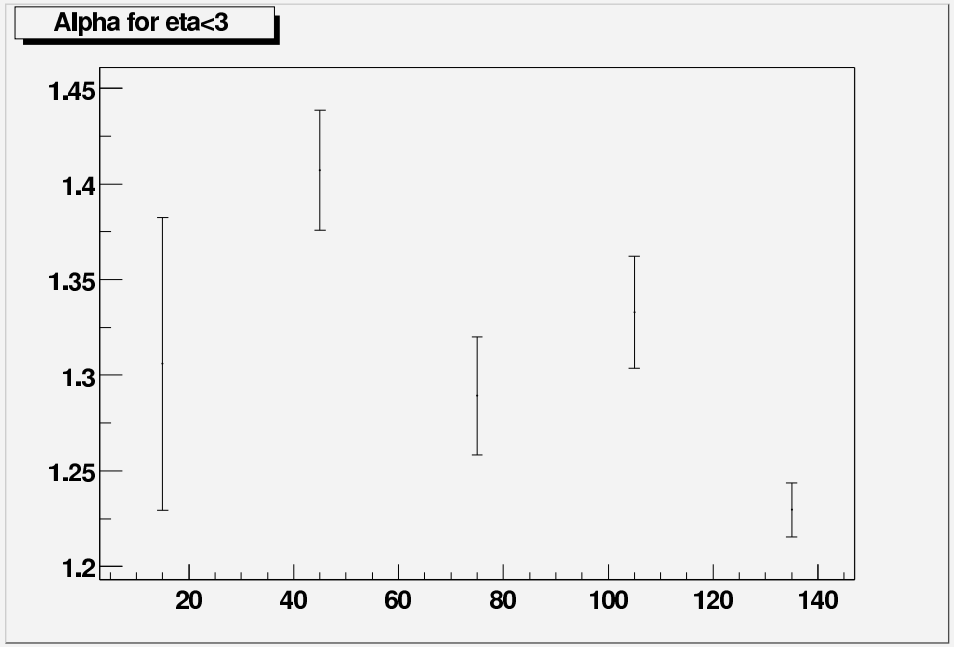
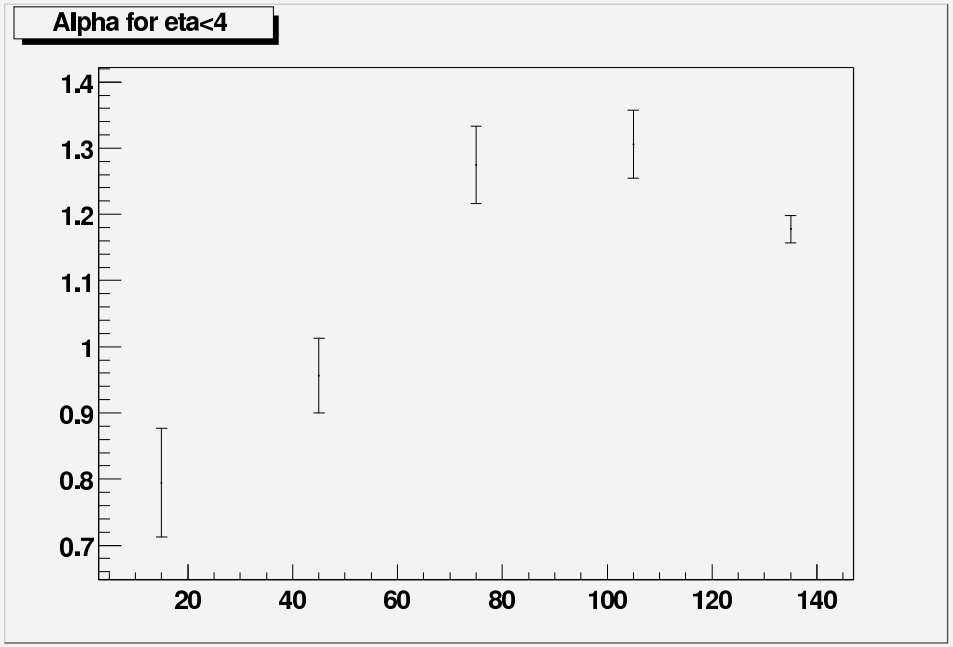
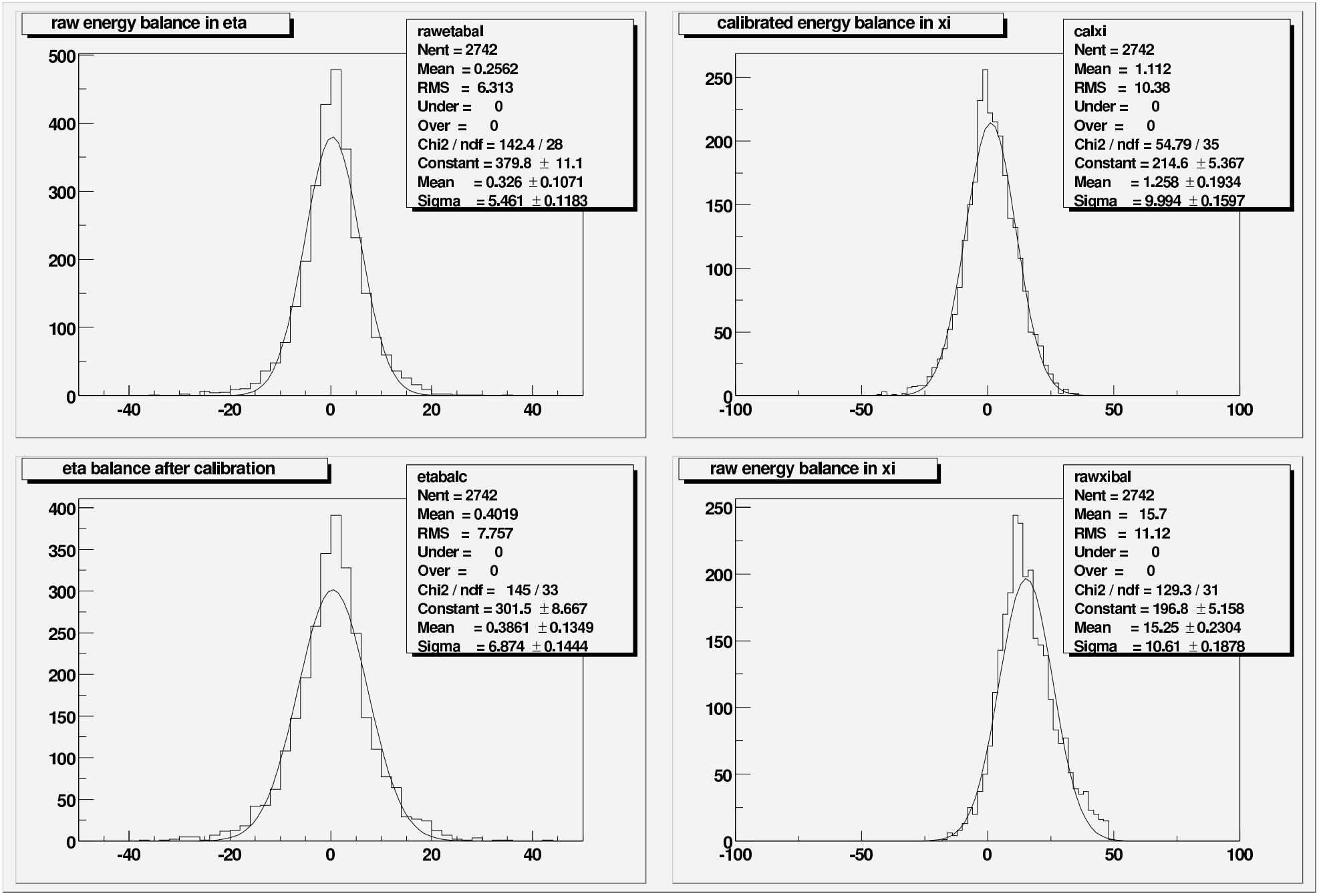
100
120
140


Alpha for eta<2
1.55
1.5
1.45
1.4
1.35
1.3
1.25
1.2
1.15
20
40
60
80
100
120
140


Alpha for eta<3
1.45
1.4
1.35
1.3
1.25
1.2
20
40
60
80
100
120
140


Alpha for eta<4
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
20
40
60
80
100
120
140


raw energy balance in eta
rawetabal
Nent = 2742
Mean = 0.2562
RMS = 6.313
Under = 0
Over = 0
Chi2 / ndf = 142.4 / 28
Constant = 379.8 ± 11.1
Mean = 0.326 ±0.1071
Sigma = 5.461 ±0.1183
calibrated energy balance in xi
calxi
Nent = 2742
Mean = 1.112
RMS = 10.38
Under = 0
Over = 0
Chi2 / ndf = 54.79 / 35
Constant = 214.6 ±5.367
Mean = 1.258 ±0.1934
Sigma = 9.994 ±0.1597
eta balance after calibration
etabalc
Nent = 2742
Mean = 0.4019
RMS = 7.757
Under = 0
Over = 0
Chi2 / ndf = 145 / 33
Constant = 301.5 ±8.667
Mean = 0.3861 ±0.1349
Sigma = 6.874 ±0.1444
raw energy balance in xi
rawxibal
Nent = 2742
Mean = 15.7
RMS = 11.12
Under = 0
Over = 0
Chi2 / ndf = 129.3 / 31
Constant = 196.8 ±5.158
Mean = 15.25 ±0.2304
Sigma = 10.61 ±0.1878