Studies of Angular and Momentum Resolutions

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FIRST meeting Rome 02-03/05/2013

About Energy and Angular Resolutions...

Among the various parameters we need to measure the DDCS:

$$\frac{d\sigma_i}{dE,d\theta} = \frac{Y_i}{N_{12}_C \times N_{t,S} \times BW_E \times BW_\theta} \times \Omega(\theta) \times \varepsilon_{rec}(E,\theta) \times \varepsilon_{sel}(E,\theta)$$

we can choose the bin widths in energy (BW_E) and angle (BW_θ) via energy and angle distributions and their respective resolutions

 We can calculate the resolution of each physical observable X of our interest (momentum, charge, energy, angle, ...) as the difference between the value of the MC truth and the one reconstructed from data, track by track:

$$reso_X = X_mc - X_rec$$

 Taking as an input for the reconstruction the output of the MC (instead of a data file) we can check the validity of the global reconstruction respect to MC

Angular Resolution

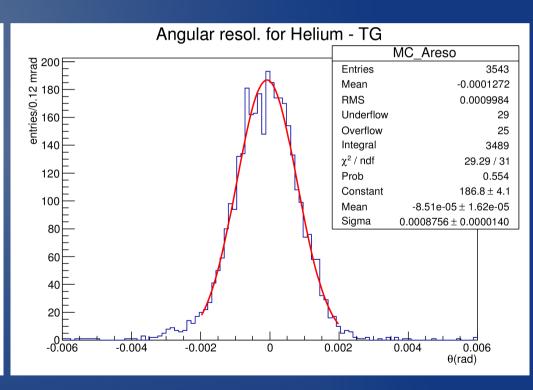
- Used last MC version
- Studied angular resolution for the different fragments in the case with carbon TG
- Fragments selected with a cut in the MC charge:
 - the new ZID algorithm will be used in next step
- Angular resolution comes only from VTX: everything is fixed by TAVTactNtuTrack.
- So we studied the reconstructed angle from vertex vs angle from the MC momentum associated with pixels (clusters) in different sensors of the vertex detector
- This study has been done both at low and high level reconstruction with the same results in resolution (~ 0.05°)

Angular resolution: protons and helium

Protons

Angular resol. for Proton - TG MC Areso entries/0.12 mrad Entries 1591 Mean -8.648e-05 **RMS** 0.001096 Underflow Overflow 15 Integral 1568 χ^2 / ndf 24.3 / 31 Prob 0.7982 Constant 75.94 ± 2.58 -2.176e-05 ± 2.775e-05 Sigma 0.0009617 ± 0.0000257 -0.002 0.002 -0.0040.004 0.006 $\theta(rad)$

Helium



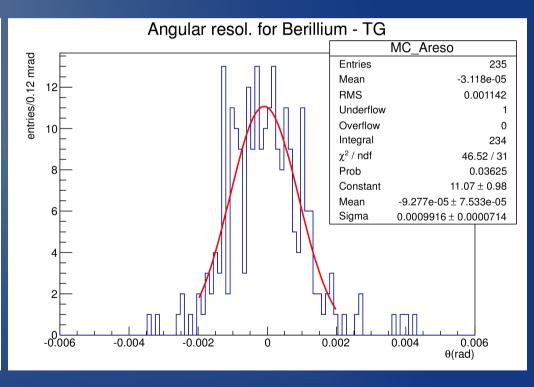
Reso ~ 0.05° Bias = Mean/Sigma ~ 2.3% Reso ~ 0.05° Bias ~ 9.7%

Angular resolution: lithium and beryllium

Lithium

Angular resol. for Lithium - TG MC Areso entries/0.12 mrad **Entries** Mean -4.61e-05 **RMS** 0.0009469 Underflow Overflow Integral χ^2 / ndf 39.26 / 31 Prob 0.1466 Constant 13.91 ± 1.12 Mean -7.096e-06 ± 6.201e-05 Sigma 0.0009193 ± 0.0000554 -0.004 -0.002 0.002 0.004 0.006 $\theta(rad)$

Beryllium

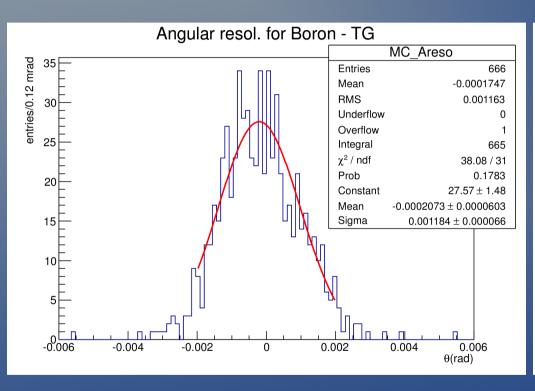


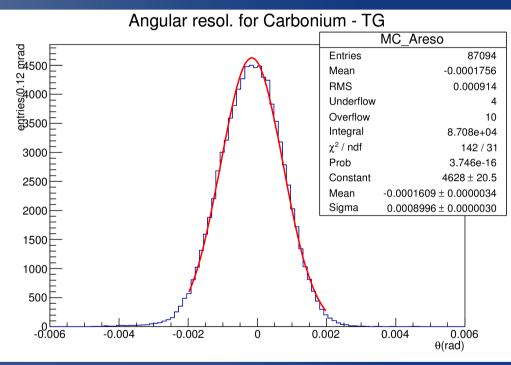
Reso ~ 0.05° Bias ~ 0.8% Reso ~ 0.05° Bias ~ 9.3%

Angular resolution: boron and carbonium

Boron

Carbonium





Reso ~ 0.06° Bias ~ 17%

Reso ~ 0.05°

Bias ~ 17%

For all fragments a small bias exists: the reconstructed angle is greater than the MC angle. The situation becomes worse in the case of momentum resolution...

Momentum Resolution

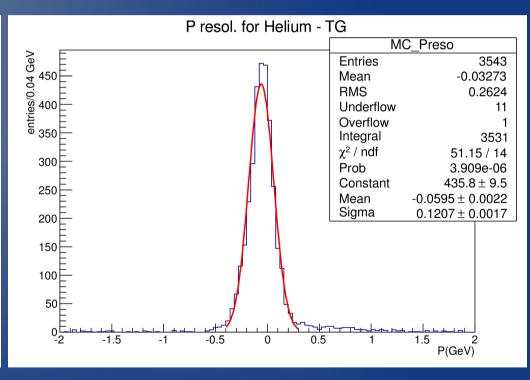
- Before studying energy resolution we started from momentum resolution for the different fragments in the case with carbon TG
- Momentum recontruction comes from:
 - TAGactGlobalTracking
 - GlobalTrack
- We studied the reconstructed momentum vs
 - The MC momentum associated with pixels (clusters) in different sensors of the vertex detector
 - The MC momentum associated with hits in the Tof Wall
- In both cases we obtain the same results

Momentum resolution: protons and helium

Protons

P resol. for Protons - TG MC Preso entries/0.04 GeV 00 00 **Entries** 1591 Mean -8.782e-05 RMS 0.1748 Underflow Overflow Integral 1591 χ^2 / ndf 343.9 / 5 Prob 393.6 ± 13.2 Constant -0.02132 ± 0.00157 Mean 300 Sigma 0.05717 ± 0.00122 200 100 0.5 1.5 P(GeV)

Helium

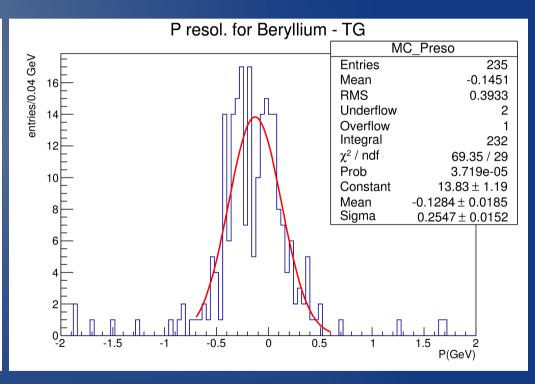


Momentum resolution: lithium and beryllium

Lithium

P resol. for Lithium - TG MC Preso entries/0.04 GeV 268 Entries -0.1358 Mean **RMS** 0.3403 Underflow Overflow Integral 263 χ^2 / ndf 30.83 / 27 Prob 0.2784 Constant 18.93 ± 1.49 -0.1286 ± 0.0139 Mean 0.2155 ± 0.0108 Sigma -0.5 0.5 1.5 P(GeV)

Beryllium

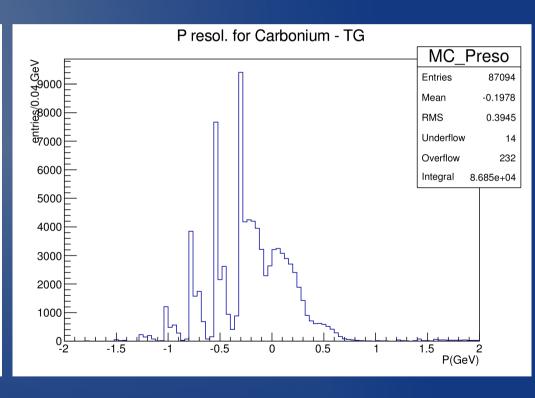


Momentum resolution: boron and carbonium

Boron

P resol. for Boron - TG MC Preso entries/0.04 GeV **Entries** 666 Mean -0.1881 **RMS** 0.4017 Underflow Overflow Integral 662 χ^2 / ndf 56.92 / 35 Prob 0.01101 27.73 ± 1.45 Constant -0.1771 ± 0.0173 Mean 0.3815 ± 0.0169 Sigma 15 10 -0.5 0.5 P(GeV)

Carbonium

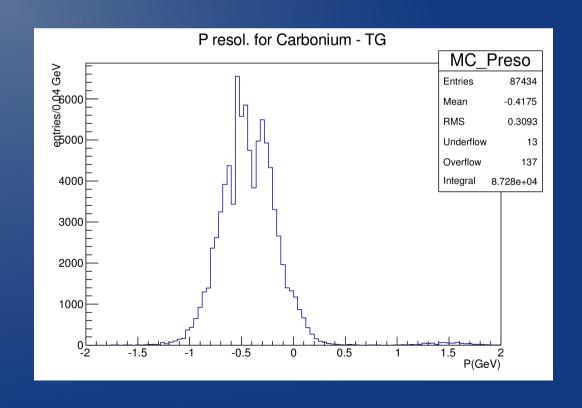


Reso ~ 380 MeV Bias ~ 46% The momentum structure here is due to the resolution in x coordinate on the Tof Wall

Conclusions

- Studied angular and momentum resolutions for the different fragments in the case with carbon TG
- Angular resolution ~ 0.05°
- It appears that we reconstruct always a momentum "harder" than the one from MC: It's necessary to understand what is happening...

 Taking the position of the Tof wall hits from MC instead of the reconstructed ones, the situation is about the same for all fragments except for carbonium:



Energy resolution for carbonium

