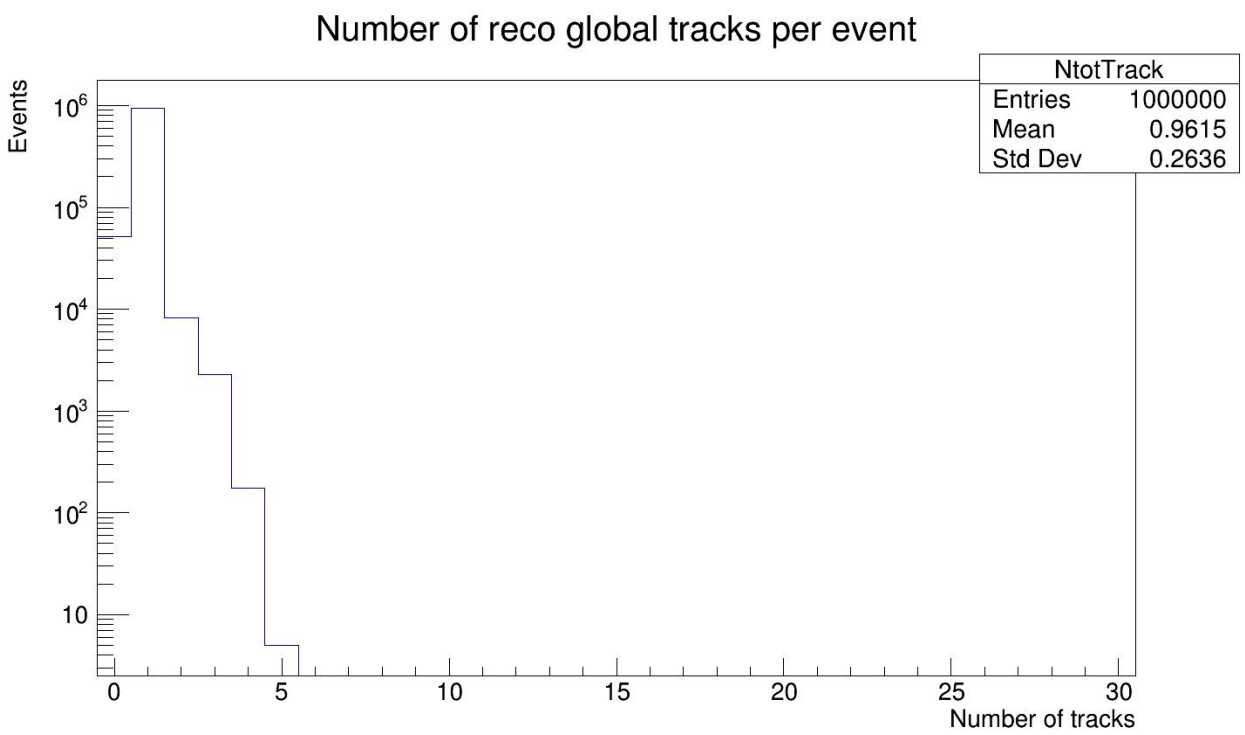
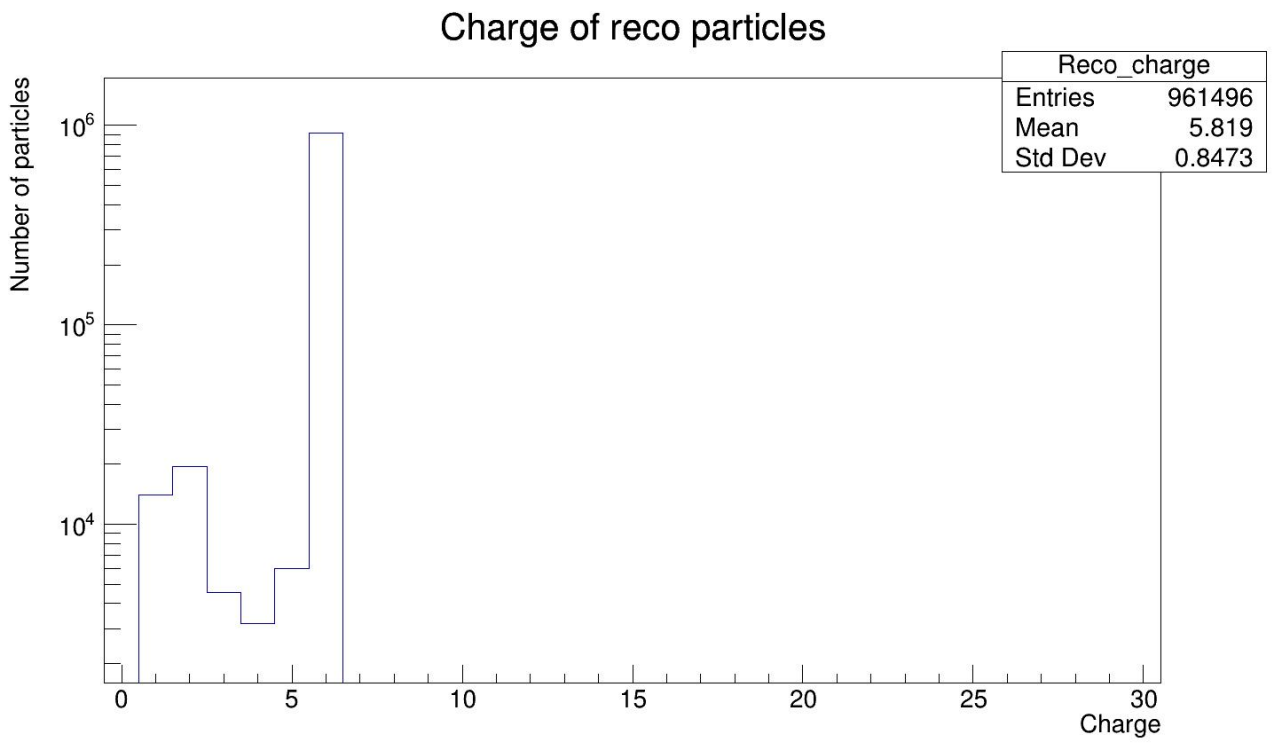
Marta Oprandi bachelor degree analysis on FOOT global reconstruction performances

For this analysis:

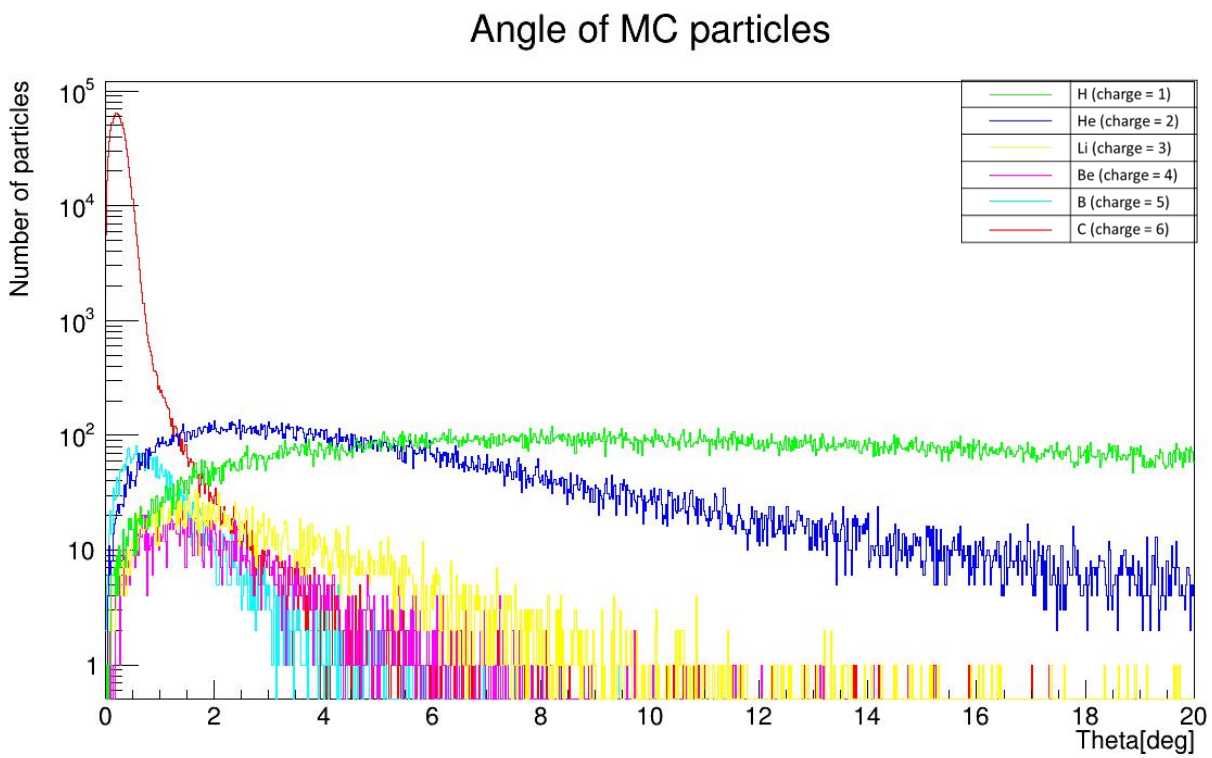
- 1mln events with 12C @ 200 MeV on C target
- Reconstruction with master branch and default parameters
- TWZmatch yes

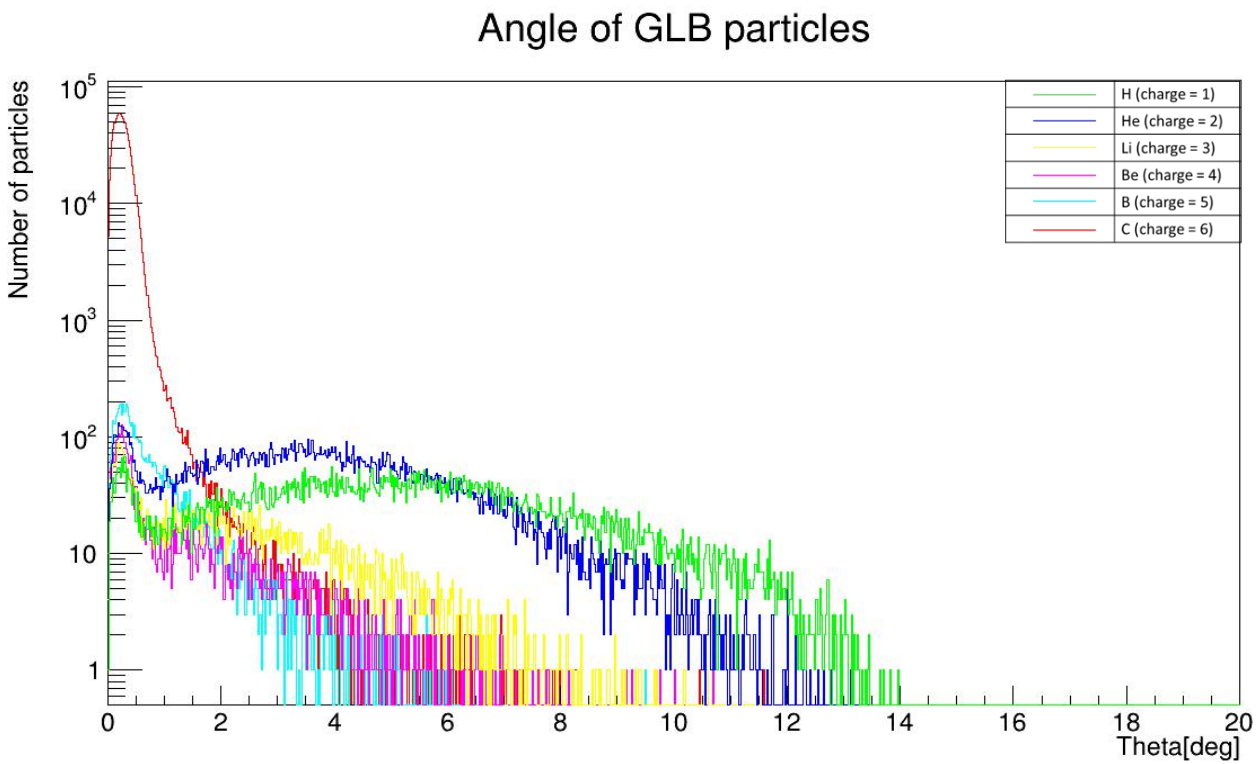
- N.B.: work in progress!
- N.B.: not all the code has been carefully controlled yet


Number of reco global tracks per event
NtotTrack
Entries 1000000
Mean 0.9615
Std Dev 0.2636
Events
10^6
10^5
10^4
10^3
10^2
10
0
5
10
15
20
25
30
Number of tracks

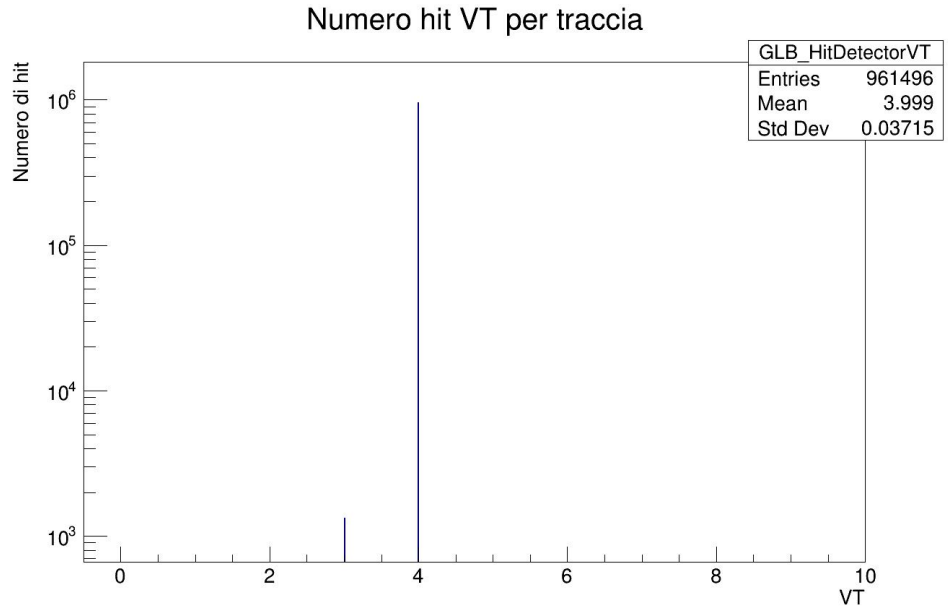

Charge of reco particles
Reco_charge
Entries 961496
Mean 5.819
Std Dev 0.8473
Number of particles
10^6
10^5
10^4
0
5
10
15
20
25
30
Charge

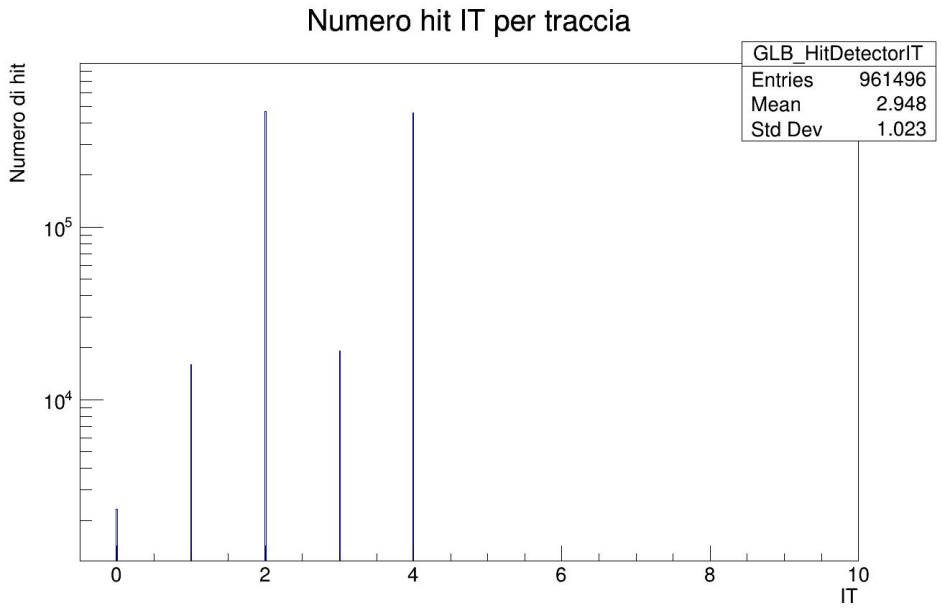
Track angles MC – GLB TRACK

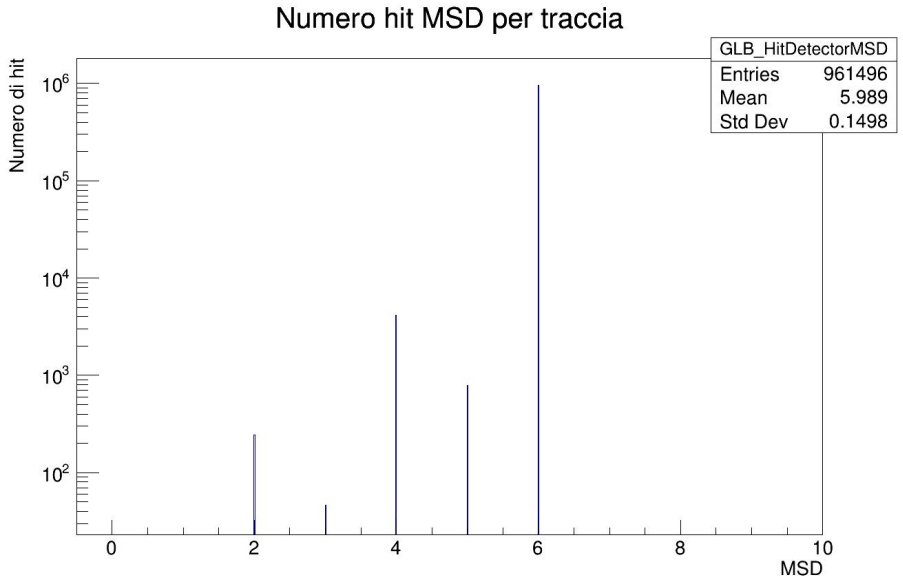


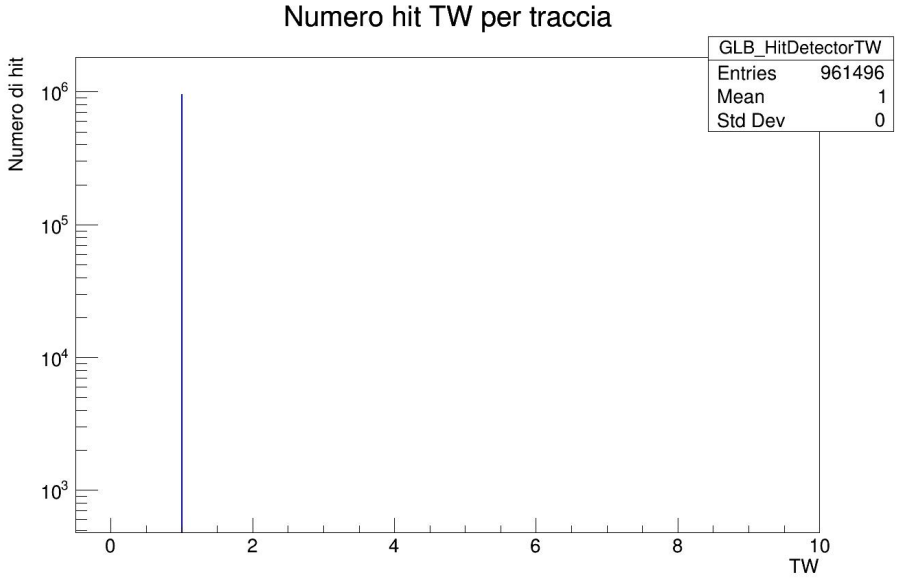


Number of hit per detector per track









EFFICIENCY:

Number of reconstructed tracks in which the GetMcMainTrackId corresponds to a MC particle born from the target that crossed the TW

Total number of MC particles born form the target that crossed the TW

```
Efficienza carica 1: 0.386572
Efficienza carica 2: 0.541216
Efficienza carica 3: 0.656410
Efficienza carica 4: 0.782828
Efficienza carica 5: 0.907821
Efficienza carica 6: 0.968456
```

PURITY:

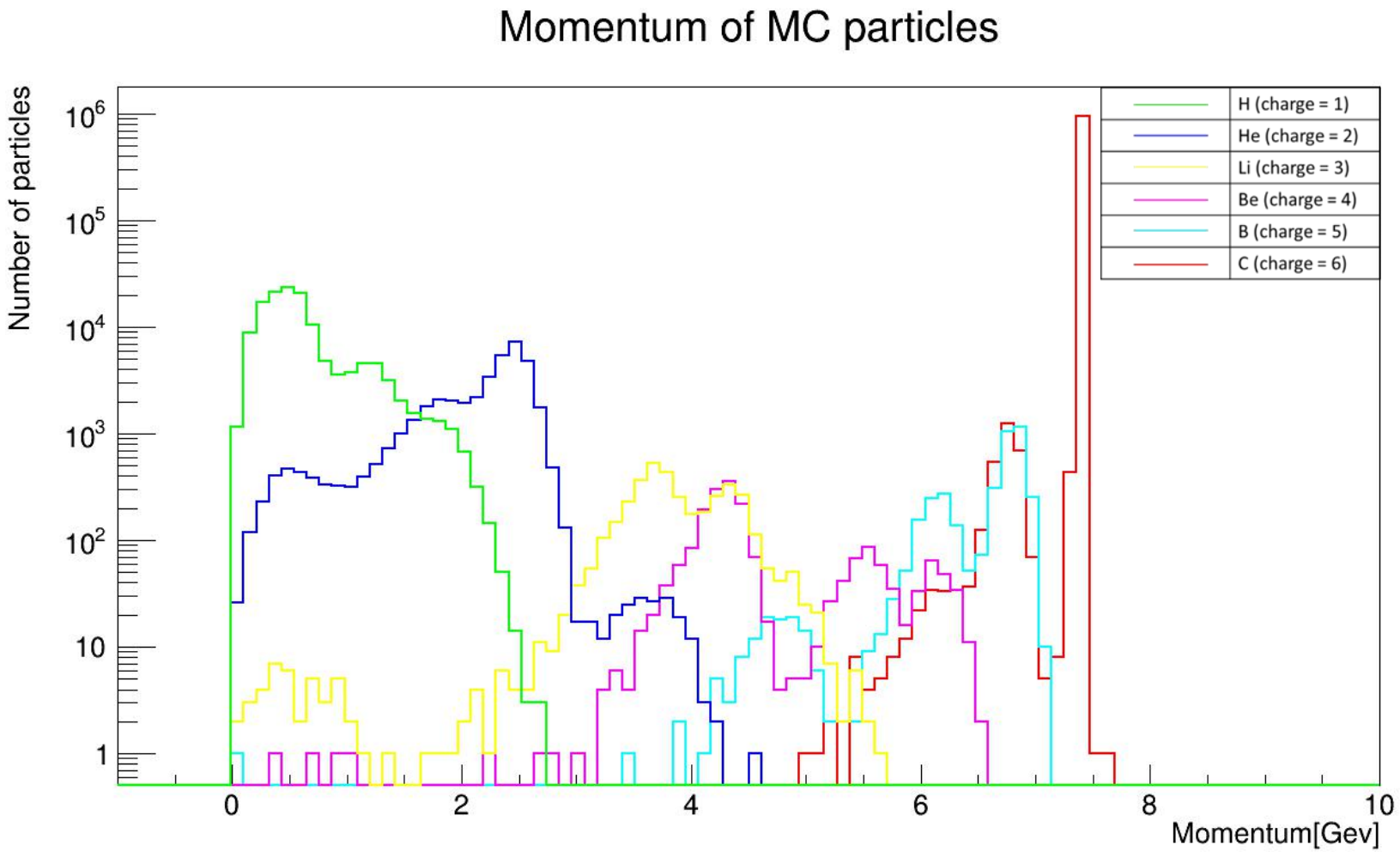
Number of hits with a MC hit equivalent to GetMcMainTrackId()

Total number of hits of a global track

```
Purezza carica 1: 0.977886
Purezza carica 2: 0.979199
Purezza carica 3: 0.980982
Purezza carica 4: 0.972968
Purezza carica 5: 0.952461
Purezza carica 6: 0.997975
```

Momentum resolution studies:

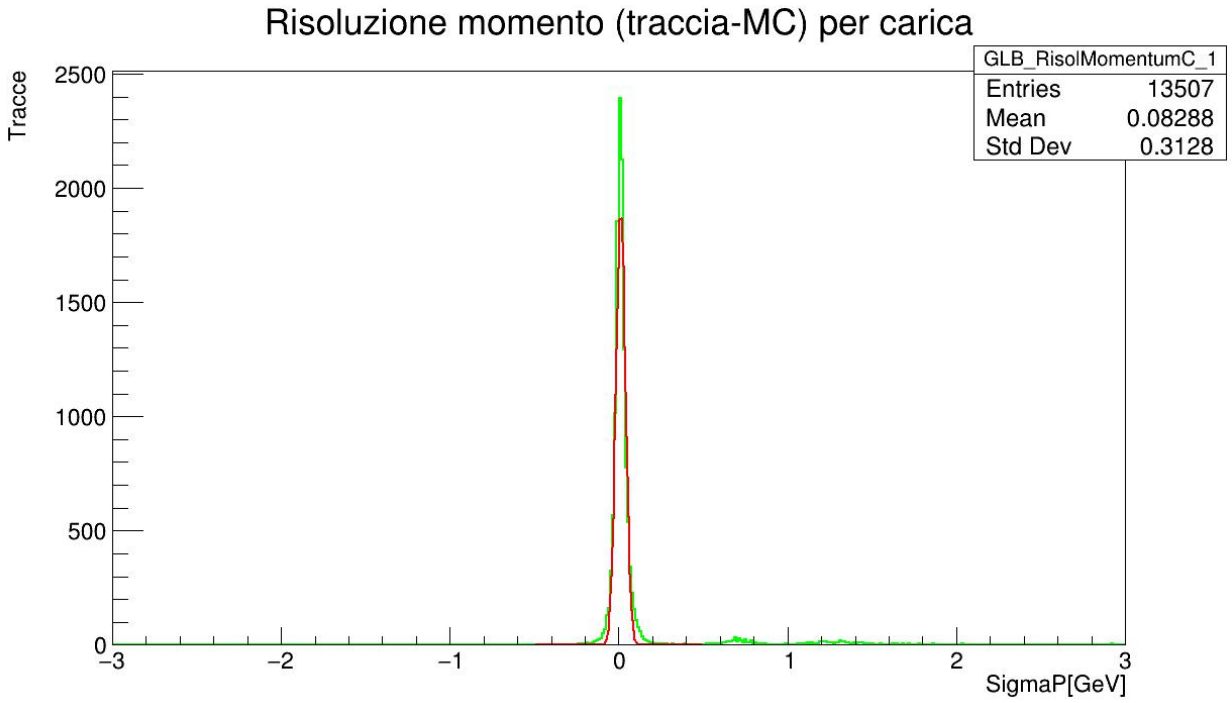
Momentum of particles exit from the target

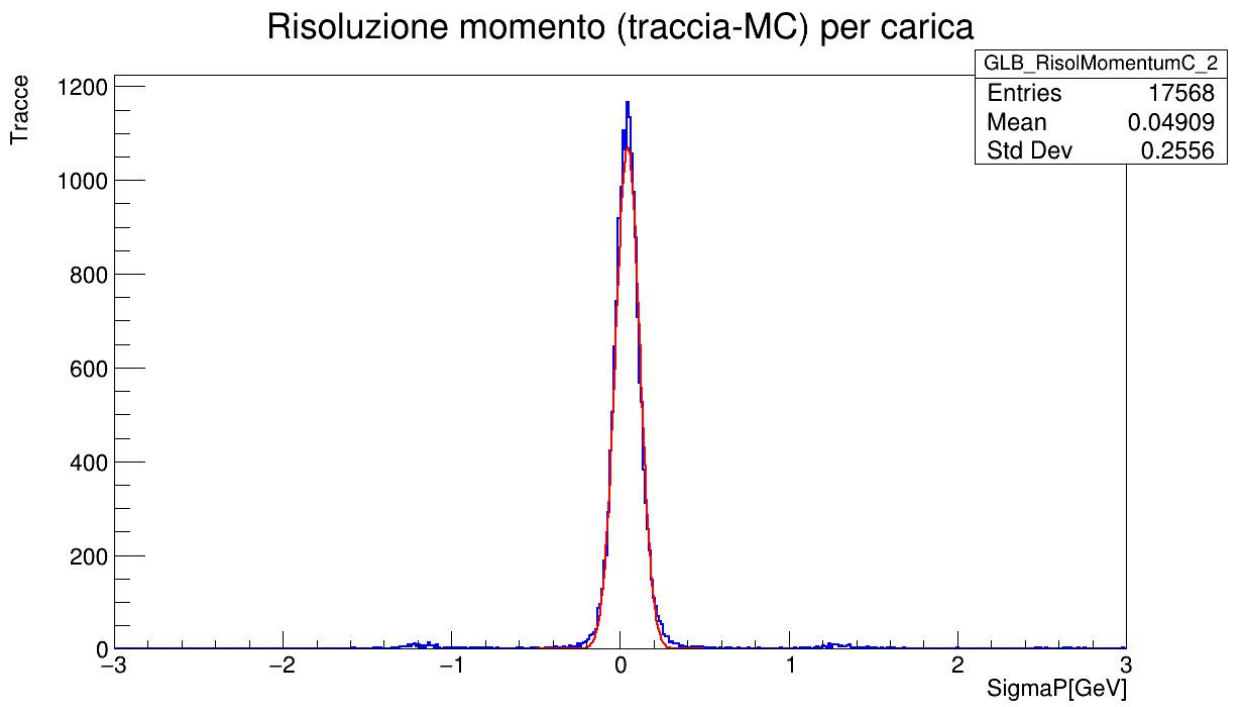


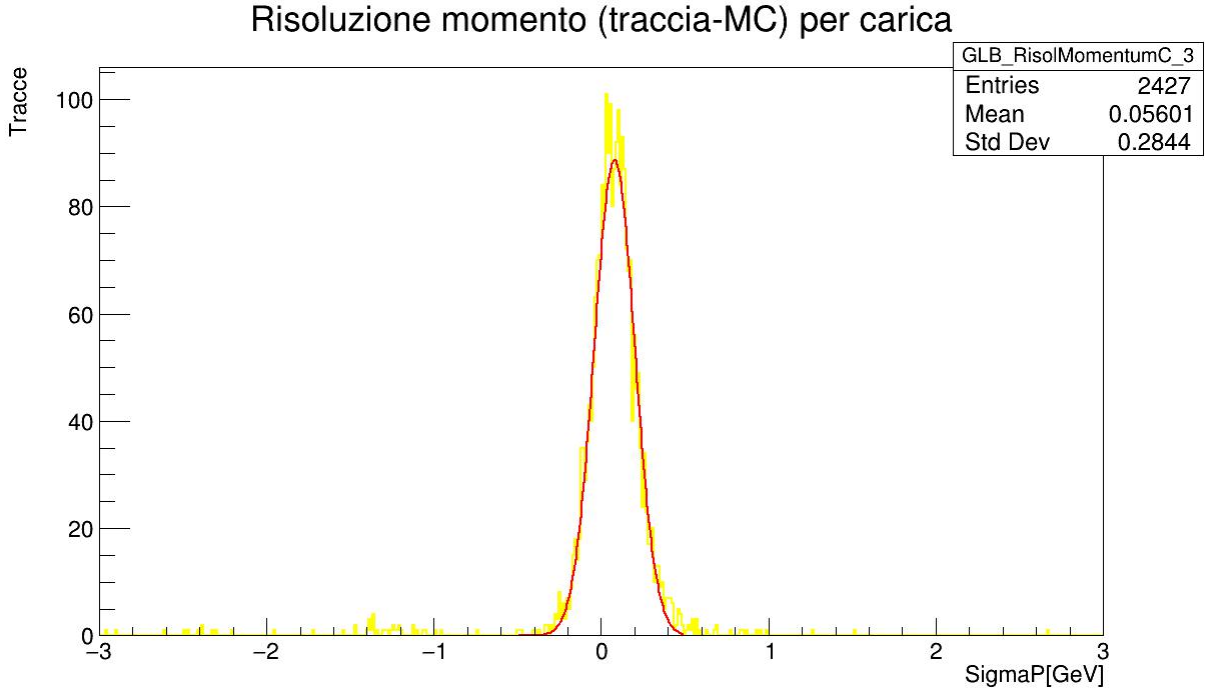
- Limite superiore momento nel calcolo della risoluzione

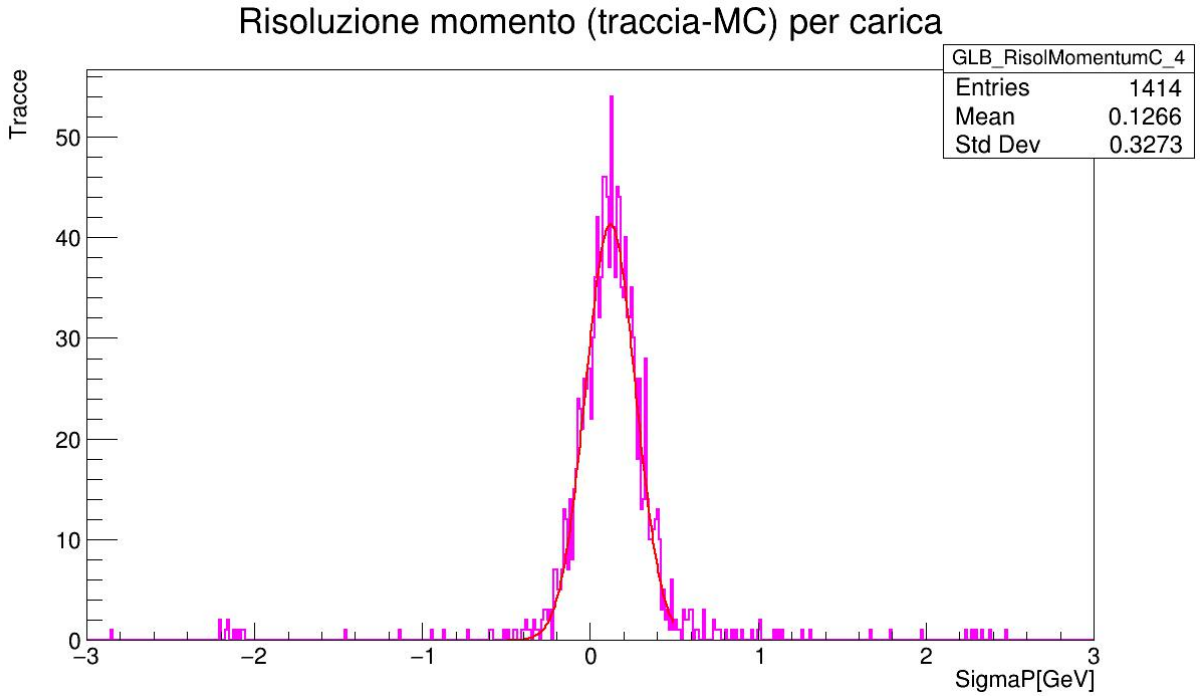
Momentum resolution by charge

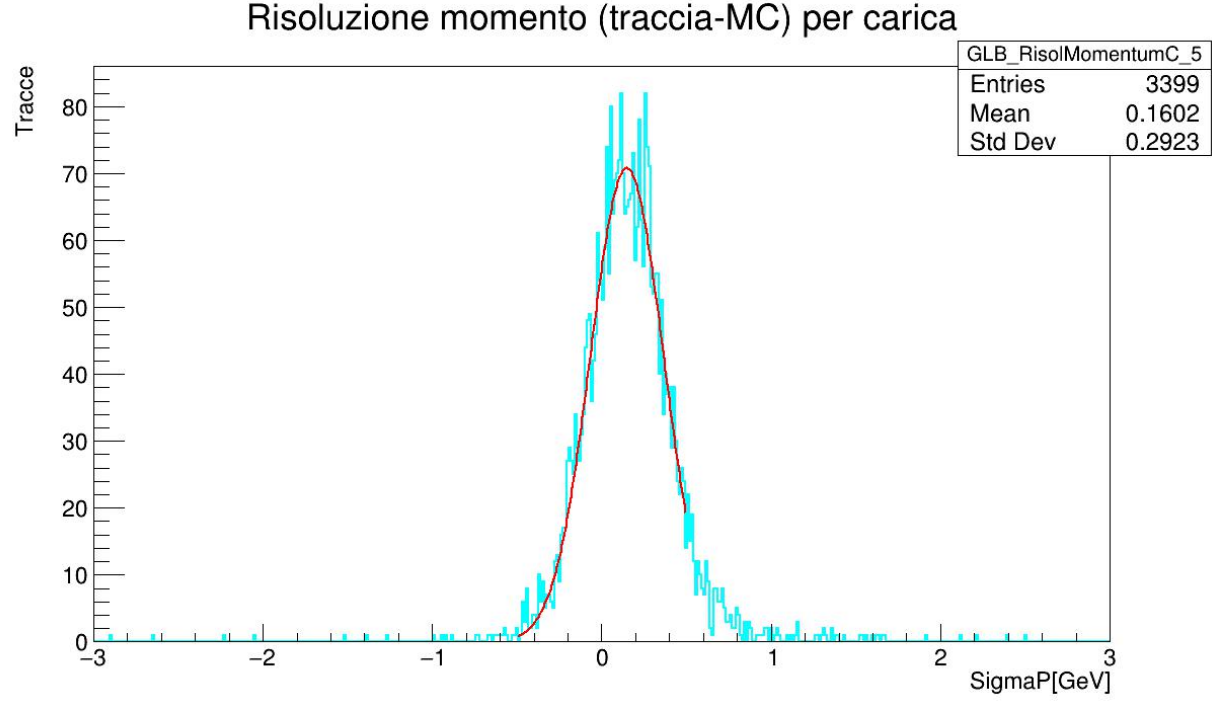
(TRACCIA-MC)

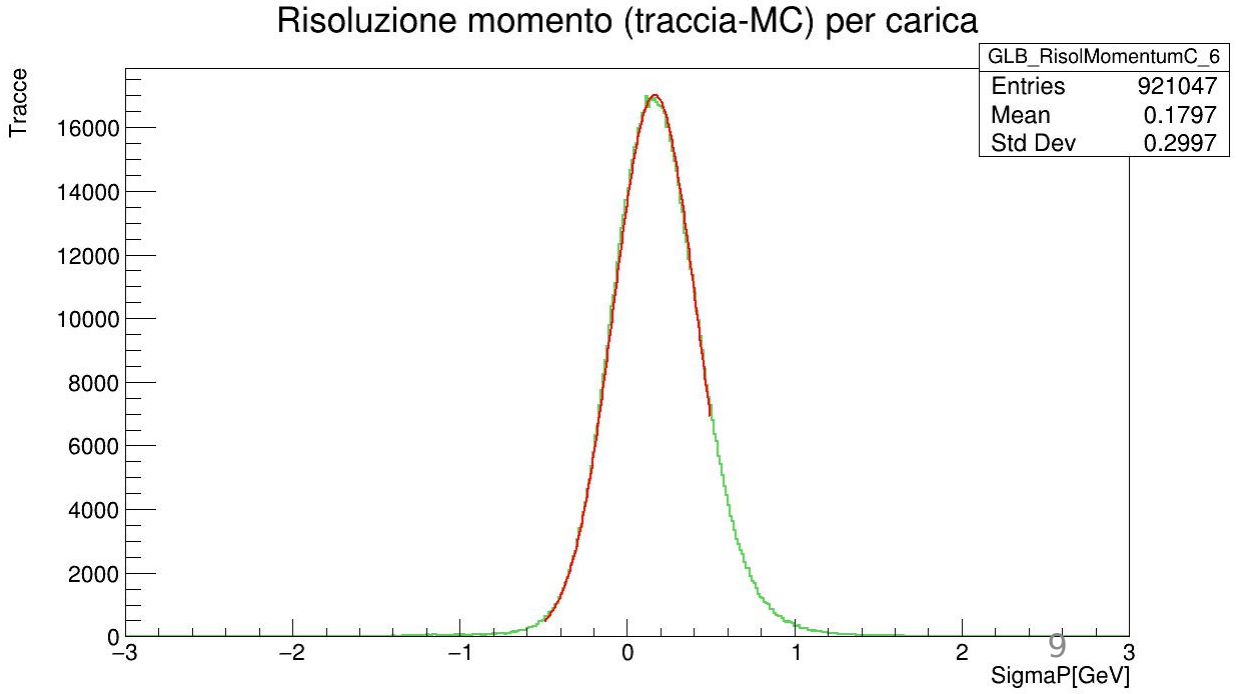





Risoluzione momento (traccia-MC) per carica
GLB_RisolMomentumC_3
Entries 2427
Mean 0.05601
Std Dev 0.2844
Tracce
SigmaP[GeV]

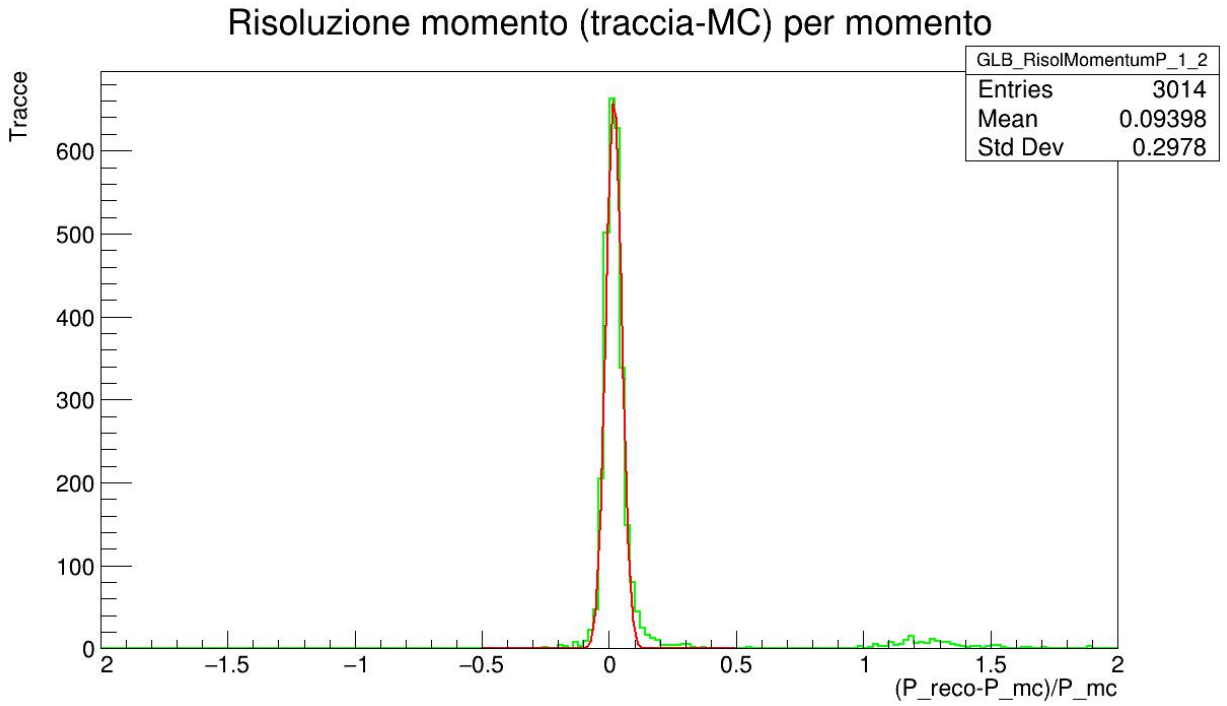

Risoluzione momento (traccia-MC) per carica
GLB_RisolMomentumC_4
Entries 1414
Mean 0.1266
Std Dev 0.3273
Tracce
SigmaP[GeV]

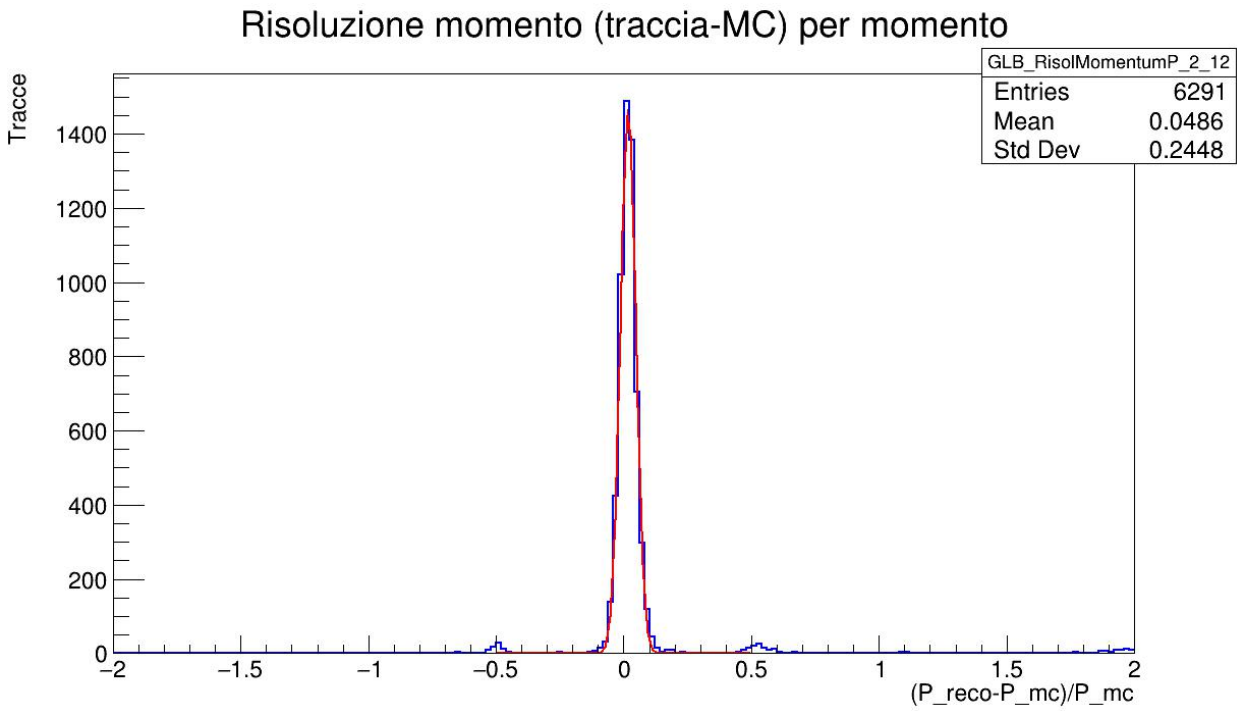

Risoluzione momento (traccia-MC) per carica
GLB_RisolMomentumC_5
Entries 3399
Mean 0.1602
Std Dev 0.2923
Tracce
SigmaP[GeV]

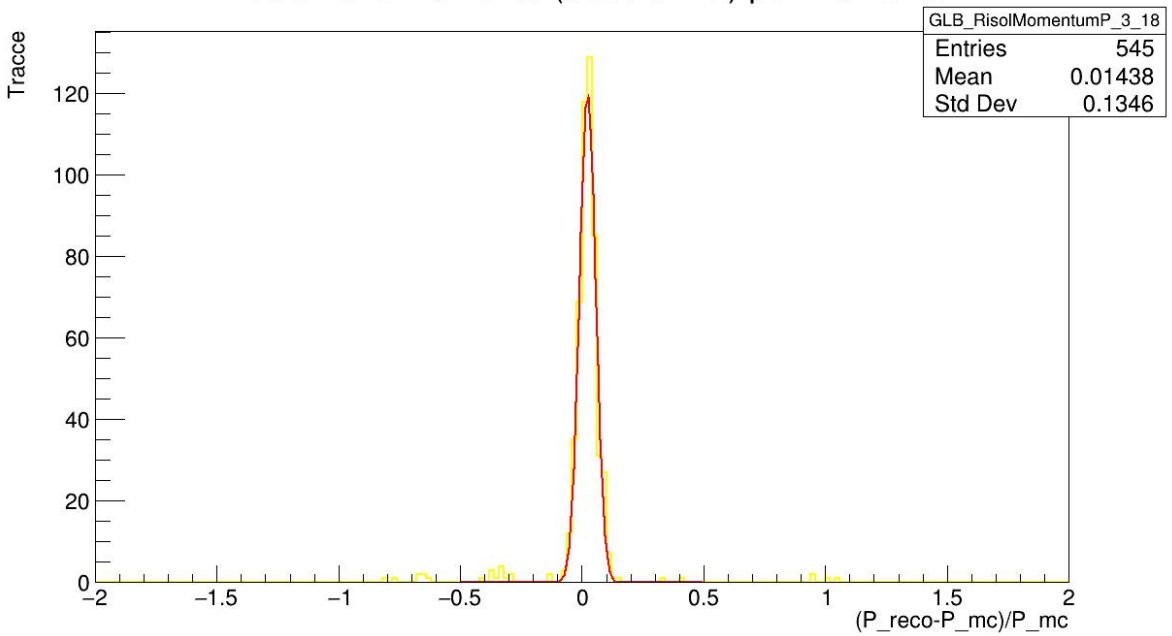

Risoluzione momento (traccia-MC) per carica
GLB_RisolMomentumC_6
Entries 921047
Mean 0.1797
Std Dev 0.2997
Tracce
SigmaP[GeV]

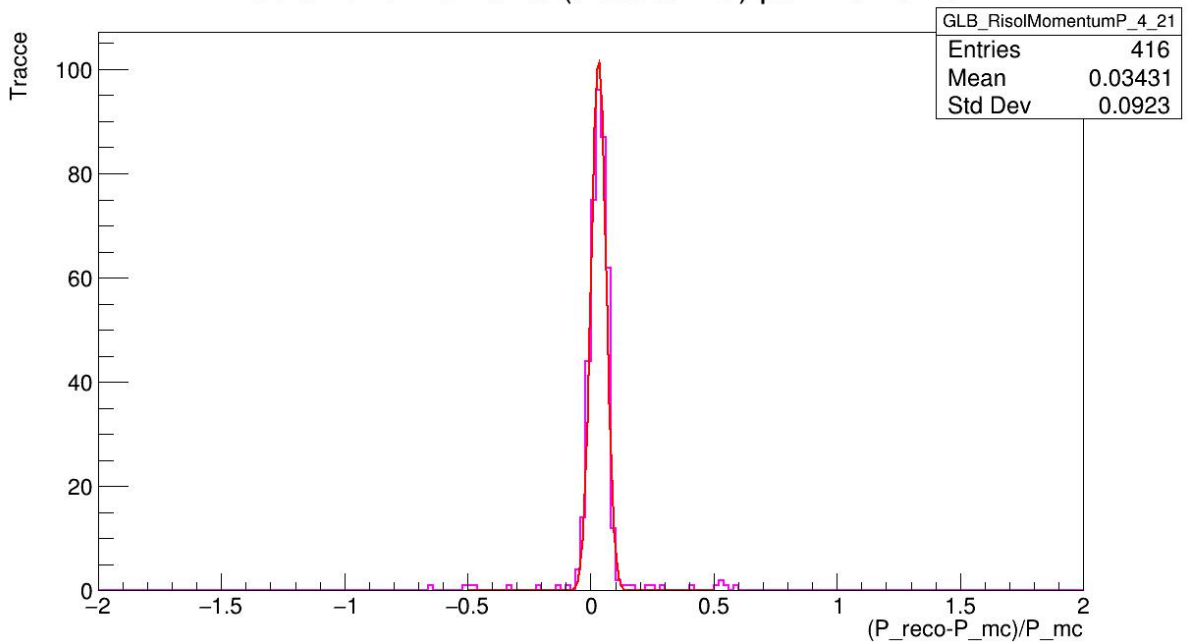
Momentum resolution by charge and by momentum (bin of 200 MeV/c)

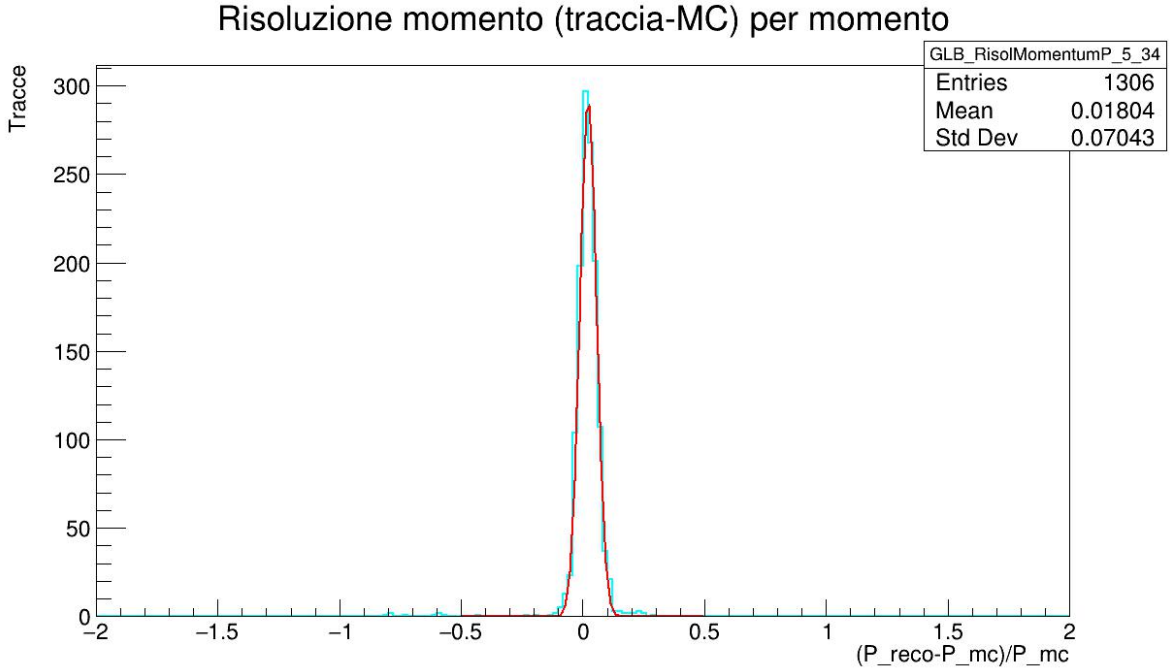
(TRACCIA-MC)

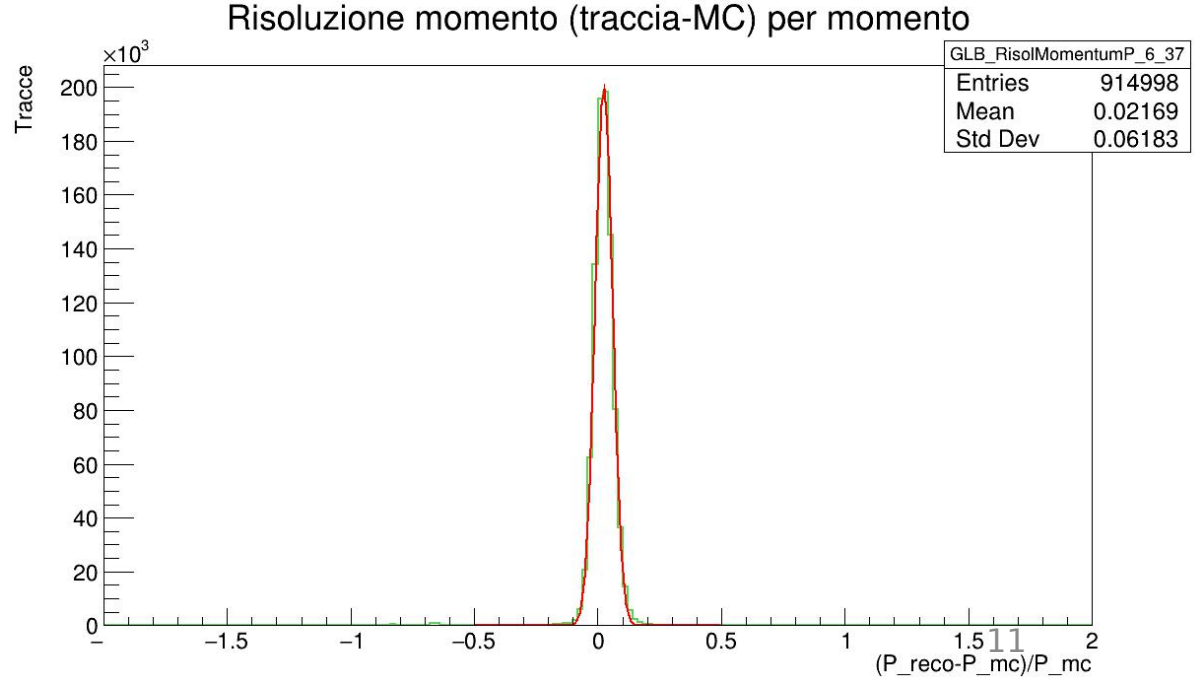




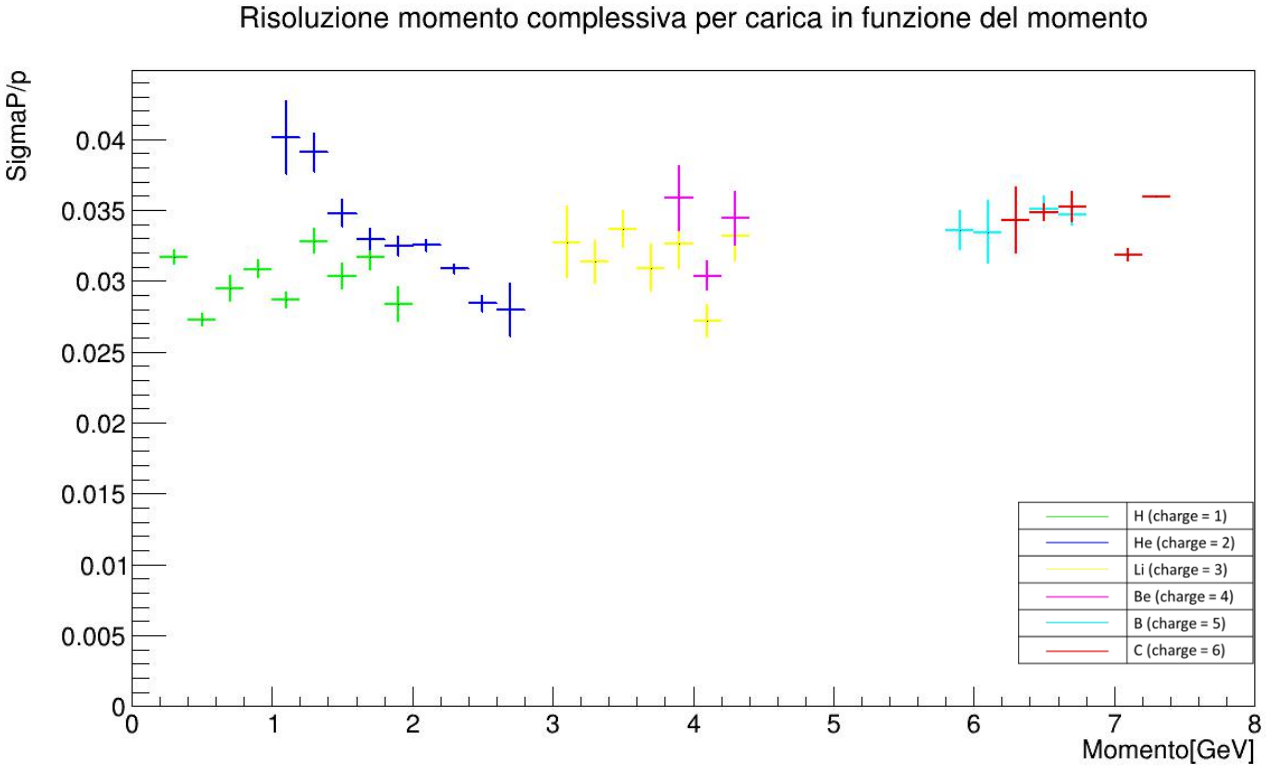

Risoluzione momento (traccia-MC) per momento
GLB_RisolMomentumP_3_18
Entries 545
Mean 0.01438
Std Dev 0.1346
Tracce
(P_reco-P_mc)/P_mc


Risoluzione momento (traccia-MC) per momento
GLB_RisolMomentumP_4_21
Entries 416
Mean 0.03431
Std Dev 0.0923
Tracce
(P_reco-P_mc)/P_mc


Risoluzione momento (traccia-MC) per momento
GLB_RisolMomentumP_5_34
Entries 1306
Mean 0.01804
Std Dev 0.07043
Tracce
(P_reco-P_mc)/P_mc


Risoluzione momento (traccia-MC) per momento
GLB_RisolMomentumP_6_37
Entries 914998
Mean 0.02169
Std Dev 0.06183
×10^3
Tracce
(P_reco-P_mc)/P_mc

Momentum resolution



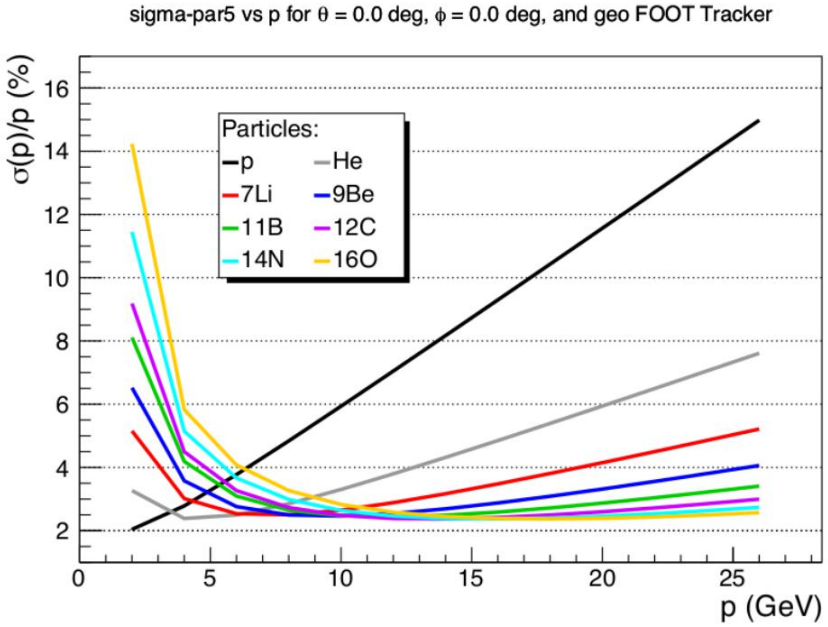


Figure 5.1: Best differential momentum resolution for a FOOT-like geometry for isotopes producing in the target.

$$\left(\frac{\sigma_p}{p}\right)^2 = \underbrace{\text{const} \cdot \left(\frac{p}{BL^2}\right)^2}_{\text{spectrometer contribution}} + \underbrace{\text{const} \cdot \left(\frac{1}{B\beta\sqrt{LX_0}}\right)^2}_{\text{Multiple Scattering contribution}}$$

Momentum resolution

-The momentum resolution is < 5%

-Results with “perfect” MC simulations... No pile up, disallignment, experimental effects

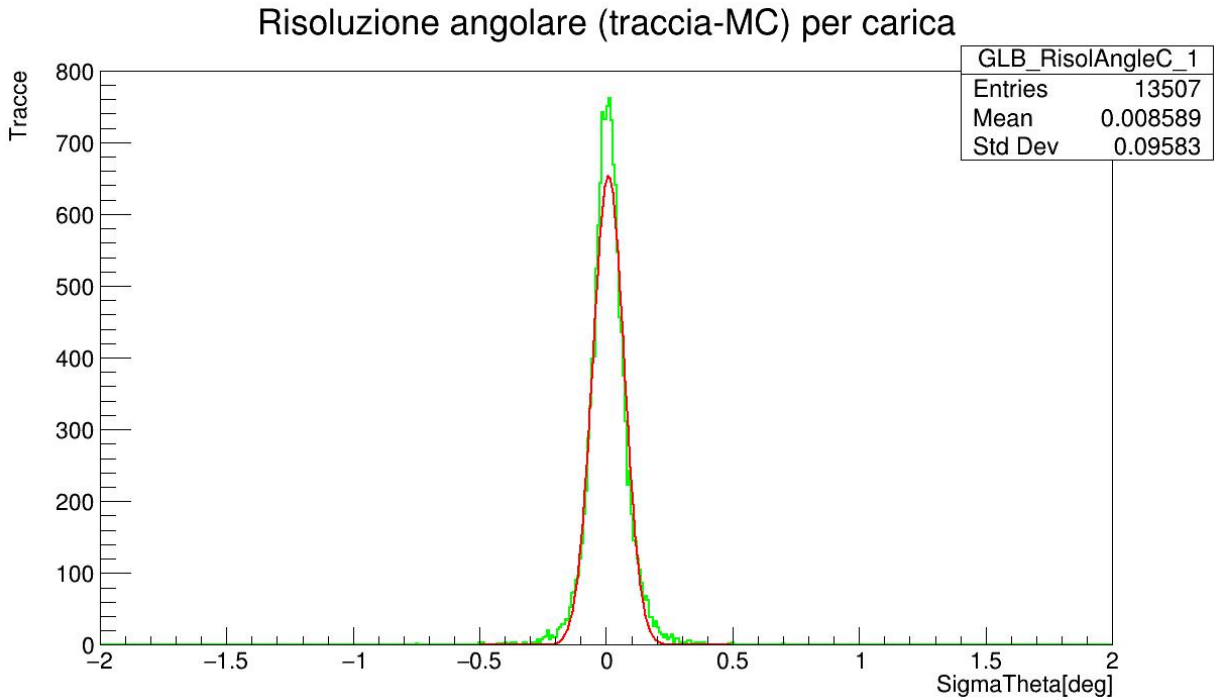
-The mean of the momentum resolution is shifted: apparently Genfit reconstructs a higher value for the momentum with respect to MC

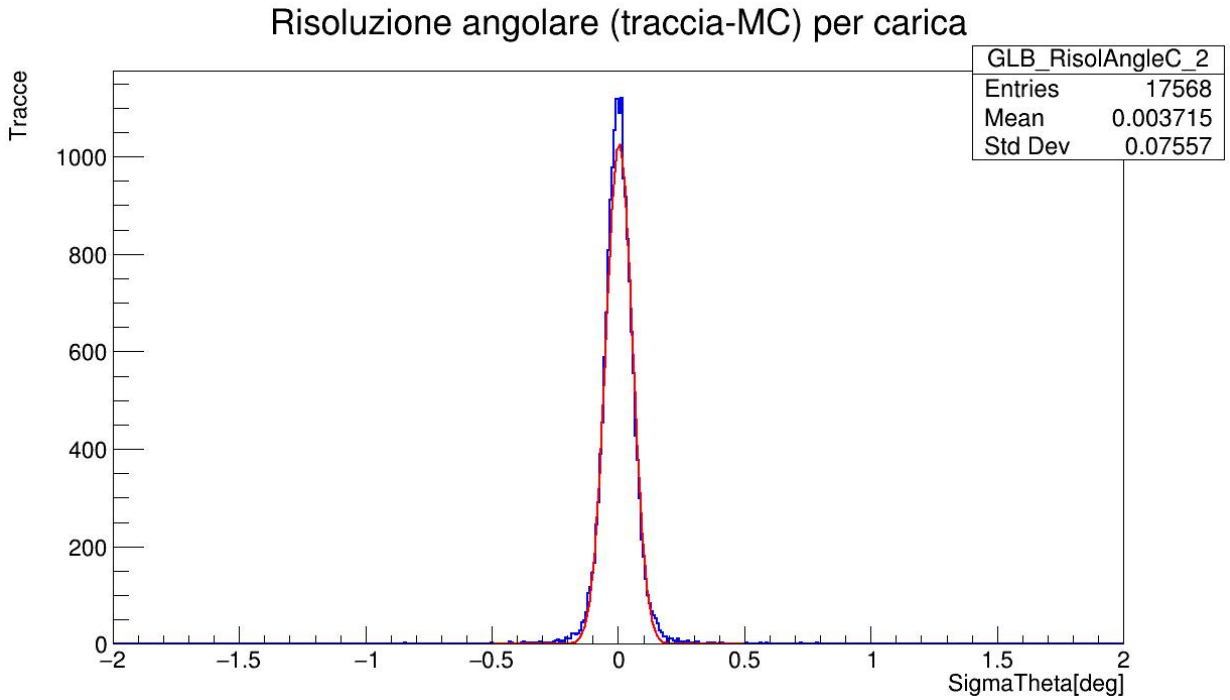
-Maybe is the initial momentum seeds (under investigation)

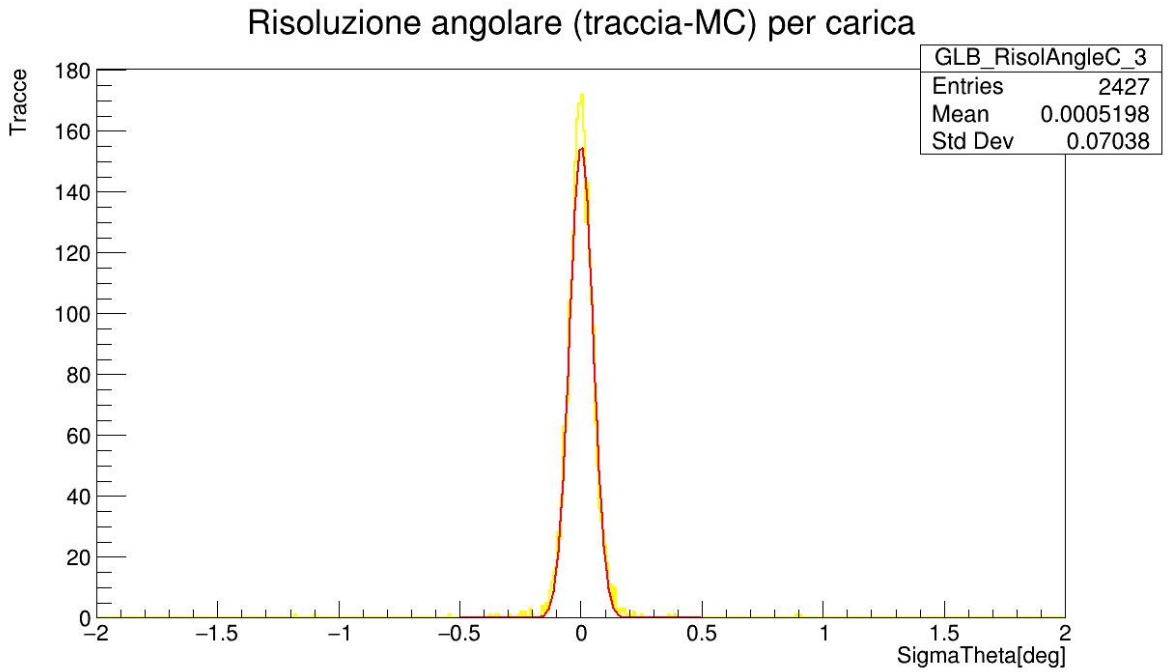
-Not all the passive material are included in the reco/genfit geometry (to be checked... and fixed)

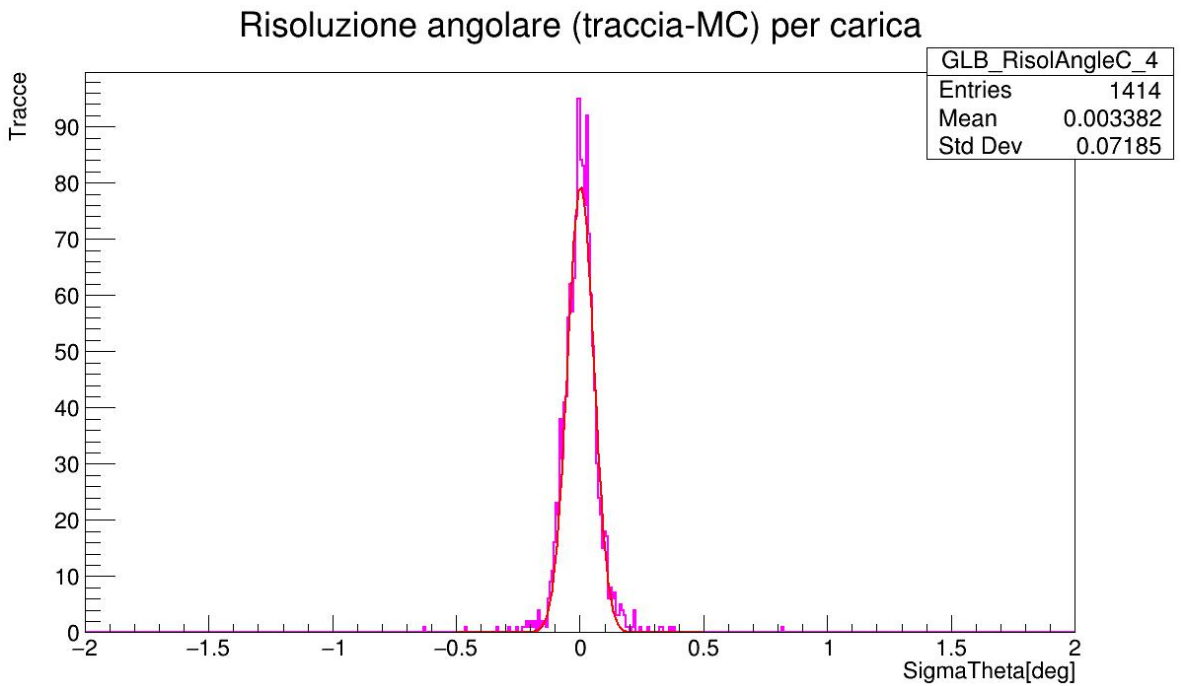
ANGULAR RESOLUTION by charge

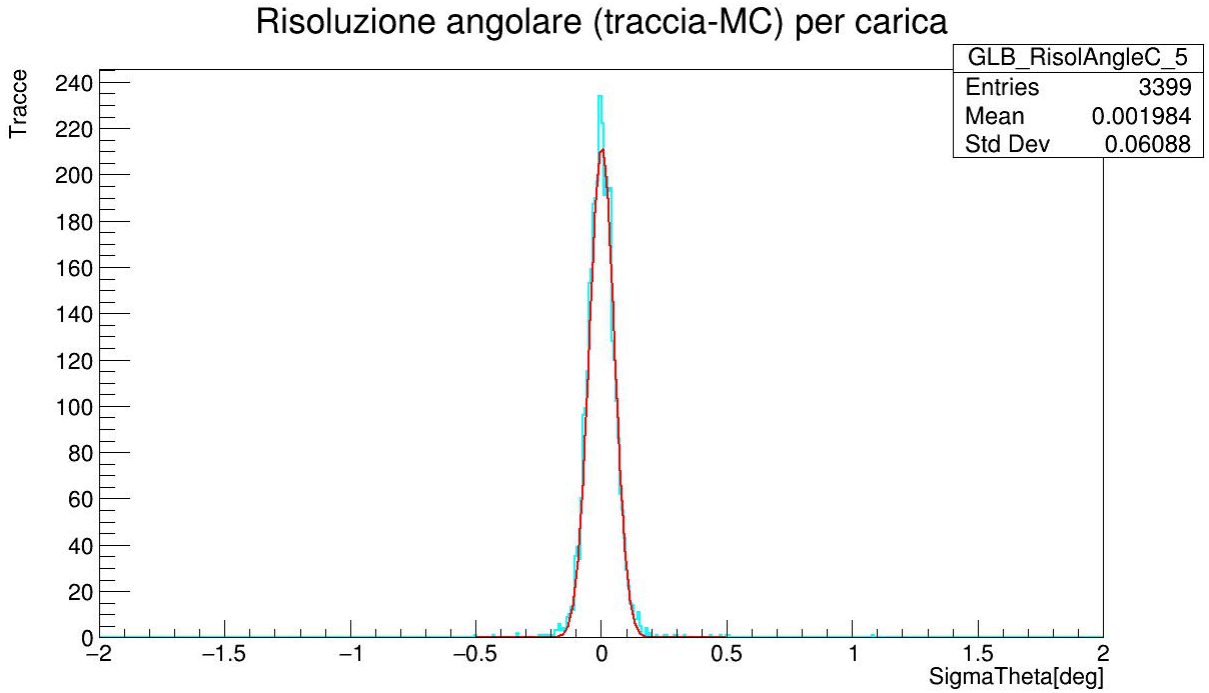
(TRACCIA-MC)

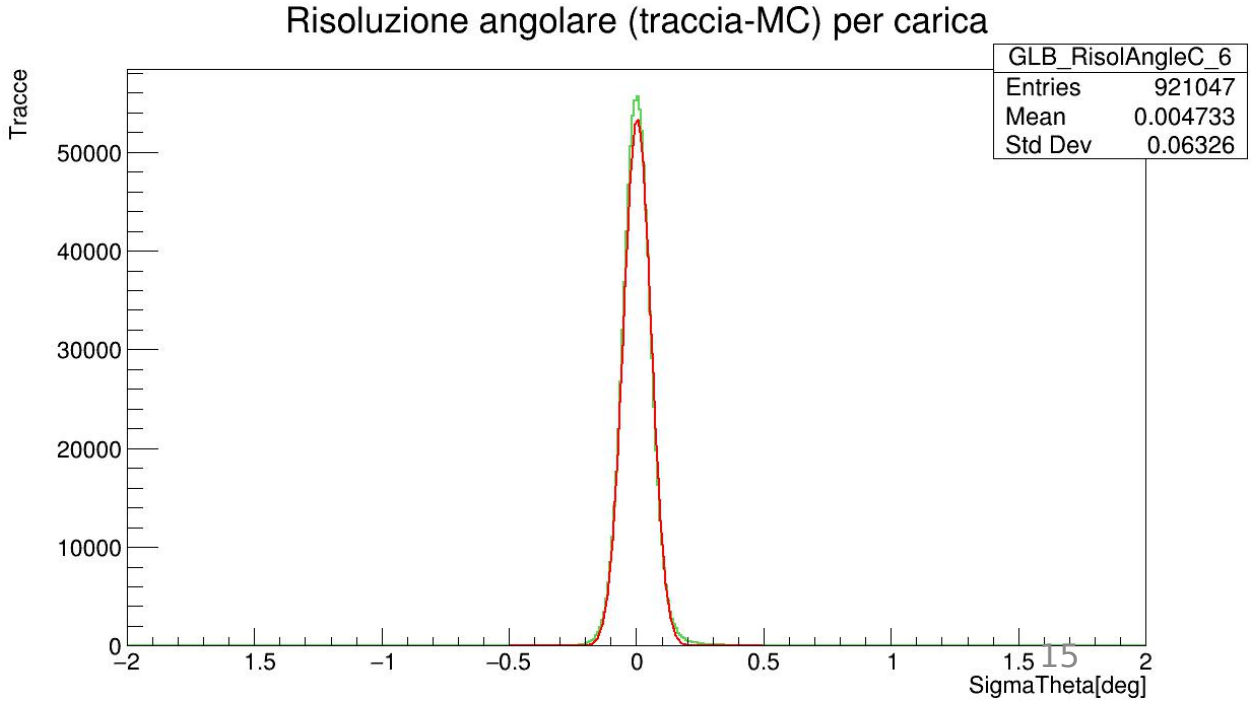





Risoluzione angolare (traccia-MC) per carica
GLB_RisolAngleC_3
Entries 2427
Mean 0.0005198
Std Dev 0.07038
Tracce
SigmaTheta[deg]

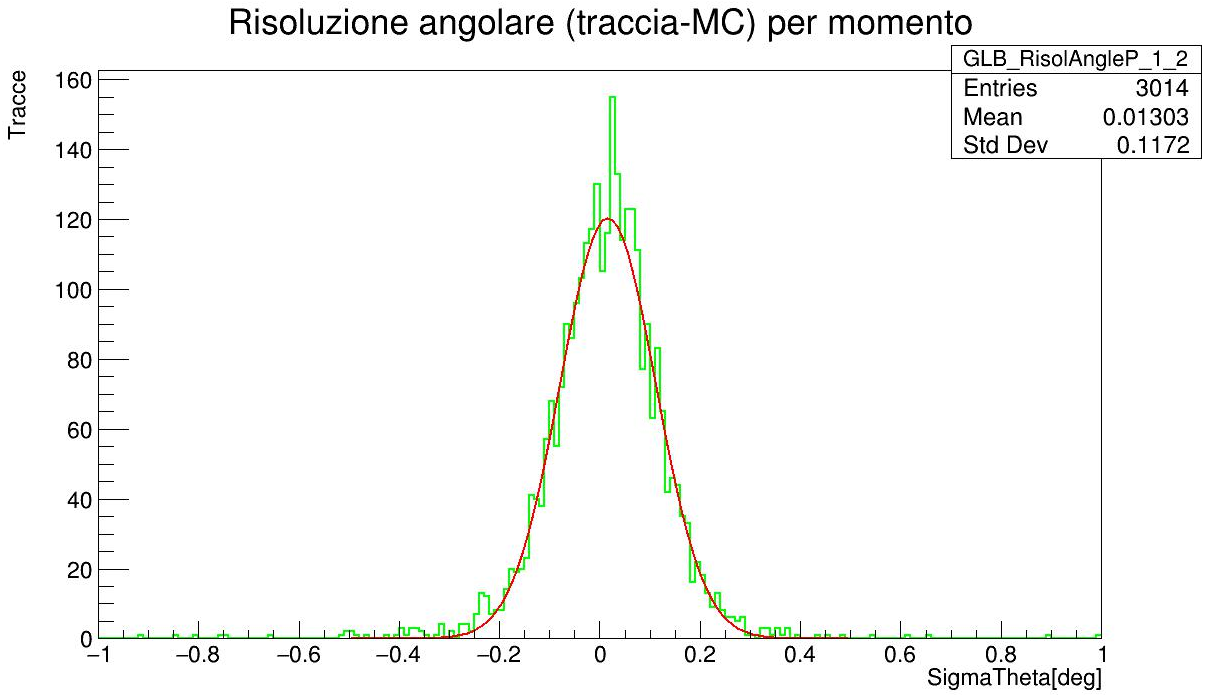

Risoluzione angolare (traccia-MC) per carica
GLB_RisolAngleC_4
Entries 1414
Mean 0.003382
Std Dev 0.07185
Tracce
SigmaTheta[deg]

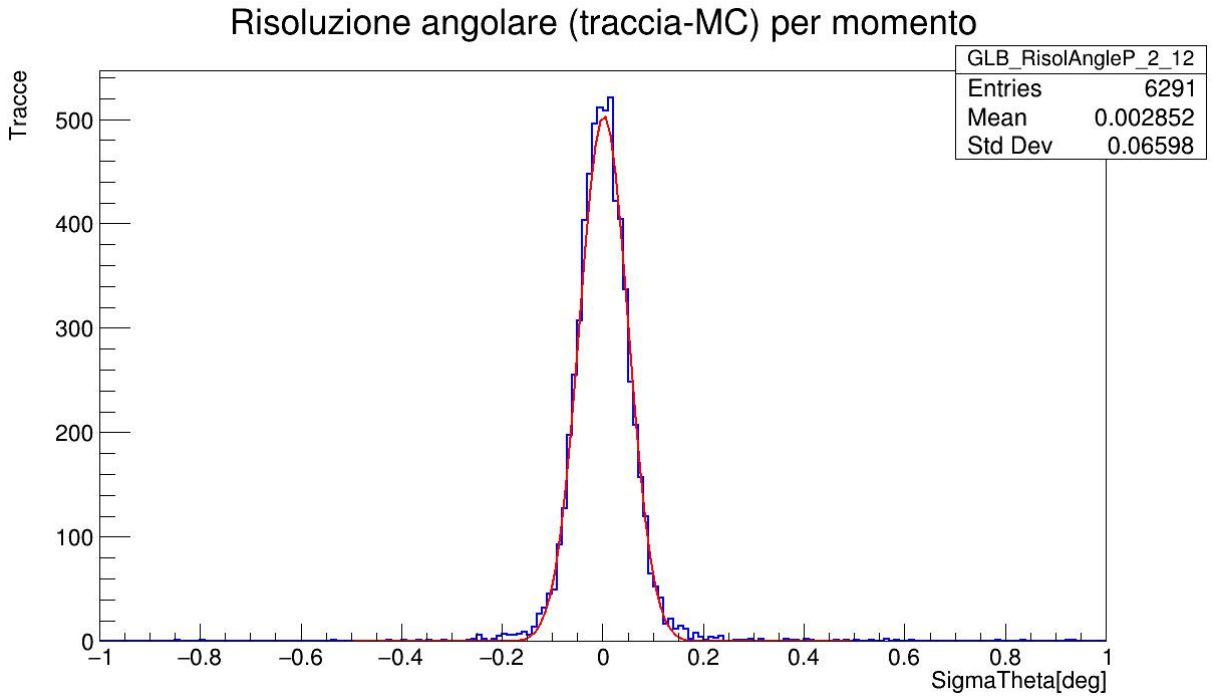

Risoluzione angolare (traccia-MC) per carica
GLB_RisolAngleC_5
Entries 3399
Mean 0.001984
Std Dev 0.06088
Tracce
SigmaTheta[deg]

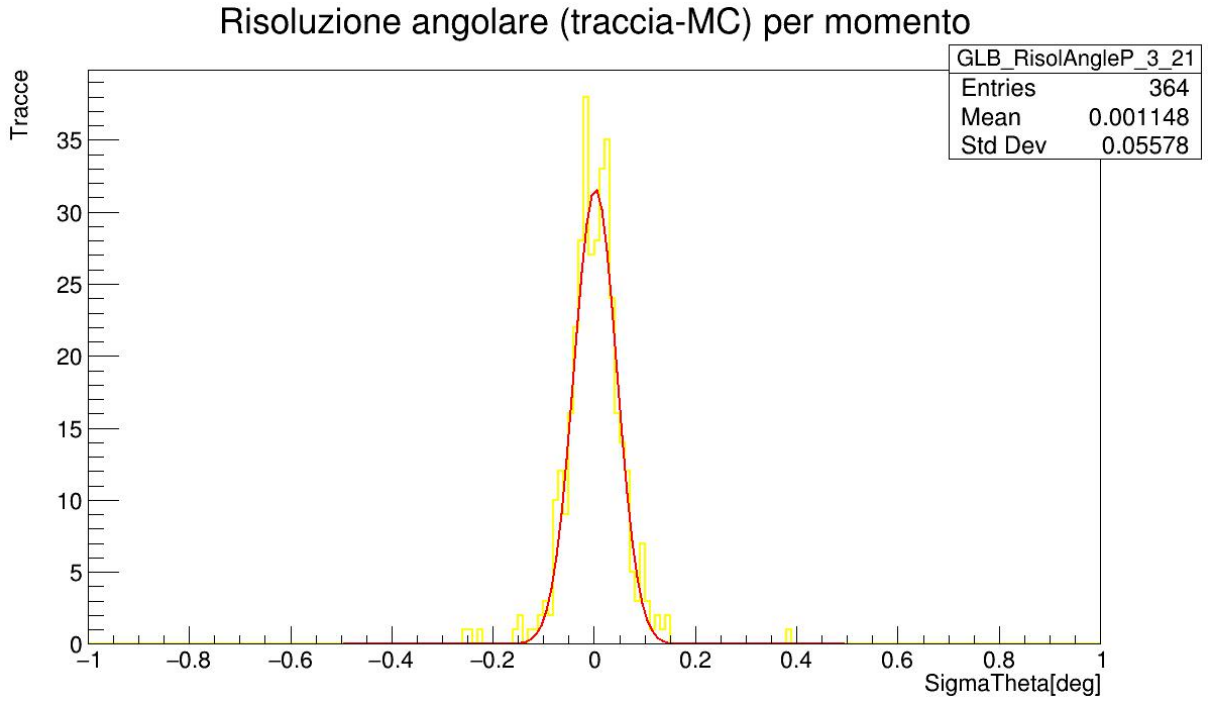

Risoluzione angolare (traccia-MC) per carica
GLB_RisolAngleC_6
Entries 921047
Mean 0.004733
Std Dev 0.06326
Tracce
SigmaTheta[deg]

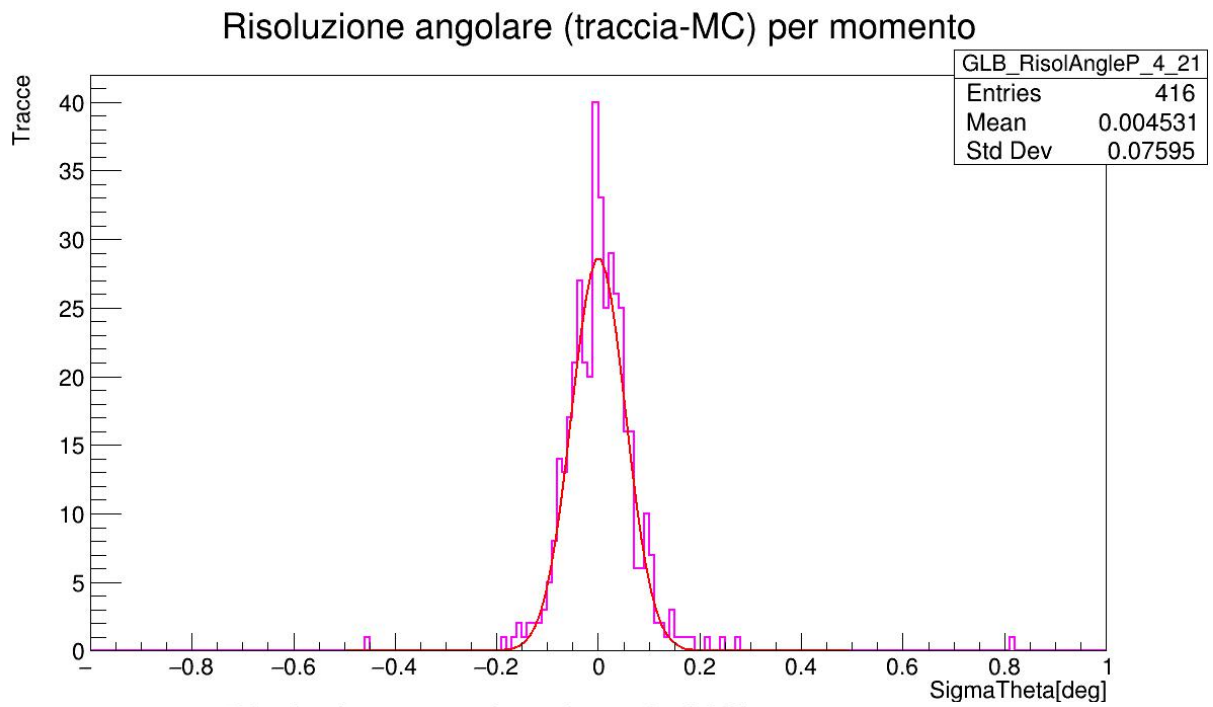
RISOLUZIONE ANGOLARE by charge and by momentum

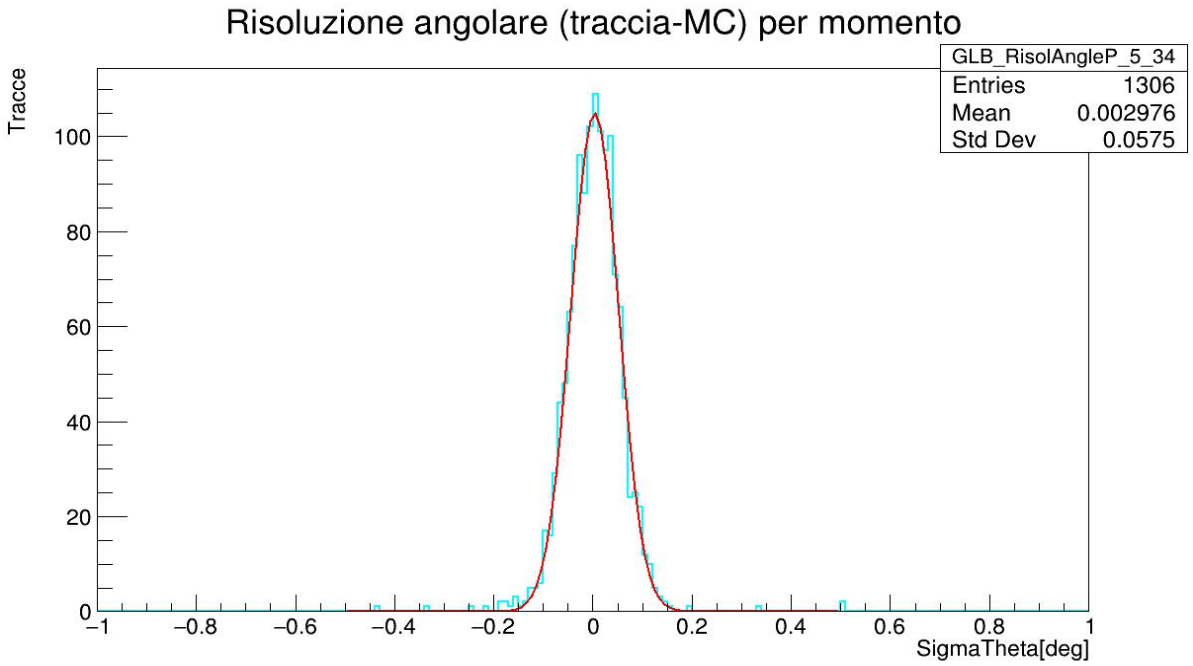
(TRACCIA-MC)

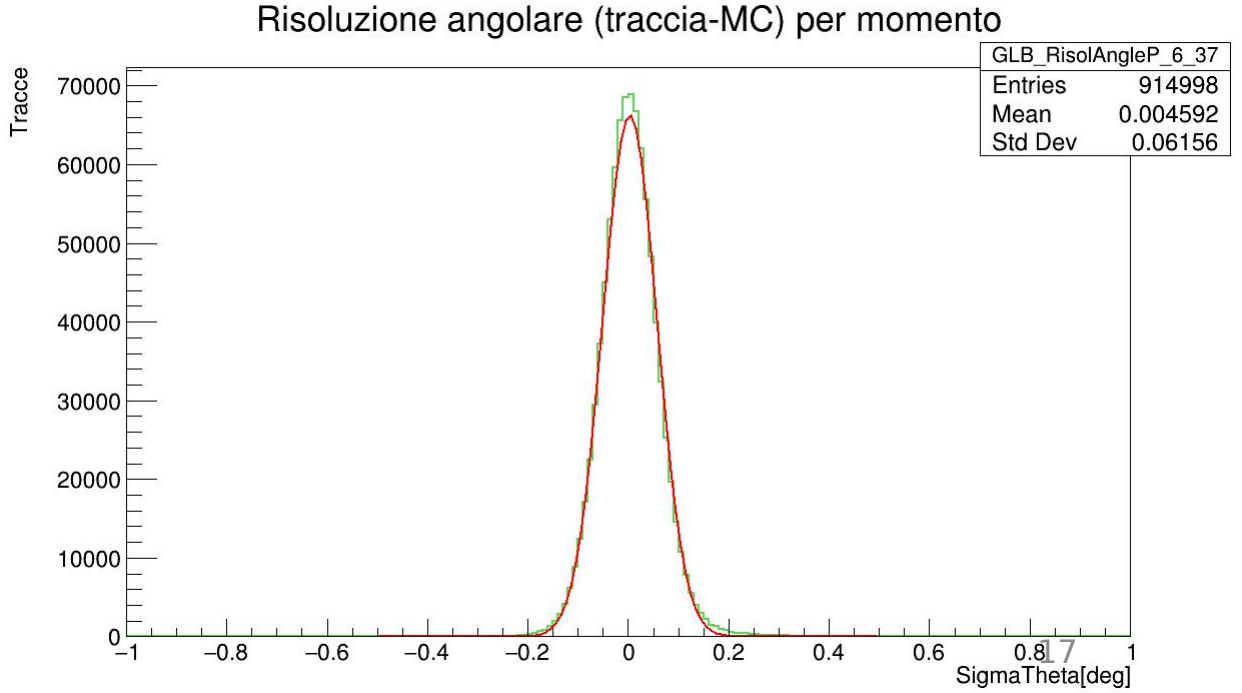




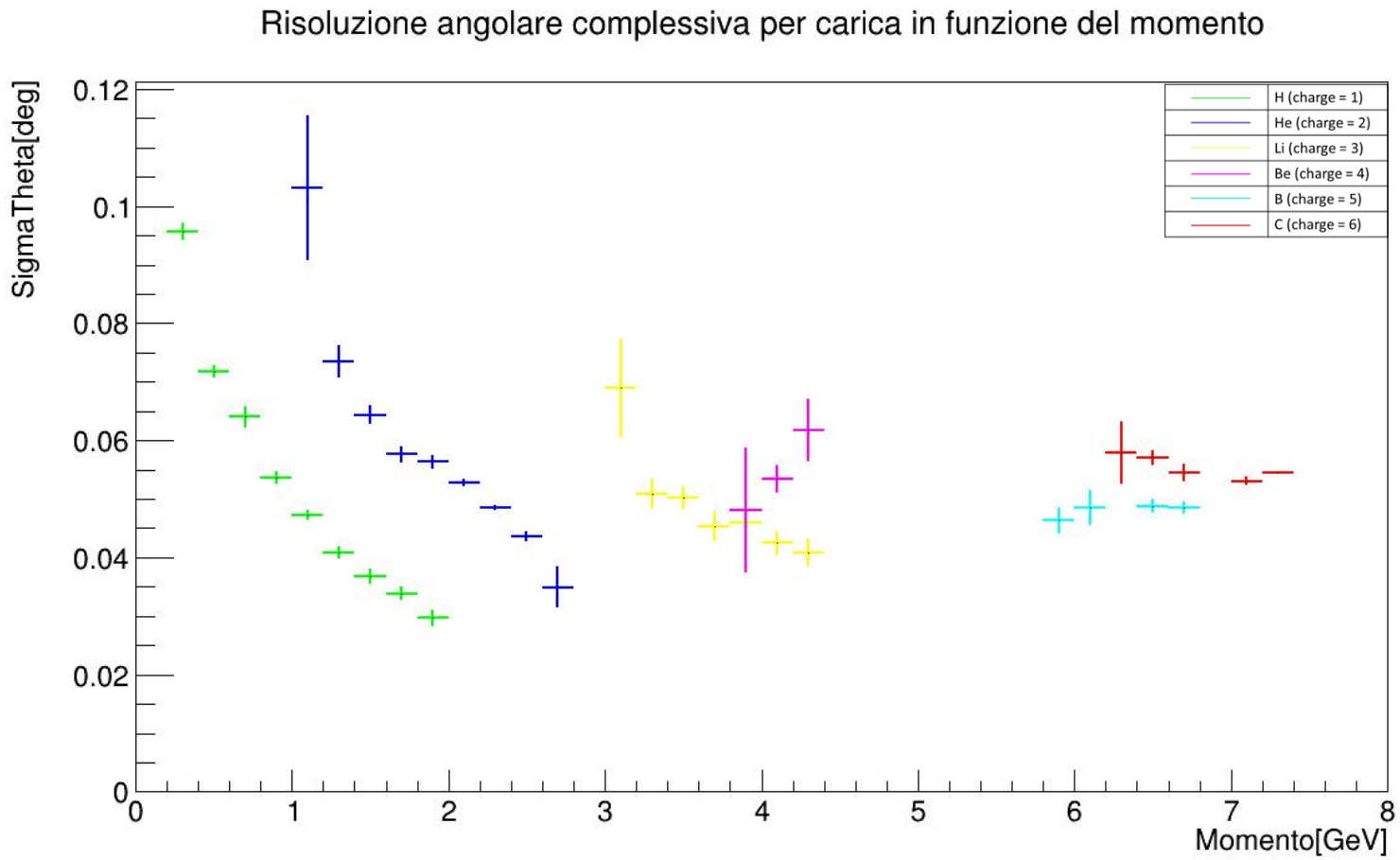

Risoluzione angolare (traccia-MC) per momento
GLB_RisolAngleP_3_21
Entries 364
Mean 0.001148
Std Dev 0.05578
Tracce
SigmaTheta[deg]


Risoluzione angolare (traccia-MC) per momento
GLB_RisolAngleP_4_21
Entries 416
Mean 0.004531
Std Dev 0.07595
Tracce
SigmaTheta[deg]


Risoluzione angolare (traccia-MC) per momento
GLB_RisolAngleP_5_34
Entries 1306
Mean 0.002976
Std Dev 0.0575
Tracce
SigmaTheta[deg]


Risoluzione angolare (traccia-MC) per momento
GLB_RisolAngleP_6_37
Entries 914998
Mean 0.004592
Std Dev 0.06156
Tracce
SigmaTheta[deg]

Angular resolution by charge and by momentum



TO DO list

- Understand the peaks in slide 3
  -do the analysis with TWZtrue
- Understand the reasons of the shift in the momentum resolution

- Maybe the code (a macro) can be used to optimize the global reconstruction parameters? (Number of minimum hit x track, tracking strategy etc.)