Ionization losses and cluster reconstruction

Investigations about the ionization losses of different particles in He-iC_4H_{10} using Garfield++.

- The final goal is to compare the results taken from Garfield with the results taken from Geant4

- **Garfield++ :**
  - study and characterization of the fundamental properties and performance of a single cell or of a drift chamber with simple geometry.
  - It can't be used to simulate a full detector and to study collider events.

- **Geant :**
  - Simulation of the elementary particle interaction with the material of a full (complex) detector.
  - Study of collider events.
  - The fundamental properties and performance of the sensible elements (drift cells) have to be parameterized or ad-hoc physics models have to be defined.

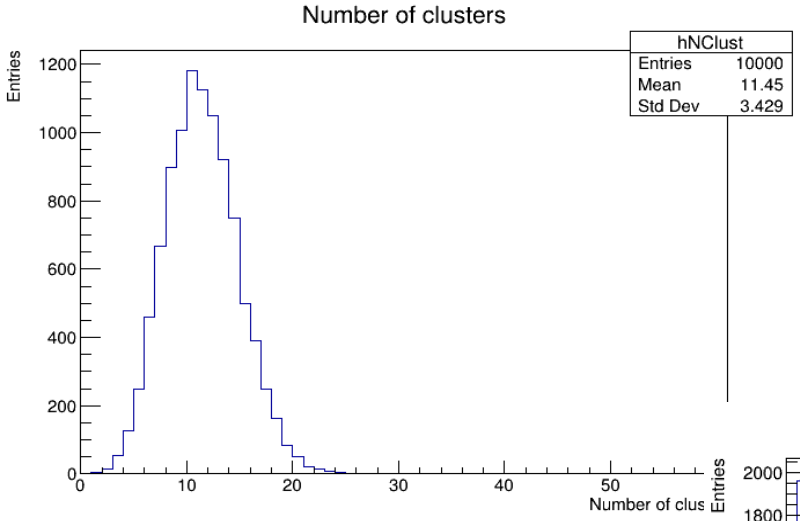
- Simulation is quite simple:
  -1cmx1cmx1cm of gas
  -Several tracks passes through this "gas-box" perpendicularly

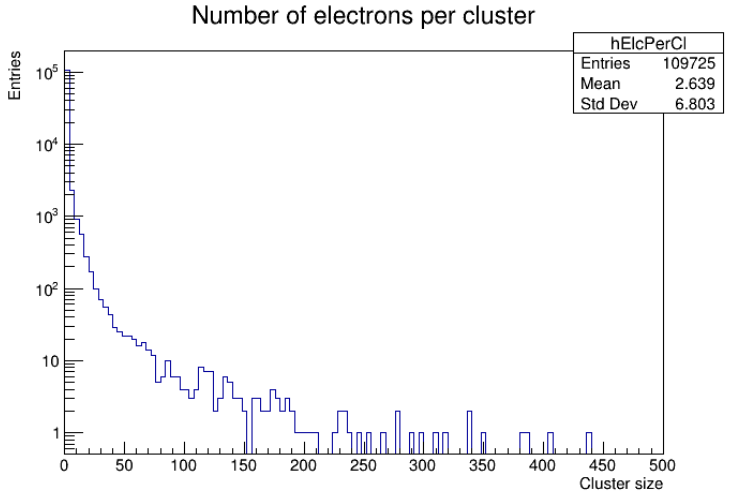
- Study of number of clusters, number of electrons, cluster size, ionization energy, ionization loss ...(relevant physics data)

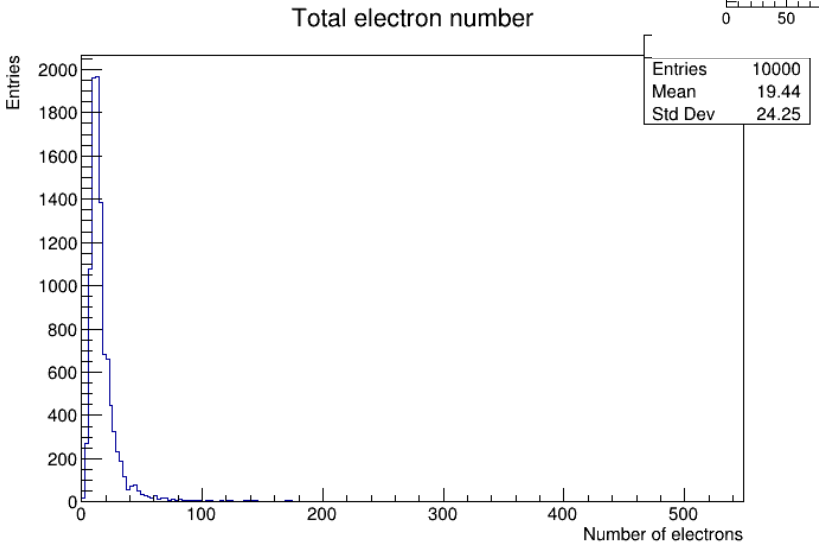
- Ionization process reconstruction starting from the results obtained.

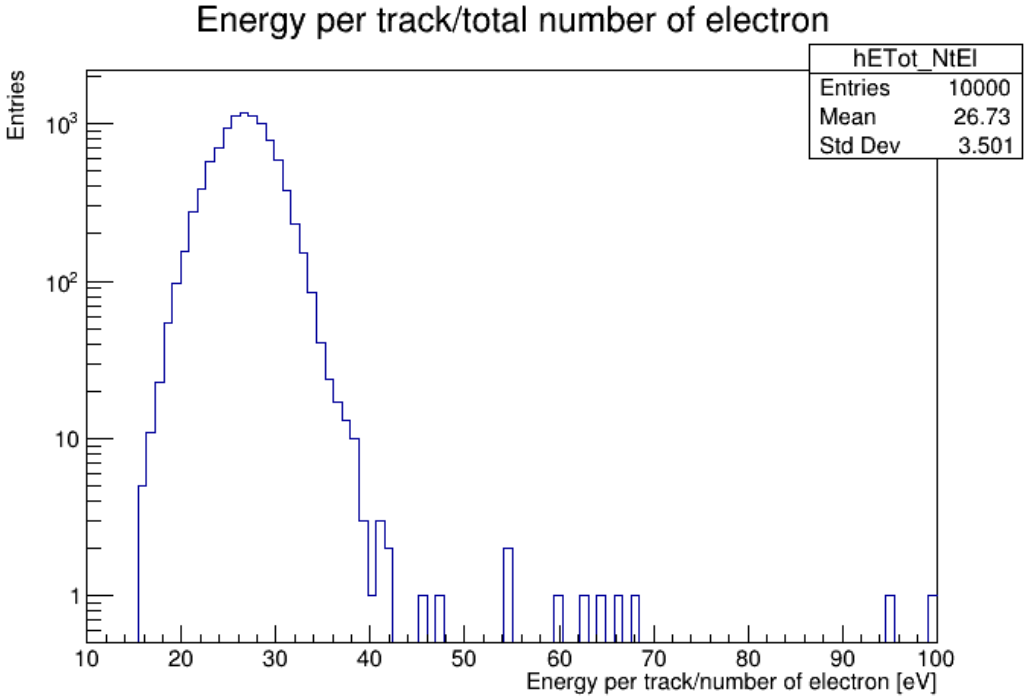
- Analysis of the number of clusters and cluster size trend for different particles with different momenta.

Results from Garifield simulation for a muon with p = 300MeV

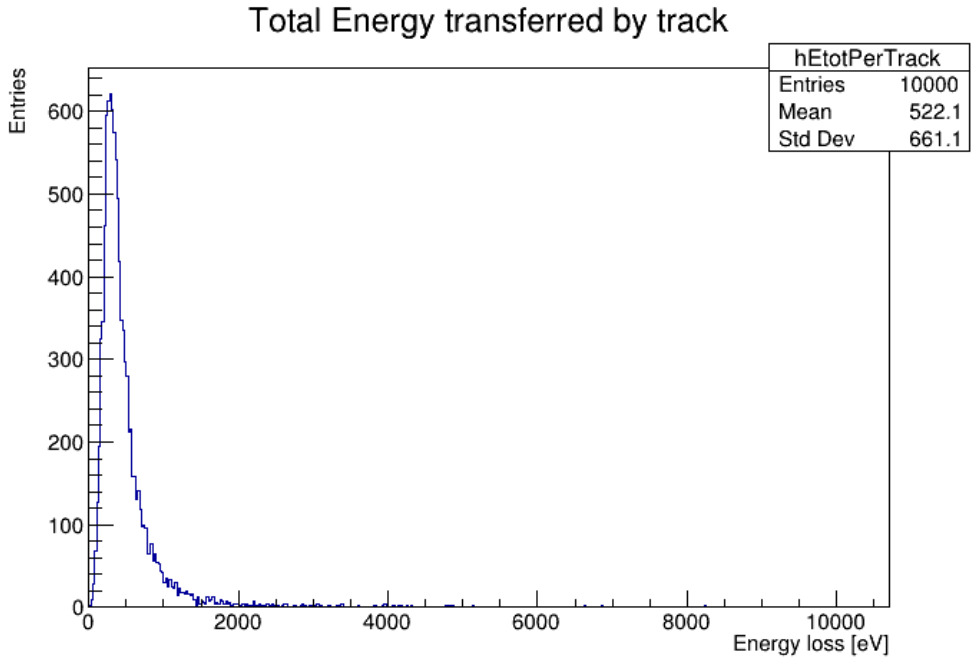






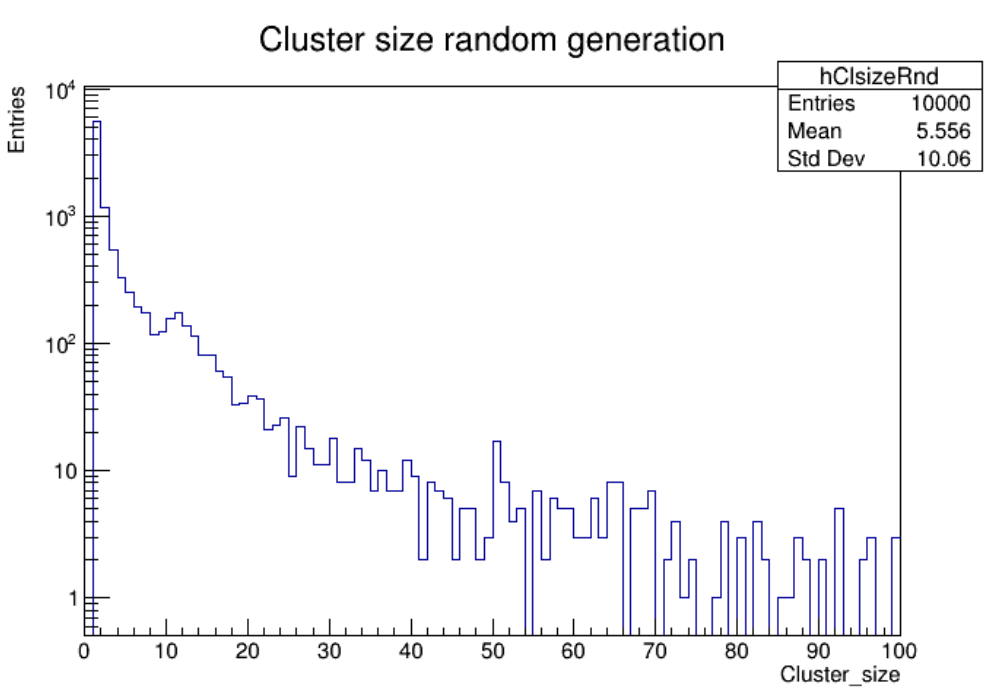


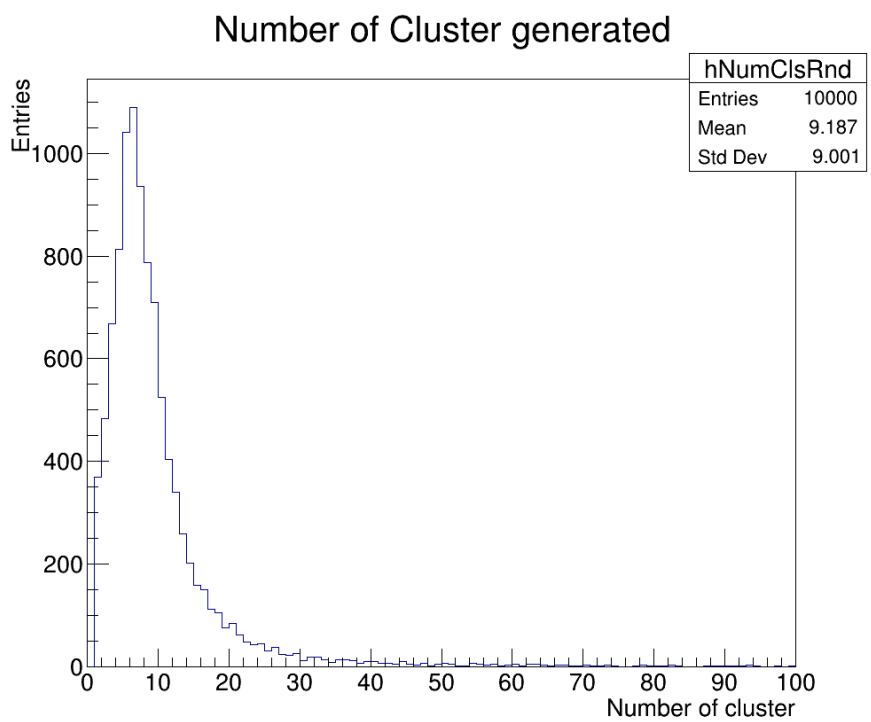
- Heed doesn't include the energy loss due to excitations.
- We can’t reconstruct the Bethe&Bloch from this analysis.



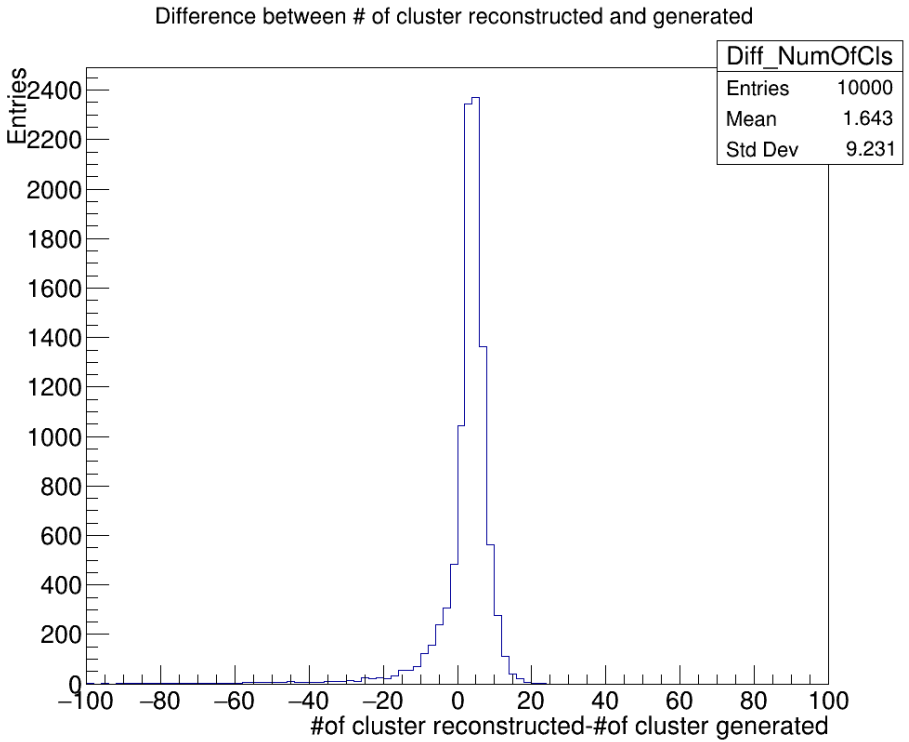
Reconstruction algorithm

1) From Garfield simulation, the energy loss, “E_{loss}” ,(track per track) and the ionization energy, ”E_{ion}”, are known.
2) Extract randomly the cluster size from the Cluster Size distribution (Garfield simulation result).
3) Evaluate the energy for generation of single cluster as $E_{cl}=E_{ion}$*Cls_size.
4) Iterate the cluster generation up to E_{loss} >= E_{cl_tot}.

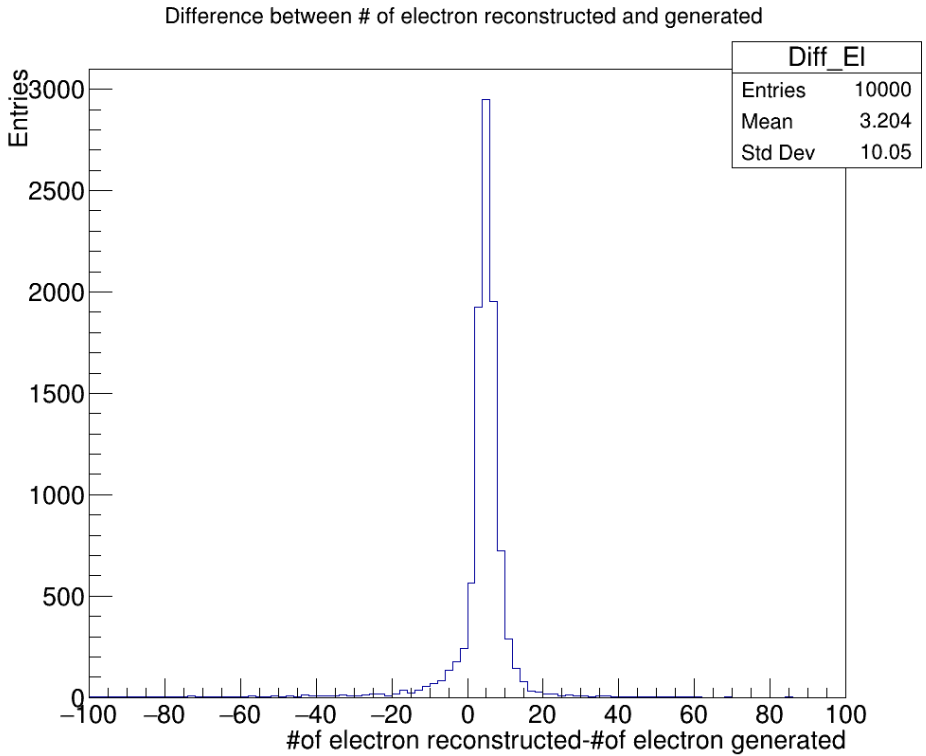




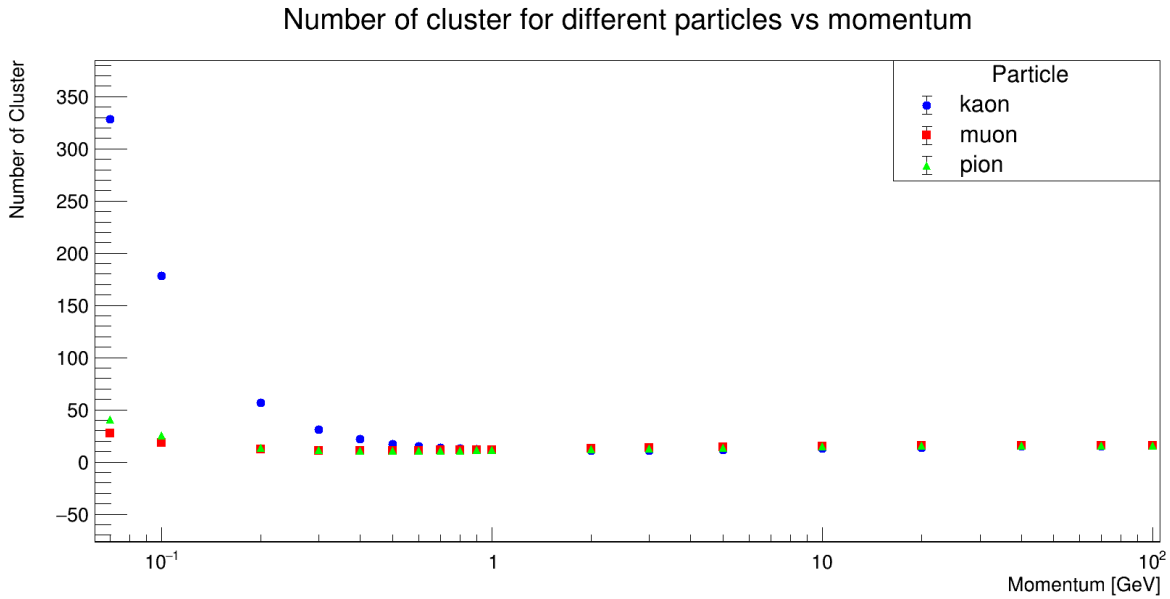
Difference between number of cluster taken from Garfield and number of cluster taken from the algorithm

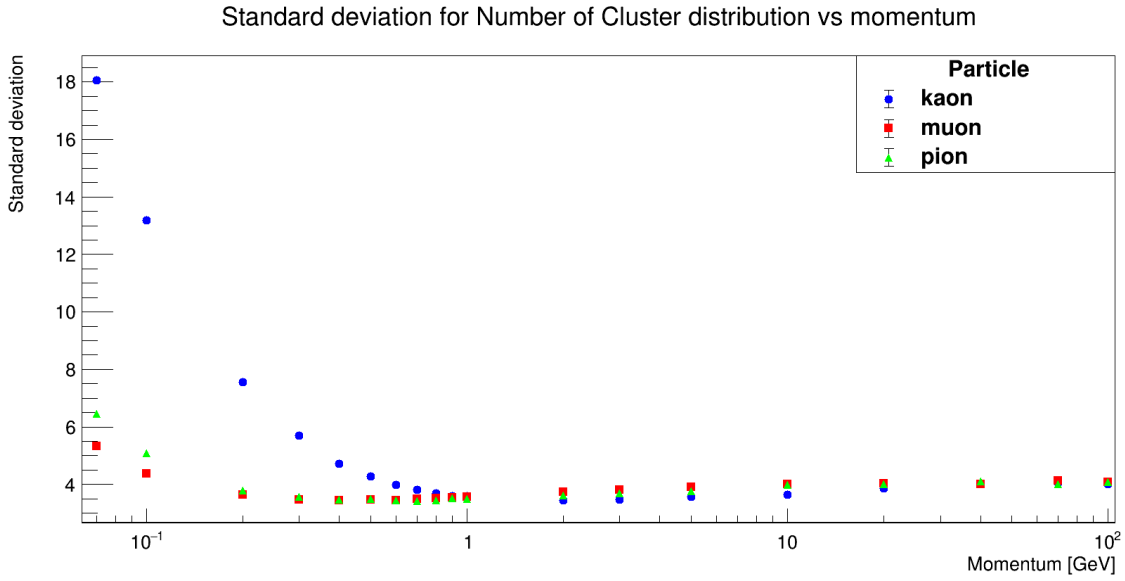


Difference between number of electron taken from Garfield and number of electron taken from the algorithm



Number of clusters and cluster size trend





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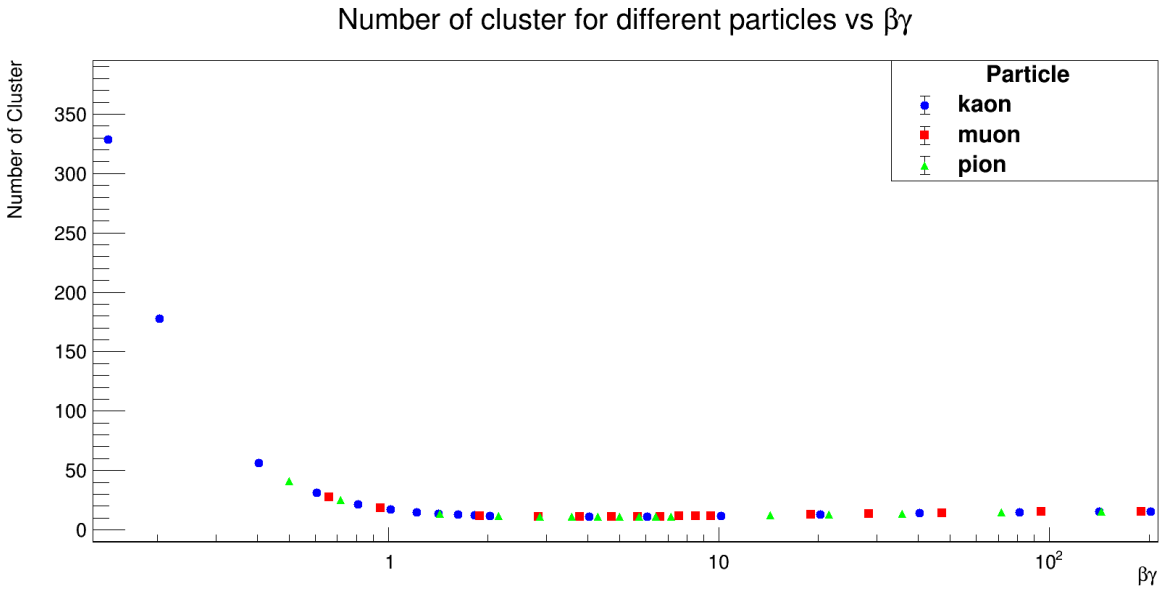
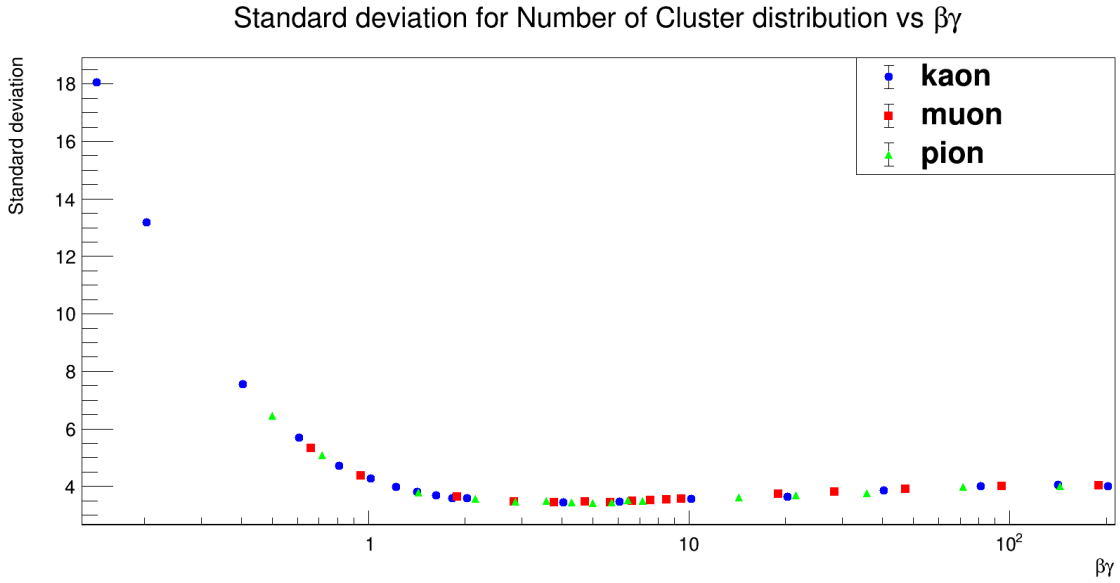
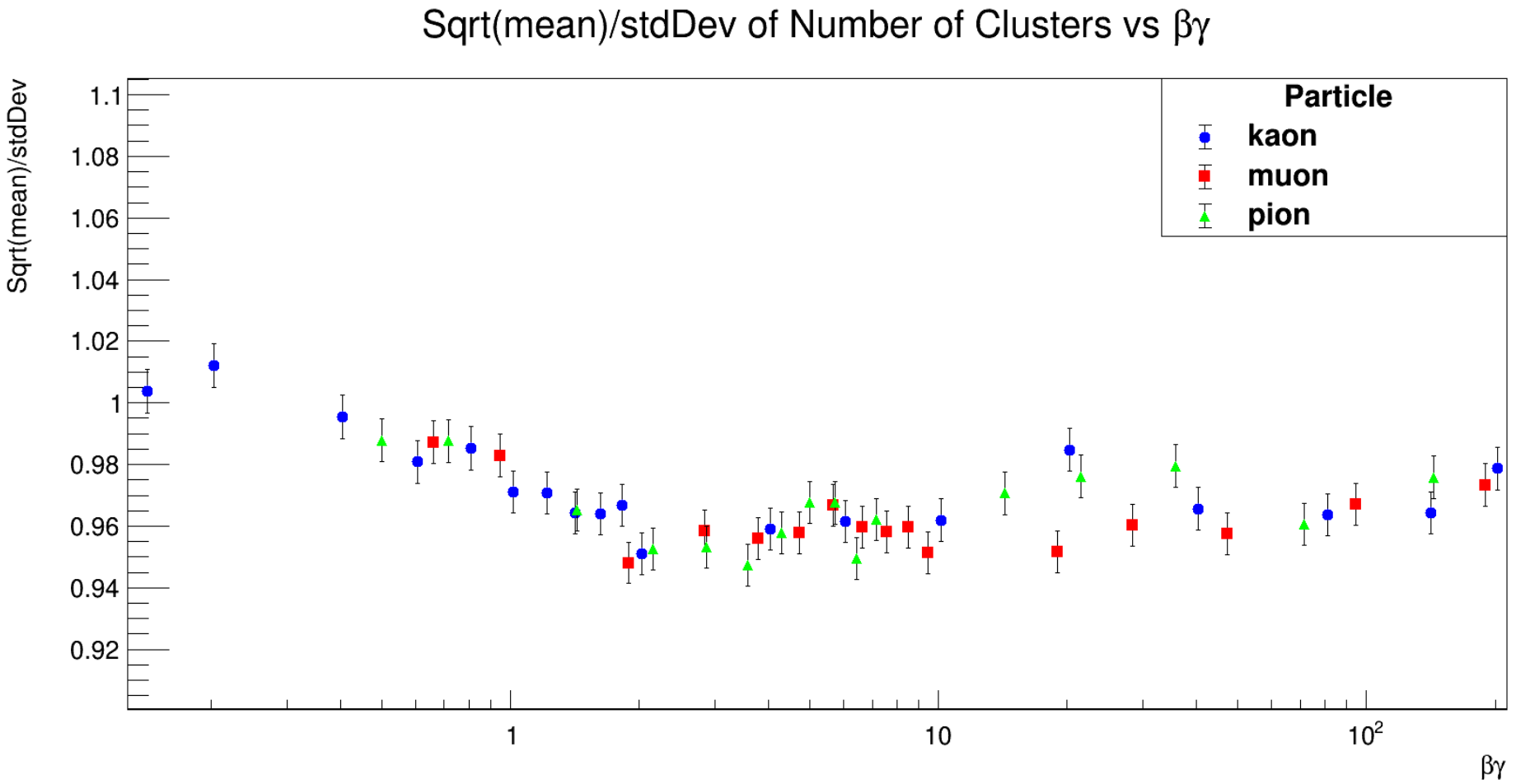
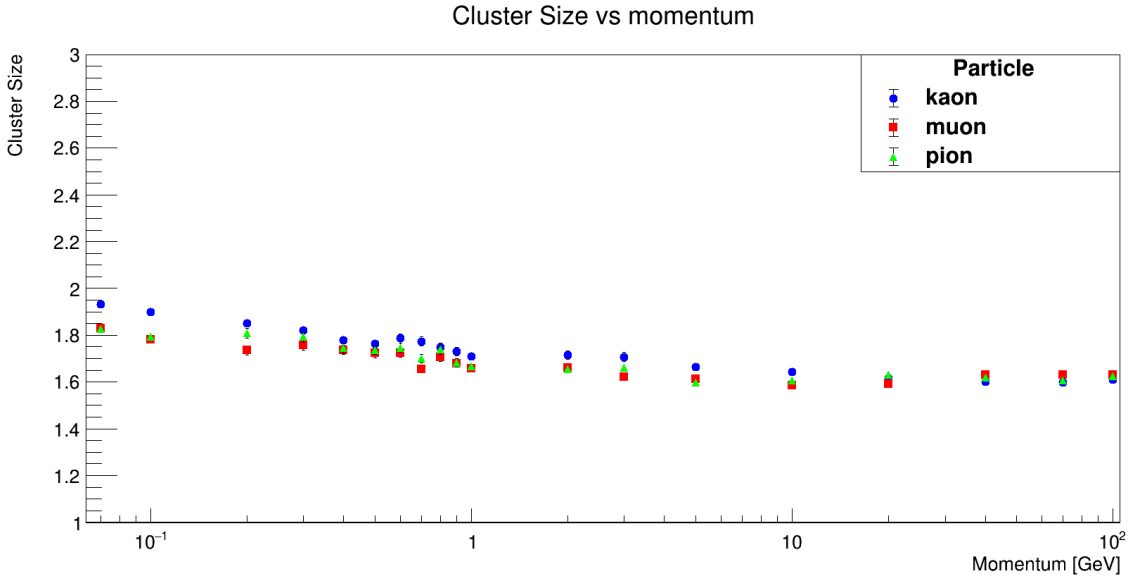
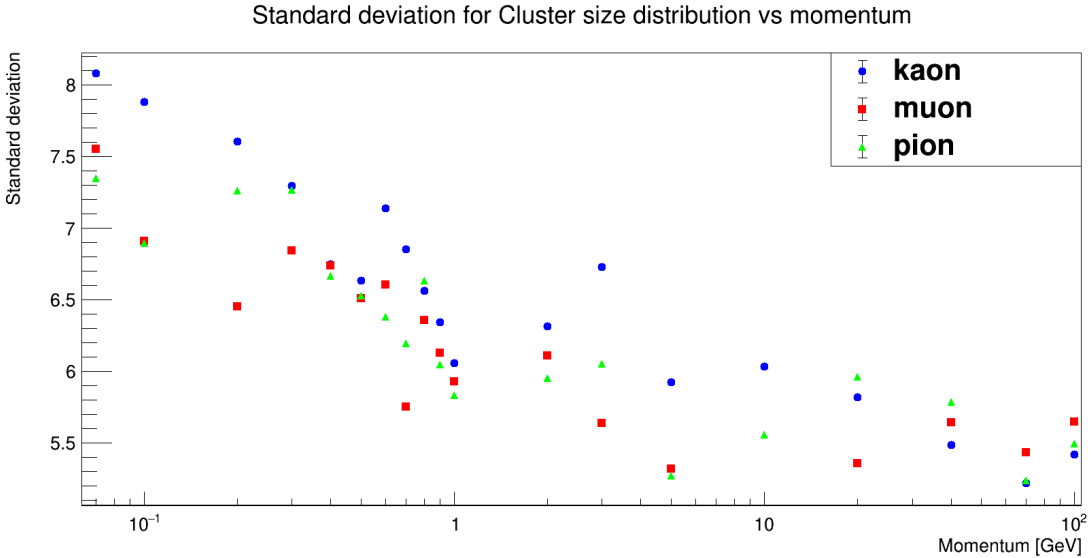





Sqrt(mean)/stdDev of Number of Clusters vs βγ
Sqrt(mean)/stdDev
1.1
1.08
1.06
1.04
1.02
1
0.98
0.96
0.94
0.92
1
10
10^2
βγ
Particle
kaon
muon
pion

Number of clusters and cluster size trend





Number of clusters and cluster size trend