ID Systematics

Manual & Plots
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FWM

ID Systematics…

- In analogy to the Energy estimation, one can try to determine if there are similar effects for the electron/gamma separation.
- It should be easier, since the ID output is continous (0..1), but the final decision is binary (either Type A or B).
- So the Question is:
- **How „stable“ is the ID algorithm w.r.t. to variations in the environment (whatever that is) ?**

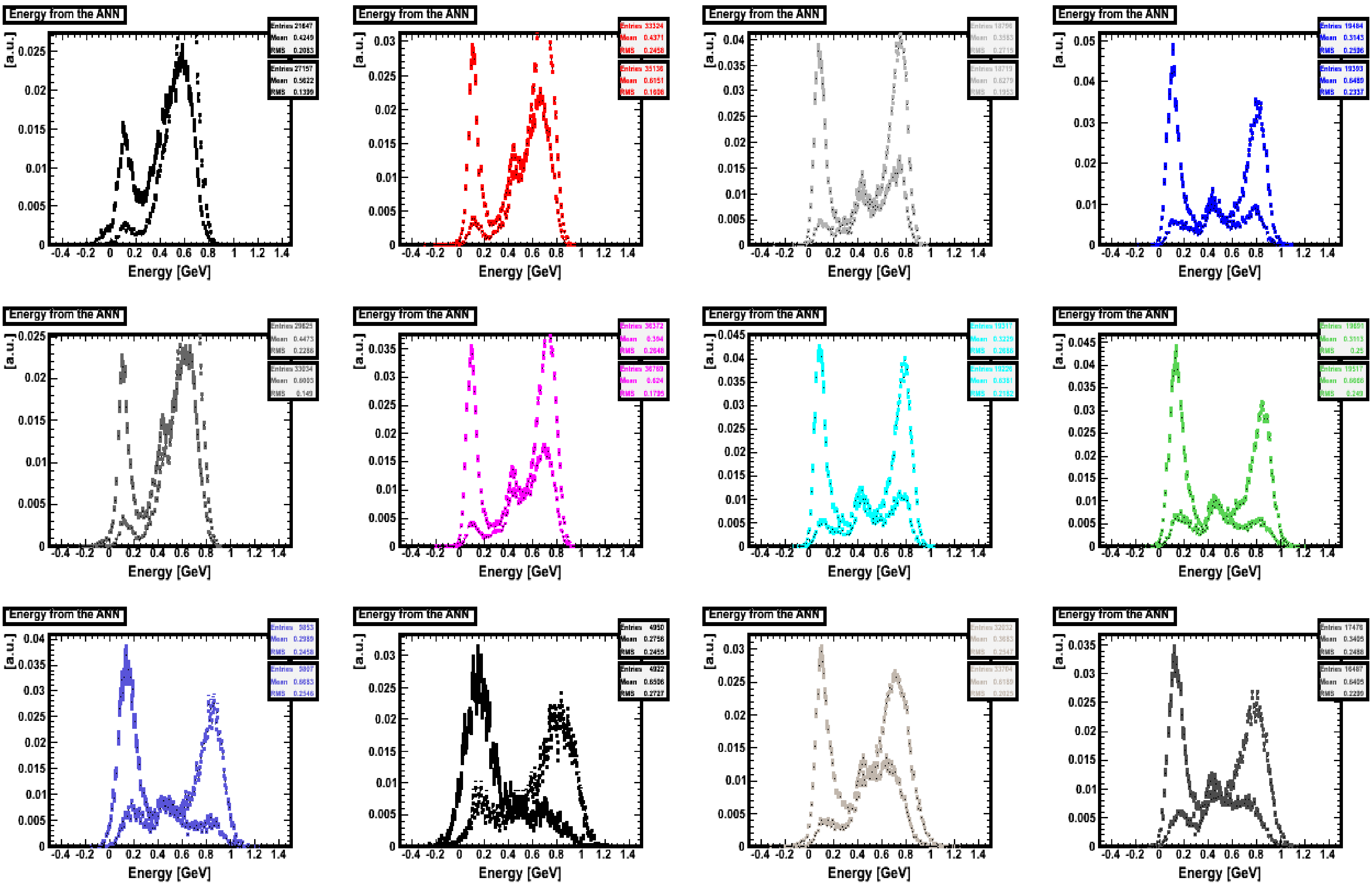
Procedure:

- For the ID algo, we are using the same input variables as for the energy
- We have different seperation modes:
  - Electron - Pion
  - Electron – Gamma
  - Gamma – Pion
-

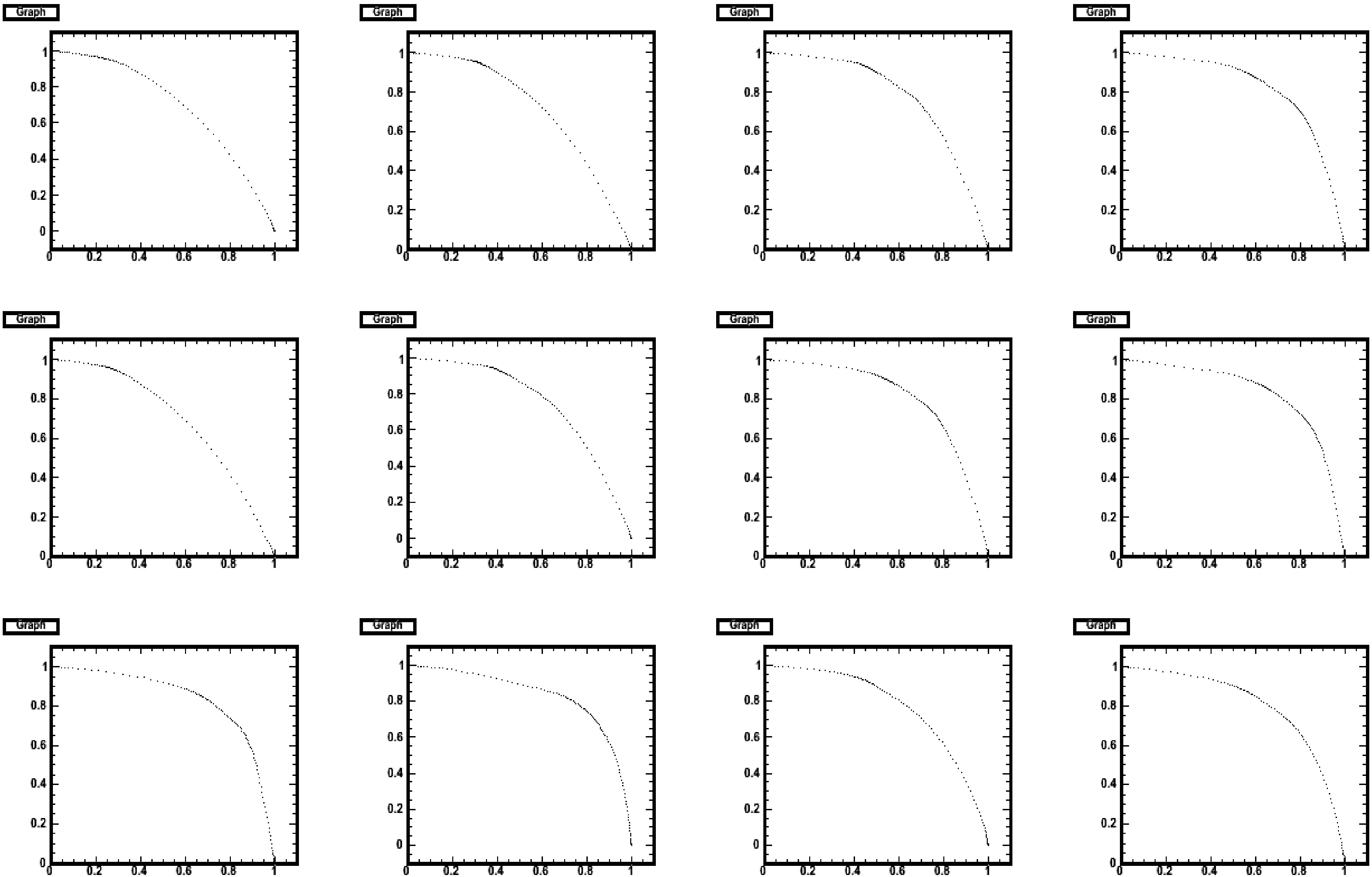
Procedure:

- And we test all it for
  - Different number of plates reconstructed and
  - Different scanning efficiencies
  - Different trainingsfiles
  - Different cut modes
  - Different shape recognition modifiers
  -
- But we wont go into more details as for the BG systematics, the information gain is limited.

Exampleplots … distributions



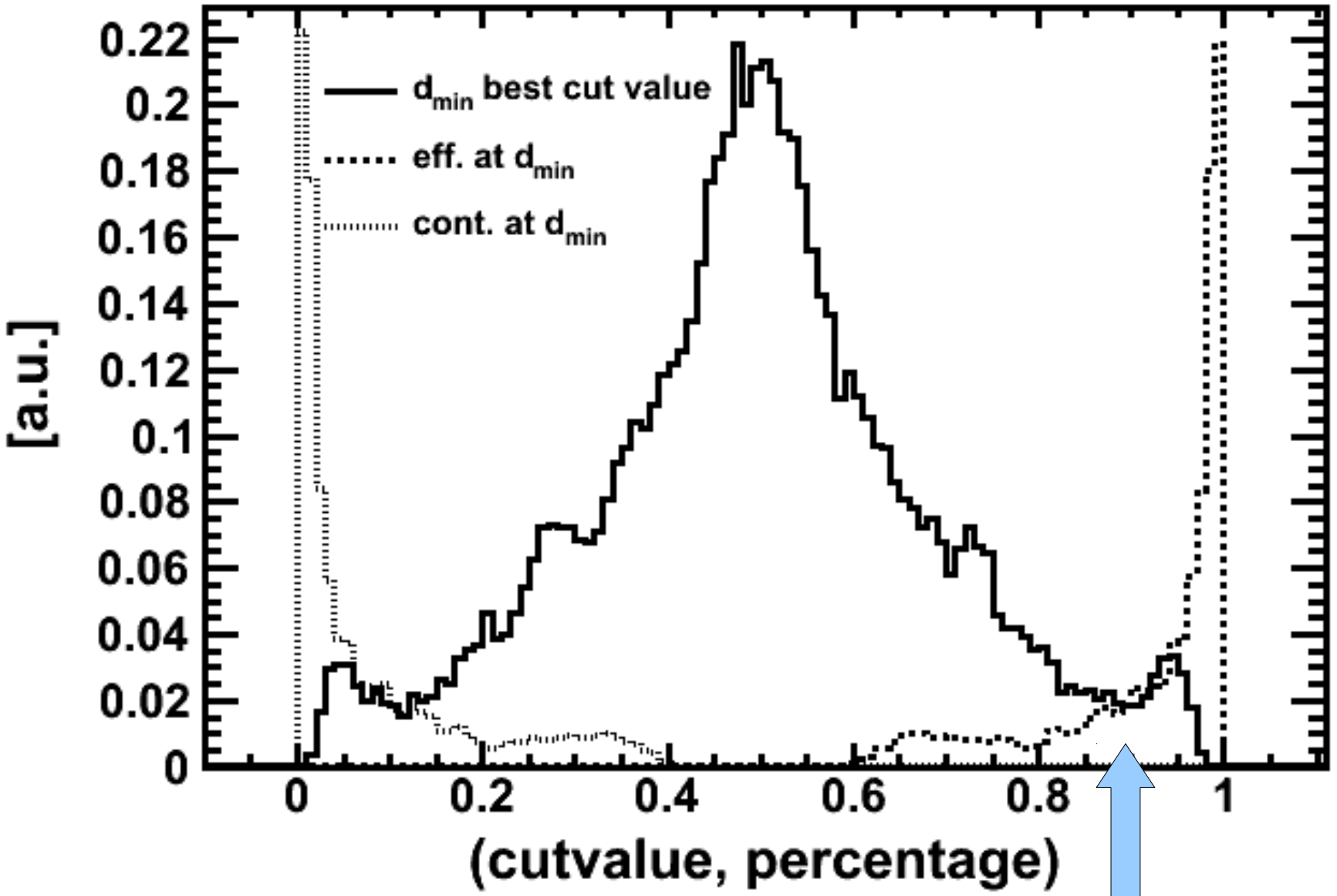
Exampleplots ...eff`s and cont`s



Cutvalues

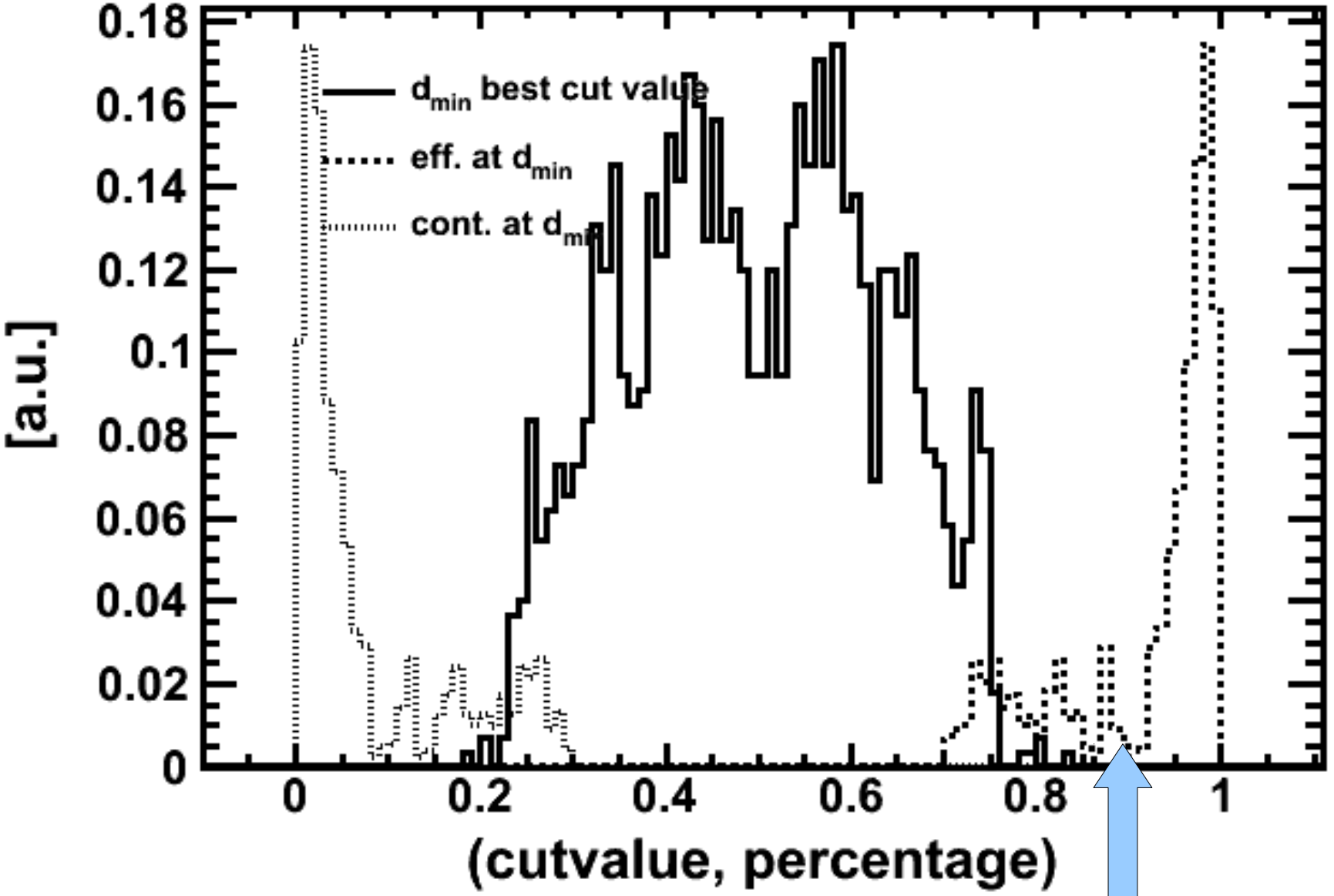
- Now it is shown the distribution
- Of the best dmin_cut to point (1/1) (which means perfect separation)
- For different shower shape analysis
- And also for the different energies
  - The negative point for the energy values is a sample of continuous energy distribution.

All Energies, All Shapes, All Plates



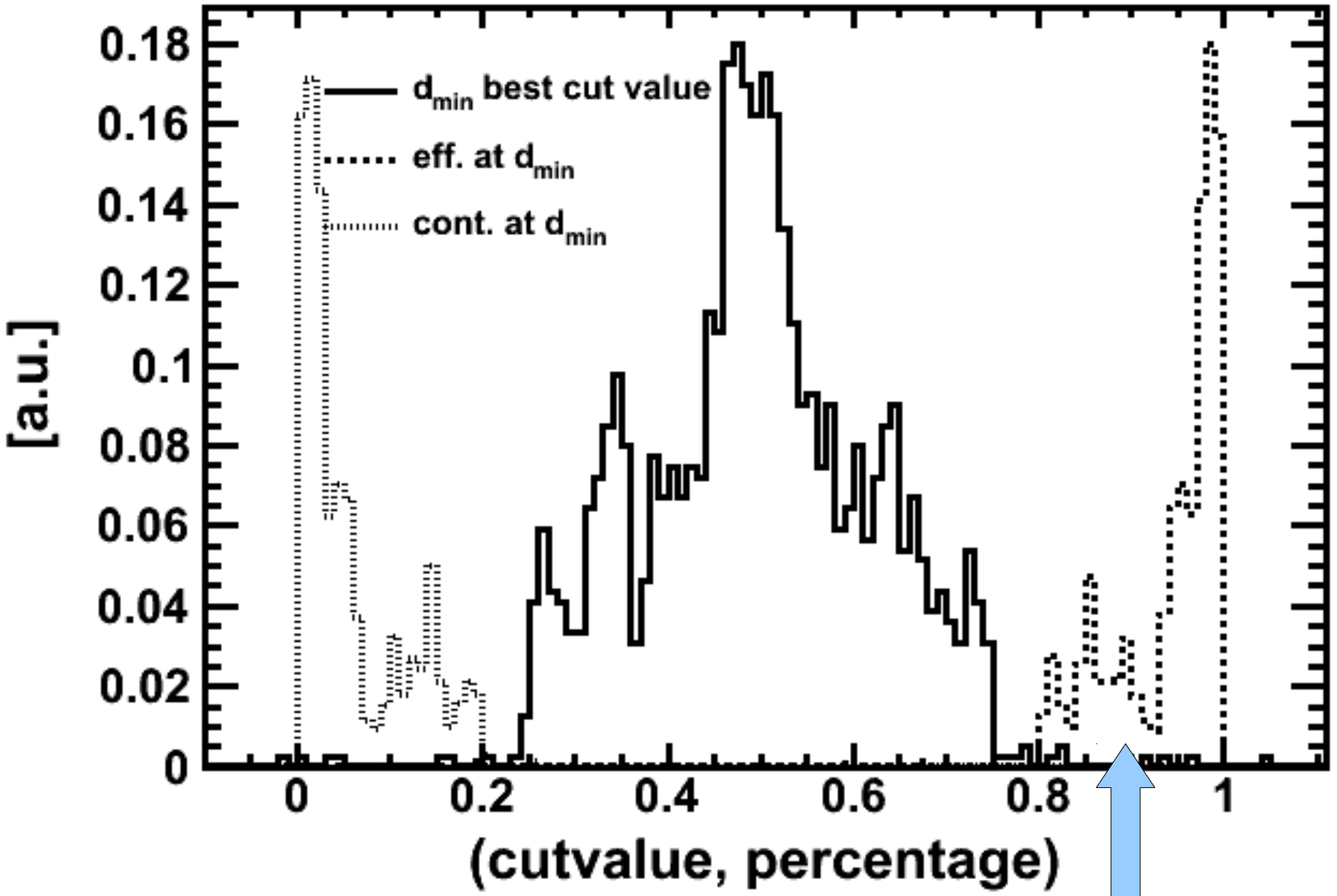
Note the shift to better values here!

Continous Energies,, All Plates, ShapeOnly



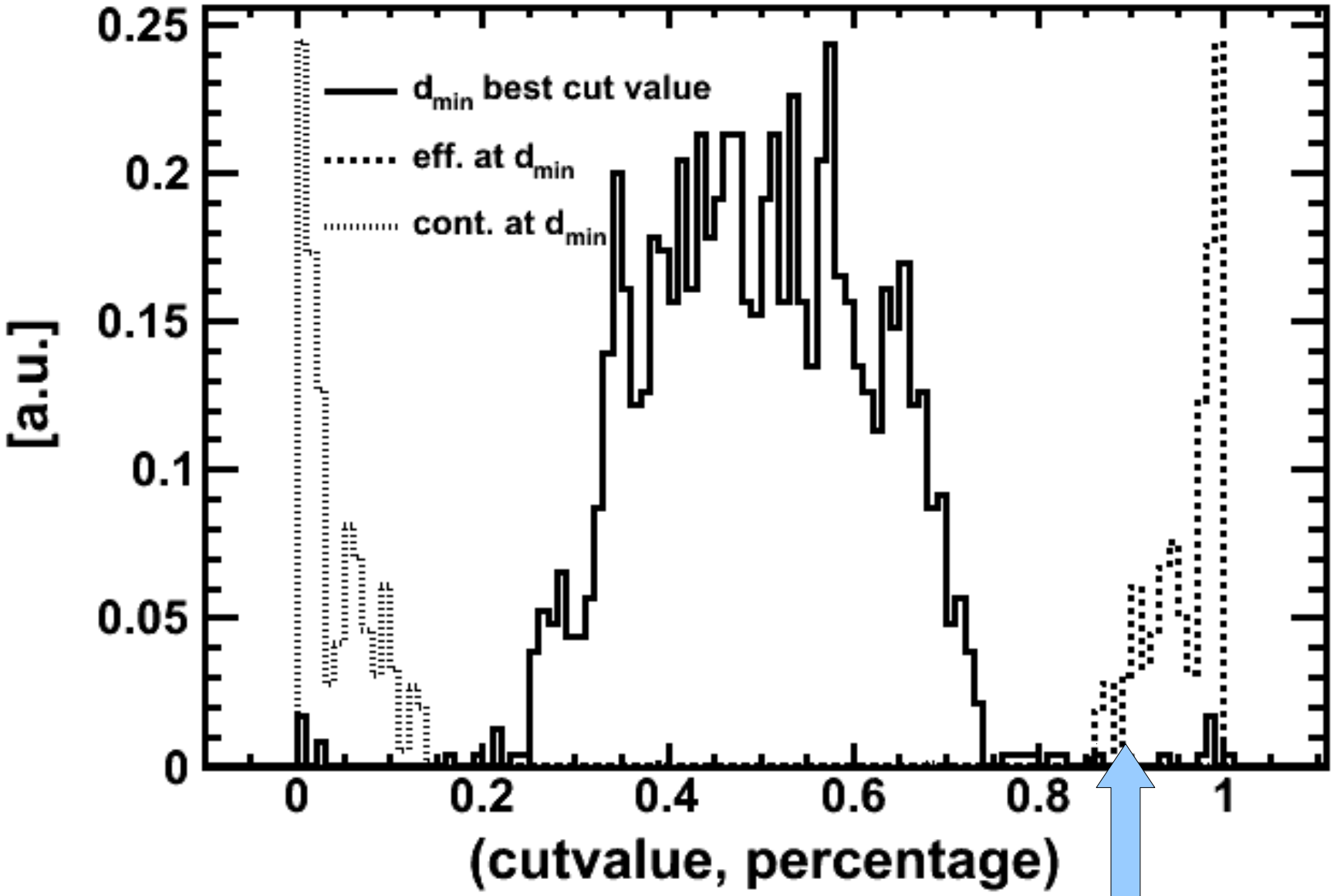
Note the shift to better values here!

Continous Energies,, All Plates, AndVtxIp



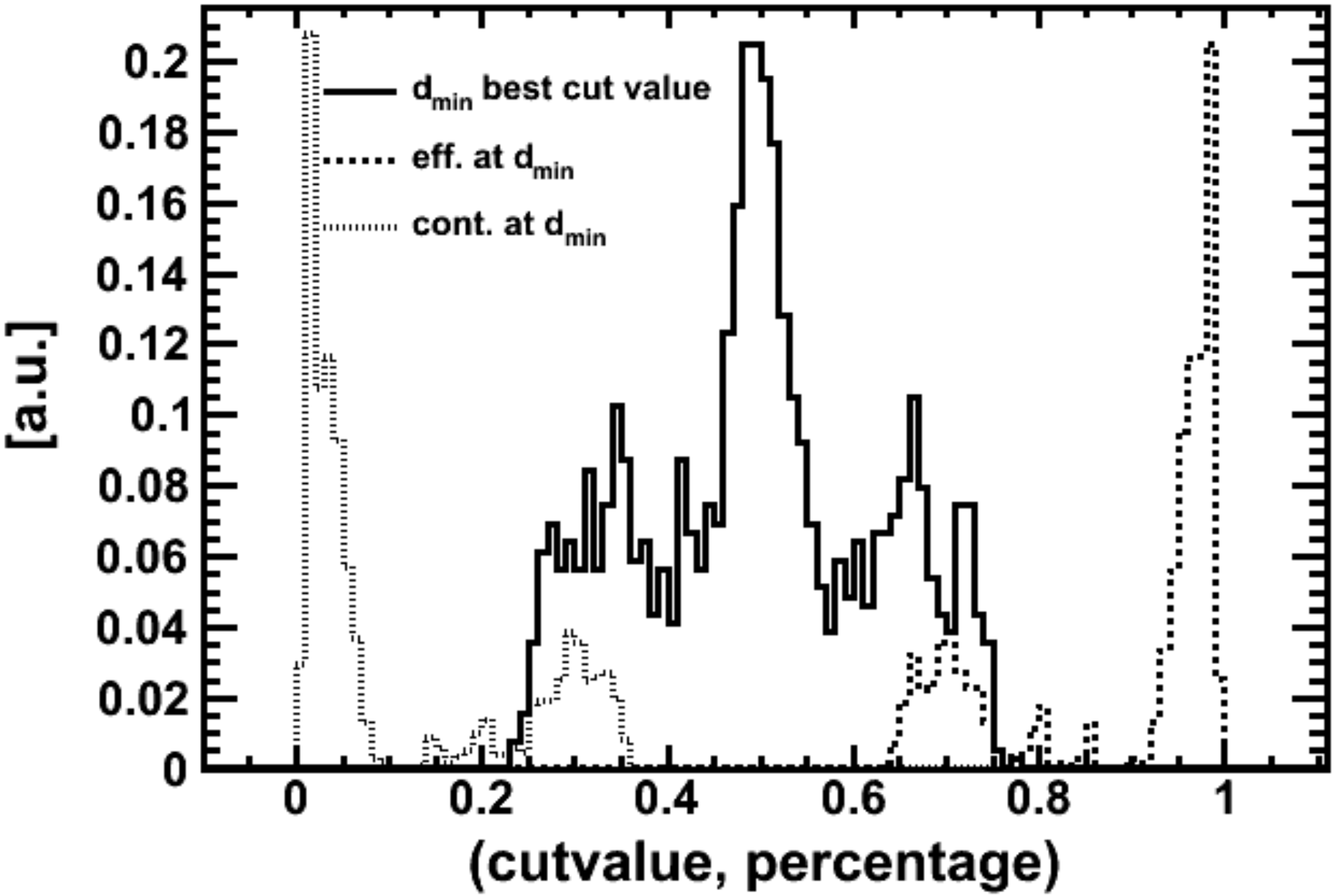
Note the shift to better values here!

Continous Energies,, All Plates, AndDeltaZ



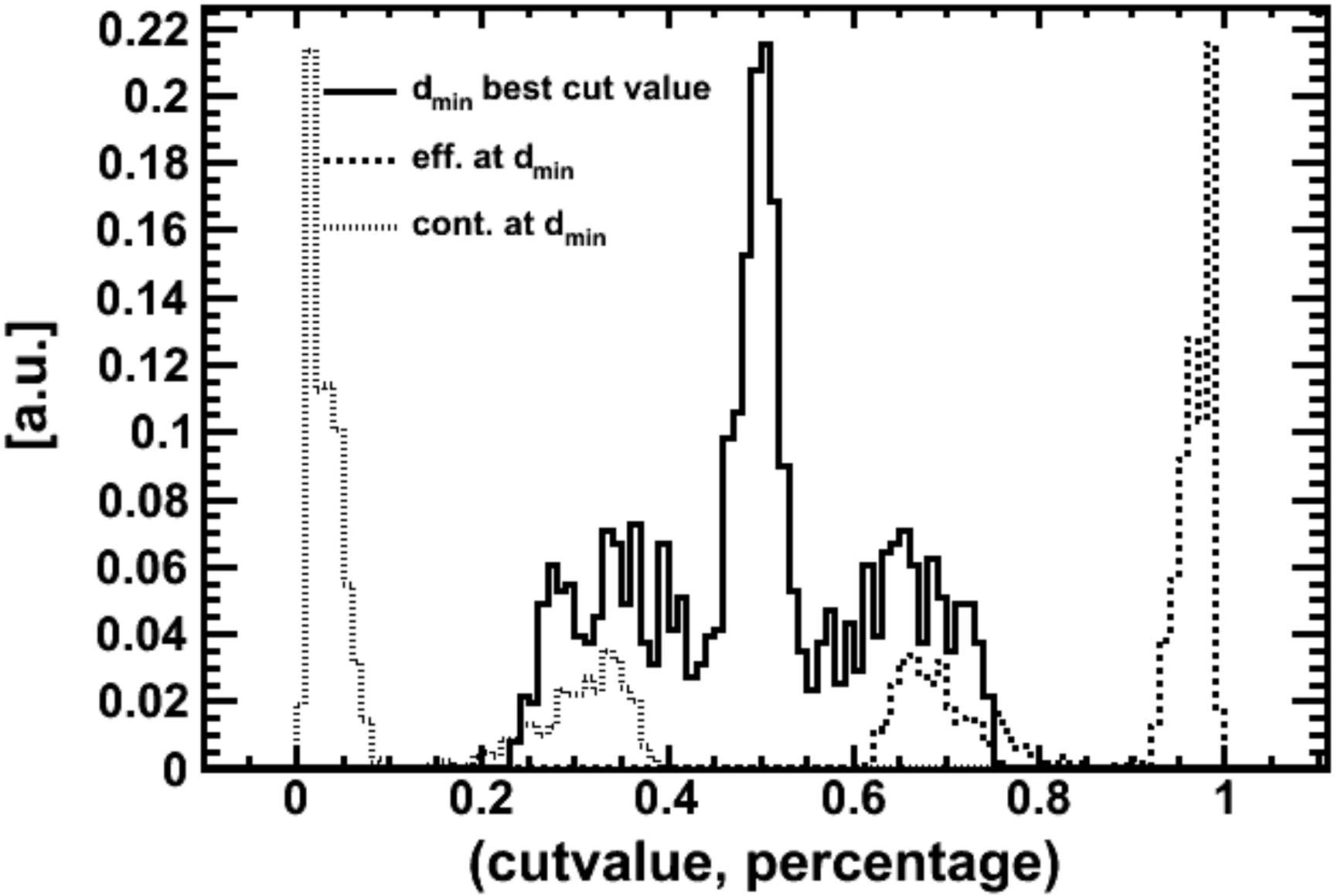
Note the shift to better values here!

Continous Energies,, All Plates, ShapeWo1



Without first two plates, result is ok,
But not as good anymore as before.

Continous Energies,, All Plates, ShapeWo12

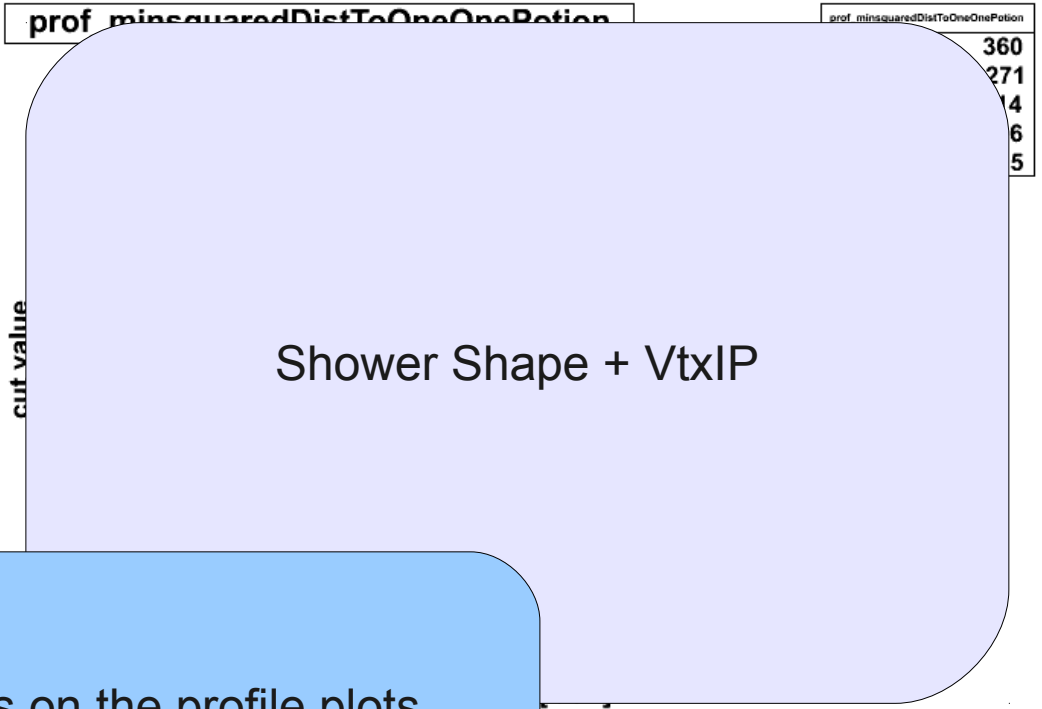


Without first two plates, result is ok,
But not as good anymore as before.

Dependency

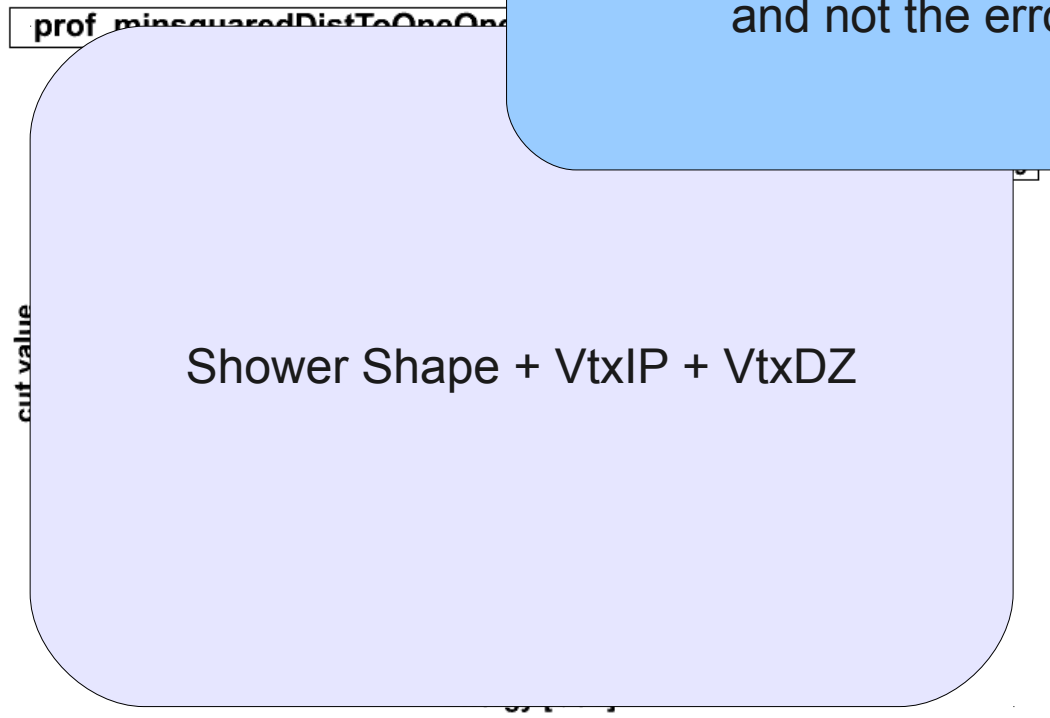
- Dependency on Single Energies
- Dependency on the Number of Plates Reconstructed

Shower Shape Only

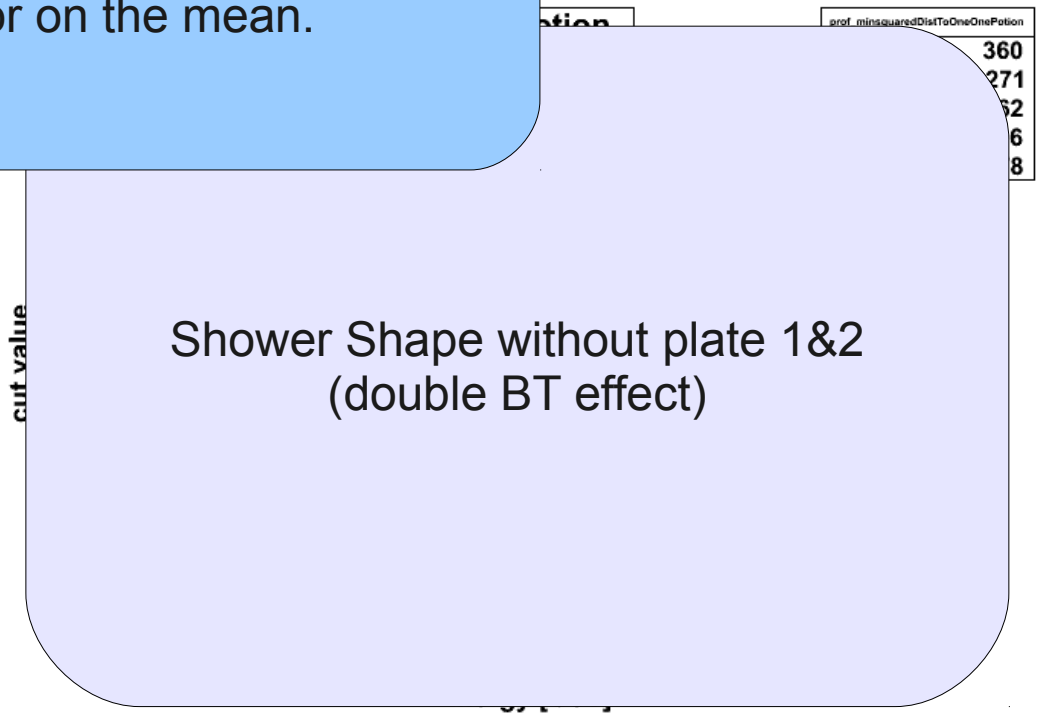


Shower Shape + VtxIP

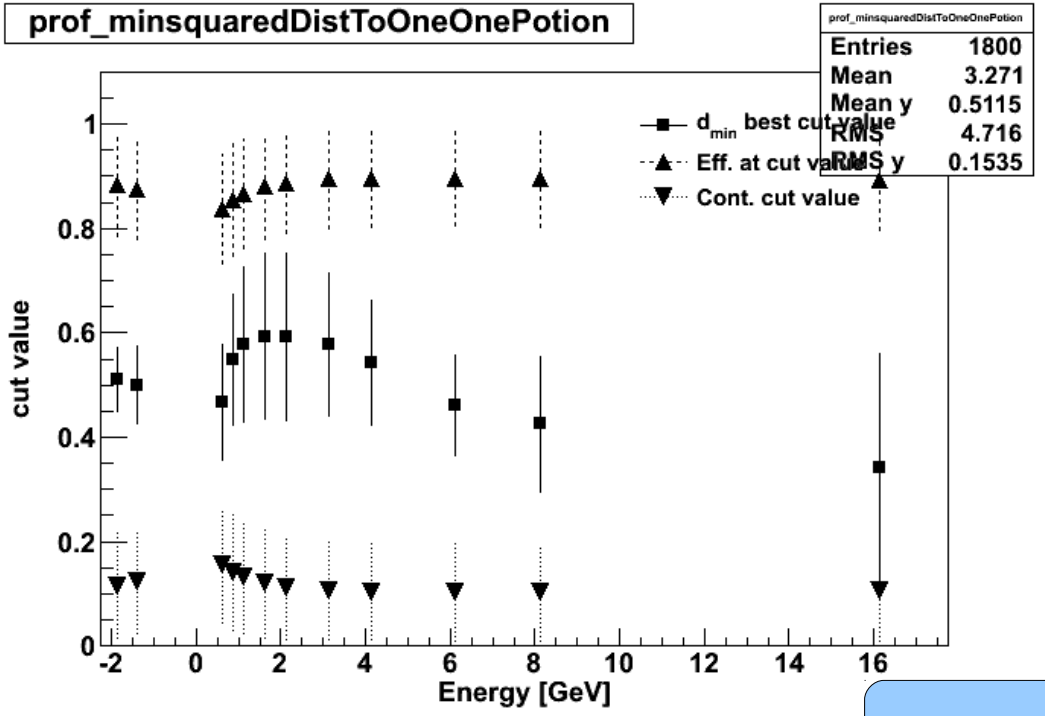
Nota bene: the errors on the profile plots
are the sigma of the corresponding distribution,
and not the error on the mean.

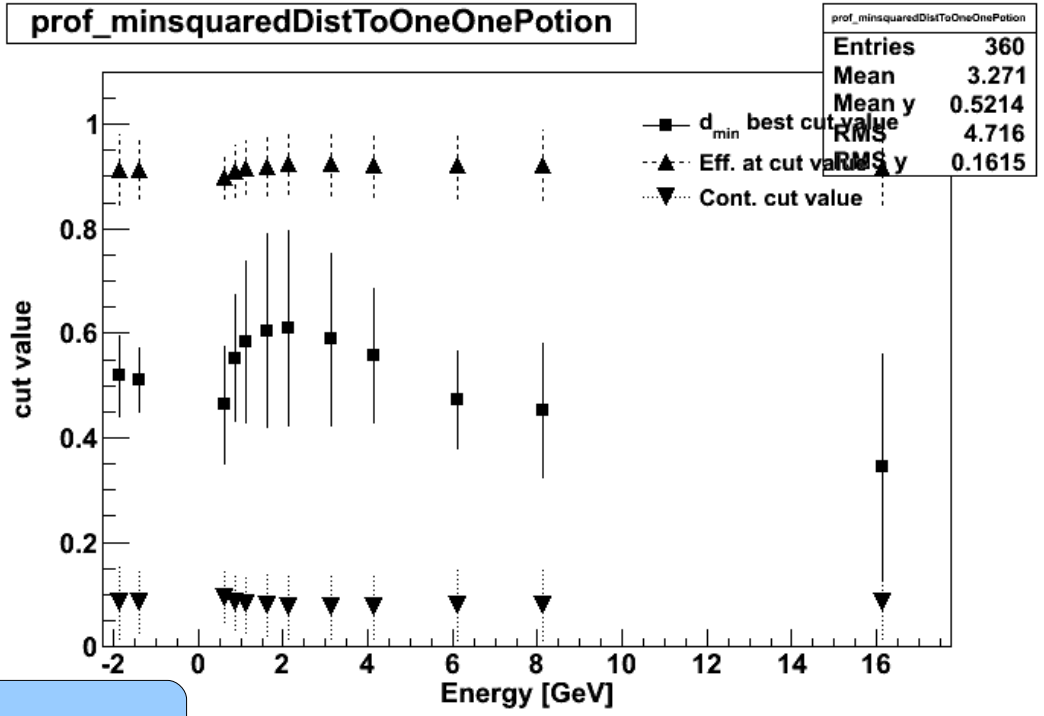


Shower Shape + VtxIP + VtxDZ

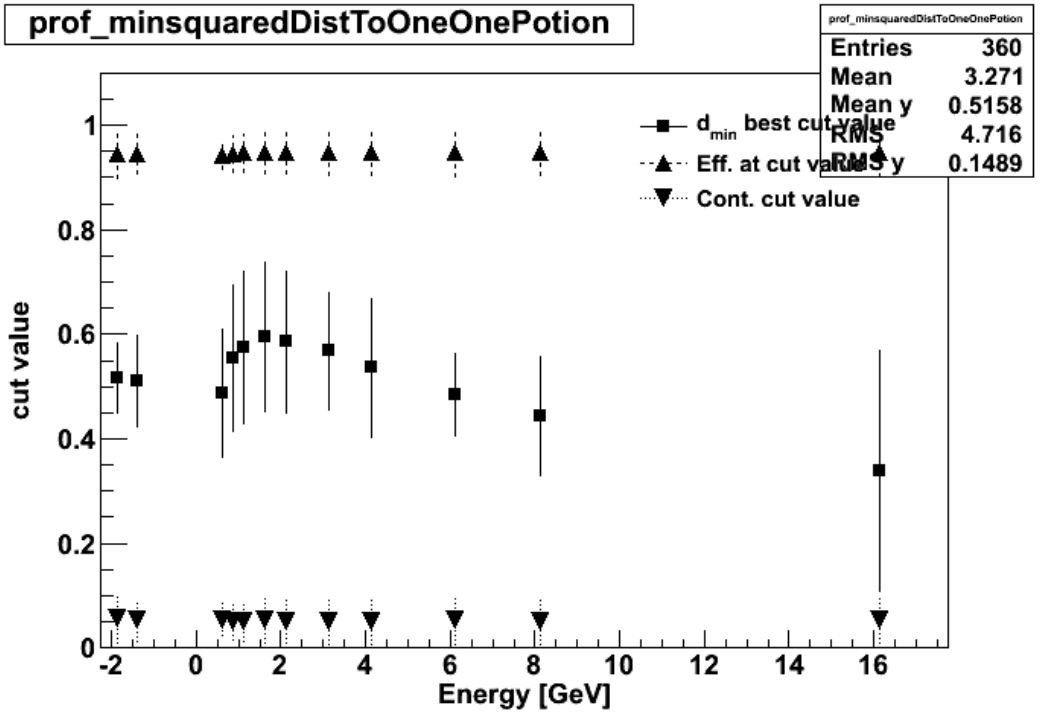


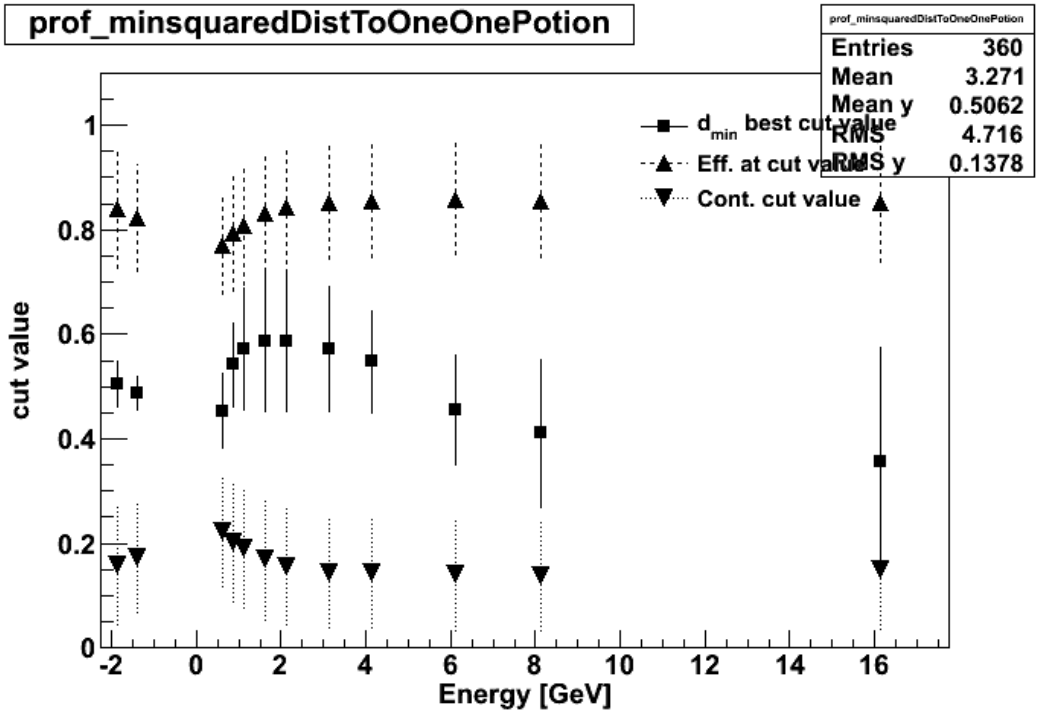
Shower Shape without plate 1&2
(double BT effect)


prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 1800
Mean 3.271
Mean y 0.5115
RMS 4.716
RMS y 0.1535
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]


prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.5214
RMS 4.716
RMS y 0.1615
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

Npl=10


prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.5158
RMS 4.716
RMS y 0.1489
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]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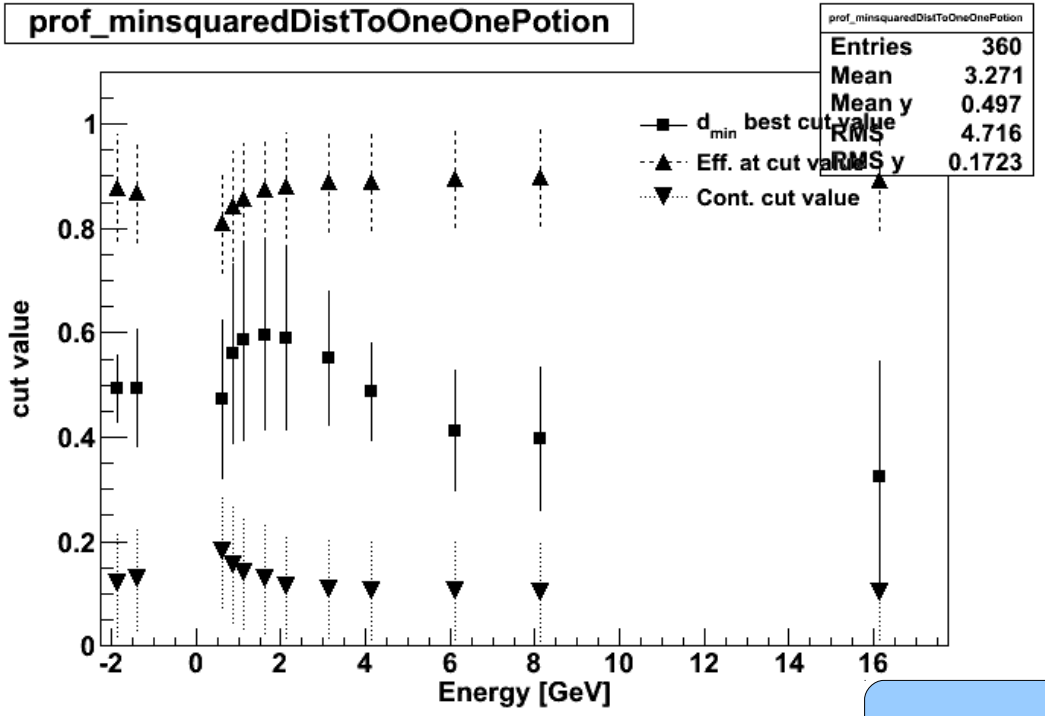
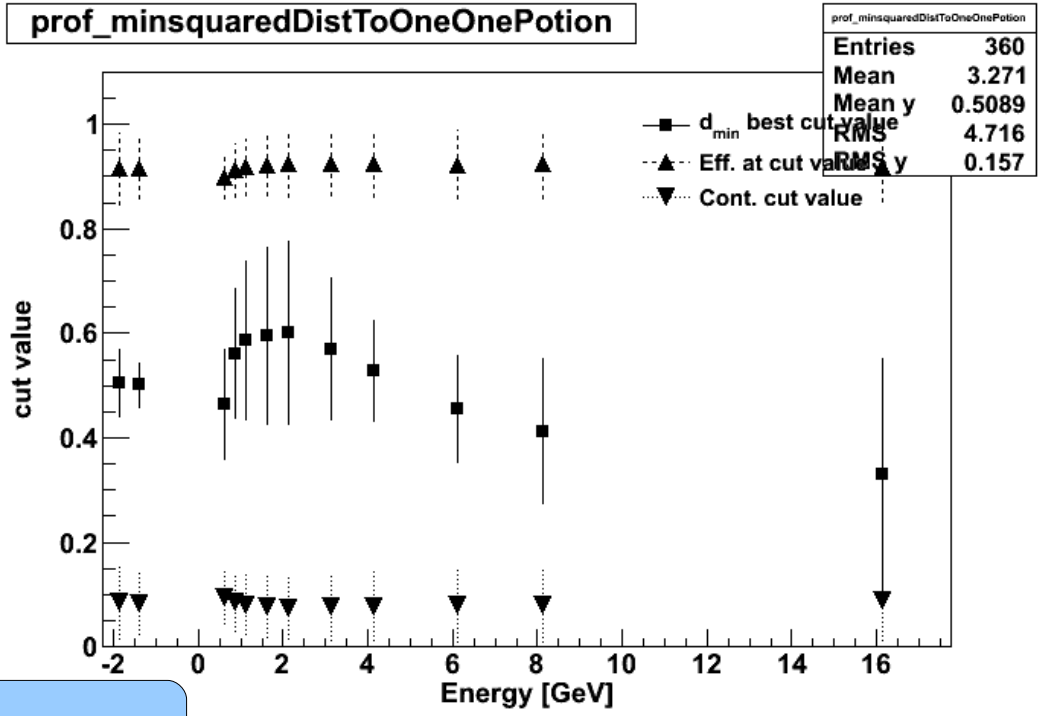
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.5062
RMS 4.716
RMS y 0.1378
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]


prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.497
RMS 4.716
RMS y 0.1723
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]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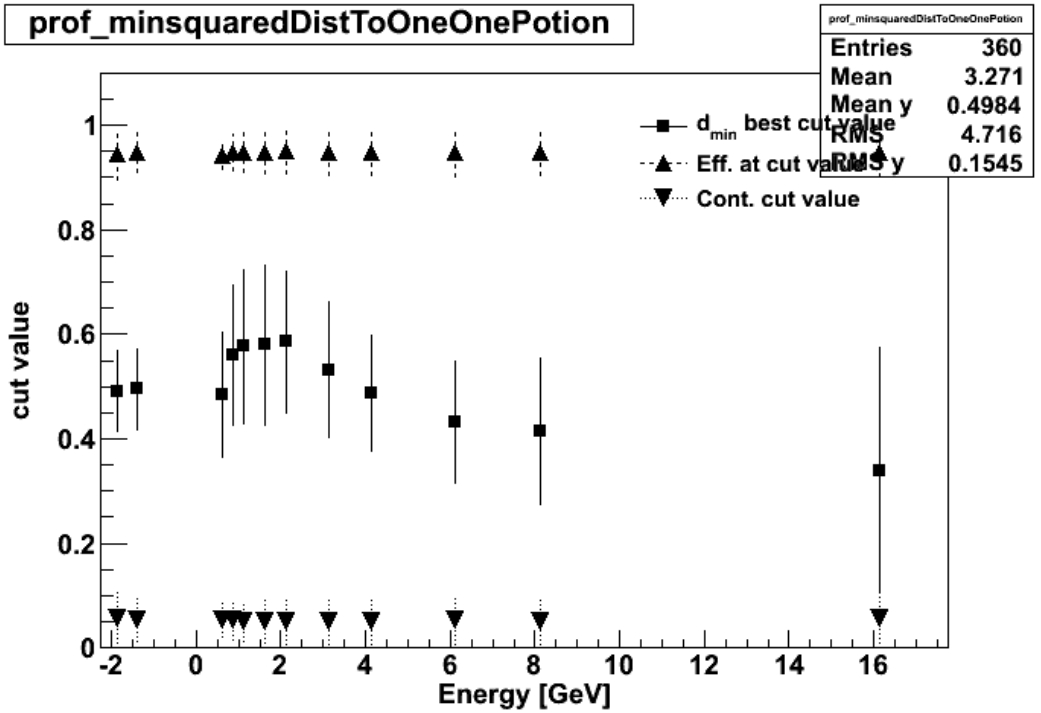
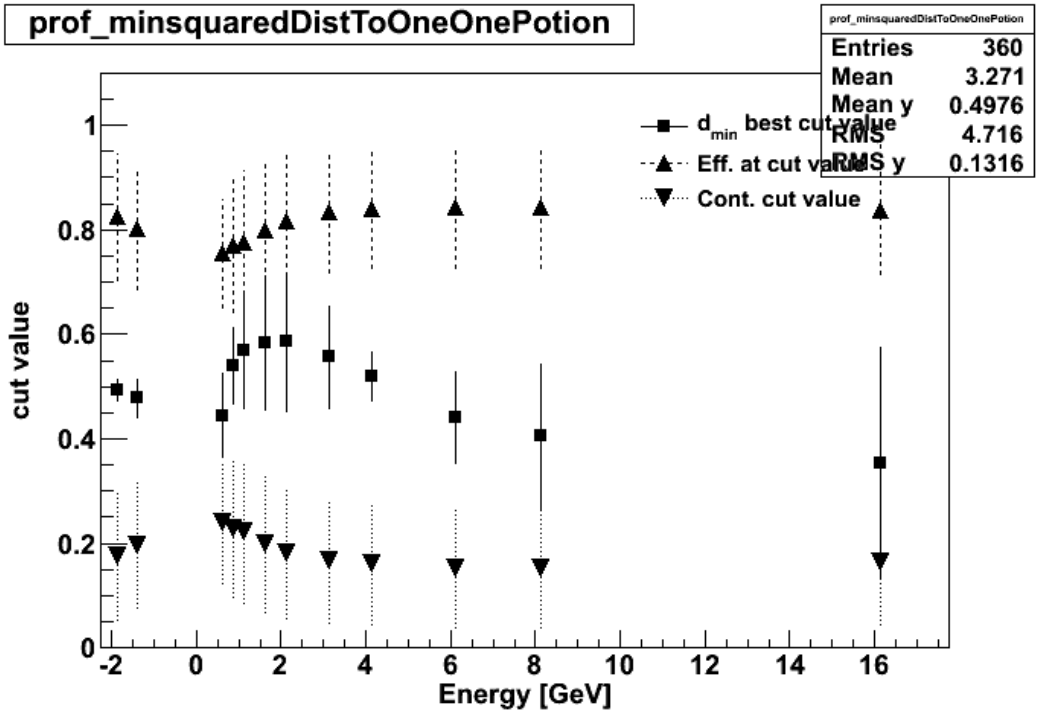
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.5089
RMS 4.716
RMS y 0.157
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

Npl=14


prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4984
RMS 4.716
RMS y 0.1545
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]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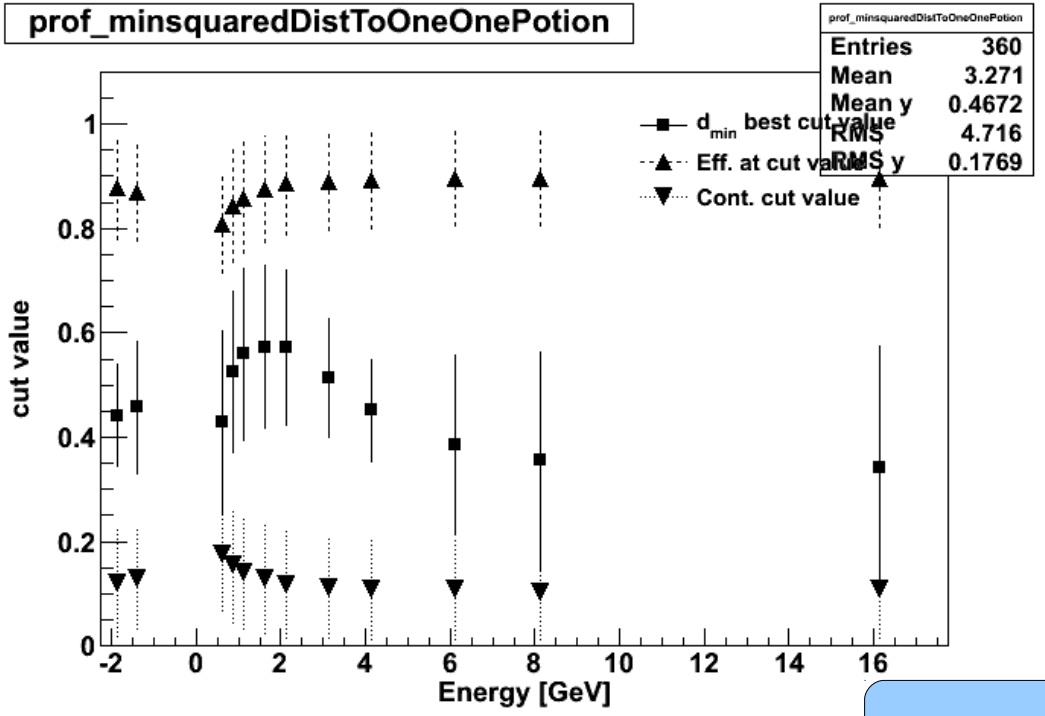
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4976
RMS 4.716
RMS y 0.1316
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]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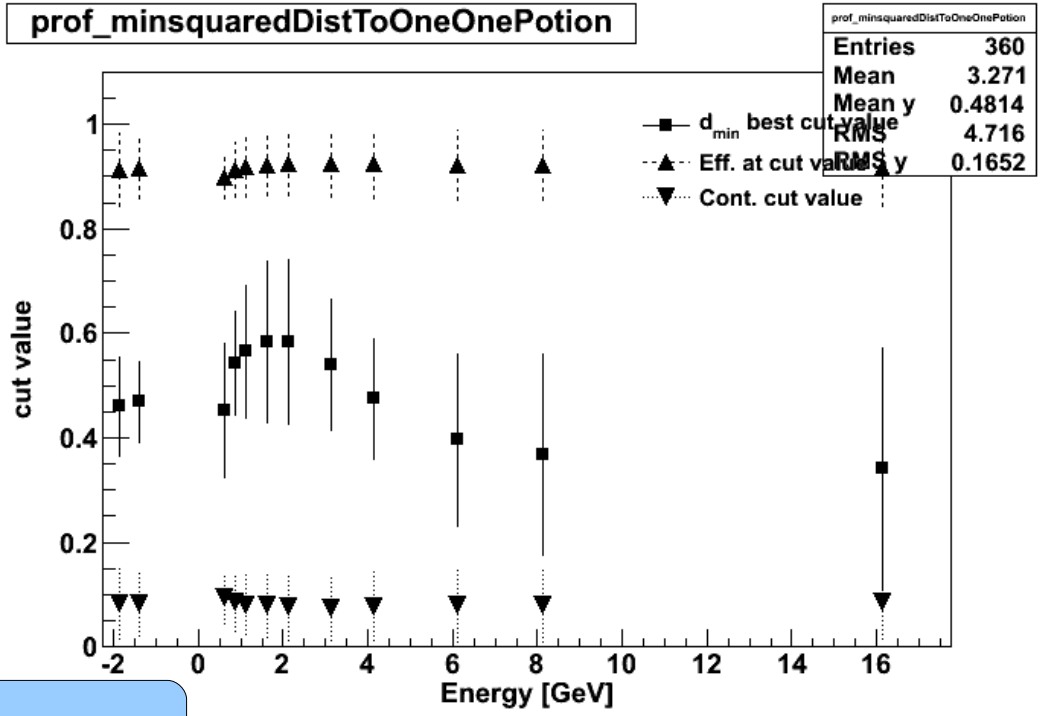
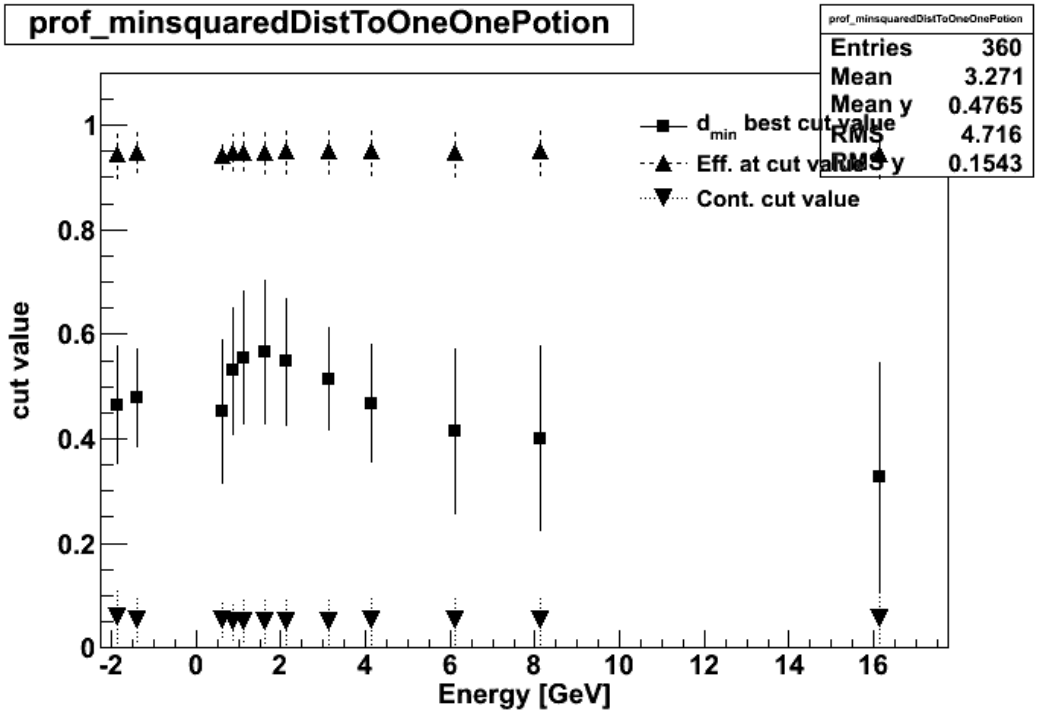
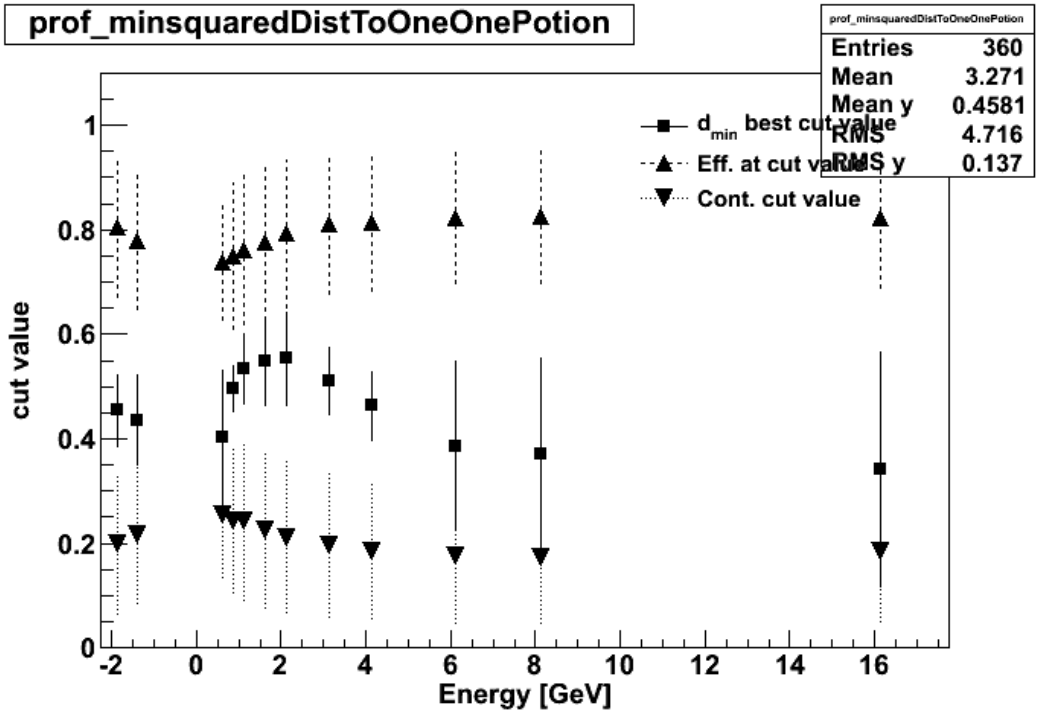
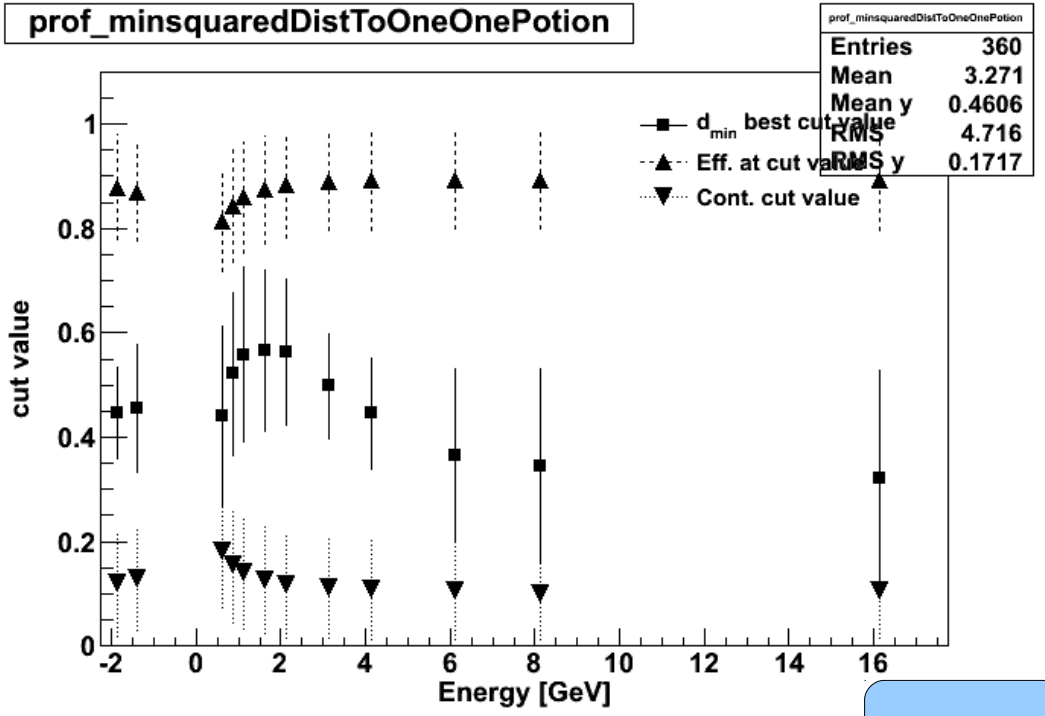
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4672
RMS 4.716
RMS y 0.1769
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

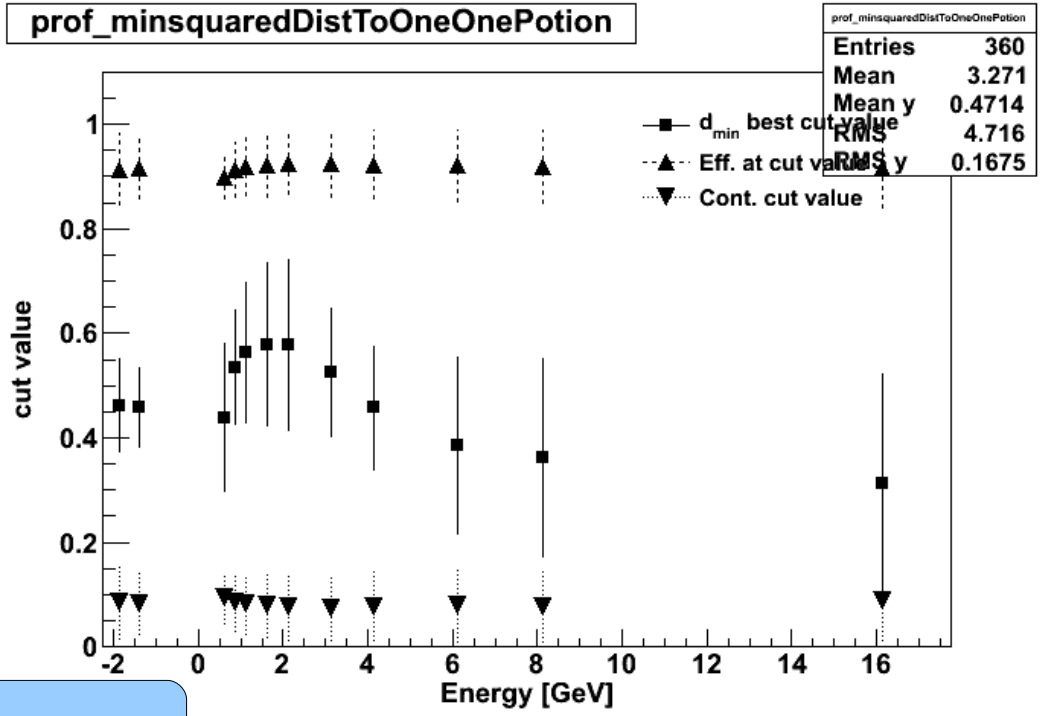

prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4814
RMS 4.716
RMS y 0.1652
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

Npl=18

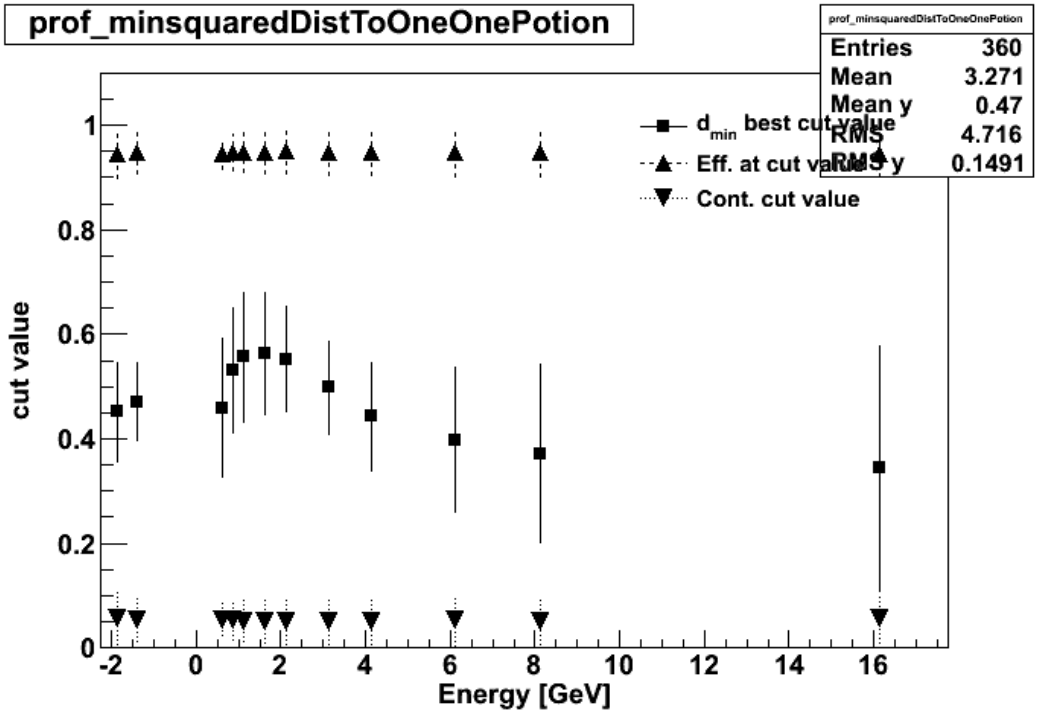

prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4765
RMS 4.716
RMS y 0.1543
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

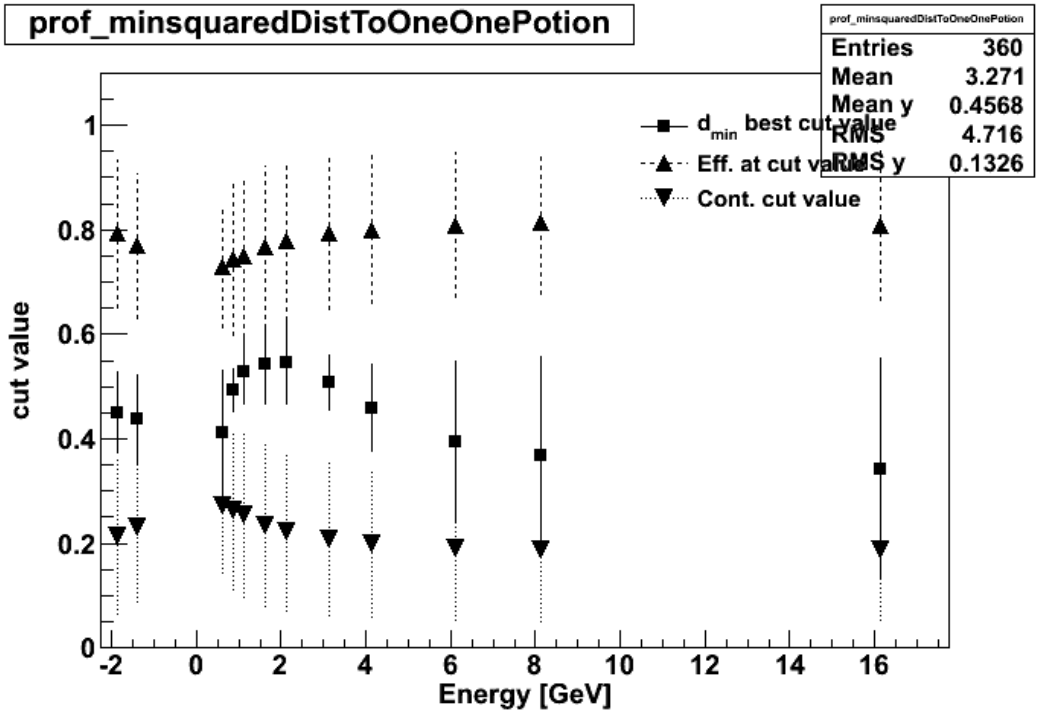

prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4581
RMS 4.716
RMS y 0.137
d_min best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

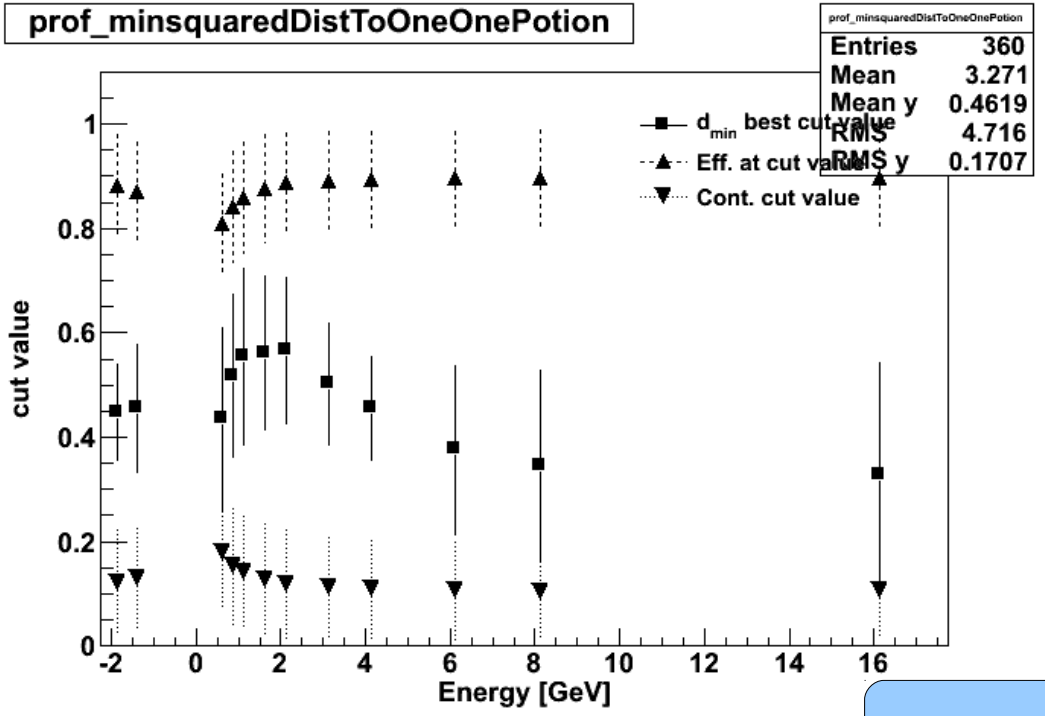

prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4606
RMS 4.716
RMS y 0.1717
d_{min} best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

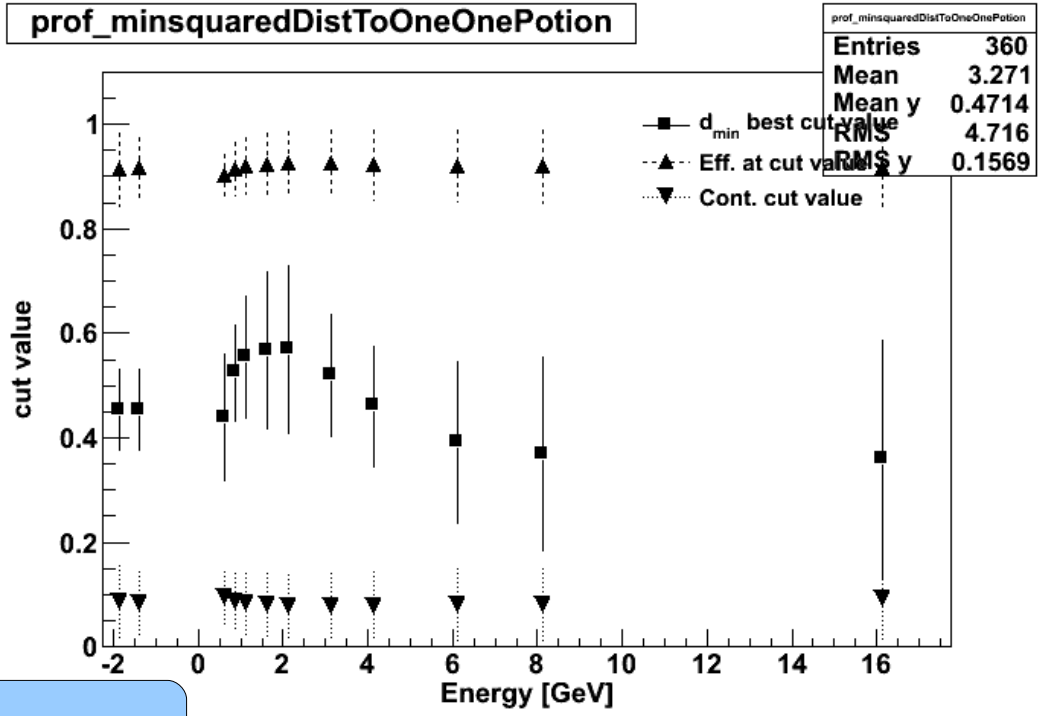

prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4714
RMS 4.716
RMS y 0.1675
d_{min} best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

Npl=23

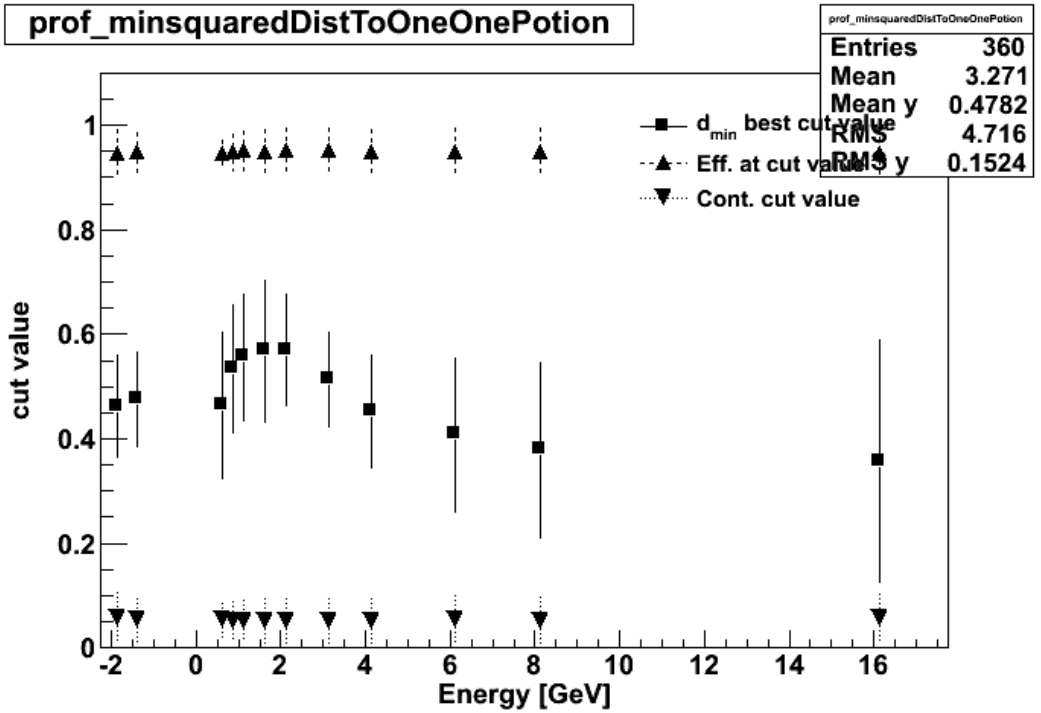

prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.47
RMS 4.716
RMS y 0.1491
d_{min} best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

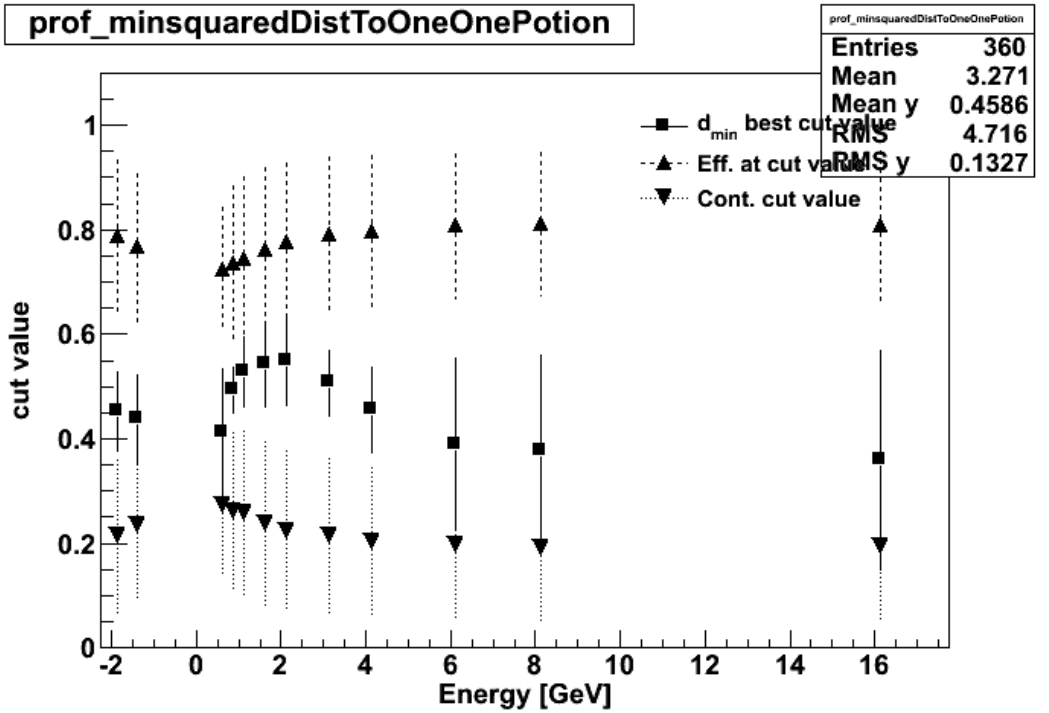

prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4568
RMS 4.716
RMS y 0.1326
d_{min} best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]


prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4619
RMS 4.716
RMS y 0.1707
d_{min} best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]


prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4714
RMS 4.716
RMS y 0.1569
d_{min} best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

Npl=26


prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4782
RMS 4.716
RMS y 0.1524
d_{min} best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

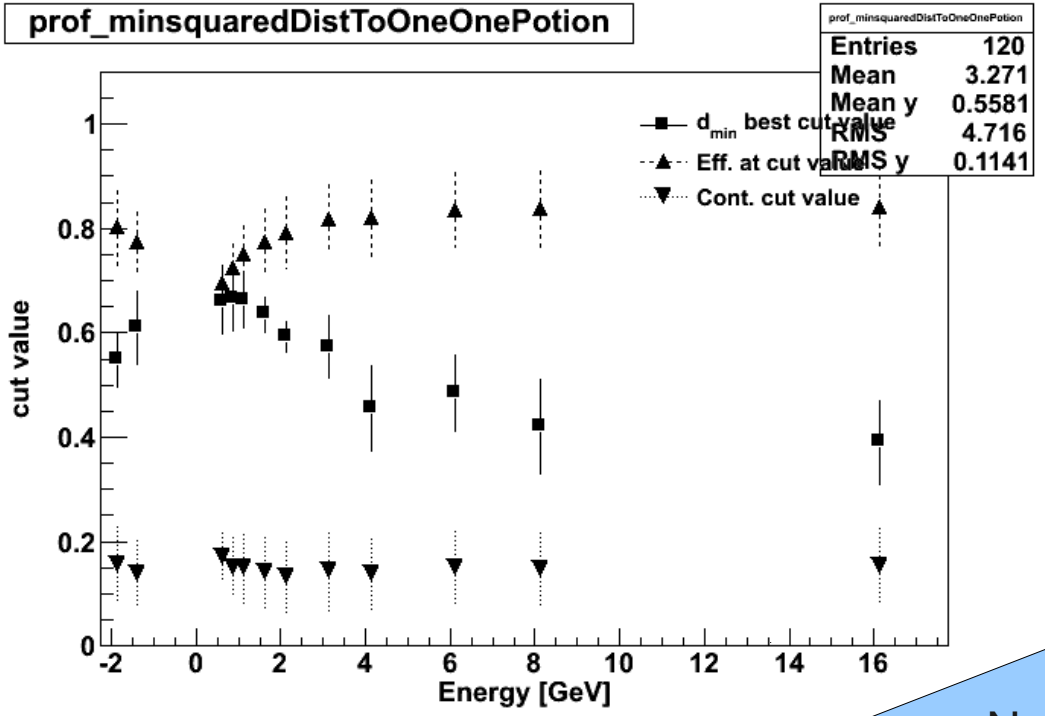

prof_minsquaredDistToOneOnePotion
prof_minsquaredDistToOneOnePotion
Entries 360
Mean 3.271
Mean y 0.4586
RMS 4.716
RMS y 0.1327
d_{min} best cut value
Eff. at cut value
Cont. cut value
cut value
Energy [GeV]

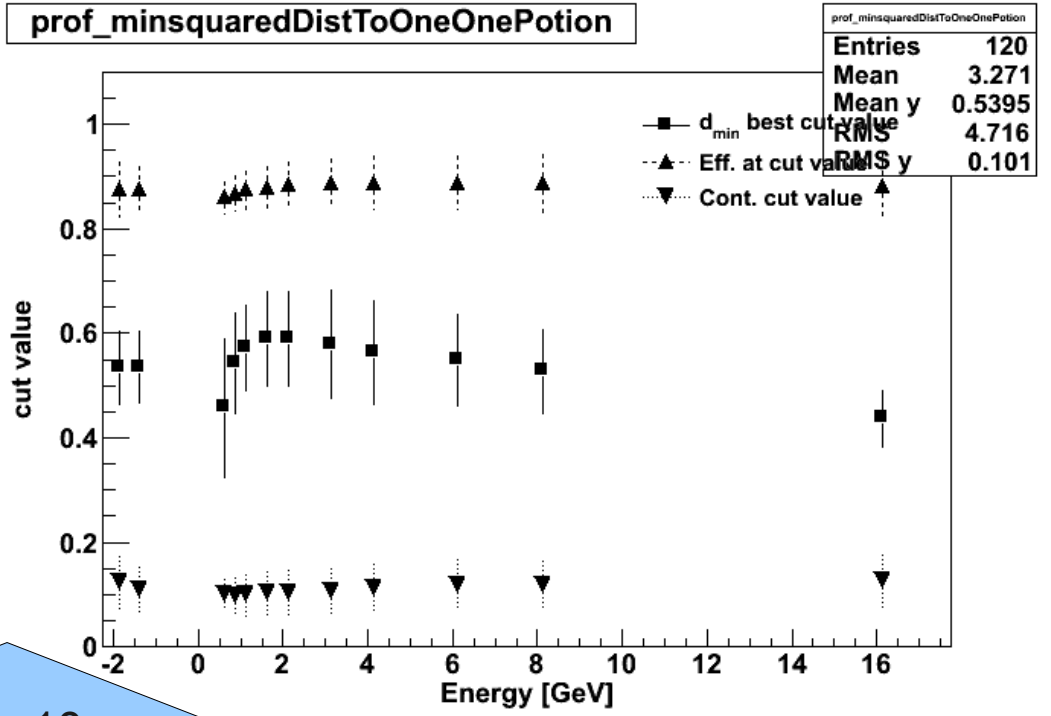
Now separated ID plots for:

Gamma-Electron
Electron-Pion
Pion-Gamma

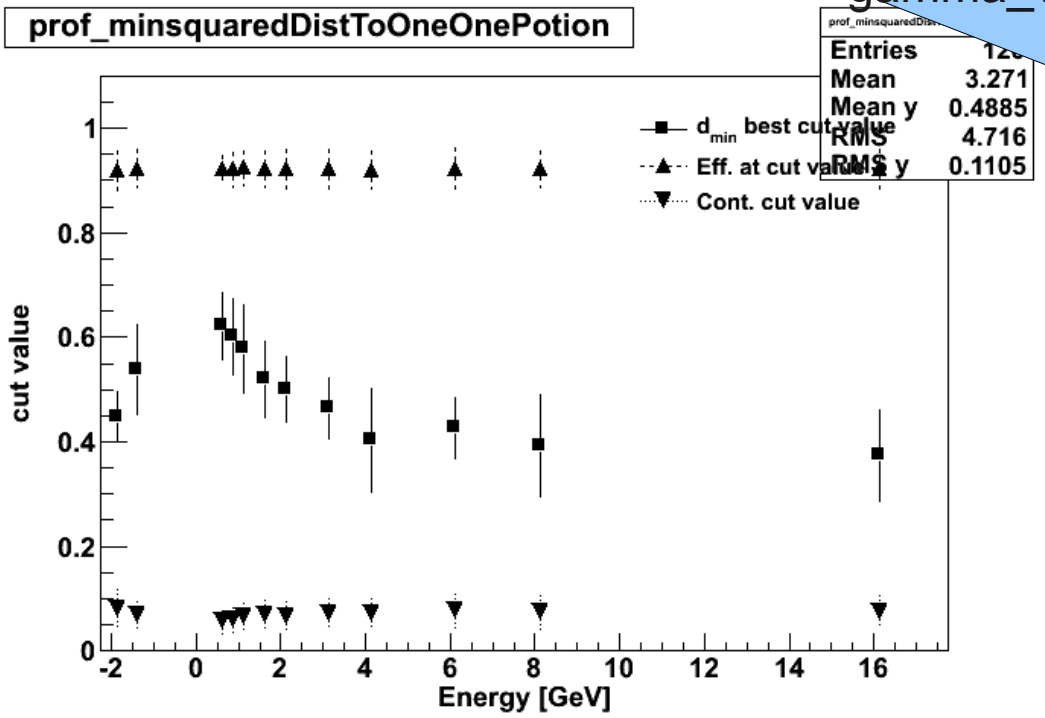
N.B.: dmin cutvalues for separation on e_g, pi_e, g_pi are obtained by substituting dmin: dmin(e_g) = 1 - dmin(g_e)

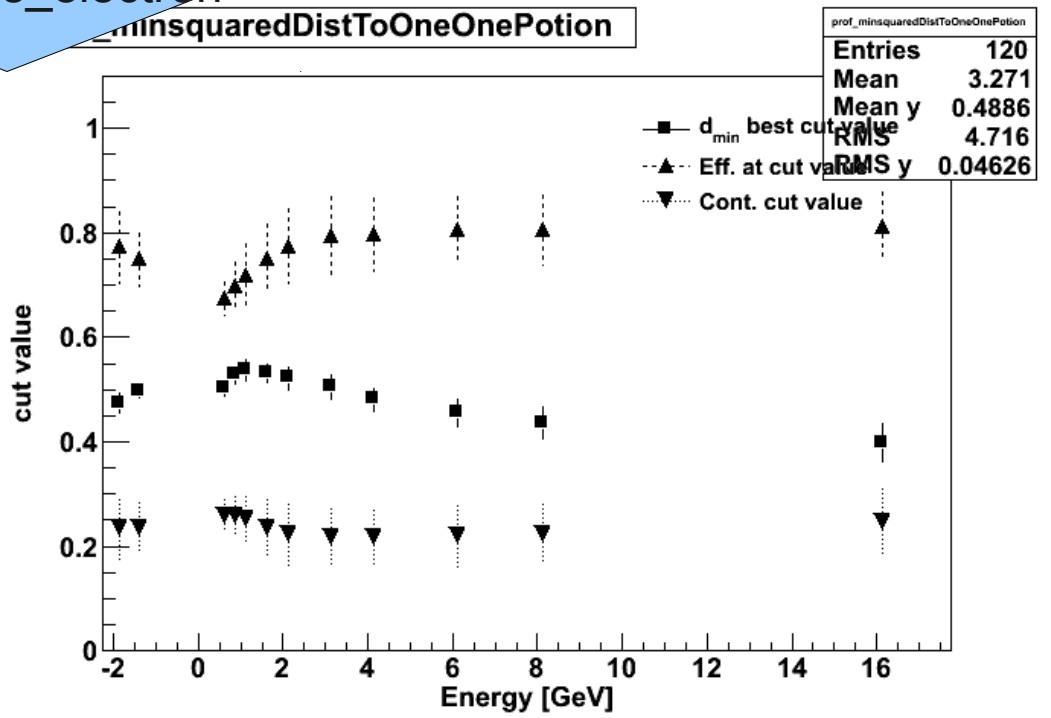
Now
gamma_electron

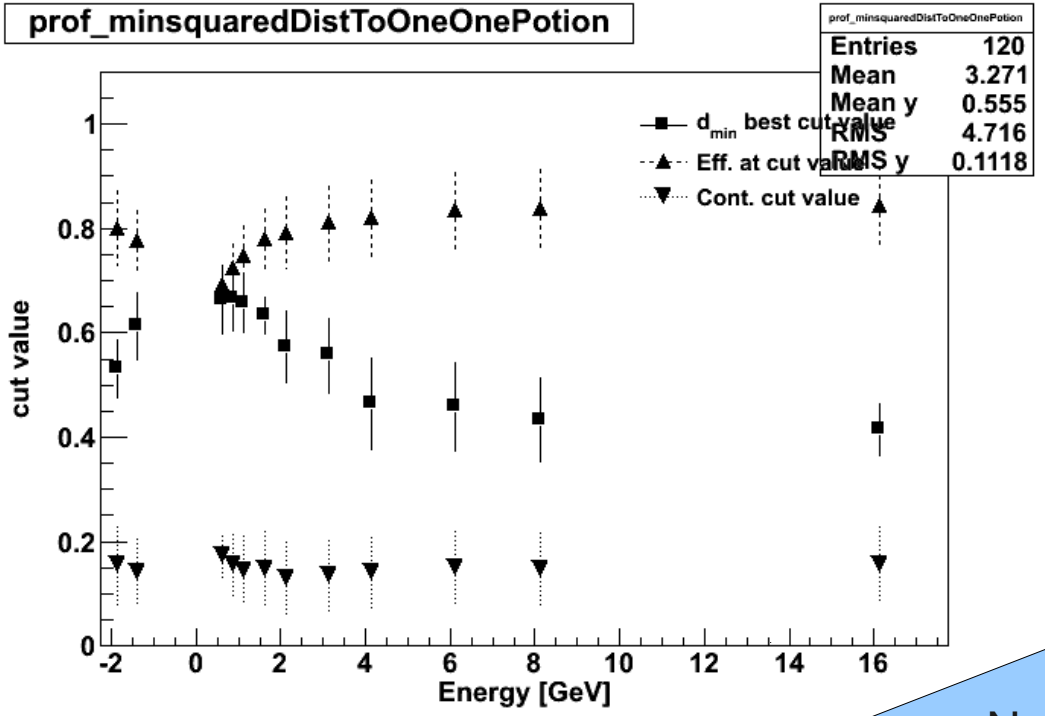


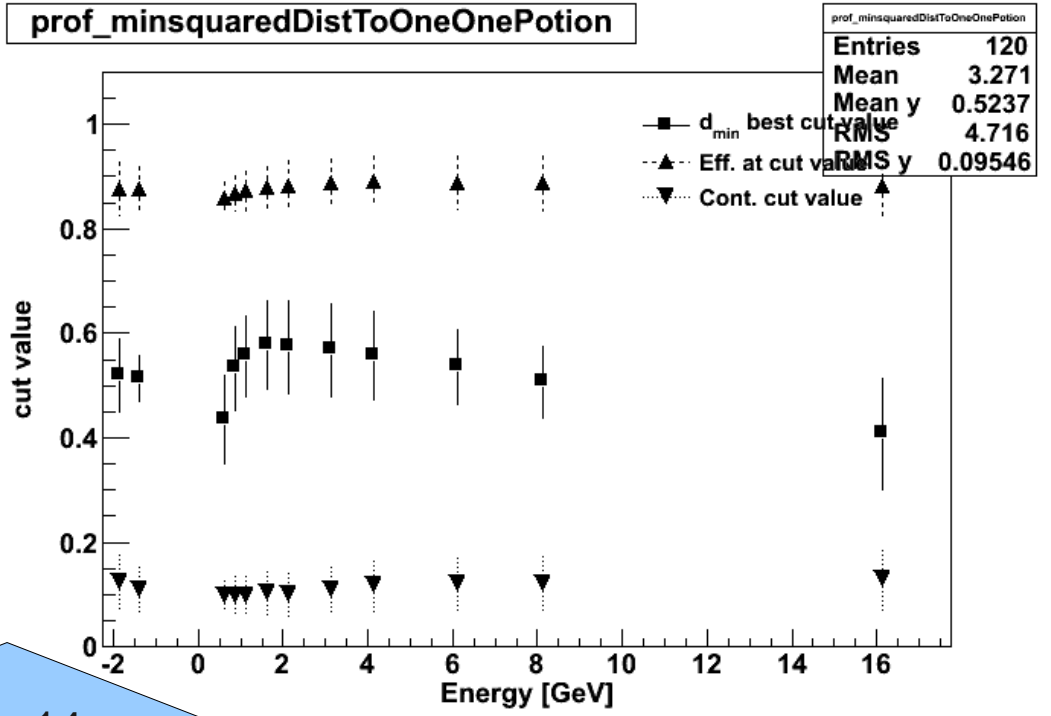


Npl=10
gamma_vs_electron

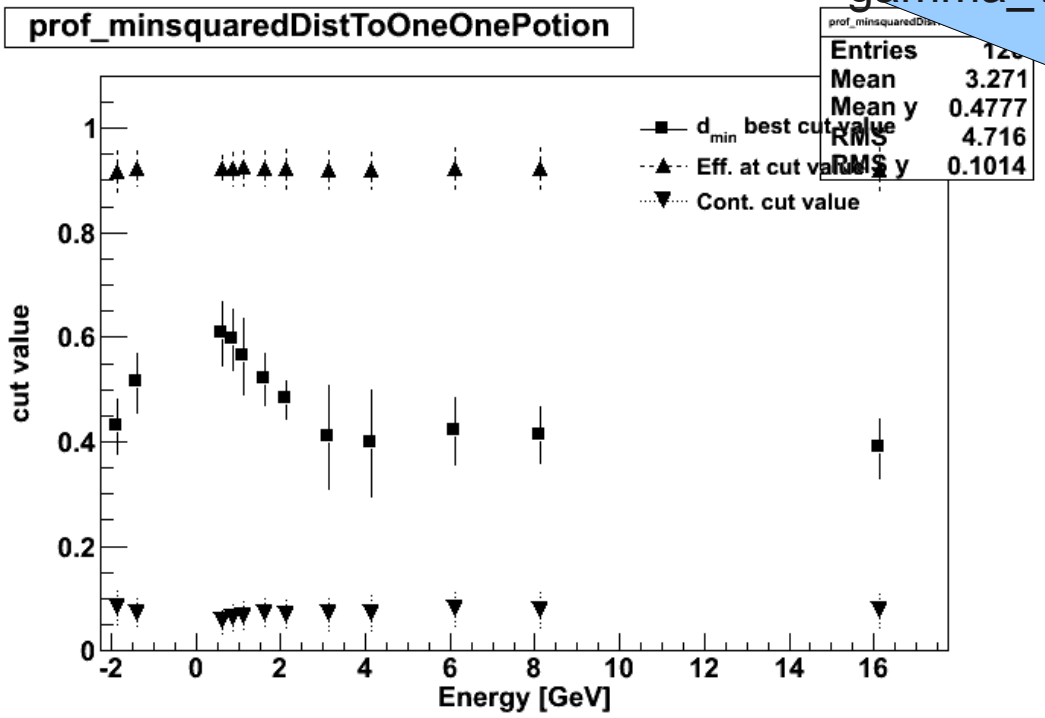


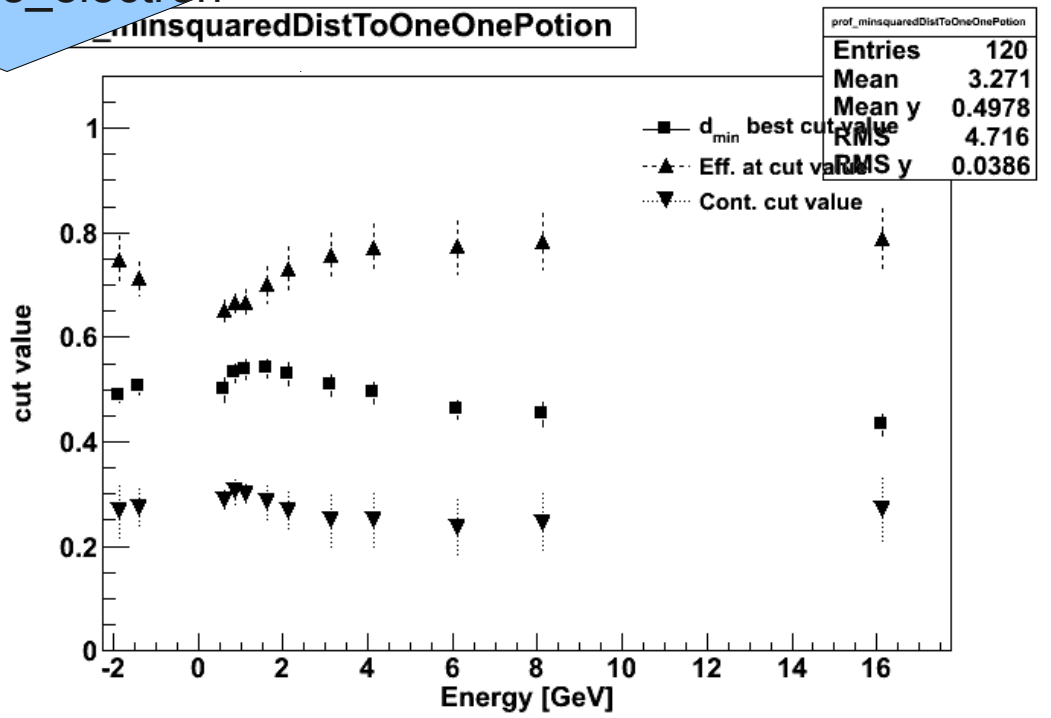


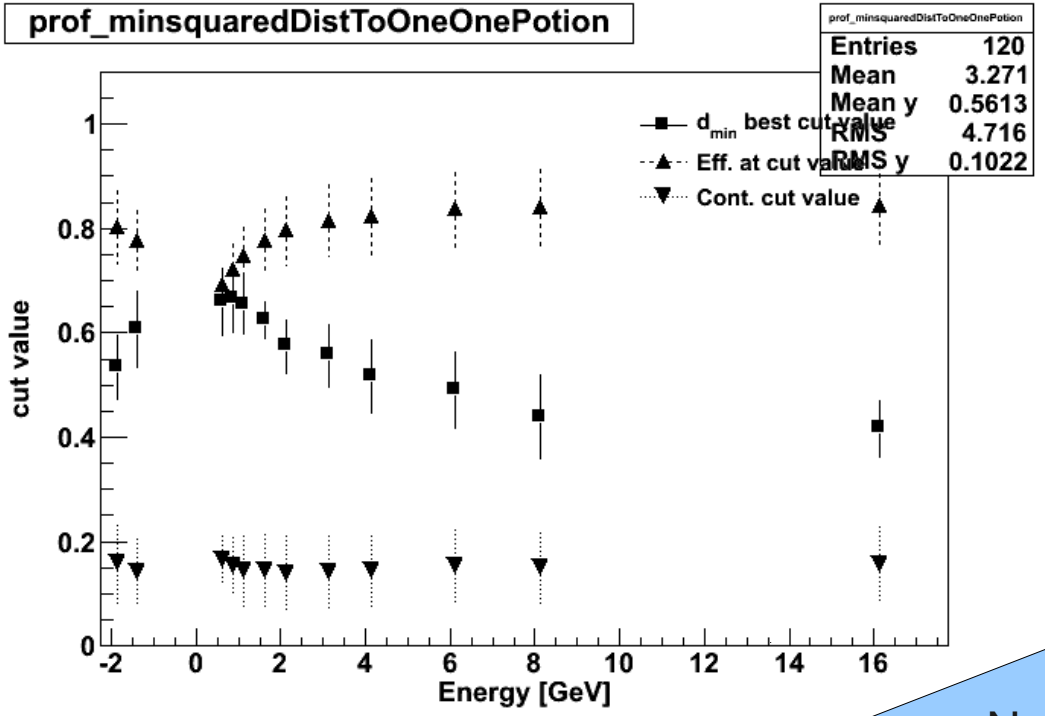


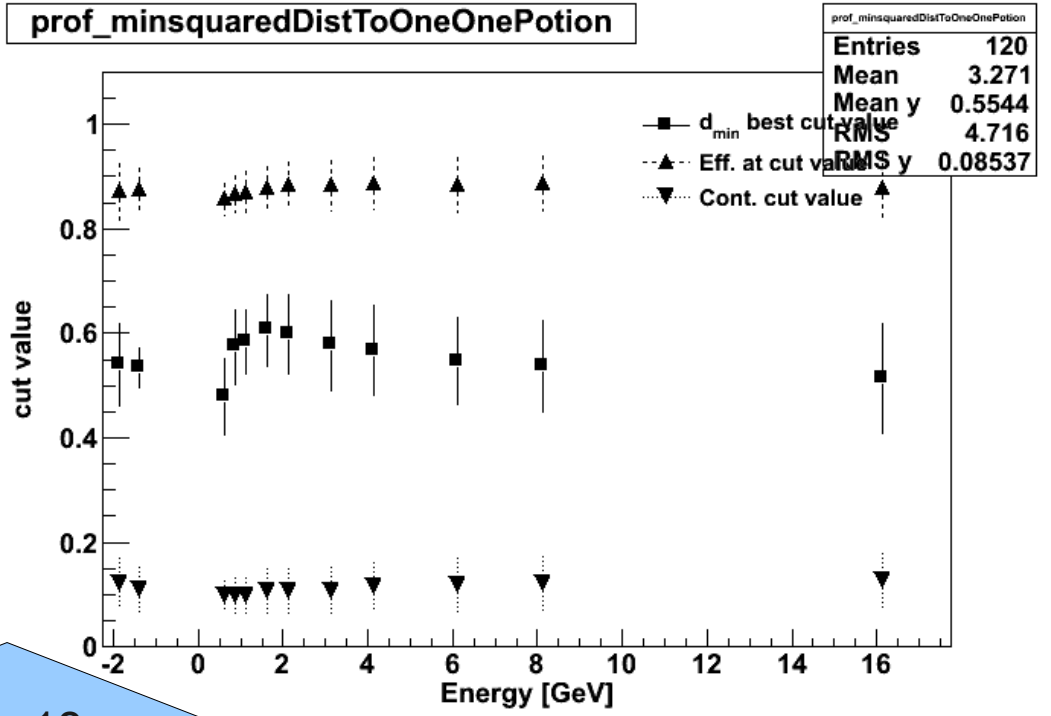


Npl=14
gamma_vs_electron

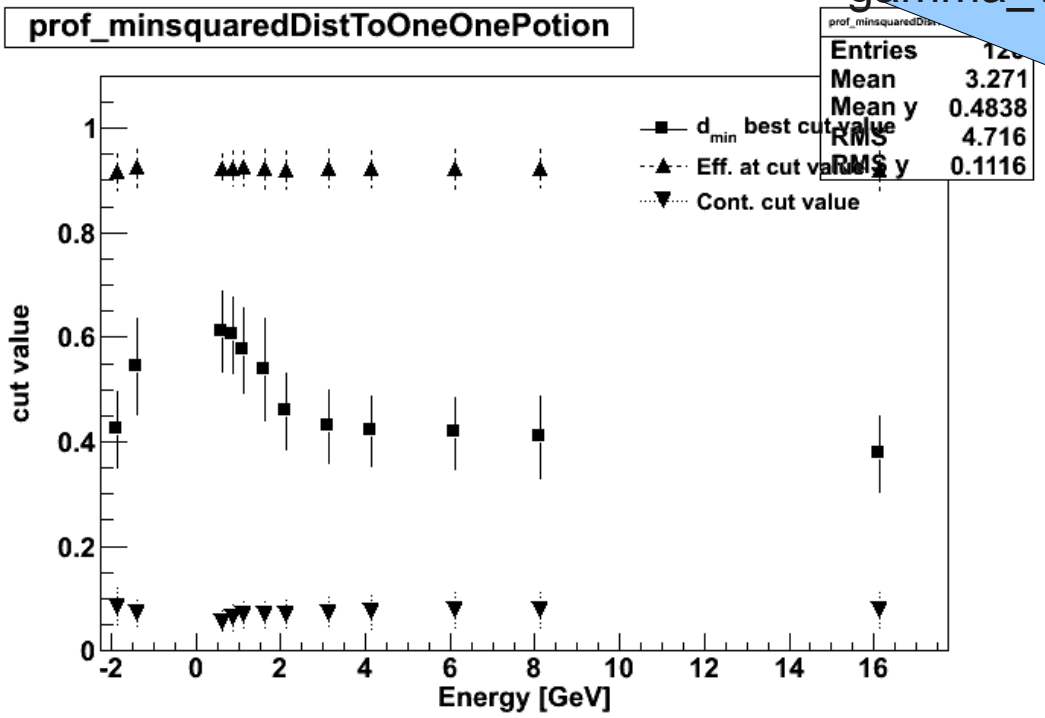


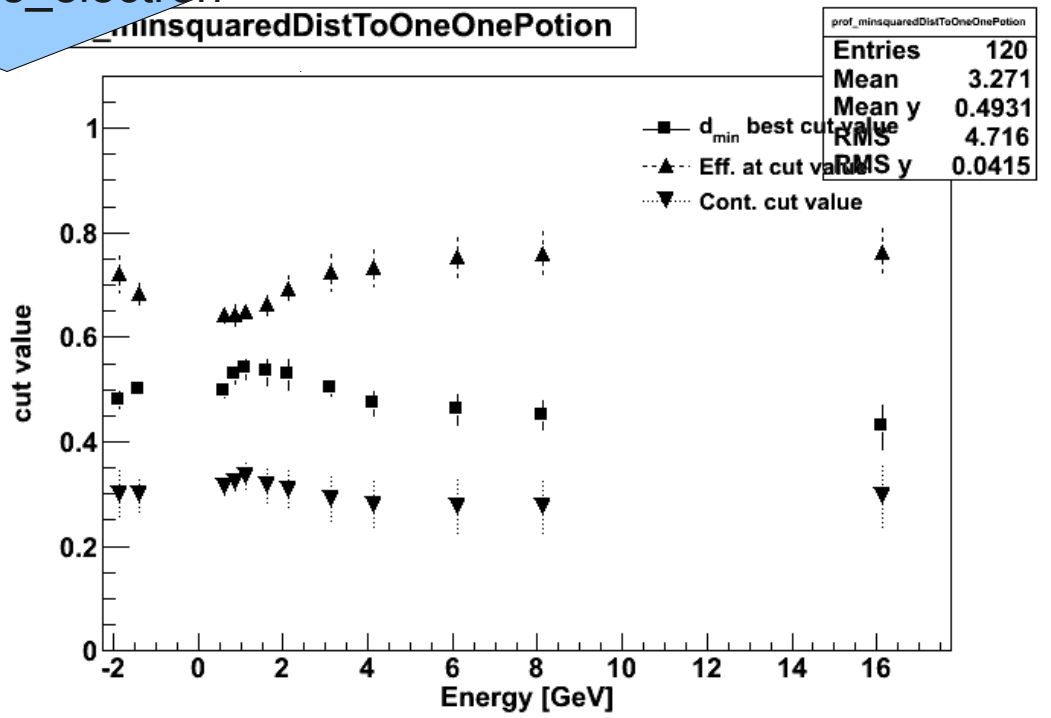


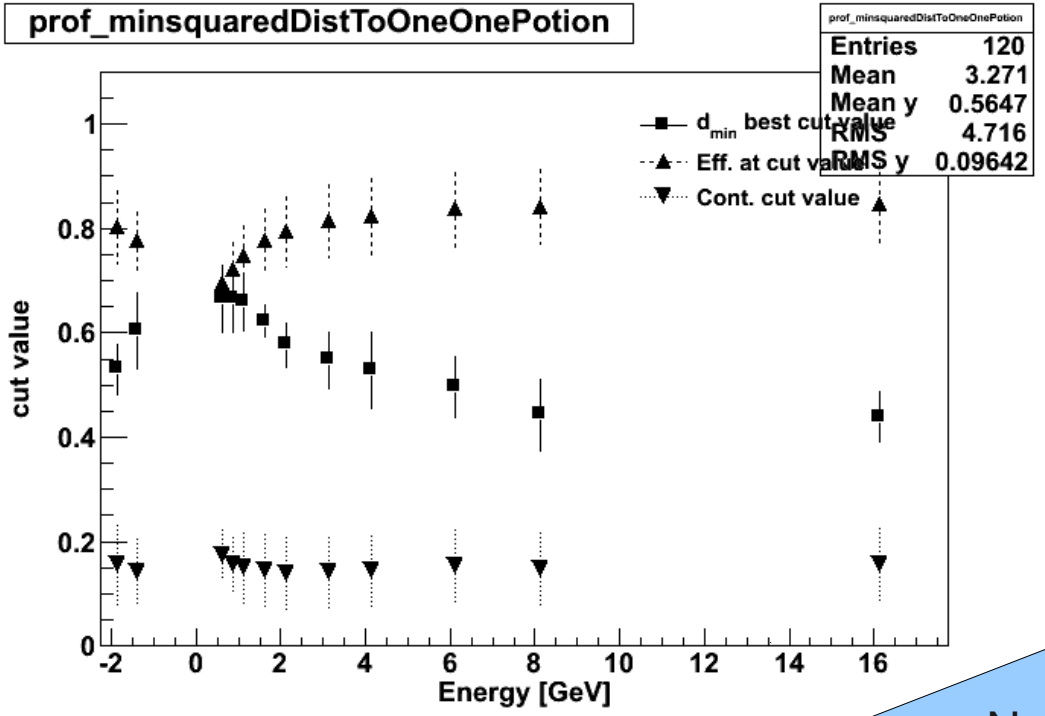


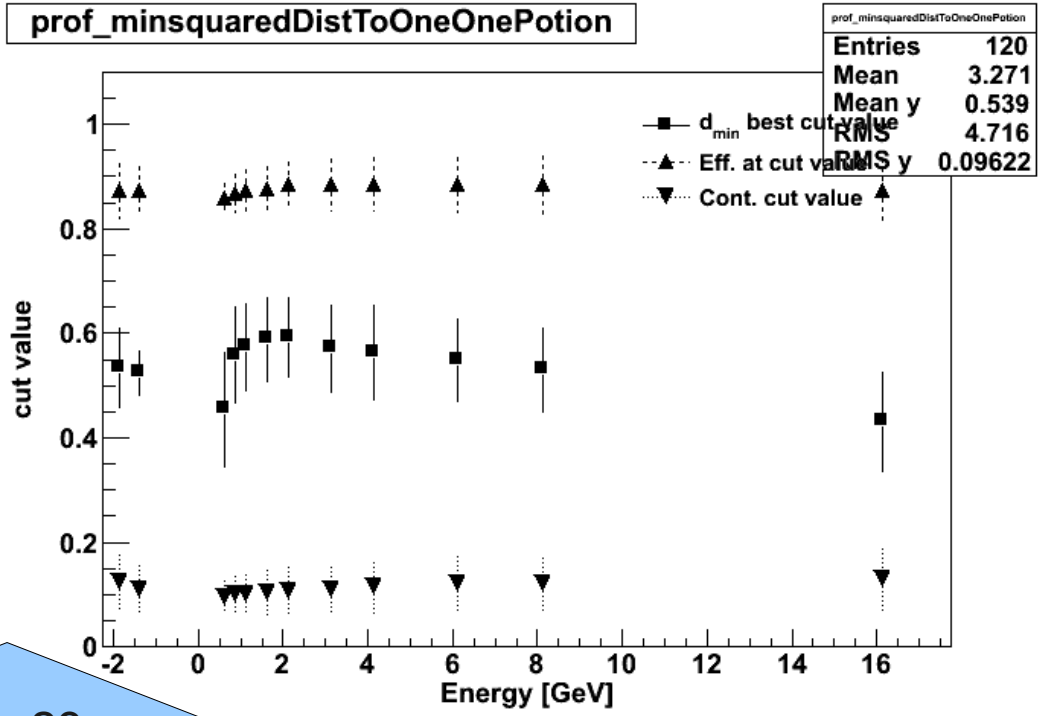


Npl=18
gamma_vs_electron

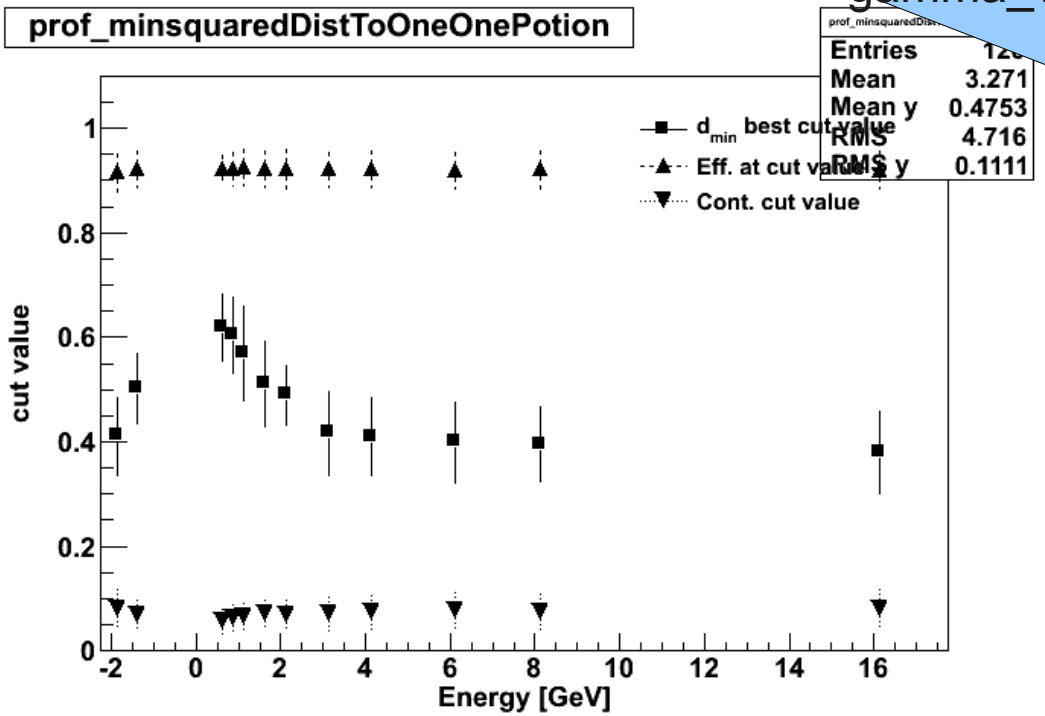


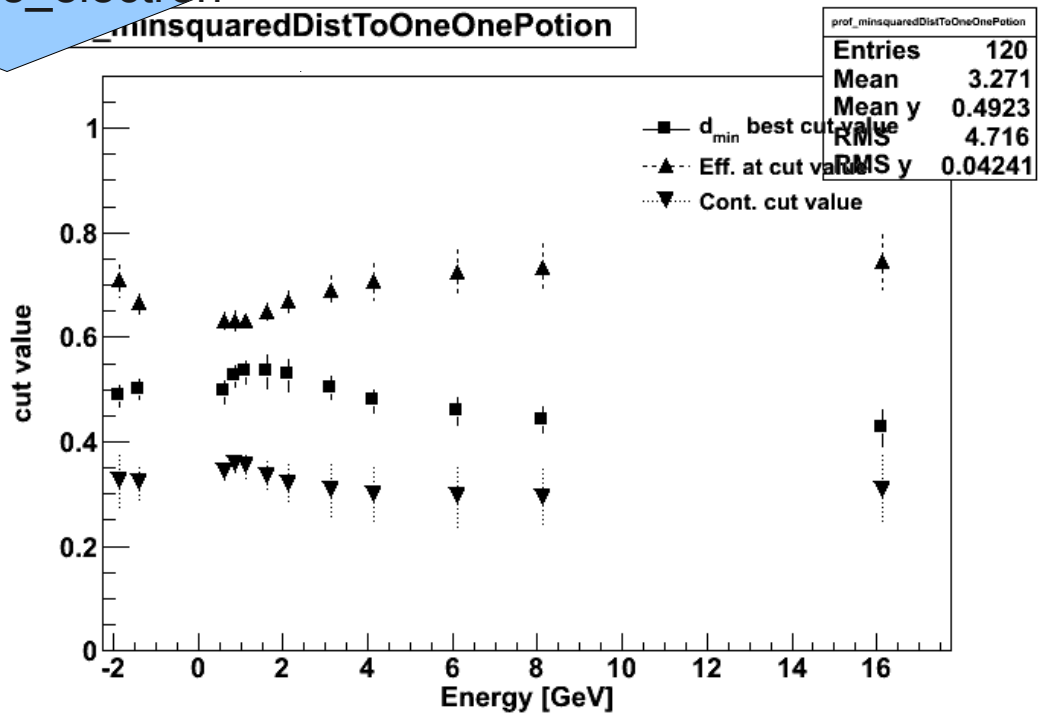


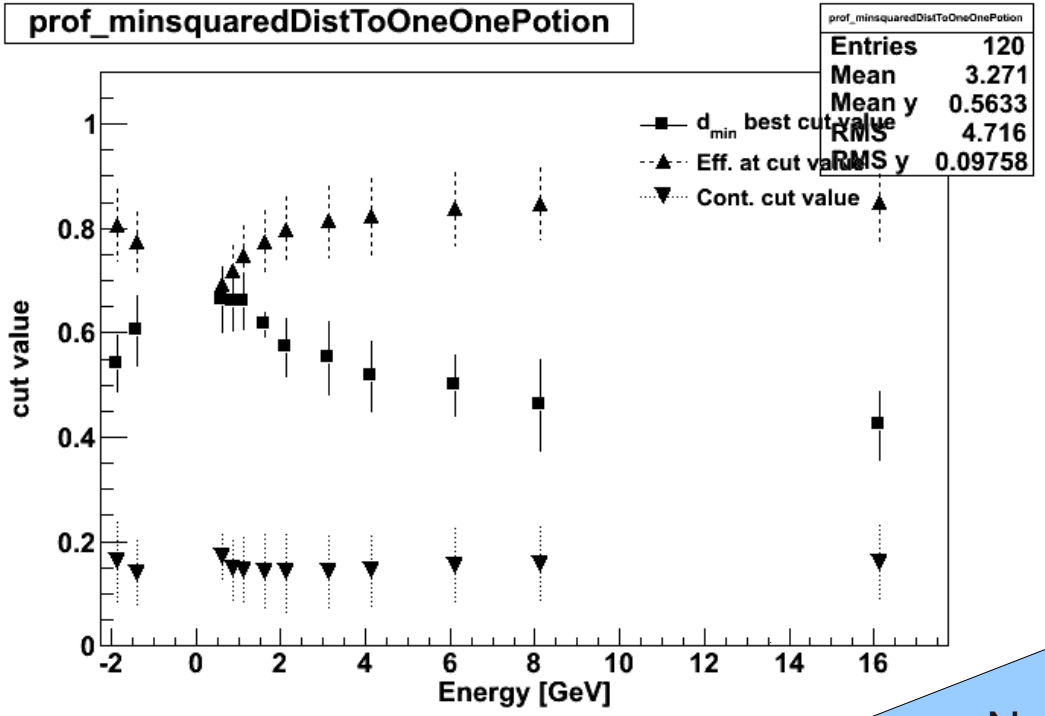


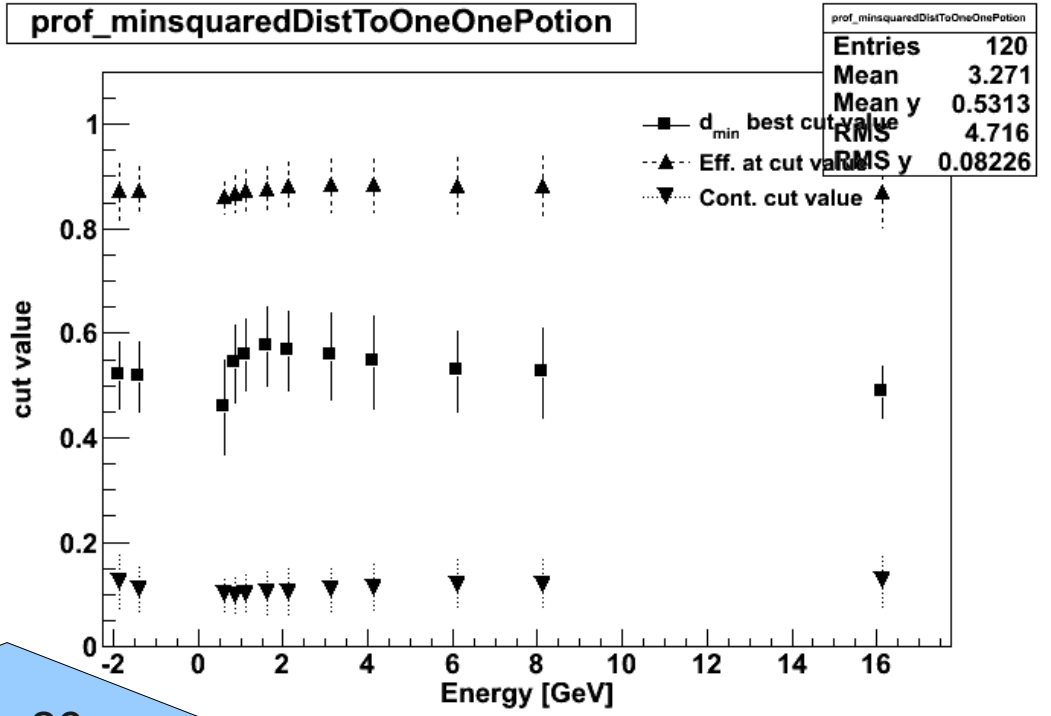


Npl=23
gamma_vs_electron

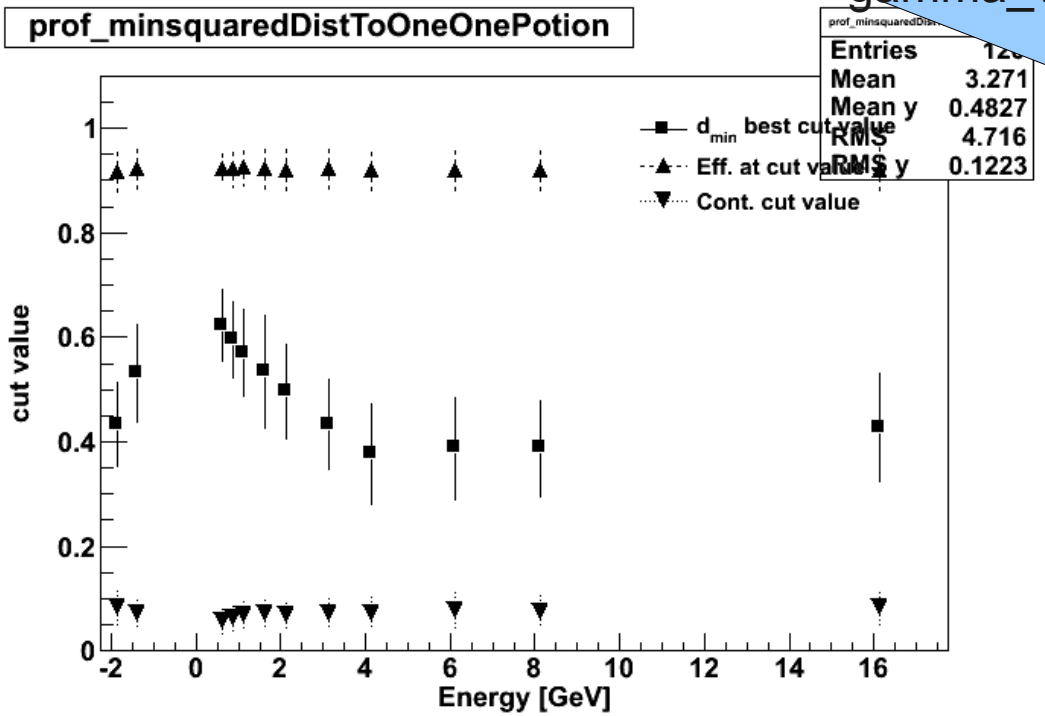


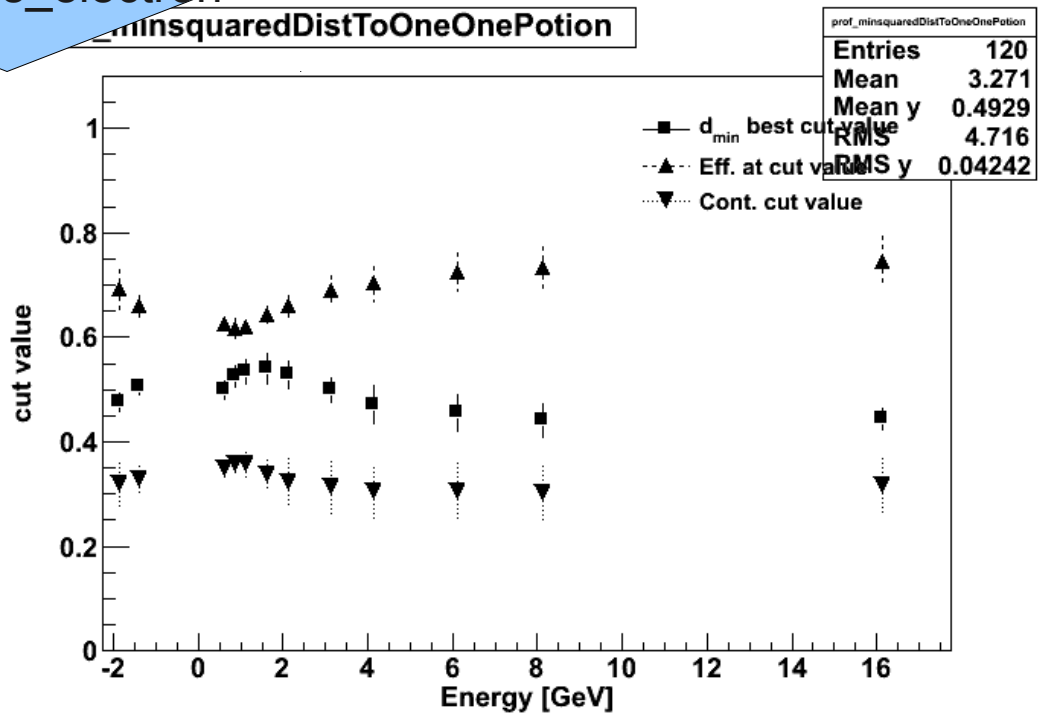


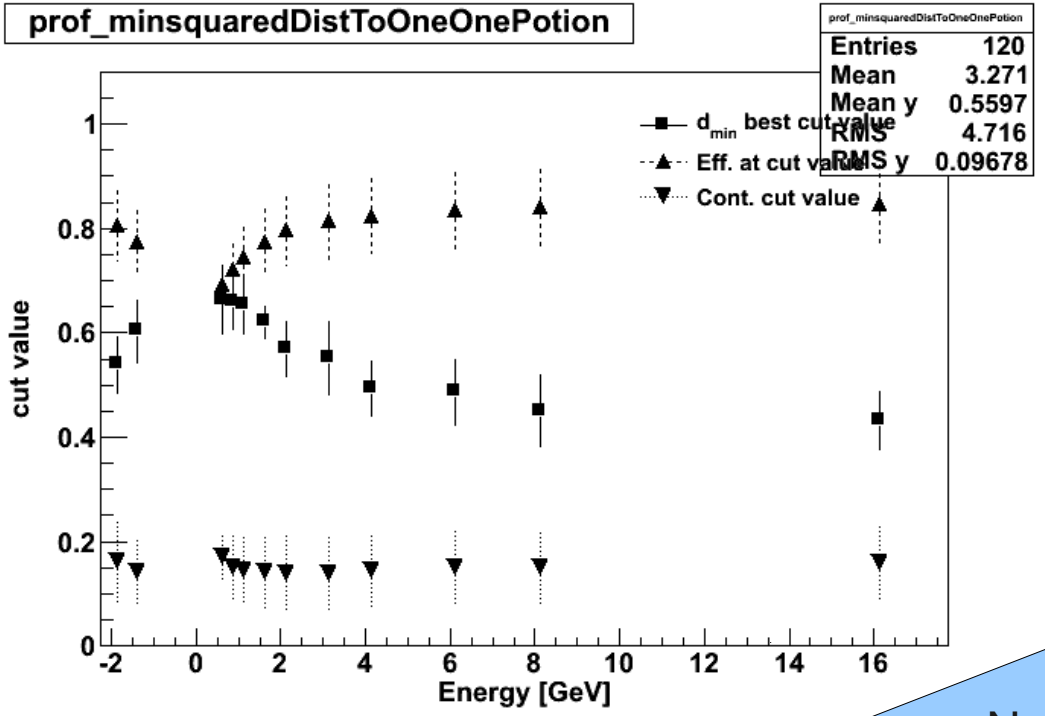


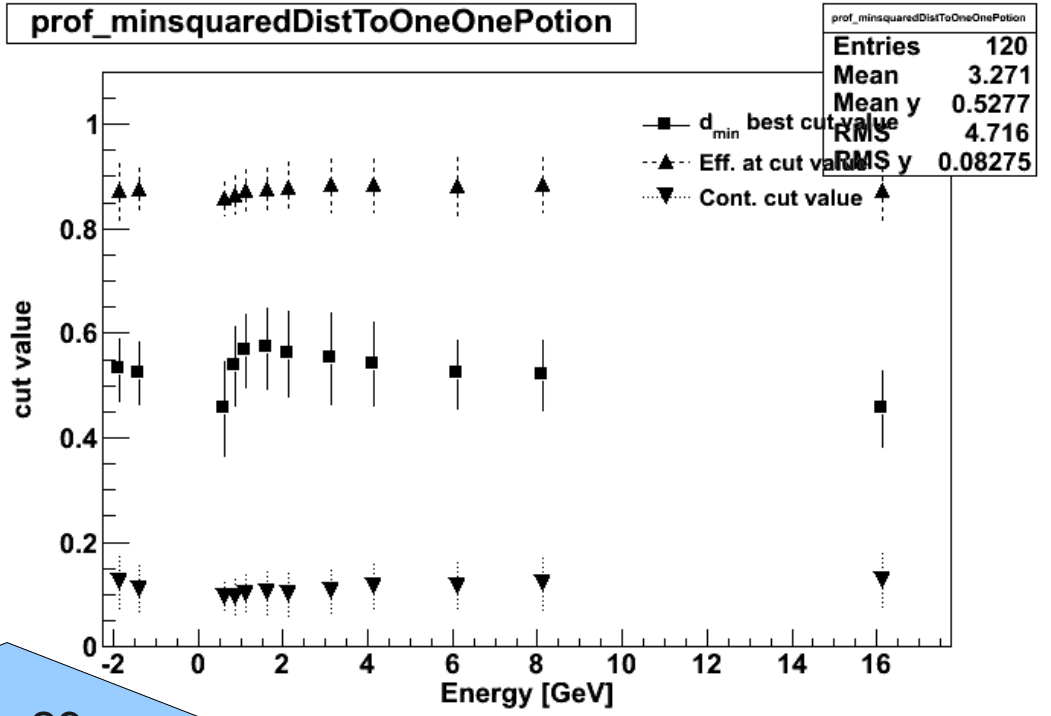


Npl=26
gamma_vs_electron

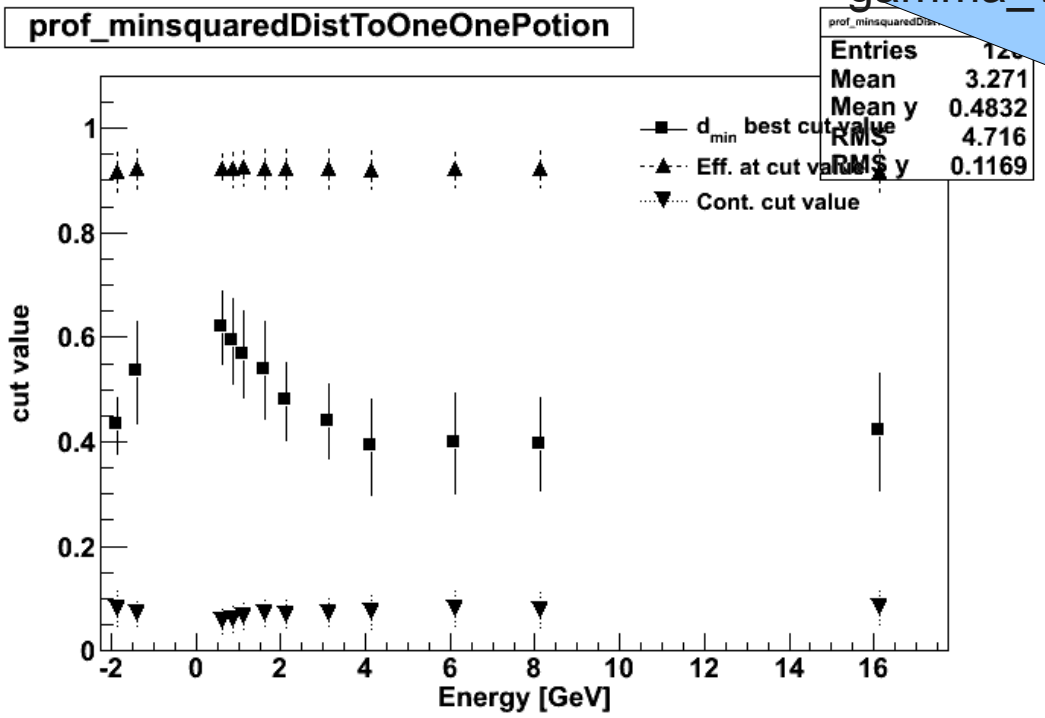


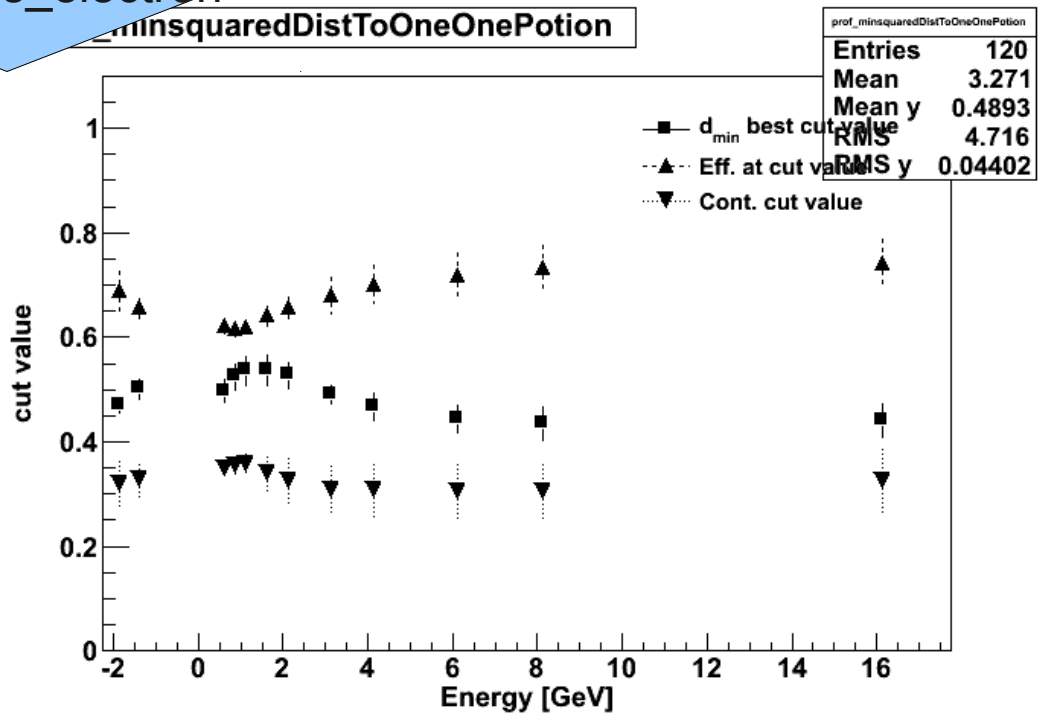




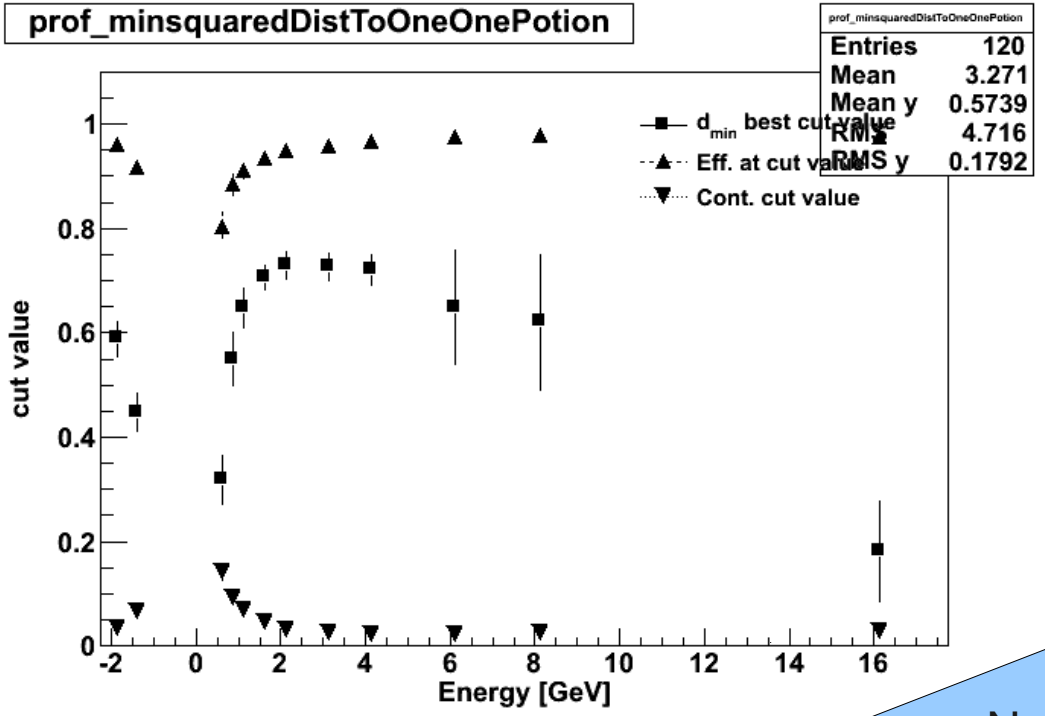


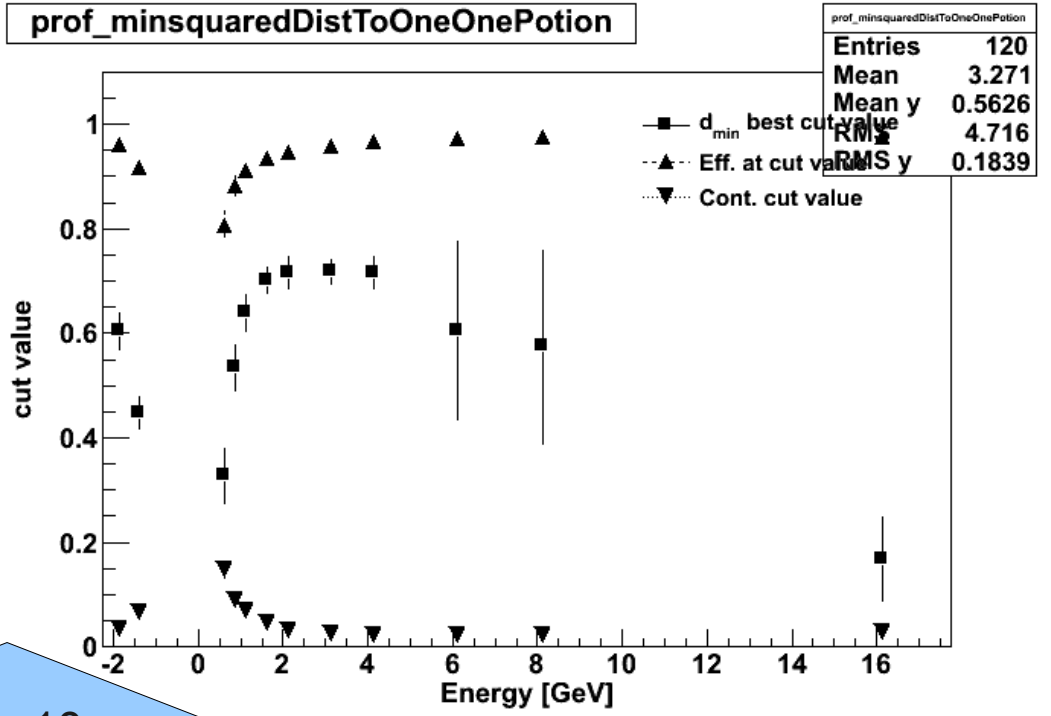
Npl=29
gamma_vs_electron



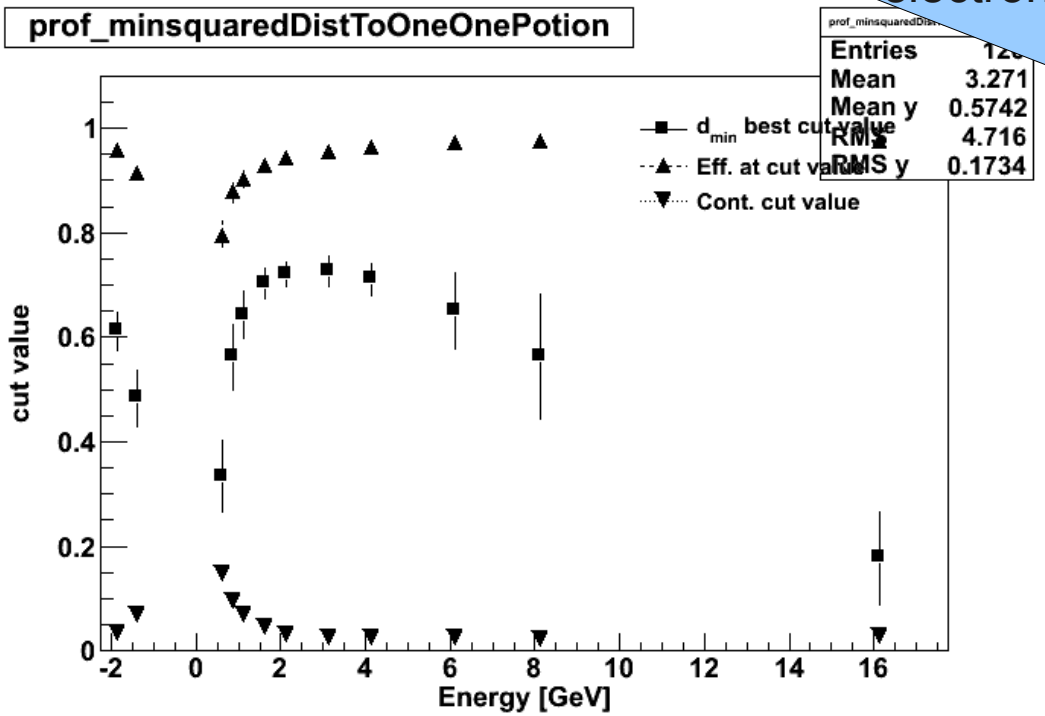


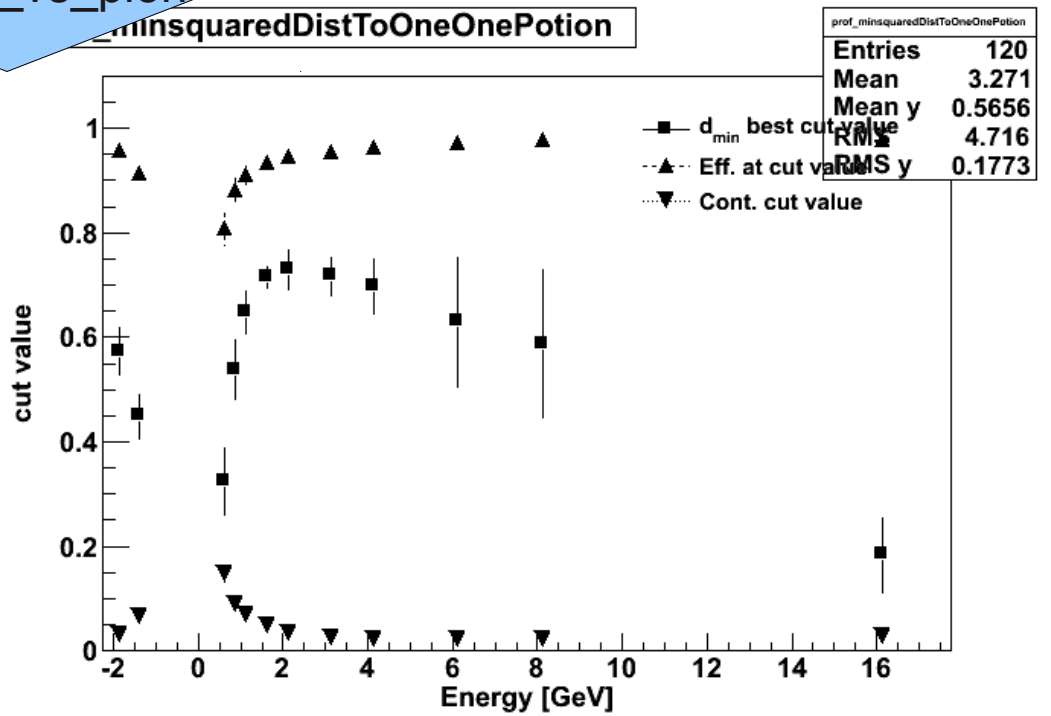
Now
electron_pion

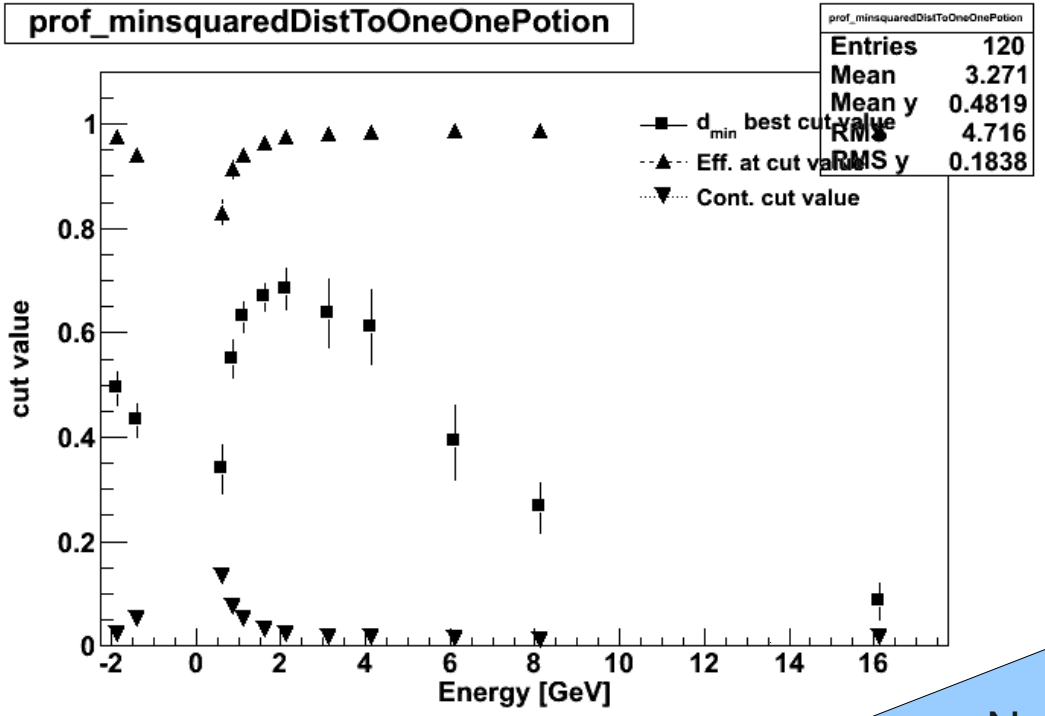


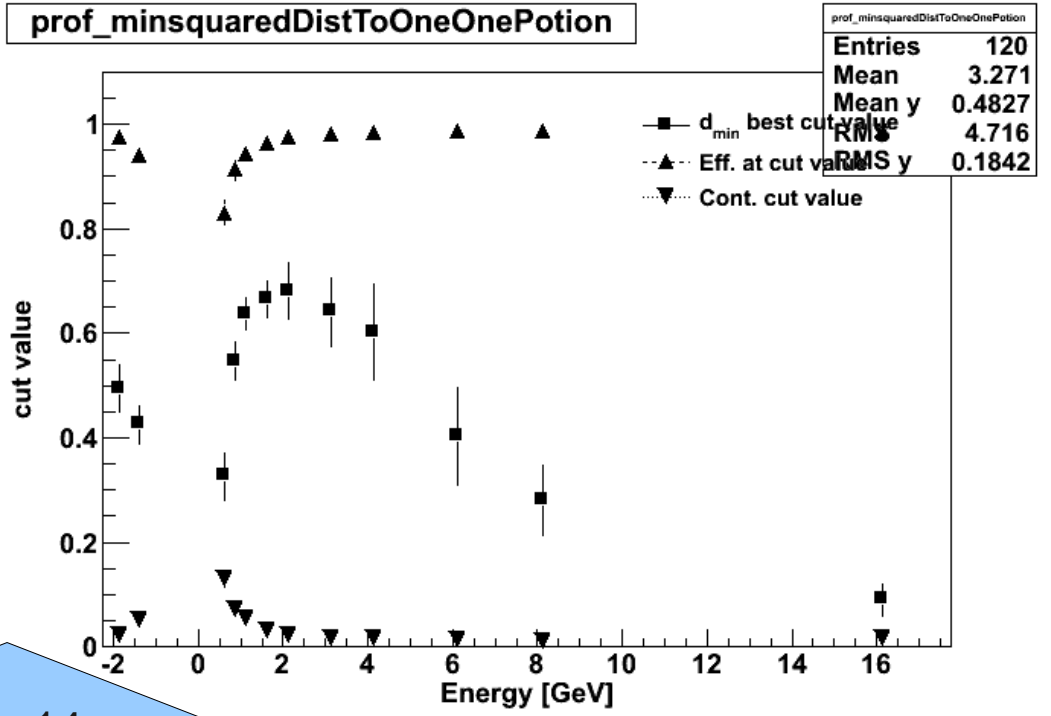


Npl=10
electron_vs_pion

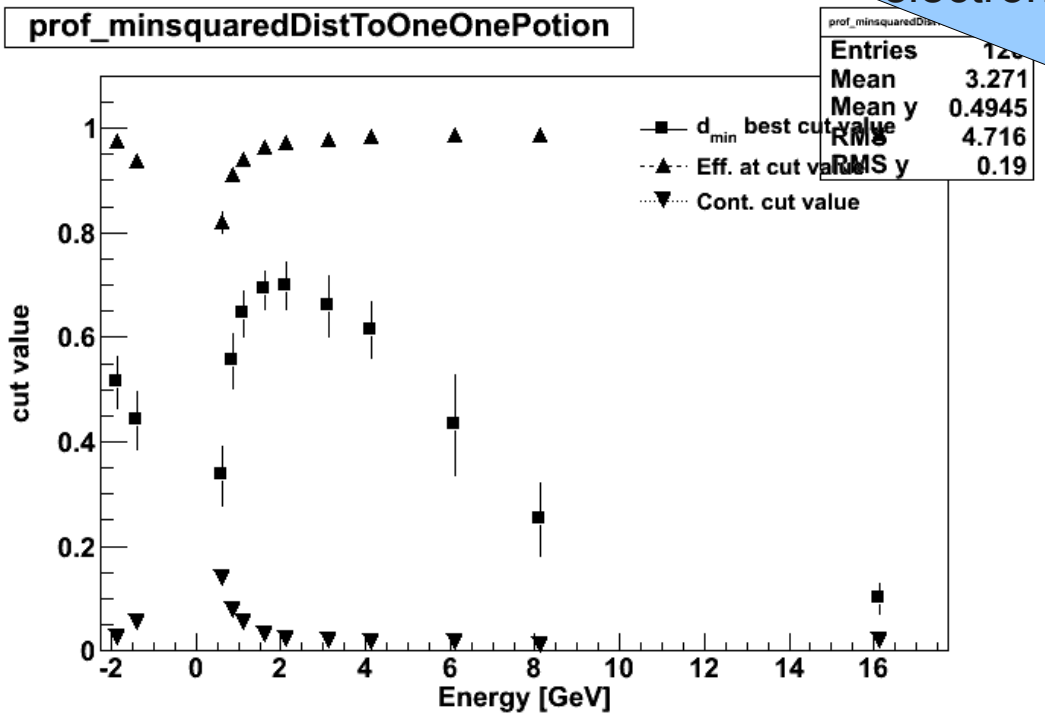


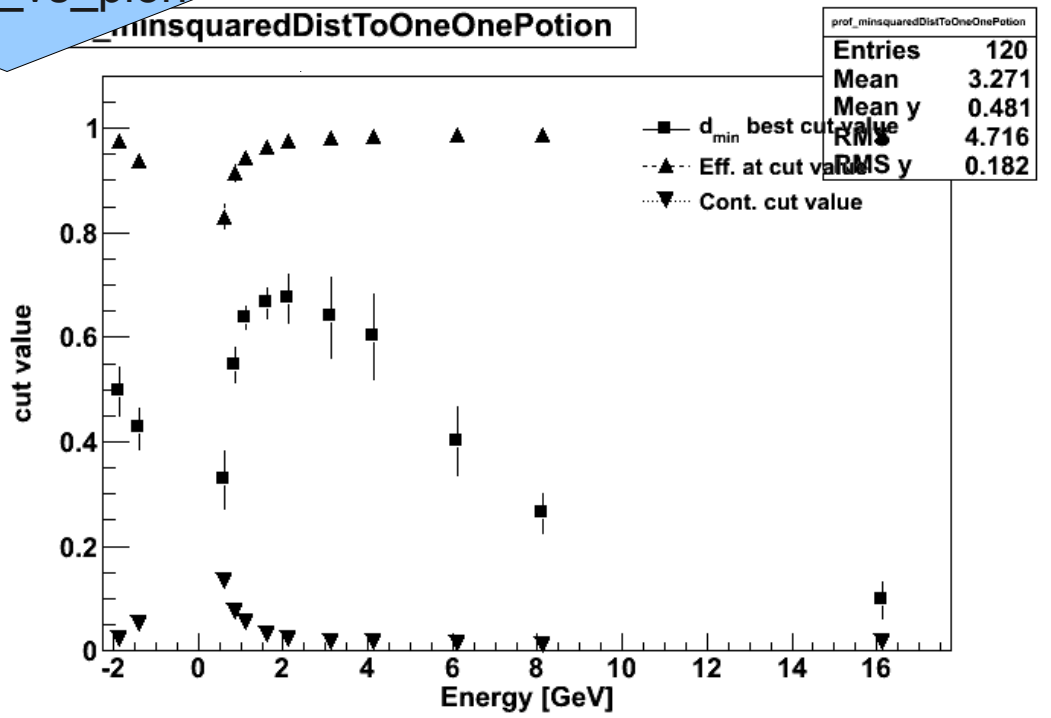


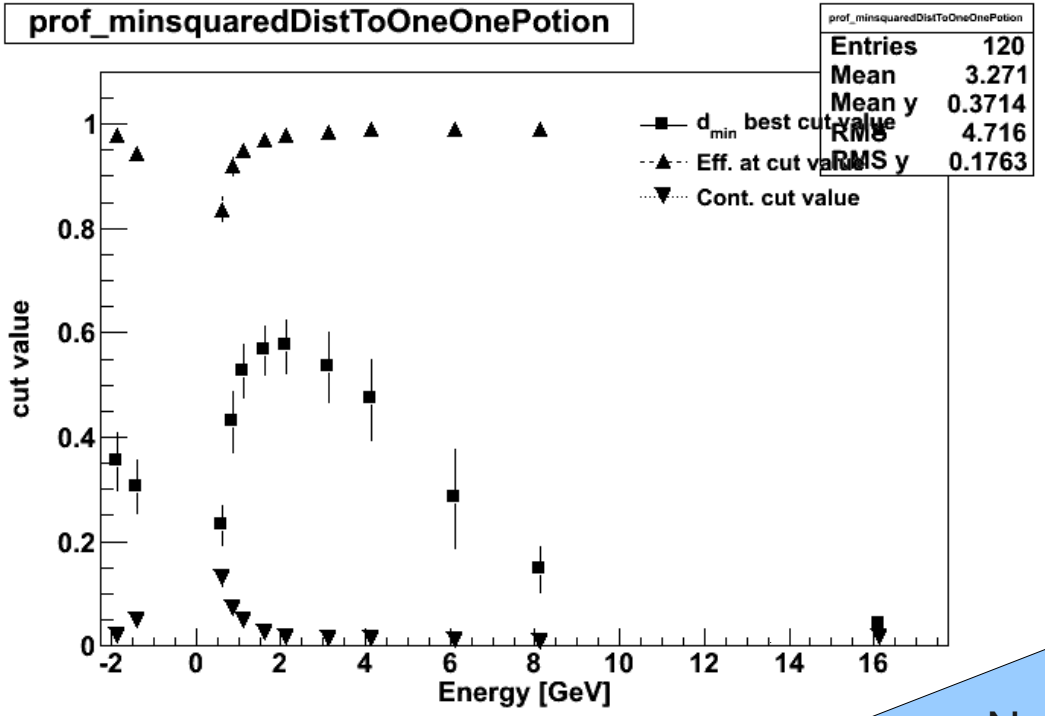


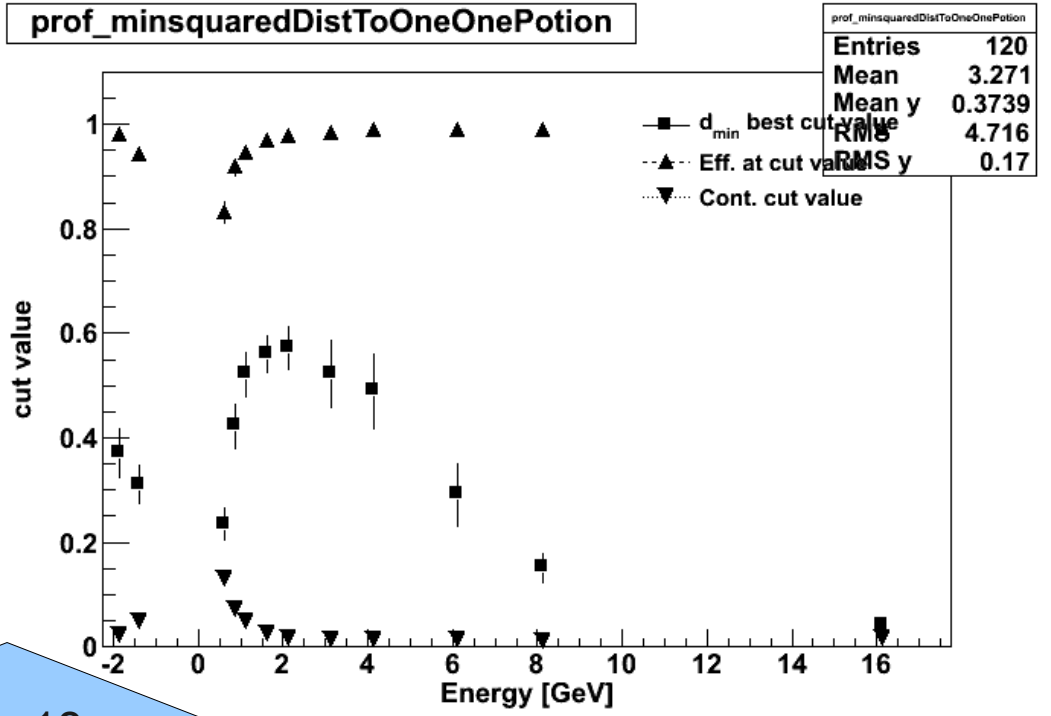


Npl=14
electron_vs_pion

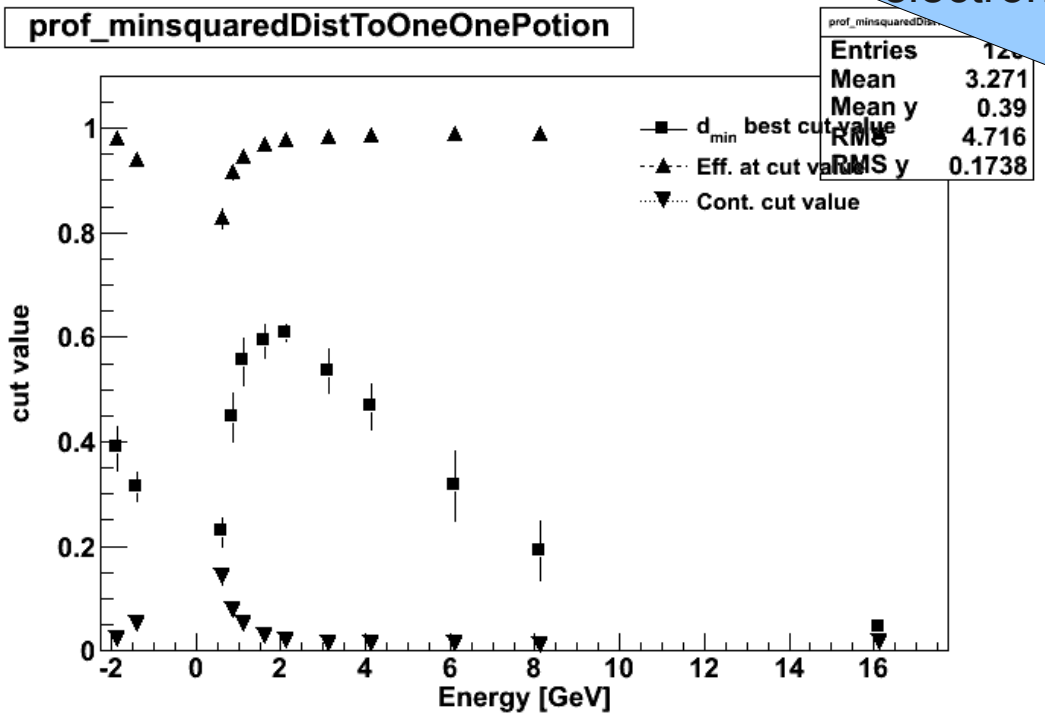


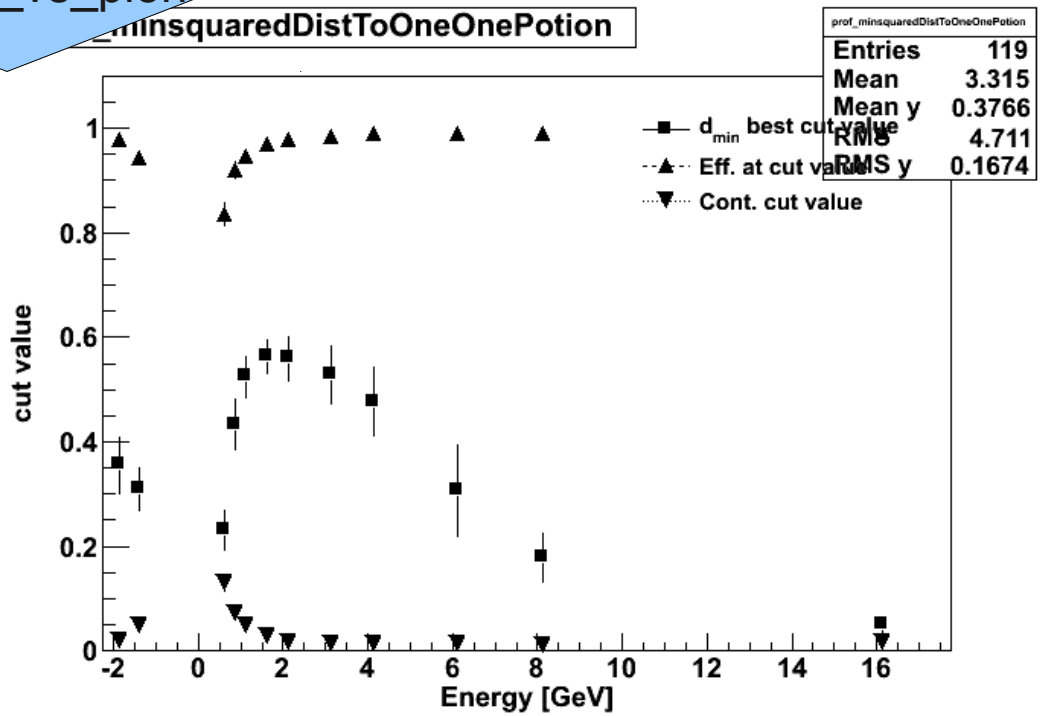


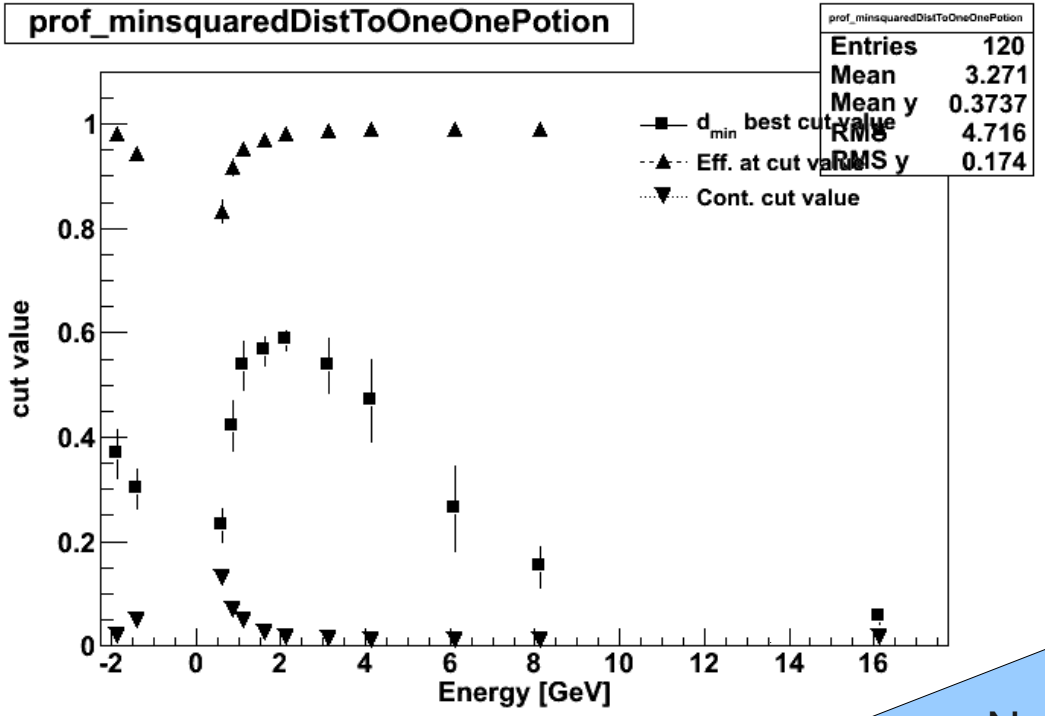


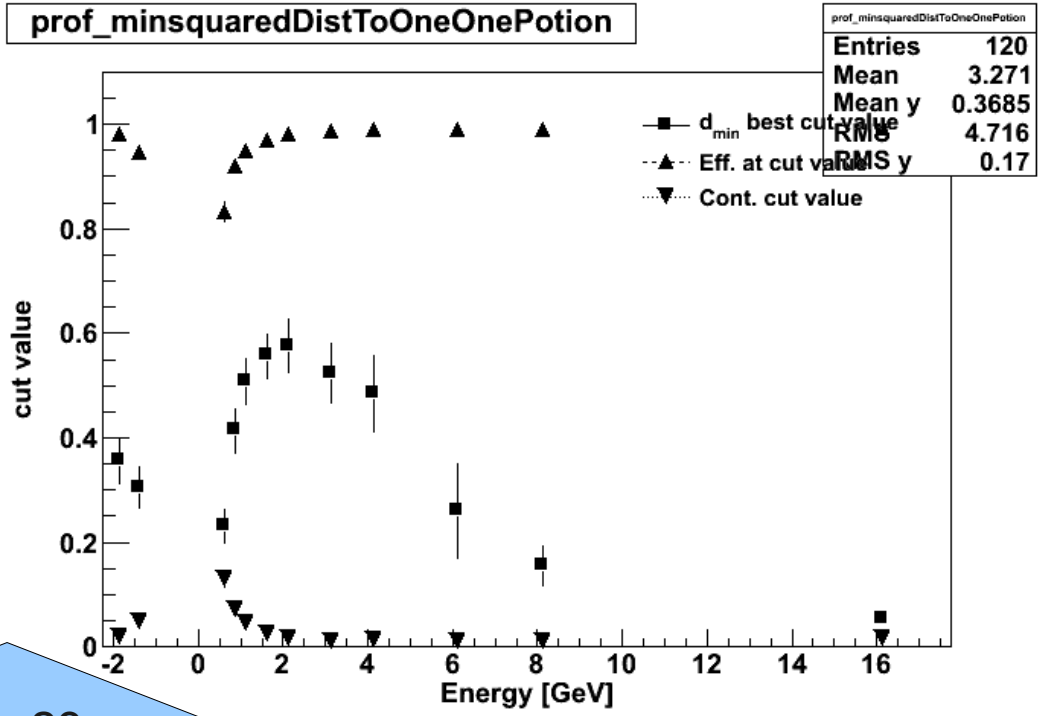


Npl=18
electron_vs_pion

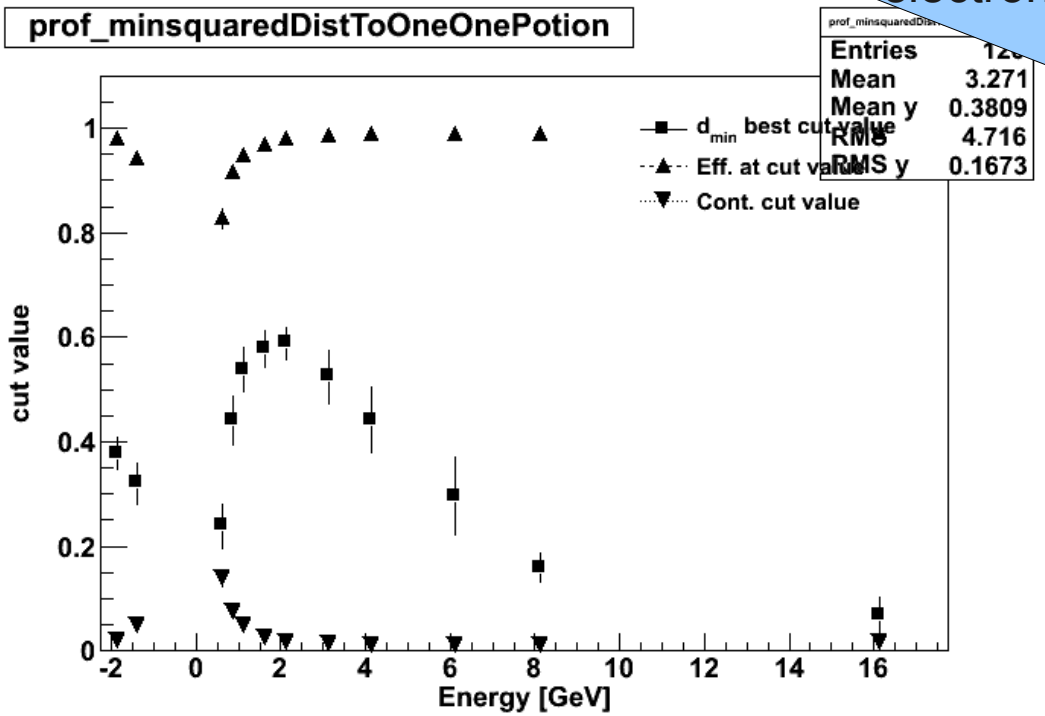


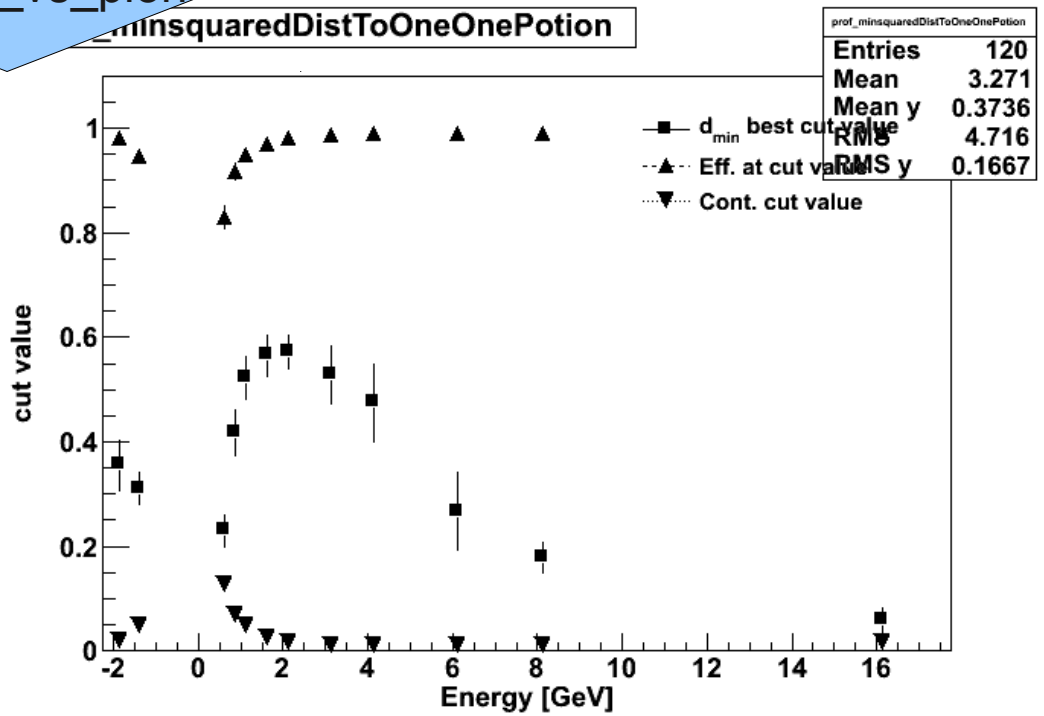


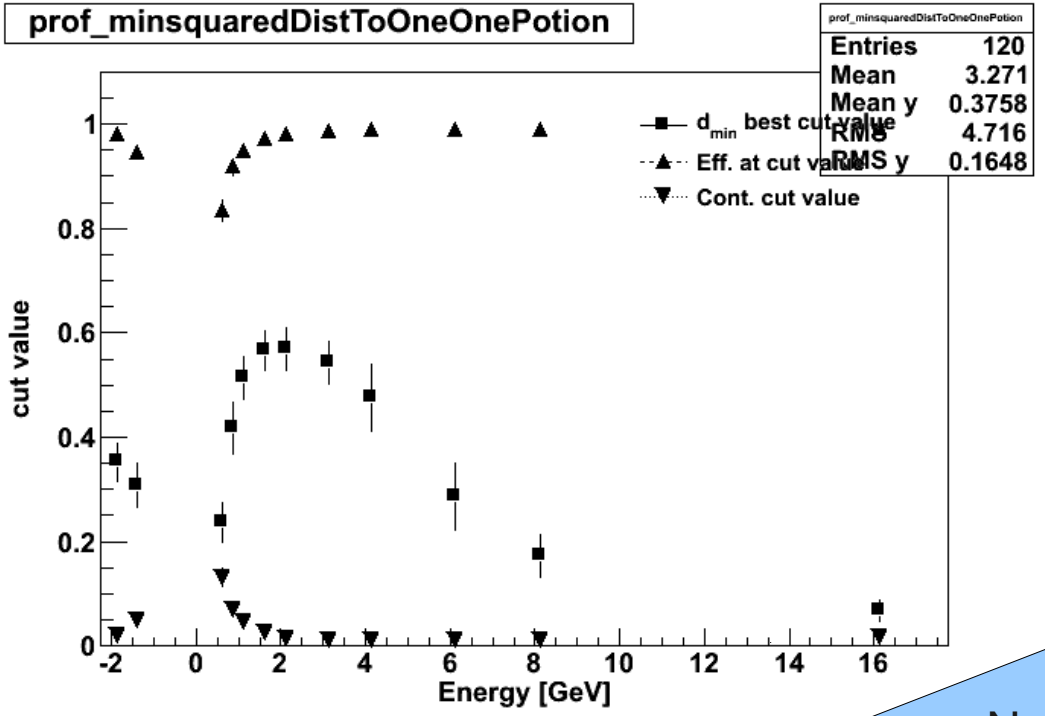


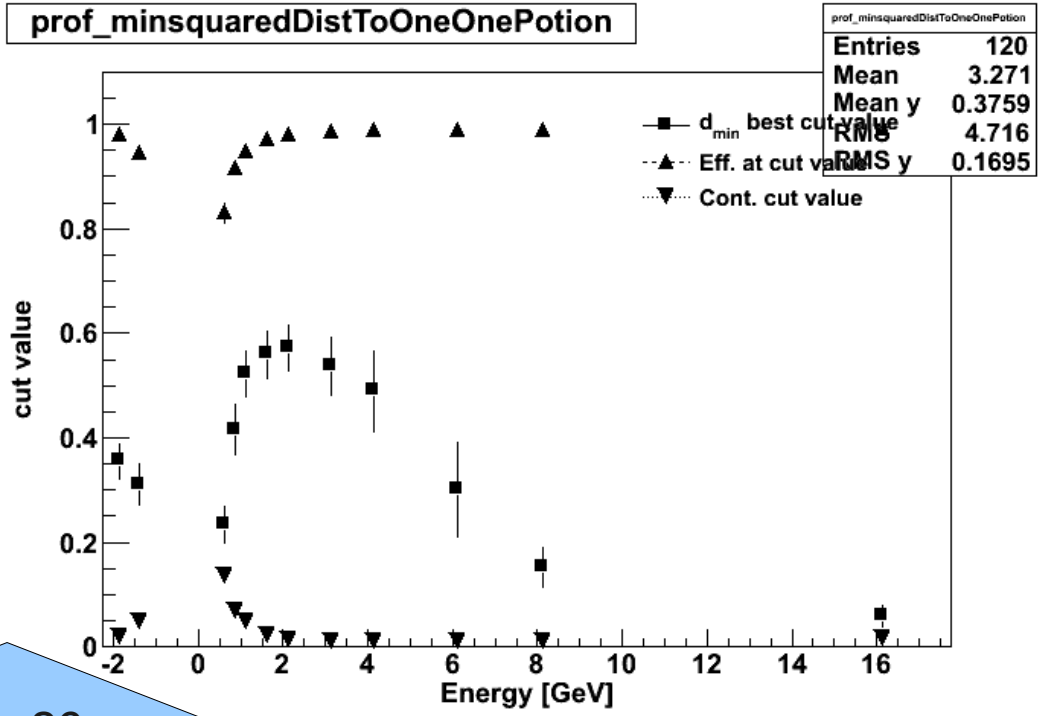


Npl=23
electron_vs_pion









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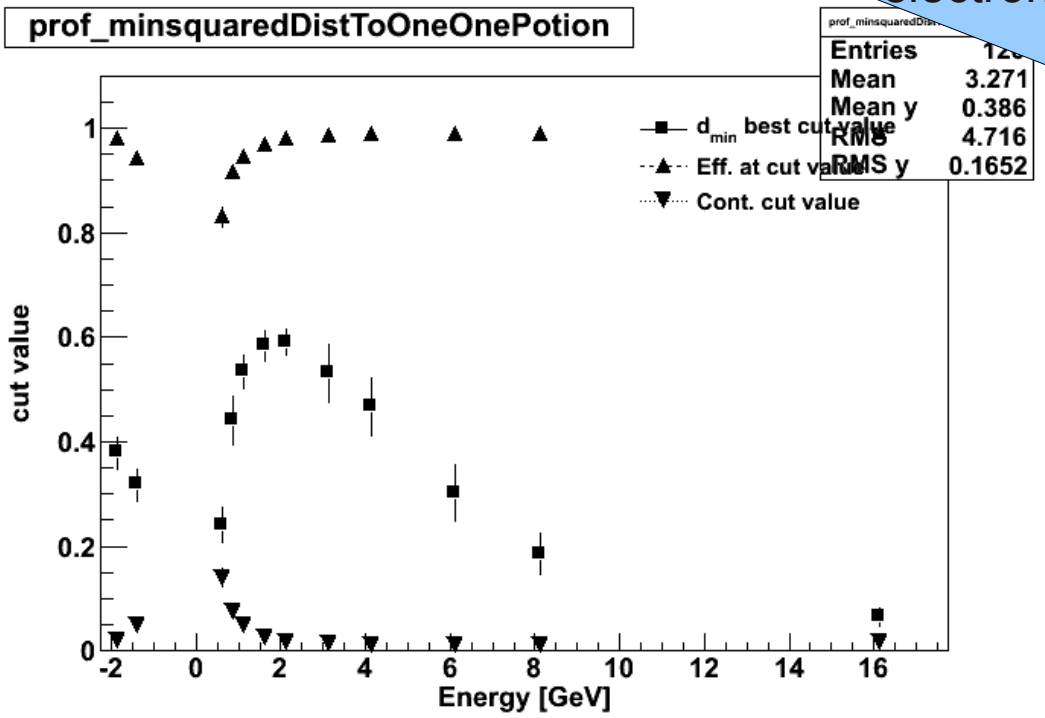
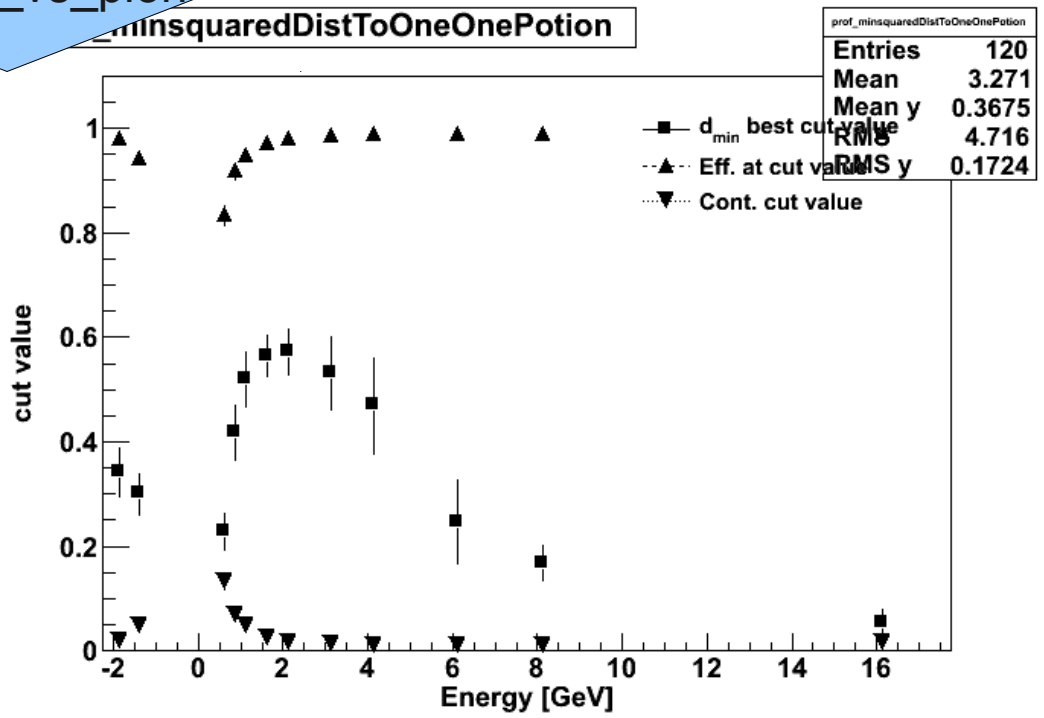
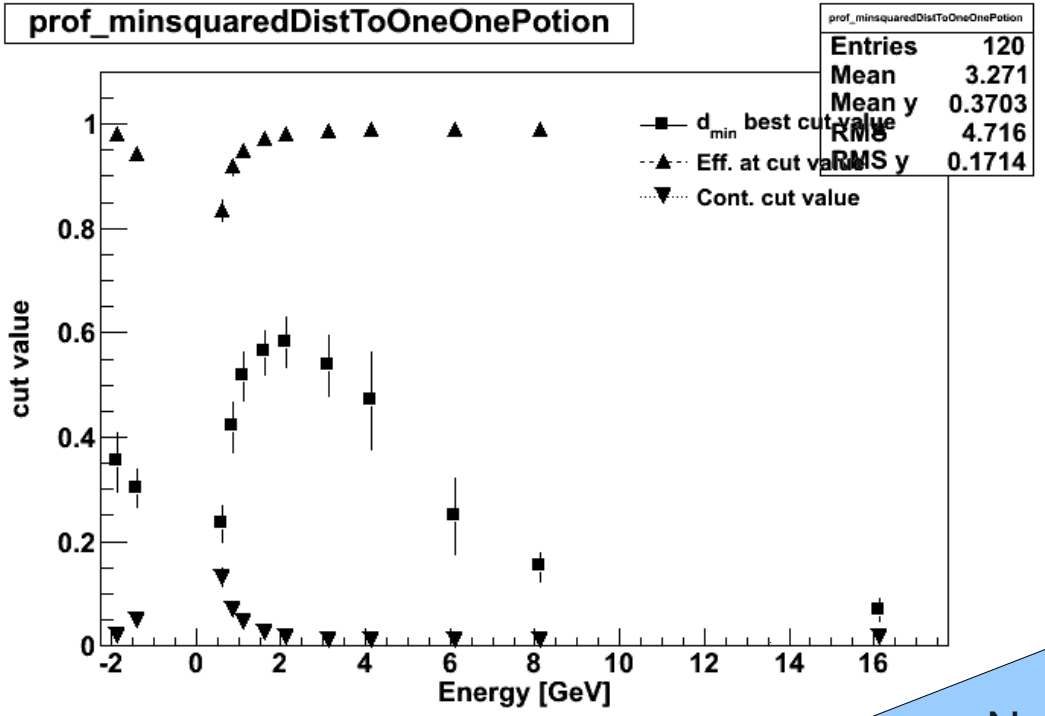
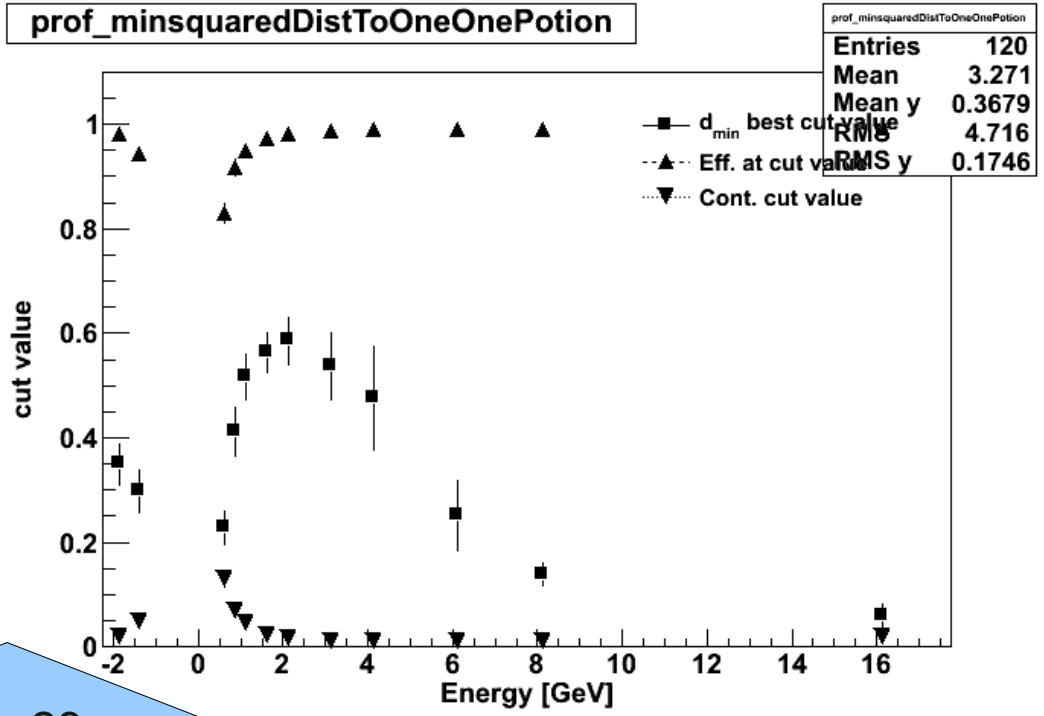
electron_vs_pion

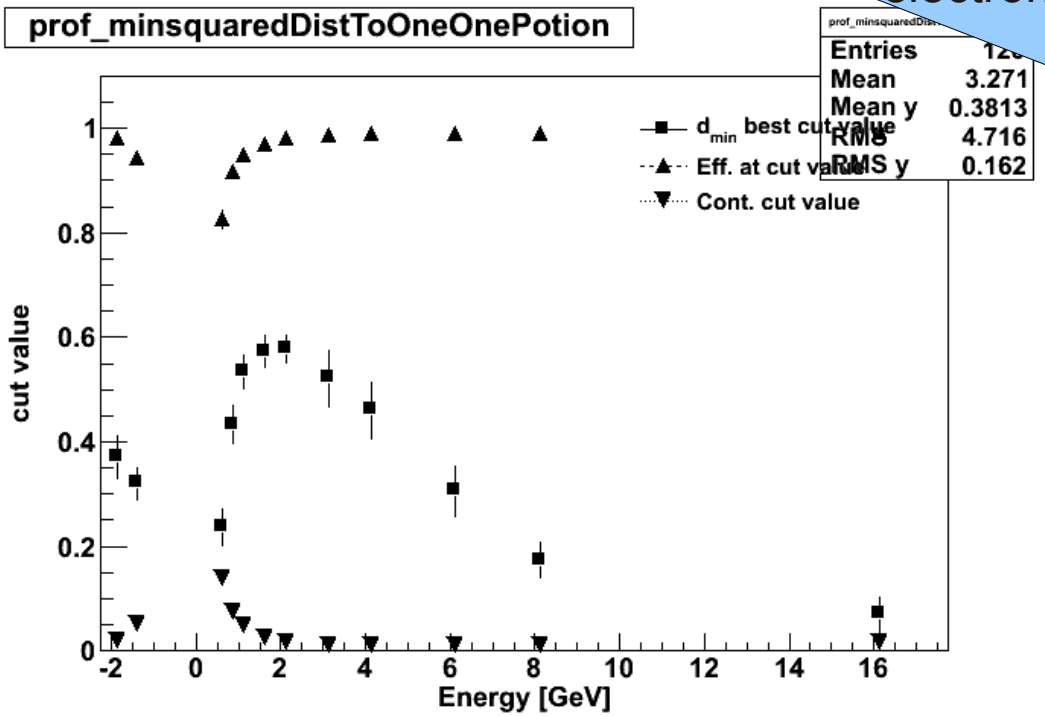


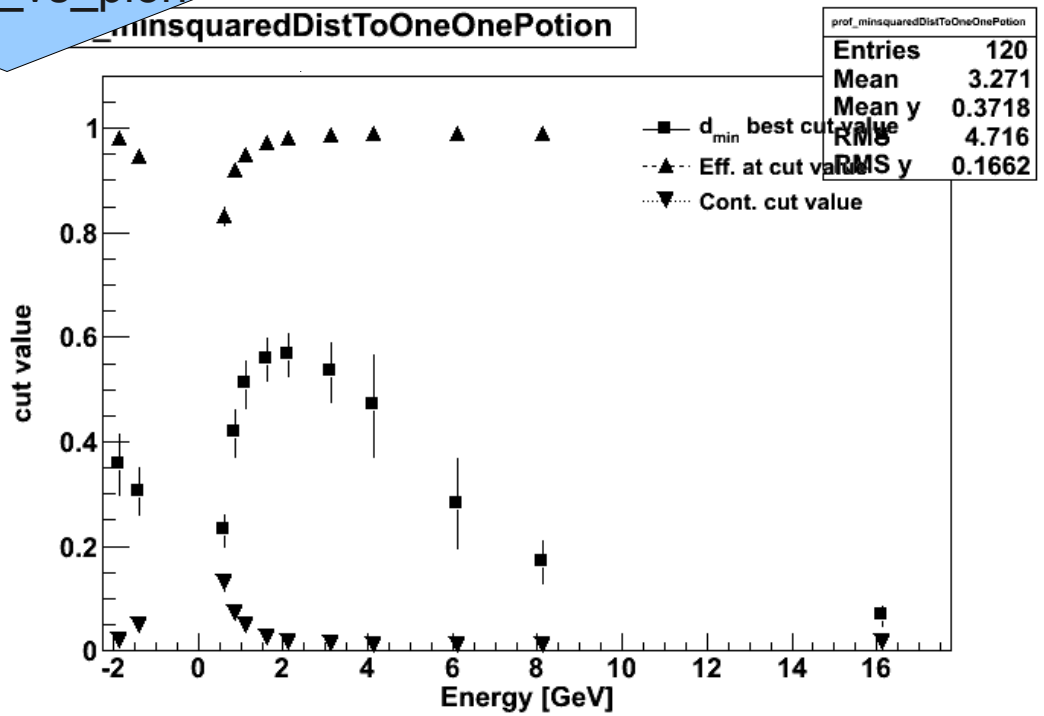




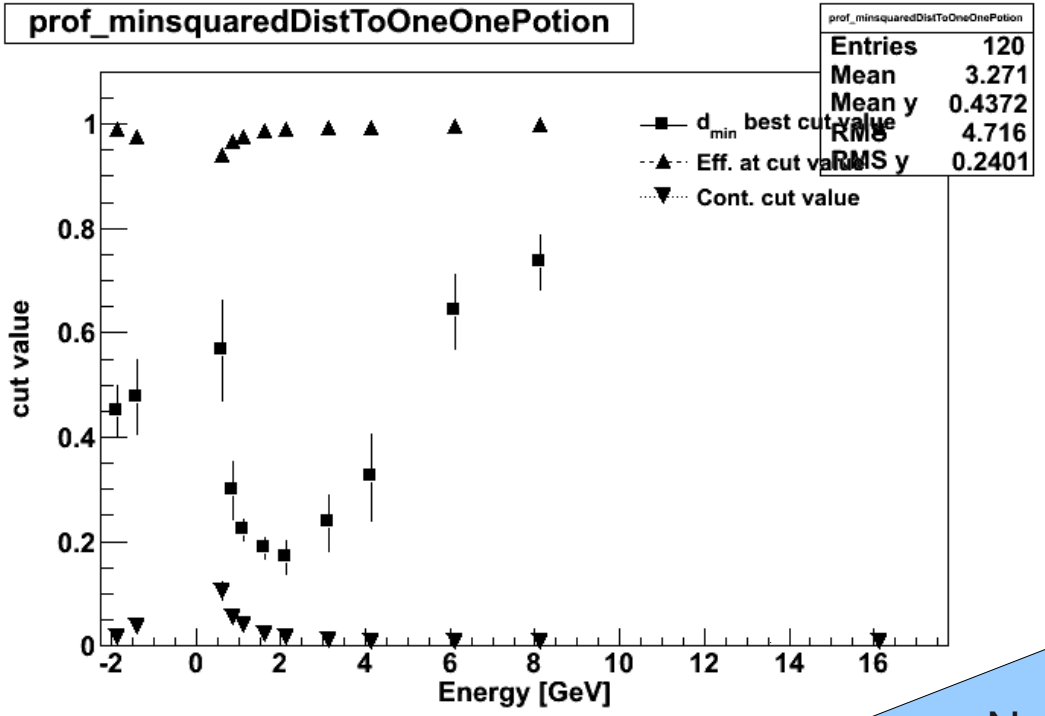


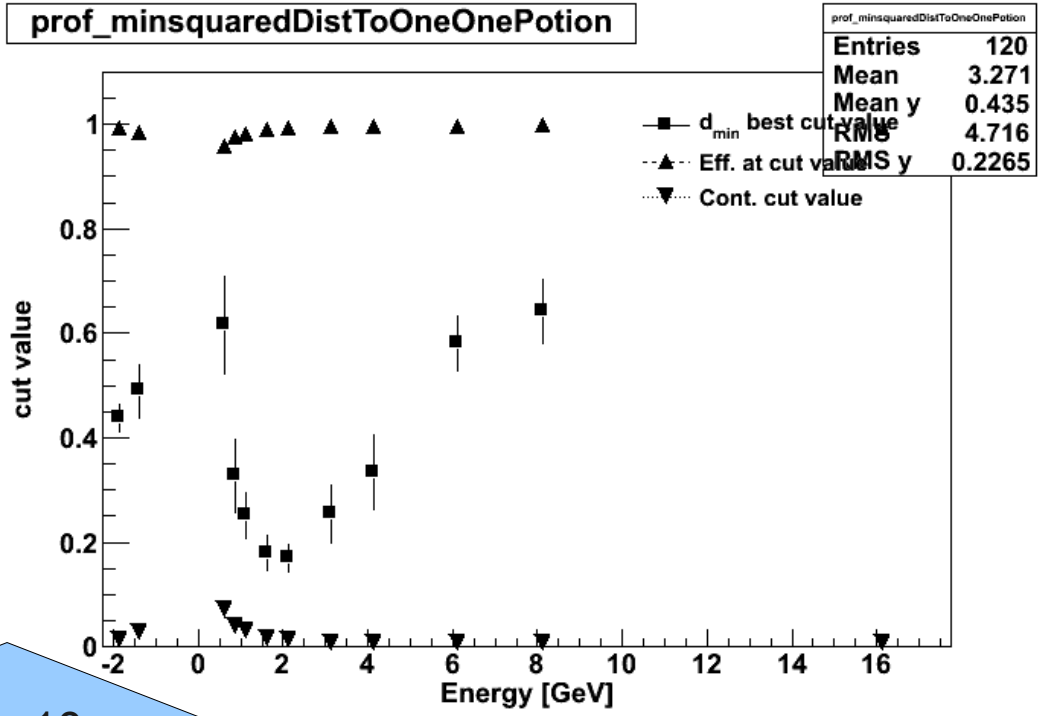
Npl=29
electron_vs_pion



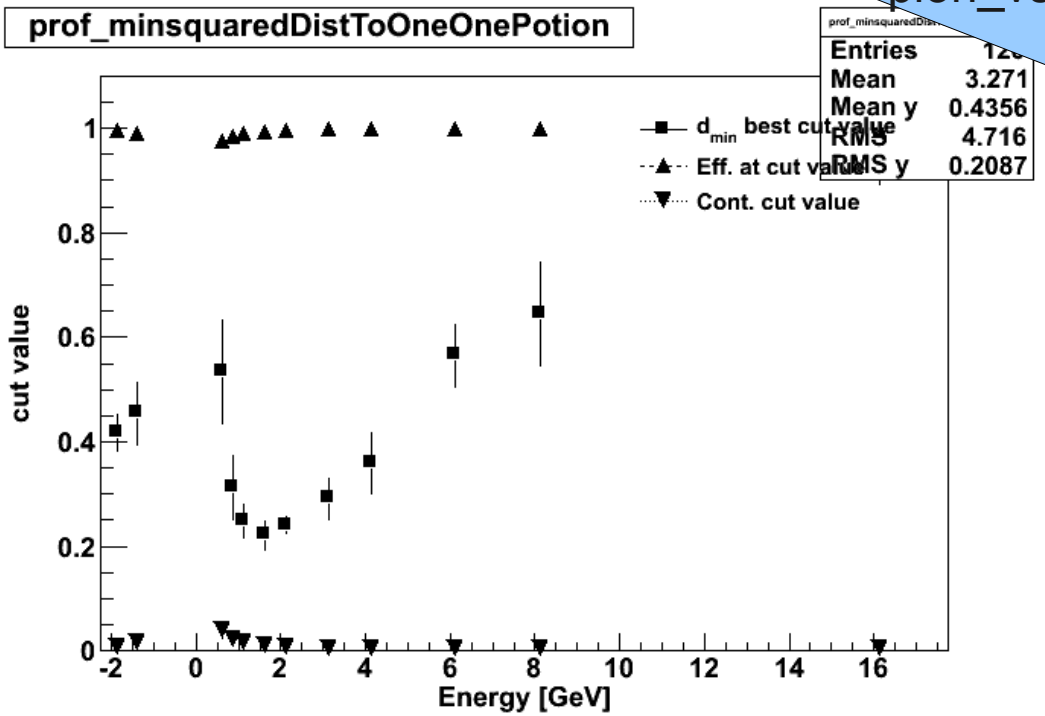


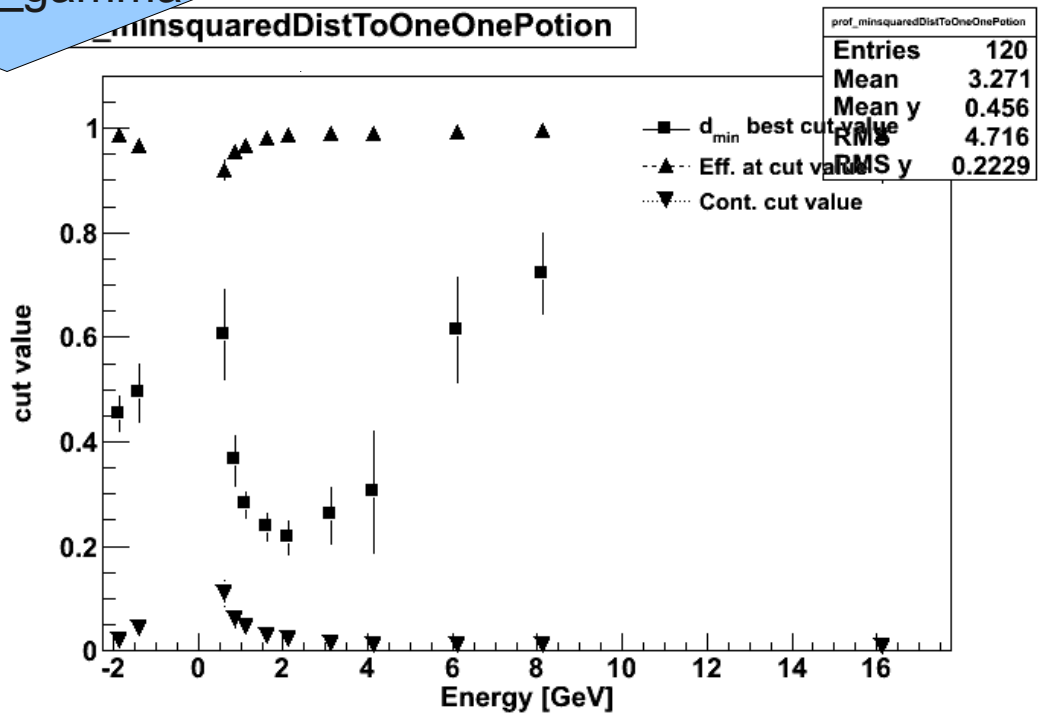
Now
pi_gamma

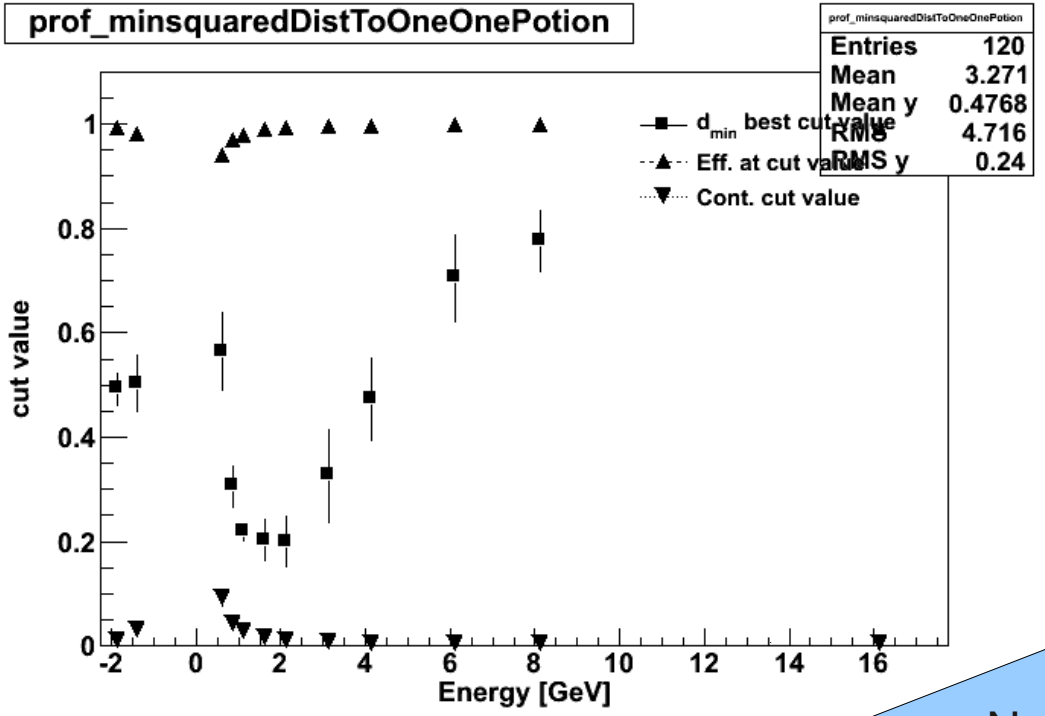


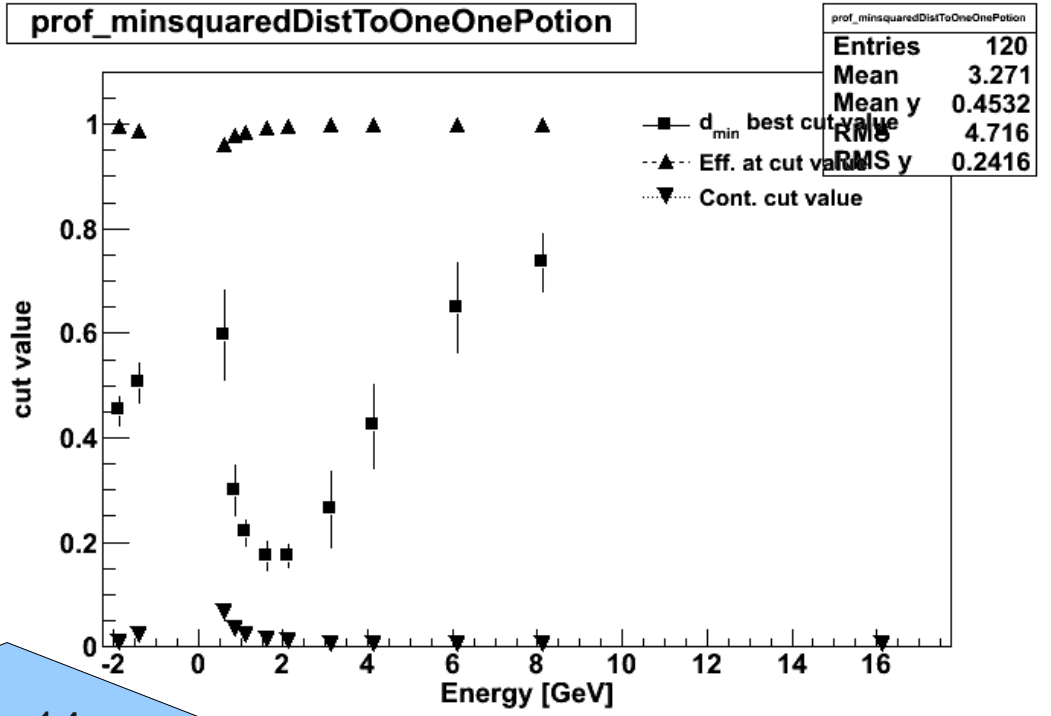


Npl=10
pion_vs_gamma









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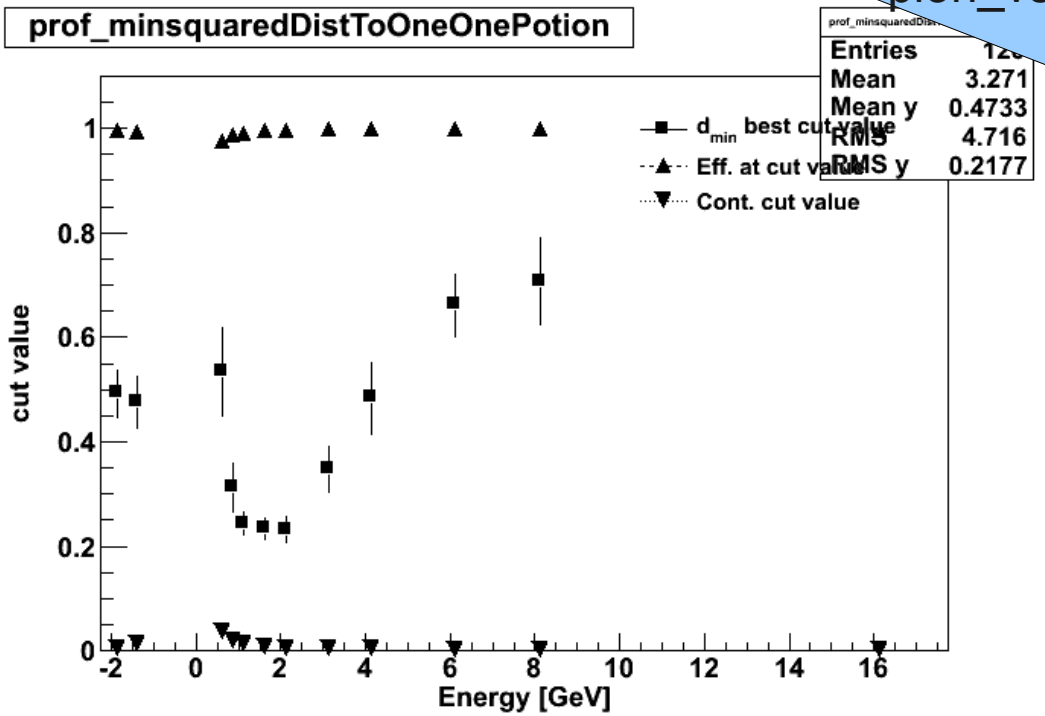
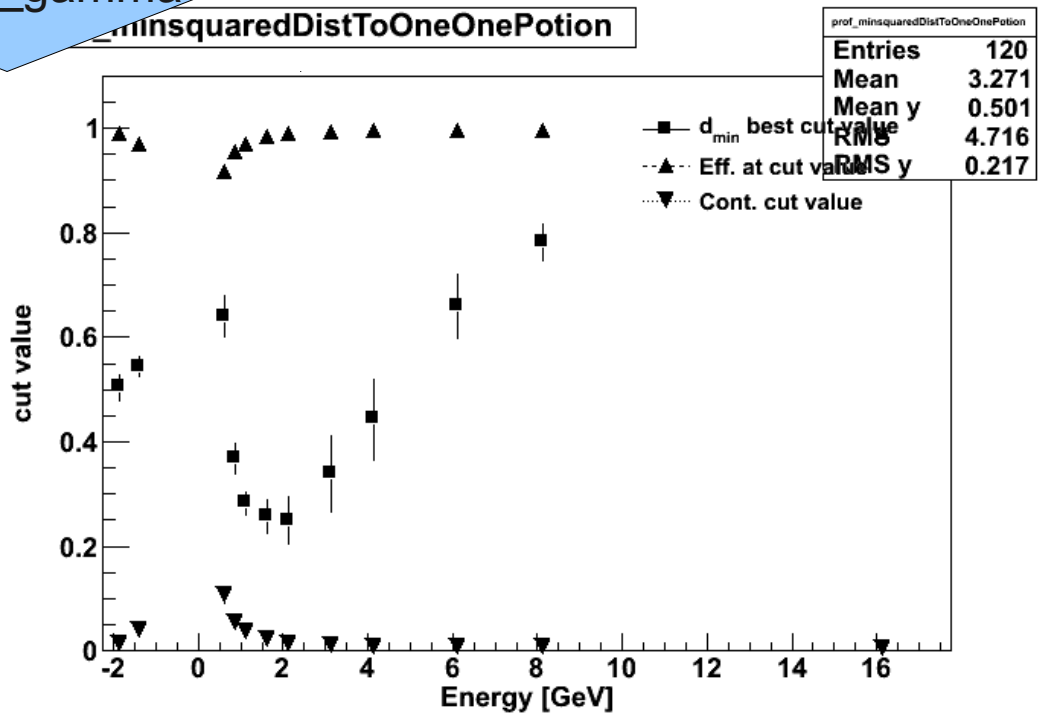
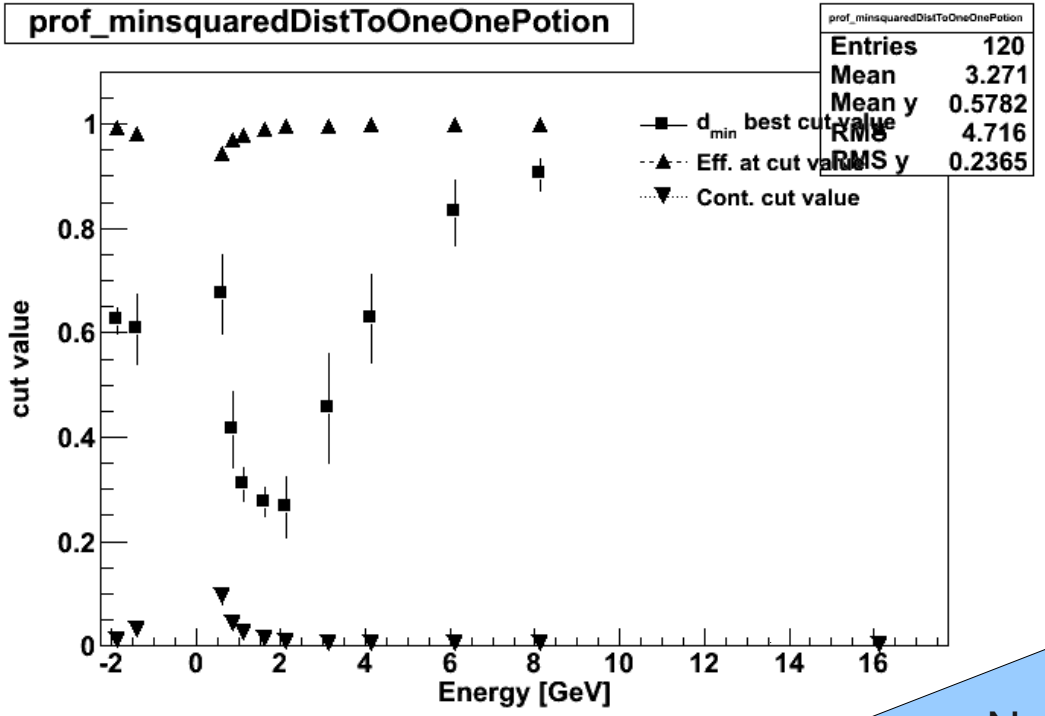
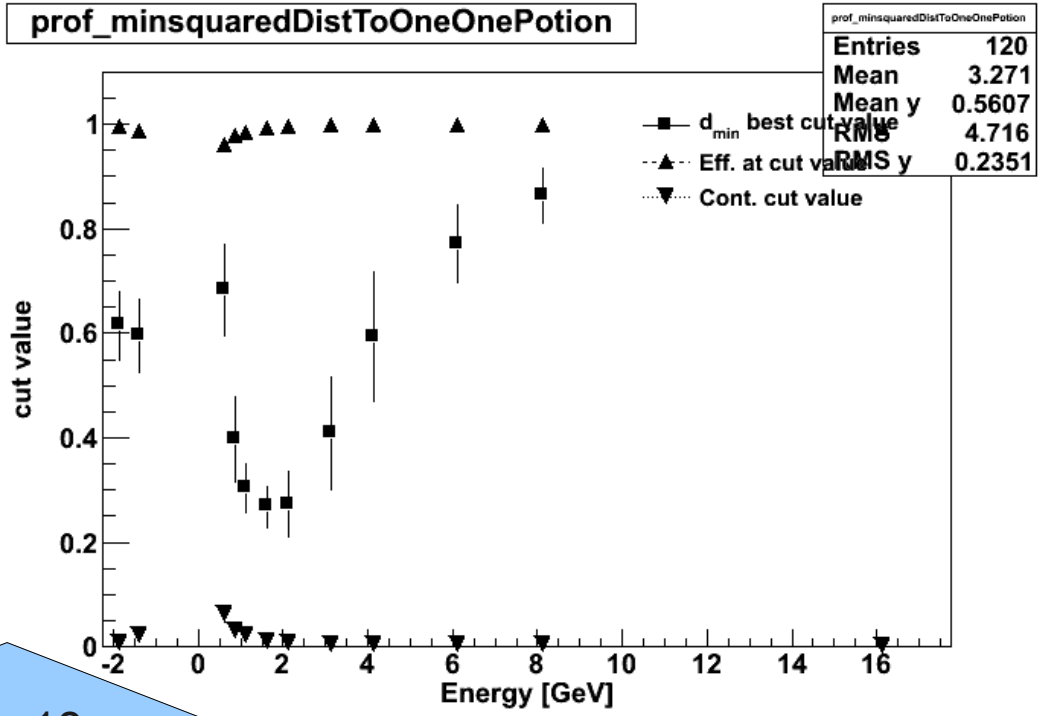
pion_vs_gamma









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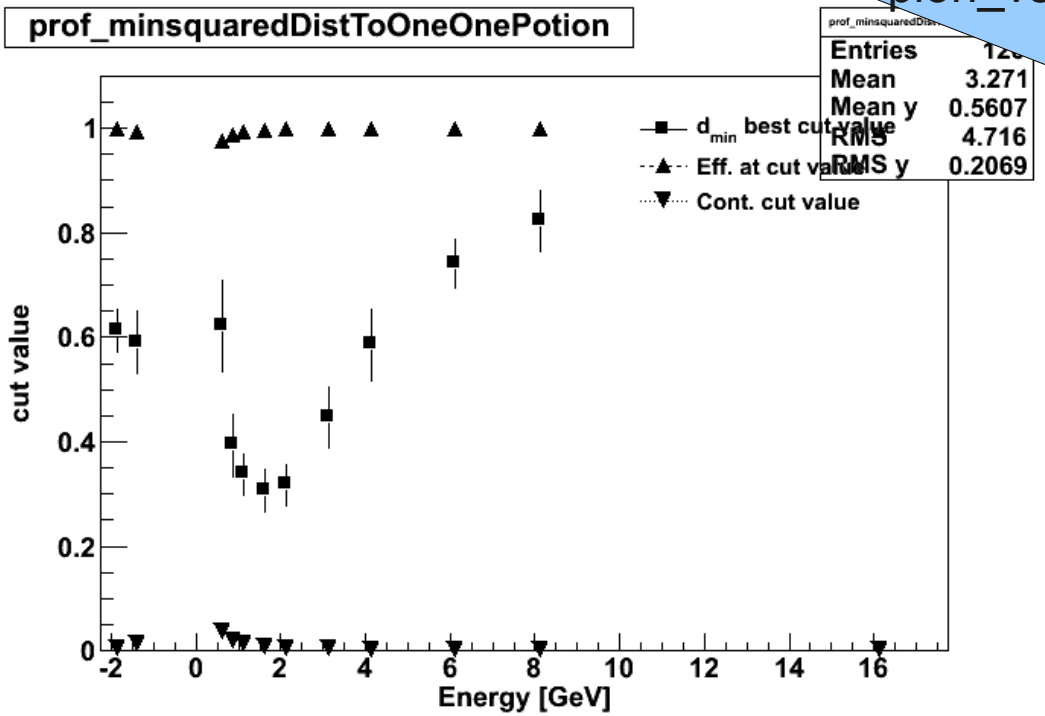
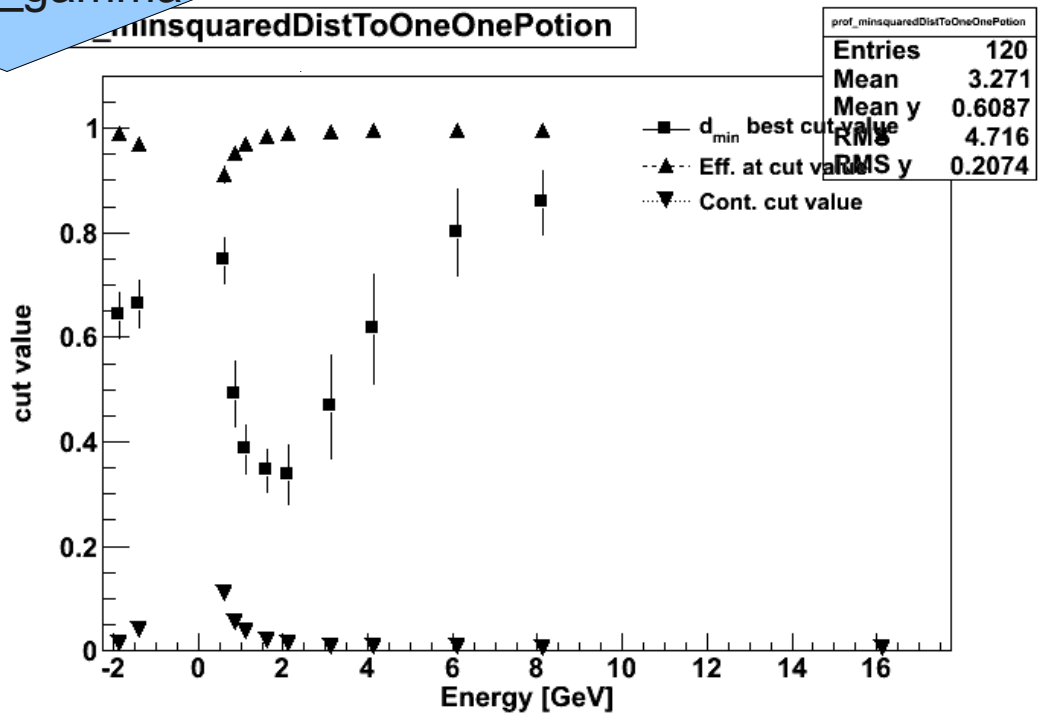
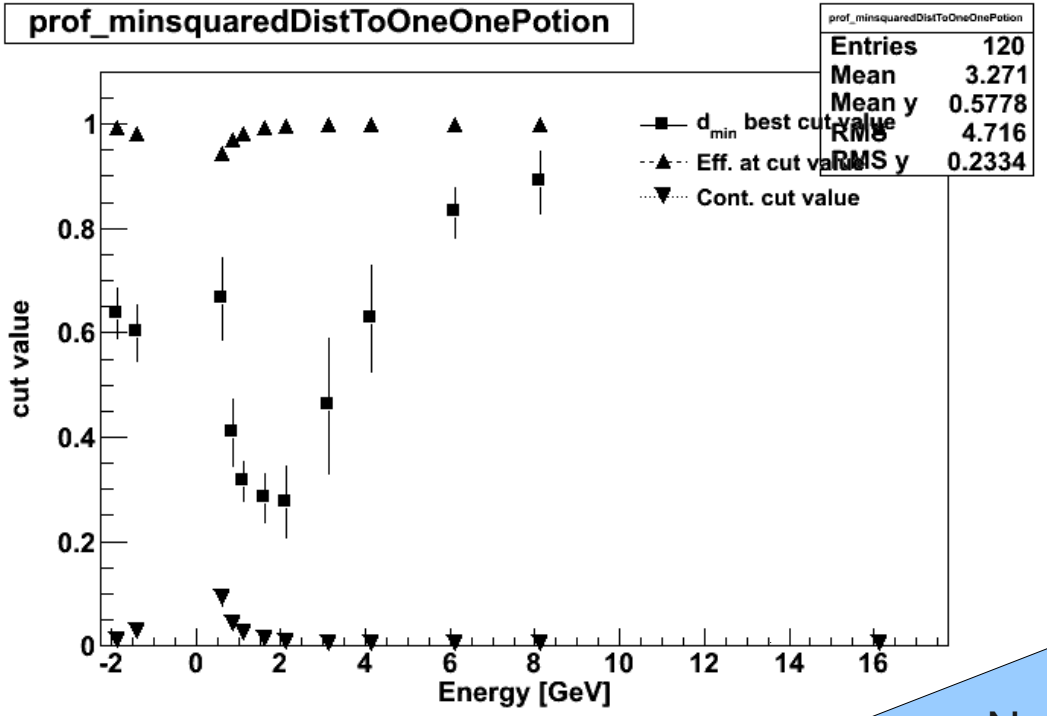
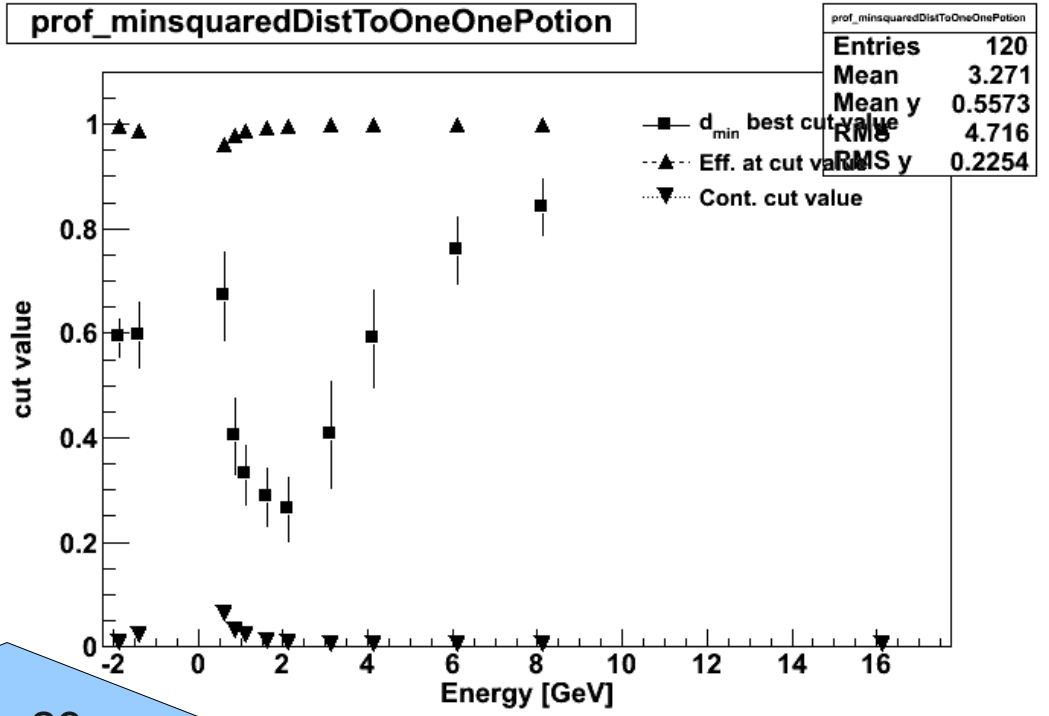
pion_vs_gamma

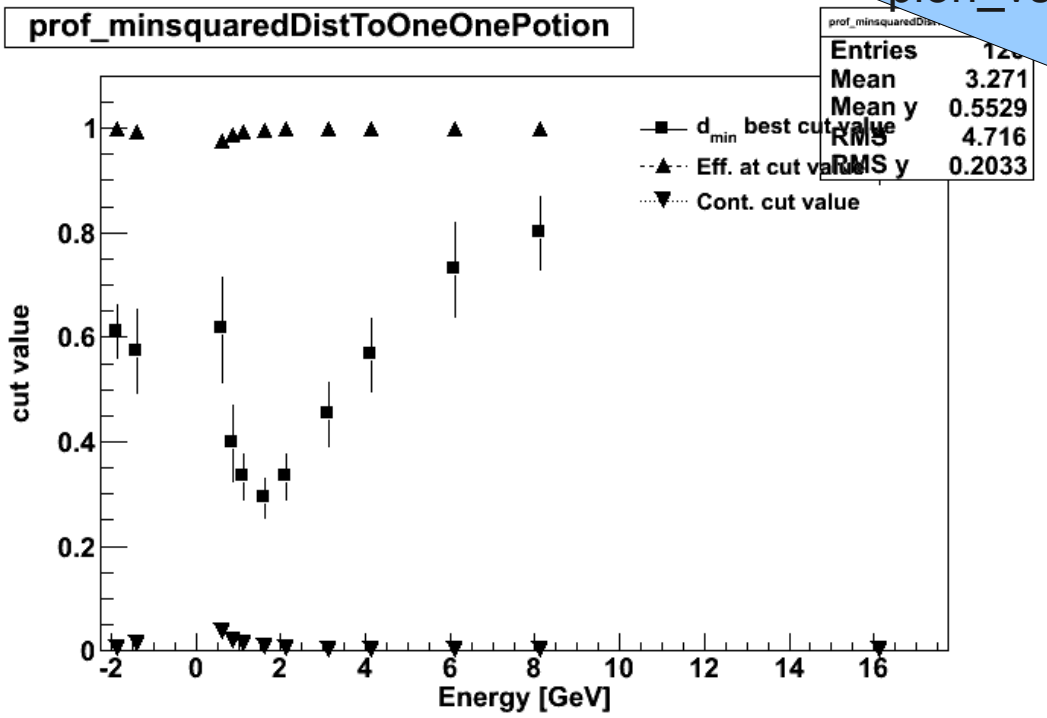


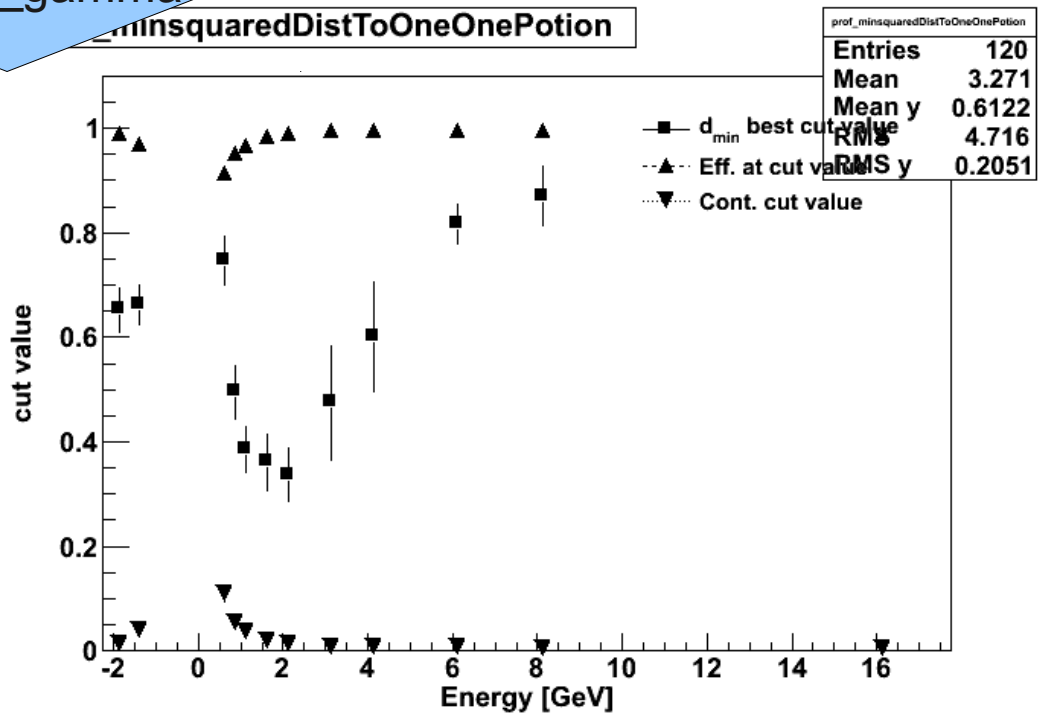


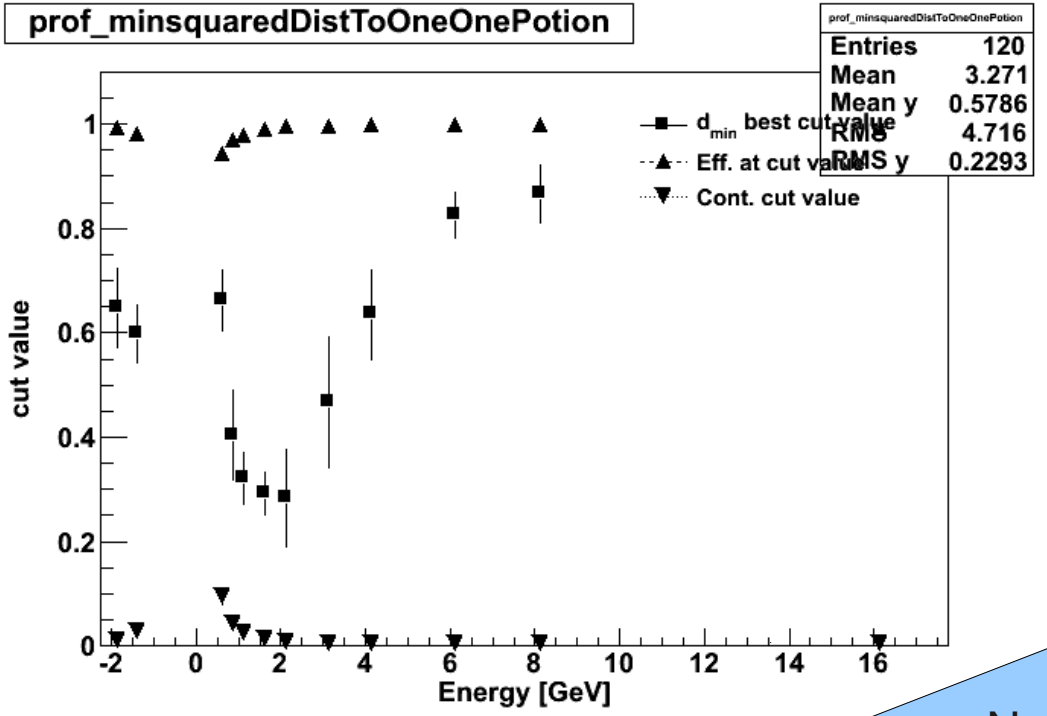


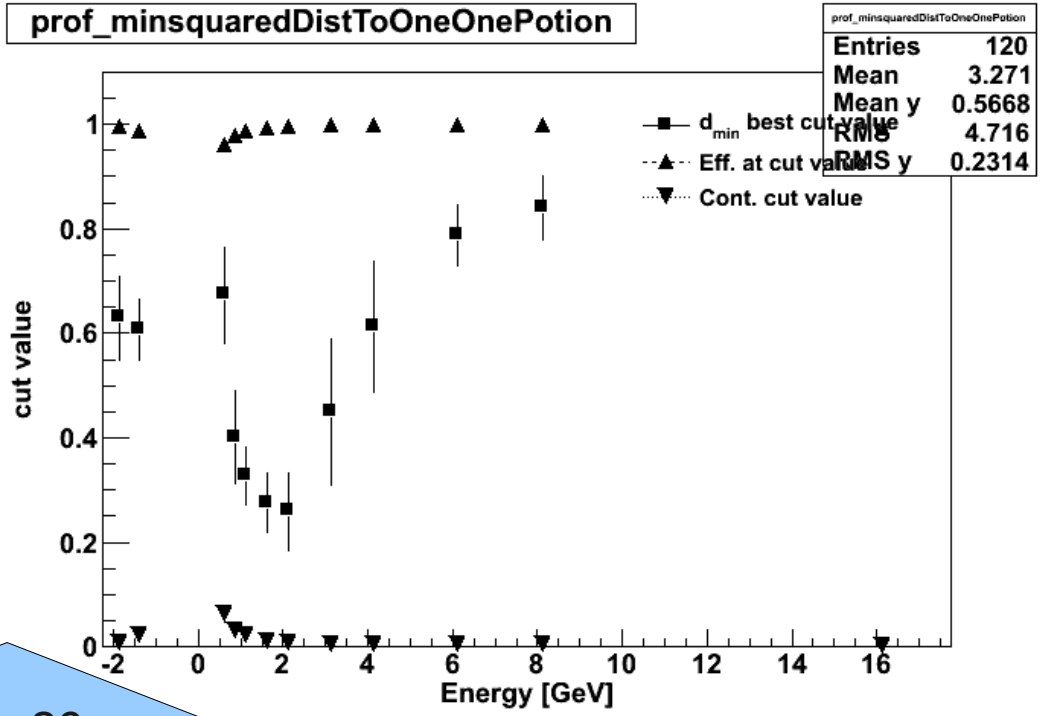


Npl=23
pion_vs_gamma

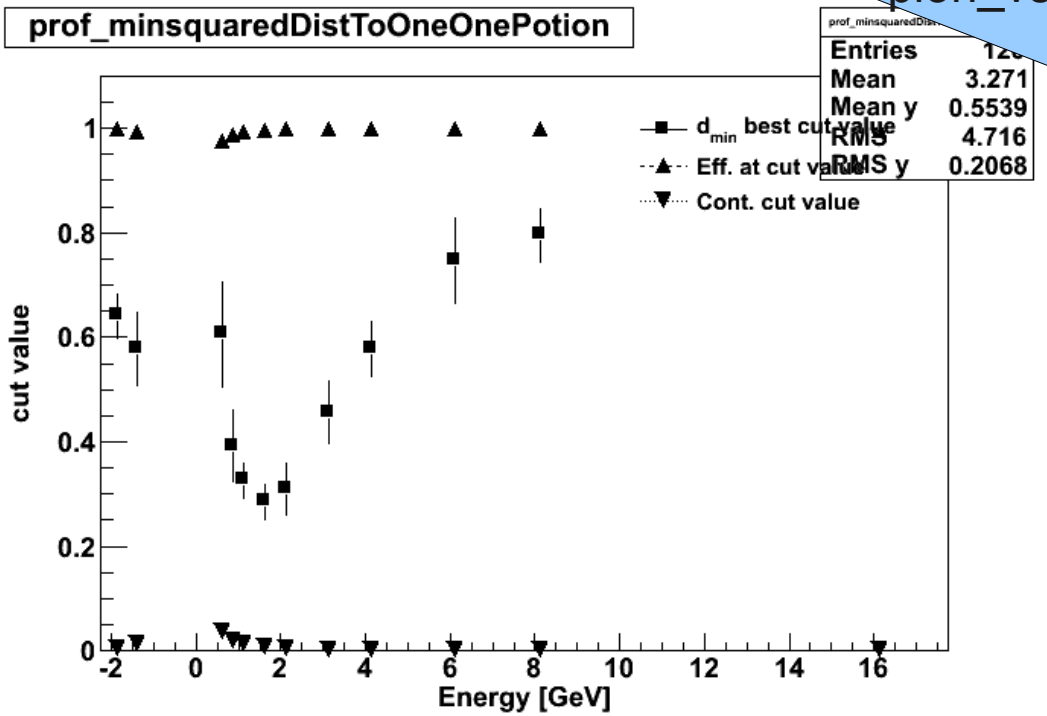


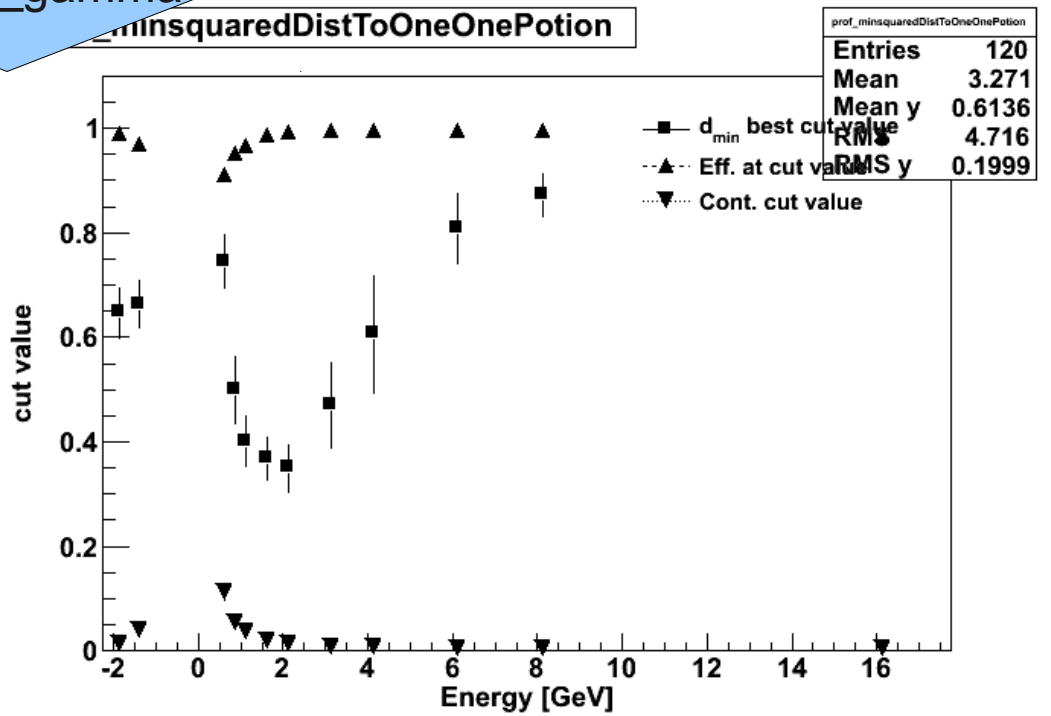


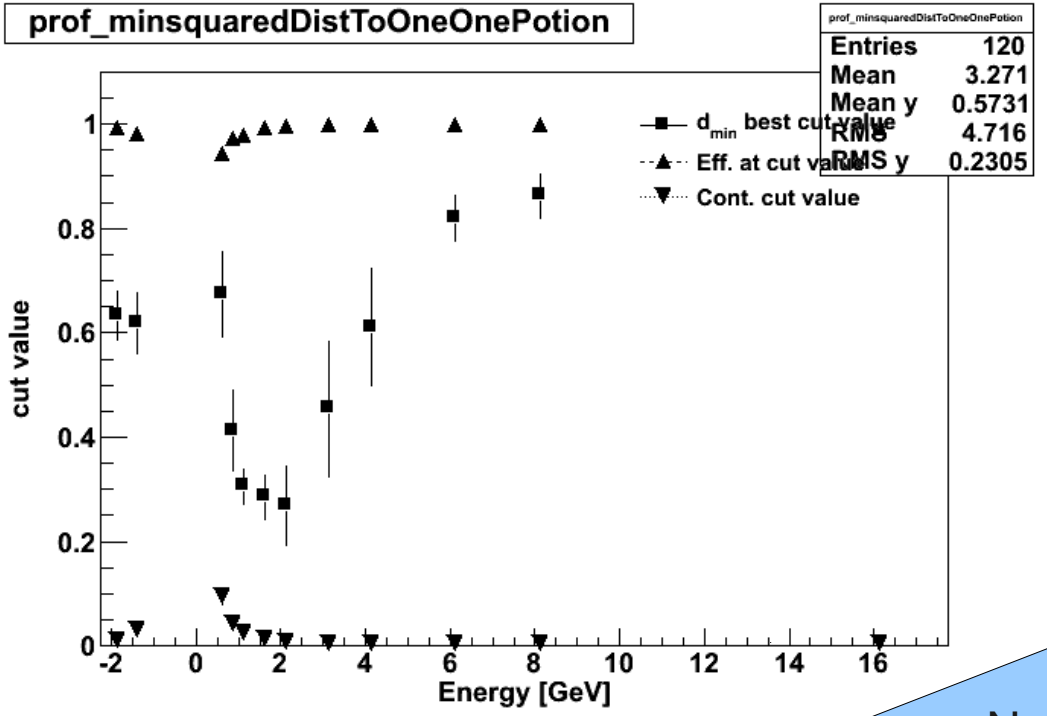


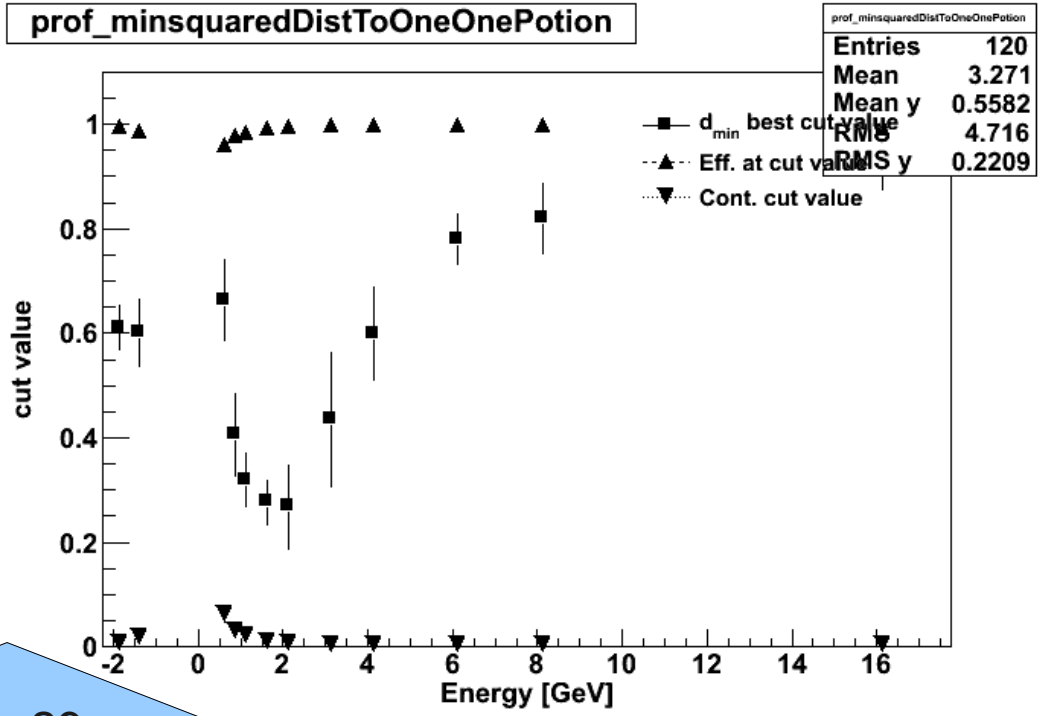


Npl=26
pion_vs_gamma

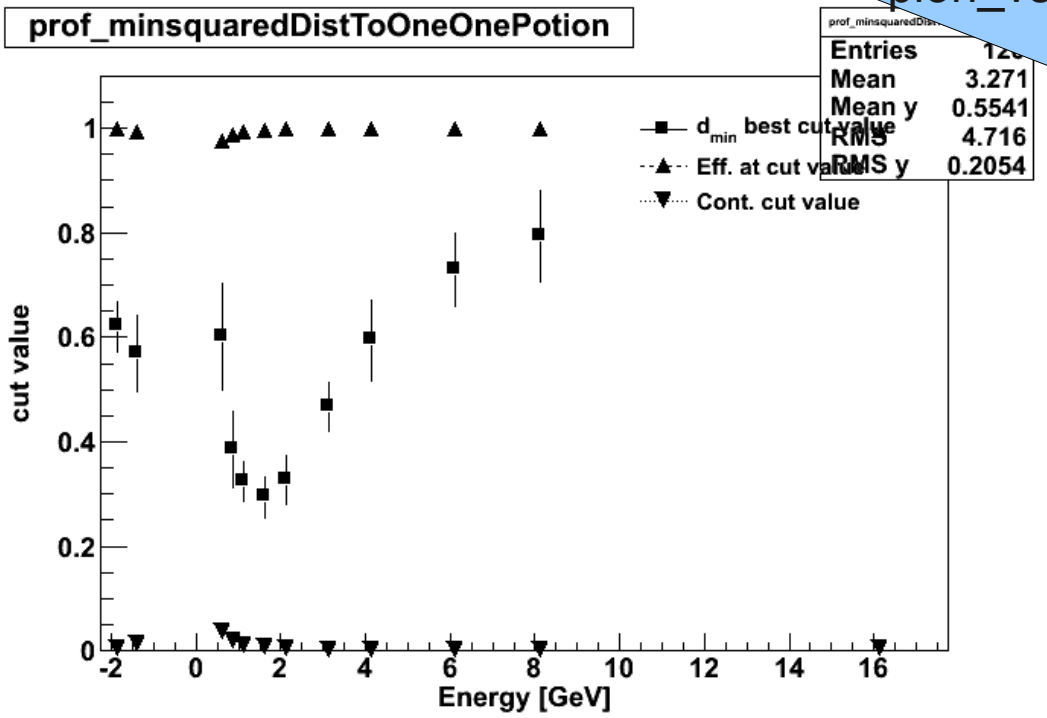


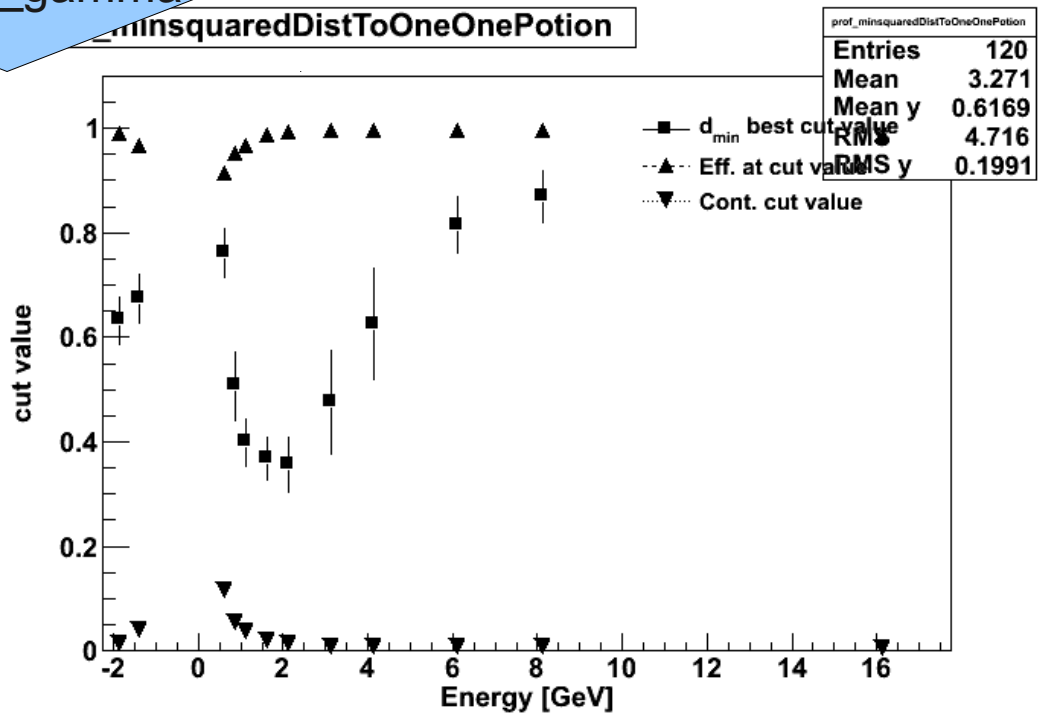






Npl=29
pion_vs_gamma





Now we run the ID estimations with these adapted cutvalues.
See if its better ….

- The d_min cut is almost independent on number of plates for e_gamma. But strongly dependendt for electron_pi and gamma_pion
- It changes for the type of separation one uses
- It changes for the energy
- Cut depending on separation method is easy to implement.
- An energy dependent cut is a priory not possible, just in a second run, after the energy estimation

Used cuts in the routines:

Npl	Separation	ShapeOnly	AndVTXIP	AndVTXDeltaZ	ShapeWOPL12
all	gamma_electron	0.58	0.55	0.50	0.50
<=10	electron_pion	0.58	0.55	0.50	0.50
<=14	electron_pion	0.45	0.45	0.45	0.45
<=18	electron_pion	0.35	0.35	0.35	0.35
>18	electron_pion	0.35	0.35	0.35	0.35
<=10	pion_gamma	0.45	0.45	0.45	0.45
<=14	pion_gamma	0.58	0.58	0.58	0.58
<=18	pion_gamma	0.6	0.6	0.6	0.6
>18	pion_gamma	0.6	0.6	0.6	0.6

Now we run the ID estimations with these adapted cutvalues.
See if its better ….

Summary

- The best min_dist cut is very well suited for general purpose ID tagging. It delivers both high efficiency and low contamination.
- Nevertheless, it does not seem to be a constant fixed value, especially around 2-4GeV, so it cannot be hardcoded in.
- But one could implement a double routing of
  - ID-Energy-ID-Energy estimations.
- In this case (not complicated to code into libShowRec) results can be improved.

Nota bene.

- These (MC)-results (with many plots and many seperate listings), will also be put into the Internal Note of the energy note.