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Status of the SiD-Iowa PFA: New developments and plans

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June 24th, 2011

Plan

1- Results from the last meeting

2- Neutral showers

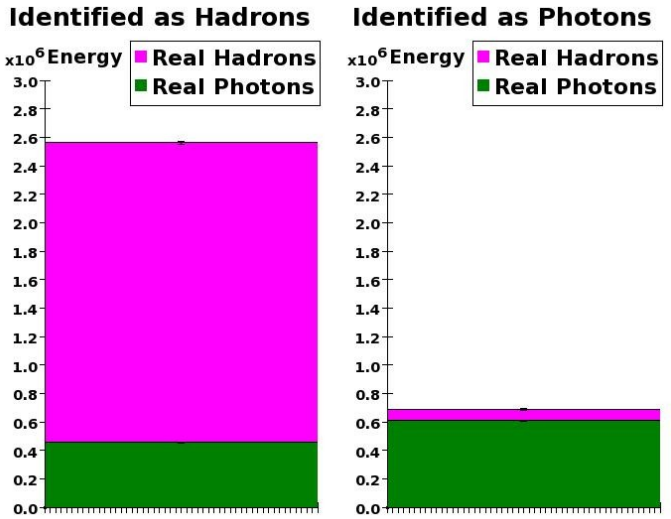
3- Increase the score cut

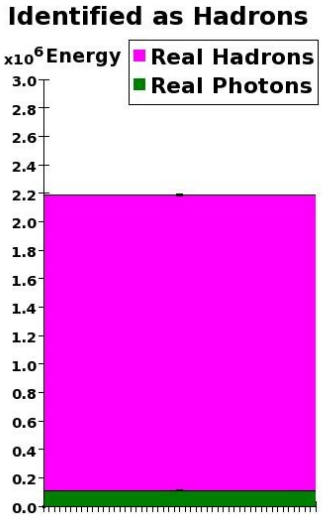
4- Search for cuts for the second iteration

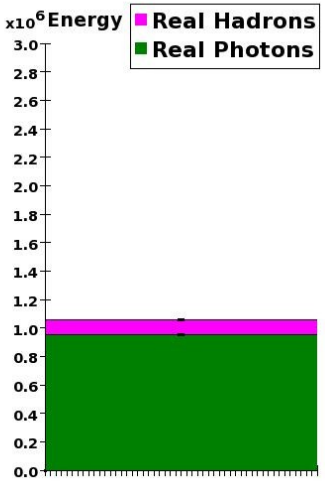
5- Search for new likelihood variables

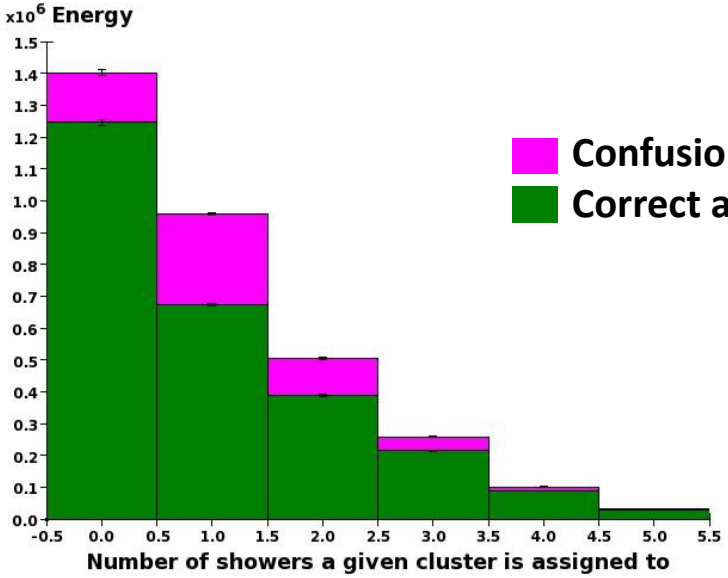
6- Estimation of the new likelihood performance

Results from the last meeting







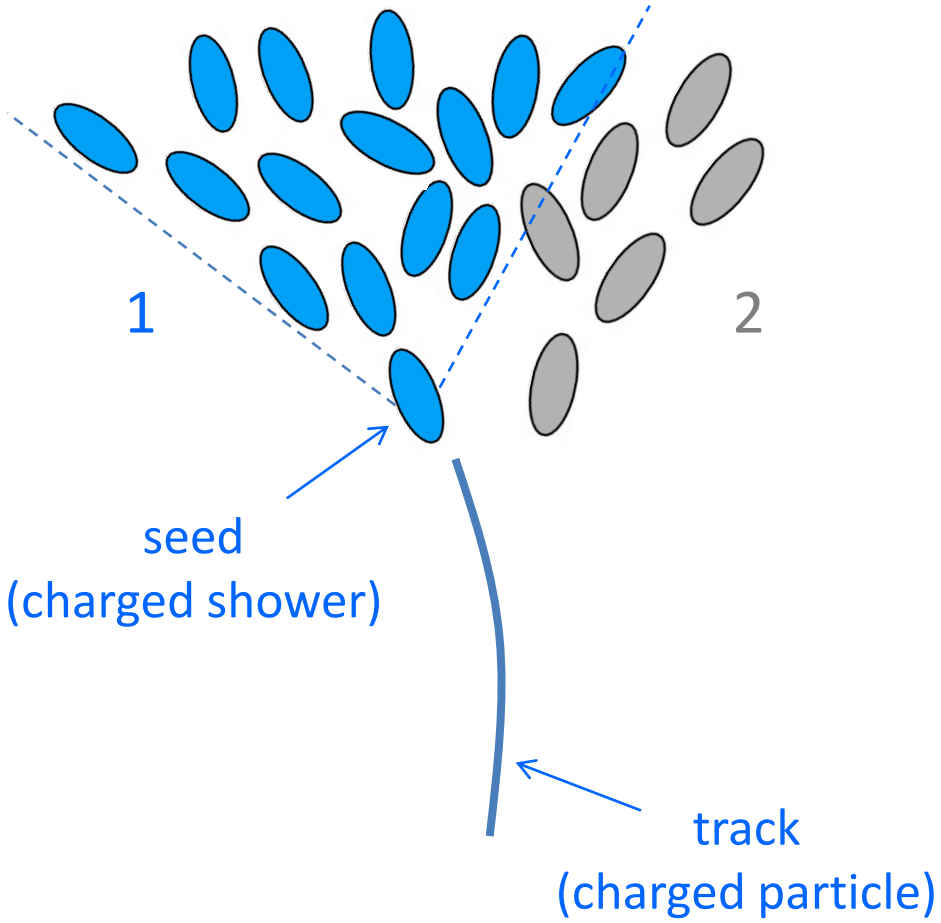


Confusion

Correct assignment

Results of the first iteration

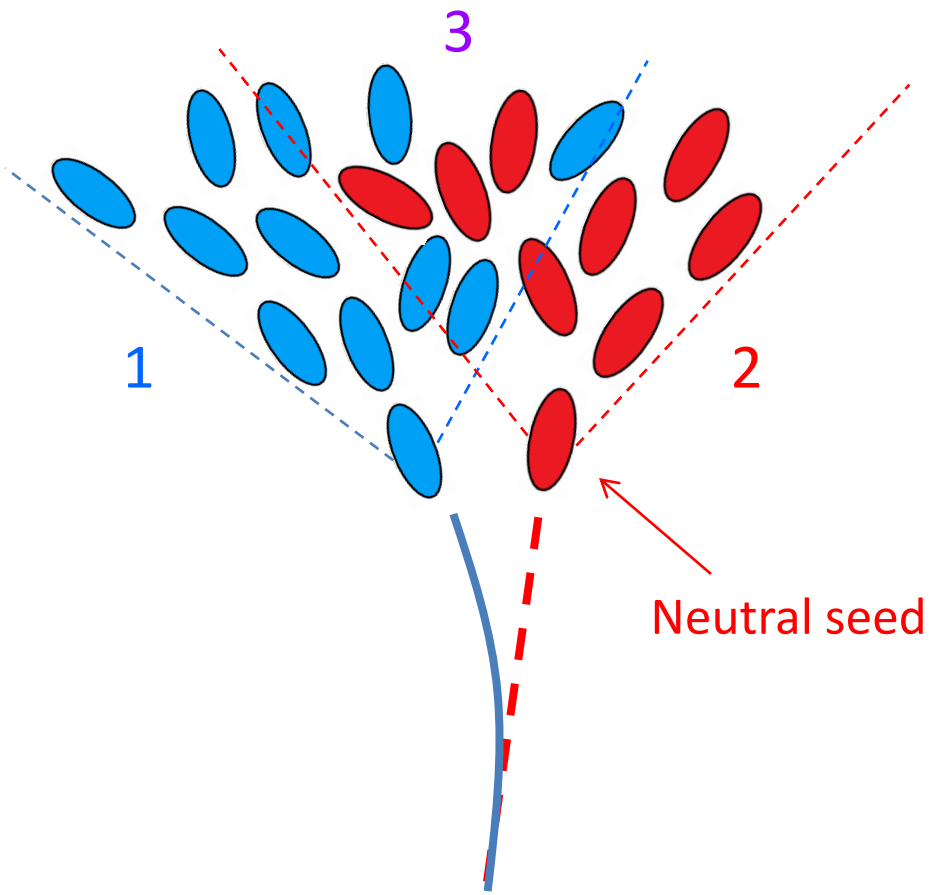
Charged sub-clusters



1- Charged sub-clusters

2- Not attached sub-clusters

Charged + Neutral sub-clusters



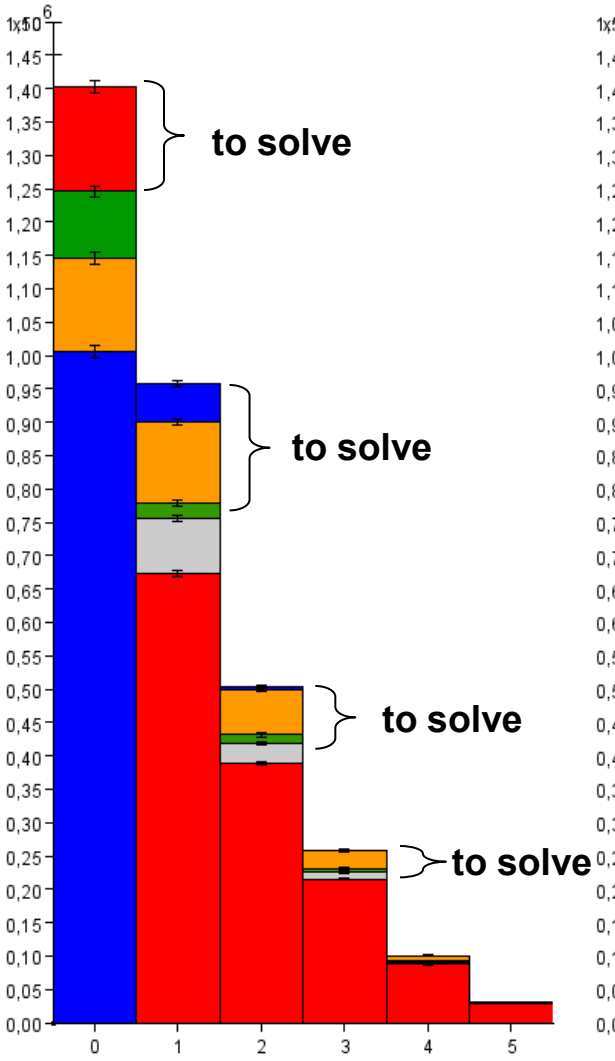
1- Charged sub-clusters

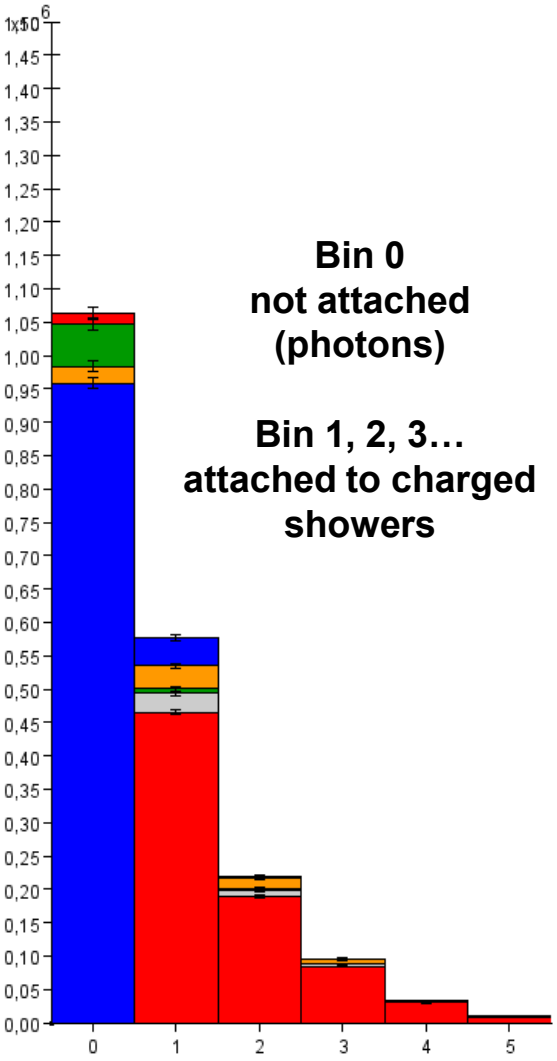
2- Neutral sub-clusters

3- Shared sub-clusters between charged and neutral showers

Results (with neutrals)

Before neutral shower reconstruction

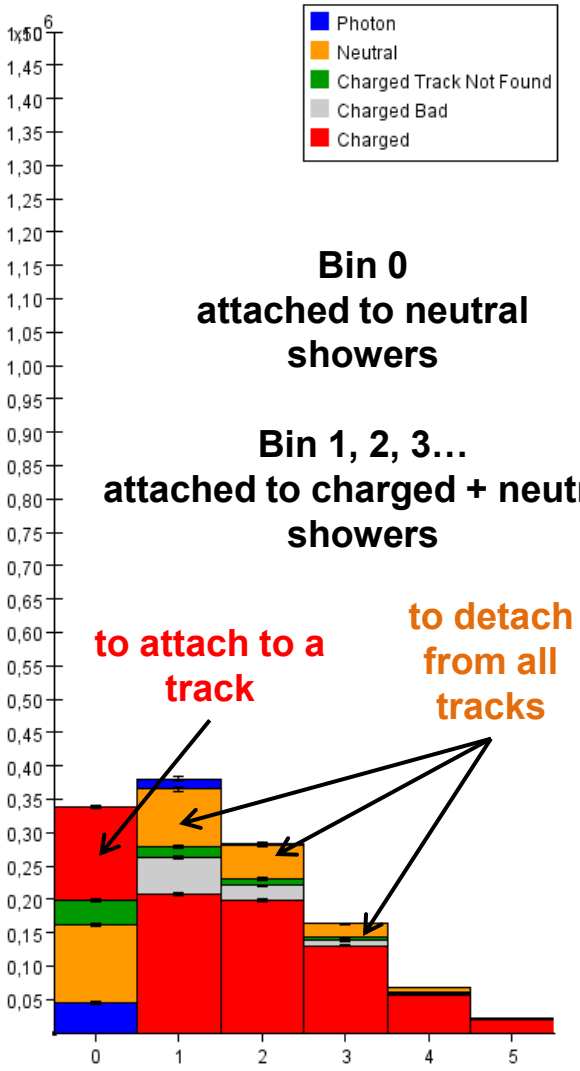




Bin 0
not attached
(photons)

Bin 1, 2, 3…
attached to charged
showers

After neutral shower reconstruction



Bin 0
attached to neutral
showers

Bin 1, 2, 3…
attached to charged + neutral
showers

Likelihood cut

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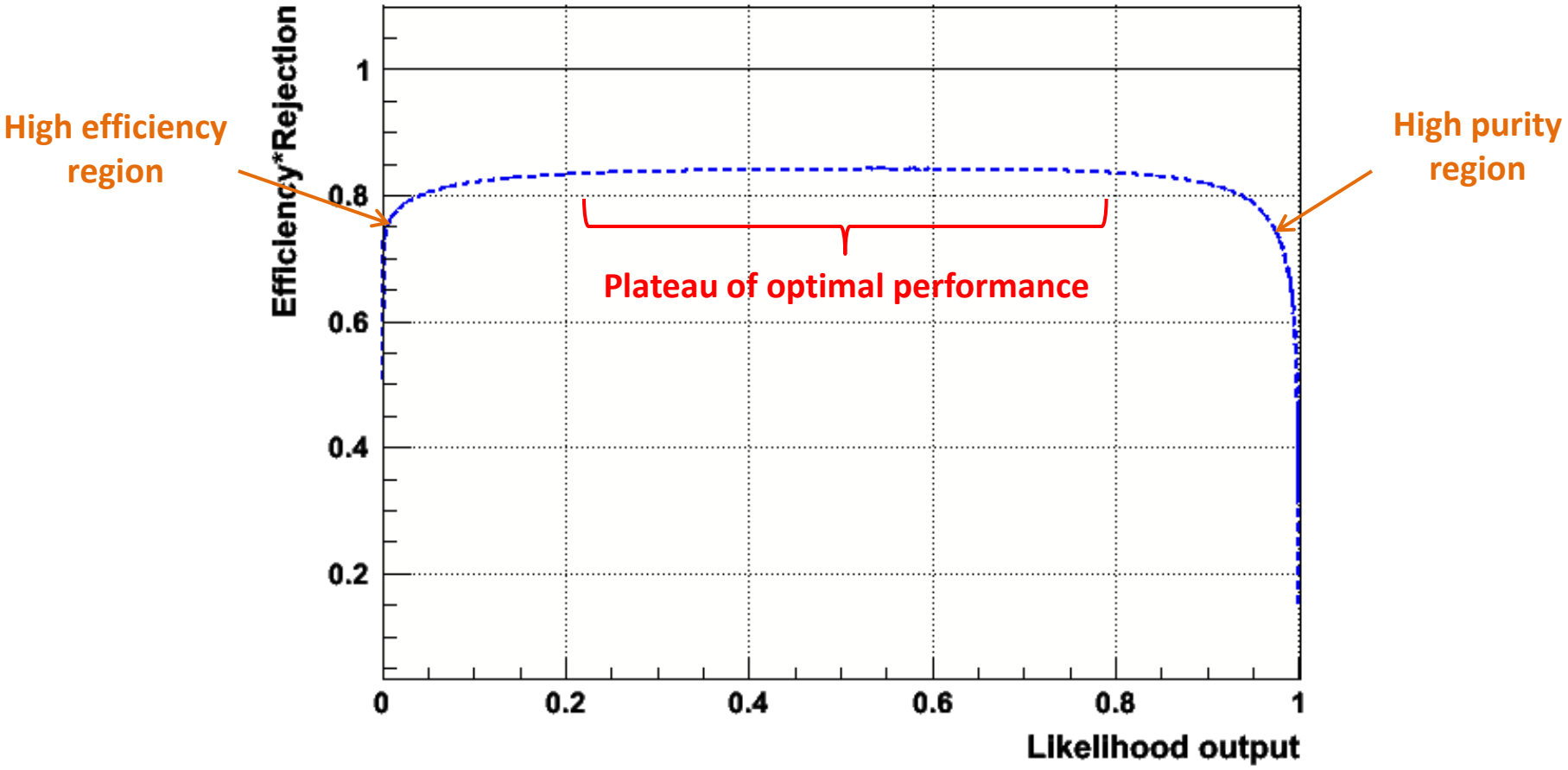
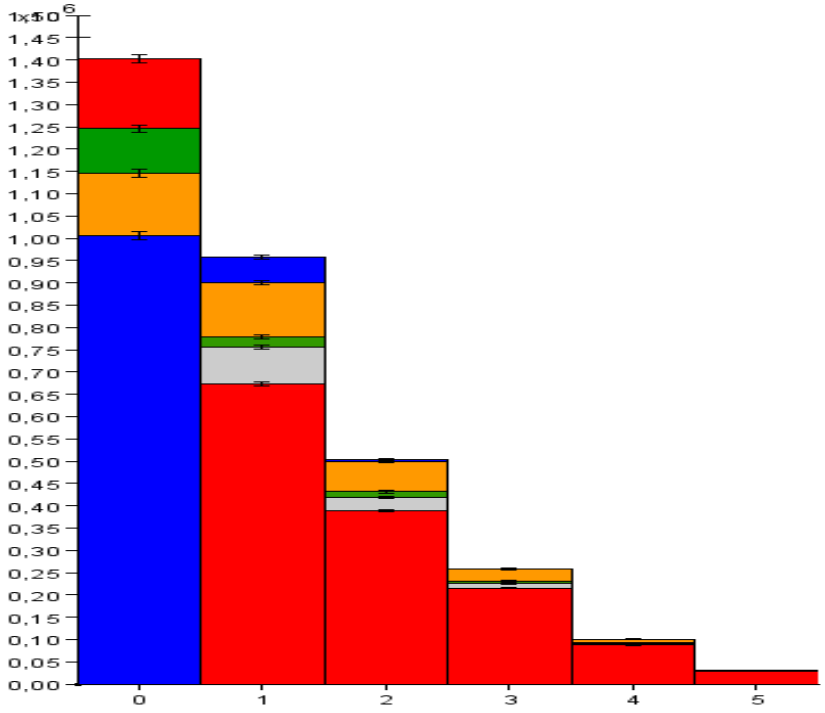
Increasing the likelihood cut to achieve high shower purity



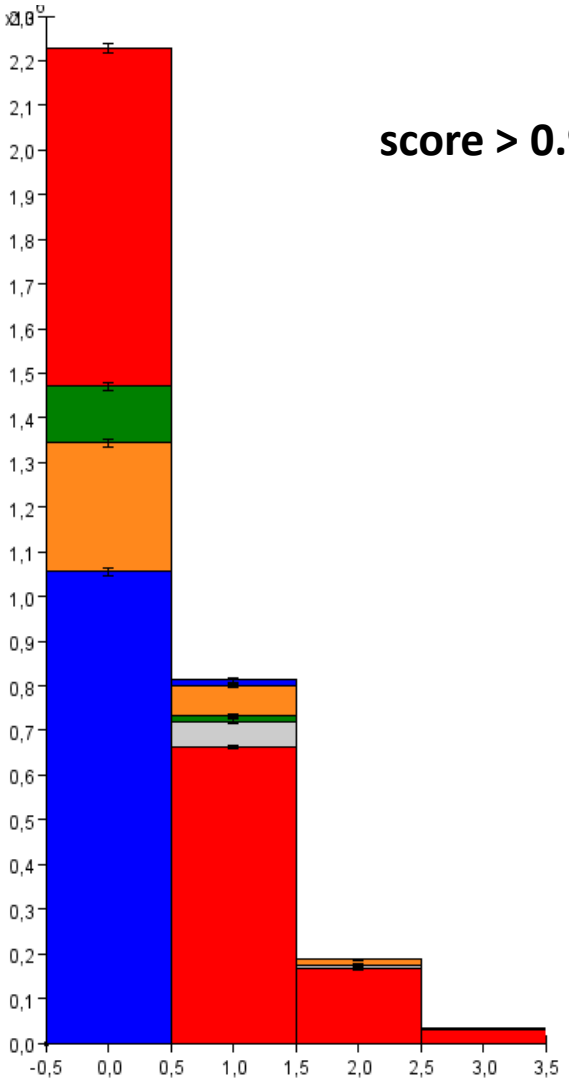
Results with different score

Before neutral shower reconstruction

score > 0.7

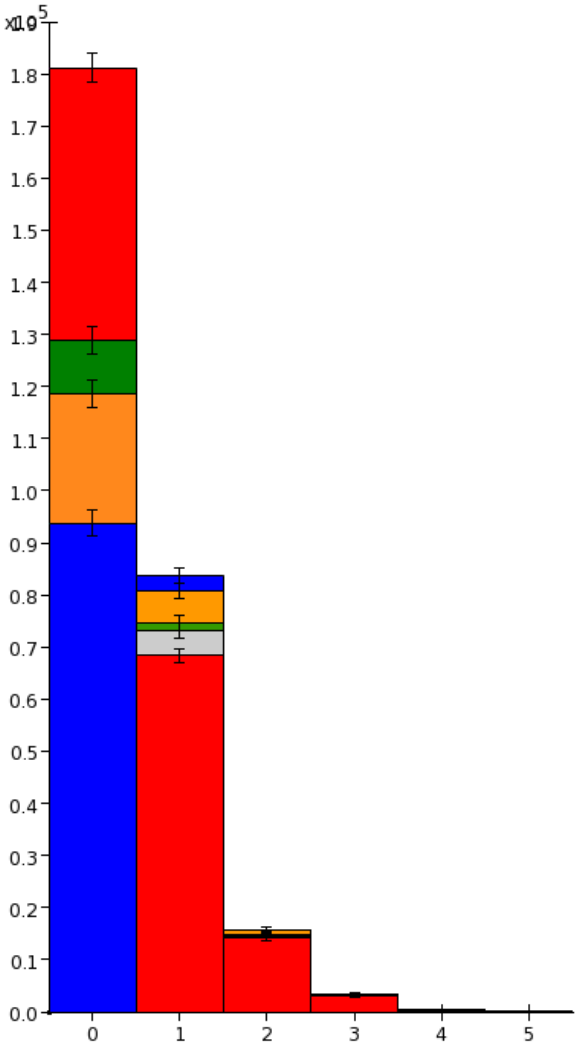


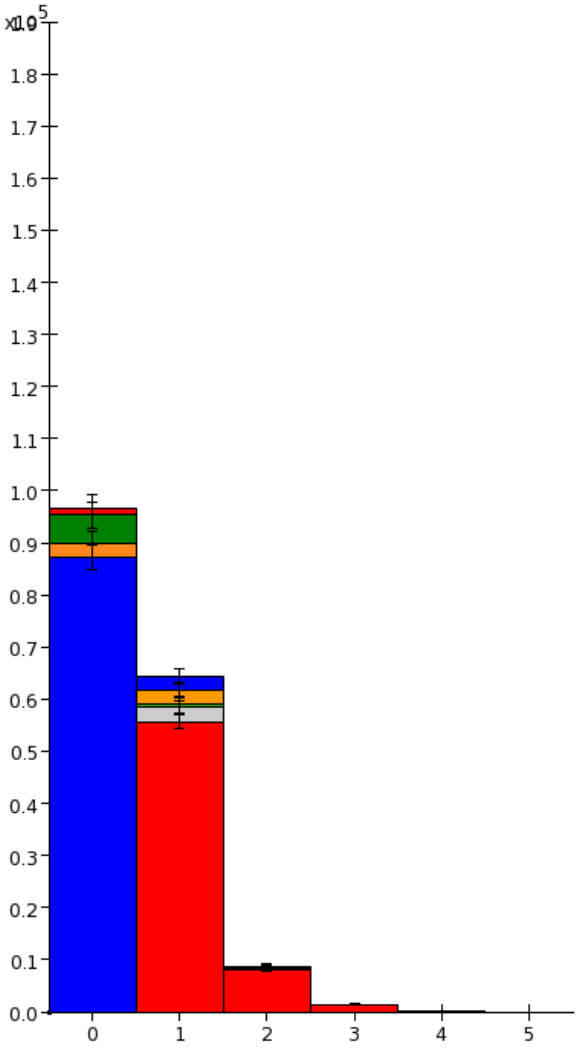
score > 0.99



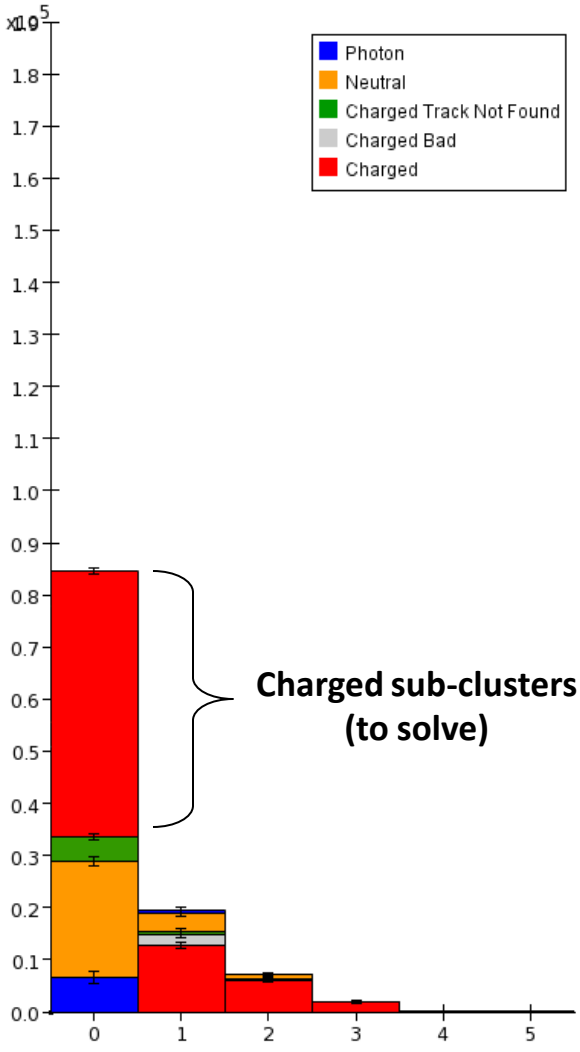
Results with the tight score cut

Before neutral shower reconstruction

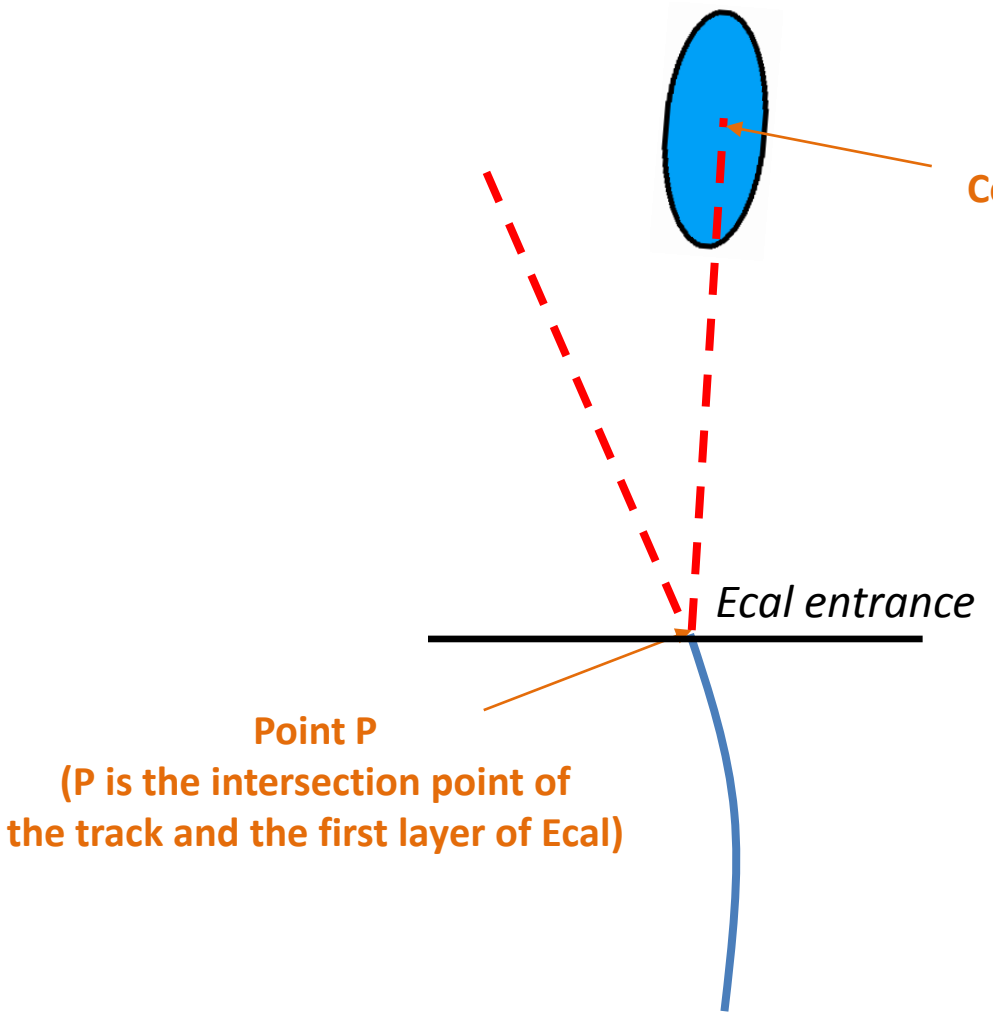




After neutral shower reconstruction



Variable 1



Distance from the center of the sub-cluster

Cut in Ecal

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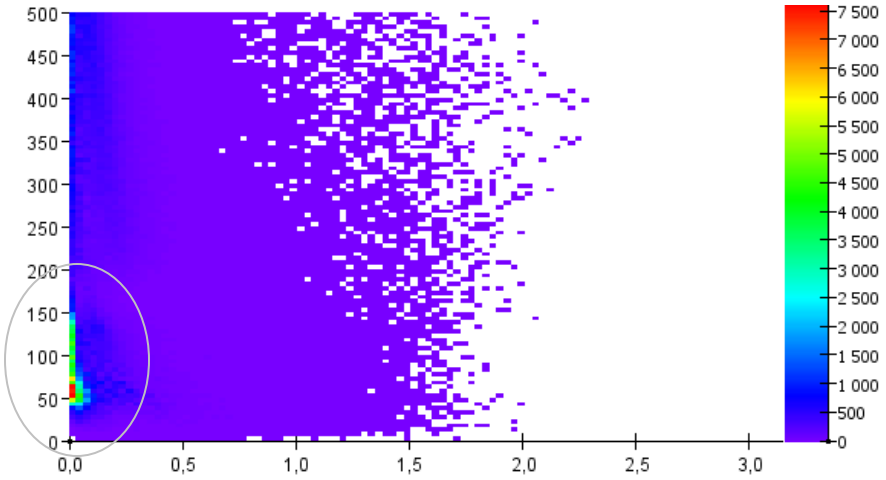
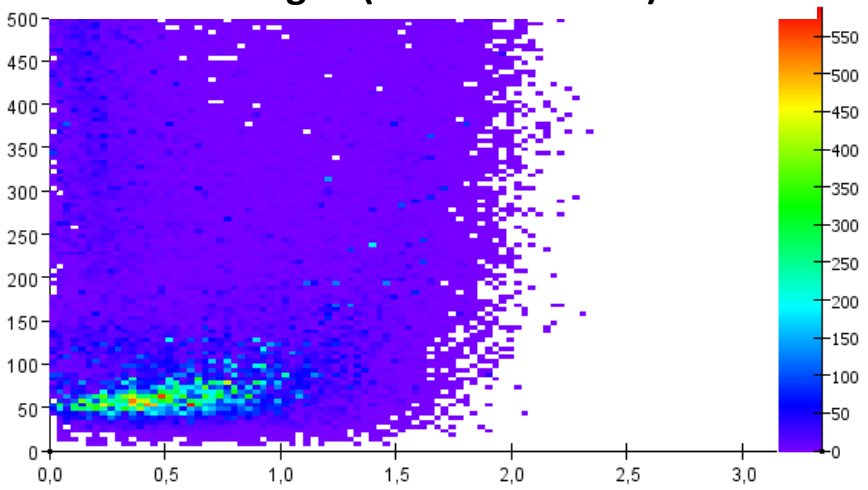
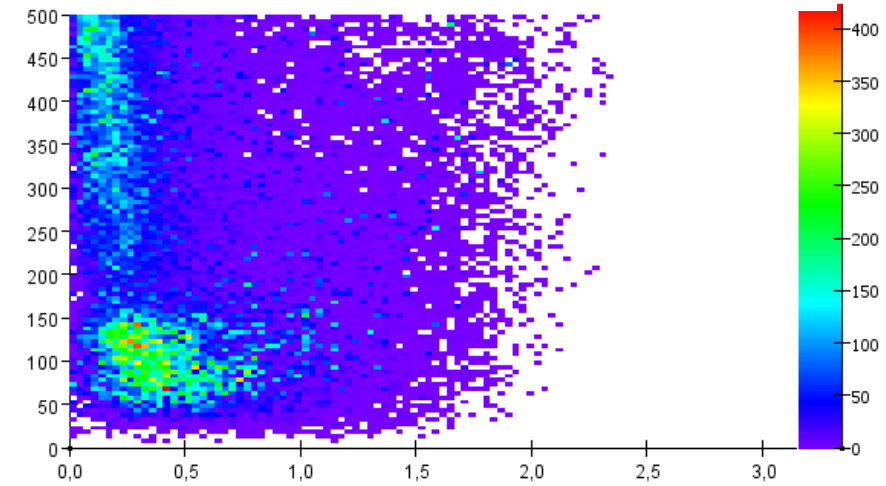
Charged



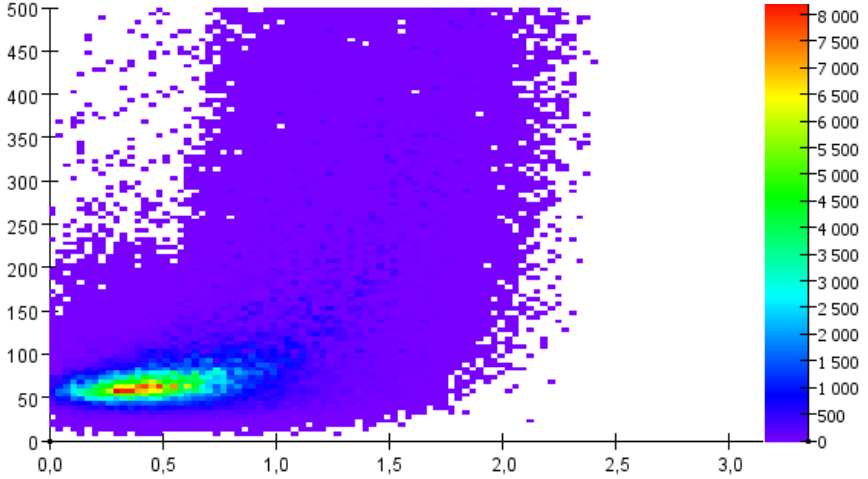
Charged (track not found)



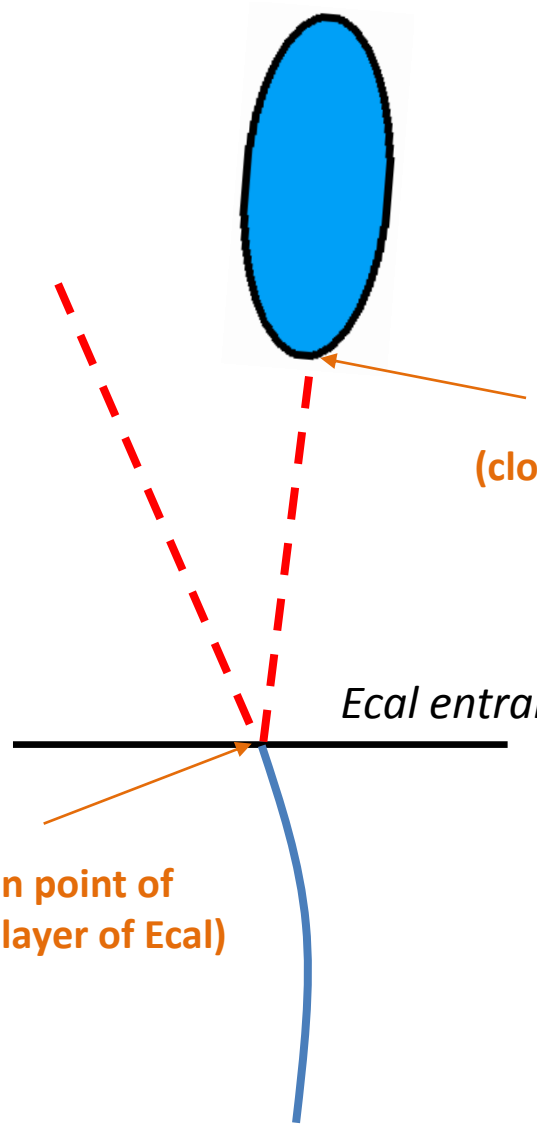
Neutral



Photon



Variable 2



Negative pole of the sub-cluster
(closest sub-cluster point to the center of the detector)

Distance from the negative pole of the sub-cluster

Point P
(P is the intersection point of the track and the first layer of Ecal)

Cut in Hcal

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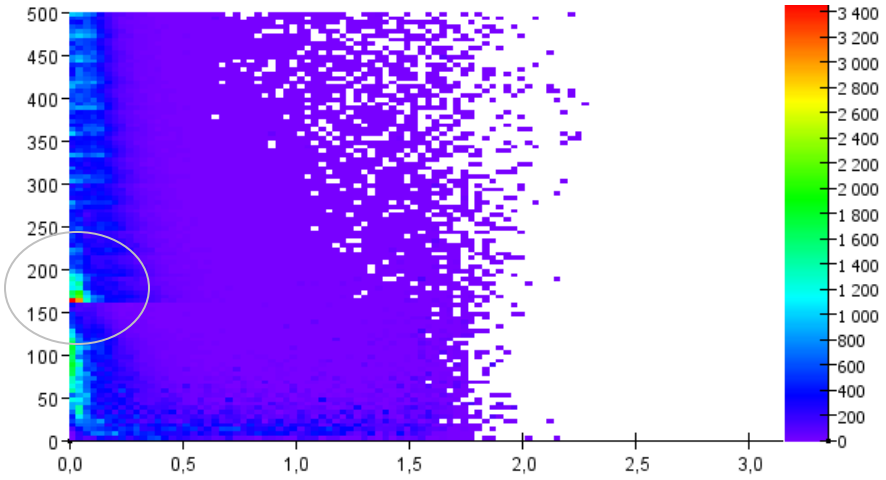
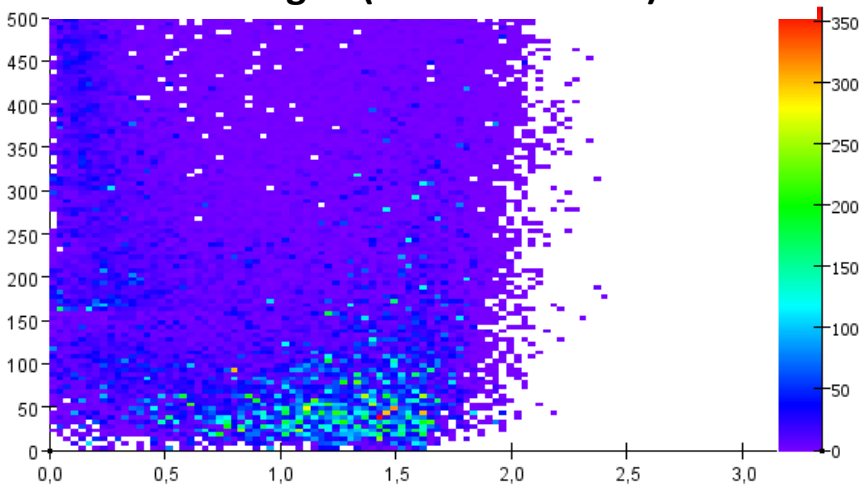
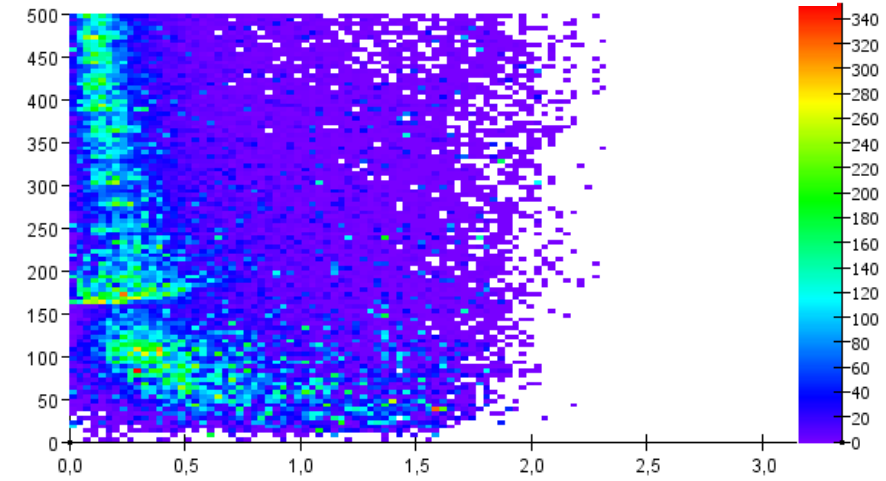
Charged



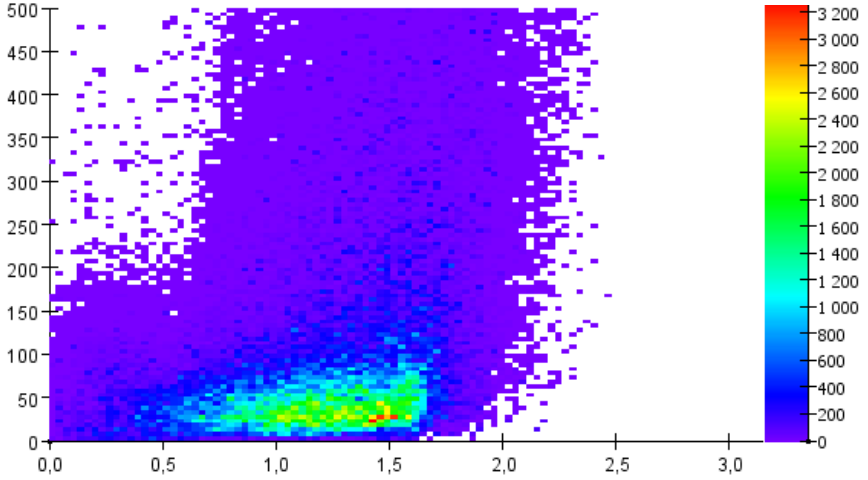
Charged (track not found)



Neutral



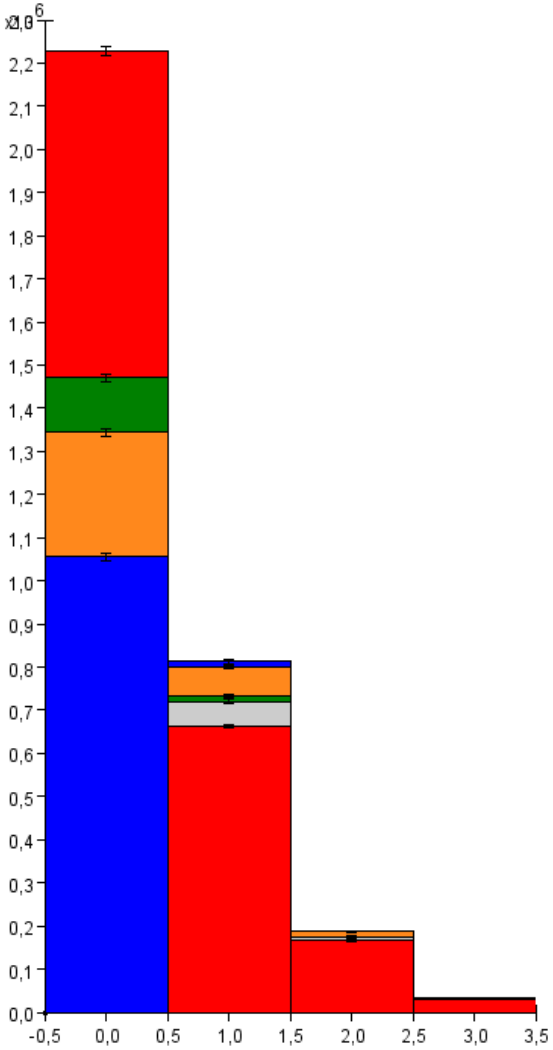
Photon



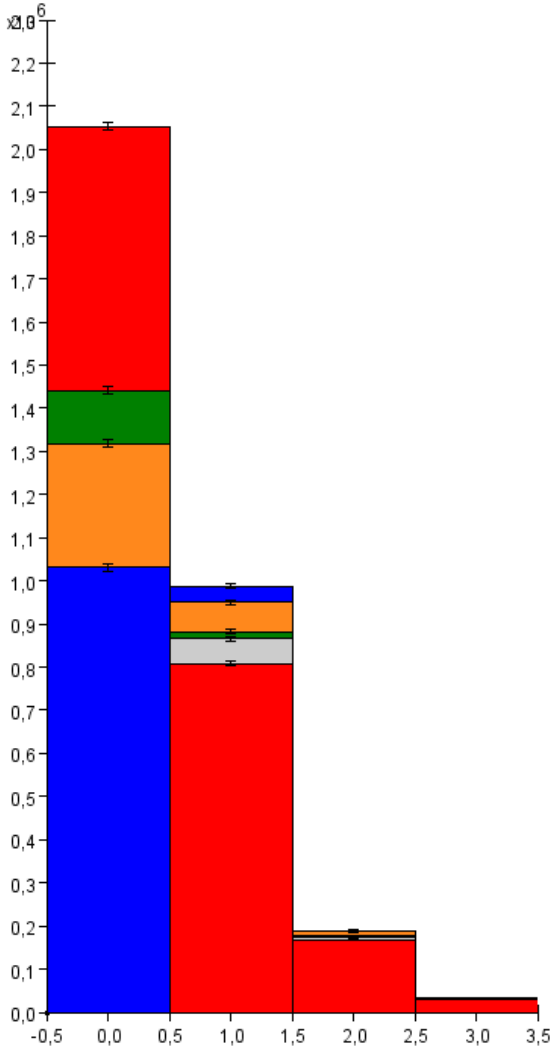
Results

Before neutral shower reconstruction

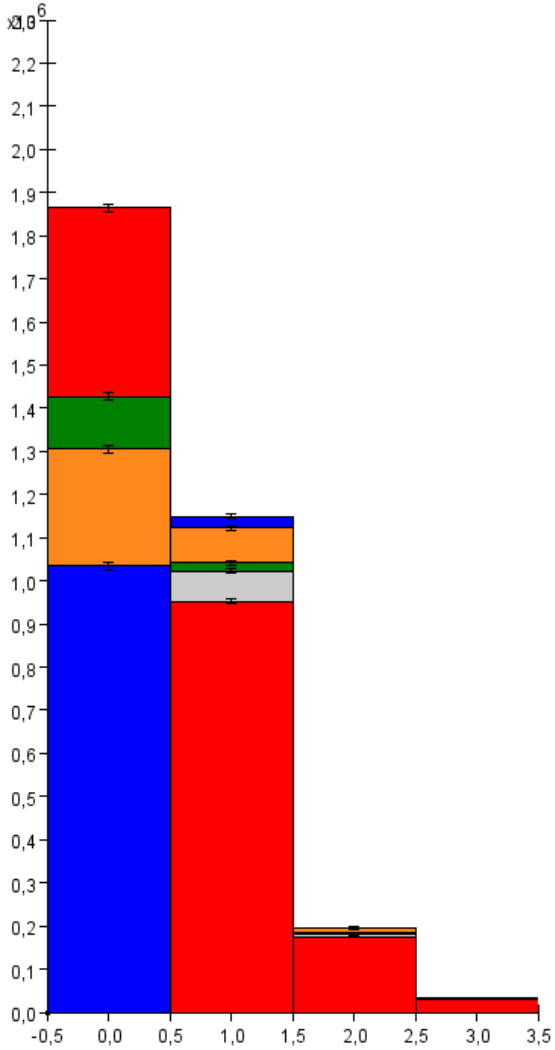
w/o cuts



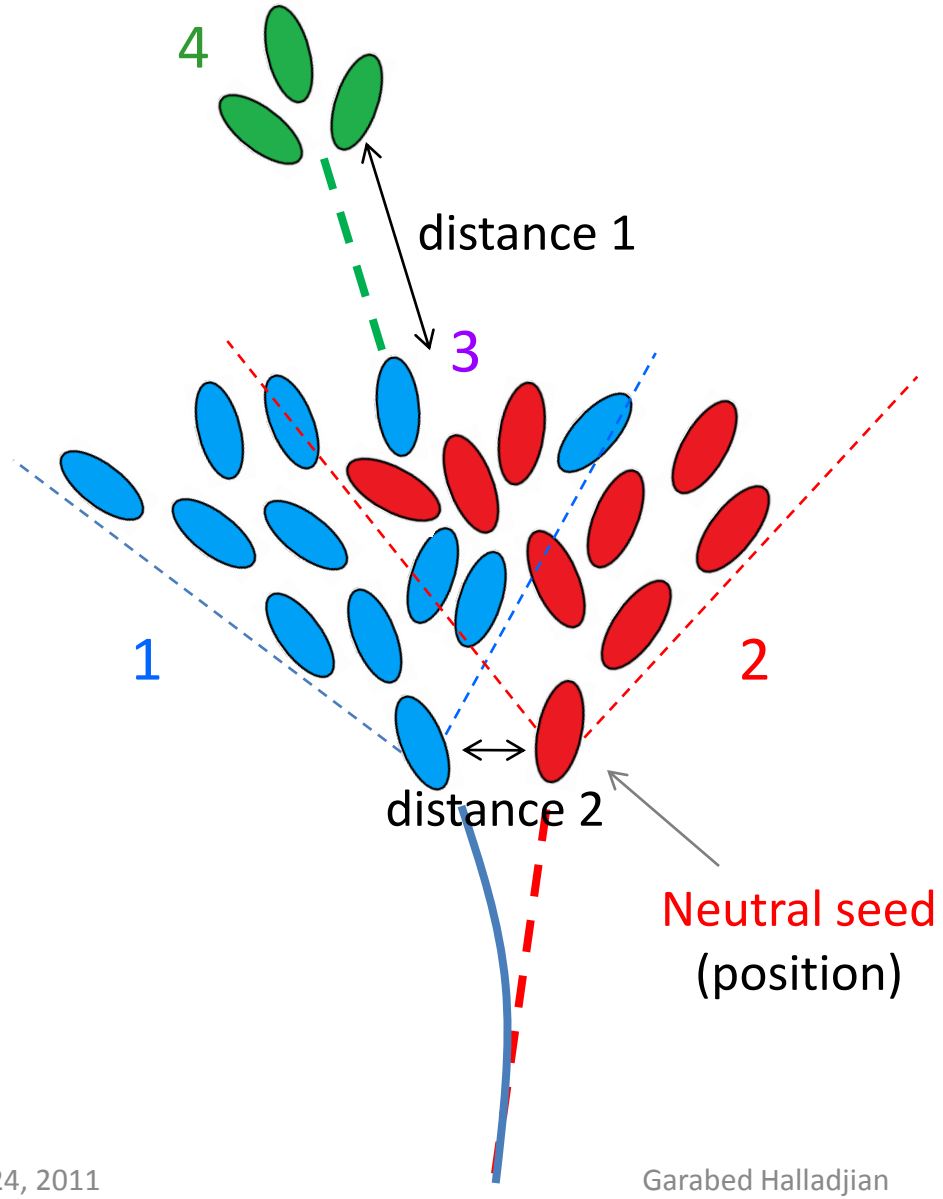
with Ecal cut



with Ecal + Hcal cuts



Secondary neutrals



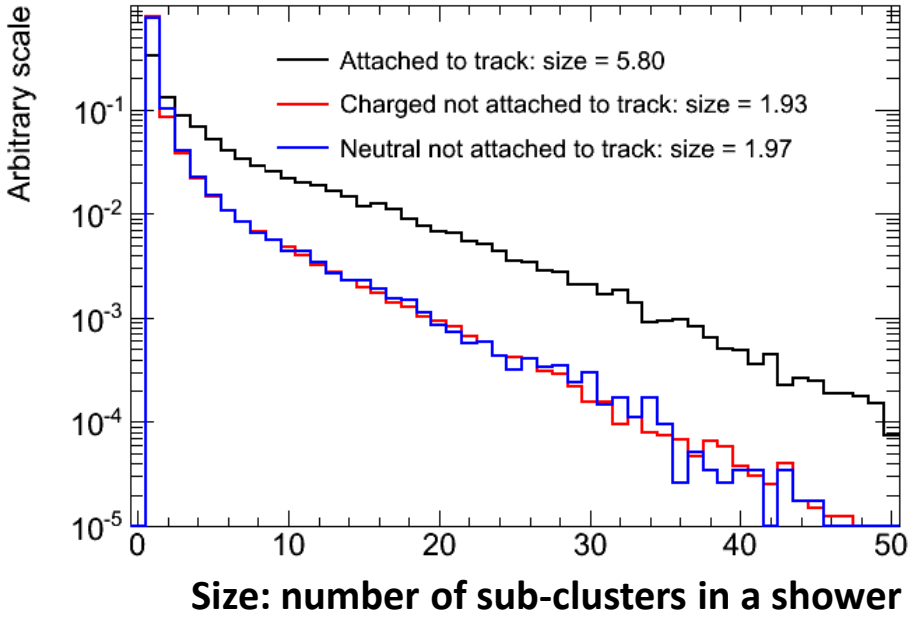
1- Charged sub-clusters

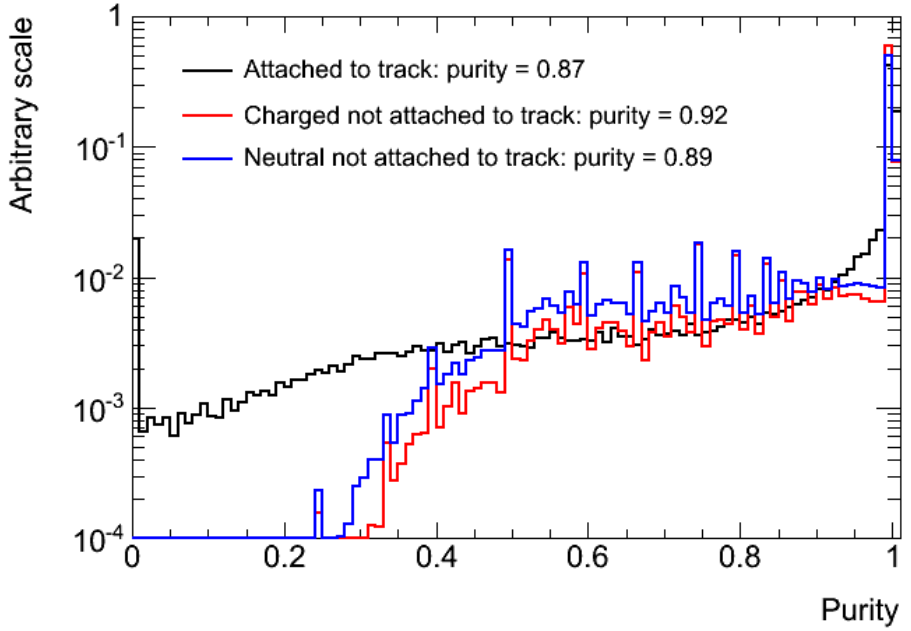
2- Neutral sub-clusters

3- Shared sub-clusters between charged and neutral showers

4- Secondary neutrals

Size and purity

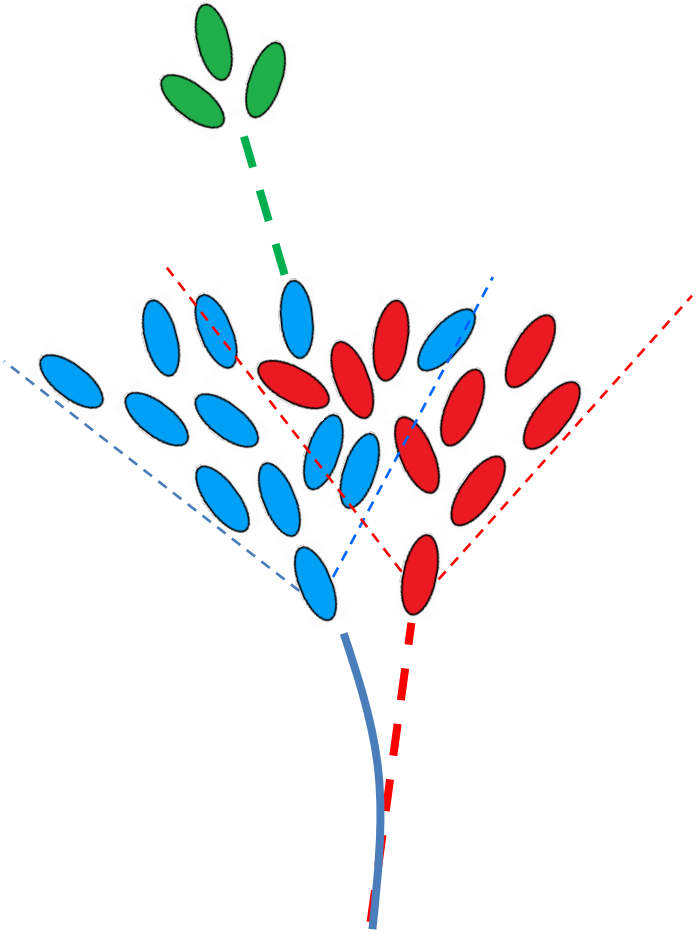




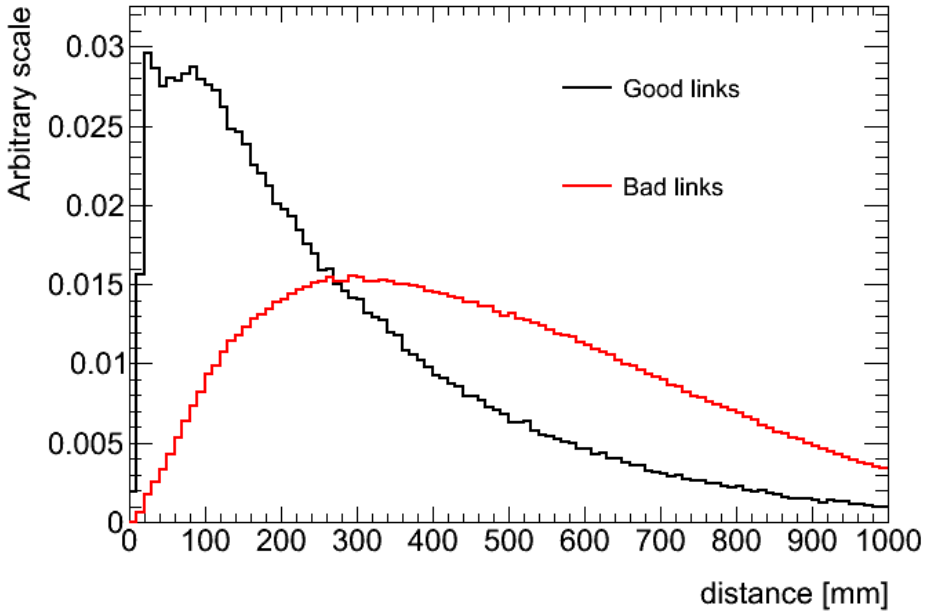
Small shower pieces with high purity:
The skeleton showers (attached to a track)
are larger and slightly less pure

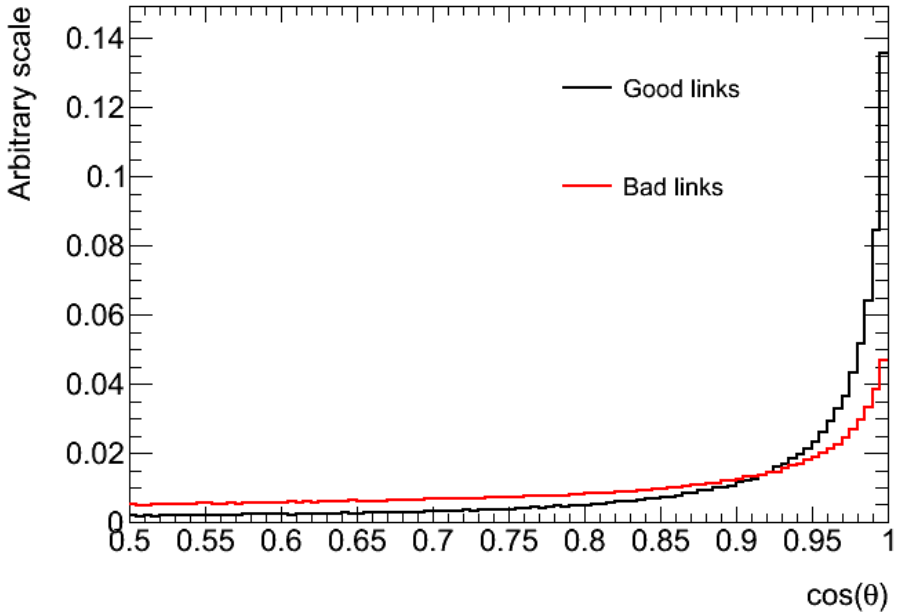
Strategy

- Do not attempt to link the remaining charge energy cluster by cluster
- Start from showers attached to a track (base):
  - Find showers not attached to a track (target) that might be identified as a detached piece of the original shower
  - Call these targets
- Identify possible discriminating variables to reject real neutrals:
  - These will be shown in the next few slides
- Can we build a new likelihood?



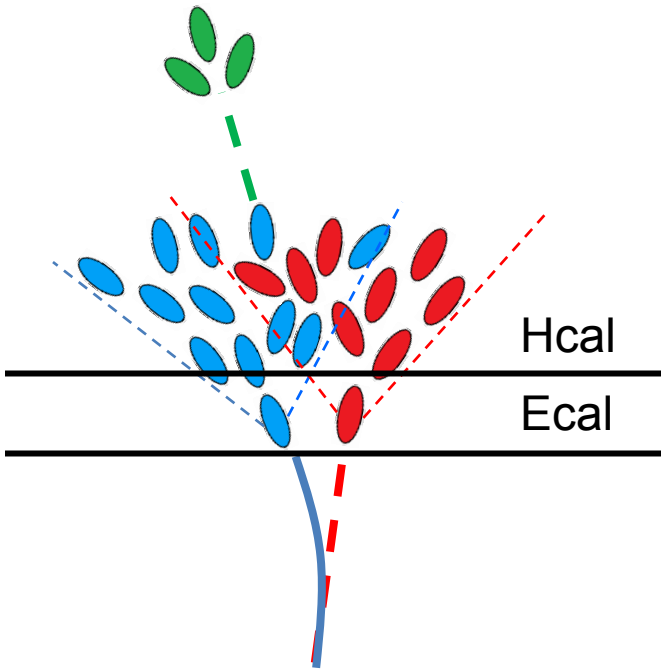
Distance and angle

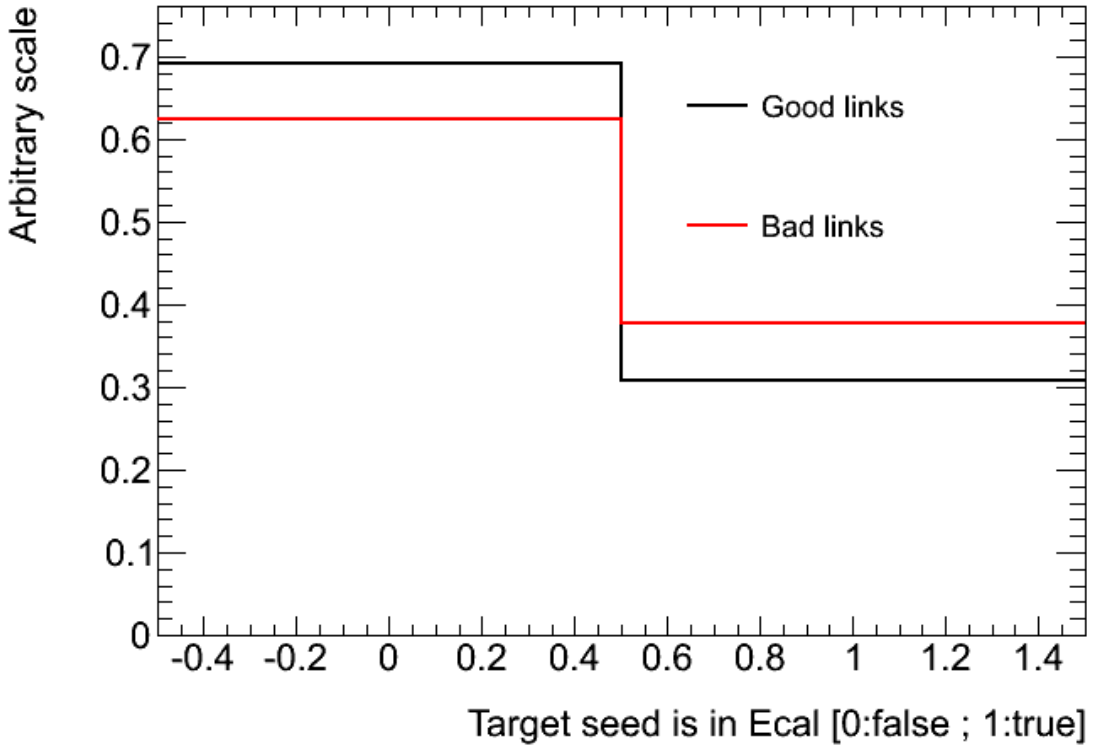




Distance and angle are the obvious variables to start with

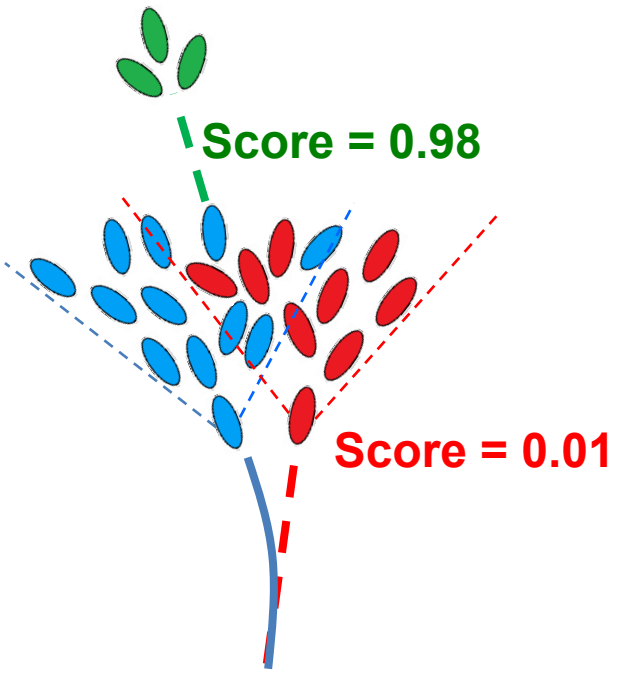
Does the target start in Ecal?

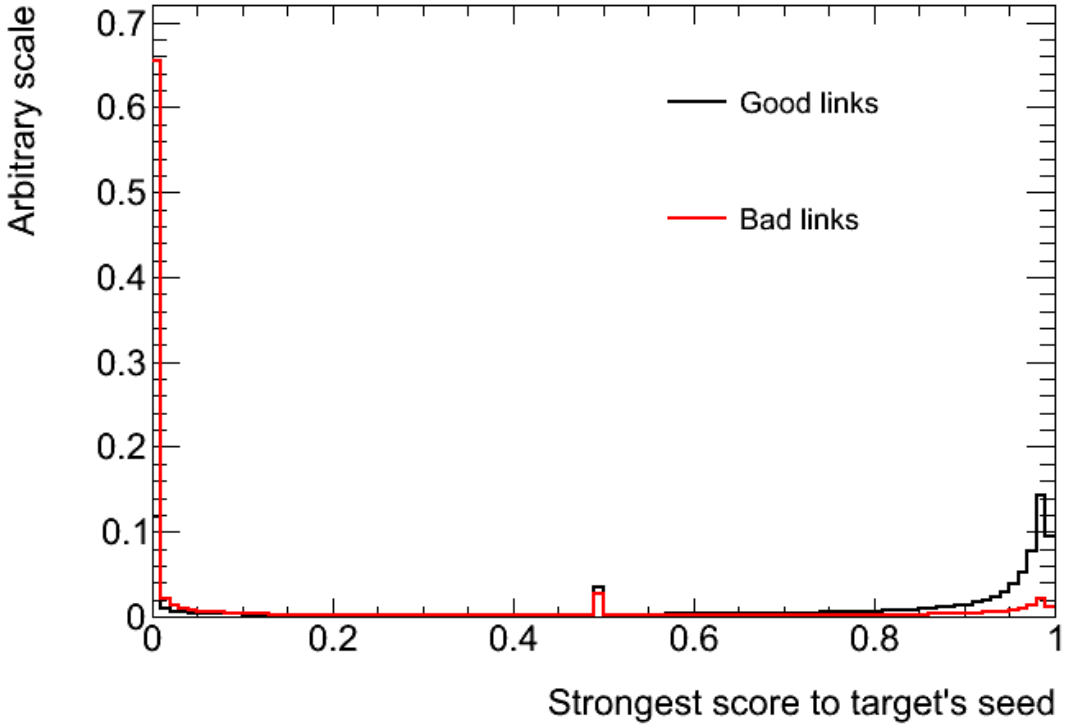




Primary neutrals will constitute showers that tend to start in the Ecal

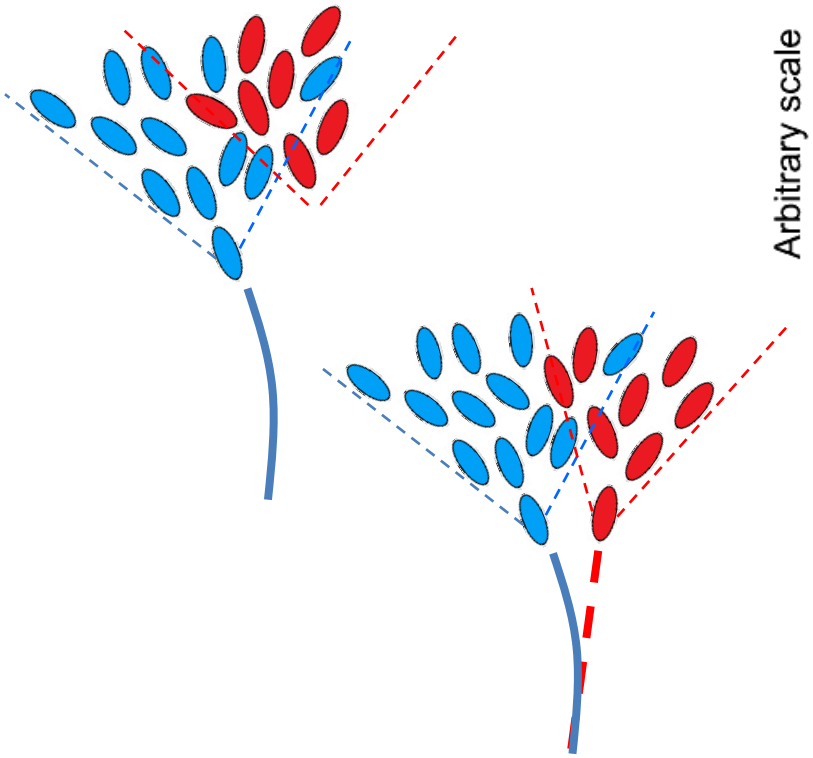
Strongest link

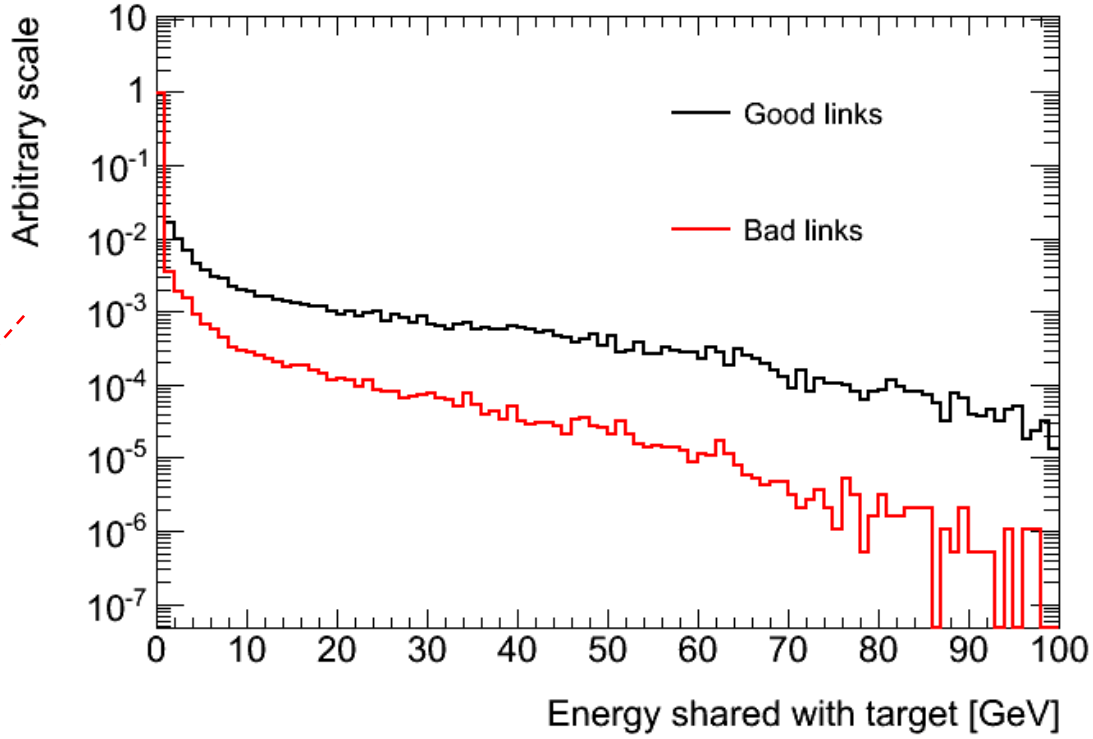




Shower pieces we failed to pick up in the first iteration have high scores often just below the threshold.
Use this information in the second iteration.

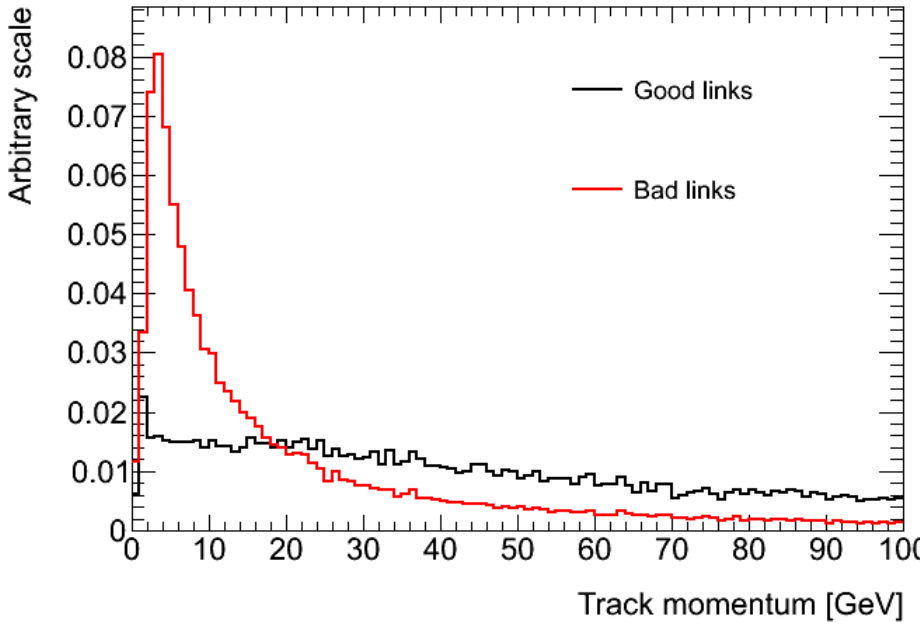
Overlaps

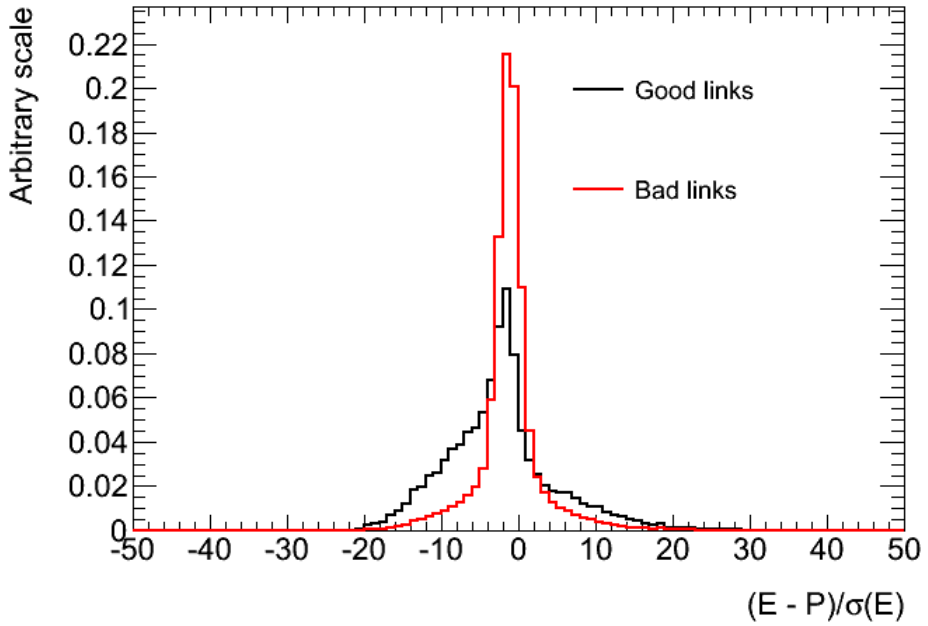




Overlapping showers are more likely to belong together

Momentum and Energy residual





Tracks with relatively low momentum and good energy residual are more likely to have their showers well reconstructed in the first iteration.

Expectation with likelihood

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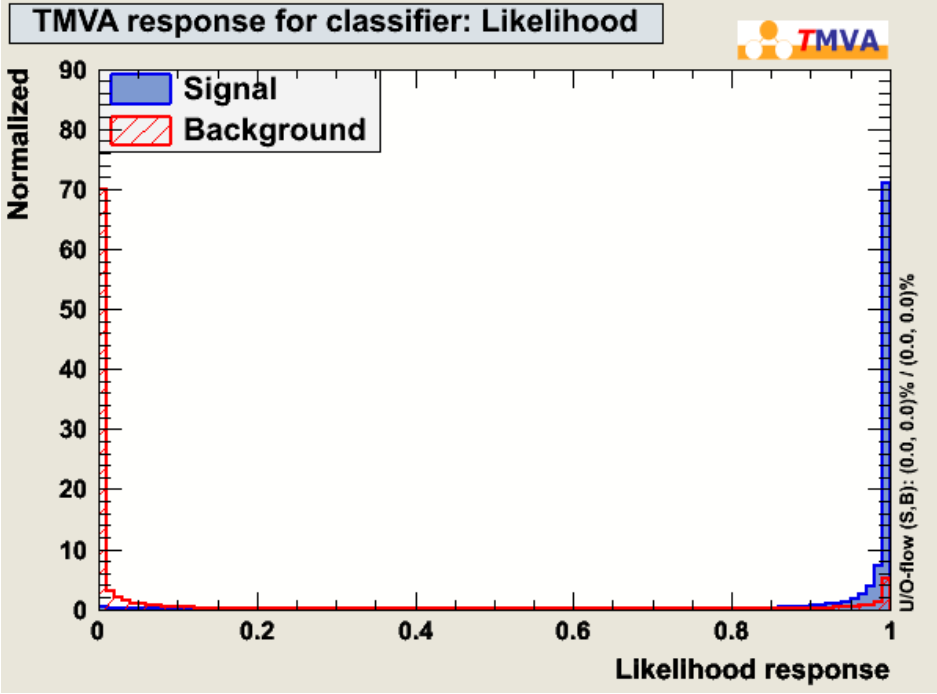
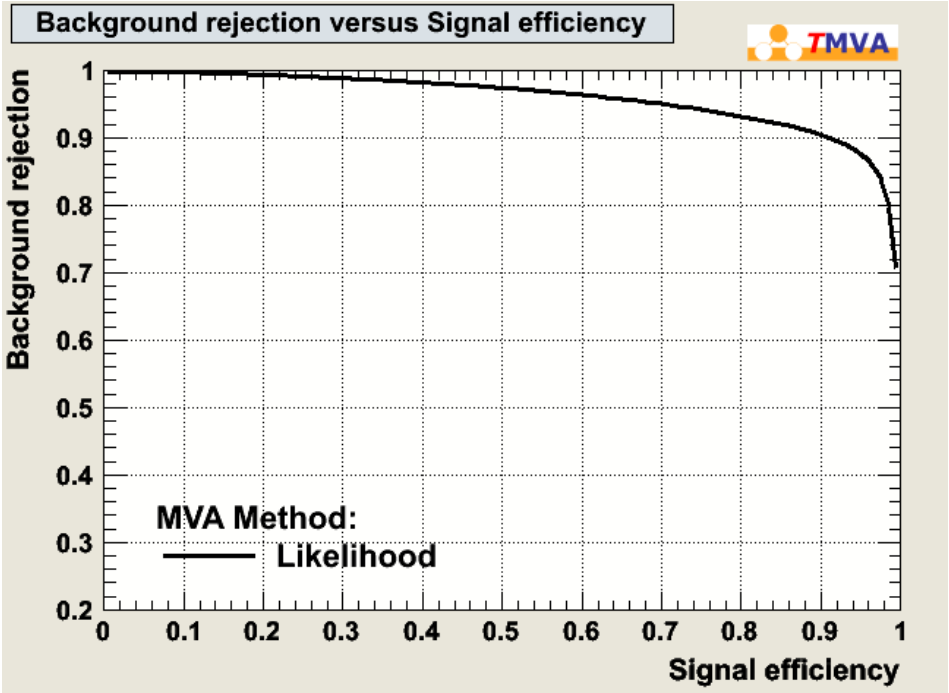
A test using toy MC

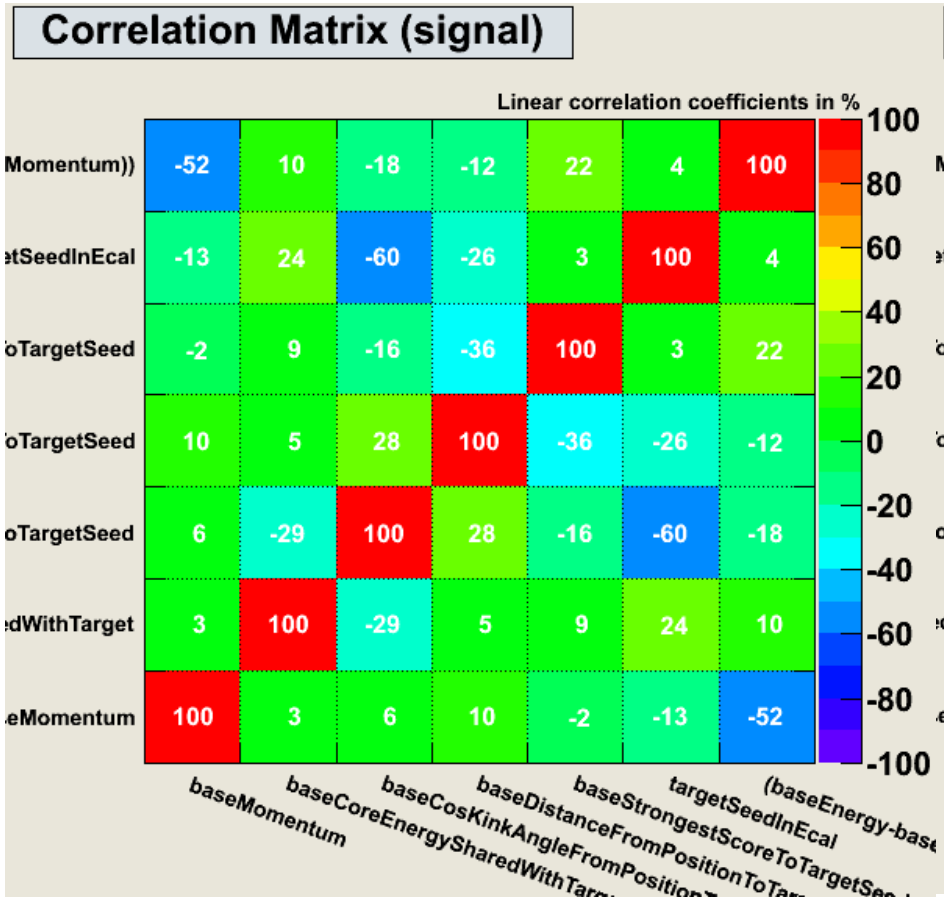
This is not yet implemented in the PFA code

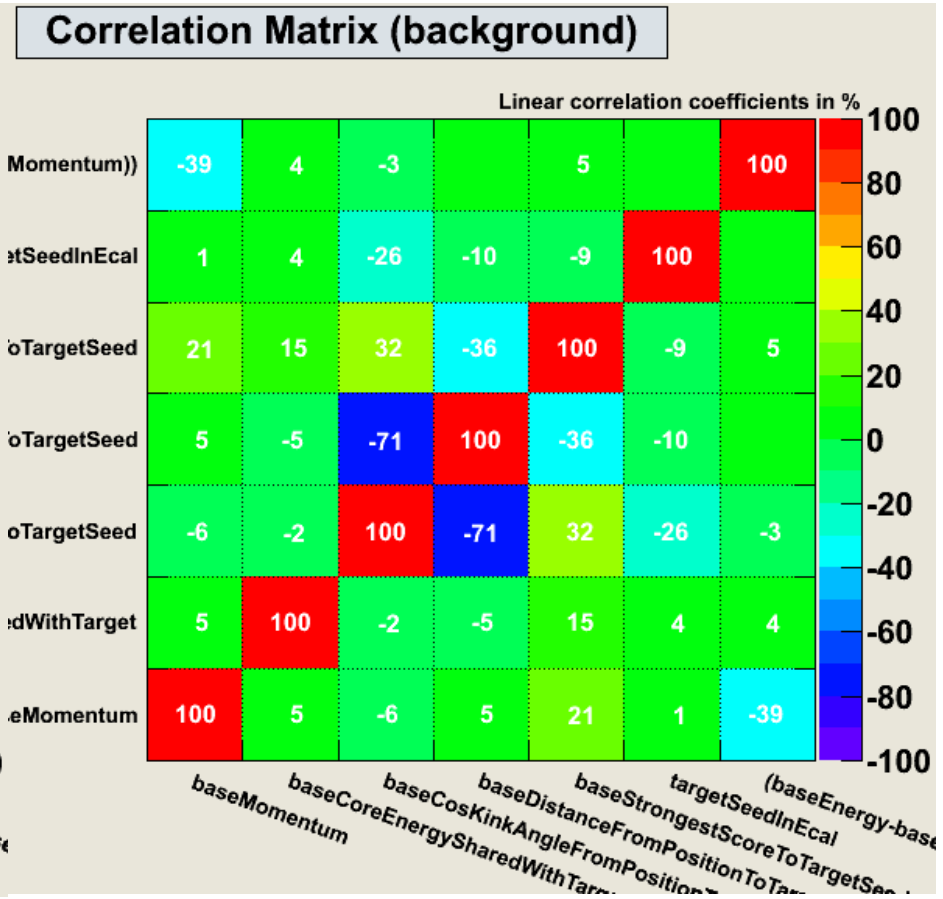




The likelihood output looks very promising
(achievement of 90% efficiency for a 90% rejection)

Correlations





Small correlations except for few cases.
Use multi-dimensional PDFs.

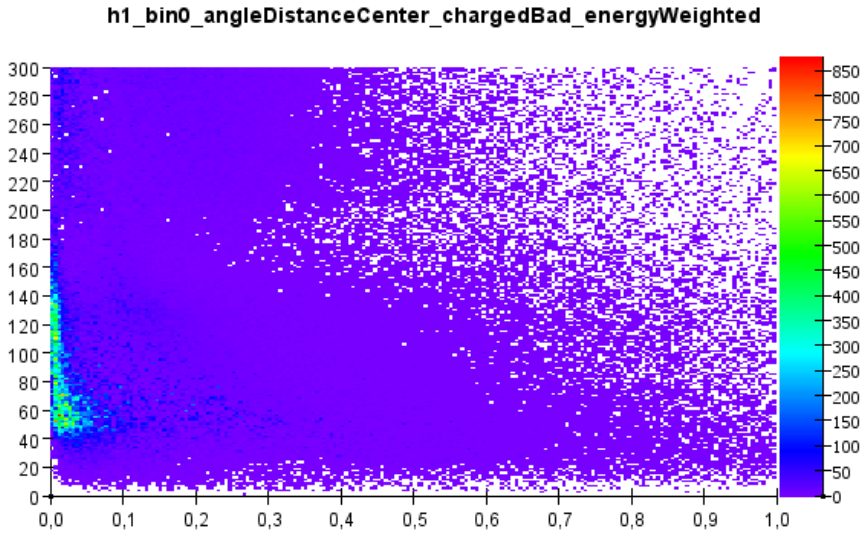
Summary

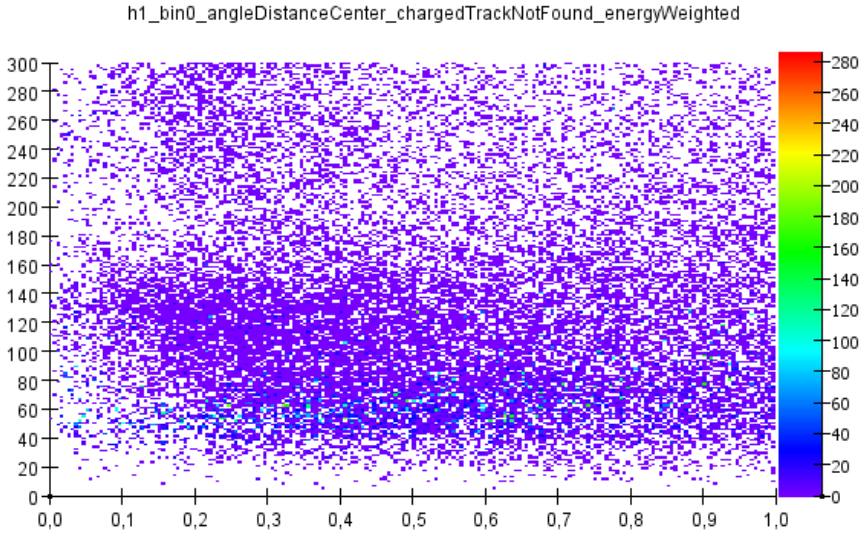
Currently implementing the new likelihood for the second iteration

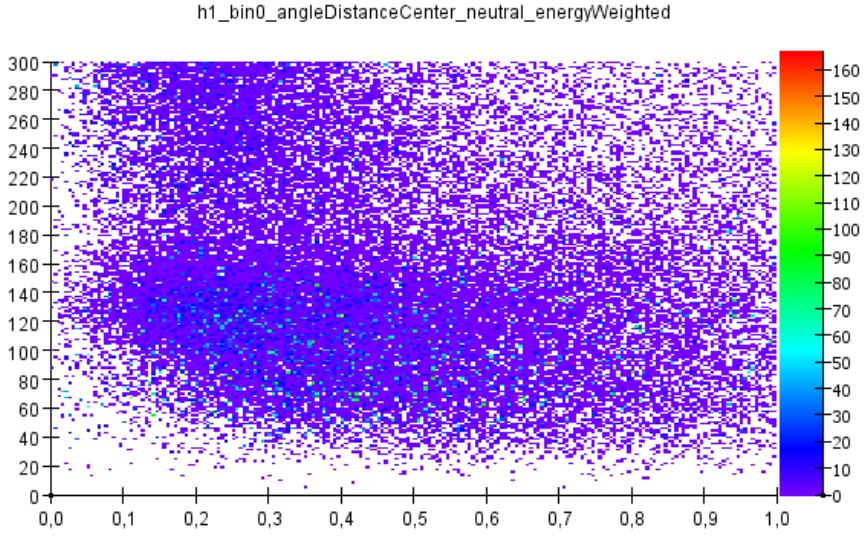
First expectations look promising

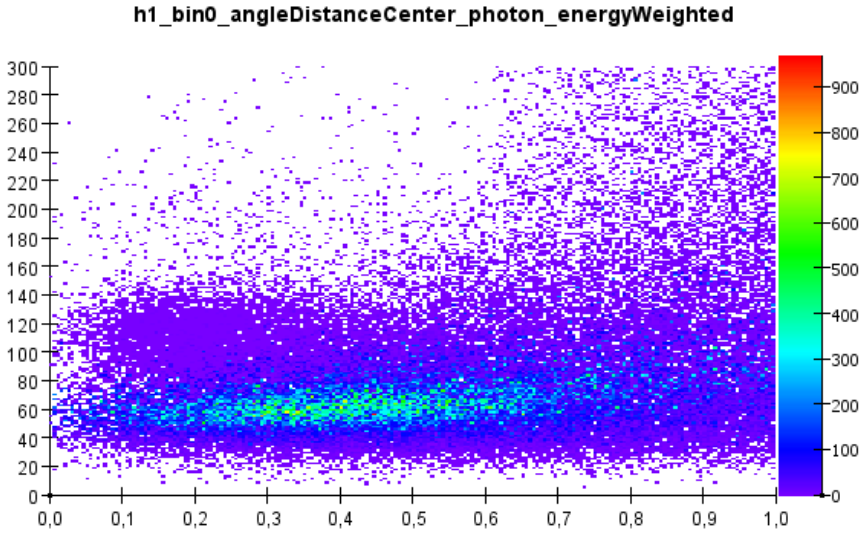
Back Up

New Cut in Ecal (zoom)

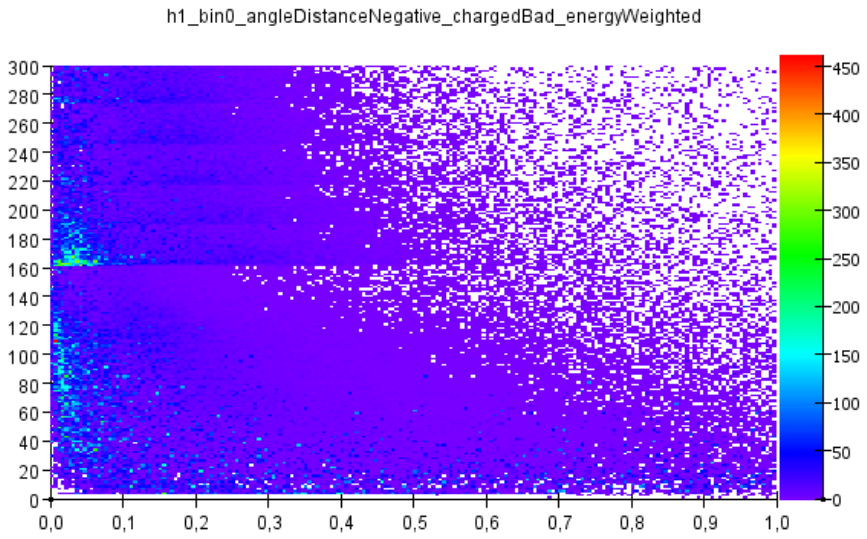


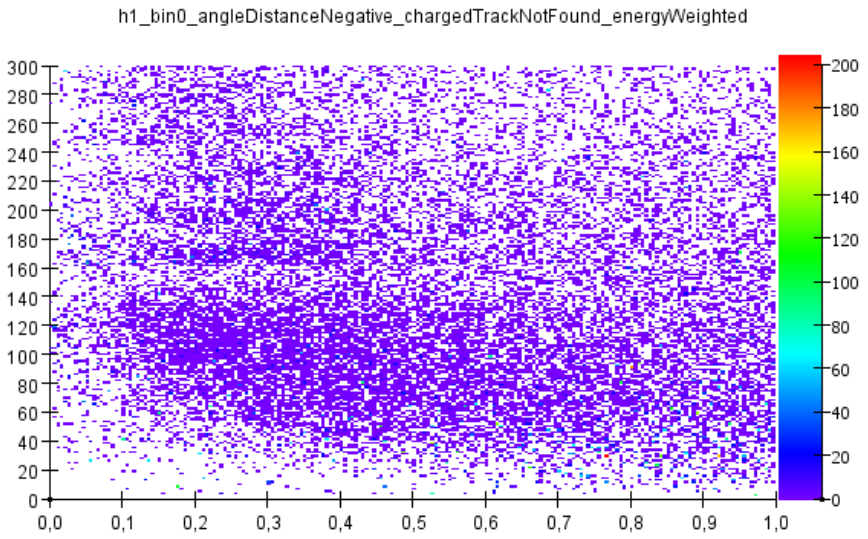


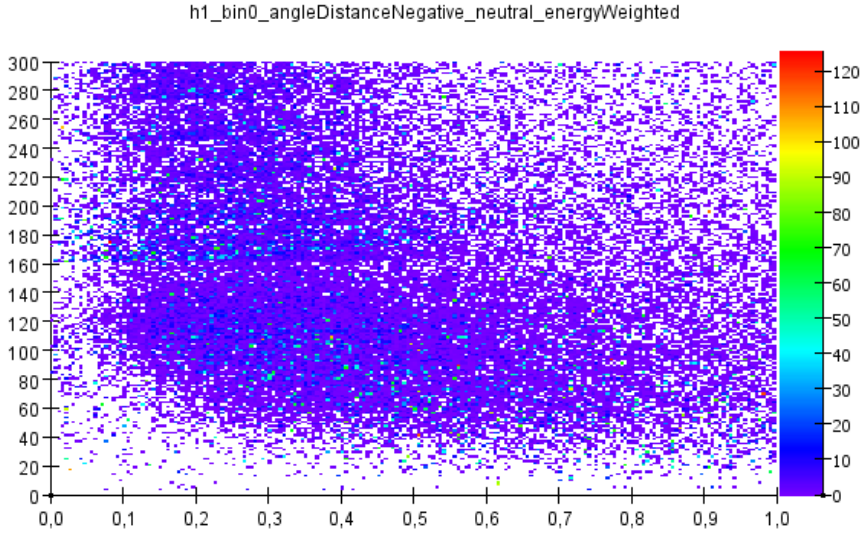


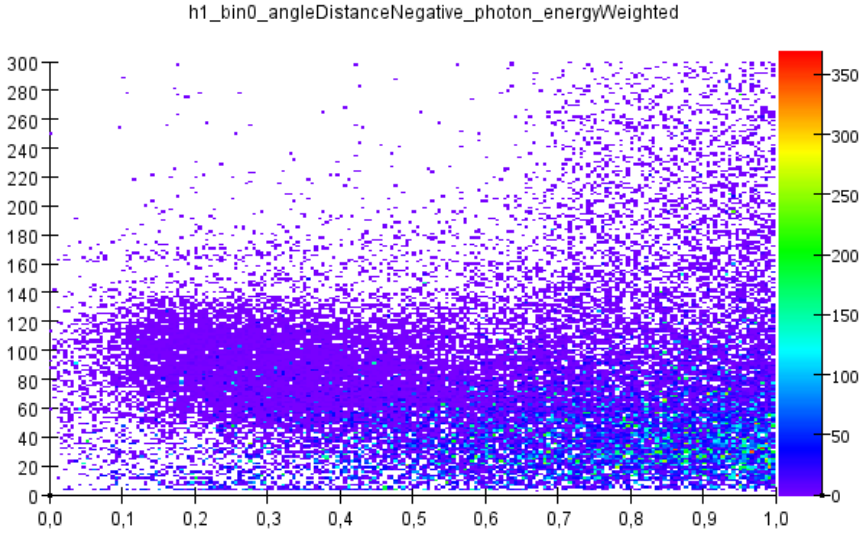


Cut in Hcal (zoom)

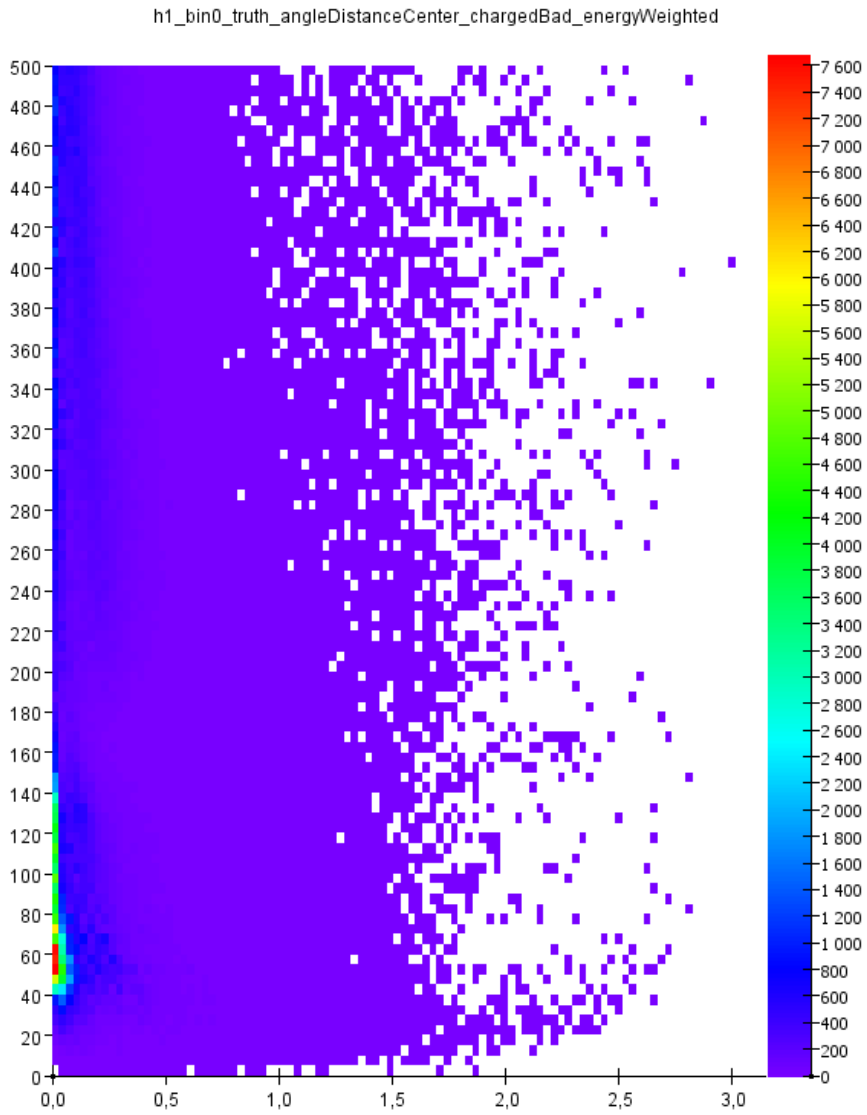


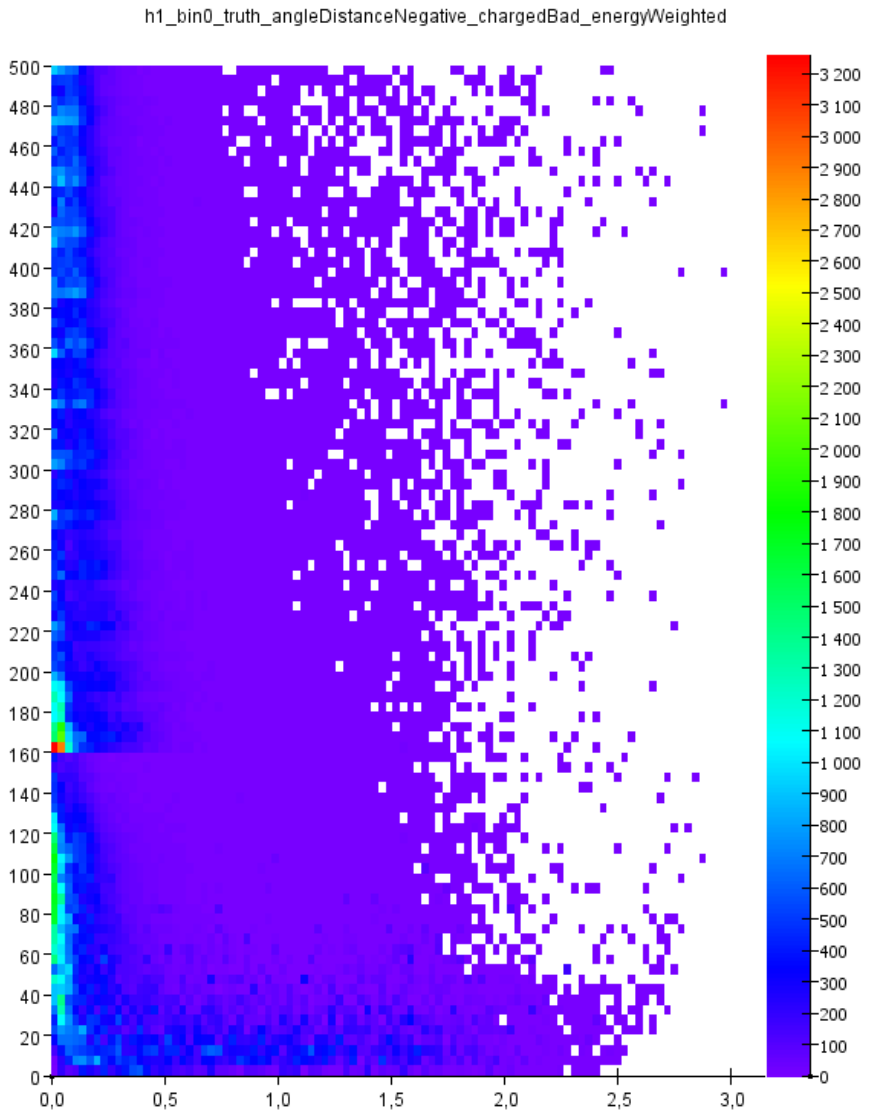




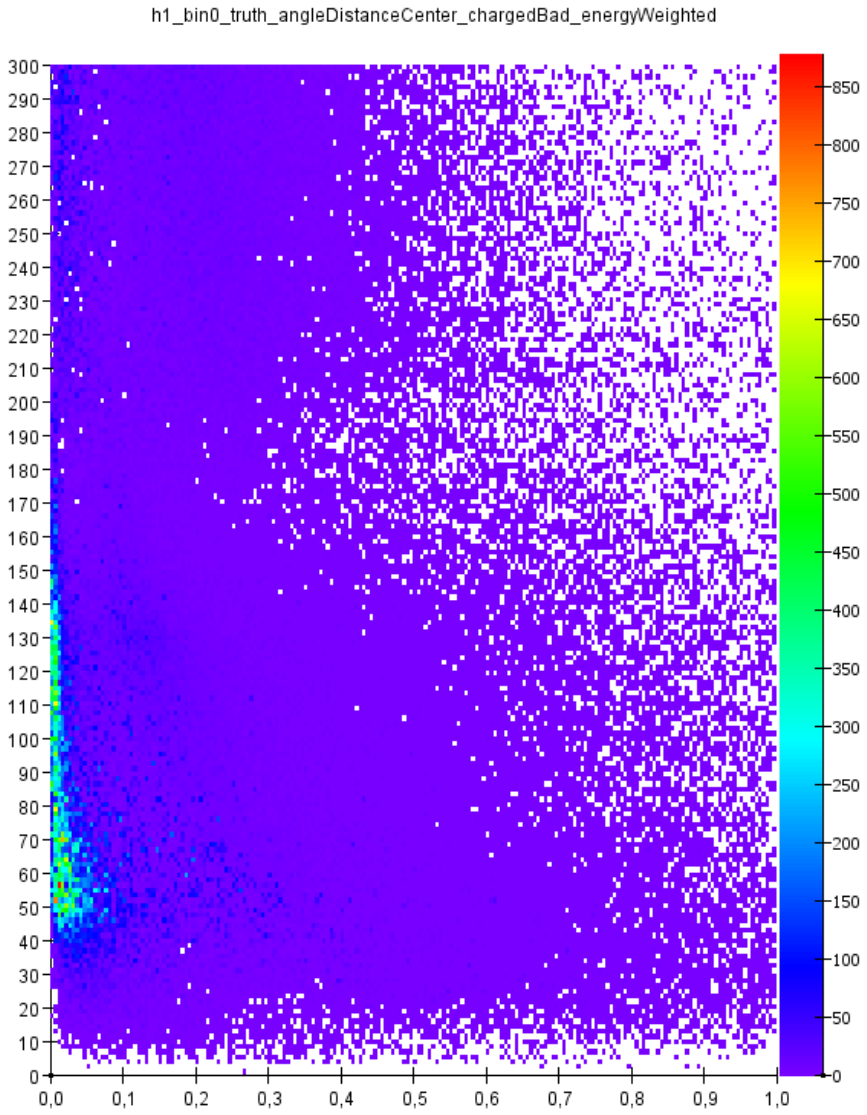


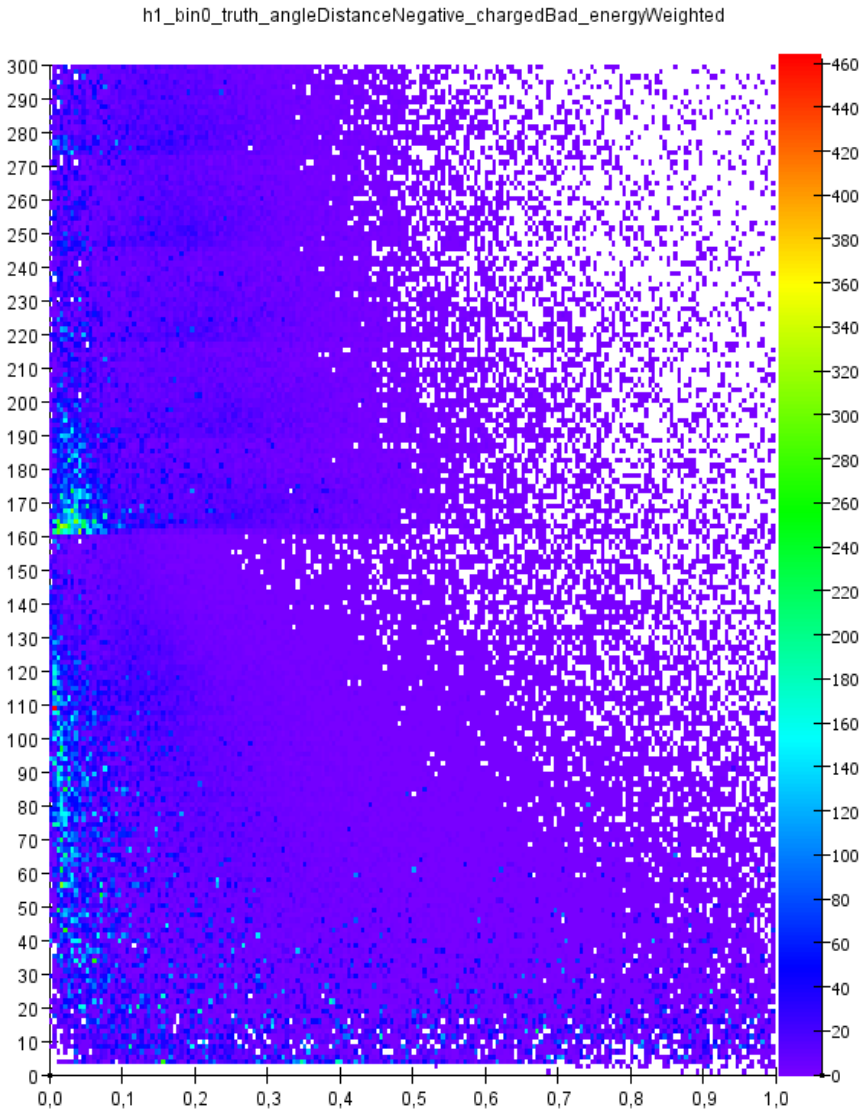
Results (truth)



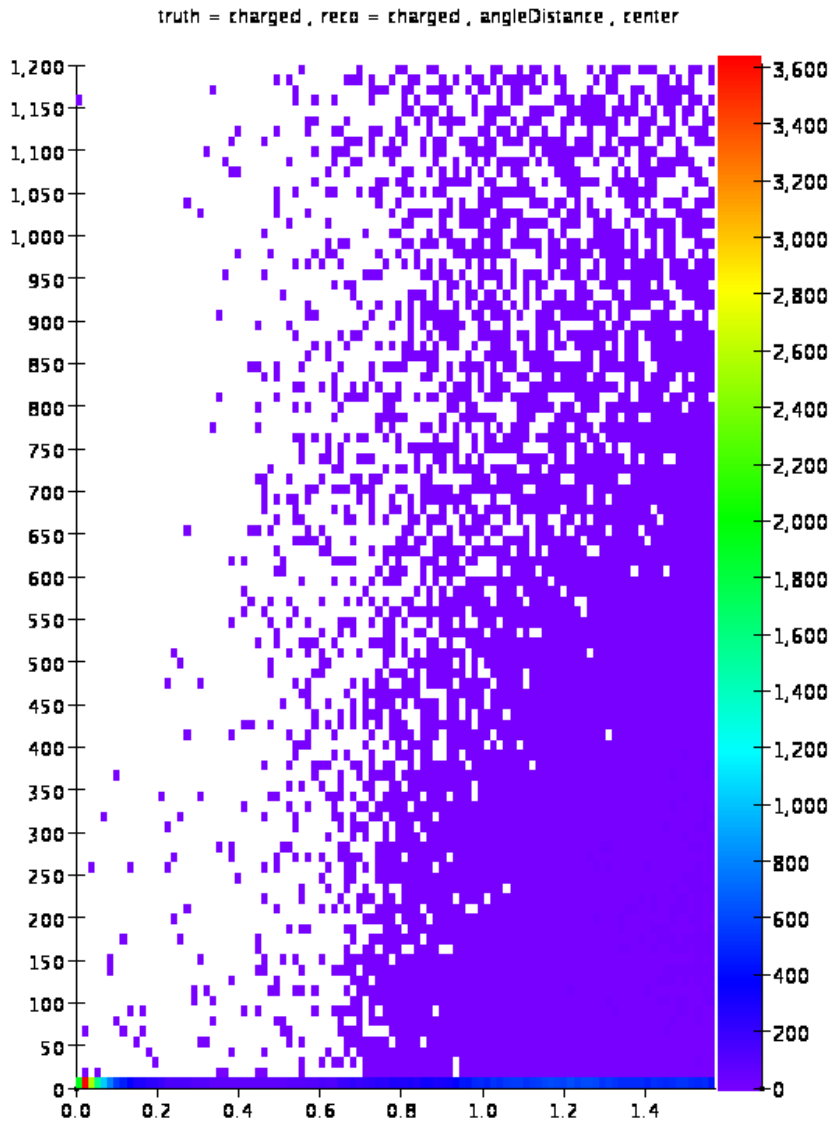


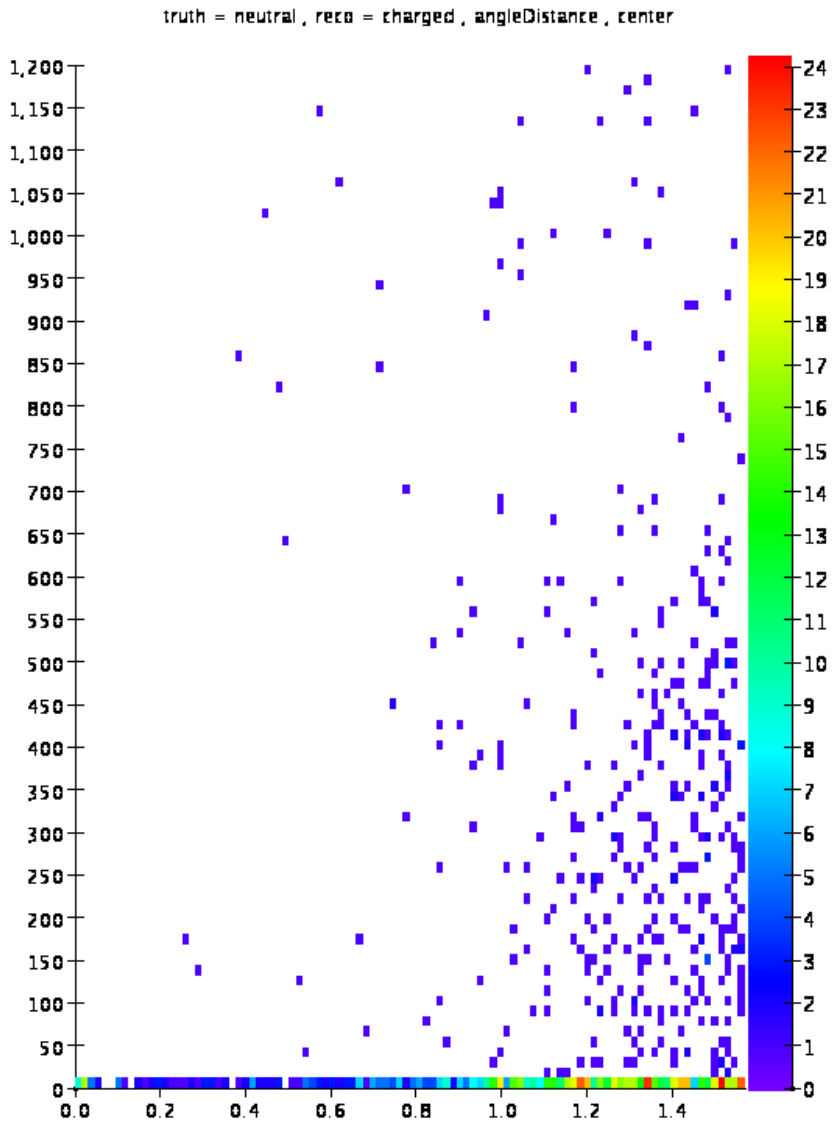
Results (truth)



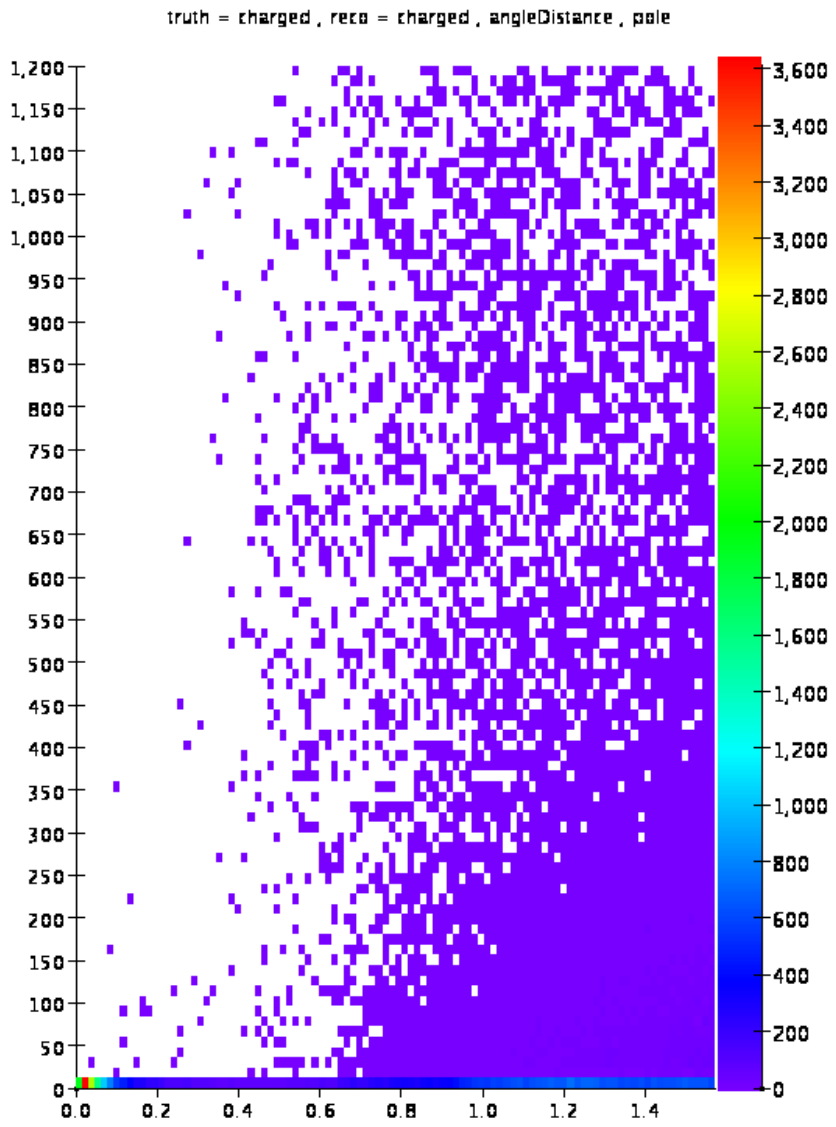


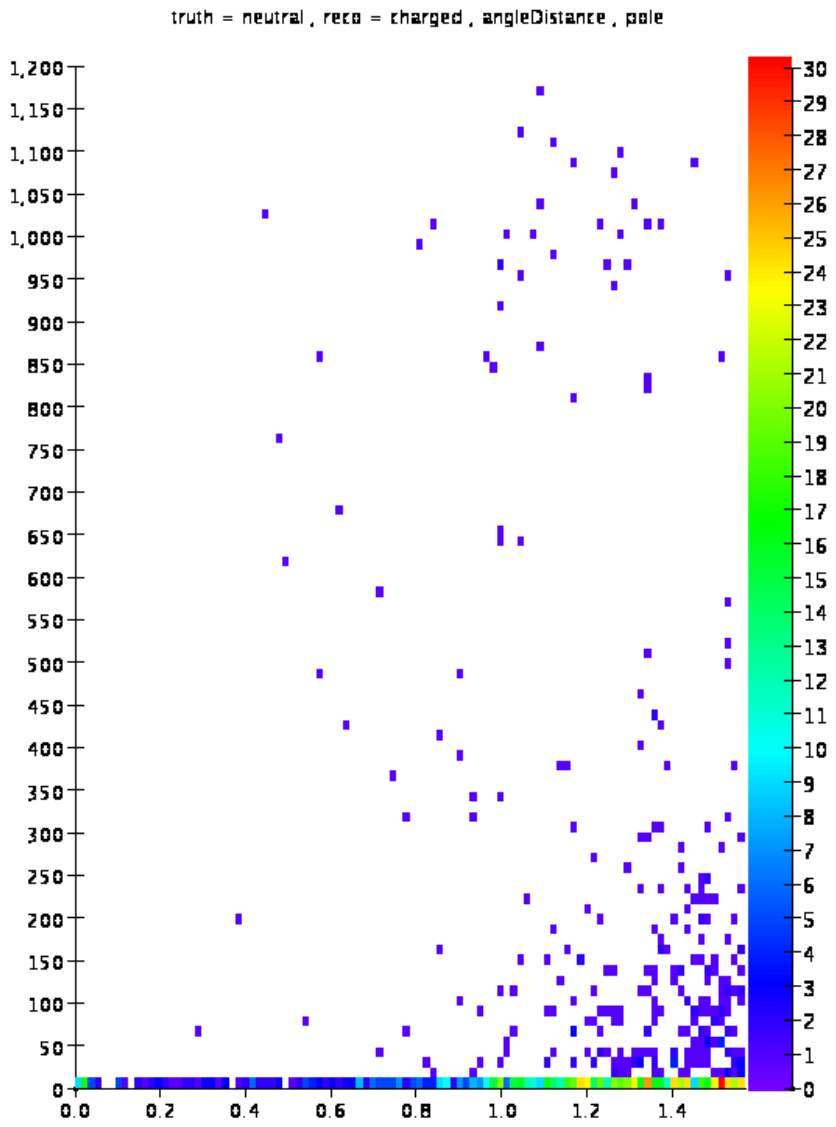
Results


truth = charged , reco = charged , angleDistance , center

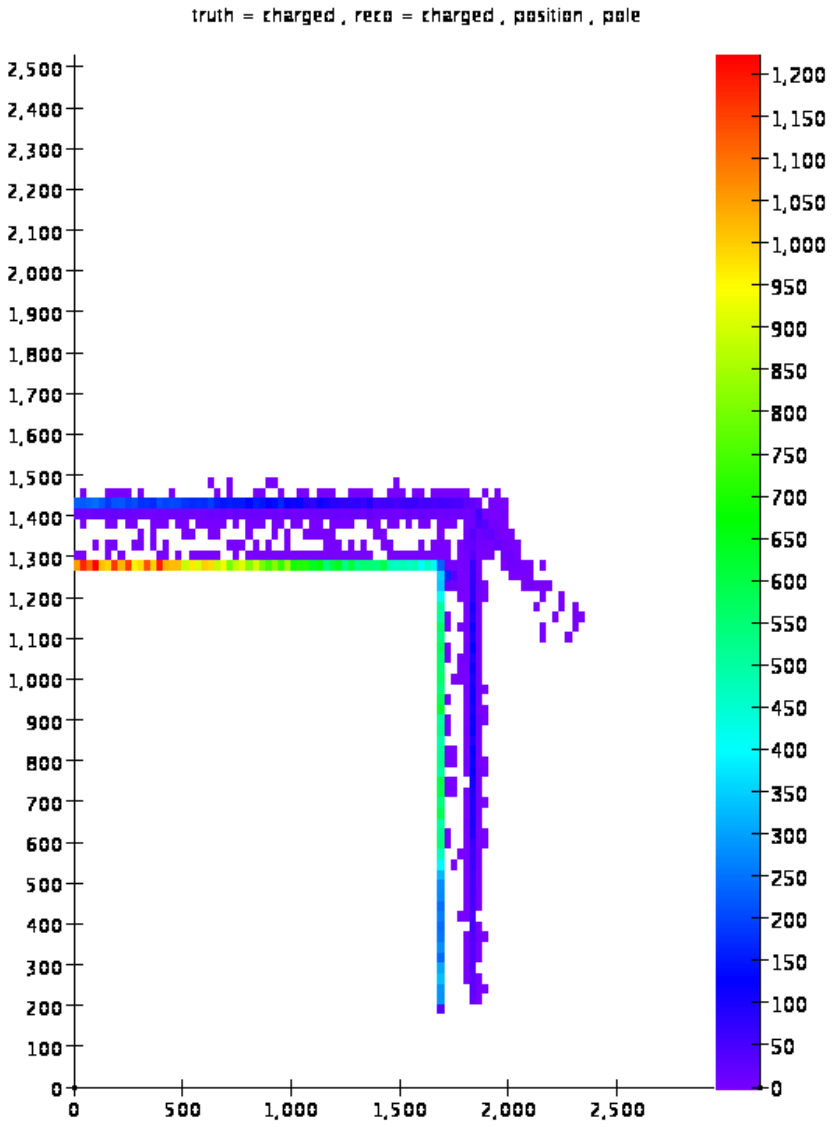

truth = neutral , reco = charged , angleDistance , center

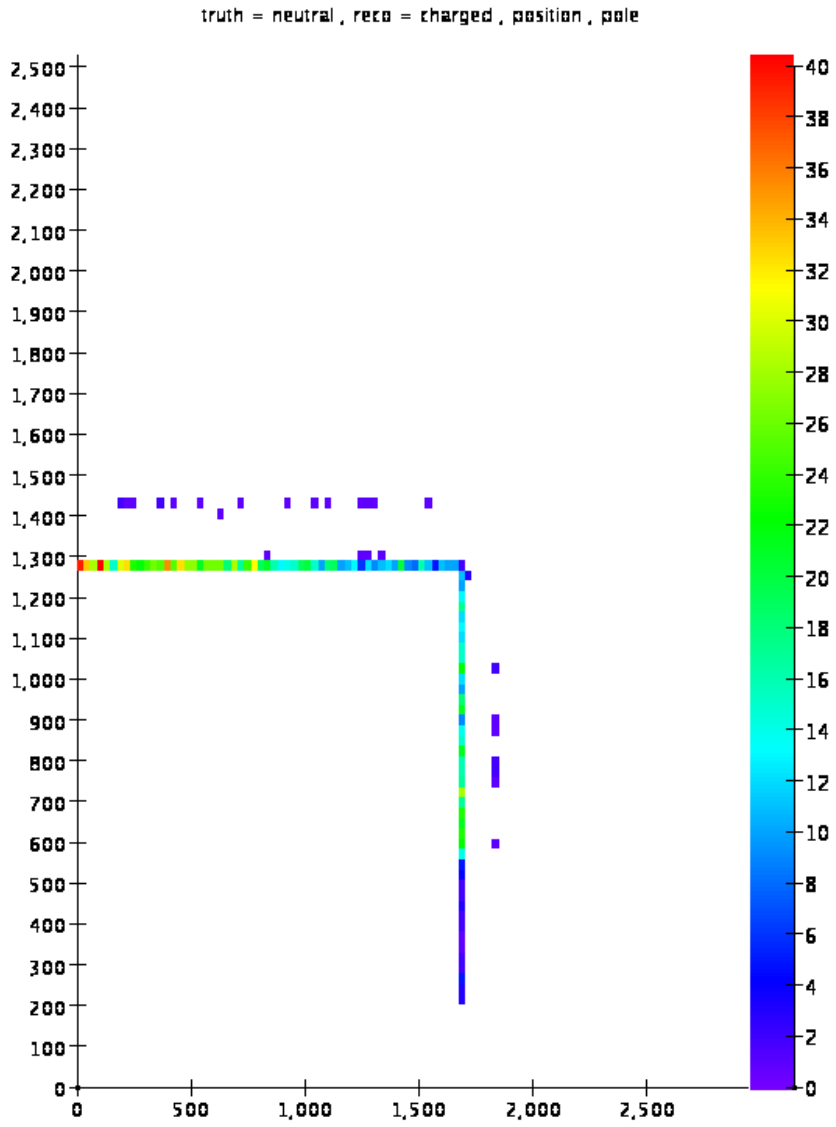
Results


truth = charged , reco = charged , angleDistance , pole
1,200
1,150
1,100
1,050
1,000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0

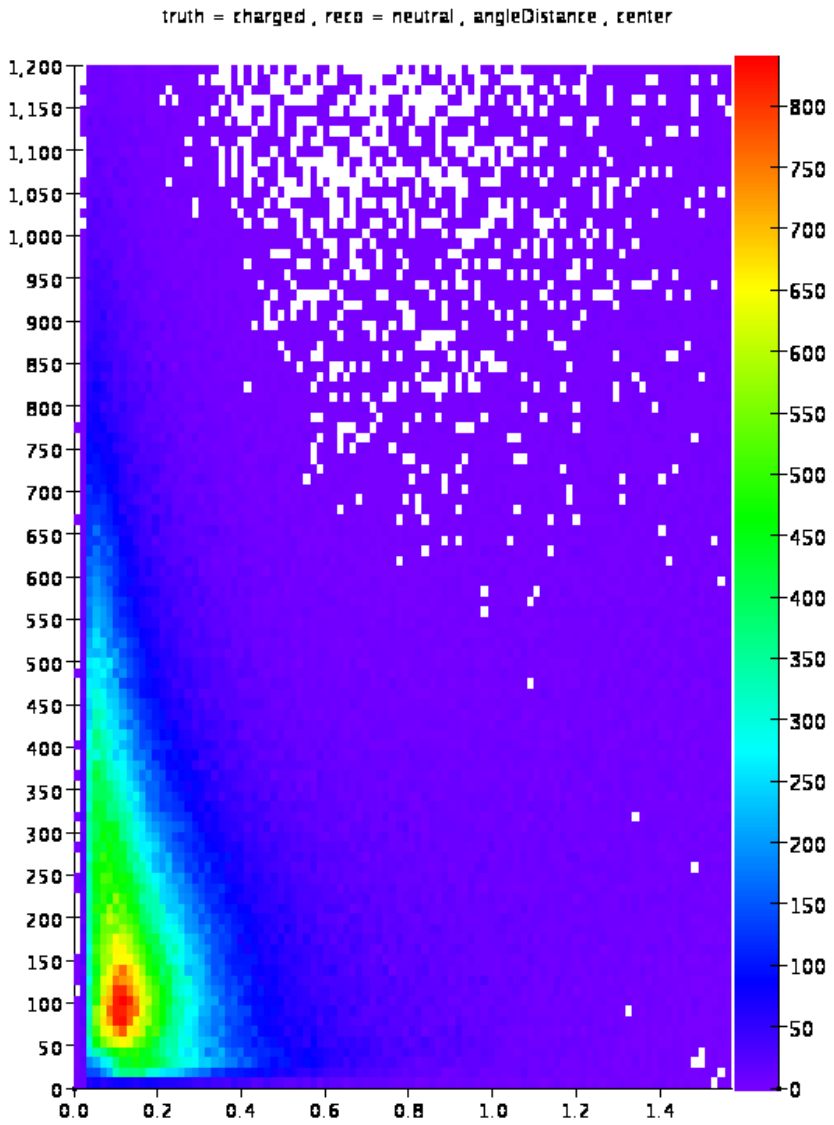

truth = neutral , reco = charged , angleDistance , pole
1,200
1,150
1,100
1,050
1,000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0

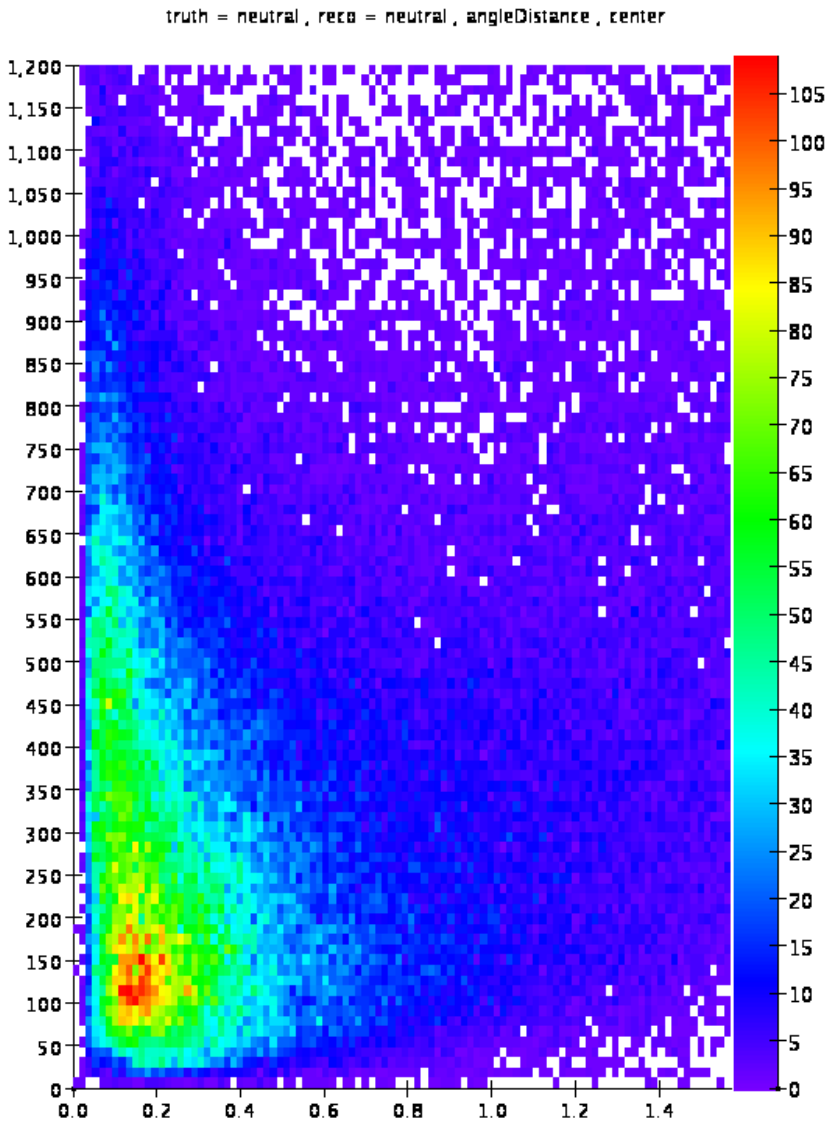
Results


truth = charged , reco = charged , position , pole
2,500
2,400
2,300
2,200
2,100
2,000
1,900
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
500
1,000
1,500
2,000
2,500
1,200
1,150
1,100
1,050
1,000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0

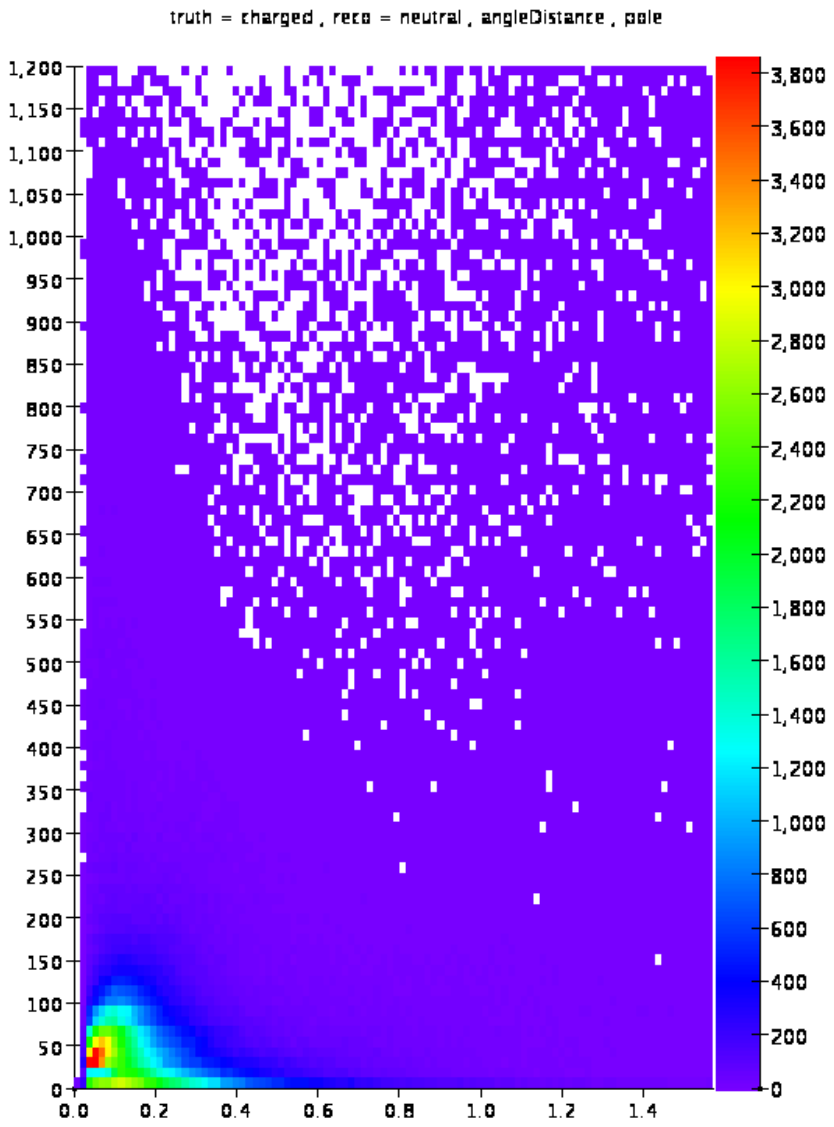

truth = neutral , reco = charged , position , pole
2,500
2,400
2,300
2,200
2,100
2,000
1,900
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
500
1,000
1,500
2,000
2,500
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0

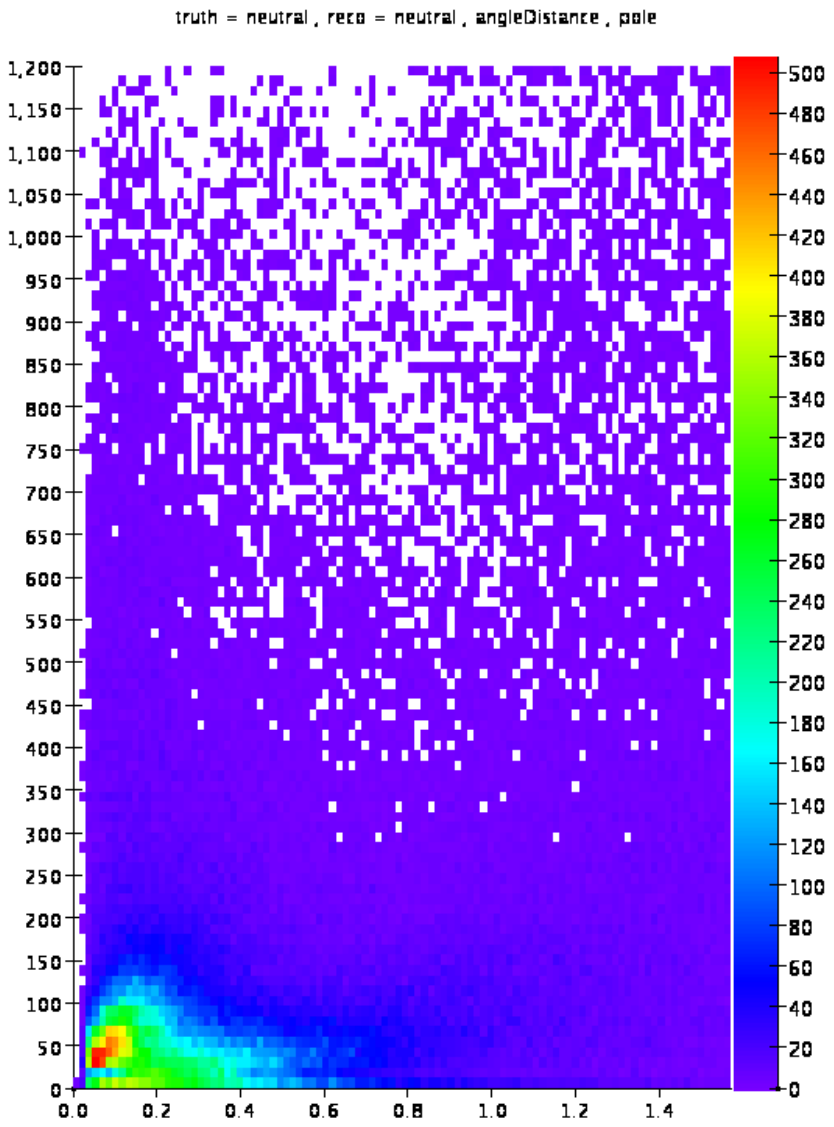
Distance between showers center





Minimal distance between showers





Showers negative pole postion