Weekly Update 1 - Semester 2

Edward Wardell

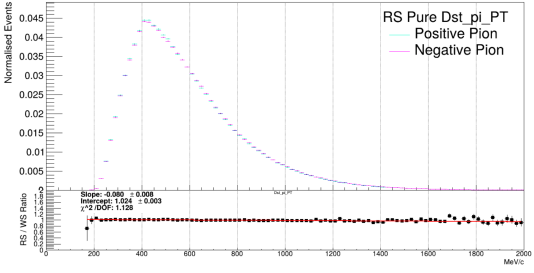
15^{th} Janurary 2025

Tasks Undertaken

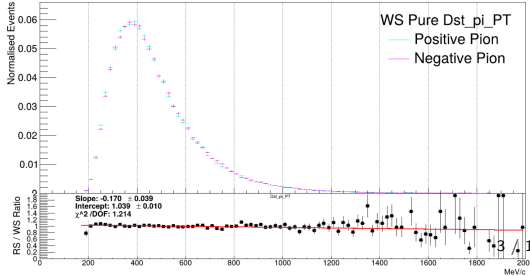
- Refining Presentation (need to change plot colours, line thickness, etc)
- Looked into Soft Pion Charge for Dst_pi_PT.
- 2D Classifier cut for deltam_ReFit (WS).
- Unsupervised Learning!

Soft Pion Charge Differences for Dst_pi_PT.
We can see good agreement with RS, WS also quite good agreement (mostly within error-bar range).

RS

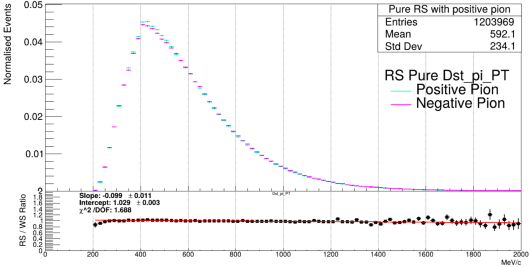


WS

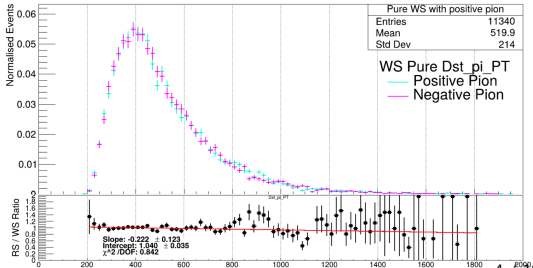


Soft Pion Charge Differences for Dst_pi_PT. deltam_ReFit Signal Region [145.25, 145.80].

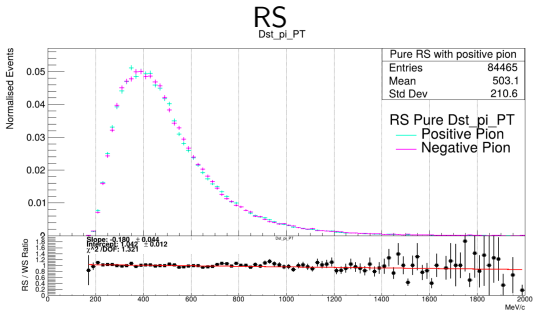
RS
Dst_pi_PT

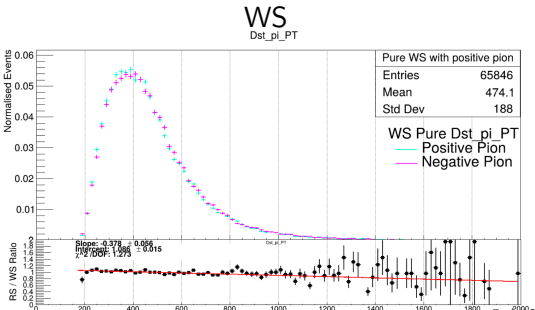


WS
Dst_pi_PT

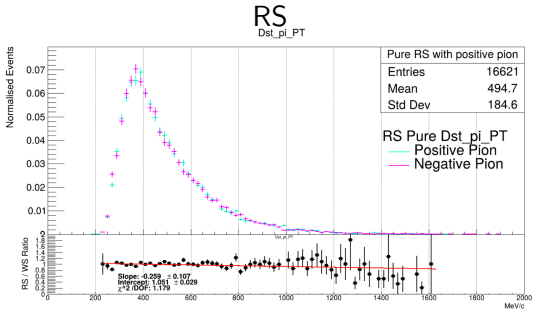


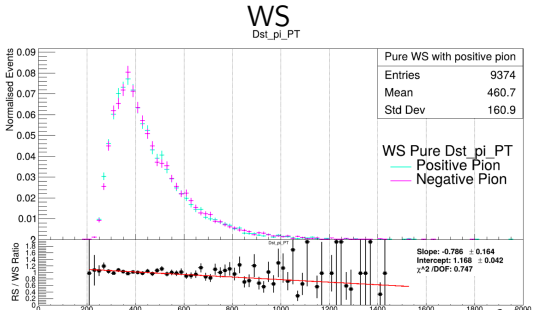
Soft Pion Charge Differences for Dst_pi_PT. deltam_ReFit higher sideband Region ≥ 148.





Soft Pion Charge Differences for Dst_pi_PT. deltam_ReFit lower sideband Region ≤ 143.

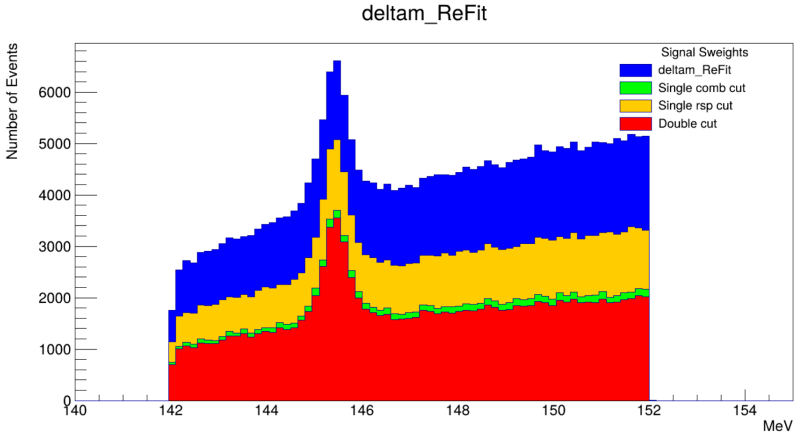




Dst_pi_PT

- There seems to be pretty consistent agreement with π_s^+ & π_s^- for different regions of deltam_ReFit, at least within error-bar range.

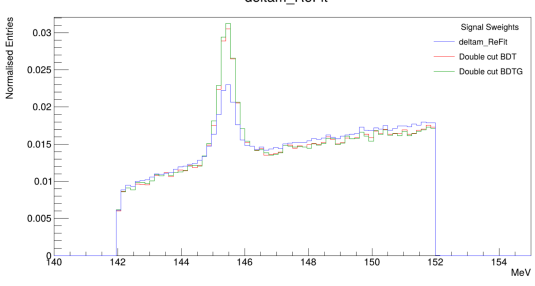
2D Classifier for deltam_ReFit for BDT



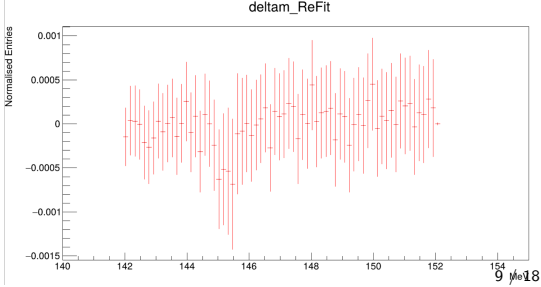
2D Classifier for deltam_ReFit for BDT vs BDTG

It looks like BDTG is a marginally better discriminator compared to BDT.

Normalised

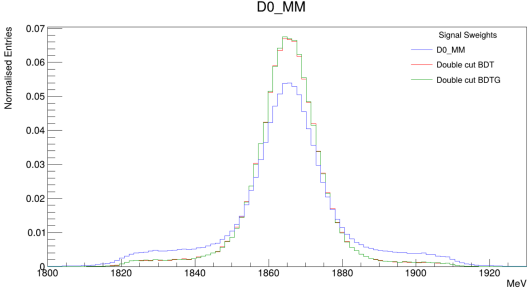


Difference (BDT - BDTG)

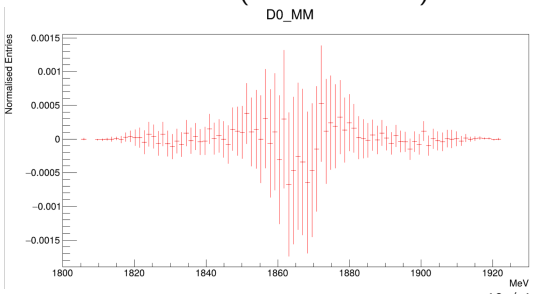


Similar story for the D0_MM mass variable (BDTG is slightly better).

Normalised

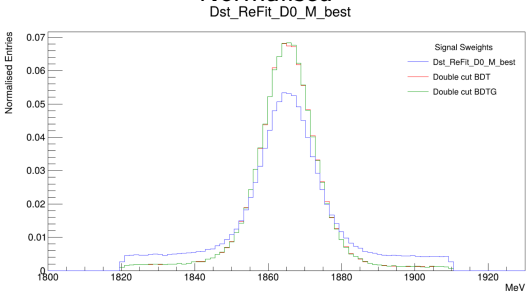


Difference (BDT - BDTG)

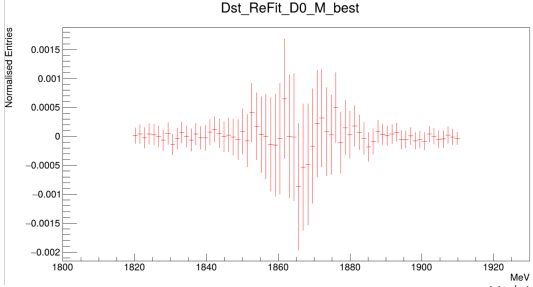


Dst_ReFit_D0_M_best (DFT mass variable).

Normalised



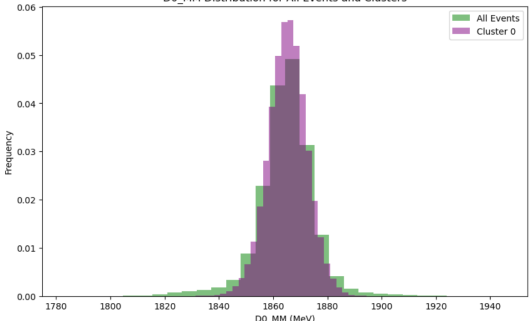
Difference (BDT - BDTG)



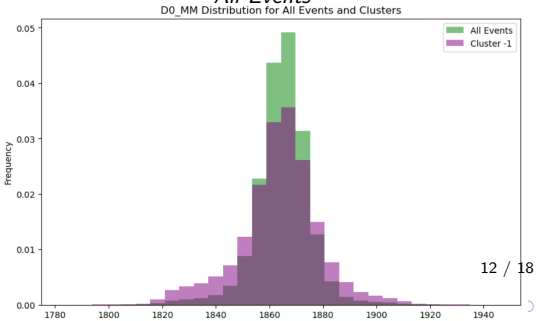
Unsupervised Learning RS - Density Based Clustering and Noise (DBSCAN).

312003 events in the "signal" cluster. 133809 events in the noise cluster.

D0_MM

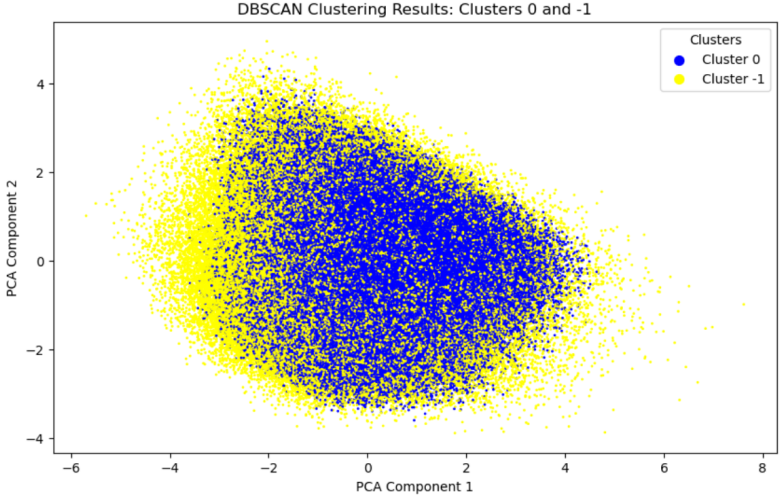


$$\frac{Signal\ Cluster}{All\ Events}$$



Unsupervised Learning RS - Density Based Clustering and Noise (DBSCAN)

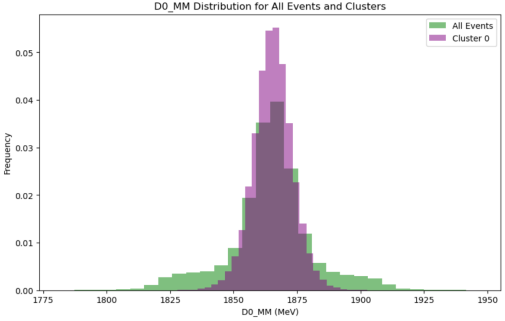
- We have seen that there isn't incredibly good discrimination of background, it seems most likely that it is better at clustering combinatorial background.
- I am excited to see if the story changes with the larger dataset.
- If we consider the two largest Principle Components, we can view the two clusters.


DBSCAN Clustering Results: Clusters 0 and -1
Clusters
Cluster 0
Cluster -1
PCA Component 2
PCA Component 1
4
2
0
−2
−4
−6
−4
−2
0
2
4
6
8

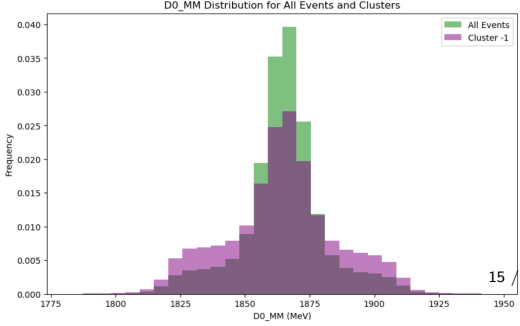
Unsupervised Learning WS - Density Based Clustering and Noise (DBSCAN). - Looking at D0_MM

149887 events in the "signal" cluster. 137839 events in the noise cluster.

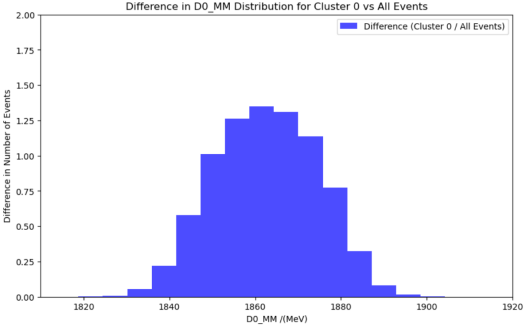
D0_MM "Signal" Cluster



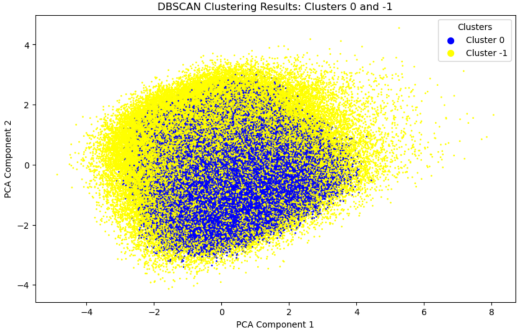
D0_MM Noise" Cluster



$$\frac{\textit{Signal Cluster}}{\textit{All Events}}$$



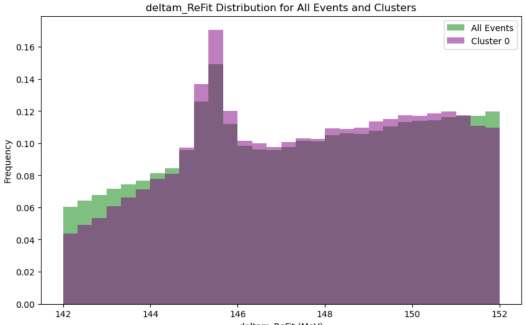
PCA



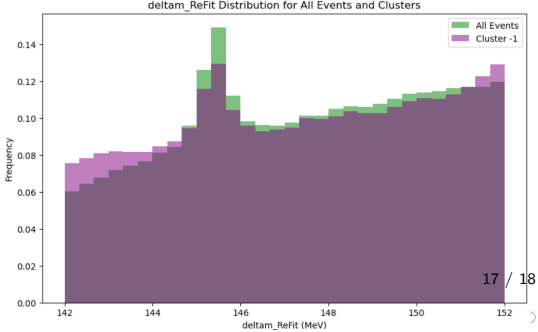
Unsupervised Learning WS - Density Based Clustering and Noise (DBSCAN). - Looking at deltam_ReFit

149887 events in the "signal" cluster. 137839 events in the noise cluster.

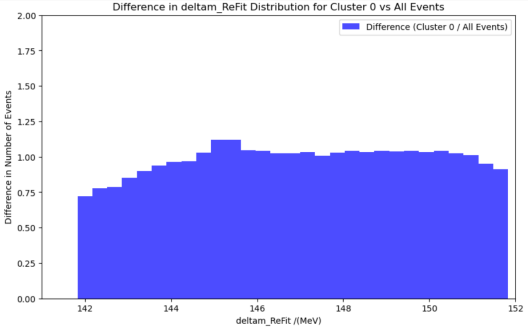
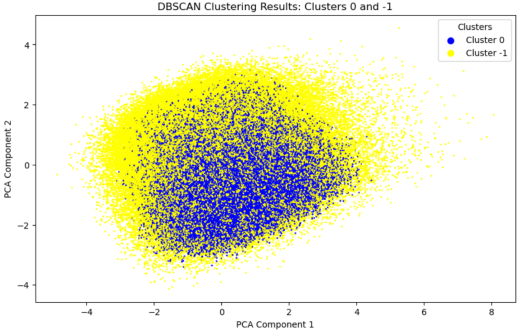
deltam_ReFit "Signal" Cluster



deltam_ReFit "Noise" Cluster



$\frac{\textit{Signal Cluster}}{\textit{All Events}}$



PCA