

Low Energy Production: Group Update for HD

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Monday 13th January | University of Warwick | FD Sim/Reco Group Meeting



WARWICK

Summary of samples and training

Currently producing weight files for 3 main algorithms

- DLSNSignalID
 - (40000 events (3) + 5000 events (4) VD) & (45000 events (8) HD)
- DLVertexing
 - (40000 events (1) + 5000 events (2) VD) & (45000 events (5) HD)
- MVAClusterMerging
 - (40000 events (3) + 5000 events (4) VD) (45000 events (8) HD)

New Production Validation Samples Available

Vertical Drift

- 1) MARLEY 5-70 MeV CC Signal Only (500 files * 100 events)
- 2) MARLEY 5-70 MeV ES Signal Only (500 files * 100 events)
- 3) MARLEY 5-70 MeV CC Signal and Background (5000 files * 10 events)
- 4) MARLEY 5-70 MeV ES Signal and Background (5000 files * 10 events)

Horizontal Drift

- 5) MARLEY 5-70 MeV CC Signal Only (500 files * 100 events)
- 6) MARLEY 5-70 MeV ES Signal Only (500 files * 100 events)
- 7) MARLEY 5-70 MeV CC Signal and Background Central APA (5000 files * 10 events)
- 8) MARLEY 5-70 MeV CC Signal and Background Lateral APA (5000 files * 10 events)
- 9) MARLEY 5-70 MeV ES Signal and Background Central APA (5000 files * 10 events)
- 10) MARLEY 5-70 MeV ES Signal and Background Lateral APA (5000 files * 10 events)

```
[phuvhw@stelvio phuvhw]$ du -h event_storage/
103G  event_storage/New_production_signal_background_CC_pndr
55G   event_storage/New_production_HD_signal_background_CC_lateral_pndr
145M  event_storage/New_production_signal_CC_pndr
68M   event_storage/New_production_signal_ES_pndr
149M  event_storage/New_production_HD_signal_CC_pndr
158G  event_storage/
```

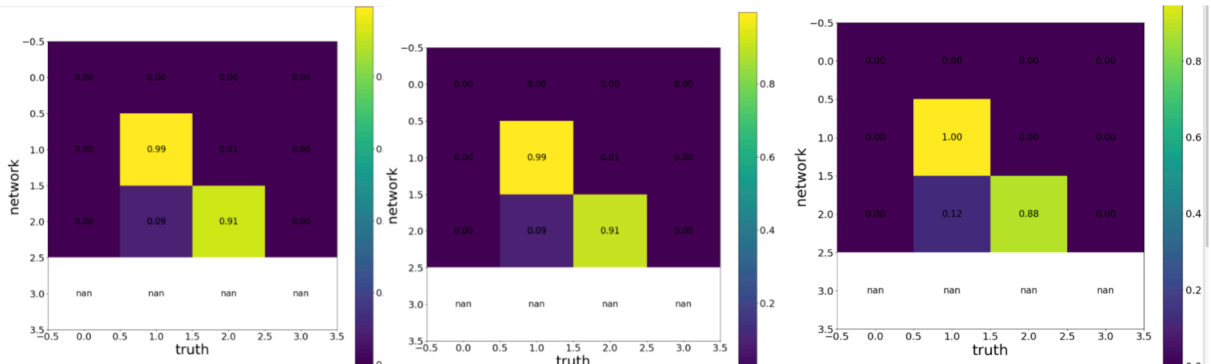
Used JustIN to generate .pndrs
from .root samples

HD Training DL SN Signal Network

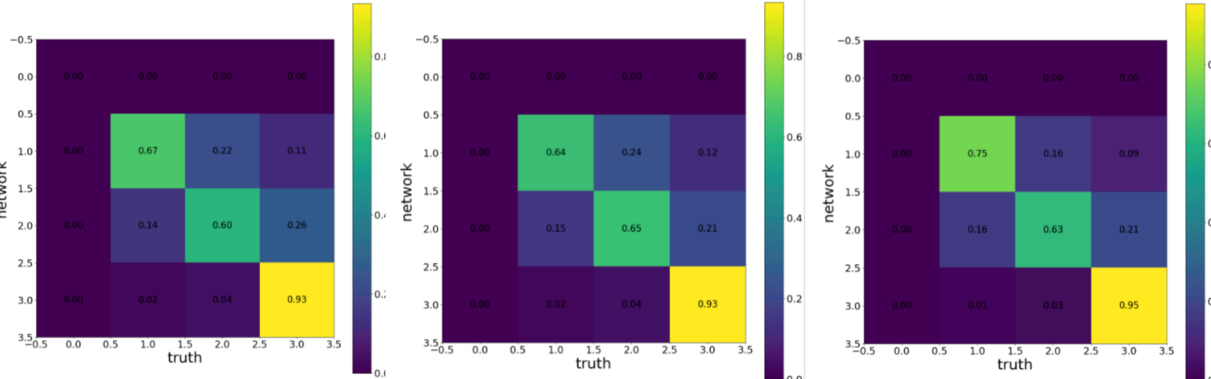
DLNSignalID - (45000 events (8) HD)

Pass 1: Null 0, Background 1, Signal 2
 Pass 2: : Null 0, Background 1, Photon 2, Electron.
 Both Network Electrons/Photons added to the same CaloHitList

Pass 1



Pass 2



- 10% validation 90% training
- Pass 1 Image size 256 (square)
- Pass 2 Image size 128 (square)
- 20 epochs

Better signal acceptance than 3.7k training stats

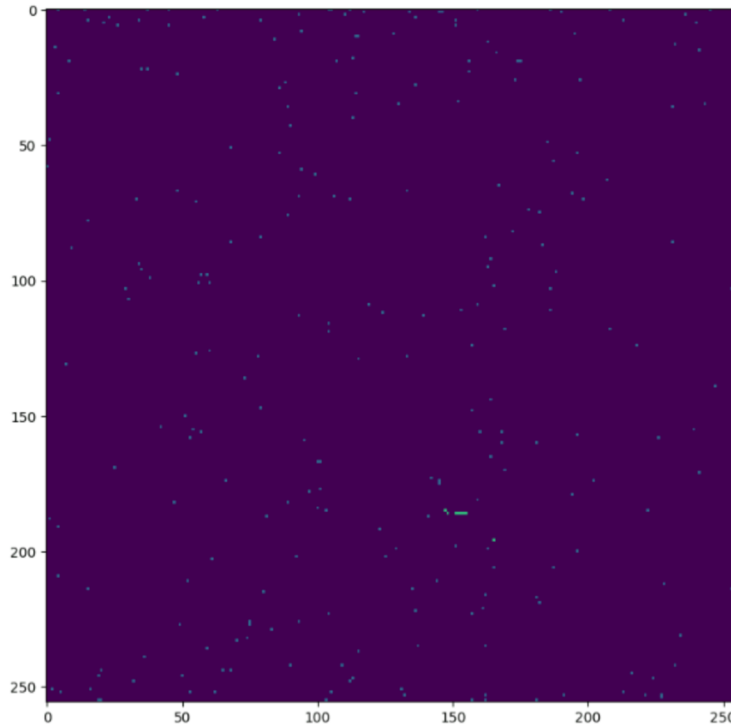
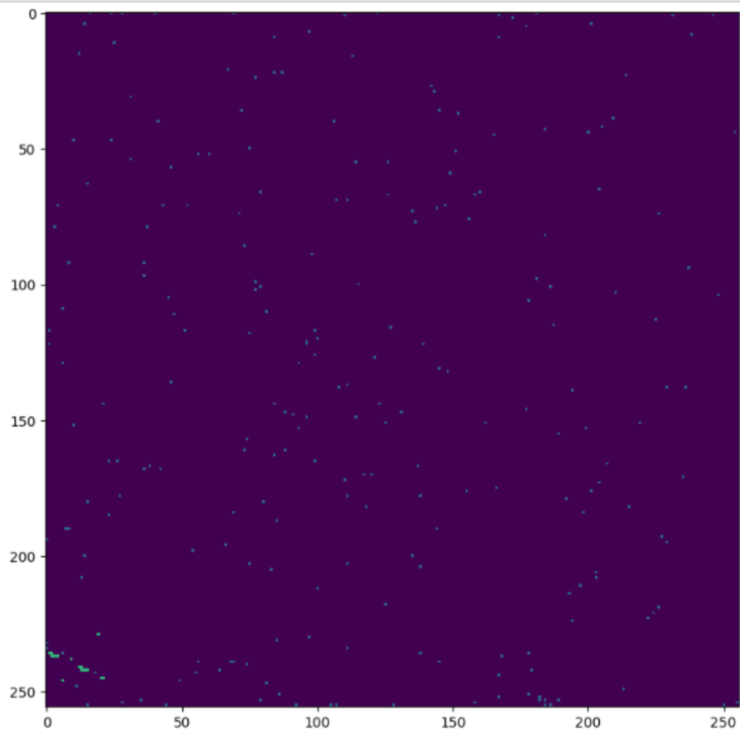


HD Training

DL SN Signal Network

Sample events (W view, Pass 1 (ROI Finding))

Pass 1: Null 0, Background 1, Signal 2
Pass 2: : Null 0, Background 1, Photon 2, Electron.
Both Network Electrons/Photons added to the same CaloHitList



■ Background

Neutrino Induced

■ Electron or Photon



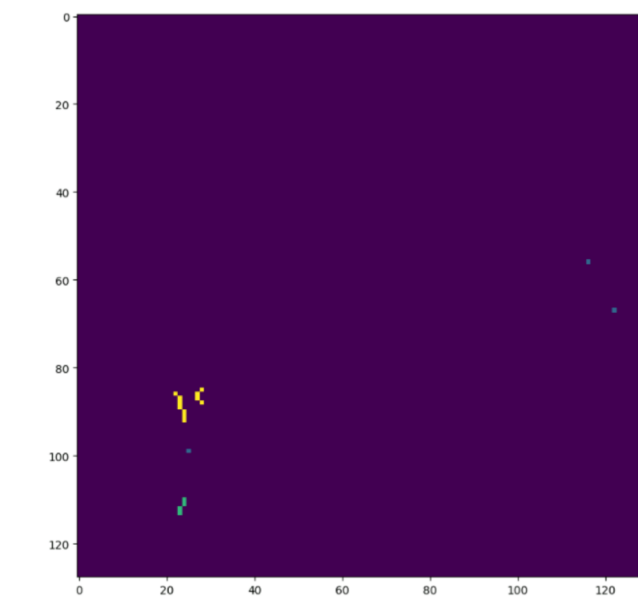
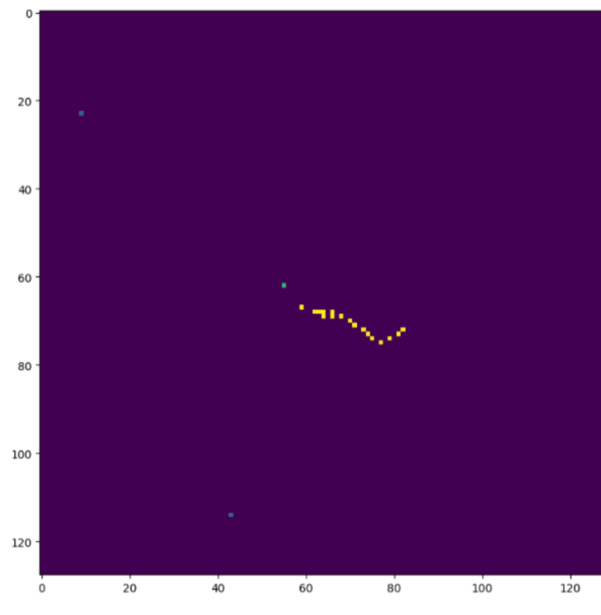
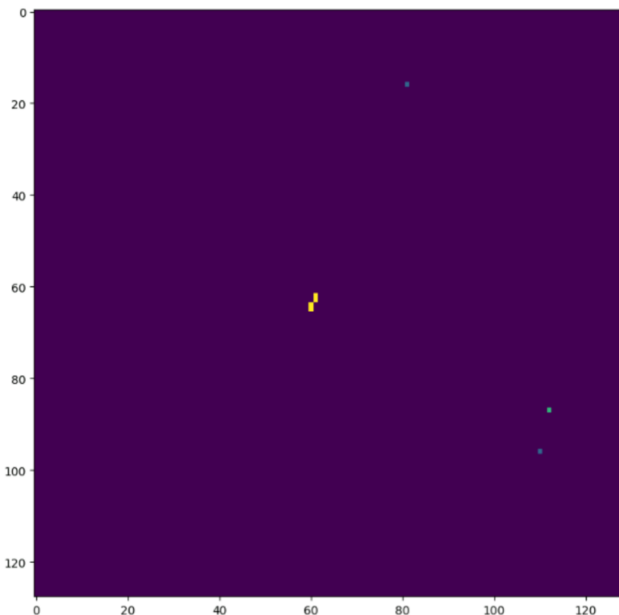
HD Training

DL SN Signal Network

Sample event (W view, Pass 2 (Hit Tagging))

Pass 1: Null 0, Background 1, Signal 2
Pass 2: : Null 0, Background 1, Photon 2, Electron.
Both Network Electrons/Photons added to the same CaloHitList

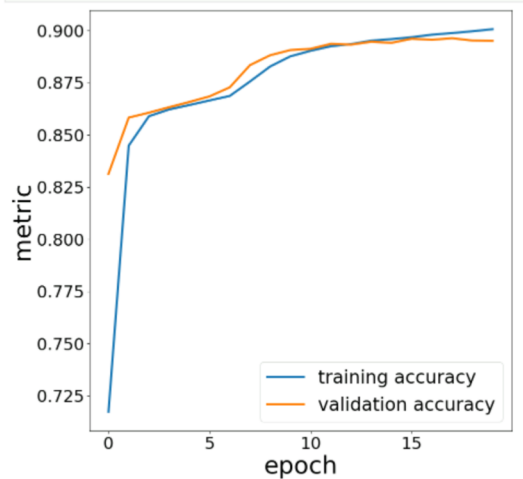
Neutrino Induced



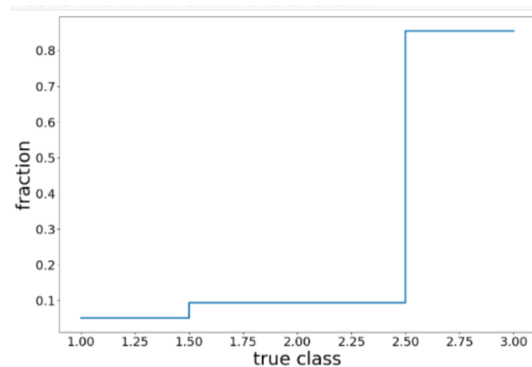
HD Training

DL SN Signal Network

Other Stats



HD Pass2 W view



HD Pass2 W view

```

[[73652286.    0.    0.    15.]
 [    0.    7955.   1668.   933.]
 [    0.   1170.   4465.  1460.]
 [    1.    831.   1820. 55396.]]

```

HD Pass2 W view

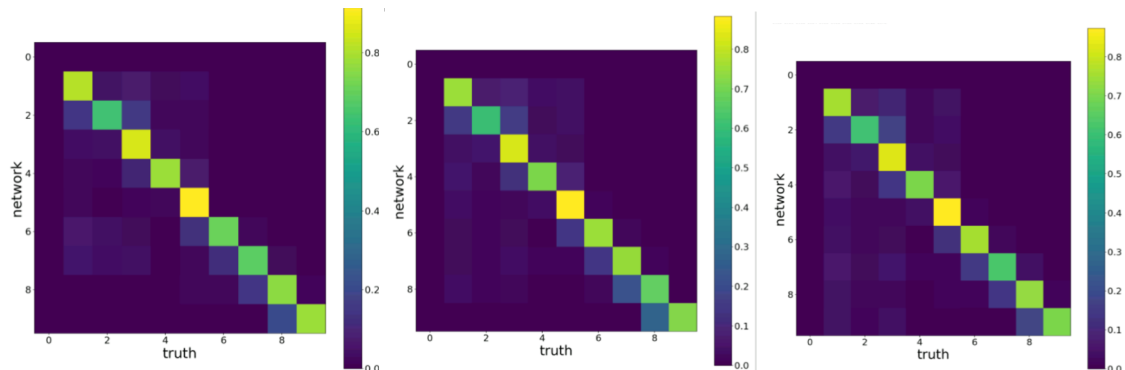
HD Training DL Vertex Network

Reduction from 20 classes to 10 classes. Fractional bounds set to:

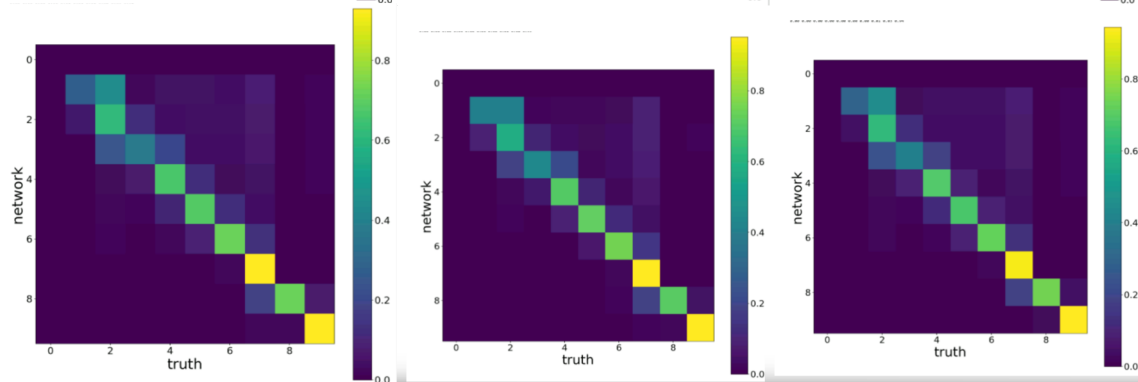
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<DistanceThresholds> 0. 0.005 0.009 0.015 0.025 0.04 0.06 0.18 0.25 1.0</DistanceThresholds>
```

DLVertex - (45000 events (5) HD)

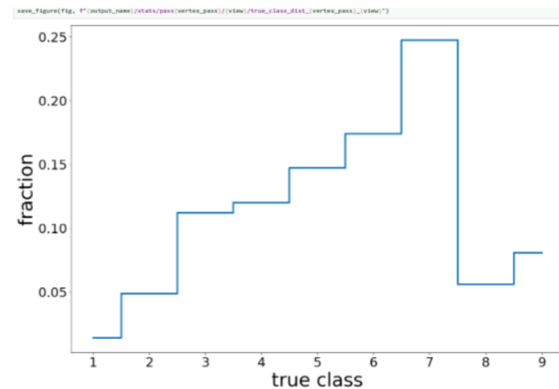
Pass 1



Pass 2



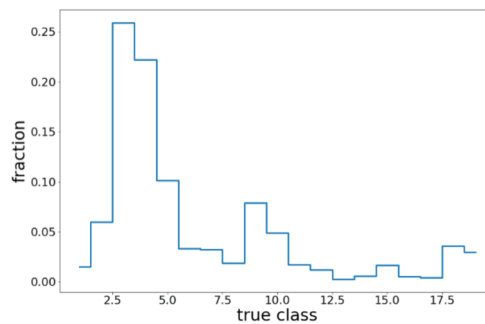
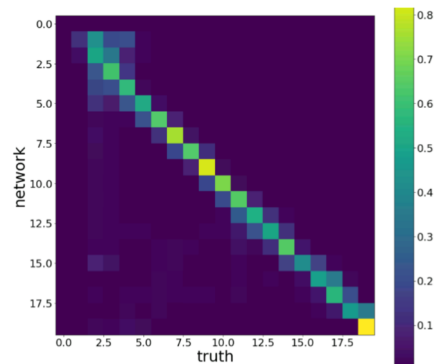
- 10% validation 90% training
- Pass 1 Image size 256 (square)
- Pass 2 Image size 128 (square)
- 20 epochs



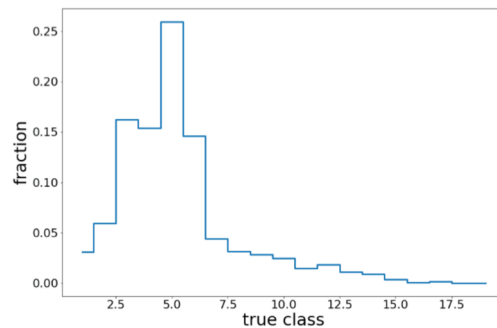
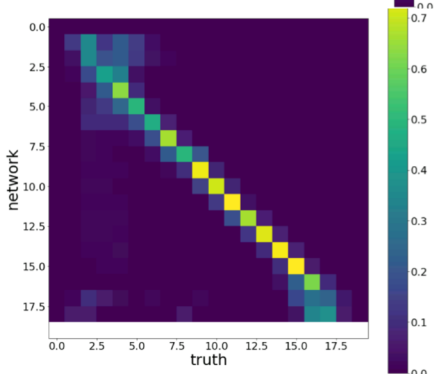
DL Vertex Network

Previous iteration VD network for reference

Pass 1



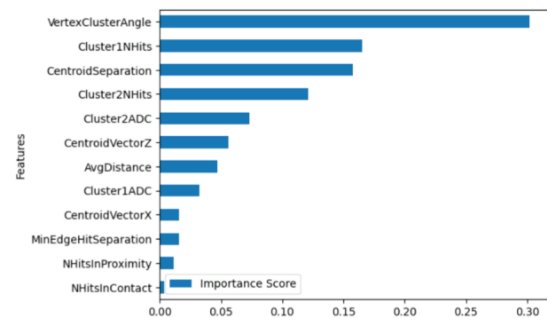
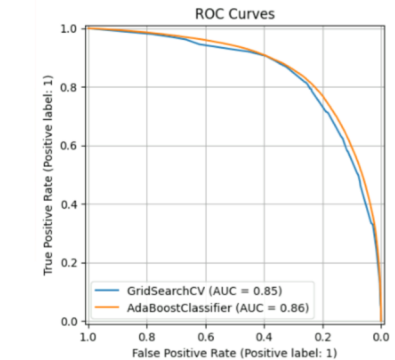
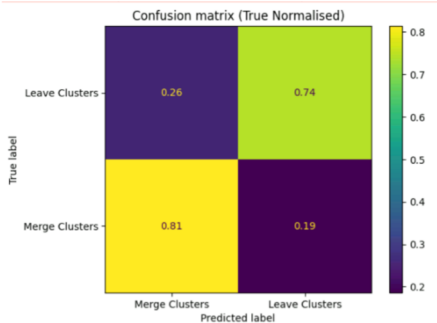
Pass 2



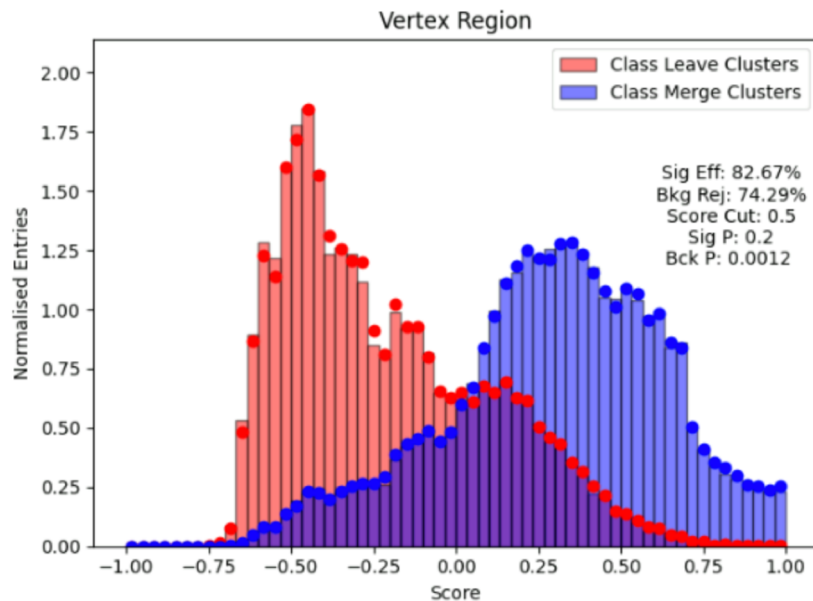
MVA Cluster Merging

BDTClusterMerging - (Trained on 300,000 clusters - including both signal and background)

- 50% validation 50% training
- 12 Parameters
- MaxDepth = 4
- No. of Trees = 1000



12
 (300978, 12)
 Total: 300978, signal: 164838 and background: 136140

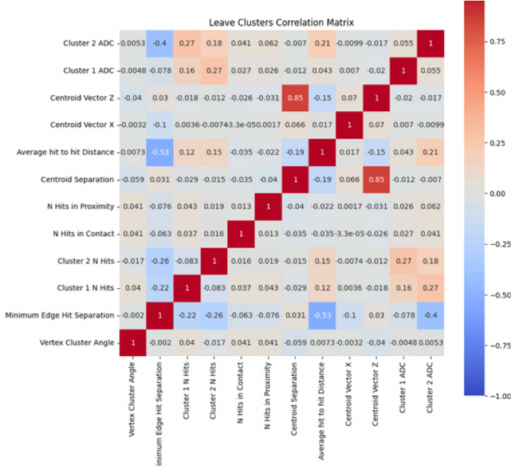
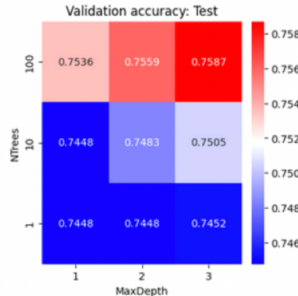
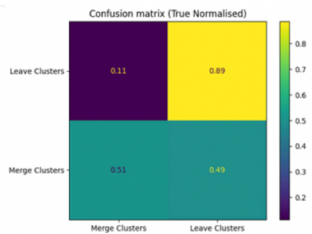
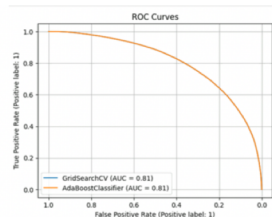


MVA Cluster Merging

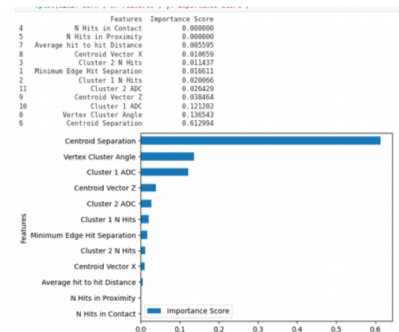
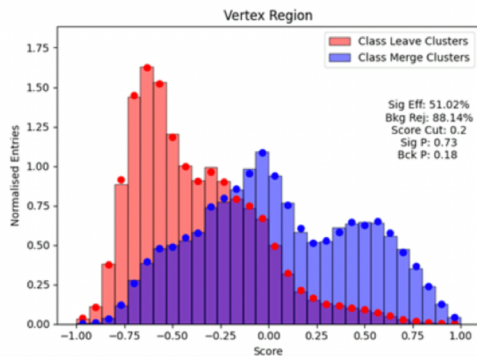
Previous BDT (for VD) (Only trained on signal only events)

Merging BDT v8

- BDT Training stats
- 12 Parameters



(224588, 12)
(224588,)
(224588, 12)
(224588,)
KS Signal: 0.0834986994323591497 with P value: 0.7314153858751964
KS Background: 0.094048885918558926 with P value: 0.1793406929159631



50% completeness/purity cut

Production Weights Efficiency

HD Lateral APA sample

