

HZZ 250 GeV Analysis

Update on the HZZ 250 GeV +80/-30 250/fb Analysis for the 29 August 2013 SiD Meeting:

Archive of the preparation and analysis code:

[subproclst-data8-delay-e250-350Gflav-4jets](#)

[flavortag-all-batch-revtx-350-4jets.xml](#) [revertex-all-batch.xml](#)

[runitallbatch2](#) [suballbatch2](#) [allSME250p80m30.lst](#) [ffhzzE250p80m30.lst](#)

[FastJetProcessor.cpp](#)

All difference in the LCFIPlus routines were commented out; not including these should make no difference in the output.

[algoEtc.cc](#) [FlavorTag.cc](#) [flavtag.cc](#)

Analysis code:

[MyDBDvvh.java](#)

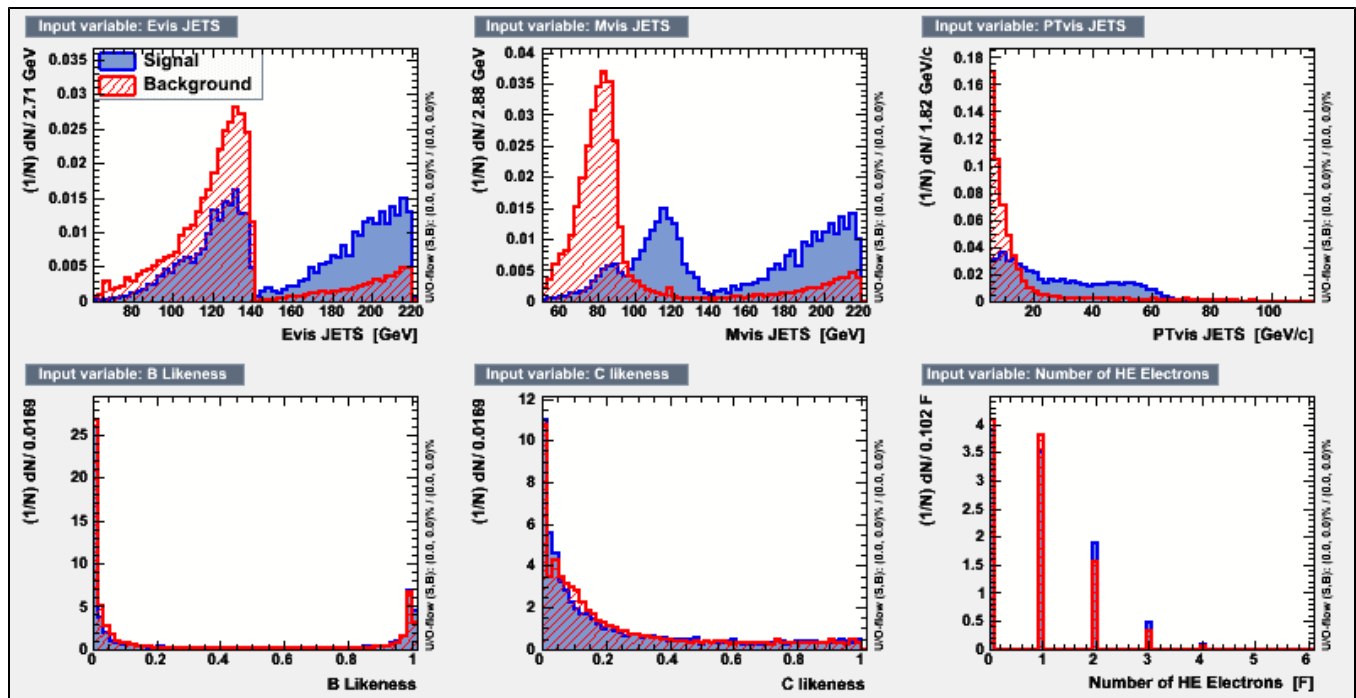
[MyDBDzHzzAnalysis.java](#)

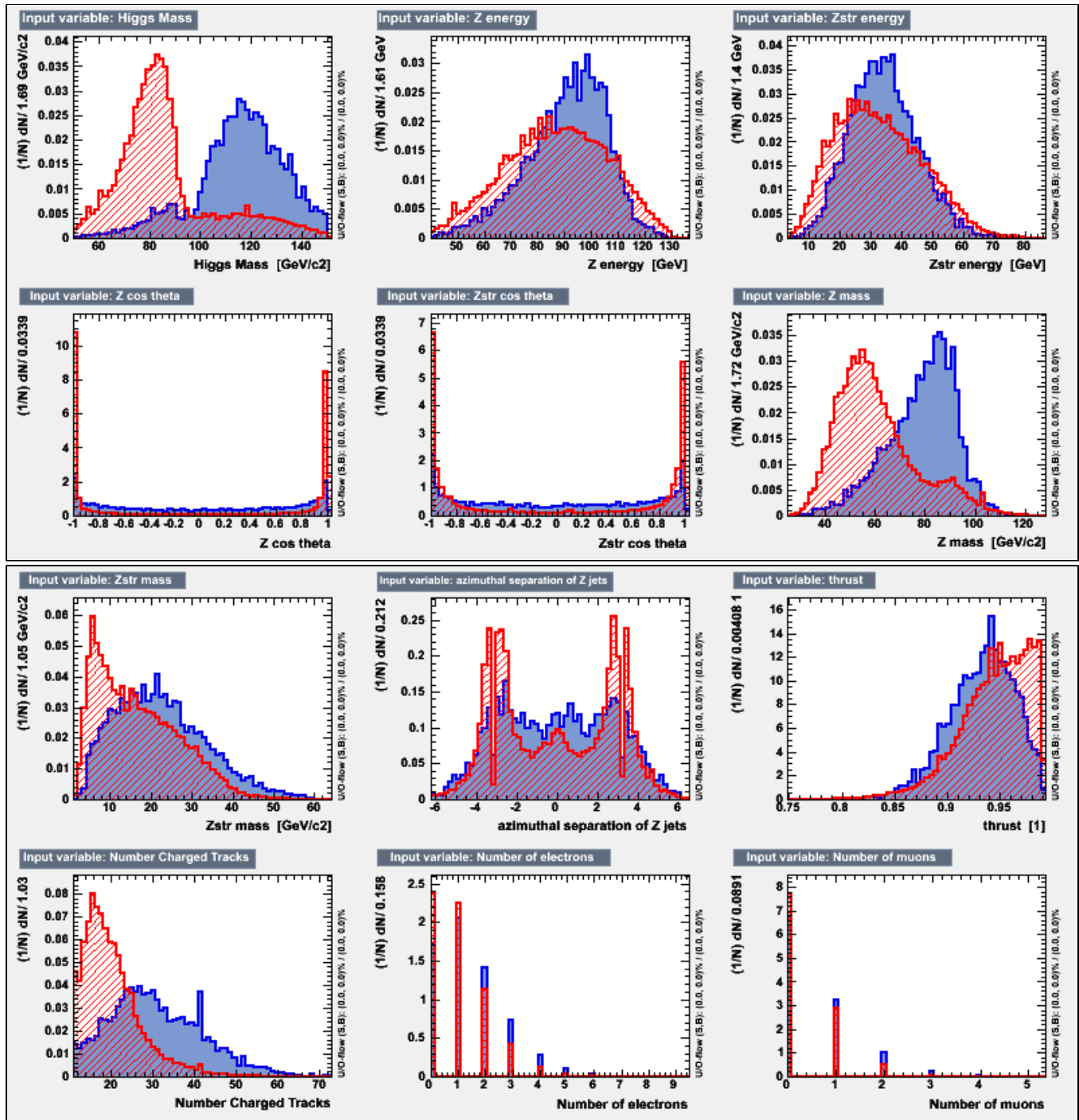
[IsolatedHighPElectronIdentifier.java](#)

Analysis:

- divide into 4 jet / 6 jet topologies
- apply preselection depending on topology
- train/apply TMVA's
- validate with cut table
- check remaining backgrounds

[variables_id_c1.png](#) [variables_id_c2.png](#) [variables_id_c3.png](#)





TMVA driver routine and cut-table code:

[sidHZZtmva-v4.C](#)

[zzhcuttabmini_v4.c](#)

Preselection variables:

[illegible]

The TMVA variables:

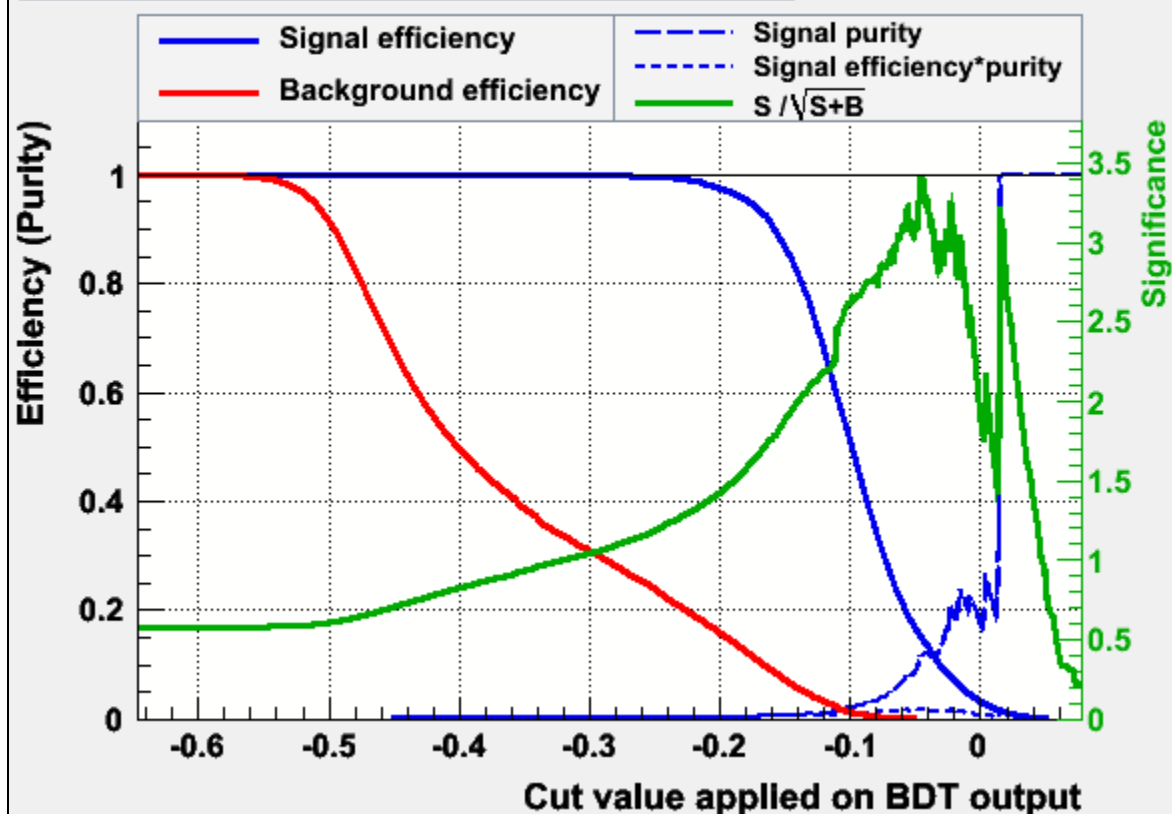
1. Evis JETS
2. Mvis JETS
3. PTvis JETS
4. B Likeness
5. C likeness
6. Number of HE Electrons
7. Higgs Mass
8. Z energy
9. Zstr energy
10. Z cos theta
11. Zstr cos theta
12. Z mass
13. Zstr mass
14. azimuthal separation of Z jets
15. thrust
16. Number Charged Tracks
17. Number of electrons
18. Number of muons

Performance of different MVA options:

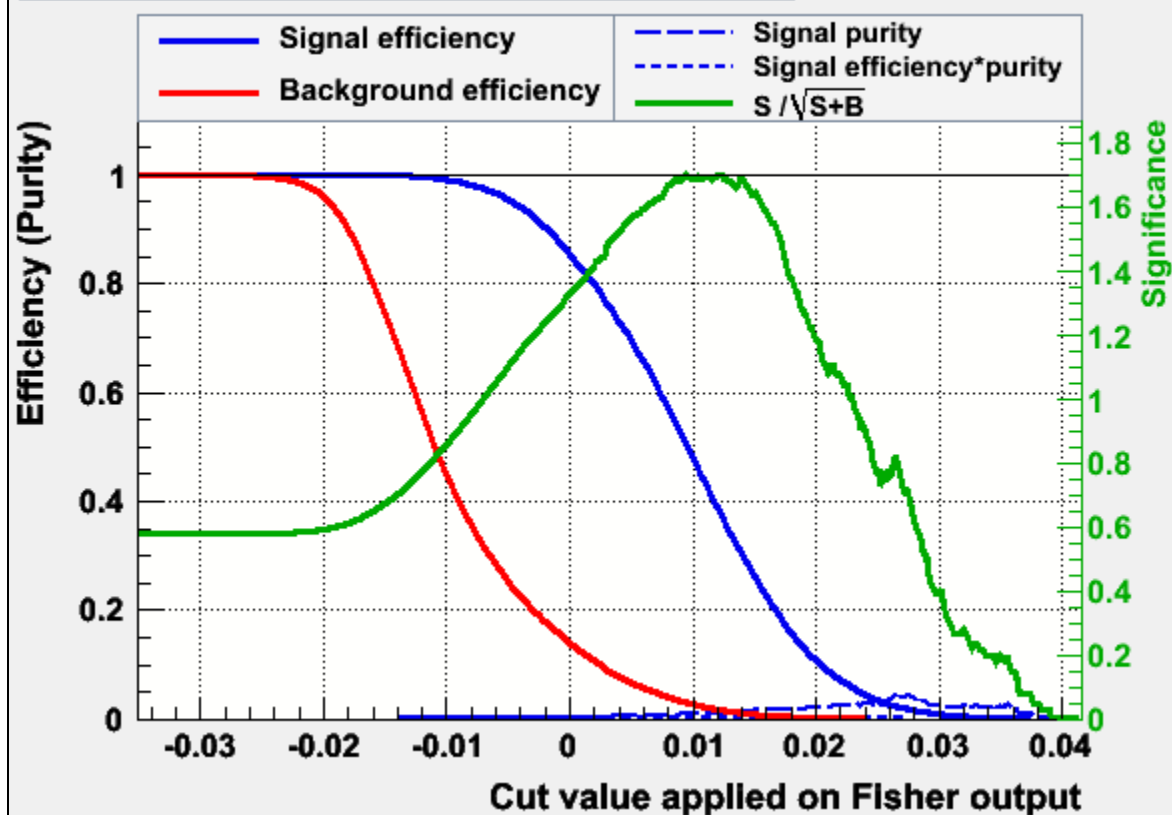
```
[neal@localhost weights]$ grep -A 8 -i optimal- ../hzzv14-presel-v4-new-common0410results.txt
--- Classifier      ( #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)  NSig      NBkg      EffSig      EffBkg
-----
--- Cuts:          ( 664.0744,1312202.5)  -0.0050      0            0          0          0          0
--- Likelihood:    ( 664.0744,1312202.5)  1.0000      0.728991    644.0848   779980.1   0.9699     0.5944
--- Fisher:        ( 664.0744,1312202.5)  0.0120      1.70335     258.2099   22721.13   0.3888     0.01732
--- BDTG:           ( 664.0744,1312202.5) -0.9823      1.17754     538.5353   208621.3   0.811      0.159
--- BDT:            ( 664.0744,1312202.5) -0.0462      3.42709     100.6751   762.2891   0.1516     0.0005809
```

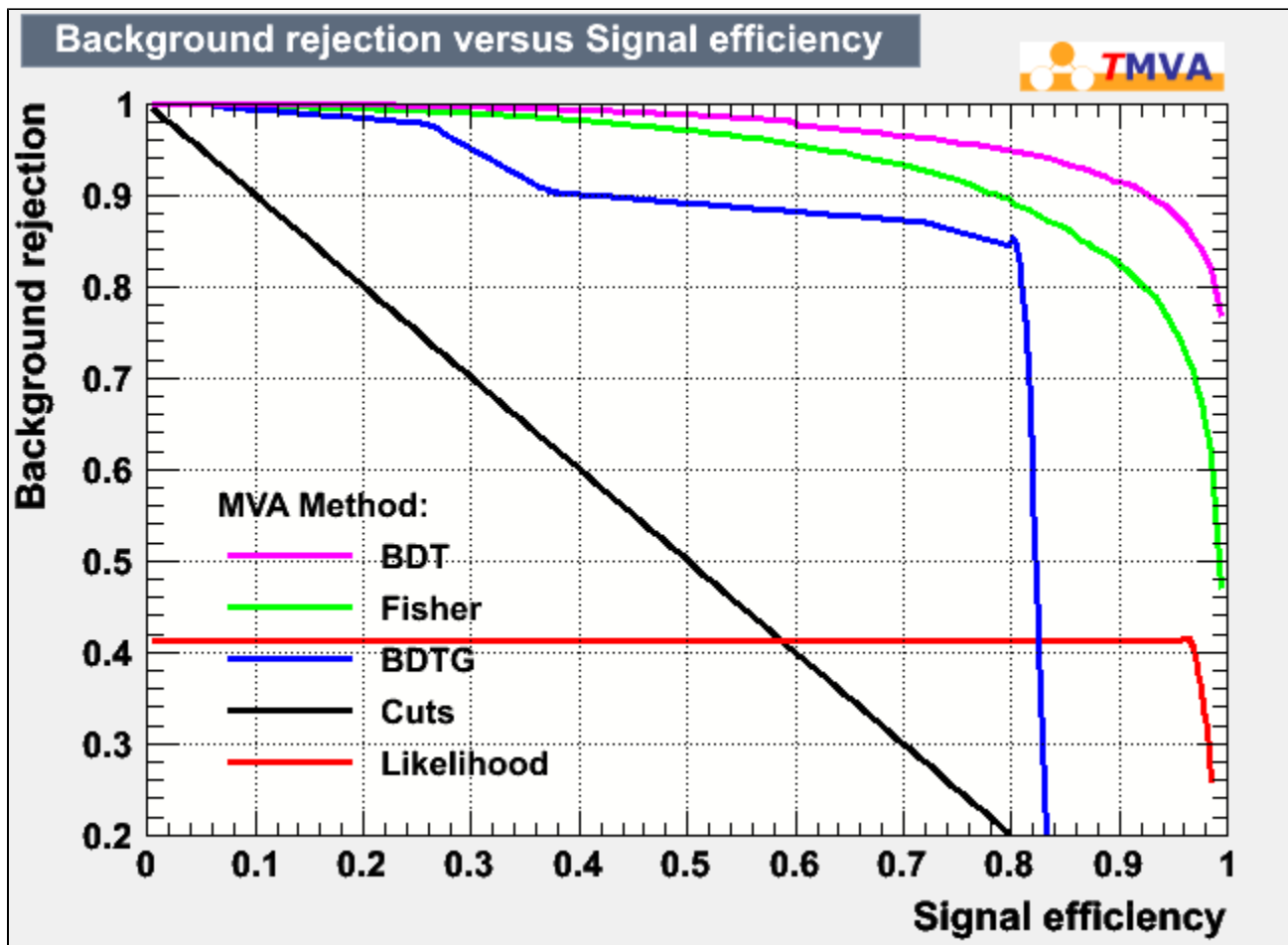
Combined 4-jet 6-jet performance using a cut at EvisJETS of 140 GeV to determine the preselection cuts to be used:

Cut efficiencies and optimal cut value



Cut efficiencies and optimal cut value





Cut table for BDT:

```

isigall= 1345.984602 isigpresel= 1460.101057 igood= 114.116455 ibad= 762.500000
intot= 77692005.984714 ipre= 876.616455
cuts__ (Cut
Name
e+mu tau nu Signif.
): all others 2f 4f 6f aa 1f 3f 5f q
cut #0 (all ): 7.769e+07 625000 14507062 1019938 0
54073784 0 7464875 0 948 91 45 262 0.15 Delta(sig*BR) = 6.548594 +/-
0.046879
cut #1 (20.<PTvisJETS ): 1.283
e+07 37500 5525512 746188 0 2968250 0 3546875 0 806 69 44 259
0.33 Delta(sig*BR) = 3.042092 +/- 0.024172
cut #2 (EvisJETS<220. ): 4.637
e+06 25000 3287550 514400 0 130196 0 678875 0 608 42 41 219
0.42 Delta(sig*BR) = 2.365748 +/- 0.020248
cut #3 (50.<hmass<140. ): 3.306
e+06 0 2542562 378675 0 60426 0 323875 0 536 38 35 206
0.45 Delta(sig*BR) = 2.233245 +/- 0.019503
cut #4 (||dph|-3.14159|>0.15 ): 2.772
e+06 0 2083912 364150 0 57097 0 266000 0 514 36 33 202
0.47 Delta(sig*BR) = 2.120439 +/- 0.018965
cut #5 (nTrks>10 ): 1.426
e+06 0 1136375 169088 0 30283 0 89875 0 466 10 19 177
0.56 Delta(sig*BR) = 1.777889 +/- 0.017994
cut #6 (jetthrust<0.99 ): 1.325
e+06 0 1044700 165588 0 30033 0 84125 0 463 10 19 173
0.58 Delta(sig*BR) = 1.730704 +/- 0.017728
cut #7 (ej1>40. ): 1.313
e+06 0 1035112 164625 0 29215 0 83250 0 462 10 19 173
0.58 Delta(sig*BR) = 1.725415 +/- 0.017704
cut #8 (MVA ): 8.766
e+02 0 138 625 0 0 0 0 51 0 1 62
3.85 Delta(sig*BR) = 0.259452 +/- 0.015456

```

Remaining backgrounds:

```

$ awk '{print $3,$7,$15}' zzhpasing.dat | sort -n | uniq -c | awk '{if (NF==4) print $1*$2*$4,$0}' | sort -k
1,1 -n
1278744 1 106562 4f_sz 12.500000
1278792 1 106566 4f_sw 12.500000
1278864 1 106572 4f_sz 12.500000
1278900 1 106575 4f_zz 12.500000
1279284 1 106607 2f_z_ 12.500000
2557224 2 106551 4f_ww 12.500000
2557272 2 106553 4f_zz 12.500000
2557704 2 106571 4f_sz 12.500000
2557752 2 106573 4f_zz 12.500000
3836664 3 106574 4f_zz 12.500000
3836808 3 106578 4f_ww 12.500000
12792960 10 106608 2f_z_ 12.500000
16625856 13 106576 4f_zz 12.500000
24299556 19 106577 4f_ww 12.500000

```

Variable distributions without any preselection:

[variables_id_c1-nopresel.png](#) [variables_id_c2-nopresel.png](#) [variables_id_c3-nopresel.png](#)

nu nu H only:

[variables_id_c1-4jonly.png](#)

qqH, lH only:

[variables_id_c1-no4j.png](#)

[TrackSubdetectorHitNumbersDriver.java](#)