

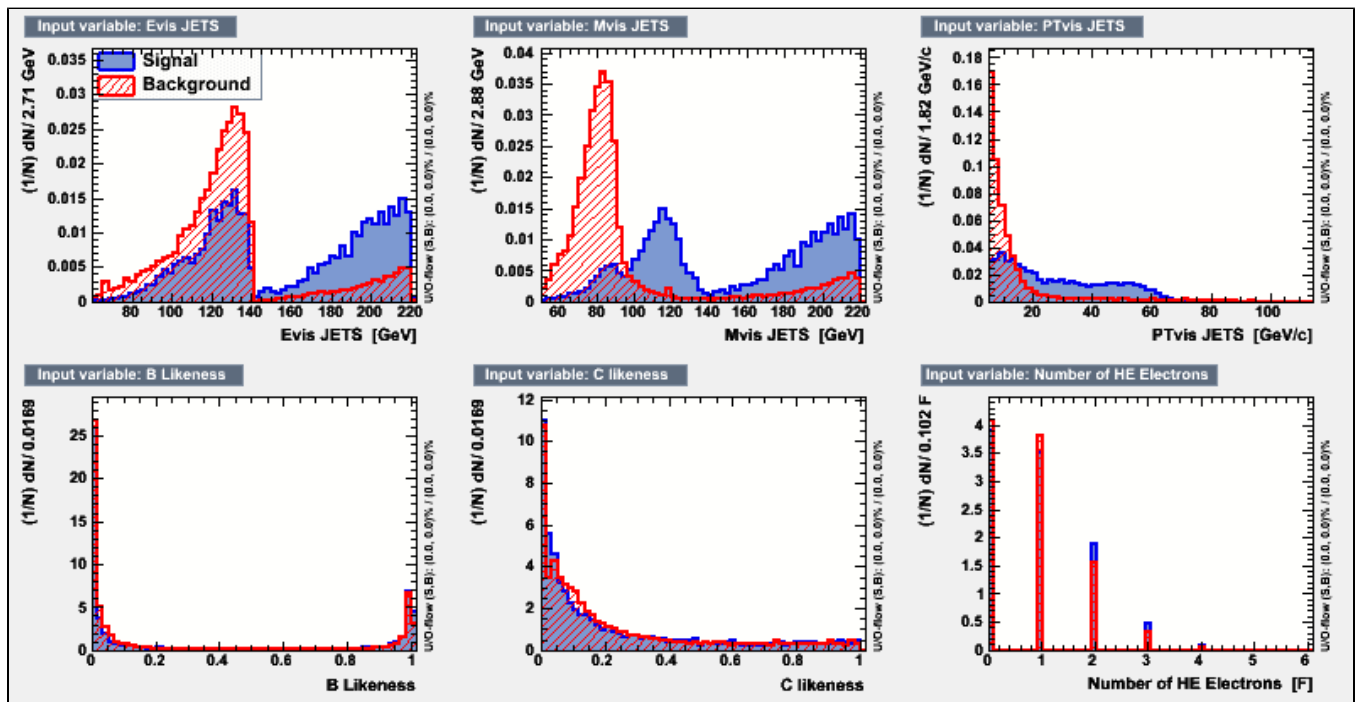
HZZ 250 GeV Analysis - Update 1b

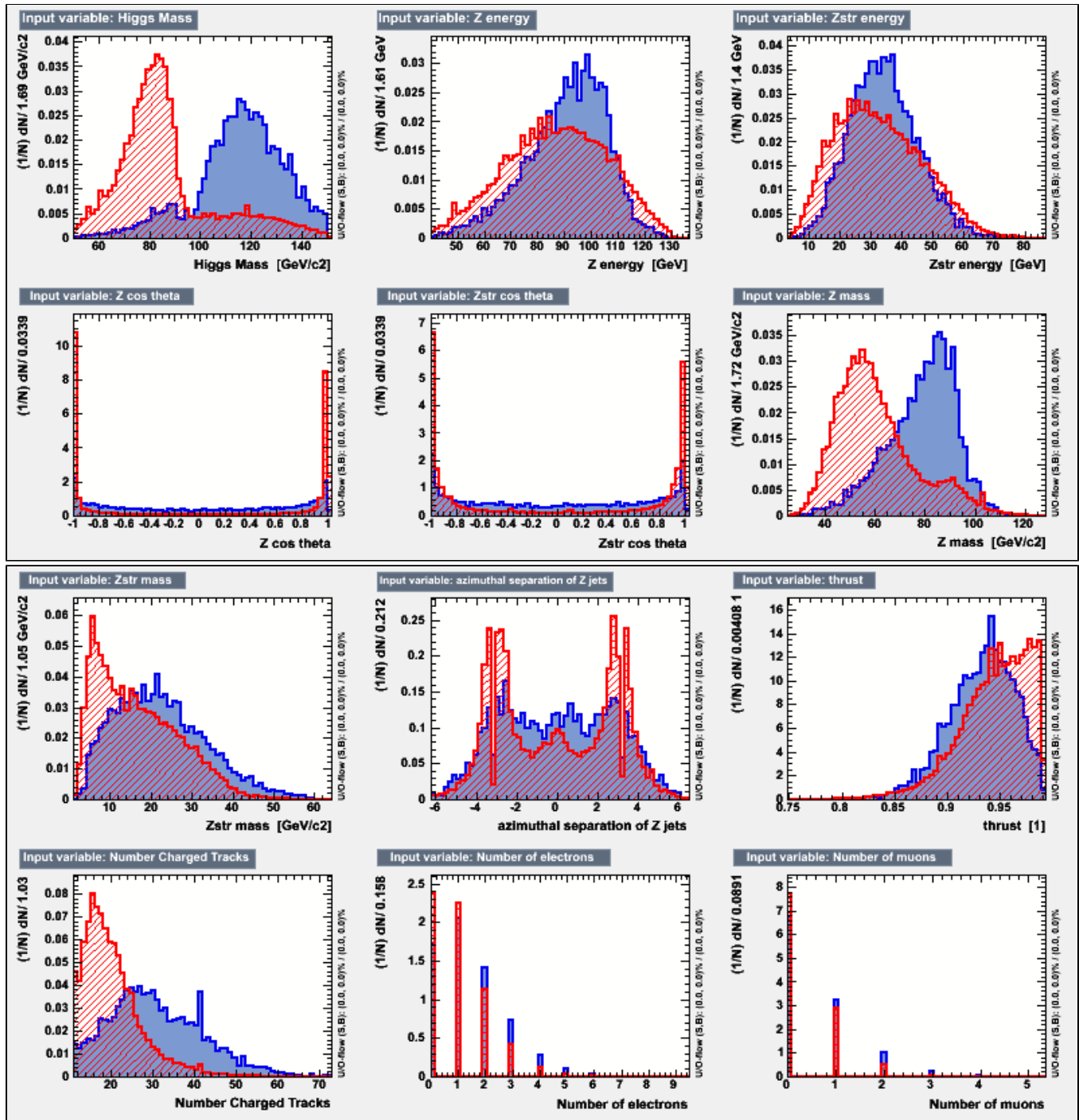
Update on the HZZ 250 GeV +80/-30 250/fb Analysis for the 5 September 2013 SiD Meeting:

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Analysis:

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





Preselection variables:

```
Evis<140.0: (4 Jet category)
# nTrks>10 &&
# EvisJETS>60.0 &&&nbsp;
# PTvisJETS>5.0 &&&nbsp;
# hmass>50. && hmass<140. &&&nbsp;
# fabs(fabs(dph)-3.14159)>0.15 &&&nbsp;
# ej1>40. &&&nbsp;
# jetthrust<0.99

Evis>140: (6 jet category)
# nTrks>20 &&
# EvisJETS<220.0 &&
# PTvisJETS>5.0 &&
# hmass>100. && hmass<150. &&
# fabs(fabs(dph)-3.14159)>0.05 &&
# ej1<130. &&
# jetthrust<0.99
```

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
---
```

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.
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:

```

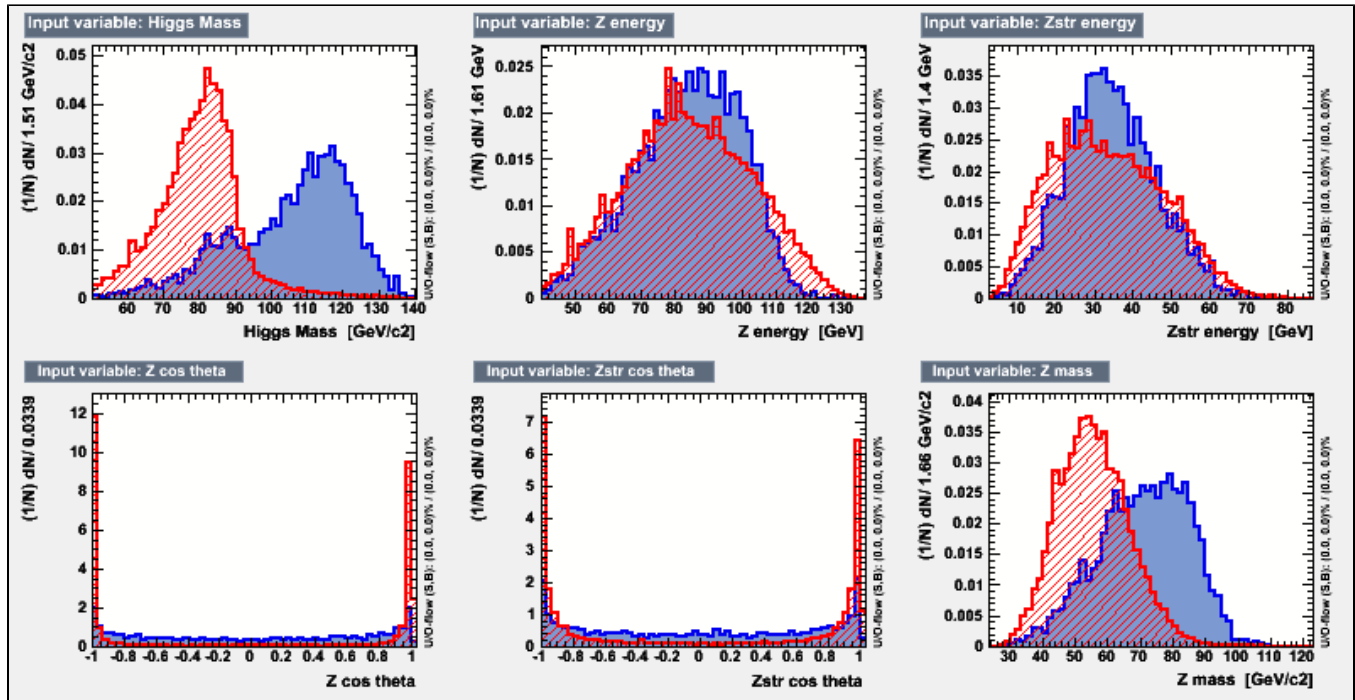
$ sed 's/\./,/g' zzhpassing.dat | awk '{if (NF==18) print $3,$7,$15}' | sort -n | uniq -c | awk '{if (NF==4)
aa+=$1*$4};print $1*$4"\t"$0}' END{print "Sum of weights = "aa}' | sort -k 1,1 -n
Sum of weights = 762,5
12,5 1 106562 4f_sz 12,500000
12,5 1 106566 4f_sw 12,500000
12,5 1 106572 4f_sz 12,500000
12,5 1 106575 4f_zz 12,500000
12,5 1 106607 2f_z_ 12,500000
25 2 106551 4f_ww 12,500000
25 2 106553 4f_zz 12,500000
25 2 106571 4f_sz 12,500000
25 2 106573 4f_zz 12,500000
37,5 3 106574 4f_zz 12,500000
37,5 3 106578 4f_ww 12,500000
125 10 106608 2f_z_ 12,500000
162,5 13 106576 4f_zz 12,500000
237,5 19 106577 4f_ww 12,500000

```

Background contributions for Evis>140:

```
[neal@localhost weights]$ sed 's/\./,/g' zzhpasing.dat | awk '{if ($18>=140. && NF==18) print $3,$7,$15}' |
sort -n | uniq -c | awk '{if (NF==4) aa+=$1*$4;print $1*$4"\t"$0} END{print "Sum of weights = "aa}' | sort -k
1,1 -n
Sum of weights = 187,5
12,5      1 106551 4f_ww 12,500000
12,5      1 106577 4f_ww 12,500000
25        2 106553 4f_zz 12,500000
25        2 106573 4f_zz 12,500000
25        2 106576 4f_zz 12,500000
37,5      3 106574 4f_zz 12,500000
50        4 106608 2f_z_ 12,500000
```

Background contributions for Evis<140:



```
[neal@localhost weights]$ sed 's/\./,/g' zzhpasing.dat | awk '{if ($18<140. && NF==18) print $3,$7,$15}' |
sort -n | uniq -c | awk '{if (NF==4) aa+=$1*$4;print $1*$4"\t"$0} END{print "Sum of weights = "aa}' | sort -k
1,1 -n
Sum of weights = 575
12,5      1 106551 4f_ww 12,500000
12,5      1 106562 4f_sz 12,500000
12,5      1 106566 4f_sw 12,500000
12,5      1 106572 4f_sz 12,500000
12,5      1 106575 4f_zz 12,500000
12,5      1 106607 2f_z_ 12,500000
25        2 106571 4f_sz 12,500000
37,5      3 106578 4f_ww 12,500000
75        6 106608 2f_z_ 12,500000
137,5     11 106576 4f_zz 12,500000
225       18 106577 4f_ww 12,500000 <*****
```

```

--- Classifier  ( #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)      NSig      NBkg      EffSig      EffBkg
-----
---      Cuts:  (309.89453, 1128865)  -0.0050      0          0          0          0          0
--- Likelihood: (309.89453, 1128865)  1.0000      0.378385  299.2573  625191.7  0.9657  0.5538
---      Fisher: (309.89453, 1128865)  0.0088      1.63217  150.0501  8301.587  0.4842  0.007354
---      BDTG:   (309.89453, 1128865) -0.9950      1.40141  134.4158  9065.234  0.4337  0.00803
---      BDT:    (309.89453, 1128865)  0.0177      3.63521  38.5486  73.90136  0.1244  6.547e-05
-----

```

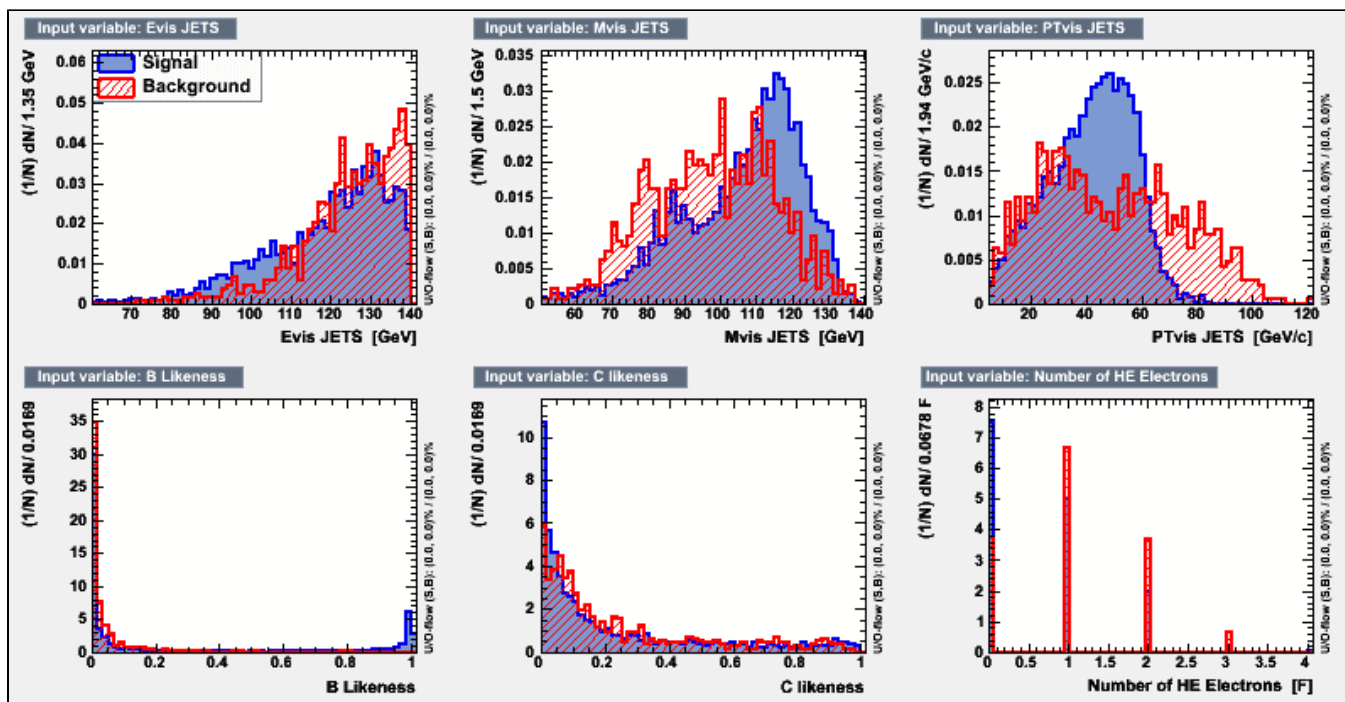
after raising reco higgs mass cut from 50 GeV to 100 GeV:

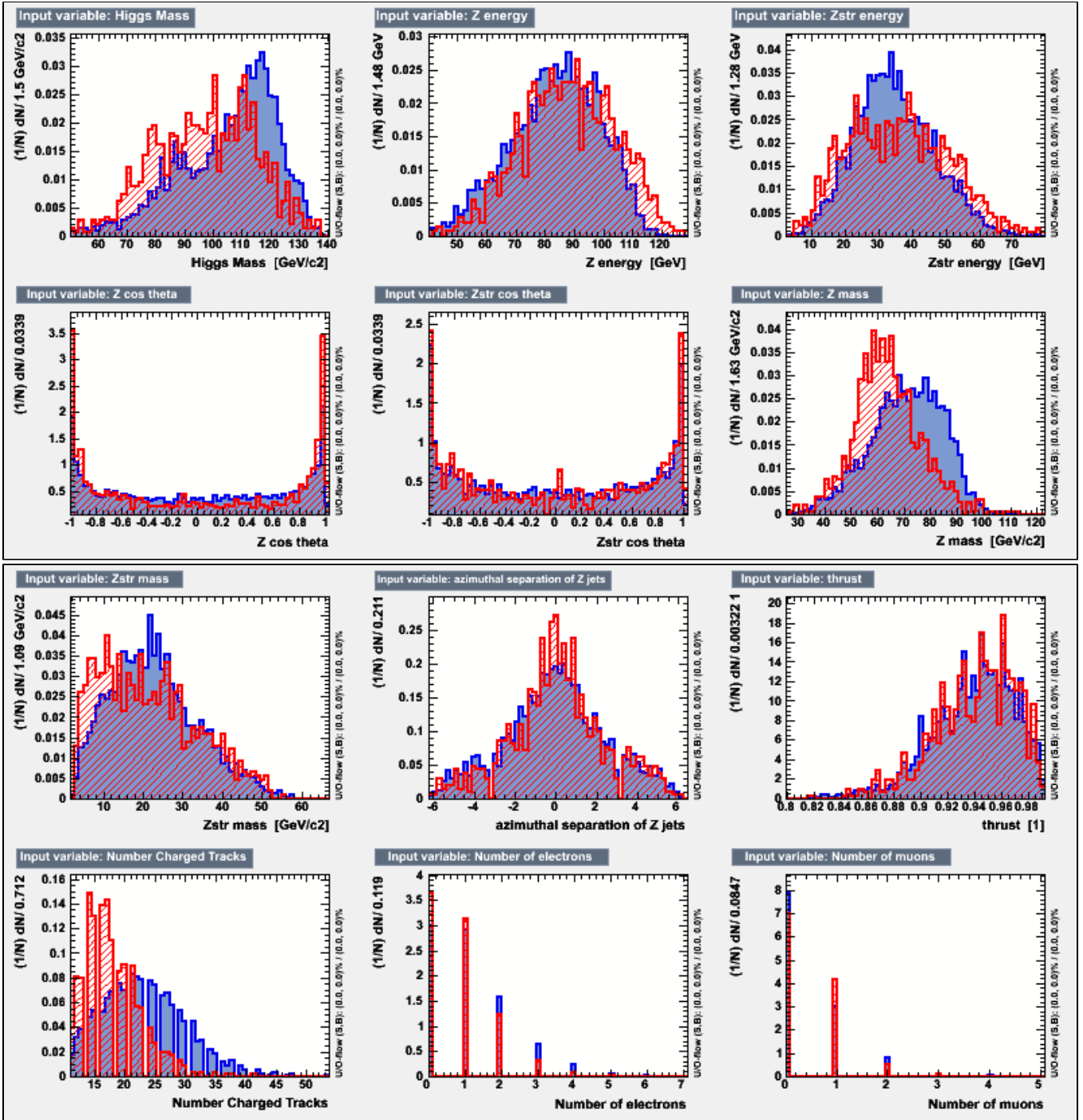
```

--- Classifier  ( #signal, #backgr.)  Optimal-cut  S/sqrt(S+B)      NSig      NBkg      EffSig      EffBkg
-----
---      Cuts:  (209.30833, 51800)    -0.0050      0          0          0          0          0
--- Likelihood: (209.30833, 51800)    0.9105      1.08931  191.9554  30860.64  0.9171  0.5958
---      Fisher: (209.30833, 51800)    0.0176      1.78558  116.8125  4162.945  0.5581  0.08037
---      BDTG:   (209.30833, 51800)    -0.5098      1.00598  204.0195  40926.24  0.9747  0.7901
---      BDT:    (209.30833, 51800)    0.0361      2.92564  72.9263  548.4119  0.3484  0.01059
-----

```

Evis<140 GeV and only idrup = 106577 for the background:





Potential tools for reducing the 4f_WW background:

- higher cut on number of charged tracks (unlikely to help S)
- extra cuts but keep any event that has high B-likeness
- redoing n-tuples adding variables for jet combos consistent with W decays (IN PROGRESS)

Note concerning ZZ background: wider cut on acoplanarity should help