

# *SiD*

## *Total Higgs Width from*

### *$e^+e^- \rightarrow ZH, H \rightarrow ZZ^*$*

### *@ $E_{cm} = 250 \text{ GeV}$*

25 July 2013

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# Inputs

[ftp://ftp-lcd.slac.stanford.edu/ilc4/DBD/ILC250/higgs\\_ffh\\_zz/](ftp://ftp-lcd.slac.stanford.edu/ilc4/DBD/ILC250/higgs_ffh_zz/)

[/nfs/slac/g/lcd/ilc\\_data4/snowmass/ILC250/higgs/sidloi3/slci/reco/higgs\\_ffh\\_zz\\_-80e-\\_30e+\\_000\\_SLIC-v3r0p3\\_geant4-v9r5p1\\_QGSP\\_BERT\\_sidloi3\\_lcsimTracking\\_lcsim-2.9\\_pandora.slci](/nfs/slac/g/lcd/ilc_data4/snowmass/ILC250/higgs/sidloi3/slci/reco/higgs_ffh_zz_-80e-_30e+_000_SLIC-v3r0p3_geant4-v9r5p1_QGSP_BERT_sidloi3_lcsimTracking_lcsim-2.9_pandora.slci)

Ecm(GeV)	mHiggs (GeV)	Processes	Event Weight Lumi (fb-1)	Pol. (% e <sup>-</sup> / %e <sup>+</sup> )	Mixed Nevents
250	2000	all_SM_background	250	-80/+30	2,822,661
			250	+80/-30	2,058,374
250	2000	evW_eeZ_vvZ_semileptonic	250	-80/+30	2,030,078
			250	+80/-30	1,485,507
250	2000	higgs_ffh_zz	250	-80/+30	120,000
			250	+80/-30	120,012

[/nfs/slac/g/lcd/ilc\\_data4/snowmass/ILC250/backgrounds/sidloi3/slci/reco/all\\_SM\\_background\\_-80e-\\_30e+\\_000\\_SLIC-v3r0p3\\_geant4v9r5p1\\_QGSP\\_BERT\\_sidloi3\\_lcsimTracking\\_lcsim-2.9\\_pandora.slci](/nfs/slac/g/lcd/ilc_data4/snowmass/ILC250/backgrounds/sidloi3/slci/reco/all_SM_background_-80e-_30e+_000_SLIC-v3r0p3_geant4v9r5p1_QGSP_BERT_sidloi3_lcsimTracking_lcsim-2.9_pandora.slci)

# Topologies

higgs\_ffh\_zz\_-80e-\_+30e+\_018\_SLIC-v3r0p3\_geant4-v9r5p1\_QGSP\_BERT\_sidloi3\_lcsimTracking\_lcsim-2.9\_pandora.slcio-flav.slcio

6 Jet

- ▷ gamma(E=1.3421 status=Intermediate)
- ▷ gamma(E=.081287 status=Intermediate)
- ▷ e-(E=46.709 status=Intermediate)
- ▷ e+(E=64.186 status=Intermediate)
- ▽ h0/H01(E=136.92 status=Intermediate)
  - ▽ h0/H01(E=136.92 status=Intermediate)
    - ▷ Zo(E=86.447 status=Intermediate)
    - ▷ Zo(E=50.470 status=Intermediate)

- ▷ gamma(E=.018825 status=Intermediate)
- ▷ gamma(E=1.4878 status=Intermediate)
- ▷ mu-(E=48.367 status=Intermediate)
- ▷ mu+(E=60.933 status=Intermediate)
- ▽ h0/H01(E=138.96 status=Intermediate)
  - ▽ h0/H01(E=138.96 status=Intermediate)
    - ▷ Zo(E=45.666 status=Intermediate)
    - ▷ Zo(E=93.293 status=Intermediate)

4 Jet

- ▷ gamma(E=2.7756E-14 status=Intermediate)
- ▷ gamma(E=1.4775E-5 status=Intermediate)
- ▷ nu\_e(E=47.906 status=Intermediate)
- ▷ nu\_e\_bar(E=51.523 status=Intermediate)
- ▽ h0/H01(E=150.99 status=Intermediate)
  - ▽ h0/H01(E=150.99 status=Intermediate)
    - ▷ Zo(E=128.37 status=Intermediate)
    - ▷ Zo(E=22.613 status=Intermediate)

- ▷ gamma(E=1.4452E-5 status=Intermediate)
- ▷ gamma(E=5.8498E-8 status=Intermediate)
- ▷ u(E=80.005 status=Intermediate)
- ▷ u\_bar(E=30.779 status=Intermediate)
- ▽ h0/H01(E=137.89 status=Intermediate)
  - ▽ h0/H01(E=137.89 status=Intermediate)
    - ▷ Zo(E=108.89 status=Intermediate)
    - ▷ Zo(E=28.993 status=Intermediate)

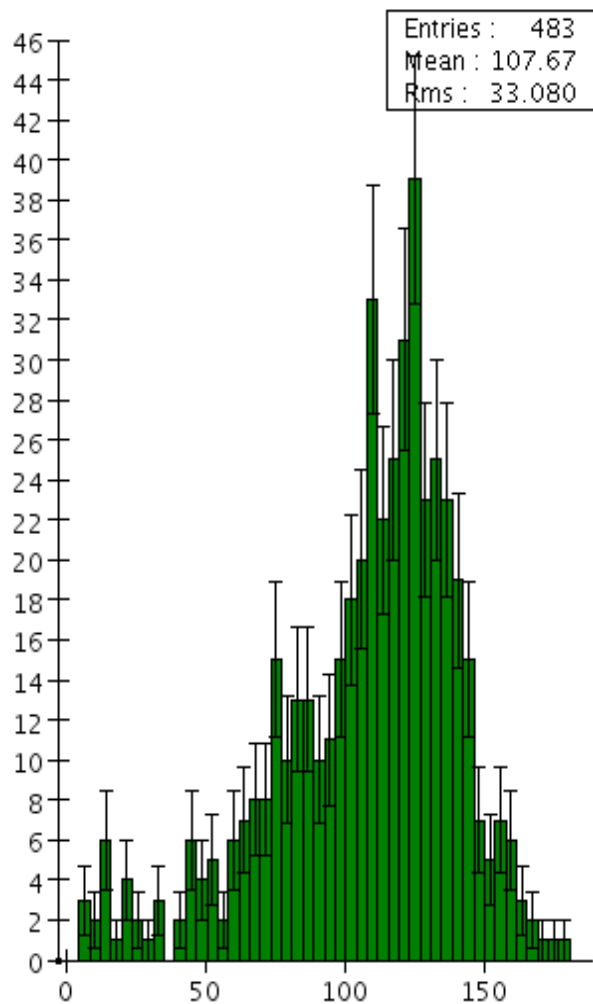
# Steps

- 6 jet topology:
  - Find 2 exclusive jet pairs giving mass most consistent with  $m(Z)$
  - Find pair that gives mass most consistent with  $m(H)$  when combined with the rest of the event
- 4 jet topology:
  - Find jet pair giving mass most consistent with  $m(Z)$
  - Form candidate  $m(H)$  from this and the rest of the event
- Select topology giving best  $m(H)$ 
  - Will add missing energy cuts and vertexing quality cuts

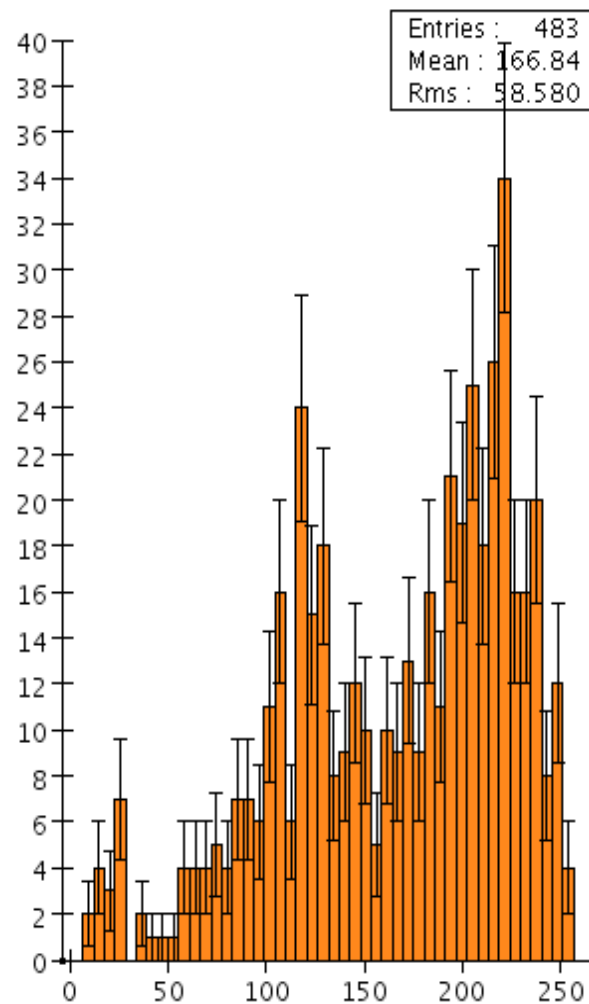
# $e^+e^- \rightarrow ZH, H \rightarrow ZZ^*$

## *best of 4/6 jet topology*

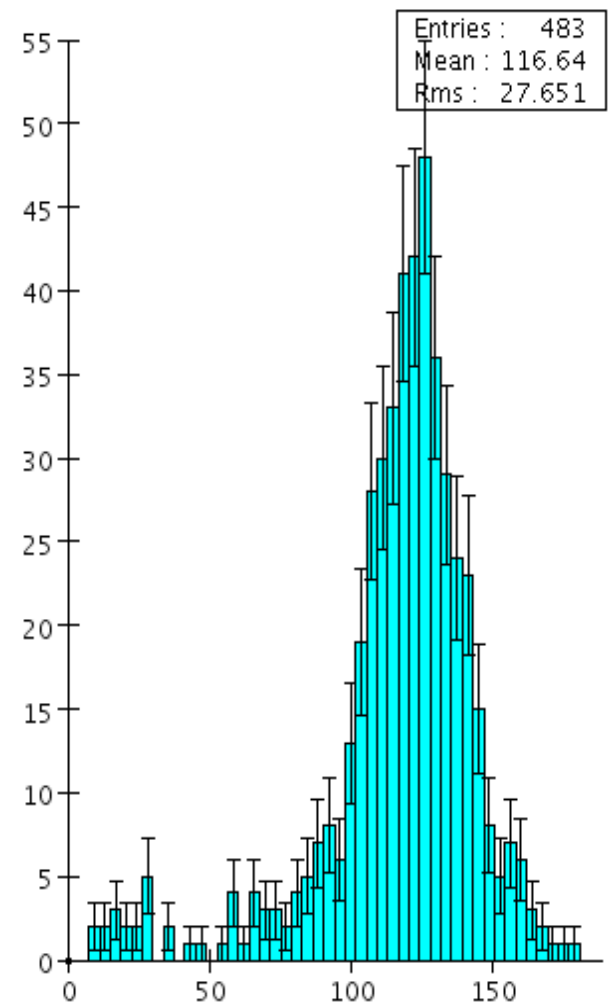
PAIR:/H mass from best pair from 6 jets



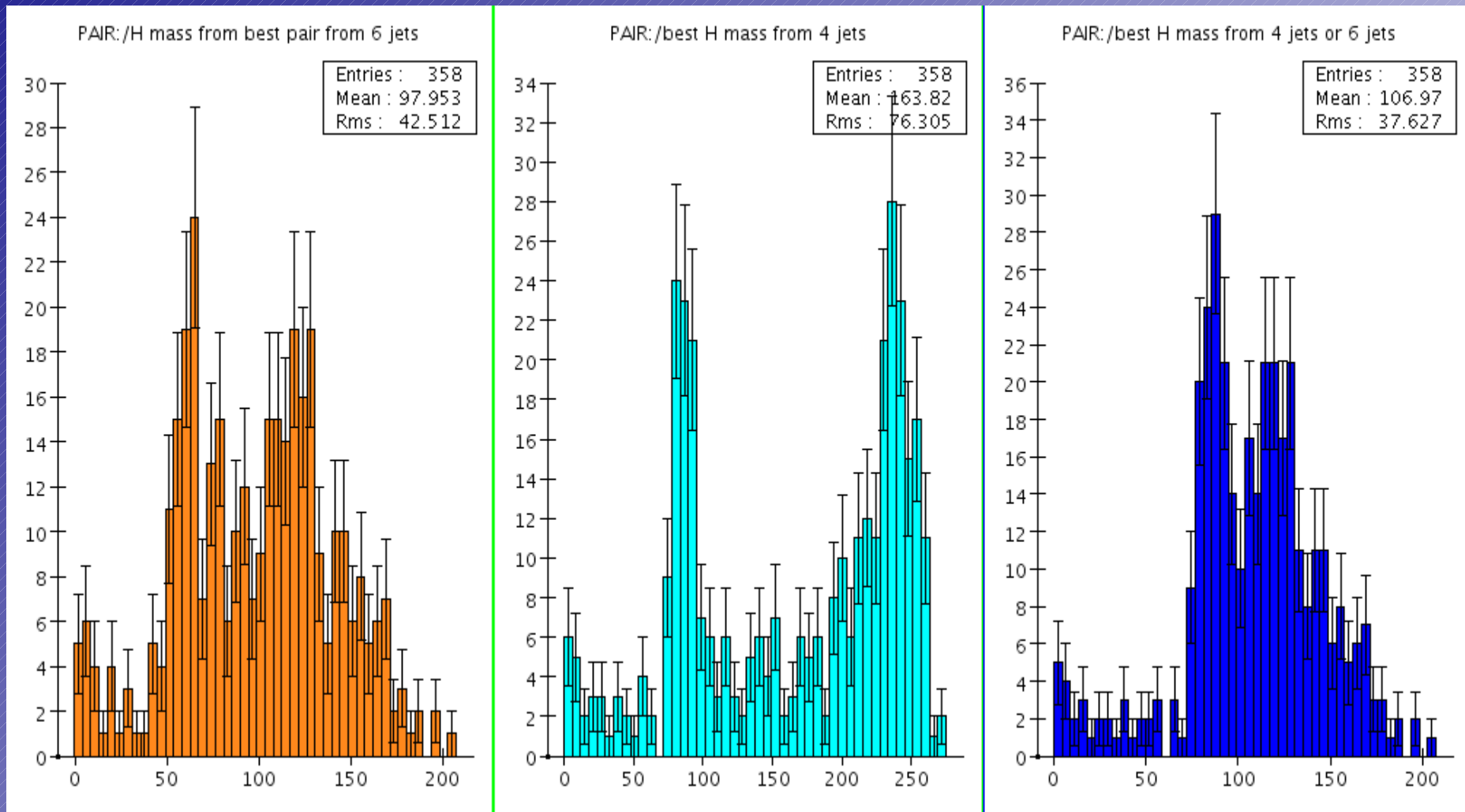
PAIR:/best H mass from 4 jets



PAIR:/best H mass from 4 jets or 6 jets

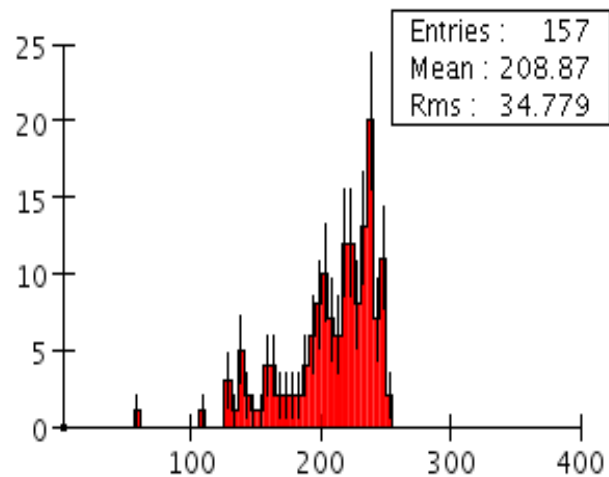


# all\_SM\_background best of 4/6 *jet topology* (NOT weighted yet)

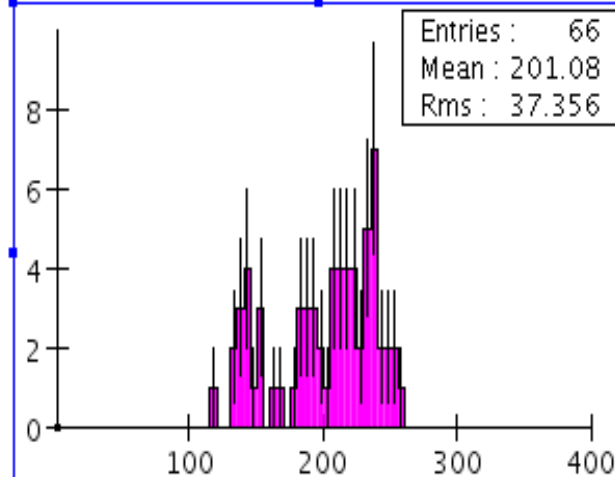


# 4/6 Jet Topology determination from Evis (Evis for $\bar{xx}H$ )

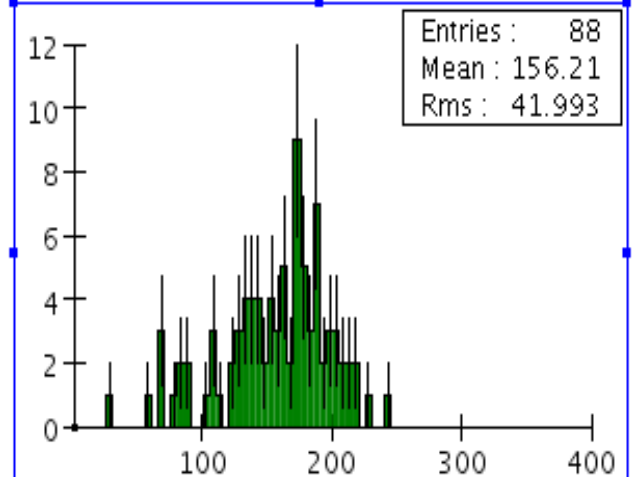
Evis from JETS ( Flavor = 11 )



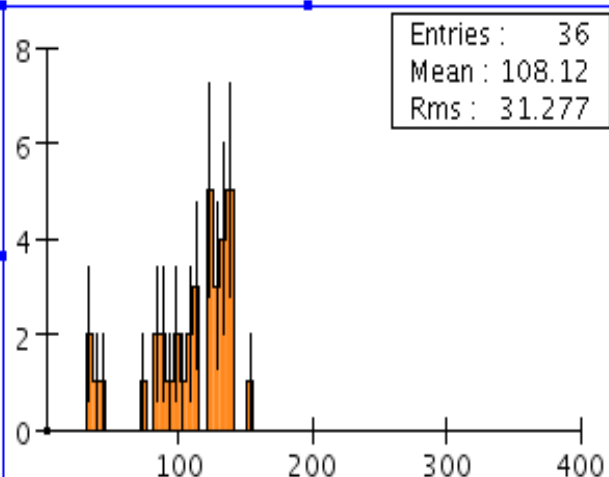
Evis from JETS ( Flavor = 13 )



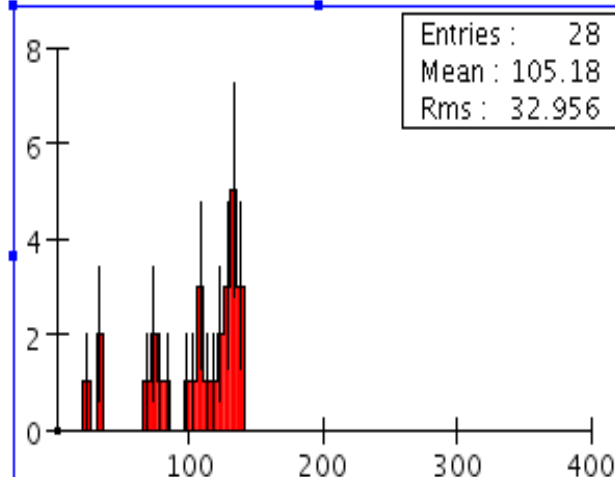
Evis from JETS ( Flavor = 15 )



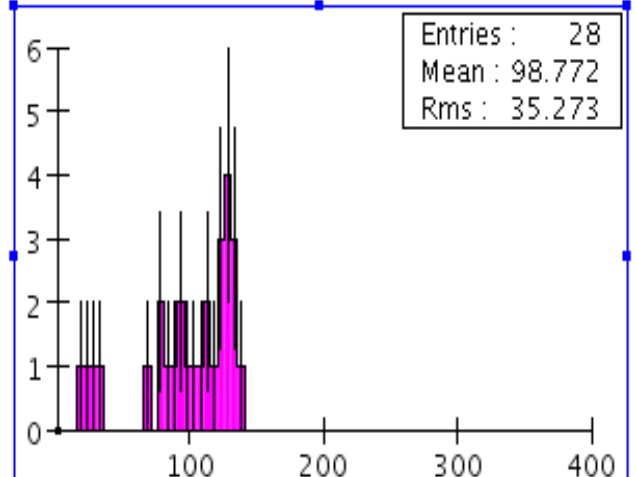
Evis from JETS ( Flavor = 12 )



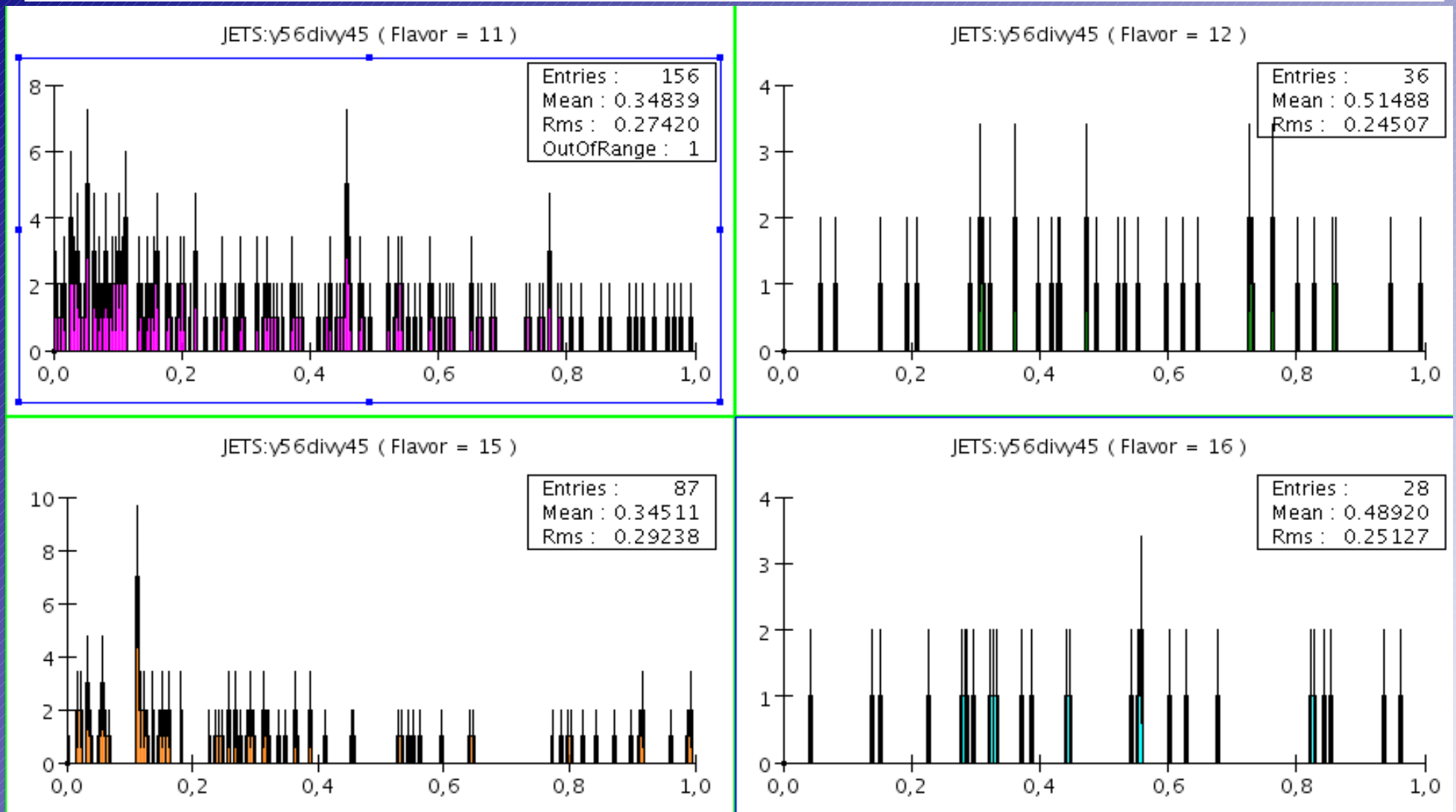
Evis from JETS ( Flavor = 14 )



Evis from JETS ( Flavor = 16 )



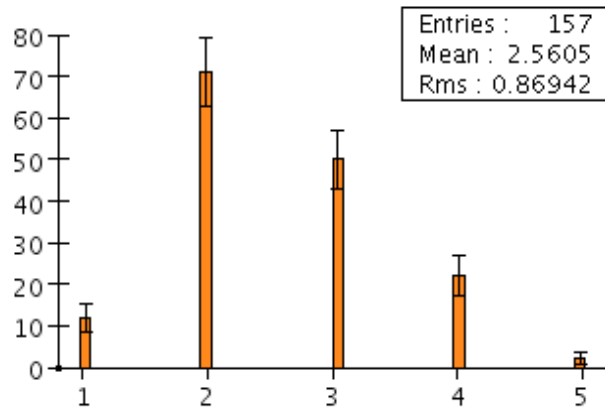
# RefinedJets: JetClustering y56/y45



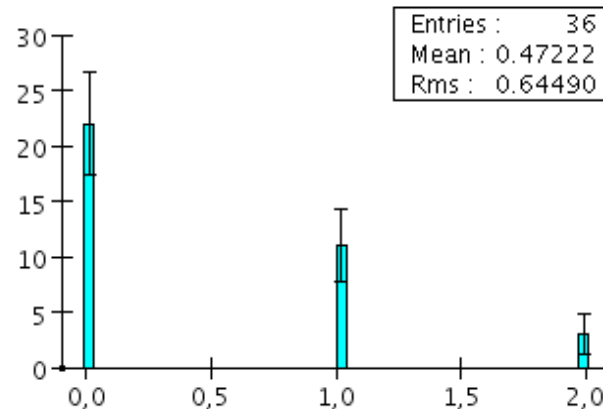


# #high energy electrons

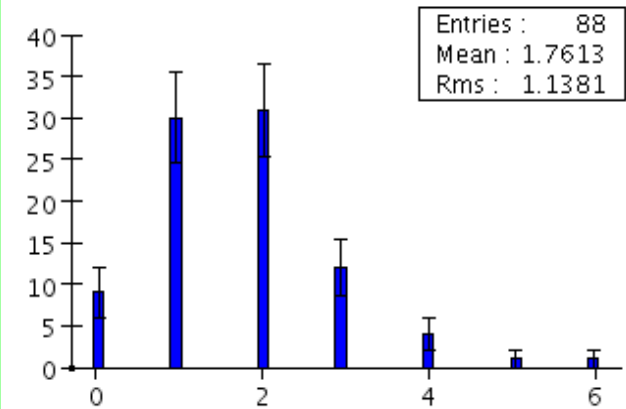
Number of electrons per event ( Flavor = 11 )



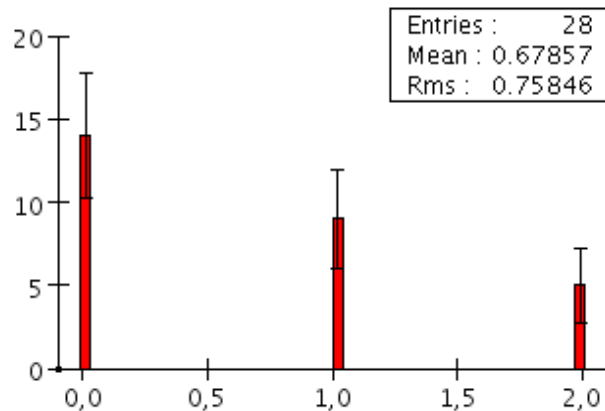
Number of electrons per event ( Flavor = 12 )



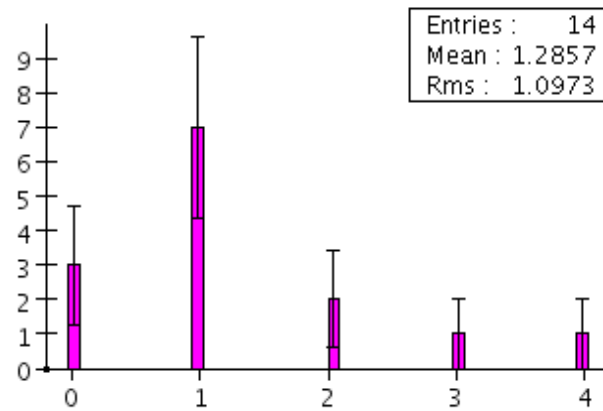
Number of electrons per event ( Flavor = 15 )



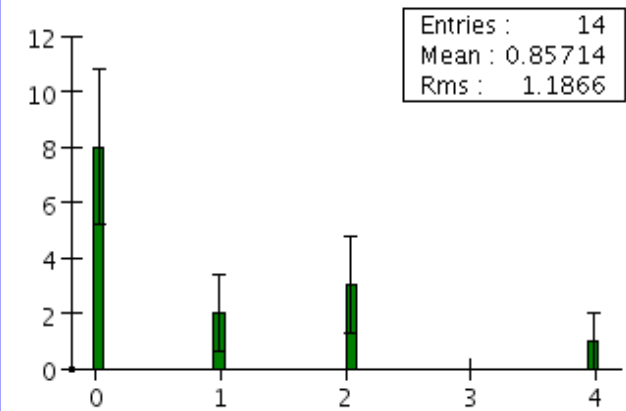
Number of electrons per event ( Flavor = 16 )



Number of electrons per event ( Flavor = 1 )



Number of electrons per event ( Flavor = 5 )

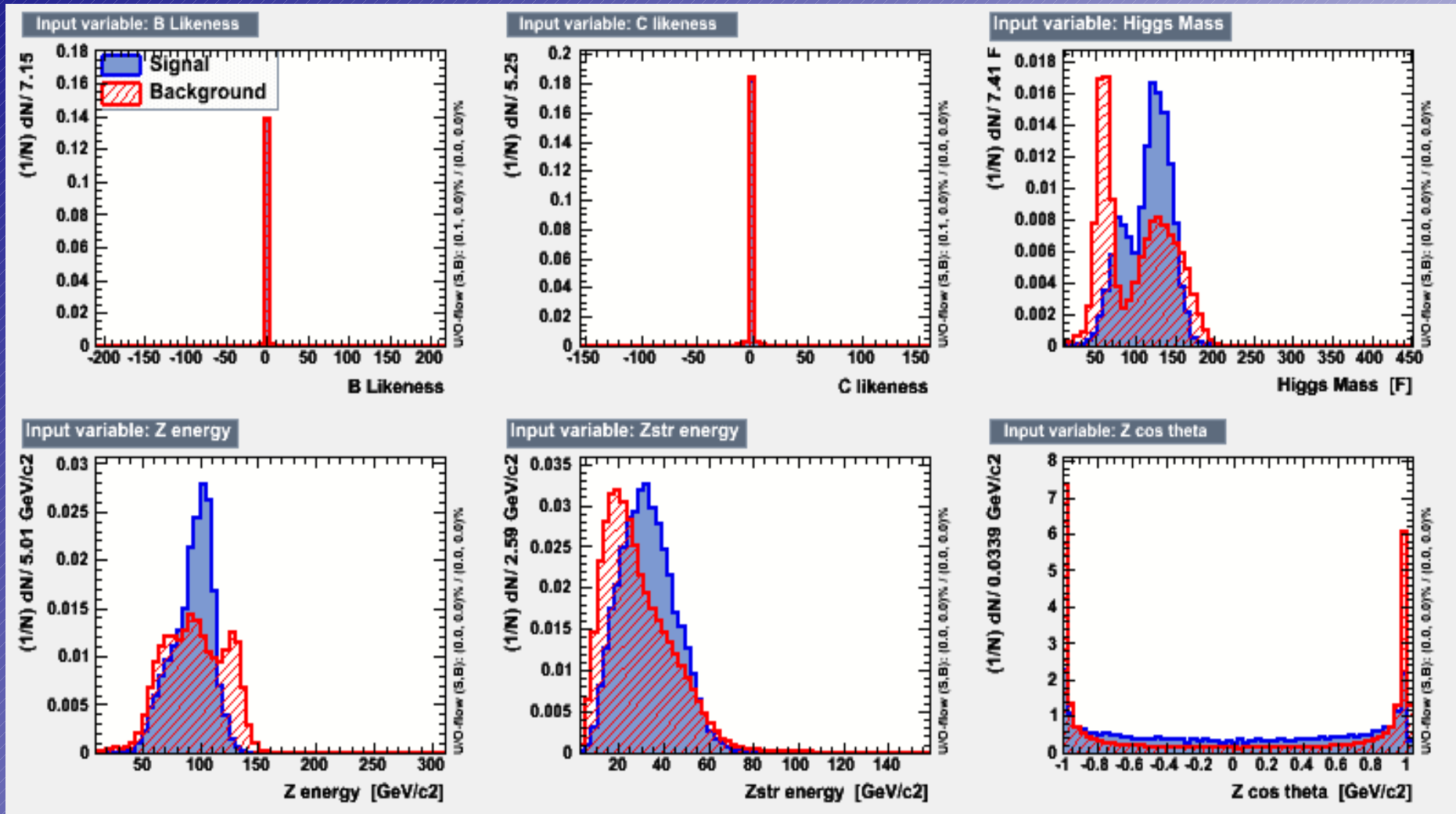


Also looking at helicity angle

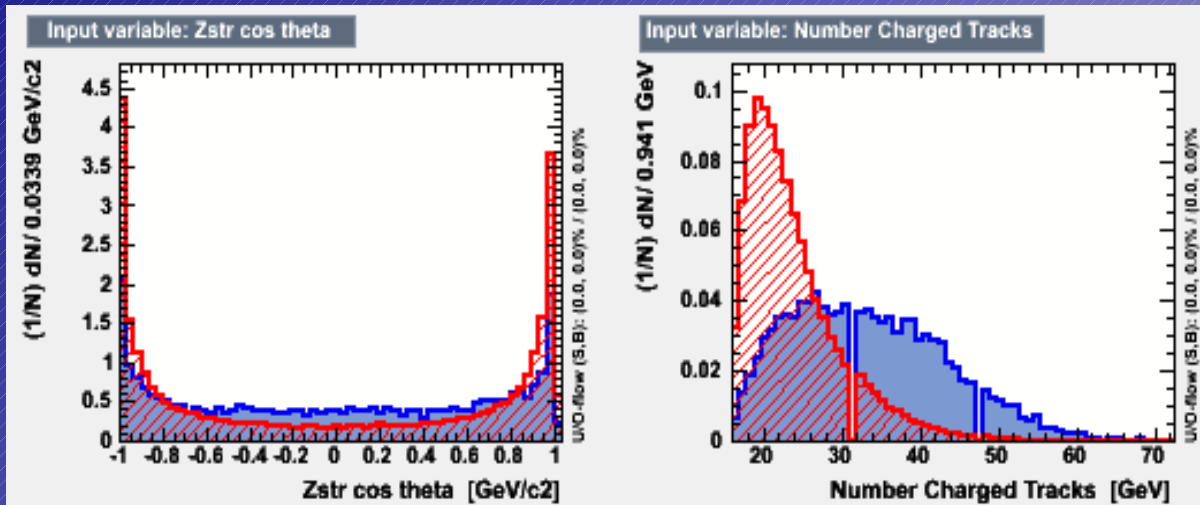
# HZZ MVA plots +80/-30 250/fb

Preselection:  
#Charged Tracks > 15

# Input Variables



# Input Variables



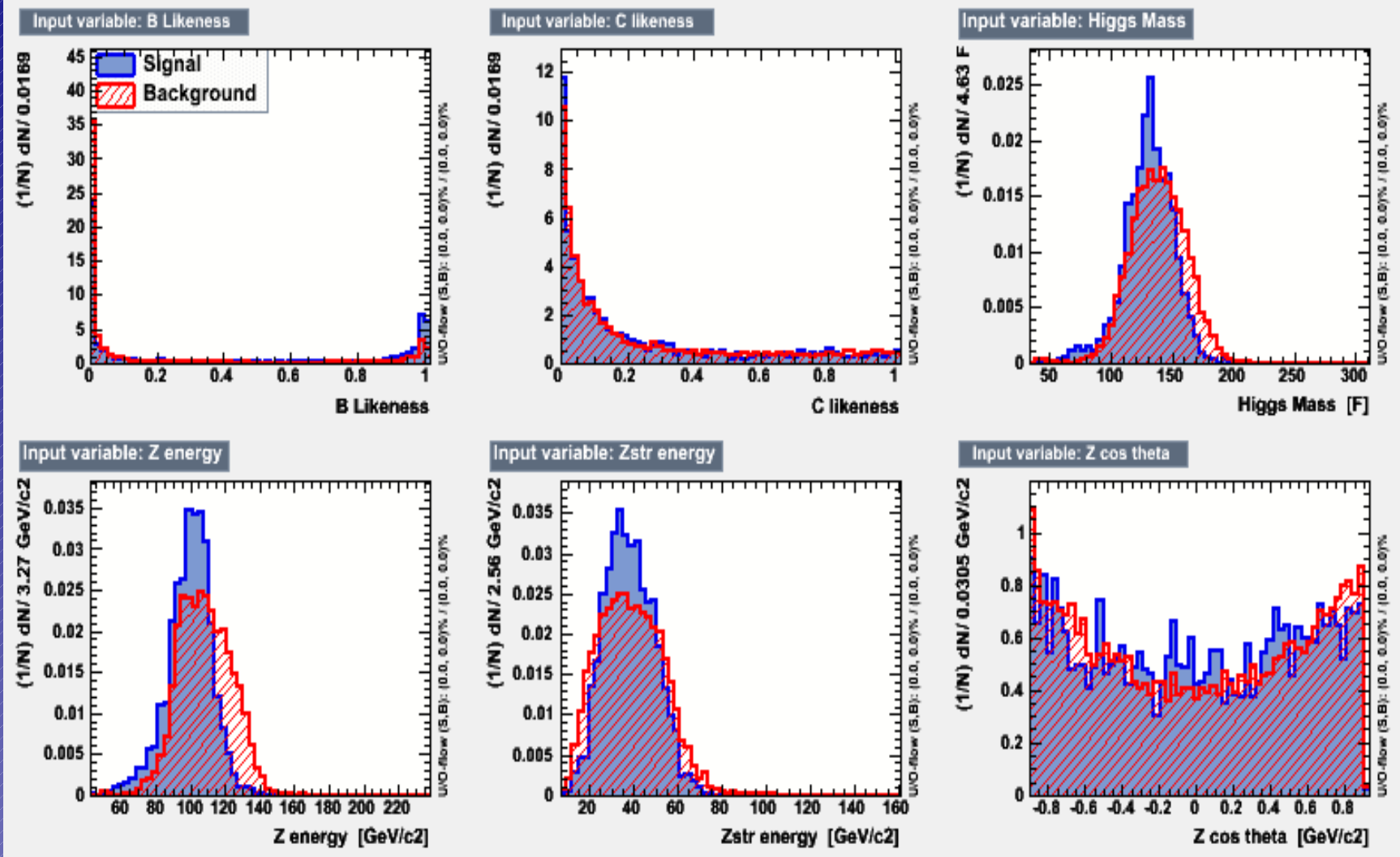
# HZZ MVA plots

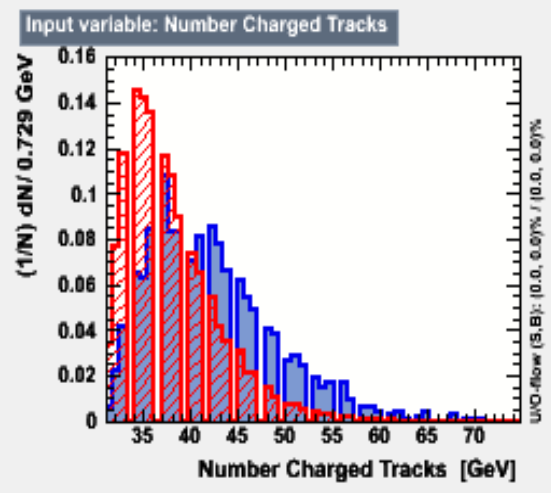
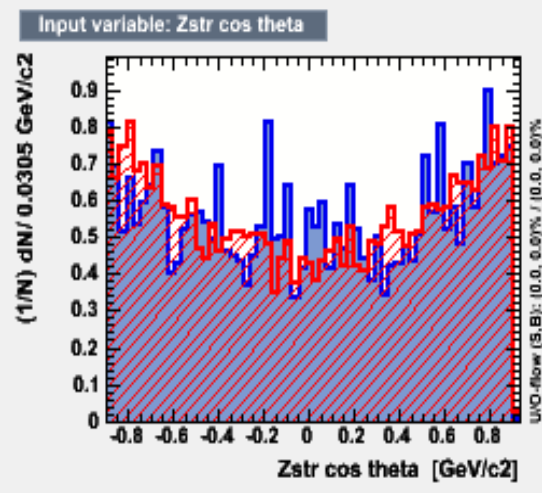
$$\#Trks > 30$$

$$|\cos\theta_z| < 0.9$$

$$|\cos\theta_{z^*}| < 0.9$$

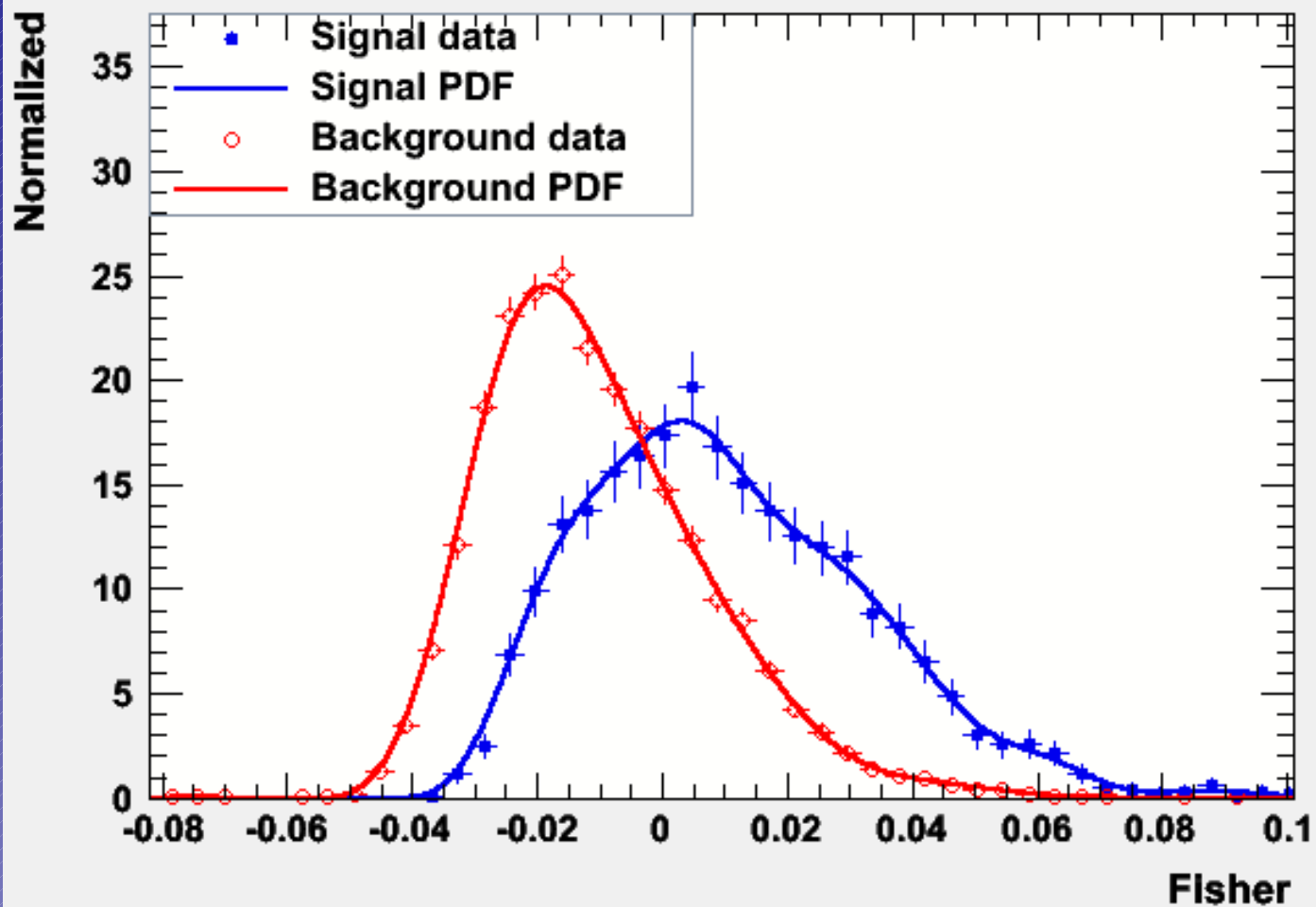
Two highest BTag Ctag values in event



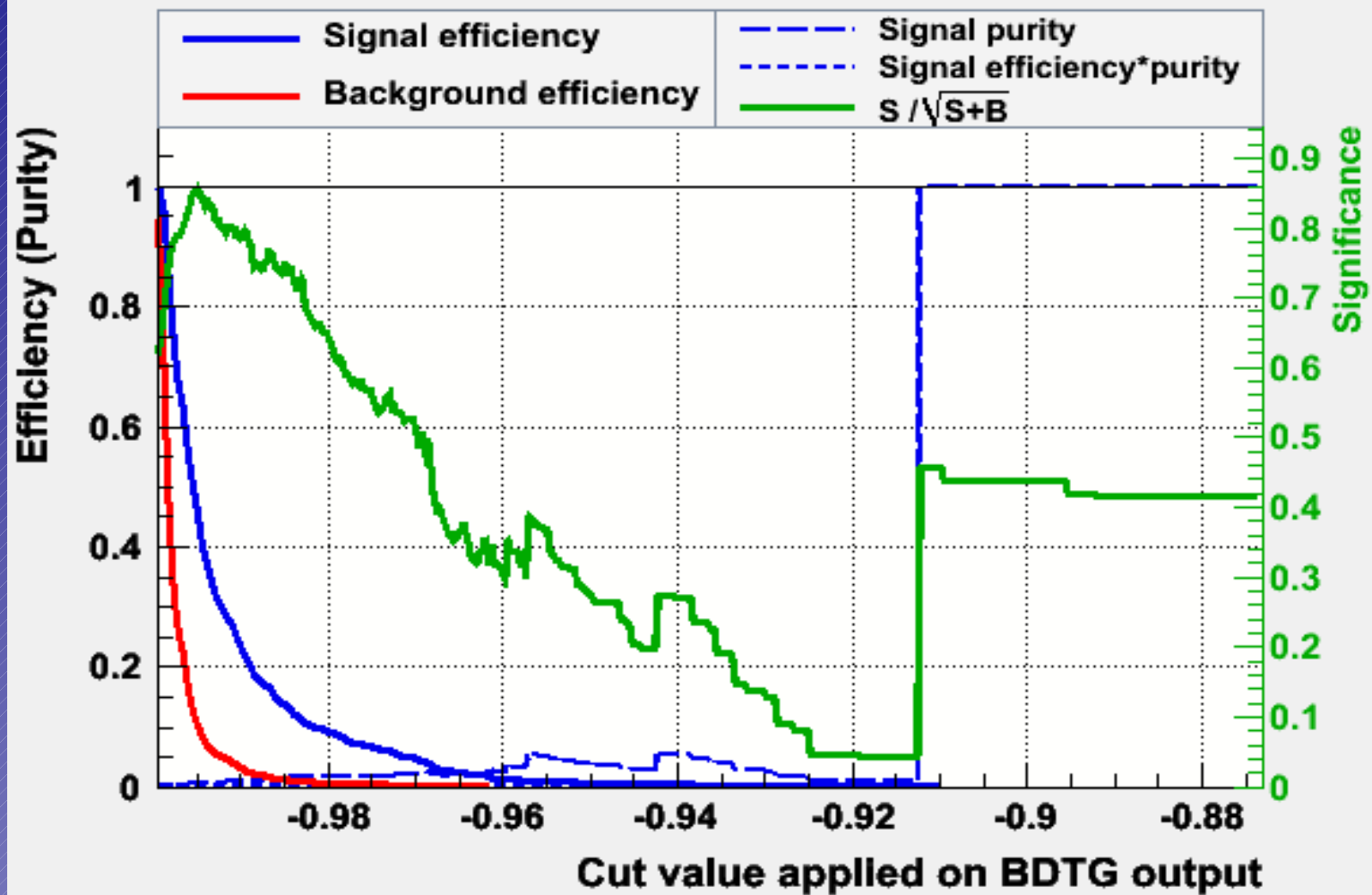




### TMVA output for classifier: Fisher



## Cut efficiencies and optimal cut value



Some slides from last meeting for reference:

# Data Preparation

- Steps of the job that prepares the data for analyzing:

**Fill hit counting values:**

source /u/ey/homer/sidhome/sid/lcsim-homer/testrunsubDetHitNum \$1 input\_prejet.slcio

**Clustering to 6 jets: (JetOut6Jets)**

Marlin /u/ey/homer/sidhome/lcfi/mfast-all-batch-6jet-step1.xml

**Clustering to 4 jets: (JetOut)**

Marlin /u/ey/homer/sidhome/lcfi/mfast-all-batch-4jet-step2.xml

**Vertexing:**

Marlin /u/ey/homer/sidhome/lcfi/steering/revertex-all-batch.xml

**Flavor tagging:**

Marlin /u/ey/homer/sidhome/lcfi/steering/flavortag-all-batch-revtx-350-4jets.xml

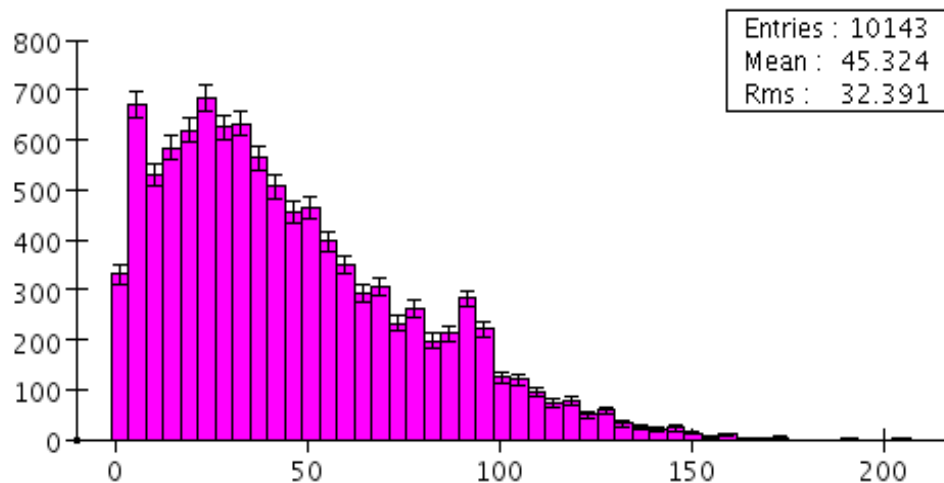
# Post-processing of reco files

```
bash-3.2$ ls -lrt ~/tagged_files/higgs_ffh_zz_-80e-_ +30e+_001_SLIC-  
v3r0p3_geant4  
-v9r5p1_QGSP_BERT_sidloi3_lcsimTracking_lcsim-2.9_pandora.slcio-dir/  
  
-rw-r--r--+ 1 homer lcddata 206374020 Jul 17 16:17 input_prejet.slcio  
-rw-r--r--+ 1 homer lcddata 204005832 Jul 17 16:18 output_postjet-6jet.slcio  
-rw-r--r--+ 1 homer lcddata    6726 Jul 17 16:18 jet-6jet-step1.log  
-rw-r--r--+ 1 homer lcddata 204434924 Jul 17 16:20 output_postjet.slcio  
-rw-r--r--+ 1 homer lcddata    7371 Jul 17 16:20 jet-4jet-step2.log  
-rw-r--r--+ 1 homer lcddata    691 Jul 17 16:20 vtx.log  
-rw-r--r--+ 1 homer lcddata 91850240 Jul 17 16:27 output_postjet_vtx.slcio
```

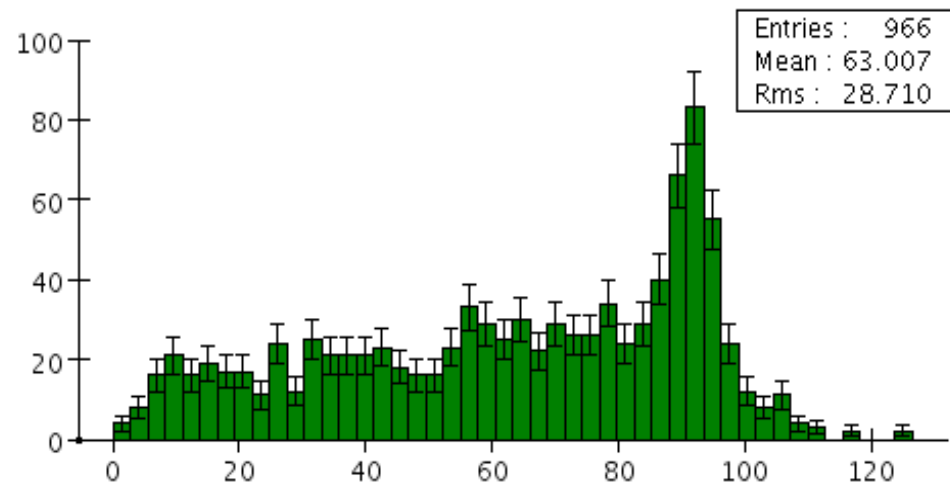
```
bash-3.2$ ls -lrt ~/tagged_files/higgs_ffh_zz_-80e-_ +30e+_001_SLIC-v3r0p3_geant4-  
v9r5p1_QGSP_BERT_sidloi3_lcsimTracking_lcsim-2.9_pandora.s  
lcio-dir/  
  
-rw-r--r--+ 1 homer lcddata    6726 Jul 17 16:18 jet-6jet-step1.log  
-rw-r--r--+ 1 homer lcddata    7371 Jul 17 16:20 jet-4jet-step2.log  
-rw-r--r--+ 1 homer lcddata    5984 Jul 17 16:34 vtx.log  
-rw-r--r--+ 1 homer lcddata 205640380 Jul 17 16:36 output_postjet_flavtag.slcio  
-rw-r--r--+ 1 homer lcddata  929495 Jul 17 16:36 flav.log  
lrwxrwxrwx 1 homer lcddata    28 Jul 17 16:36 higgs_ffh_zz_-80e-_ +30e+_001_SLIC-  
v3r0p3_geant4-v9r5p1_QGSP_BERT_sidloi3_lcsimTracking_l  
csim-2.9_pandora.slcio-flav.slcio -> output_postjet_flavtag.slcio
```

# $e^+e^- \rightarrow ZH, H \rightarrow ZZ^*$ 6 jet topology

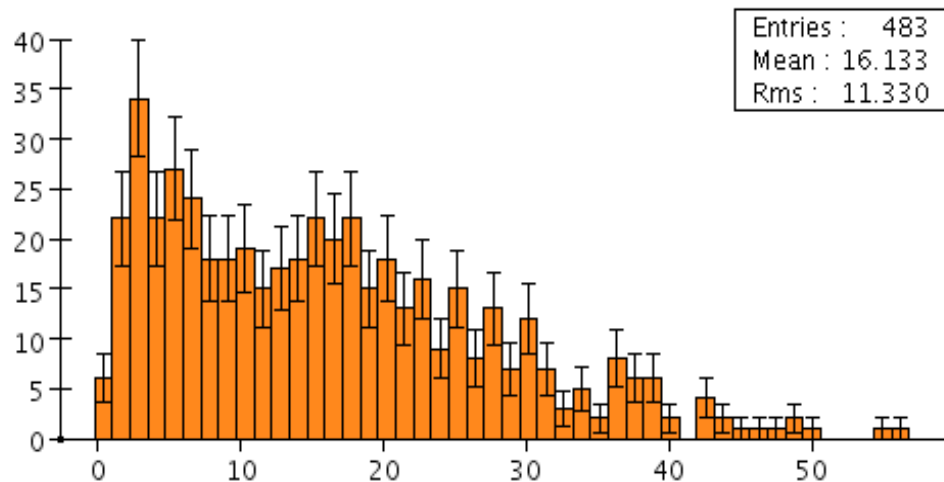
PAIR: /all 6 jet non-trivial pair masses



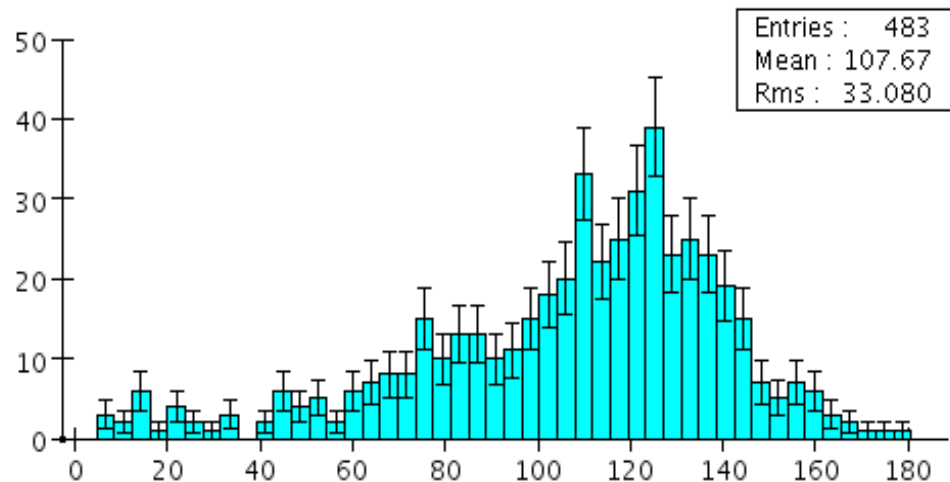
PAIR: /mass of best two Z pairs from 6 jets



PAIR: /mass of other pair from 6 jets



PAIR: /H mass from best pair from 6 jets

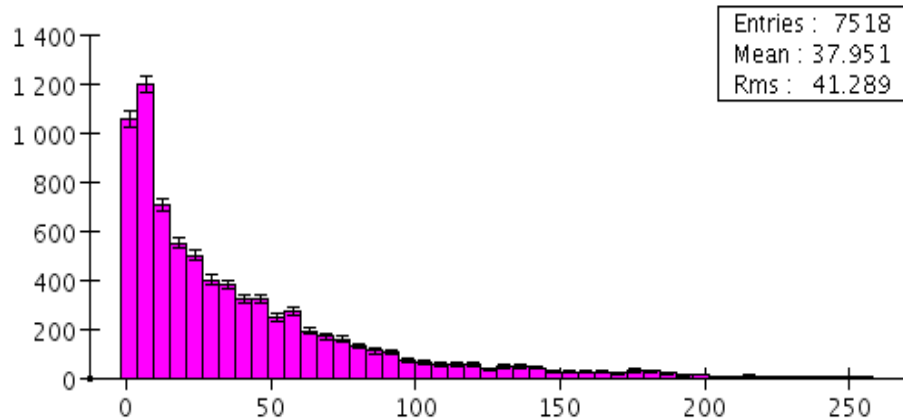


# all\_SM\_background

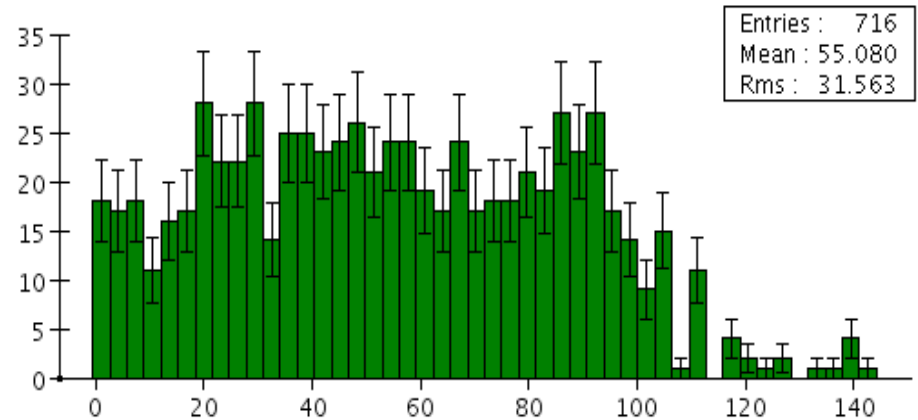
## *6 jet topology*

(NOT weighted yet)

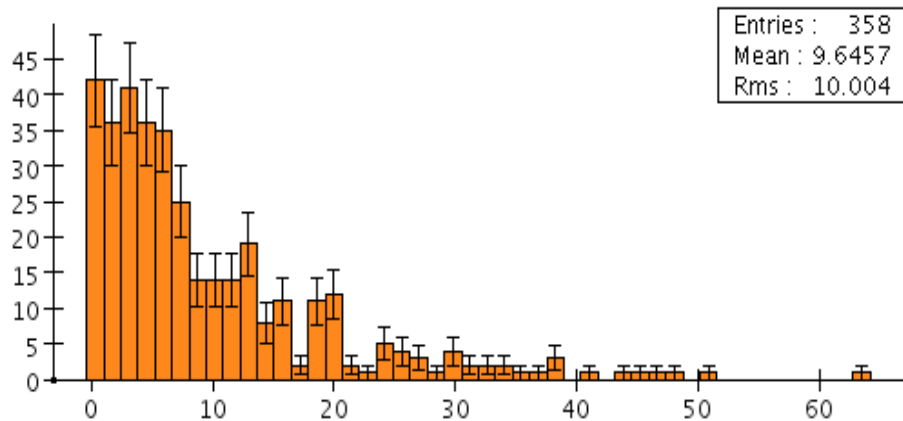
PAIR:/all 6 jet non-trivial pair masses



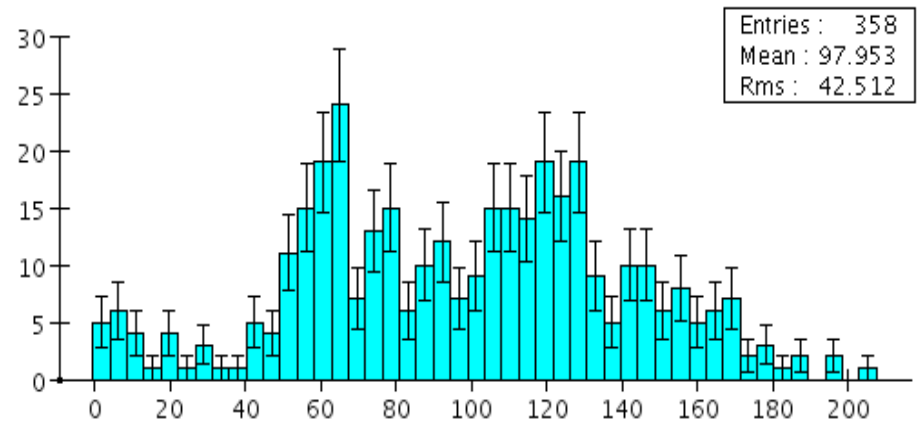
PAIR:/mass of best two Z pairs from 6 jets



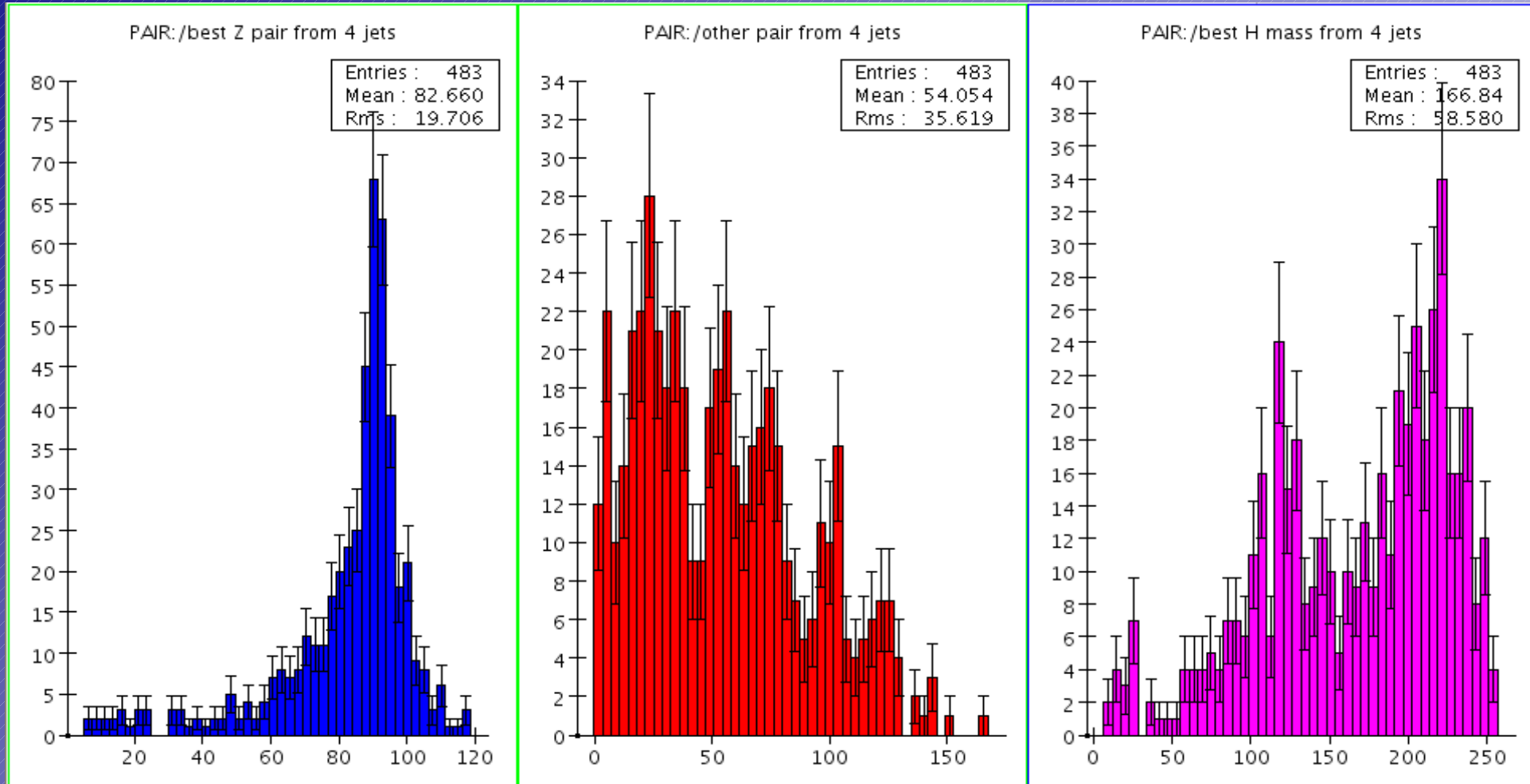
PAIR:/mass of other pair from 6 jets



PAIR:/H mass from best pair from 6 jets



# $e^+e^- \rightarrow ZH, H \rightarrow ZZ^*$ 4 jet topology





# all\_SM\_background 4 *jet topology* (NOT weighted yet)

