Measurement of H→ WW* fully hadronic in HZ at 350 GeV

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Analysis strategy

- **Semileptonic FS: 4 jets + 2l**

❑ Lepton isolation $N_{lept} = 2$

FastJet Finder: Kt ex, $N_{jets}=4$, $R=1.2$

- **Hadronic FS: 6 jets**

❑ Lepton isolation $N_{lept}=0$

FastJet Finder: Kt ex, $N_{jets}=6$, $R=1.2$

- ❑ Preselection
- ❑ 2 jets hypotesis to apply b tagging
- ❑ Multivariate analysis
- ❑ Extract N_S, N_B to get

$$\frac{\Delta\sigma}{\sigma} = \frac{\sqrt{S+B}}{S}$$

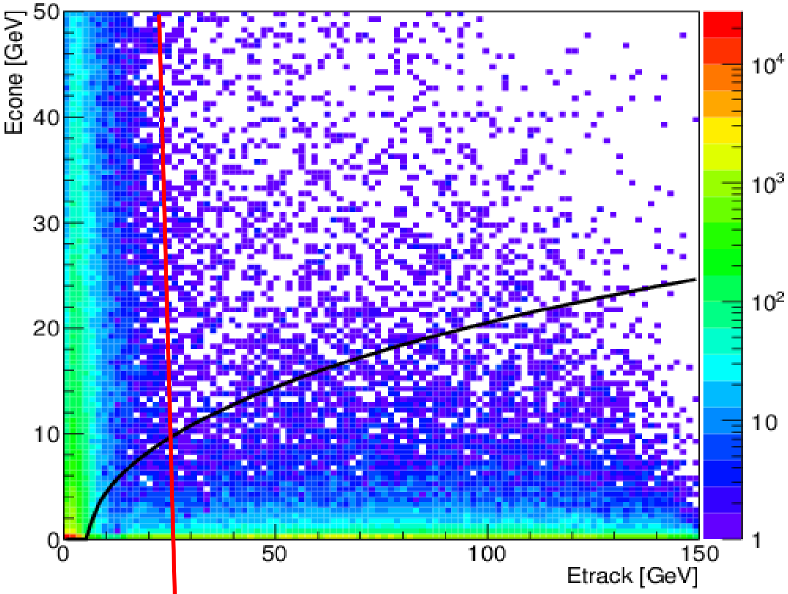
Signal and background processes

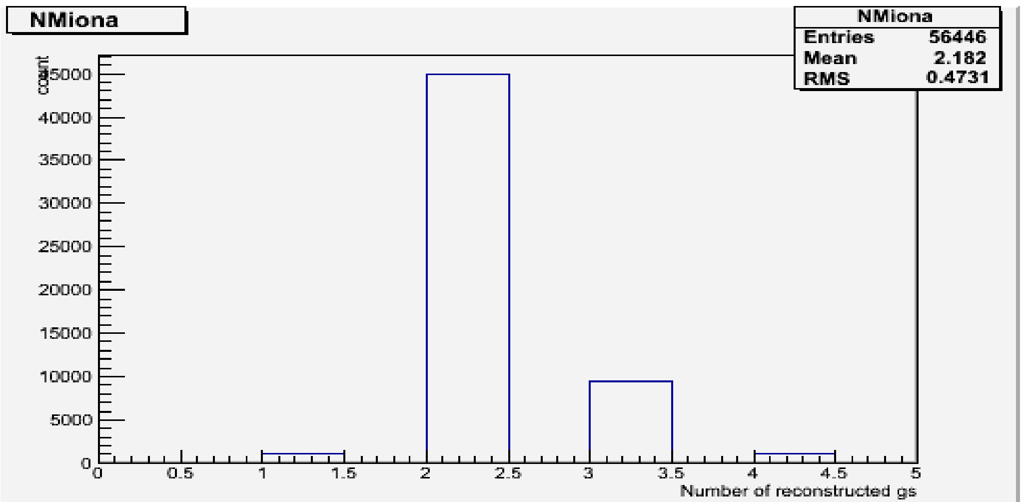
Signal HZ, $H \rightarrow WW \rightarrow qqqq$	ID	σ [fb]
$Z \rightarrow ee$	2085	0.48
$Z \rightarrow \mu\mu$	2088	0.48
$Z \rightarrow qq$	2558	9.7
Background		
HZ, other H decays, Z visible decays		92
$e^+e^- \rightarrow qqqq$	2871	5847
$e^+e^- \rightarrow qqll$	2868	1704
$e^+e^- \rightarrow qql\nu$		5914
$e^+e^- \rightarrow qq\nu\nu$		324.6
$e^+e^- \rightarrow h\nu\nu$		53.4
$e^+e^- \rightarrow$ ttbar	**1369**	**450.0**
$e^+e^- \rightarrow$ WWZ	**1439**	**10.0**

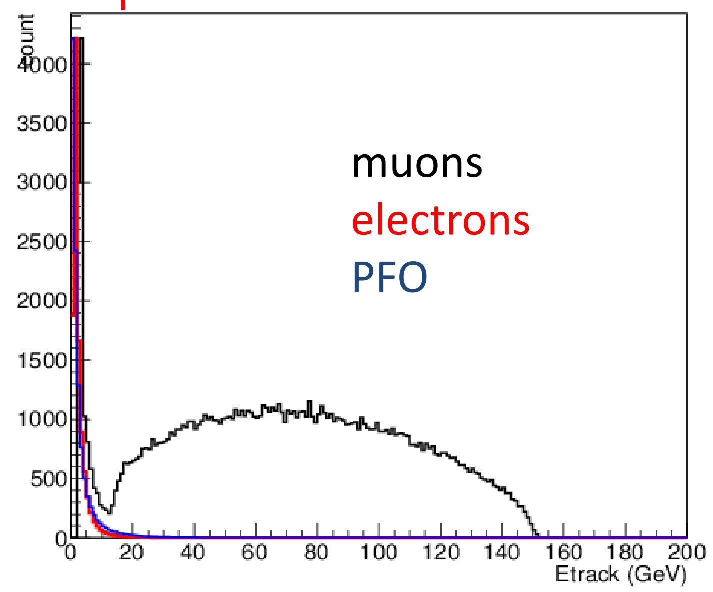
Lepton definition 4jets+2 muons

- previous definition Etrack>12 GeV

	Refined Lepton Isolation
Cosine Cone Isolation angle	0.995
Polynomial isolation	$E_{cone} < -0.005\ E_{tr}^2 + 5.0\ E_{tr} - 30.0$
ECAL/(HCAL+ECAL)	0.9
Etot/P min	0.7
Etot/P max	1.2

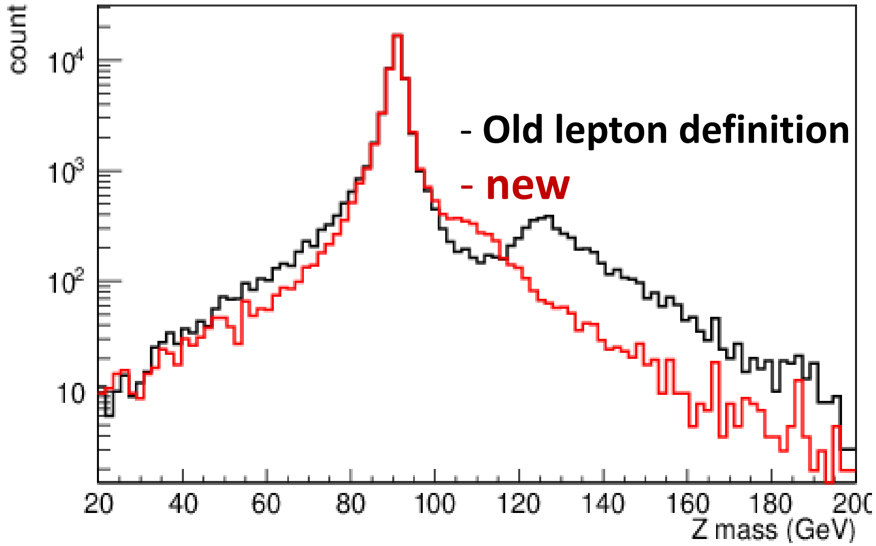


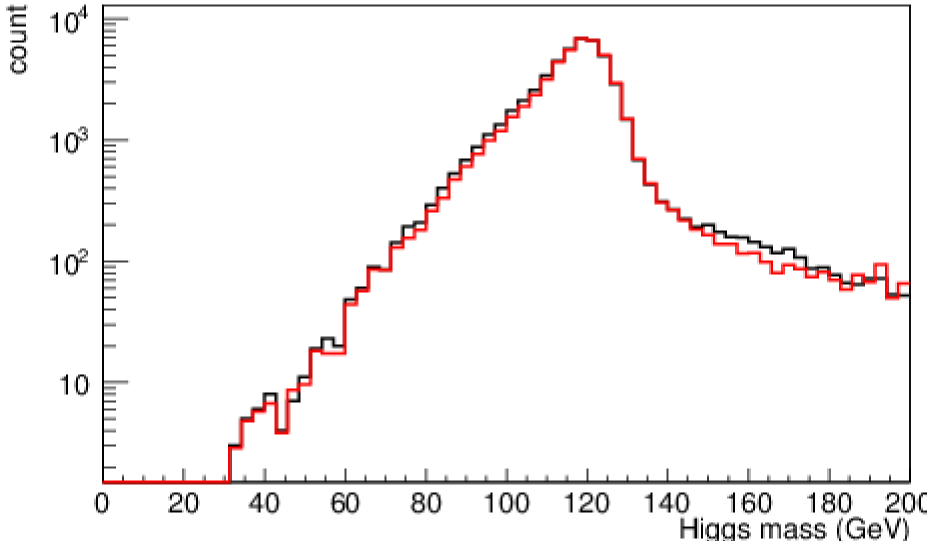




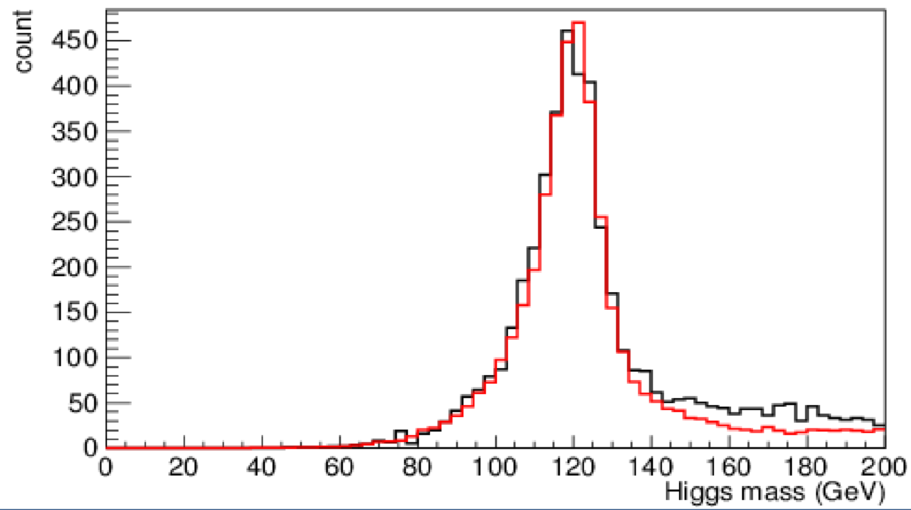
Reconstruction of invariant masses

- Negligable improvement of the invariant mass of Z and Higgs





4jets +2e $\Rightarrow$



Preselection 4jets+2 muons

Preselection
$80< m_Z <100$ GeV
$100< m_H < 140$ GeV
$40< m_W <120$ GeV
$100<$ Evis <250 GeV
jetPt>40 GeV
$-\log_{10}(y12) <2.5$ $-\log_{10}(y23) <3.0$ $-\log_{10}(y34) <4.0$ $-\log_{10}(y45) <4.2$
btag <0.9

Process	σ [fb]	ε_{ff}	σ_{pres} [fb]
Signal	0.454	63.3%	0.28
HZ, nonWW-qqqq	4.176	26.0%	
qqqq	5914	$<10^{-5}$	/
qqll	1704	0.27%	4.56
qqlν	5914	$<10^{-5}$	0.12
qqνν	324.6	$<10^{-5}$	/
hνν	53.4	$<10^{-5}$	/
ttbar	450	0.043%	0.08
wwz	10	2.7%	/

- Preselection could be refined even to reduce qqll and still preserve signal efficiency but not relevant stat for training &testing ~900/2 evts

Preselection 4jets+2muons

- Considering statistics very loose preselection applied only to cut-off hadronic background while preserve enough statstics for training and testing with semileptonic samples

Preselection
70 GeV< m_Z < 120 GeV InvMassW1>10.

Process	σ [fb]	ε_{ff}	σ_{pres} [fb]
Signal	0.49	87%	0.25
HZ, nonWW-qqqq	4.13	70%	0.4
qqqq	5914	$<10^{-5}$	/
qqll	1704	4.79%	81.62
qqlν	5914	0.23%	13.6
qqνν	324.6	$<10^{-5}$	/
hνν	53.4	0.1%	/
ttbar	450	0.27%	1.2
wwz	10	5.22%	0.52

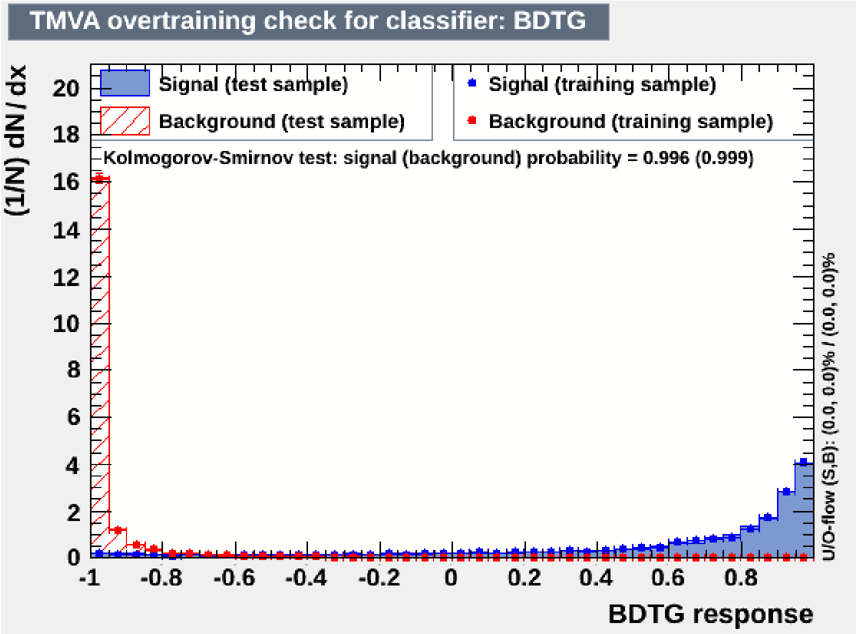
BDTG 4jets+2 muons

BDT trained on :

1. HZ, Z-ll, non WW-qqqq decays
2. qqll

Total signal Eff= 36 %

TMVA Variables
NPFO
E_{vis} P_tJet
-log(y12), -log(y23), -log(y34)
log(y45), -log(y56)
m_z m_H m_{w*}
Thrust
btag, ctag



$$\frac{\Delta\sigma}{\sigma} = \frac{\sqrt{S+B}}{S} = 12.15\%$$

Count in the region of

80 GeV< m_Z < 110 GeV

Summary

- Muon channel:
  - Redid lepton isolation:
    insignificant change in the Z, H reconstruction
  - new background added:
  - preselection kept loose do to low stat of the dominant qqll background (the signs of overtraining)
  - optimizing set of BDT variables

NO improvement in muon channel : 12.2% $\rightarrow$ 12.17 %

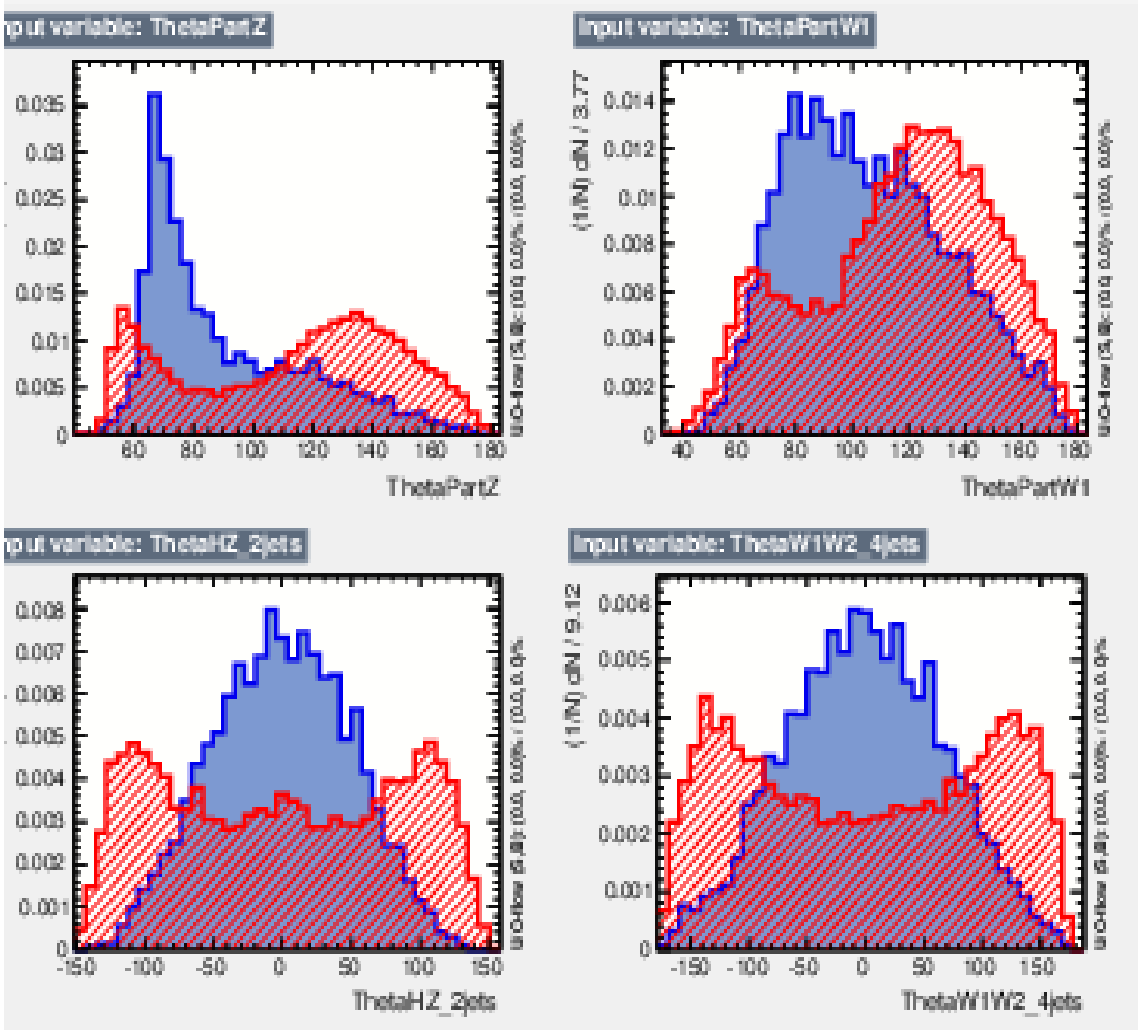
Outlook:

- Hadronic decay channel:
  background : ttbar improve ststistics
  Force event into six jets and btag all the jets

- Overall result stable around 6 %

END

Variables ANGLES 6 jets FS



Variables ANGLES

1. ThetaPartZ
   FORCE EVENTS INTO 6 jets
   the angle between two jets
   that consitute Z
2. ThetaPartW1
   FORCE EVENTS INTO 6 jets
   the angle between two jets
   that consitute W real
3. ThetaW1W2_4jets
   FORCE EVENTS INTO 4 jets
   the angle between W and W*
4. ThetaHZ_2jets
   FORCE EVENTS INTO 2 jets
   the angle between H and Z