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

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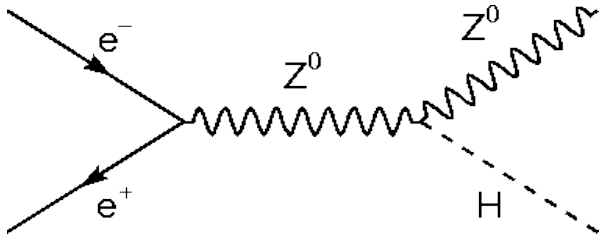
Introduction

HZ @350GeV $\sigma(e^+e^- \rightarrow HZ)=134$ fb $\Rightarrow$ 68000 ZH evts

$H \rightarrow WW \rightarrow qqqq$, $Z \rightarrow ff$, $f=e,\mu,q$



Motivation:

precision of the measurement of

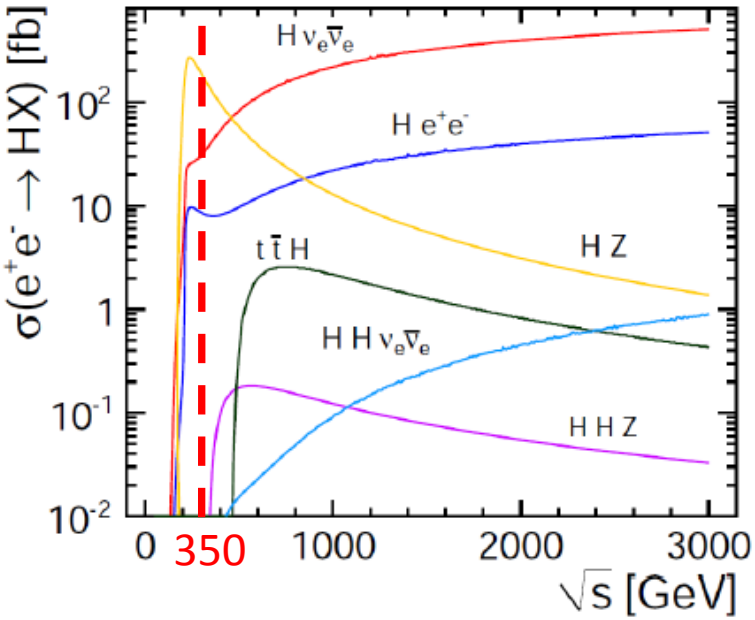
$$\frac{g^2_{HZZ} \cdot g^2_{HWW}}{\Gamma_H}$$

Signal evts:

BF(H→WW→qqqq)~10%

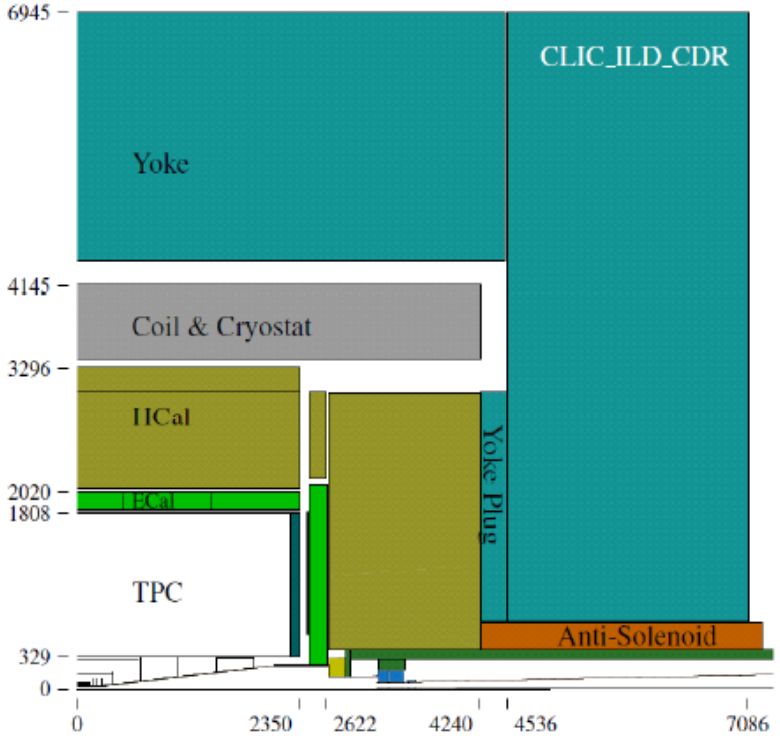
&BF(Z→ll)~10% $\Rightarrow$ 1%~680 evts

&BF(Z→qq)~70% $\Rightarrow$ 7%~4800 evts



Simulation and reconstruction

- Event generation with WHIZARD v.1.95 , ISR and BS
- Beamspectrum generated with GUINEAPIG
- Hadronization with PYTHIA
- Assuming m_H=126 GeV
- CLIC_ILD detector
- Particle reconstruction and identication using PandoraPFA



Signal and background processes

Signal HZ, H→WW→qqqq	σ [fb]
Z→ee	0.48
Z→μμ	0.48
Z→qq	9.7
Background	
HZ, other H decays, Z visible decays	92.02
$e^+e^- \rightarrow qqqq$	5847
$e^+e^- \rightarrow qqll$	1704
$e^+e^- \rightarrow qql\nu$	5914
$e^+e^- \rightarrow qq\nu\nu$	324.6
$e^+e^- \rightarrow h\nu\nu$	53.4

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, $N_{jets} = 6$, $R = 1.2$

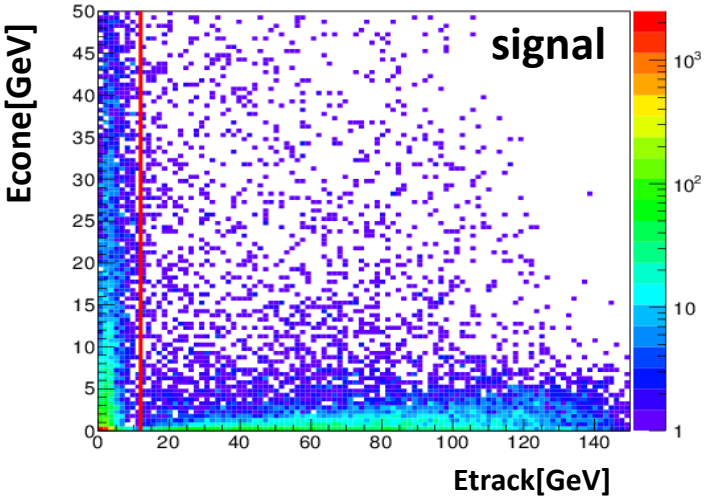
Preselection

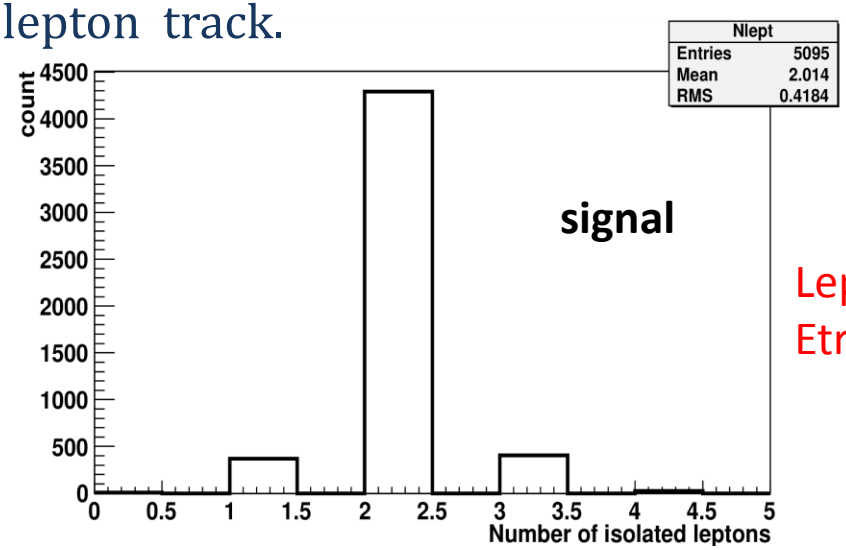
Multivariate analysis

Extract N_S, N_B to get $\frac{\Delta\sigma}{\sigma} = \frac{\sqrt{S+B}}{S}$

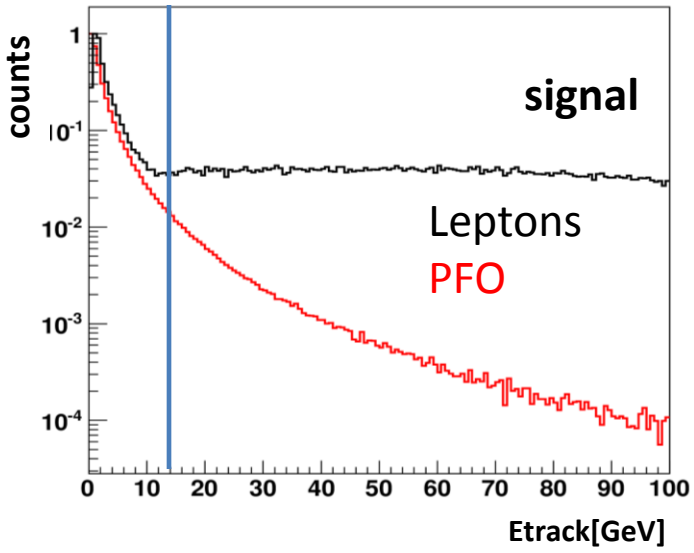
Lepton definition 4jets+2l

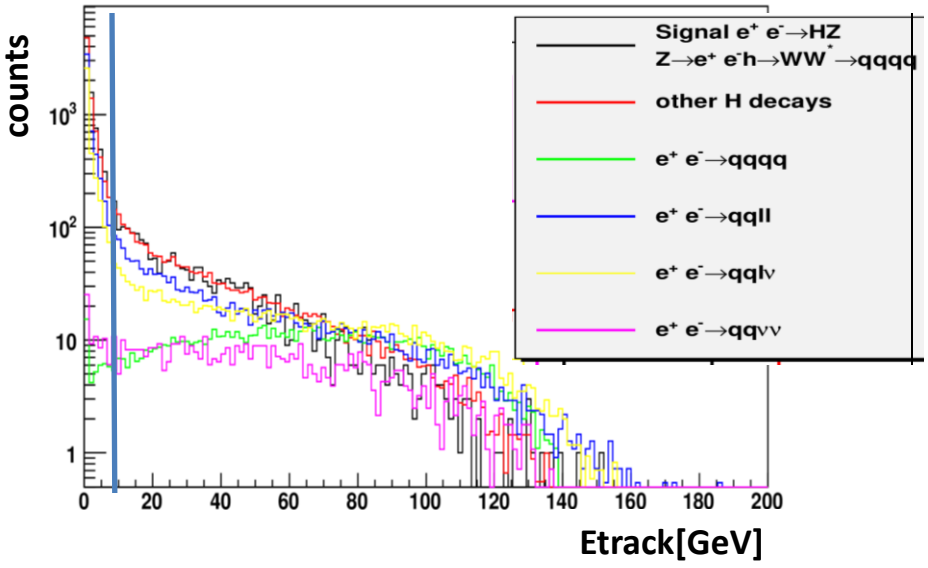
Relays on: track energy of a lepton candidate and calorimeter depositions within a cone cos θ=0.995 around lepton track.





Lepton:
Etrack>12 GeV



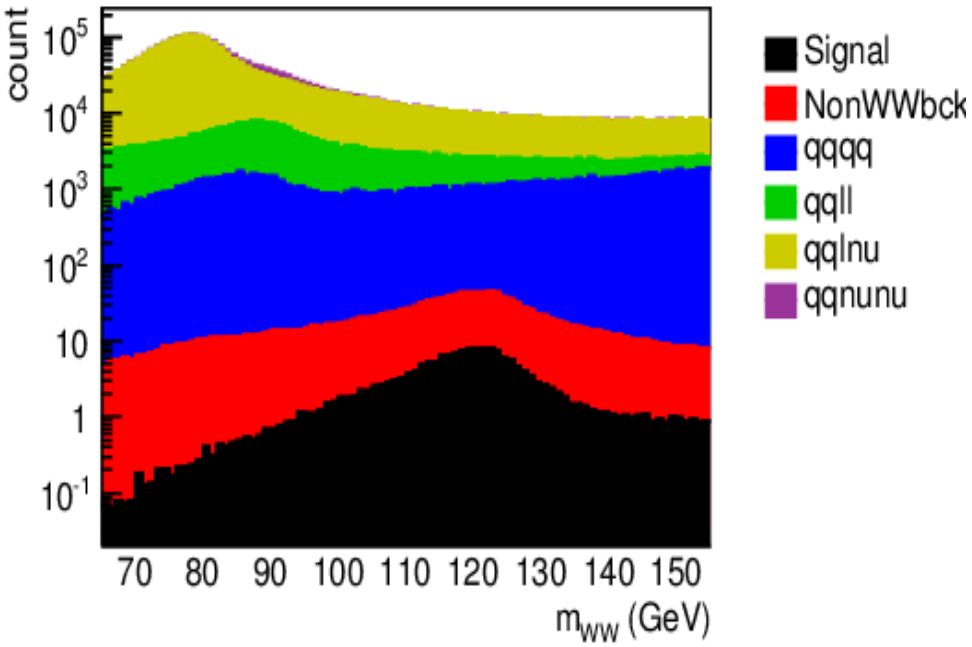


Preselection 4jets+2l

The reconstruction of W is based on the combination of the pair of jets with the mass closest to the mass of real W.

Preselection is aiming to reduce 'hadronic' background

Original samples

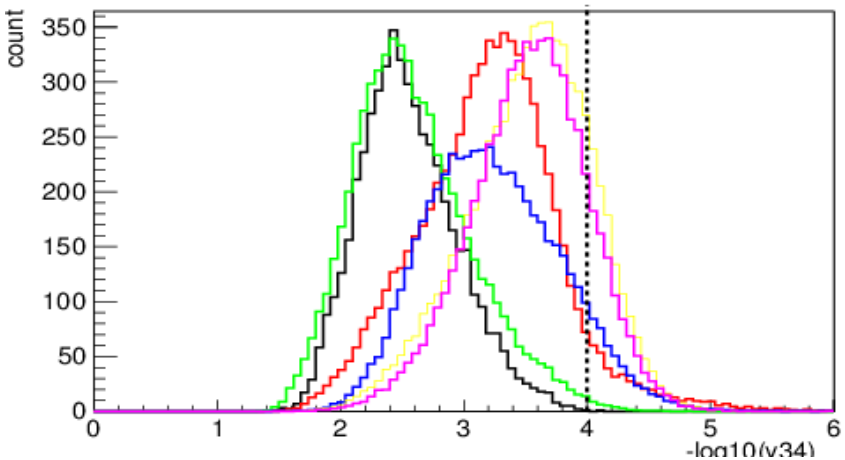


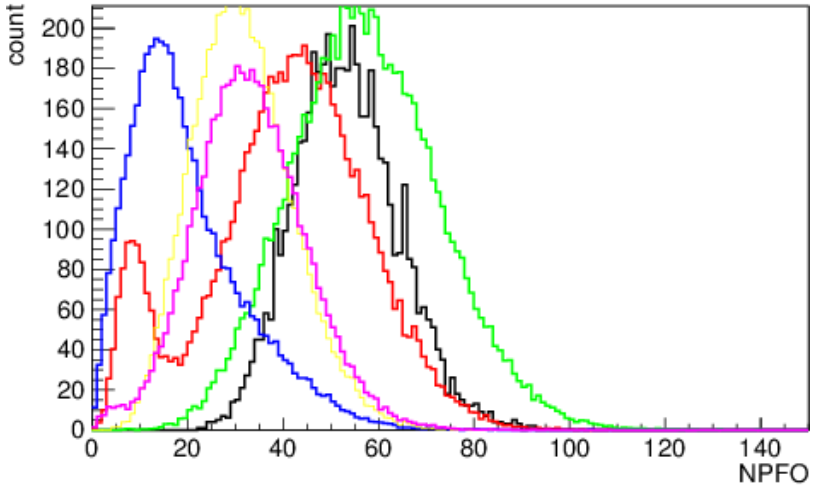
	Eff signal	Bck left
$m_Z > 50$ GeV	90.0%	6.0%
-log(y34)<4.0	92.8%	5.0%
-log(y23)<2.5	92.7%	5.2%
45 GeV $< m_W <$ 95 GeV	91.0%	5.0%
jetPt > 20 GeV	91.0%	4.9%
100 $< E_{vis} <$ 300 GeV	92.6%	5.8%

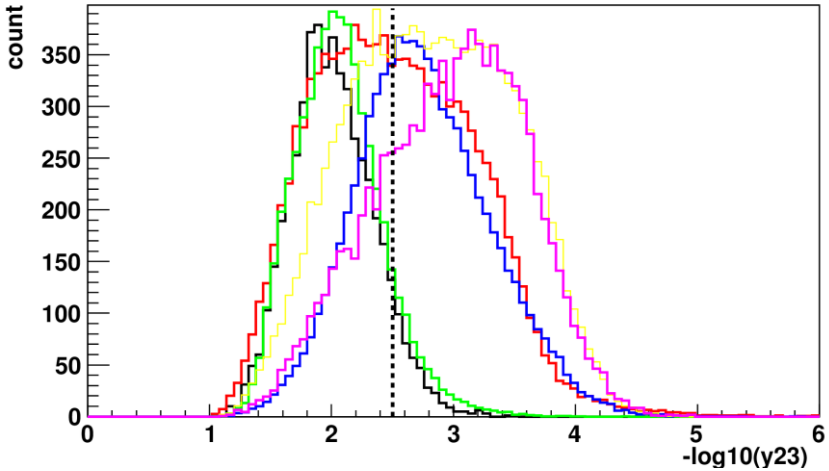
Event variables 4jets+2l

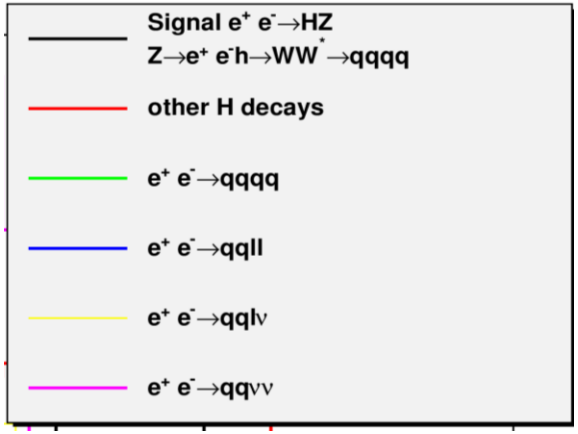
TMVA trained on 11 variables : $-\log(y_{34})$, NPFO, $-\log(y_{23})$

m_W, m_H, m_Z, Evis, P_t^{jet}, θ_{el} , btag ,ctag





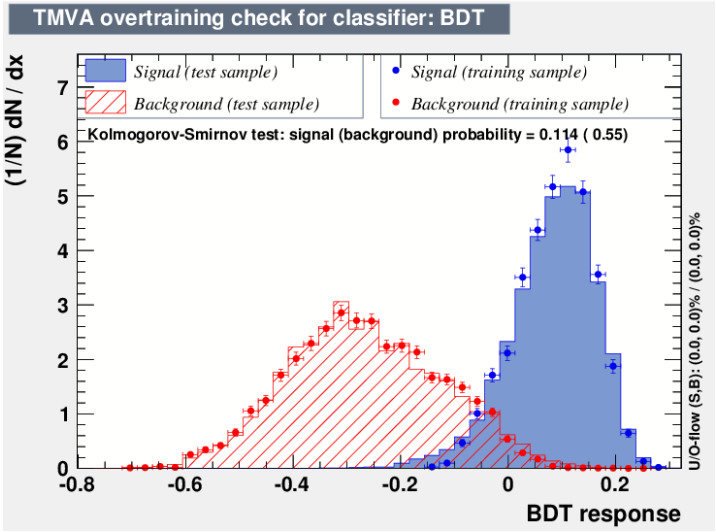




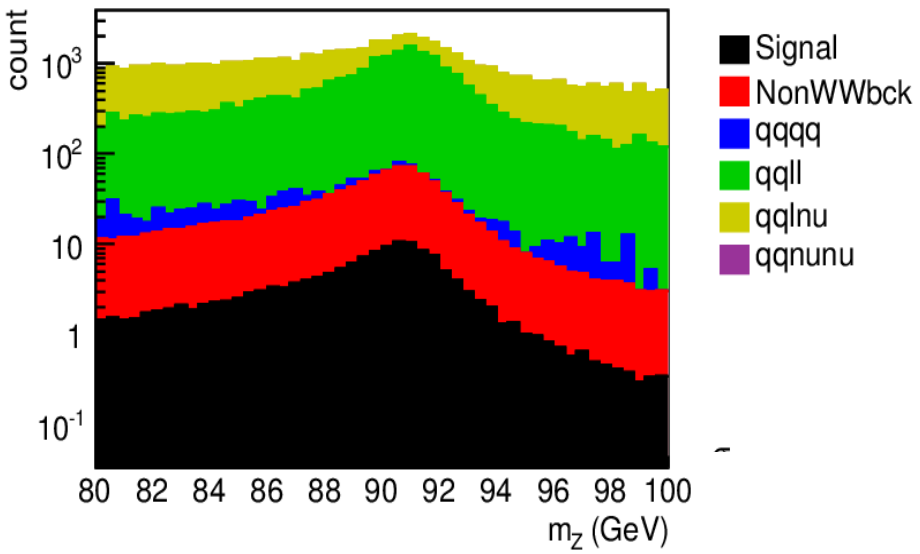
BDT application 4jets+2l

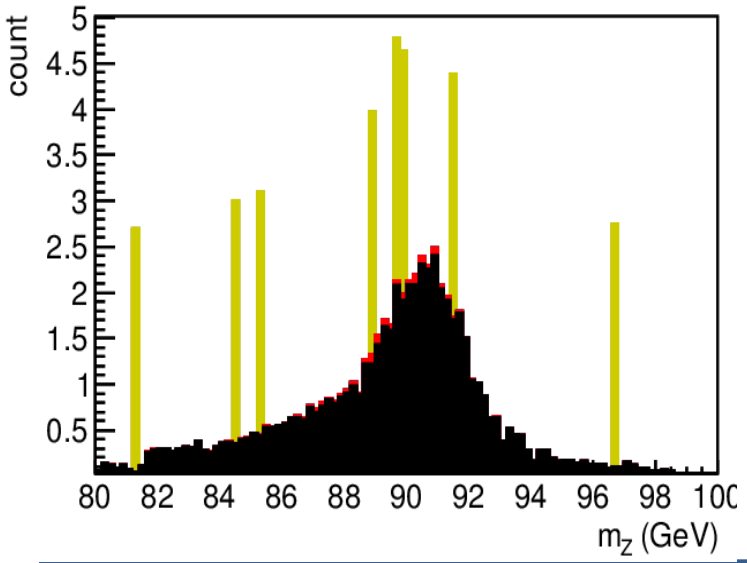
- BDT trained on semileptonic:
  1. HZ, Z-ll, nonWW-qqqq decays,
  2. qqll
  3. qqlν

$$\frac{\Delta\sigma}{\sigma} = \frac{\sqrt{S+B}}{S} = 15.3\%$$

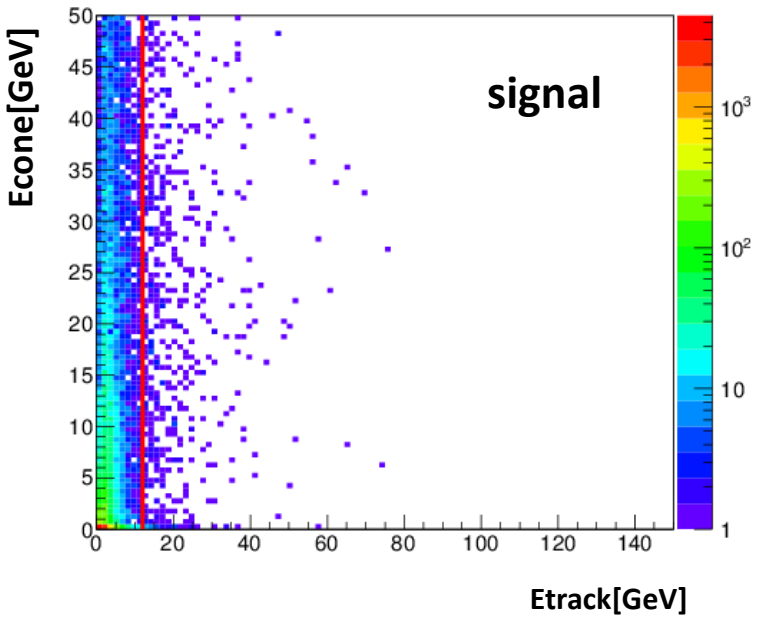


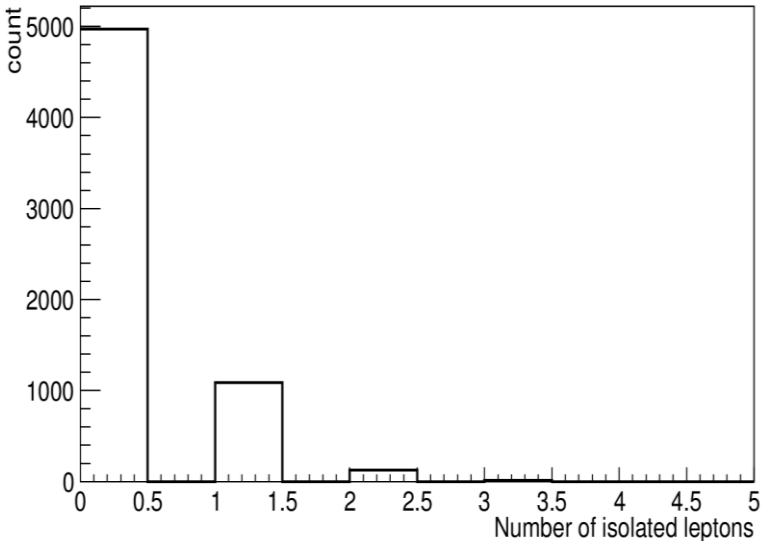
After preselection Overall signal Eff=30 % BDT CUT= 0.144





Lepton definition 6 jets FS





Simultaneous reconstruction of the real W, Z, Higgs.
W virtual is the free parameter.

$$\chi^2 = \frac{\left(M_{ij} - M_W\right)^2}{\sigma^2_W} + \frac{\left(M_{kl} - M_Z\right)^2}{\sigma^2_Z} + \frac{\left(M_{ijmn} - M_H\right)}{\sigma^2_H}$$

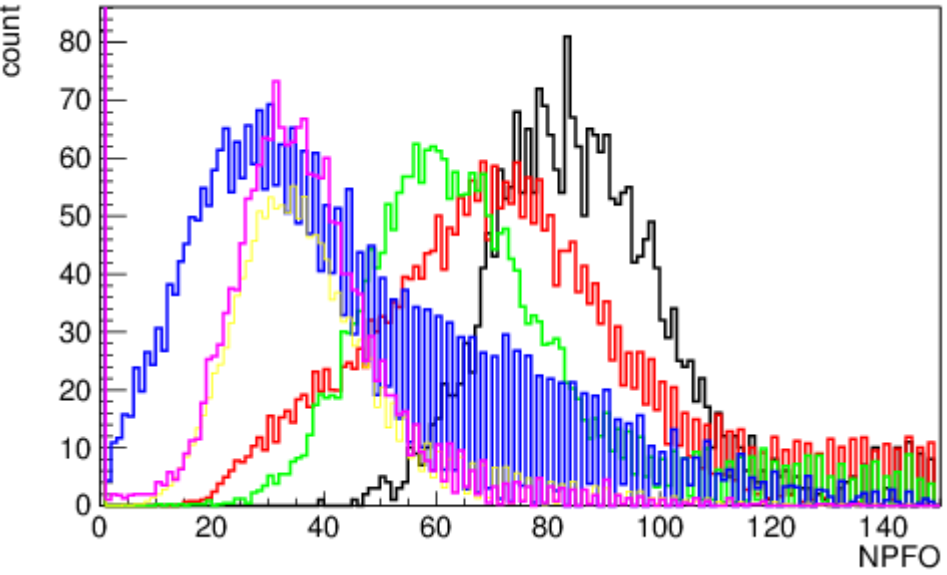
Preselection 6 jets FS

Preselection optimized to reduce ‘semileptonic’ bck .

Main background, qqqq, poorly responds to any kind of preselection.

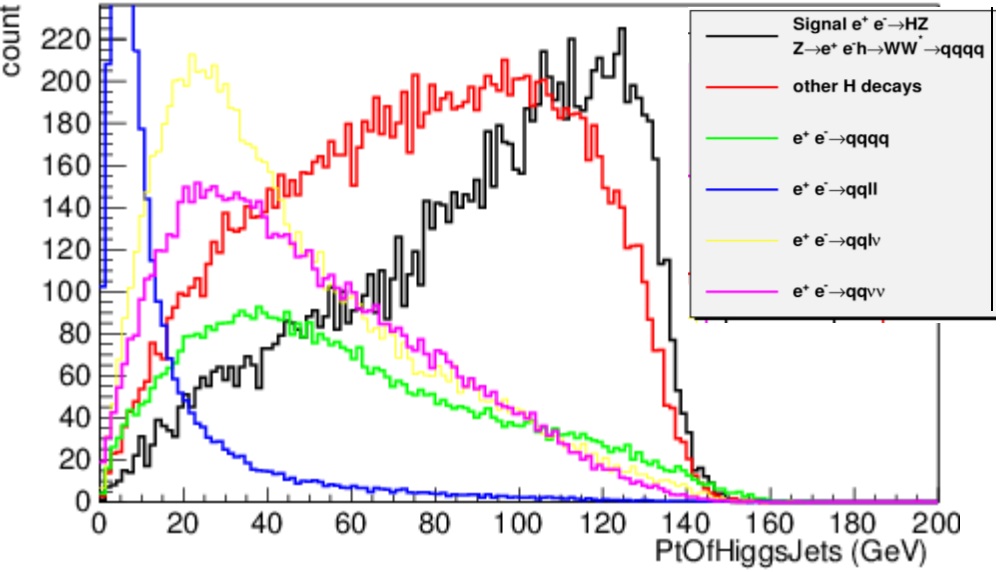
	Signal Eff	‘Leptonic’ bck left	Background left
$m_Z > 70$ GeV	89%	2%	29%
-log(y12)<2.0	99%	70%	76%
-log(y23)<2.6	99%	35%	59%
-log(y34)<3.0	98%	14%	43%
-log(y45)<3.2	91%	5%	18%
$E_{vis} > 250$ GeV	94%	8%	42%

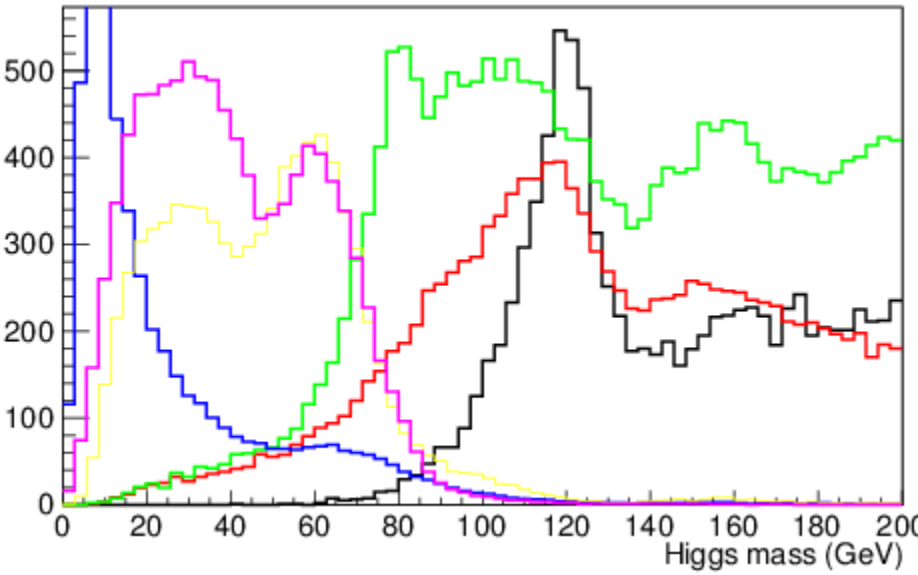
Event variables 6 jets FS



BDT trained on 11 variables:

NPFO , **PtofHiggsJets**, Evis
Masses: **Higgs**, W, W*
JetTransitions:
-log(y12,y23 ,y34,y45,y56)



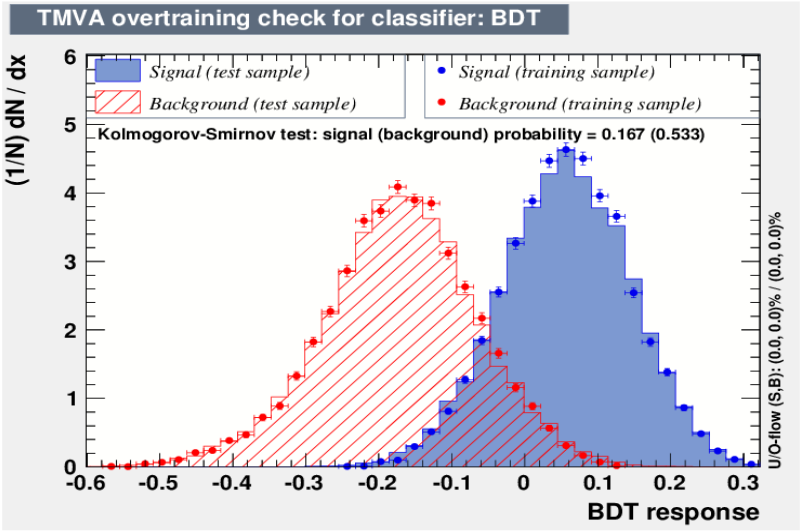


BDT application 6 jets FS

BDT trained on 'hadronic' bck:

- HZ, Z-qq, nonWW-qqqq decays
- qqqq

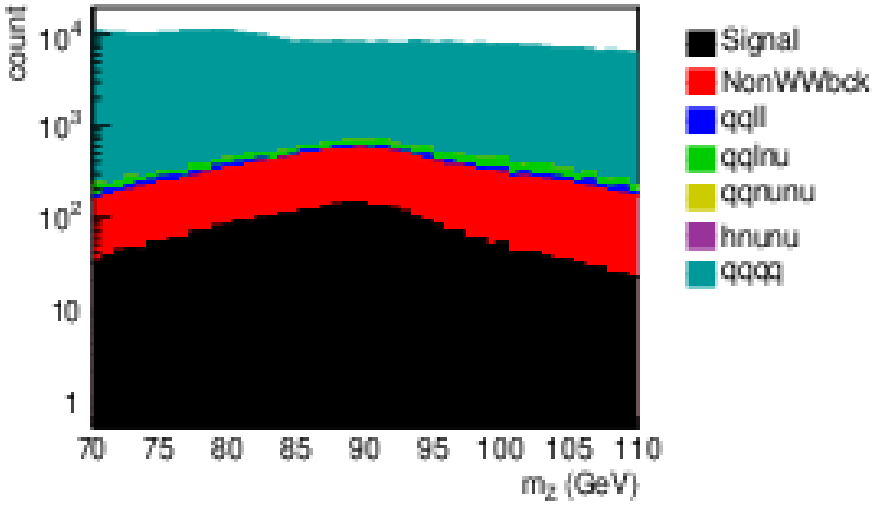
$$\frac{\Delta\sigma}{\sigma} = \frac{\sqrt{S+B}}{S} = 7.0\%$$



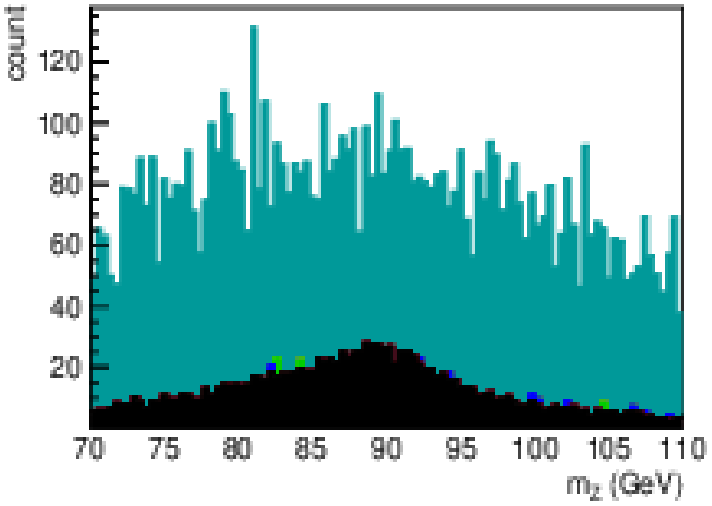
BDT CUT= -0.072

Overall signal Eff=50 %

After preselection



After MVA



Summary

Analysis ingredients present

Preliminary results presented

Include more variables for 6 jet FS – event shape

Expect improvement

from the optimized lepton isolation in both FS

END