

## Search for the Higgs boson in the $ZH \rightarrow \nu\nu b\bar{b}$ channel at DØ



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C.Ochando - Rencontres de Moriond EW 2008

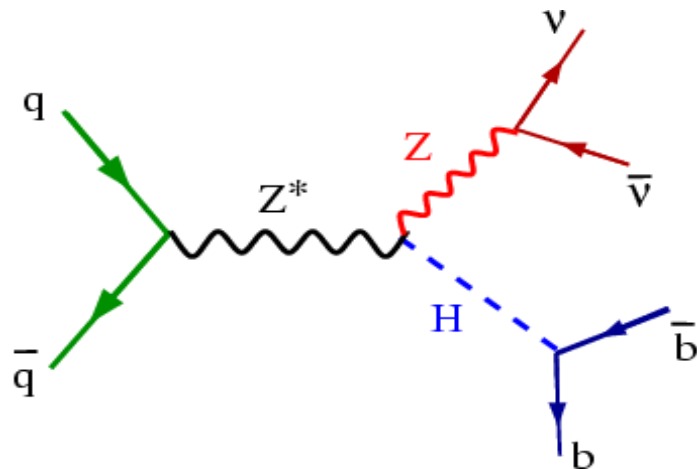
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# Introduction: The $ZH \rightarrow \nu\bar{\nu}b\bar{b}$ channel

The  $p\bar{p} \rightarrow HZ$  reaction with  $H \rightarrow b\bar{b}$  and  $Z \rightarrow \nu\bar{\nu}$  is among the most promising for the discovery of a low mass Higgs boson at the TeVatron.

## Experimental Signature:

Missing Transverse Energy (MET),  
no isolated lepton



Two high  $p_T$  jets, acoplanar, b-tagged

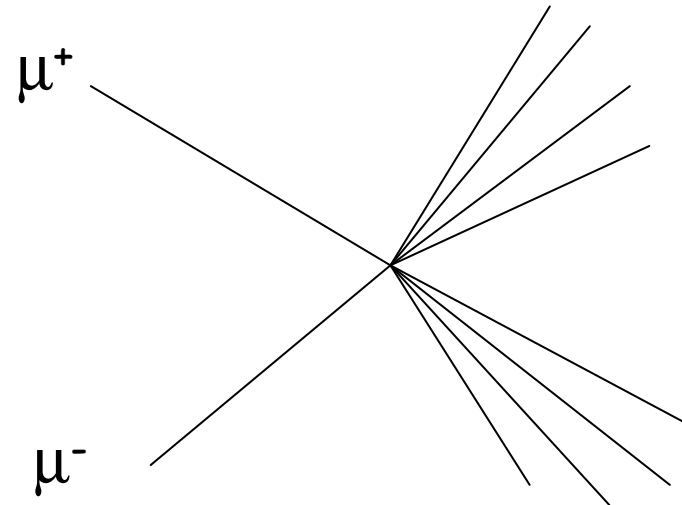
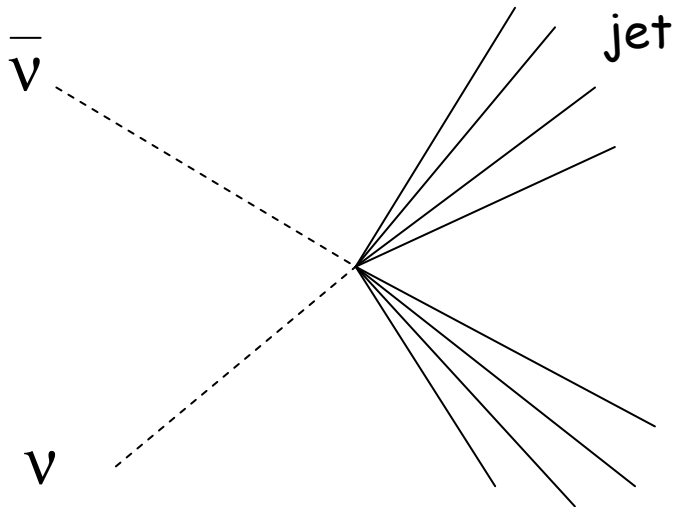
- The search is also sensitive to the  $W(-\rightarrow l\nu)H(-\rightarrow b\bar{b})$  channel where the lepton is not identified.

## Backgrounds:

- **Physics ("SM"):**  $W/Z$ +jets, diboson, top.
- **Instrumental ("QCD"):** multijet events produced by the strong interaction with fake MET resulting from fluctuations in jet energy measurements.

# Triggers

- Specific triggers were designed for the jets+MET searches:  
jet acoplanarity, MET...
- The calibration of the trigger response was performed on  $Z \rightarrow \mu^+ \mu^- + \text{jets}$  events,  
with the same jet topology as the signal:  
Muons deposit only MIP energy in the calorimeter.



# Basic Event Selection

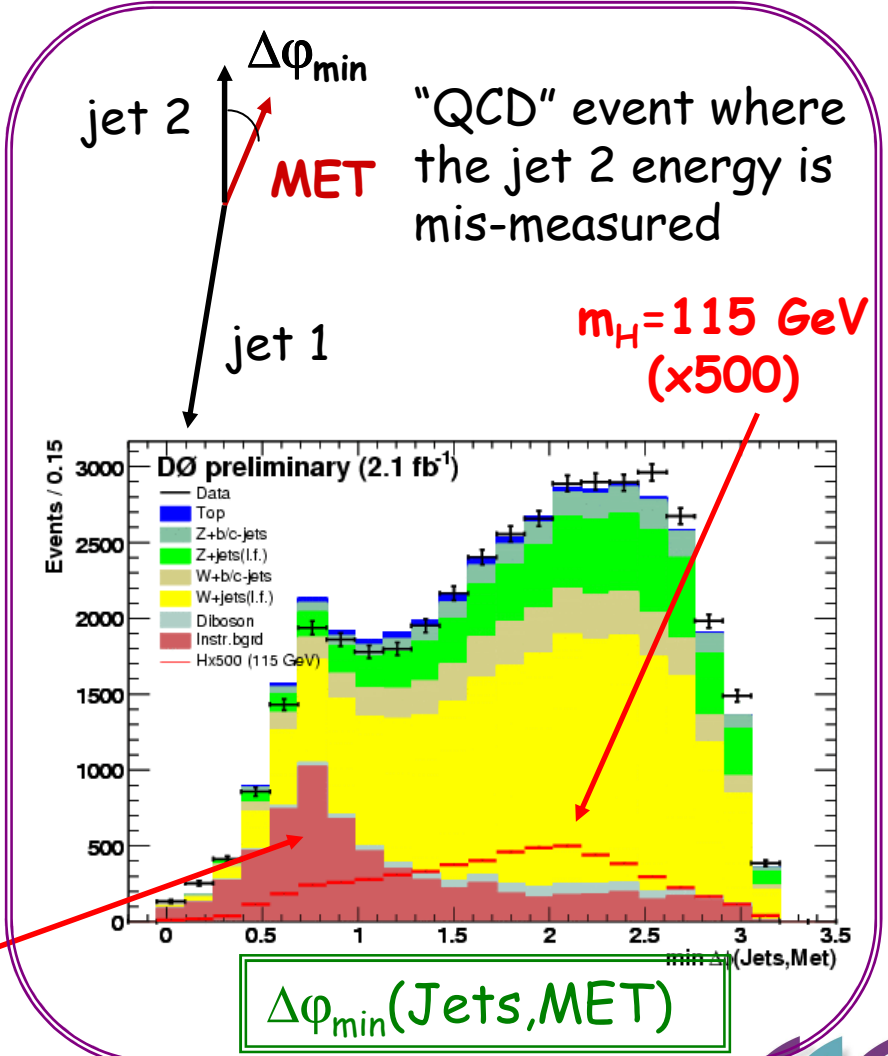
- The search was performed with  $2.1 \text{ fb}^{-1}$  (RunIIa + RunIIb data taking periods).

- Basic Selection:

- 2 or 3 jets with  $p_T > 20 \text{ GeV}$
- $\text{MET} > 50 \text{ GeV}$
- No isolated electron or muon (against W/Z+jets)



- Set of kinematic cuts.
- Reduce the overwhelming "QCD" background (MET should be close to the jets)



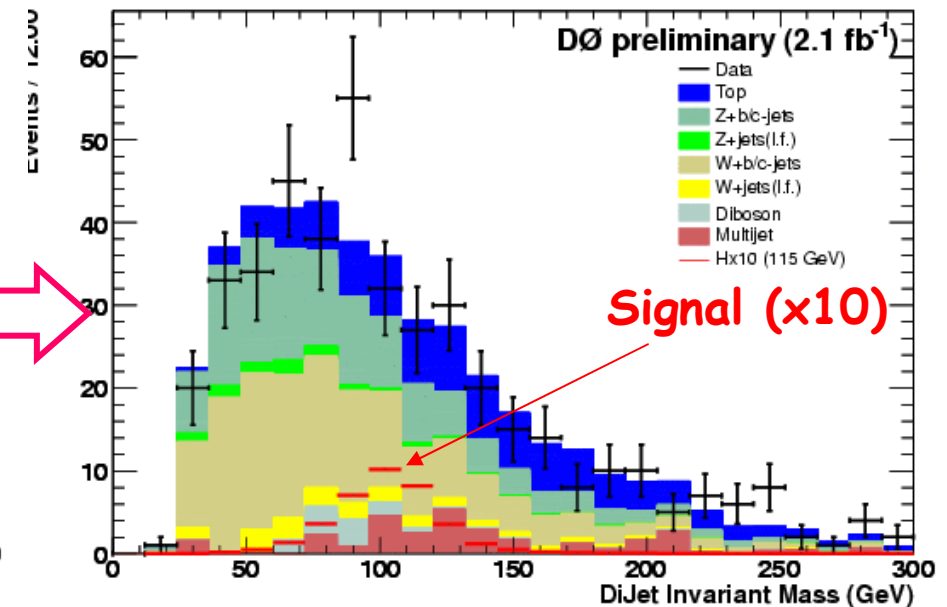
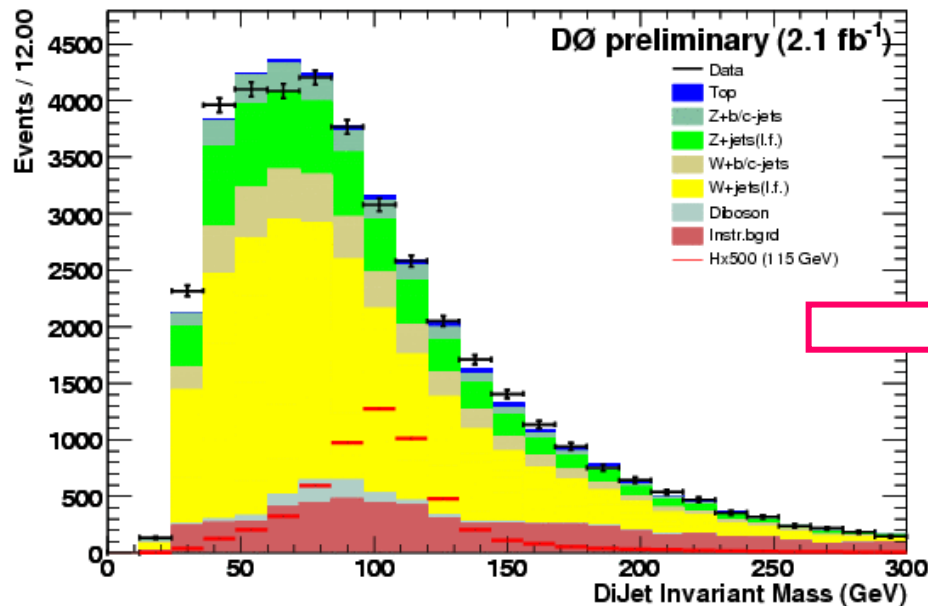
# Heavy Flavor Tagging

The two jets expected to arise from the Higgs boson  $H \rightarrow bb$  decay were required to be tagged as b-jets, using a Neural Network b-tagging algorithm.

## Dijet Invariant Mass

Before

After



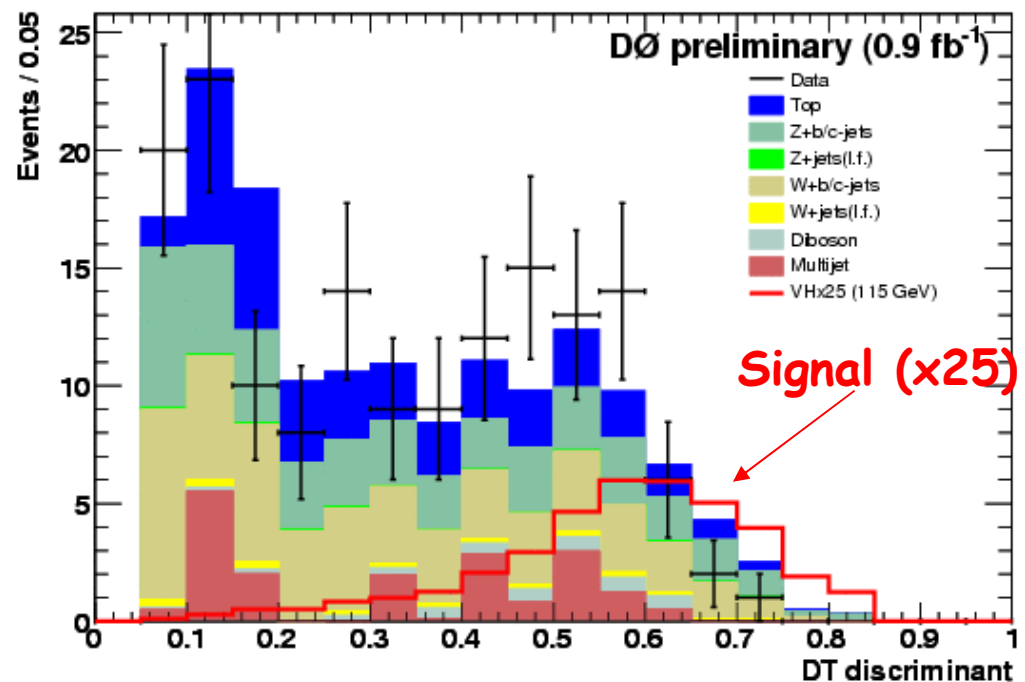
A good description of the data is achieved by the simulation, both before and after b-tagging.



# Discriminant Analysis

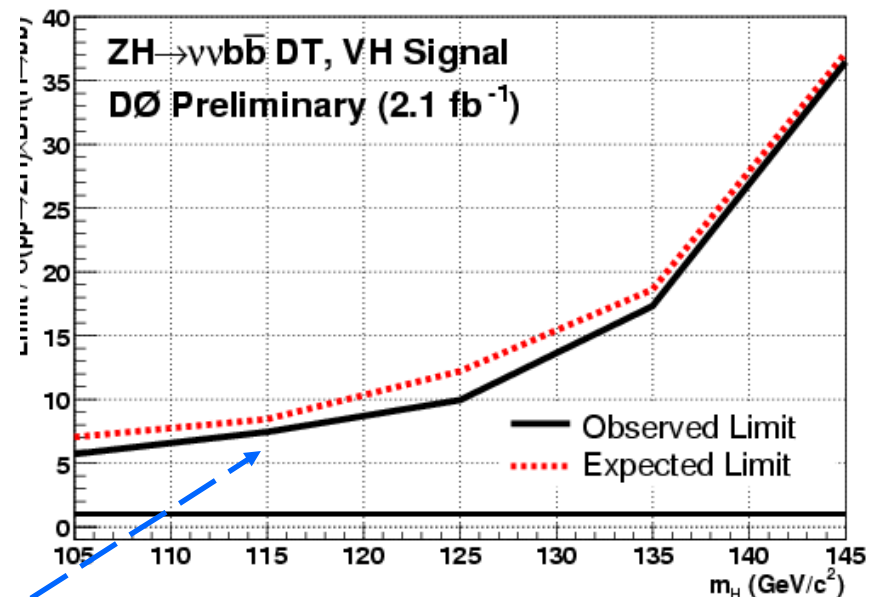
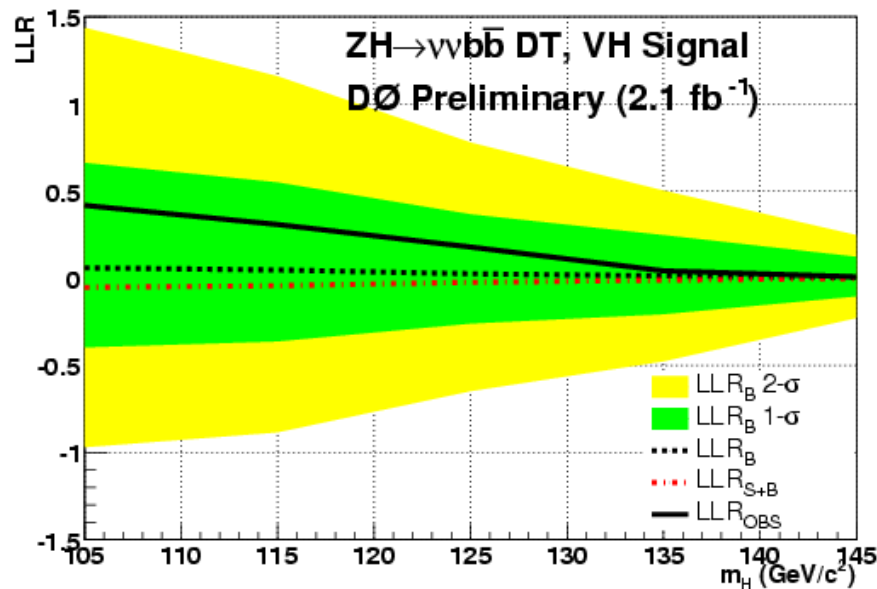
- Final separation between signal and remaining backgrounds was obtained with a Boosted Decision Tree (DT). The WH and ZH signals are combined.
- A separate DT was trained for each Higgs mass probed, and for both RunIIa and RunIIb data taking periods.

DT discriminant output:  
Example for a Higgs signal with  
 $m_H=115$  GeV, for Run IIa



# Limits

- No deviation from the SM expectation was observed.
- Set limits, based on the DT output, on the SM Higgs boson production  $\sigma \cdot BR(H \rightarrow b\bar{b})$  (relative to the SM value) using a "modified frequentist", a.k.a CLs, approach.



- For a mass of 115 GeV, the limit is a factor 7.5 larger than the SM cross section.
- Most sensitive DØ result for a low mass Higgs boson in a single channel.



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# BACK UP SLIDES



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8

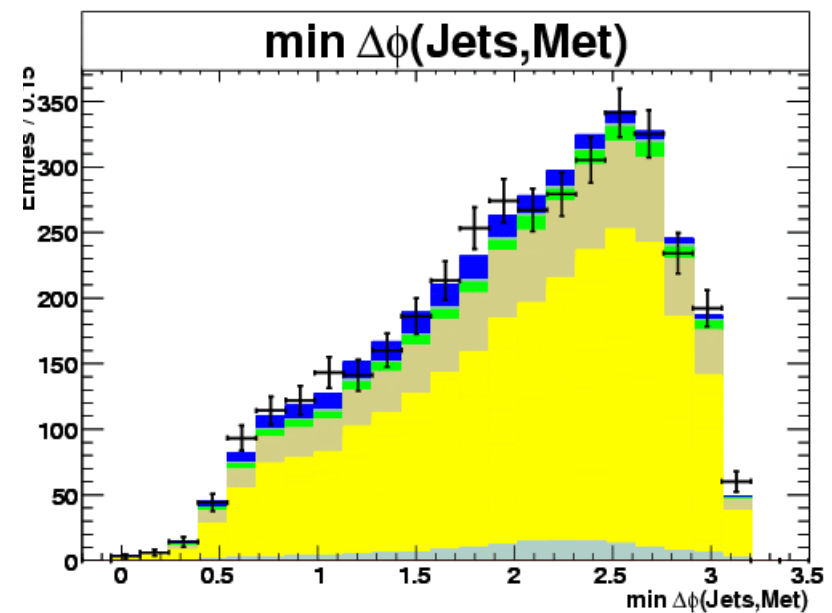
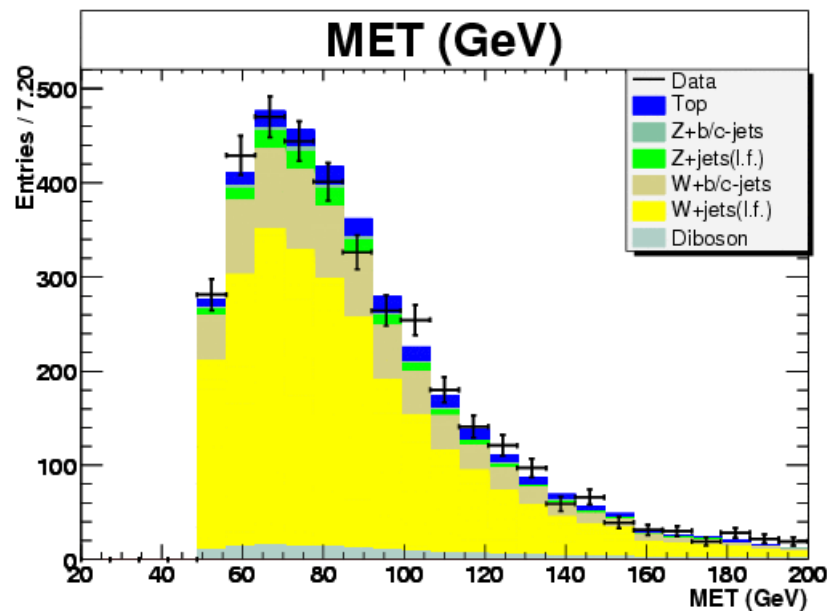




# Backgrounds determination & control

- The SM background is controlled by inverting the lepton veto.

$W(\rightarrow\mu\nu)+\text{jets}$  control sample



- "QCD" is extracted from the data where MET from tracks and calorimeter are de-correlated.



# RunI Ib DT output

DT discriminant output:  
Example for a Higgs signal with  
 $m_H = 115 \text{ GeV}$ , for Run I Ib

