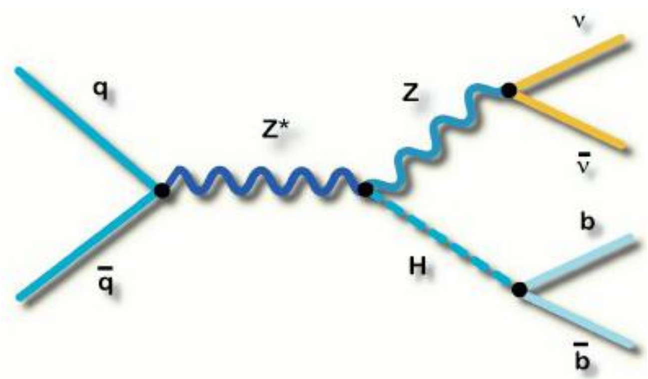


$ZH \rightarrow \nu\nu bb$: towards EPS 2011

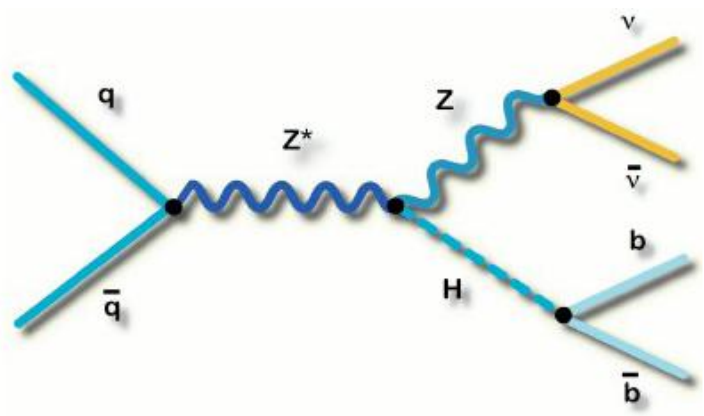
Thibault Guillemin,

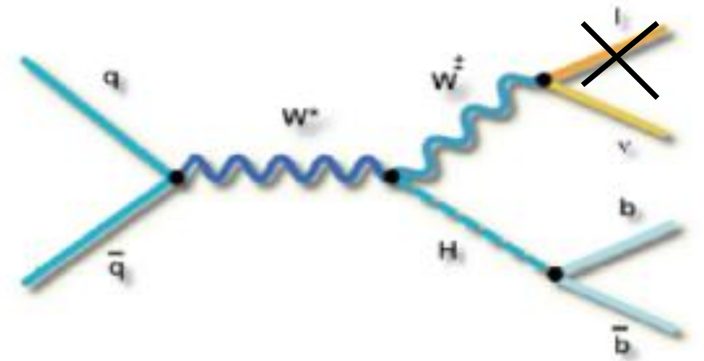
on behalf of the *ZHννbb* team

D0-France

May 30, 2011

Analysis strategy





1) Jets + MET trigger
2) Basic selection:
   2-3 taggable jets (p_T>20 GeV, $|\eta|$<2.5), $\Delta\Phi$>2.88, MET>40 GeV, METsig>5

   + lepton veto to ensure orthogonality with the WH direct search
3) Reduction of the multijet background with a discriminant
4) Apply b-tagging
5) Separate the signal from the remaining SM backgrounds with two physics discriminants (1-tag, 2-tag)

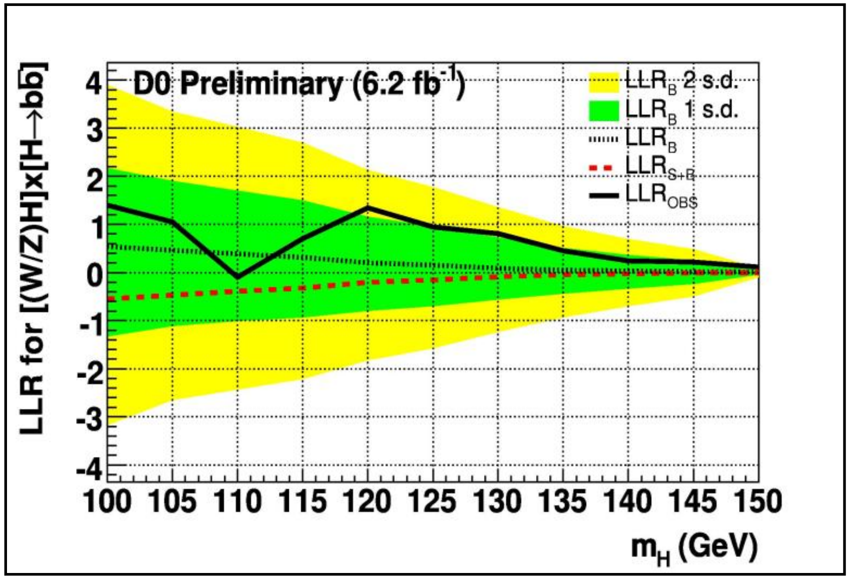
Definition of two samples in addition to the signal one:

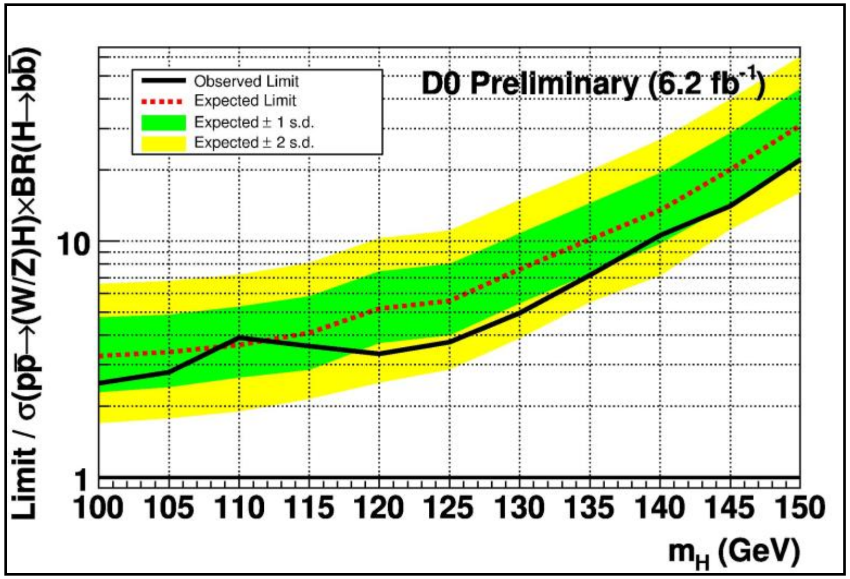
Multijet control sample:
- MET>30 GeV
- no MET significance cut

Electroweak control sample:
- invert the muon veto
- METMU>20 GeV and M_{TW}>30 GeV

From Moriond to EPS

Moriond: 6.2 fb^{-1} Run IIb result





Limits at 115 GeV

Measured: 3.4

Expected: 4.0

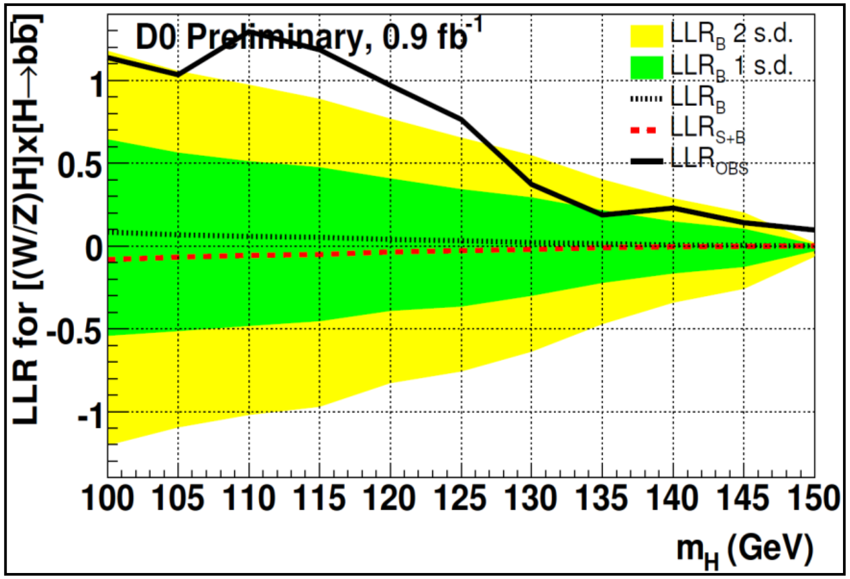
EPS: 8.4 fb^{-1} Run II result, including Run IIa

Run IIa re-analysis

The decision to re-analyse Run IIa data was taken for two reasons:

1) optimize the sensitivity of this dataset using all the Run IIb improvements

2) cross-check the Run IIa publication result, where a very background-like fluctuation was observed (this result was not published by itself but only combined with the Run IIb result)



Limits at 115 GeV

Measured: 3.3

Expected: 10.3

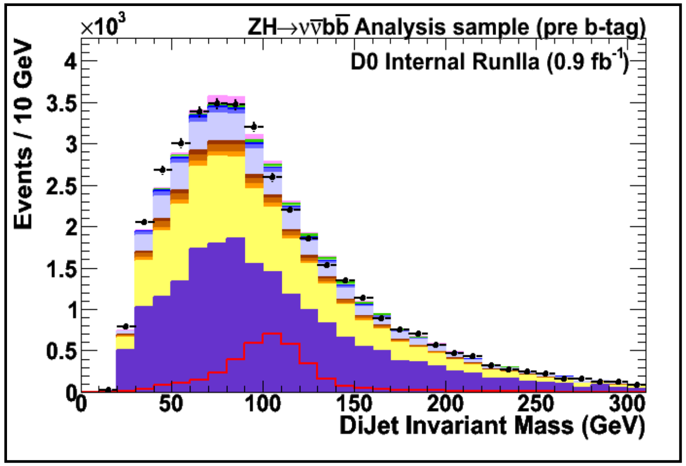
Run IIa vs Run IIb differences

Main difference at the trigger level

In Run IIa:

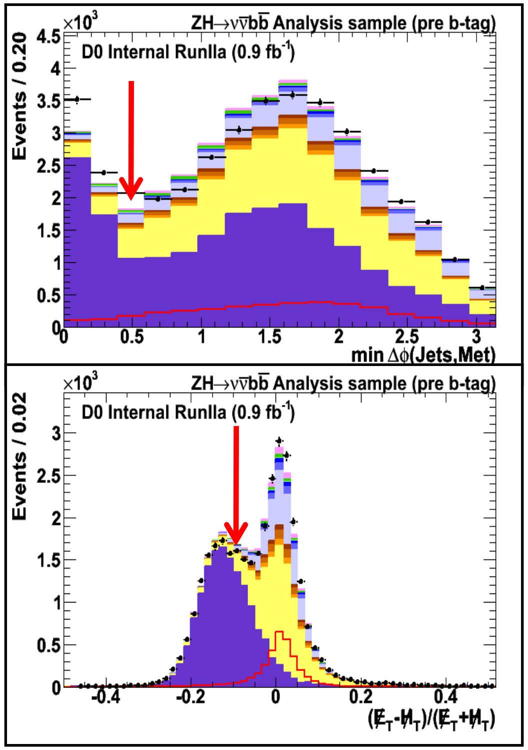
- no MET cut at L1
- no min$\Delta\Phi$(jets,MHT)>25° cut at L3

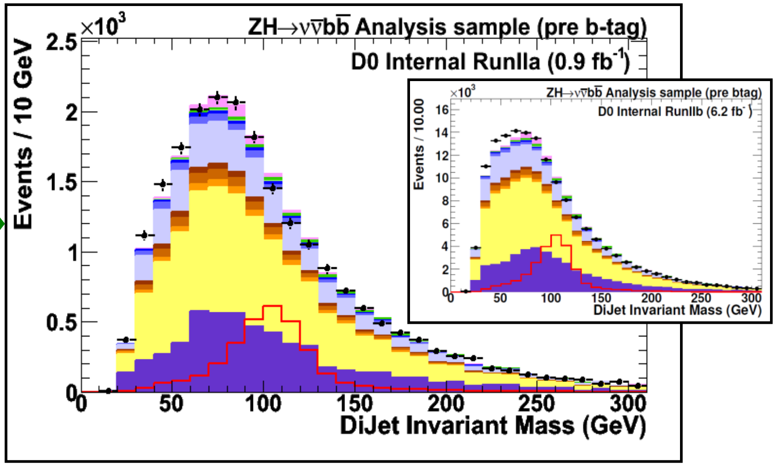
➔ significant enhancement of the relative multijet contribution in RunIIa



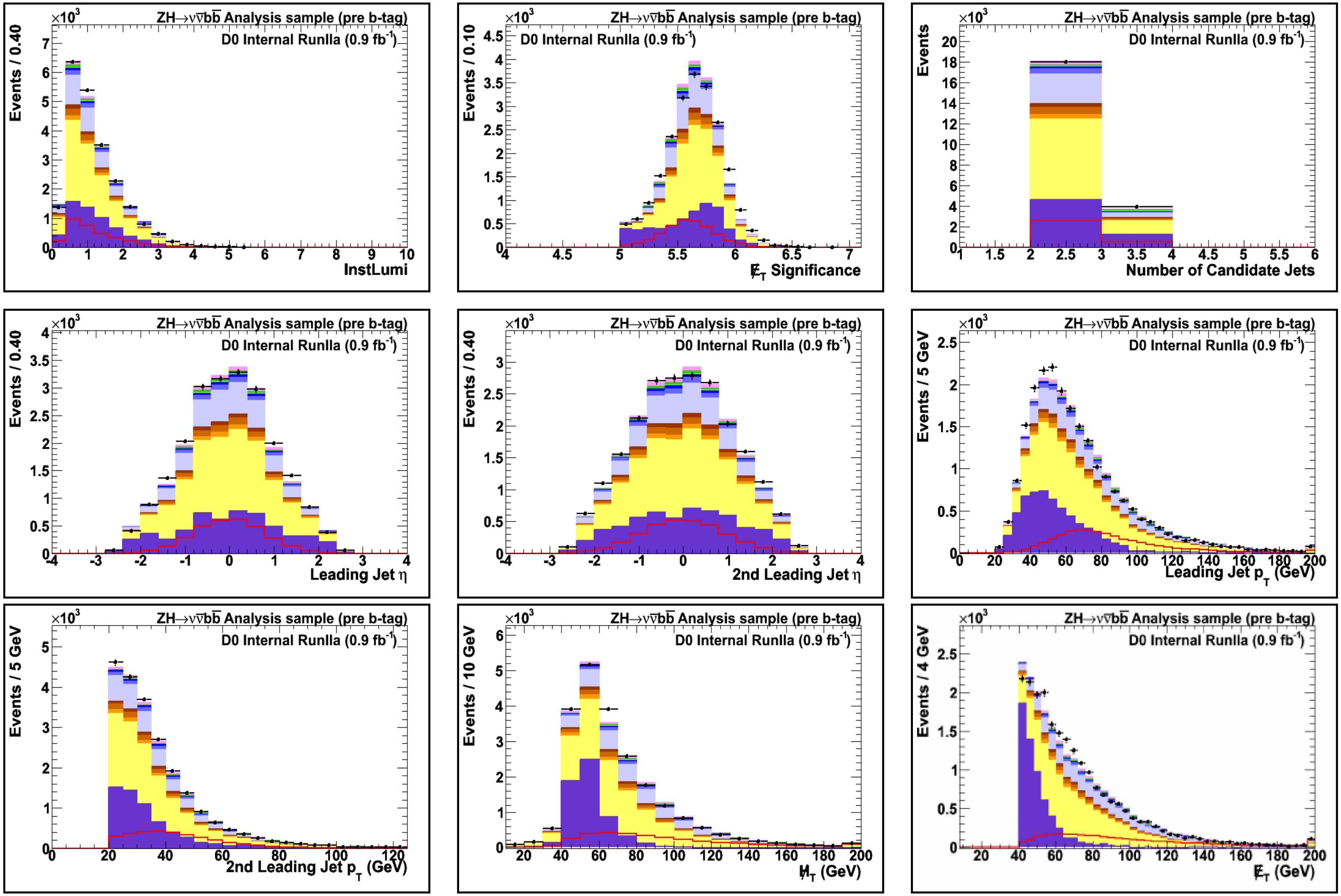
Run IIb-like selection applied + 2 extra cuts:

- min$\Delta\Phi$(jets,MHT)>25°
- MA>-0.1





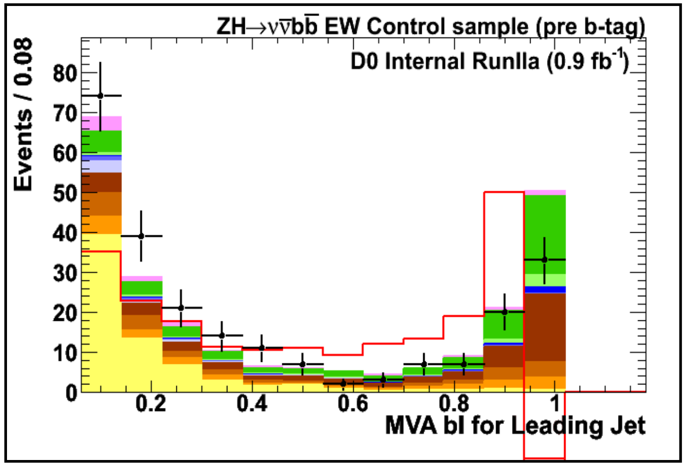
Data modeling for Run IIa

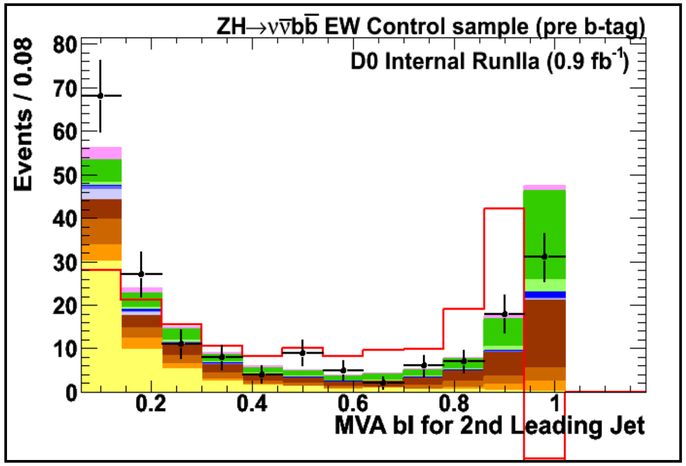


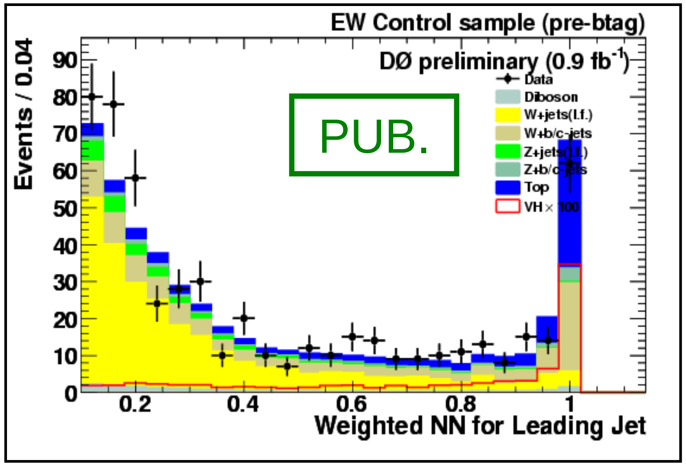
b-tagging for Run IIa

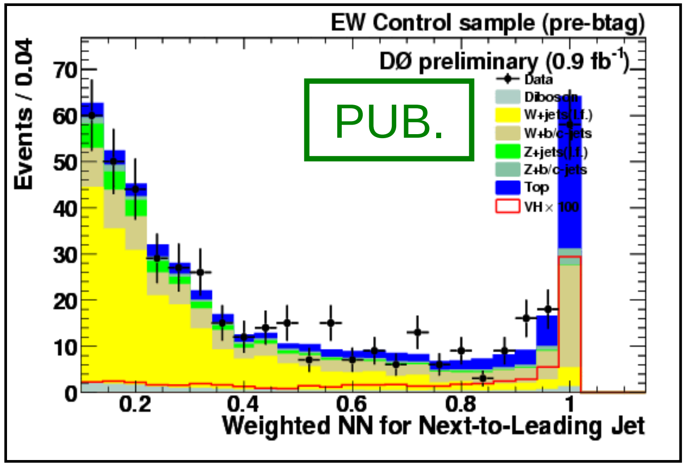
In the publication, the NN algorithm was used

➔ we now use the MVA technique and inject the MVA bl outputs of the tagged jets in the physics decision trees



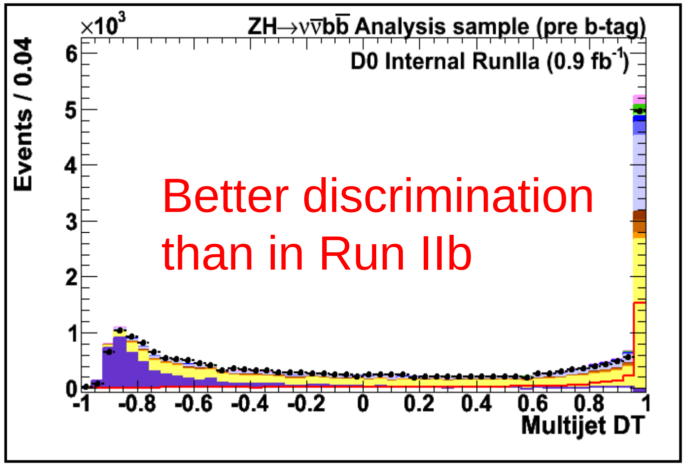


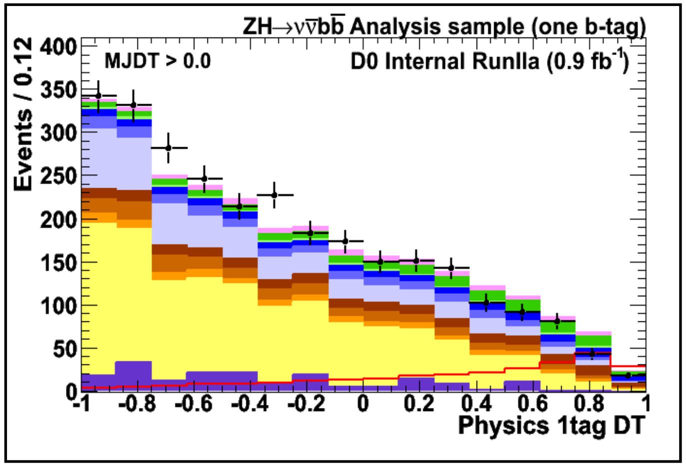


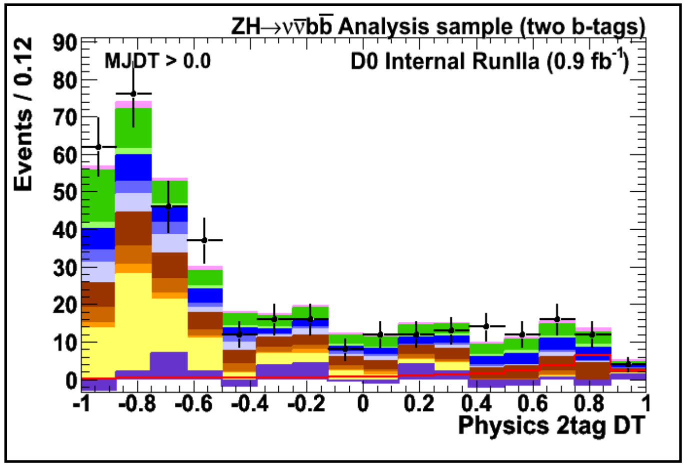


Decision trees and limits for Run IIa

The techniques and the variable sets applied in the Moriond analysis are used







CLFast limits

Limits at 115 GeV

Measured: 8.4

Expected: 7.7

Publication limits at 115 GeV

Measured: 4.8

Expected: 7.7

Updates for the Run IIb analysis

- We include the full Summer dataset:

additional 1.3 fb^{-1} of data ➔ 7.5 fb^{-1} Run IIb data

- Update of the analysis framework

• add a lot of tracking information

• new jet treatment

• latest combined vertex confirmation/taggability weights

• latest b-tagging TRFs

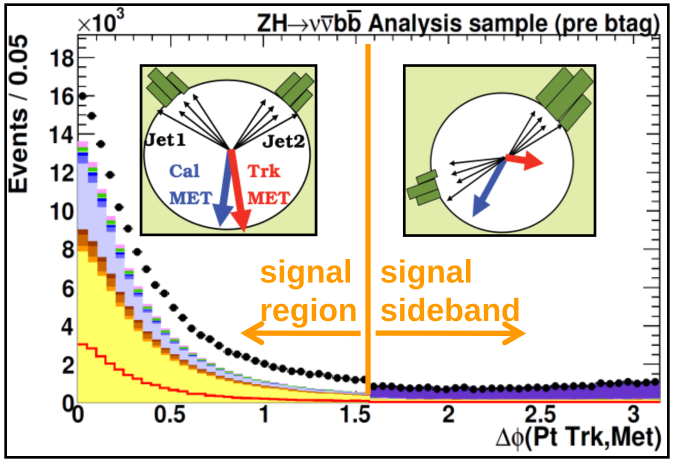
- Strategy: capitalize on our Moriond result

and investigate two improvement areas:

• multijet model

• MVA optimization

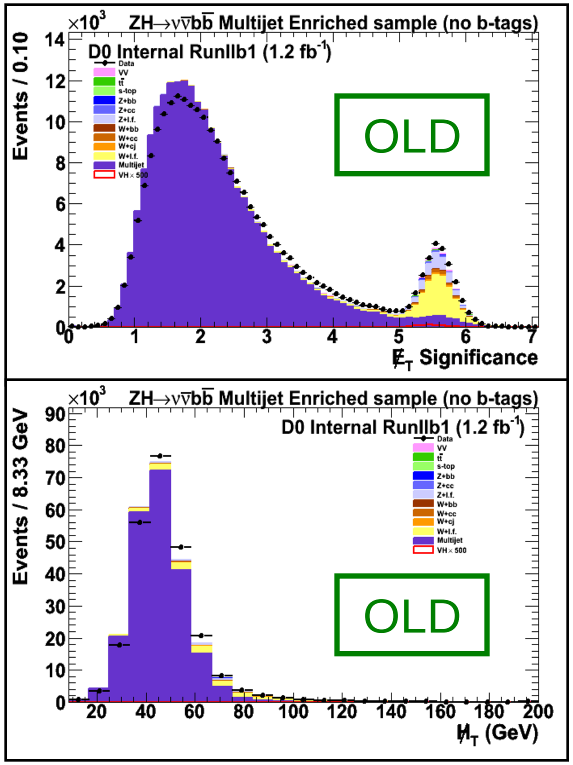
Multijet model (1/2)

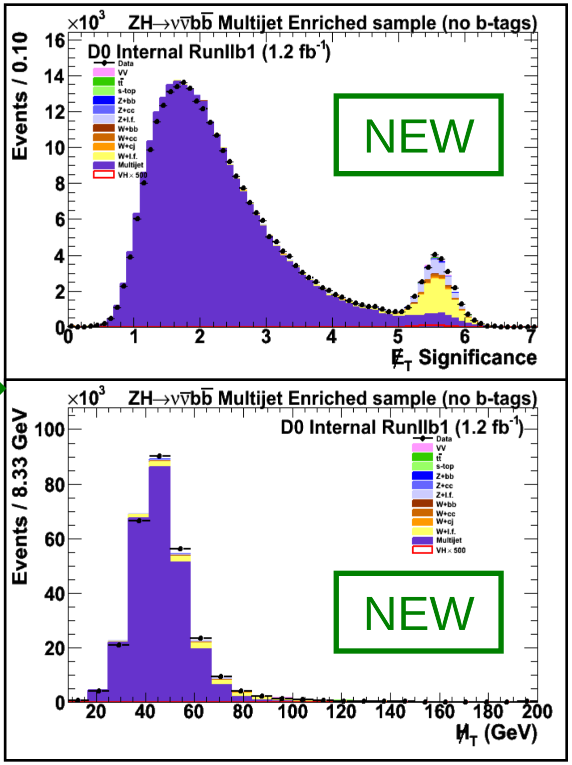


Our current sideband definition uses the variable $\Delta\Phi$(PtTrk,MET)

➔ to try to minimize the impact of calorimeter energy mismeasurements:

[min$\Delta\Phi$(jets,PtTrk)+max$\Delta\Phi$(jets,PtTrk)]/2, considering all jets p_T>15, $|\eta|$<3.2





Multijet model (2/2)

- WH has a relatively low efficiency (92%) for the default signal/side band definition cut (ZH: 98%)

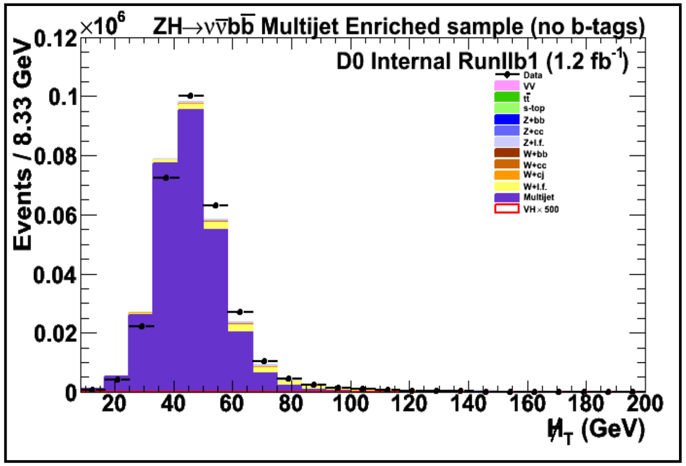
➔ this is mainly due to muons being found in the tracking system but not in the muon system

➔ the WH acceptance can be increased by ~5% if we remove the isolated tracks from the missing track p_T calculation

➔ we performed several tests using various track p_T thresholds and also the fake track killer information

We still have modeling issues

➔ not sufficiently validated to be used for EPS



MVA optimization (1/2)

- A lot of efforts to try to optimize the sensitivity, starting from the "Moriond MVA":
  - merging epochs for training
  - optimization of the MJDT cut value
  - choice of the MJDT and physics DTs input variables
  - ➔ new variables but also trying to reduce the number of input variables
  - binning of the final DT ouputs

see N. Osman's talk tomorrow

- More improvements to come (post EPS):
  - 3^{rd} jet b-tagging
  - kinematic inputs for third jet (various masses)
  - separate training for 2-jet and 3-jet events
  - train separate DTs against different backgrounds (*W*, *Z*, top)

MVA optimization (2/2)

- Ex: impact of the MJDT number of variables reduction

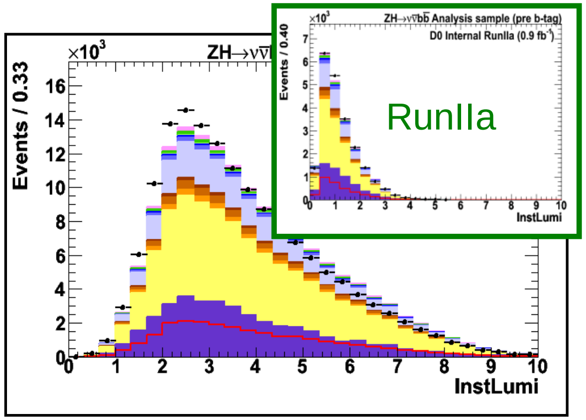
CLFit2 Fast Approximation limits

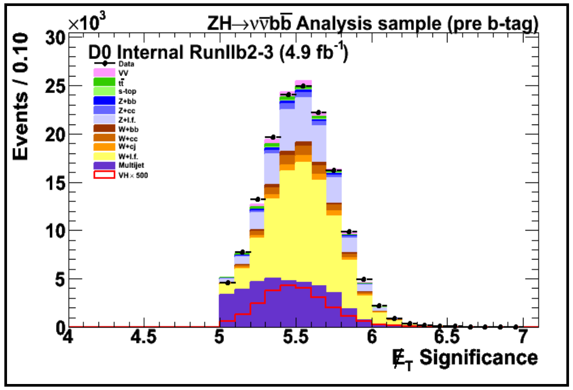
# Variables	5	10	20
RunIIb1	7.92	8.01	7.95
RunIIb23	4.02	4	3.96
Combined	3.56	3.58	3.53

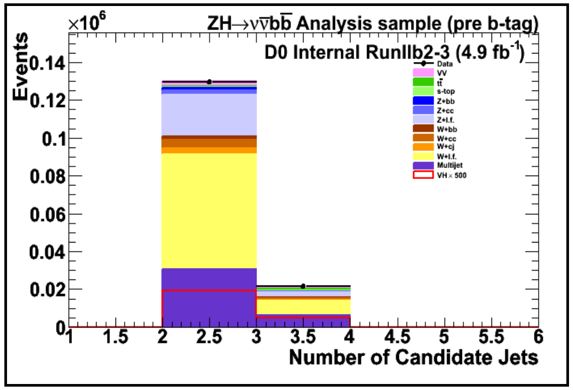
Final sensitivity with only 5 variables similar to the one with 20 variables

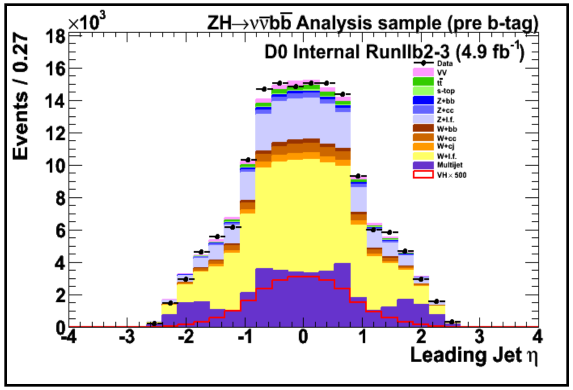
- Frozen set of DT input variables:
  - MJDT: 5 variables
  - Physics DTs: 10 + MVA bl of tagged jets

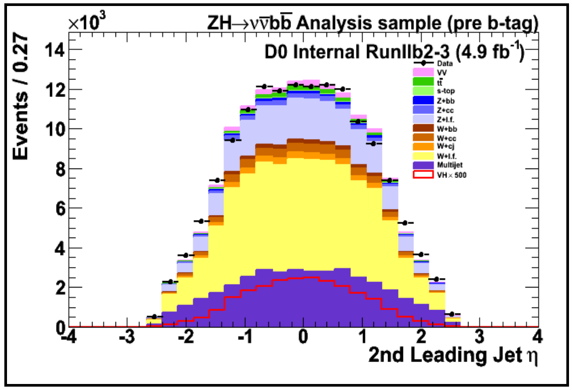
Data modeling for Run IIb2-3-4 data (6.3 fb^{-1})

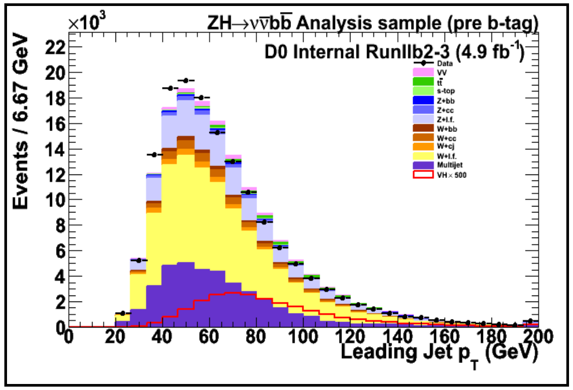


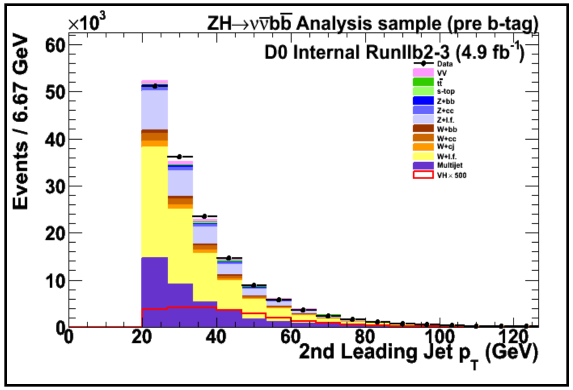


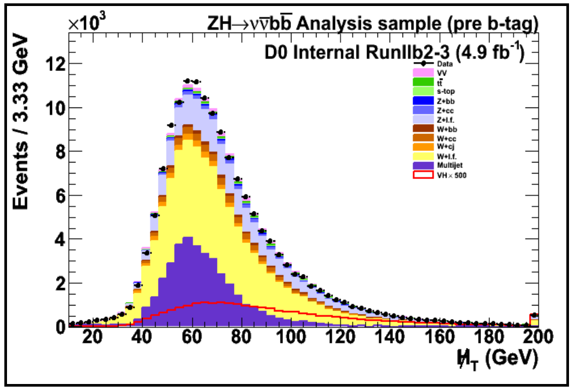


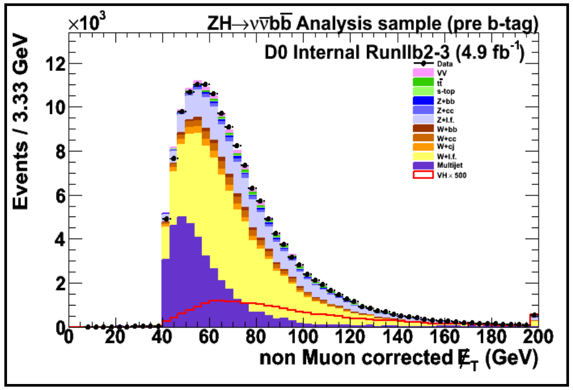






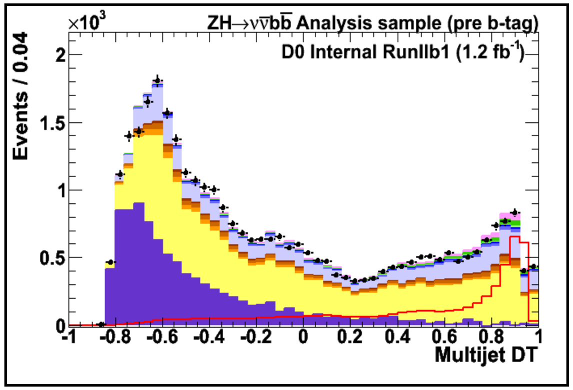


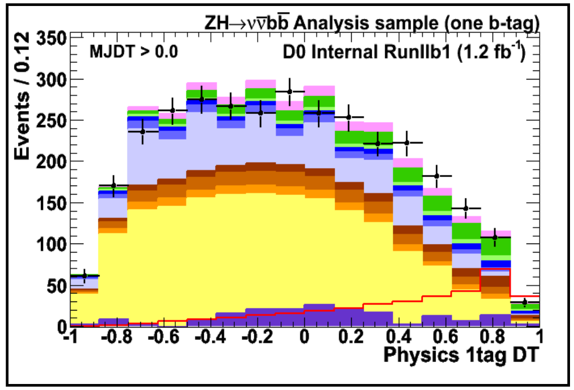


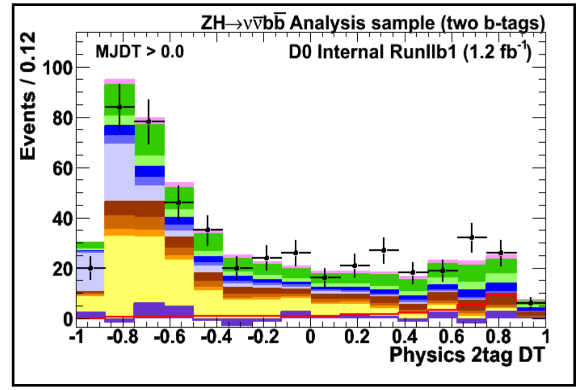


Decision trees for Run IIb

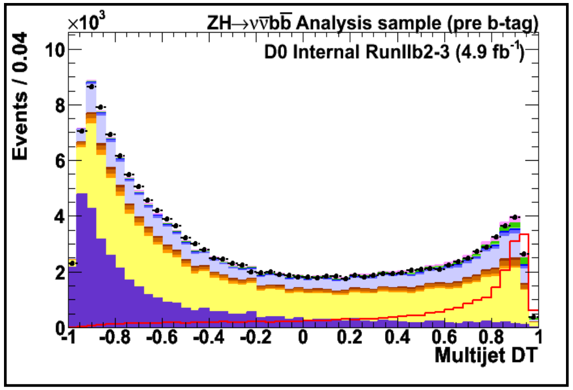
Run IIb1

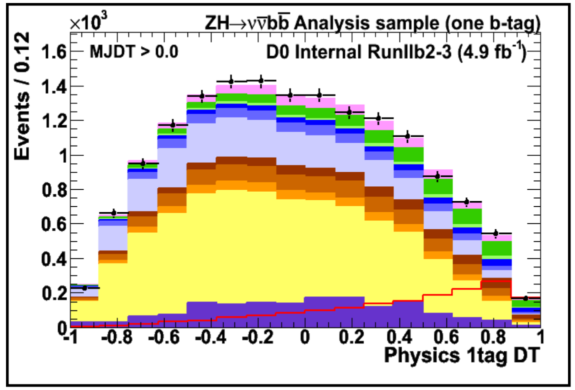


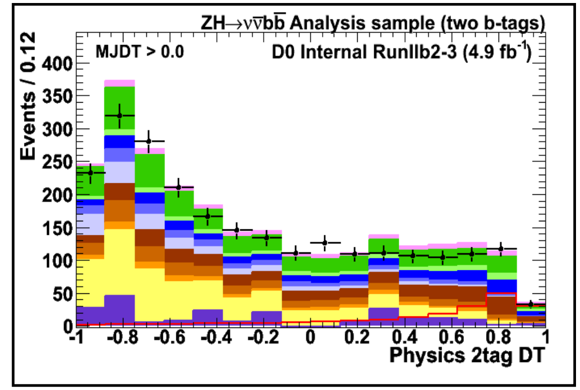




Run IIb2-3-4







All the MC samples (nominal and systematics) have been processed
➔ final limits are about to be computed…

Conclusion

- Very solid result for Moriond:

6.2 fb^{-1} Run IIb data ➔ $\sigma_{exp} = 4.0$

- Building on this result for EPS:

➔ use this analysis as a baseline for the re-analysis of Run IIa data

➔ implement only validated/understood improvements in Run IIb:

• multijet model

• MVA optimization

We are very close to get **final results for 8.4 fb^{-1} of Run II data**

- Summer 10 Tevatron combination: $\sigma_{exp} = 4.3$

We should be close to $\sigma_{exp} \sim 3$
(more than 30% improvement, what is needed to reach the SM sensitivity at 115 GeV)