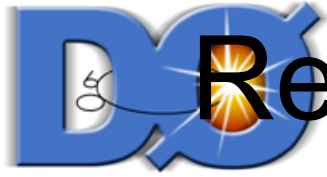
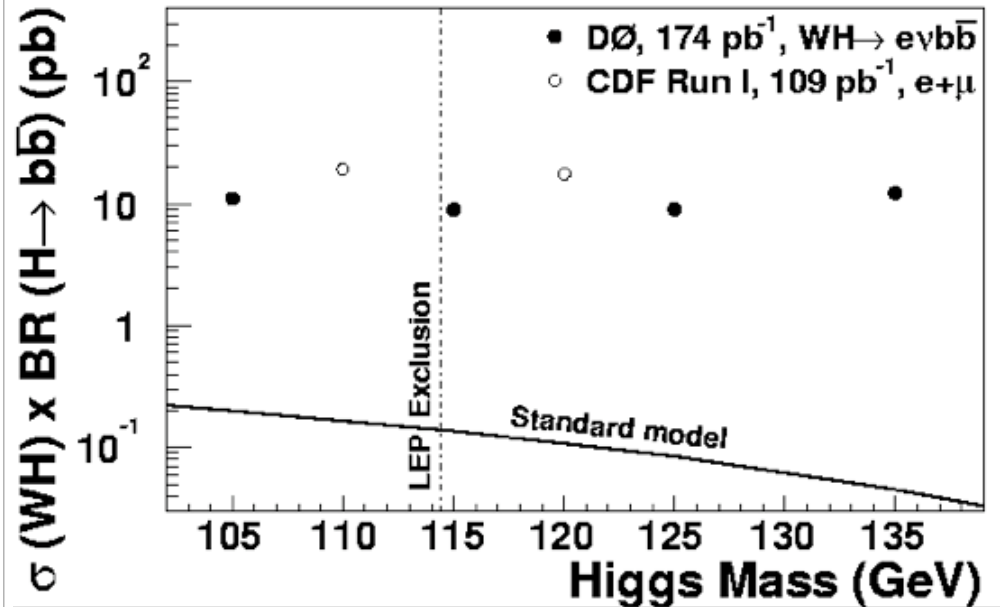
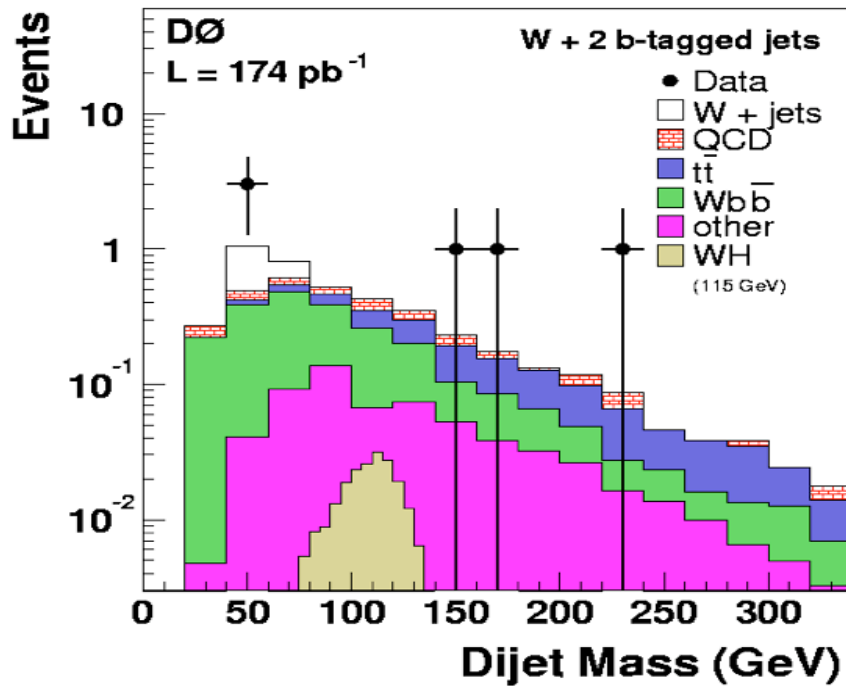


# $WH \rightarrow l(e, \mu) \nu b \bar{b}$ Searches At D0 experiment

Hyunwoo KIM for the D0 Collaboration  
University of Texas Arlington  
TeV4LHC, Oct 20 2005, @FNAL



# Result in electron channel with 174 pb<sup>-1</sup> published



- In 2 b-jet mass distribution, in mass window, for 115 GeV Higgs signal
- 0 data, 0.05 expected Higgs, 1.07 background
- 95 % CL limits on WH, 11.0, 9.0, 9.1 and 12.2 pb for 105 to 135 GeV
- Wbb limit is 6.6 pb from 6 events with 4.4 total expectation



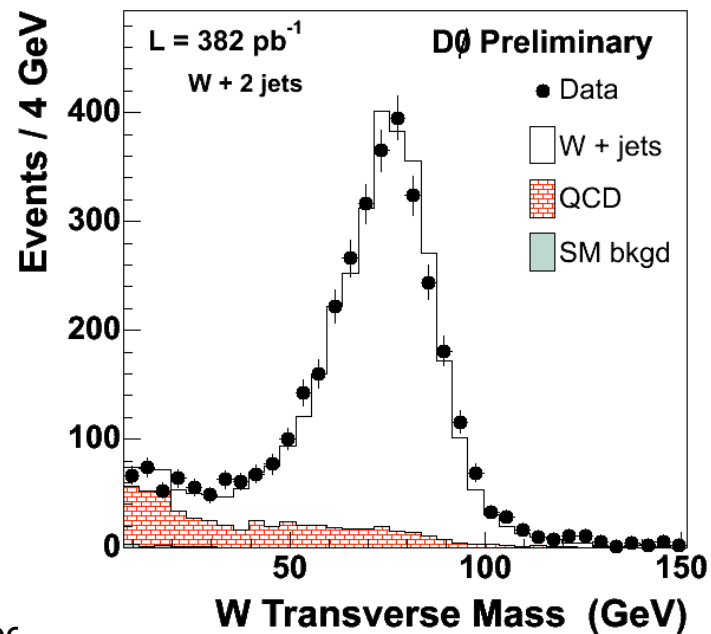
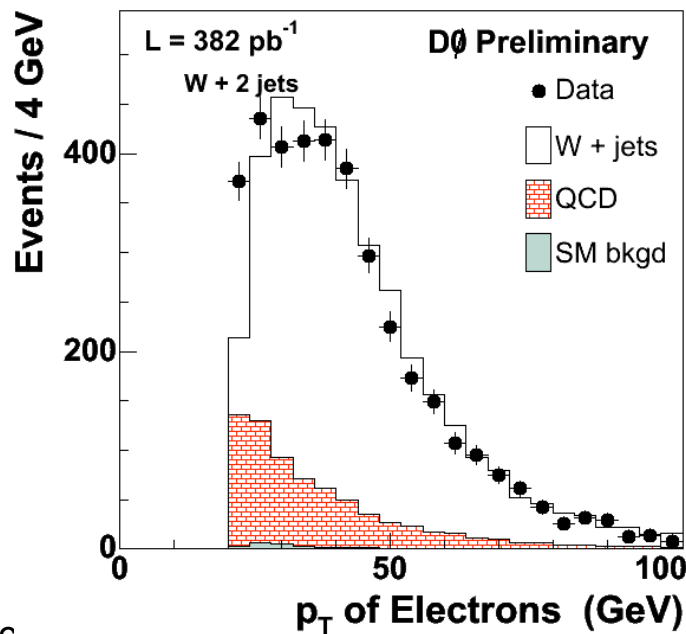
# Update with larger data set

- A New “preliminary” result released in May 2005
- New data set(382 pb<sup>-1</sup>) includes entire previous set(174 pb<sup>-1</sup>)
- Event selection starts with one electron, missing transverse energy and two jets
- Backgrounds considered include : t-tbar, WZ, single top, Wbb, W/Z+jets and multi-jet
- MC estimations use cross-sections normalized to MCFM NLO calculation
- Two jet multiplicity because of good S/N ratio after b-tagging: t-tbar and single top are biggest backgrounds



# Event Selection I

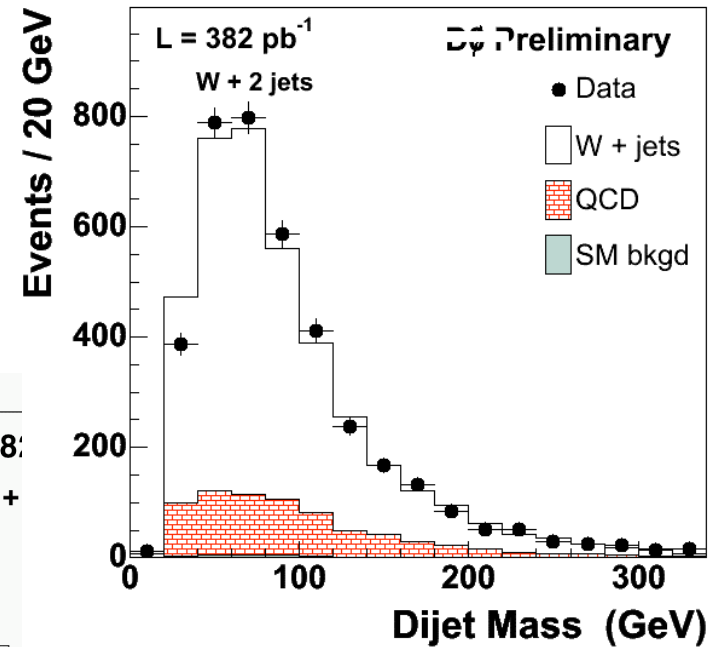
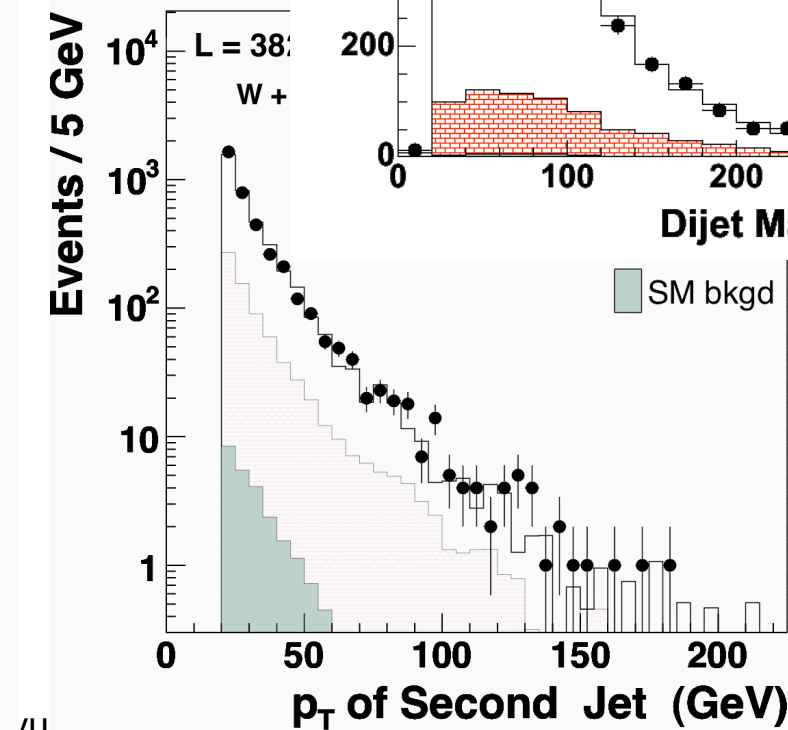
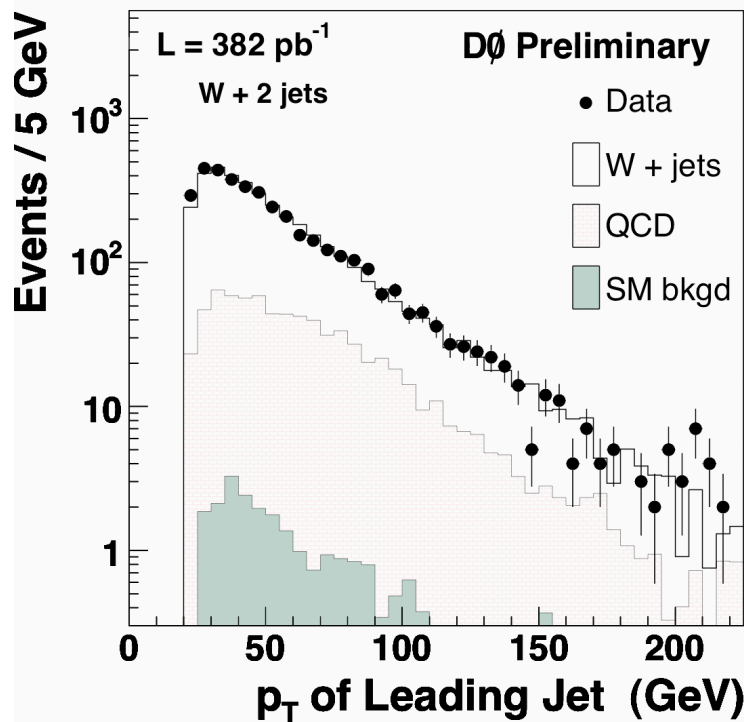
- An electron with  $p_T > 20$  GeV in central region, veto 2nd lepton
- Shower shape cuts; EMF  $> 0.9$ , Isolation  $< 0.1$  etc.
- Missing  $E_T > 25$  GeV, all corrections to electrons and jets are propagated

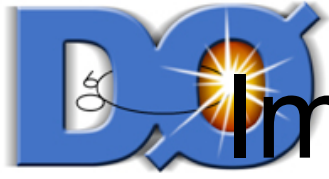




# Event Selection II

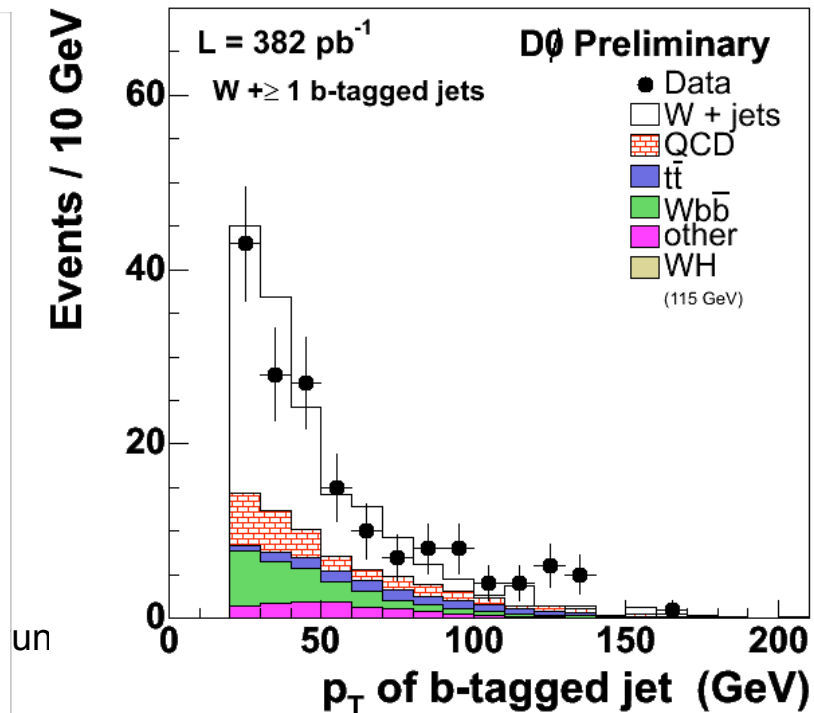
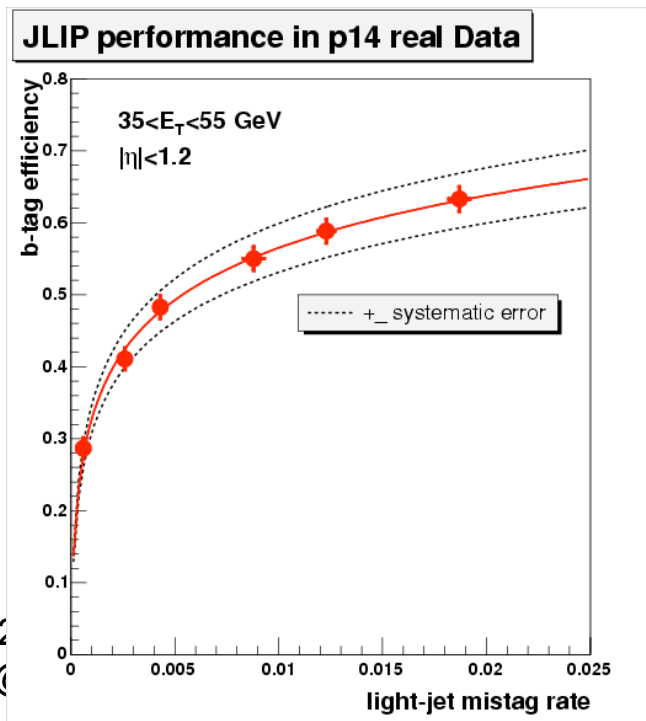
- Two jets with  $E_T > 20$  GeV in  $|\eta| < 2.5$
- Particle level energy scale correction
- Jets with electrons near rejected
- Backgrounds other than W+jets small





# Impact parameter b-tagging

- A b-tagging method(JLIP) based on impact parameters of tracks
- Probability of jet-tracks to originate from the same vertex
- Non b-jet has a large probability and a b-jet small probability
- 50 % efficiency( b-jet ) with 0.5 % mistag rate( light jet )
- Top, Wbb begin to show up(153 events with total expectation of 153.6)



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# Double b-tagging

- Double tag is needed to increase S/B ratio
- With single b-tagging, bkg contributions from W+jets, multijets, t-tbar much larger than processes not observed yet : Wbb, single-top and WH
- 13 events  $10.2 \pm 2.4$  expected

## Composition

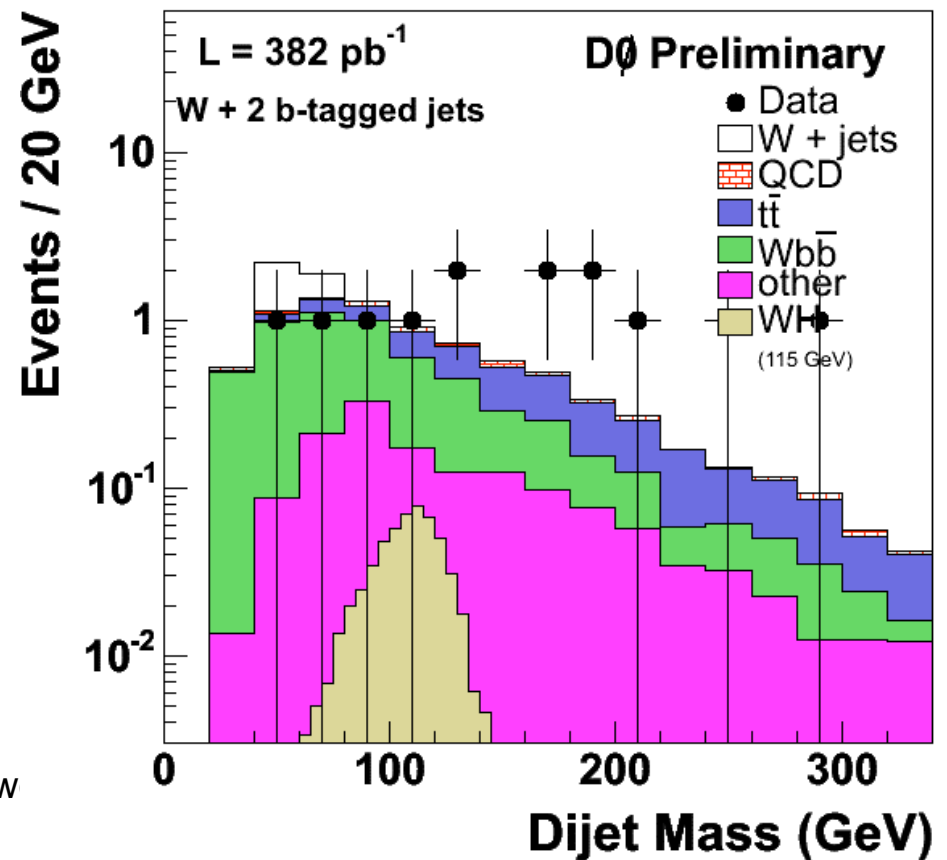
Wbb :  $4.3 \pm 1.0$

Top :  $3.4 \pm 0.8$

W or Z + jets :  $1.6 \pm 0.4$

Multijet :  $0.4 \pm 0.2$

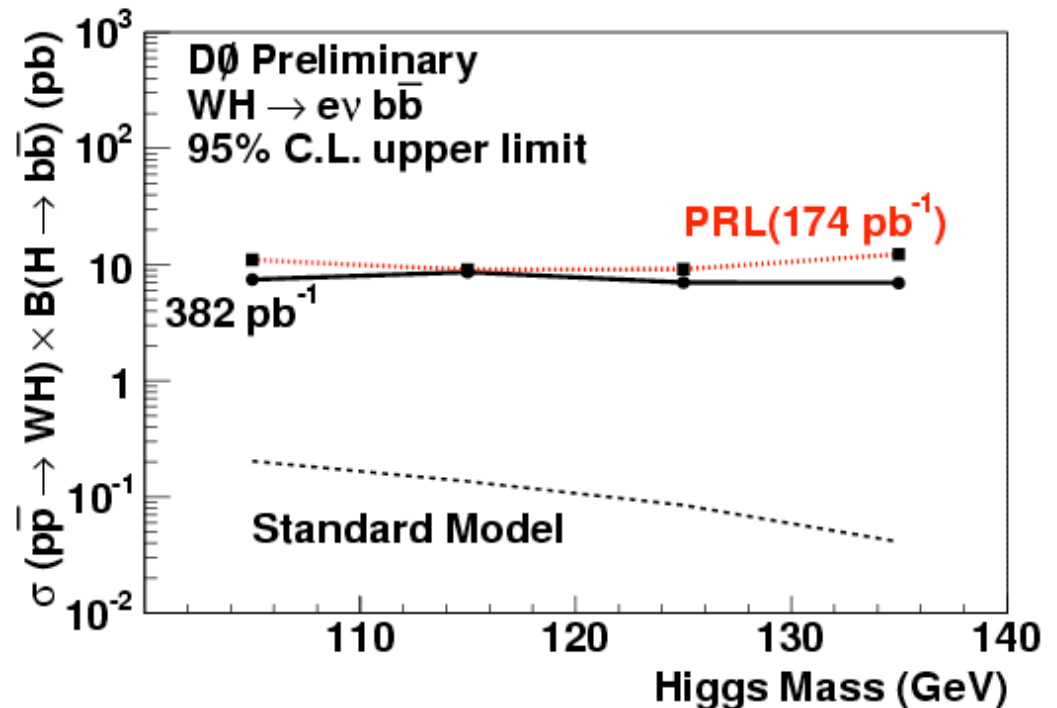
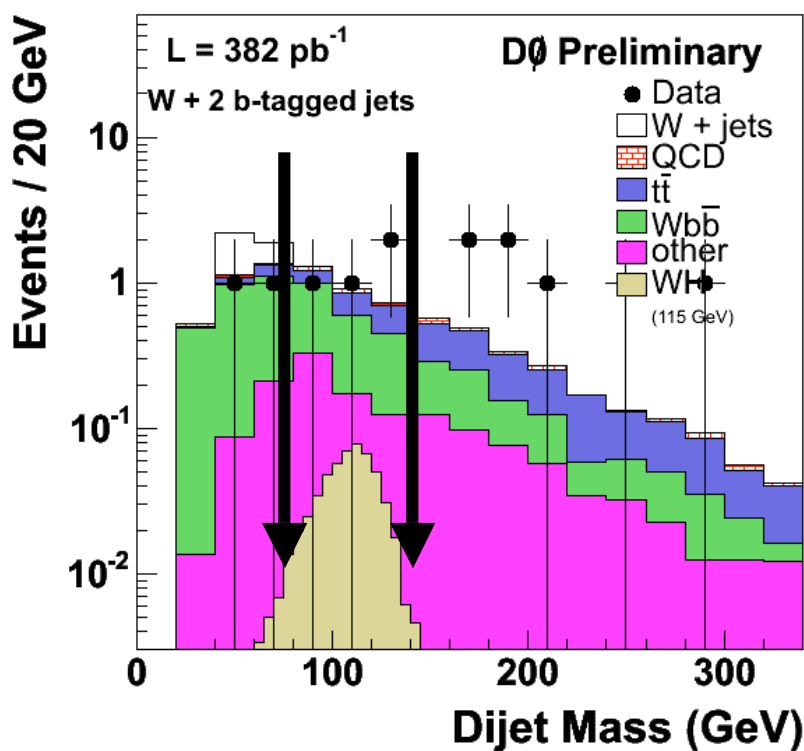
95 % C.L. upper limit on Wbb : 4.6 pb





# WH : Mass Window

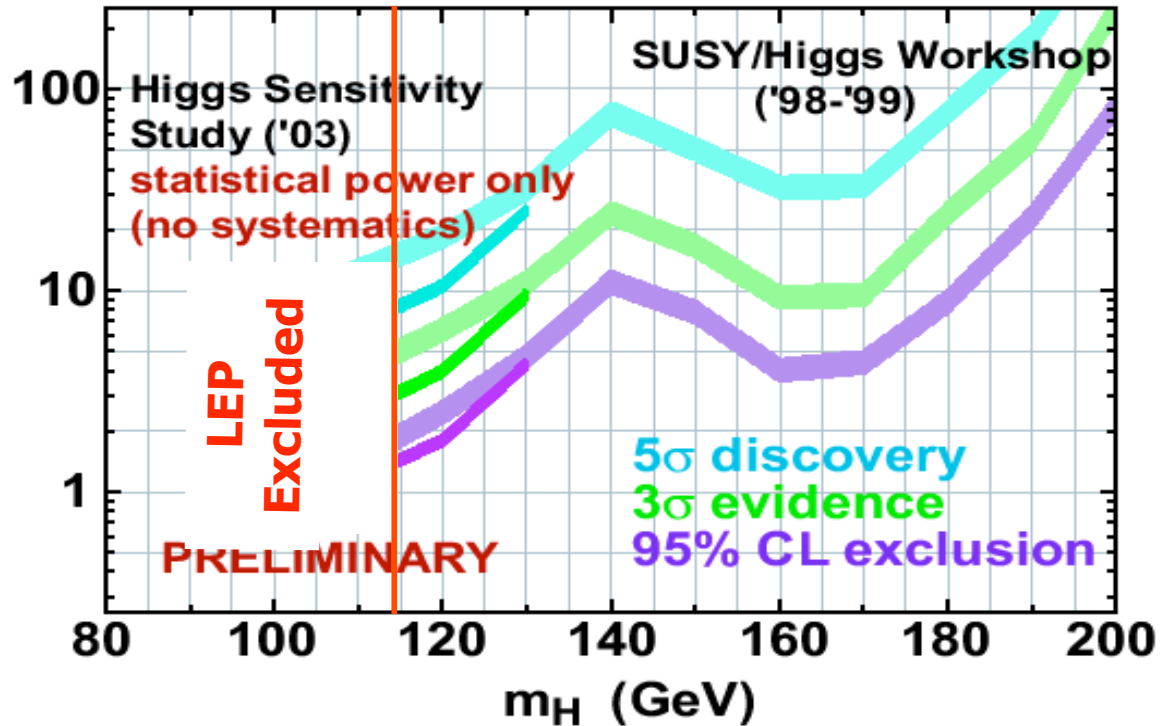
- Count in 85 to 135 GeV mass window
- 4 events observed with total expectation of  $2.5 \pm 0.6$
- 95 % C.L. upper limit on WH : 6.9 pb to 8.6 pb for Higgs masses of 105 to 135 GeV(previous 9.0 pb to 12.2 pb)







# Sensitivity Issues



We are not as sensitive as assumed in 2003 HSS  
WH in electron channel alone : short by a factor of  
2.4 in terms of  $S/\sqrt{B}$



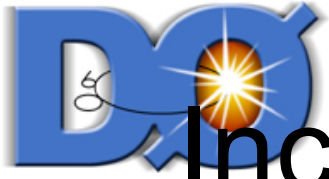
# Optimization in order

- Need to optimize analysis to increase sensitivity
- Refer to Gregorio Bernardi's talk(tomorrow) for details
- Loosen b-tagging (JLIP) cut
- Combine double-tag and single-tag sample
- Increase electron acceptance (Cracks in phi-modules)



# Looser b-tagging and Combining single and double

- So far our final result has been based on double tag with JLIP cut value of  $< 0.7 \%$
- We found that  $2.0 \%$  is optimal point in terms of  $S/\sqrt{B}$  for double tag
- If we combine results from single tag and double tag, we gain by about  $40\text{-}50 \%$  in terms of  $S/\sqrt{B}$  or  $20 \%$  in terms of luminosity
- We are thinking about using different cut values for Single Tag ( $0.1\%$  very tight) and Double Tag ( $2.0\%$ ) and combining results



# Increasing electron acceptance

- Currently, in order to ensure full shower containment, we are not using electrons going into a “crack” in modules in phi and its vicinity
- But if we remove this constraint, we can have 15 % gain, without compromising energy measurement too much
- We need to get new efficiency correction factor because MC does not reproduce materials in that region (high efficiency in MC)



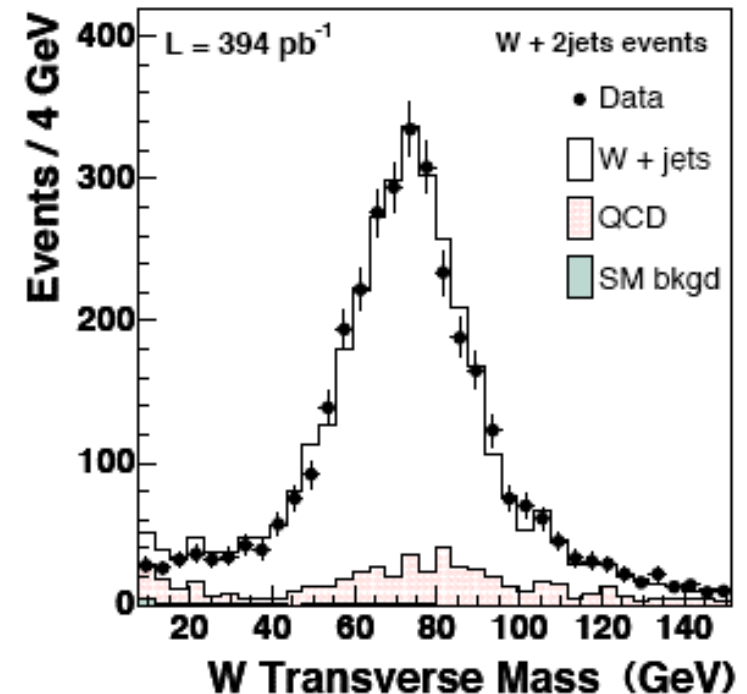
# Improvement Estimation

	Preliminary(May05) (115 GeV)	New analysis Under way
WH signal acceptance	0.23 % $\pm$ 0.03 (0.12)	0.46 % $\pm$ 0.08 (0.24)
Total Bkg	2.37 $\pm$ 0.59	5.71 $\pm$ 1.46
S/sqrt(B)	0.08	0.19
Expected Limit	5.7 pb	4.1 pb



# $WH \rightarrow \mu \nu bb$ status

- Use  $394 \text{ pb}^{-1}$
- One muon with  $p_T > 20 \text{ GeV}$
- Same selection conditions for 2 jets and MET
- 4731 events with 4703 expectation before b-tagging
- This study is under way and we expect a sensitivity comparable to electron channel
- We will combine these two channels very soon





# Summary

- WH in  $e \nu b \bar{b}$  channel was first D0 RunII Higgs search and published with  $174 \text{ pb}^{-1}$  data in PRL
- Updated with  $382 \text{ pb}^{-1}$  data
- WH limit 6.9 - 8.3 pb for Higgs of 105 to 135 GeV
- We hope to release a improved new result combined with muon channel very soon

