

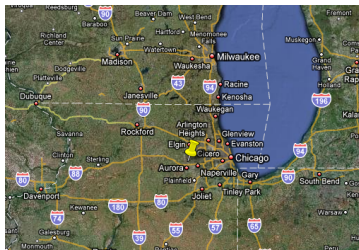
Higgs search at DØ

Melvin Meijer

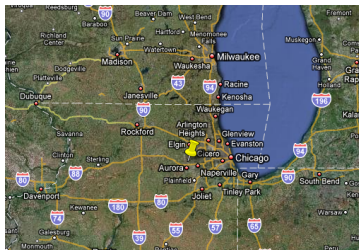
September 13th, 2009



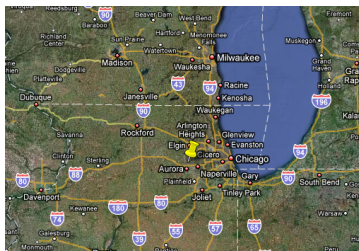
Tevatron at Fermilab



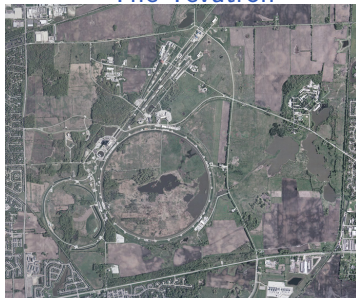
Tevatron at Fermilab



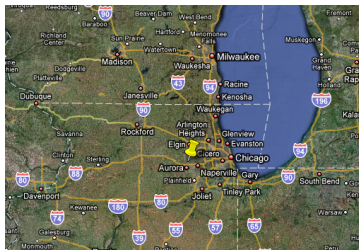
Tevatron at Fermilab



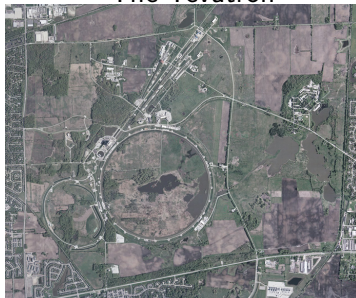
The Tevatron



Tevatron at Fermilab



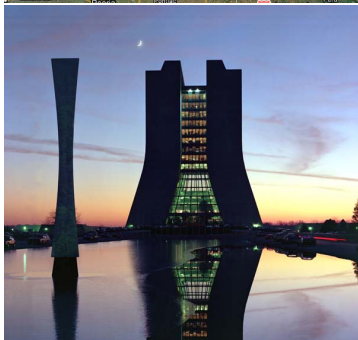
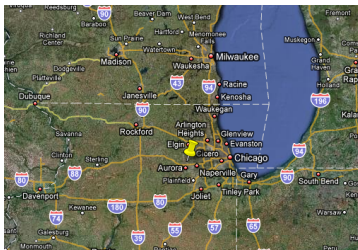
The Tevatron



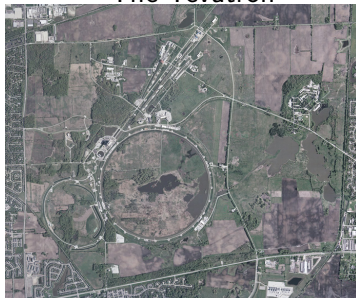
$$\bar{p} \rightarrow \leftarrow p$$



Tevatron at Fermilab



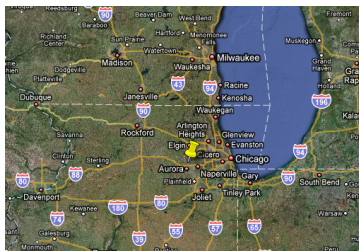
The Tevatron



$\bar{p} \rightarrow \leftarrow p$ 0.98 TeV per beam



Tevatron at Fermilab



The Tevatron

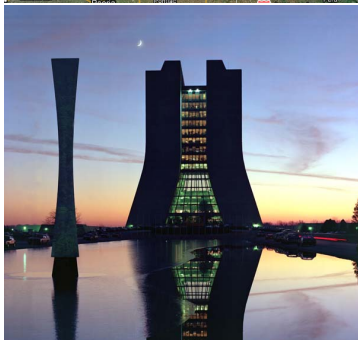
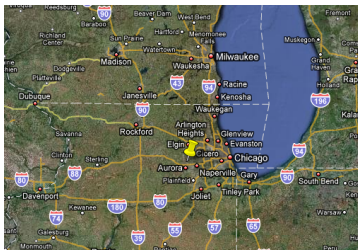


$\bar{p} \rightarrow \leftarrow p$ 0.98 TeV per beam

Tevatron



Tevatron at Fermilab



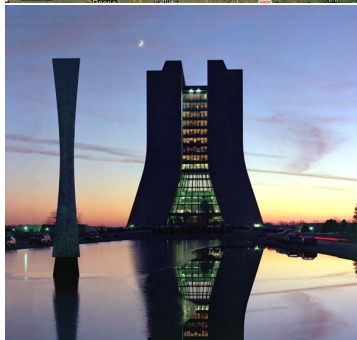
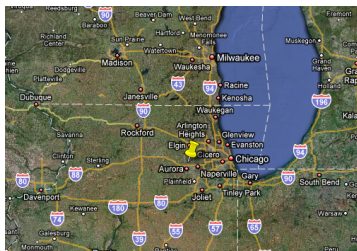
The Tevatron



$\bar{p} \rightarrow \leftarrow p$ 0.98 TeV per beam
Tevatron, main injector



Tevatron at Fermilab



The Tevatron



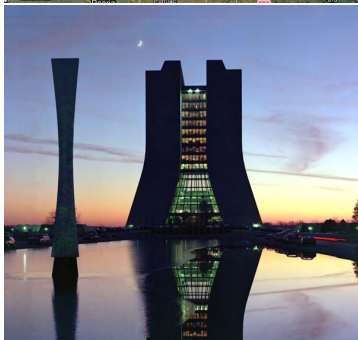
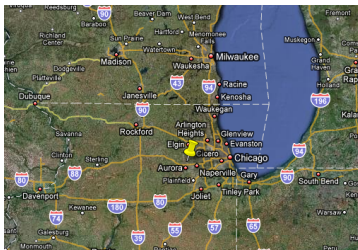
$\bar{p} \rightarrow \leftarrow p$ 0.98 TeV per beam

Tevatron, main injector,

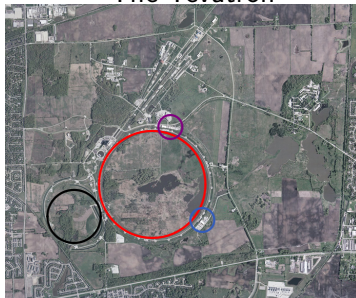
CDF



Tevatron at Fermilab



The Tevatron



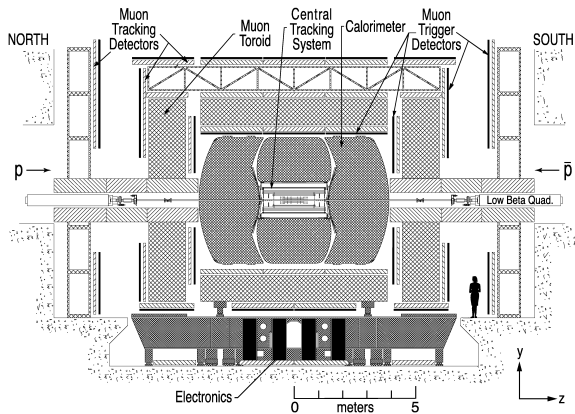
$\bar{p} \rightarrow \leftarrow p$ 0.98 TeV per beam

Tevatron, main injector,

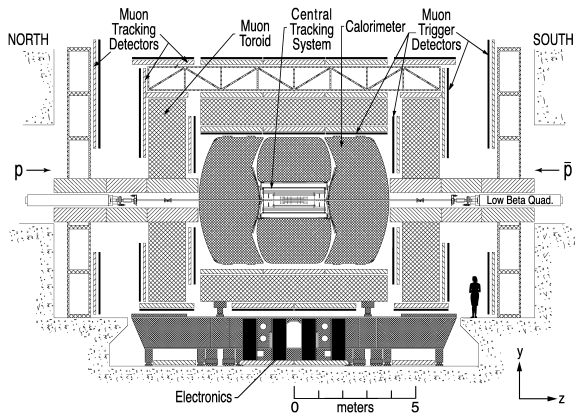
CDF, **DØ**



The DØ detector



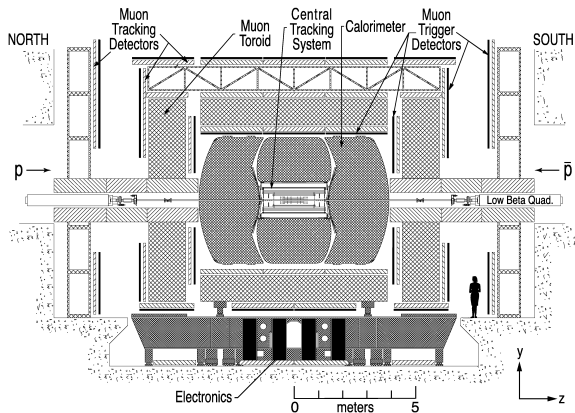
The DØ detector



Run I 1992 - 1996 110 pb^{-1}



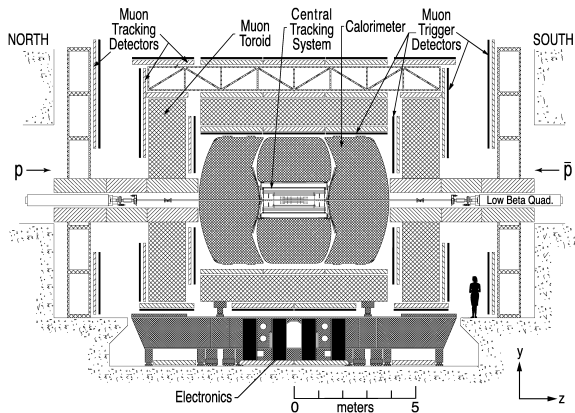
The DØ detector



Run I	1992 - 1996	110 pb^{-1}
Run IIa	2000 - 2006	1.0 fb^{-1}



The DØ detector

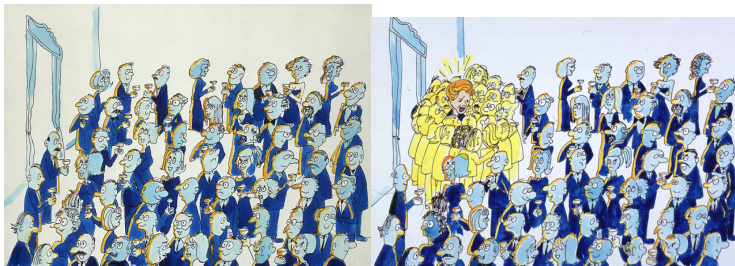


Run I	1992 - 1996	110 pb^{-1}
Run IIa	2000 - 2006	1.0 fb^{-1}
Run IIb	2006 - 201?	4.5 fb^{-1} and counting



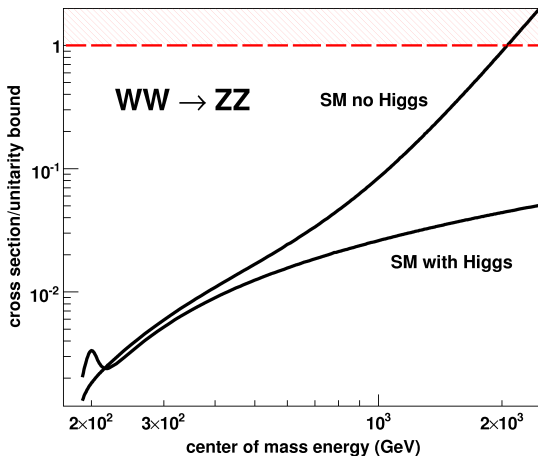
Why Higgs

?



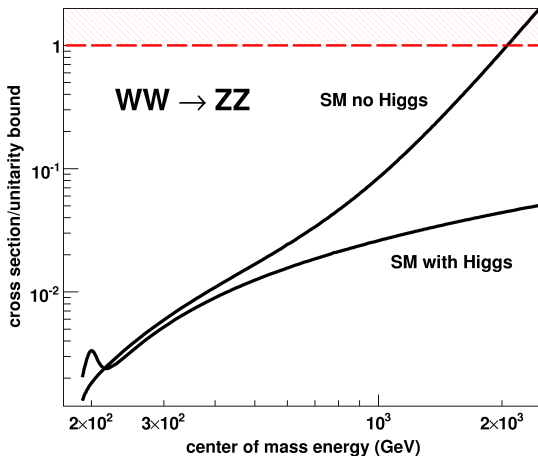
Why Higgs

?



Why Higgs

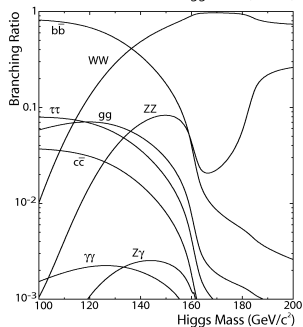
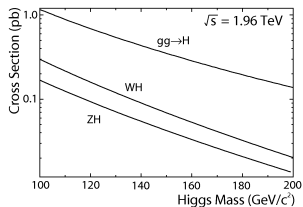
?



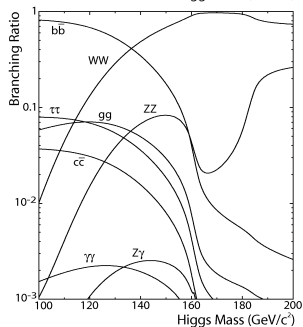
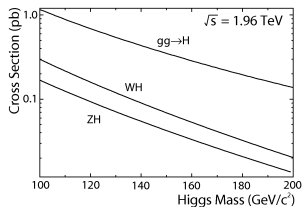
Problems at high energies!



Why Higgs and where?



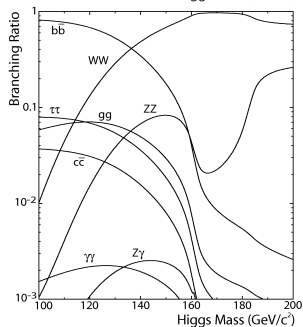
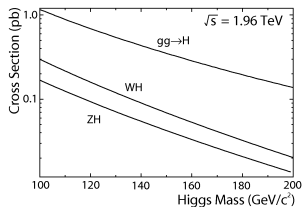
Why Higgs and where?



Important Higgs production and decay methods:



Why Higgs and where?

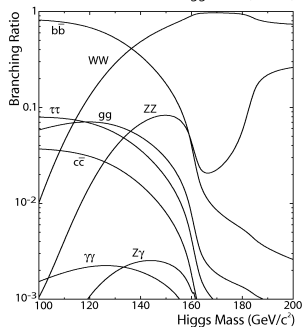
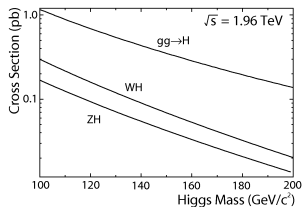


Important Higgs production and decay methods:

- $gg \rightarrow H \rightarrow bb$
not feasible...



Why Higgs and where?

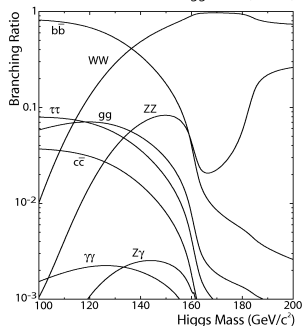
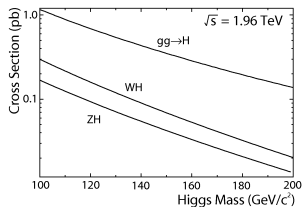


Important Higgs production and decay methods:

- $gg \rightarrow H \rightarrow bb$
not feasible...
- $gg \rightarrow H \rightarrow WW$
very important
($m_H > 130$)
-



Why Higgs and where?

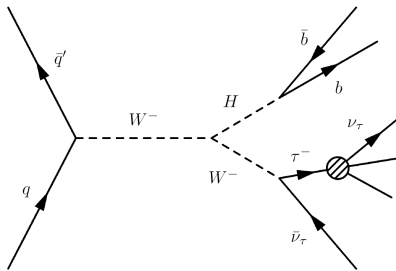


Important Higgs production and decay methods:

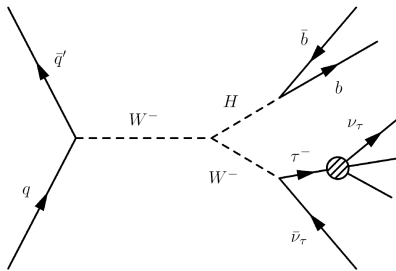
- $gg \rightarrow H \rightarrow bb$
not feasible...
- $gg \rightarrow H \rightarrow WW$
very important
($m_H > 130$)
- $W \rightarrow WH \rightarrow Wbb$
important ($m_H < 140$)



My channel: $WH \rightarrow \tau \nu_\tau b \bar{b}$



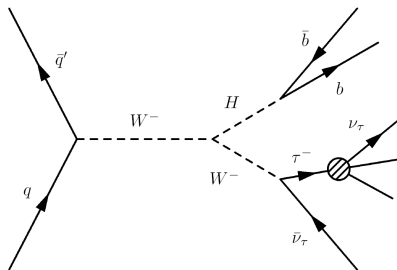
My channel: $WH \rightarrow \tau\nu_\tau b\bar{b}$



Detector response:



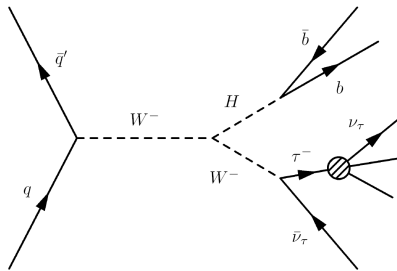
My channel: $WH \rightarrow \tau \nu_\tau b \bar{b}$



Detector response:

- Missing energy: $\cancel{E}_T$
-
-

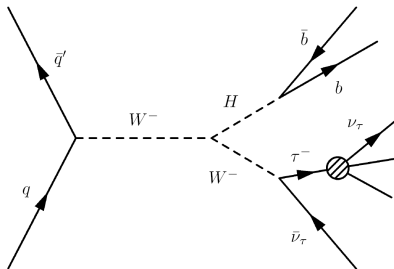
My channel: $WH \rightarrow \tau \nu_\tau b \bar{b}$



Detector response:

- Missing energy: $\cancel{E}_T$
- Hadronic τ : $\pi^\pm \nu_\tau$, $\pi^\pm \pi^0 \nu_\tau$ and $\pi^\pm \pi^\pm \pi^\mp \nu_\tau$
-

My channel: $WH \rightarrow \tau \nu_\tau b \bar{b}$



Detector response:

- Missing energy: $\cancel{E}_T$
- Hadronic τ : $\pi^\pm \nu_\tau$, $\pi^\pm \pi^0 \nu_\tau$ and $\pi^\pm \pi^\pm \pi^\mp \nu_\tau$
- b -jets

Analysis flow chart

Trigger:
multijet OR $\cancel{E}_T$



Analysis flow chart

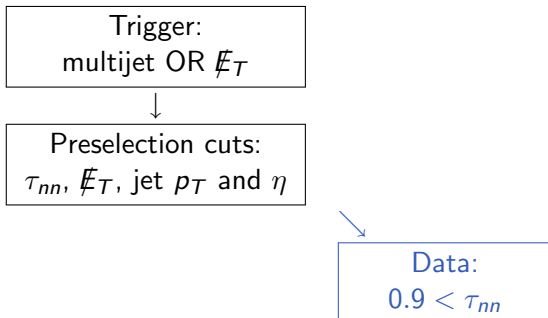
Trigger:
multijet OR $\cancel{E}_T$



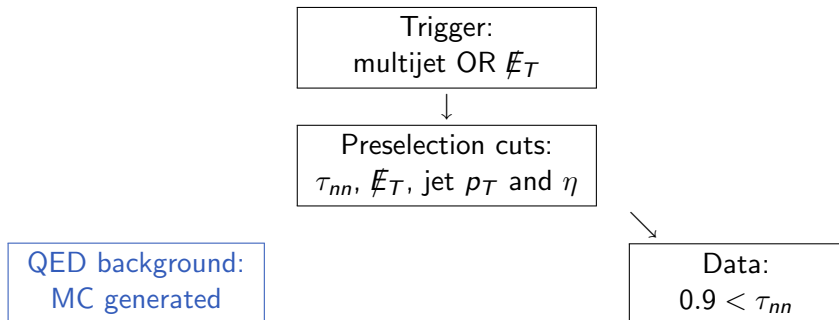
Preselection cuts:
 τ_{nn} , $\cancel{E}_T$, jet p_T and η



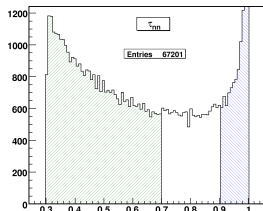
Analysis flow chart



Analysis flow chart



Analysis flow chart



QED background:
MC generated

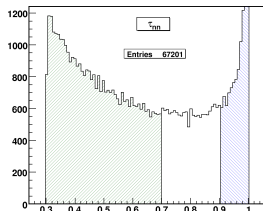
Trigger:
multijet OR $\cancel{E}_T$

Preselection cuts:
 τ_{nn} , $\cancel{E}_T$, jet p_T and η

QCD background:
 $0.3 < \tau_{nn} < 0.7$

Data:
 $0.9 < \tau_{nn}$

Analysis flow chart



QED background:
MC generated

Trigger:
multijet OR $\cancel{E}_T$

Preselection cuts:
 τ_{nn} , $\cancel{E}_T$, jet p_T and η

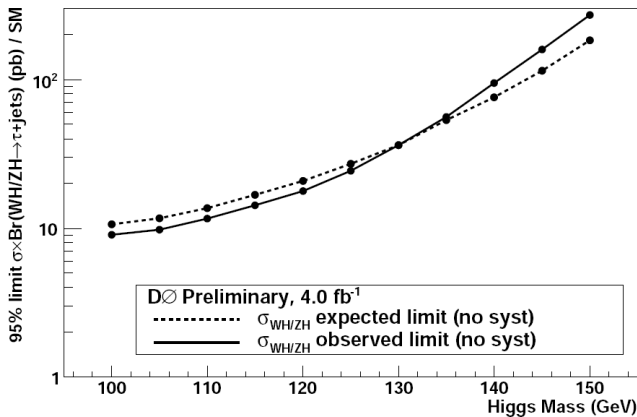
QCD background:
 $0.3 < \tau_{nn} < 0.7$

Data:
 $0.9 < \tau_{nn}$

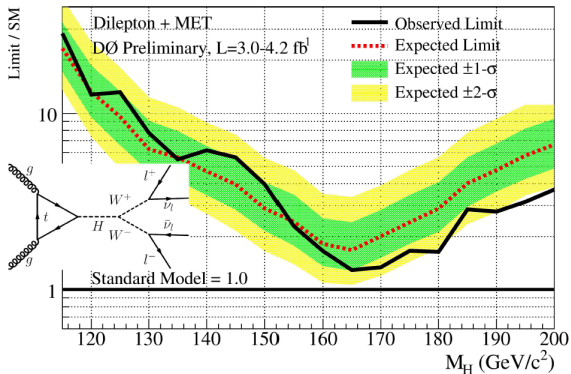
Multivariate analysis:
Boosted Decision Tree
(BDT)



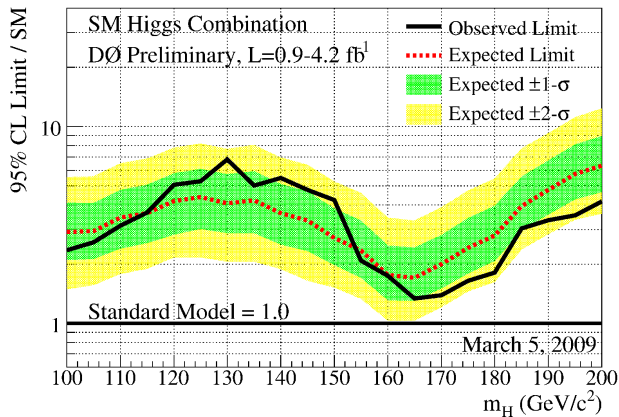
Setting the limit



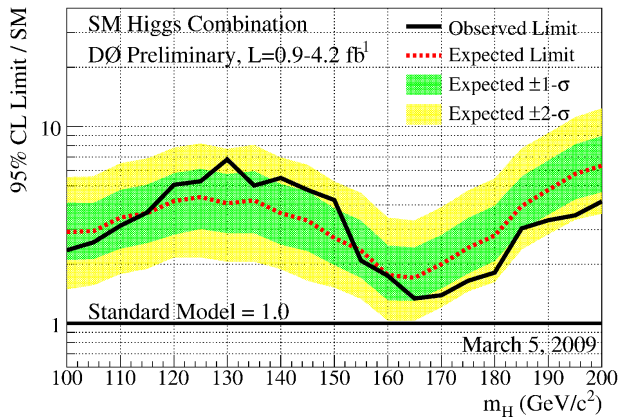
Setting the limit



DØ combination



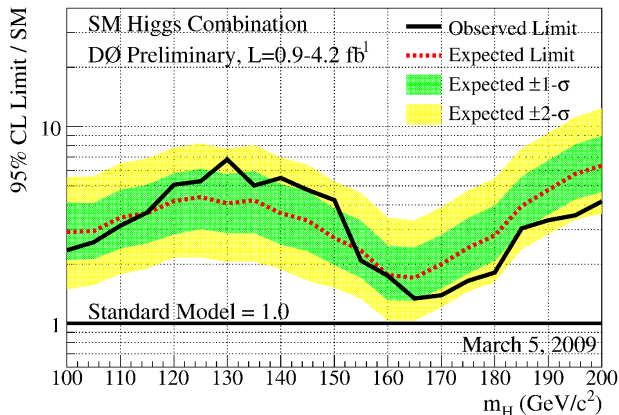
DØ combination



- For $m_H > 130$ dominated by $H \rightarrow WW$



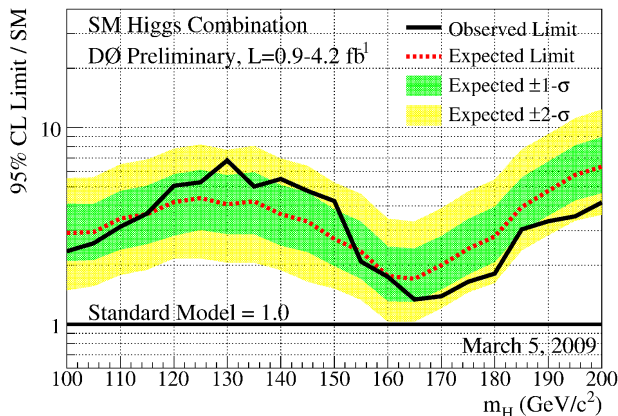
DØ combination



- For $m_H > 130$ dominated by $H \rightarrow WW$
- For $m_H < 125$ dominated by $V \rightarrow VH \rightarrow llb\bar{b}$



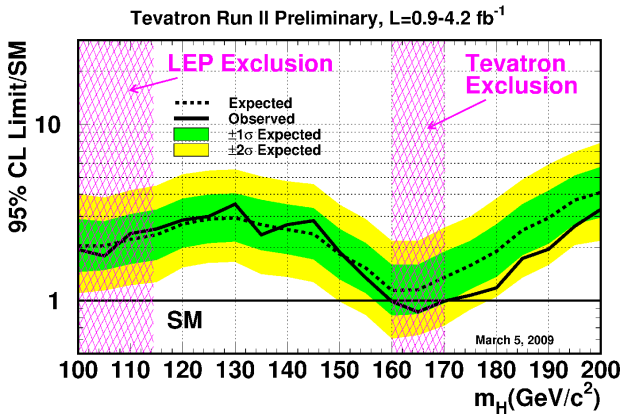
DØ combination



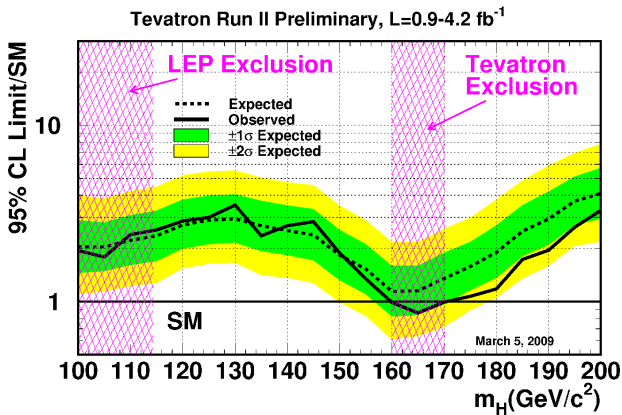
- For $m_H > 130$ dominated by $H \rightarrow WW$
- For $m_H < 125$ dominated by $V \rightarrow VH \rightarrow llb\bar{b}$
- Close to exclusion of 165-170 GeV



Tevatron combination

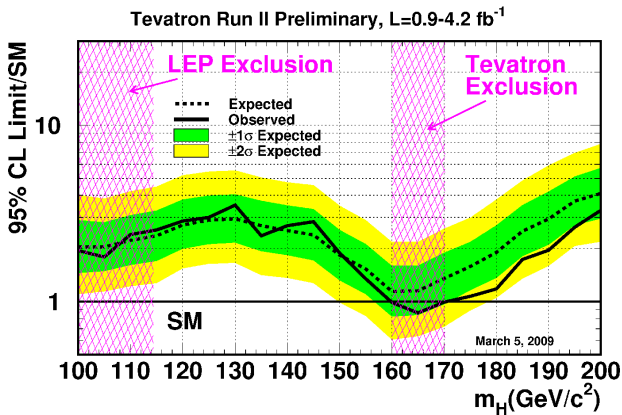


Tevatron combination



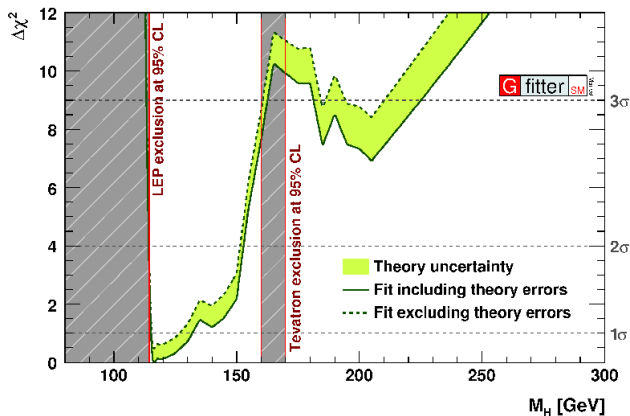
- First exclusion after LEP: 160-170 GeV

Tevatron combination

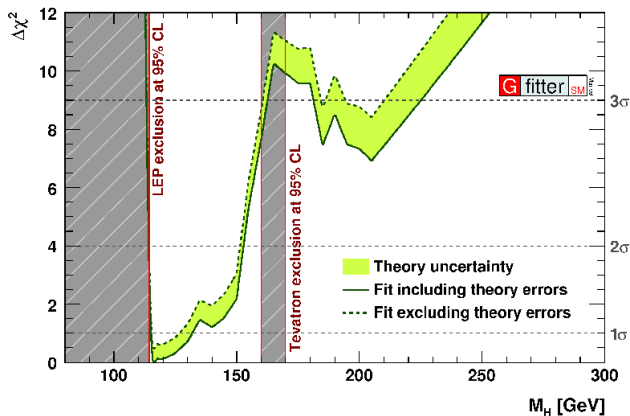


- First exclusion after LEP: 160-170 GeV
- Exclusion up to 180 GeV is high

Worldwide combination



Worldwide combination



Higgs is probably 'light'



Conclusions

- The Tevatron is closing in on Higgs



Conclusions

- The Tevatron is closing in on Higgs
- A lot of work needs to be done



The End

