Search for Higgs at DØ Decaying to

$$H \rightarrow WW^{*} \rightarrow \mu + \tau_{had}$$

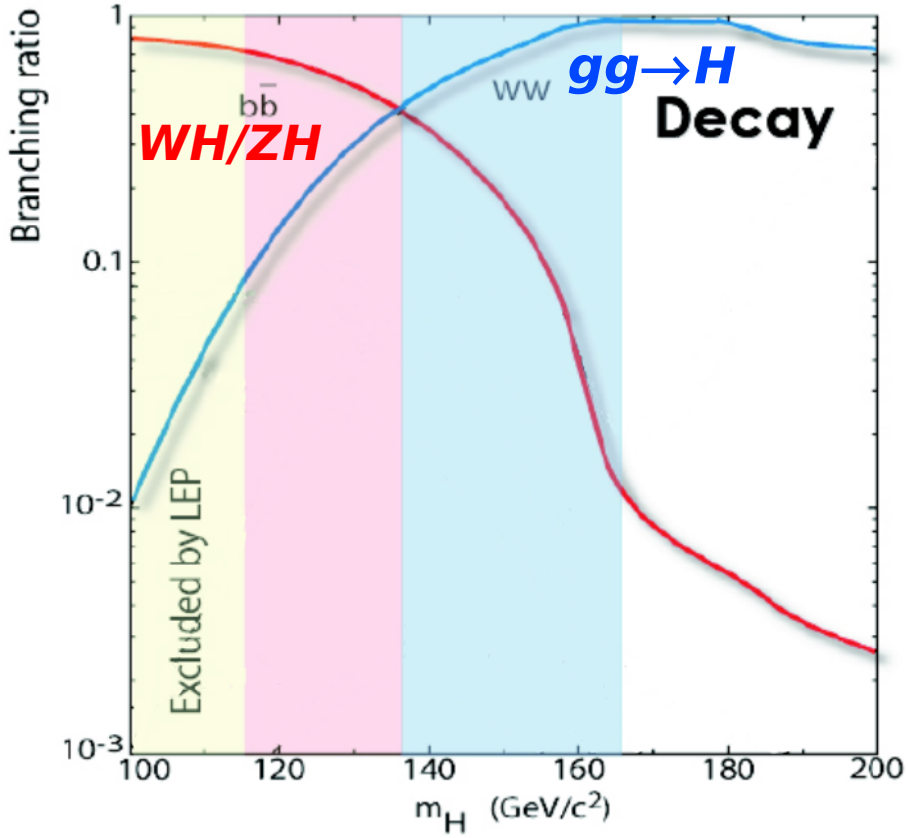
and

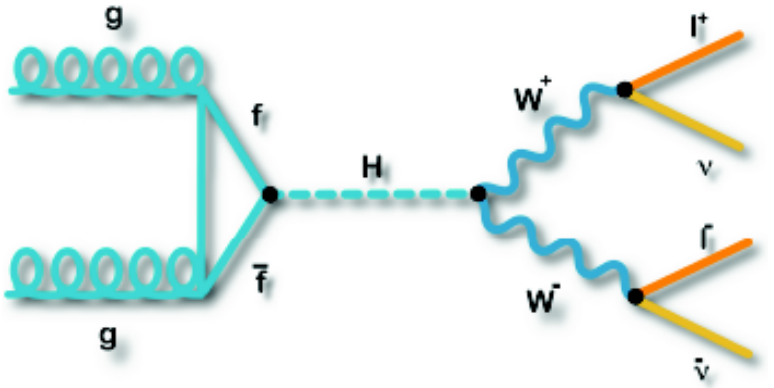
$$H \rightarrow WW^{*} \rightarrow ee$$

Björn Penning
University of Freiburg

Introduction $H \rightarrow WW \rightarrow ll$

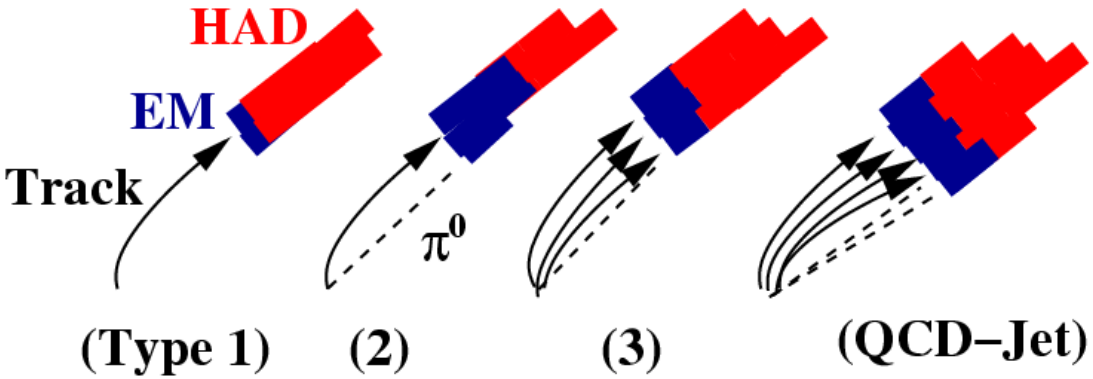
- Main production via Gluon Fusion and Associated Production, dominant decay:
  - m_H<135 GeV: $b\bar{b}$
  - m_H>135 GeV: $WW \rightarrow ll$ decay
- Search strategy:
  - two high p_T leptons, opposite charge
  - high missing transverse energy (ν)
- Main background sources for $H \rightarrow WW \rightarrow ll$:
  - WW production (high Higgs masses)
  - $W+jet/\gamma$ (low Higgs masses)
- $H \rightarrow WW \rightarrow ll$ highest sensitivity for m_H=160GeV
- Major channels: $\mu\mu$, $e\mu$, ee, exploiting τ
- Presented here: $H \rightarrow WW \rightarrow ee/\mu\pi$



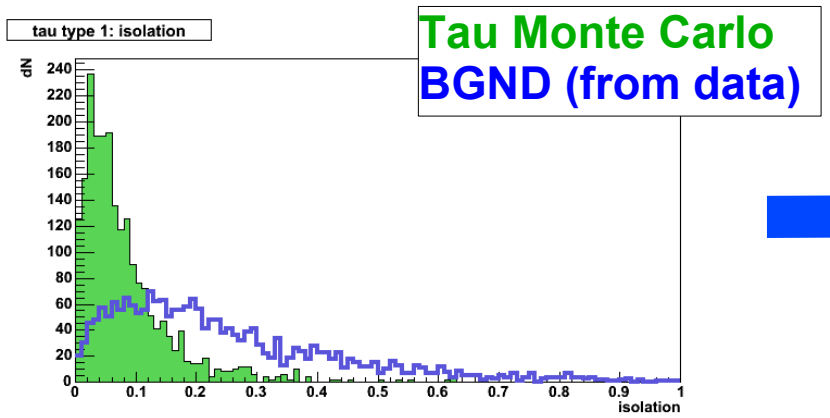


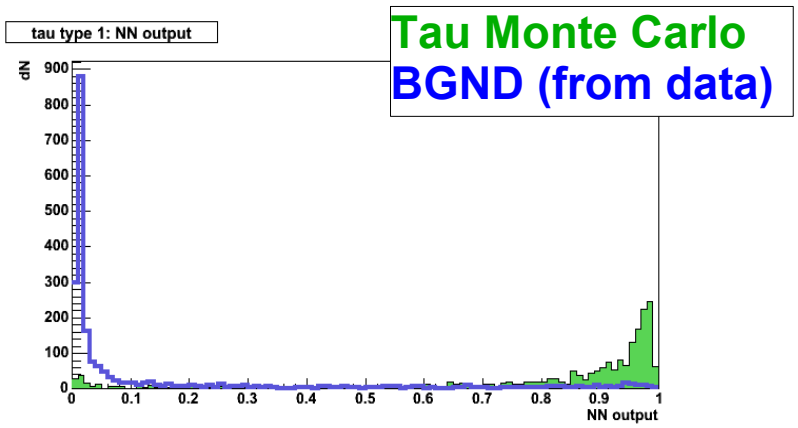
τ Identification at DØ

- Tau = narrow isolated jet with low track and π^0 multiplicity
- Taus decay inside detector:
  - $BR(\tau \to e/\mu + \nu\ \nu)$ ~17%
  - $BR(\tau \to \text{hadrons} + \nu)$ ~65%



- Final states with τ initially neglected in sensitivity studies
- DØ uses one Neural Network per tau type to discriminate taus from jets





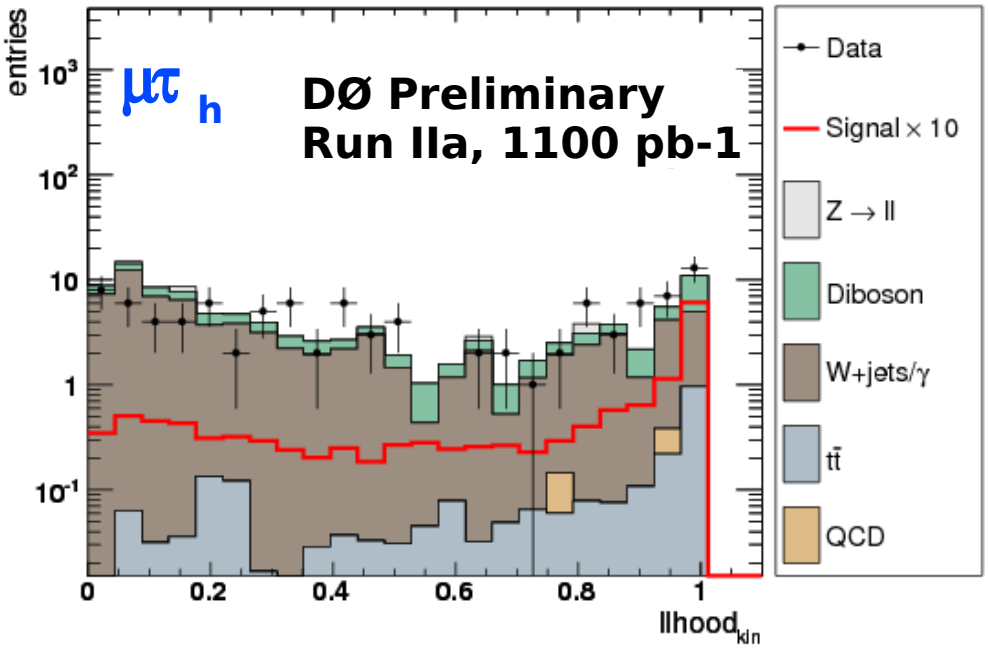
- Electrons picked up not selected by default EM-ID → recover efficiency

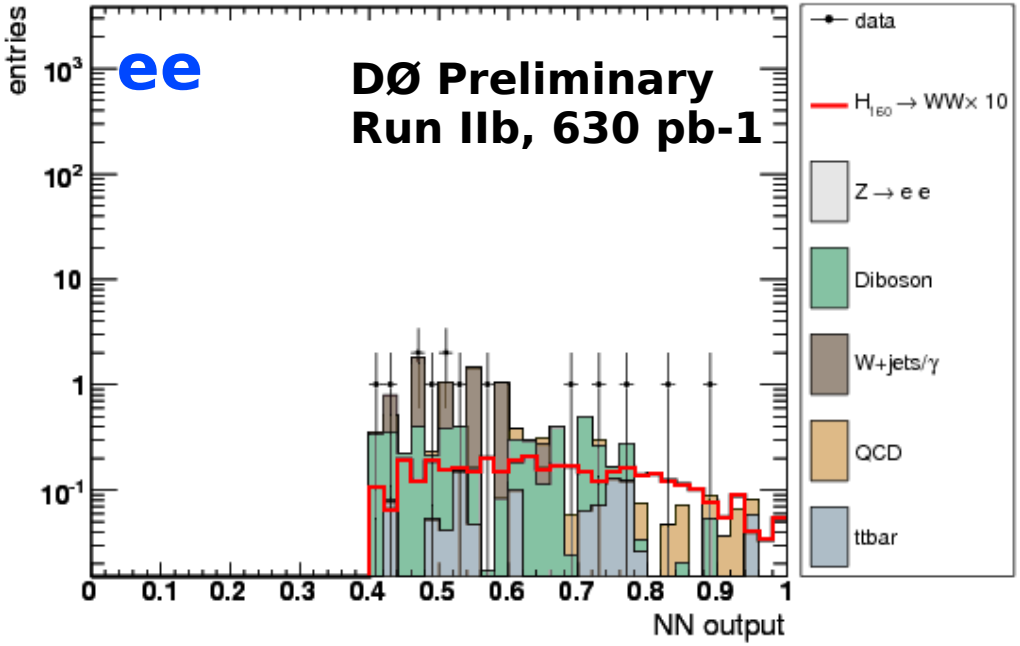
Searching for the Higgs

- Remove dominant backgrounds ($Z/\gamma^* \rightarrow ee$ dominates) by applying one-dimensional selection requirements ('Cuts')

- Using multivariate techniques to maximize separation power between signal and background ($WW \rightarrow \ell\ell$ and W+jet/γ most difficult to separate)

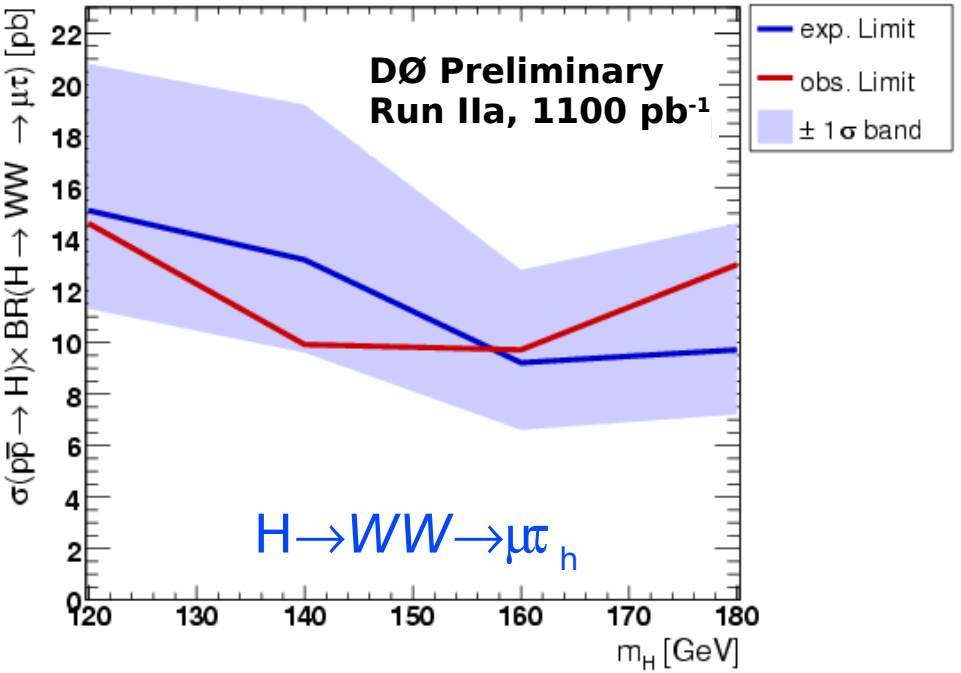
  - $\mu\tau_h$ analysis: 2 separate Likelihoods/τ type (5 & 6 input variables)
  - *ee* analysis: Neural Network (8 input variables)

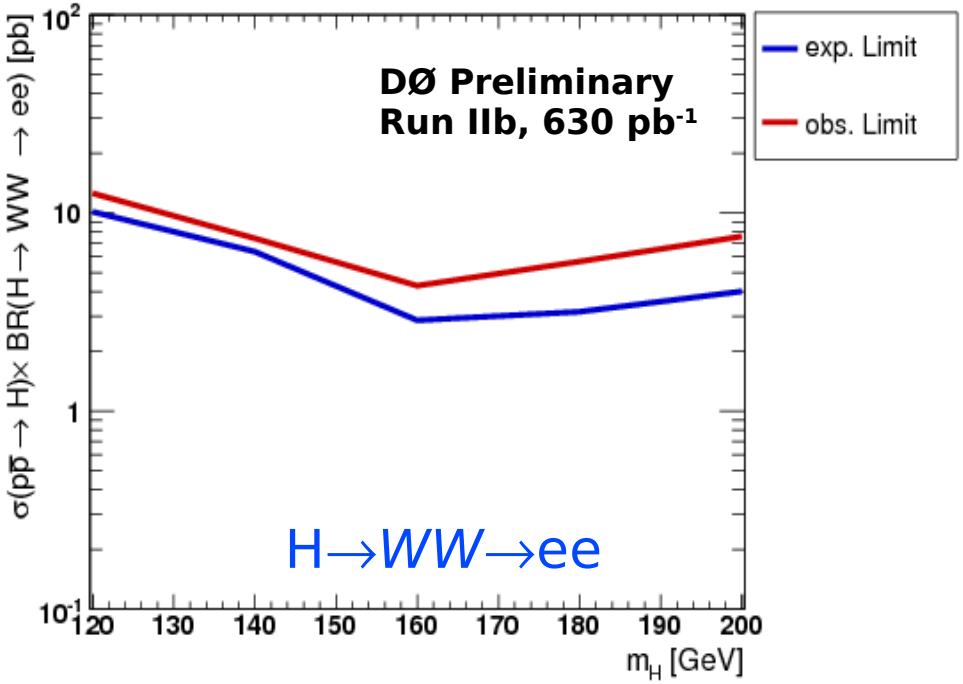




Limit Setting

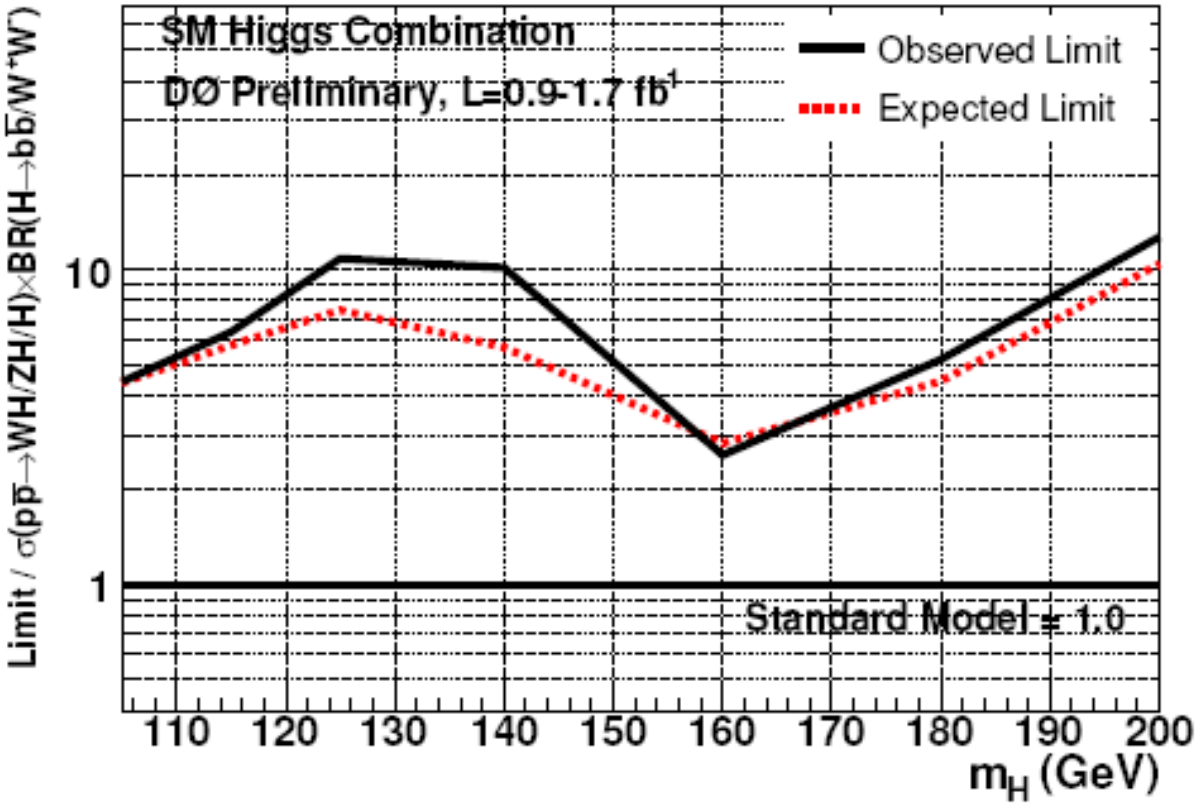
- No excess in data seen above the background expectation
- Set limits on the $\sigma \times BR(H \rightarrow WW \rightarrow ee/\mu\tau_h)$
- $\mu+\tau_h$ channel less sensitive than *ee* channel





Results & Conclusion

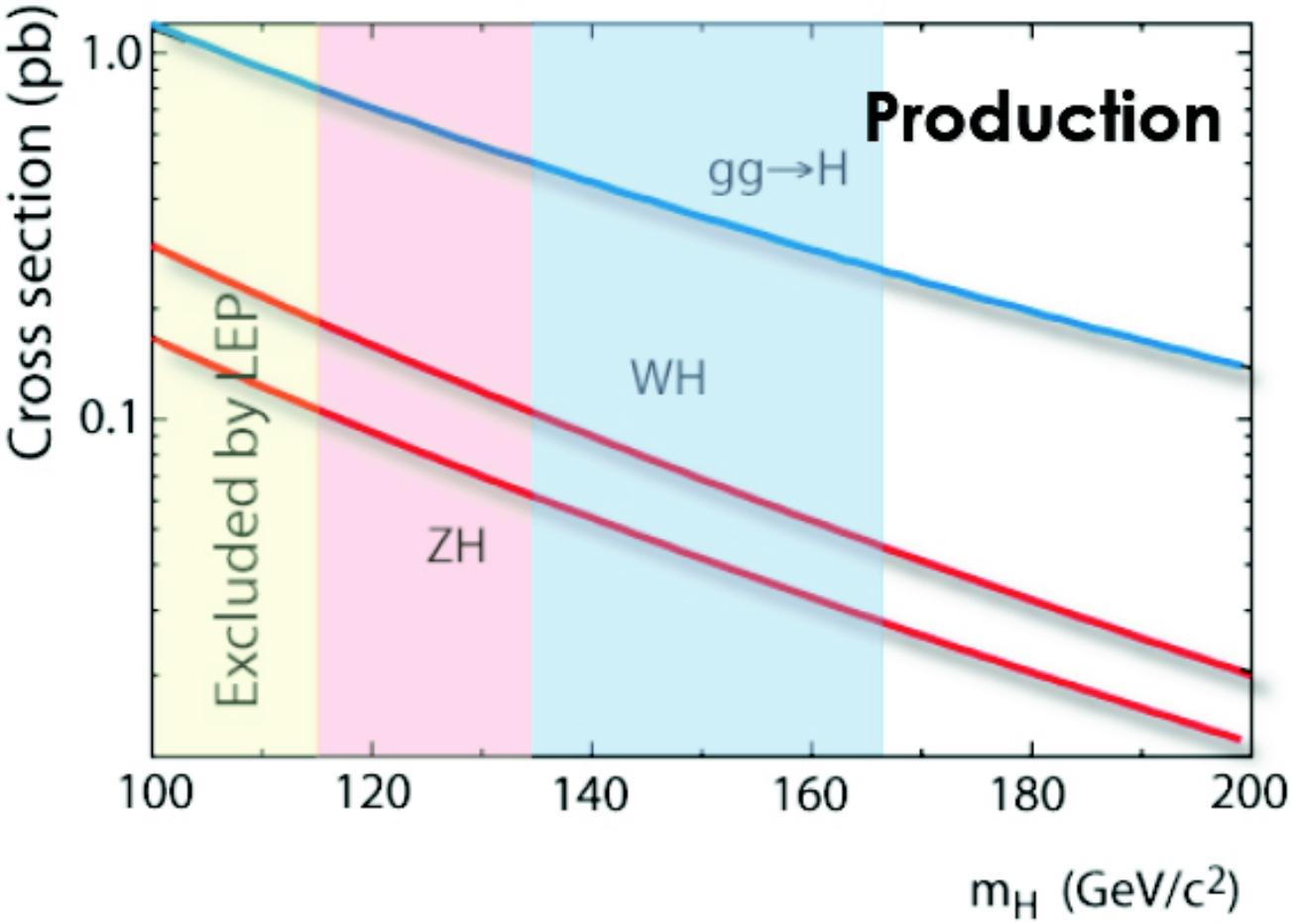
- DØ analysis has similar sensitivity as CDF
- Results combined with μ μ/eμ channel



- Adding more data and improvements in analysis techniques will further increase the sensitivity, updated results soon available

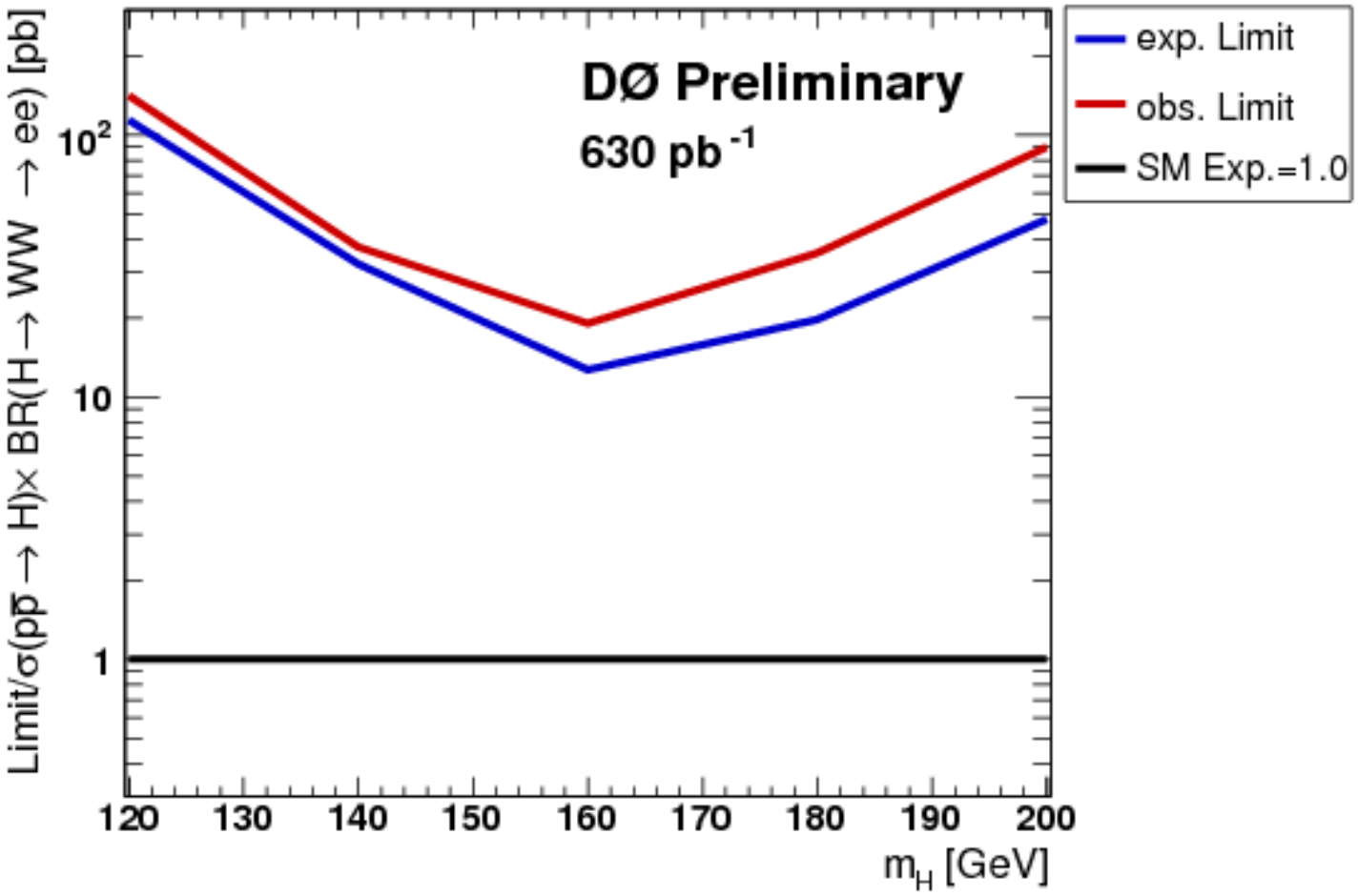
Backup Slides

Higgs Production at the Tevatron



- Cross Section Higgs production (100<m_H<200 GeV):
  - $\sigma(g\,g \to H) \approx 2 - 0.1\ pb$
  - $\sigma(q\,\bar{q} \to WH) \approx 0.25 - 0.02\ pb$

Limits x SM



Limits x SM for H→*WW*→ee

Data/MC Expectations

H→*WW*→μτ$_h$

Cut	Data	$m_H = 160$ GeV Tot. Exp. Bkgd	$H \to WW$
Preselection	1749.00 ± 41.82	1719.19 ± 33.58	0.20
$\Delta\phi(\mu,\tau)$	30.00 ± 5.48	21.66 ± 2.74	0.11
Final Sel. incl.	2.00 ± 1.41	4.63 ± 1.22	0.05
Final Sel. excl.	3.00 ± 1.73	1.78 ± 0.68	0.01

H→*WW*→ee

Sel. Req.	Data	Sum Bkgd	$H \to WW \to ee$
Preselection	45017.99 ± 212.17	45169.85 ± 101.76	0.71
Final Selection	17.00 ± 4.12	15.49 ± 1.71	0.46