Resonant Higgs Searches at DØ

Satish Desai -- Fermilab

on behalf of the DØ Collaboration

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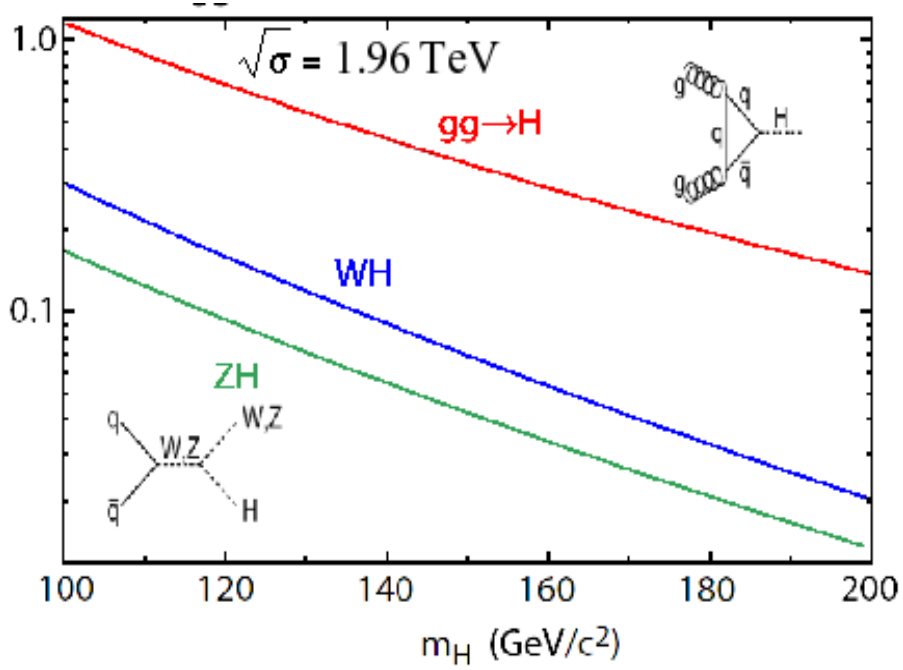
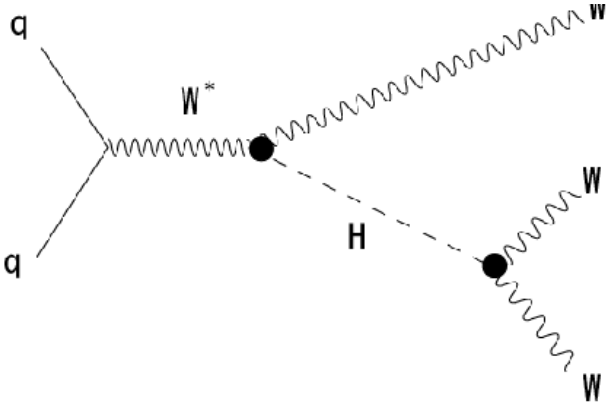
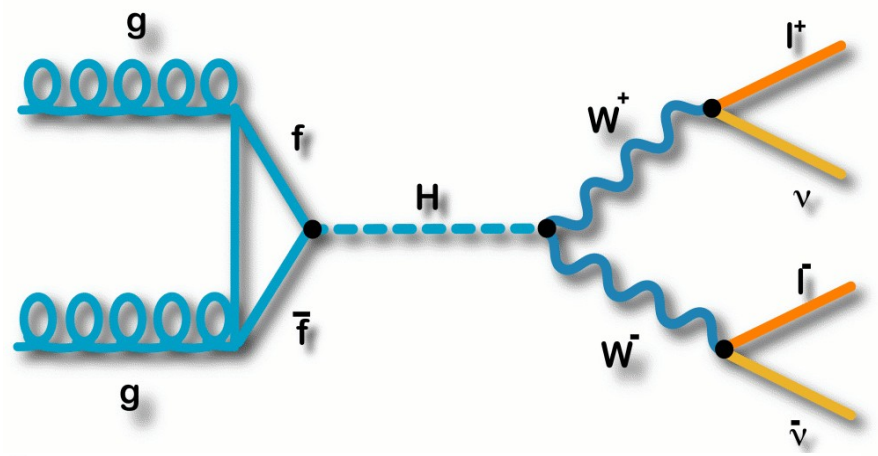
Introduction

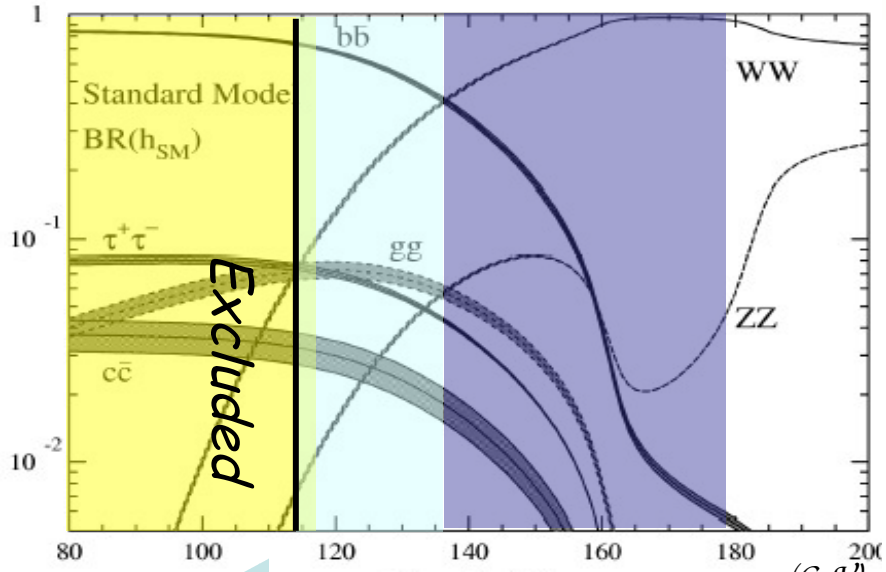




Associated Higgs Production with WW decays*

Resonant Higgs Production



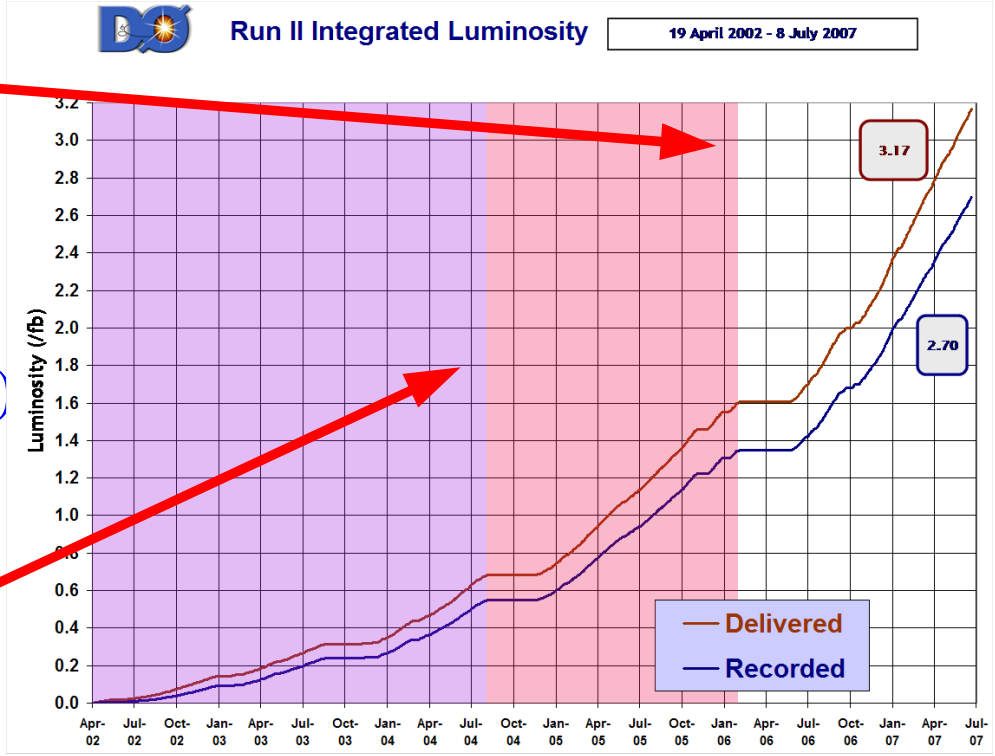


$H \rightarrow b\bar{b}$

$H \rightarrow WW$

Outline

- Resonant Higgs searches:
  - H to WW* to ee/eμ/$\mu\mu$
  - H to WW* to $\mu\tau_h$
  - Use full Run IIa dataset (~950 pb^{-1})
- Additional multilepton channels:
  - WH to WWW* to ee/eμ/$\mu\mu$ +X
  - Uses 360 pb^{-1} – 380 pb^{-1}



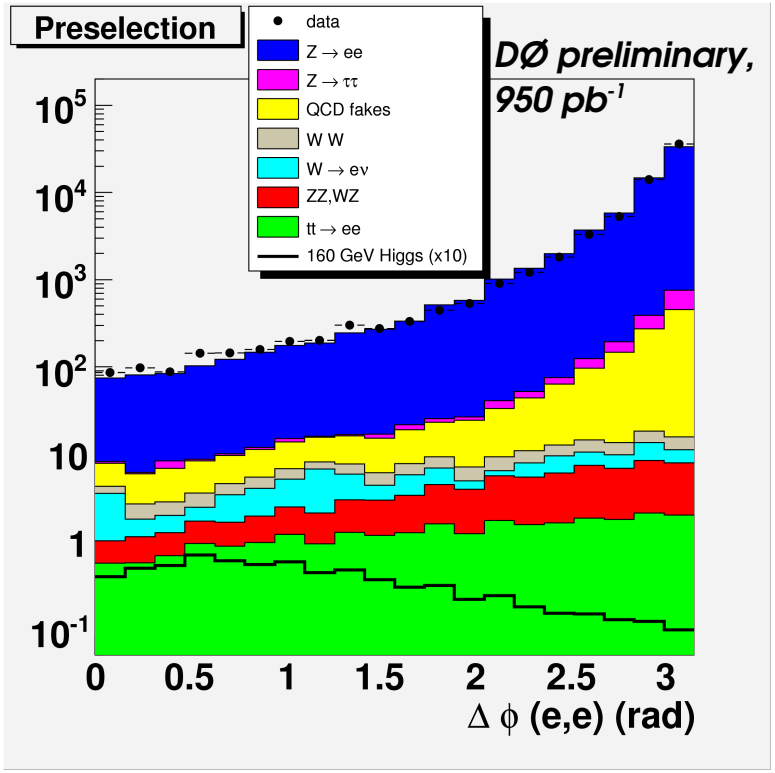
$gg \to H \to WW \to ee/e\mu/\mu\mu$

Backgrounds

- W + γ/j
- WW

Dominant

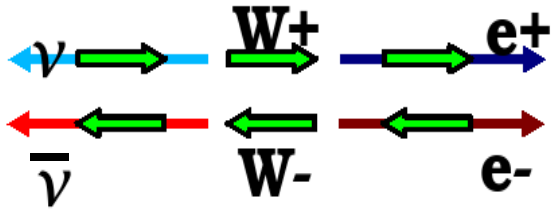
- Drell-Yan
- $t\bar{t}$ to dilepton
- Other diboson processes
- Multijets



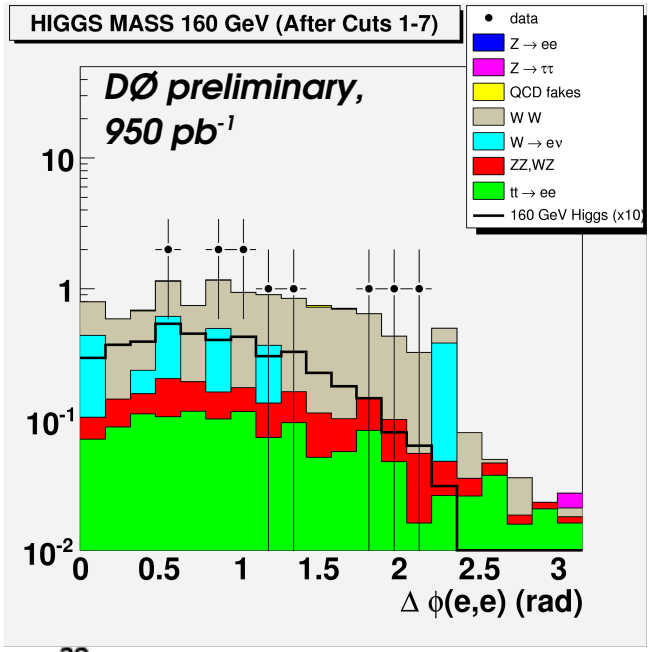
Selection

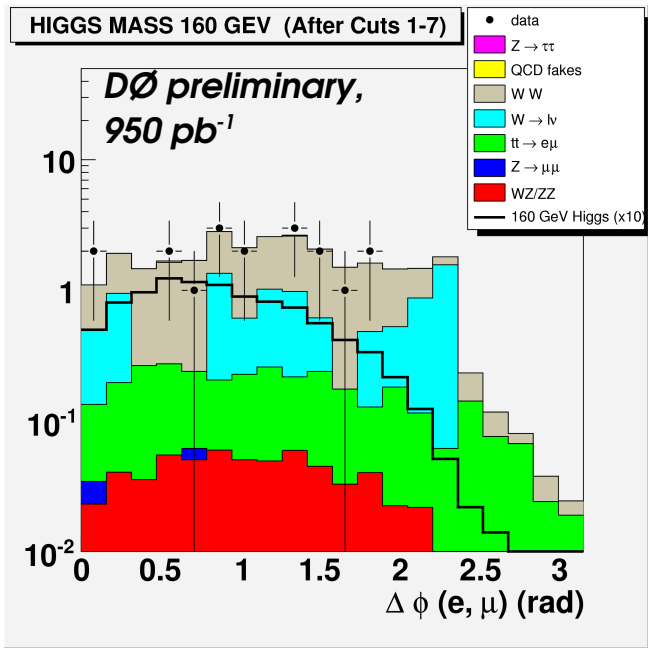
- Two isolated leptons (e or μ)
  - $p_T^1 > 15$ GeV, $p_T^2 > 10$ GeV
- High $\not{E}_T$ and $\not{E}_T$ significance
- Cuts on topological variables optimized by M_H and channel

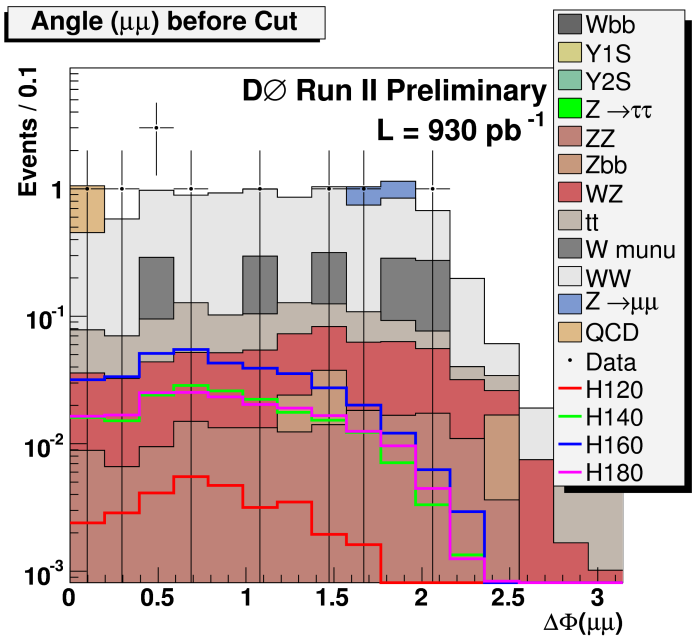
- Opening angle between leptons is a powerful discriminant

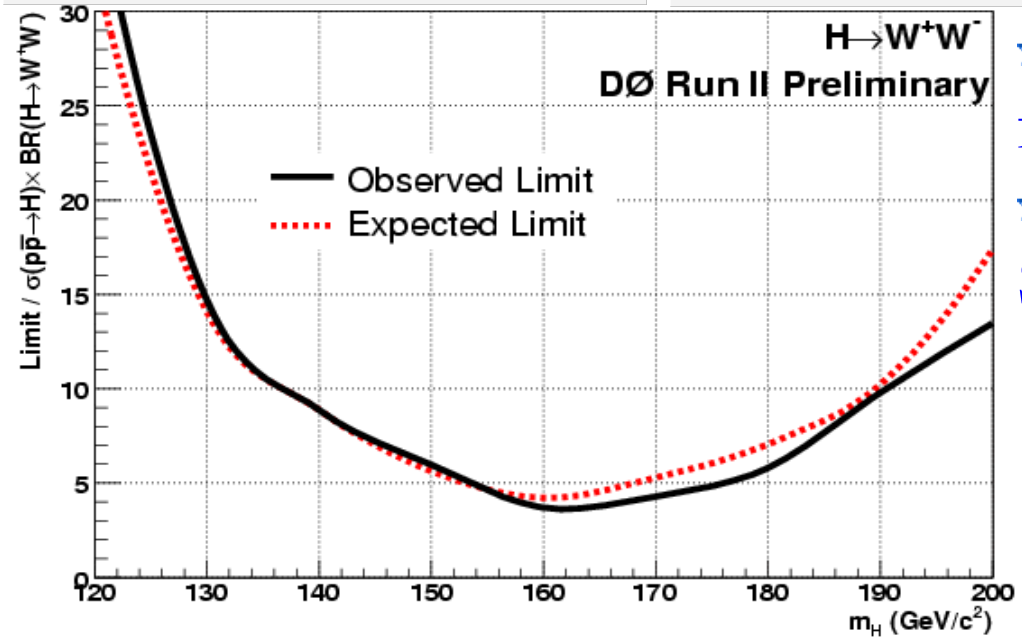


$gg \to H \to WW \to ee/e\mu/\mu\mu$







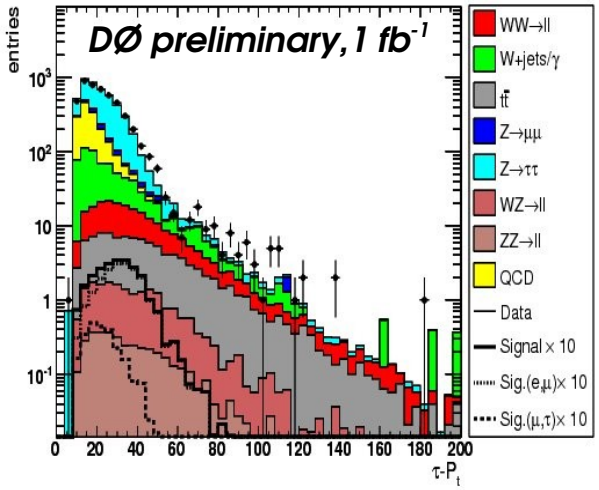


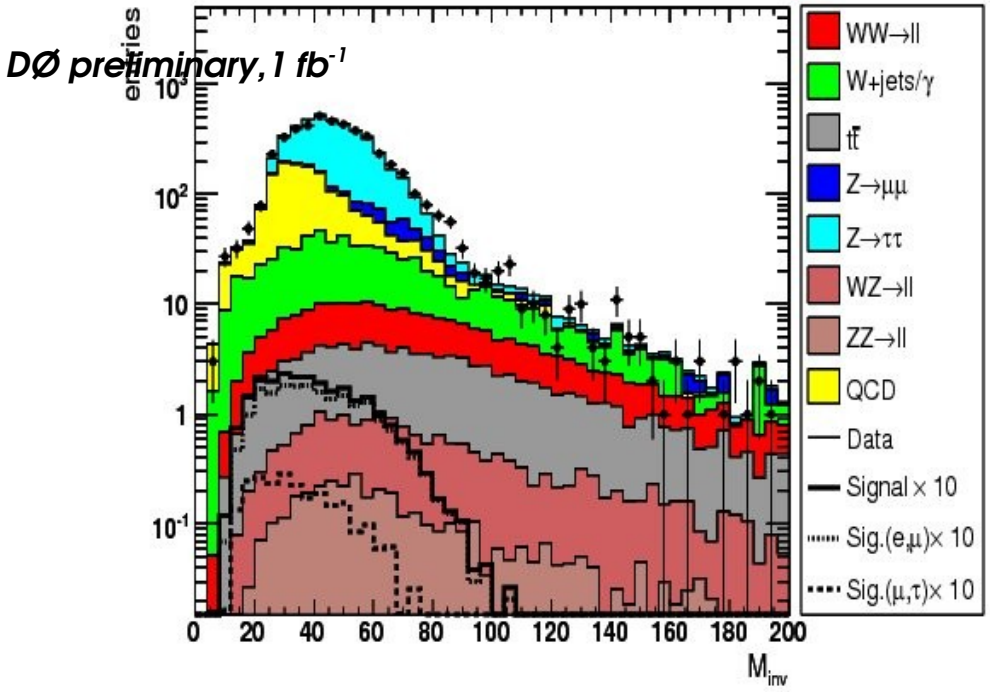
- Use LEP method to generate limit from shapes of $\Delta\Phi(\ell,\ell')$ distributions
- Obs (exp) limits 3.7 (4.2) times Standard Model cross section

M_H = 160 GeV	ee	eμ	μμ
Signal	0.42	0.97	0.35
Background	10.3	24.4	9.8
Data	10	18	9

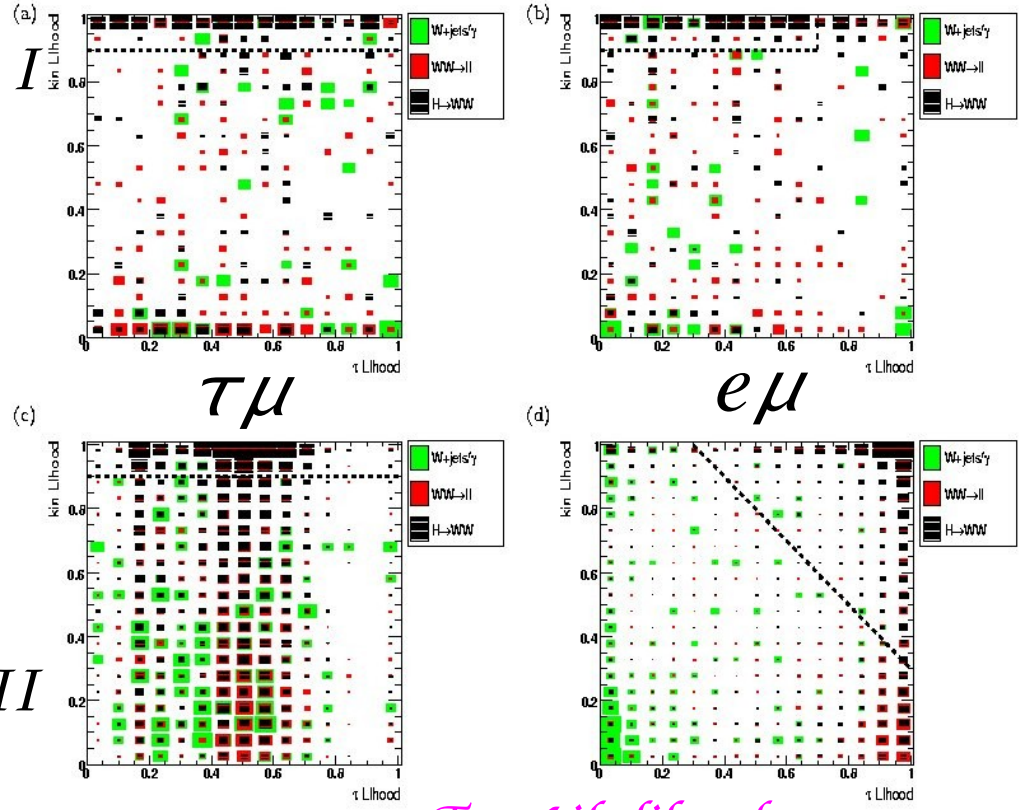
$gg \to H \to WW \to \mu\tau_{had}$

- New result extends H → WW* search to the τ sector
- Most sensitive to $e\mu$ events that do not survive the dedicated analysis
- Use neural nets to identify hadronic taus
  - Only consider "One Prong" (Type-I and Type-II) channels
- Basic selection is the same as other H → WW* searches
  - Exception: lepton p_T cuts are softer
  - 10 GeV for τ, 12 GeV for μ





$gg \to H \to WW \to \mu\tau_{had}$

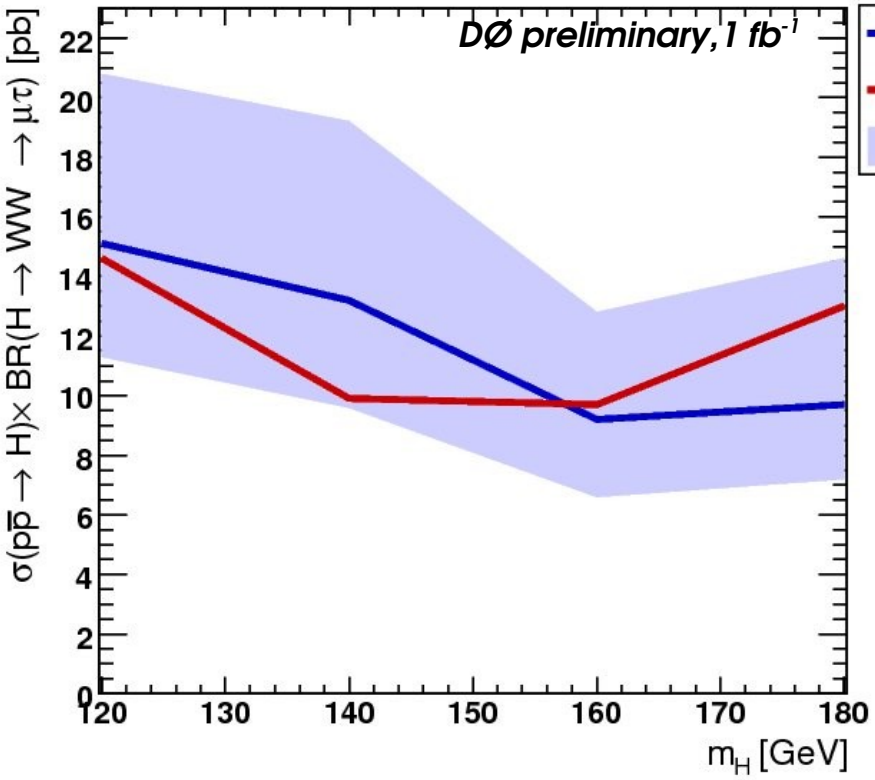


$M_H = 160$ GeV

- Use two likelihoods:
  - One on τ input variables
  - One on event kinematics
- Four training samples
  - Type I, true τ
  - Type I, eμ
  - Type II, true τ
  - Type II, eμ

- Feed event first through eμ likelihood
- If it doesn't pass, try the true τ likelihood

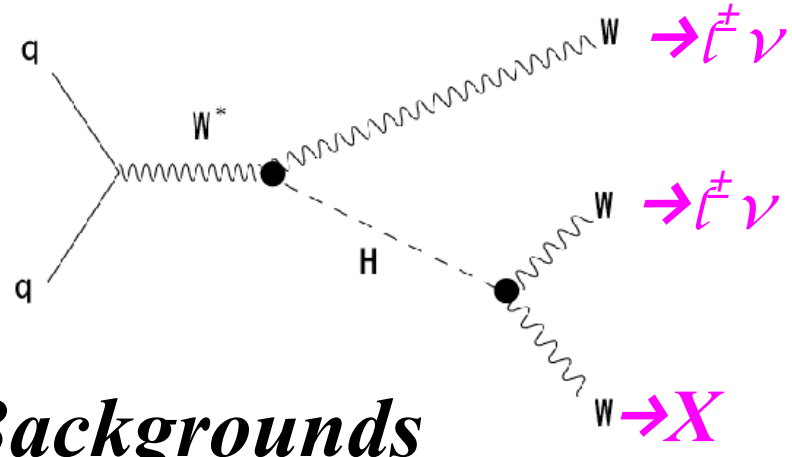
$gg \to H \to WW \to \mu\tau_{had}$



- Use LEP method as a to extract limits from event counts
- $\sigma \times BR$ @ M_H 160 GeV = 0.025 pb
- Results not yet propagated to full combination

M_H = 160 GeV	$e\mu$ Type I	$e\mu$ Type II	$\tau\mu$ Type I	$\tau\mu$ Type II
Signal	0.05	0.27	0.01	0.05
Background	4.63	14.11	1,78	7.08
Data	2	15	3	8

$qq' \rightarrow WH \rightarrow WWW \rightarrow ee/e\mu/\mu\mu + X$



- Check final states with two like sign leptons
- Standard Model backgrounds small
- Physics Backgrounds from MC
- Old analysis (360 pb^{-1} - 380 pb^{-1})
- Update with full Run IIa dataset in progress

Backgrounds

- WZ → $\ell\nu\ell'\ell'$, ZZ → $\ell\ell\ell'\ell'$
- Triboson production, tt+V
- Charge Flips
- Fake Leptons

Main physics backgrounds

Very small cross sections

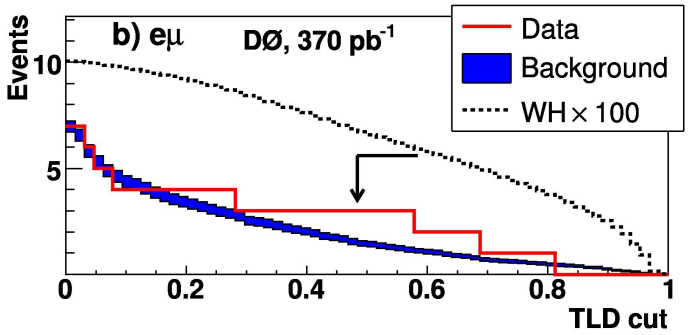
Estimated from data

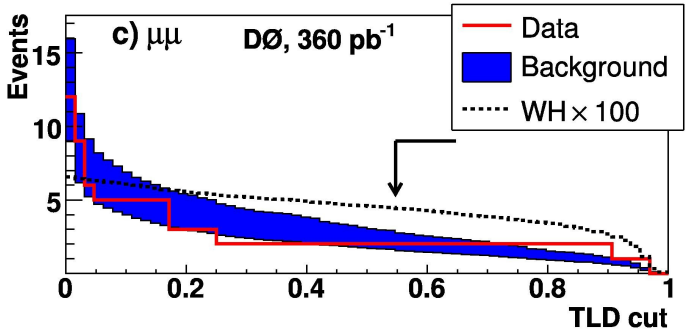
Preselection

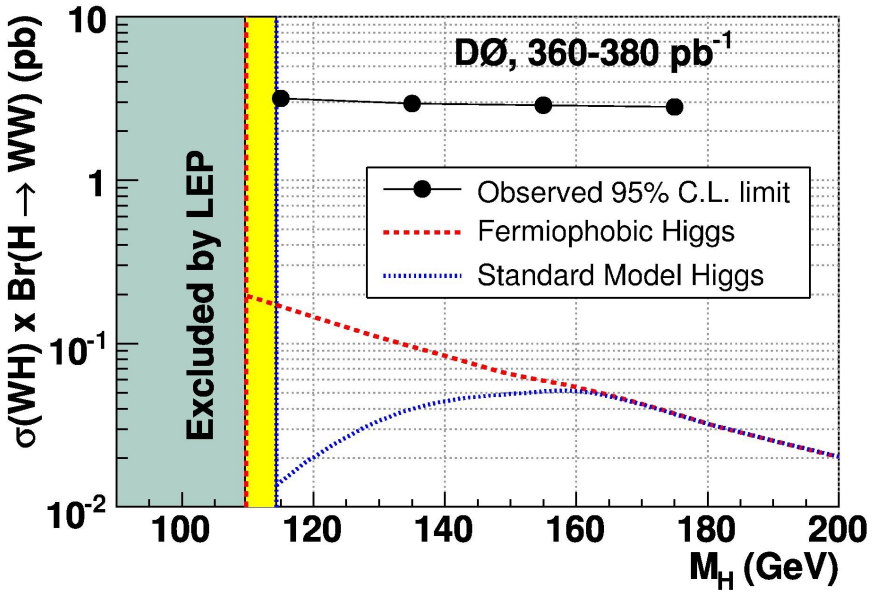
- Require two like sign electrons or muons
- p_T > 15 GeV

$qq' \to WH \to WWW \to ee/e\mu/\mu\mu + x$

- Only additional selection is a topological likelihood discriminant (TLD)
- Several input variables:
  - $\not\!\!E_T$, $\not\!\!E_T'$, $\Delta\Phi(\ell,\ell)$, $\Delta\Phi(l,\not\!\!E_T')^{min}$
- Optimize cut separately for each channel and M_H







Combined Higgs Limits

Channel	Lum (fb^{-1})	Final Variable
$WH \rightarrow e\nu bb$	0.97	Dijet mass
$WH \rightarrow \mu\nu bb$	1.05	Dijet mass
$WH \rightarrow \not{\ell}\nu bb$	0.93	Dijet mass
$ZH \rightarrow \nu\nu bb$	0.93	Dijet mass
$ZH \rightarrow eebb$	0.84	Dijet mass
$ZH \rightarrow \mu\mu bb$	0.92	Dijet mass
$WW \rightarrow ee$	0.95	$\Delta\Phi(e,e)$
$WW \rightarrow e\mu$	0.95	$\Delta\Phi(e,\mu)$
$WW \rightarrow \mu\mu$	0.95	$\Delta\Phi(\mu,\mu)$

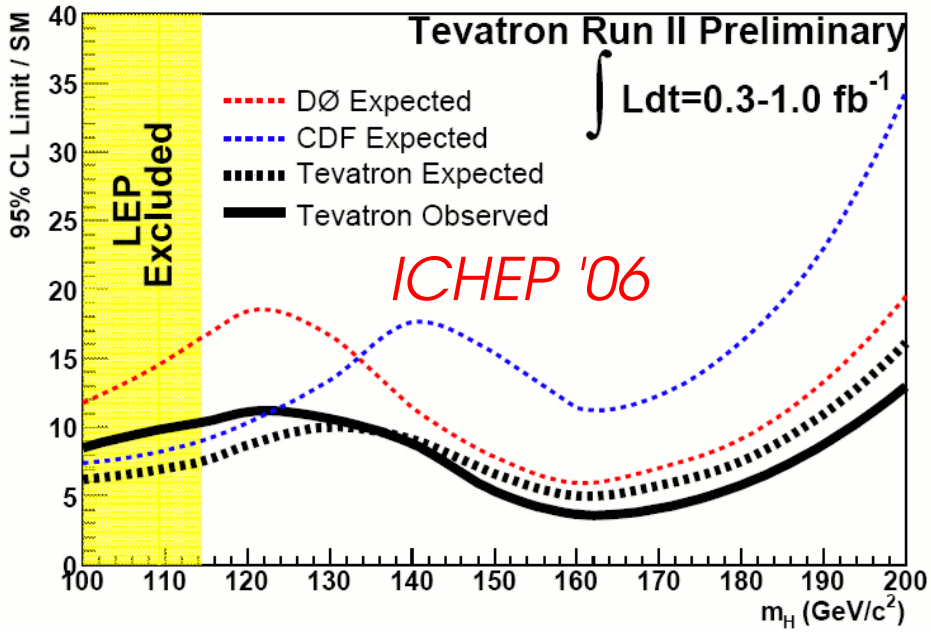
Orthoganal Single and Double Tag Samples

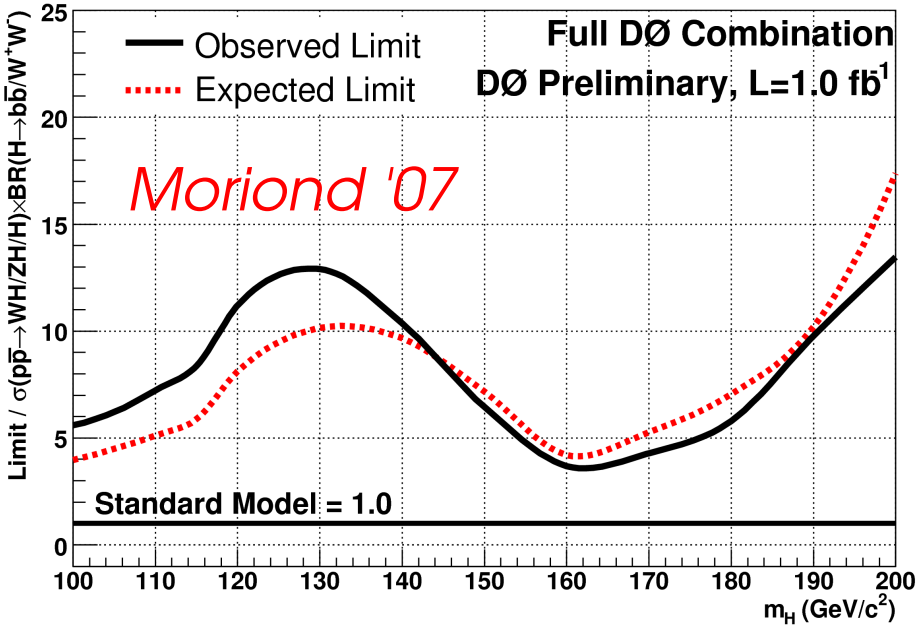
Double Tag Samples Only

Presented in this Talk

- Eleven channels in total
- Not included in combination:
  - $H \rightarrow WW \rightarrow \mu\tau_h$
  - $WH \rightarrow WWW \rightarrow ee/e\mu/\mu\mu$
- Extract limits with the LEP method
- Use shapes of final variable distributions

Combined Higgs Limits





- LEP method uses log likelihood ratios for each bin to get limits from distribution shapes
- Sensitivity is within a factor of ~4 (6) of Standard Model at Higgs mass of 160 GeV (115 GeV)
- More channels (like H→WW→$\mu\tau_h$) in the pipeline
- That's just DØ!

A Promising Future...

- The Higgs hunt at DØ (and at the Tevatron) is in full swing
- Presented results of Higgs searches:
  - $H \rightarrow WW \rightarrow ee/e\mu/\mu\mu/\mu\tau_h$
  - $WH \rightarrow WWW \rightarrow e^{\pm}e^{\pm}/e^{\pm}\mu^{\pm}/\mu^{\pm}\mu^{\pm}$
- Saw results for lower masses earlier today
- Combination of 1 fb^{-1} results are encouraging
- We are working hard to update these searches:
  - larger datasets
  - improved analysis techniques
- Look to hear from us again