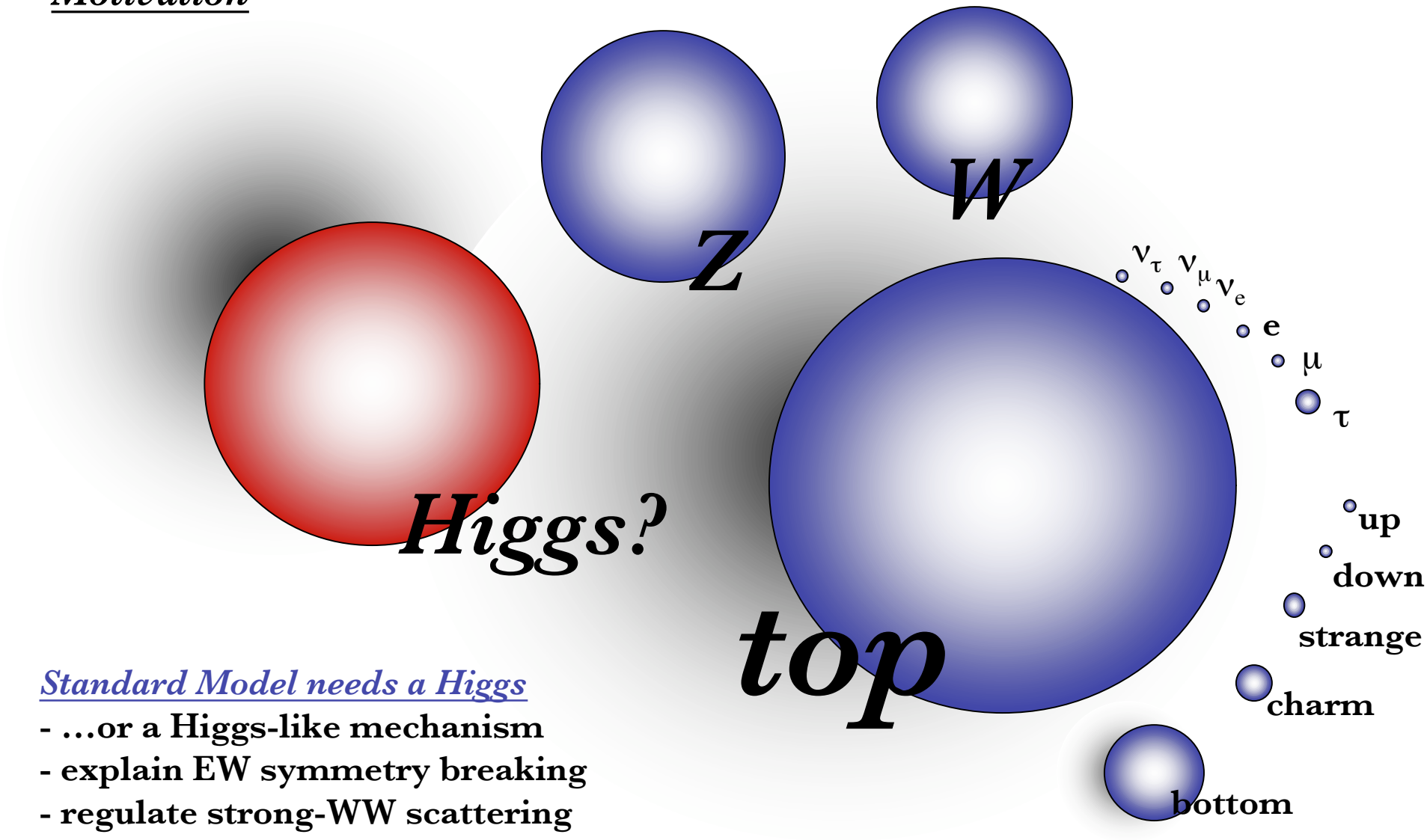
SM Higgs Searches at the Tevatron

(high mass)

Daniel Whiteson

UCIrvine

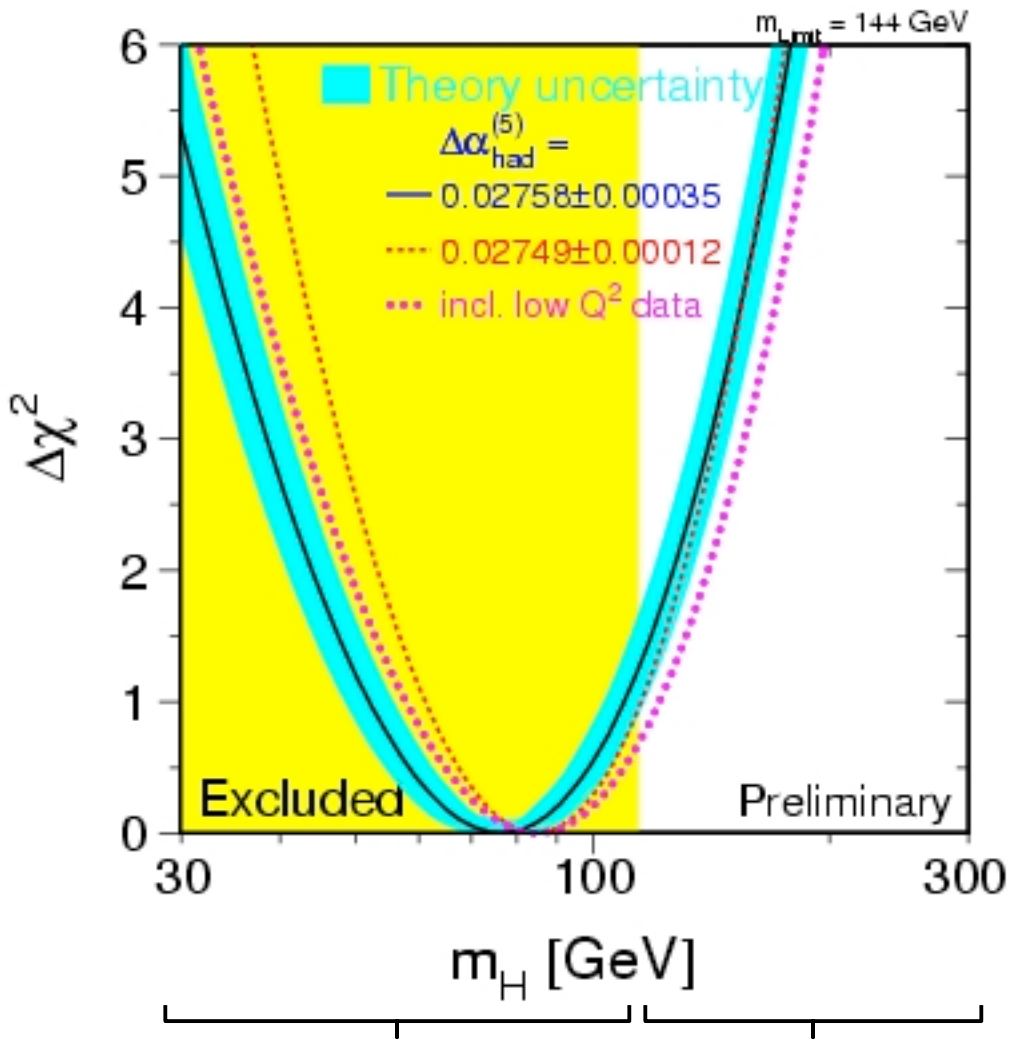
Motivation



Standard Model needs a Higgs

- …or a Higgs-like mechanism
- explain EW symmetry breaking
- regulate strong-WW scattering

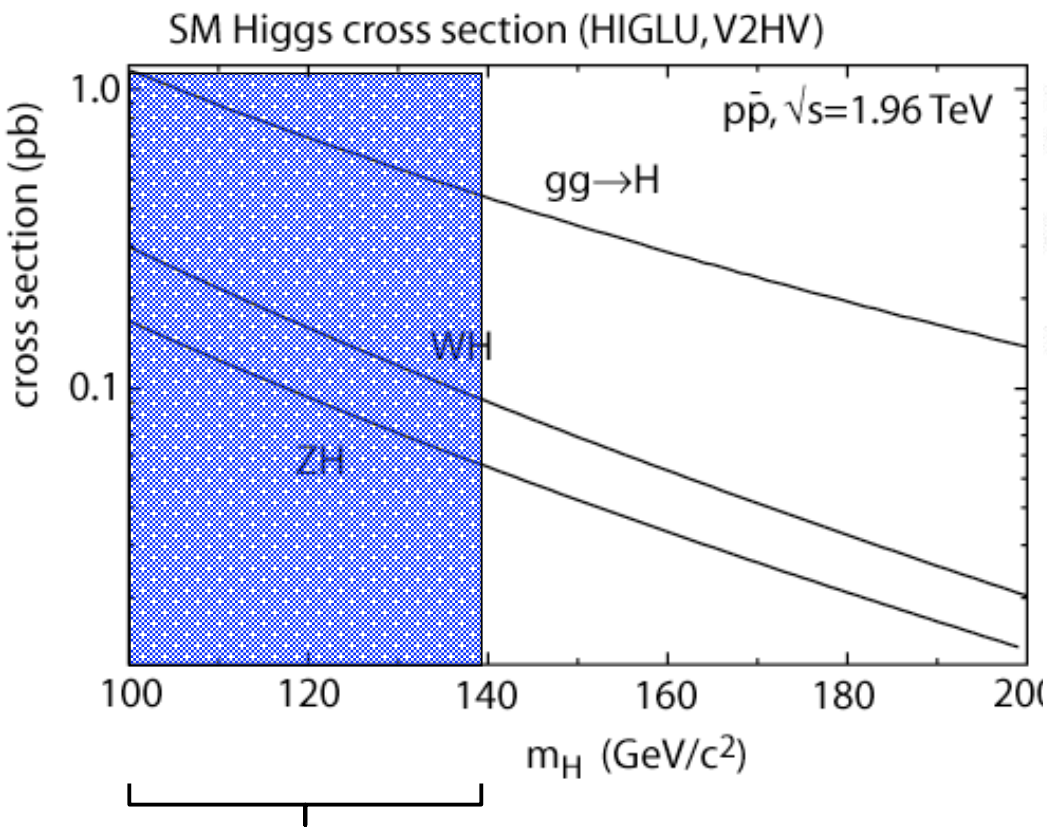
Current limits

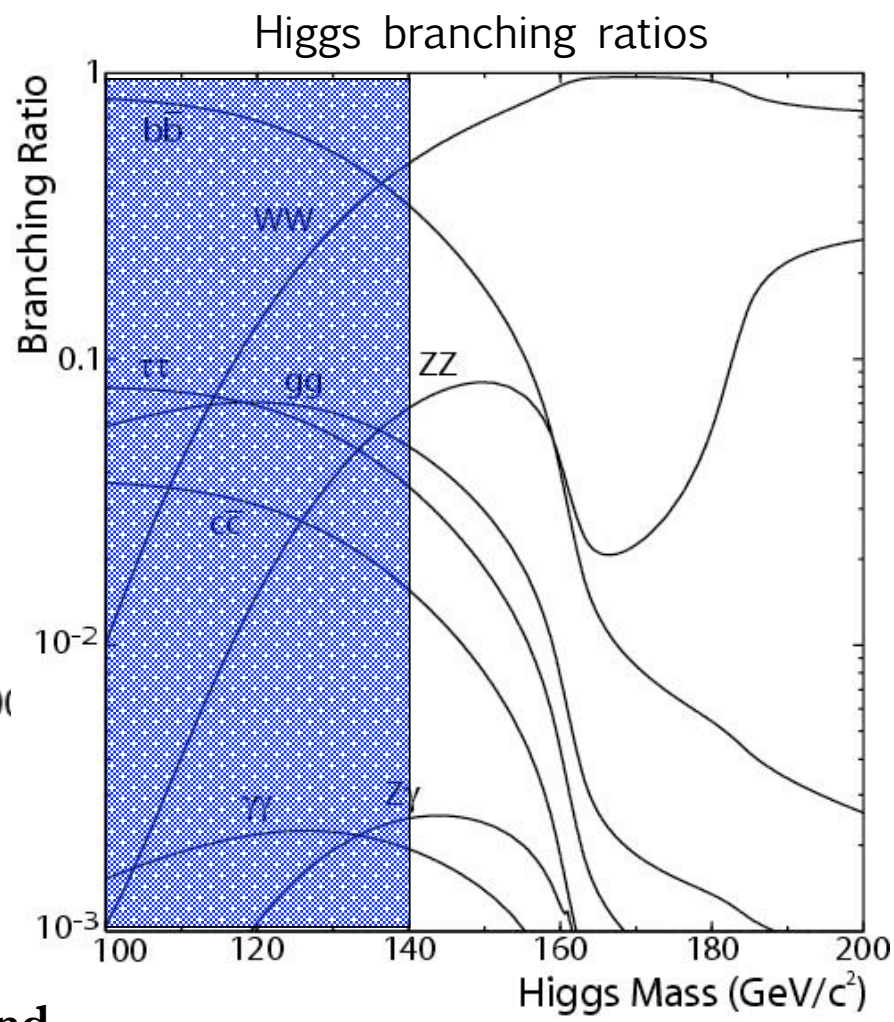


LEP direct searches

Tevatron opportunity

Higgs Production





Low mass

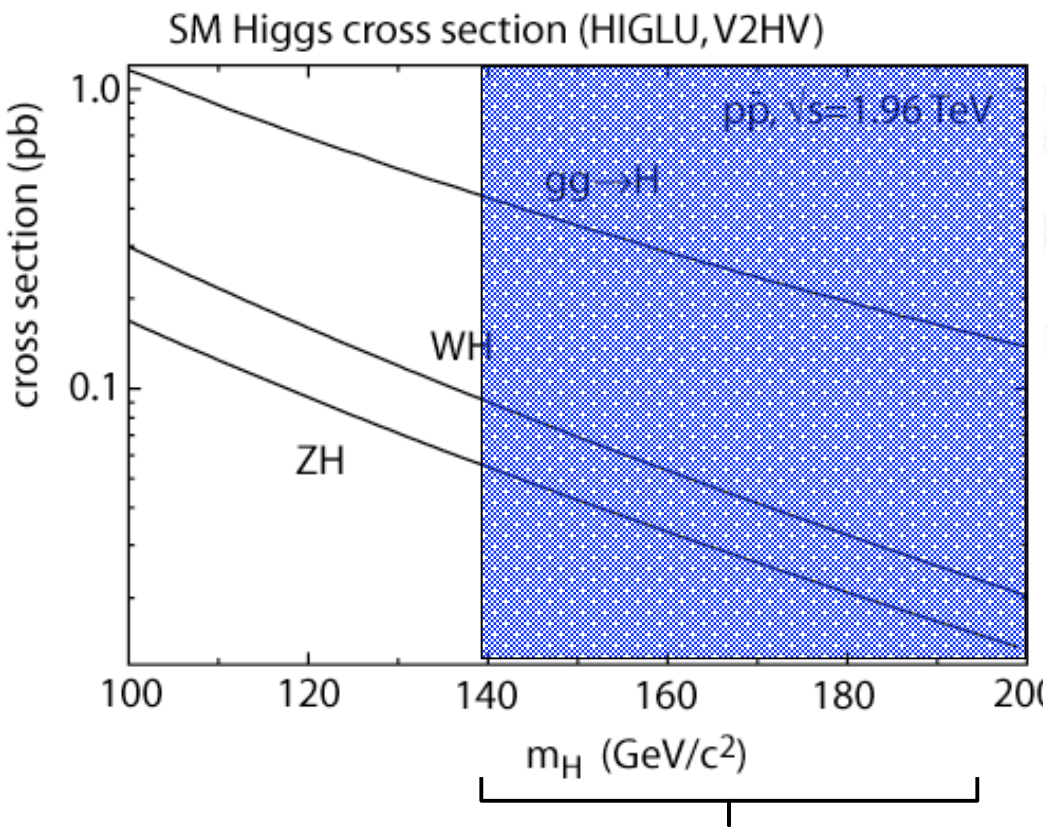
***gg -> H -> bb* dominates**

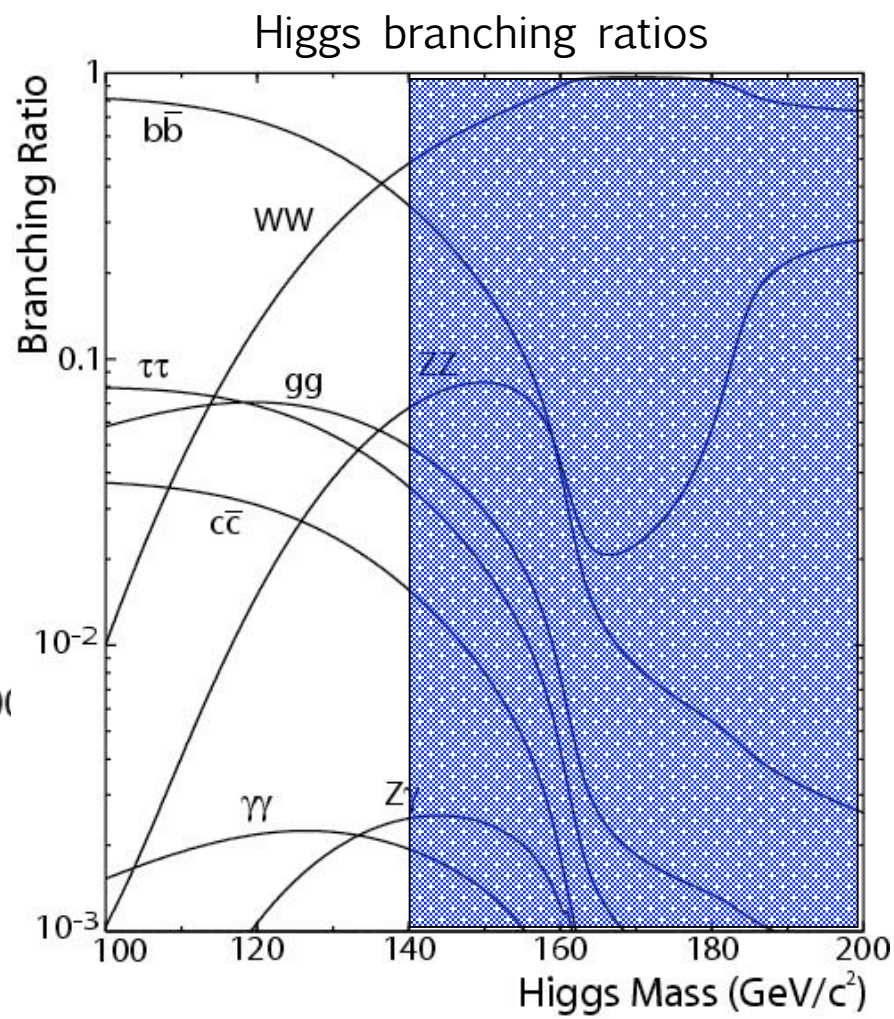
Nearly impossible to see over background

***Wh, Zh* channels difficult but possible**

(See talk by M. Sanders)

Higgs Production



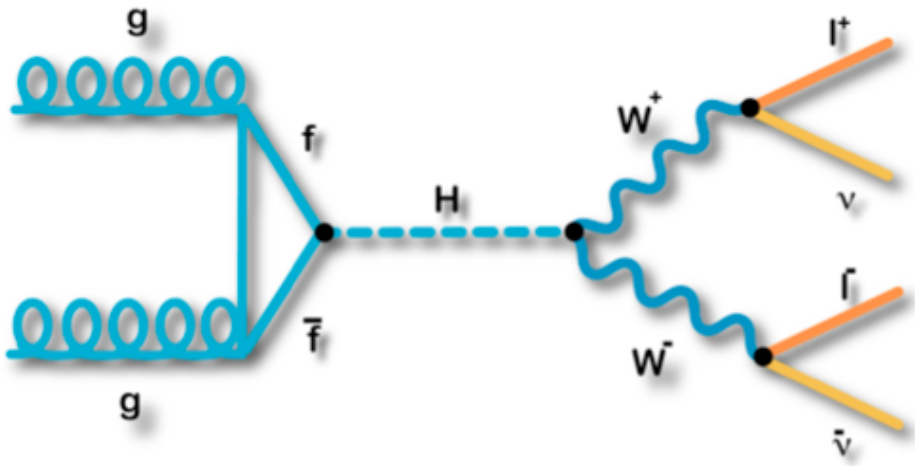


High mass

***gg -> H -> WW* dominates**

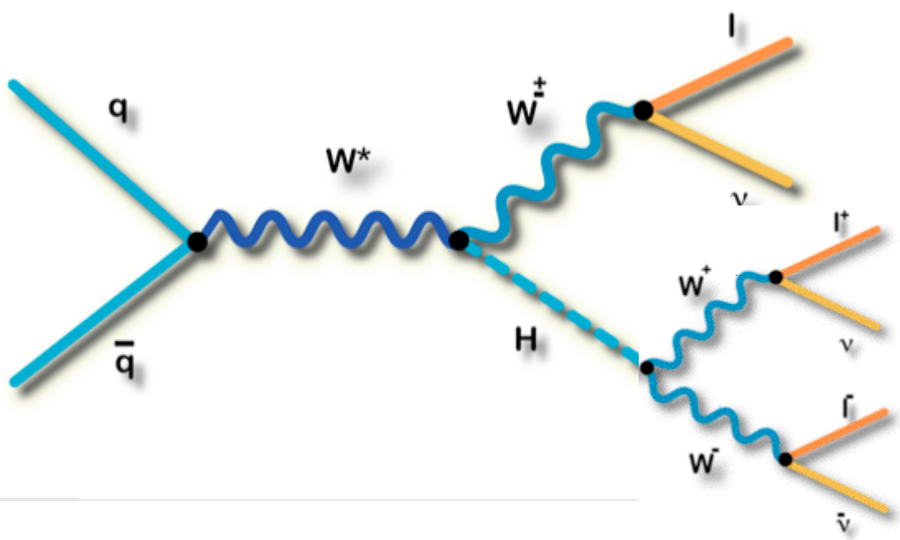
***WH -> WWW* contributes**

Most promising SM channels (high mass)



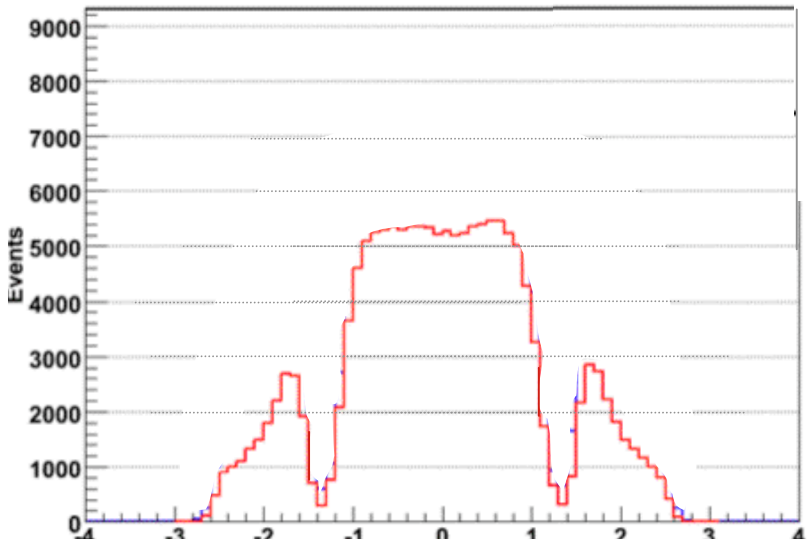
Bigger!

More words

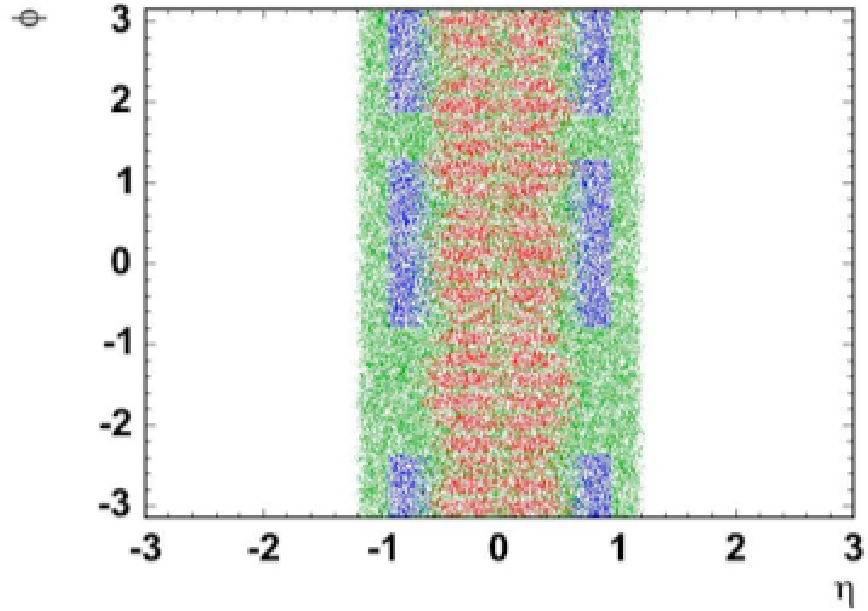


Lepton acceptance

e.g. **Electrons at D0**



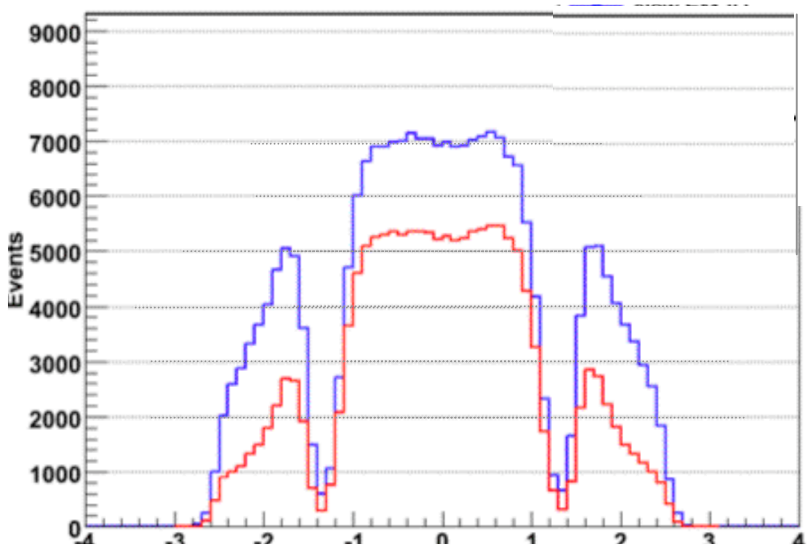
e.g. **Muons at CDF**



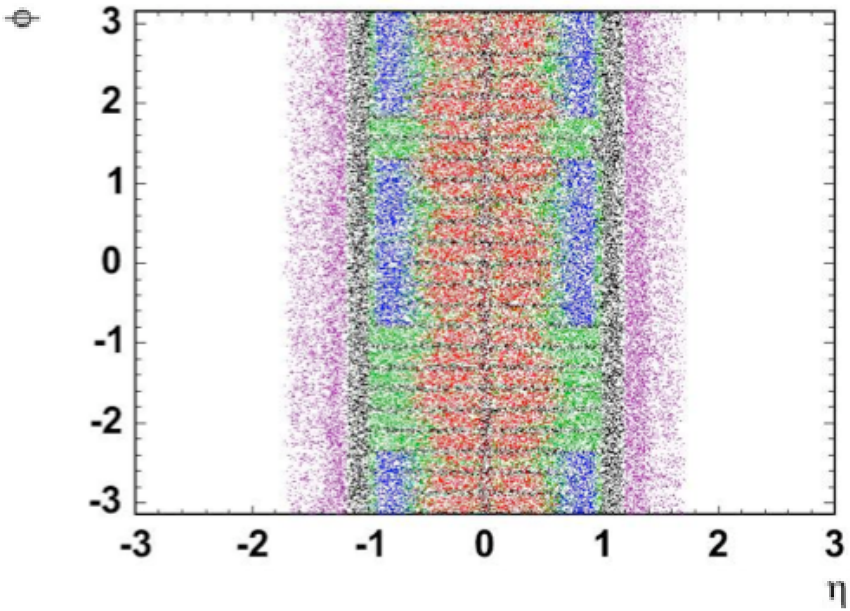
Standard lepton identification

Lepton acceptance

e.g. **Electrons at D0**



e.g. **Muons at CDF**

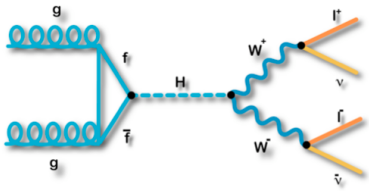


Improved lepton acceptance

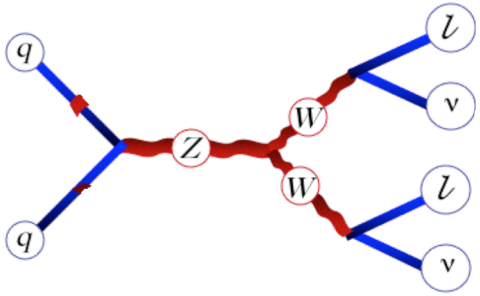
CDF: Use every track, forward MIP signals

D0: Loosened electron ID requirements using neural network

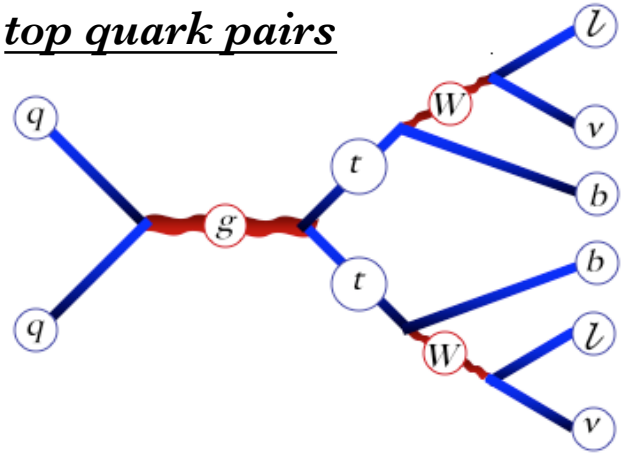
H-> WW Backgrounds



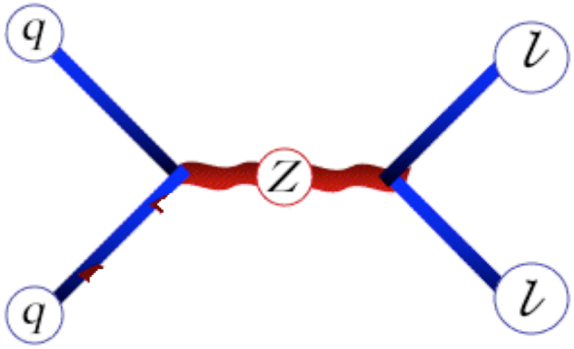
Diboson (WW/WZ/ZZ)



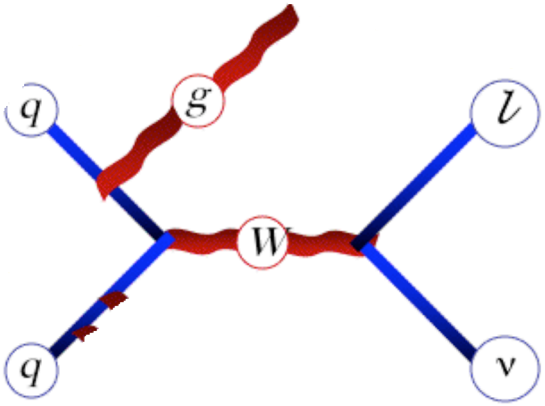
top quark pairs



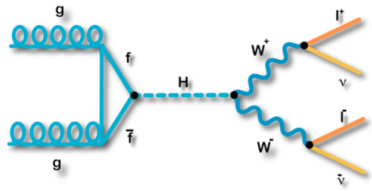
Drell-Yan

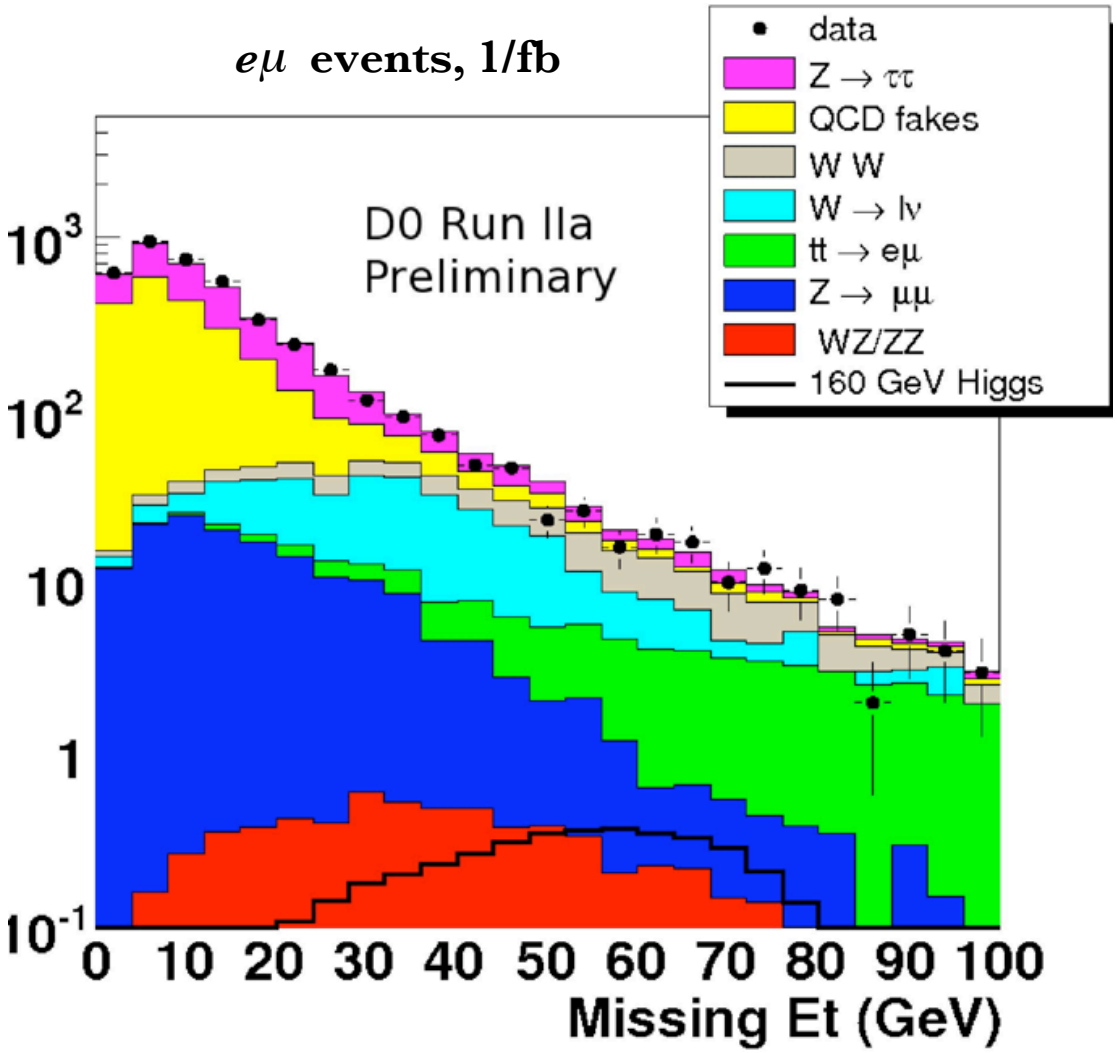


W+jets (fake lepton)



Missing energy





Missing energy

Must be well understood

Validated in control samples

Expected samples

Selection

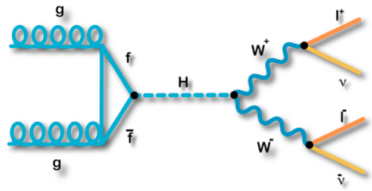
Two leptons
Missing energy
< 2 jets

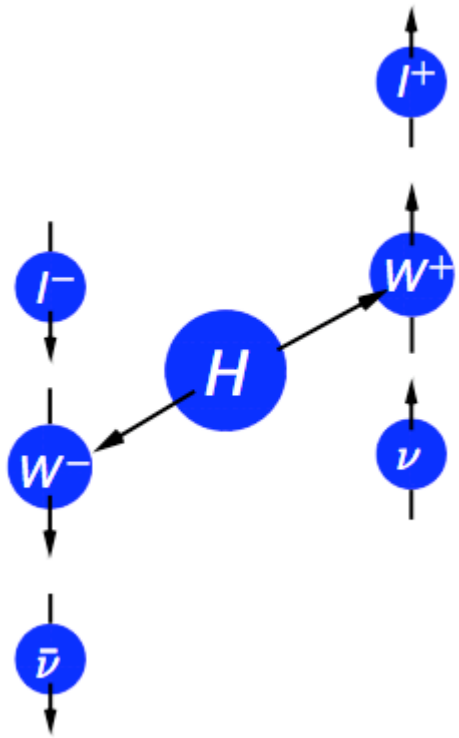
D0 eμ 1/fb

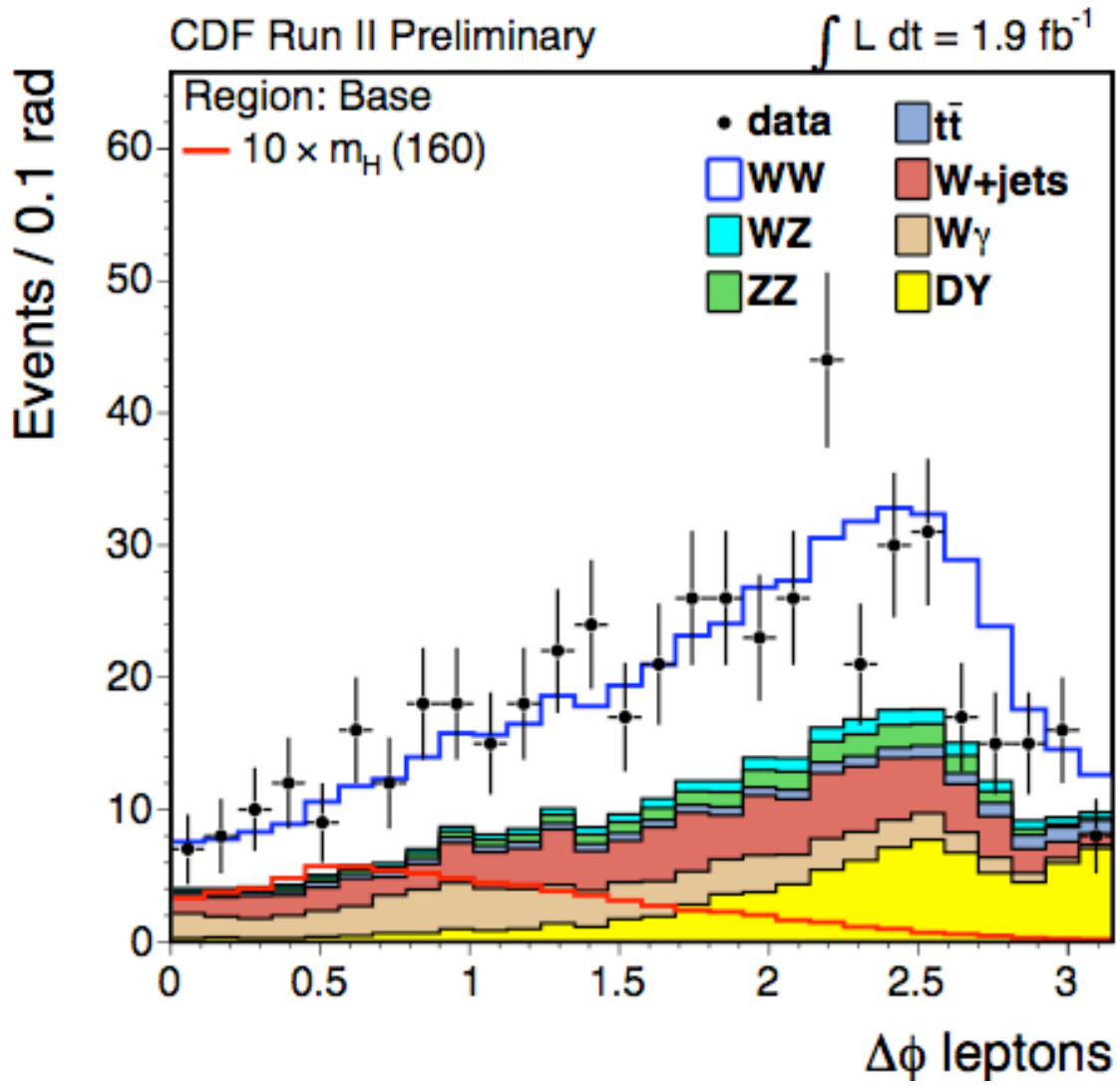
M_H (GeV)	160
$H \to W^+W^-$	1.64 ± 0.03
$Z/\gamma \to ll$	0.2 ± 0.1
Diboson (WW, WZ)	13.2 ± 0.1
$t\bar{t}$	1.25 ± 0.1
W+jet/γ	7.5 ± 1.9
Multi-jet	2.1 ± 0.2
Background sum	24.2 ± 2.0
Data	20

CDF numbers here….

Kinematic selection & separation

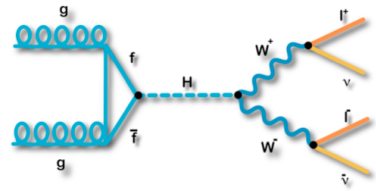


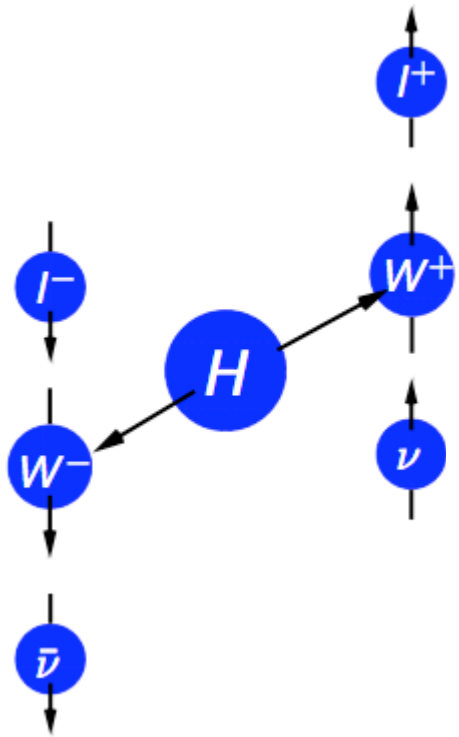




scalar decay
W spins correlated
Leptons more collinear

Kinematic selection & separation





Separation

CDF calculates probability, integrating over matrix element:

$$P(\vec{x}_{obs}) = \frac{1}{<\sigma>} \int \frac{d\sigma_{th}(\vec{y})}{d\vec{y}} \epsilon(\vec{y}) G(\vec{x}_{obs}, \vec{y}) d\vec{y}$$

Theory at leading order

$\sigma_{th}(\vec{y})$	leading order calculation of the cross-section
$\vec{y}$	true lepton four-vector (include neutrinos)

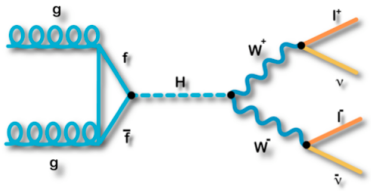
What we measure

$\vec{x}_{obs}$	observed "leptons" and $\vec{\not{E}}_T$

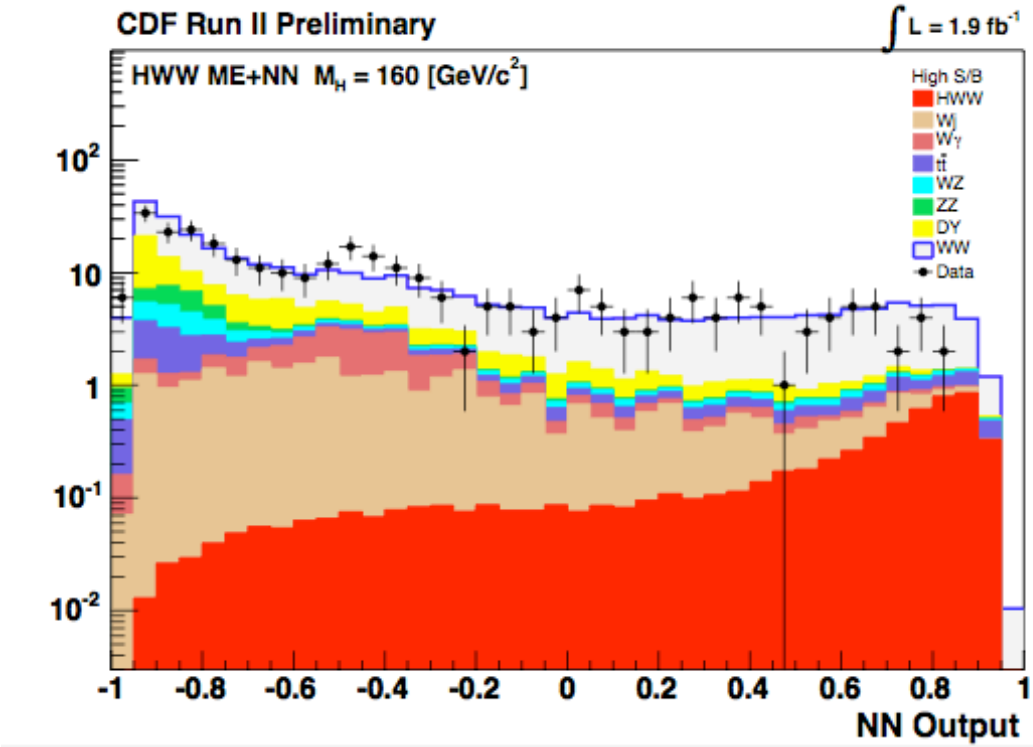
Detector Effects

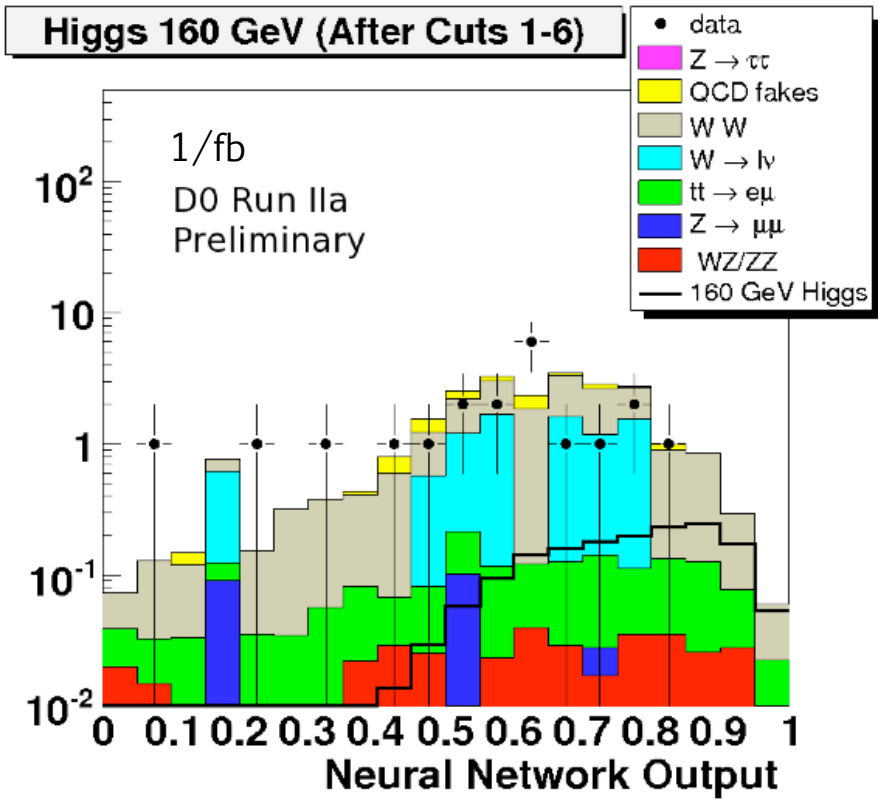
$\epsilon(\vec{y})$	total event efficiency $\times$ acceptance
$G(\vec{x}_{obs}, \vec{y})$	resolution effects

Results



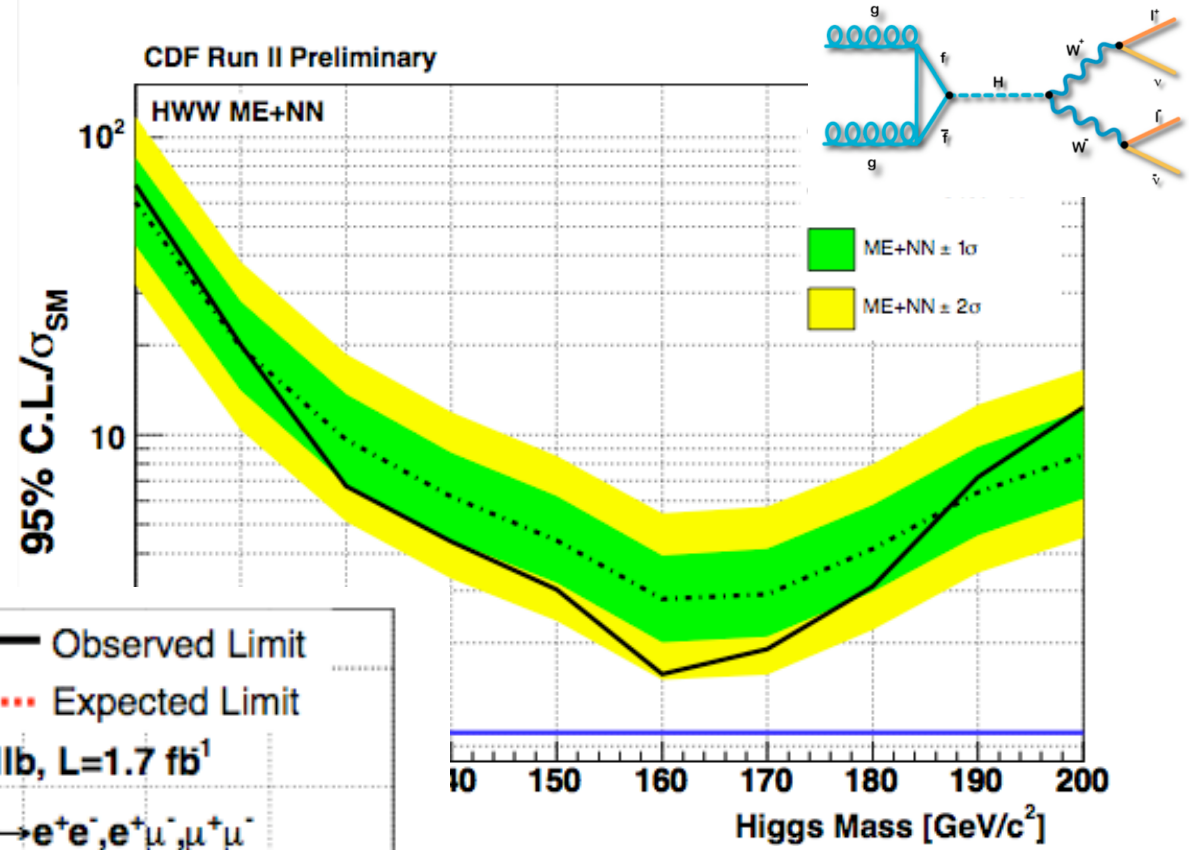
Neural network combines all discrimination into single dimension

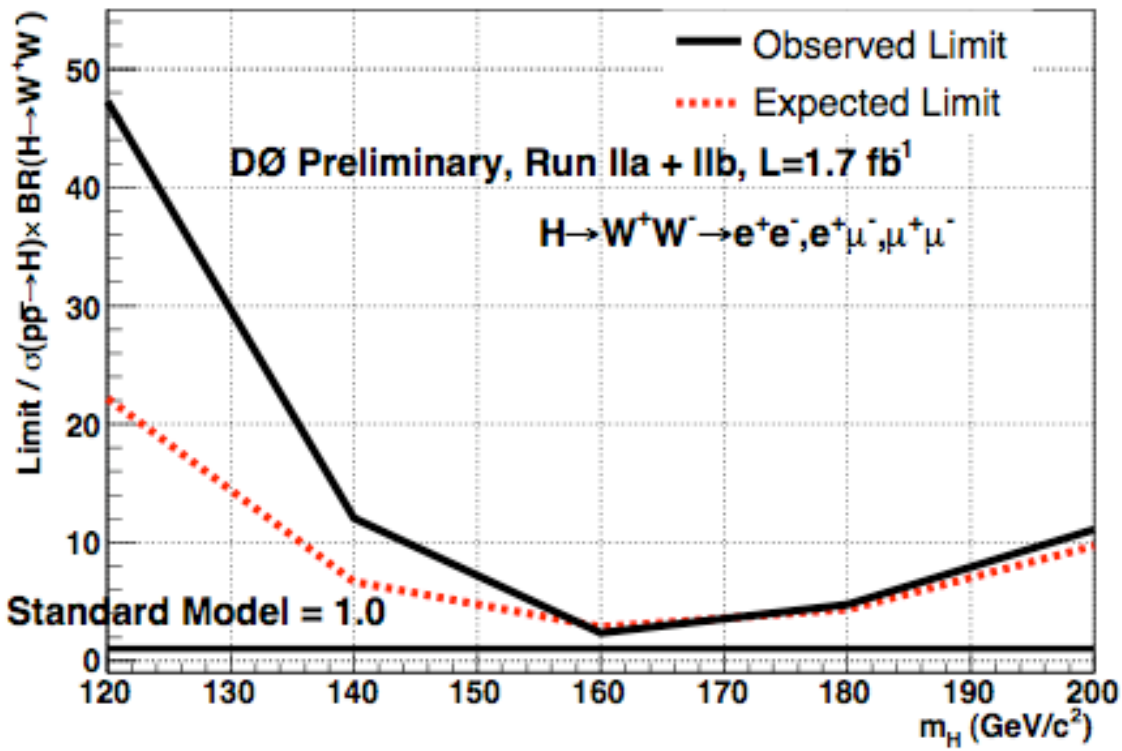




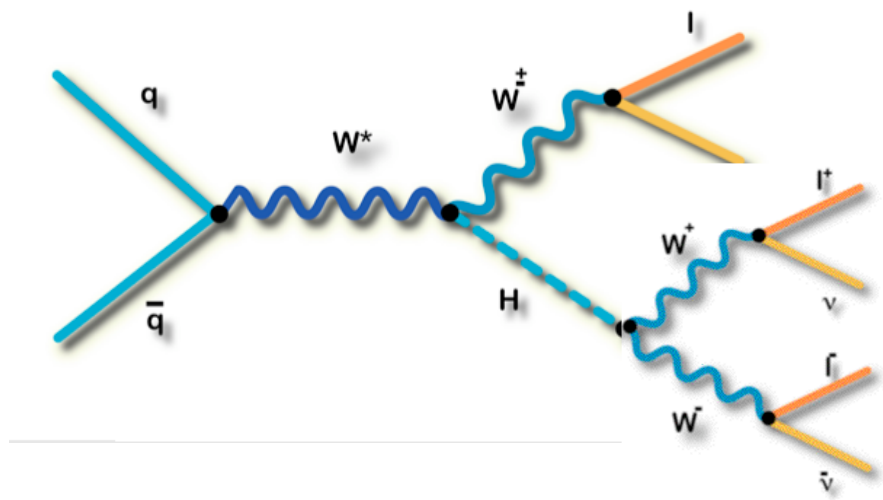
Results

Limits are set using CL_s method





WH -> WWW

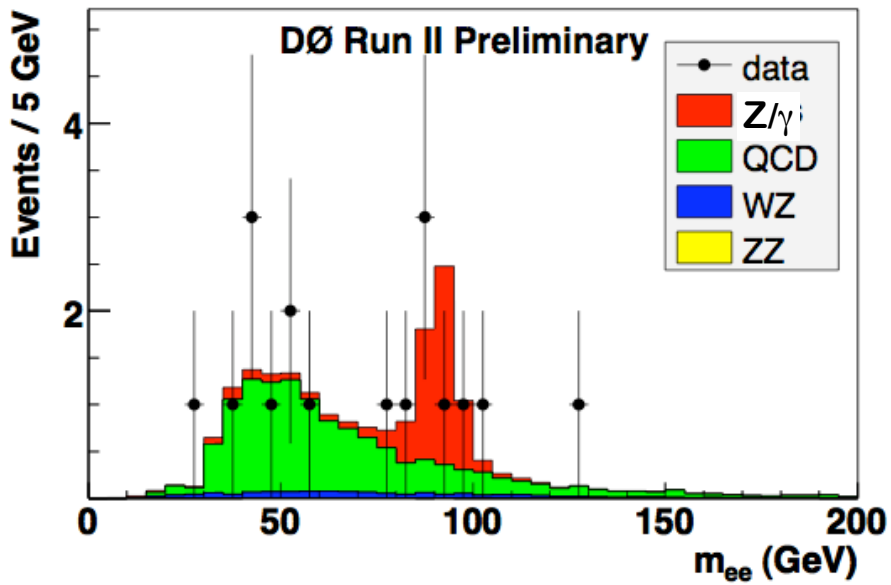


Selection

2 *like-signed* leptons

D0, 1/fb

	ee	*eμ*	*μμ*
Diboson	*1.4*	*2.6*	*1.4*
Z/γ	*11.9*		*0.8*
QCD	*7.4*	*15.4*	*2.8*
Total	20.6	18.0	5.0
Wh(160)	*0.1*	*0.2*	*0.1*
Data	19	15	5



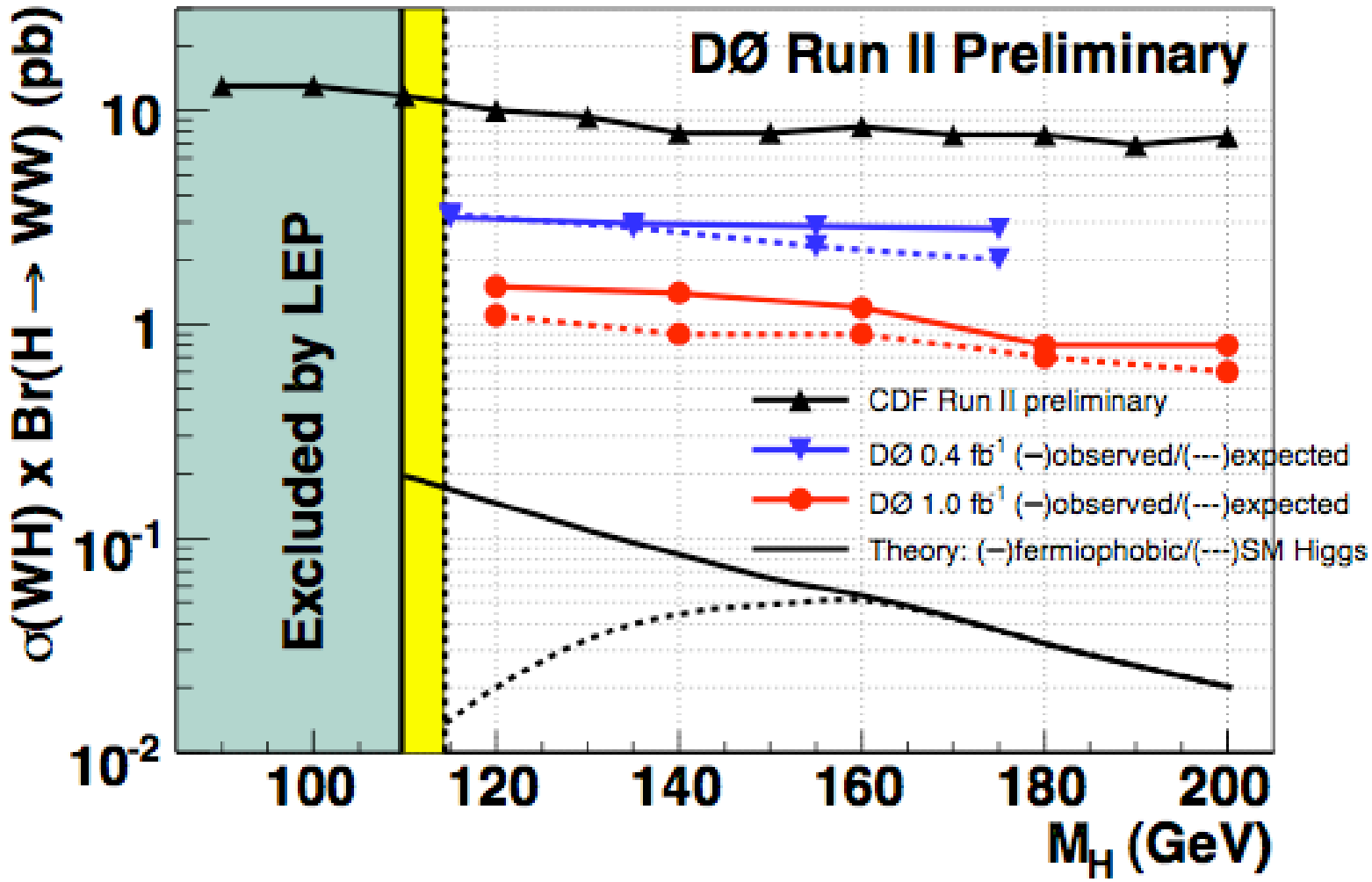
WH -> WWW

Limits

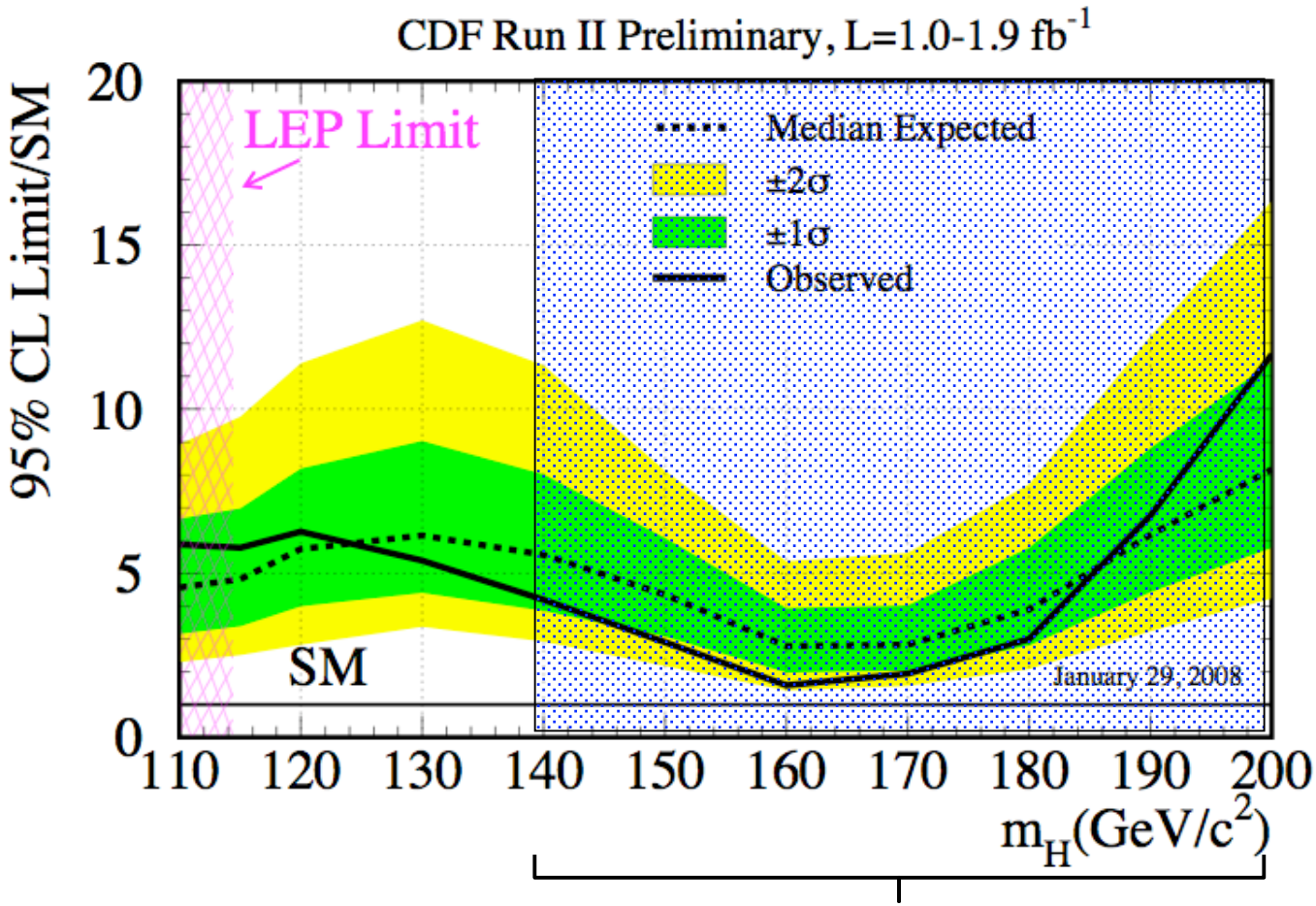
D0: 1/fb

CDF: 0.2/fb

Updates coming soon!



Combination

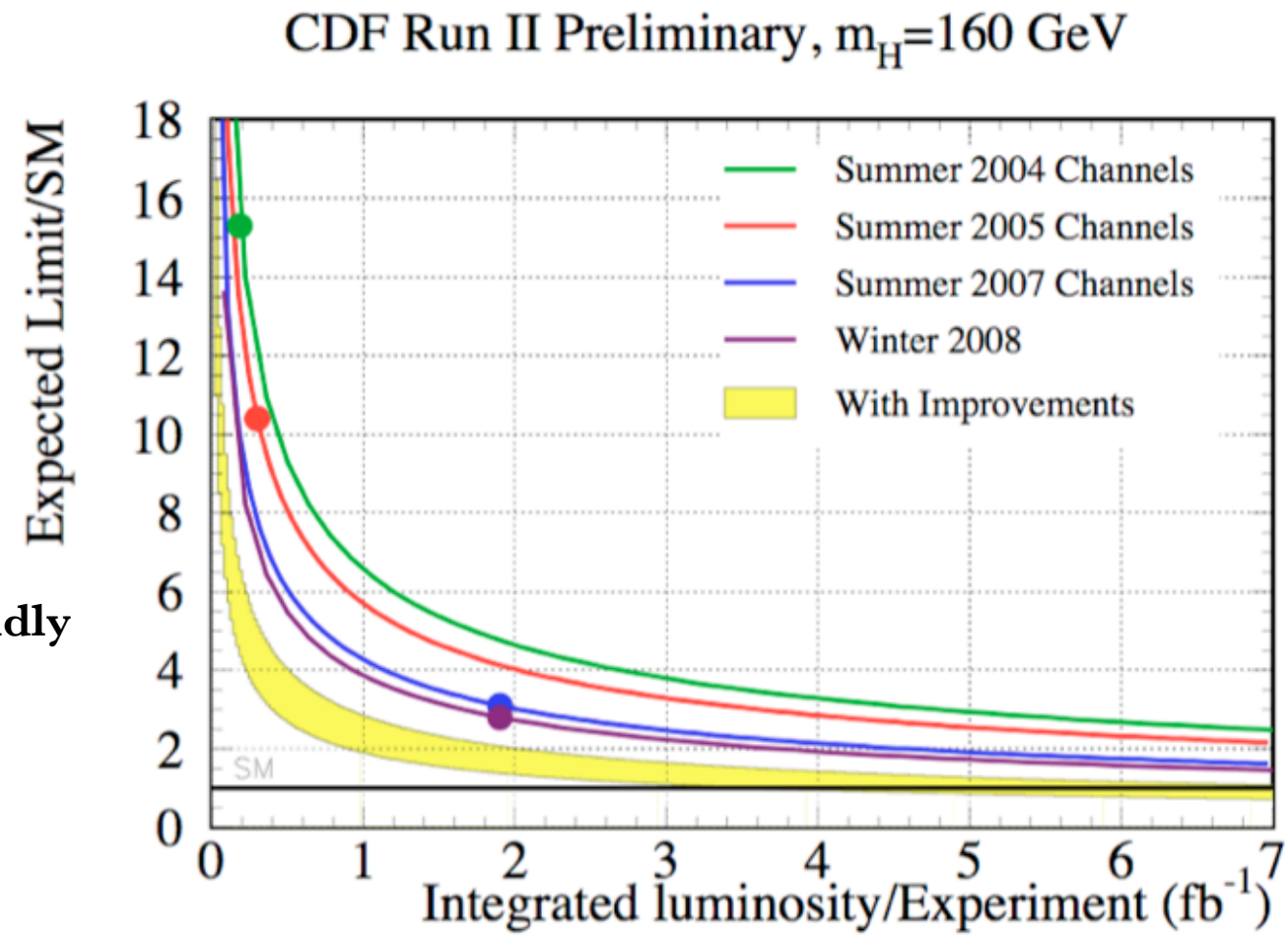


Very close to SM prediction

Very exciting time

No evidence for Higgs

High mass sensitivity
approaching SM

Sensitivity improving rapidly
faster than √L

Much more to say
before LHC turns on