Higgs Review for PDG-2010

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HIGGS BOSONS: THEORY AND SEARCHES

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Introduction
The Standard Model Higgs Boson
Higgs Bosons in the MSSM
Charged Higgs Bosons
Other Model Extensions
Other Searches for Higgs Bosons Beyond the SM
Outlook

Previous reviews: 2006 / Igo Kemenes
2008 / GB/MC/TJ

Remarks from the review committee on 2008 review

> Specifically, we would like to point that between the 2006 and the 2008 editions the
> review article of the Higgs bosons has almost doubled its size, though this does not
> reflect any significant theoretical or experimental development. We recommend that
> the following edition should try to reduce the size of the Higgs section with the caveat
> that a discovery at LHC could change the scope of the Higgs section in the reviews.
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Indeed the 2008 review has been expanded, since the 2006 one was short:

Text only doubled while number of authors tripled ;)

Remarks from the review committee on 2008 review

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More seriously,

1) **specialists now covering more experimental and theoretical areas**
2) **Tevatron ramped up in new domains, while previous results are still relevant**

Example:	in 2006	2008
SM Higgs at Tevatron	< 0.5 page	8 pages (~like LEP)
SUSY Higgs theory	< 1 page	4 pages
SUSY Higgs @TeV	< 2 pages	8 pages
Model extensions	1.5 pages	4 pages

Right strategy since the Tevatron searches are going to continue for a while, and since the LHC ones are partly similar (but there will be an expanded experimental version due to LHC in 2012)

Conclusions for Higgs review 2008

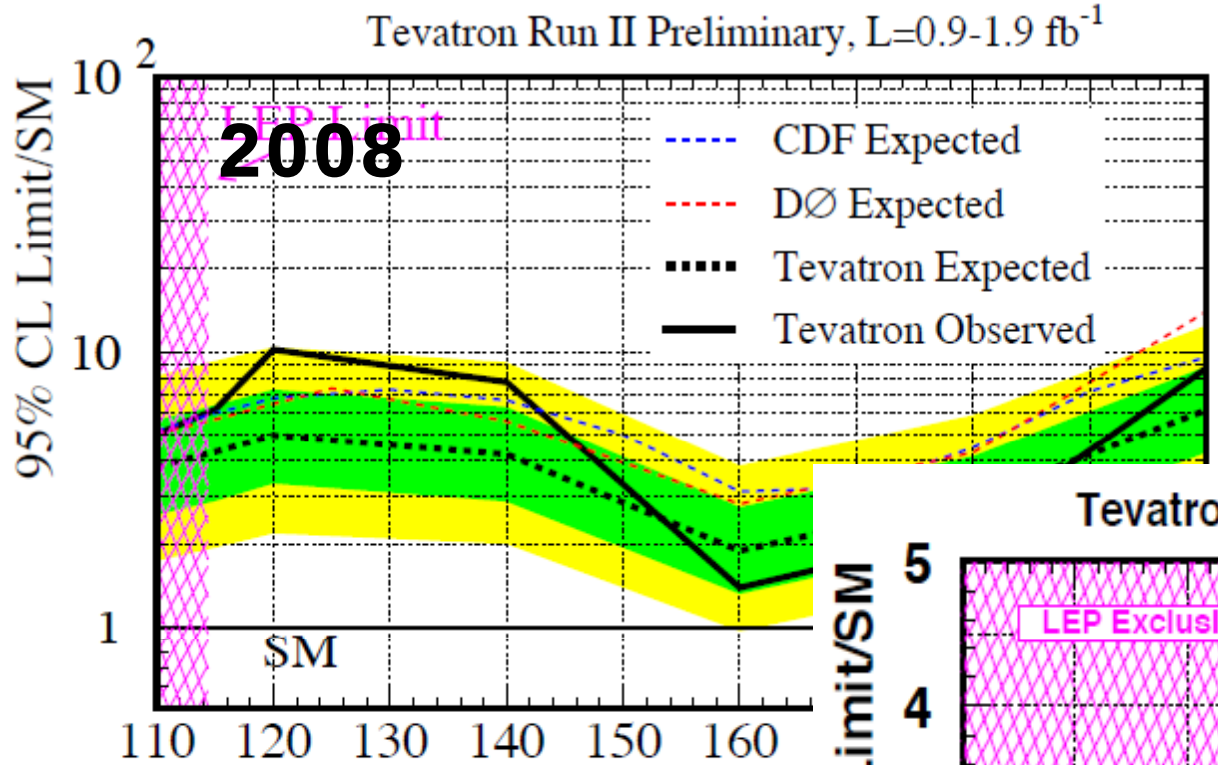
Significant update was done for the 2007-2008 version (beyond new experimental resutls, theory section was also updated (little Higgs, Extra D...), relation to cosmology,)

Tevatron data are being taken at high rate, and CDF and D0 have a major fraction of their analysis effort now on Higgs → many new results coming in regularly, with combinations updated in a timely fashion by the TeV-NP-Higgs working group.

(SUSY Higgs combination being prepared for Moriond 08)

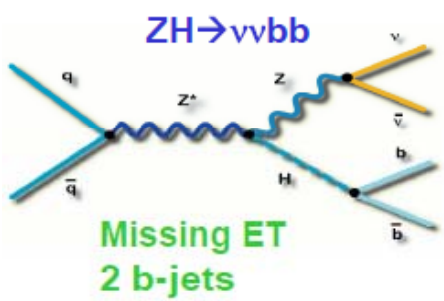
2009-2010 version will still be strongly focused on Tevatron results, with hopefully some very first Higgs results from LHC (limits at that stage)

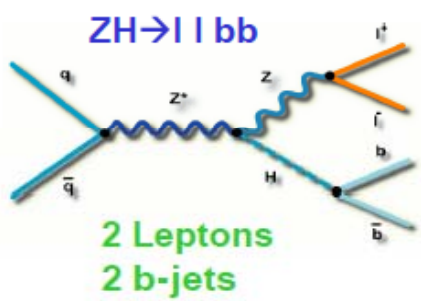
Higgs Review / low mass

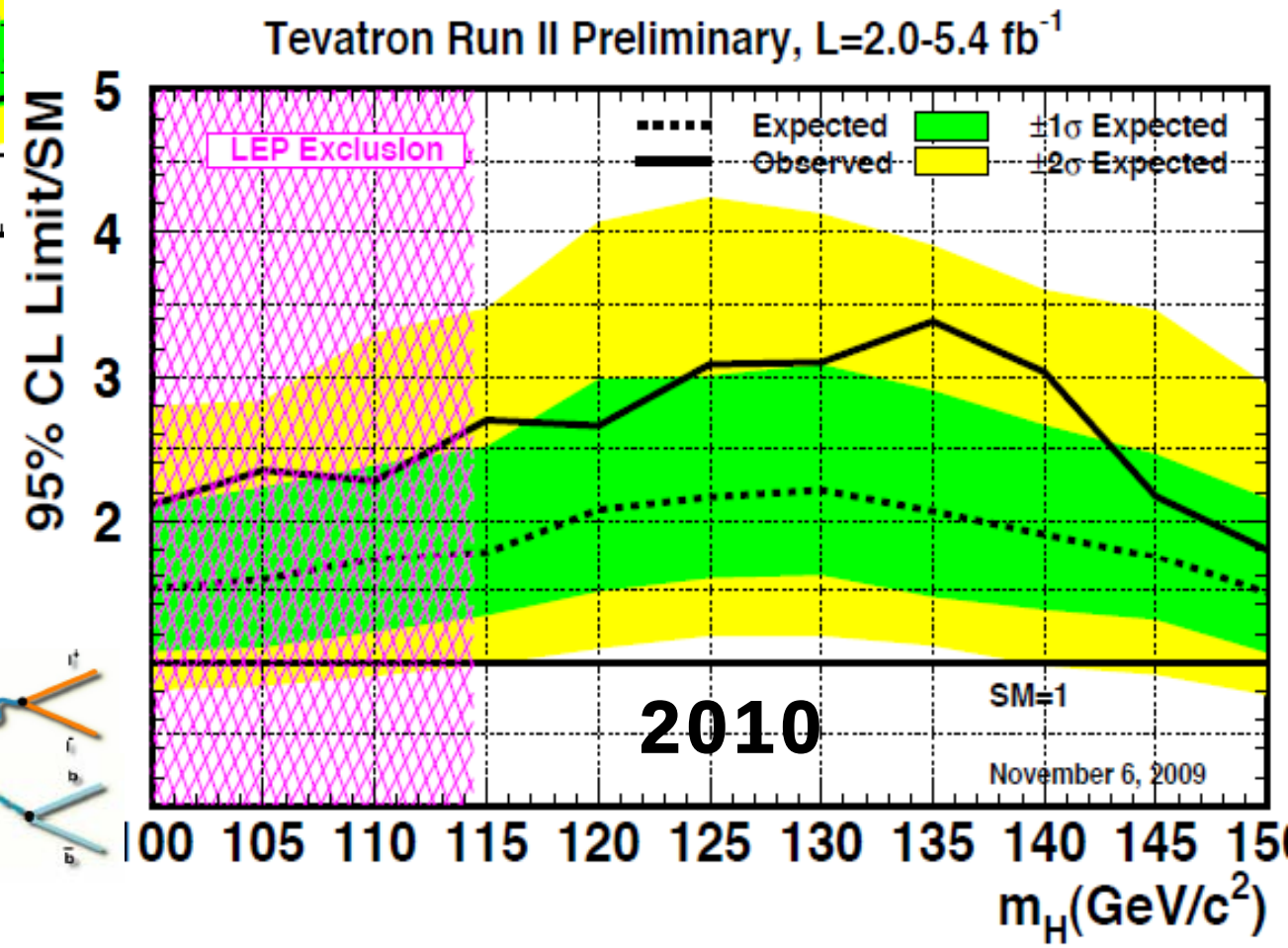


More details now, splitted figure for low and high mass

More channels described in detail.



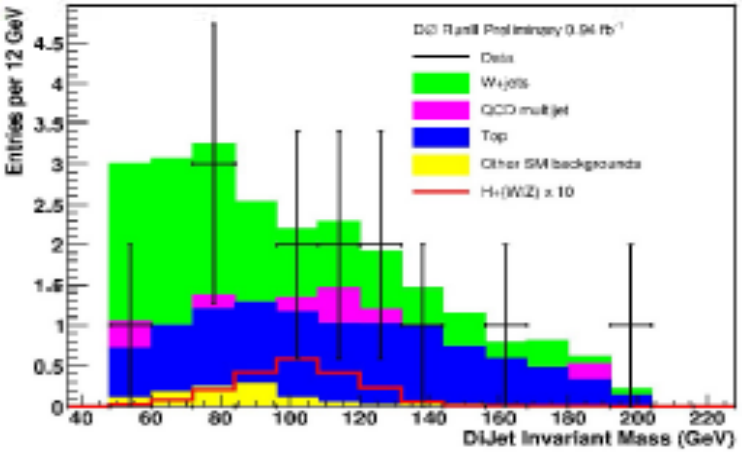




New SM Higgs Searches not in the review 2008

CDF and DØ are performing searches in every viable mode

- CDF/DØ: WH→WWW: same sign leptons
  - Adds sensitivity at high and middle masses
  - Also Fermiophobic Higgs search
- CDF: VH→qqbb: 4 Jet mode.
- CDF: H→ττ with 2jets
  - Simultaneous search for Higgs in VH, VBF and gg→H production modes
  - Interesting benchmark for LHC
- DØ: H→ γγ
  - Also model independent and fermiophobic search
- DØ: WH→τνbb, new mode
  - Dedicated search with hadronic τ decays
- DØ: ttH, new mode

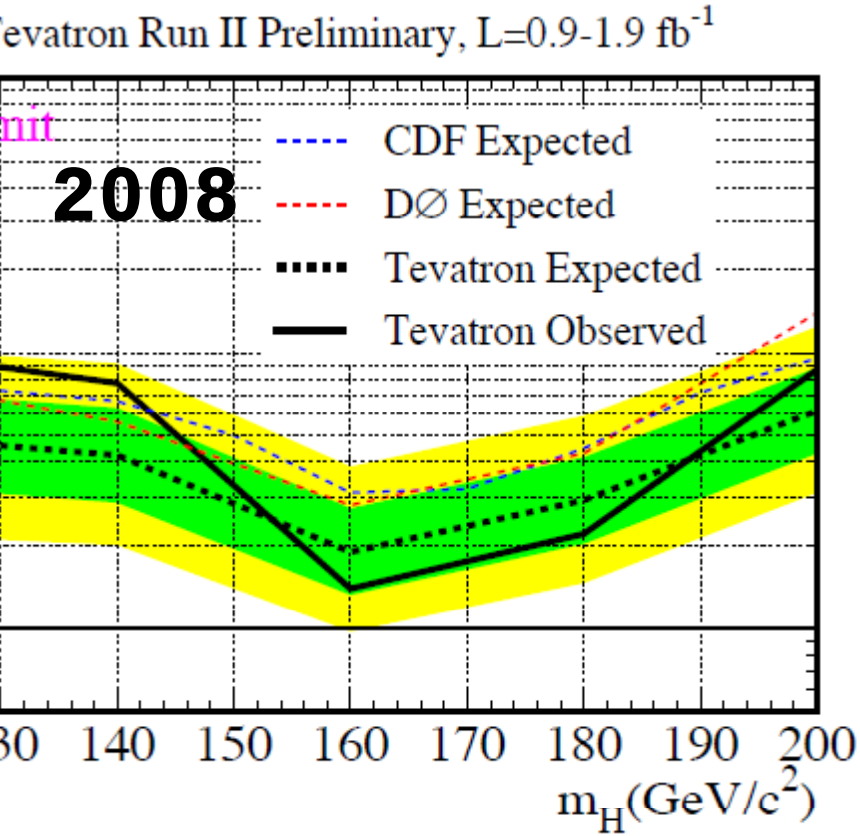


Analysis: Limits at 160 and 115GeV	Exp. Limit	obs. Limit
CDF WH→WWW	33	31
DØ WH→WWW		26
CDF VH→qqbb		
CDF H→ττ	25	
DØ WH→τνbb	42	35
DØ H→γγ	23	31
DØ ttH	45	64

2008 slide

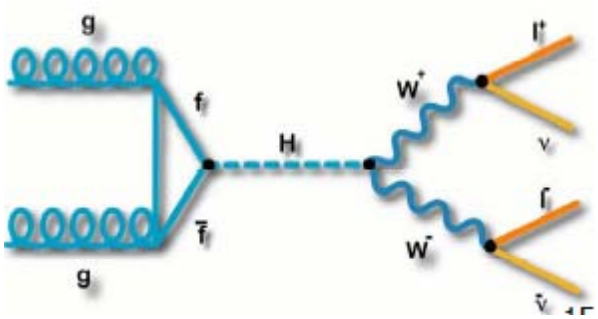
Now channels updated and in the review

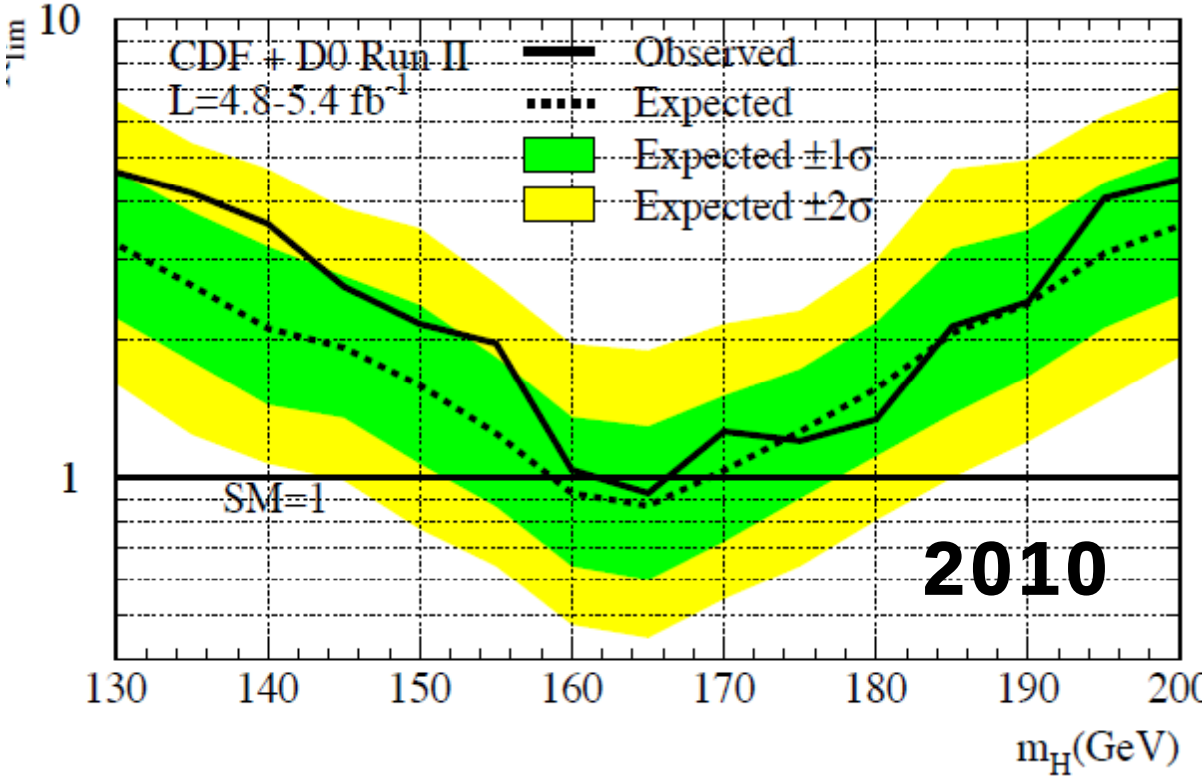
Higgs Review / High mass



More details also on high Higgs Mass (>130 GeV)

LHC will first contribute at high mass





Higgs Review / 4th generation

New part on Higgs limits in 4th generation models

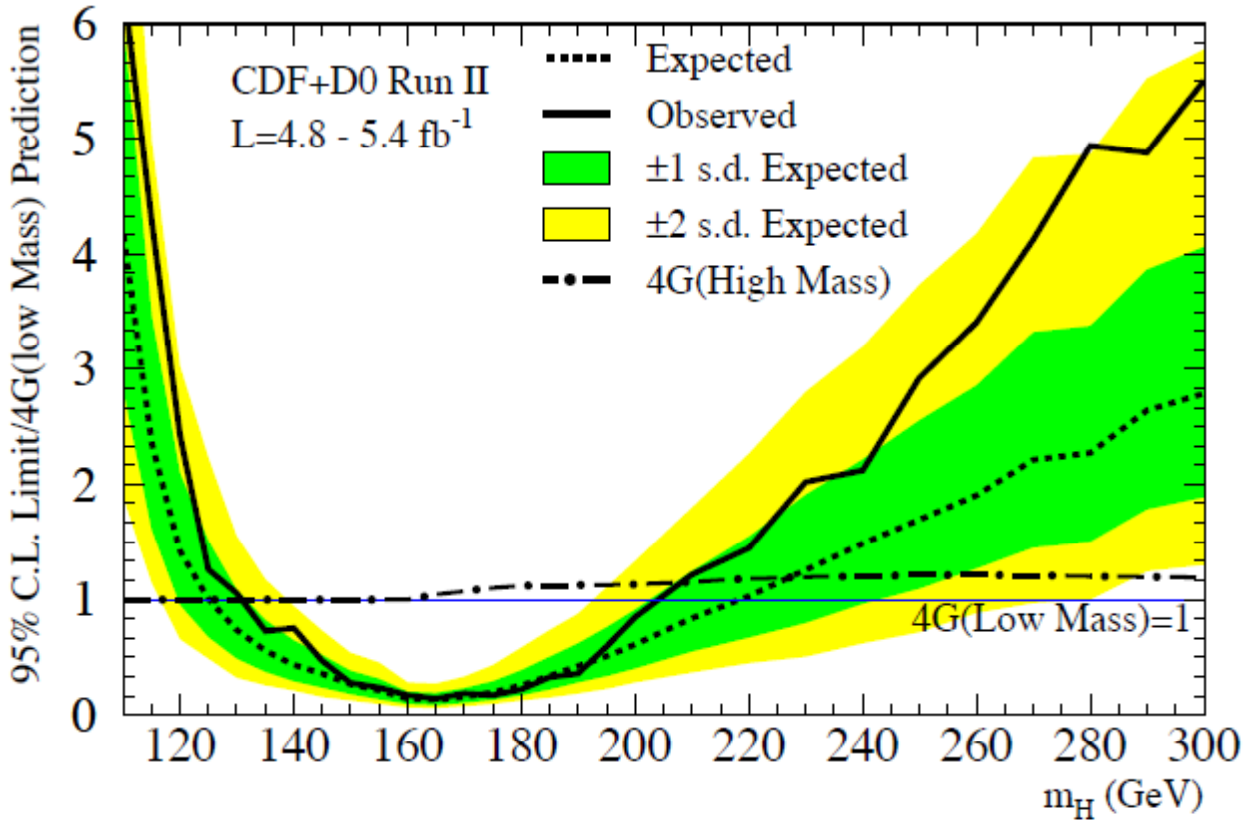
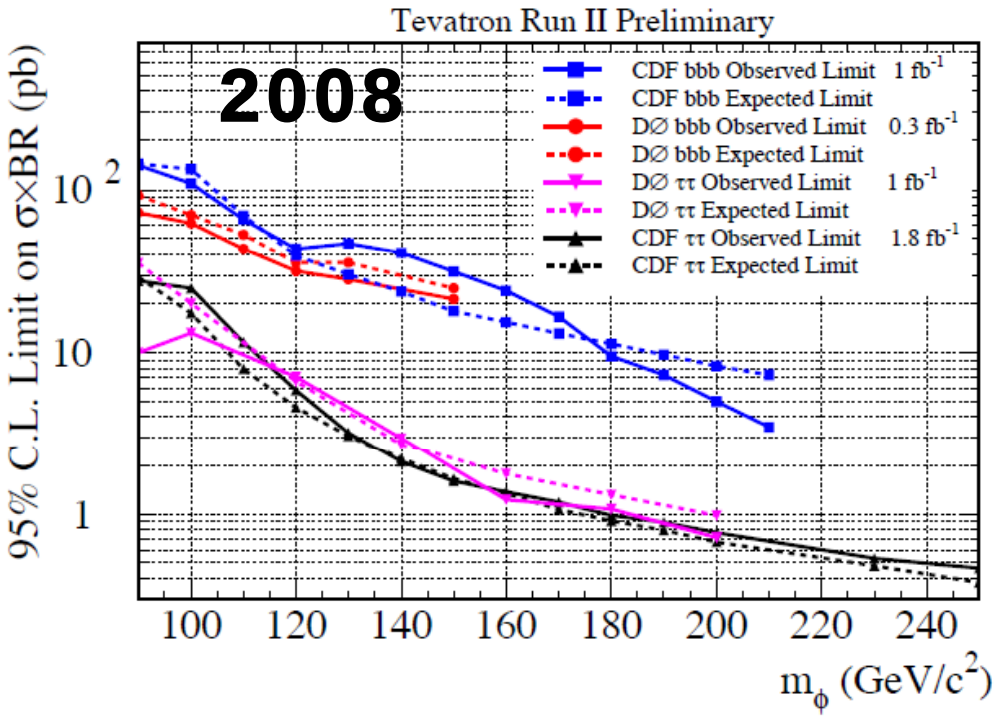


Figure 8: Upper bound on the Higgs boson cross section of the 4th generation sequential model obtained by combining CDF and DØ search results in the $H \to W^+W^-$ decay mode,

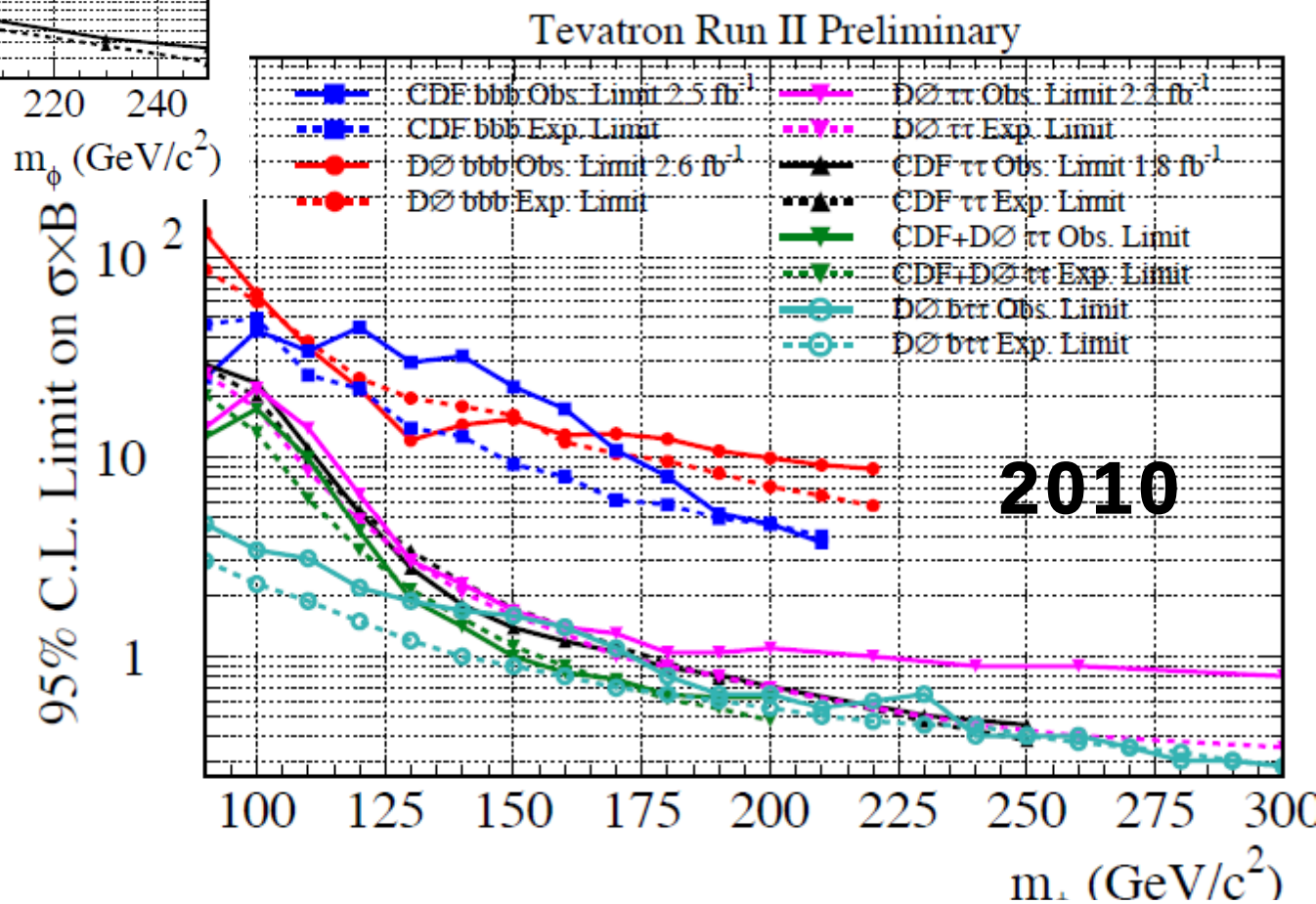
LHC will also soon contribute and extend the kinematic range

Higgs Review / SUSY limits



Update of neutral susy higgs limits,

Not yet published then



Higgs Review / combined SUSY exclusions

New in 2010

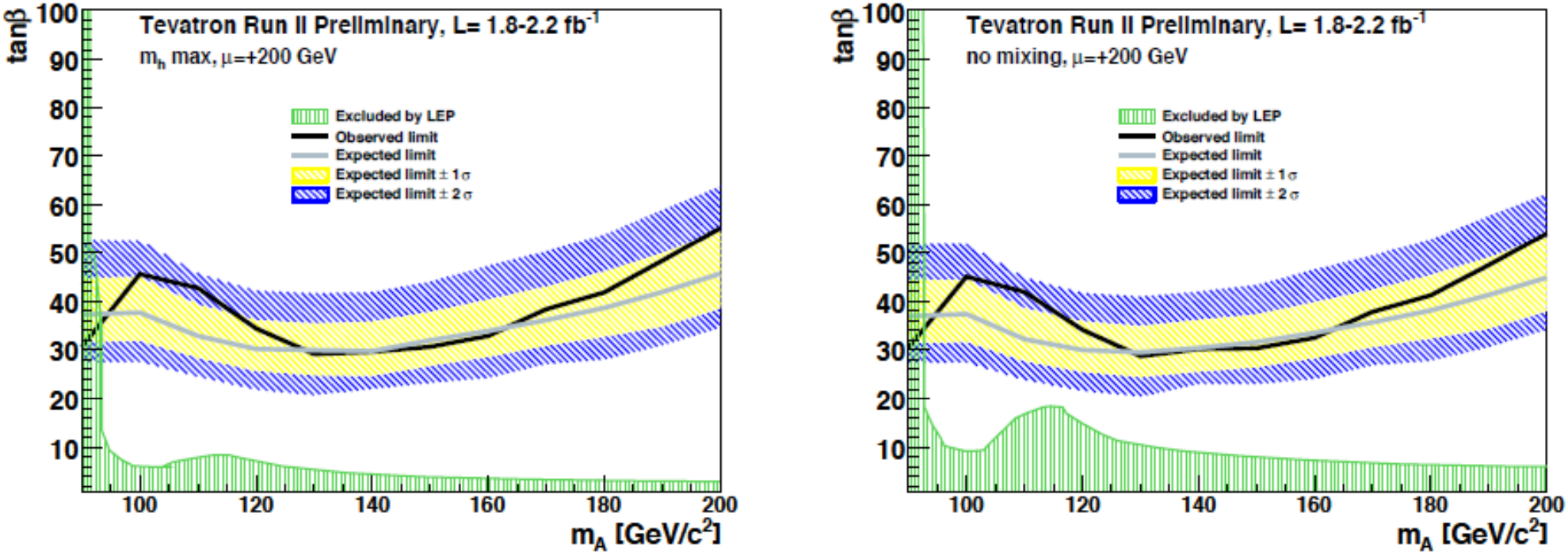


Figure 11: The 95% C.L. MSSM exclusion contours obtained by a combination of the CDF and DØ searches for $H \to \tau^+\tau^-$ in the m_h-max (left) and *no-mixing* (right) benchmark scenarios, both with $\mu = 200$ GeV, projected onto the $(m_A, \tan\beta)$ plane [147]. The regions

Higgs Review 2012 – a Preview

Will include all results up to HCP 2011 (November '11)

Electroweak fit including direct limits?

Tevatron ~ 8 fb^{-1}

LHC ~ 0.8 fb^{-1}

Competition at high mass

Complementarity at low mass and in some Susy channels