Higgs Review for PDG-2010

Gregorio Bernardi, LPNHE-Paris-6/7
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HIGGS BOSONS: THEORY AND SEARCHES

Updated May 2010 by G. Bernardi (LPNHE, CNRS/IN2P3, U. of Paris VI & VII), M. Carena (Fermi National Accelerator Laboratory and the University of Chicago), and T. Junk (Fermi National Accelerator Laboratory).

Previous reviews: 2006 / P. Igo-Kemenes
2008 / GB/MC/TJ

Conclusions for Higgs review in 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,)

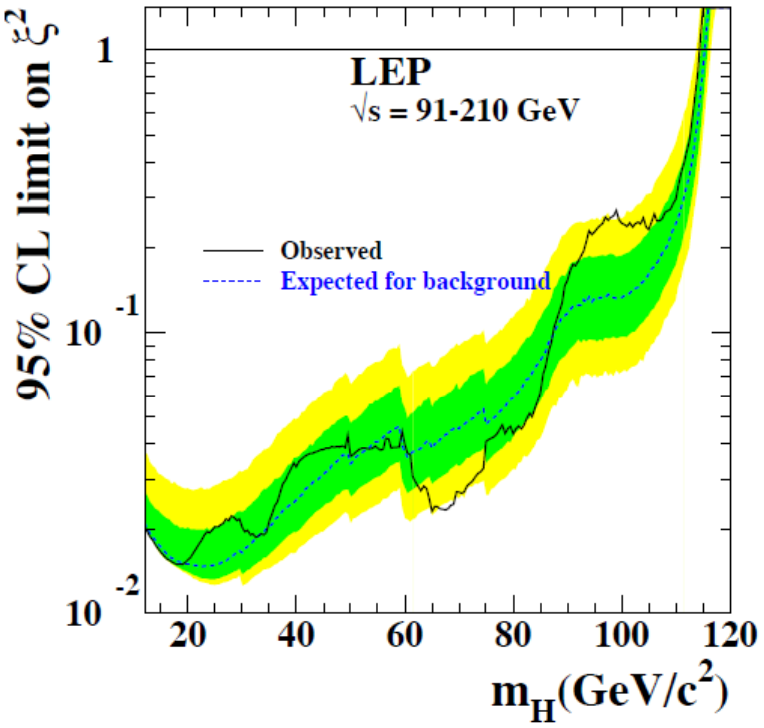
Tevatron data are being taken at high rate, and CDF and D0 have a major fraction of their analysis effort now on Higgs → many new results coming in regularly, with combinations updated in a timely fashion by the TeV-NP-Higgs working group.

(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)

Let's see what has changed between 2008 and 2010

LEP, still relevant



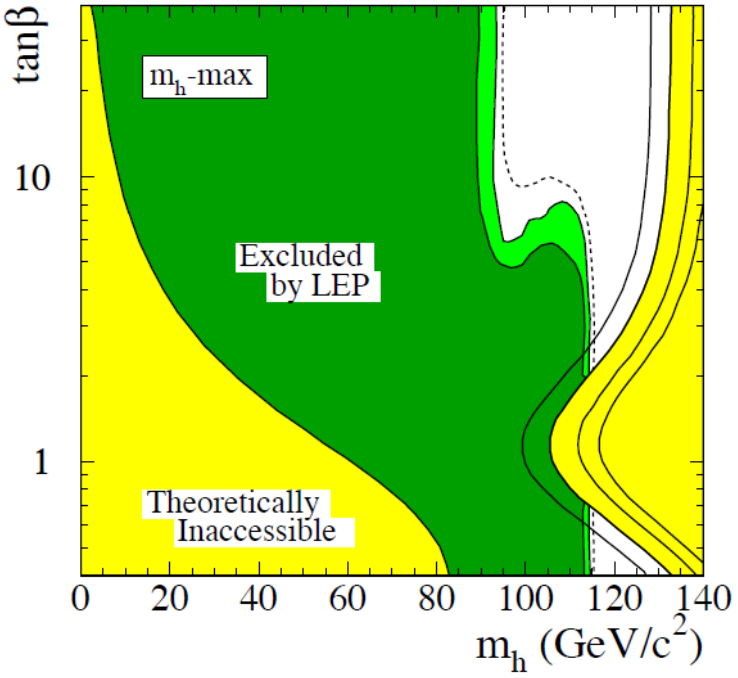
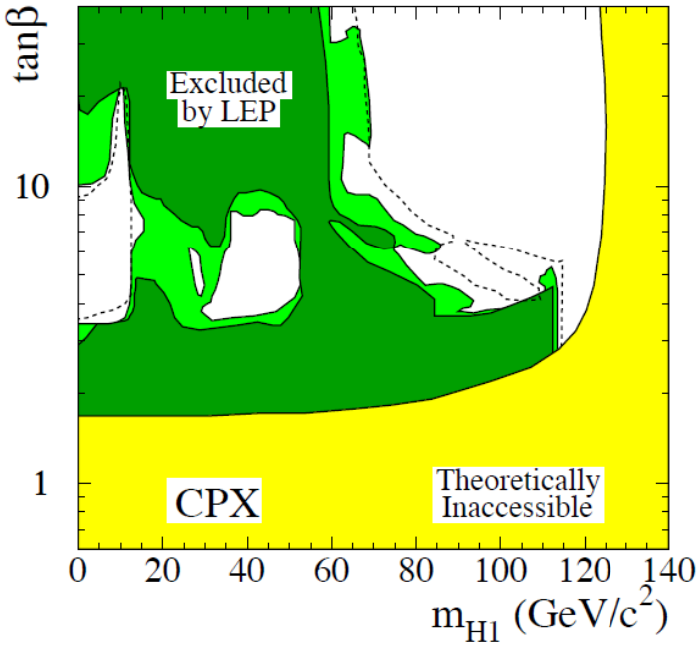
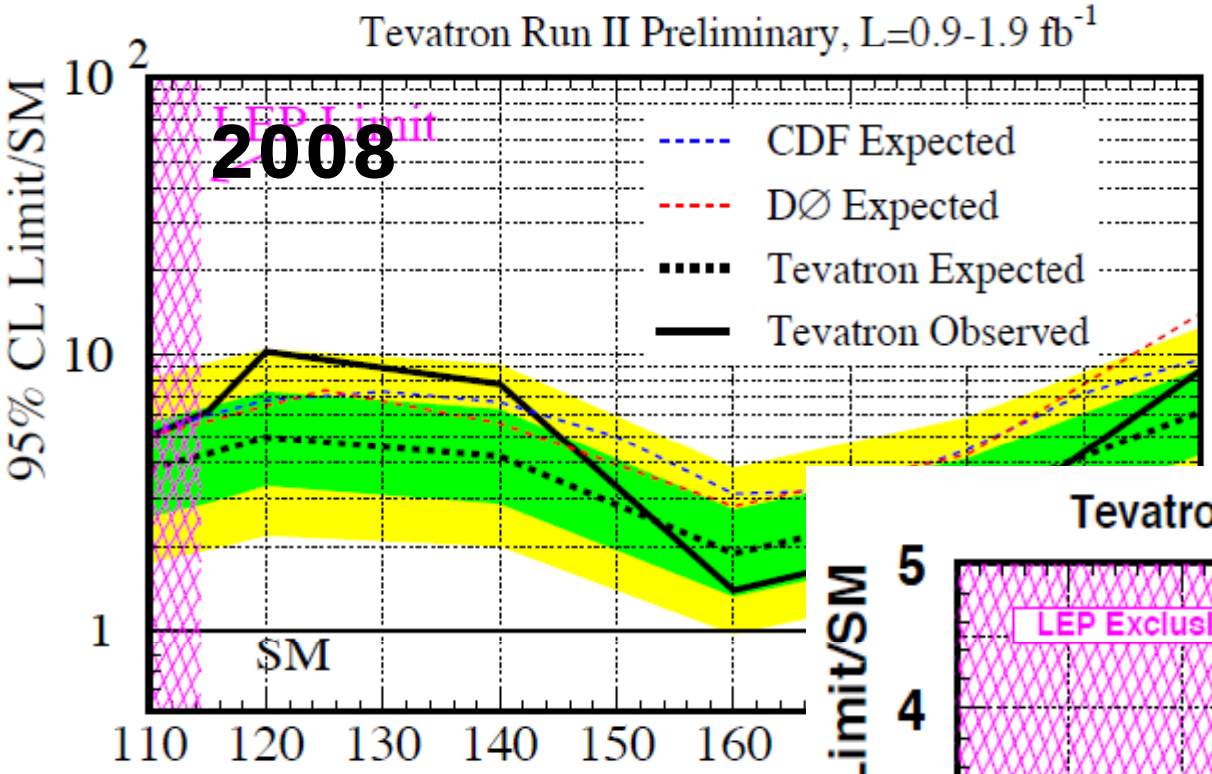


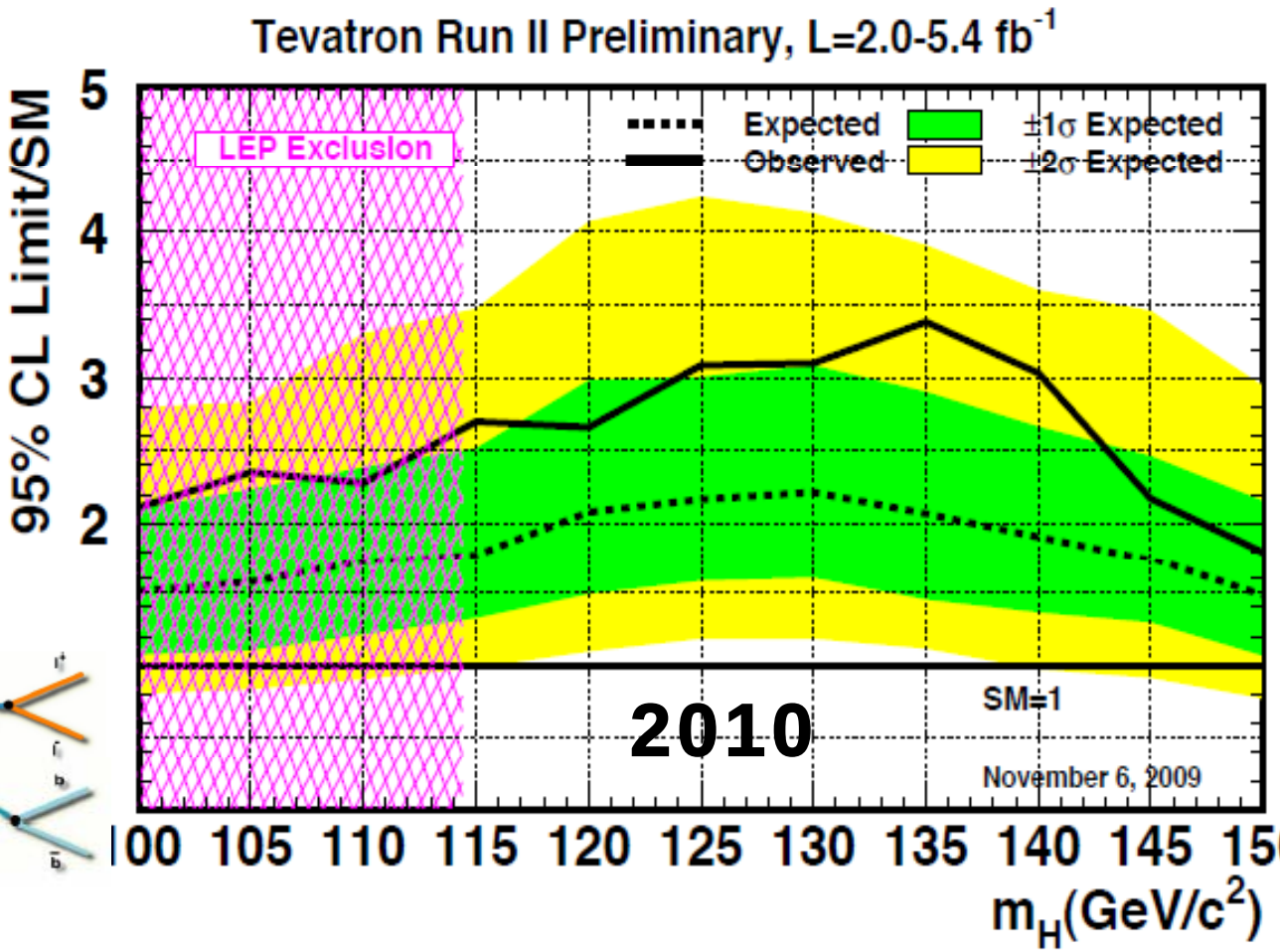
Figure 9: The MSSM exclusion contours, at

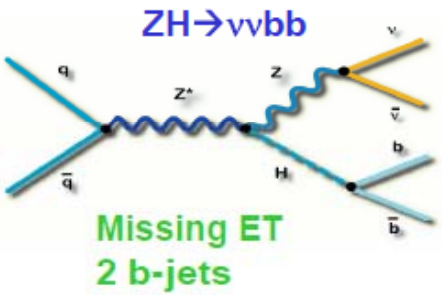


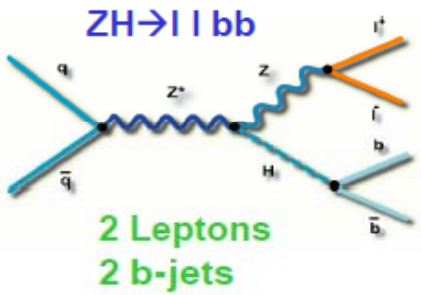
Higgs Review / low mass



More details now, splitted figure for low and high mass (Low mass still preliminary) More channels described in detail.



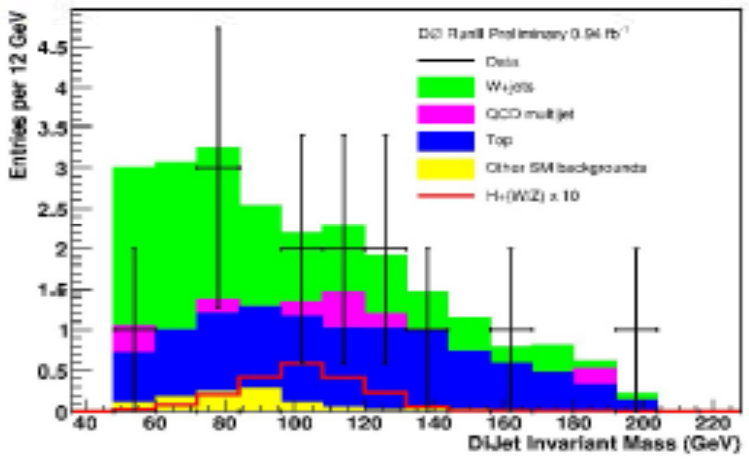




New SM Higgs Searches not in the review in 2008

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

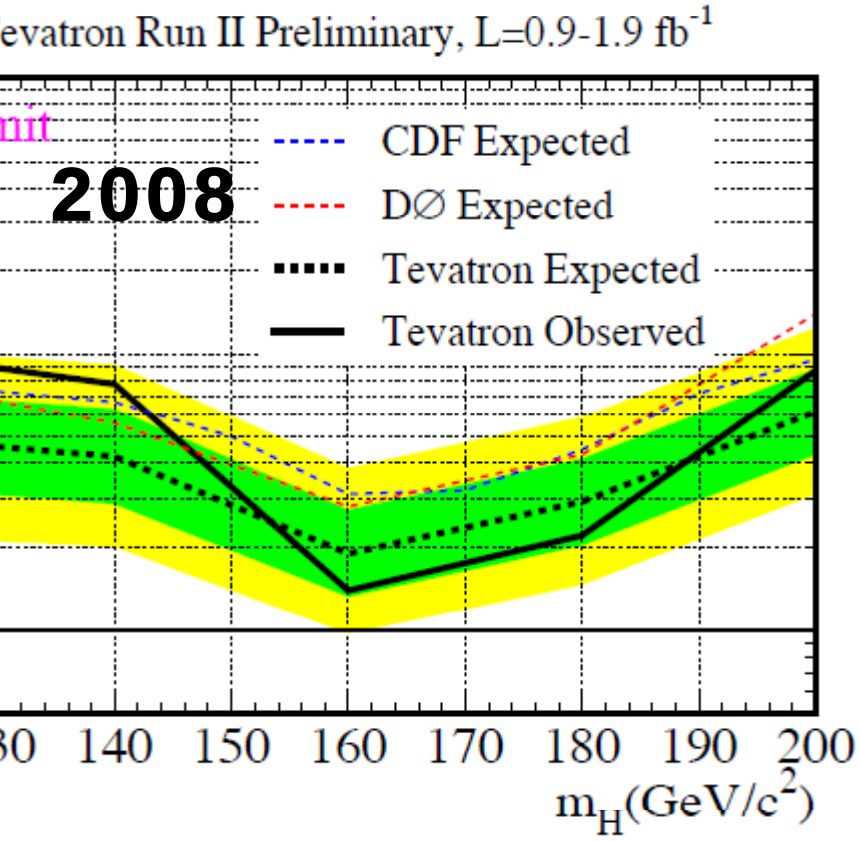


Analysis: Limits at 160 and 115GeV	Exp. Limit	obs. Limit
CDF WH→WWW	33	31
DØ WH→WWW		26
CDF VH→qqbb		
CDF H→ττ	25	
DØ WH→τνbb	42	35
DØ H→γγ	23	31
DØ ttH	45	64

2008 slide

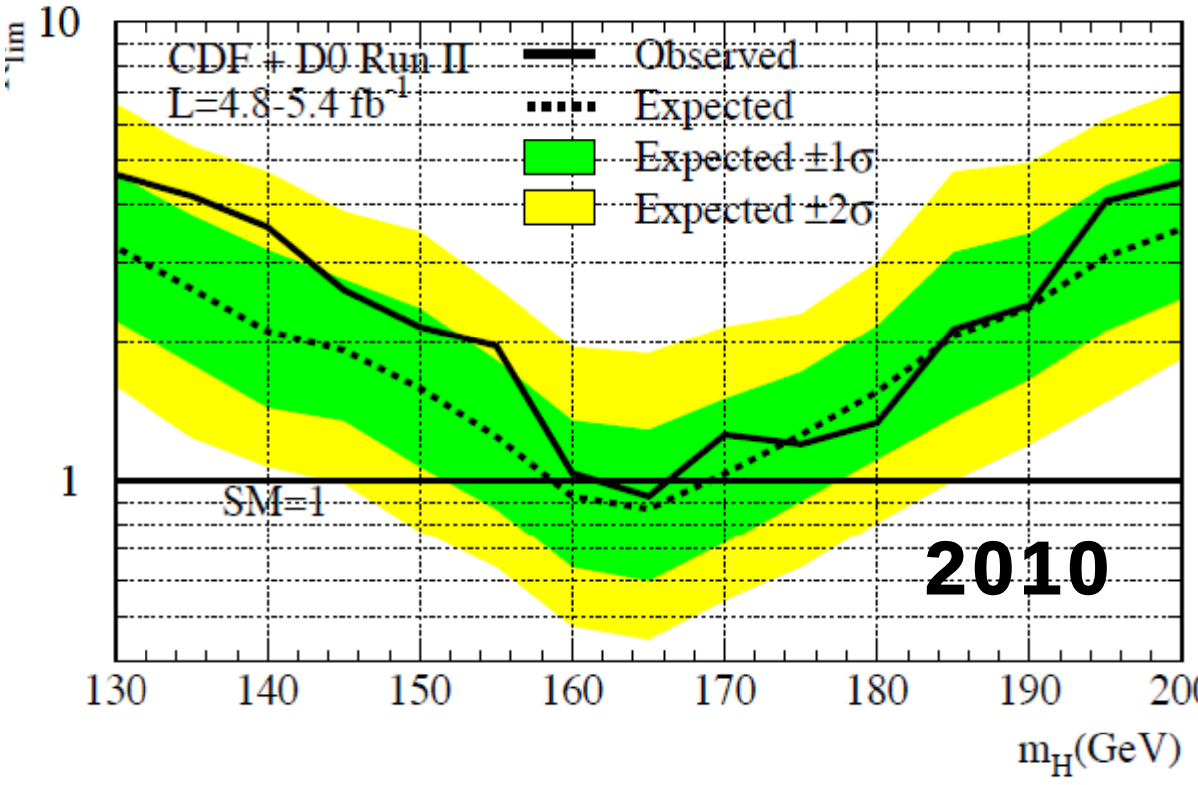
Now channels updated and in the 2010 review

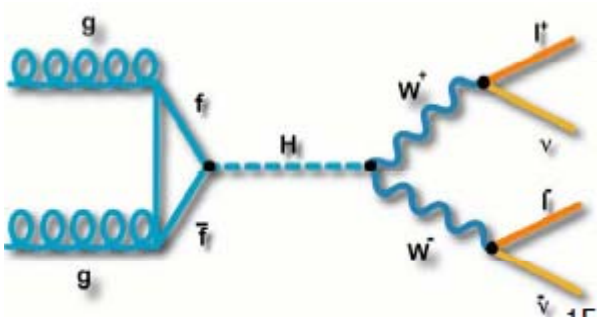
Higgs Review / High mass



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

LHC will first contribute at high mass

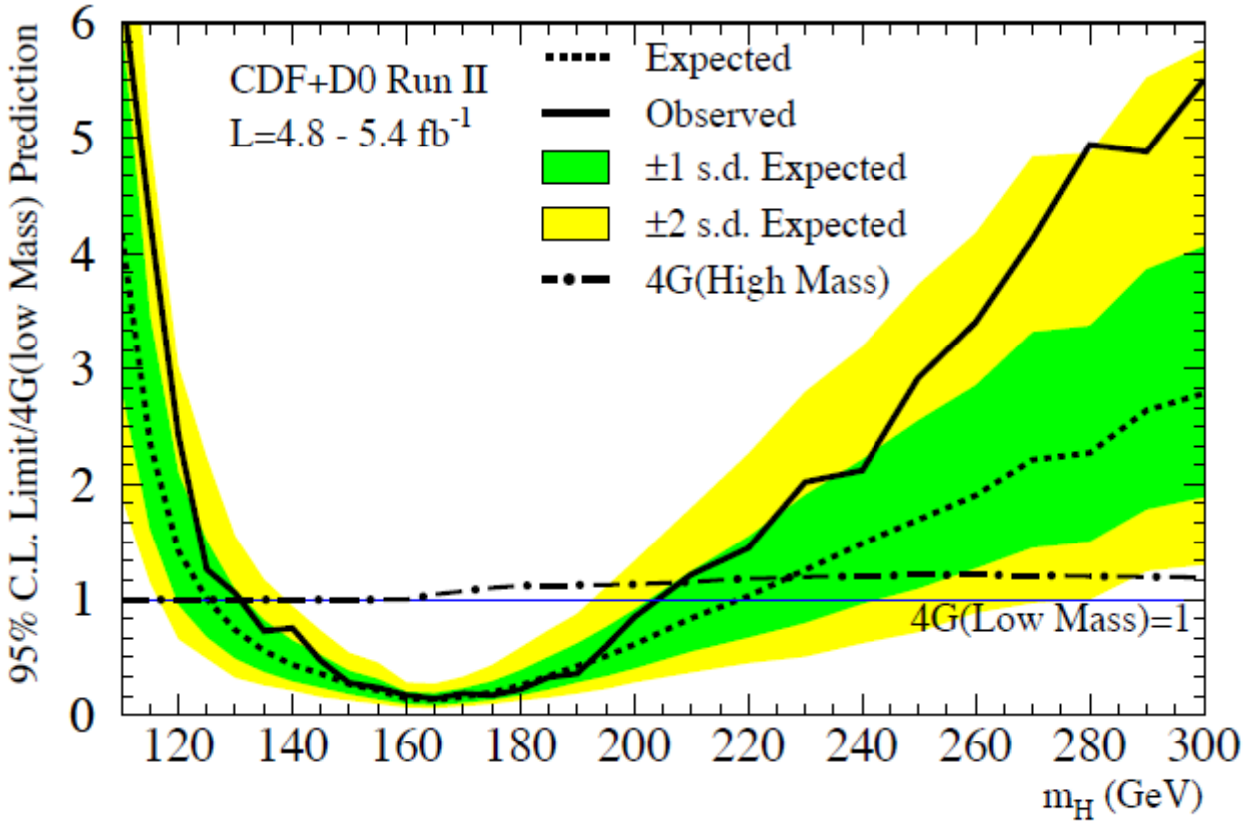




First published Higgs exclusion since LEP,162-166 GeV

Higgs Review / 4th generation

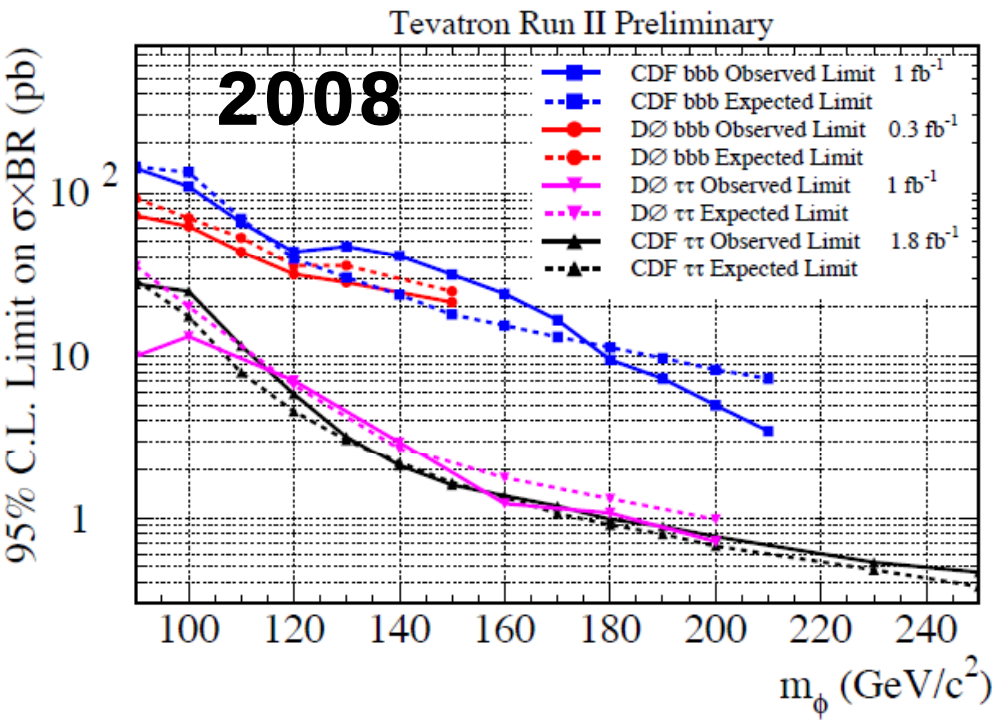
New part on Higgs limits in 4th generation models



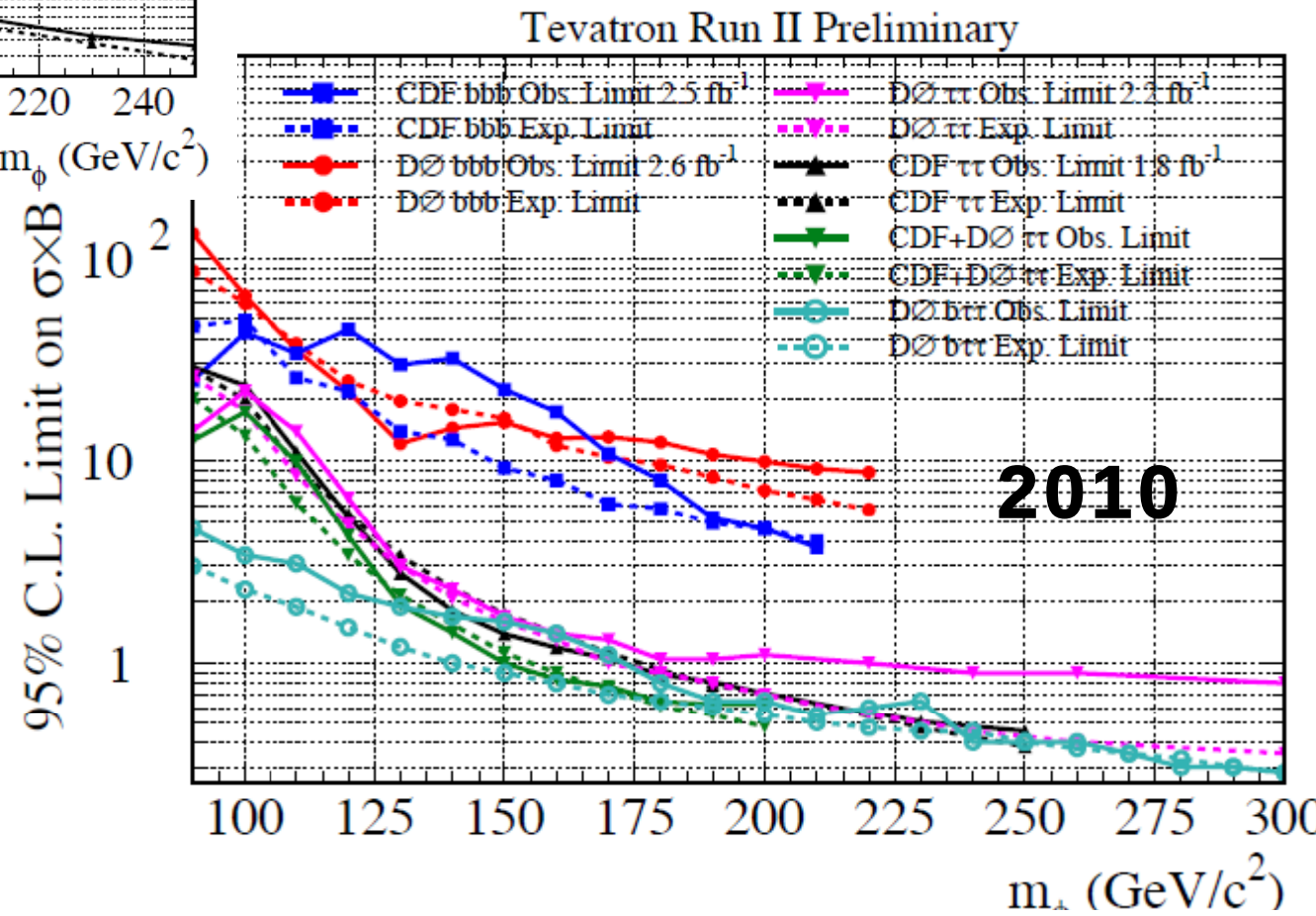
LHC will also soon contribute and extend the kinematic range

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

Higgs Review / SUSY limits

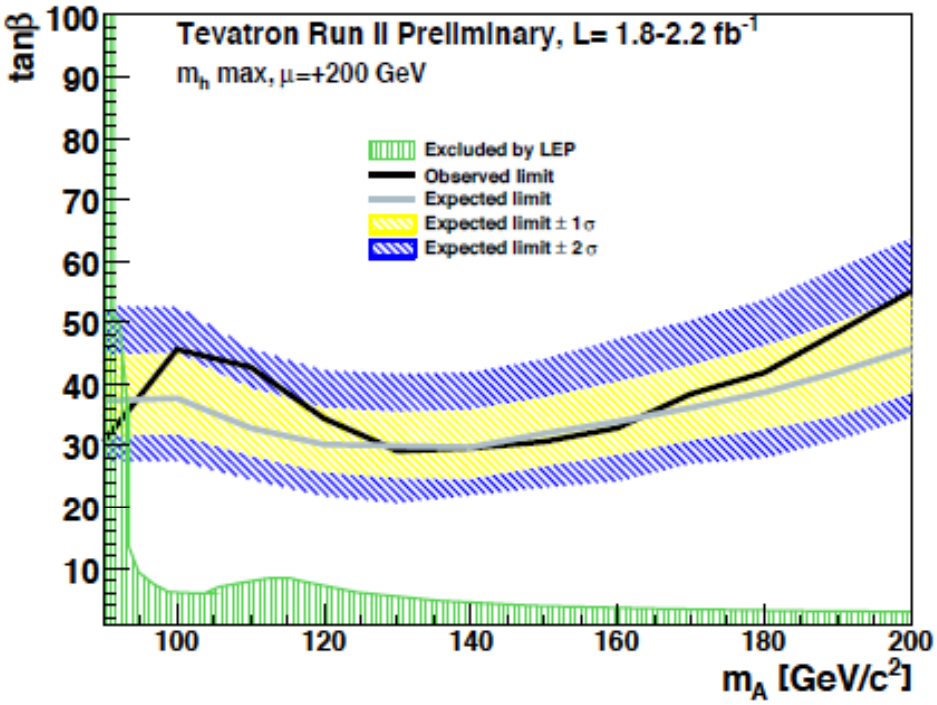


Update of neutral susy higgs limits, Not many published then, more publications coming in



Higgs Review / combined SUSY exclusions

New in 2010



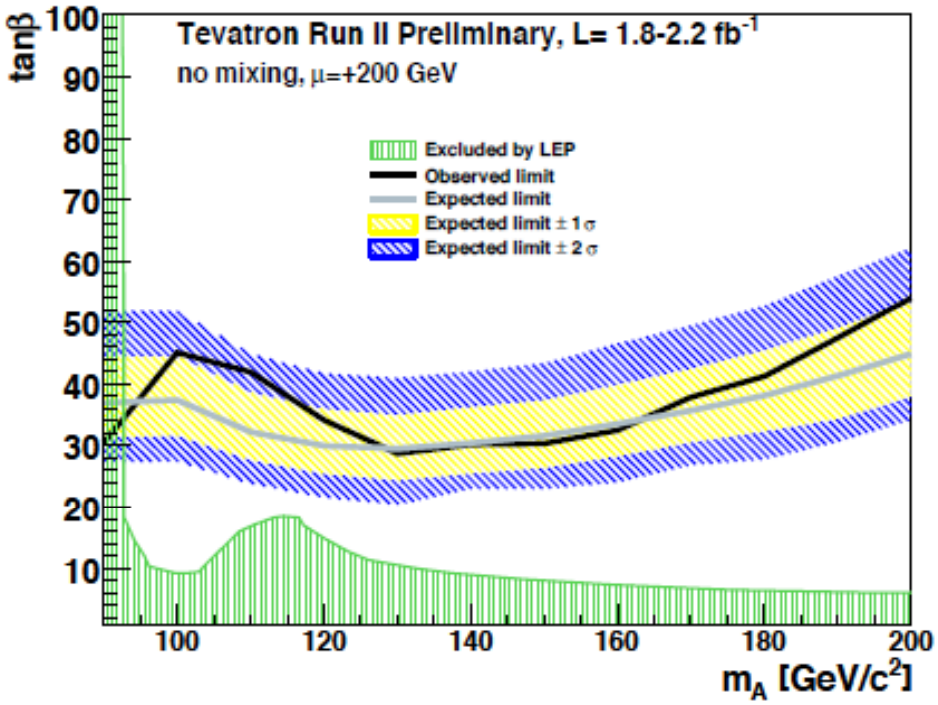
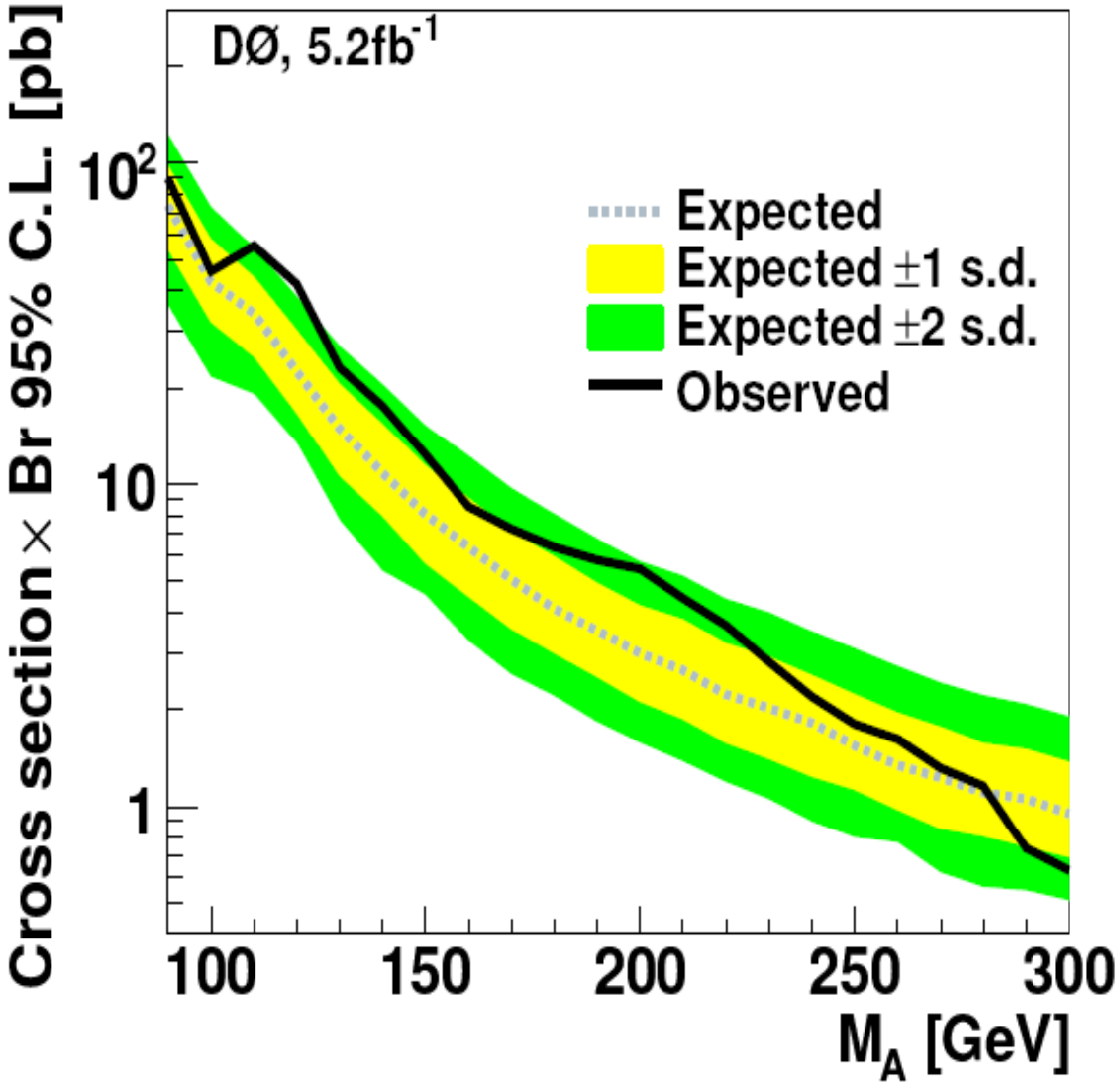
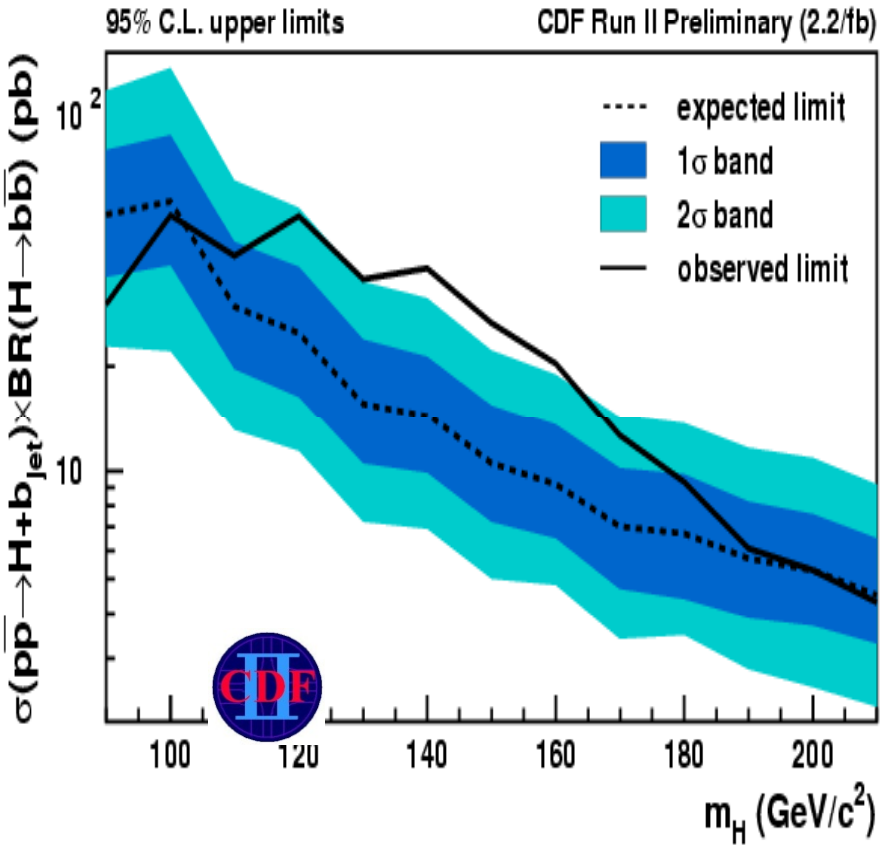


Figure 11: The 95% C.L. MSSM exclusion contours obtained by a combination of the CDF and DØ searches for $H \to \tau^+\tau^-$ in the m_h-max (left) and *no-mixing* (right) benchmark scenarios, both with $\mu = 200$ GeV, projected onto the $(m_A, \tan\beta)$ plane [147]. The regions

Susy updates starts to be exciting, will they be confirmed for the 2012 edition?





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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In fact the 2008 review has been expanded because the 2006 one was short, and that's why PDG expanded authorship in this domain.

But text only doubled while number of authors tripled ;)

Remarks from the review committee on 2008 review

- **More seriously,**

  " no significant theoretical or experimental development"

1) specialists now covering more experimental and theoretical areas

➔ **The theory part was rewritten in 2008 in an effort to include the main theoretical ideas in the field by then, and their impact on the experimental searches.**

2) Tevatron ramped up in new domains, many channels unexplored at LEP while previous results are still relevant

Example:	in 2006	2008
SM Higgs at Tevatron	< 0.5 page	7 pages (~like LEP)
SUSY Higgs theory	< 1 page	4 pages
SUSY Higgs @TeV	< 2 pages	4 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 often similar (but there will be an expanded experimental version due to LHC in 2012)

Higgs Review 2012 – a Preview

Theory: inclusion of new computational developments (SM in particular) and BSM ideas will be done

Electroweak fit including direct limits?

Will include all results up to HCP 2011 (November '11) or Moriond 2012 (March 2012)

Tevatron ~ 10 fb^{-1} (doubling of the statistics)
LHC ~ 1 fb^{-1}

Competition at high mass, but already excluded

Complementarity at low mass and in some Susy channels

LHC – Tevatron combinations?

Or something more fun?