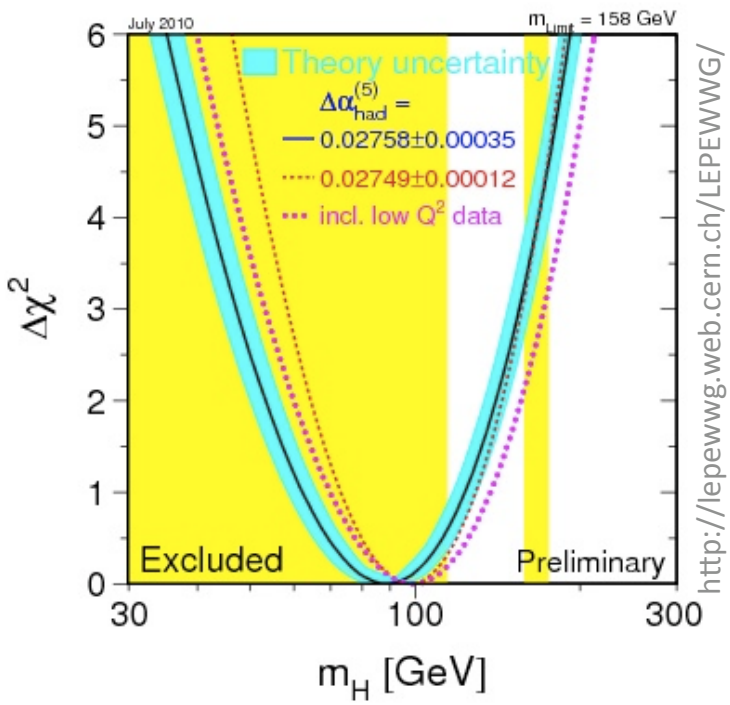
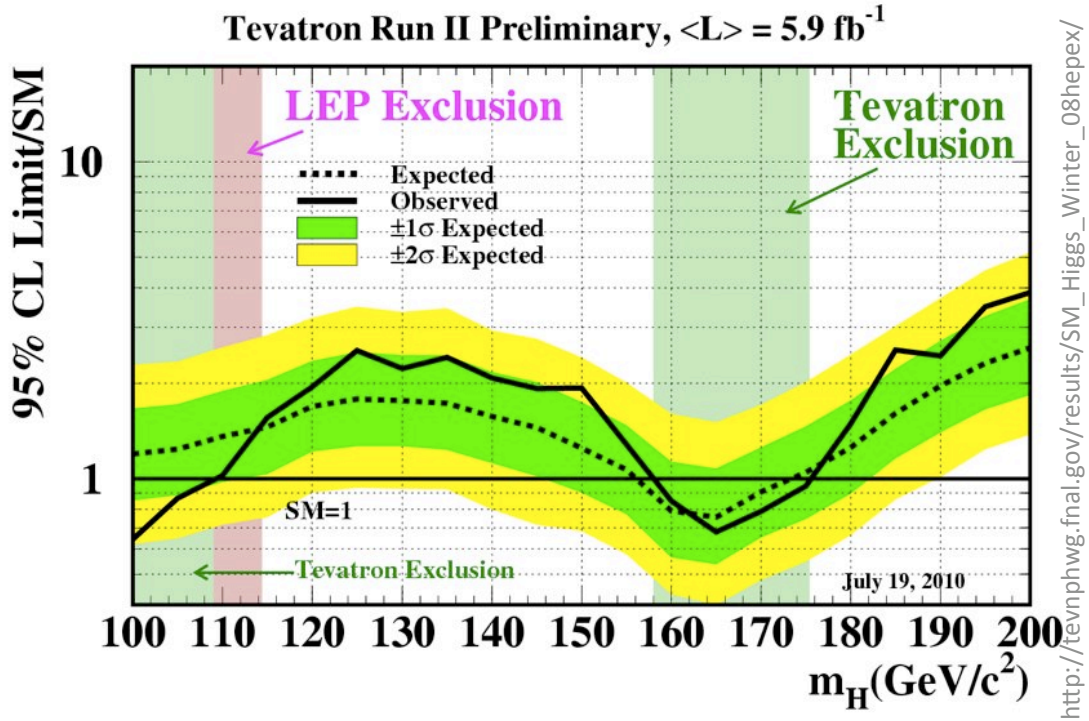
Higgs & More Session – Overview

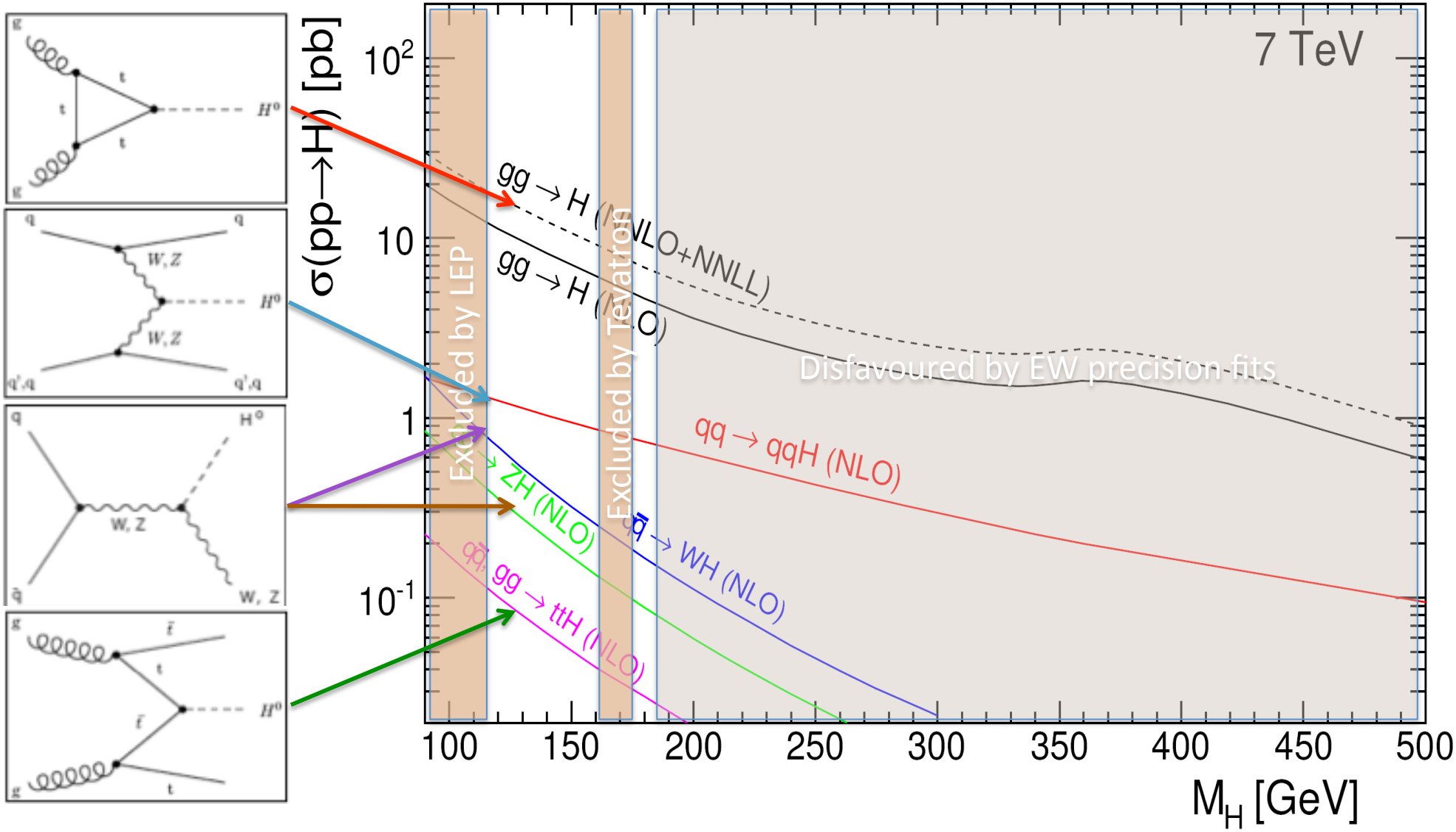
Sinead Farrington (Oxford), Ricardo Gonçalo (RHUL)

Higgs current limits

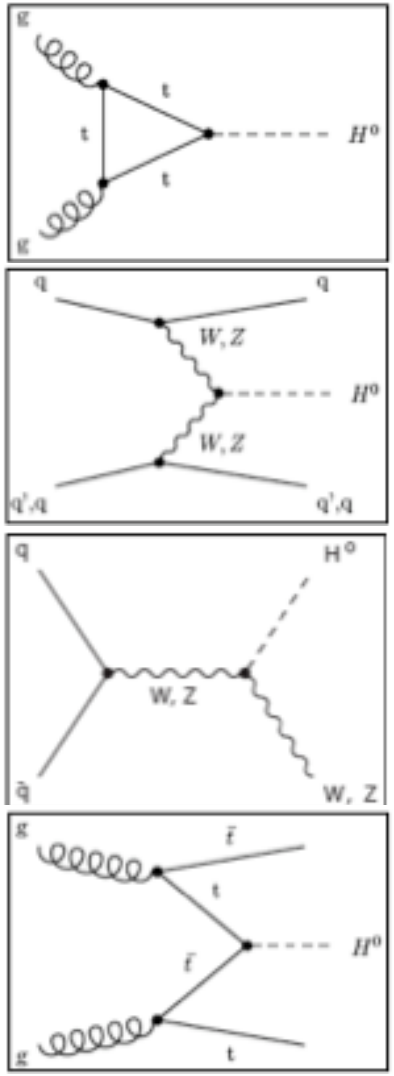
- Current direct mass limits at 95% C.L. as of July 2010:
  - LEP **excluded** mass range below **114.4 GeV/c^2**
  - Tevatron **excluded** mass range of **158 – 175 GeV/c^2**
- Indirect mass limits from precision fits to electroweak observables:
  - $M_H = 89^{+35}_{-26}$ **GeV/c^2** (from $\Delta\chi^2 = 1$)
  - $M_H <$ **158 GeV/c^2** (one-sided 95% C.L. not including LEP direct exclusion)
  - Including LEP: $m_H <$ **185 GeV/c^2** (one-sided 95% C.L.)

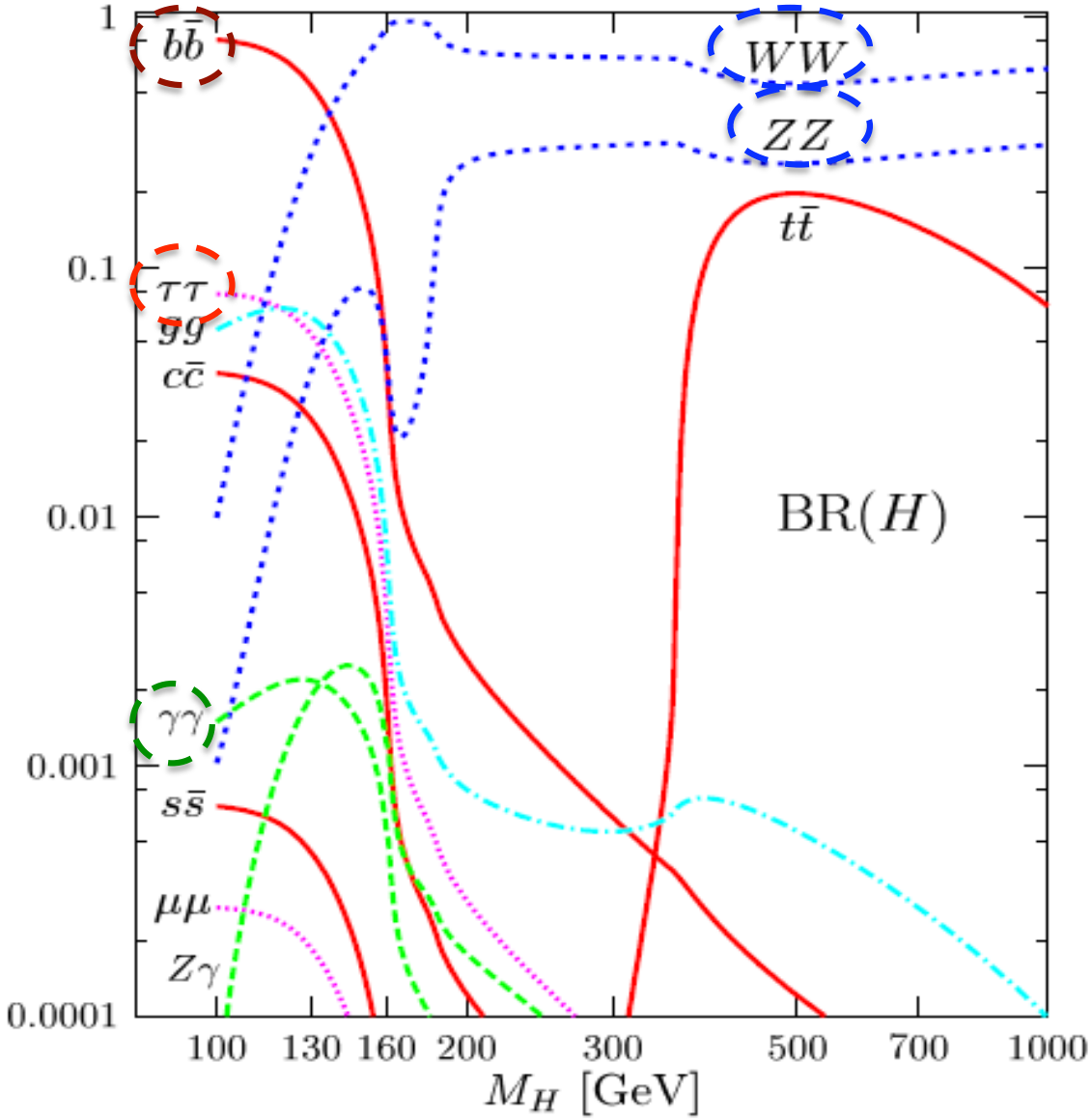






If σ = 10pb then 450 Higgs bosons were already produced!


g
t
t
t
H⁰
g
q
q
W, Z
H⁰
W, Z
q',q
q',q
q
H⁰
W, Z
q̄
W, Z
g
t̄
t
t̄
H⁰
t
g

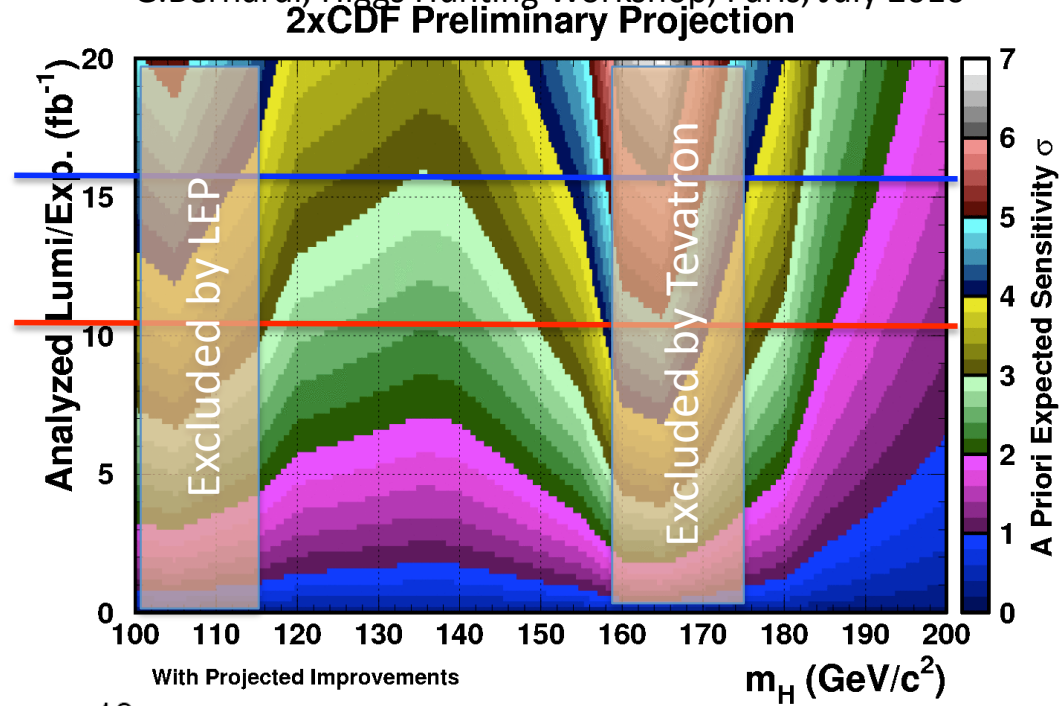

1
0.1
0.01
0.001
0.0001
$b\bar{b}$
WW
ZZ
$t\bar{t}$
$\tau\tau$
gg
$c\bar{c}$
$\gamma\gamma$
$s\bar{s}$
$\mu\mu$
$Z\gamma$
BR(H)
100
130
160
200
300
500
700
1000
M_H [GeV]

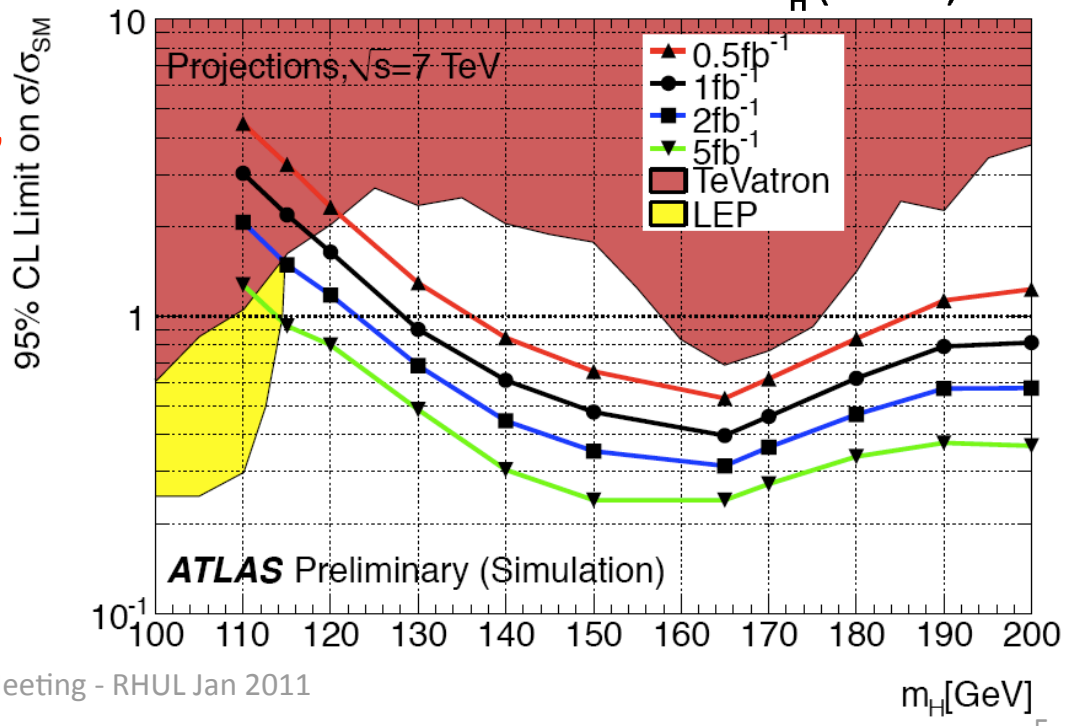
Projections

- Tevatron expects:
  - 12fb^{-1} recorded per experiment by end of 2011
  - 16 fb^{-1} analyzed by end of 2014

- Current LHC expectations:
  - Earlier plans were **1 fb^{-1} @ 7 TeV** by end of 2011
  - From Roger Bailey's talk in November LHCC: **2 - 7 fb^{-1} @ 8 TeV** by end of 2011
  - More news after the LHC Chamonix workshop…

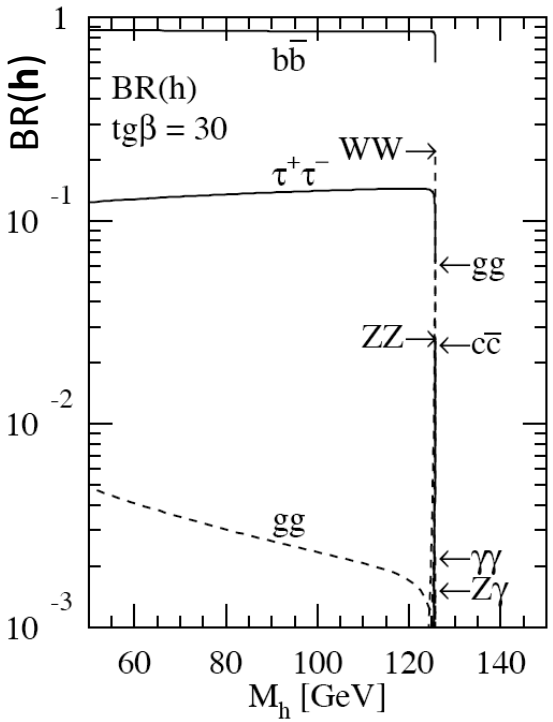
G.Bernardi, Higgs Hunting Workshop, Paris, July 2010

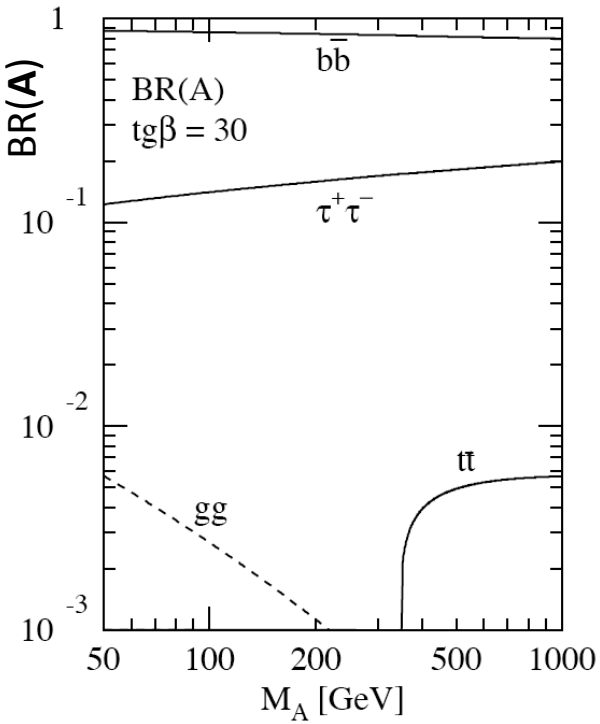


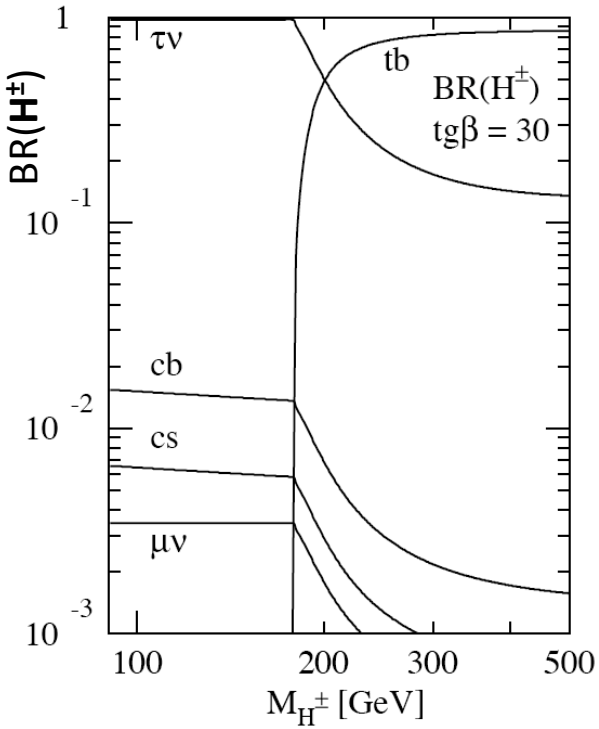


But perhaps Nature hides her secrets more subtly than is written in the Standard Model …

- In the MSSM, 2 Higgs doublets give 5 Higgs bosons
  - Three neutral: **h**, **H** (CP-even), **A** (CP-odd); two charged: **$H^{\pm}$**
- At tree level $m_h < m_Z$ – after radiative corrections $m_h < 135$ GeV/c^2
- Important parameters: m_A, $\tan\beta = v_1/v_2$
  - As **tan β increases**, Higgs decays to **b quarks** and **tau** leptons **enhanced**







M.Spira, Higgs Hunting workshop, Orsay, July 2010

Higgs & Trigger Menu

Gemma Wooden

- Good trigger menu outlook for Higgs physics at 10^{33}:

  Expect peak luminosities between around 6×10^{32} and 2×10^{33} (see Nov. LHCC)

  - mu20 and e20_medium_tight for **H -> ZZ, WW, ττ; ZH; H^+ -> csbar, τν**
  - 2e12_medium, 2mu10, e10_loose_mu6 for **H -> ZZ, WW**
  - 2g20_loose for **H -> γγ**
  - e15_tight_xe30_noMu for **H^+ -> τν (fully leptonic)**
  - 2tau29_loose1, tau16_loose_e15_tight, tau16_medium_mu15, tau29_medium_xe35_noMu for **H -> ττ, H^+ -> τν(had)**
  - je350, 4j50 for **ttH (fully hadronic), VBF H -> bbbar**

- Difficult channels:
  - **Fully hadronic ttH** (UK effort) – missing 7 TeV MC, but should be able to use triggers for fully hadronic ttbar
  - **H^+ -> τν** and **a1 -> ττ-> eμ** require very low thresholds – work ongoing

- Schedule:
  - Plan to build MC_pp_v2 by 10th Jan
  - Physics_pp_v2 should be finalised by 1st Feb

	Low Mass Higgs I (ttH and VH ->bb	*GEMMELL, Alistair*
	Auditorium, Windsor Bdg., Royal Holloway, University of London	09:40 - 09:55
10:00	**Low Mass Higgs II - H->tau tau and H->gamma gamma**	*LARNER, Aimee Bridget*
	Auditorium, Windsor Bdg., Royal Holloway, University of London	09:55 - 10:10
	H->WW	*WOODEN, Gemma Holly*
	Auditorium, Windsor Bdg., Royal Holloway, University of London	10:10 - 10:25
11:00	**H->ZZ**	*PRICE, Joe*
	Auditorium, Windsor Bdg., Royal Holloway, University of London	11:00 - 11:15
	MSSM Higgs	*MARTYNIUK, Alex Christopher*
	Auditorium, Windsor Bdg., Royal Holloway, University of London	11:15 - 11:30
	Higgs Overview and 2011 ATLAS Physics Outlook	*MURRAY, Bill*
	Auditorium, Windsor Bdg., Royal Holloway, University of London	11:30 - 11:55

Conclusions

- 2011 will be extremely important for Higgs searches in ATLAS

- The Higgs UK activity is in good health – see talks in this session!
  - But there is a lot to do! – plenty of opportunities…

'Well, either we've found the Higgs boson, or Fred's just put the kettle on'

Backup – LHC running in 2011

Two possible LHC scenarios for next year: expect 2 to 7 fb^{-1} … and pileup!
http://indico.cern.ch/getFile.py/access?contribId=0&sessionId=0&resId=1&materialId=slides&confId=112439

- 4 TeV (to be discussed at Chamonix)
- 936 bunches (75 ns)
- 3 micron emittance
- 1.2 x 10^{11} protons/bunch
- β* = 2.5 m, nominal crossing angle

Peak luminosity	6.4 x 10^{32}
Integrated per day	11 pb^{-1}
200 days	2.2 fb^{-1}
Stored energy	72 MJ

- 4 TeV
- 1400 bunches (50 ns)
- 2.5 micron emittance
- 1.5 x 10^{11} protons/bunch
- β* = 2.0 m, nominal crossing angle

Peak luminosity	2.2 x 10^{33}
Integrated per day	38 pb^{-1}
200 days	7.6 fb^{-1}
Stored energy	134 MJ