Cross-Talk Higgs Discussion
Note: these are preliminary results

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Introductory remarks

We desperately wanted a Higgs for Christmas: we got something which looks furiously like it,

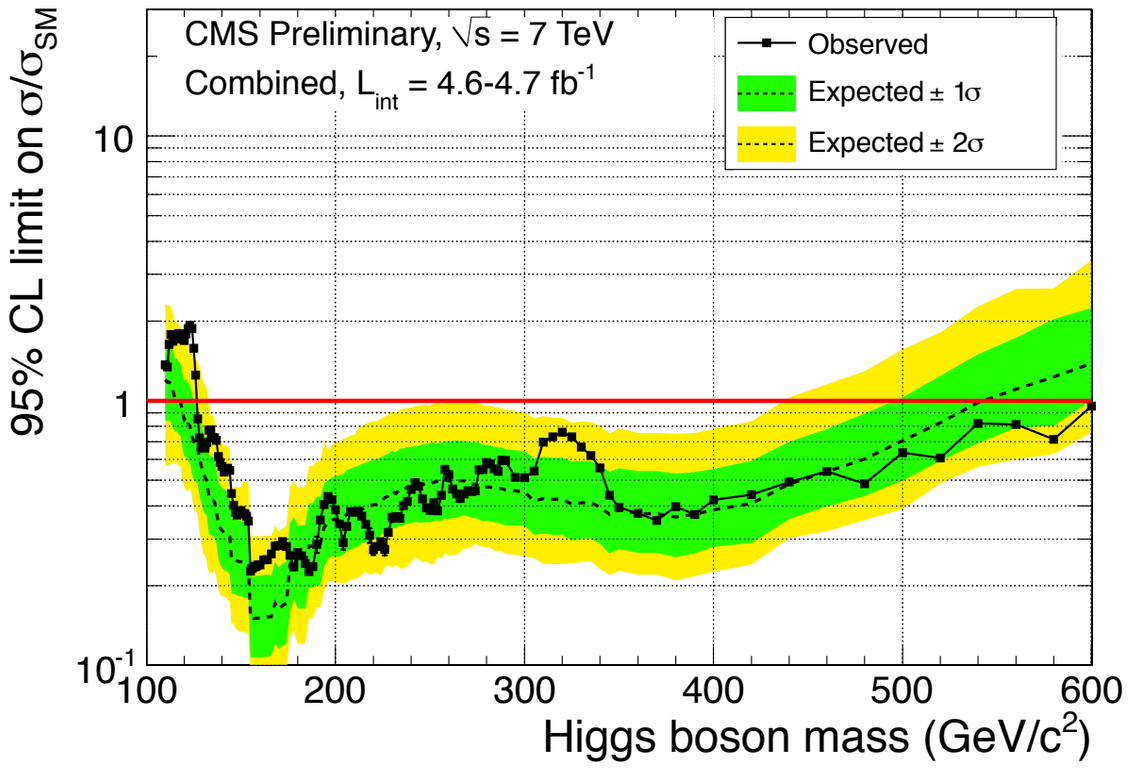
$\longrightarrow$ thanks to LHC, ATLAS, CMS!

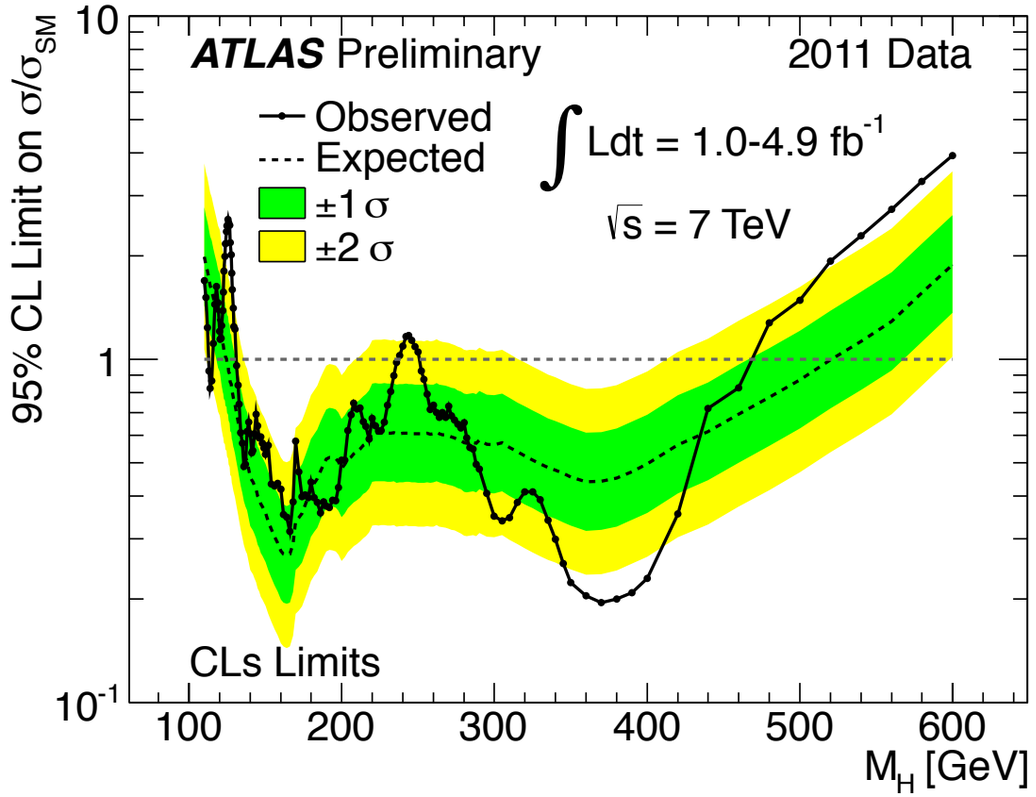
A huge amount of information to digest in ATLAS and CMS talks and the various notes!

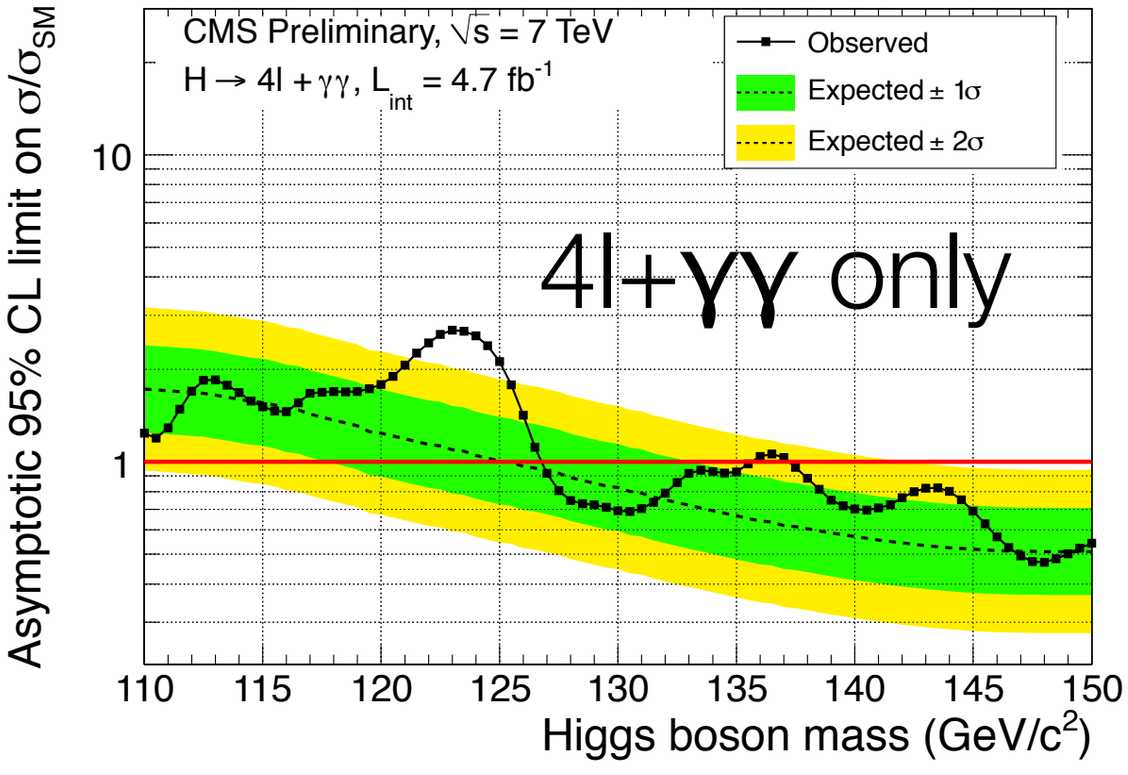
What a (naive) theorist would like to know:

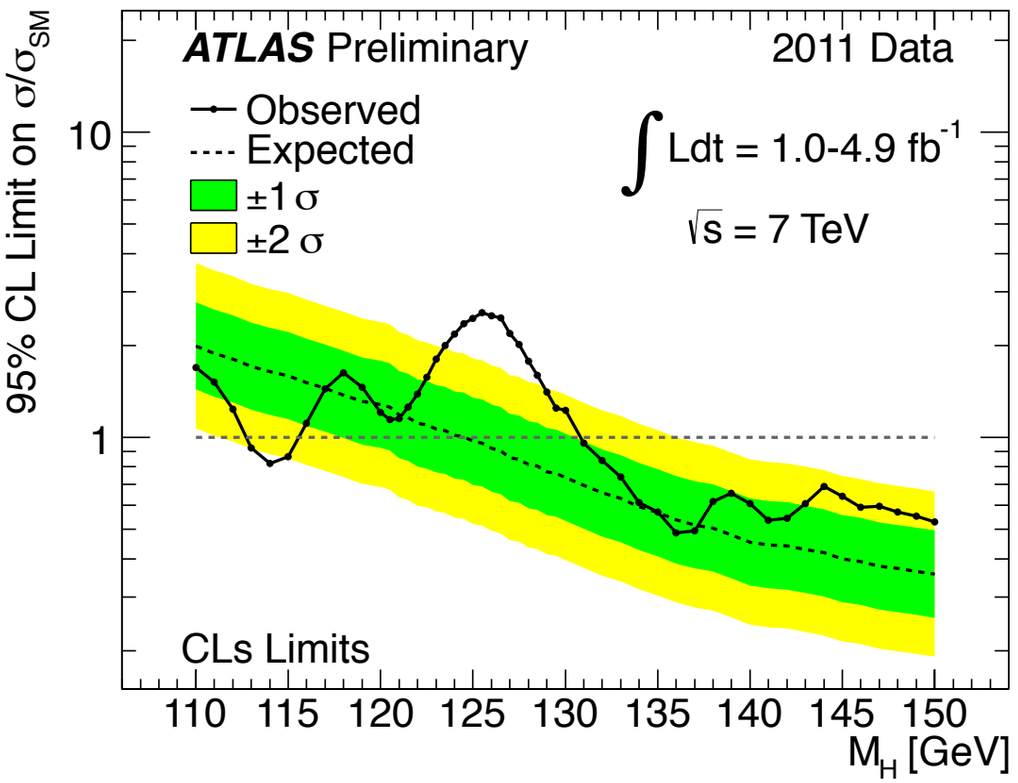
- **Significance of Higgs signal in each channel and how many events.**
- **Combination of all channels and how one gets the global significance.**
- **Are we talking about same peak? Why $\Delta \mathrm{M_H} \approx 2$ GeV (res., Escale)?**
- **Anything special about other peaks and (excluded) mass regions?**
- **Any new development foreseen for Moriond? WW, $\tau\tau$,bb; combo?**
- **How much effort needed to make "combined significance" (2.98σ)?**
- **The LEE story poses many questions: why for the first time? Should elsewhere=the other experiment? Should we change conventions for evidence and discovery? Should it also apply in case of deficit?...**

ATLAS + CMS Summary Results





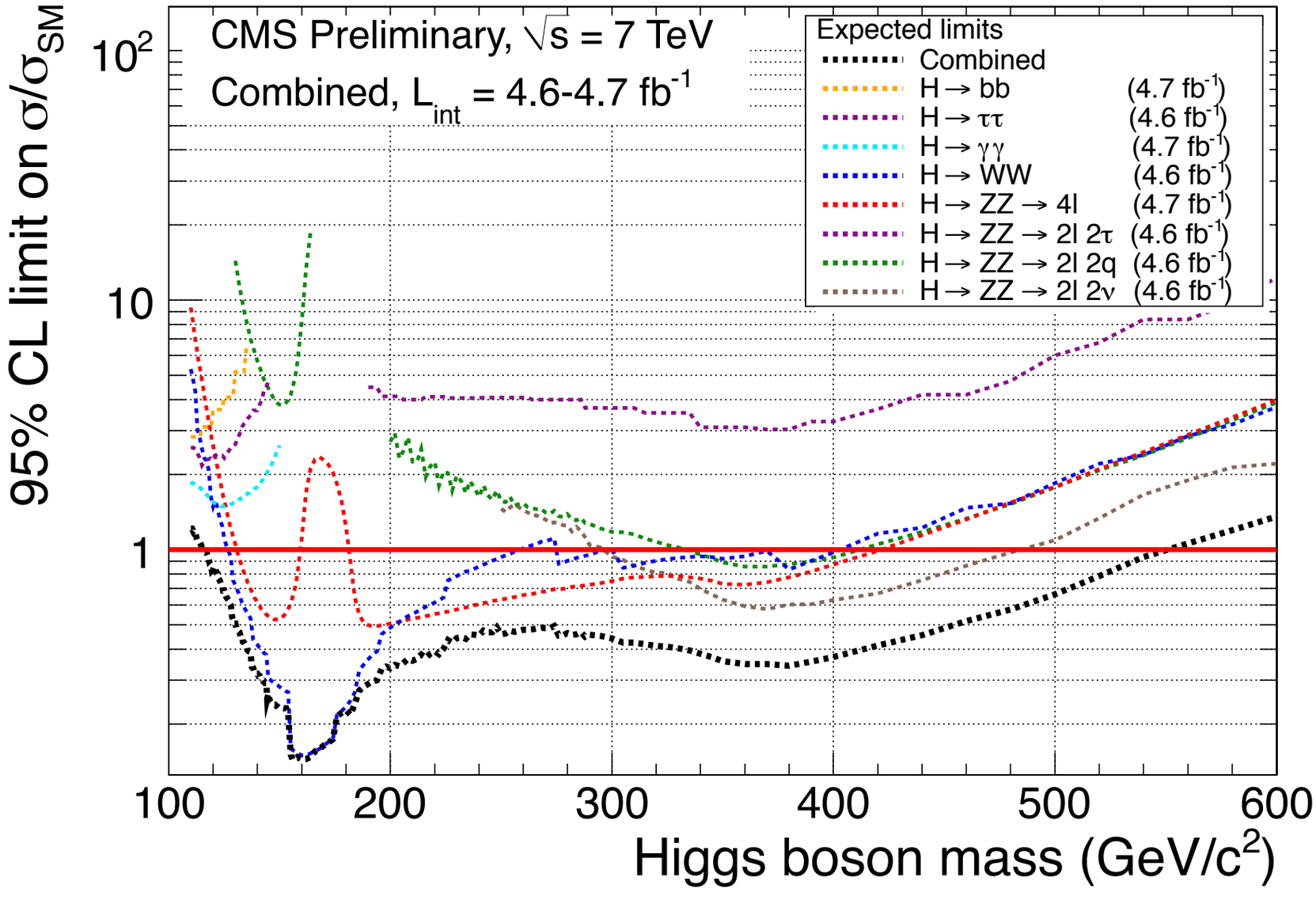




Introduction to HWW -> 2l 2nu channel with CMS

- BR(H->WW) is the largest for m_H > 140 GeV

- Clean final state because of the 2 isolated, prompt leptons



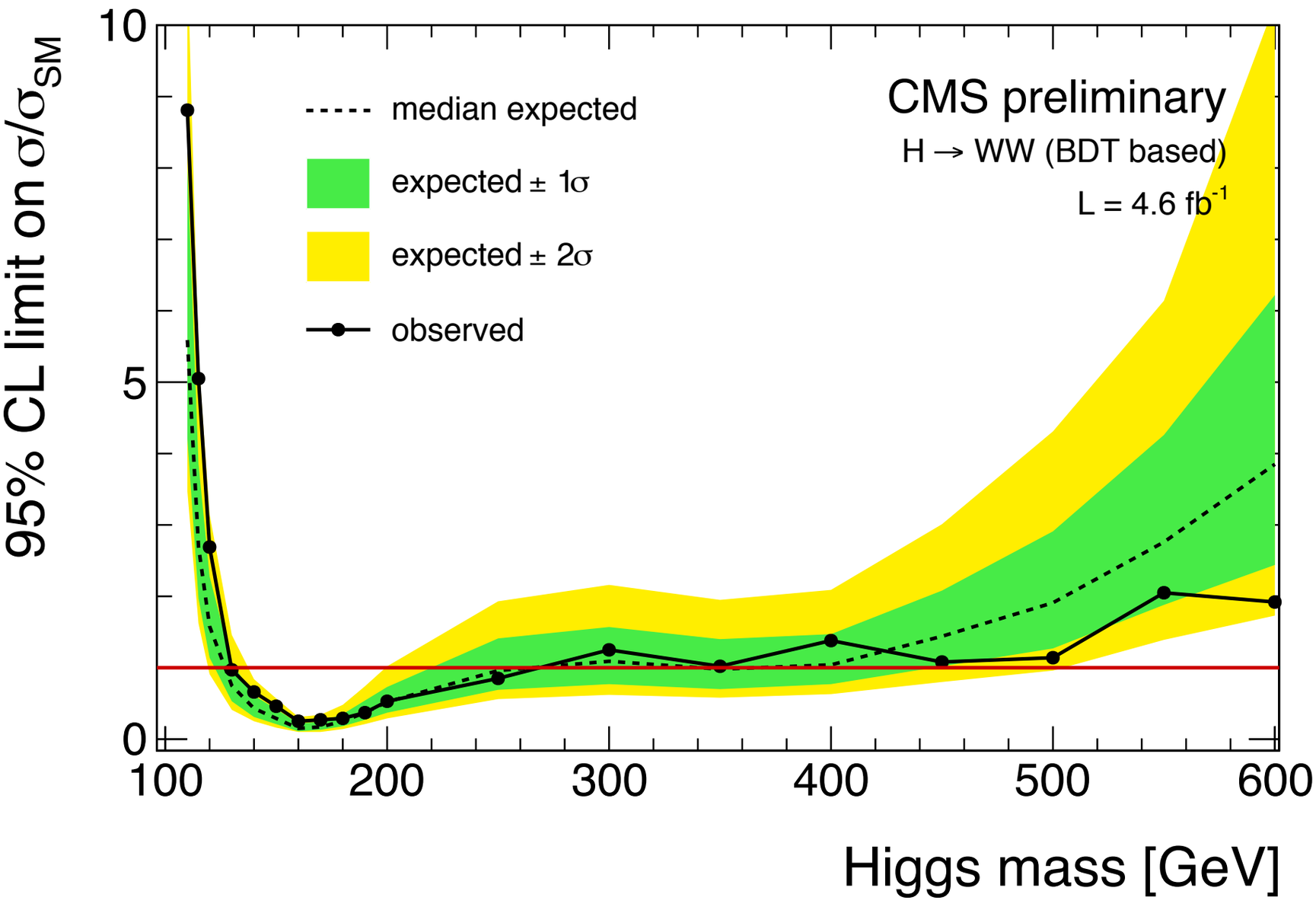
HWW2l2nu channel has the best expected sensitivity fo a very wide range of Higgs masses

B. Mangano

Introduction to HWW -> 2l 2nu channel with CMS

State of the final particles cannot be fully reconstructed (there are 2 neutrinos)

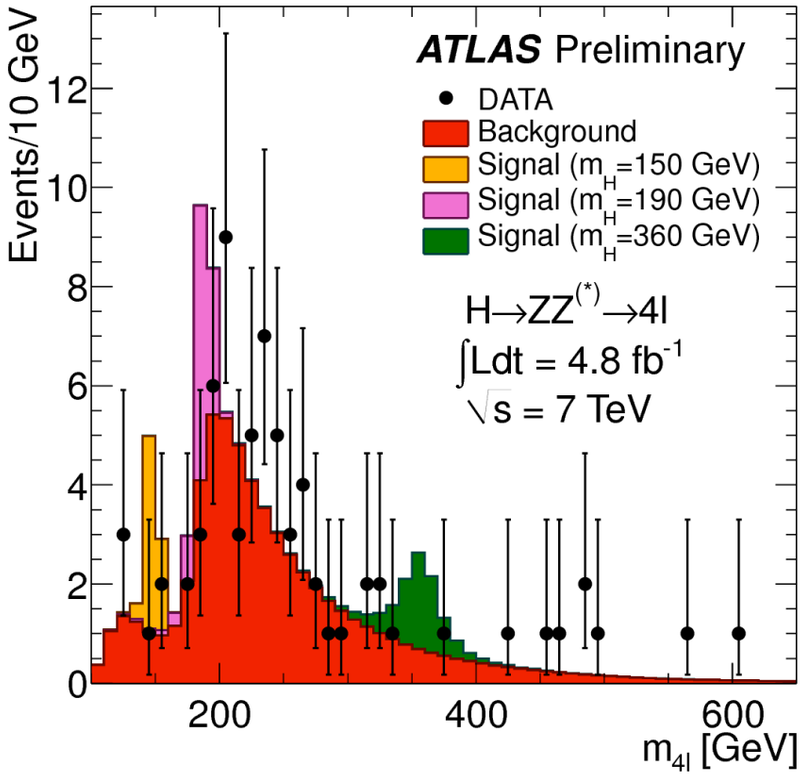
- No mass peak is reconstructed.
- Counting experiment measurement.

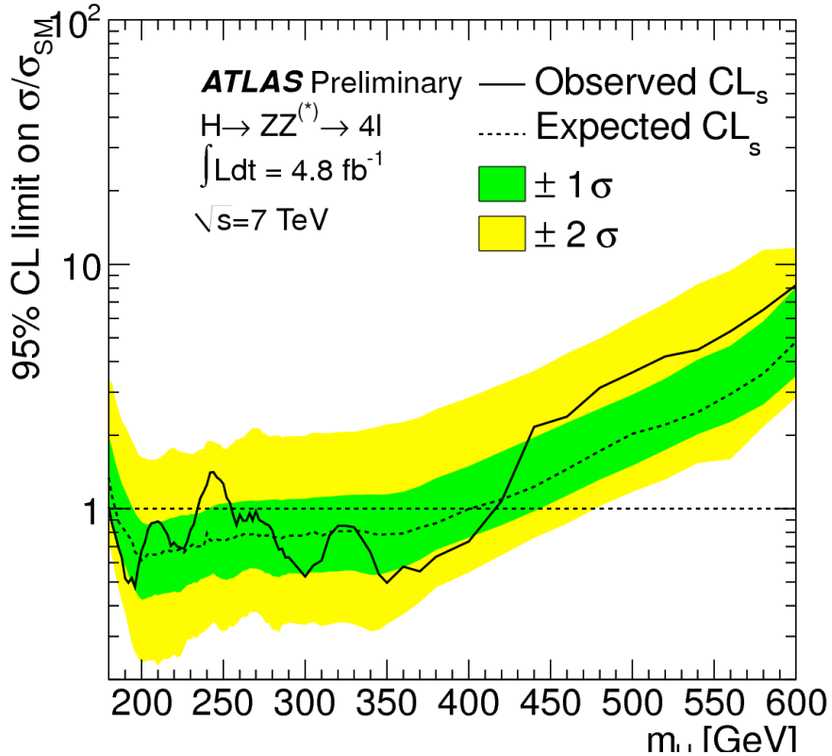


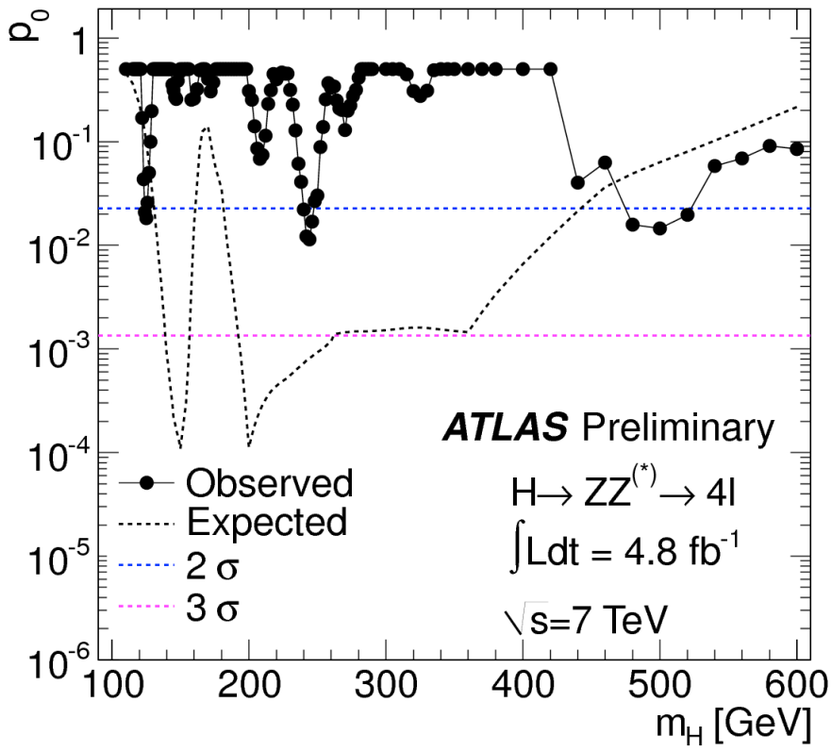
- Poor (~20 GeV) resolution on the mass of the Higgs boson.
- Fluctuations of the background are wide in m_H

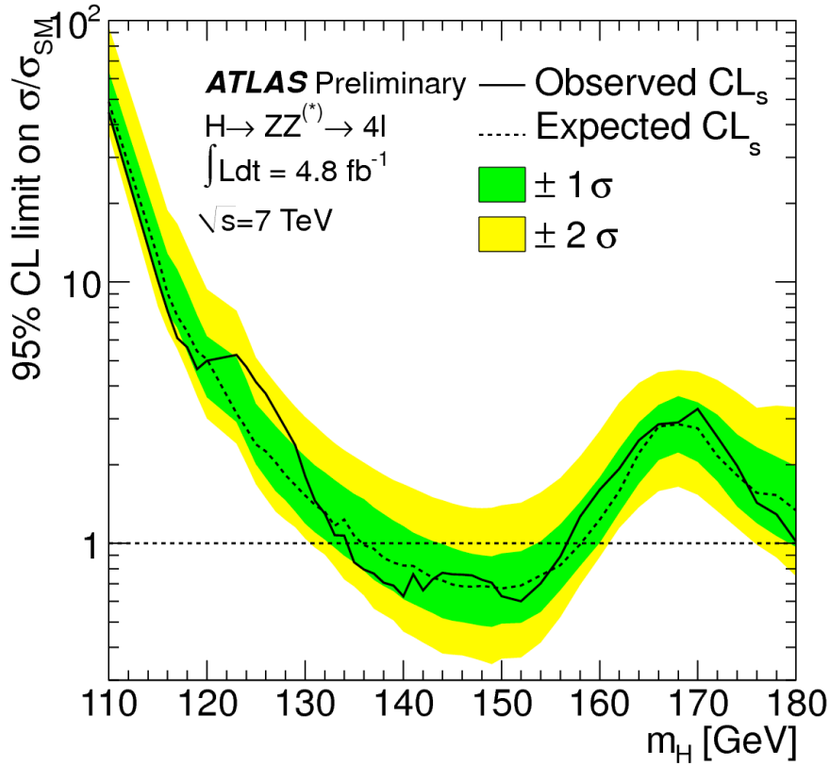
B. Mangano

H TO ZZ TO FOUR LEPTONS

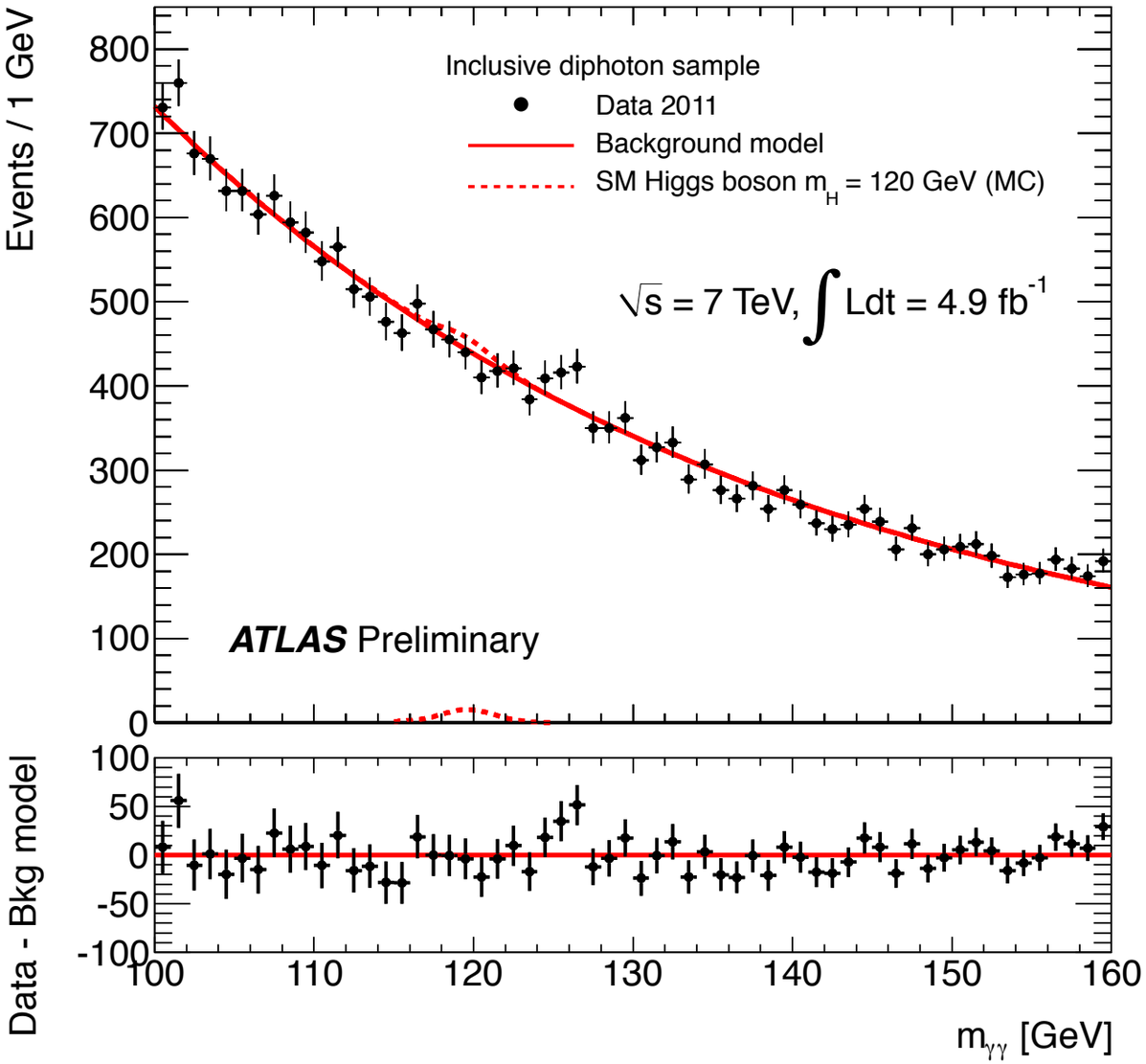


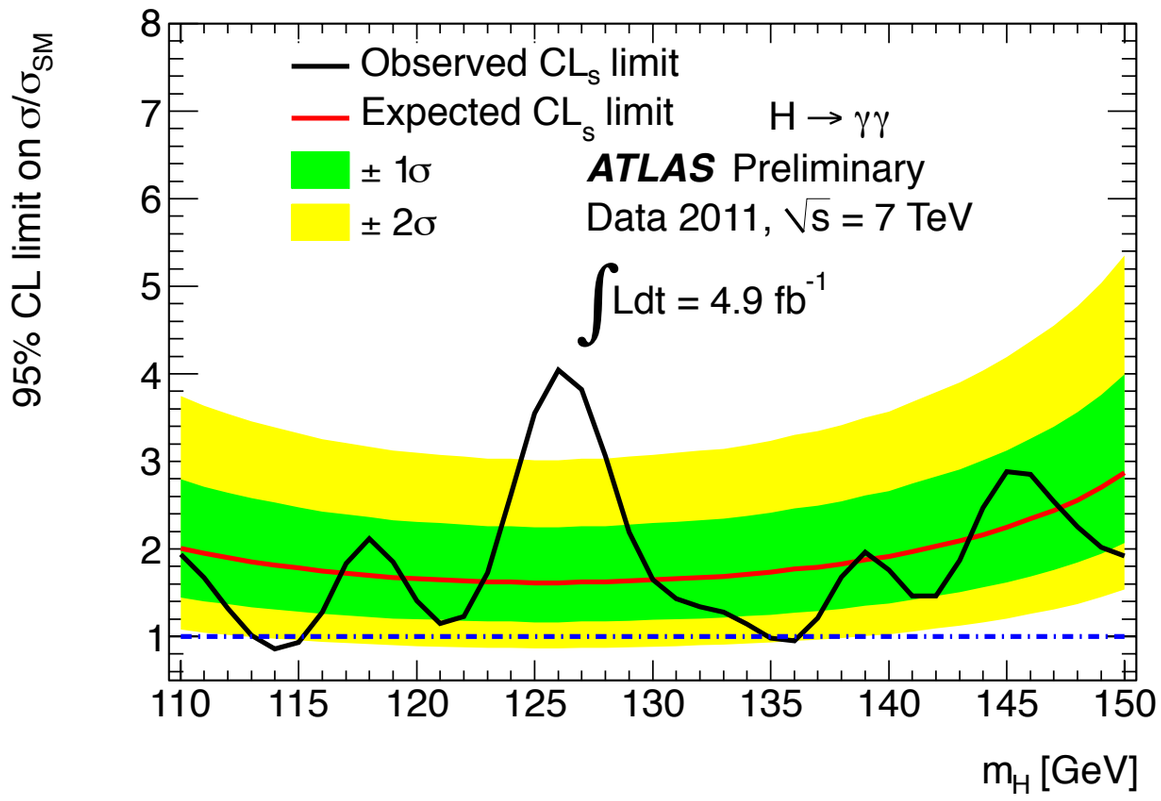






ATLAS, H→γγ

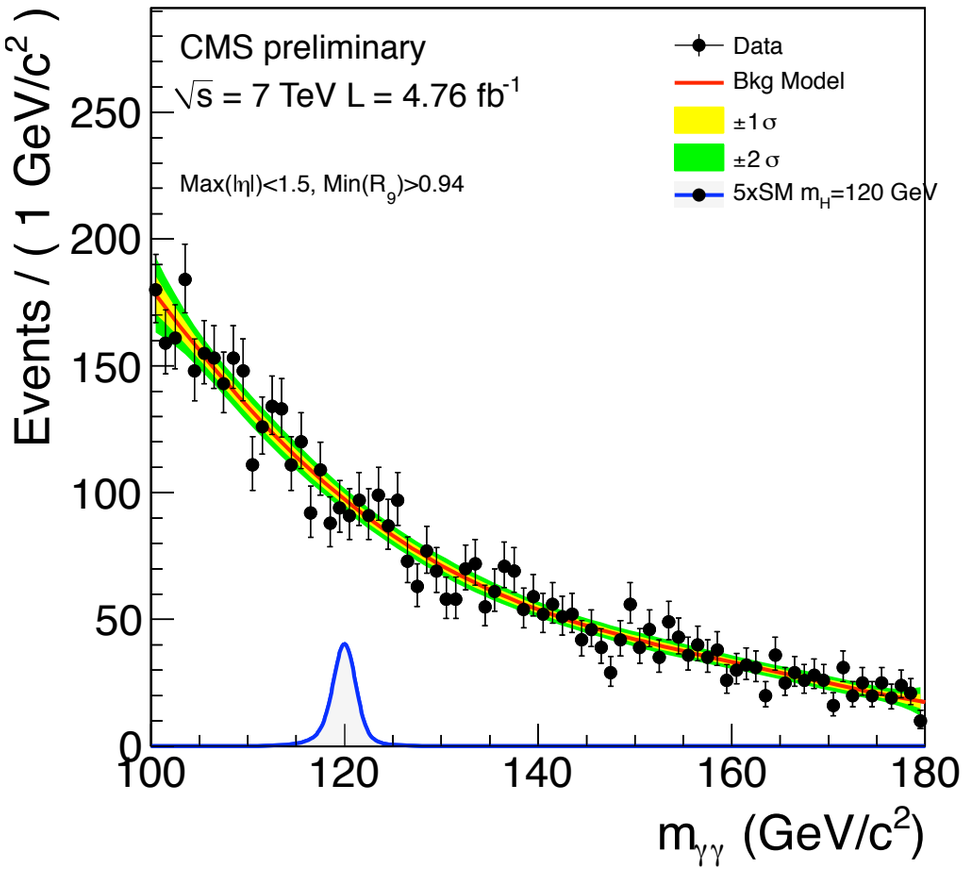




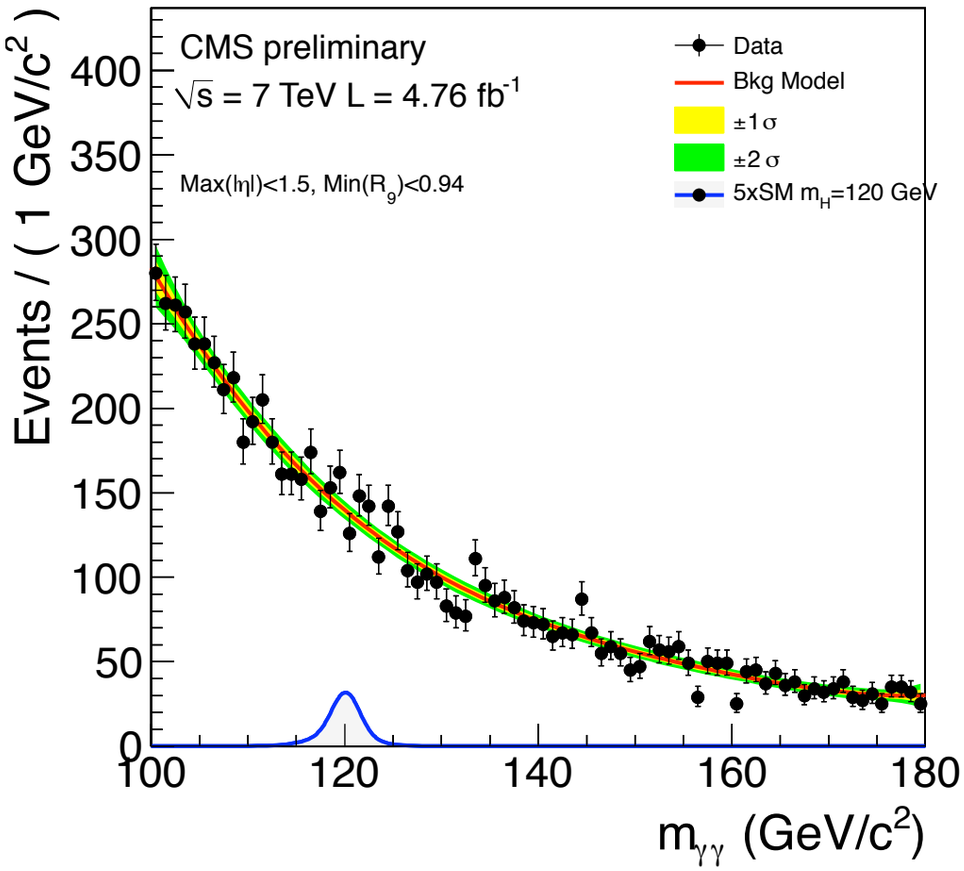
K. Peters

Higgs$\to \gamma\gamma$ Search at CMS

- Straightforward analysis in principle: Search for small but narrow mass peak on smoothly falling background
- Select two high p_T isolated photons, and extract signal or set limits with likelihood fit to the di-photon mass distribution in four event classes based on Barrel vs Endcap and Converted vs Unconverted photons

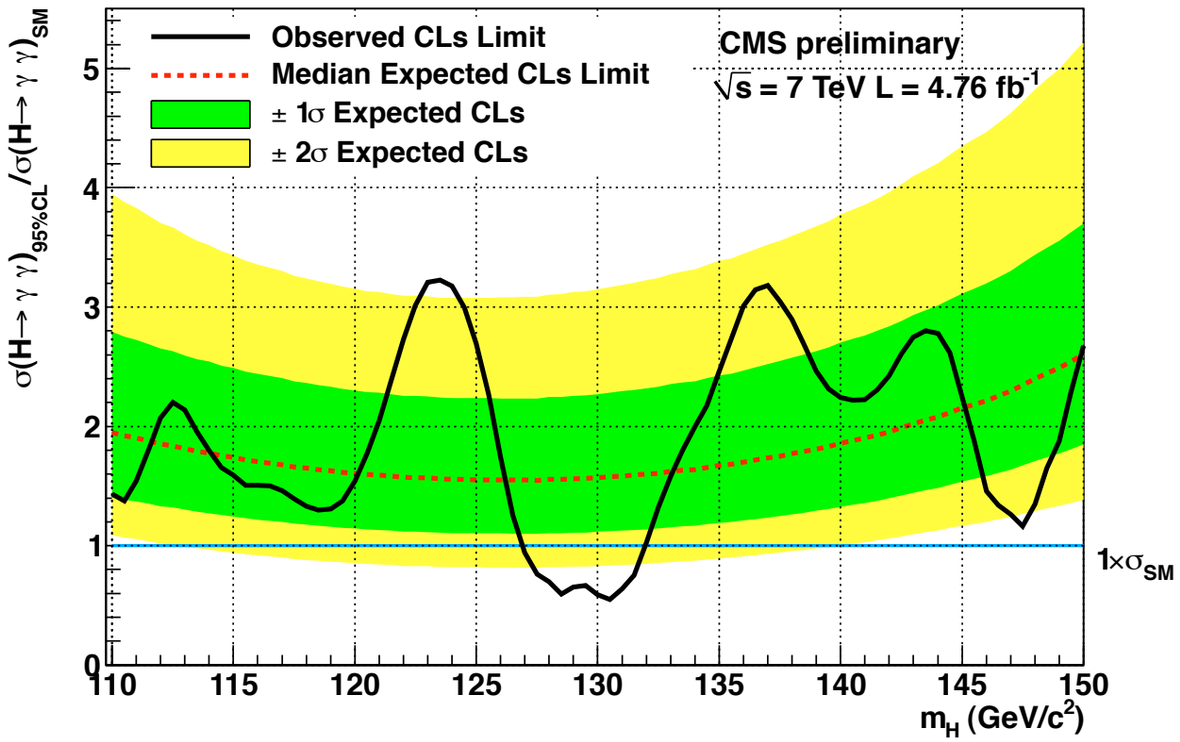


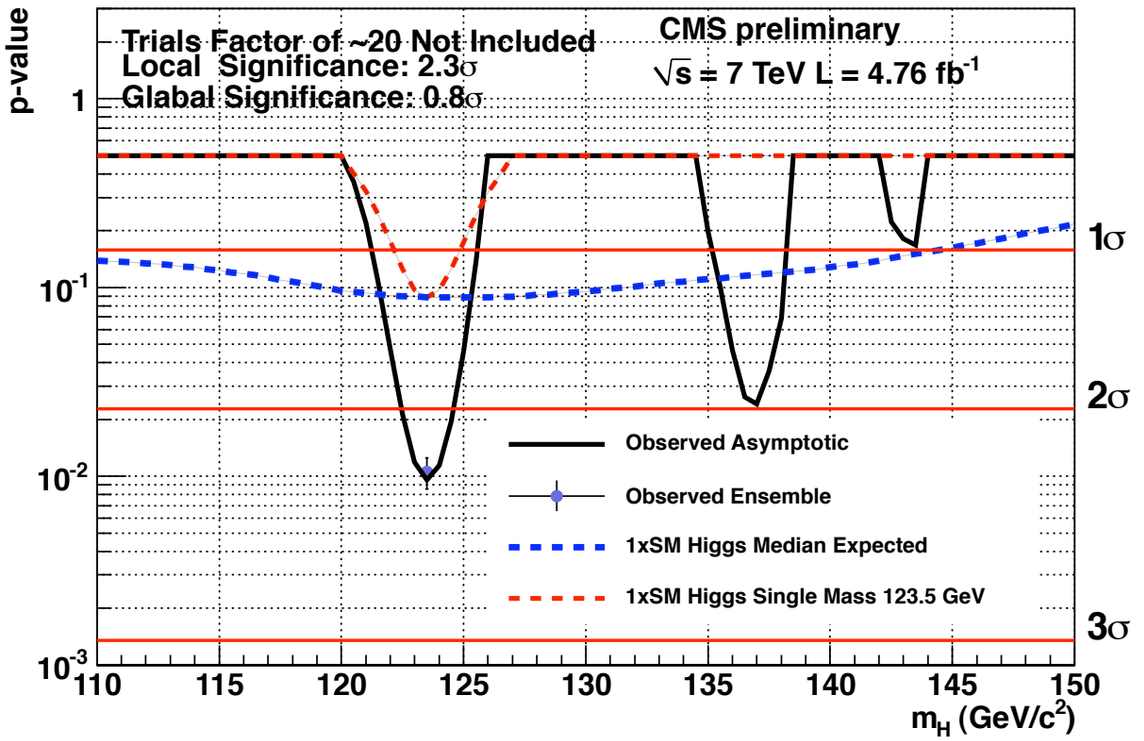
(a) Barrel Unconverted



(b) Barrel, >= 1 Converted

Higgs$\to \gamma\gamma$ CMS Results





- Expected exclusion limits between 1.5 and 2.0 times the Standard Model cross-section in the mass range of interest
- Observed excess at $\sim$123.5 GeV has a local significance of 2.3 σ, but only 0.8 σ accounting for the Look-Elsewhere-Effect over the 110-150 GeV search range

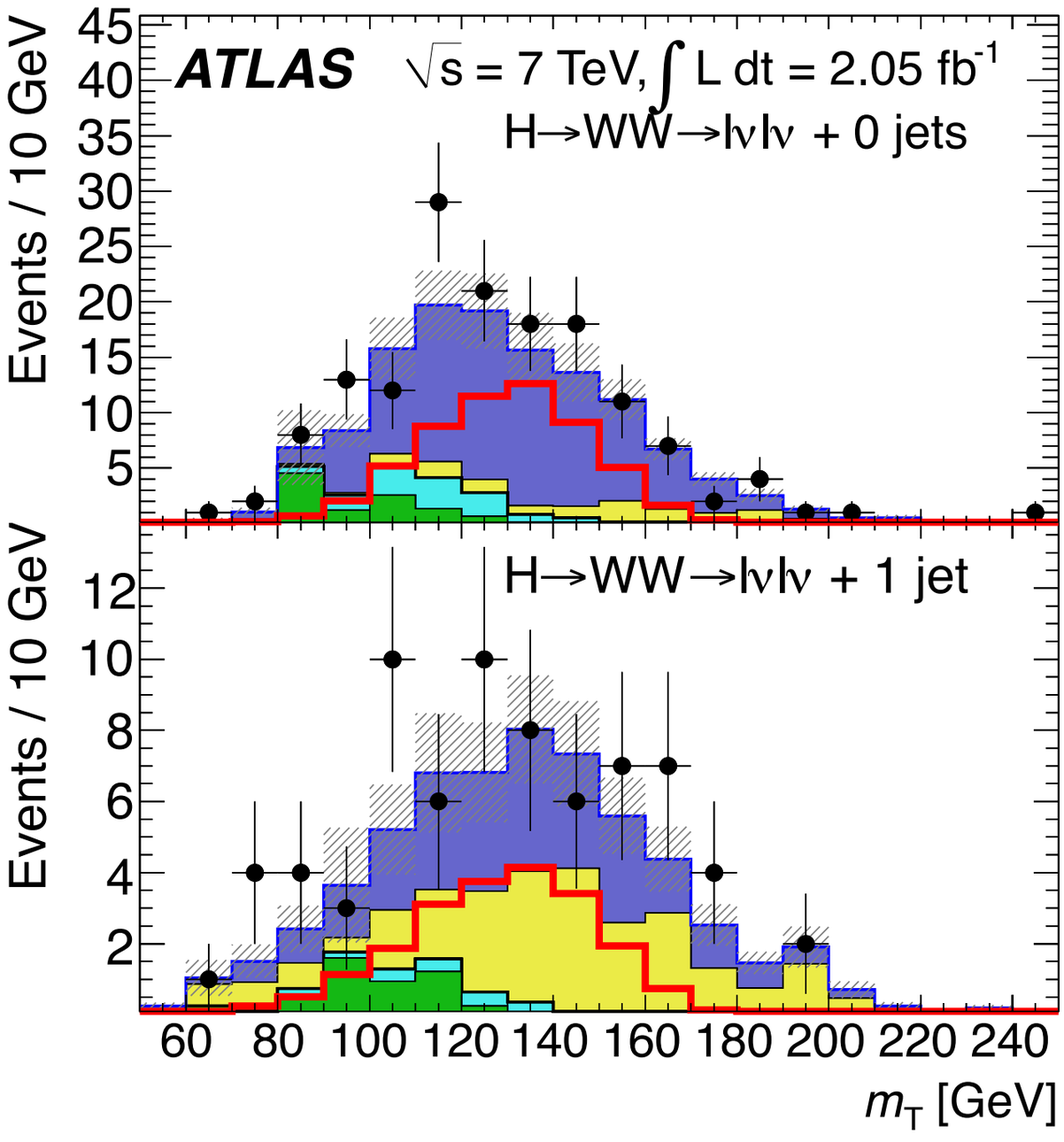
CMS Results

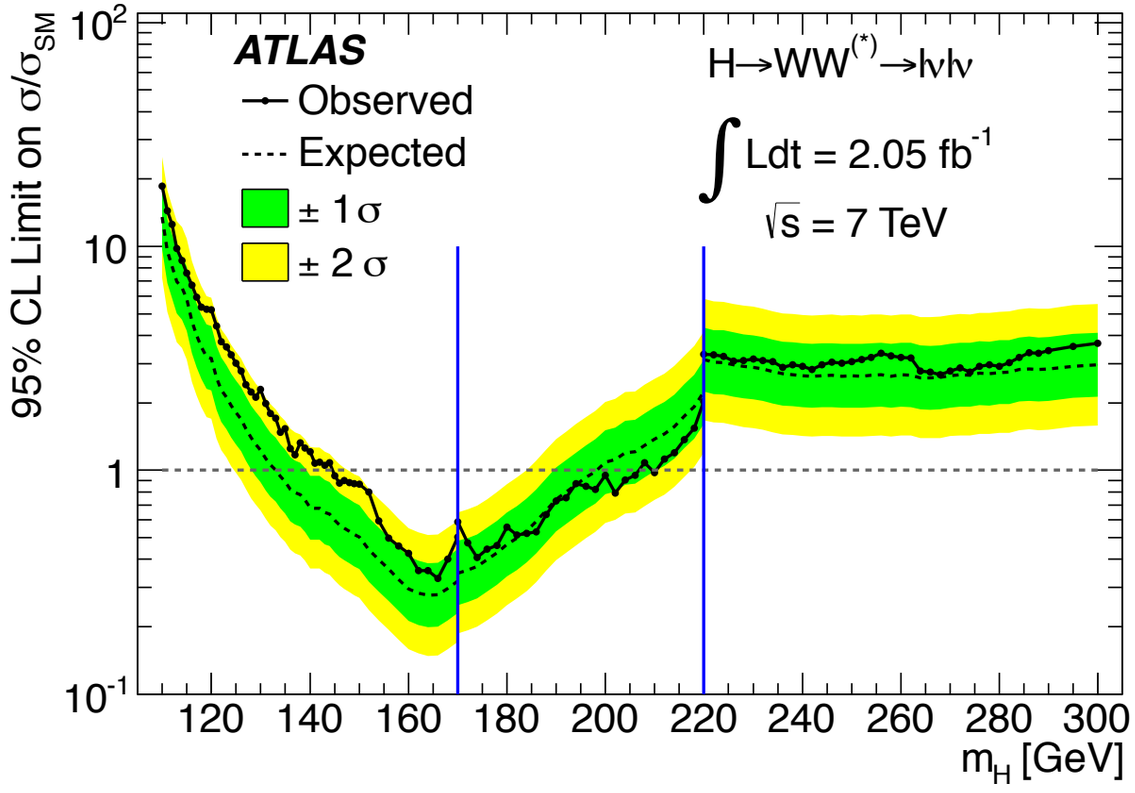
- Guido's talk from Tuesday: https://indico.cern.ch/getFile.py/access?contribId=1&resId=0&materialId=slides&confId=164890
- Higgs Results: https://twiki.cern.ch/twiki/bin/view/CMSPublic/PhysicsResultsHIG
- **Channels**
  - **H→WW**: https://twiki.cern.ch/twiki/bin/view/CMSPublic/Hig11024TWiki
    - Local p-value: http://cms-higgs-results.web.cern.ch/cms-higgs-results/Comb/HIG-11-032/pvala_all_zoom.png
  - **H→ZZ**: http://cdsweb.cern.ch/record/1406342?ln=en
  - **H→gg**: http://cdsweb.cern.ch/record/1406346?ln=en
- Combination: https://twiki.cern.ch/twiki/bin/view/CMSPublic/Hig11032TWiki

ATLAS Results

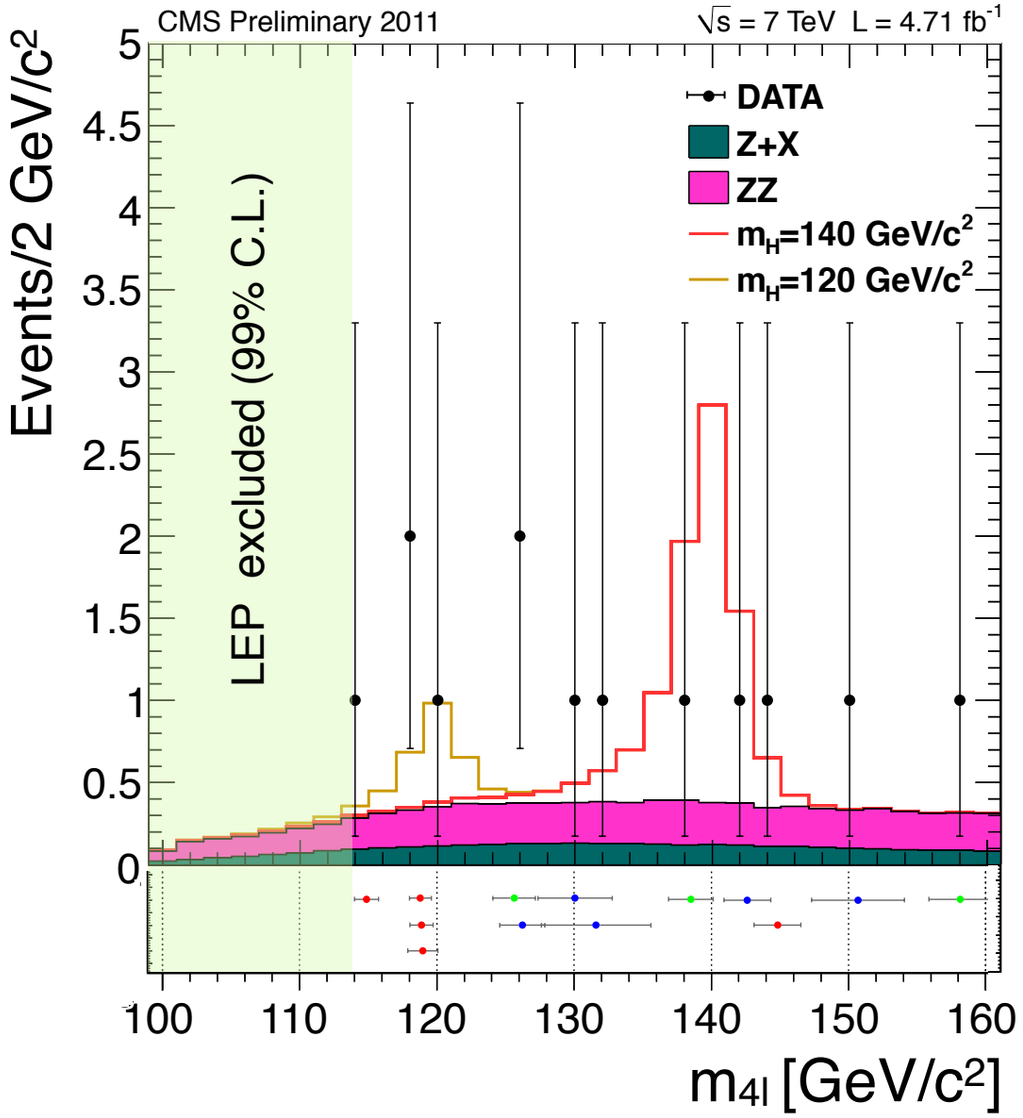
- Fabiola's talk from Tuesday: https://indico.cern.ch/getFile.py/access?contribId=0&resId=1&materialId=slides&confId=164890
- Higgs Results: https://twiki.cern.ch/twiki/bin/view/AtlasPublic/AtlasResultsHiggsDec11
- Channels
  - **H→WW**: http://arxiv.org/abs/1112.2577
  - **H→ZZ**: https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2011-162/
  - **H→gg**: https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2011-161/
- **Combination**: https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/CONFNOTES/ATLAS-CONF-2011-163/

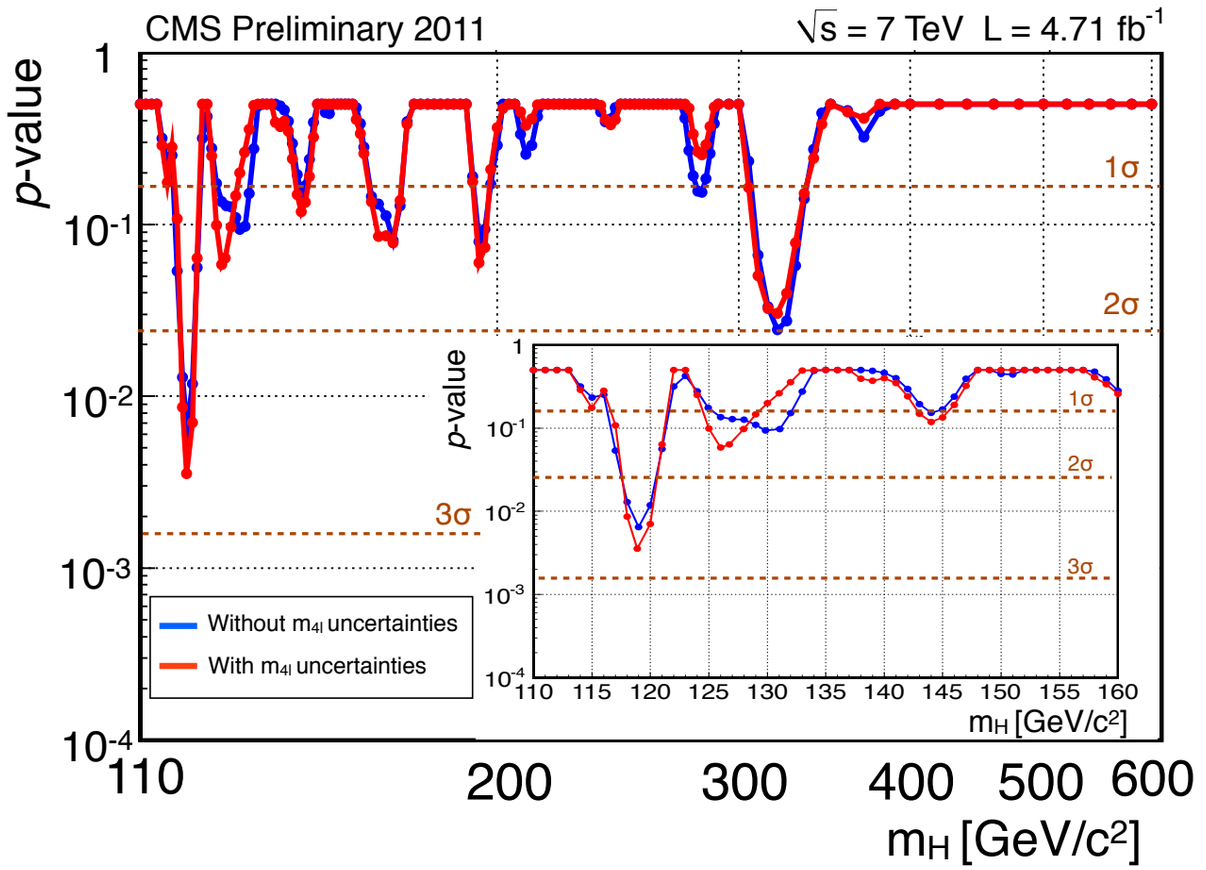
ATLAS, WW

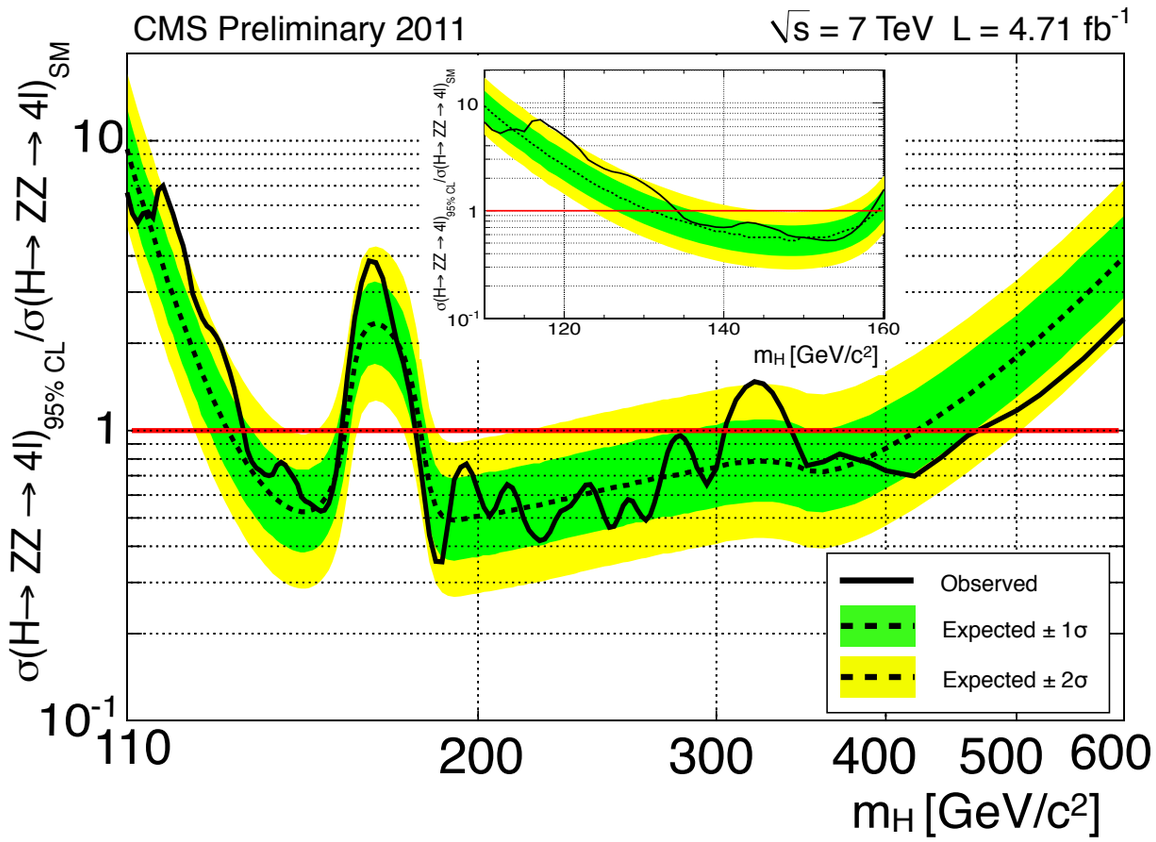

ATLAS
√s = 7 TeV, ∫ L dt = 2.05 fb-1
H→WW→lνlν + 0 jets
H→WW→lνlν + 1 jet
Events / 10 GeV
Events / 10 GeV
mT [GeV]


ATLAS
Observed
Expected
± 1σ
± 2 σ
H→WW(*)→lνlν
∫ Ldt = 2.05 fb-1
√s = 7 TeV
95% CL Limit on σ/σSM
mH [GeV]

CMS, ZZ


CMS Preliminary 2011
√s = 7 TeV L = 4.71 fb-1
DATA
Z+X
ZZ
mH=140 GeV/c2
mH=120 GeV/c2
LEP excluded (99% C.L.)
Events/2 GeV/c2
m4l [GeV/c2]


CMS Preliminary 2011
√s = 7 TeV L = 4.71 fb-1
p-value
1σ
2σ
3σ
Without m4l uncertainties
With m4l uncertainties
mH [GeV/c2]


CMS Preliminary 2011
√s = 7 TeV L = 4.71 fb-1
σ(H→ ZZ → 4l)95% CL/σ(H→ ZZ → 4l)SM
Observed
Expected ± 1σ
Expected ± 2σ
mH [GeV/c2]