Special Report

Big Day for Higgs Boson

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Abstract

Today at the EPS conference in Grenoble the world's largest hadron colliders will be revealing the results of their latest searches for the Higgs boson, using data collected up until the last few weeks. We will be posting the plots here as they appear. The individual experiments Dzero, CDF, ATLAS and CMS will each show their all channel combined plots. There will also be separated plots for individual channels and some separate searches for a charged Higgs as predicted in some models such as MSSM.

Key Words: Higgs Boson, LHC, ATLAS, CMS, D0, CDF, ESP-HEPS, 2011.

Our expectation is that the Tevatron plots (Dzero and CDF) will show some good exclusion limits but we will have to wait for the plenary talks next week to see the full Tevatron combined plot. From a press release last night we already know that they will claim to limit the Higgs to a region of 114 geV to 137 GeV, but that is not the end of the story. Above 185 GeV they only use indirect measurements to exclude the Higgs and these assume that no new particles beyond the standard model exist. That could be a weak assumption.

Later today the CMS and ATLAS plots will tell us about those heavier mass regions with direct searches. They should be able to exclude a heavy Higgs or provide a plausible signal above 190 GeV, so what will it be? We won't get a full combined LHC plot at this confernece but the individual plots for ATLAS and CMS will already have strong results.

Click on big titles below to bring up the full slide presentation.

Dzero

First up is Dzero with this combined plot that we first saw a couple of days ago

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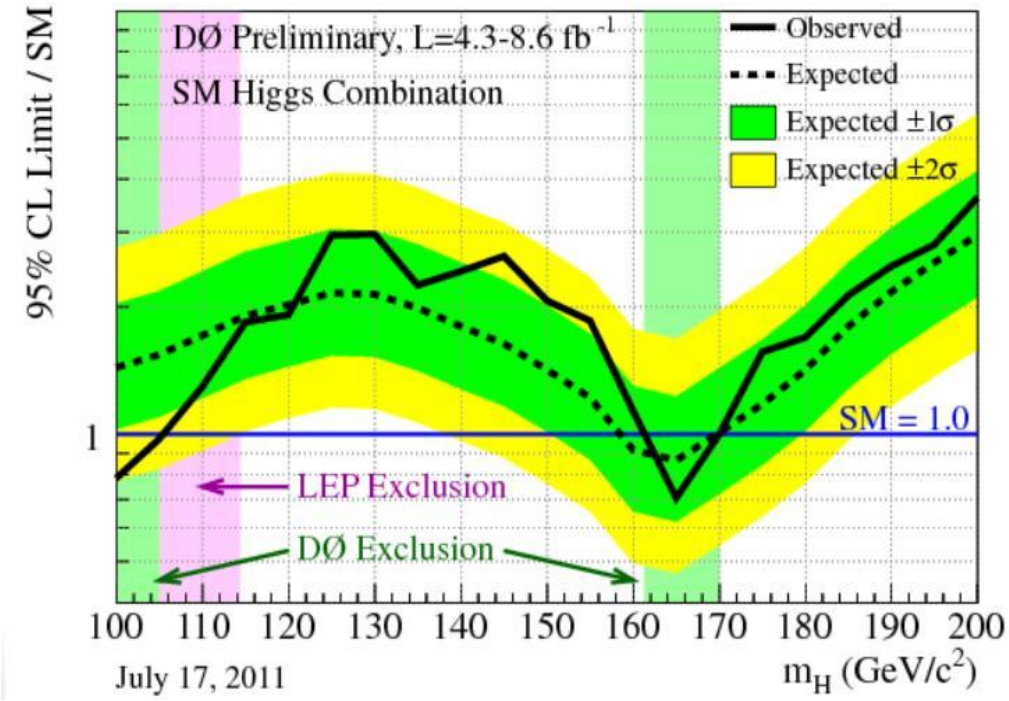
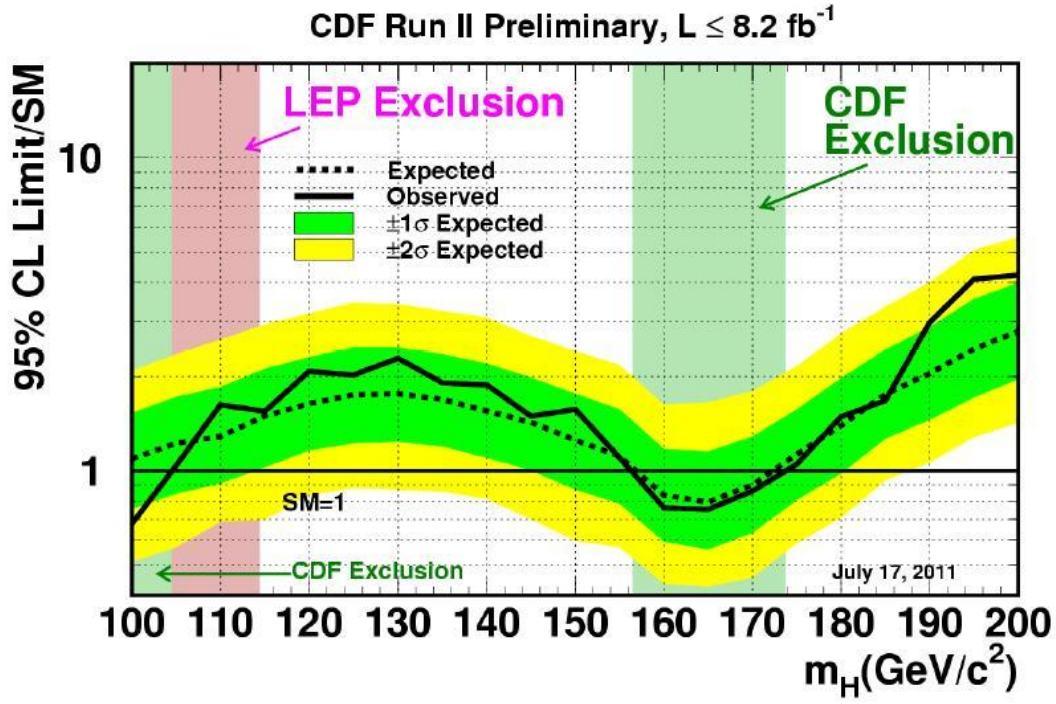


It shows a good exclusion from 162GeV to 170 GeV, not a new result but good to see that the limits imposed by the individual experiments at Fermilab are already strong.

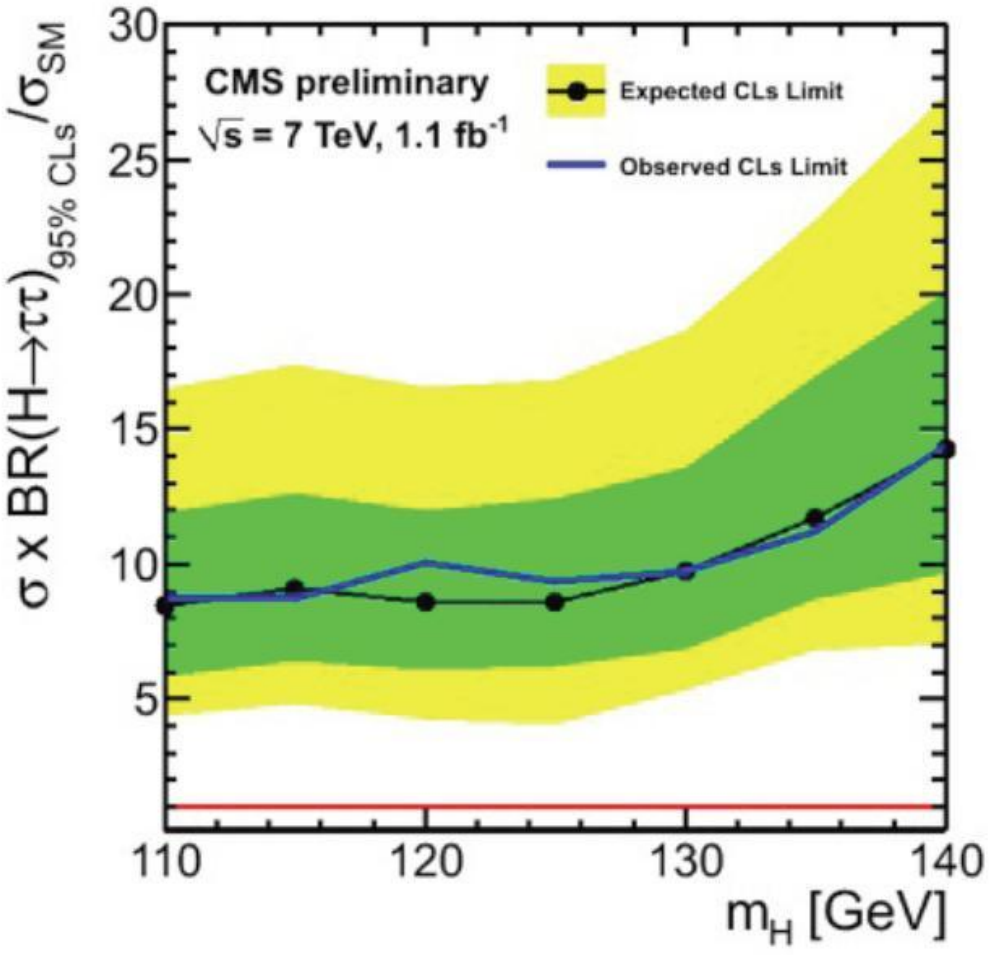
CDF

The CDF combined plot is not very different.



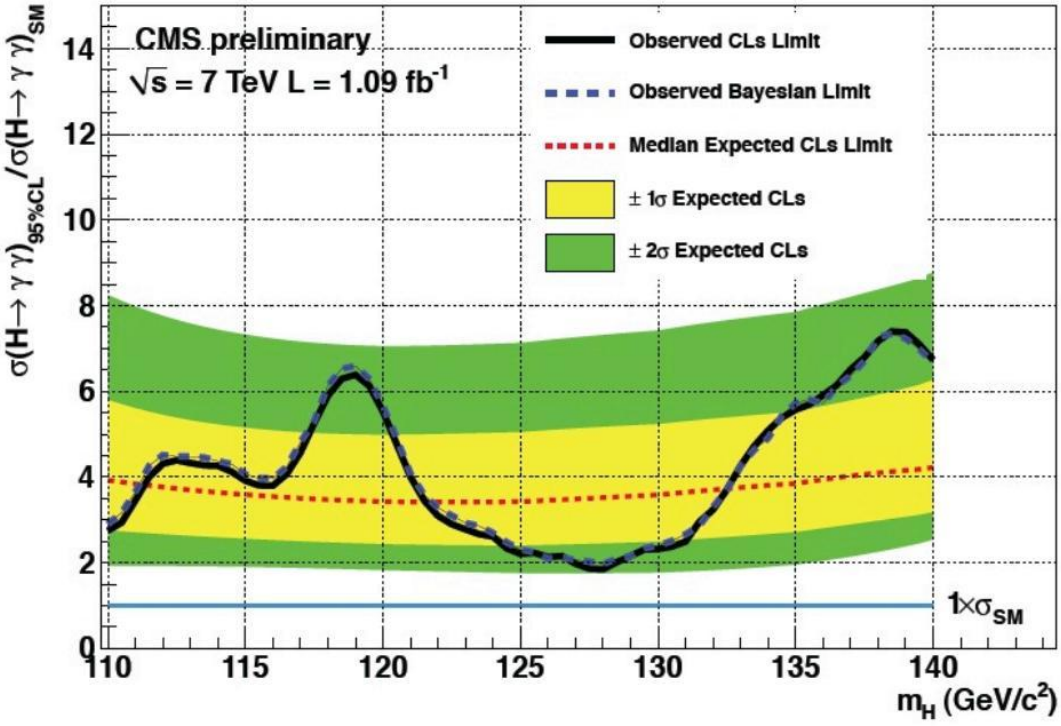
CMS ττ

In the Higgs to tau lepton pair decay channel CMS produce this plot. Remember that the observed limit has to drop below the horizontal line at 1.0 to provide a 95% confidence level exclusion. There is not enough data to do that here, but this data will go into the combined plot later too. It is good to see that 1.1/fb is being used. The same presentation also provides good SUSY exclusion results.



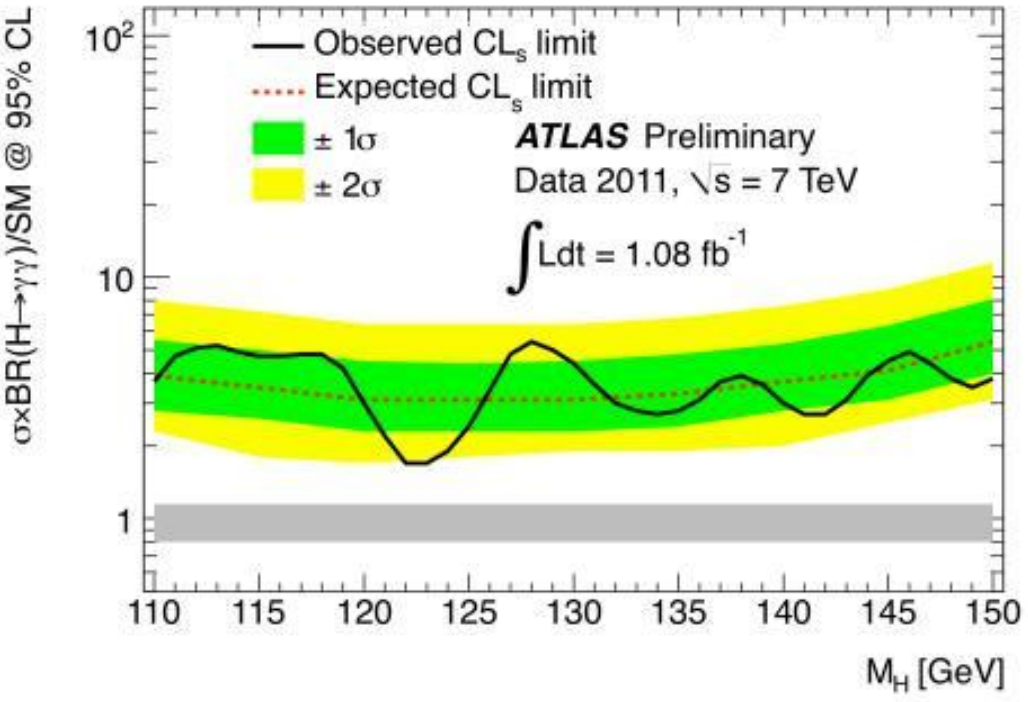
CMS γγ

The Higgs decay into two photons is a crucial channel for finding the Higgs. The LHC do not yet have enough data in this region but with this new plot we see just how close they are getting. A full combination of Tevatron and LHC data at this time might almost have something to say about low mass Higgs if this is anything to go by.



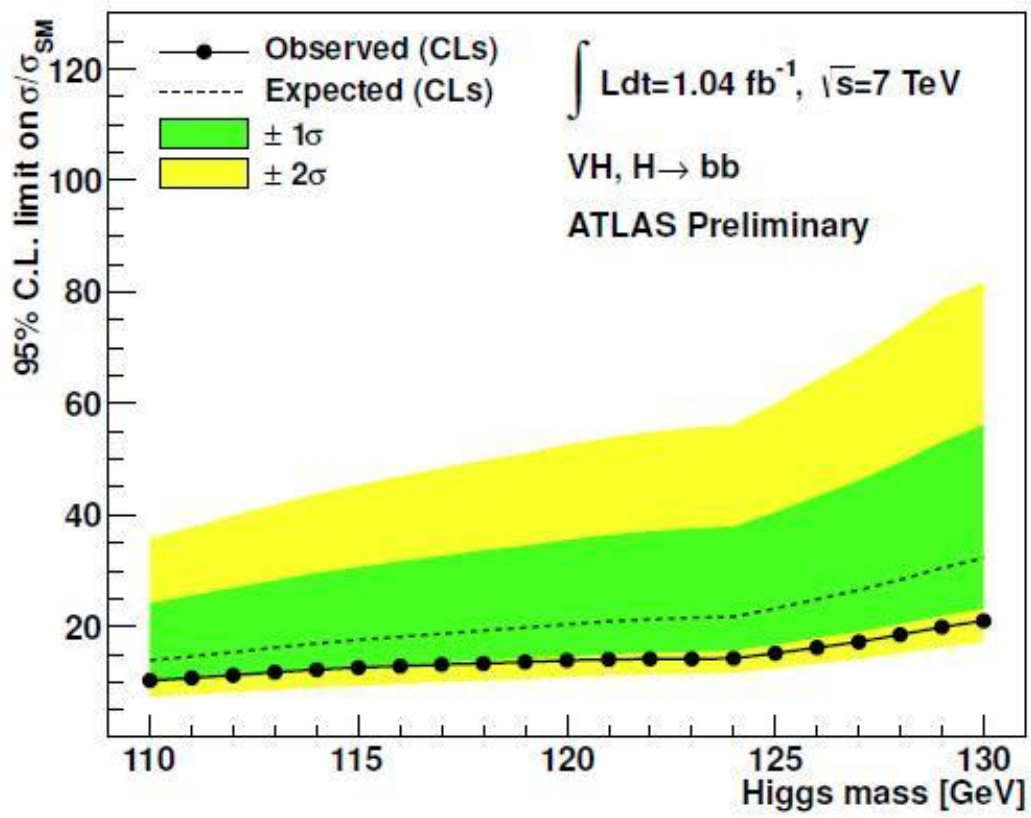
ATLAS γγ

Much the same from ATLAS



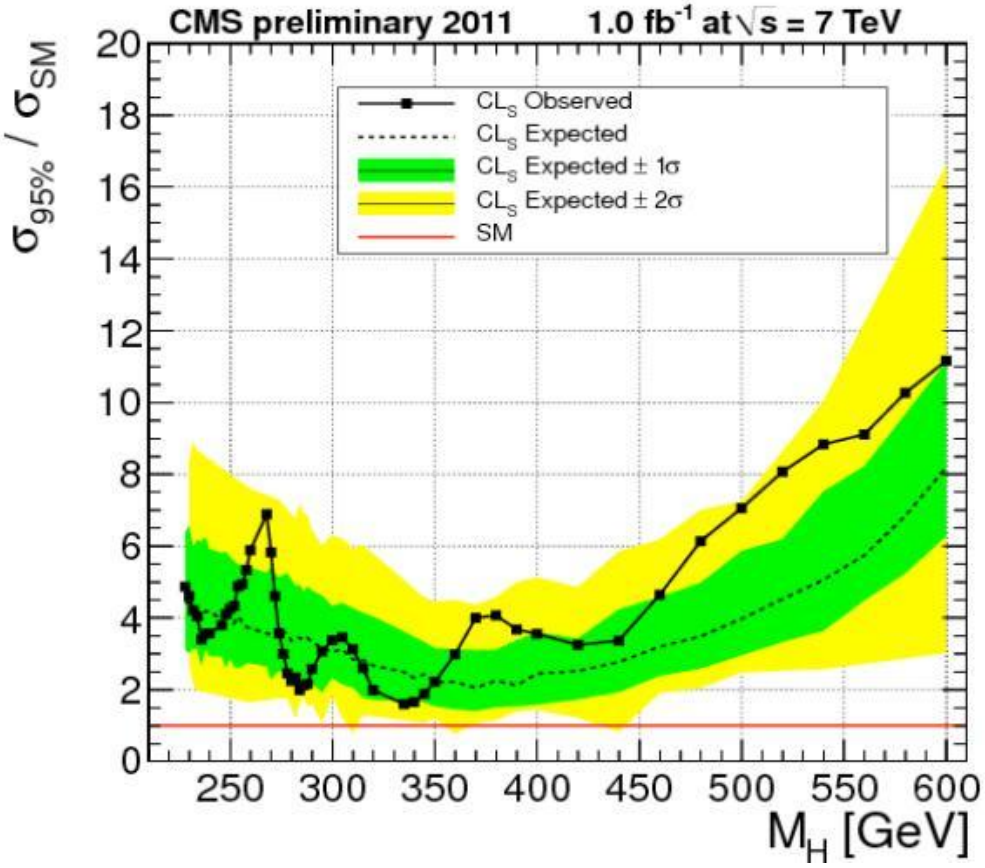
ATLAS bb

ATLAS have looked at the decays of a Higgs to decay into a bottom quark pair in conjunction with a W or Z boson. They see no excess at twenty times the standard model Higgs signal.

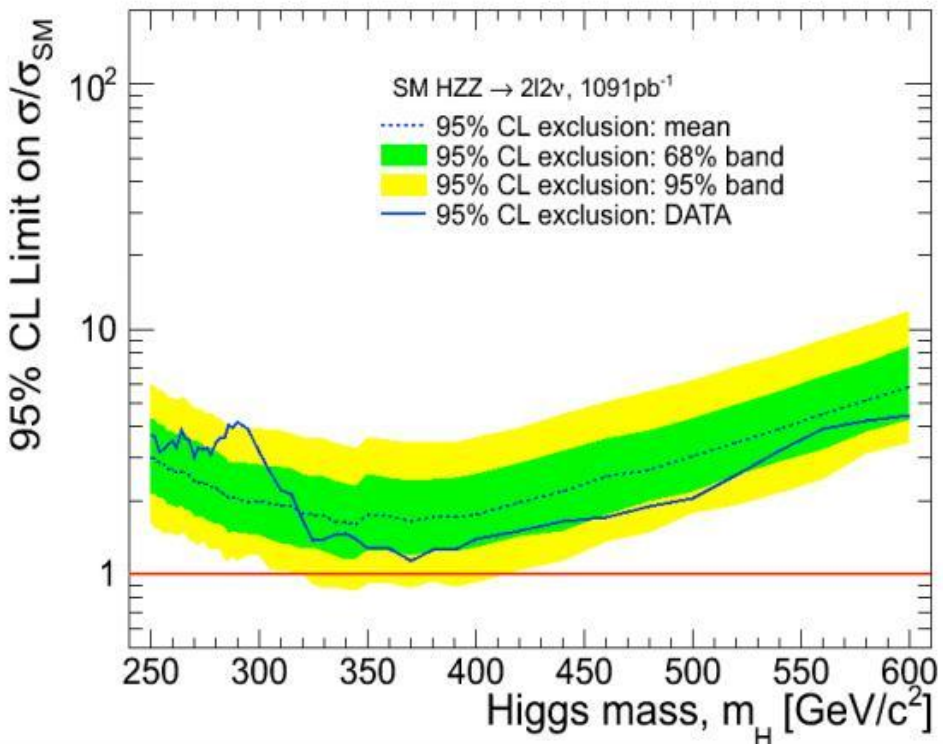


CMS ZZ

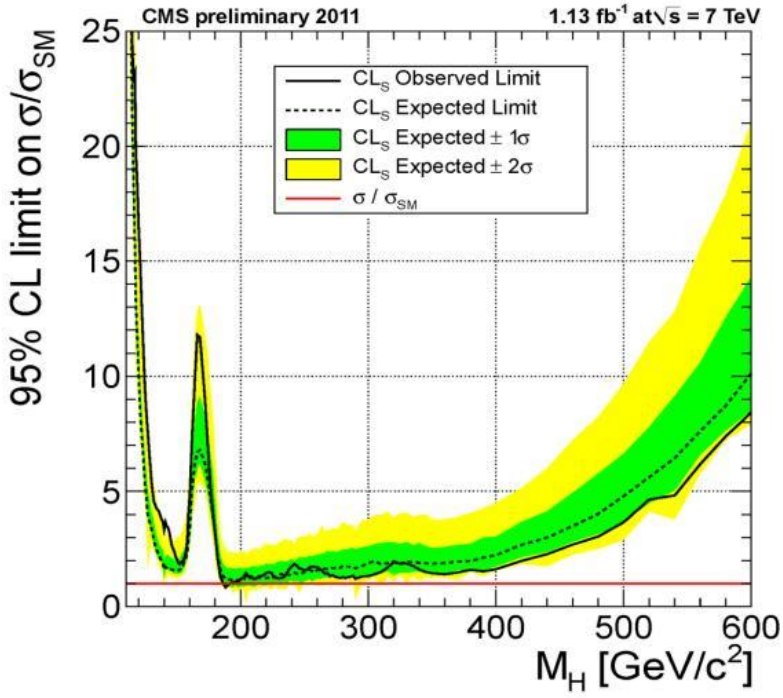
Tow Z bosons from a Higgs can decay into pairs of leptons, quarks or neutrinos giving different channels to search in. First the 2 leptons plus two quarks plot. This is an exciting result that comes close to exclusion at some points, but why has it been cut-off below 220 GeV?



The decay into two leptons and two neutrinos gets even closer

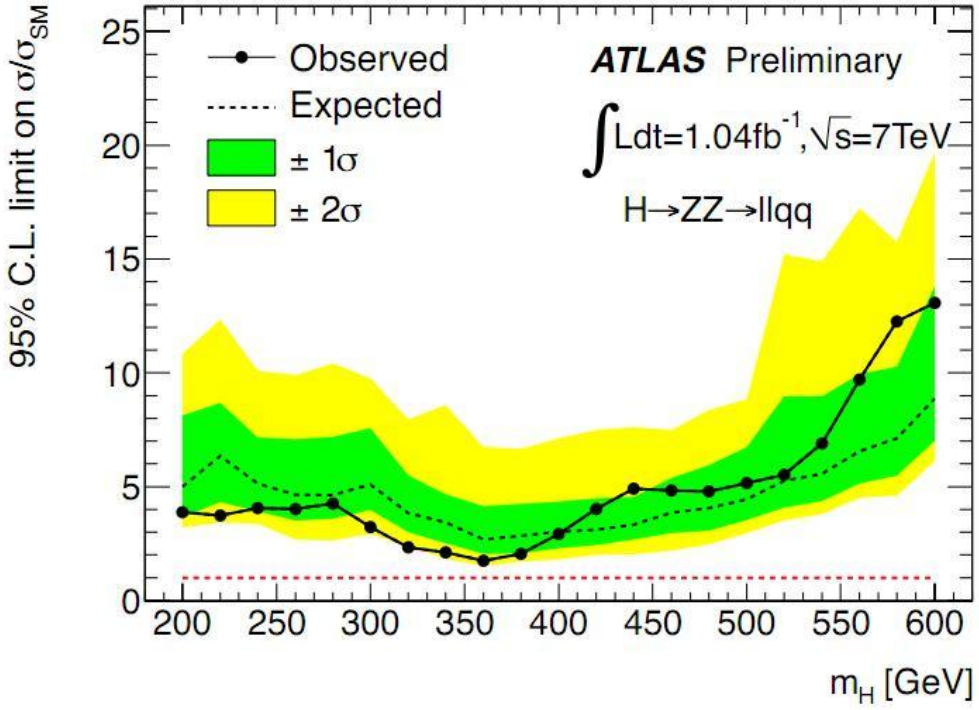


Finally the golden channel of four leptons crosses the line with a tiny exclusion around 185 GeV

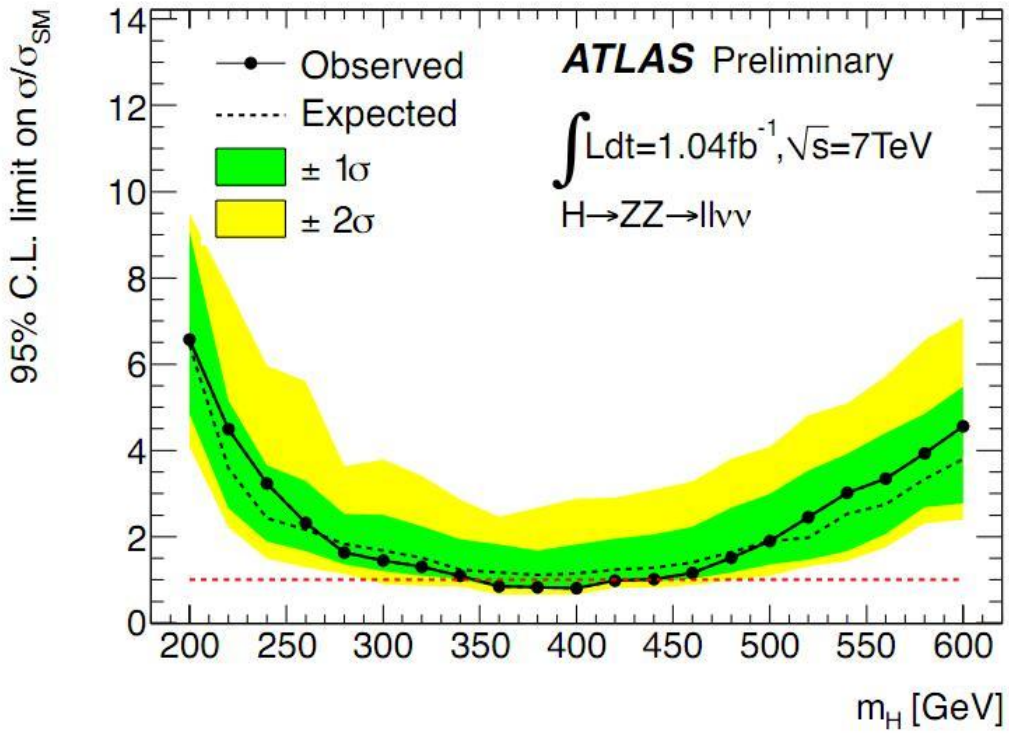


ATLAS ZZ

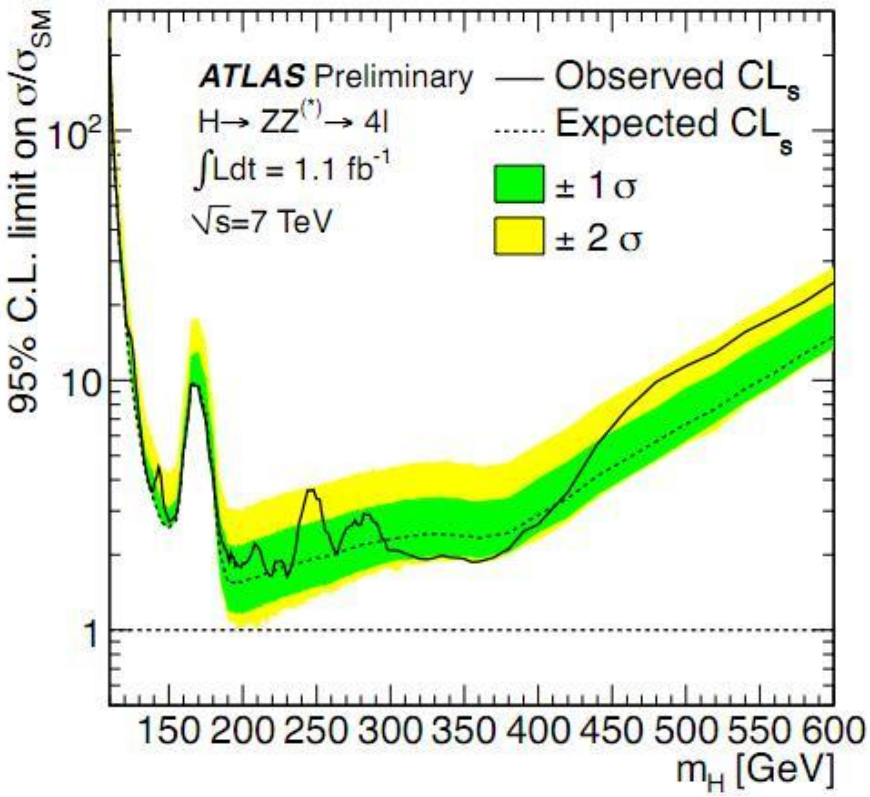
The story from ATLAS is pretty much the same



The 2lepton+2 neutrino channel even has a good exclusion on its own

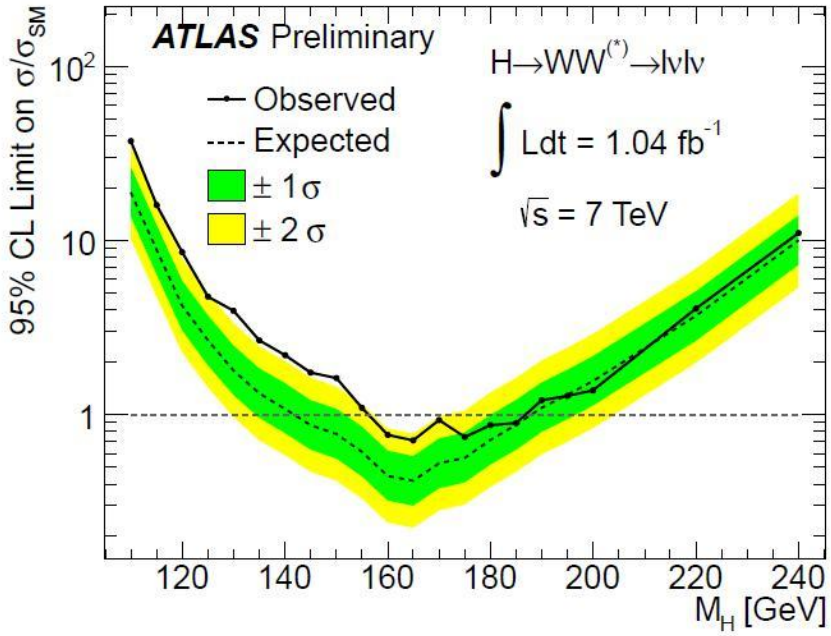


The golden channel is close to expectation levels for no Higgs

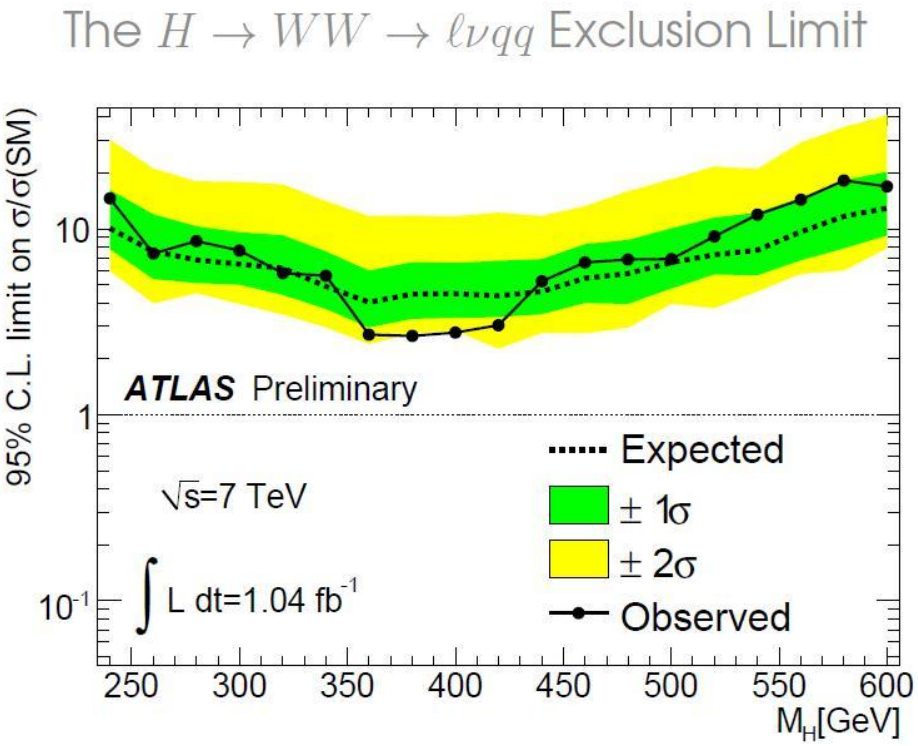


ATLAS WW

This splits into two main channels, first each W decays to a lepton and a neutrino. Here we get an impressive exclusion.

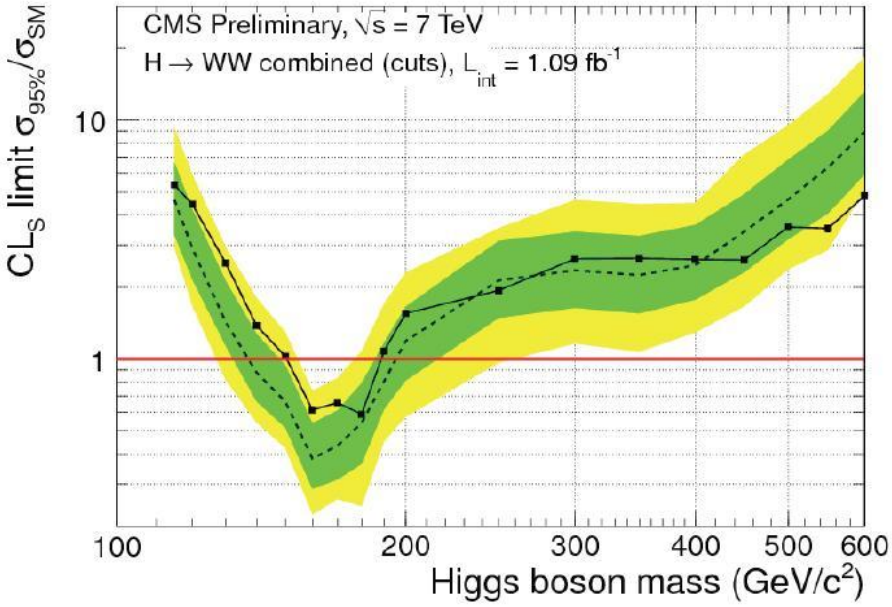


The lepton neutrino 2 quark channel is not so strong



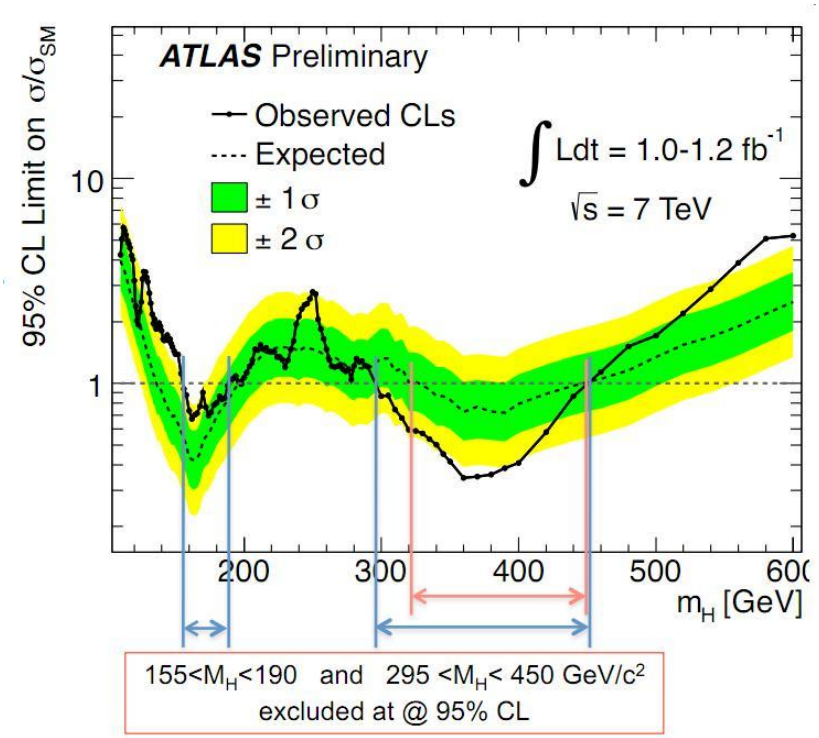
CMS WW

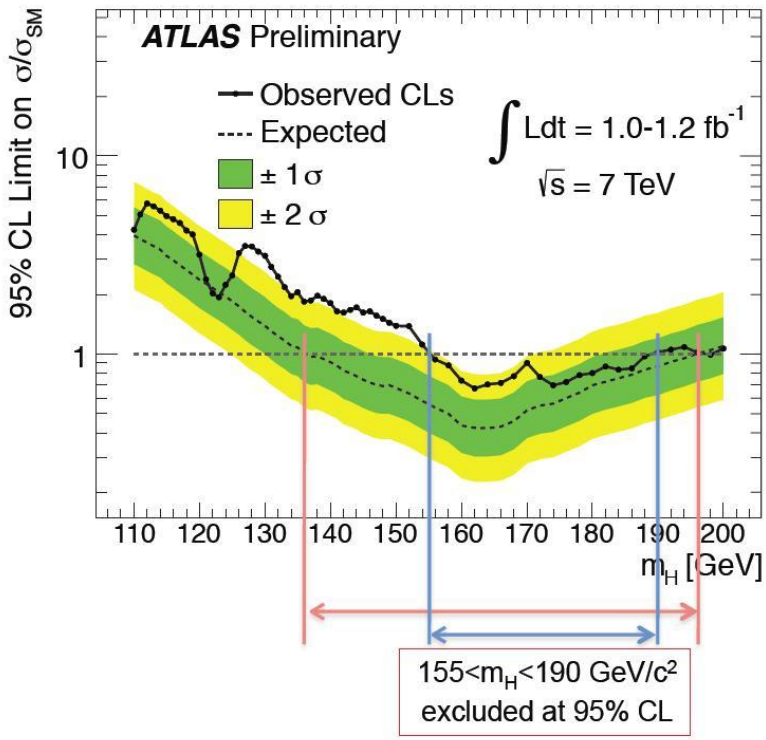
For CMS just one combined plot for the WW channel is all we need



ATLAS

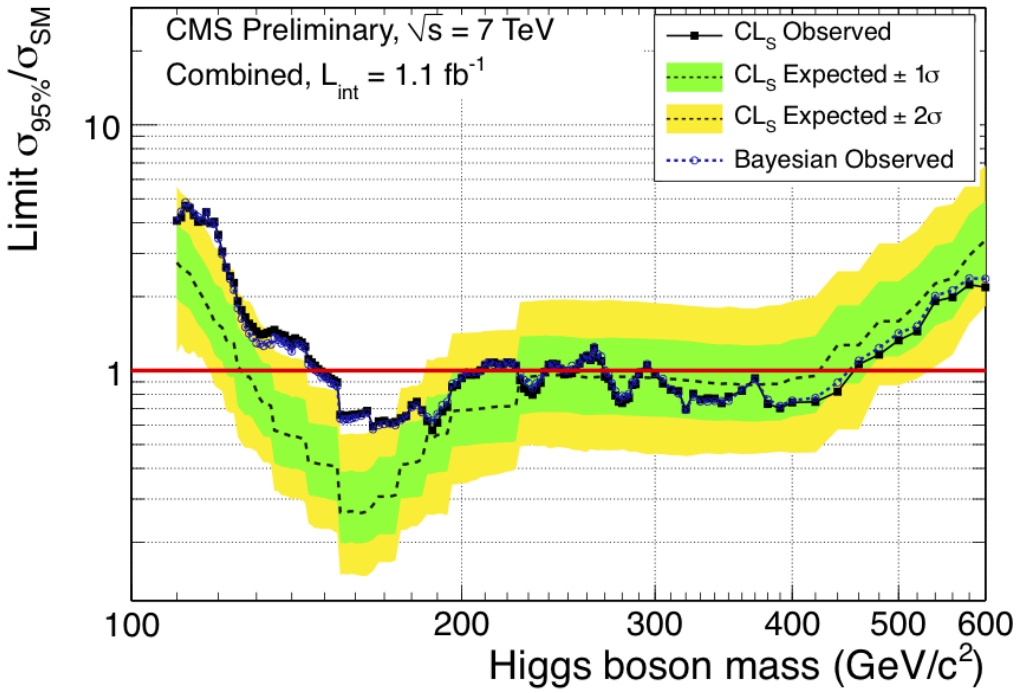
Combined result. WOW!





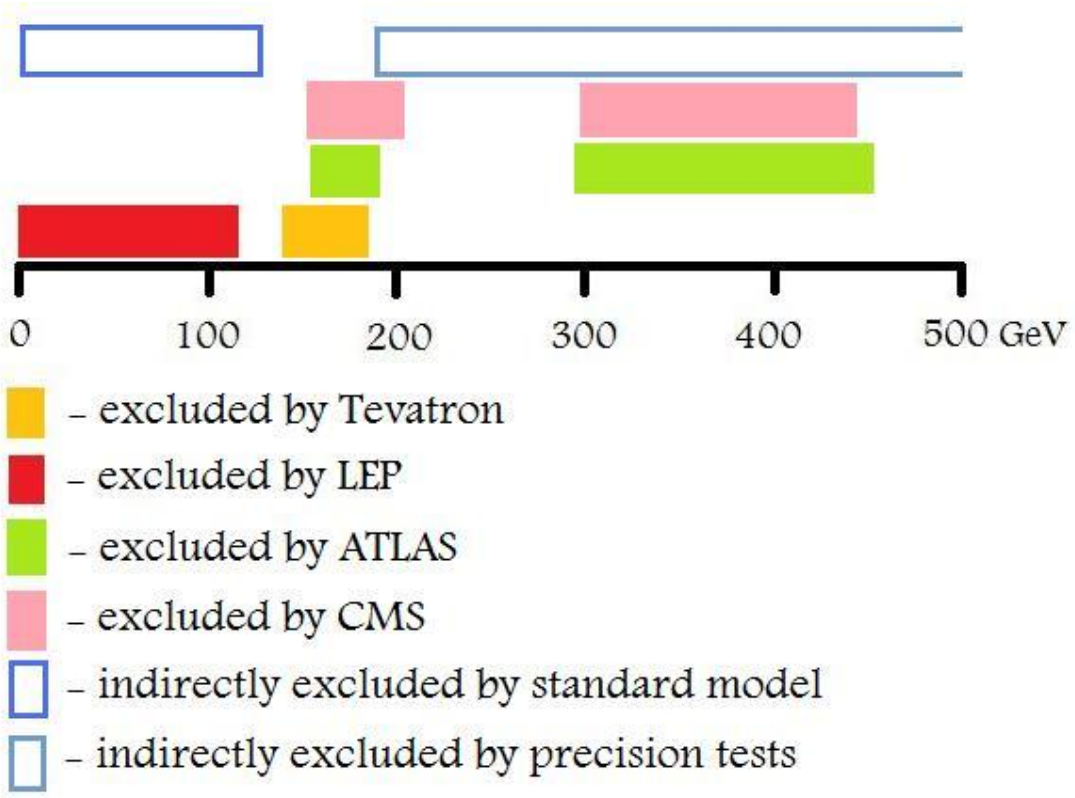
CMS

Finally the CMS combined plot. The exclusions are from CMS are 149-206 and 300-340 GeV with some large exclusions in the space between.



Conclusion

We still have to see the combined CMS plot and the combined Tevatron plot but already we have some strong results. Much of the Higgs mass range has now been excluded leaving just a window from about 114 GeV to 137 GeV and 205 GeV to 295 GeV. the higher range is excluded by precision tests for a standard Higgs, but a combination of massive particles is not ruled out.



There are excess in the 140 GeV to 150 GeV and a curious deficit at 350 GeV, seen consistently across the data. These results are compatible with a number of options including a light Higgs and a multiplet of Higges. More data will be required to finish and we should get enough this year but already we see that a standard model Higgs on its own only just fits the data if around 130 GeV. This is an outstanding result.

See also TRF for more discussion especially about the deficit.

References

1. http://blog.vixra.org/2011/07/22/big-day-for-higgs-boson/