

Special Report

Higgs Hunting 2011

Philip E. Gibbs*

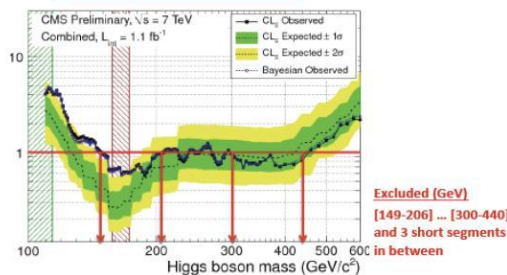
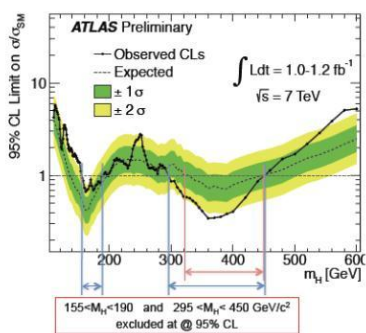
Abstract

The Europhysics HEP conference (EPS) starts in earnest on July 22, 2011 with a good chance that some very strong results on Higgs searches will be revealed. There is likely to be either a plausible signal or an extensive exclusion, and maybe both.

Key Words: LHC, ATLAS, CMS, Higgs, ESP-HEPS 2011, Lepton-Photon 2011.

The first is the three day meeting “Higgs Hunting 2011” in Orsay which ended yesterday. For such a workshop the words of the presenters and discussions after are what count, but these are not webcast so all we have to go on as outsiders are [the slides](#) (**Update 5-Aug-2011:** video recordings of the talks have now also been made available at the same link). Nevertheless there are some interesting points in the slides and it is worth picking out some highlights. The workshop started with a talk by [Massimiliano Grazzini](#) with this slide showing the main new Higgs results and how it makes the theorists feel

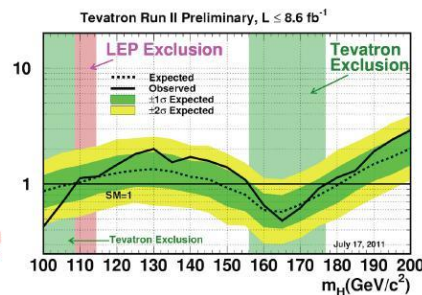
Where we are now !



How a theorist feels.....



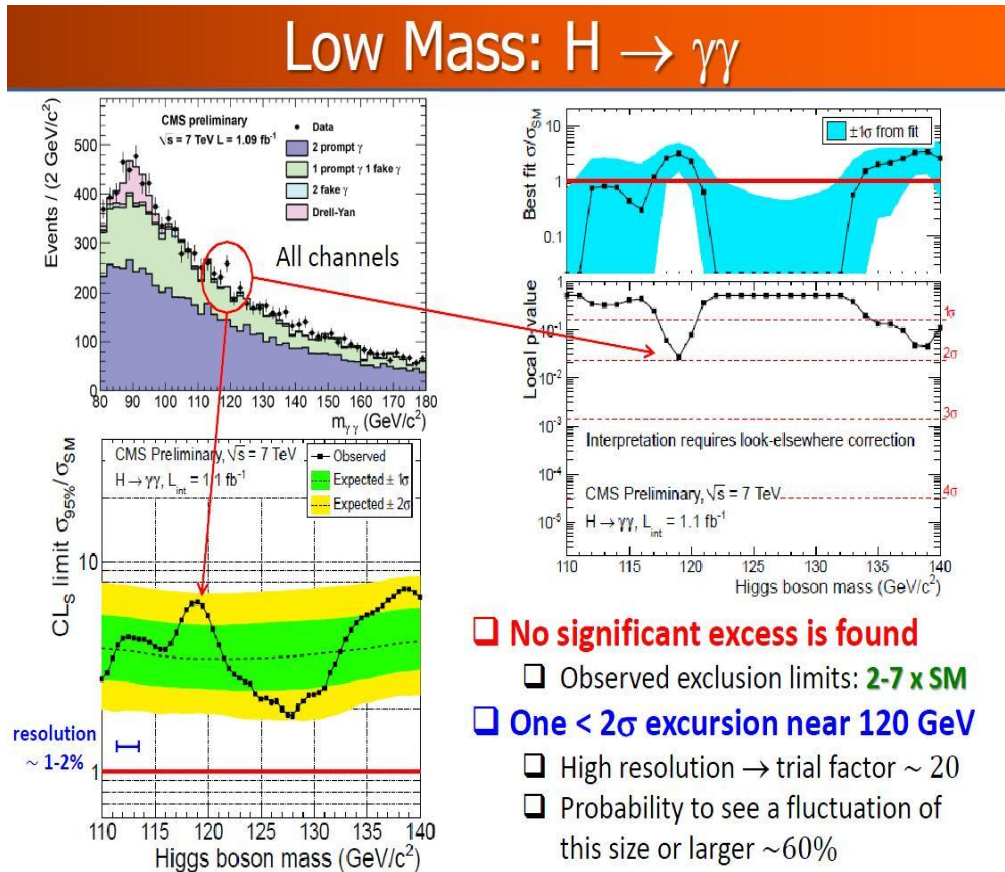
...like having a banquet after years of diet !



These exclusion plots only tell part of the story and it is easy to be misled by excesses that look convincing because they have lots of substructure that makes them appear to show complex signals. In truth the excess comes from a small number of events often seen in just

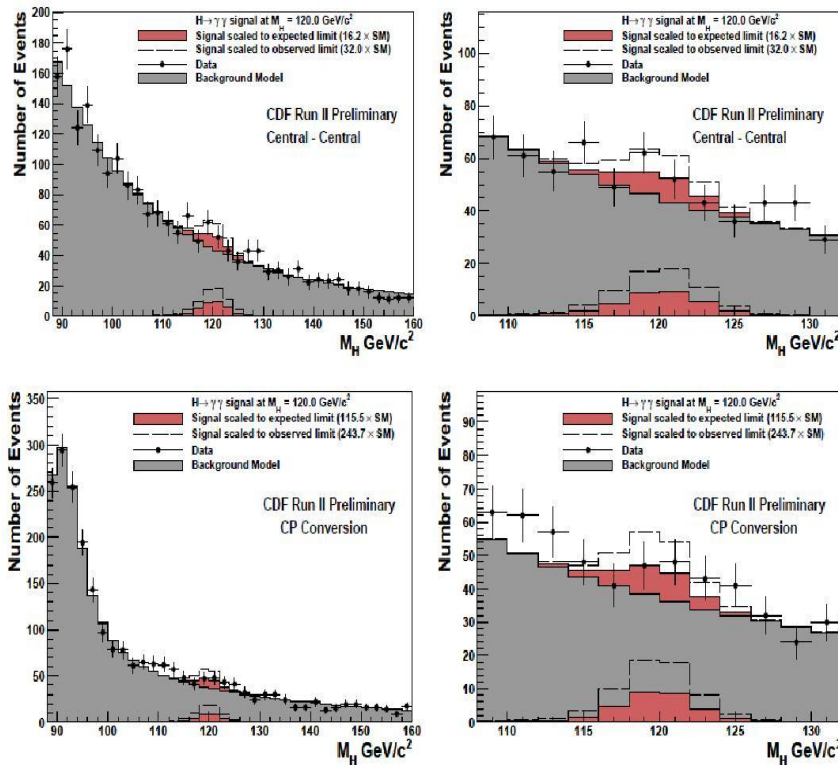
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one channel, with the detailed noise coming from the background. A slide from [James Olsen](#) for CMS shows the event data from the diphoton channel. On the lefthand plot you can see some excesses at 120 GeV and 140 GeV that make bumps in the exclusion plots but on their own they don't count for very much. If you look at enough plots you are bound to see excesses of this size somewhere.



A slide shown by [Elisabetta Pianori](#) shows some signals at around 120 GeV in the same diphoton channels. These are still weak and they are not seen elsewhere. It's easy to get carried away if you are selective about what you show

$H \rightarrow \gamma\gamma @ m_H = 120 \text{ GeV}/c^2$

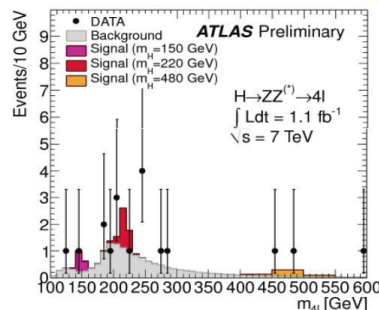


Here is an more extreme example from [Aurelio Juste](#) (see also [Paul Thompson](#)). This slide shows events recorded by ATLAS in the $H \rightarrow ZZ \rightarrow 4l$ channels. As you can see there are not a lot of events there. This leads to the exclusion limits on the right. As you can see there are bumps giving nearly two sigma excesses, but they correspond to single events. These are not signals on their own.

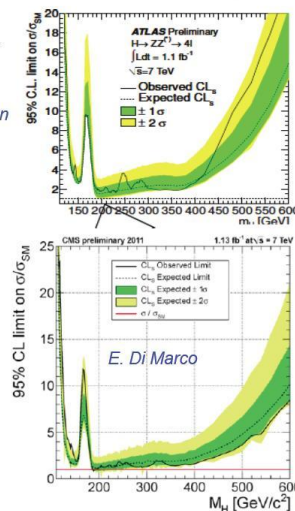
H → ZZ → 4l

- Cleanest channel at high mass but small statistics.
- Main background ZZ production.
- Higgs mass reconstruction with good resolution!

P. Thompson

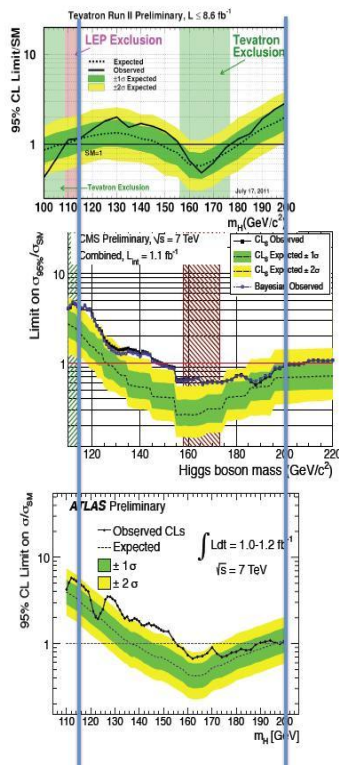


- No excess observed.
- Expected limit: $\sim 2 \times \text{SM}$ in $M_H \sim 200\text{-}350 \text{ GeV}$



E. Di Marco

When we combine all the channels and all the experiments we do get some slightly better signals, but still the signal is quite weak. [Ben Kilminster](#) has conveniently lined up the plots to show us where they agree, Draw your own conclusions.



TEV, CMS, ATLAS

Consistencies TeV, CMS, ATLAS

- Sensitivities to $\sim 2 \times SM$ for 125 to 200 GeV
- Exclusion above 155 GeV
- Excesses overlap 130 to 155 GeV
 - CMS injected signal studies indicate 130-140 GeV can produce such an excess as seen in CMS & ATLAS
 - Tev most signal-like point is 130 GeV
- Sensitivity at 130 GeV
 - CMS : $0.8 \times SM$
 - Tevatron : $1.35 \times SM$
 - ATLAS : $1.4 \times SM$

Here is the update from [Matthias Schott](#) on behalf of the gfitter group

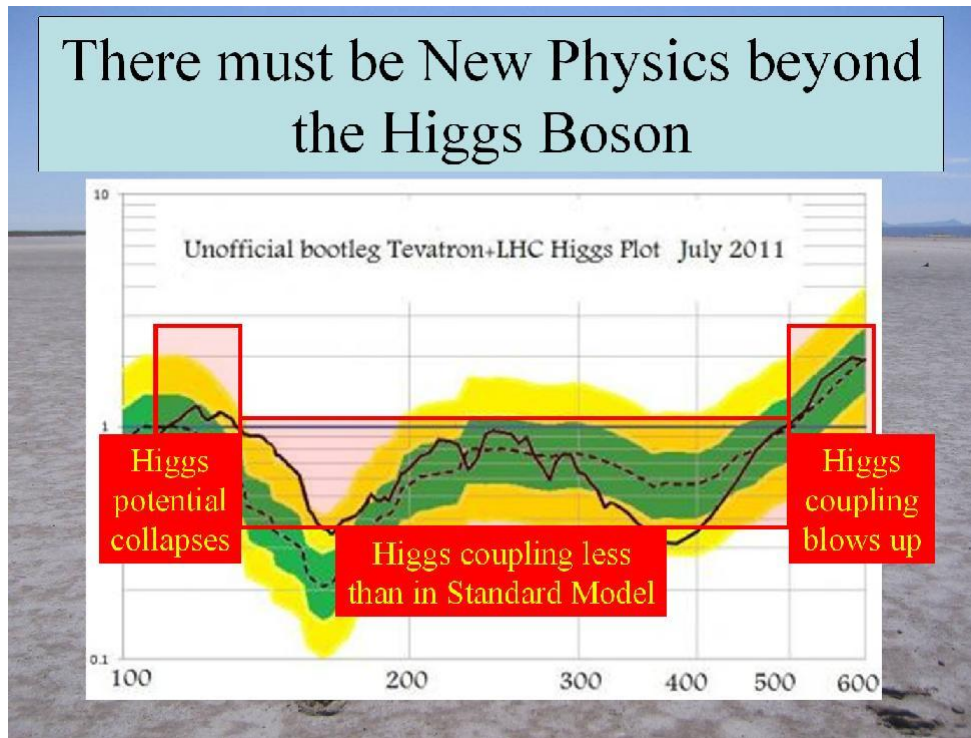
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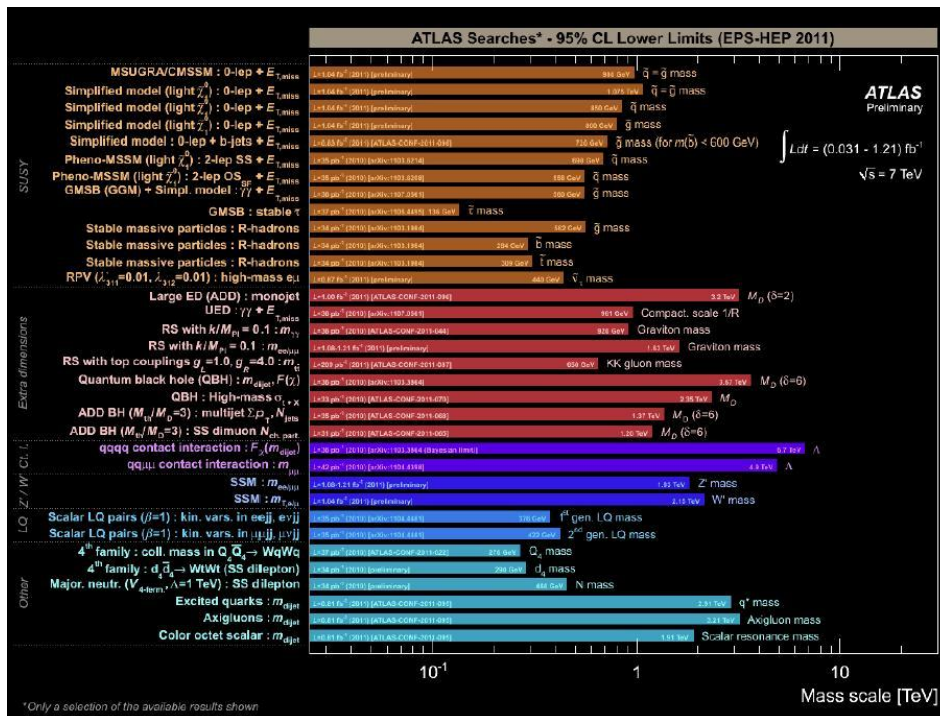
Last Minute Updates

- Update of Higgs-Mass Scan including Tevatron results of EPS2011
 - Standard Fit
 - $M_H = 94.7 +24 -30$ GeV
 - upper 95% CL limit of 166 GeV
 - Complete Fit
 - $M_H = 125 +8 -19$ GeV
 - upper 95% CL limit of 154 GeV
- We did not include the latest ATLAS and CMS results
 - Not yet clear how to interpret the excess(es)
 - Combination not trivial anymore
- In the meanwhile
 - P-value versus M_H of the standard electroweak fit as obtained from pseudo-MC simulation.
 - The error band represents the statistical error from the MC sampling size
- Some speculations
 - $m_H = 140 \pm 0$ GeV : $p = \text{Prob}(18.95, 14) = 0.17$
 - $m_H = 140 \pm 30$ GeV : $p = \text{Prob}(18.1, 14) = 0.20$

As you can see they wont include the ATLAS and CMS data anymore claiming that it is “not trivial anymore”. This did not stop [John Ellis](#) using the “bloggers combination” to draw some tentative conclusions about the standard model Higgs



The discussion was not just about Higgs but I just have the energy to show one slide summarising the mass limits on various possible new particles according to [Paris Sphecas](#) on behalf of ATLAS



References

1. <http://blog.vixra.org/2011/07/31/higgs-hunting-2011/>