Special Report

End of Year Higgs Roundup

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Abstract

All the channels are now giving signals close to the standard model prediction for a Higgs around 125 to 126 GeV except perhaps the γγ where the discrepancy appears to be about 3.2 sigma but with systematic errors included this will drop to about 2.5 sigma. If it stays there is a good chance that it will be explained by new particles such as a charged Higgs or vector-like fermions waiting to show up in other searches.

Key Words: Higgs roundup, 2012, LHC, ATLAS, CMS, CERN.

It has been a sensational year for particle physics with the discovery of the Higgs"-like" boson making front page news and cash stuffed awards going to some of the deserving scientists at CERN who made it possible. Congratulations to them and sympathies to the many people at CERN who were overlooked from the likes of Steve Myers and John Ellis down to the humble post-grad who was pictured falling asleep at the July announcement after having queued all night for his place.

Reuters reports that they will (maybe) finally be able to remove the "-like" at Moriond in March when the analysis of the full dataset is presented. With alternative spin and parity possibilities already ruled out with low to medium confidence many of us have already reached that conclusion. Serious doubters will wait for the self-couplings to be measured in twenty years time before conceding.

In the same Reuters report it is claimed that CERN scientists have "*dismissed suggestions circulating widely on blogs and even in some science journals that instead of just one type of the elementary particle they might have found a pair (of particles)*" Of course the truth is that every independent blog that has been following the developments has debunked the two-Higgs claim. This is the kind of no-thanks we have become used to for our efforts, Merry Christmas (**Update:** see comments). To add a little more credance , here is a plot made by merging two plots from the ATLAS conference note on the ZZ analysis.

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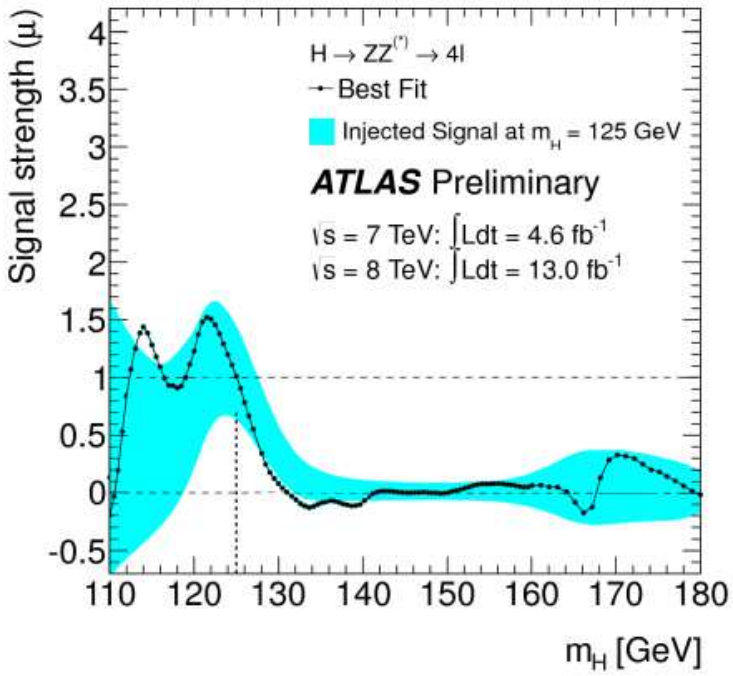


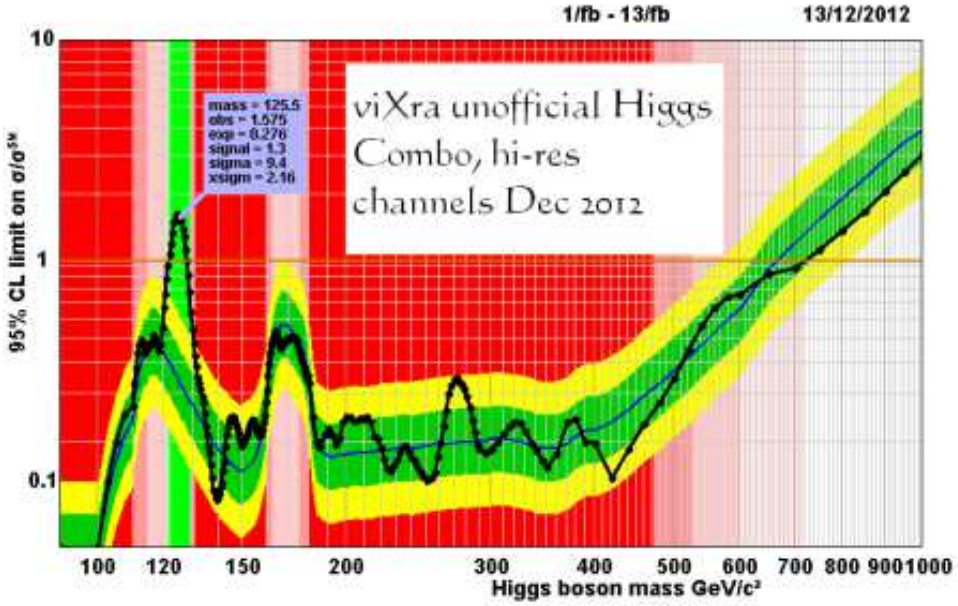
This shows the observed signal best fit for Higgs to ZZ decays (black dotted line) overlaid on the simulated one-sigma bands for a 125 GeV Higgs boson. This makes it clear that the observed signal is perfectly consistent everywhere with a 125 GeV Higgs within about one-and-a-bit sigma. It is only when they try to do a fit to this data that they get a discrepancy with other observations. Obviously the right conclusion is that it is too soon to do the fit because the error bands below 125 GeV are still widening too rapidly.

All the channels are now giving signals close to the standard model prediction for a Higgs around 125 to 126 GeV. Most of the new data is loaded into the Unofficial Higgs Combination Applet so you can roll your own, but here are the combined signals by channel at 126 GeV on a scale where 1.0 is the standard model cross-section, with statistical only errors

Bb: 1.24 +- 0.40
ττ: 0.4 +- 0.40
WW: 0.63 +- 0.21
ZZ: 0.99 +- 0.16
γγ: 1.77 +- 0.24

All of these are close enough to the standard model signal except perhaps the γγ where the discrepancy appears to be about 3.2 sigma but with systematic errors included this will drop to about 2.5 sigma. CMS have not yet updated this channel and rumours are that they see less excess. It seems daft that they have not released the results yet especially after the ATLAS delay turned out to be a fuss over nothing. Show us what you've got, please.

Here too is the unofficial global combination of high-resolution channels (ZZ, γγ) showing an impressive 9.4 sigma signal at 125.5 GeV and just noise everywhere else.



Where does this leave us? Everything looks standard-model-like except the diphoton over-excess which may go away. If it stays there is a good chance that it will be explained by new particles such as a charged Higgs or vector-like fermions waiting to show up in other searches. If it goes we have the possibility of split SUSY or perhaps just the standard model at the LHC scale. Many models have been swept away leaving us to contemplate the implications of an unnatural little mass hierarchy. In one year our view of particle physics has moved on a long way. It's just not clear which direction yet.

References

1. http://blog.vixra.org/2012/12/20/end-of-year-higgs-roundup/