Special Report

BSM CPV in LHCb at HCP11 and New Higgs Combinations Released

Philip E. Gibbs*

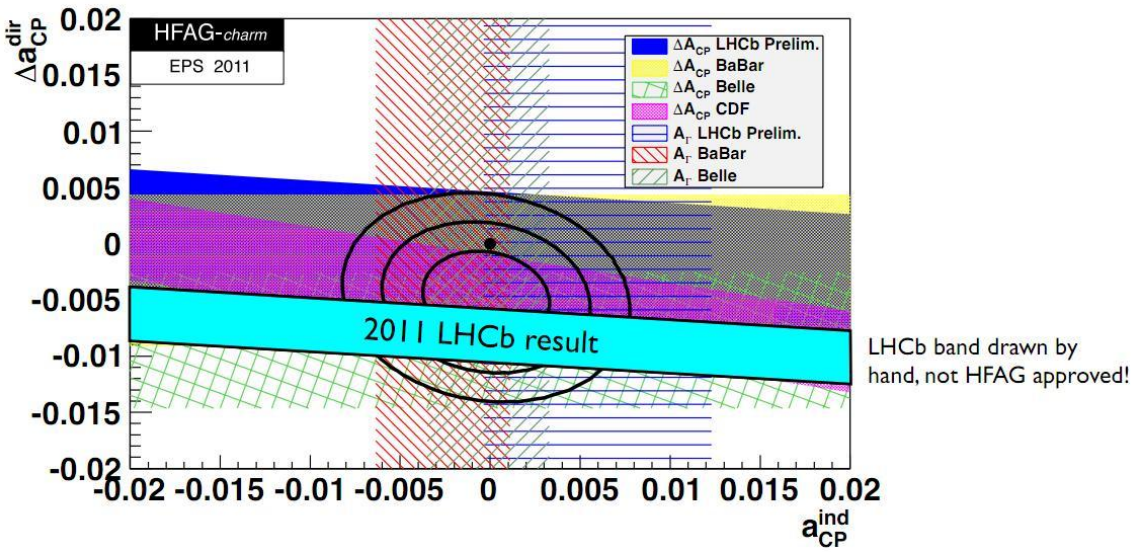
Abstract

Beyond standard model CP violation has been reported by Mat Charles for the LHCb collaboration at the Hadron Collider Physics conference recently. On the other hand, the LHC Higgs combination group has presented their ATLAS+CMS Higgs combination plot at the Hadron Collider Physics conference in Paris. It includes some nice individual channel combinations as well as the full one we have been expecting.

Key Words: BSM, CPV, LHCb, HCP11, new Higgs Combination, CERN.

November 14, 2011: BSM CPV in LHCb at HCP11

Beyond standard model CP violation has been reported by Mat Charles for the LHCb collaboration at the Hadron Collider Physics conference today. Here is the relevant plot in which the cyan coloured band indicating the measurement fails to cross the black dot as predicted by the standard model.



LHCb band drawn by hand, not HFAG approved!

The numerical result which was already rumoured at the weekend is ΔA_{CP} = -0.82% ± 0.25% which is just over 3 sigma significance.

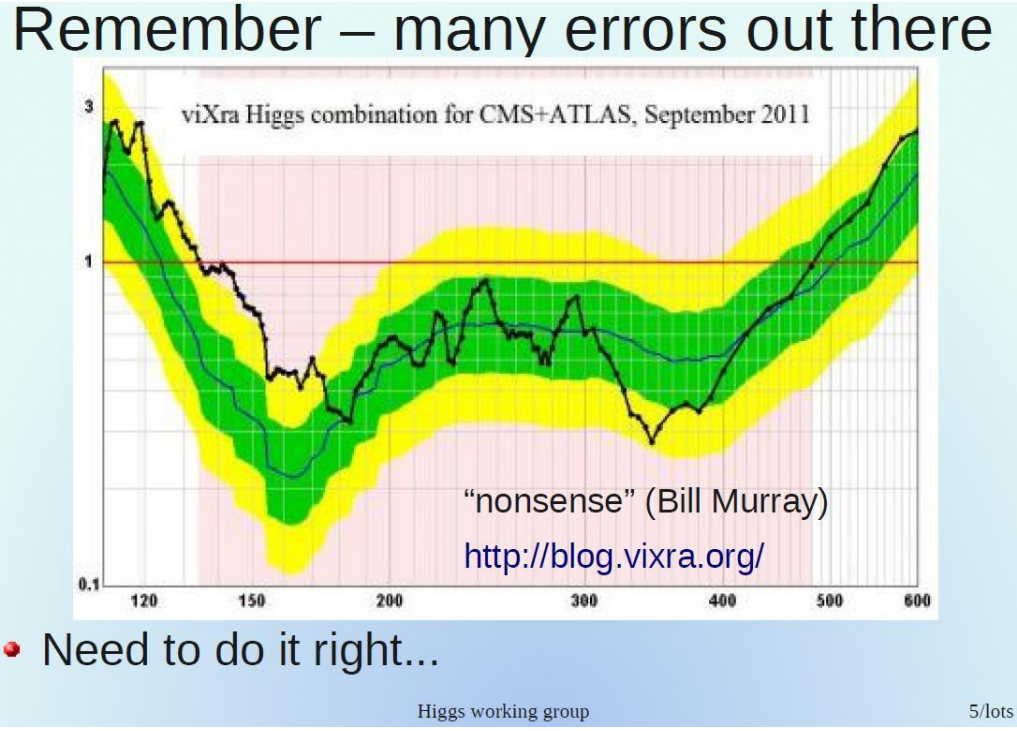
* Correspondence: Philip E. Gibbs, Ph.D., Independent Researcher, UK. E-Mail: phil@royalgenes.com Note: This report is adopted from http://blog.vixra.org/2011/11/14/3036/ ; http://blog.vixra.org/2011/11/18/new-higgs-combinations-realeased/

This measurement is sensitive to new physics such as higher mass particles with CP violating interactions so that could be the explanation. On the other hand it is also a very tricky measurement subject to background and systematics. The significance will improve with more data and already twice as much is on tape so this is one to watch. The interesting thing will be to see if the phenomenologists can account for this result using models that are consistent with the lack of other BSM results from ATLAS and CMS.

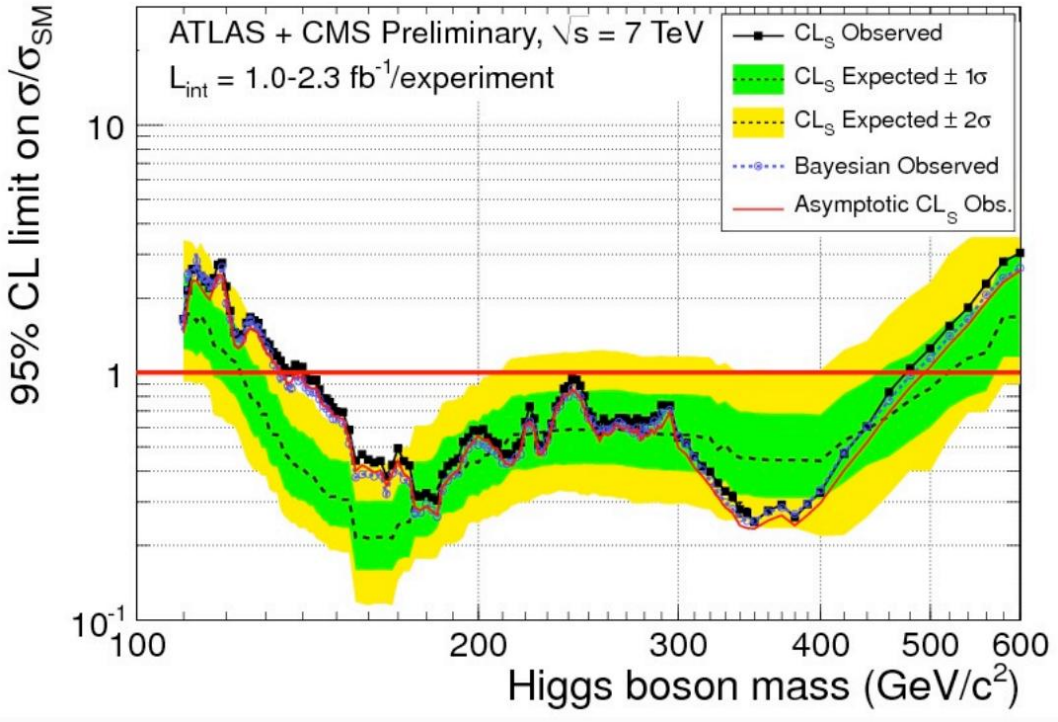
Update: This is also being reported in other blogs of course e.g. here and here, but for the most expert details see the LHCb public page and the CERN bulletin

November 18, 2011: New Higgs Combinations Released

The LHC Higgs combination group is presenting their ATLAS+CMS Higgs combination plot at the Hadron Collider Physics conference in Paris today at noon and the slides of the talk (Gigi Rolandi) are already online. It includes some nice individual channel combinations as well as the full one we have been expecting. Before I look at those here is my approximate version of the full combination that I showed here two months ago. This version of it is taken from a slide shown by "Bill and Vivek" for the Higgs Combination Group themselves at a kickoff meeting in September for the plots finally shown today.



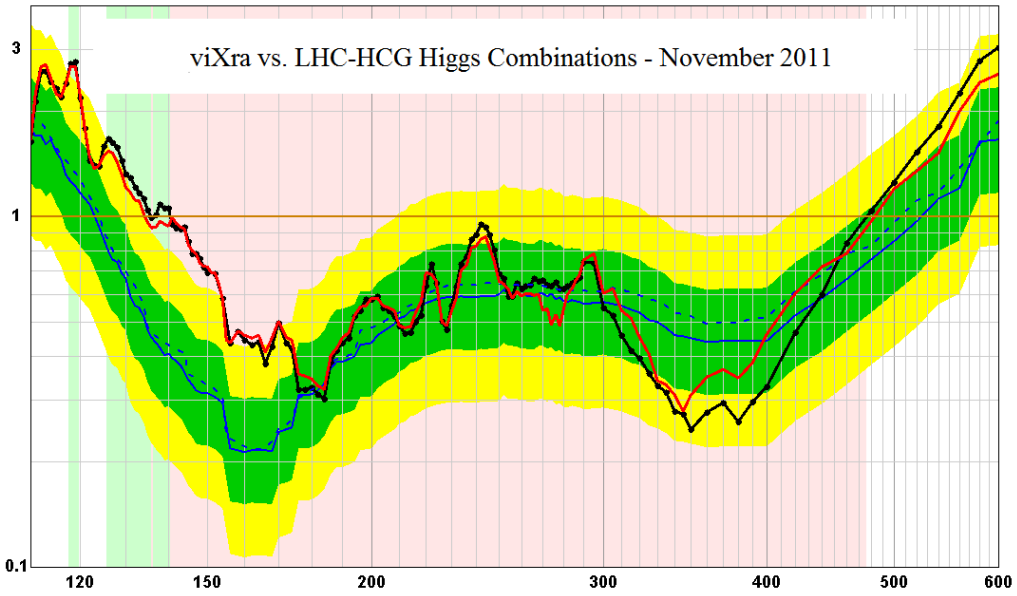
So how did I do? Here is a version of the new combination that conveniently shows some of the variations you can get just by using different methodologies.



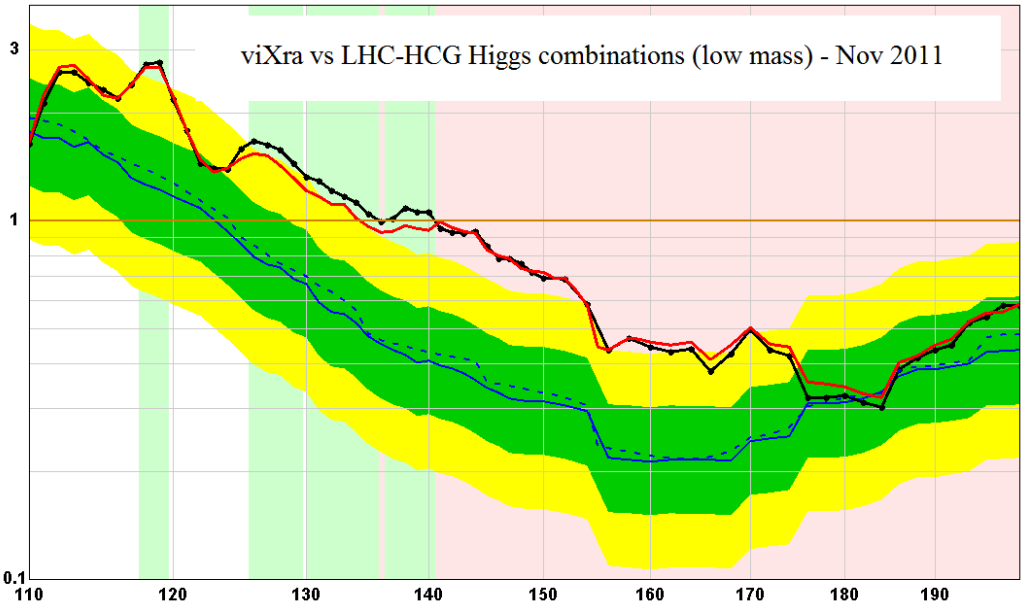
The viXra version of the plot was produced using the minimal data available in the individual ATLAS and CMS Higgs Combination plots shown at Lepton Photon 2011 and approximates the probability distribution function by flat normal error curves. the calculation takes a few milliseconds. The full combination from the HCG goes back to the original data using the real log likelihood numbers and takes into account all known correlations between the data and background calculations. The calculation takes hundreds of thousands of hours of CPU time, yet the difference between the viXra plot and the official HCG one is no bigger than the differences of using alternative methodologies such as Bayesian. This is a nice demonstration of the power of the central limit theorem which says that and error distribution becomes normal given enough data and a finite variance. It also confirms that the effect of correlations on the plot cannot be very big.

To be clear, I think it is important that the full official combinations are worked out carefully because if you want to claim a discovery you have to make sure you have covered all the sources of error correctly. The Higgs Combination Group have done a good job. But if you just want to see the signal in the data we now know that an approximate combination is good enough.

If you want to compare more closely here is the official version with the viXra combination overlaid in red. The areas where it deviates are regions at high mass where there is low background and few events have been recorded. The approximation is not so good there because the normal distribution approximation is less accurate.

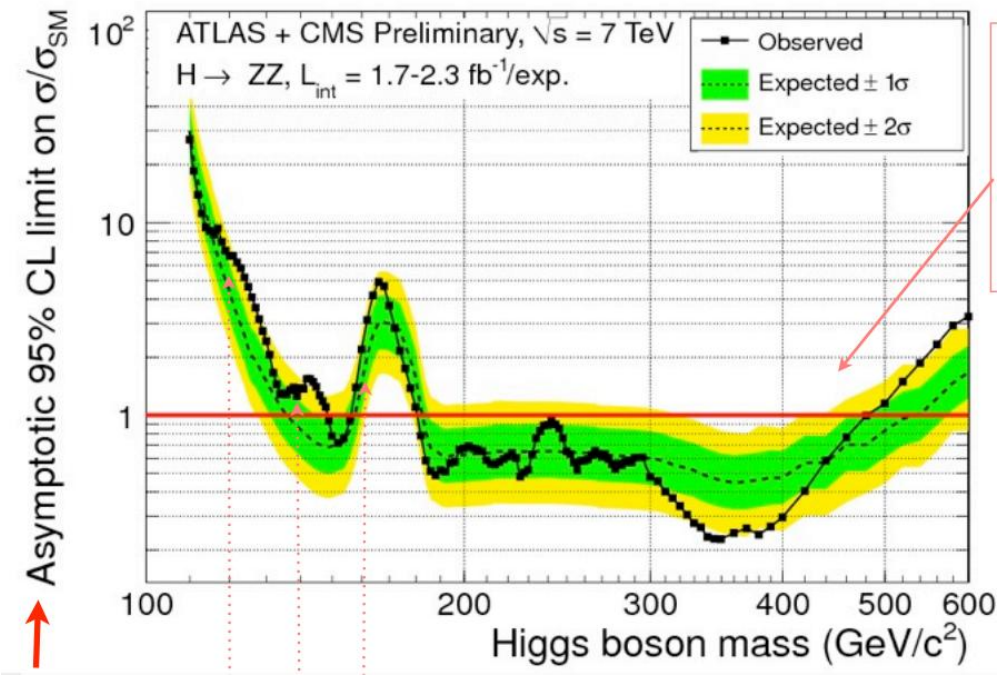


Here is the zoom onto the lower mass region

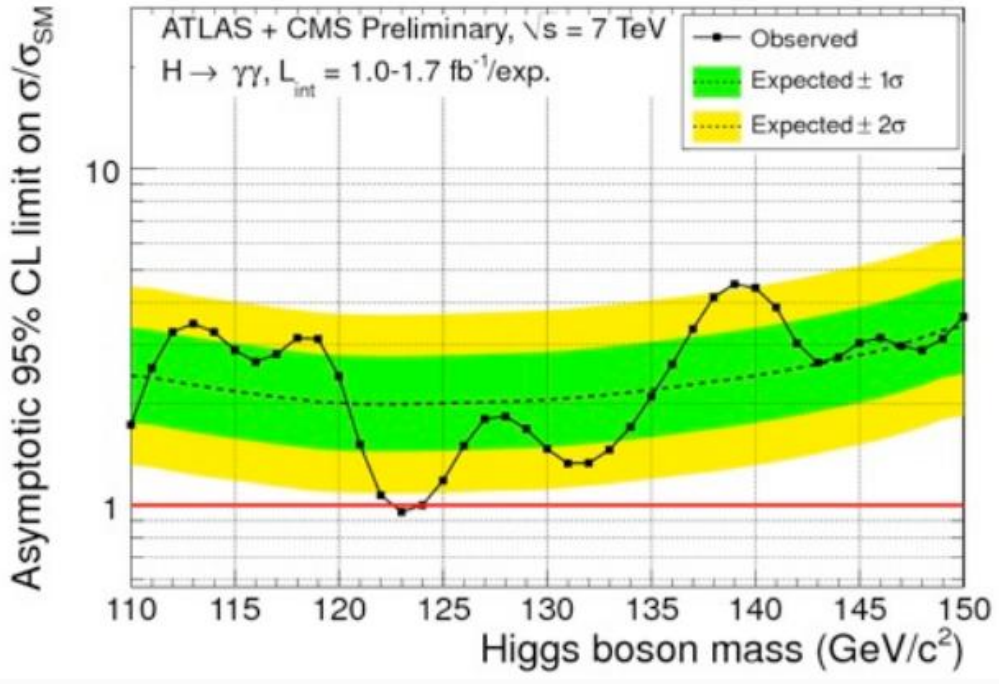


I Like that the combination group have also produced combinations for all the individual channels. My own verisons of these are a little less reliable because there is less data in each case so the normal distribution is not such a good approximation. Even so my plots were not far out which means that with the next batch of data using two to three times the statistics I can expect to get good results.

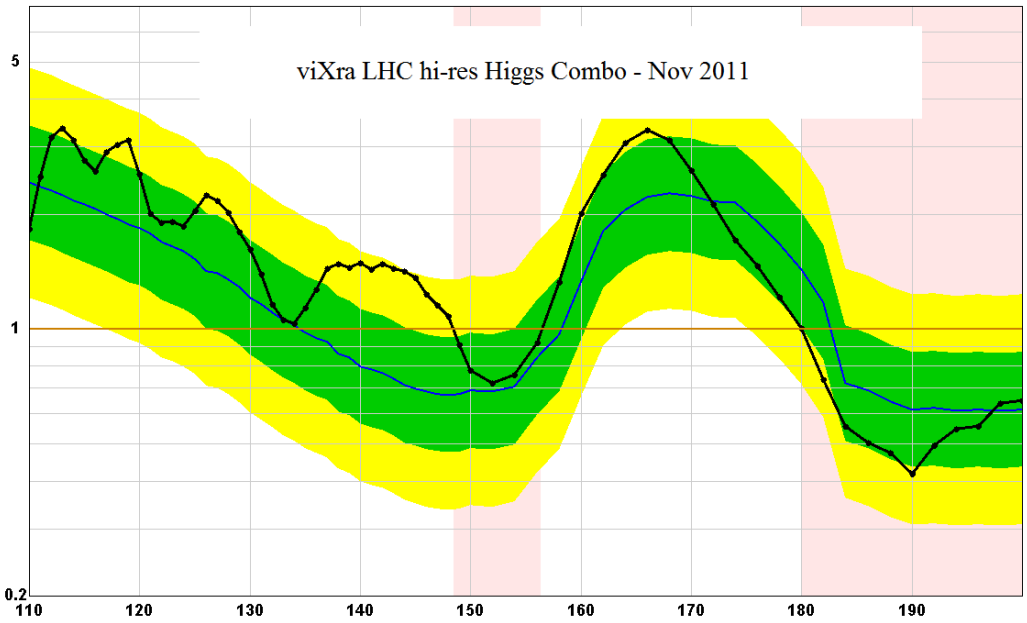
Here is the crucial combination for the golden channel. This is one of the best hopes for a signal because its high resolution and good branching ratio at low mass. If you want to compare with my earlier combination it is here.



The other channel that has the potential to find a low mass Higgs is the direct diphoton decay and there is a new combination for that too



I think it is striking that both these plots have healthy excesses at around 140 GeV and perhaps again at lower mass. To see this better we need to combine them both together.



But this data is by now very old and it is no longer worth speculating on the basis of what the plots might show. The story has already been superceded by rumours over at Résonaances that the 5/fb plots show no more than a 2-sigma excess at 120 GeV. If all goes well we may get first results via the CERN Council Meeting during the week starting 12th December.

References

1. http://blog.vixra.org/2011/11/14/3036/

2. http://blog.vixra.org/2011/11/18/new-higgs-combinations-realeased/