Special Report

Higgs Combination and Fits Revisited

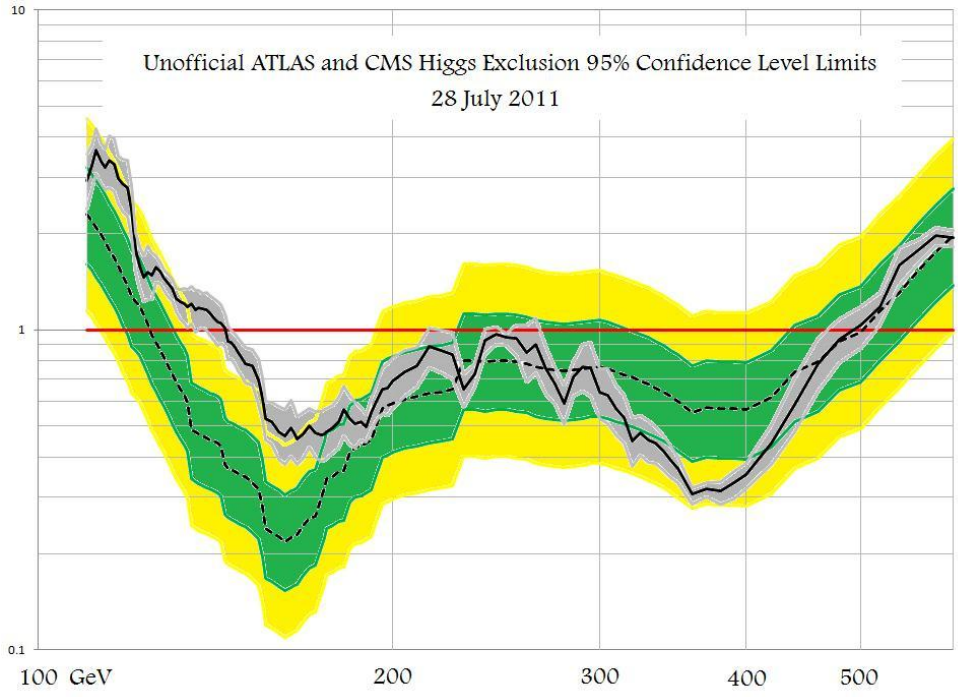
Philip E. Gibbs*

Abstract

Now that the Tevatron Higgs combination is public and I can see how much error there is in the direct combination process, it seems like a good idea to redo my earlier combinations. I know lots of people are interested to see these now to give information about where we stand.

Key Words: SUSY, Standard Model, MSSM, Higgs Boson, CERN, LHC, ESP-HEPS, 2011.

This first plot is the LHC Combination with a grey band to show the uncertainty in the combination process. This is based just on the observation that the Tevatron combination was up to half a sigma out in places and I am assuming that similar size errors can be expected for the LHC combination. Up to you to decide whether this is "Nonsense."



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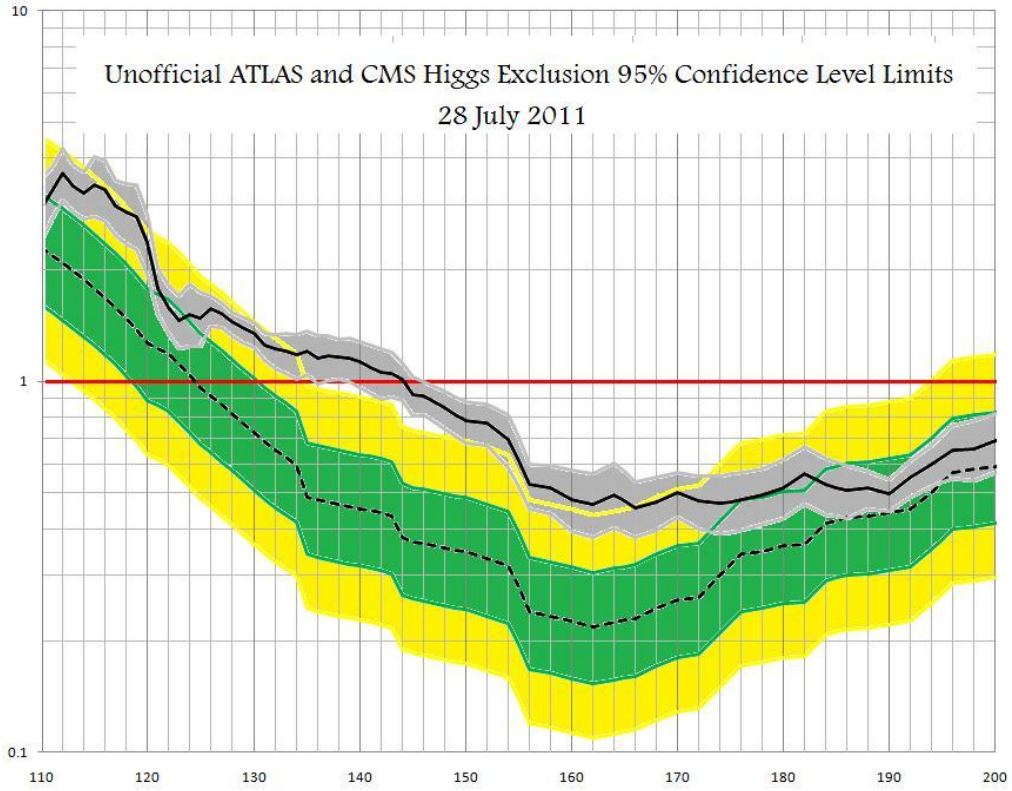
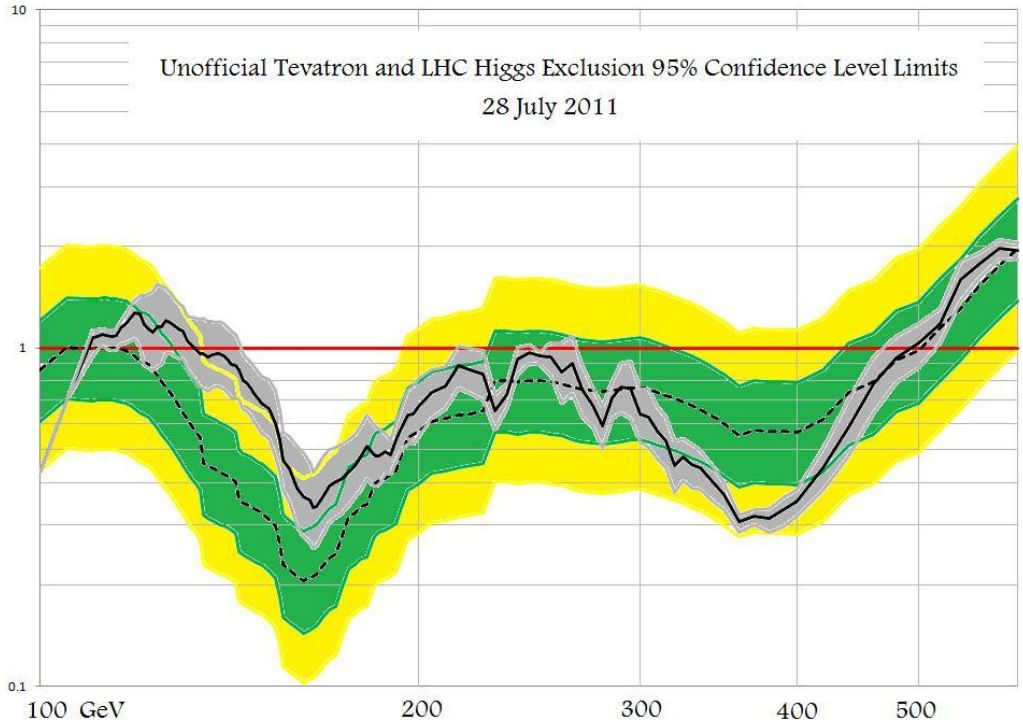
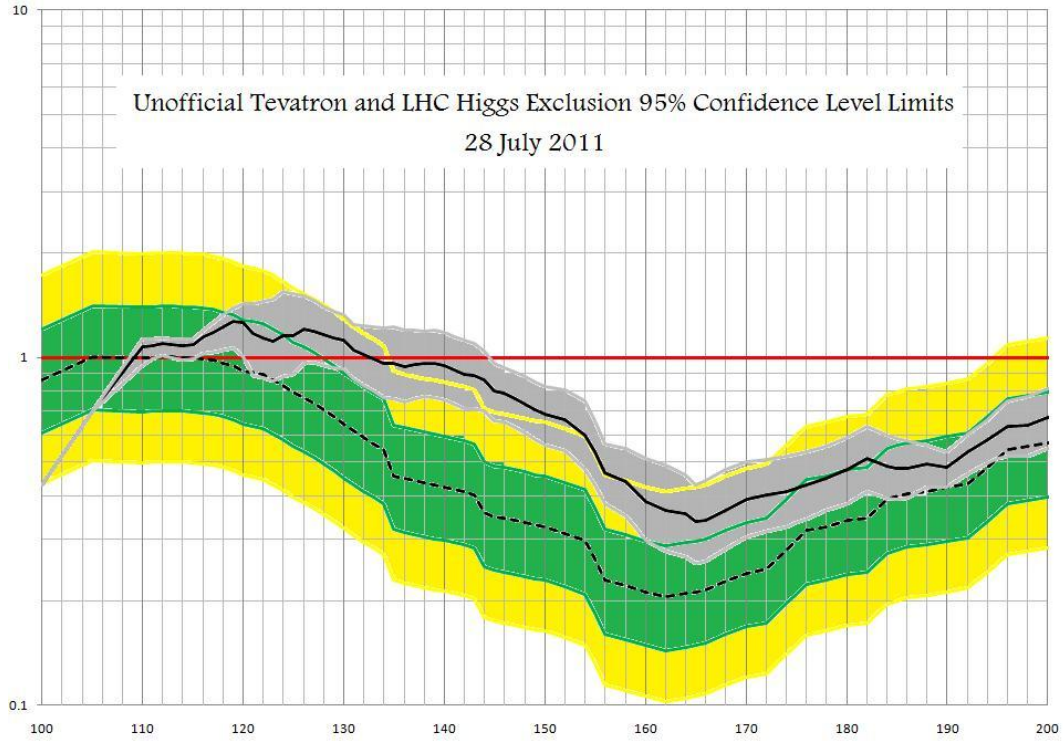
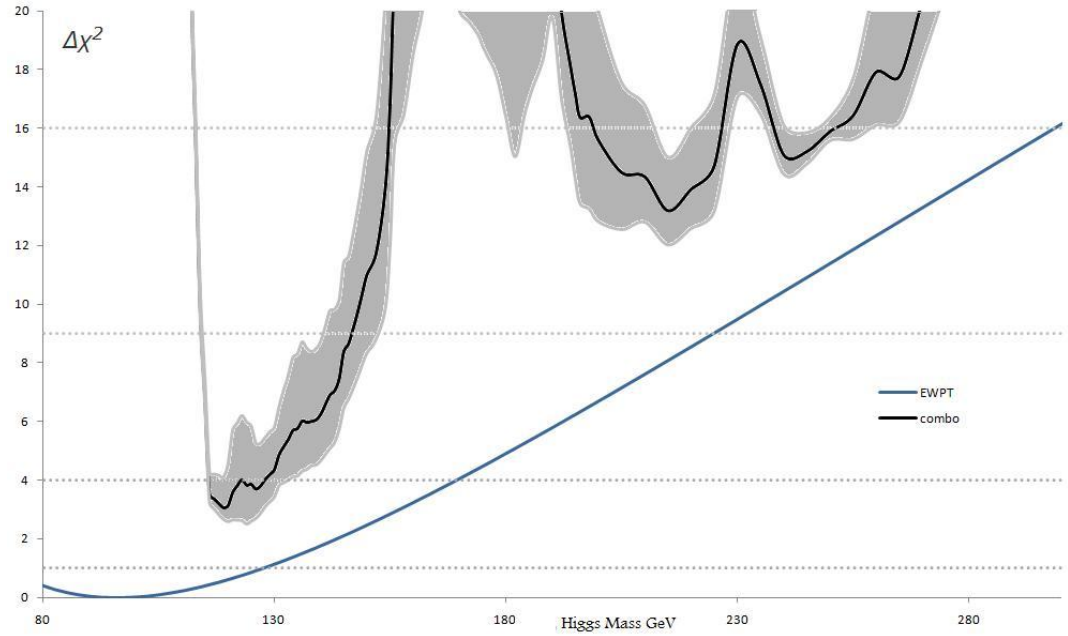


The Tevatron results are still best at the lowest masses so let's combine the new Tevatron combination with this one. there is most uncertainty in the regions where all experiments have similar limits.





What this is showing is that an excess around the 140 GeV area is possible but it is not likely to be consistent with a standard model Higgs because it is below or near the red line. We can strengthen this by doing the global fit with the combination uncertainty shown. The electroweak precision tests reduce the likelihood that a Standard Model Higgs Boson is at this mass.



If you compare this with my previous Standard Model Killer plot you will see that the black line is slightly lower at the minimum point because of the marginally less restrictive Tevatron

combination. The combination uncertainty now added in grey shows that the $\Delta\chi^2$ could go as low as 2.5. Although this is not as dangerous for the Standard Model as before it still corresponds to a 90% or better exclusion for all Standard Model Higgs masses.

Some of the updated SUSY model fits only manage an 85% exclusion and other less restricted supersymmetry models would surely have a better chance. I think it is therefore reasonable to claim on this basis that Supersymmetry is in better shape than the Standard Model Higgs. This is contrary to the slant from the media and some other blogs who suggest that the excesses at 140 GeV are hints of the Higgs Boson while supersymmetry is in more trouble.

Of course many possibilities are still open and more data will certainly make a difference.

Update 29-July-2011: To be clear about what this does and does not rule out.

If we accept the combination uncertainty estimate and the statistical validity of combining all direct searches with electroweak fits:

- We indirectly rule out a lone standard model Higgs boson of any mass with no additional BSM physics at 90% confidence, i.e. a fair bit short of conclusively.
- We directly rule out any standard model Higgs boson at 95% confidence except in the mass ranges 114GeV to 144GeV or 240 GeV to 265 GeV or above 480 GeV.
- We do not rule out other BSM Higgs-type mechanisms including composite Higgs, technicolor Higgs, Higgs doublets, SUSY Higgs etc.
- We do not rule out high-mass Higgs bosons above 480 GeV in combination with other BSM physics that could explain electroweak fits and cure theoretical limitations of the SM at higher energies.
- We see excesses at around 130 GeV to around 160 GeV that could be between two and three sigma level. It might suggest some new physics such as some kind of Higgs particle(s) in this region. However, these are not high levels of statistical significance.

Reference

1. http://blog.vixra.org/2011/07/28/higgs-combination-and-fits-revisited/