Special Report

Global Fit Kills (or at least Wounds) the Standard Model

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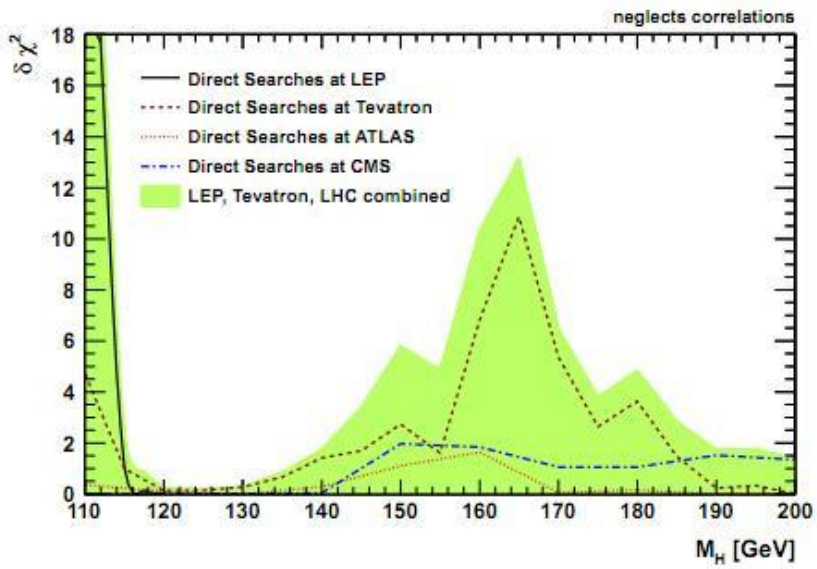
Abstract

A few days ago I showed how to combine the Higgs confidence level plots by adding in inverse square. At the time I did not understand why this worked (I am a bit slow at statistics.) Since then I have looked again at the work on electroweak precision tests and the global fit where you can find the same calculation being done. The inverse square of the 95% confidence level limits is just one-quarter of the $\Delta\chi^2$ estimator. For independent variables these can be directly added to give an overall $\Delta\chi^2$ which can then be mapped back to an overall confidence level limit. This is exactly what I was doing in my combinations. So now I know that these combo plots are essentially correct, neglecting any correlations which should be zero.

Key Words: Standard Model, Global Fit, Higgs Boson, ESP-HEPS, 2011.

The latest update to the Global Electroweak Fit was submitted to arXiv earlier this month. There is a good plot showing the $\Delta\chi^2$ combination of the results from LEP, CMS, ATLAS and the Tevatron.



The global fit also takes into account the measurements of parameters such as the masses and widths of the W,Z and top particles. These can be fitted to the standard model to get another $\Delta\chi^2$ plot for the Higgs mass which looks like this

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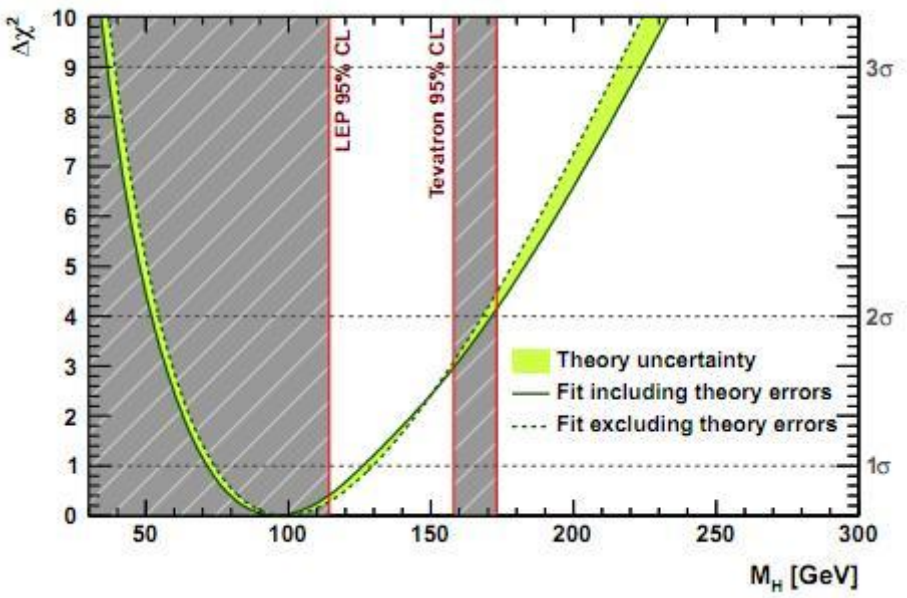
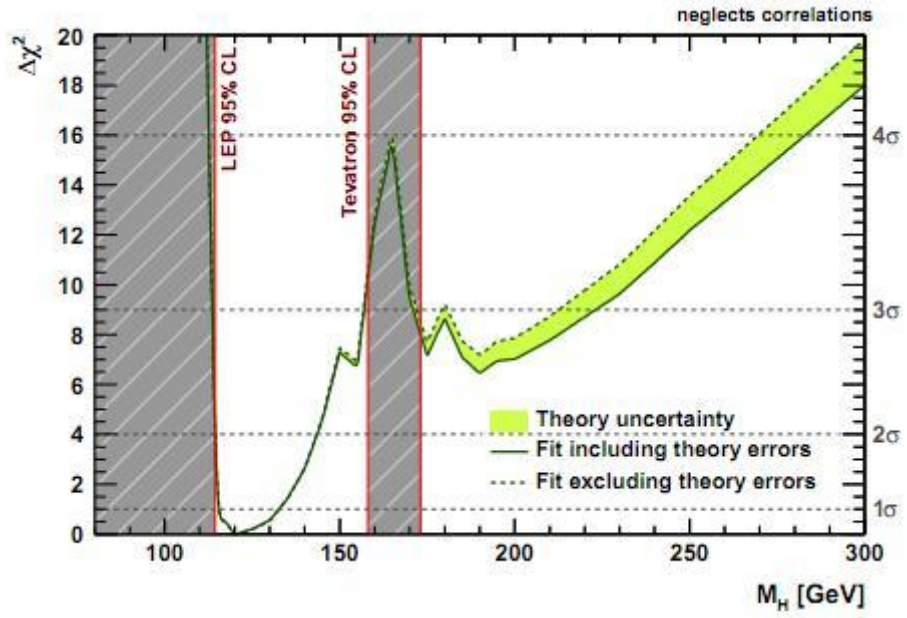


This can be combined with the direct searches to give an overall estimator plot

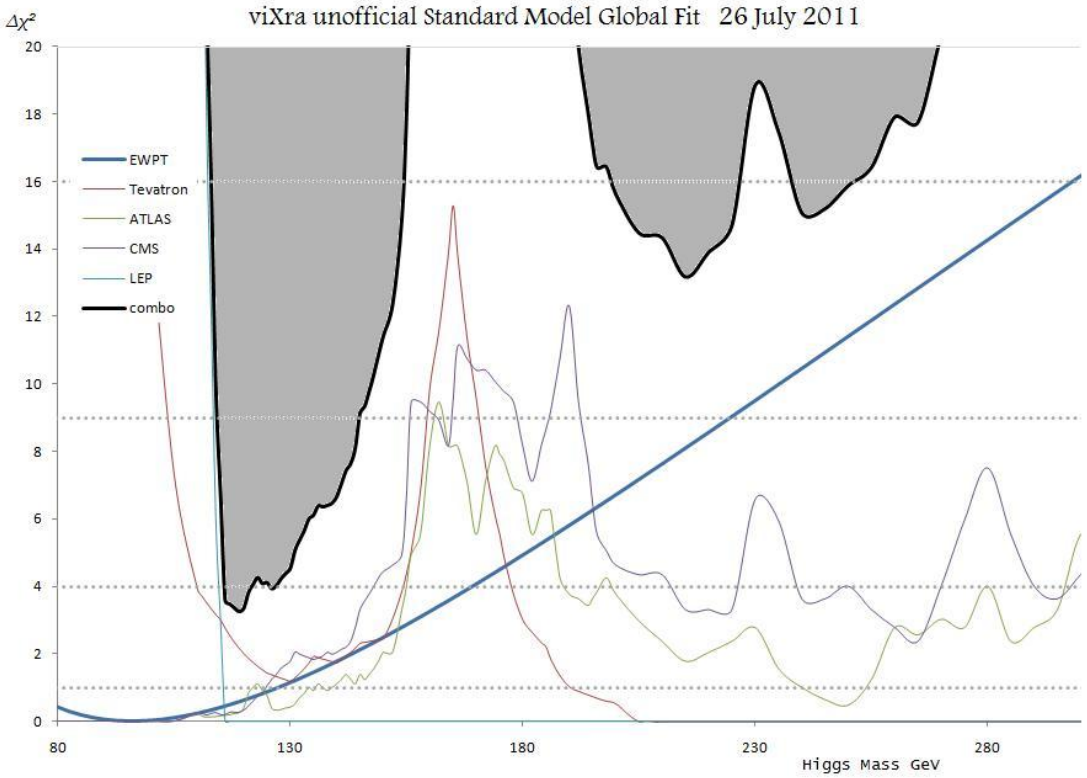


The way you read these plots is to look at the limits allowed below the horizontal dotted lines. The line at $\Delta\chi^2 = 1$ tells us the one standard deviation points so we estimate a value for the Higgs mass,

$M_H = 120^{+12}_{-5}$ GeV. (pre-EPS best fit)

The region below $\Delta\chi^2 = 4$ tells us what is allowed at 95% confidence level. Already this plot limits the Higgs mass to between 114 GeV and 143 GeV assuming that the standard model is correct.

These results were derived before the recent results of direct searches for Higgs announced at EPS HEP Now we just have to wait for the Gfitter group to update their charts using the new data. Of course you know that I am impatient and want to see this now so here is my unofficial reconstruction of the global fit using the recent direct searches and the electroweak fit from gfitter.



As you can see there is nothing in the gray region that survives at 1 sigma level. At 95% confidence everything is excluded except a small window between 115 GeV and 122 GeV. In this region the Standard Model vacuum is unstable.

In conclusion, the Standard Model is dead.

This does not kill the Higgs variants in other models such as MSSM but other fits can and will be made for these, not by me though.

References

1. http://blog.vixra.org/2011/07/26/global-fit-kills-the-standard-model/