

Special Report

Higgs 2012

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Abstract

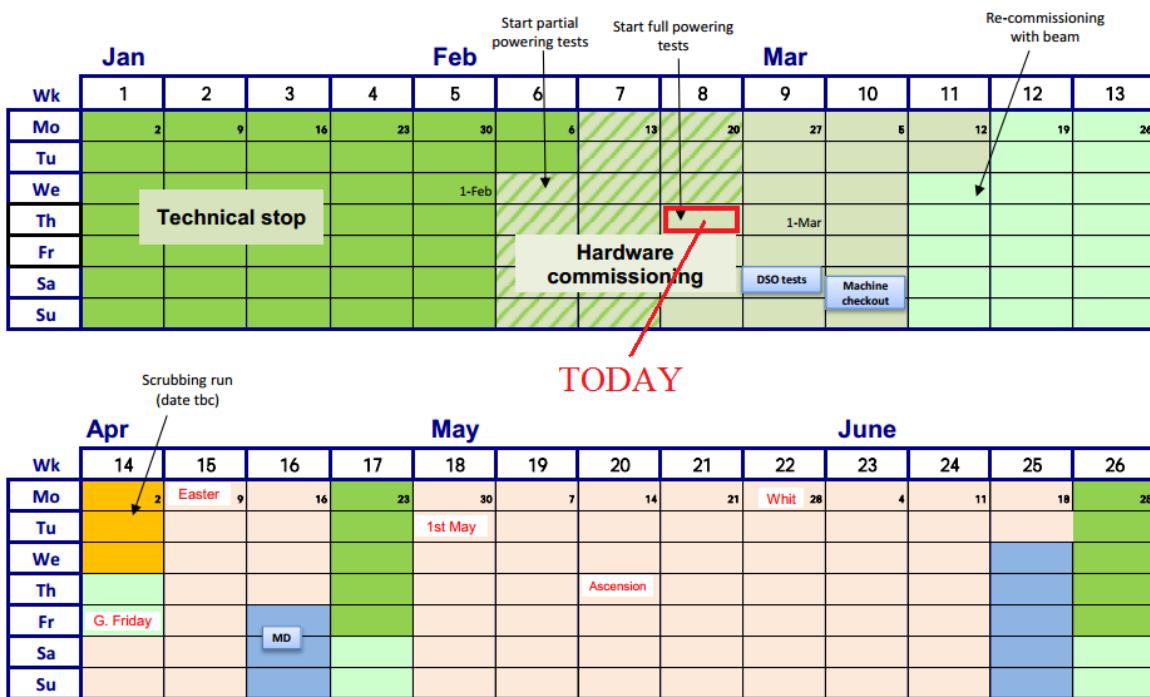
2011 lived up to all expectations and hopes for news about the Higgs Boson, but 2012 promises to be its crunch year and the excitement is about to begin.

Key Words: Higgs Boson, 2012, CERN, LHC startup, ICHEP 2012, Moriond 2012.

February 23, 2012: Higgs 2012

LHC startup

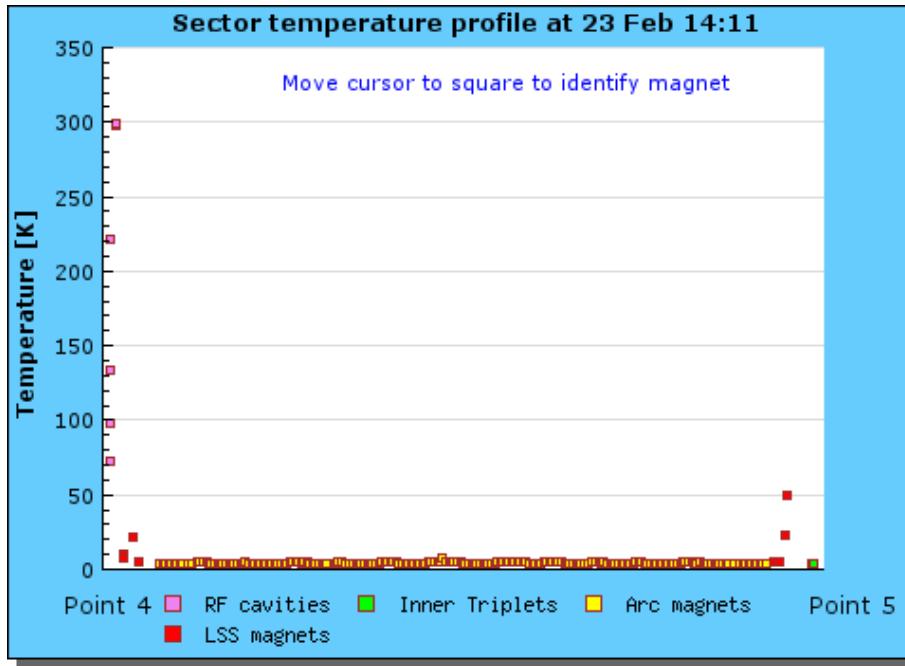
The Large Hadron Collider is getting ready to restart operations after the winter shutdown. The first part of the schedule looks like this



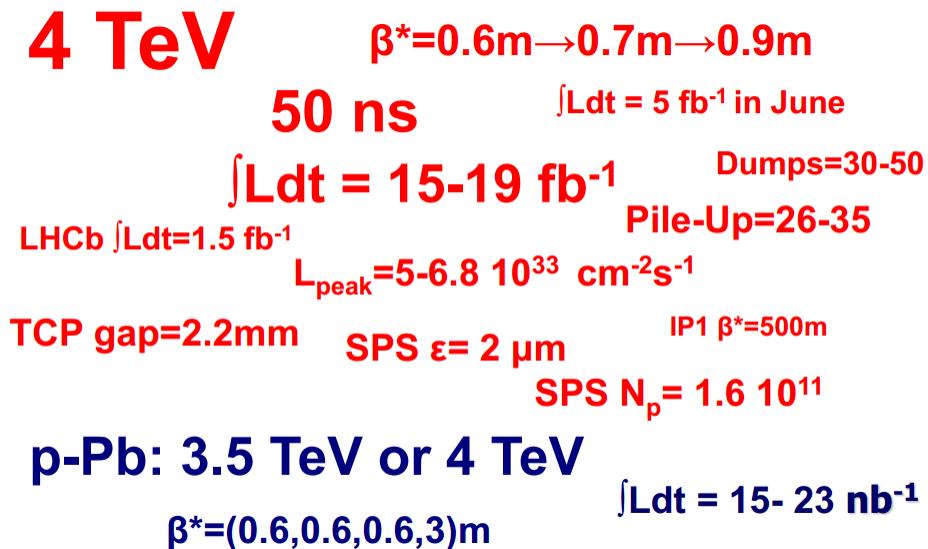
As you can see they should be starting full powering tests today which means the complete circuit of magnets should be cooled down to its working temperature of 1.9 Kelvin. However, as

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you can see in the picture below one of the RF cavities is still at room temperature. I hope it is something that can be sorted soon and they will be on their way.



A summary of how the LHC will run during 2012 can be found in a [presentation by Rogelio Garcia](#). This slide in particular says it all.



They expect 15/fb to 19/fb integrated luminosity for the whole year. Last year they expected 1/fb and delivered more than 5/fb, but this year we should not expect such a large overshoot. The machine has been brought close to its present operating capabilities and the peak luminosity

cannot be pushed much beyond the numbers they are aiming for. The main uncertainty is in how efficiently it will run. last year there were times when it ran smoothly for two weeks and other times when technical issues held up progress for almost as long. The estimates for 2012 are based on the assumption that an average of the two extremes will be seen, but reality may differ. The decision to stick with 50ns at least means that the running will not be too different, although the higher energy and tighter squeeze than last year will be challenging enough.

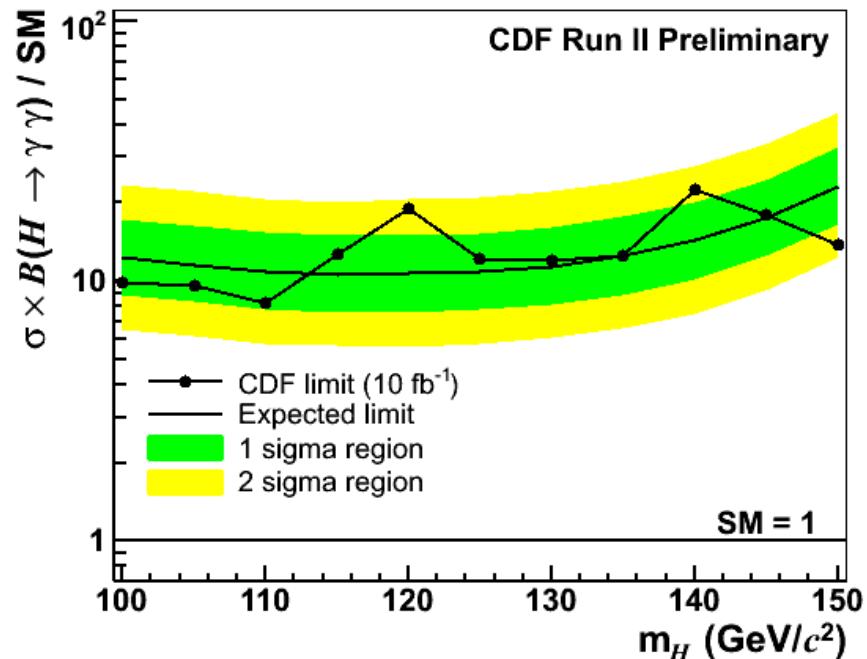
ICHEP 2012

This year the [International Conference for High Energy Physics](#) will be taking place in July in Melbourne. This is the largest meeting on the HEP calendar and it is only held every two years. The experiments will be keen to have something new to say about the Higgs for the occasion so they have asked for 5/fb by June. With the 5/fb already analysed at 7 TeV and another 5/fb at 8 TeV there is a good chance that very convincing evidence for the Higgs will be found. However, I understand that they will not be combining the results at different energies immediately. I will of course perform my usual party trick of combining the plots unofficially to provide combinations over the different energies, channels, and experiments. I expect to be very busy. However, the approximate combinations do not give a definitive answer to how many sigmas of statistical significant have been observed. That will have to wait for official combinations to provide the pvalue plots.

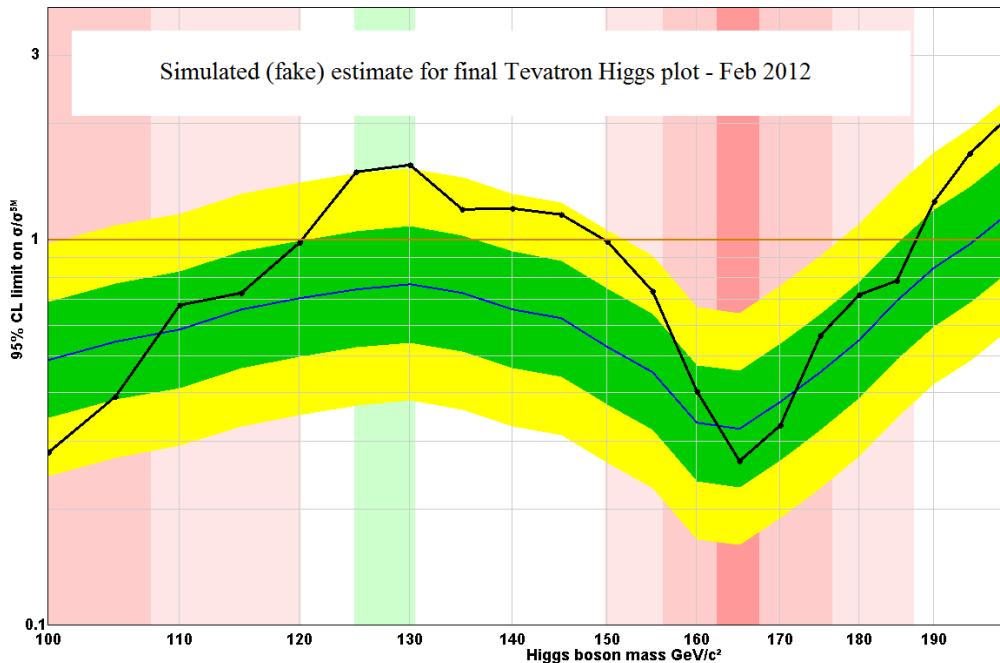
Moriond 2012

Much sooner than ICHEP we will have the Moriond Meetings. This is split into several parts including the [Electro-Weak conference](#) and the [QCD conference](#) (there is also Theory and Cosmology). The Higgs reports should be in the electroweak section but from the preliminary programs you can see that there is more about the Higgs at the QCD meeting with Sunday 11th of March being the crunch day. One talk that is so far noticeable by its absence is the ATLAS+CMS Higgs combination. I am led to believe that this will not now be ready in time due to the recent update by CMS. Producing the combinations is a long process and as the amount of data to analyse increases it can only get longer. It is also possible that the difference in position of the peak excess from the two experiments is giving some cause for delay while they improve their calibration methods to see if they can be brought closer together. I would not be surprised if they abandon the full combination and aim to just get decisive results from both individual experiments instead.

Since the LHC has nothing new to show about the Higgs, the interest will be in what the Tevatron can produce from its complete 10/fb of data. In the last month they have published their final results for the diphoton channel (already reported at [AP](#) and [TRF](#)) here is the plot



This plot tells us almost nothing because the limits are at ten times the expected Higgs cross-section. Any bumps at this level of sensitivity would be almost certainly statistical fluctuations. The Tevatron is not very sensitive in the diphoton channel because Higgs production is lower at the lower energy and because the mass resolution is not very good compared to the LHC. However, the Tevatron does much better in the bb decay channel and their complete combination should be quite good.



The overall expected sensitivity of the Tevatron to a 125 GeV Higgs is 3-sigma we are told. Previous published results reached 2-sigma sensitivity but only a 1-sigma excess was seen, they were probably unlucky. Due to the inferior energy resolution of the Tevatron any excess at the low mass region should also be expected to be quite wide compared to what we have seen recently at the LHC. Here is my simulation of what we might see as the final result.

Hopefully we will see the real deal on 11th March if they are ready in time. If the excess is any bigger than this fake version we should be happy, any less will be a bit disappointing, but it is all down to chance

References

1. <http://blog.vixra.org/2012/02/23/higgs-2012/>