

News

LHC Update: Another Week, Another Inverse Femtobarn

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Abstract

This news is adapted from viXra log (<http://blog.vixra.org>) and contains LHC updates through May 28, 2012. LHC has now passed the milestone of delivering 1/fb in one week to ATLAS and CMS.

Key Words: LHC update, luminosity, milestone, 1/fb.

May 17, 2012: [LHC Update May](#)

The Large Hadron Collider crawled out of a scheduled technical stop two weeks ago and passed through a rocky patch. There was a series of cryogenic failures that slowed the build up back to normal luminosity. They are currently running with the worst hit sectors around point 8 at a temperature of 2.0 Kelvin rather than the normal 1.9 K. This appears to have fixed the problem but as an uninformed outsider I can't help wondering what extra risks this entails. Another issue was emittance blow-up from the SPS that was limiting peak luminosity to around 4.3/nb/s. This was fixed in the last couple of days and now luminosities have returned to the record levels set before the technical stop of around 5.7/nb/s with bunch intensities up to 138 billion protons per bunch. Previous discrepancies between luminosity recorded by CMS and ATLAS have been resolved by data from the Van de Meer scans run just before the technical stop. The two experiments are now in perfect agreement and previous record numbers from CMS have been rescaled downwards. The present luminosity should be close to the maximum they can achieve this year unless they have kept back some tricks for later.

On the plus side, minimum turnaround times are well under two hours which is about half last years waiting time. Recovery from loss of cryogenics also looks much faster than before. This means that if they can avoid problems with cryogenics and RF they should be able to accumulate data at a high rate. As I write they are passing the 2/fb mark for this year's total with a little under 5 weeks before the next technical stop. It should be a breeze to reach the stated 5/fb target in time for the summer conferences.

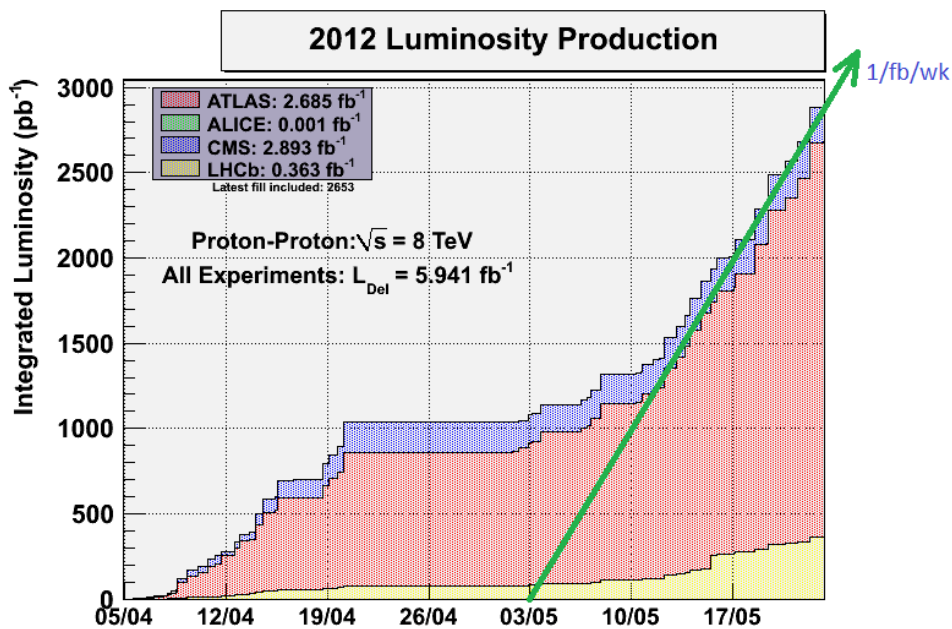
There are a few conferences coming up over the next three weeks that could be opportunities for the experiments to present some early results using the 2012 data at 8 TeV. In particular [Recontres de Blois](#) opens on 27th May and [Physics at LHC](#) begins in Vancouver on the 4th June. However, we may need to wait for the big ICHEP conference in Melbourne where they should be able to add about 5/fb from this years data at 8 TeV to last years similar total at 7 TeV. This looks likely to be a watershed moment for the Higgs search with a likelihood of at least an

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unofficial discovery moment if the combined significance exceeds 5-sigma (it is currently around 4.2 sigma) There is even the possibility that one of the two experiments could pass the discovery threshold with the diphoton decay mode. It depends on how lucky they are with the stats. There is also the possibility that this years data will tell a different story from last year and we will be left waiting for the full year's dataset to complete the story. Whichever way it goes the ICHEP conference is billed as a historic moment for the Higgs boson, and it is just seven weeks away.

May 24, 2012: [Another week, another inverse femtobarn](#)

The Large Hadron Collider has settled into a steady period of running and is now delivering about one inverse femtobarn each week (actually it was about 0.98/fb in the last seven days including a single fill of over 200/pb yesterday.) There are 17 days until the cut-off for ICHEP ([contribution list now filling out](#)), the biggest international particle physics conference of the HEP calendar that is being held in Melbourne from 4th July. If there are no snags they should still be able to reach the target of 5/fb delivered and the experiments will show new Higgs results with at least 4/fb at 8 TeV. That is about as potent as last years 5/fb at 7 TeV. If they get similar bumps at the same places as last year that should settle the existence of the Higgs at least unofficially, but unlucky statistical fluctuations could still leave the result hanging. Official discovery will probably have to wait a little longer. I think they will hold back from combining the new data with last years until both experiments can claim discovery. ATLAS and CMS have shown very similar sensitivity and resolution especially in the crucial diphoton channel despite completely different detector technologies. It would not be fair if one of them got the discovery first due to lucky statistics. They can conveniently time their combinations to avoid that hapening.



According to Paul Collier (commenting at [LHCportal](#)) they still have some scope to slowly increase the bunch intensity up to 160 billion protons per bunch for another 20% increase in luminosity. That is the limit for this year and realistically I think that 1/fb per week will be about the average amount delivered over the remaining 17 week of proton physics minus any time for recovery from technical stops, extra MD or special runs for TOTEM. They should comfortably reach their target of 15/fb total delivered to each of ATLAS and CMS.

Full Higgs combinations of ATLAS+CMS have not been seen since autumn last year when they had just 2/fb. Although they have not given any explanation for this there are several factors that come into play. The sheer complexity and quantity of all the data means that the big combinations require enormous amounts of computer resources (when done exactly). By time they could complete the calculation the experiments have usually added something new making the answer obsolete before it is ready. I imagine they can't afford to waste their computer resources or manpower in that way with so many other things to be done. Another problem is that the two experiments have seen maximum peaks at slightly different Higgs masses. The favorite theory for this is that the energy calibration has worked out slightly differently through systematic errors in the two experiments. The consequence is that the combination only gives a small improvement in significance over the individual results. But I think the most important reason for not doing the full combination now is that they can reach discovery level this year with both experiments separately. It will make a more spectacular and convincing presentation of the discovery if they can do it that way rather than with a cross-experiment combination. I could be wrong but I think there is a good chance that they will do full combinations of ATLAS+CMS only during the long shutdown as part of a more detailed analysis to compare observations with the standard model predictions. Until then people will have to be content with unofficial approximate versions.

While you are waiting for ICHEP do not miss the meeting at [Blois](#). The first session has some particularly interesting talks not least of which is a presentation by Nima Arkani-Hamed on why he thinks a 125 GeV Higgs smells like SUSY. It's a 30 minute talk but there is already a YouTube version online where he crams it into 1 hour 42 minutes and still skips slides at the end. You are recommended to set aside the time to watch it.

Update 25-May-2012: They have now passed the milestone of delivering 1/fb in one week to ATLAS and CMS. Here is a table of the fills that did it with the latest still running.

fill	start date time	dur	ATLAS /nb	CMS /nb
2663	25.05.2012 03:30:00	06:00+	100000+	100000+
2660	24.05.2012 17:34:00	01:14	24315.4	24738.1
2658	24.05.2012 03:53:00	01:22	26748.5	27252.6
2657	23.05.2012 18:41:00	06:03	92480.8	93457
2653	23.05.2012 08:55:00	00:37	11738.2	11521.5
2651	22.05.2012 08:48:00	19:35	209131.5	201505

2649	21.05.2012 13:41:00	07:19	109045.9	111447.2
2648	20.05.2012 18:15:00	05:34	78680.4	80486.8
2646	19.05.2012 13:14:00	16:06	187771.5	194043.1
2645	19.05.2012 10:23:00	00:30	9981.2	10042.3
2644	18.05.2012 13:55:00	14:45	170798.8	176034.6
		total	1020692.2	1030528

References

1. <http://blog.vixra.org/2012/05/17/lhc-update-may/>
2. <http://blog.vixra.org/2012/05/24/another-week-another-inverse-femtobarn/>