

LHC Update: LCH Plans for 2011 & Beyond

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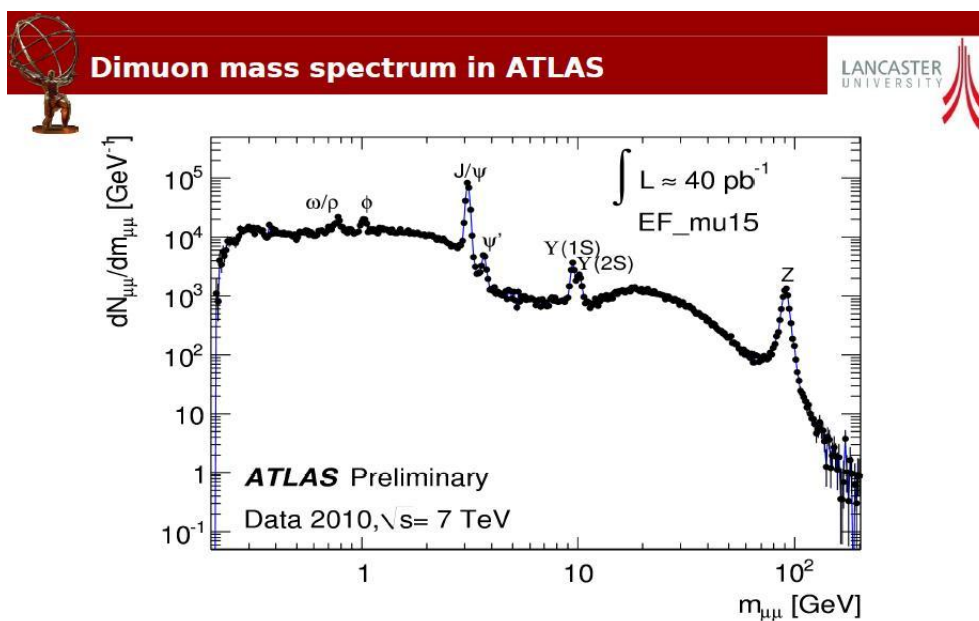
Abstract

This news article contains LHC updates for the period of November 29, 2010 to December 21, 2010 which appeared in viXra Log at <http://blog.vixra.org>. In other news, current FQXi contest is also mentioned.

Key Words: LHC, Update, status, plan, 2011, 2012.

December 3, 2010: [New LHC Plots with 40/pb](#)

Some plots of data from the LHC using the full 40/pb are starting to show up including this dimuon plot from ATLAS



One muon with $p_T > 15 \text{ GeV}$, the other $> 2.5 \text{ GeV}$

This was from a talk by Vato Kartvelishvili at a "[Physics Day](#)" colloquium in CERN today.

December 3, 2010: [LHC run may be extended until end of 2012](#)

Since the Large hadron Collider started physics runs early this year, the plan has been to run to the end of 2011 in order to collect 1/fb of data at 7 TeV. After that the collider would shut

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down for over a year to upgrade the magnets before allowing it to run at its full 14 TeV. But the plans at CERN for the LHC have always been somewhat flexible. Now with Fermilab hoping to extend the running of the Tevatron in order to scoop the LHC to the discovery of the Higgs, CERN are fighting back with talk of an extension of the current run that might find the Higgs even sooner.

This year the commissioning of the LHC has run somewhat better than hoped. In July when they stepped up the beam intensity they found it easier than expected to get to the designed count of 115 billion protons per bunch circulating in the ring. This meant that they could reach their target luminosity of 100/ $\mu\text{b/s}$ without stretching other parameters to their potential limits. By time the proton runs came to an end for the year, they had reached twice that target and were already trying out procedures to go to higher luminosity next year. With so much optimism in the air they have recently been talking of increasing the energy to 8 TeV during 2011. Projections suggest that they may be able to collect between 2/fb and 7/fb at that energy if they can live up to expectations of run efficiency. This would make the discovery potential of next year's run much better than anticipated and so the payoff for continuing the run is much better. With such considerations in mind the CERN directorate is now proposing to extend the run to two years instead of just one, taking them to the end of 2012 before the long shutdown.

It remains to be seen how this will affect the decision at Fermilab to continue their run. Although they have expressed a strong wish to continue, they can only do so if they can find an extra \$150 million and it is not clear where that will come from. Even if the money arrives as a new budget, other experiments at Fermilab will be held back by the continued running of the Tevatron. Not everyone thinks this is the best way forward for the lab.

As a successful run of Heavy Ion collisions enters its last few days at the LHC, the beam commissioning teams are now preparing their cases for how to run the collider when it starts up next year. A [meeting at Evian](#) on the 7th-9th December will be used to go over the possibilities with final details to be hashed out at Chamonix in January. The LHC is then expected to restart proton physics in February.

Meanwhile there will be some conferences to present any physics results they have using the 40/pb of data collected so far such as the "[LHC First data](#)" conference in Michigan on 12th December. (This does make me wonder how many more times the words "LHC" and "First" can appear together in a title.) We should not expect new positive results unless the physics gods are unusually kind with their favours.

As the year comes to an end let's take this opportunity to thank CERN for allowing us such an open public view of the workings of the accelerator. We also thank the physicists who work on the detectors for bringing us their initial results so quickly. We look forward to so much more next year and beyond.

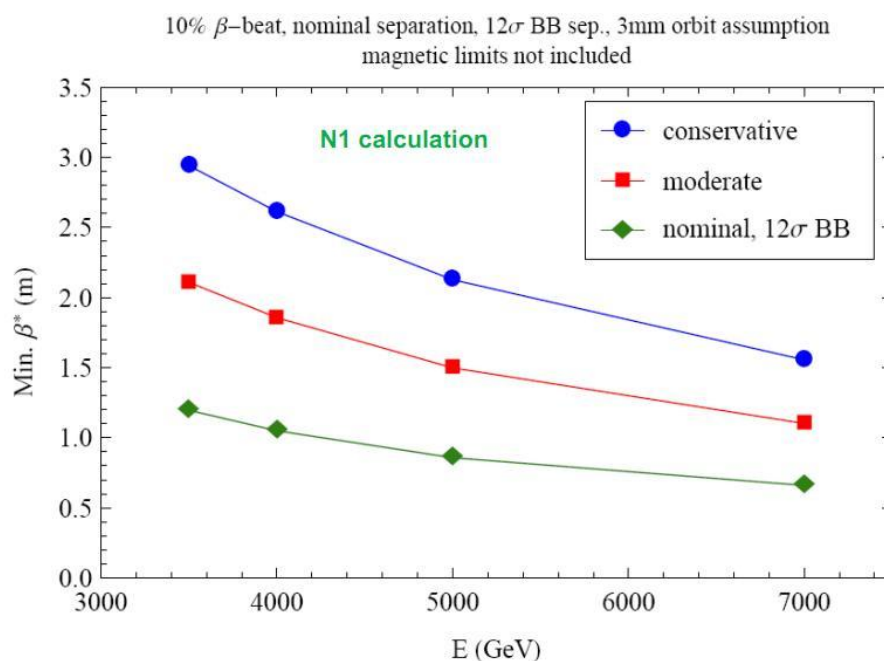
December 11, 2010: [LHC Plans for 2011](#)

The Large Hadron Collider ended its 2010 physics runs on 6th December last week and has now shut down until February. For the rest of the week the LHC beam teams met up in Evian to open discussions on how to run the LHC throughout 2011 with the goal of collecting at least 1/fb of integrated luminosity. The slides from the full set of talks can be found on the [CERN indico server](#).

Towards the end of the proton runs this year a peak luminosity of 0.2/nb/s was reached. If they could run very efficiently during the year this would be enough to collect 1/fb, but that is too optimistic. To be confident of reaching the target they will aim for a peak luminosity of 1.0/nb/s. There will also be a small increase of the collision energy from 7 TeV this year to 8 TeV in 2011.

Reaching a luminosity of 1.0/nb/s will take some time and hard work. The increased performance will come from several factors, but the main ones will be an increase of bunch numbers up to 930 per beam and a tighter beam squeeze down to β^* of 2.0m or less. Last year they reached 368 bunches using a bunch spacing of 150ns. To get more bunches in they must decrease the bunch spacing and at the end of last year they already tried 75ns and 50ns spacing. This was not without problems, but they think they can manage 75ns runs for next year to fit in the 930 bunches.

It is less clear what value of β^* they will aim for. The luminosity is inversely proportional to the β^* value and last year they squeezed to 3.5m. If they can get this down to 1.75m it will give a factor of 2 in luminosity. This plot from a [talk by R. Bruce](#) gives some idea of what is possible. Notice that the higher energy helps to get to lower beta



To implement these new parameters there will have to be a completely new beam and collimator setup. Last year it took about three weeks in August to perform the commissioning

for the parameters used in the final runs and they expect a similar time next year. That will be followed by a gradual build up of luminosity by increasing the number of bunches. According to a scenario [suggested by Mike Lamont](#), first they will go up in steps of 50 bunches until they reach 300, then in steps of 100 until 900 bunches. This would take another six weeks to complete (This obviously not intended to be a precise plan since they normally go up in multiples of 24 bunches.) This means that full operating conditions will not be reached until May. After that the amount of data they can collect depends on how efficiently they can run the collider for the remaining 6 months of proton runs. A draft schedule can be found in the [talk by J. Wenninger](#) . Unfortunately there are no slides for the closing words from Mike Lamont and Steve Myers.

There remain a number of issues that will make the run for 2011 challenging. The famous “Hump” is still causing some problems and its cause is unknown. The UPS (Uninterruptable Power Supply?) is a suspect but the unusual pattern of the interference is hard to explain. They are working to pin down the true frequency of the signal by observing its effects and are using magnetic probes around the ring to try and pick it up directly. The beam damping systems have largely removed the problem of the hump, but it still has some potential to destabilise the bunches and reduce luminosity. Hump spectators can read the [slides of G. Arduini](#) for full details.

Other problems considered include the UFOs (Unidentified Falling Objects) which may be cleaned out by running some high intensity beams for a while. The e-cloud is another big issue that was found at the end of the runs this year. It is a build up of electrons that leads to unwanted background collisions near the detectors. No doubt some work will take place during the shutdown to help address these and other problems for next year. Final decisions on run parameters and schedule will be taken at the Chamonix meeting in January.

Meanwhile, a conference on [LHC First Data](#) is scheduled for next week!

December 21, 2010: [LHC Conference Round Up](#)

The LHC shut down for the winter on the 6th December and since this month we have already had several conferences with new results released and some indications of future plans for the LHC. In particular

- [First Results, Heavy Ions](#) – 2 Dec
- [Charm and Bottom](#) 3 Dec
- [Evian Beam Workshop](#) 7-9 Dec
- [LHC First Data](#) 12 – 15 Dec
- [End-of-year Jamboree](#) 17 Dec
- [Precision Physics](#) 15-18 Dec

In some cases we have seen plots using almost all of the 45/pb of data so far collected. The summary is that so far no new Beyond-Standard-Model discoveries have shown up. Some

new limits have been set for exotic particles and the allowed parameter space for SUSY has been trimmed down.

The lack of black holes in particular has led to a flurry of headlines saying that string theory predictions have failed. On this subject I am fully in agreement with [Lubos when he says](#) that very few theorists expected (including string theorists) expected to see these black holes. They are part of a speculative theory about large extra dimensions. It has some interesting features, but it is not a definite prediction from string theory.

Lubos has also pointed out that some results from the Tevatron are [favouring a SUSY Higgs sector](#). The elimination of some SUSY parameter space is not a big deal for SUSY supporters. There was always a possibility of SUSY showing up at this point, but it is much more likely to appear with more data. Until the Higgs sector has been fully explored and understood by the LHC, [everything is to play for](#).

In Other News:

December 19, 2010: [FQXi contest: First Essays Online](#)

This years FAXi Essay contest will try to answer the question “Is Reality Digital or Analog?” The competition opened for submissions in November and the [first seven essays are now online](#). If you want to submit your own entry you have until February the 15th.