News

LHC Update: More Heavy Ion Collisions & Further Status and Plans

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Abstract

This news article contains LHC updates for the period of Ocotober 31, 2010 to November 29, 2010 which appeared in viXra Log at http://blog.vixra.org .

Key Words: LHC, Update, heavy ion collision, status, plan.

November 4, 2010: LHC end of proton-proton physics for 2010

Today the LHC is ending proton on proton physics for 2010 as planned and moving on to heavy-ion physics.

The pp runs that started back in February have been outstandingly successful. A peak luminosity of 201/ub/s was reached on one run, and that's twice the set target. This means that collecting 1/fb of data during 2011 as planned should be possible.

The really good news is that the stability of the systems and the proton beams proved to be better than hoped. This meant they were able to surpass the target luminosity without having to take the collider to the limits it is capable of. Next year they have the option to increase the luminosity even further .

The experiments collected about 45/pb of data each and that might be enough to find some new physics. We may hear something about that at conferences scheduled for the winter months. They could easily have collected more data this year but the higher priority was to understand the running of the collider with closer bunch spacings so that they can make a well-informed plan for the early part of 2011 when they will set the run parameters for next year.

The commissioning has not been without its hitches. That would be too much to expect from such a large and complex machine pushing well beyond known boundaries. Most of the problems that have cropped up have been solved. However, they have still not traced the source of "The Hump" which still sometimes plagues the stability of the beams. Then there were UFOs and Ufions which are though to be dust particles in the beam pipe that trigger the protection systems and dump the beams. They also have problems with an electron cloud which is producing high unwanted backgrounds in ATLAS. The recent runs at 50ns also turned out to need "scrubbing" to clean up the beams. The last few days were spent trying to understand these issues so that they can implement fixes during the shutdown, or at least understand how to work round them and plan accordingly.

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None of these problems are show stoppers and overall there is no doubt that the LHC has performed very well this year. This is surely down to some good decisions from the management together with the hard work of the thousands of dedicated individuals who have been looking after the many components of the experiment.

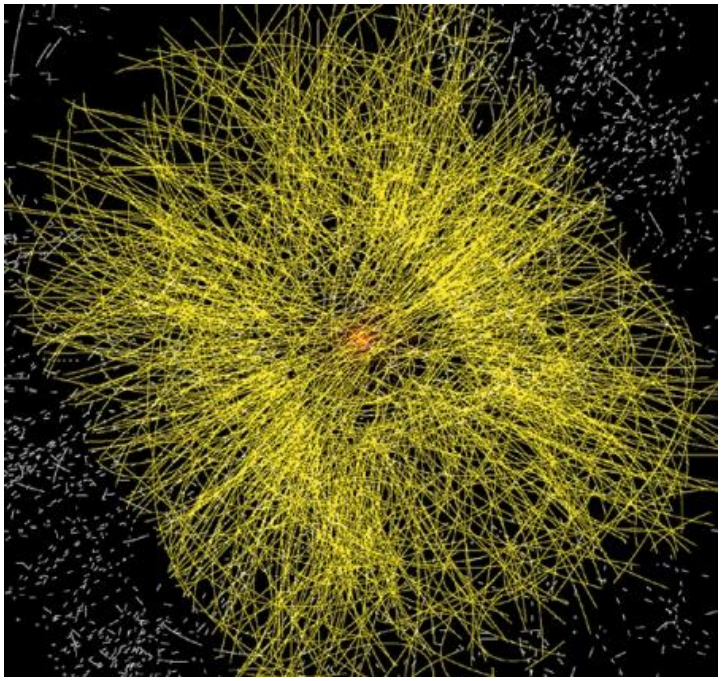
Update: Ion beams have already been circulating in the LHC today!

November 7, 2010: Heavy Ion Collisions at 574 TeV

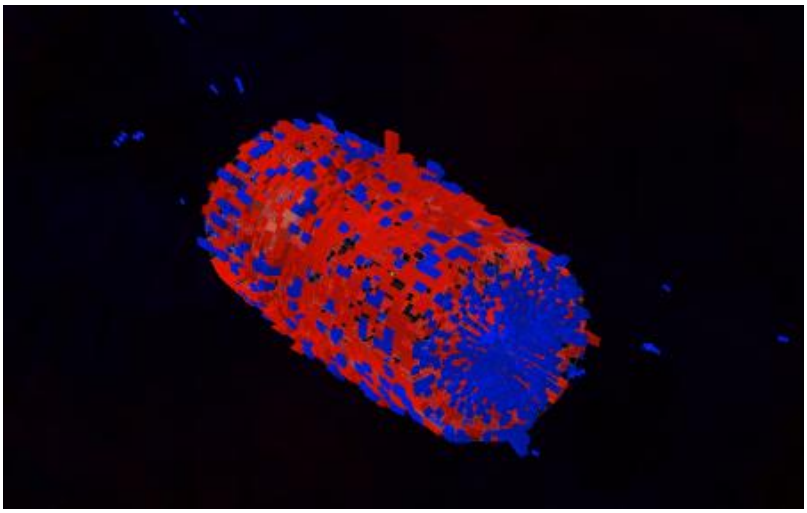
The Large Hadron Collider has succeeded in colliding lead nuclei at a centre of mass energy of 574 TeV. That is by far the highest energy collisions ever seen in any particle accelerator exceeding previous records of the RHIC collider by a factor of 14.

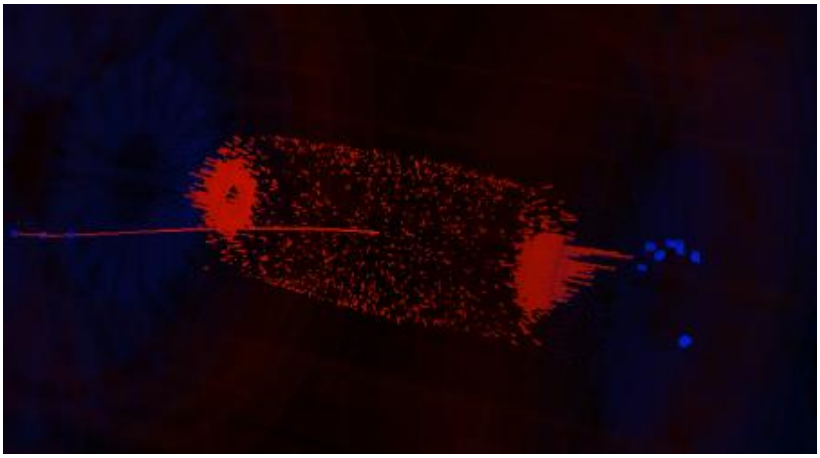
The process of commissioning heavy Ion collisions at the CERN accelerator started less than three days ago so the speed with which they have started collisions is impressive. In fact the physical process of colliding heavy ions is almost identical to colliding protons. The lead nucleus has a charge of exactly 82 times the charge on a proton, but the curvature of a particle in a magnetic field depends only on the ratio of charge to energy. So if the lead ions are accelerated to exactly 82 times the energy of the protons they will follow the same path and the setup used to collide protons works just as well for ions.

The luminosities used last night were just a fraction of the records set with proton collisions a few days ago, but the lead ions have a larger cross-section so some interesting data may already have been collected in last night's run which lasted three hours. Two bunches per beams were used to provide collisions in CMS, ATLAS and ALICE, but it is the ALICE detector that is best suited to studying the showers of thousands of particles that these collisions produce.



The above is a simulated picture of a collision in ALICE. Hopefully some real pictures will be available soon. **Update**: they are, see below.





Here is a superb animation of a 3D recording of one of the first Heavy Ion events seen today in ALICE http://www.youtube.com/watch?feature=player_embedded&v=HTj8FaERjXY

More pictures from ALICE are here.

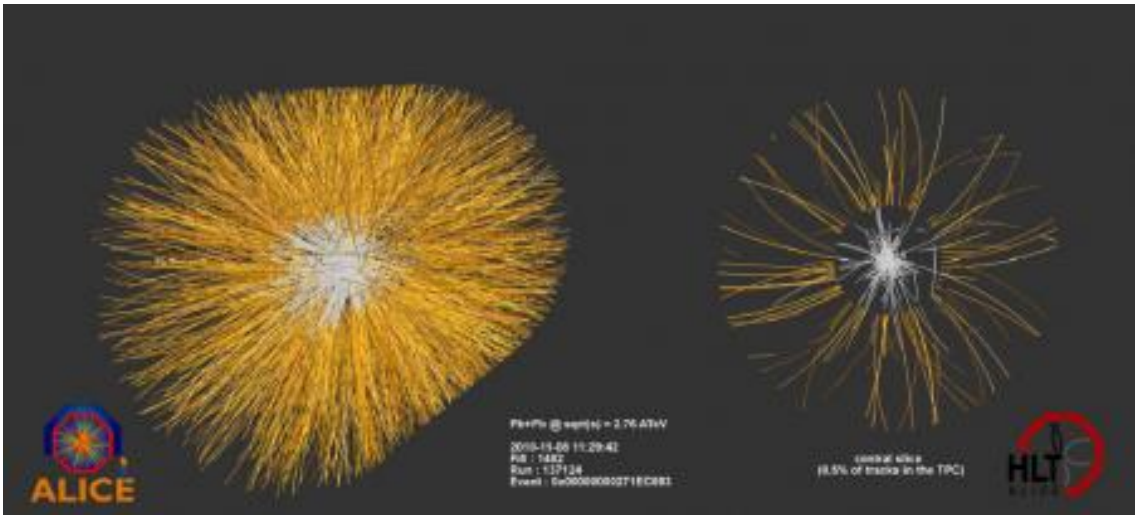
November 8, 2010: More Heavy Ion Pictures from the LHC

Reports of the first day of Heavy Ion collisions at the Large Hadron Collider with lots of nice pictures can be found at http://indico.cern.ch/conferenceDisplay.py?confId=112724

Today they have reached stable beams so the full functionality of the detectors can be turned on. Now they are preparing for the first step up in luminosity with 4 bunches per beam to provide four times as many collisions.

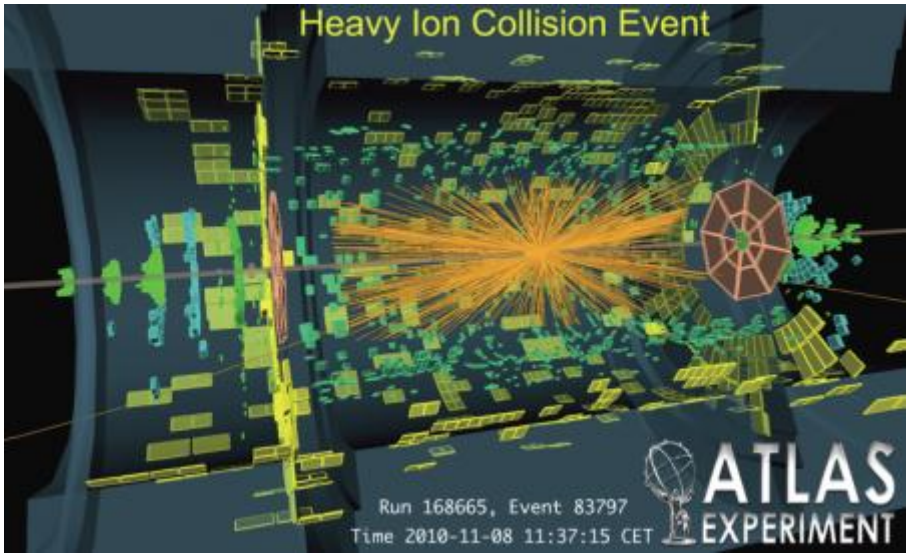
Here are some of the better pictures

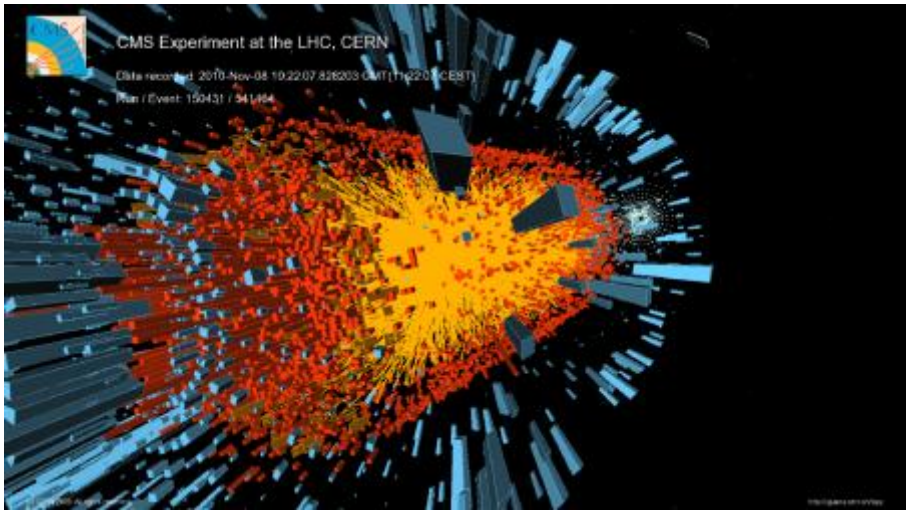
ALICE:

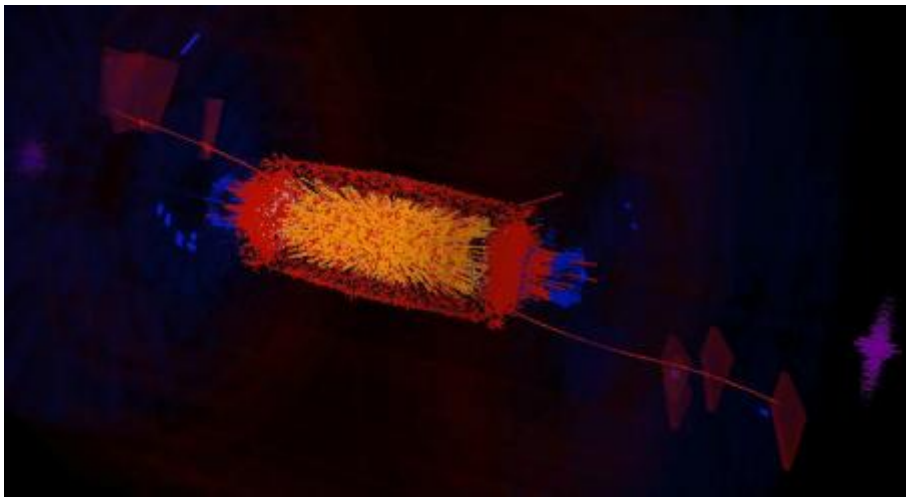


http://www.youtube.com/watch?feature=player_embedded&v=io8rQrQUxEc

ATLAS

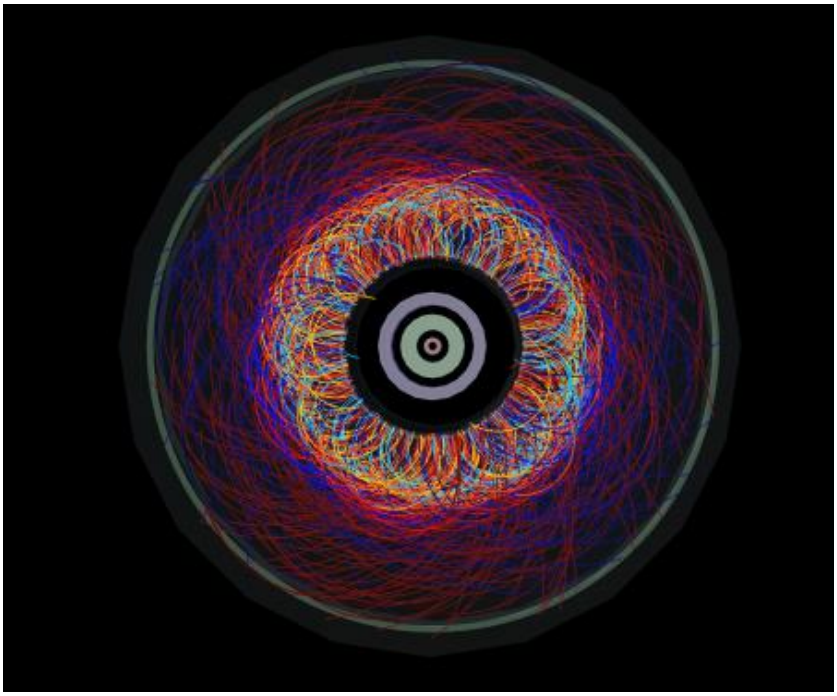


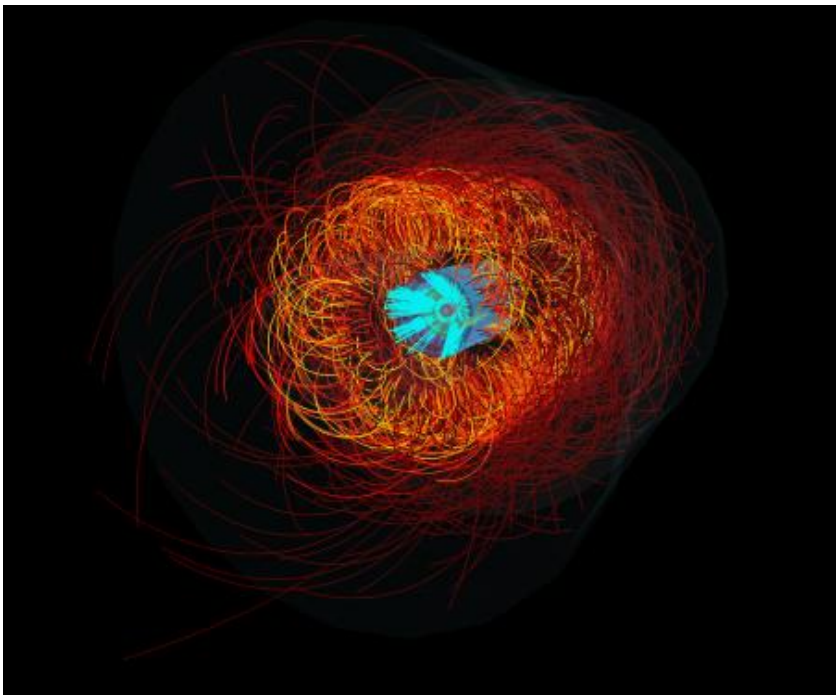




November 9, 2010: More Pictures and Video from ALICE

With the outer tracking systems turned on the images of heavy ion collisions from ALICE get even better. Up to 3000 charged particles are produced and tracked as the radiate out from the central collision point. As they reach the outer detector they are bent by powerful magnets so that the energy of each one can be measured to get a complete picture of the fallout from the quark gluon plasma produced in the centre of the detector.



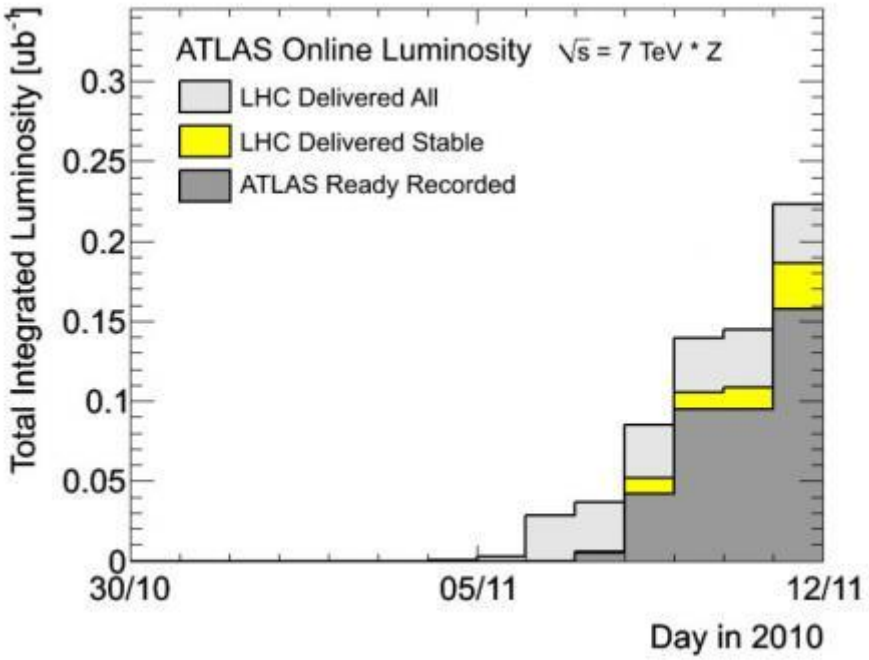


http://www.youtube.com/watch?feature=player_embedded&v=FEUfFBaAn-8

November 13, 2010: LHC Status and Plans

The Heavy Ion runs are continuing at the Large Hadron Collider with 69 bunches per beam being circulated. Next they will increase to 121 bunches. Watching live collisions is very

impressive when these runs are active. The live 3D CMS display is especially worth looking at but you need to keep refreshing the image.



Meanwhile plans for next year are beginning to take shape and a presentation by Mike Lamont yesterday gave some details. Although no definite decisions have been taken, they are now talking in terms of a slight energy increase to 4 TeV per beam. The amount of luminosity collected will depend on the exact parameters used and how efficiently the collider runs. Using "reasonable" numbers (936 bunches, beta* = 2.5m, 120 billion protons per bunch, 3 micron emittance) it should be possible to collect about 2.2/fb, more than twice the target value. With "Ultimate" numbers (1400 bunches, beta* = 2m, 150 billion protons per bunch, 2.5 micron emittance) , it may be possible to reach 7.6/fb next year. Reality is likely to be somewhere between these two numbers.

Update (14-Nov-2010): Overnight there was a clean run using 121 bunches that ran for eight hours. Here is a clip showing the entire run as seen from CMS

http://www.youtube.com/watch?feature=player_embedded&v=GHowsQW4TBU

November 18, 2010: First ALICE paper

The ALICE collaboration has already published its first paper about lead on collisions. It is a ten page paper with the first five pages listing the authors.