CERN – LHC NEWS 2012

WEBSITE: TAKING AT CLOSER LOOK AT LHC

The space between proton bunches in the beams was halved.

A beam in the LHC is not a continuous string of particles, but is divided into hundreds of bunches, each a few tens of centimetres long. Each bunch contains more than a hundred billion protons. During the last few days, the space between bunches has been successfully halved, achieving the design specification of 25 nanoseconds rather than the 50 nanoseconds used so far. Halving the bunch spacing allows the number of bunches in the beam to be doubled. A record number of 2748 bunches was recorded in each beam in 2012 December, almost twice as many as the maximum reached previously in 2012, but at the injection energy of 450 GeV and without collisions. Several hours of physics were then performed with up to 396 bunches in each beam, spaced by 25 nanoseconds, each beam being accelerated to the energy of 4 TeV.

CERN PRESS RELEASE December 2012

LHCb presents evidence of rare B decay. The Large Hadron Collider beauty (LHCb) collaboration presented evidence for one of the rarest particle decays ever observed at the Hadron Collider Physics Symposium in Kyoto, Japan (November 2012). The Standard Model of particle physics predicts that the B^0_S particle, which is made of a bottom antiquark bound to a strange quark, should decay into a pair of muons (μμ) about 3 times in every billion (10^9) decays. LHCb's measurement, from an analysis of data from 2011 and part of that from 2012, gives a value of $(3.2^{+1.5}_{-1.2}) \times 10^{-9}$. So, this result is in very good agreement with the prediction.

CERN BULLETIN, November 2012

LHC Report: increasing Luminosity. The last two weeks have seen steady luminosity production. The total luminosity of ATLAS and CMS exceeded 19 fb^{-1}, while LHCb reached 1.8 fb^{-1} and ALICE, 6 pb^{-1}.

CERN BULLETIN, November 2012.

Searching for new physics in rare kaon-decays. The LHCb experiment was originally conceived of to study particles containing the beauty-flavoured b quark. However, there are many other possibilities for interesting measurements that exploit the unique forward acceptance of the detector. For example, the physics programme has already been extended to include the study of particles containing charm quarks, as well as electroweak physics (CERN Courier January/February 2012 p7 and April 2012 p34). Now, a new result from LHCb on a search for a rare kaon-decay has further increased the breadth of the experiment's physics goals.

CERN COURIER, October 2012.

Towards 15/fb in 2012. The LHC has delivered more than twice as many collisions to the ATLAS and CMS experiments this year as it did in all of 2011. On 4 August, the integrated luminosity recorded by each of the experiments passed the 10 fb^{-1} mark. Last year, they each recorded data corresponding to around 5.6 fb^{-1}. On 22 August this year, the more specialized LHCb experiment passed 1.11 fb^{-1}, the same as its entire data sample for 2011.

The LHC is well on its way towards its goal of delivering in the order of 15 fb^{-1} in 2012. Indeed, at the beginning of September, CMS and ATLAS had already recorded more than 13 fb^{-1}.

CERN CURIER, Setember 2012.

Tevatron helps LHC over possible discovery of the Higgs particle. The CDF and DØ collaborations at Fermilab have found evidence for the production of a

Higgs-like particle decaying into a pair of bottom and antibottom quarks, independent of the recently announced Higgs-search results from the LHC experiments. The result, accepted for publication in *Physical Review Letters*, will help in determining whether the new particle discovered at the LHC is the long-sought Higgs particle predicted in the Standard Model

CERN COURIER, August 2012.

A Particle consistent with Higgs boson. The ATLAS and CMS experiments see strong indications for the presence of a new particle, which could be the Higgs boson, in the mass region around 126 gigaelectronvolts (GeV). Both ATLAS and CMS gave the level of significance of the result as 5 sigma on the scale that particle physicists use to describe the certainty of a discovery. One sigma means the results could be random fluctuations in the data, 3 sigma counts as an observation and a 5-sigma result is a discovery. The results presented today are preliminary, as the data from 2012 is still under analysis. The complete analysis is expected to be published around the end of July.

CERN PRESS RELEASE. July 2012.

Back to record performance. The technical issues that caused a rocky re-start after the technical stop and a relatively low performance of the machine have been tackled and resolved in the past days. Assuming realistic machine availability with no major hardware problems, producing about 1 fb^{-1} per week seems feasible. Compare this to the 5.6 fb^{-1} produced over the whole of 2011.

CERN THE BULLETIN. May 2012

Two beautiful new particles. In beautiful agreement with the Standard Model, two new excited states of the Λb beauty particle have just been observed by the LHCb Collaboration. Similarly to protons and neutrons, Λb is composed of three quarks. In the Λb's case, these are up, down and beauty.

CERN. THE BULLETIN. MAY 2012.

LHC yields data rapidly at new collision energy of 8 TeV. LHC shift crew declared "stable beams" as two 4 TeV proton beams were brought into collision at the LHC's four interaction points. This signalled the start of physics data-taking by the LHC experiments for 2012. The collision energy of 8 TeV is a new world record. By 11 April the LHC had already delivered a total integrated luminosity of 0.2 fb^{-1} to the experiments. Last year, it took six weeks achieve the same number.

Although the increase in collision energy is relatively modest, it translates to an increased discovery potential that can be several times higher for certain hypothetical particles. Some, such as those predicted by supersymmetry, would be produced much more copiously at 8 TeV than the 7 TeV of 2011.

CERN COURIER APRIL 2012

New world record: first pp collisions at 8 TeV. 5 April 2012, the LHC shift crew declared 'stable beams' as two 4 TeV proton beams were brought into collision at the LHC's four interaction points. This signals the start of physics data taking by the LHC experiments for 2012. The collision energy of 8 TeV is a new world record, and increases the machine's discovery potential considerably.

CERN PRESS RELEASE APRIL 2012.

LHC: Beam on. The powering tests were successfully finished at the end of the first week of March opening the way for 4 TeV operations this year. The beam was back in the machine on Wednesday 14 March. The first collisions at 4 TeV are scheduled for the first week of April.

CERN THE BULLETIN MARCH 2012.

LHC to run at 4 TeV per beam in 2012. CERN today announced on February 13th that the LHC will run with a beam energy of 4 TeV this year, 0.5 TeV higher than in 2010 and 2011. This decision was taken by CERN management following the annual performance workshop held in Chamonix last week and a report delivered today by the external CERN Machine Advisory Committee (CMAC). It is accompanied by a strategy to optimise LHC running to deliver the maximum possible amount of data in 2012 before the LHC goes into a long shutdown to prepare for higher energy running. The data target for 2012 is 15 inverse femtobarns for ATLAS and CMS, three times higher than in 2011. Bunch spacing in the LHC will remain at 50 nanoseconds.
The schedule announced today foresees beams back in the LHC next month, and running through to November. There will then be a long technical stop of around 20 months, with the LHC restarting close to its full design energy late in 2014 and operating for physics at the new high energy in early 2015.

CERN PRESS RELEASE. FEBRUARY 2012.

The LHC will resume colliding protons in late March. The goal is to deliver about 1600 trillion proton-proton collisions (16 "inverse femtobarns" of data) to the experiments, compared to the 500 trillion collisions delivered in 2011. More collisions will help the LHC experiments to improve the precision of their measurements and push searches for new physics further.

CERN, FEBRUARY, 2012.

LHCb sees first evidence for CP violation in charm decays. The LHCb experiment was initially designed for the study of B physics (the "b" in its name stands for beauty, or b quark). However, the LHC is also a copious source of particles that contain the charm quark, such as the D meson, which also makes the experiment well suited to their study. The rate at which data are selected by the LHCb trigger and written to storage was therefore increased last year by 50% with the extra capacity dedicated to charm. This has now paid off spectacularly, with one of the most interesting (and unexpected) results to come from the LHC so far: evidence of CP violation in charm decays. CERN COURIER JANUARY 2012