

Status of the LHC Machine

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The LHC can be expected to provide first collisions very soon. The current machine status and prospects for the near future are reviewed.

*RADCOR 2009 - 9th International Symposium on Radiative Corrections (Applications of Quantum Field Theory to Phenomenology),
October 25 - 30 2009
Ascona, Switzerland*

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1. Short summary

The 27 km long LHC machine is starting operation at CERN in Geneva. The LHC is the worlds largest and most energetic particle collider. It took many years to plan and built this complex machine, which promises exciting, new physics results with an excellent potential for major discoveries.

The status of the LHC as presented in this workshop in October 2009, will have significantly changed by the time that these proceedings will be published. Only a brief summary is given here. Details on the LHC machine can be found in the design report [1] and a more pedagogical description in a book [2].

Initial commissioning of the LHC with beams started in September 2008. The progress with beam commissioning was excellent [3]. Circulating beams could be established within hours.

Just a few days after the start of the commissioning of the LHC with beams in 2008, operation was interrupted by an incident which occurred in training magnets to higher currents and which resulted in a local loss of the energy stored in the magnets, causing significant collateral damage. A poor contact in a splice in a magnet interconnect was identified as initial cause of this incident [4]. The repair and consolidation program which followed is progressing well.

Already before this incident it was clear, that a major challenge in the LHC is the large amount of energy stored in the superconducting magnets (10 Giga Joule) and the beams (360 Joule at design parameters). The LHC is equipped with a machine protection system designed to automatically turn off and dump the energy in the magnets and the beam safely in case of problems. This system was further enhanced, based on the experience gained in the initial operation and the incident.

The LHC is scheduled to restart for operation with beams in November 2009 and to provide first proton-proton collisions before christmas. For the initial operation in 2009, currents in the LHC magnets will be limited to 2 kA which corresponds to a maximum centre of mass energy of just over 2 TeV. After a short technical stop in the winter 2009/2010, it is planned to restart the LHC early in 2010 and to deliver several hundred pb^{-1} integrated luminosity at 7 TeV c.m.s. in proton proton collisions within the year. Towards the end of 2010 or early in 2011, it is planned to increase the c.m.s. energy to 10 TeV. Several winter shutdowns may be required to consolidate magnet interconnects and perform magnet training to allow for safe operation of the LHC at the full design energy of 14 TeV. Similarly, ramping up beam intensities and squeezing down beam sizes to increase the luminosity in proton proton collisions towards the very challenging design luminosity of $10^{34} \text{ cm}^{-2}\text{s}^{-1}$ will be done gradually, over several years.

References

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- [2] L. Evans, *The Large Hadron Collider: a Marvel of Technology*. EPFL Press, 2009.
- [3] M. Lamont, *LHC: status and commissioning plans*, [arXiv:0906.0347](https://arxiv.org/abs/0906.0347), CERN, June 2009.
- [4] M. Bajko et al., *Report of the task force on the incident of 19th September 2008 at the LHC*, CERN-LHC-PROJECT-REPORT-1168.