Chapter 5

Summary

The LHCf is an experiment to measure very forward neutral particles emitted in LHC collisions in order to calibrate the hadron interaction models used in simulation of Extremely High Energy Cosmic-Rays at a laboratory equivalent energy of 10^{17} eV. In this paper, we have given an experimental overview, a description of details of the instrumentation and data acquisition system, simulation of performance of the detectors during LHC operation and reported preliminary results of SPS test beam experiments.

Two LHCf detectors are installed at ± 140 m from IP1 where the neutral particle absorbers (TAN) are located. Each of the two detectors is composed of two independent sampling calorimeters made of tungsten plates, plastic scintillators and position sensitive layers. The position sensitive layers are scintillation fibers and multi-anode photomultipliers for detector 1 and silicon strip detectors for detector 2. Because of the limited space for installation, these calorimeters are very compact, but are still capable of measuring energy and position of the incident particles with sufficient resolutions. Simulations predict that the energy resolution is better than 5% and the position resolution as good as 0.2 mm at 100 GeV; these predictions have been confirmed by measurements in SPS test beams at CERN. The use of front scintillation counters is expected to help reduce background events generated by beam-gas interactions during early LHC operation when vacuum conditions may not be as good as anticipated. The detectors are equipped with vertical manipulators to increase the P_T range that can be measured and to remove the detectors from unnecessary radiation damage when they are not in use. The experiment covers a pseudo rapidity range from 8.4 to infinity. Data acquisition during LHC operation will be carried out in the ATLAS counting room, USA15. An event tagging scheme based on the time stamp of the LHC clock has been developed to correlate LHCf and ATLAS events for possible further analysis. Detectors, data acquisition and electronics are optimized to operate during the early phases of LHC commissioning with luminosity below $10^{30}\,\mathrm{cm^{-2}s^{-1}}$. The event rates are expected to be high enough that LHCf can get all of its data in one week of LHC operation at the luminosity of $10^{29}\,\mathrm{cm^{-2}s^{-1}}$. After a week of operation under these conditions, the output of the plastic scintillators will be degraded by $\sim$10% due to radiation damage. Radiation damage will be monitored and corrected for with a pulsed laser calibration system. The LHCf detectors will be removed once the luminosity exceeds $10^{30}\,\mathrm{cm^{-2}s^{-1}}$.

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