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The Electronics System of the ALFA Forward Detector for Luminosity Measurements in ATLAS

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The ATLAS Forward Detectors for Measurement of Elastic Scattering and Luminosity (ALFA) have been fully installed during the 2010-2011 winter LHC shutdown. ALFA consists of 8 mini tracking detectors made of 20 planes of scintillating fibers placed in Roman Pot units near the beam and 240m away on both sides of the interaction point. The front-end electronics sit directly on top of the PMTs and has been designed to facilitate the connectivity to the ATLAS control room. The full system consisting of the detectors units, the control electronics and the connections to the ATLAS TTC, DAQ and DCS systems has been successfully tested.

Summary 500 words

The ATLAS Forward Detectors for Measurement of Elastic Scattering and Luminosity (ALFA) have been fully developed and the installation has been completed during the 2010-2011 winter LHC shutdown. The installation is composed of the 8 Roman Pot detectors located at ˜240m on both sides of the ATLAS interaction point in the LHC tunnel, the low voltage power supplies positioned in nearby alcoves, the HV power and control electronics in the ATLAS control room and the connections to the ATLAS TTC, DAQ and DCS systems.

During the preparatory phase with test beam, for the full detector consisting of 10 layers of 0.5mm squared scintillating fibres for each coordinate per detector, the tracking efficiency has been measured close to 100% with a typical resolution of 30 microns. The typical layer efficiency was about 94%.

The electronics box on each of the Roman Pot detectors has been designed to minimize the number of cables running along the LHC tunnel, allowing for fast detector installation and removals. It contains the front-end elements: 23 mini-assemblies (PMF) plugged directly on the pins of 23 multi-anode PMTs, reading a total of 1460 scintillating fibers, a main board (MB) which handles the data from the PMFs, the clock and Level1 signals coming from the ATLAS TTC system, the slow commands controlled from the ATLAS DCS. It sends the detector data to the control room through a fast optical link.

An additional ALFA trigger system has been developed, tested and installed. It produces a local "fast"trigger signal from each detector and the signals from the 8 detectors can be combined in the ATLAS Central Trigger system. The "fast"trigger signal is configurable from 2 single anode high gain PMTs optically connected to two scintillating tiles covering the full detector tracking area. When a "fast"trigger signal appears, analogue values proportional to the charge of the two PMTs are captured and digitized.

The transmitted data is formatted for the MROD-X Readout Devices, developed for the ATLAS muon detector system. The formatted data packet has one bit per fiber of the detector, the trigger pattern and the trigger charge data, together with the event identification.

In addition to the electronics systems on the Roman Pot detectors, the low voltage power supplies have been installed in the nearby LHC tunnel alcoves: the voltage drop is therefore minimized and the power system is less exposed to the environmental radiation. All the electronics parts in the tunnel are remotely controlled and monitored through the DCS experiment control system. It makes use of the ELMB local monitor boards. Apart of the temperatures, current and voltages monitoring, the DCS system is used for the detailed configuration of the front-end electronics, the setting of the low voltage and high voltage power supplies, as well as other detector controls, like the Roman Pot movement monitoring and the alarms.

At the end of the installation period, the operations of the electronics of the 8 detectors have been demonstrated, and the system is running stably since the beginning of the 2011 LHC runs.

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