ATLAS MUON DCS UPGRADES AND OPTIMIZATIONS

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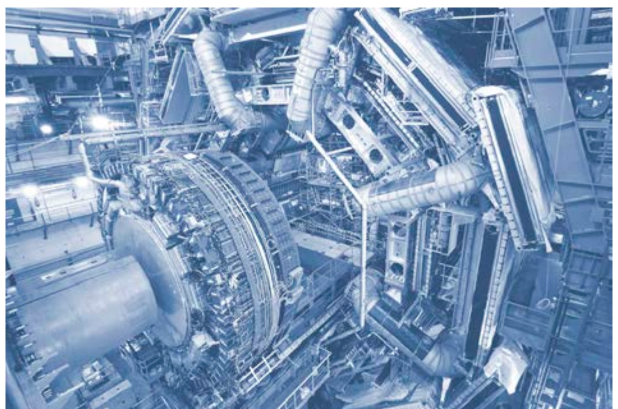
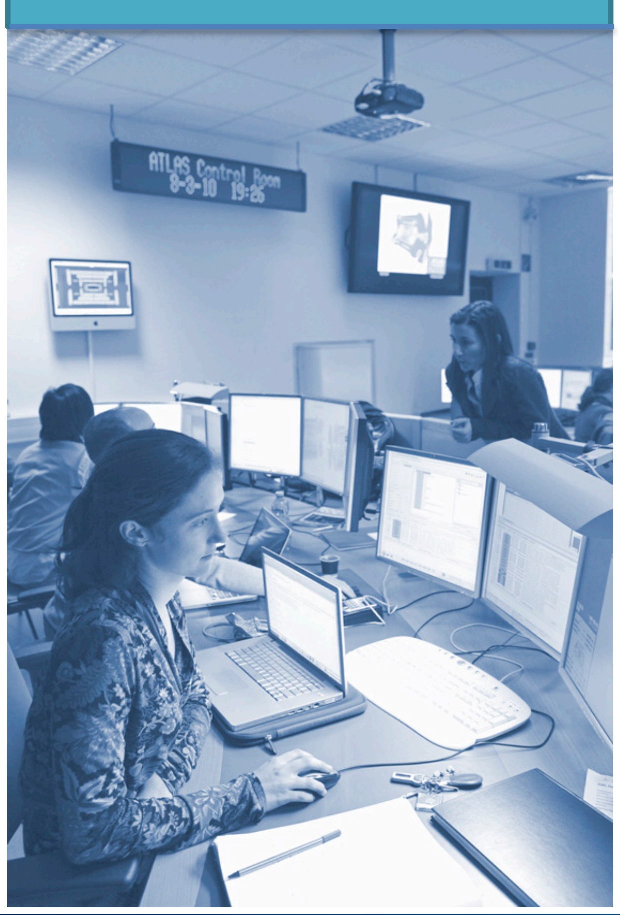
INTRODUCTION – THE ATLAS MUON DETECTOR SUBSYSTEM

The Muon subsystem is comprised of four detector types: Resistive Plate Chambers (RPC) and Thin Gap Chambers (TGC) for trigger purposes, and Cathode Strip Chambers (CSC) and Muon Drift Tubes (MDT) for muon track reconstruction. The MDTs cover a large area at the outer part of the detector. In total, there are over a 1’000 MDT chambers, which are made of about 350’000 tubes [1]. The luminosity upgrade of the HL-LHC is expected to pose a serious challenge to the MDTs. The expected increase of particle flux will set new, higher standards regarding the operation and control of the chambers. A step towards optimizing the ATLAS Muon Detector Control System (DCS) was to develop several DCS tools, namely a High Luminosity vs Trip Limit panel with its accompanying scripts and managers. The ultimate goal of this tool is to protect the MDT chambers from the rising particle flux and its associated increase in chamber current. In addition to optimizing the ATLAS Muon DCS, several tasks to accommodate the newly installed BMG chambers in the DCS infrastructure have been carried out as well. The BMGs, which are similar to the original MDTs but have a smaller tube diameter, required the creation of new Finite State Machine (FSM) JTAG and Power Supply nodes, and the addition of their corresponding Data Point Elements (DPEs) to Oracle's PVSS2COOL archiving scheme. Finally, maintenance work has been conducted to the CSCs of the ATLAS small wheel, and further DCS upgrades have been implemented to their subsystem as well.



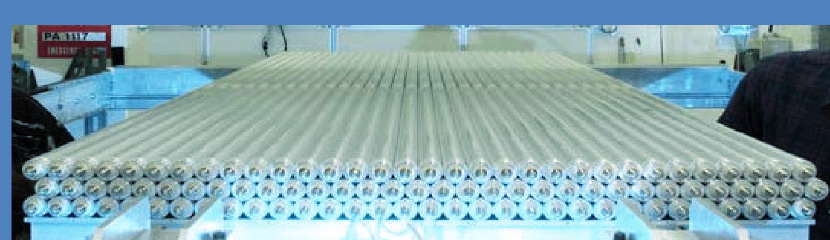
THE ATLAS DETECTOR AND ITS CONTROL SYSTEM - OVERVIEW

ATLAS is the largest high-energy physics detector ever built by man. It is essentially a big cylinder: 46 meters long, 26 meters in diameter, and it weighs 7’000 tons. The LHC delivers millions of collisions each second, that take place in the heart of ATLAS. Out of these violent collisions, exotic particles may be produced, which may yield information on how our Universe was born. These collisions, though, create a dangerous radiation environment which the detector has to endure. In order to monitor and control the operation of the detector, a framework has been devised, which allows for remote supervision and intervention in the detector and its subsystems: The Detector Control System. This control scheme is what is being used every day, in the ATLAS Control Room, and by the subdetector experts, to guarantee a safe and efficient Physics run.



BMG DCS INTEGRATION

In the end-of-year shutdown of 2016, new MDT chambers were installed, the BMGs. The installation of these new chambers involved performing several changes and additions in the DCS. These chambers were incorporated in the ATLAS central FSM, which monitors and controls the high and low-voltage power supplies of each individual chamber, and configures upon run initialization the on-chamber electronics through the JTAG protocol. New front-end electronics called for alterations of the FSM interface panels. Also, ATLAS DCS stores data in an Oracle database, through the PVSS2COOL archiving scheme, as keeping records of all chamber-related variables is a necessity. The BMG-related DPEs are now being constantly uploaded in the database. An auxiliary panel was created for assisting the MDT DCS experts to perform this task.



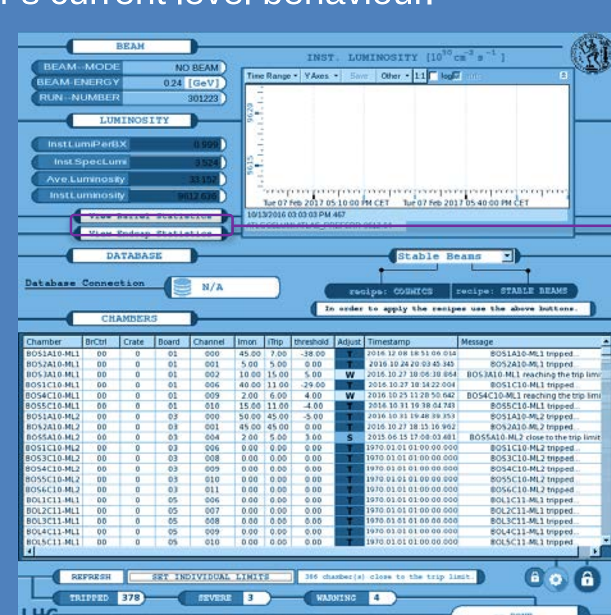
CSC DCS UPGRADE AND REPAIRS

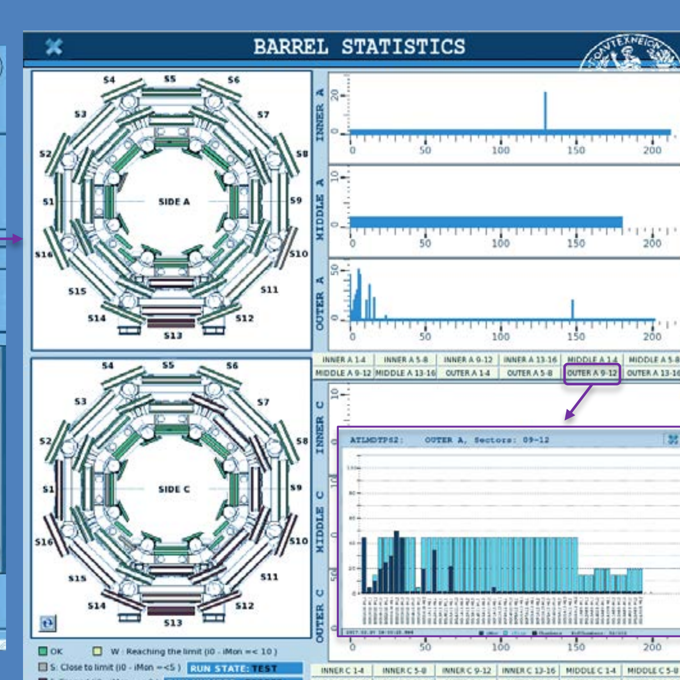
The CSC chambers, which cover the high pseudorapidity range of ATLAS and are installed in its small wheels, receive particles at a very high rate. Hence, maintenance work is often needed. In particular, the chambers at side C in sector 1 and 3 had been removed from ATLAS cavern to fix 3 broken wires. The wires have been fixed and the chambers have been recommissioned. In addition, a new mechanism has been developed to monitor and notify with alarms the quality of the connection between the control station and the VME crate used for TTC and control of Wiener Maraton low voltage system of CSC. The communication is established using an ATLAS designed OPC-UA server-client that replaced the stiff OPC-DA. Finally, a new approach was examined on the reaction to several safety alarms. The alarms normally cause a harsh shutdown for the electronics reaction and developments are underway to replace that with more delicate action on individual devices.

MDT HIGH-LUMINOSITY PANEL

As the energy and the luminosity of the LHC proton beam increases, more data is being recorded by the detector, but the environment is becoming even harsher for the chambers and their infrastructure. An increased particle flux usually leads to an increase in the current recorded by the chamber, and a too high current may lead to permanent damage. A certain threshold, called the ‘trip limit’, sets a maximum current a chamber can tolerate. In order to monitor the current of each MDT chamber and its relation to the trip limit, a new DCS panel was created, that will prove to be a valuable tool for the safety of the muon chambers. Through this panel, the operators and experts can monitor the main parameters of the run, such as luminosity and beam mode, with several trend plots that depict each individual chamber’s current level behaviour.

Automatic notifications upon the exceeding of the current threshold can be sent to on-call experts, which can then implement a predefined database recipe. Finally, statistics and histograms based on the chamber topology can be accessed through the panel, depicting the maximum current per run for each chamber, thus providing an extra parameter to make more accurate conclusions regarding the safety operation limits of the MDT chambers.





References: [1] Y. Arai et al. *ATLAS Muon Drift Tube Electronics,* [2] A. Barriuso Poy et al. *ATLAS DCS Integration Guidelines*

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ATLAS EXPERIMENT