Atlas Pixel Detector Test System in Marseille

Magdalena Bazalova[1], Patrick Breugnon, Jean-Claude Clemens, Gregory Hallewell, Tobias Henß[3], Dirk Hoffmann, Alexandre Rozanov, Damien Tézier, Vaclav Vacek[3], Eric Vigeolas

Centre de Physique des Particules de Marseille, [1]now at: McGill University, Montreal (Canada),
[2]on leave from: Bergische Universität Wuppertal (Germany),
[3]on leave from: Ceske vysoké ucení technické v Praze, Fakulta strojní (Czech Republic)

Abstract

Before going into installation and later on operation, parts of the Atlas Pixel Detector are being tested outside the Atlas Experiment in an environment that is as similar as possible to the final conditions, including efficient cooling at ambient temperature as well as at -20°C. Permanent monitoring of the parameters and functional analysis of the precious detector modules, as well as the cooling system that grants a safe environment for their operation, are enabled by various hardware elements, which are controlled by appropriate software. These parts of the setup correspond to those used in the final setup within the experiment and have been provided as final product samples or up-to-date prototypes by the respective institutes of our collaboration, which are responsible for their production. In Marseille we have built the first testbench for operating a complete stave, consisting of 13 detector modules with 46,080 readout channels each, which are mounted on a thin carbon stave of approximate dimensions 2×80 cm². Obviously this detector is very fragile and operating temperatures above 40°C can cause severe damage to it. The nominal power dissipation of such a stave lies around 100 W. We have installed a complete system for automatized tests that can run for several days without permanent operator survey. The mechanical setup, including an environmental box for dry air environment, and a cooling plant have been manufactured and tuned at CPPM. The cooling plant has been tuned to work with the perfluoroalcanes C_3F_8 and C_4F_{10} and is in that sense a unique facility within the Atlas Pixel Collaboration.

The Detector Control System (DCS) is based on the commercial product PVSS by ETM (Austria) that has been choosen to be the unique LHC-SCADA (System Control and Detector Application) across experiments and accelerator. We received the state-of-the-art development version from the development team in Wuppertal, which was subsequently extended to satisfy our specific needs in Marseille. A package for automatic survey and steering of the cooling system, including a graphical user interface, valve position final state machine, display diagrams for relevant data, environment parameter watchdog and automatic operator alert has been added. Environmental values can be logged permanently in compressed format to an Oracle database instance via the ODBC/SQL interface. Critical ranges for operating temperatures and dew point are observed by the software

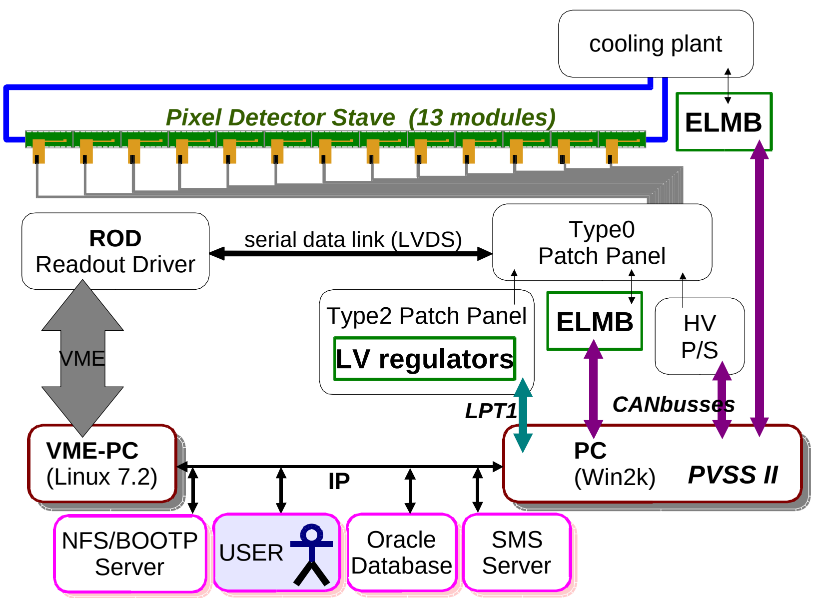

Figure: The detector elements are mechanically connected to a distant cooling plant by isolated copper pipes. Control and monitoring of the detector and the cooling system are performed by a PVSS II application running on a Windows PC using standard LHC interfaces (ELMB) or specifically designed hardware for low and high voltage power supplies and regulators. Detector calibration and functional analysis by means of pulses is performed by DSPs on a special Readout Driver board, which is in turn controlled by a VME-PC. Both PCs communicate via internet among themselves and to external authorities like fileservers, database and last but not least the user.

autonomously and messages can be sent out via email or SMS. The PVSS system uses LHC-standard embedded local monitor boxes (E-LMB) via CANbus where appropriate and possible. Other Pixel-Detector specific hardware modules, that are mainly needed for low and high voltage power supplies, are controlled via the parallel printer port (LPT2) and a proprietary LPT1/CANbus respectively. For connectivity details refer also to the figure on the previous page. Electronic watchdog and interlock hardware completes safety issues in case of software or network failure.

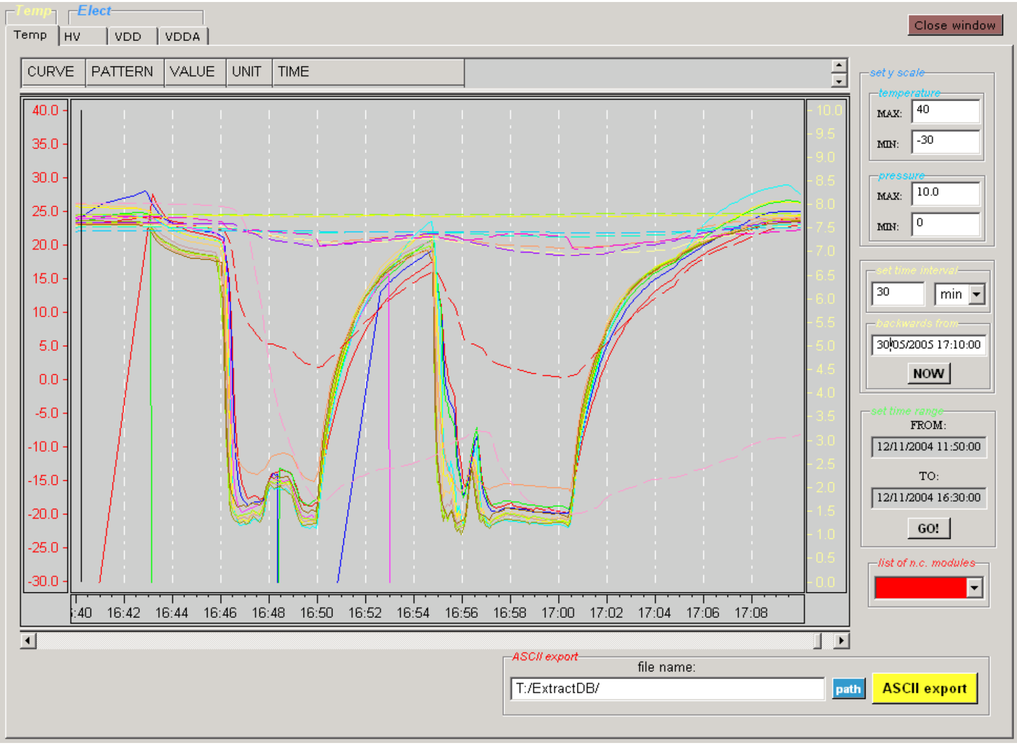

Figure: Recording and display of the environmental values during thermal cycling of a pixel detector stave (screenshot from PVSS user interface).

The function or possible degradation of the detector modules can be monitored in addition by digital or analog pulsing of the detector cells (pixels). The Readout Driver (ROD) module which is used for online datataking in the final configuration contains five Digital Signal Processors (DSP), that can perform these primitive operations and also complete 2D-threshold scans autonomously and simultaneously on four detector modules in parallel. The DSPs are coordinated from a Single-Board-CPU (SBC) which is controlling the ROD module over VME bus. Up to 16 ROD modules will be controlled by the same SBC in the final configuration. In this sense, our testbench also serves as a testbed for the online calibration DAQ (Data Acquisition) software, that is developped in a common effort of several institutes within our collaboration. The aspect of DAQ-DCS interaction and communication as well as data storage and the extraction of significant result data are key elements for continuos monitoring of the detector during the automatized long-term system tests. A first application runs an automatic module configuration process, whenever the power supply control software indicates an OFF-ON transition. The corresponding inter process communication is implemented in the DELPHI Information Management (DIM) framework, which is now widely used in LHC and has a reliable and transparent interface to PVSS.

In this contribution we report in particular on the specific software and hardware tools and complements developped in Marseille, results of first results of systematic tests of the integrated system in view of the final installation in the Atlas Experiment.