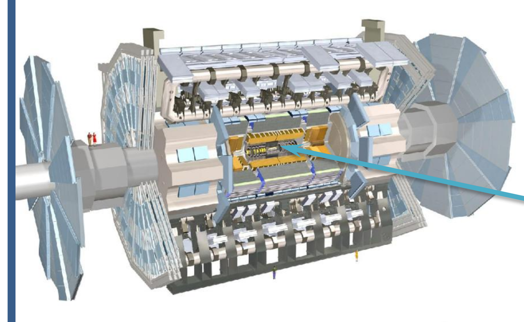
The ATLAS Transition Radiation Tracker (TRT) Detector Control System

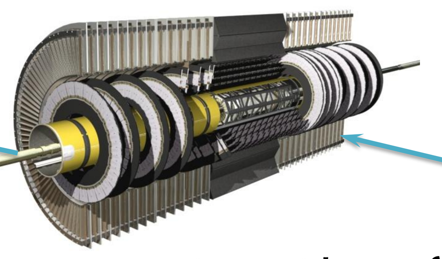
icalepcs 2011

J. Olszowska, E. Banas, Z. Hajduk , IFJ-PAN, Cracow Poland; T. Kowalski, B. Mindur, AGH, Cracow, Poland;
R. Mashinistov, K. Zhukov LPI, Moscow, Russia ; A. Romaniouk MEPhI, Moscow, Russia;
M. Hance, D. Olivito, P. Wagner, University of Pennsylvania, Philadelphia, Pennsylvania , USA

TRT Detector



...a part of ATLAS



...an outermost layer of Inner Detector

...a Tracker identifying electrons

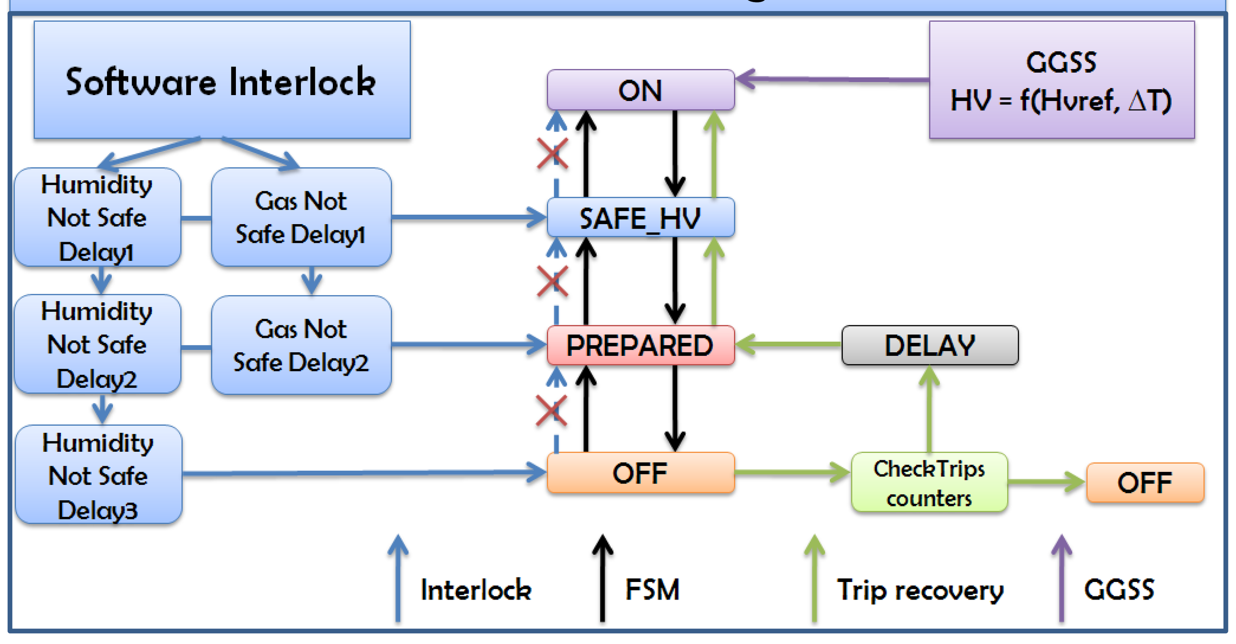
consists of ~300 000 straws (proportional counters)

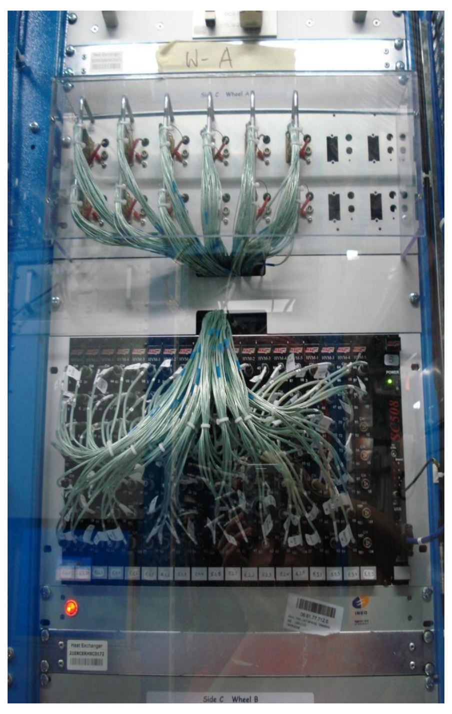
...to operate it needs:

- active gas mixture - 70%Xe, 27%CO_2, 3%O_2
- high voltage biasing - ~ 1530 V
- distribution of low voltage power to front end electronics
- cooling of electronics, straws and power cables
- monitoring temperatures of different structures inside detector
- stabilization of gas gain – depends on active gas pressure, composition and temperature.

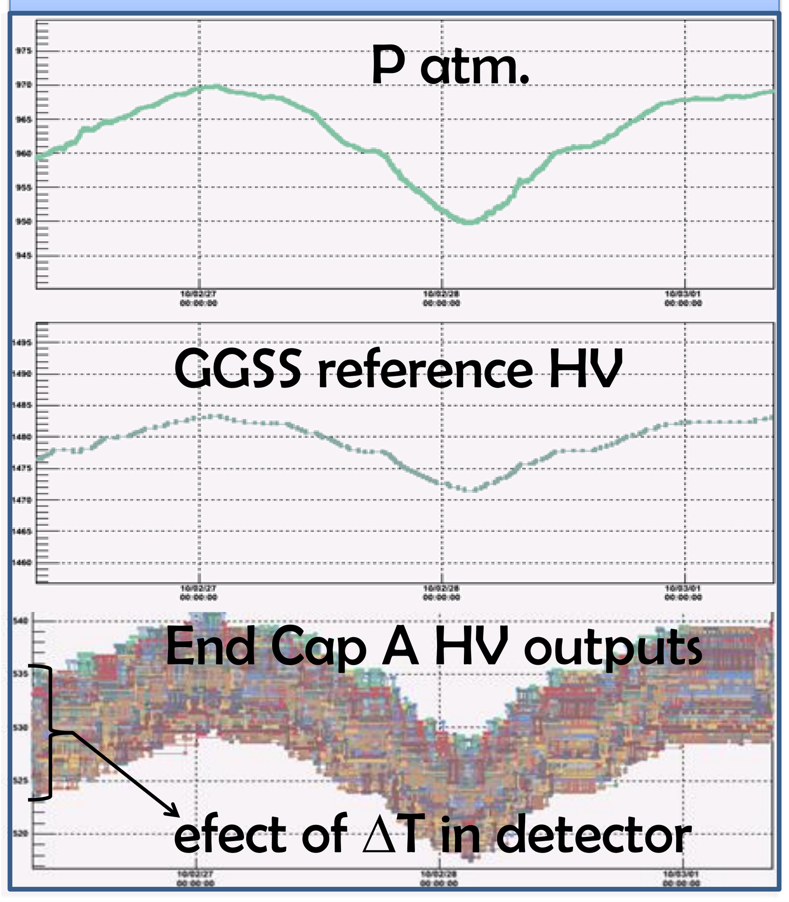
HV Automation

HV Cell State Diagram



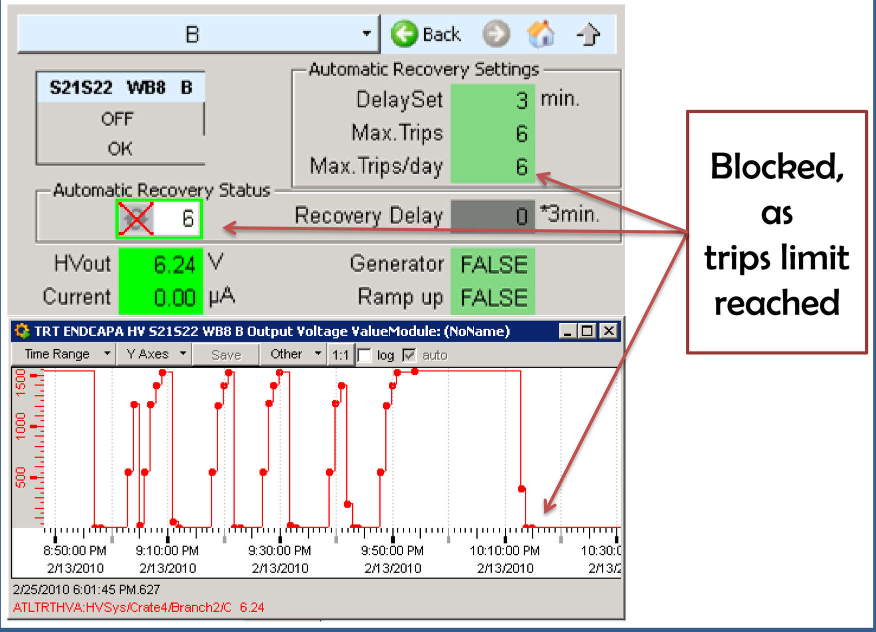


GGSS to HV Feedback



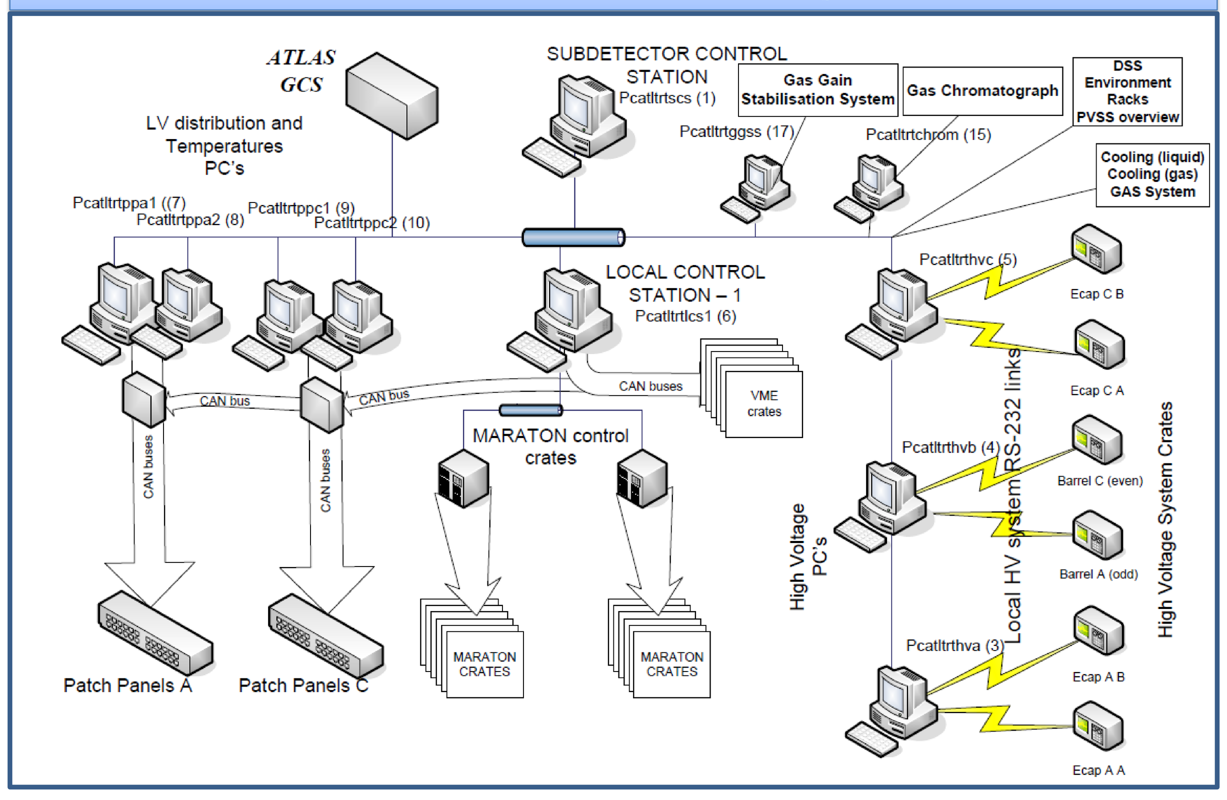
HV Cell Automatic Trip Recovery

- can be enabled and parameterized for each cell
- number of trip recover attempts is limited
- delay between trip and start of recovery can be changed

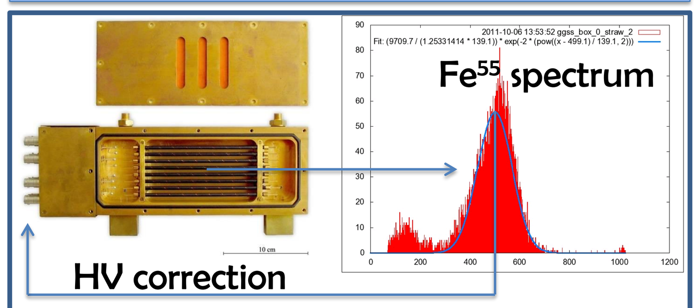


TRT Detector Control System

TRT DCS Hardware layout

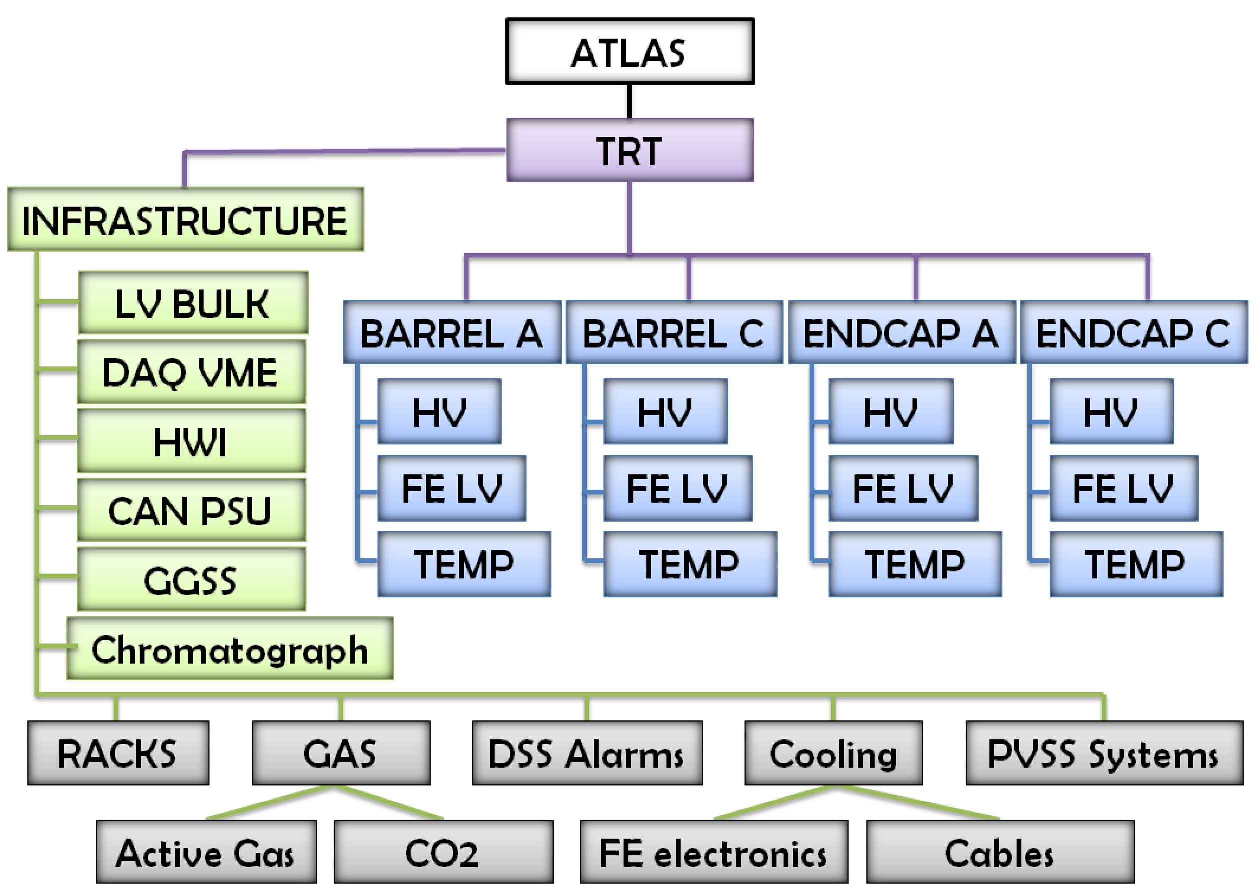


Gas Gain Stabilization System

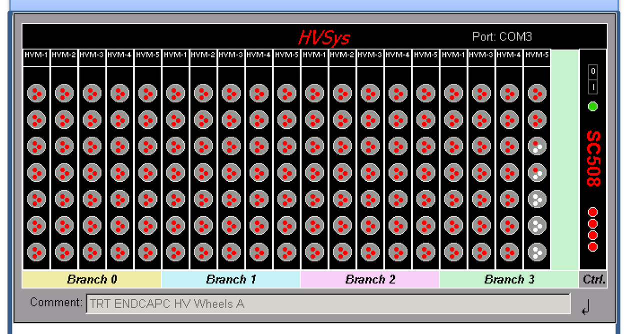


- Standalone process running in a loop
- Finding a HV bias needed to keep Fe^{55} peak position in required bin (reference HV)
- Custom DIM server communicates with PVSS
- Sends out: reference HV, gas temperature, status words and normalized HV – a very sensitive gas composition guarding parameter

TRT DCS Hierarchy



HV OPC server



- Dubna HVSys crates, RS-232 protocol, no middleware layer delivered
- No internal polling mechanism is embedded in the crate firmware
- Custom OPC DA server was developed using Softing Toolkit
- Separate threads for each serial port
- Separate „fast transaction" queues for commands and statuses handling
- Supports calibration files for each HV cell's ADC and DAC
- Runs continuously for months without any problems

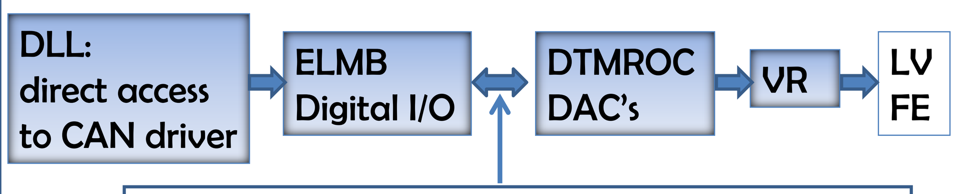
TRT DCS Graphical Users Interfaces

- FSM panels for operators
- Expert extensions guarded by Access Control
- Technical panels for detailed problems diagnosis
- Alarms handling

TRT custom DLL for LV FE

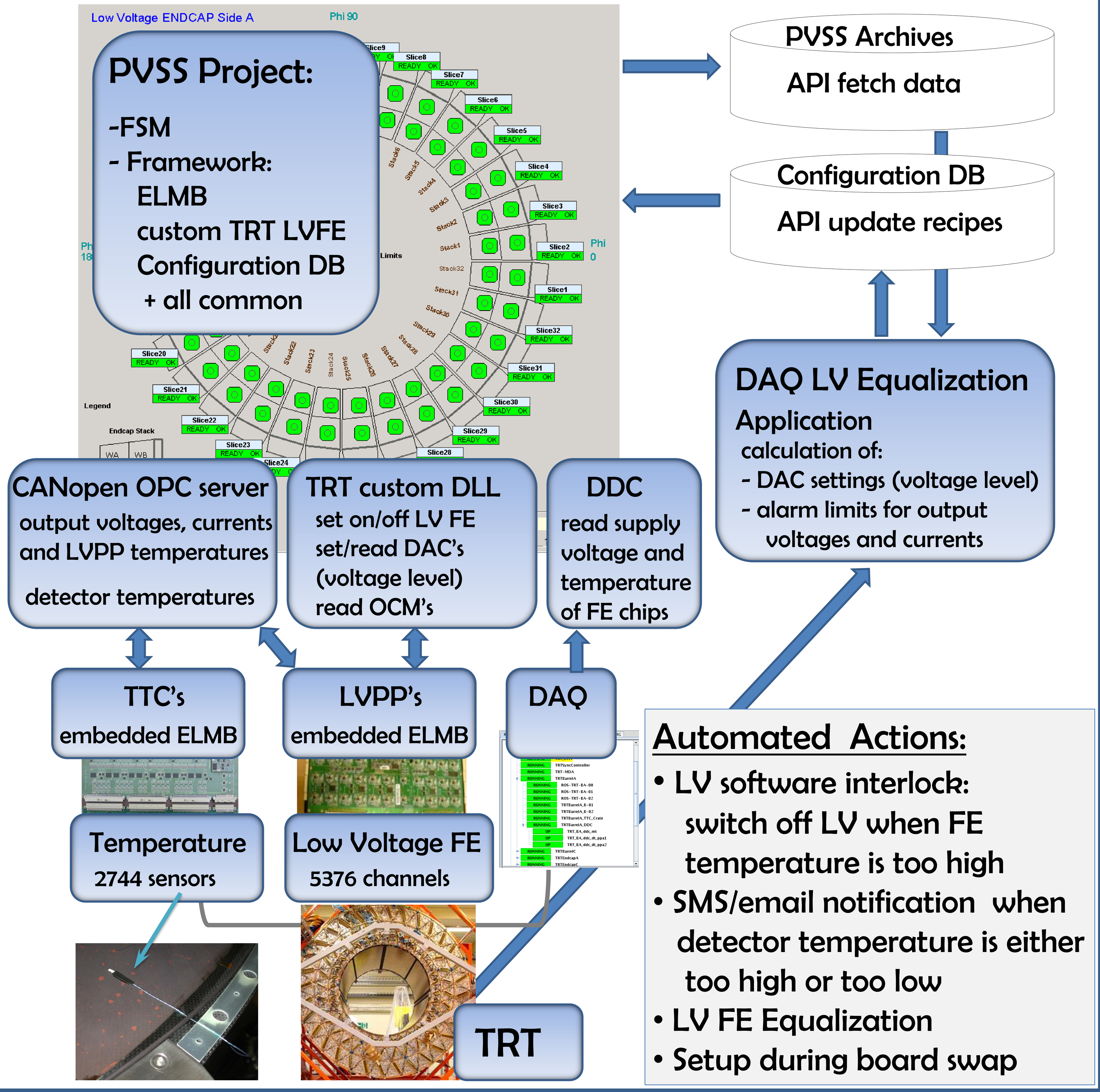
Voltage regulators (VR) are controlled by DTMROCs: set on/off, voltage level is defined by DTMROC's DAC's

DTMROC's are programmed via ELMB digital I/O



Commands are sent in DTMROC serial protocol, simulated on 3 lines: clock, data in, data out with ELMB CAN messages

LV Automation and Tools



Automated Actions:

- LV software interlock: switch off LV when FE temperature is too high
- SMS/email notification when detector temperature is either too high or too low
- LV FE Equalization
- Setup during board swap

Conclusions

The TRT DCS is operating the detector very stably and reliably and is an important factor for detector safety, excellent performance and good quality of data taken during LHC collisions. The hardware failures can't be avoided in such a big and complex system. Some of them can be recovered without stopping of ATLAS data taking, especially during LHC collisions, but a dedicated DCS tools for it need to be developed. HV cables „hot swap" to a spare (free) connector position tool is already in operation, the other will come in a near future.

References

[1] Inner Detector Technical Design Report ATLAS TDR 4, CERN/LHCC/97-16, 1997
[2] ETM professional control: PVSS, http://www.etm.at
[3] O. Holme et al. "The JCOP framework", ICALEPCS 2005, Geneva
[4] C. Gaspar, B. Franek, Tools for the automation of large distributed control systems, IEEE Trans. Nucl. Sci., vol. 53,pp.974-979, 2006
[5] B. Hallgren et al. "The Embedded Local Monitor Board (ELMB) in the LHC front-end I/O control system", Proc. Of the 7th Workshop on Electronics for the LHC Experiments, Stockholm, Sweden, 2000
[6] Gaspar, C., et al., Comput. Phys. Commun., vol 140, pp. 102-109, 2001
[7] http://www.hvsys.dubna.ru/SC508_atl.pdf
http://www.hvsys.dubna.ru/CELL_ATL.pdf
[8] Z.Hajduk et al. "Distributed Low Voltage Power Supply System for Front End Electronics of the TRT Detector in ATLAS Experiment", Proc. of the 12th Workshop on Electronics and Future Experiments, València, Spain, 2006
[9] M. Deptuch et al. Gas Gain Stabilisation System prototype for the TRT - ATL-INDET-2002-010
[10] Z.Hajduk et al. Gas Gain Stabilisation System - from model and prototype to final construction ATL-IT-ER-0025