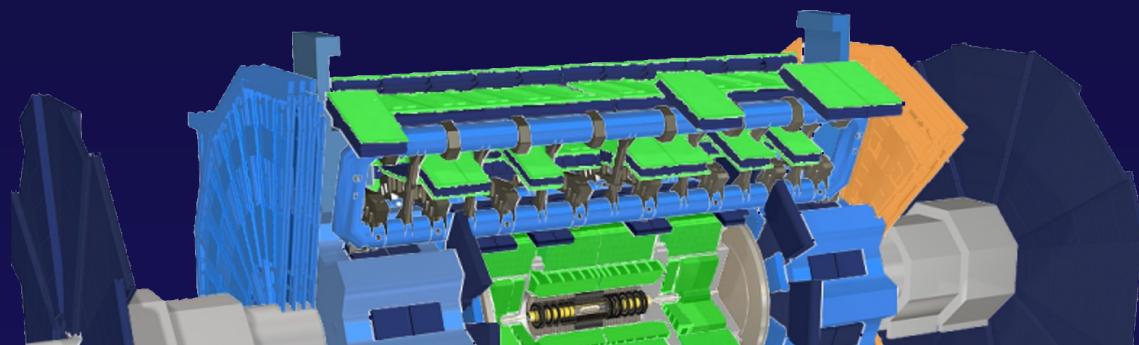




Shift Training: Detector Control System

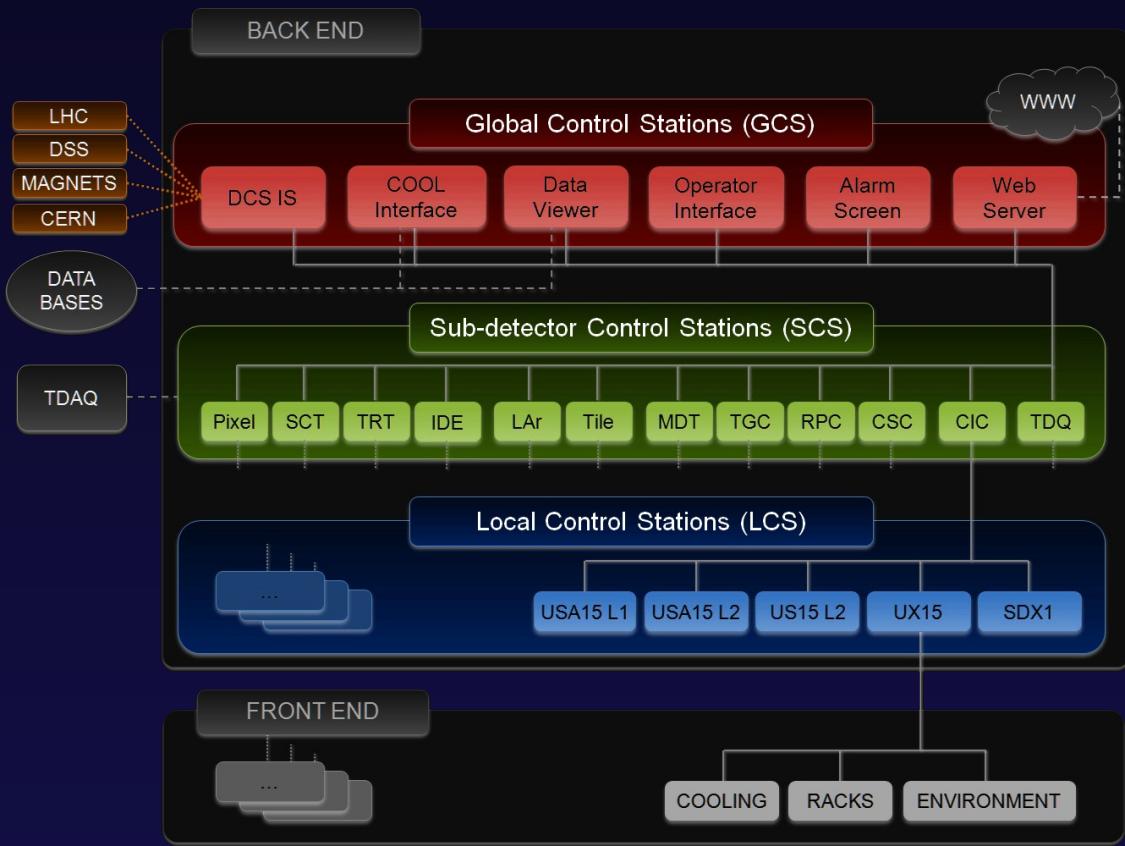
Stefan Schlenker, CERN
for ATLAS DCS



ATLAS DCS Overview

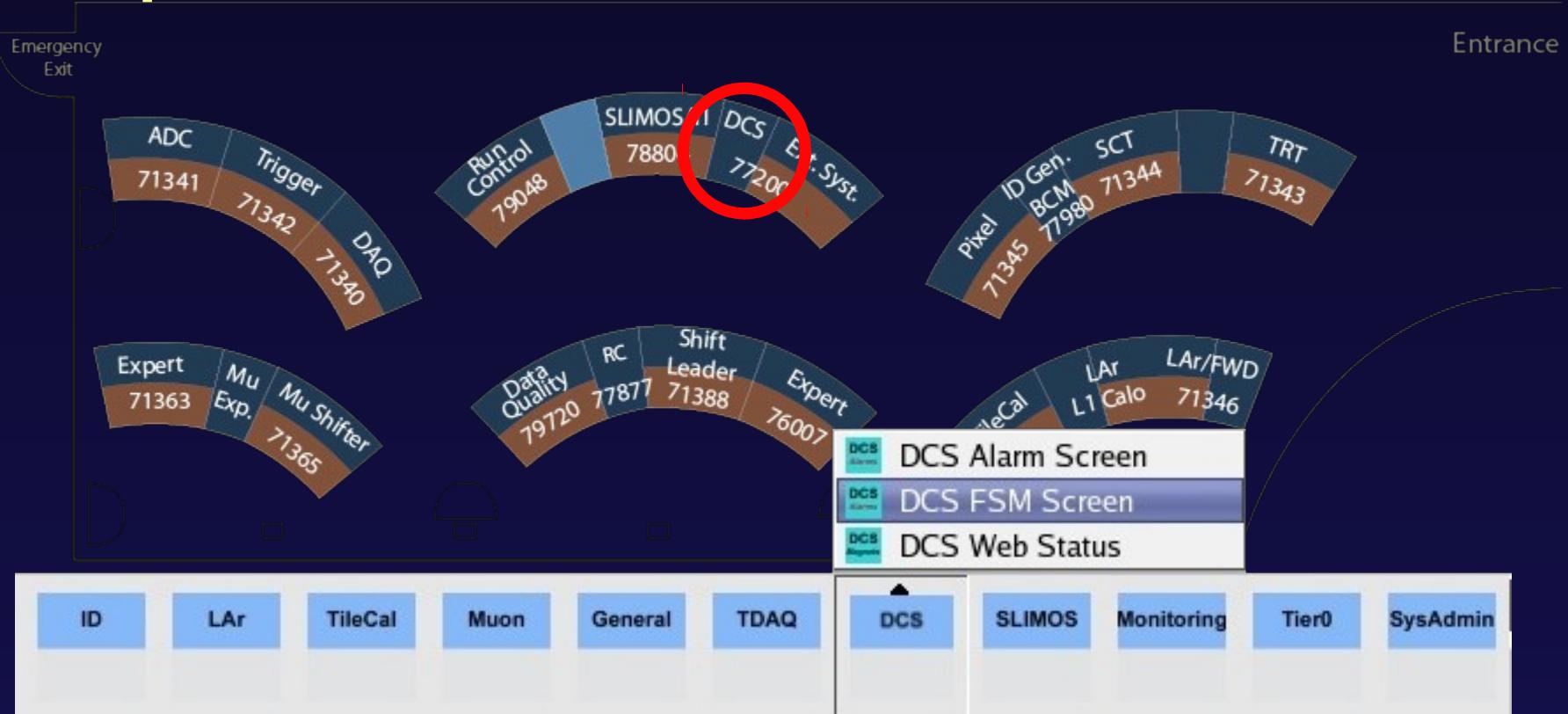
Function & Architecture

- ▶ Monitor and control detector operation
- ▶ Total $>10^7$ parameters distributed over >130 LCS (rack servers)
- ▶ Archiving of selected parameters to Oracle database
- ▶ Interfaced with DAQ/RunControl
- ▶ Links to external controls systems (LHC, Infrastructure)
- ▶ Remote access: direct and via web applications



System	Component	# Servers (# Appl.)	# Archived Parameters	Total # Parameters	# FSM Objects
Inner Detector	Pixel	11(12)	57k	1'086k	9.1k
	Silicon strips	11(11)	106k	1'265k	14.7k
	Transit. radiation Services	11(11)	69k	123k	13k
Calorimeters	7(8)	16k	494k	3.7k	
	Liquid Argon	13(13)	27k	910k	8.3k
Muon Spectrometer	Tile	5(5)	51k	719k	2.4k
	Drift tubes	29(29)	214k	3'229k	19.2k
	Cathode strip	2(2)	1.3k	109k	0.6k
	Resistive plate	7(7)	139k	1'597k	2.5k
Forward detectors	Thin gap	7(7)	81k	1'225k	10k
	Services	2(2)	0.7k	55k	0.04k
		4(4)	4.9k	194k	0.9k
Common Services	Counting rooms	7(7)	23k	568k	4.7k
	Trigger & DAQ	2(2)	11k	386k	1.3k
	External+safety	4(6)	8.0k	144k	0.4k
	Global services	9(13)	1.2k	222k	0.4k
Total		131(139)	809k	12.3M	91.2k

Operation in ACR



Interfaces

- Finite State Machine (FSM) and Alarm Screens



Desk Details

DCS Desk pc-atlas-cr-dcs



Shifter Desk pc-atlas-cr-*



ACR Stations

- ▶ DCS desk: Global FSM for Control, FSM ownership, global Alarms
- ▶ Shift Leader desk: Global FSM for Monitoring and LHC interaction (handshake), global Alarms
- ▶ System Shifter desks: FSM and Alarms for respective system group (ID, CAL, MUON)

Be aware:

- ▶ All desks: limited # of UIs!! Counts per system, alarm if close to limit

ATLAS ALARM SCREEN

GROUP ACKNOWLEDGEMENT

Acknowledge ▾

!!! Unacknowledged

xxx Group acknowledged

x Individually acknowledged

Sh	Dir.	Description	Alarm text	Online Value	Ack	Time	Co
E	CAME	CIC RackControl USA15level2 LUCID Y0402A2 DSS_Trigger_Fault	ERROR	TRUE		2014/11/04 14:41:01	
F	CAME	DSS Alarm INF WaterLeak LAR CoolingStation UX15	DSS Event	TRUE		2014/11/11 08:38:42	
E	WENT	CIC RackControl PLC Connection USAL1	PLC disconnection	1	!!!	2014/11/16 09:28:07	

- ▶ Options for each alarm (right-click):
 - ▶ Mask alarm on UI level until the alarm condition goes
 - ▶ Insert alarm to ELOG with
 - ▶ Display trend plot of value
 - ▶ Alarm help on TWiki
- ▶ Acknowledgement:
 - ▶ Only for some alarms
 - ▶ Operator needs to acknowledge (left-click on “!!!”), otherwise
 - ▶ Unacknowledged, but resolved
- ▶ Summary alert:
 - ▶ Single alarm entry hiding several alerts of same type (accessible via “Details”)
- ▶ Filters:
 - ▶ Different sets of filters exist, e.g. sub-detectors
 - ▶ Use always “Default” unless you know what you are doing, always revert back

ATLAS Alarm Screen - Masked Alarms

Masked	Short	Dir.	Description	Alarm Text	Time
✓	F	CAME	ATLTGCA2 ElmbPsu sideA sector09 CANvoltage	Very low	2009/09/05 15:08:55.973
✓	F	CAME	ATLTGCA2 ElmbPsu sideA sector09 AnalogDigitalVoltage	Very low	2009/09/05 15:08:56.176
✓	F	CAME	ATLTGCA2 ElmbPsu sideA sector10 CANvoltage	Very low	2009/09/05 15:08:56.676
✓	F	CAME	ATLTGCA2 ElmbPsu sideA sector10 AnalogDigitalVoltage	Very low	2009/09/05 15:08:56.895
✓	F	CAME	ATLTGCC2 ElmbPsu sideC sector09 CANvoltage	Very low	2009/09/17 10:46:16.512
✓	W	CAME	TIL EBC Drawer 5 external HV Opto PMT Temperature	WARNING	2010/01/25 10:32:25.421
✓	W	CAME	TIL EBC Drawer 5 internal HV Opto PMT Temperature	WARNING	2010/01/25 10:32:52.452
✓	W	CAME	TIL EBC Drawer 5 internal HV Opto PMT Temperature	WARNING	2010/01/25 18:28:13.530
✓	W	CAME	TIL EBC Drawer 5 internal HV Opto Board Temperature	WARNING	2010/02/16 13:24:50.398
✓	E	CAME	TIL EBC Drawer 5 internal HV Opto Board Temperature	ALERT	2010/02/16 13:25:17.430
✓	W	CAME	TIL EBC Drawer 5 external HV Opto Board Temperature	WARNING	2010/02/16 13:26:20.383
✓	E	CAME	TIL EBC Drawer 5 external HV Opto Board Temperature	ALERT	2010/02/16 13:27:32.384
✓	W	CAME	ATLTGCA2 ElmbPsu sideA sector09 CANvoltage	Low	2009/09/05 15:08:55.973
✓	W	CAME	TGC C M2 sector03 ph1 F L1 thresholdw01 settings!=readout	Inaccurate	2009/09/20 09:43:35.715
✓	W	CAME	TGC C M2 sector03 ph1 E1 L1 thresholdw00 settings!=readout	Inaccurate	2009/09/20 09:43:35.449
✓	W	CAME	TGC C M2 sector07 ph1 E1 L2 thresholdw01 settings!=readout	Inaccurate	2009/09/20 09:43:34.809
✓	W	CAME	TGC C M2 sector07 ph1 F L2 thresholdw01 settings!=readout	Inaccurate	2009/09/20 09:43:33.366
✓	W	CAME	TGC C M3 sector07 ph1 E1 L2 thresholdw03 settings!=readout	Inaccurate	2009/09/20 09:43:28.746
✓	W	CAME	ATLTGCC2 ElmbPsu sideC sector09 CANvoltage	Low	2009/09/17 10:46:16.512
✓	W	CAME	TGC GAS Data CopyMechanism Warning	WARNING	2009/09/10 13:16:28.101
✓	W	CAME	ATLTGCA2 ElmbPsu sideA sector10 AnalogDigitalVoltage	Low	2009/09/05 15:08:56.895
✓	W	CAME	ATLTGCA2 ElmbPsu sideA sector10 CANvoltage	Low	2009/09/05 15:08:56.676
✓	W	CAME	TGC C M3 sector03 ph1 E2 L1 thresholdw02 settings!=readout	Inaccurate	2009/09/20 09:43:35.746
✓	W	CAME	TGC C M3 sector03 ph1 E2 L1 thresholdw02 settings!=readout	Inaccurate	2009/09/20 09:43:35.778
✓	W	CAME	TGC C M3 sector03 ph1 E5 L2 thresholdw03 settings!=readout	Inaccurate	2009/09/20 09:43:35.866
✓	W	CAME	TGC C M3 sector07 ph1 E5 L1 thresholdw02 settings!=readout	Inaccurate	2009/09/20 09:43:36.871

Filter settings:

Systems Severity Description

ATLRTTVC
 ATLRTLCS1
 ATLRTPPA1
 ATLRTPPA2
 ATLRTPPC1
 ATLRTPPC2
 ATLRTSCS
 ATLZDC01

W Alert Text
 E DPE Name
 F

Displayed: 46 Masked: 60 Refresh time: 3/3/2010 1:26:07 AM (553) Apply Filter

Close

Finite State Machine (FSM)

State machine hierarchy

- Detector hardware represented by FSM objects, hierarchically structured

State&Command propagation

- State model for devices (ON, OFF, ...) and logical objects (READY, NOT_READY, ...)
- Propagation upwards (using programmed logic for parent depending on child states)
- Commands propagated downwards

Status

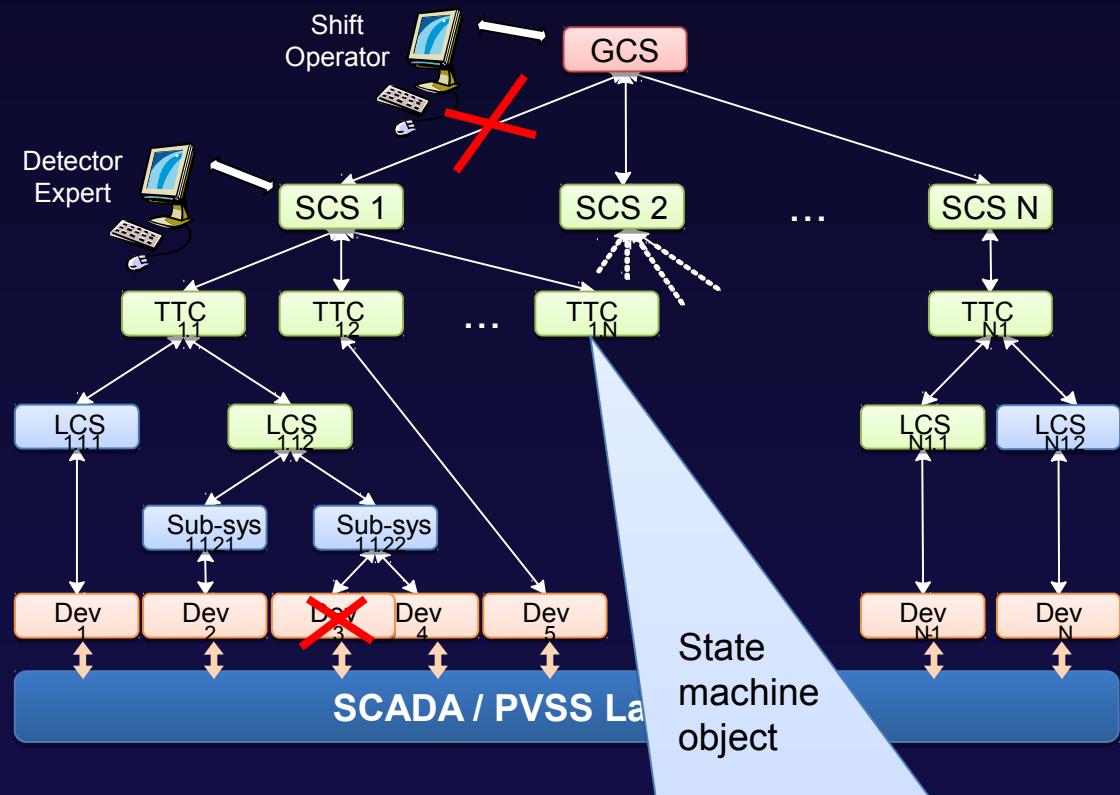
- Error handling upwards

Object operations

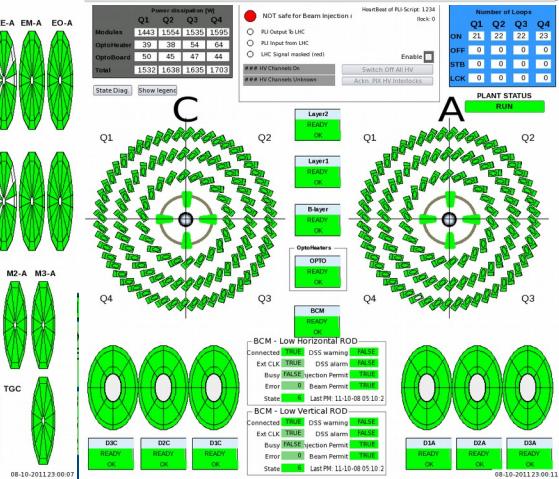
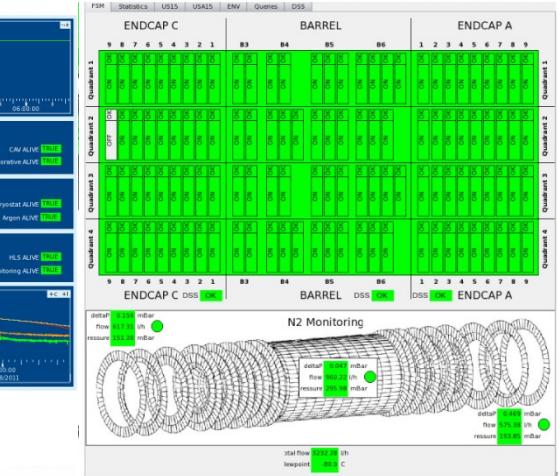
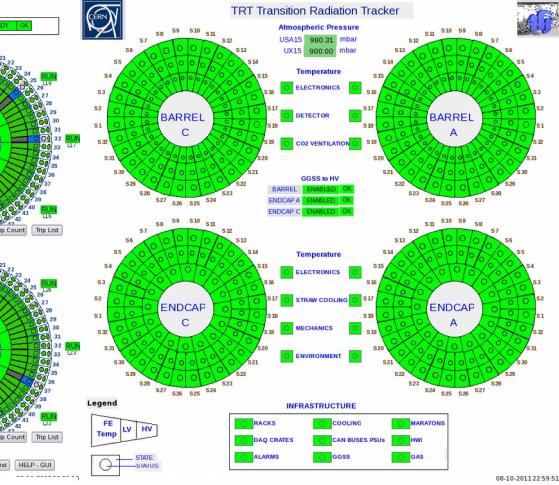
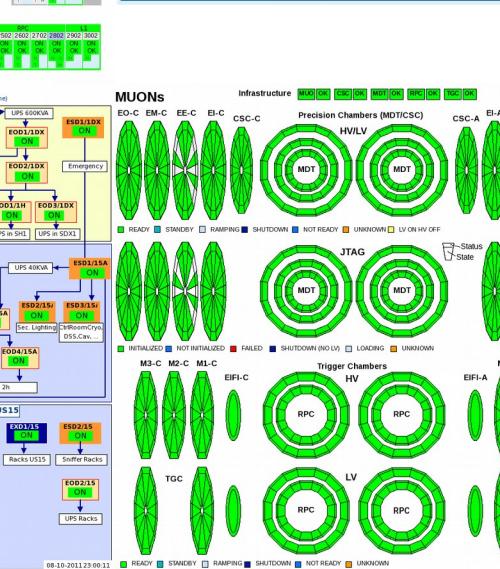
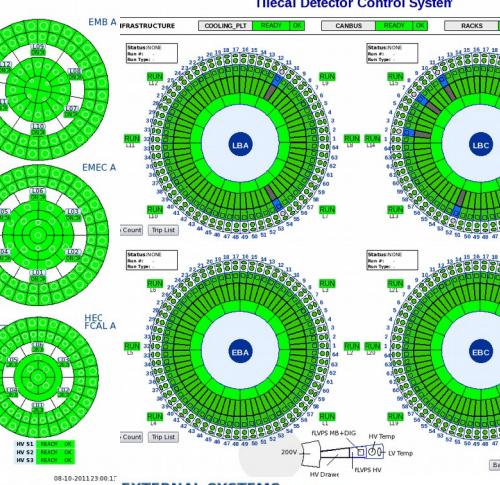
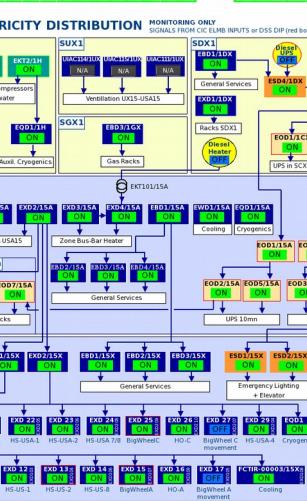
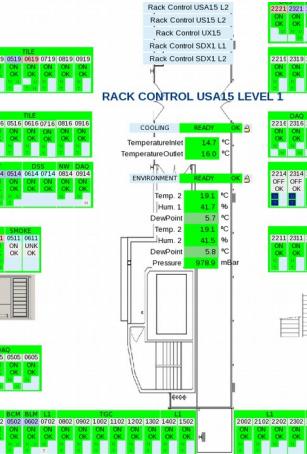
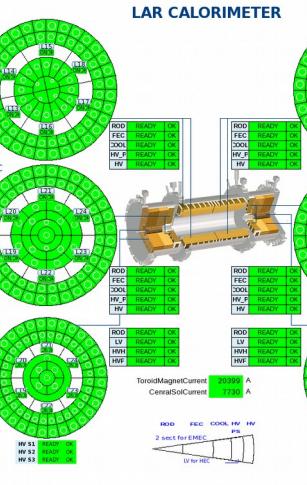
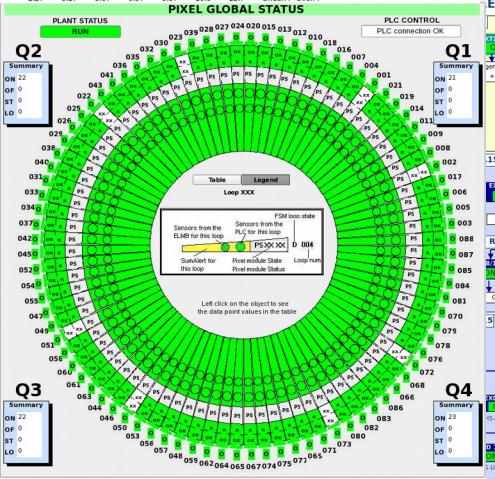
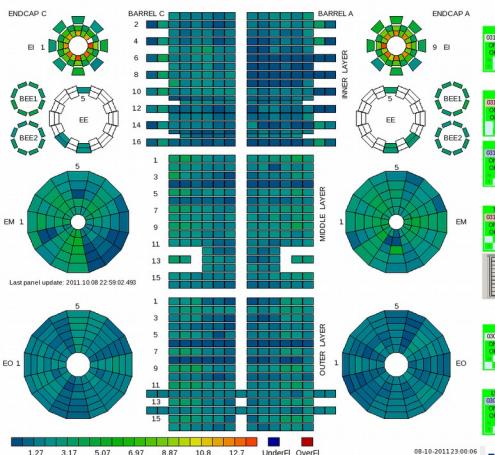
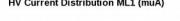
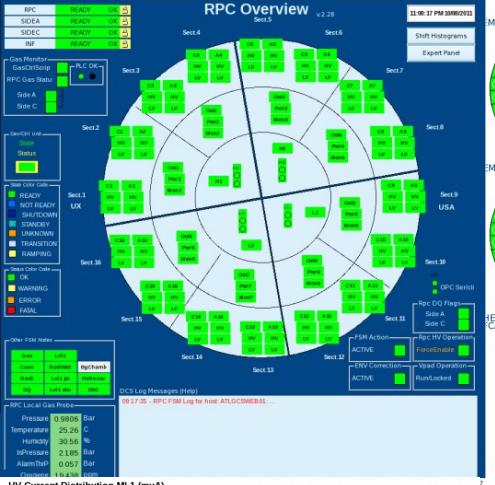
- Commands
- Enable/disable (low level)
- Take/release/include/exclude (high level)
- Access control for all operations

User Interface

- Browsing and object operation...



**only mandatory for relevant sub-detectors



FSM Screen: Partitioning Modes

High level objects:

Padlocks:

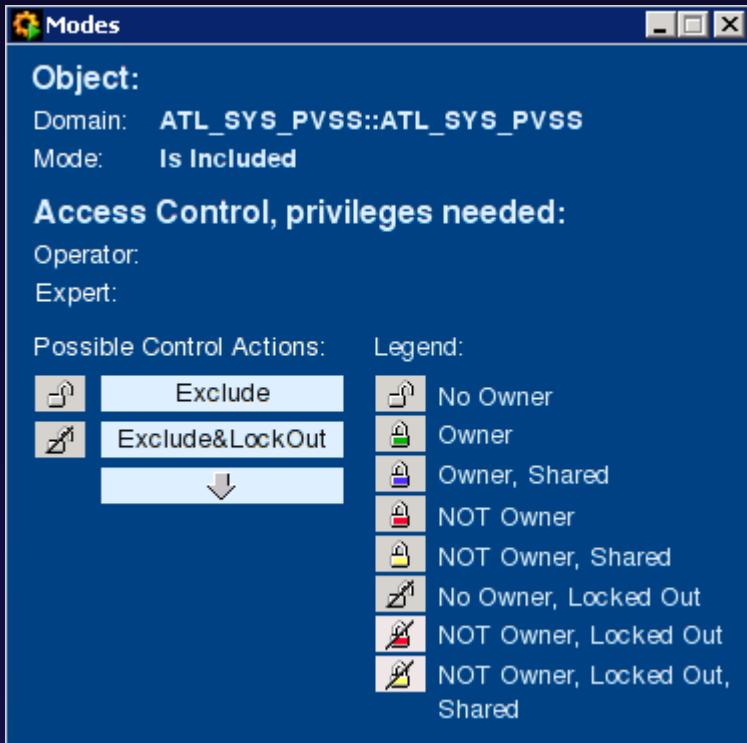
- No control, Free
- Exclusive, Owner
- Shared, Owner
- Exclusive, NOT Owner
- Shared, NOT Owner
- No control, Locked Out
- No control, Included

Low level objects:

Checkboxes:

- Enabled, Controllable
- Disabled, Controllable
- Enabled, Not controllable (either free or not owned + exclusive sub-tree)
- Disabled, Not controllable

Change mode with left-click on padlock:



Padlock background = tree completeness:

- Tree complete
- Excluded children (!)
- Disabled children

Change mode with left-click on checkbox:



Access Control

Aim: prevent accidental actions

- ▶ Username, Password: CERN account
- ▶ Shifters get DCS:<sub-det>:operator privileges for shift, thus could:
 - ▶ Mask/acknowledge alarms
 - ▶ Operate FSM objects:
 - ▶ Enable/disable
 - ▶ Take/release/include/exclude (if owner)
 - ▶ Commands
- ▶ Please use **FSM actions only after request by an expert or if stated explicitly in sub-system instructions!**
- ▶ Shift Leader roles/privileges:
 - ▶ DCS:<sub-det>:operator for all sub-dets, but **not** in sub-domains (e.g. LARHV) as fallback solution
 - ▶ Additionally **BIS operator** (see Beams training)



DCS Back-End Monitoring

- ▶ Monitor state of DCS back-end itself (processes, machines, ...)
- ▶ Accessible on FSM screen
- ▶ Global: “DCS BE”
- ▶ Sub-det: “XYZ SYSTEMS”
- ▶ Control over running panels from within ACR, possibility to monitor and kill (emergency only!) user interfaces by shift leaders
- ▶ Follow up of problems only by DCS experts (sub-detector or central)

ATLAS DCS BACK-END MONITORING

LHC	ID	CALO	MUON	SERVICE
LHC READY OK	ID OK	CALO OK	MUON OK	SERVICE OK
Stable Beams	PX OK	LAR OK	MDT OK	CIC OK
Energy 3400.0 GeV	SCT OK	TIL OK	RPC OK	EXT OK
Interactions Per Event	TRT OK	TGC OK	TDAQ OK	ATLASSIMOK
ATLAS is beam-safe	IDE OK	CSC OK	FWD OK	SAF OK
Stable Beams Flag	Handshake			

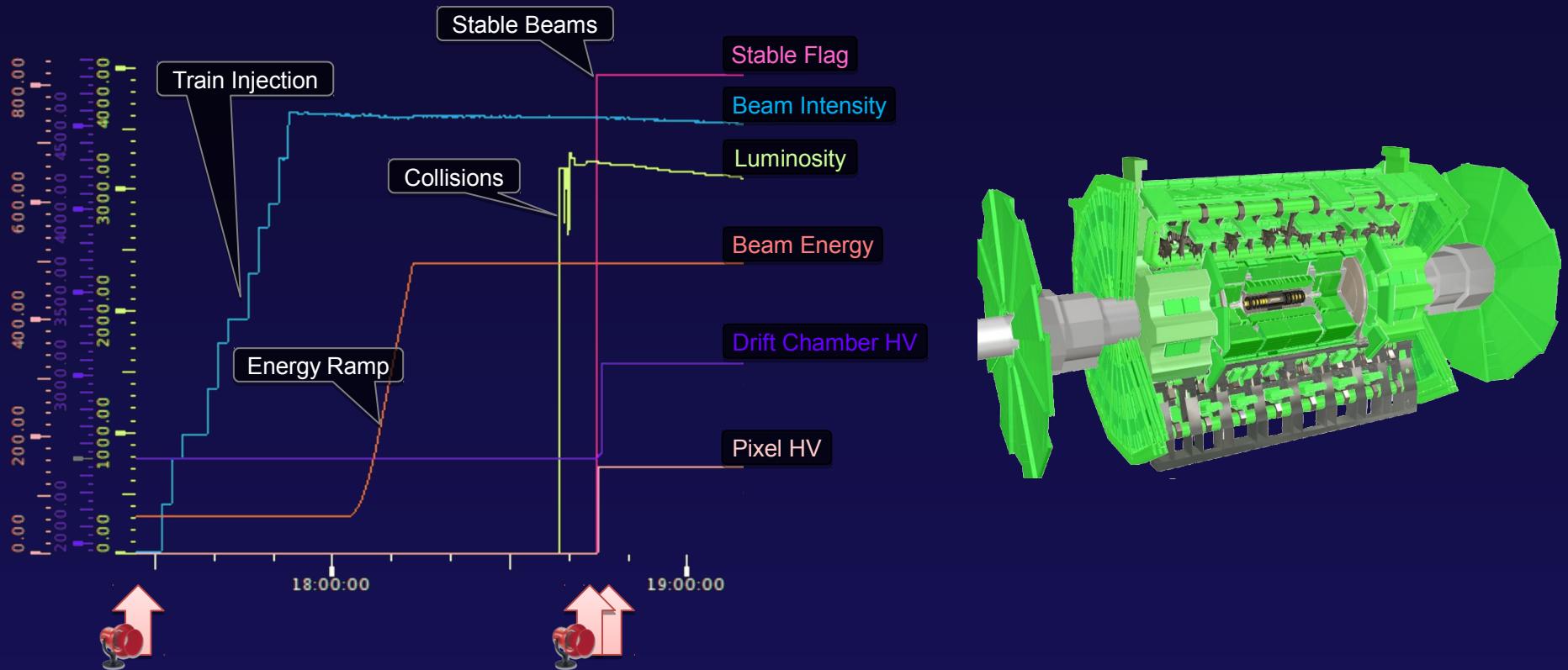
ATLAS DCS - PVSS Systems Overview

PIX SYSTEMS	READY	W
ATLPIXLCS1	OK	
ATLPIXLCS10	OK	
ATLPIXLCS11	OK	
ATLPIXLCS12	OK	
ATLPIXLCS13	OK	W
ATLPIXLCS2	OK	
ATLPIXLCS3	OK	
SCT SYSTEMS	READY	OK
ATLSCTS5	OK	
ATLSCTSABPS1	OK	
ATLSCTSABPS2	OK	
ATLSCTSABPS3	OK	
ATLSCTSABPS4	OK	
ATLSCTSABPS5	OK	
ATLSCTSABPS6	OK	
ATLSCTSABPS7	OK	
ATLSCTSABPS8	OK	
ATLSCTSABPS9	OK	
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ATLSCTSABPS409	OK	
ATLSCTSABPS410	OK	
ATLSCTSABPS411	OK</	

LHC Interaction

Synchronization of DCS with LHC operation and run control

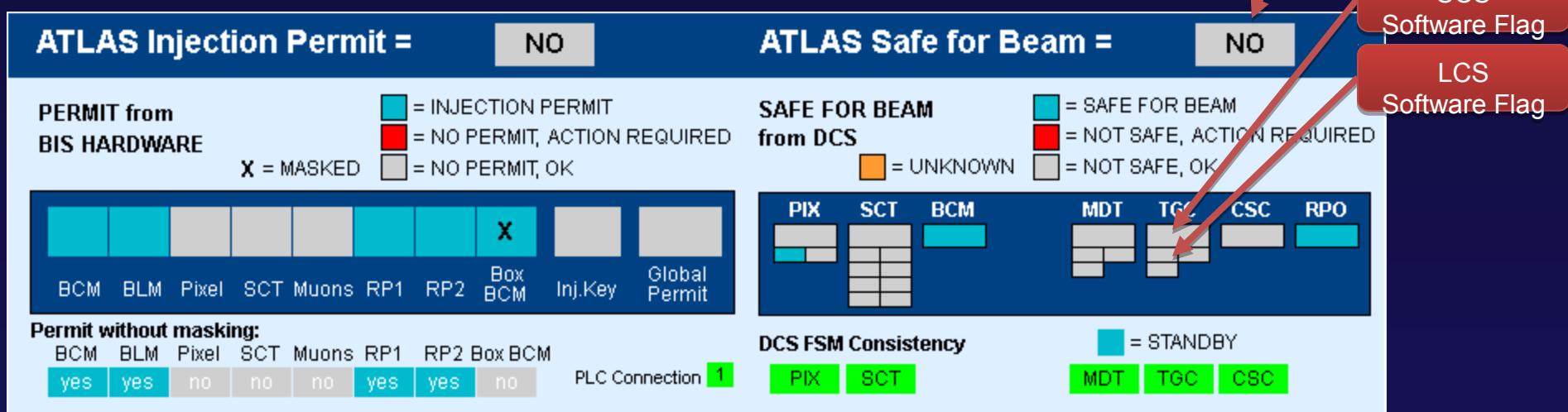
- Detector safety requires lower voltage levels during unstable beam conditions (beam injection, adjust, **STANDBY** = **READY**)
- State changes **STANDBY** → **READY** automated (atm except IBL/Pixel), synchronization with DAQ run control, should take max. 5 minutes
- Audible notifications from DCS for important beam events
- Beam backgrounds and luminosity monitored via DCS (LHC FSM tree)



Beam Interaction – Details

Hardware permits vs. Software “safe for beam”

- ▶ Hardware permits (left widgets) sometime generated via DCS
- ▶ Software flags (right widgets) evaluate total sub-detector condition independent of FSM configuration
- ▶ FSM states to x-check consistency
- ▶ Right-click on widgets to get history (if archived)



Global Software Flag

SCS Software Flag

LCS Software Flag

Shifter Tasks

Preparation

- ▶ Check respective system documentation
- ▶ In particular inform yourself about current problems and solutions, on-line

You are logged in as stefan [Logout](#) [ChangeLog v8.0.12](#)

Flat View Threaded View New Entry Advanced Search Display Thread [Contact us @](#)  

Message Type: Default Message Type ▾ **Author:** Stefan Schlenker **Status:** open closed

System Affected: Tile, DCS

Subject: Several HV trips in LBA

Text Editor: Expert was informed, recovery ongoing.
Alarms masked.
List of channels follows...

- ▶ Check actively with other shifters when suspecting problem cause in other systems,
- ▶ Inform shift leader about possible efficiency
- ▶ Report to ELOG:
 - ▶ Message Type = Default System
 - ▶ System affected: assignment DCS + sub-detector (2015)

Desk	System Identifiers
ID	PIX, SCT, TRT, IDE
CALO+FWD	LAR, TIL, FWD, LCD, ZDC, RPO
MUON	MDT, CSC, RPC, TGC, MUO
DQ	LHC, LUM
SLIMOS	CIC, EXT, SAF, GCS
SHIFT LEADER	TDQ, GCS

Shifter Tasks: Alarms

Aim: Get / Keep alarm screen empty!

Procedure:

- ▶ Follow up according to severity
- ▶ Try to understand alarms, check documentation (= system shifters instructions and right-click alarm help) for specific procedures
- ▶ If problem cannot be fixed, contact system expert
- ▶ If alarm condition cannot be removed on short timescale (<~30min), *mask* alarm in agreement with expert or following specific instructions
- ▶ If (masked) alarm condition cannot be removed on long timescale (>1week), expert is responsible to *deactivate* alarm or change alarm limits until problem is solved
- ▶ Acknowledgeable alarms: *acknowledge* after informing expert
- ▶ Report to ELOG what has been done, including details (list of alarms treated)

FATAL

ERROR

WARNING

Fatal failure, immediate attention required. Call.

Failure condition which might prevent taking good data. Call.

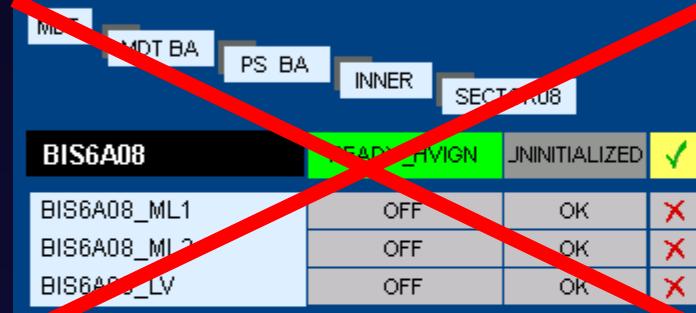
Minor problem. Upcoming failure which might be avoidable. Elog/maybe call.

The screenshot shows the 'ALARM SCREEN' window for the ATLAS experiment. At the top, there's a toolbar with icons for file operations. Below it is a header bar with the title 'ALARMS_CIC: ATLASAlarmScreen'. The main area contains a table of alarms with the following columns: Sh, Dir., Description, Alarm text, Online Value, Ack, Time, and Co. There are also buttons for 'Acknowledge' (with dropdown), 'Unacknowledged' (with exclamation mark icon), 'Group acknowledged' (with 'xxx' icon), and 'Individually acknowledged' (with 'x' icon). The table lists three alarms:

Sh	Dir.	Description	Alarm text	Online Value	Ack	Time	Co
E	CAME	CIC RackControl USA15level2 LUCID Y0402A2 DSS_Trigger_Fault	ERROR	TRUE		2014/11/04 14:41:01	
F	CAME	DSS Alarm INF WaterLeak LAR CoolingStation UX15	DSS Event	TRUE		2014/11/11 08:38:42	
E	WENT	CIC RackControl PLC Connection USAL1	PLC disconnection	1	!!!	2014/11/16 09:28:07	

Shifter Tasks: FSM

Aim: Get / Keep FSM



Procedure:

- ▶ Beginning of shift: check for tree being incomplete □ no objects should show (excluded sub-trees), in case they do □ contact expert
- ▶ Understand problems ($\text{State} \neq \text{READY}$, $\text{Status} \neq \text{OK}$)
 - ▶ Navigate down to object causing the problem, check on respective panel
 - ▶ Check documentation for specific procedures
- ▶ If problem cannot be fixed, contact system expert
- ▶ If problem cannot be solved on short timescale (<~30min), *Disable or Exclude* only affected FSM object in agreement with expert or following specific instructions
 - ▶ Use with caution since this object will not receive global FSM commands nor will report further state/status changes, do not disable all children objects and leave parent enabled

Note: Exclude/Include can only be done on DCS desk, Disable/Enable on all FSM screens

- ▶ Interventions on monitored trees should be done by handing over ownership from DCS desk to experts (*Exclude*), then *Include* sub-tree back into tree via 'Include sub-tree' function (green icon)

