Muon Shift Training
DCS

Muon DCS Community

Introduction

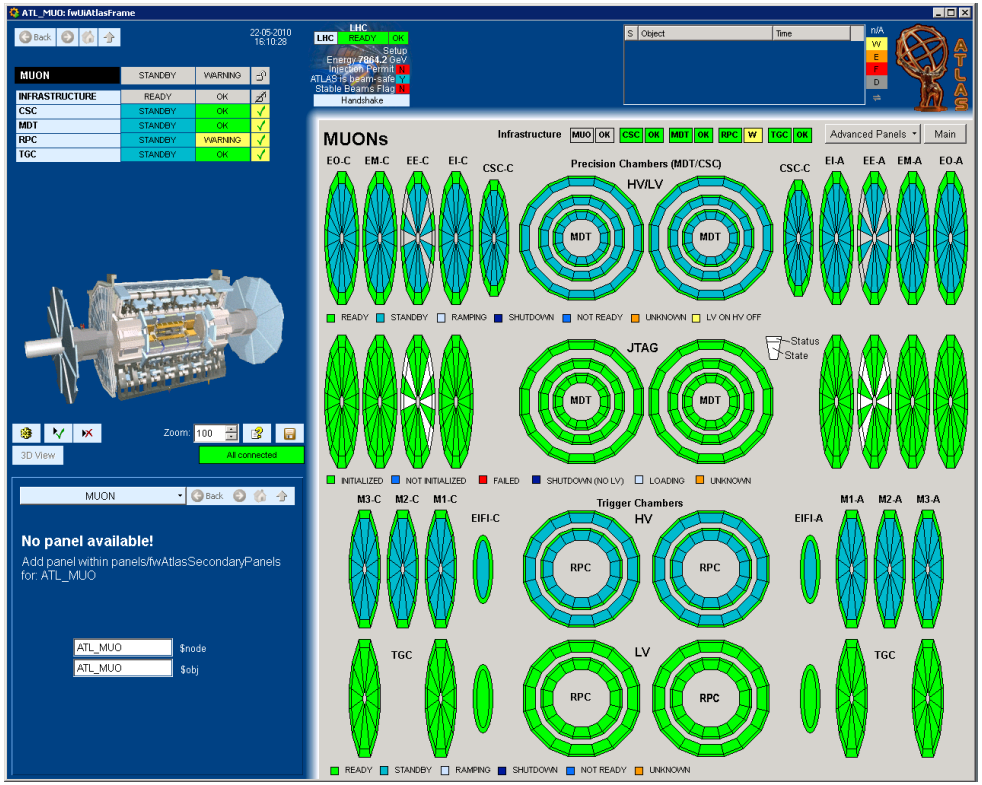
We assume you already followed the ATLAS general DCS training module, such that you are familiar with DCS concepts of the FSM :

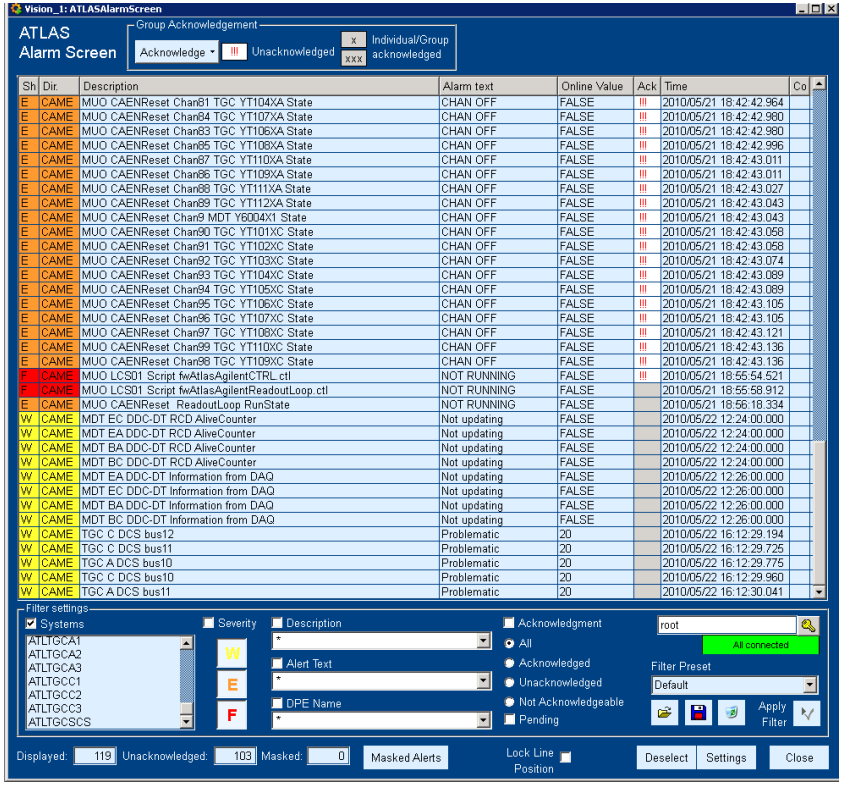
- *alarms.*
- *alarm screen features and alarm screen operation, ….*

Shifter DCS Tools

There are 2 DCS User Interfaces for Shifter Use in the ATLAS Control Room

- The Finite State Machine (FSM) UI
- The DCS Alarm Screen

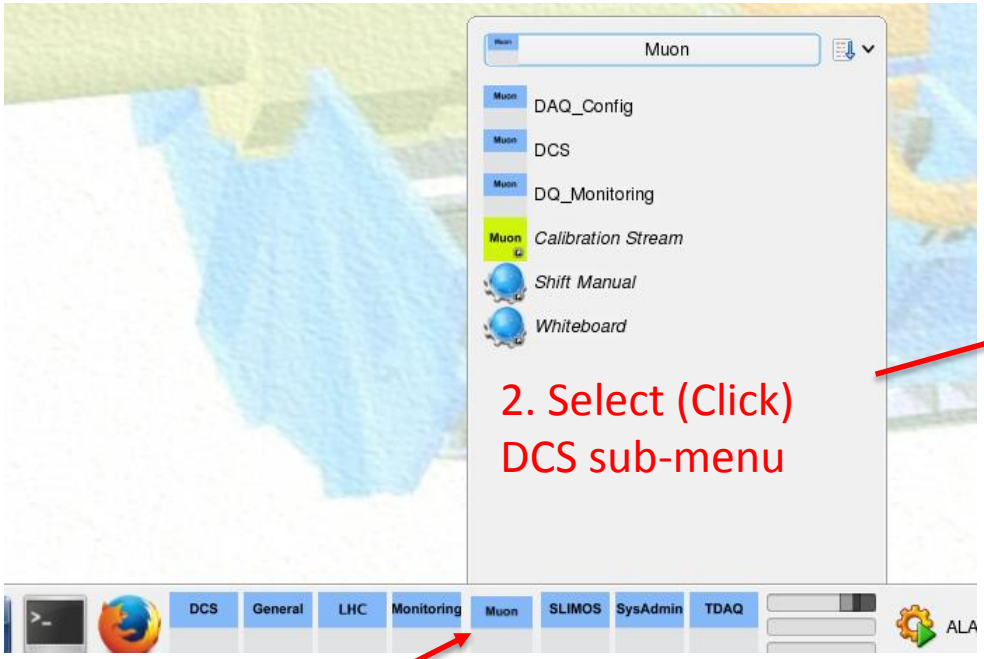


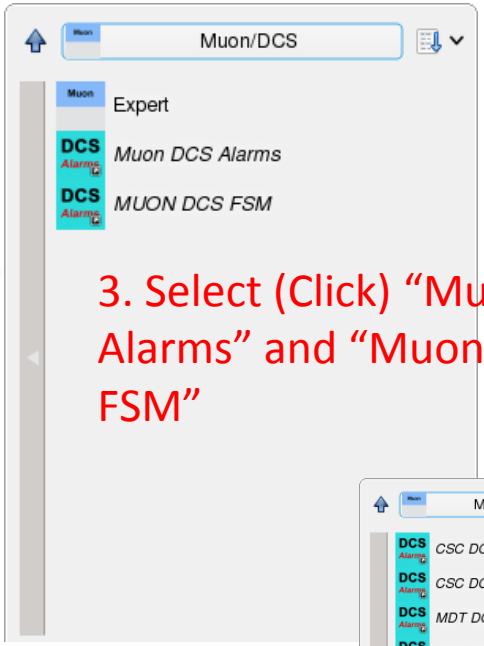


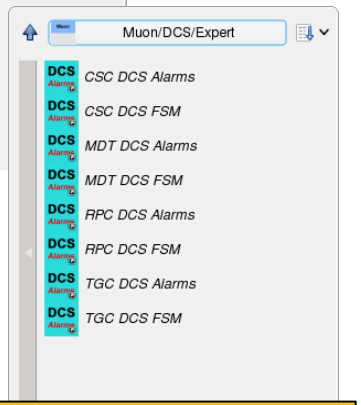
Both shall be open at all times and monitored – you are expect to react to them !

Muon FSM and Alarm Screen UI

How to start the Muon DCS user interfaces: Muon desk







1. Click on “Muon” menu

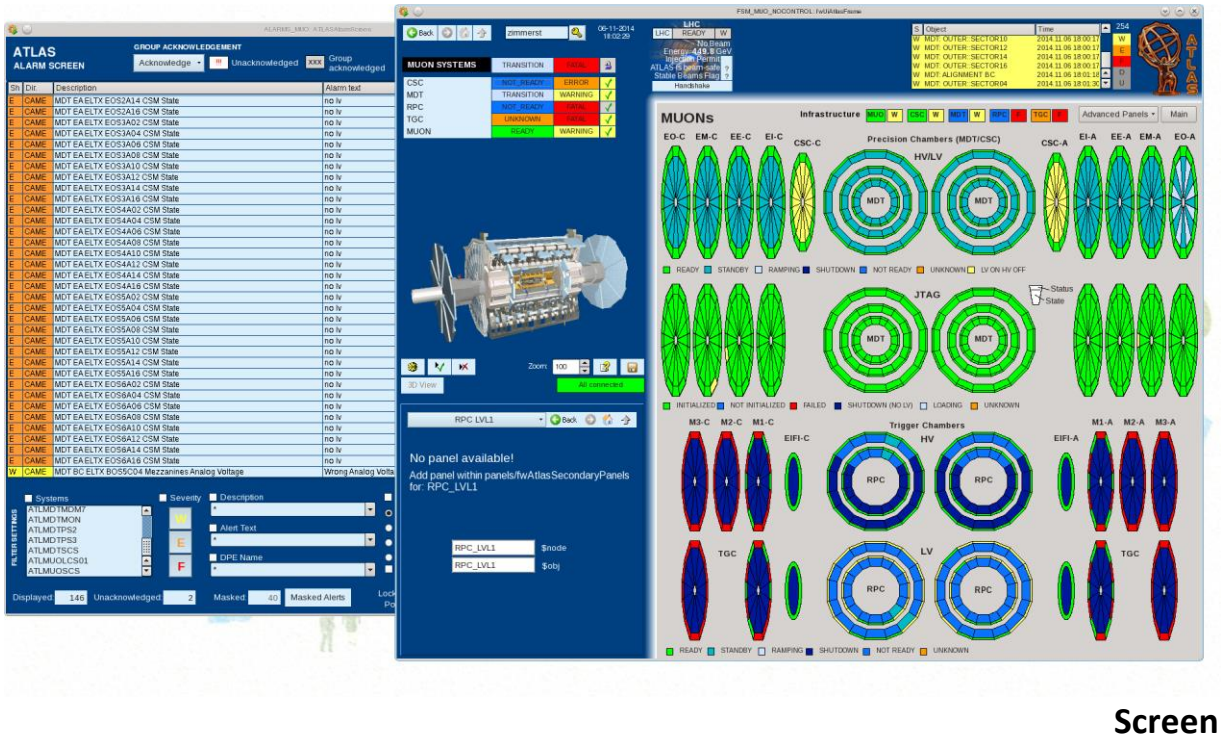
Note: The alarm screen/FSM UI can be open also per sub-detector (CSC, MDT, RPC, …),this is usually for experts → shifters use the MUON FSM/Alarms !

At the start of your shift, make sure there is one FSM UI and one alarm screen open --- close duplicate and superfluous interfaces, number of open UIs is limited and the system may become unusable eg for an expert on call otherwise

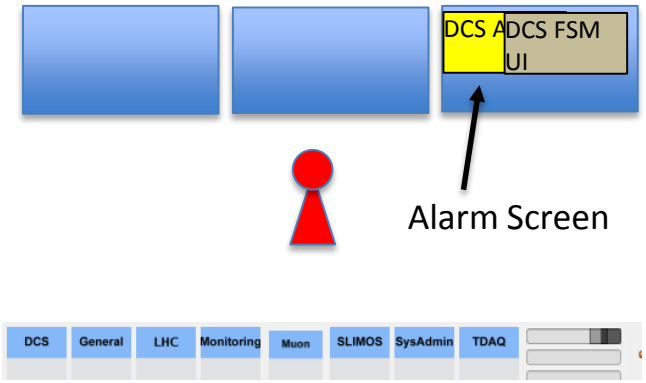
Recommended Screen Layout for DCS UIs

User Interfaces were developed over the course of several years, optimized for the then standard 4:3 screen size ….. Which is no longer in use, so Panels no longer nicely fit one to a ACR display/monitor/screen

Screen **Screen**



Screen

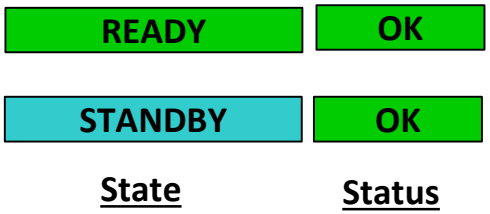


- Recommended overlapped placement on the right most monitor
- Toggle between FSM and Alarm Screen by clicking into the Panels
- Display DCS UIs on all 3 virtual Desktops !

Recap: (Muon) Shifter DCS Duties

Muon shifter shall ensure that

1. In the FSM, the MUON as well as the sub-detector state should always be



(nominal HV, stable beams or no beam)

(safe HV, outside stable beams)

2. The Alarm Screen should be empty (no alarms)

3. When reaching stable beams, the system shall correctly ramp to nominal HV for physics data taking
4. When in STANDBY, the system shall give the safe for beam flag, and grant the injection permit → this shall be explicitly checked during Injection and Adjust Handshakes

1. and 2. hold while taking physics data and in interfill periods etc. – different from maybe DQ …

Recap: DCS Best Practice (Policy) -- Alarms

1. At the start of your shift log in to the alarm screen UI, reapply the default alarm screen filter

2. Understand what an alarm is about. Check the alarm help and/or instructions.

3. Document alarms in separate elogs, at the time when they appear and not only in the shift summary. Put as much details as you can, including circumstances, time, name of an expert you called, actions taken yourself

4. Alarms can be of Severity **WARNING** or **ERROR** or **FATAL**.
   - If you can not resolve a **ERROR** or **FATAL** and it persists for more than a few 10s of seconds or a minute, you must call an expert.
   - **WARNINGs** are a type of pre-alarm. Observe for a while. Report in elog, do not need to call an expert (especially out of hours) if not stated explicitly in the instructions/alarm help.

5. If a new alarm is for a float type parameter, observe it for a few minutes (trend plot). If it comes and goes or just "crazes" the warning limit, document it in elog, take a pragmatic decision whether to call an expert (example: environmental temperatures)

6. Acknowledge or mask alarms only when instructed to do so (alarm help/shift manual/expert). Document the acknowledgement in a separate elog. Muon alarms are acknowledged or masked by the muon shifter, not the SL

Recap: DCS Best Practise (Policy) -- FSM

1. Do not forget to log in to the FSM UI at the start of shift

2. Monitor the system from 'high up in the tree'

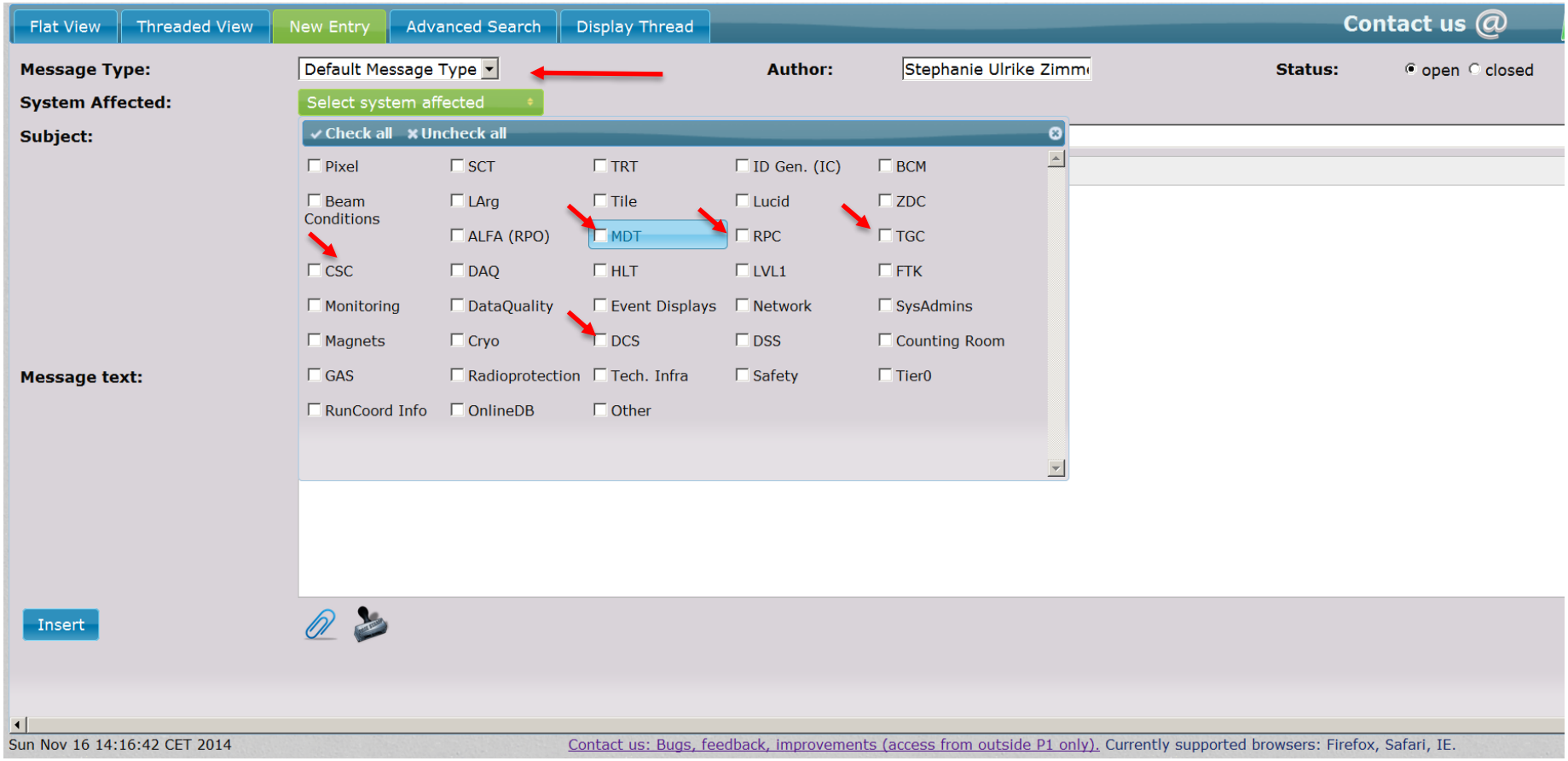
3. Navigate to nodes at the bottom of the hierarchy only if MUONs or a Muon sub-detector is no longer in state READY/OK.

4. Disable anything in the FSM only if instructed to do so
   - For certain specific situations covered in the sub-detector sections, if you can not recover the state to READY—OK
     - Only cases where overall affected part of the detector is small – single chamber
     - MDT tripping channels upon second or more reoccurring trip
     - TGC and CSC tripping HV channels once max. number of automatic recoveries is exceeded
   - Upon instruction from the on-call expert

5. Document in a separate e-log entry (not the shift summary) what you excluded/disabled, the circumstances and who instructed you to do so. No nodes shall be disabled by the SL

DCS related e-log entries

- Make sure you select “Default Message Type” when making e-log entries for a DCS issue
- Make sure you select “DCS” + the concerned sub-detector (CSC, MDT, RPC, TGC, MMG) as affected system, and not only the sub-detector



Muon DCS Issues: Whom to call for help

On-call phone numbers are listed on the Muon Whiteboard

Telephone Numbers

System	Numbers	Who/Where/What
Control Rooms	71365 71363 62941	**ACR Muon Desk 1** (3162-R-K01) **ACR Muon Desk 2** (3162-R-K01) Muon SCR (3196-R-025)
Run Coordinator	160226	**On-Call Phone** Philipp Fleischmann Nicoletta Garelli
CSC DAQ	164832	Cenk Yildiz
MDT/CSC **primary on-call**	162018	Tiesheng Dai
RPC L1 / DAQ	161853	**On-Call Phone**
RPC DCS / Detector	160664	**On-Call Phone**
TGC **primary on-call**	161905	**On-Call Phone**
MMG **on-call**	168679	Paolo Iengo
Additional Numbers		
Extended list of on-calls		see Current On-Call List
Collection of muon expert phone numbers		see Muon Expert Phone List
Other Systems		see the ATLAS Phone List

- For MDT and CSC DCS issues, call the MDT/CSC primary on call.
- For TGC DCS issues, call the TGC primary on call.
- The primary on call will contact the DCS (secondary) experts when needed
- For RPC DCS issues, call the RPC DCS & Detector on-call
- For Muon global DCS issues (BIS system, Muon cooling, Muon overall FSM UI stuck, ….) call the MDT/CSC primary on call

- DCS experts on-call may contact you for follow-up, to announce interventions or for questions in case of a problem

Muon FSM

Main Muon FSM Panel

Sub-Detectors
MMG = MicroMegas

Muon **common** infrastructure

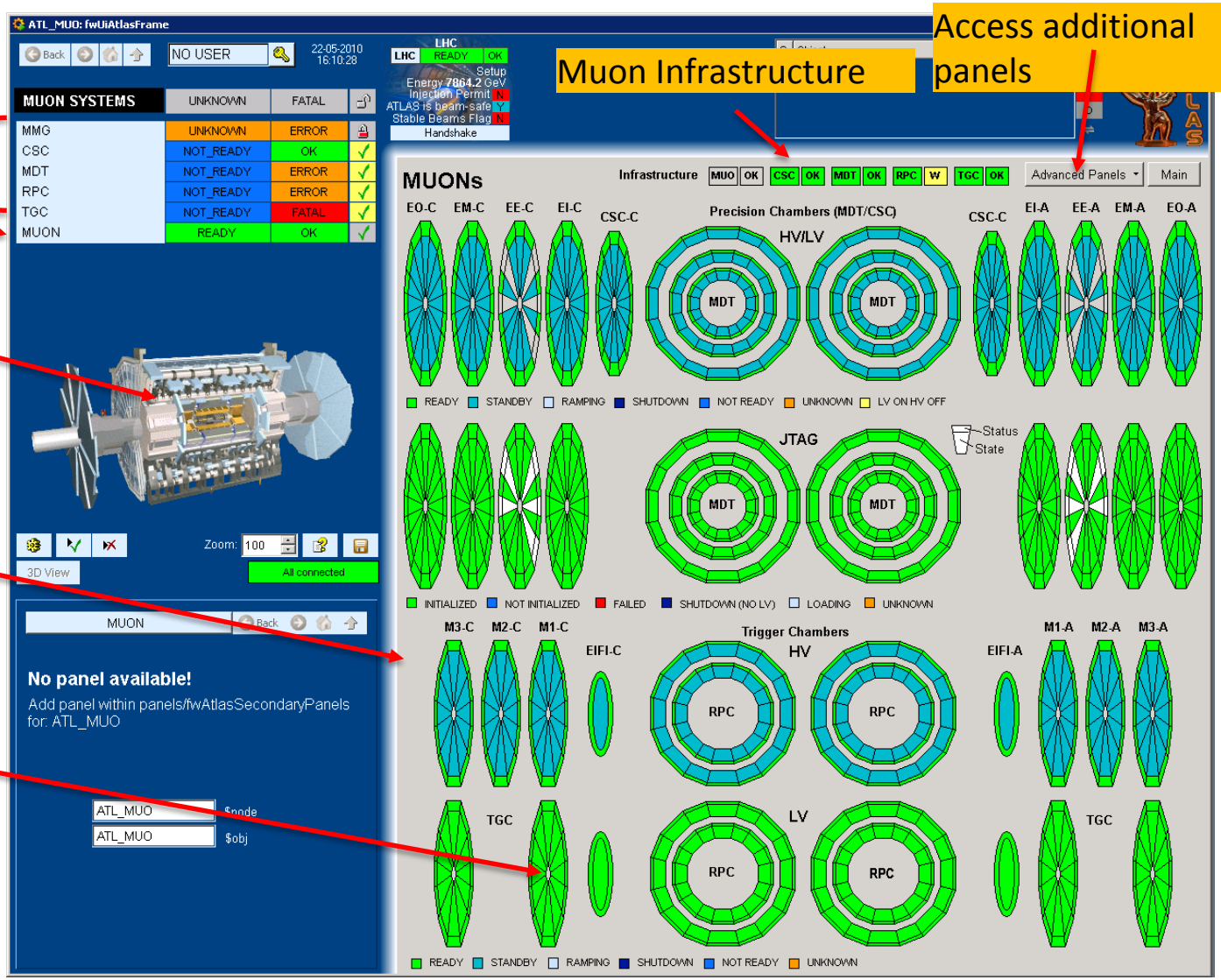
"Click": bring me home to MUON node

Overview over most important detector states: LV, HV, JTAG – Partition graphical representation

"Click": Navigate to sector/layer

Muon Infrastructure

Access additional panels



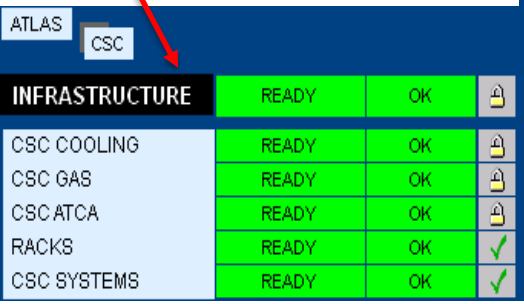
CSC FSM

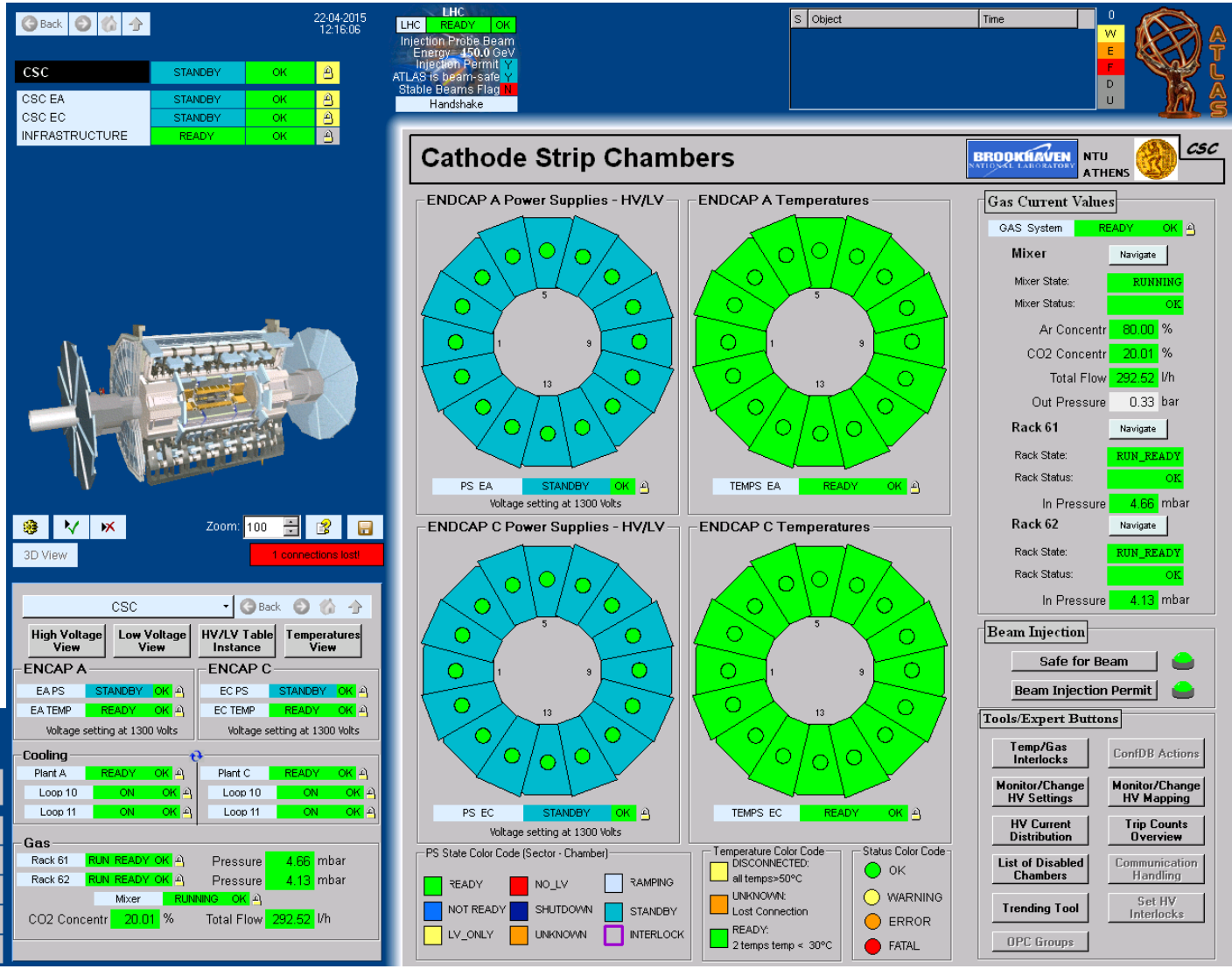
FSM structure

CSC
- Endcap Side A
- Endcap Side C
- Infrastructure

Side A/C
- PS (Power System)
- Temperature

Infrastructure
- …





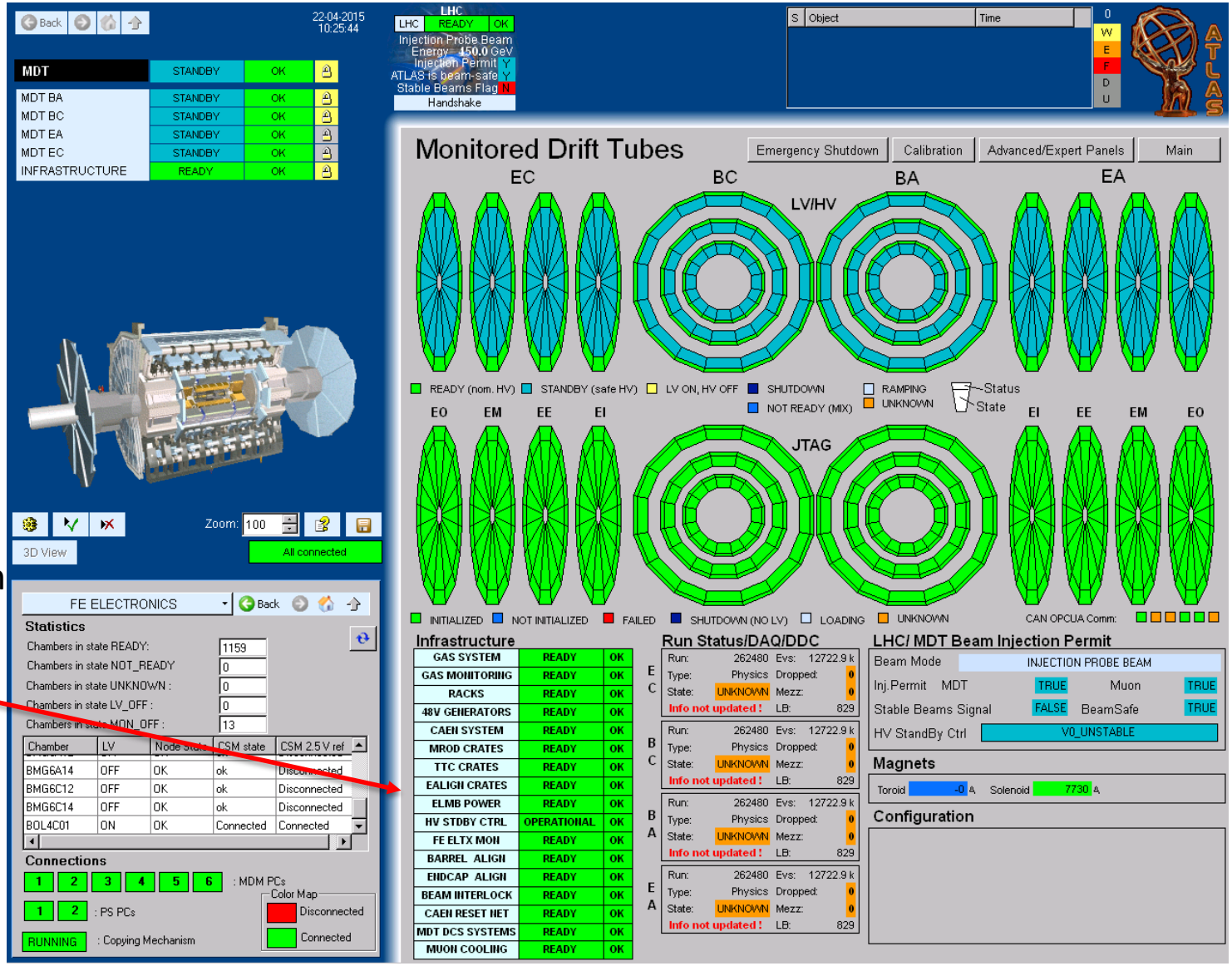
MDT FSM

FSM structure

MDT
- Barrel Side A
- Barrel Side C
- Endcap Side A
- Endcap Side C
- Infrastructure

BA/BC/EA/EC
- PS Power System
- JTAG Initialization

Infrastructure
- ….



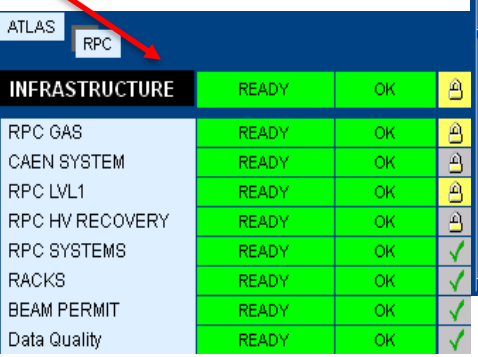
RPC FSM

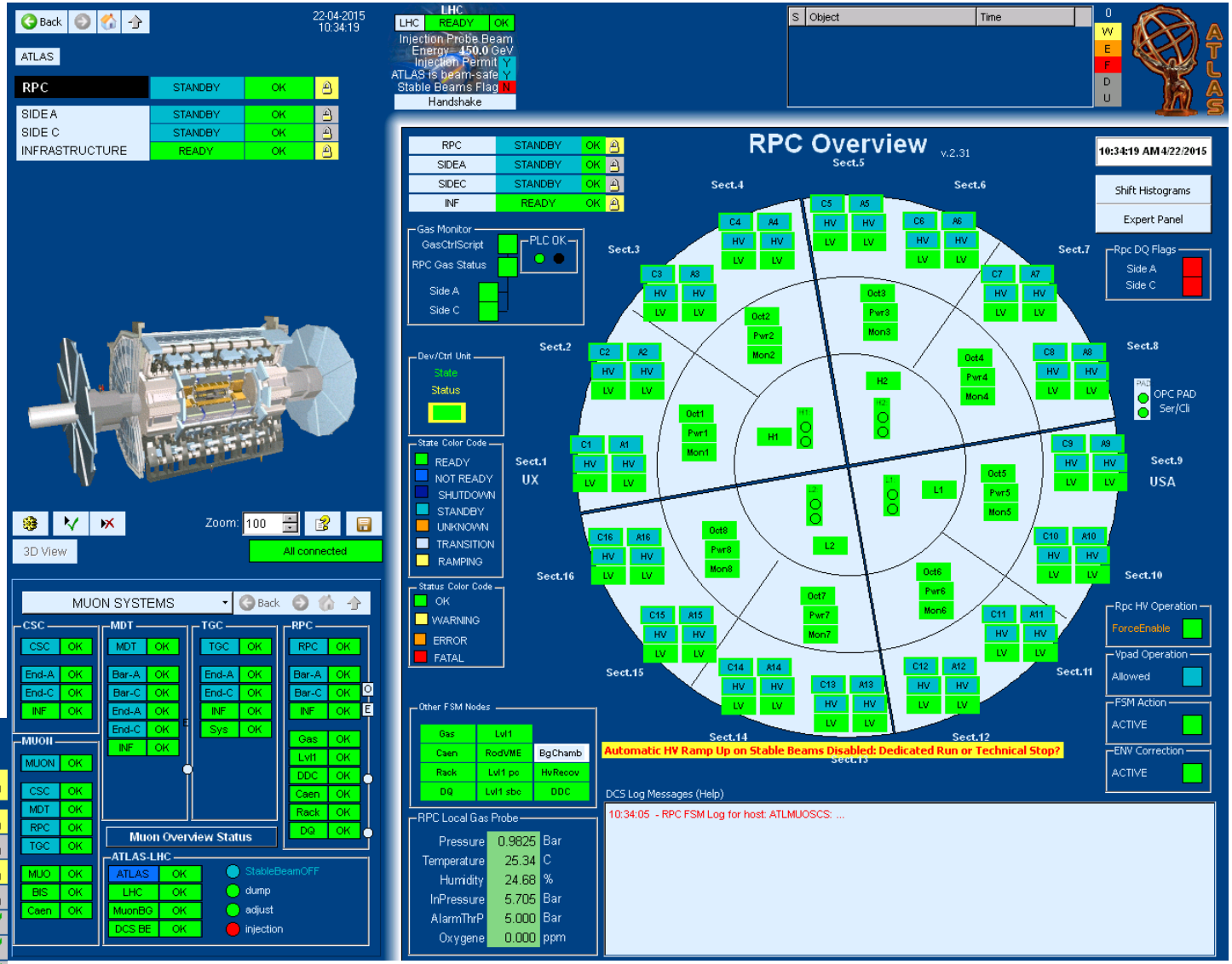
FSM structure

RPC
- Barrel Side A
- Barrel Side C
- Infrastructure

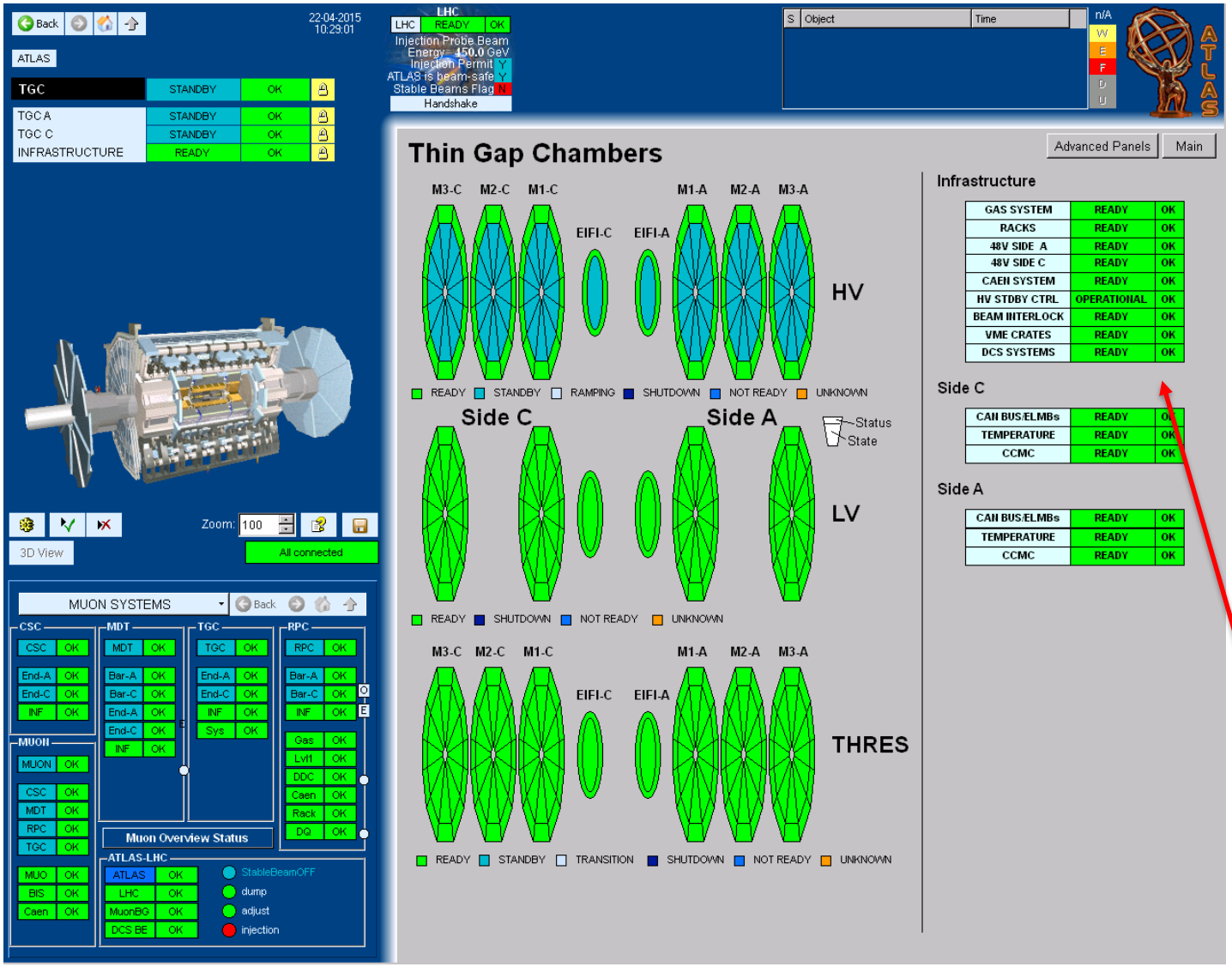
Side A/Side C
- Sector 01
- …
- Sector 16

Infrastructure
- ….





TGC FSM



FSM structure

TGC
- Endcap Side A
- Endcap Side C
- Infrastructure

TGC A/TGC C
- HV
- LV
- Temperature
- Threshold

Infrastructure
- ….

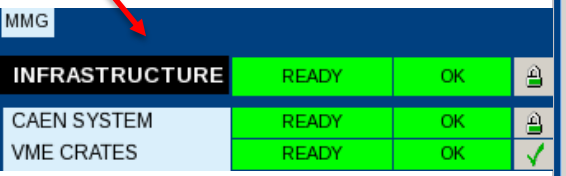
MMG FSM

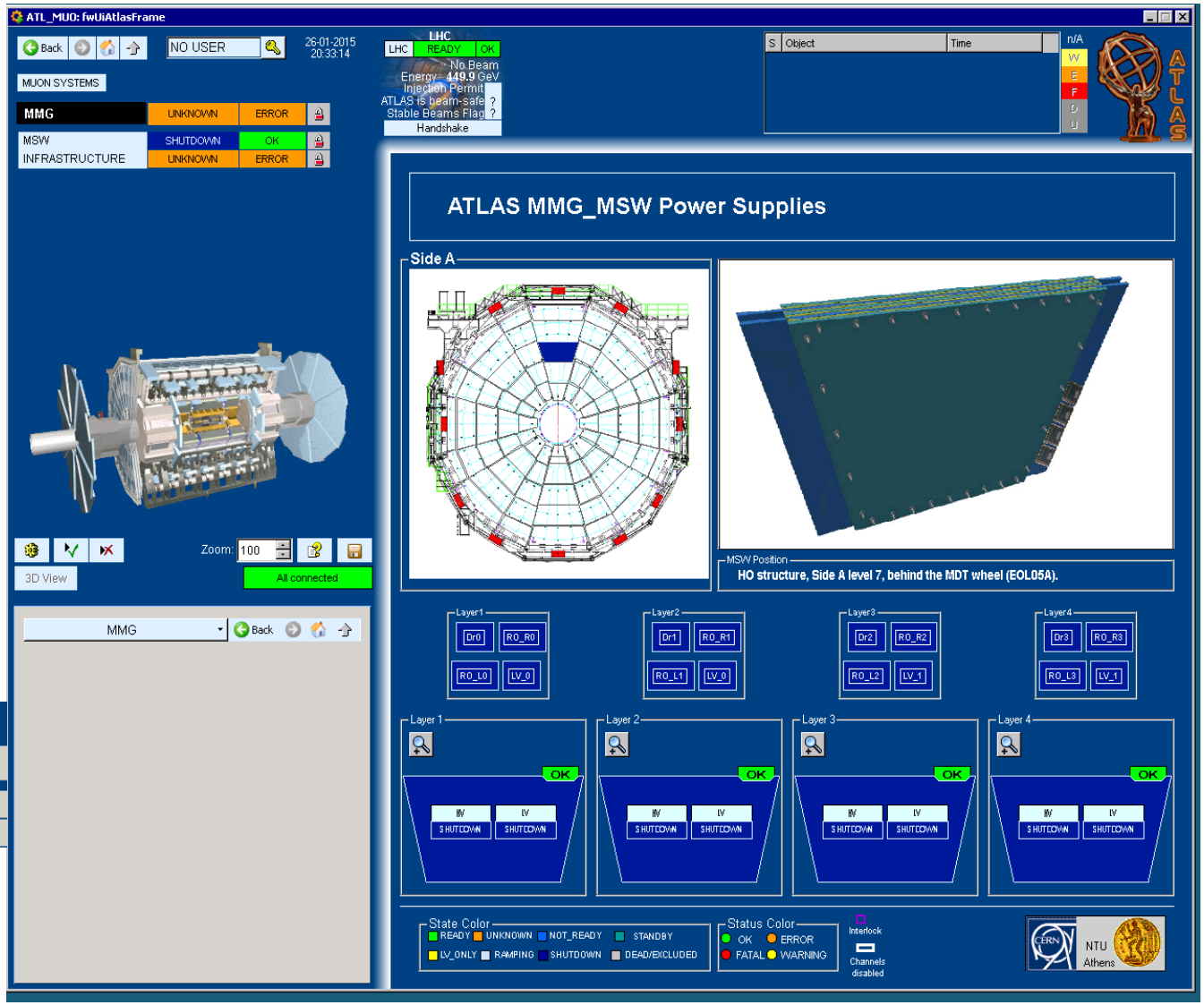
FSM structure

MMG
- MSW
- Infrastructure

MSW
- HV
- LV

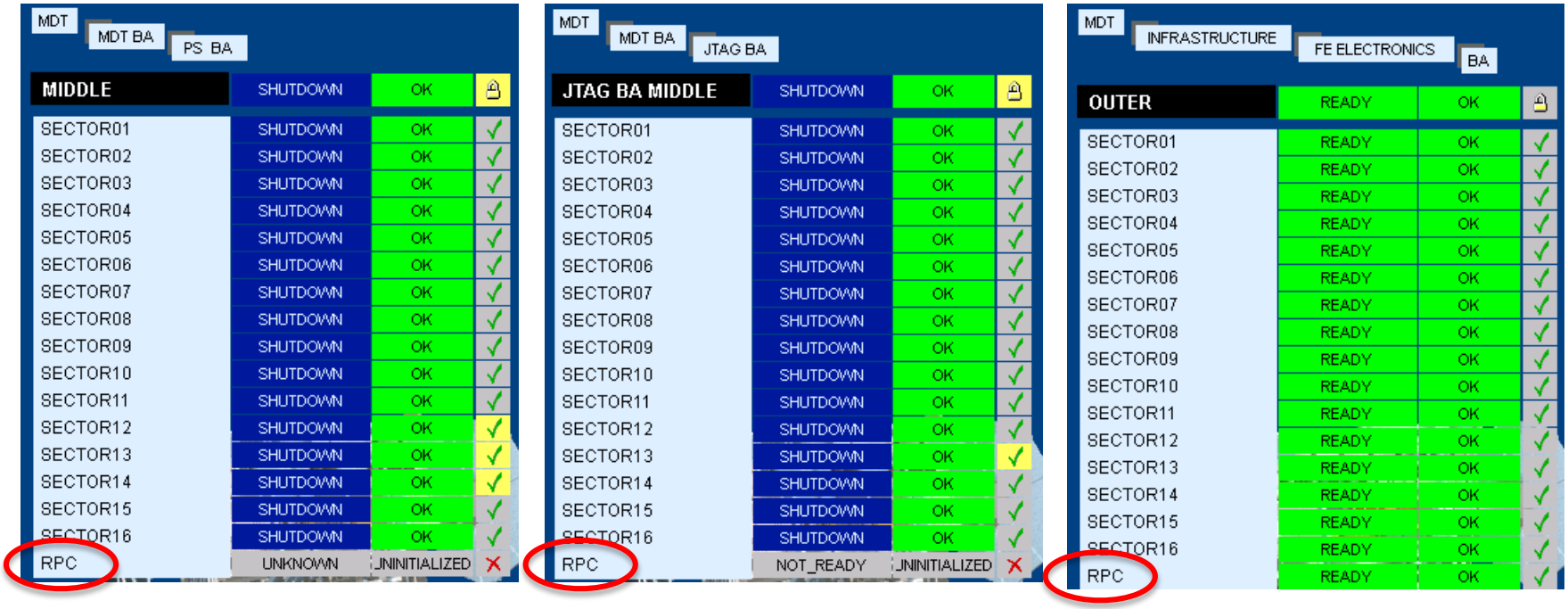
Infrastructure
- ….





Special “MDT”-RPC nodes

Exception to FSM organization by sub-detector:



MDT Barrel Middle and Outer PS, JTAG and FE Electronics FSM trees have a “sector” RPC

—> Contains BMR and BOR related controls.

—> BMR/BOR: RPC chambers which are additionally read out also via the MDT system for electronics studies

In case of problems – can be disabled (Upgrade study, not for physics data taking) – note that it also needs to be disabled in the DAQ then

DCS Operations
LV, HV

- Operating instructions are described according to functionality.
- Instructions are not always the same for all Muon sub-detectors.

- You may feel overwhelmed by the instructions if hearing them all one after the other. Don't panic !

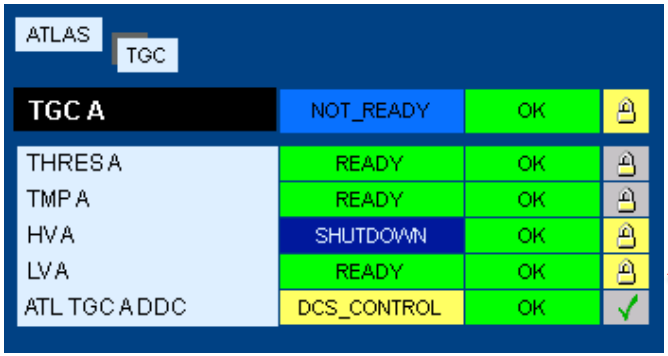
- Actions and procedures explained here shifters usually handle without need to referring to the shift manual after a few shifts

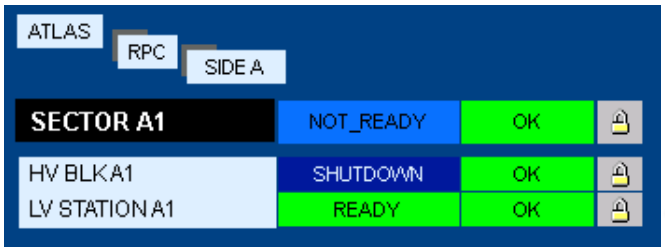
- Use your shadow shifts or first shifts to go through the slides again, in front of the ACR computer !

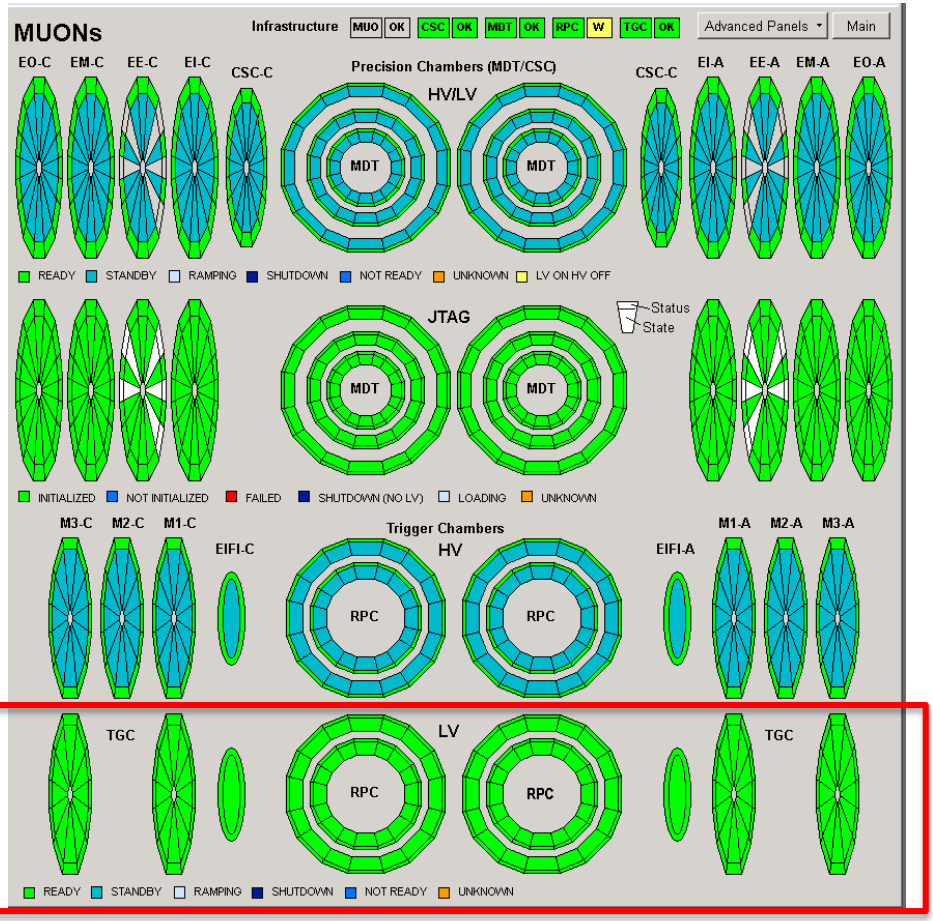
LV Operation I – Assessing LV State

Normally, when you come on shift, the detector will be powered

- For RPC and TGC, HV and LV are separate FSM trees (for RPC up to sector level)



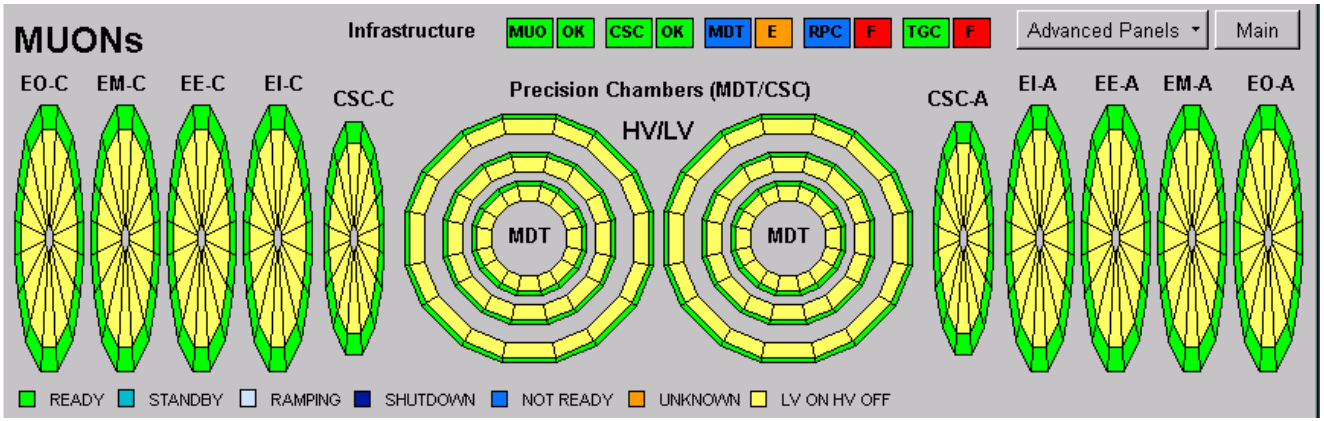




LV state must be READY for any run, even if calibration data taking with no HV – DAQ will fail at Configure otherwise, miserably !!!

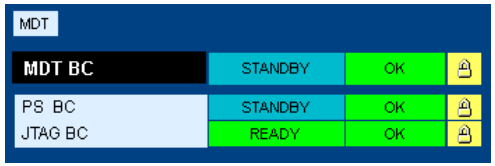
LV Operation II – Assessing LV State

- For MDT and CSC, LV and HV are combined into a “PS” state for each chamber

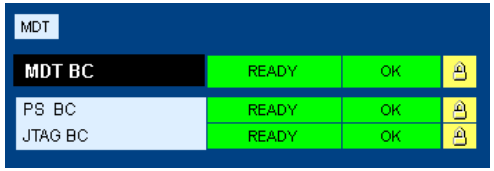


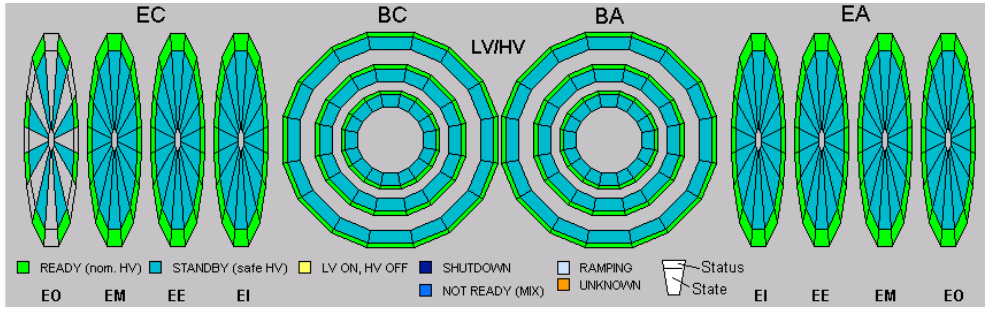
- If LV is ON and HV is off, MDT (partition) state is NOT_READY. Sectors and chamber state is LV_ONLY

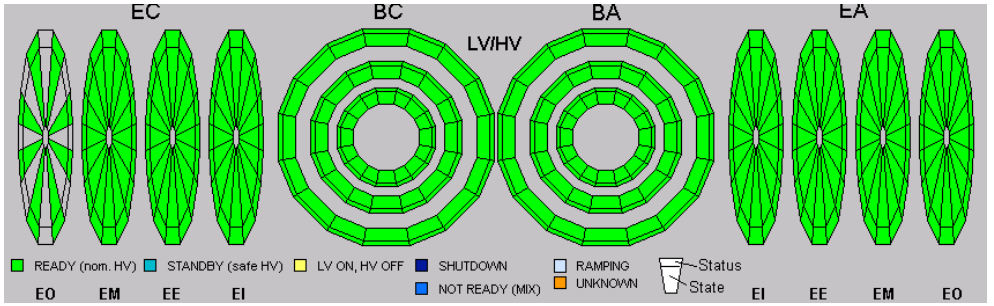
- If LV is ON and HV is ON and at safe voltage, MDT (partition) state is STANDBY



- If LV is ON and HV is ON and at nominal voltage, MDT (partition) state is READY





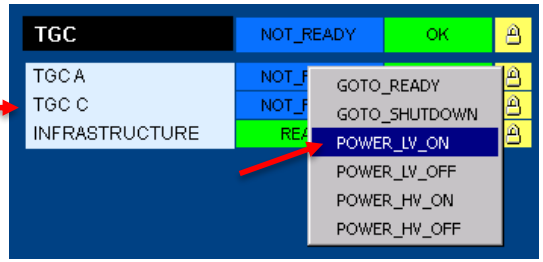


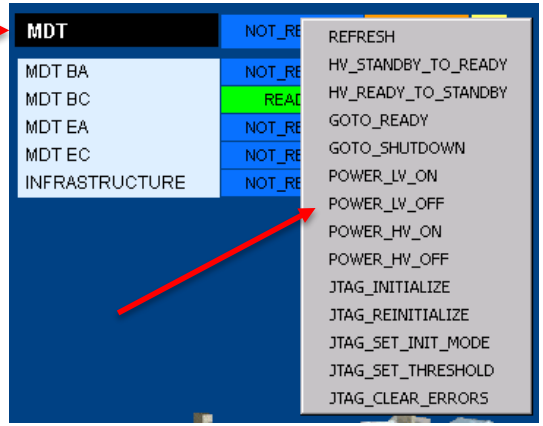
LV must be ON/READY for any RUN !!

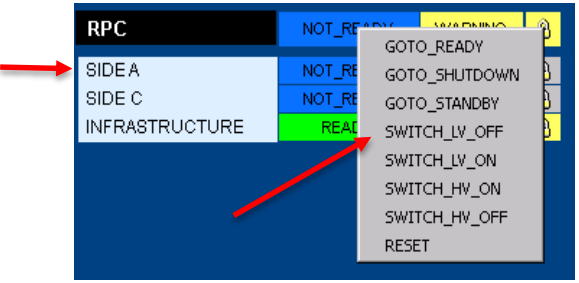
LV Operation III – Global Actions

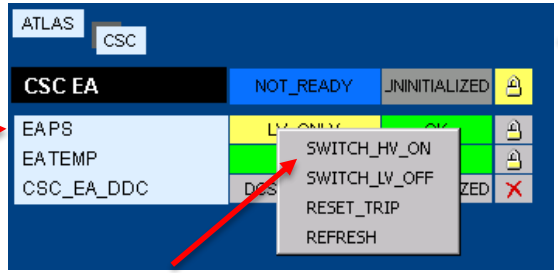
Occasionally you may be asked to “TURN” the full detector (LV) “OFF” or “ON” – usually before or after an intervention. Only in close interaction/communication with an expert !

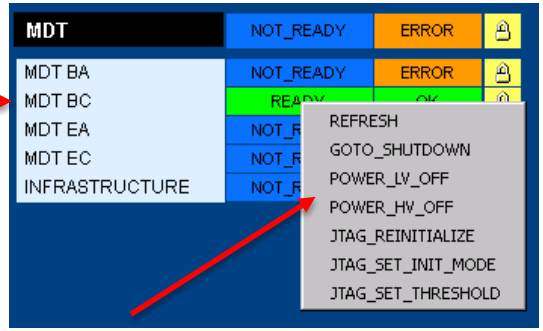
- For TGC, execute a POWER_LV_ON or POWER_LV_OFF from the TGC A and TGC C node
- For MDT execute a POWER_LV_ON or POWER_LV_OFF from the main MDT node (same command can also be used on partition, layer or sector level)
- For CSC execute a SWITCH_LV_OFF or SWITCH_LV_ON on the CSC PS level under CSC A and CSC C node
- For RPC, execute a SWITCH_LV_OFF or SWITCH_LV_ON on main RPC node or on the Side A/C level







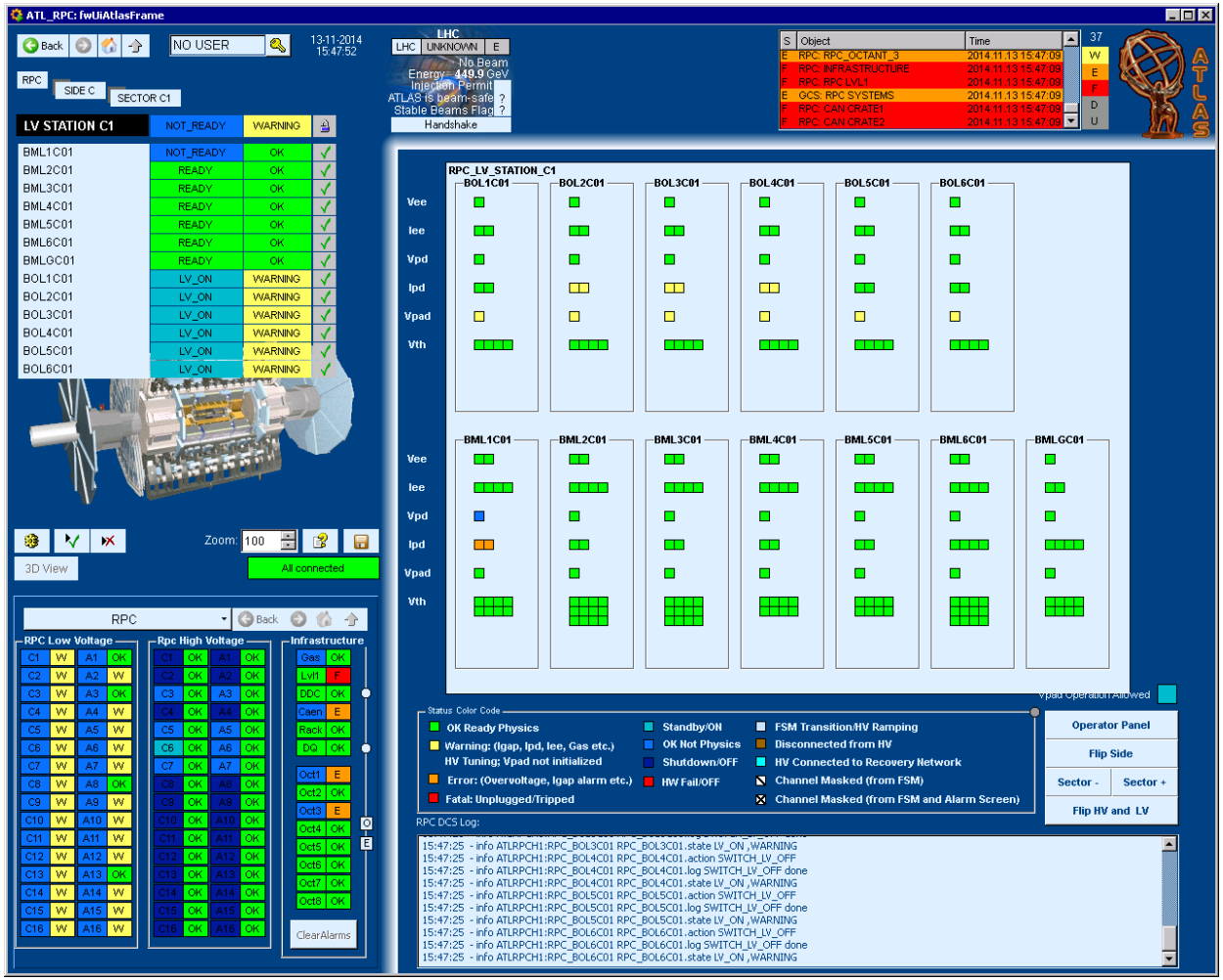




LV Operation IV – Problems and single channel operation -- RPC

RPC LV not READY

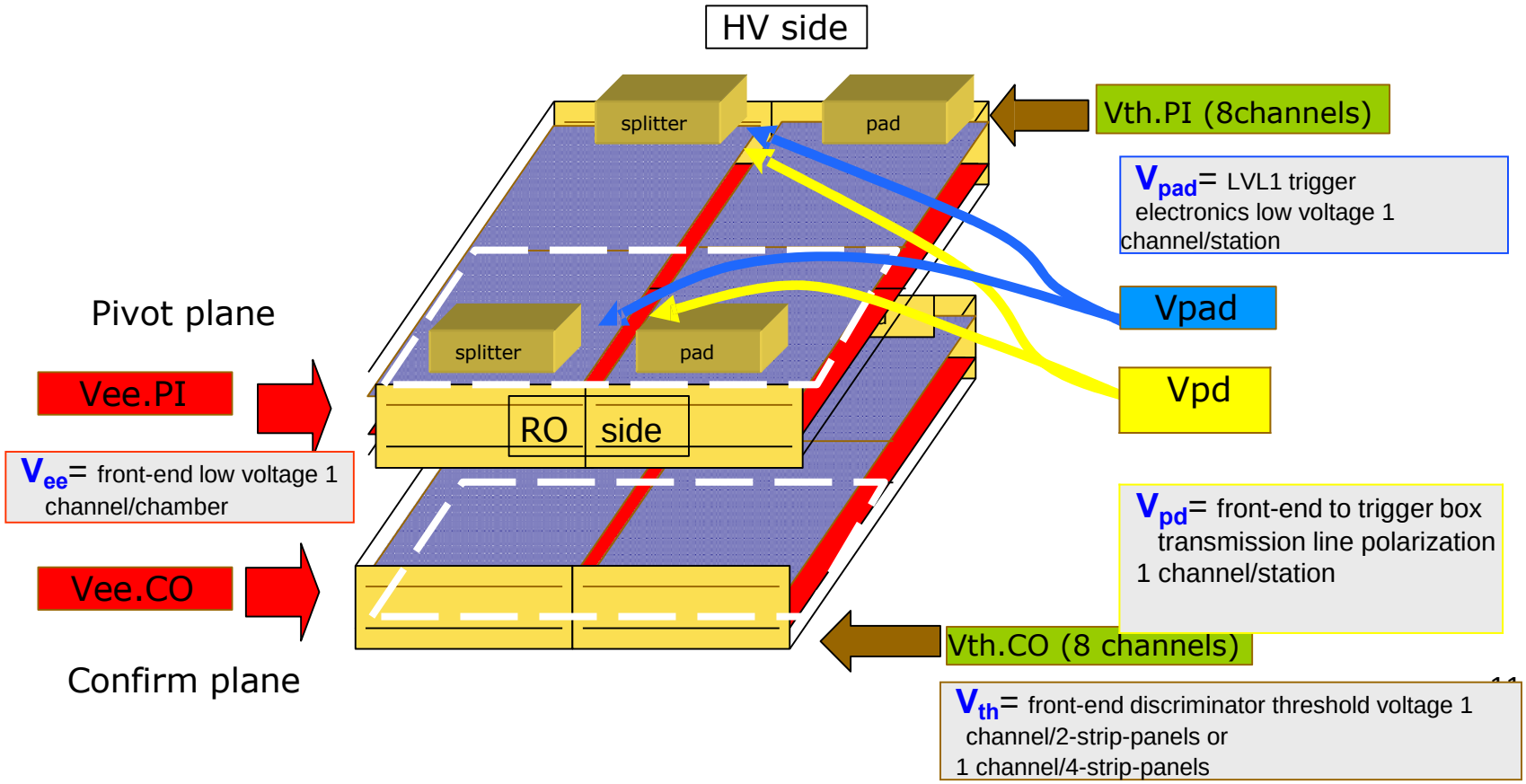
1. Navigating to STATION panel gives details on the status of the various voltages supplied to chambers (of a sector)
   - Alerts/color coding are based on PS channel status, voltage settings, current driven
2. If a LV trips, for Vpd, Vth, Vee you may try to recover it with a GOTO_READY once.
   - Recovering Vpad is reserved to experts !!



3. Alarms other than a channel being tripped/off require expert intervention

Backup: RPC LV Architecture

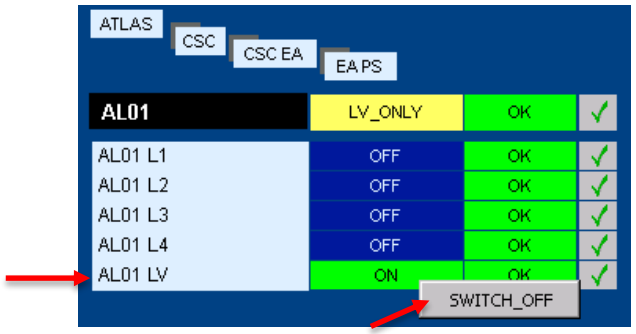
Each RPC chamber is connected to 4 different LV channels and voltages



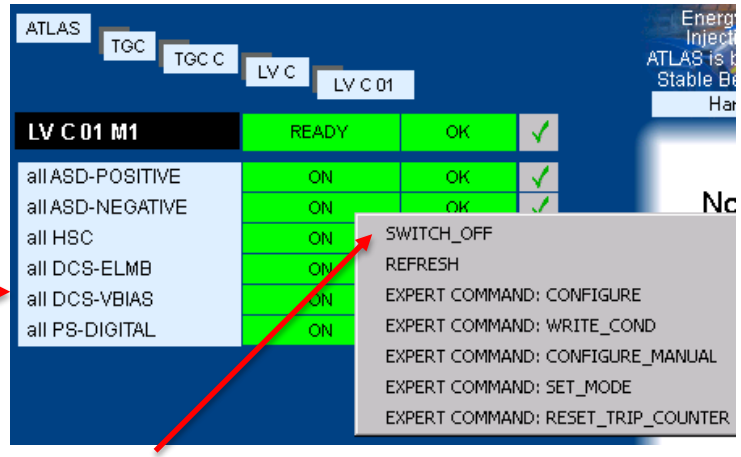
LV Operation V – Problems and single channel operation – CSC, TGC

CSC or TGC LV not READY:

- DCS does not prevent shifters from turning LV channels ON or OFF (there is no access control restricting this to experts only), however
- If a LV channel trips or unexpectedly goes to OFF state, you ABSOLUTELY MUST check with the expert before/when repowering it !



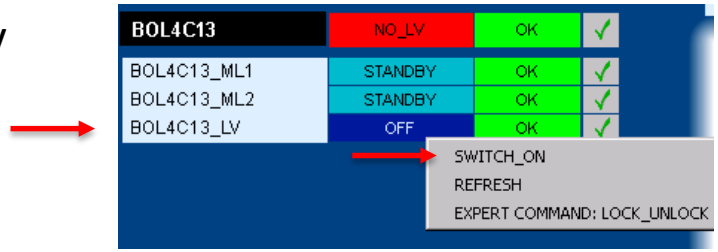
- After a LV power cycle, frontend electronics need to be configured again correctly to be able to take events → DAQ actions involved !!
- If forgotten, CSC/TGC may look perfectly fine (READY/OK) in DCS while data is junk and the run will be discarded !!



- If you are asked to power cycle/switch on/off a LV channel, you do so by executing the SWITCH_OFF/ON action on the corresponding LV channel node
- If LV fails or trips again, more in-depth investigations are needed – do not try many times
- If an individual LV channels unexpectedly goes to OFF state, it may have been cut by an interlock – CSC temperature, TGC LV board temperature …

LV Operation VI – Problems and single channel operation -- MDT

- For MDT power cycling/switching on/off an individual LV channel is a shifter operation
- Execute action SWITCH_ON/SWITCH_OFF on the concerned LV node



- Power cycling a chamber's LV during a run will cause a loss of JTAG initialization
- If a chamber's LV is switched off, LV and JTAG is usually also lost for a second chamber due to the LV distribution

1. In case a chamber LV trips or unexpectedly goes to OFF:

- Attempt ONCE to recover by switching LV back on on chamber level via the LV node SWITCH_ON action, followed by a JTAG_INITIALIZE of the concerned chambers
- If it trips again, call an expert. Disable the individual channel in the FSM, and corresponding chamber in JTAG if told to do so.

2. Power-cycling a chamber on purpose:

- Try if a chamber continuously fails JTAG initialization
- Attempt if DQ shows data from a specific data is corrupted, and simply JTAG reinitializing it does not help
- Do not repeat many times, if once does not help, usually something else is wrong → expert

HV Operation I – Assessing HV State

You can assess the HV state from the MUON main panel

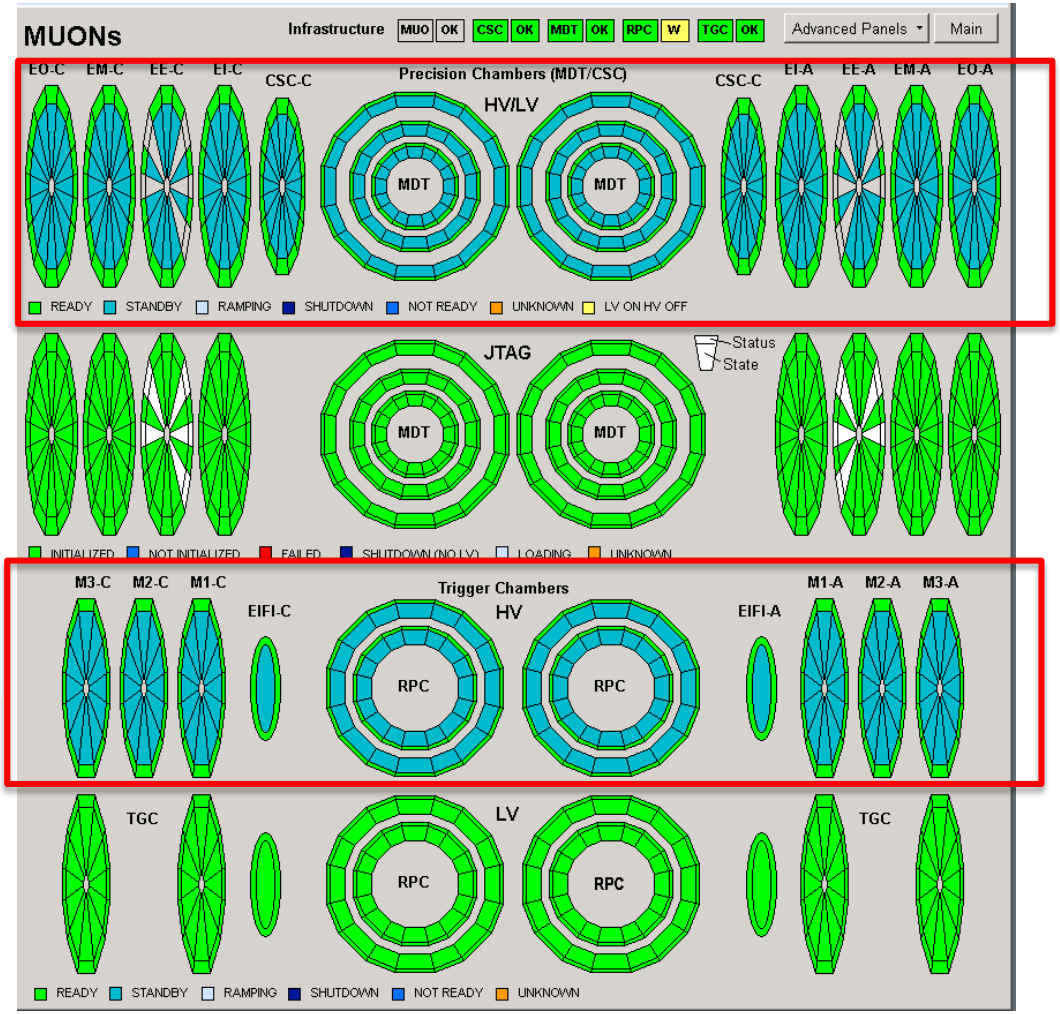
STANDBY state is the nominal state (all ok) during operation with beam outside STABLE BEAMS.

- HV is lowered to a safe voltage level.
- Occupancy histograms show no hits where voltage is lowered

READY state is the nominal state (all ok) during operation with beam during STABLE BEAMS.

- HV is at nominal voltage, detector is fully efficient.

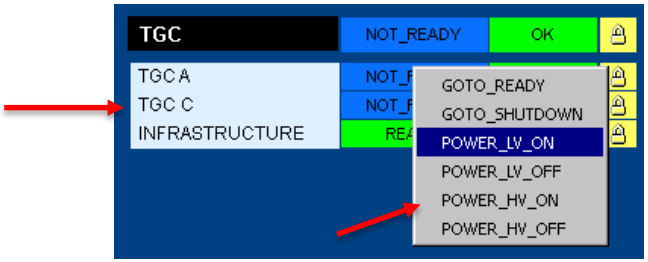
Provided LV ON

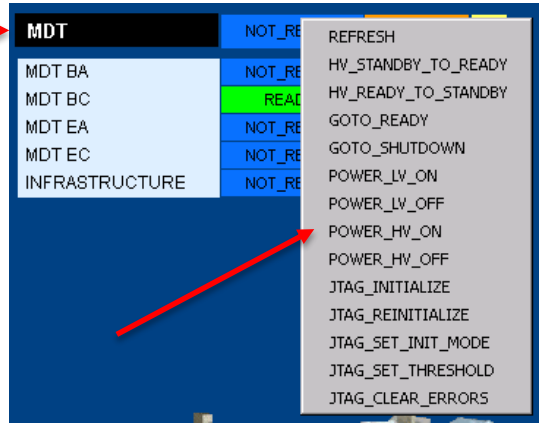


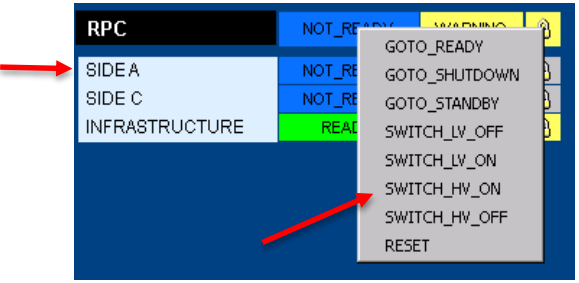
HV Operation II – Global Actions

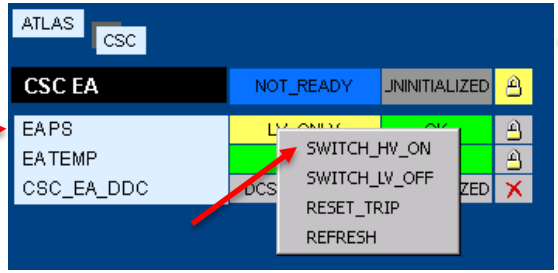
Occasionally you may be asked to “TURN” the full detector (HV) “OFF” or “ON” – usually before or after an intervention. Only in close interaction/communication with an expert !

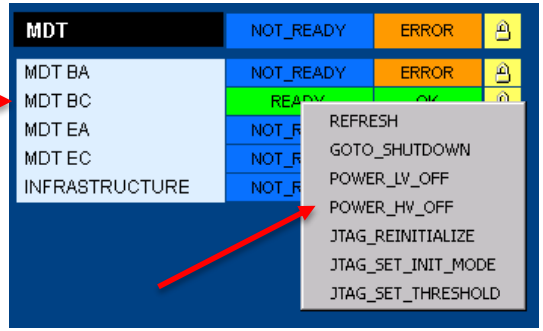
- For TGC, execute a POWER_HV_ON or POWER_HV_OFF from the TGC A and TGC C node
- For MDT execute a POWER_HV_ON or POWER_HV_OFF from the main MDT node (same command can also be used on partition, layer or sector level)
- For CSC execute a SWITCH_HV_OFF or SWITCH_HV_ON on the CSC PS level
- For RPC, execute a SWITCH_HV_OFF or SWITCH_HV_ON on main RPC node or on the Side A/C level





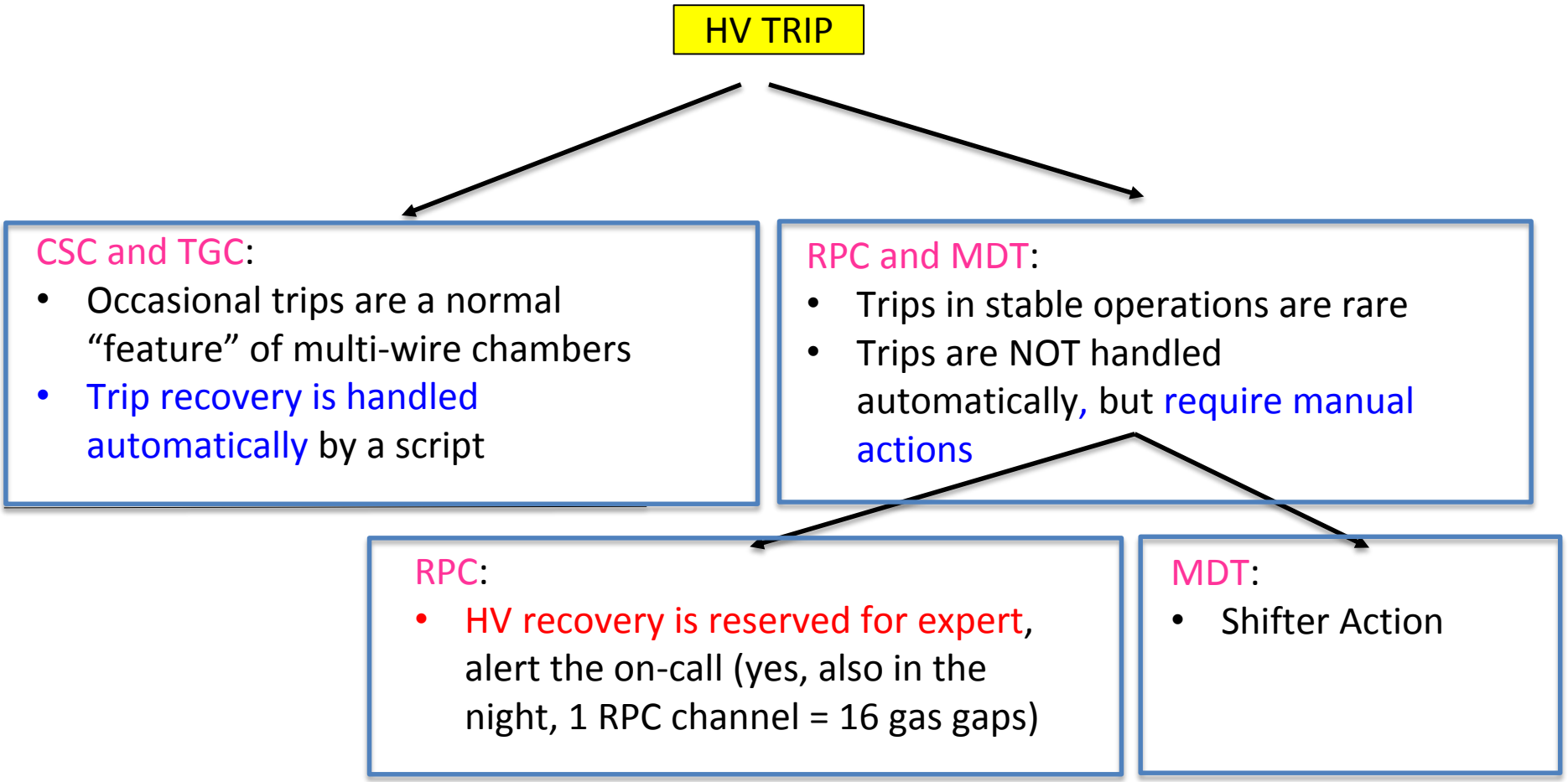






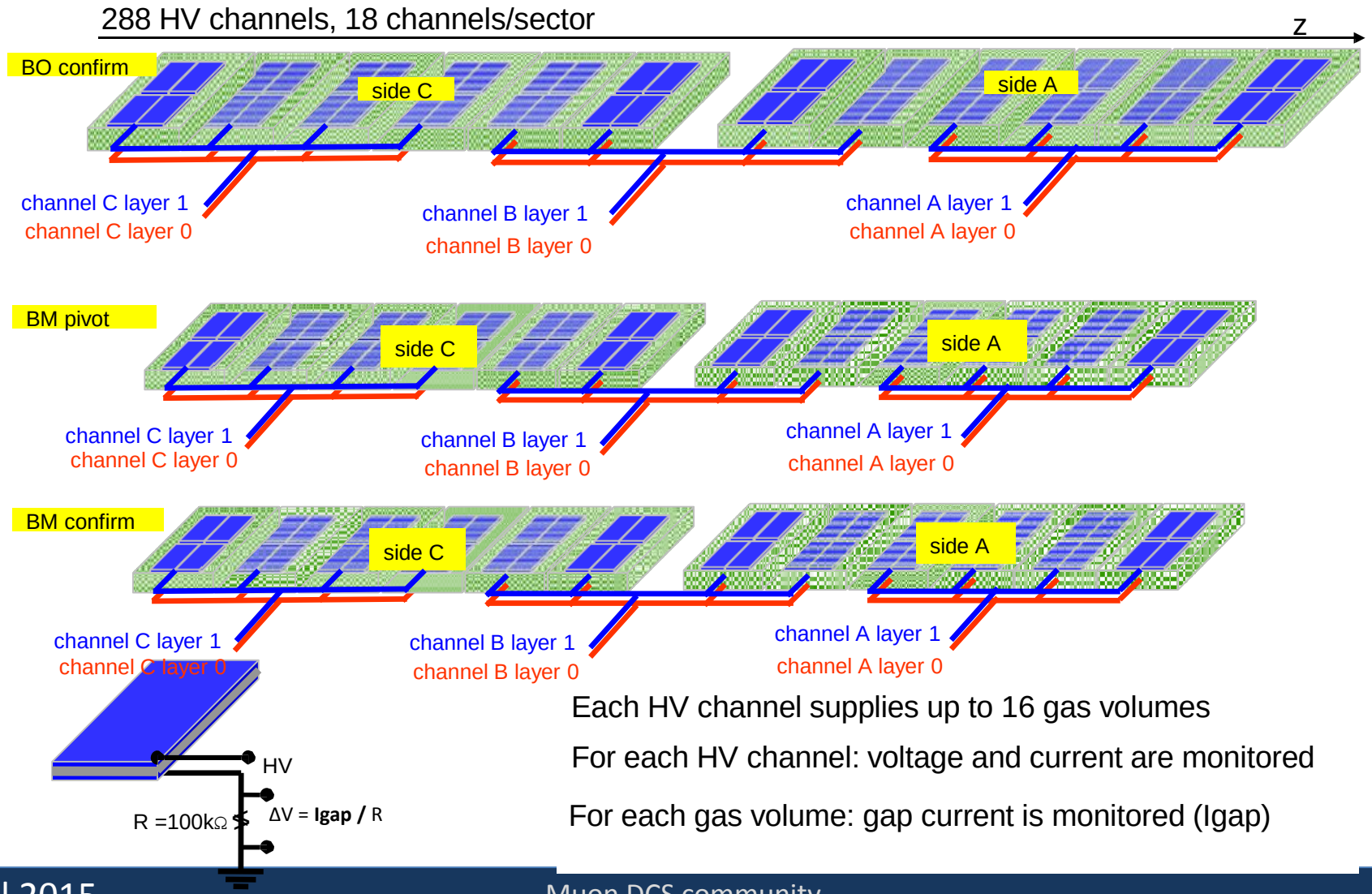
HV Operation III – Dealing with Trips

- A HV channel trips if its current exceeds a programmed limit for longer than a programmable grace period (trip time)



Backup: RPC HV Architecture

For CSC, MDT and TGC each chamber multilayer/layer corresponds to a separate HV channel. This is not the case for RPC



Each HV channel supplies up to 16 gas volumes

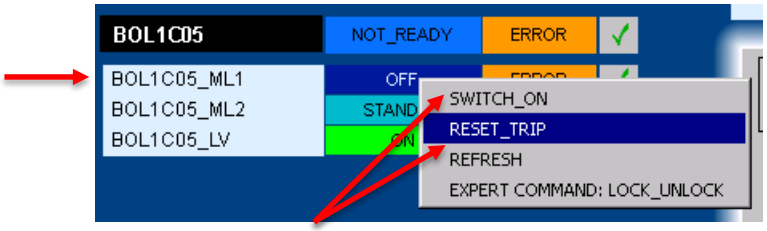
For each HV channel: voltage and current are monitored

For each gas volume: gap current is monitored (Igap)

Dealing with HV Trips – CSC, MDT

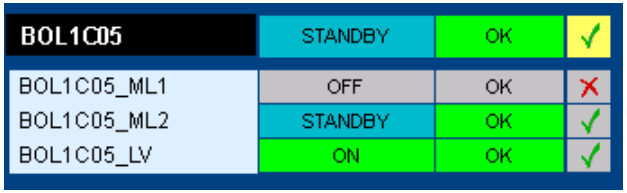
MDT:

1. Check the tripped channel's HV history. If it looks "normal", ie no instabilities/over voltages,
2. Attempt ONCE to recover by switching HV back on on multilayer level via the SWITCH_ON action



If the multilayer trips again

3. Try to clear the TRIP error with a RESET_TRIP (ML level)
4. Disable the multilayer node from the FSM
5. Document in elog for expert follow up



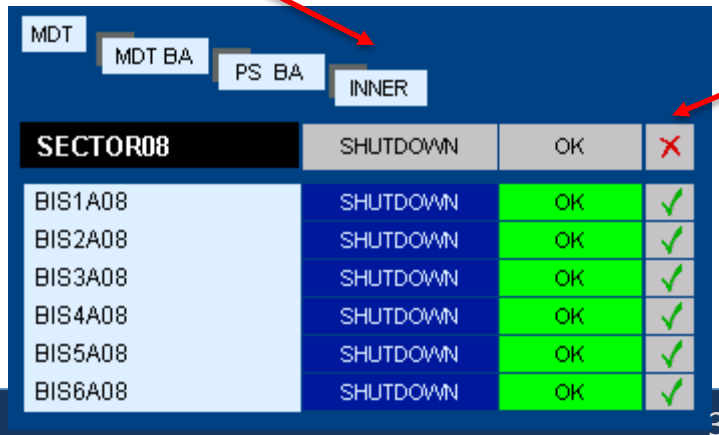
Correct: Disable the affected channel only !

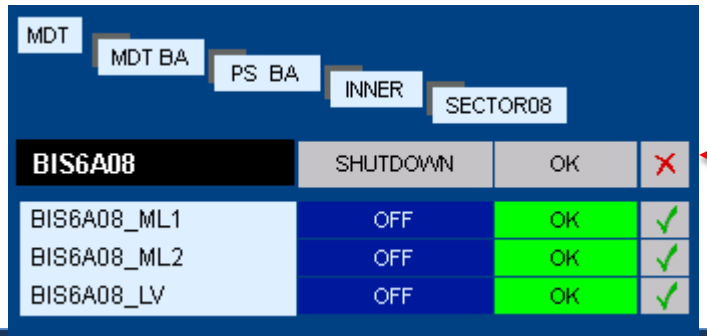
CSC:

- If automatic trip recovery fails, disable the concerned layer from the FSM and inform the expert

Excursion: How not to disable FSM nodes

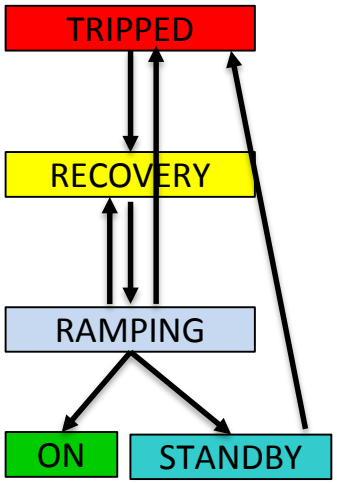
Wrong: Would loose all chambers in BI sector 08





Wrong: Also ML2 and LV disabled

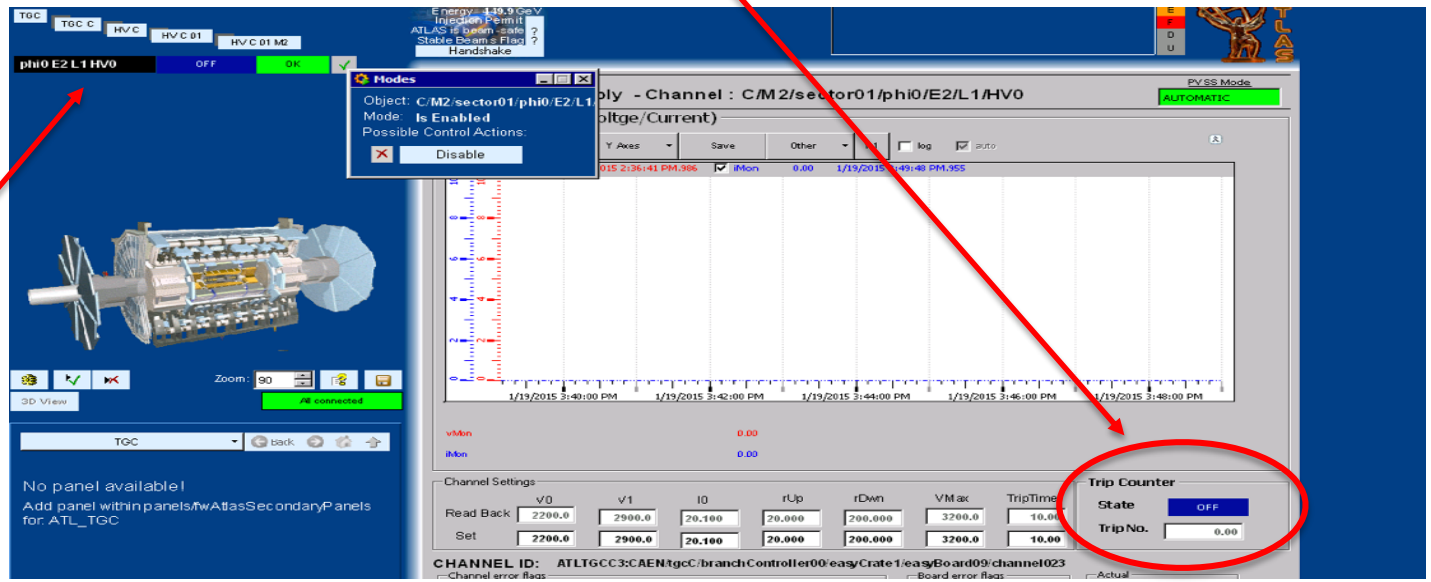
Dealing with HV Trips -- TGC



- Automatic trip handling puts tripped channels into state RECOVERY.
- Some wait time
- Try to ramp HV up again, in steps, with some waiting time. RECOVERY state propagates as READY
- No more automatic recovery after 4 trips !

Shifter instructions:

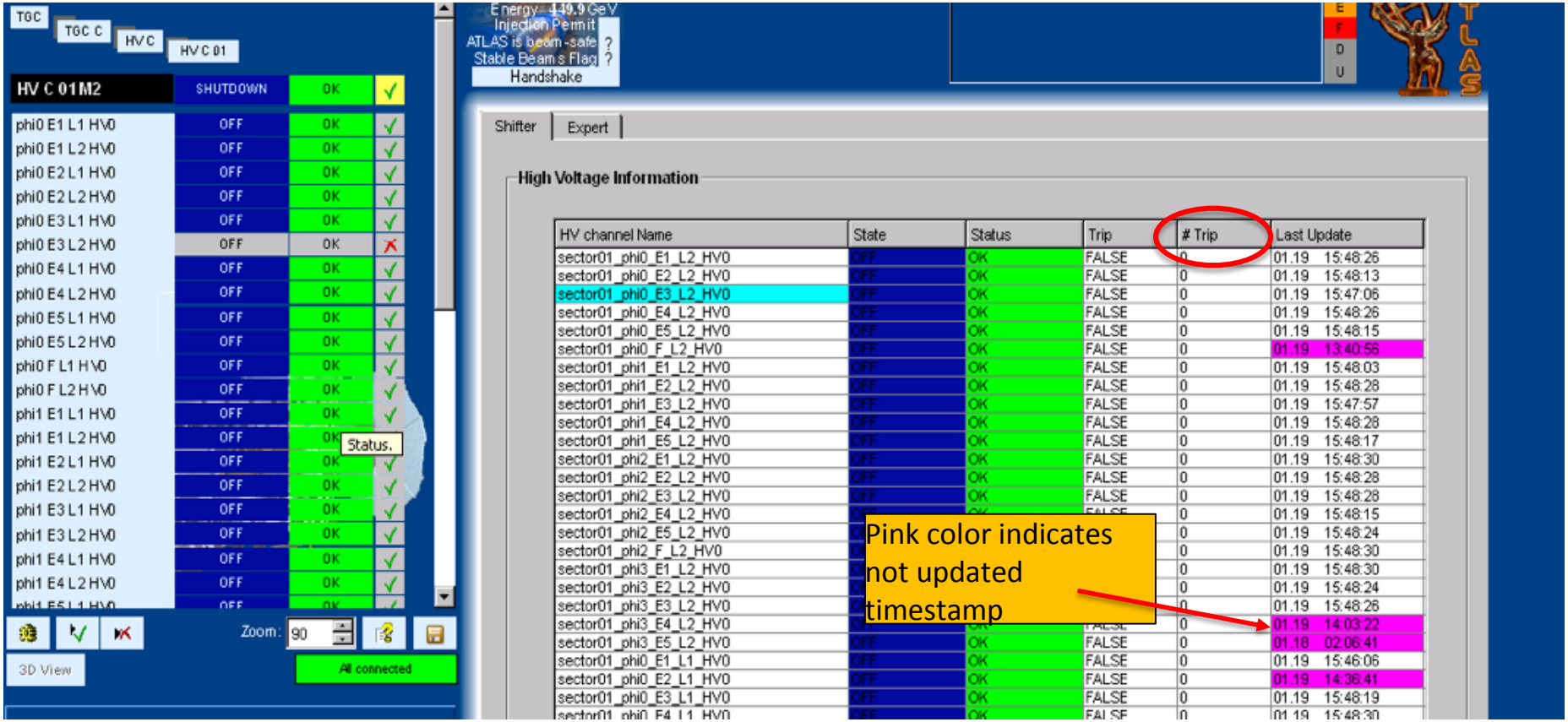
1. While channel is in RECOVERY, do nothing
2. If a channel remains in TRIPPED, navigate to the channel node
3. Check the trip counter. If it is 4 or above, disable the channel from the FSM, mask the alarm and report the disable in elog



Dealing with HV Trips -- TGC

Individual HV channel information can be found in :

- TGC → TGC A/C → HV A/C → Choose the sector reporting ERROR or UNKNOWN state.
- Summary table: Displays relevant information for the different channels.
- Pressing on "# Trip" in the table, it will arrange the channels according to the number of trips.

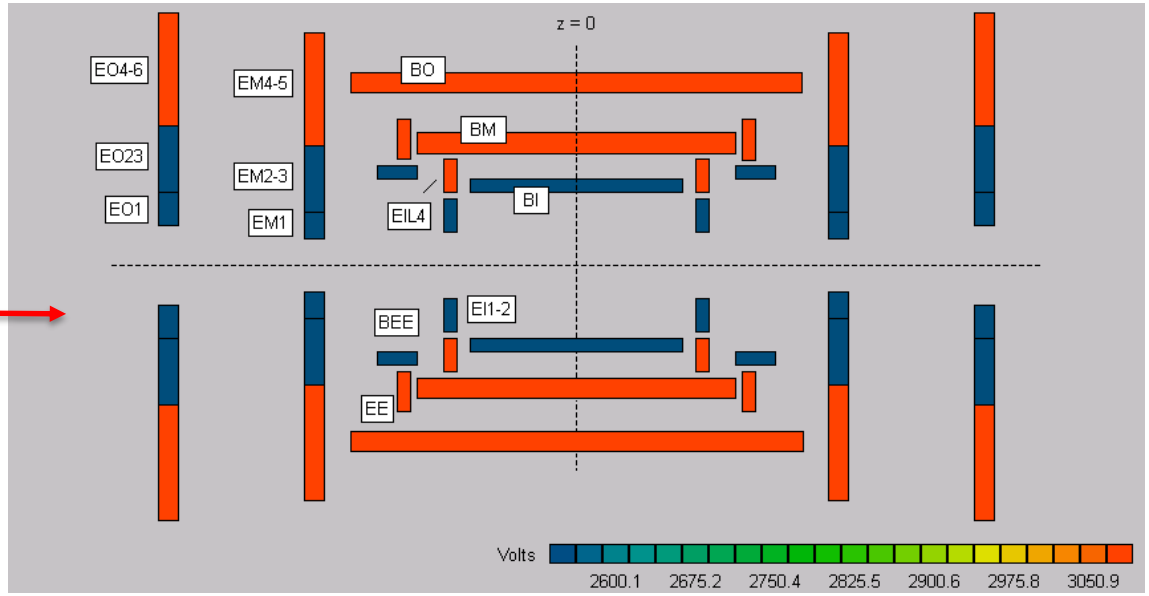


HV Operation -- STANDBY ←→ READY I

- Tracking detectors (Muons: CSC, MDT, TGC, PIX + IBL + SCT) lower HV to “safe STANDBY state” while there are beam manipulations (inject, ramp, adjust) with increased risk of high intensity dumped into detector region

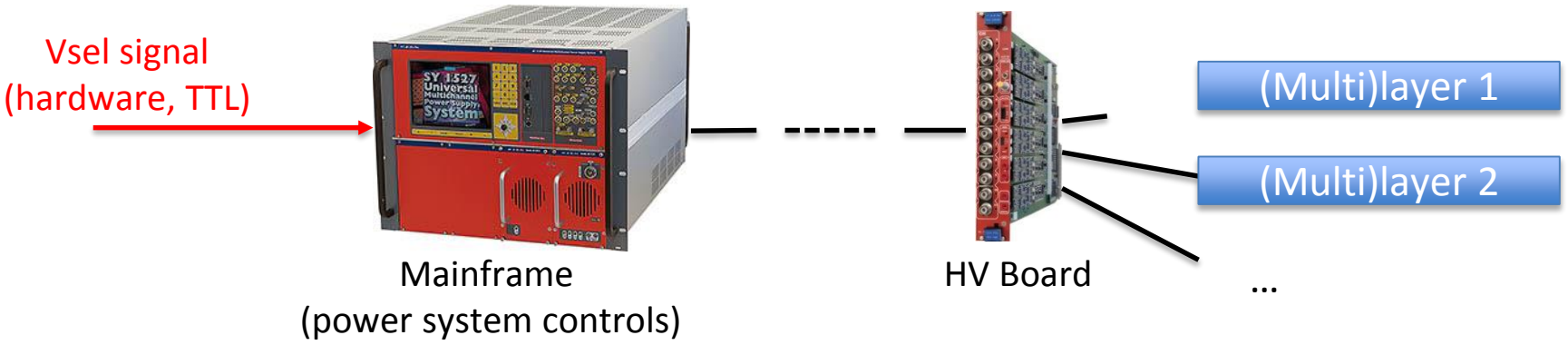
- MDT Standby voltage is 2500/3080 V depending on the detector region (for “Inner Chambers” BI;BEE;EM1,2,3;EO1,2,3;EI1,2 lower standby voltage due to smaller tube), compared to 3080V nominal
- TGC Standby voltage is 2200V, compared to 2800V nominal
- CSC Standby voltage is 1300V, compared to 1850V nominal

MDT: Standby voltage colormap panel



HV STANDBY ←→ READY II - CSC,MDT,TGC

Switch between Standby and Ready is hardware signal driven



- Vsel signal TRUE → HV channel output is pre-configured voltage setpoint V1 — READY
- Vsel signal FALSE → HV channel output is pre-configured voltage setpoint V0 — STANDBY

—>Switching channels ON is a single command, HV ramped to V0 or V1 according to Vsel presence

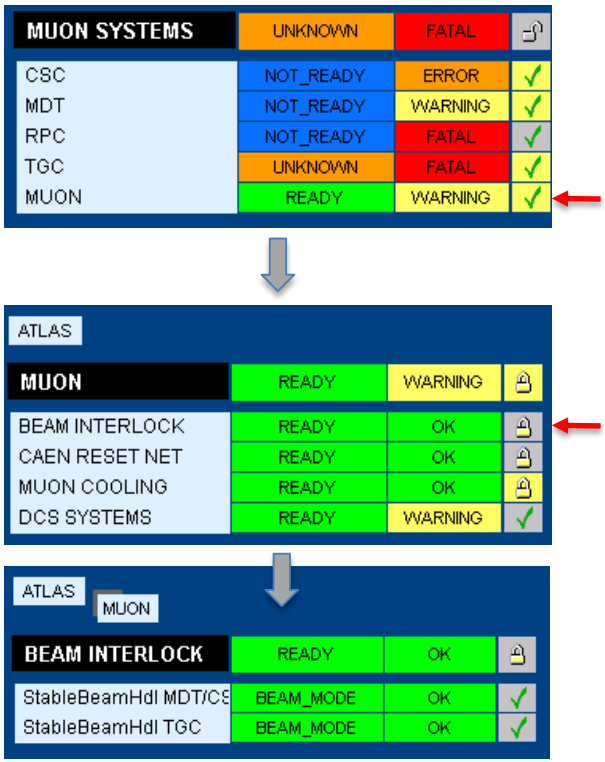
During operations with beam:

- Use LHC stable beams signal as Vsel input → no stable beams, ie beam conditions unsafe → STANDBY voltage

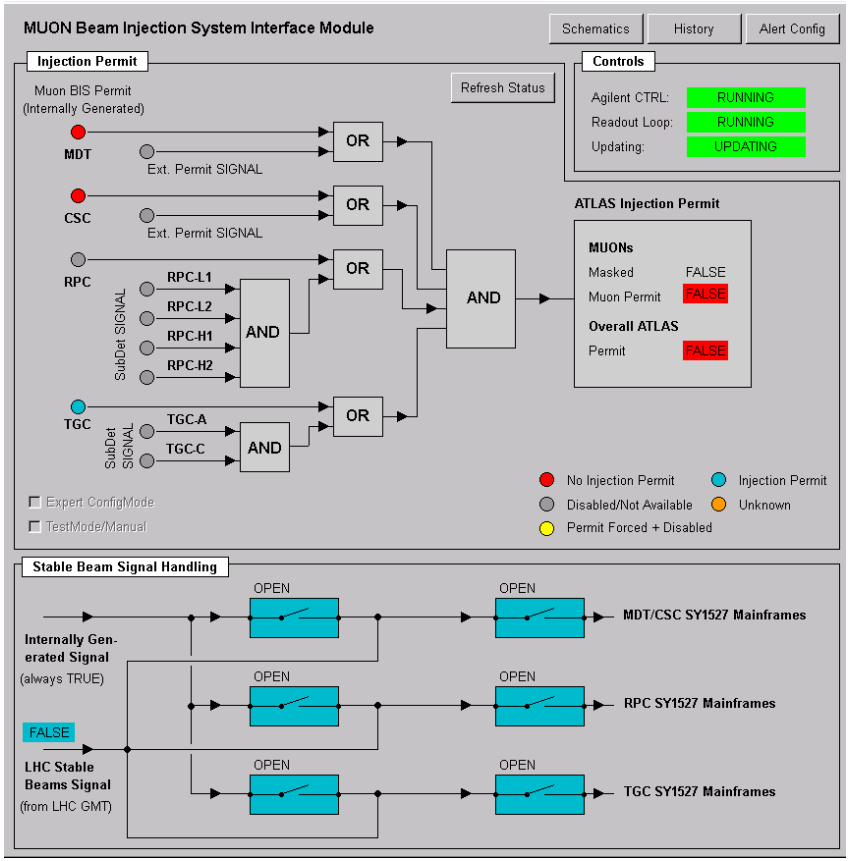
HV STANDBY ←→ READY III

Simple hardware-signal coupling has 2 complications:

- Want to have a possibility to go to nominal HV when there is no beam at all (no stable beams, no unsafe beam conditions)
- LHC requires detectors to be put into safe state @ Adjust Handshake --- before the stable beams flag is dropped.



Muon BIS (Beam Interlock) System



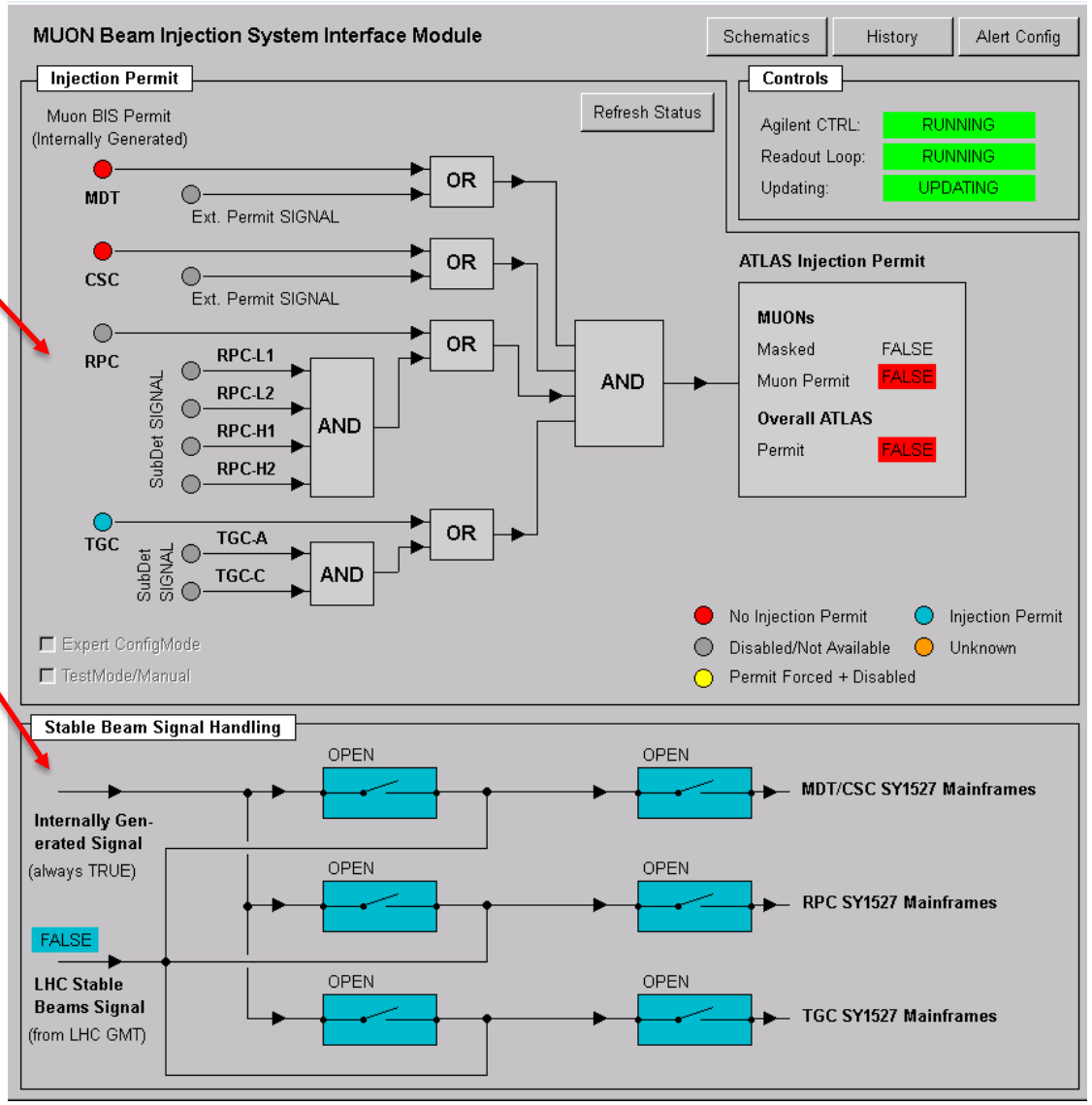
Muon BIS System

Upper part:

- Injection Permit handling

Lower Part: Standby/Ready Handling

- LHC stable beams signal goes to Mainframe via a remote (DCS) controllable simply electrical on/off switch or breaker
- With signal present (stable beams), go to STANDBY by opening the switch – ADJUST HANDSHAKE
- Override Mode: Fake stable beam signal by parallel Muon BIS generated signal

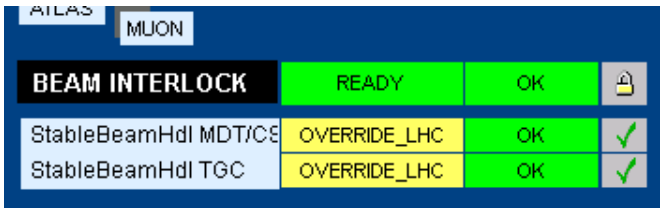


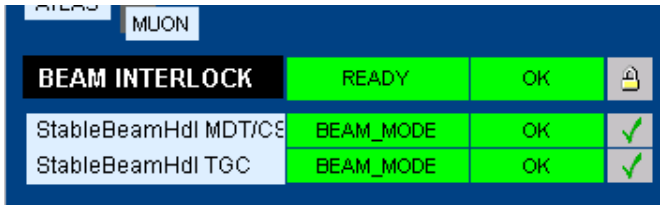
Muon BIS Actions – CSC, MDT, TGC

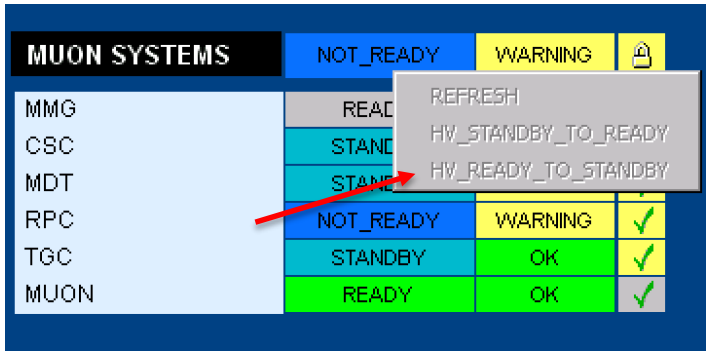
1. Override Mode (Nominal HV without stable beams flag)

- Override mode can only be asserted by the Muon run coordinator and selected experts, not the shifters → call

- Shifter may be requested to return to BEAM_MODE when LHC is ready to reinject after a period without beam
  - Execute HV_READY_TO_STANDBY on the Muon top node, followed by
  - Execute GOTO_BEAM_MODE on the Beam Interlock node







Detailed description in shifter manual, make sure you go thru it before shifts with beam !

Manual STANDBY ←→ READY transitions

Transition between STANDBY and READY are normally automatic, for all 4 muon sub-detectors

2. Manual transition -- CSC, MDT, TGC:

If stable beams flag is present or Override Mode asserted, you can manually switch between the 2 states by executing the actions

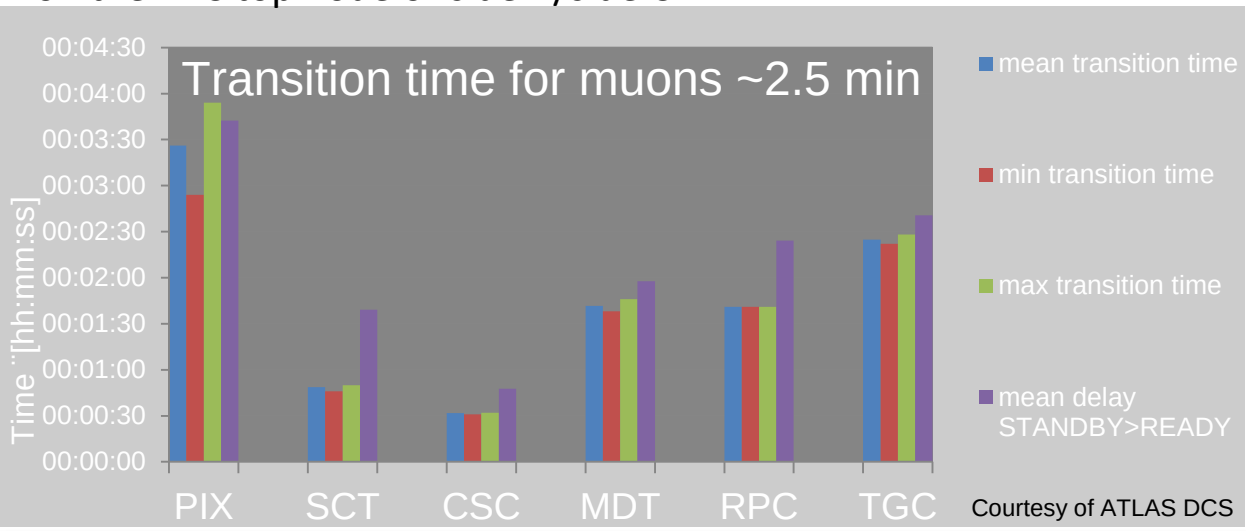
- HV_STANDBY_TO_READY
- HV_READY_TO_STANDBY
- Note that CSC are a part of the MDT system for this

3. Manual transition -- RPC:

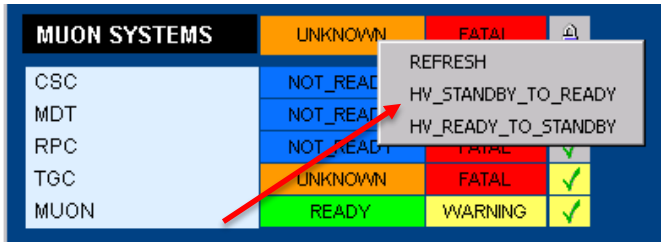
If stable beams flag is present or Override Mode asserted, you can manually trigger going to nominal HV by executing the action

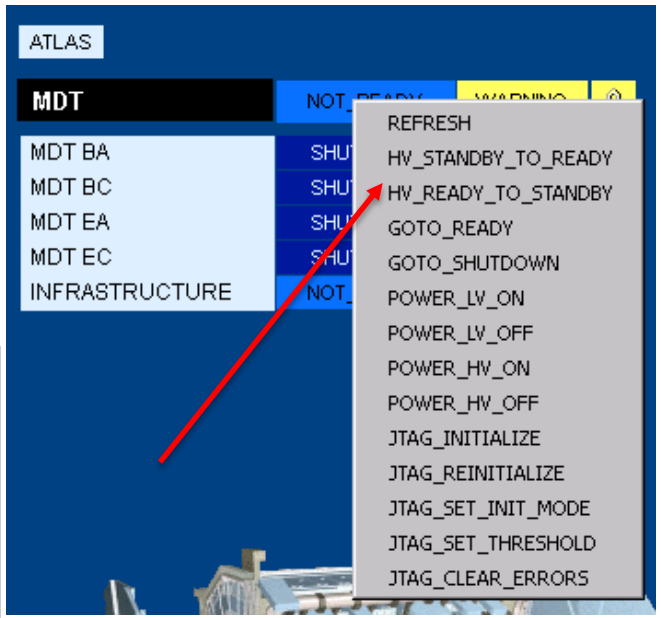
- GOTO_READY
- GOTO_STANDBY

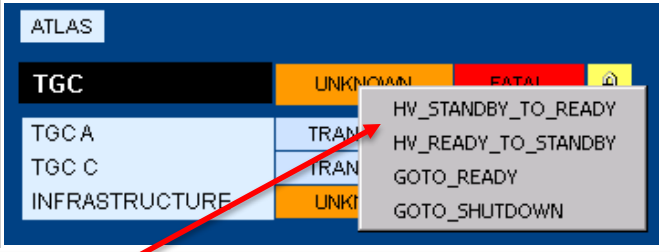
on the RPC top node or side A/side C



Courtesy of ATLAS DCS



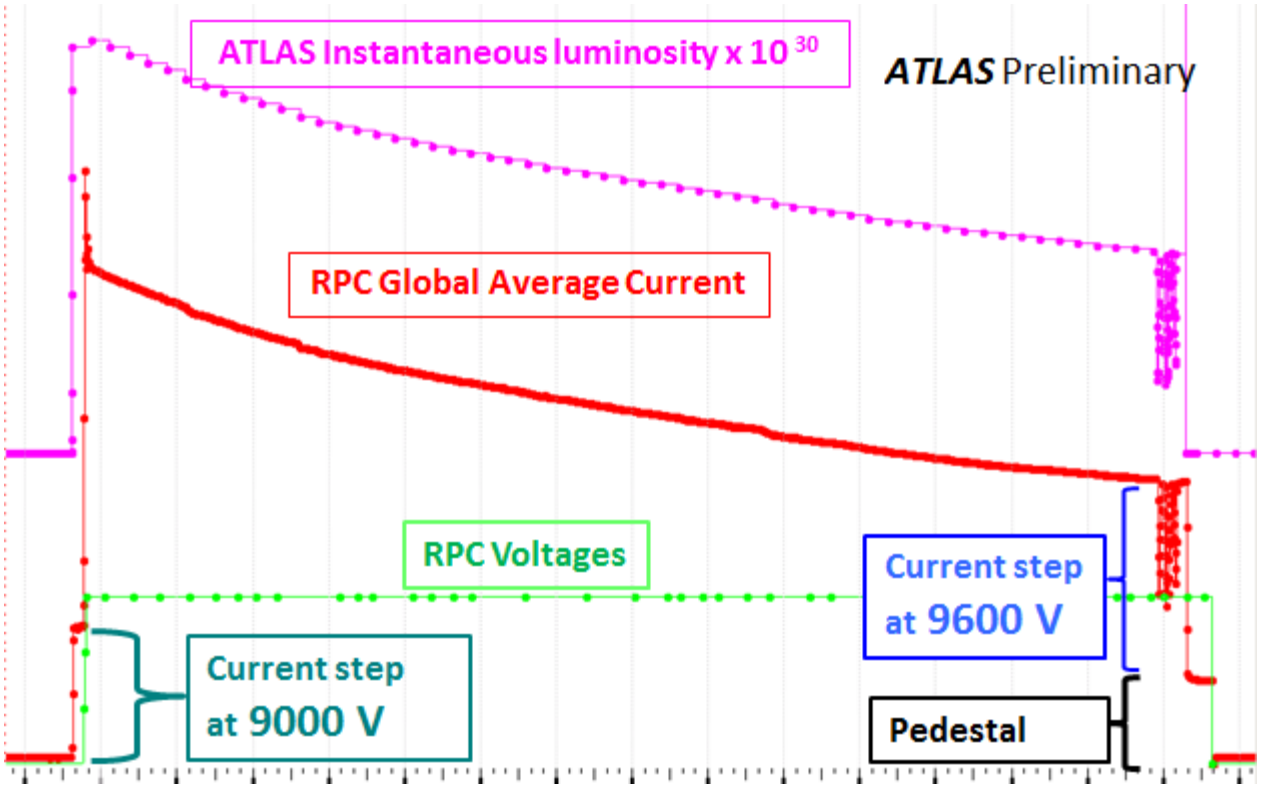




RPC HV Regime – a closer look

More complex scheme for RPC, Voltage set points beam mode dependent

- Before the beam injection the HV is kept at 7000V or changed by experts for calibration purposes
- At injection the HV is raised automatically to STANBY (9000V)
- As stable beam is declared the DCS ramp HV to READY (9600V)



- After beam dump, HV is kept nominal for ~20 mins for calibration

Shifter Actions

- If HV is not ramping automatically as expected, call the RPC DCS on-call

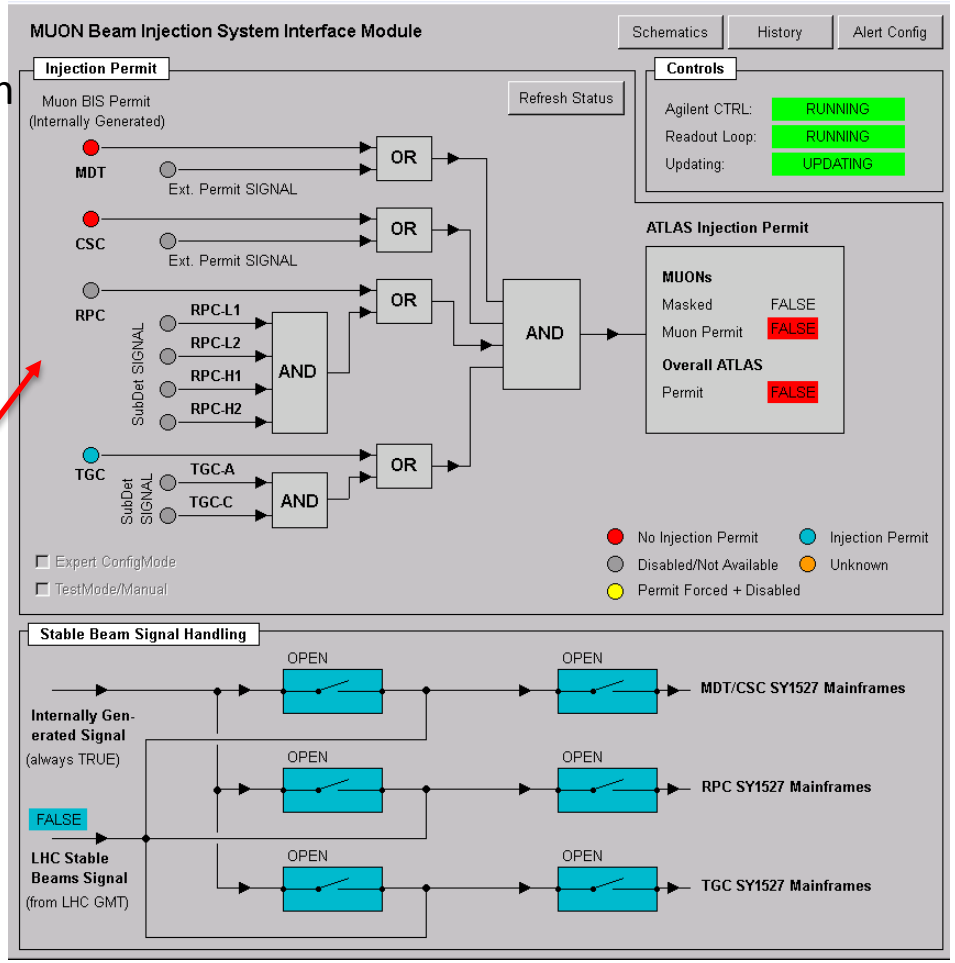
Muon Injection Permit

- You learned yesterday that LHC can not inject beam if hardware injection permit signal is not given by ATLAS
- Injection permit is the AND of several sub-detectors signals, for Muons: CSC, MDT and TGC

To find out which Muon system withholds injection permit, and thus to know which expert to call:

- Navigate to the Beam Interlock node

- Check the upper part of the diagram
- BIS permit “circles” are blue if permit is given, and red if not
- RPC are not part of the Muon injection permit logic in run2 --- “grey” = disabled



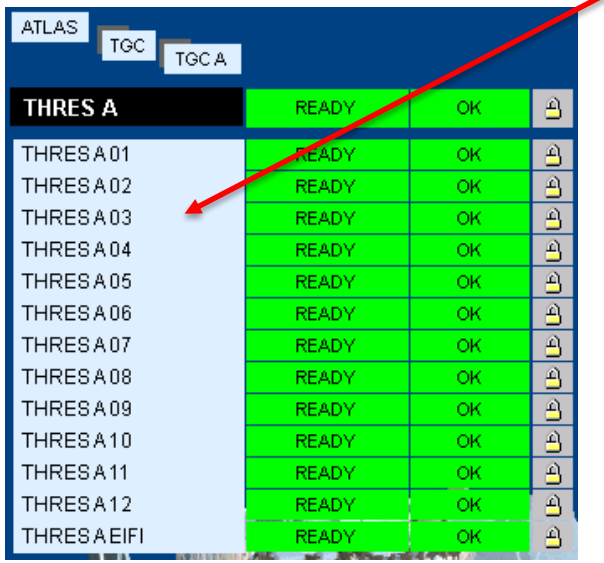
DCS Operations
Thresholds and JTAG

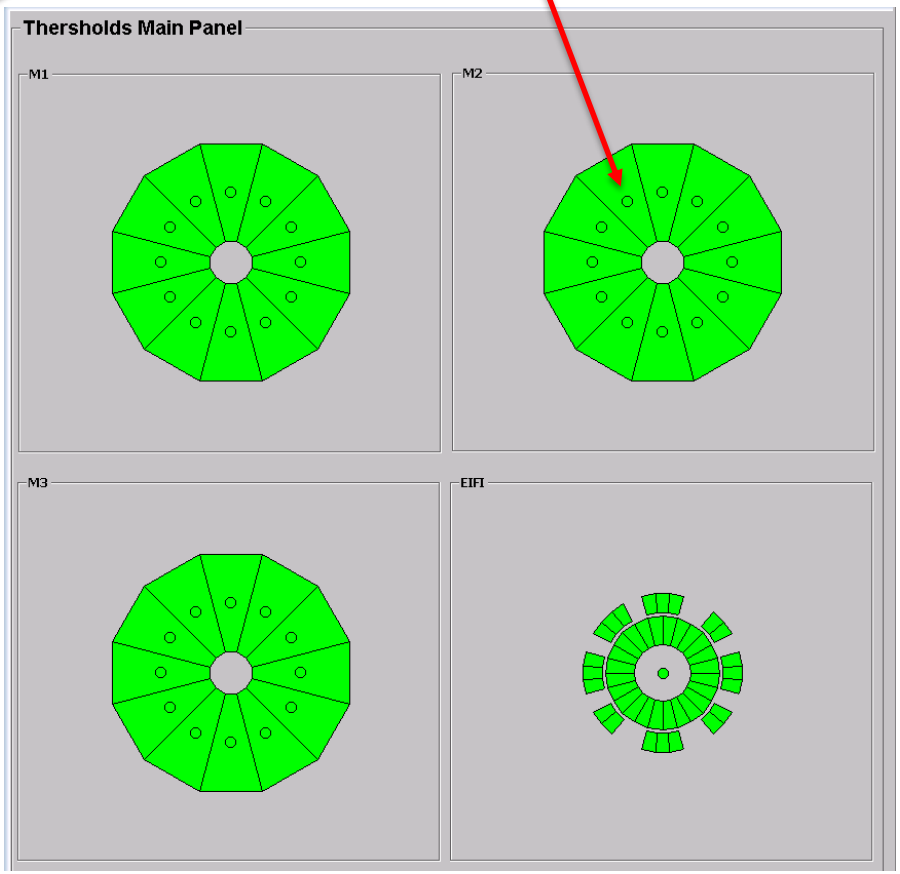
- Threshold settings define which pulse height is needed for a signal to create a hit in the frontend amplifier – shaper – discriminator.
- CSC thresholds are set during CONFIGURE transition of the RunControl -- not covered here, not DCS controlled
- RPC threshold settings are part of the RPC LV architecture – covered in the LV section

→ **Here: MDT and TGC**

TGC Thresholds I

- TGC thresholds detailed state and status can be found in: TGC □ TGC A/C□ THRES A/C
- The panel indicates the state and status per wheel: M1,M2,M3 and EIFI (M4)
- Navigation to detailed table information is possible via two ways:
  - Pressing on the graphical image of the corresponding sector
  - Pressing on the navigation panel on the left



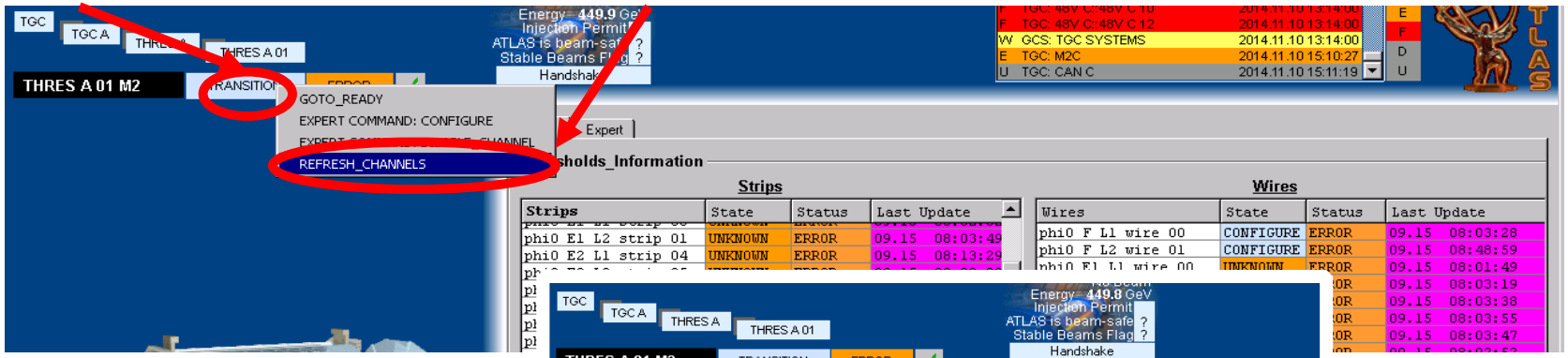


TGC Thresholds II: “Not Responding” Error

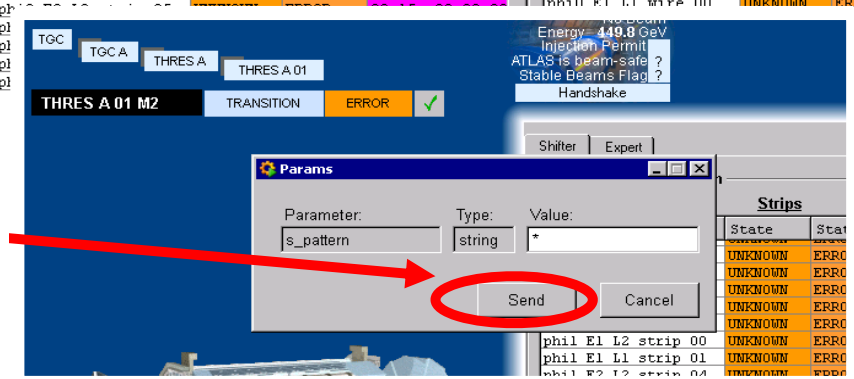
- In case the alarm screen indicates a threshold strip/wire “Not Responding”:

1. Click on the graphic image of the sector or follow the relevant channel’s path: TGC □ TGC A/C □ THRES A/C □ THRES A/C + “Sector Number” + “Wheel”

2. Click on



3. Click “Send” in the pop-up window → action will issue a refresh command to the entire list of channels



4. The thresholds might transfer to READY state, however one needs to verify that they stay in READY after a few minutes, if not please report to the TGC On-call

MDT JTAG Operation I

- JTAG initialization refers to the loading of configuration, reset and setup of the frontend electronics (CSM + mezzanines) for data taking.

- Logically, JTAG initialization belongs to the CONFIGURE step of the DAQ state machine – not initialized chambers can not provide data, ie MDT JTAG state must be READY before starting a run

- For MDT, DCS in in charge of frontend electronics (JTAG) init, via CanBus, and not DAQ

Remarks:

- JTAG initialization is not possible if chamber LV is OFF
- JTAG initialization can be lost during a run (JTAG FSM transtion)
  - JTAG initialization will be lost if LV is lost (trip, switch off, …)
  - JTAG initialization will be lost if TTC clock is lost (TTC crate power loss)

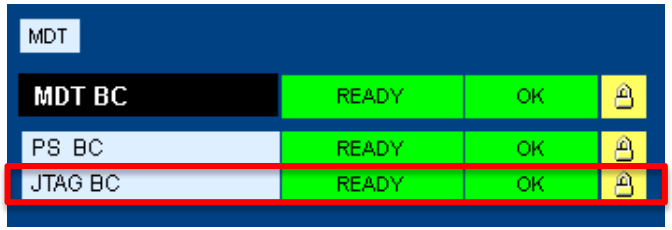
ATTENTION

- While a JTAG INITIALIZED state is a necessary pre-requisite for the chambers providing intact data, situations exist also where JTAG is ok and data are corrupted → DQ checking !!

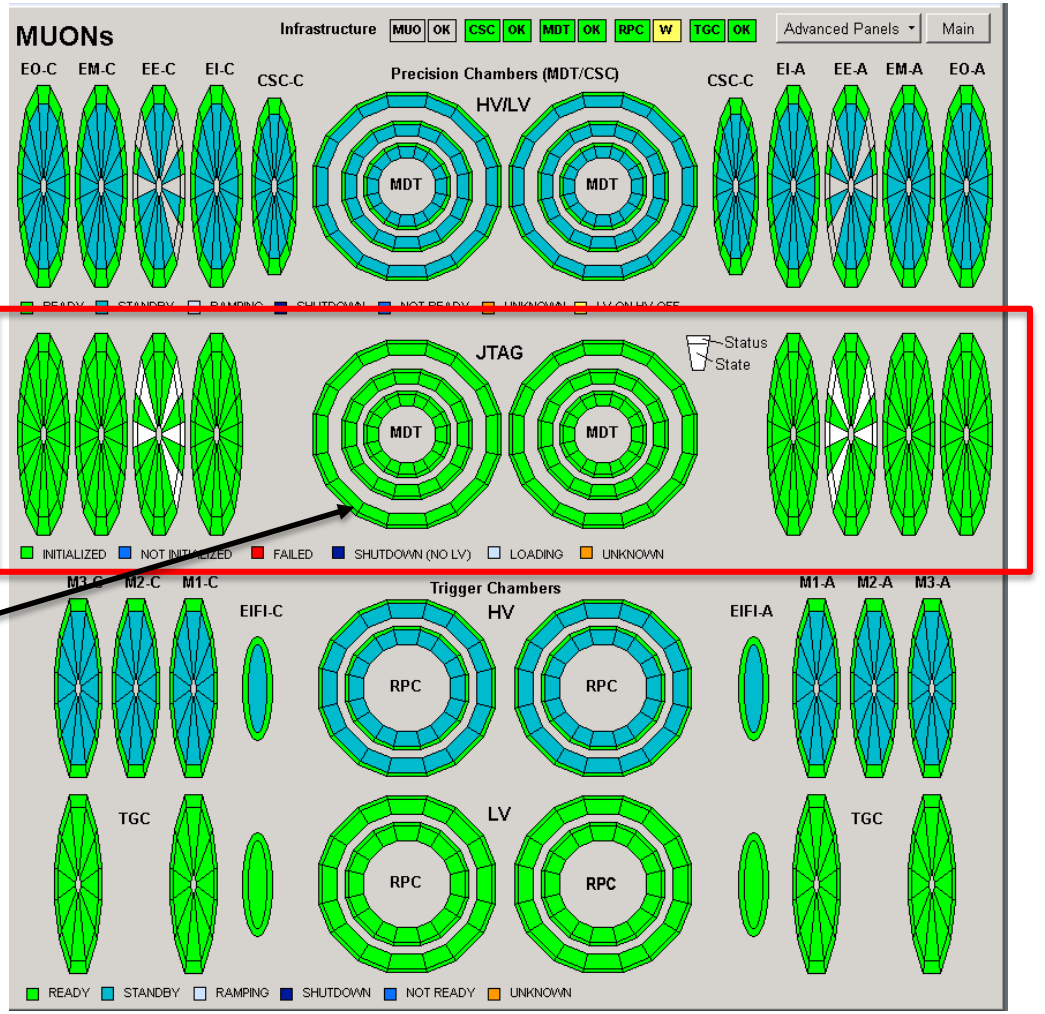
MDT JTAG II – Assessing JTAG State

You can assess the MDT JTAG state from the MUON main panel

and of course also from within the MDT partitions ….



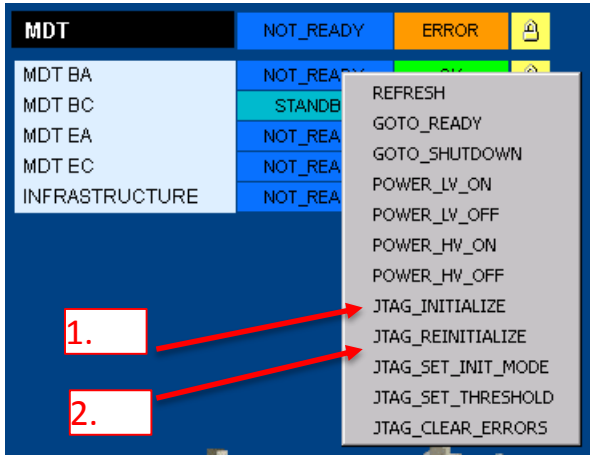
- Clicking on a (NOT_READY) sector allows easy navigation to the problematic part



MDT JTAG Operation III -- Actions

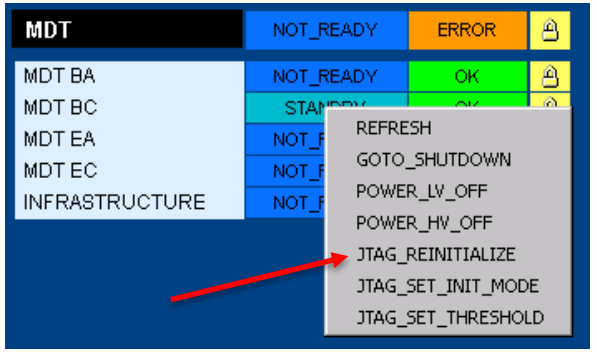
1. INITIALIZE

- Execute the action JTAG_INITIALIZE to init chambers which are currently not in INITIALIZED state
- Easy way to avoid navigating individually to chambers with a failed or unsuccessful init
- Can be executed without problems more than once
- On chamber level: Action is called INITIALIZE (without JTAG prefix)
- If a chamber persistently fails JTAG INIT, disable it from the FSM (and DAQ) and inform an expert (elog)

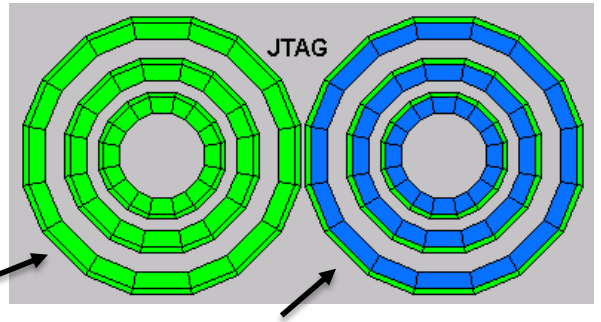


2. REINITIALIZE

- Execute the action JTAG_REINITIALIZE to force-reload the configuration of all chambers, irrespective of the current init state. Example: Apply database change, eg latency



- On chamber level: Action is called REINITIALIZE (without JTAG prefix), only available in state INITIALIZED
- Never do a REINITIALZE on a global level during a run !
- Can try a REINITIALIZE (once) on an individual chamber in case of corrupted data

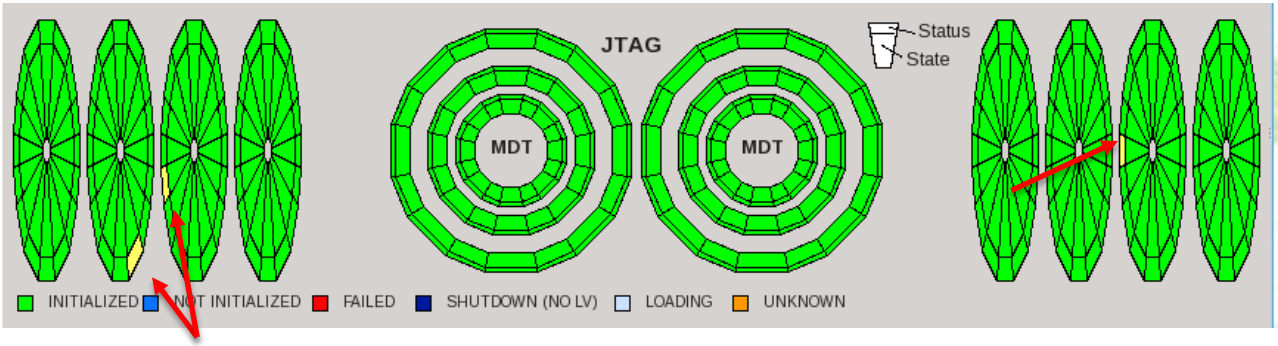


Initialize: no effect

Initialize and Reinitialize effect

MDT JTAG Operation IV – Problems

3. How to deal with JTAG WARNINGS: FSM state/status INITIALIZED/WARNING (instead OK)



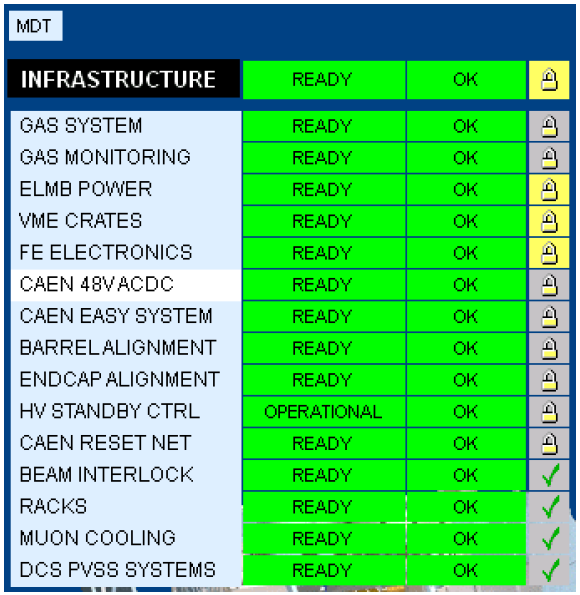
- A Warning status for JTAG indicates a mismatch in expected CSM firmware or mezzanine mask. Please check with the expert. Temporary differences in mezz masks should be listed on the whiteboard
- Note that there is no corresponding DCS alarm (relevant only during data taking)

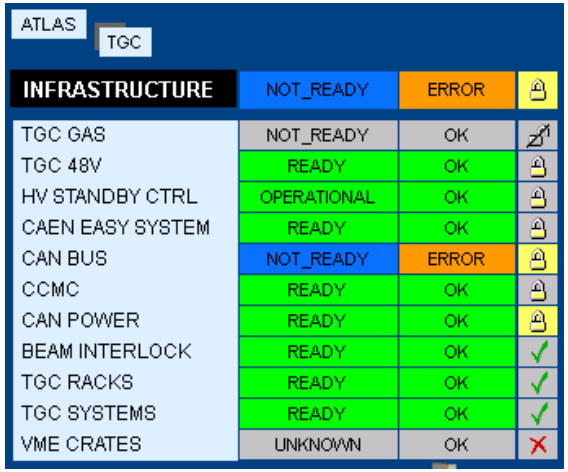
4. How to deal with a JTAG UNKNOWN

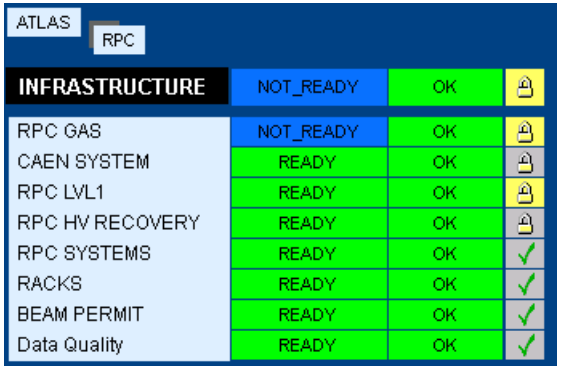
- The JTAG FSM state relies both on information directly monitored on the hardware as well as the results of the last INIT sequence.
- If communication with the Can nodes/CanBus is lost for more than few minutes, JTAG state is set to UNKNOWN, and kept as UNKNOWN also when nodes are back responding
- Recovery: Perform another INITIALIZE on the detector/affected part – DO SO ONLY OUTSIDE a run, during data taking rely on DQ information to assess if chamber state is good or not

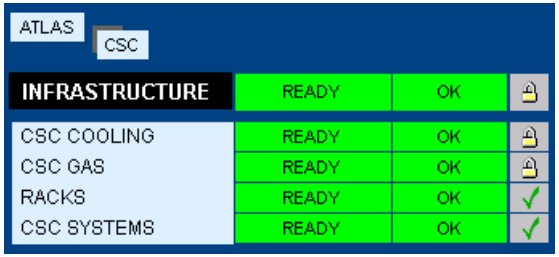
DCS Operations
Infrastructure FSM Nodes

Infrastructure FSMs





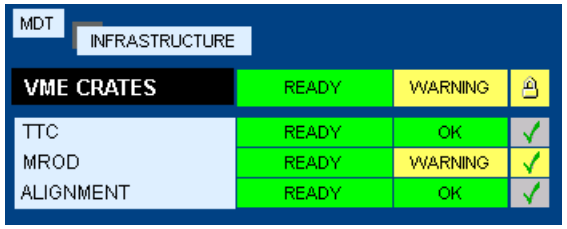




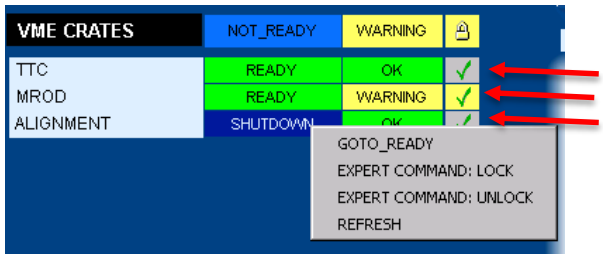
- There are no actions shifters shall perform on the Infrastructure trees without an expert instructing them to do so, with 2 exceptions:
  - Clearing Override Mode when returning from no beam to beam situation,
  - Specific action on endcap alignment crates, see later

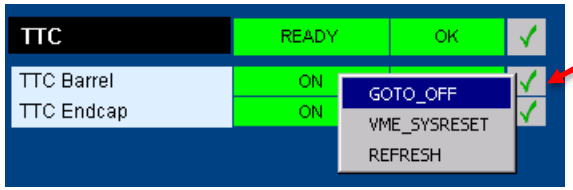
- Different from most other ATLAS sub-detectors, in particular MDT and some TGC/CSC infrastructure actions are available to shifters – save time when an expert is reachable by phone but not near the ACR or in front of a PC.
  → know how to do things
  → for when you are told to do them!

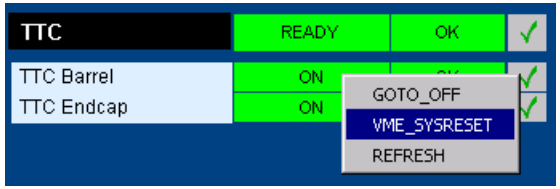
MDT VME Crate Operations/Power Cycling



- MDT VME crates are used either for DAQ (MROD/ TTC) or endcap alignment readout
- (MROD "Test" and "Spare" Crates are by default OFF and disabled in the FSM tree)





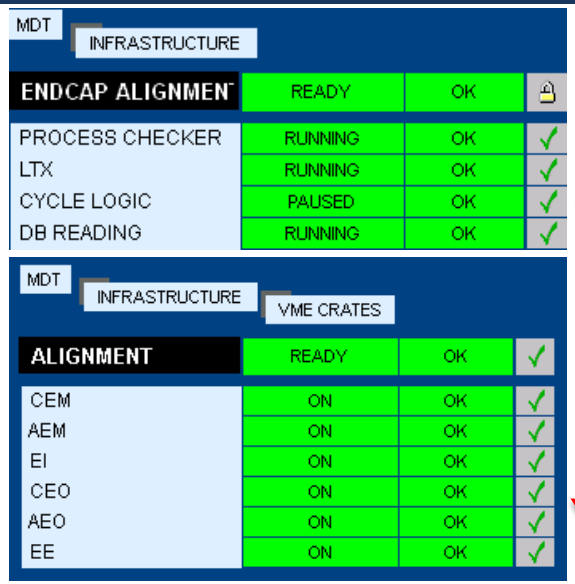


1. Switch on/off all crates of a Group:
- Execute the action GOTO_READY/GOTO_SHUTDOWN on crate GROUP level

2. Switch on/off and individual Crate
- Execute the action SWITCH_ON/SWITCH_OFF on cate level

3. Reboot a SBC
- MROD and TTC crates contain single board computers SBCs) which are part of the DAQ
- To reboot a stuck SBC, issue a VME_SYSRESET action to the crate. Identify the crate from the SBC name
  sbc-mdt-rcc-ba-01 → MROD crate BA01.
  sbc-mdt-ttc-ba-01, ec-01 → TTC Barrel/Endcap

MDT Endcap Alignment System



- Endcap alignment is monitored via MDT Infrastructure FSM
- One data block per ~day is needed from alignment system → unavailability for a few hours is uncritical

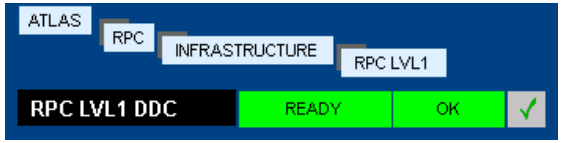
1. If a Endcap Alignment node goes to NOT_READY or UNKNOWN, disable the node from the FSM tree, report in elog, call the expert only during the day

2.

!! Certain conditions where alignment internal communication with the hardware is stuck can damage the equipment → we automatically cut power by turning off alignment crates in this conditions

2. If there is a message on the alarm screen on a Alignment crate turn-off action having been taken, verify crates are indeed off.
   - If yes, acknowledge the alarm
   - If no, turn crates off manually, then acknowledge the alarm
- Document in elog, you may call expert during day time
- If crates are off, disable them in the FSM to return overall Infrastructure state to READY

RPC LV1 DDC



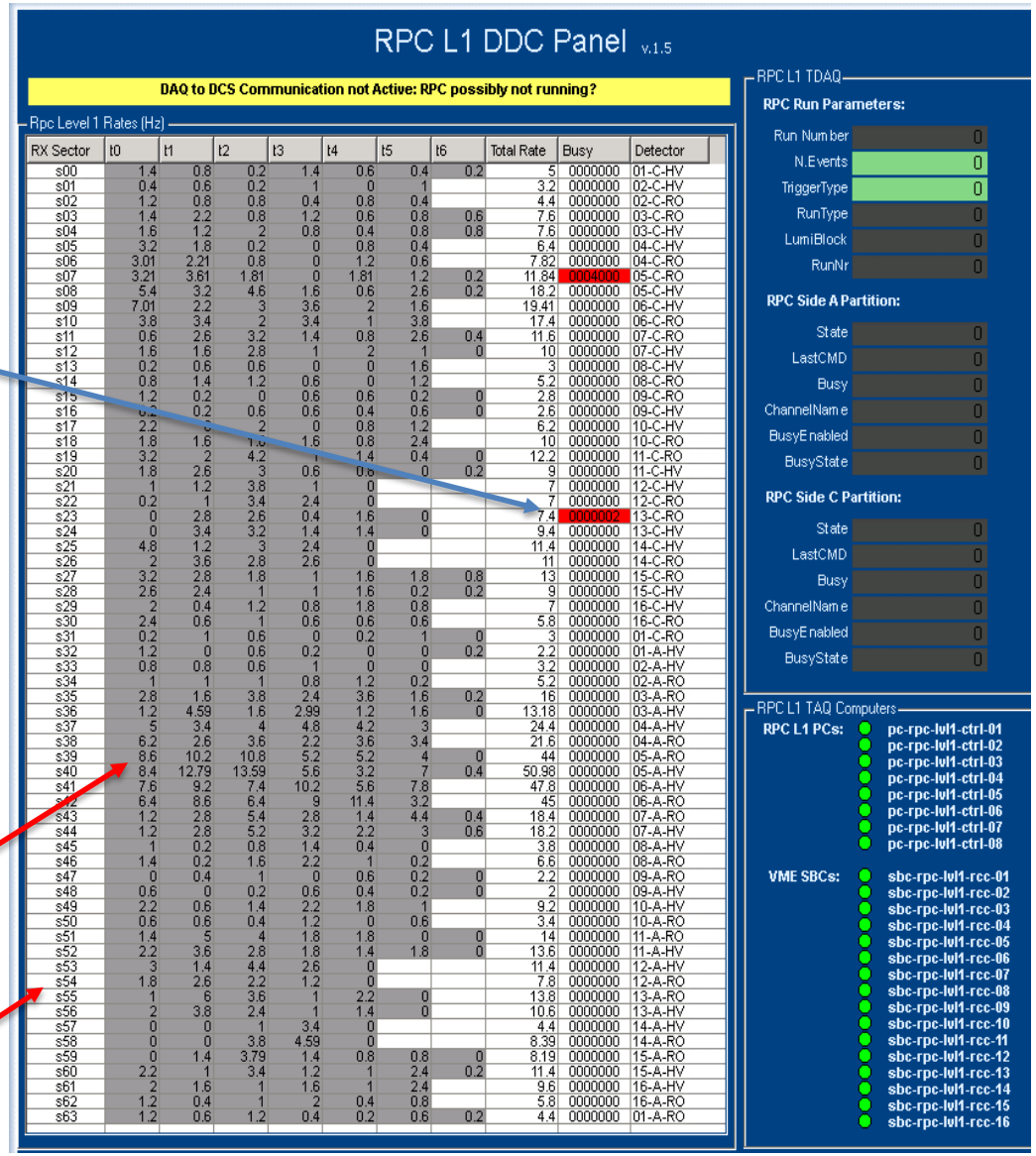
Panel can be used to check

- BUSY trigger towers
- Killed trigger towers
- Noise/Rate of trigger towers

- Call the DAQ/LV1 expert if too many towers appear BUSY or KILLED

Trigger Tower

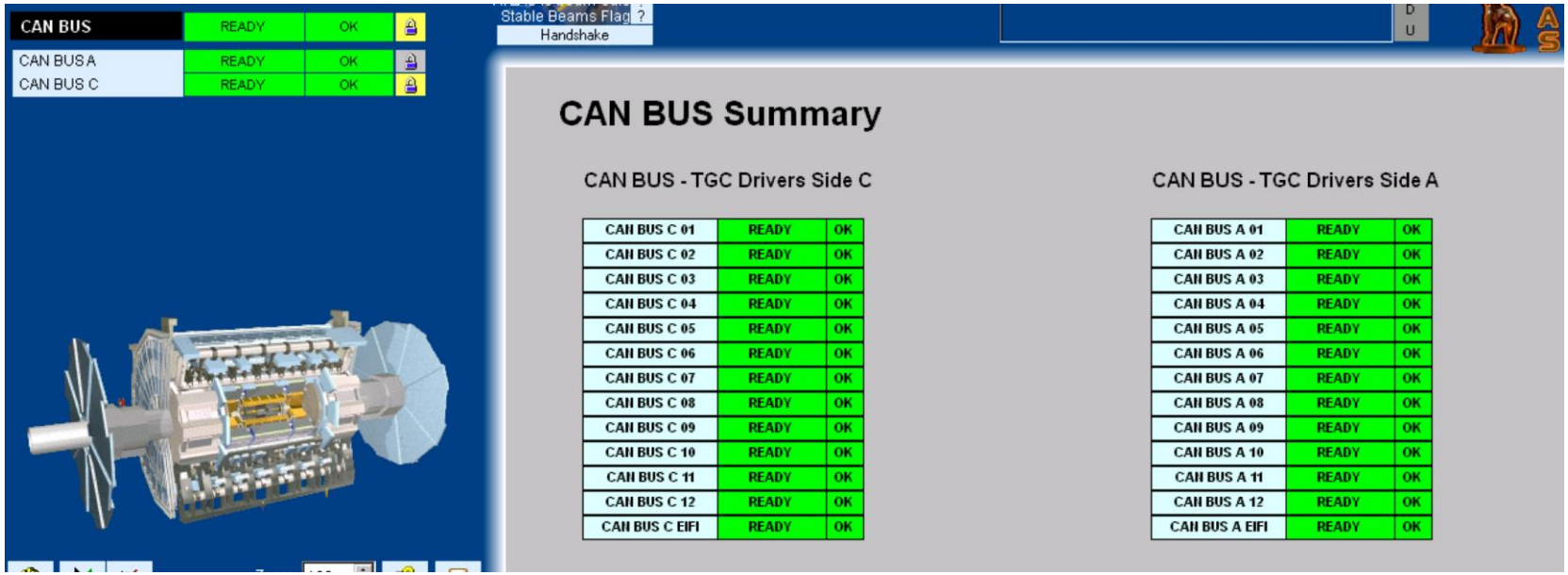
Sector logic



TGC CAN Bus Errors

Can Bus Reporting an Error

- Can Bus detailed **state** and **status** can be found in :
  - TGC → INFRASTRUCTURE → CAN BUS (see figure below)
- The panel indicates the **state** and **status**
  - from sectors 01 to 12 + EIFI
- If the Can Bus is reporting an Error, the solution by the shifter should be the same as for the thresholds, i.e. “refresh channels” procedure to the relevant Thresholds sector (slide 43,44)



DCS Operation
MDT Dropped Chamber/Mezz Recovery

MDT Dropped Recovery I

If a mezzanine or a chamber gives corrupted data (e.g. messed up BCID, L1ID, headers/trailers) → CSM and/or MROD can not build the event fragment → Get stuck in a "Wait" condition → Assert BUSY → ATLAS trigger suspended

MROD can dynamically kick-out chambers or mezzanines (i.e. ignore them = no longer wait for their data) → Chamber or mezzanine is "dropped"

- BUSY is cleared, triggers continue to flow
- But hole in chamber or overall hit map

- Lower level (smaller granularity) action compared default TDQ stopless removal of a ROD,
- MDT specific
- Takes place without explicitly holding the trigger, on the fly

- MDT mezzanine drops occur routinely (O(handful/run)) during data taking with high luminosity, especially for EI* chambers: highest background → single event upsets of registers.

MDT Dropped Recovery II

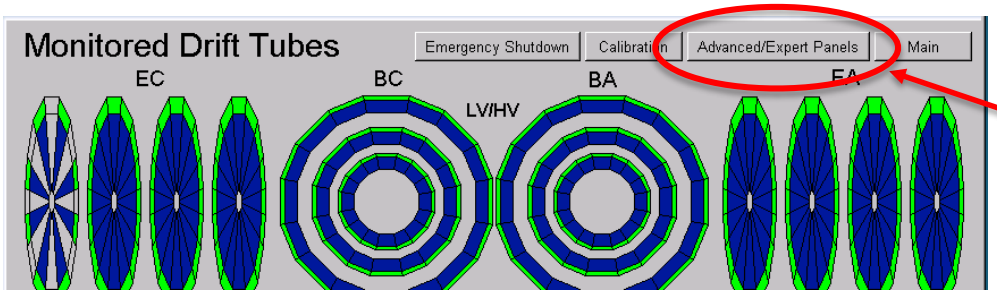
Detecting dropped chambers/mezzanines:

- A chamber drop is notified by a WARNING message in ERS (DAQ) stating that a CSM channel was DISABLED and the chamber name
- A mezzanine drop is notified by a WARNING message in ERS (DAQ) stating that a mezzanine card was disabled, the concerned chamber name and mezzanine mask
- Data quality will show a hole in the occupancy histograms
- DCS alarm screen will show an alarm if there are dropped chambers or chambers with dropped mezzanines in any of the 4 partitions. This alarm will be replaced by Shifter Assistant rules in the future.

Automatic Recovery:

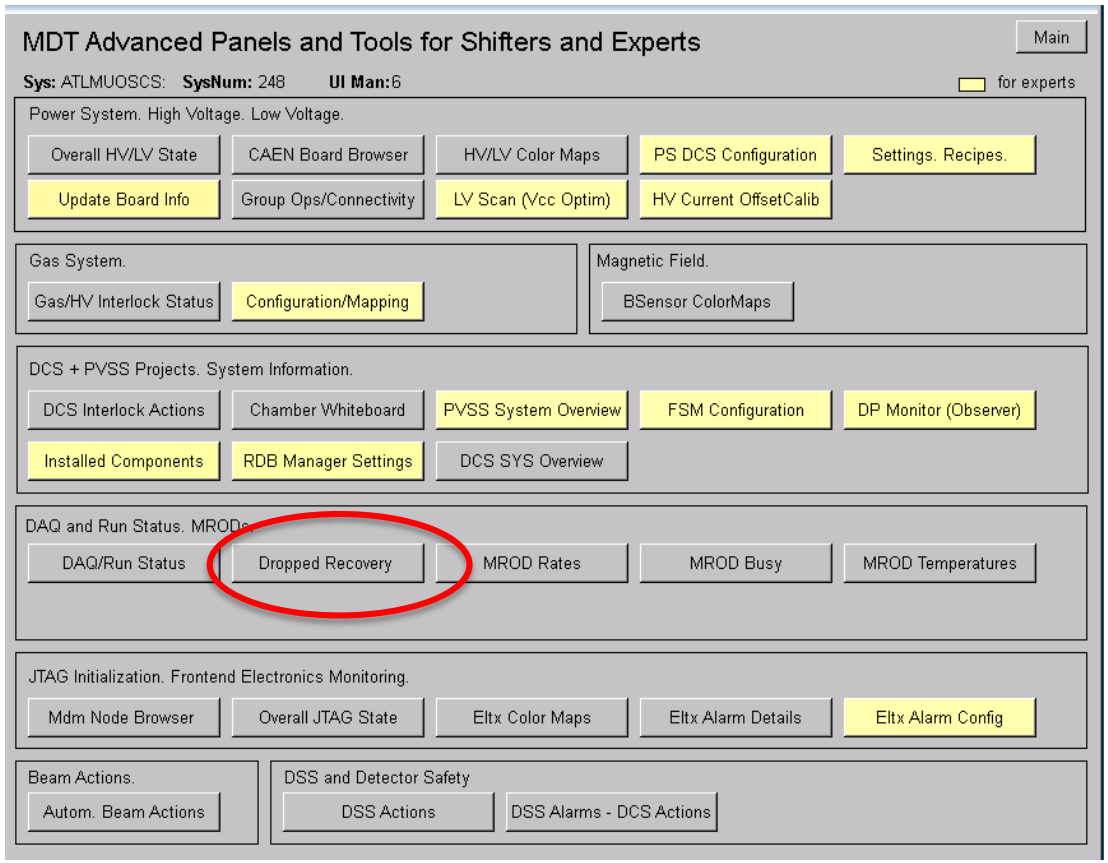
- Per default, recovery of dropped chambers ands mezzanines is automatic
- Automatic recovery does not take place if a chamber/mezzanine drops too often, or if too many chambers drop at the same time → Manual Recovery after understanding what happened

Dropped Recovery Panel



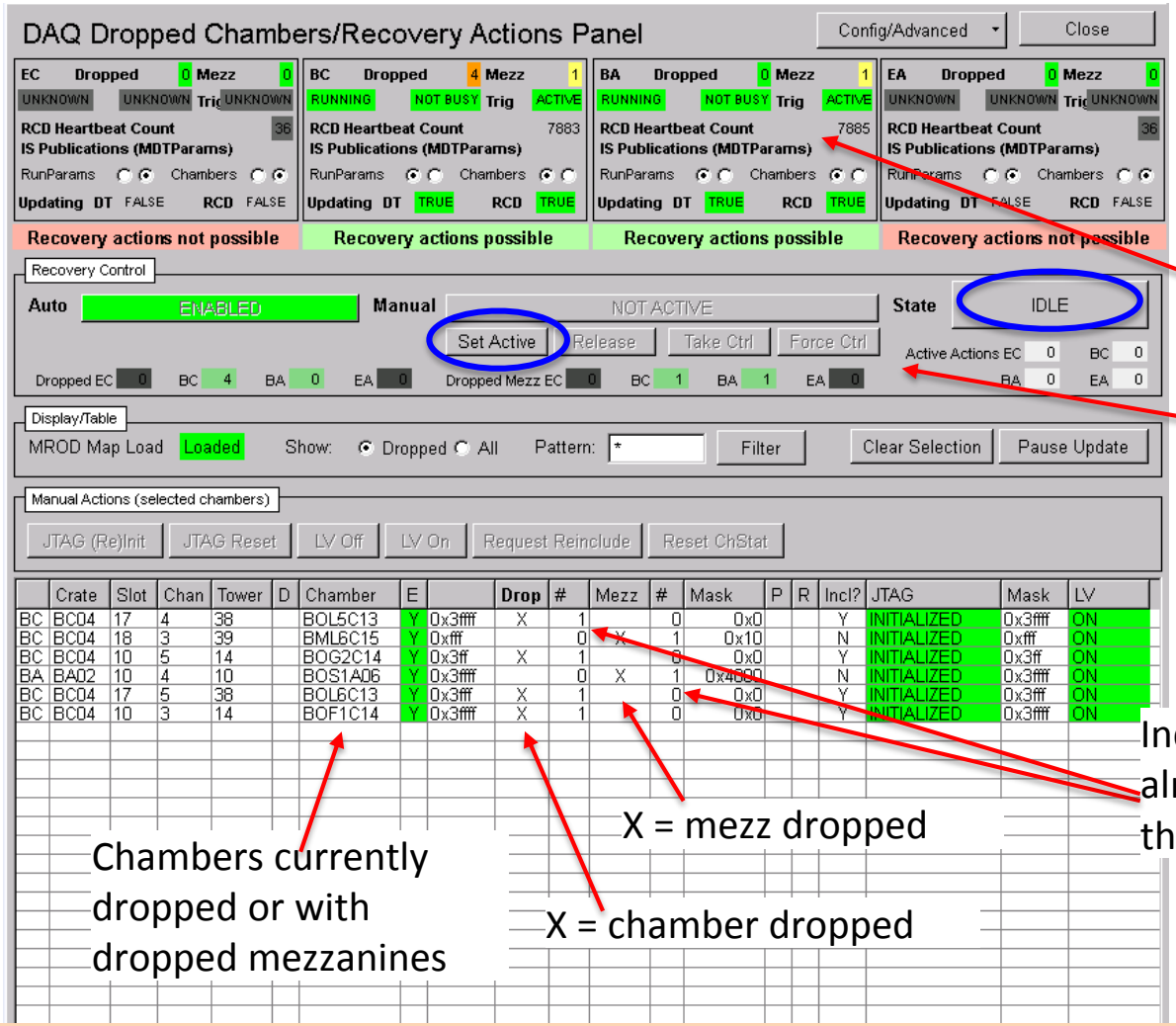
From main Muon FSM panel

- click on “Advanced/Expert Panels”
- Select MDT



- Click on Dropped Recovery

MDT Dropped Recovery IV: Manual Op



Note: Panel takes some 10-15 secs to initialize, be patient !

Partition/Run state. Indicator if run state allows a recovery

Automatic or Manual Recovery selector/indicator

Indicator on how often a chamber already dropped/had mezz drops this run

X = mezz dropped

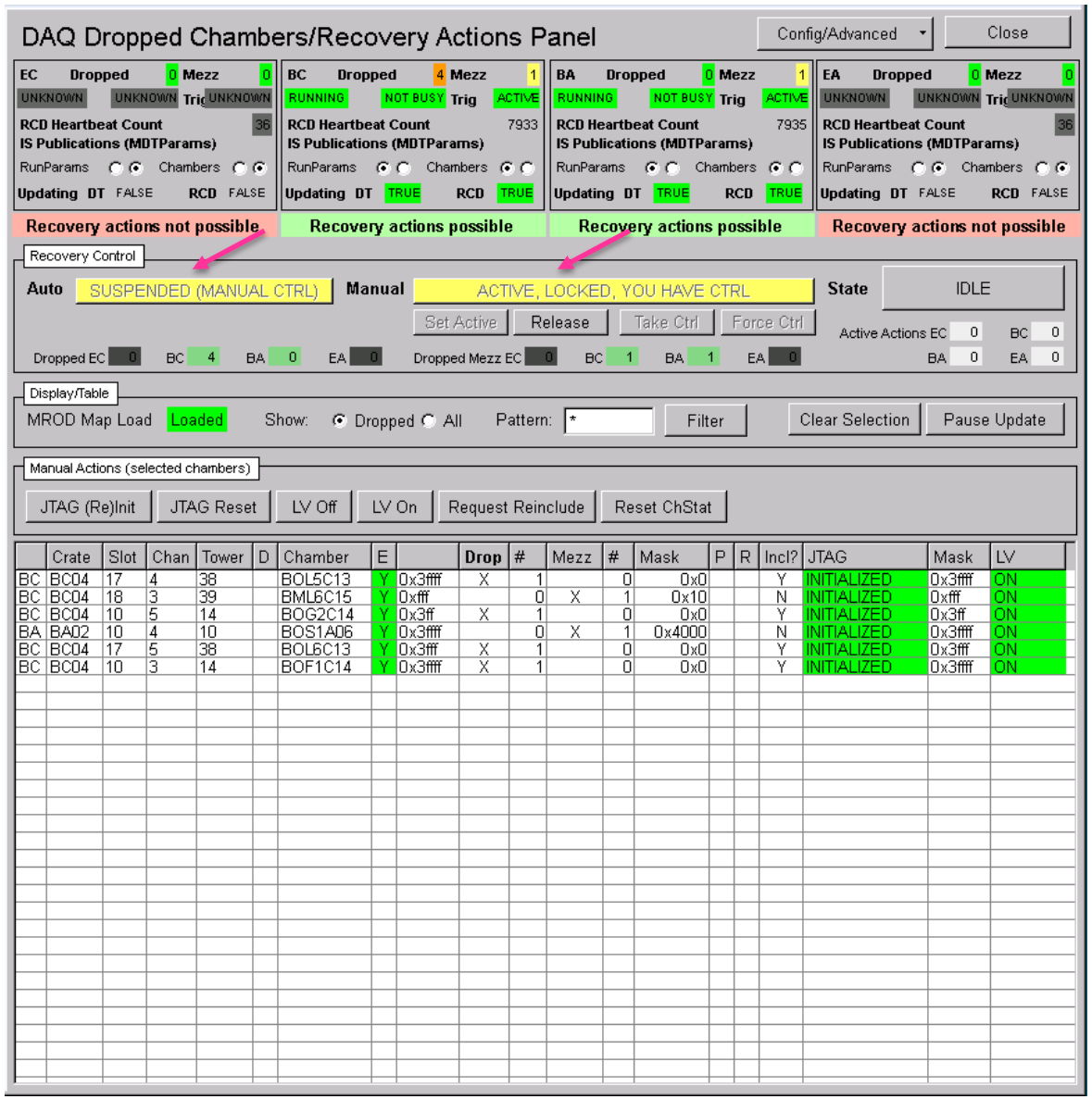
X = chamber dropped

Chambers currently dropped or with dropped mezzanines

To do any manual actions:

1. Check recovery control is IDLE
2. Set Manual Control active (suspends auto actions) – do not forget to release when done

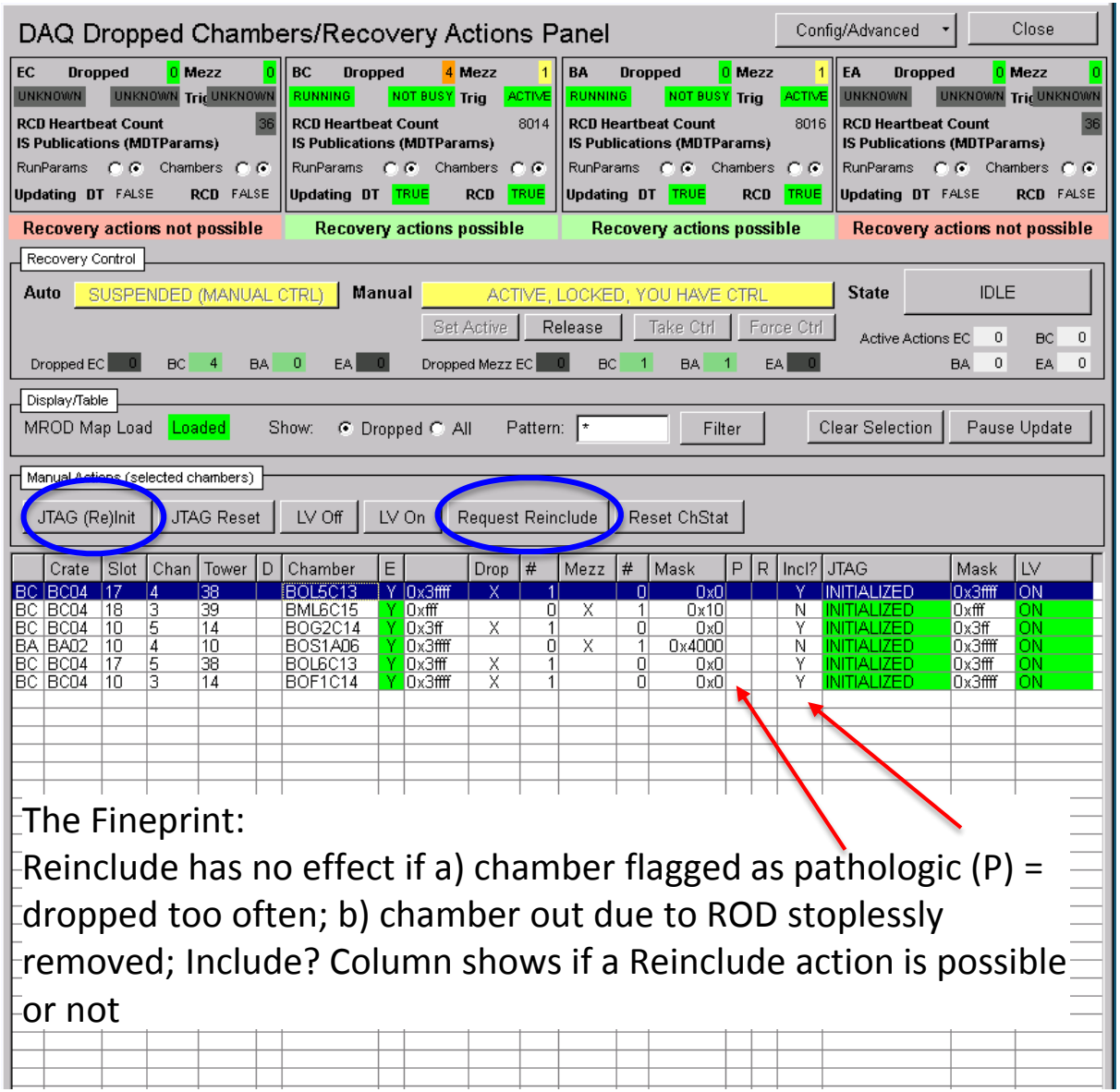
MDT Dropped Recovery V: Manual Op



	Crate	Slot	Chan	Tower	D	Chamber	E		Drop	#	Mezz	#	Mask	P	R	Incl?	JTAG	Mask	LV
BC	BC04	17	4	38		BOL5C13	Y	0x3ffff	X	1		0	0x0			Y	INITIALIZED	0x3ffff	ON
BC	BC04	18	3	39		BML6C15	Y	0xfff		0	X	1	0x10			N	INITIALIZED	0xfff	ON
BC	BC04	10	5	14		BOG2C14	Y	0x3ff	X	1		0	0x0			Y	INITIALIZED	0x3ff	ON
BA	BA02	10	4	10		BOS1A06	Y	0x3ffff		0	X	1	0x4000			N	INITIALIZED	0x3ffff	ON
BC	BC04	17	5	38		BOL6C13	Y	0x3fff	X	1		0	0x0			Y	INITIALIZED	0x3fff	ON
BC	BC04	10	3	14		BOF1C14	Y	0x3ffff	X	1		0	0x0			Y	INITIALIZED	0x3ffff	ON

Having taken manual control → ready for some action !

MDT Dropped Recovery VI: Manual Op



The Fineprint:
Reinclude has no effect if a) chamber flagged as pathologic (P) = dropped too often; b) chamber out due to ROD stoplessly removed; Include? Column shows if a Reinclude action is possible or not

1. Dropped chambers
   - Select the chamber or chambers to reinclude (chamber must be dropped)
   - Check their JTAG and LV state is ok
   - Click Request Reinclude and confirm the popup
2. Dropped Mezzanines
   - Select the chamber or chambers
   - JTAG Reinitialize it/them
   - Wait for the chamber(s) to drop
   - Click Request Reinclude and confirm the popup
3. Release the manual control

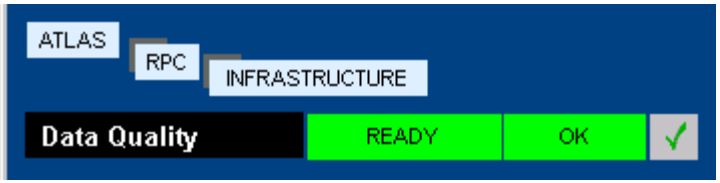
MDT Dropped Recovery VII

Recommendation and Best Practice:

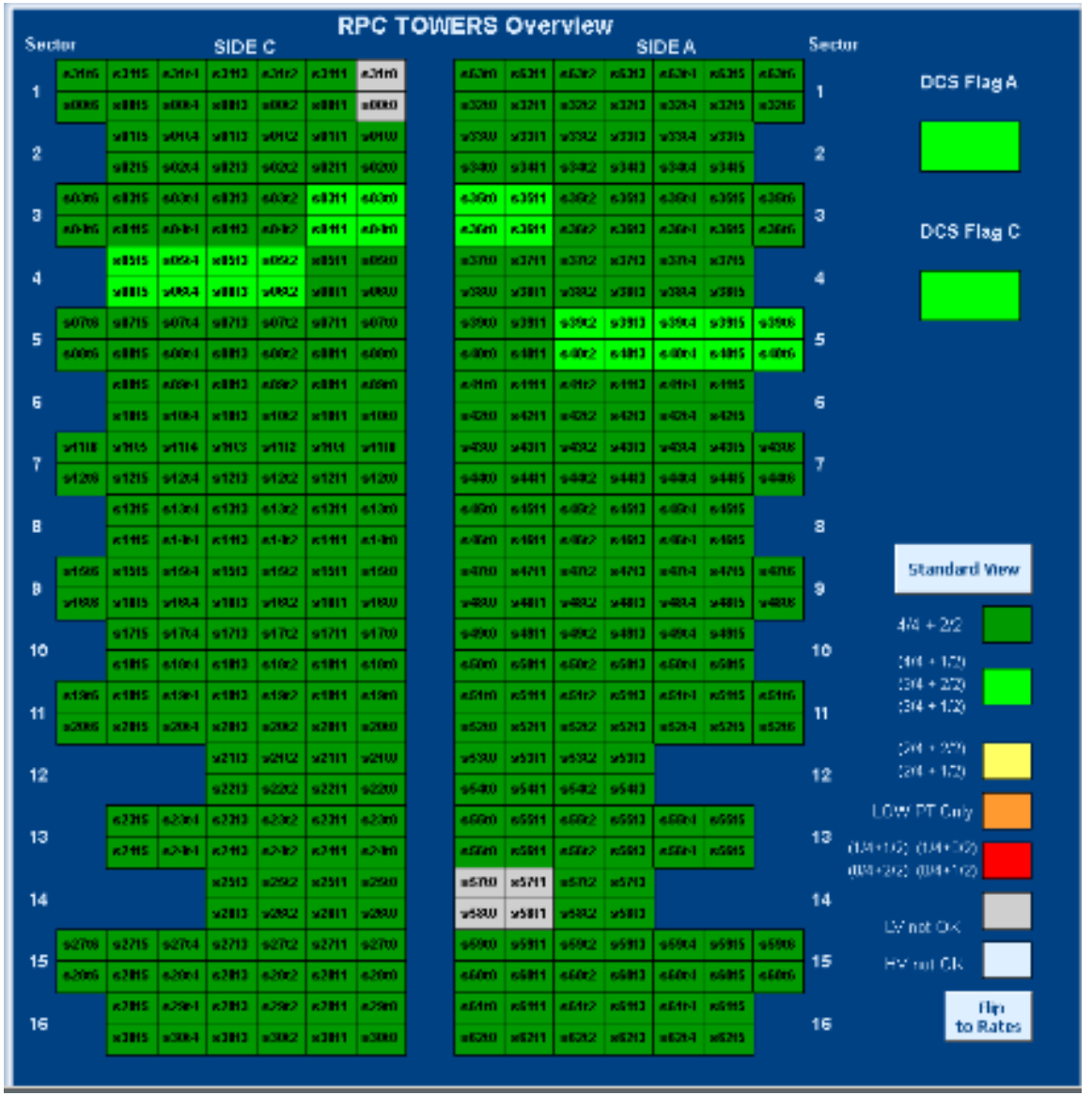
- Normally dropped recovery should be automatic
- If a chamber is dropped and not auto-recovered, try to reinclude it ONCE
- If a chamber has dropped mezzanines and they are not auto-recovered, JTAG Reinitialize the chamber to make the chamber drop. Issue a Reinclude request. If this is not successful and the mezzanine drops immediately again, leave it out

Global Tools

RPC DCS DQ Panel

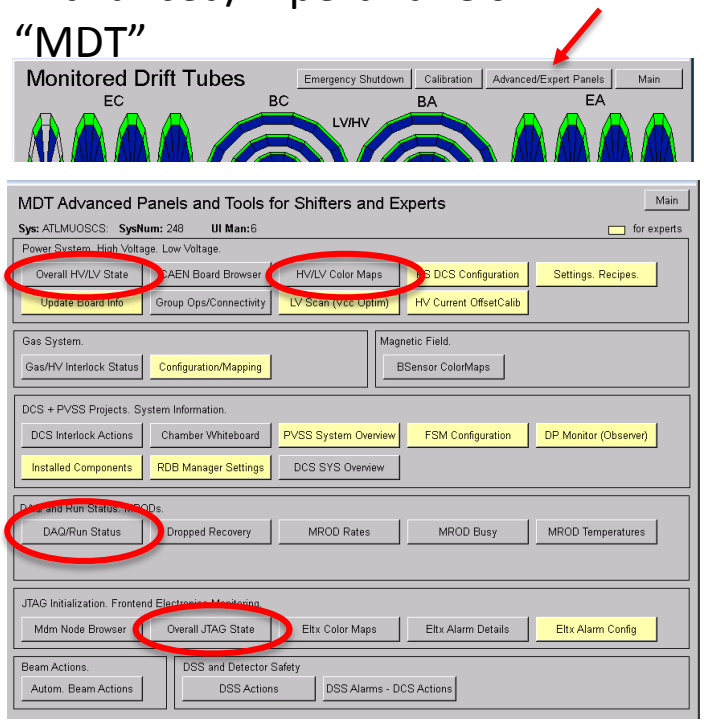


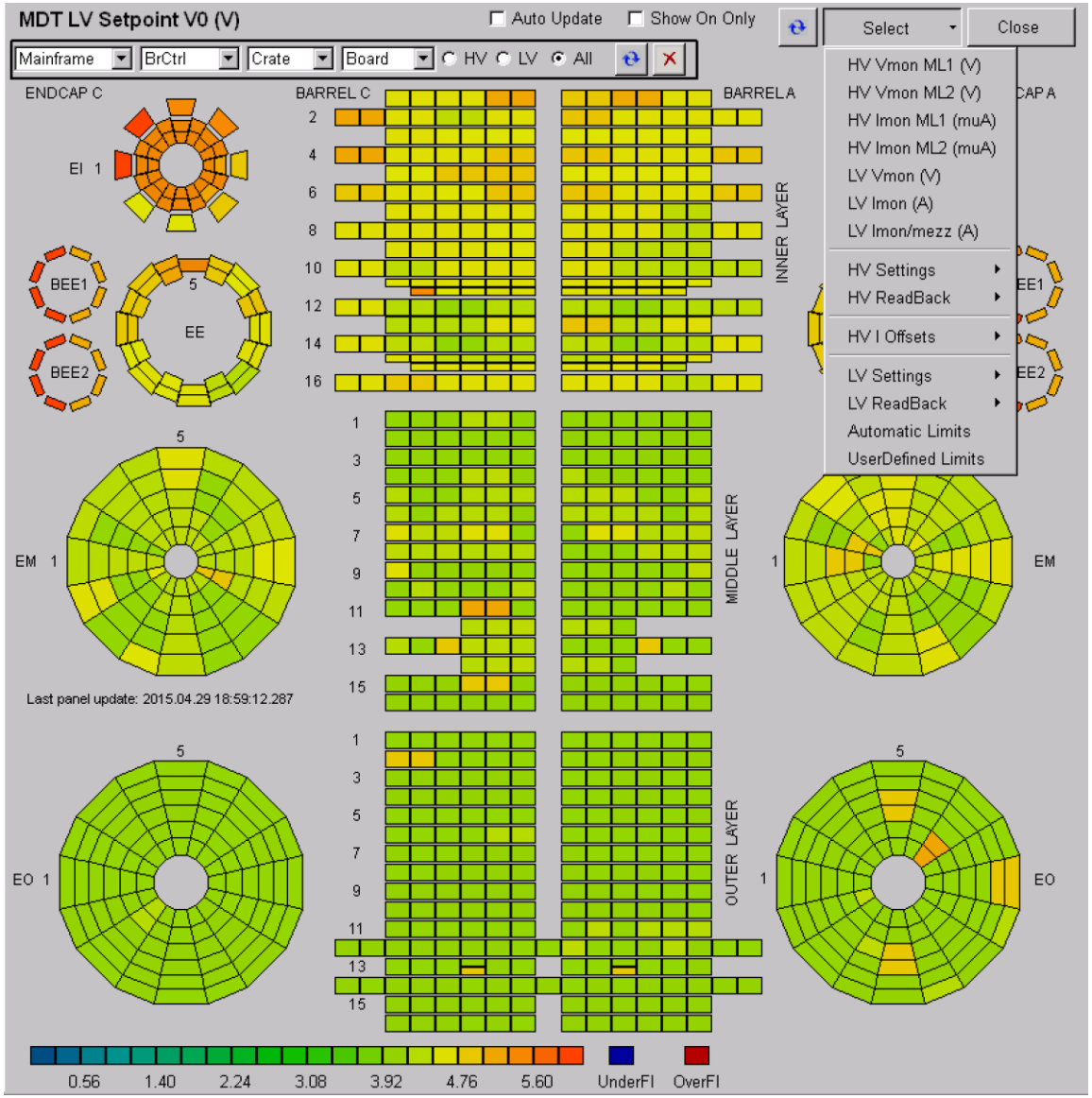
- RPC Data Quality FSM panel provides an easy way to assess fraction of the detector in good state for data taking
- Toggle between Standard and Detailed view with the “View” buttons
- Toggle between Rates, DAQ/LV1 and DCS views with the “Flip” button
- Combines LV, HV, … information by trigger tower = relevant physical granularity



MDT Detector Overview Panels

Global MDT overview panels can be accesses via the "Advanced/Expert Panels" → "MDT"





- Color Maps: Graphical display of HV/LV settings and momentary readings (select from drop menu)
- Panel update on request (Refresh button)

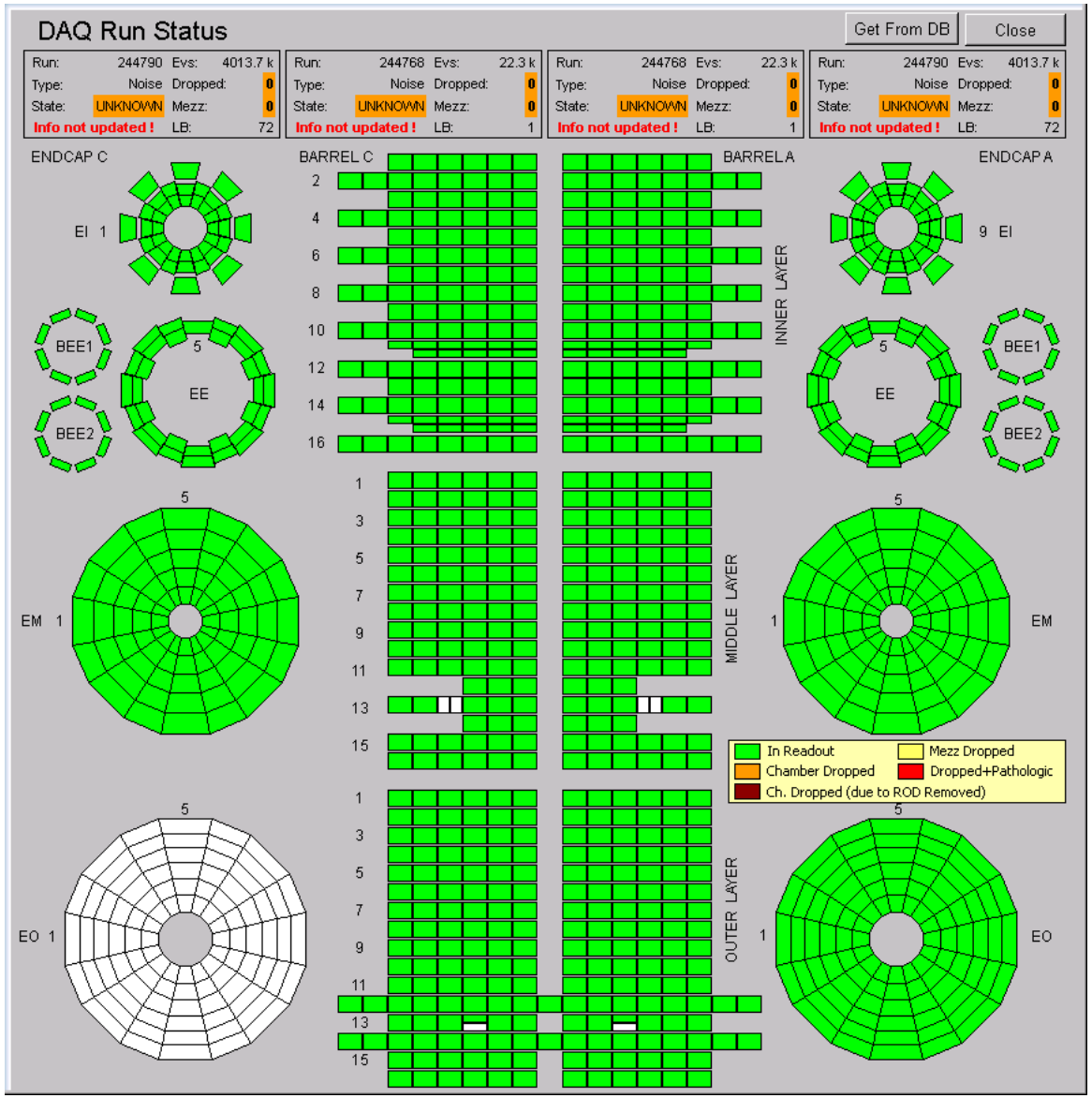
MDT Detector Overview: DAQ/Run Status

DAQ/Run Status

- Chambers included/ excluded in readout (DAQ/OKS)
- Dropped chambers
- Chambers with dropped mezzanines
- Removed chambers due to ROD removal

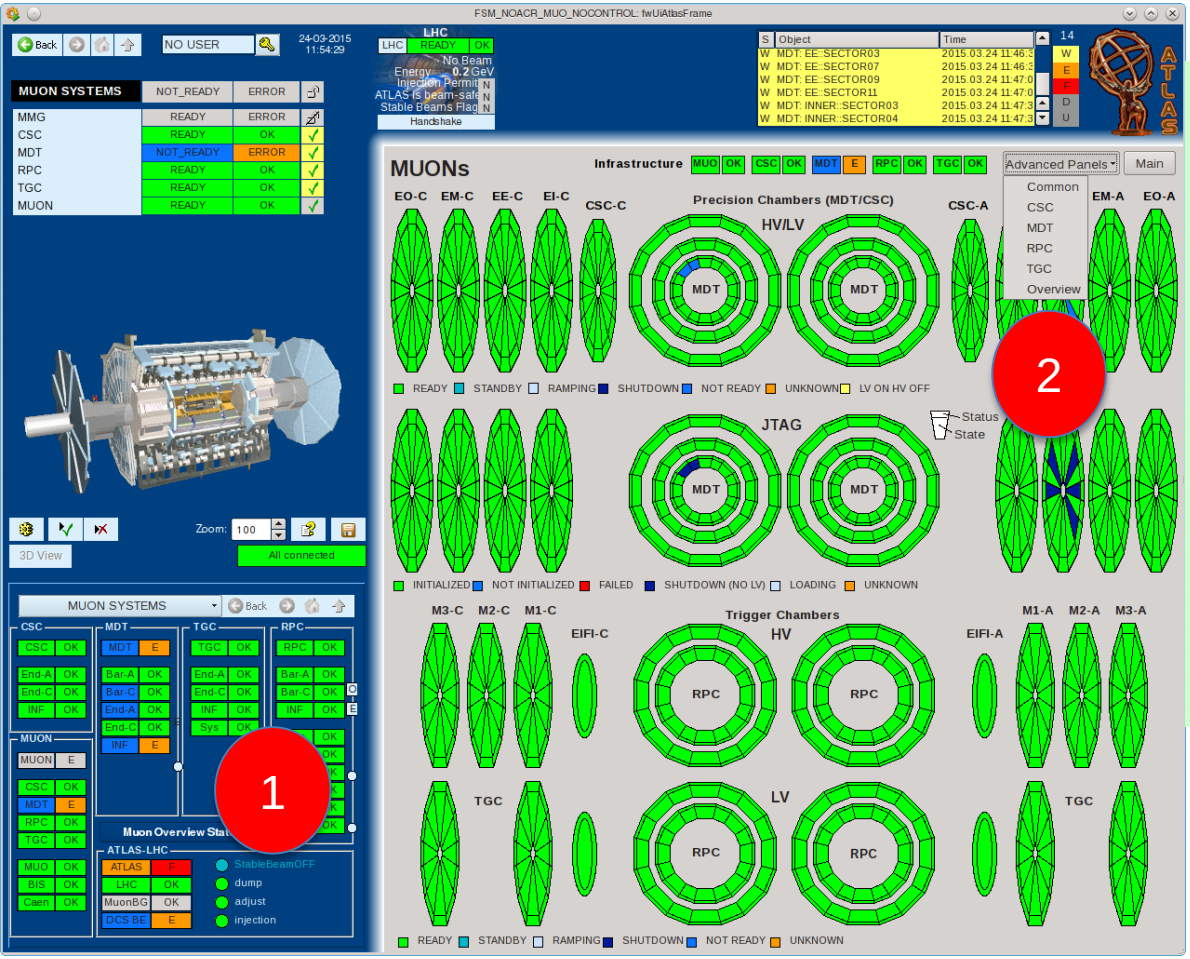
- Up to date information if a run is ongoing, otherwise show situation during last Configure transition

- Auto updating during a run
- Panel available via web monitoring



Muon STATUS Overview Panel (1/2)

- Additional tool for shifter to check the Muon system overview
- Before the data taking(combined run), make sure no unexpected disabled channels
- Report the disabled channel list into shifter summary (tbd)

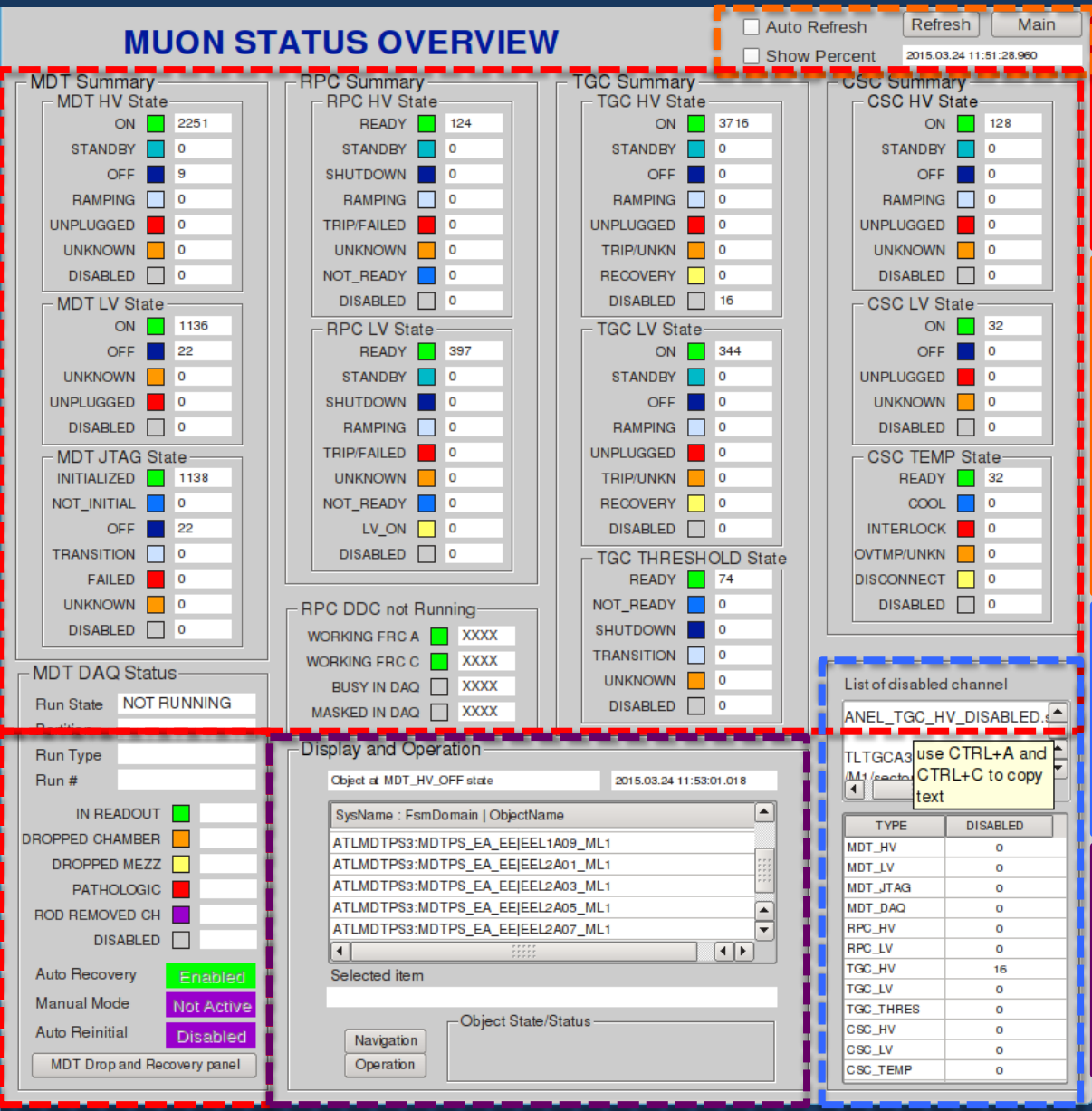


- How to access panel

① To open an individual panel, click “Muon Overview Status” button via Muon system secondary main page

② To open it inside main Muon FSM page, via Advanced Panels menu and click “Overview” option

Muon STATUS Overview Panel (2/2)



- Summary of Muon FSM device objects (HV/LV/etc except INFRASTRUCTURE)
- MDT DAQ status

- Available options

1) Auto refresh with interval time 1 minute
2) Show percentage instead of number
3) Manual refresh

- Text field to allow copy and paste disabled channel list
- Summary table of disabled channel

- Display the channel list at certain state
- Simple navigation or operation on selected channel

We need your feedback!!