Shift Leader Training
Part 2

v.2.4

A. Polini, A. Cerri

February 25th 2015

Acknowledgements:

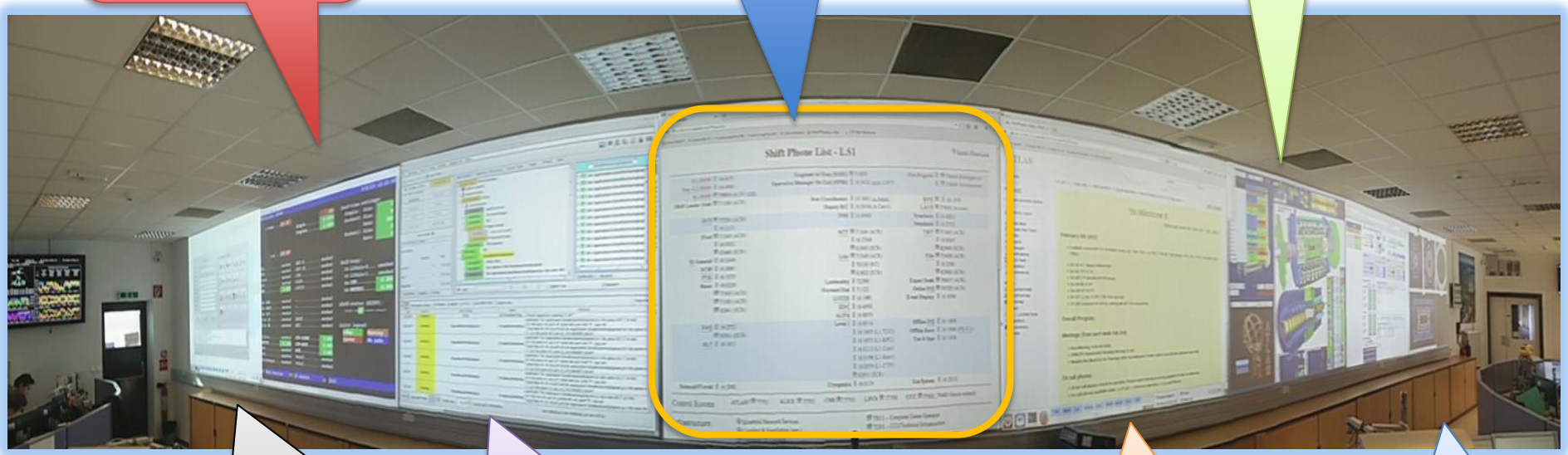
Thilo, Stephanie, Sigi

Outline:

- Beam Protection
- LHC Interaction
- Luminosity

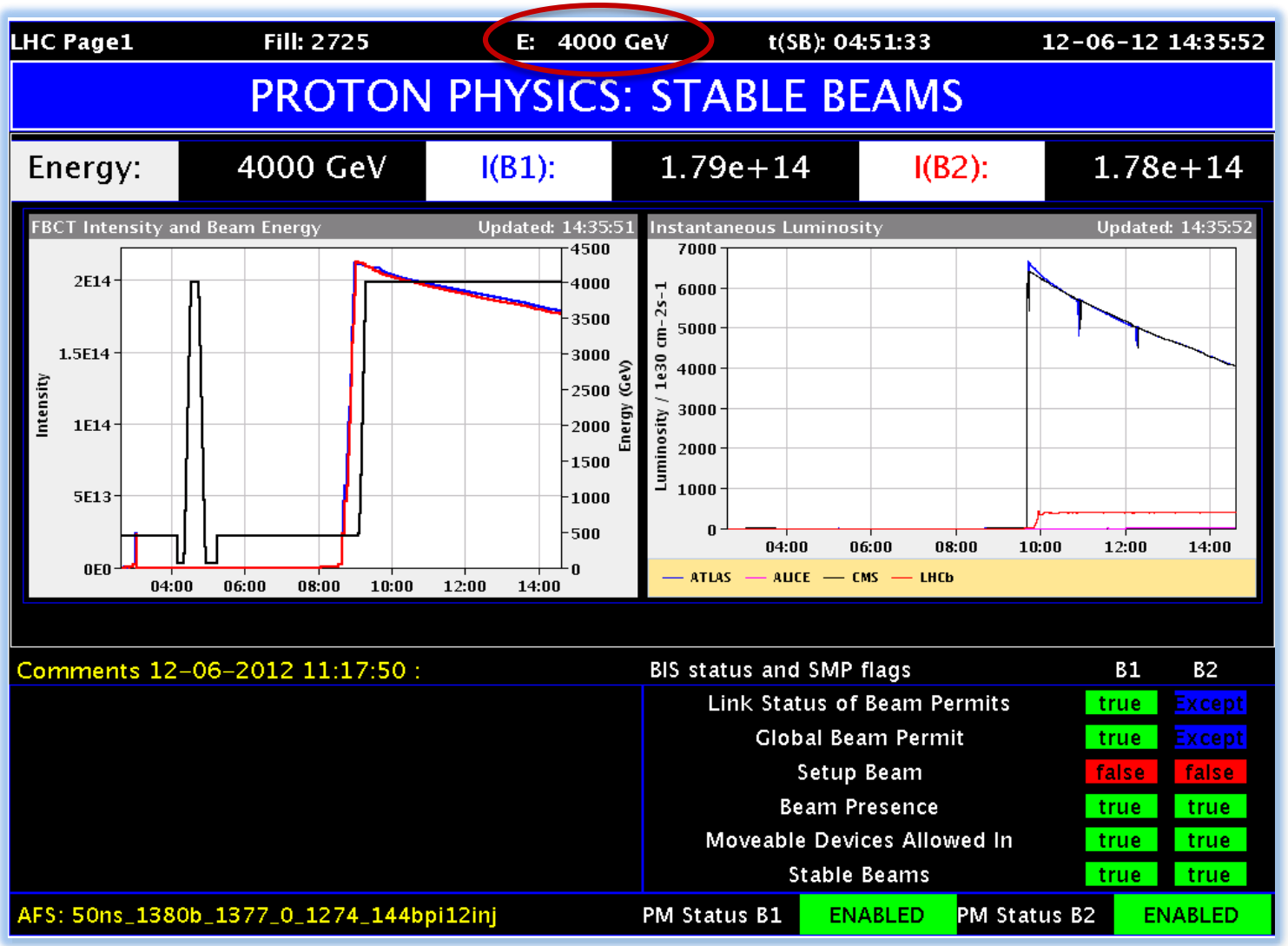
The ATLAS Control Room

Now and when preparing for beam operation



LHC Page 1

- LHC Page 1 should always be displayed by one of the projectors. It is your main source of information for what is going on on the machine side



LHC Page 1

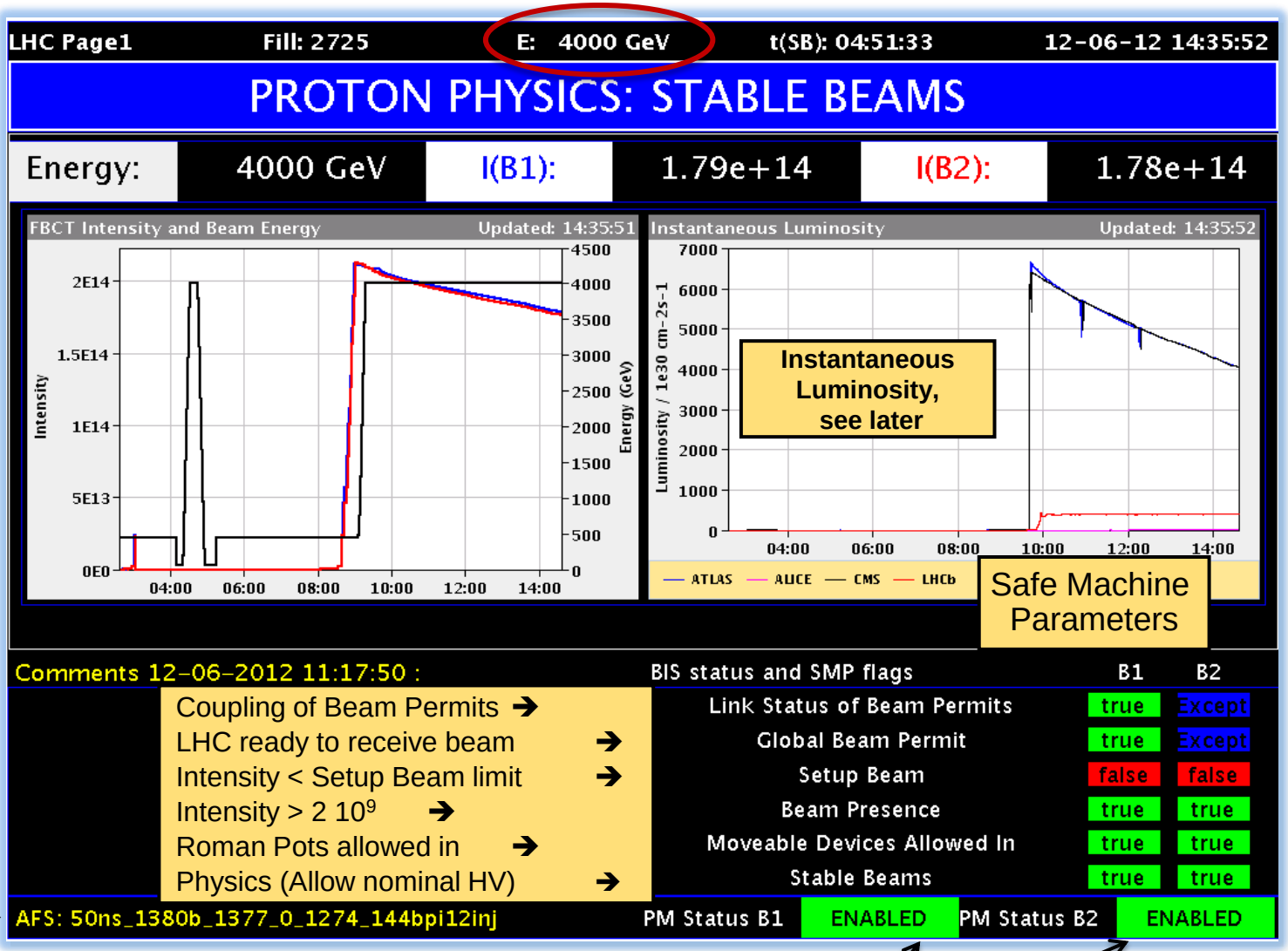
- LHC Page 1 should always be displayed by one of the projectors. It is your main source of information for what is going on on the machine side

Accelerator: Beam Modes

Energy (Magnet current)
(If strange – coded)

I(B1) – I(B2)
TOTAL BEAM INT.
DCCT
DC Current Transf.

BUNCHED BEAM INT.
FBCT
Fast Beam Current Transformer

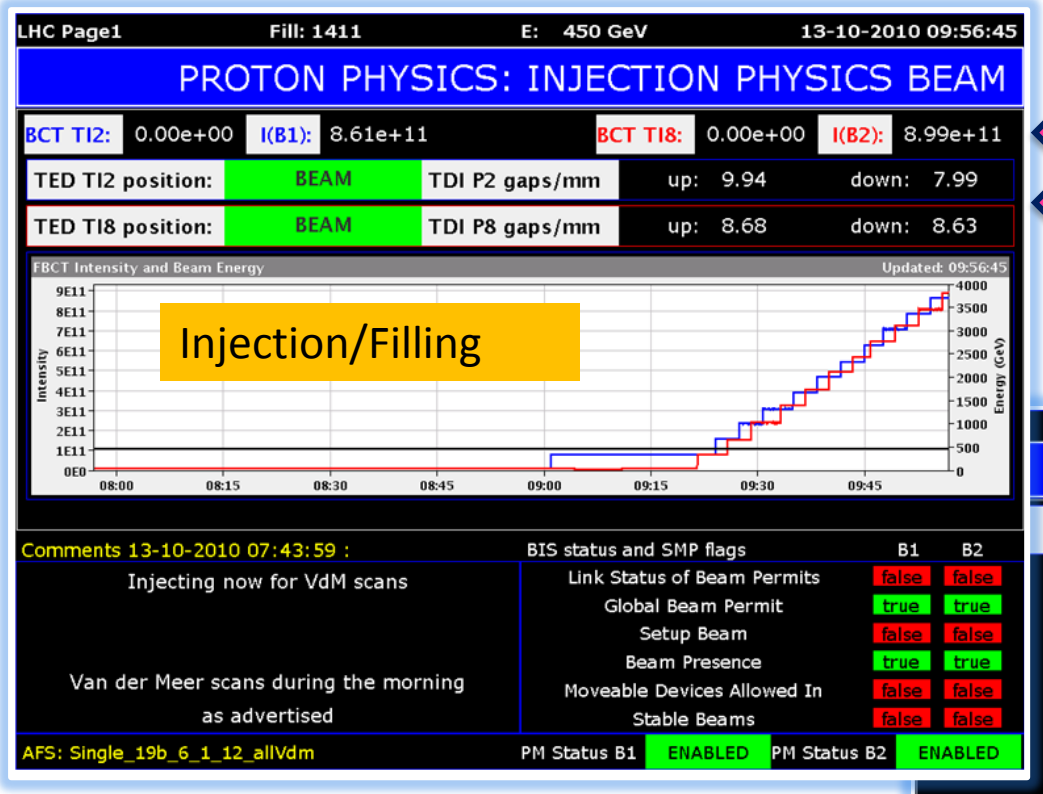


Filling scheme →

Post Mortem Signal

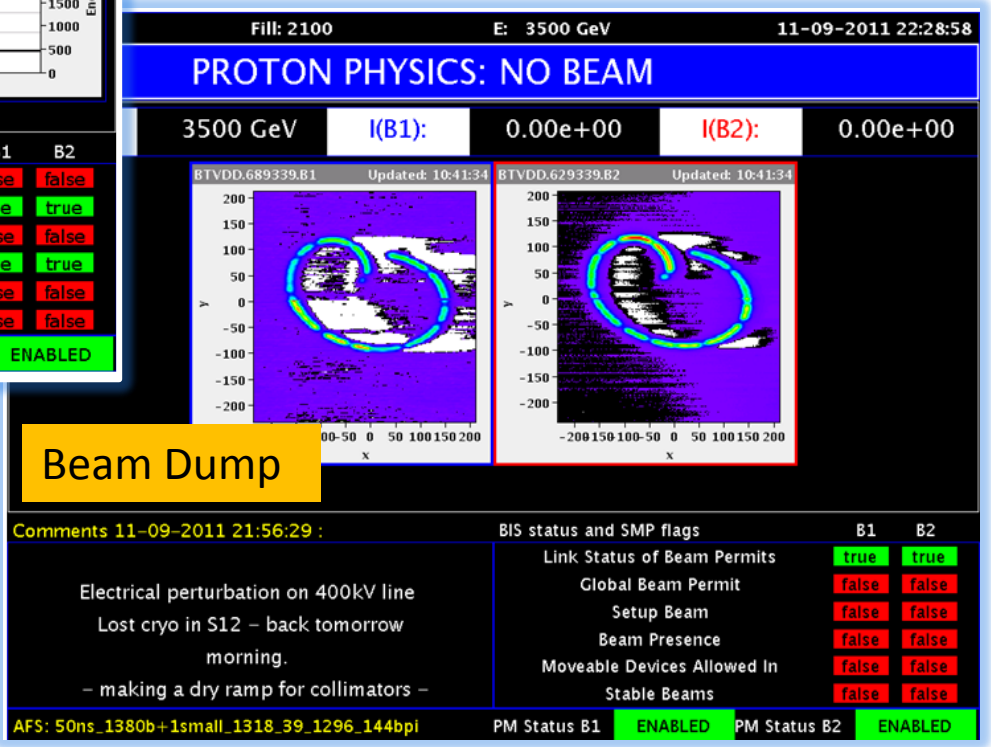
LHC Page 1 (ii)

- Page 1 content changes depending on state of the beam ...



BCT TI2 – BCT TI8
Injected intensity

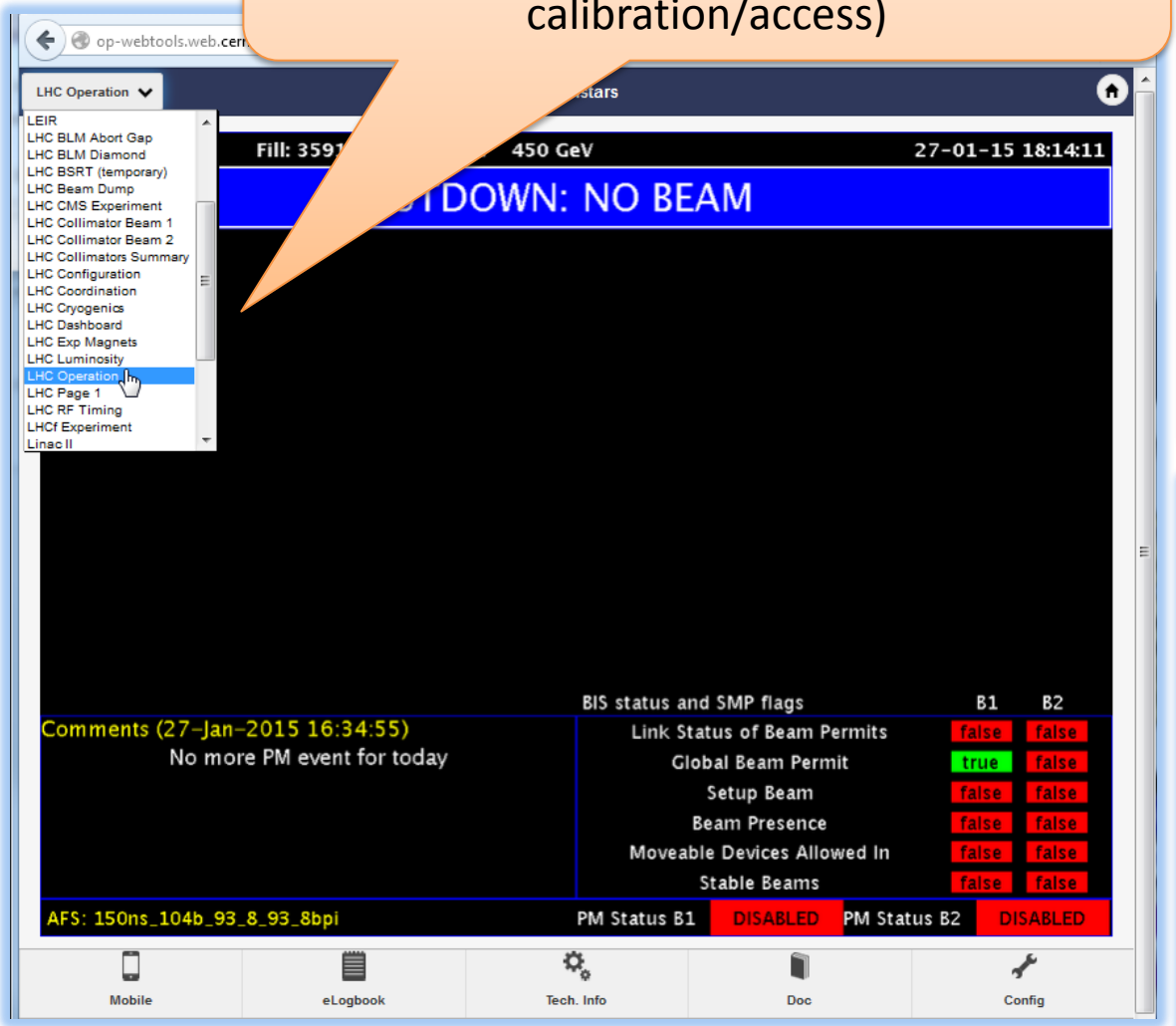
Beam Absorbers for Injection
TED: Beam Dump
TDI: Protect LHC

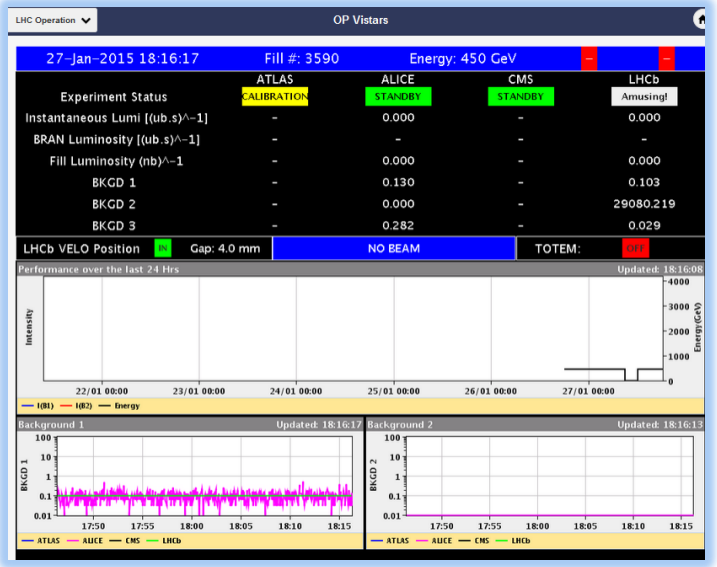


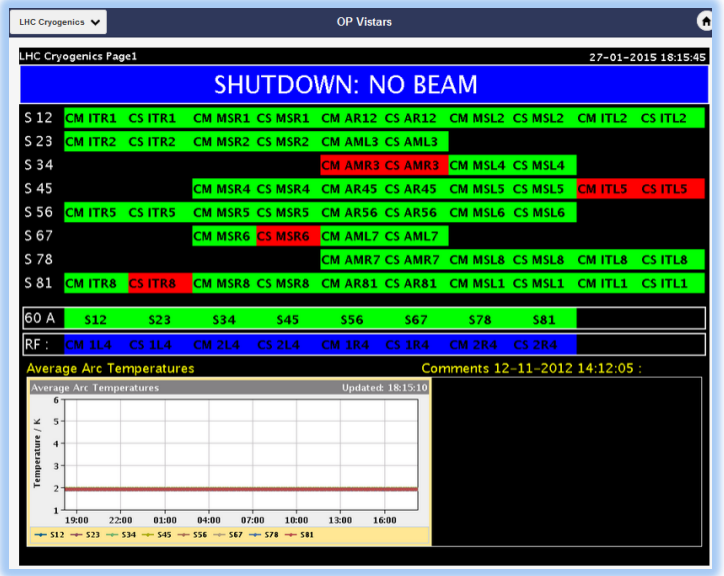
Knowing more on what the LHC is doing at a given moment: check the LHC logbook
http://elogbook.cern.ch/eLogbook/eLogbook.jsp?lgbk=60
Also available from the LHC menu on the SL desk in the ACR

LHC Page 1 (iii)

More pages and information available (can be useful during data taking and calibration/access)

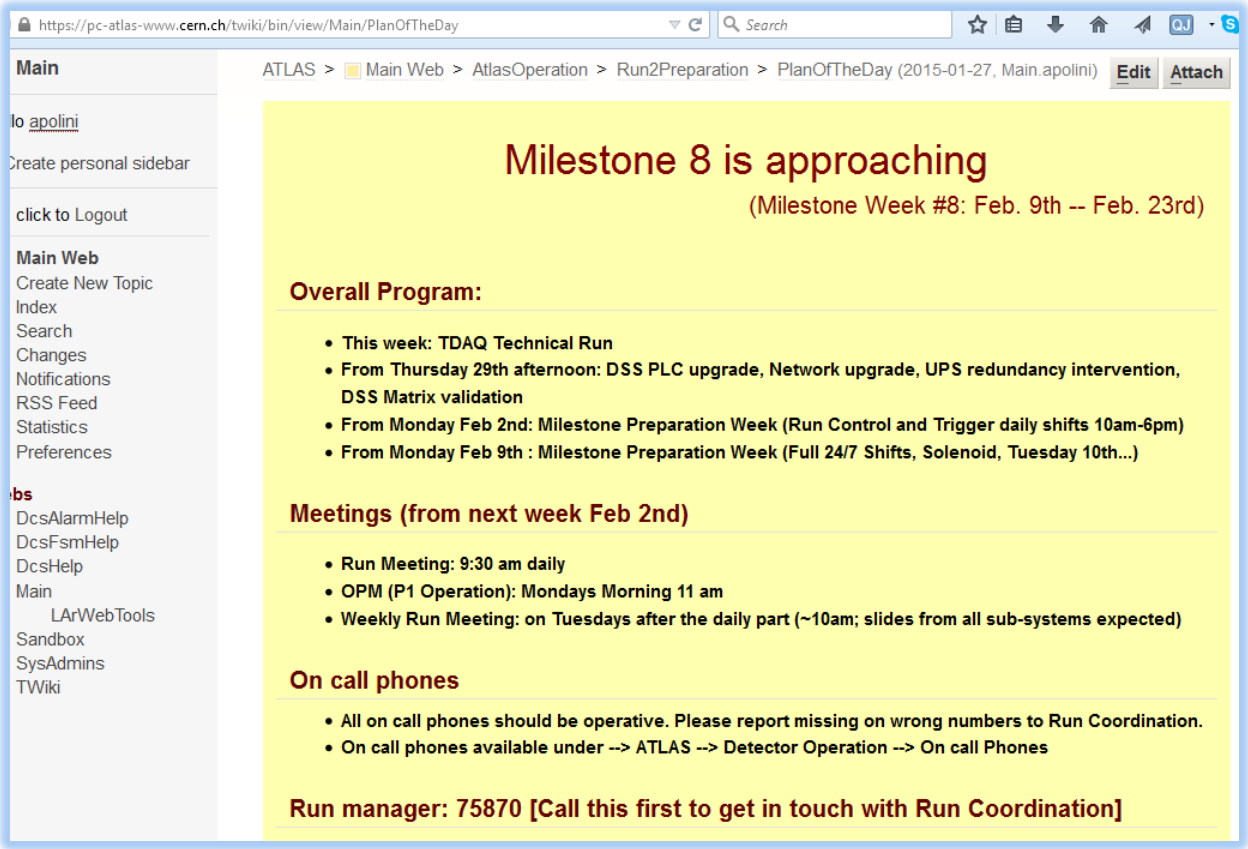






ATLAS: Plan of the Day

- Since RunCom is no longer available and no better option was found:
- The ATLAS plan of the day is now posted on a standard Twiki Page:
- This has been already linked to a number of ATLAS Summary Pages:



  - https://atlasop.cern.ch/operation.php
  - https://atlasop.cern.ch/mobile.php

- This Page is kept updated by (Run Coordinator/Run Manager and) Shiftleader
- In particular it's very important to kep this up-to-date to allow experts to follow activities (tests, calibration, accesses, maintenance etc.)

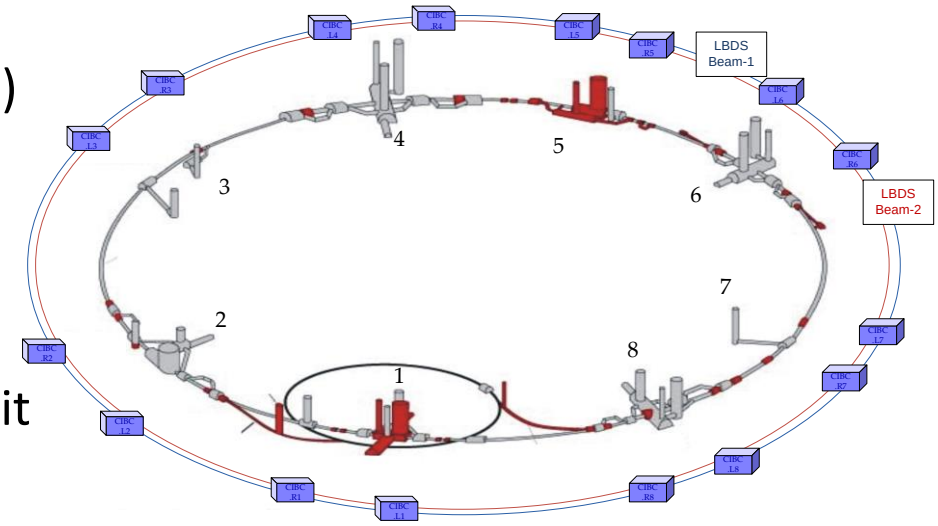
Detector Control System

- One of the main tools for the Shift Leader is the DCS (FSM and Alarm Screen)
- Monitoring of all of ATLAS, FSM and Alarm Screen
- Luminosity, Beam Protection
- React on other aspects which are maybe on the boundaries of sub-systems (TDQ LVL1 crates)

Beam Protection

The LHC Beam Interlock System

- LHC Beam Interlock System (BIS)
  - 16 Beam Interlock Controllers (BIC)
  - More than 4 000 inputs, machine elements, access system, experiments, vacuum, cryo …



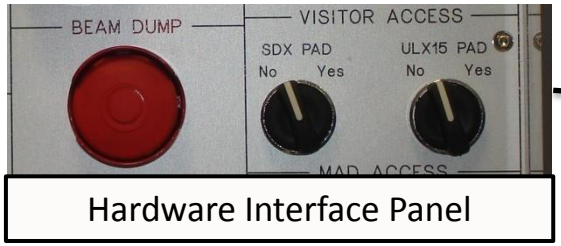
- All inputs TRUE ➔ Global Beam Permit = TRUE ➔ Beam allowed in LHC
- If one input goes FALSE ➔ **Beam is dumped** (beam abort)
- Global Beam Permit is shown on LHC Page 1

ATLAS --- 3 independent inputs delivered to the LHC Beam Interlock System

1. Detector BIS
2. Roman Pot BIS (ALFA detectors)
3. Magnet BIS – (beam dump if the Solenoid is ramped down **New in Run-2!**)

Detector and Roman Pot BIS are in turn the “logic AND” of several input signals which all must be TRUE ATLAS internal

ATLAS Detector and Roman Pots BIS



Hardware Interface Panel

Hardware Interface Panel Override

- ATLAS can dump the beam
  - By pressing the Beam Dump button
  - By the ATLAS BLM (Beam Loss Monitor) detecting abnormally high rates
  - By the ATLAS BCM (Beam Conditions Monitor) detecting abnormally high rates
- BLM and BCM inputs can be masked – current configuration is BLM and BCM both enabled (check on the shift leader Whiteboard)
- BLM/BCM conditions which (would) dump the beam cause a „BeamConditions“ DSS alarm in the control room

ATLAS Aborting the Beam …

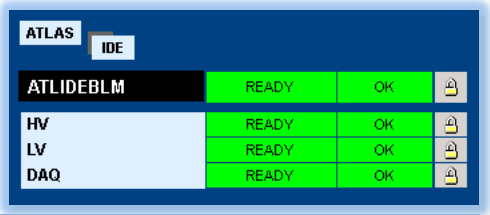
- Pressing the Beam Dump Button .... never, only case we could imagine is you see somebody moving in the cavern !!!

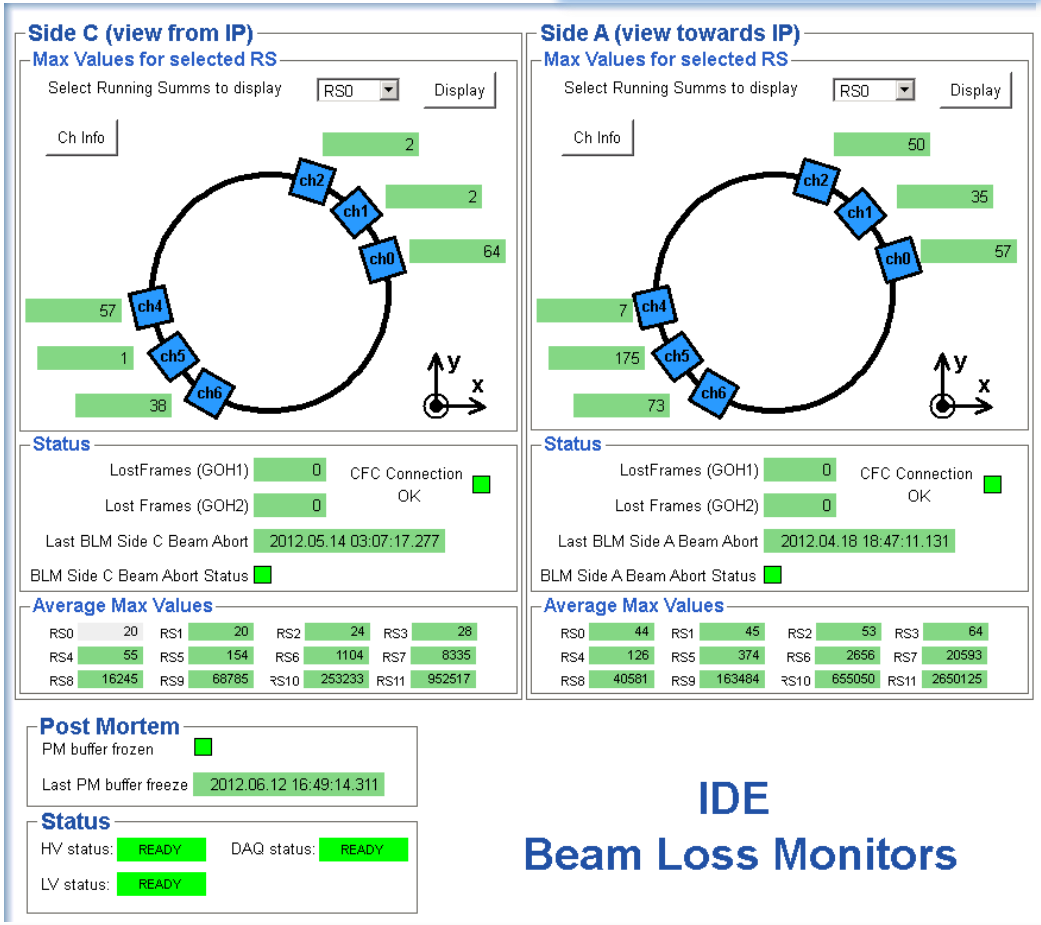
If BLM aborted the beam:

- You'll get a DSS alarm
- In the DCS FSM BLM panel (ATLAS → IDE → ATLIDEBLM) the timestamps for both Side A and Side C are the same and coincide with the beam dump
- Call the BLM/BCM on call for an analysis was happened
- Inform the run manager/coord.

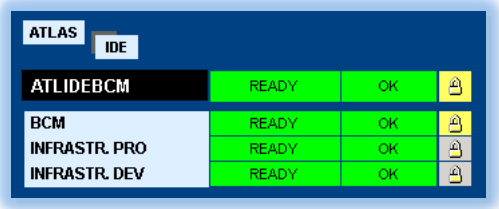
In case of a **BLM Side A or C Beam Abort Status Flag DCS alarm** without dump:

- Call the BCM/BLM on call
- Do not acknowledge the alarm yourself





BCM Beam Conditions Warnings



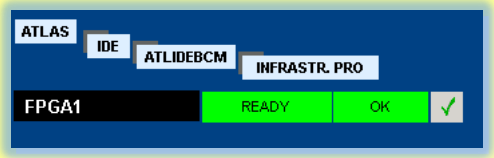
- Information on BCM can be found in DCS under ATLAS → IDE → ATLIDEBCM

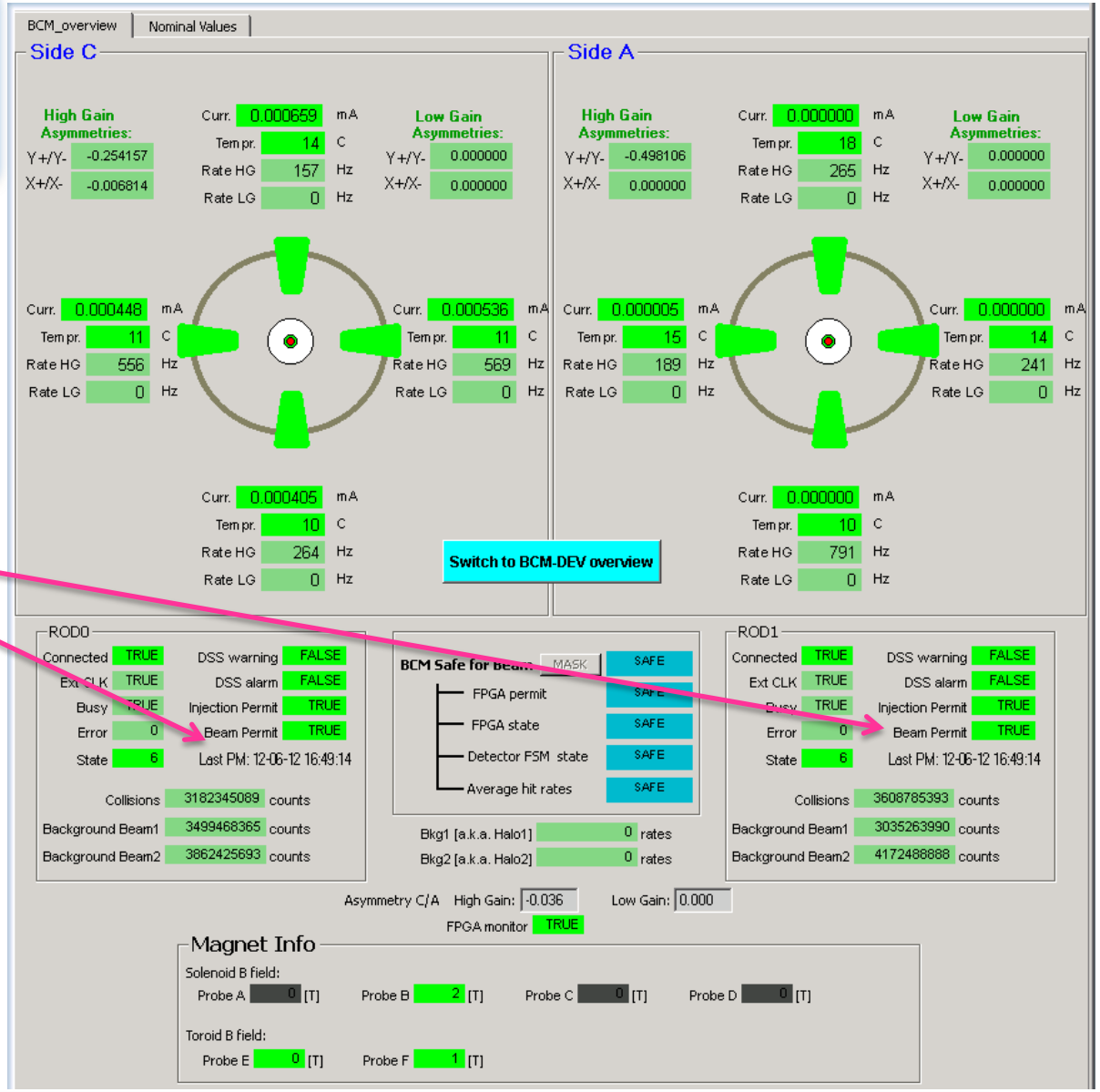
BCM aborted the beam:

- DSS alarm
- Permit = FALSE

BCM DSS alarms:

- Call the BCM/BLM on call
- If asked to acknowledge, since triggered by an intervention, do so via BCM FPGA1/2 node in the FSM





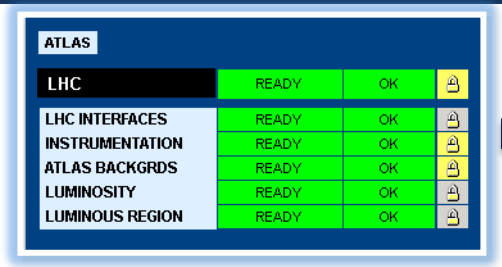
Refer to the Beam Protection section of the shift leader manual for more details

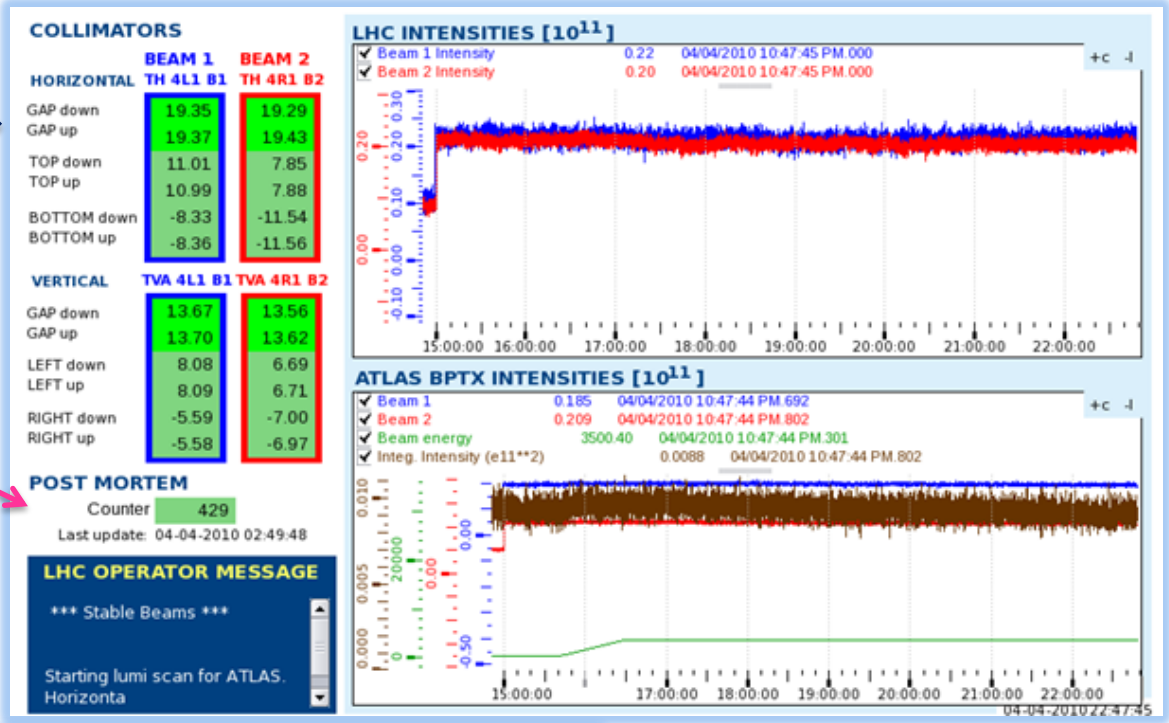
LHC Post Mortem (PM) Signal

- For each **non-scheduled** beam dump a Post Mortem (PM) Signal is sent out if PM Status B1/B2 on LHC Page-1 is **ENABLED**
- An audio alert is produced in the control room on a post mortem: “Flushing toilet sound” 
- The PM signal removes Injection Permit
- The PM signal freezes BCM/BLM PM buffer for analysis
  - After a PM, wait until reading out the BCM buffers has completed (few mins), things are finished once the corresponding “BCM reading out buffers” warning is gone from the DCS alarm screen
  - Check with with the Inner Detector shifter if the Post Mortem was clean, or if there were high losses.
  - If the PM was clean, the injection permit can be given back
    - Immediately if during injection
    - During the injection handshake once it is initiated by the LHC
  - If the PM was not clean, inform the CCC and call the BCM/BLM on call for further investigations. **Involve the run manager as well.**

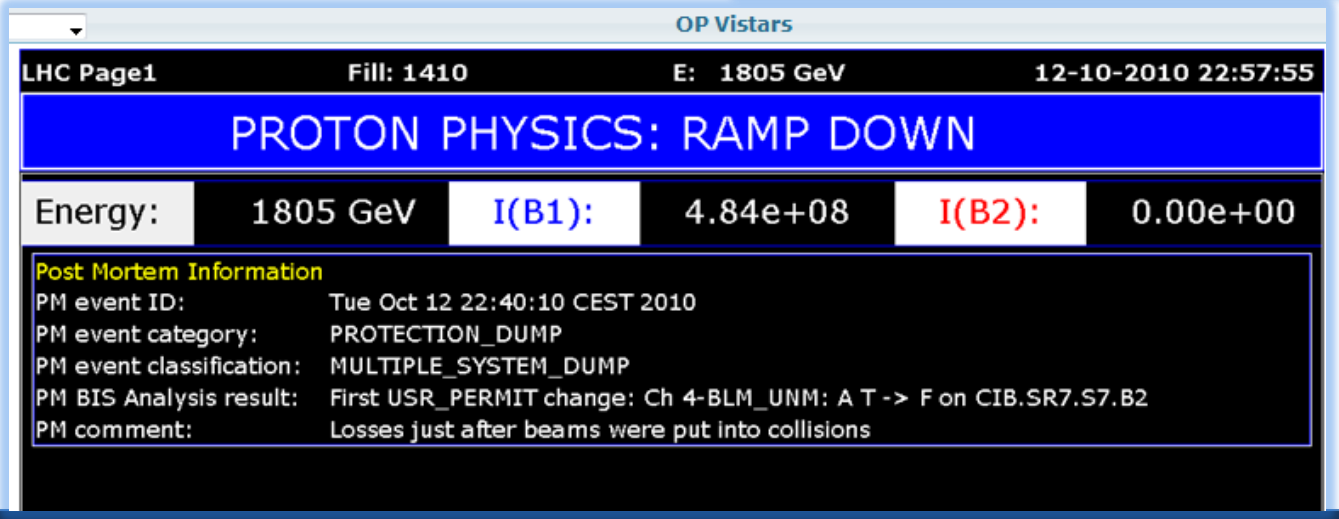
Note: In case of beam mode Inject/Dump (ie no stable beams!), if LHC is in a hurry accommodate them and give the injection permit back immediately, before reading out buffers

LHC Post Mortem …





- PM counter and time stamp can be checked in DCS:
- ATLAS → LHC "top" page, look at POST MORTEM



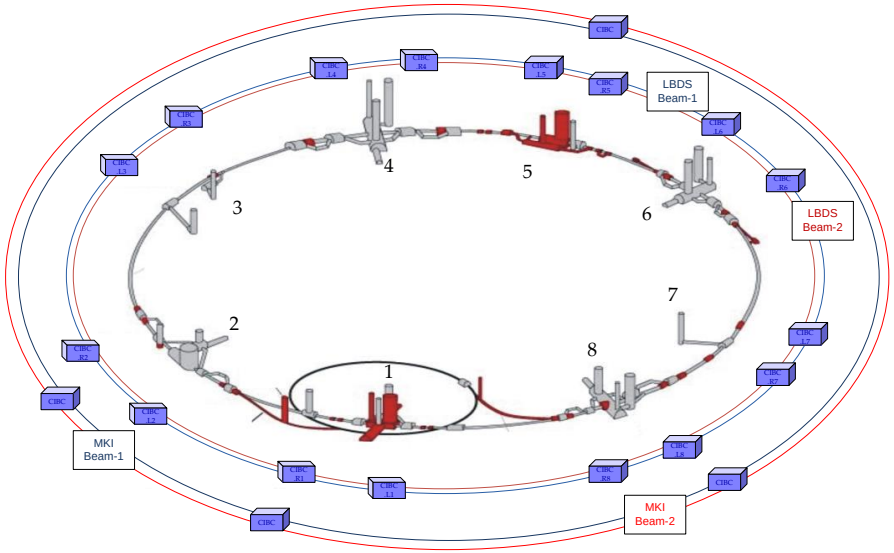
- LHC Page 1 shows futher post mortem information, including cause of dump and comments by the operators

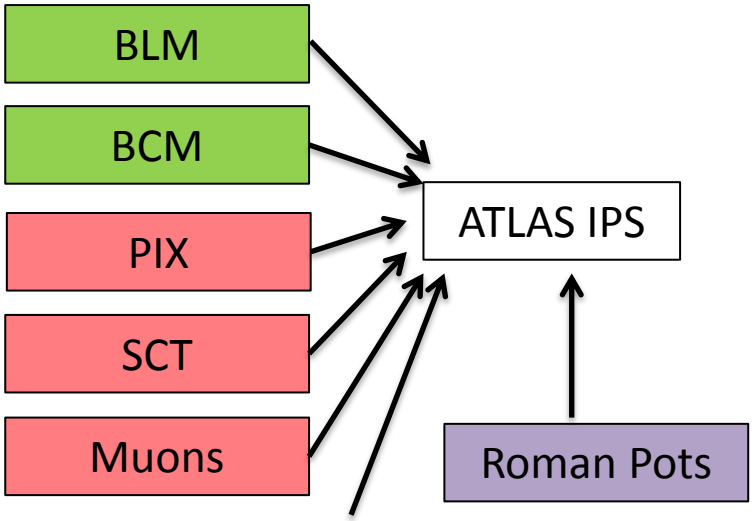
LHC Injection Permit System IPS

In addition to the Beam Interlock System (BIS):

Injection Permit System, with much less inputs than the BIS

- ATLAS delivers 1 injection permit signal to the LHC IPS
- ATLAS injection permit signal is the "**AND**" of a number of hardware signals





Injection key

- Without the injection permit, no further bunches can be injected into the LHC
- Beam already in the machine is kept **(IPS ≠ BIS)**
- ATLAS injetion permit requires
  - BCM and BLM operational, (if BCM not masked) BCM buffers readout
  - Muons, PIX, SCT HV at safe value (Standby)
  - Roman Pots in HOME position
  - Injection key turned
  - BCM currently is **unmasked** from injection permit logic

The Injection Key

- Injection Key is turned by the shift leader as last step in the injection handshake sequence (see later) injection permit is given and green light lits up.
- Injection permit is removed (and the light goes off) automatically by key returning to idle position in case
  - Stable Beams Flag is asserted
  - A Post Mortem Signal is received
- Injection permit can be removed manually, by pressing the „Stop Injection“ button. **Note:** The button has to be pulled out again afterwards before being able to turn the injection key

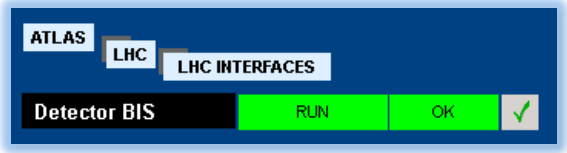
- Press Stop Injection button to
  - Interrupt the injection sequence after READY was published in the injection handshake
  - If beam conditions appear highly abnormal during injection

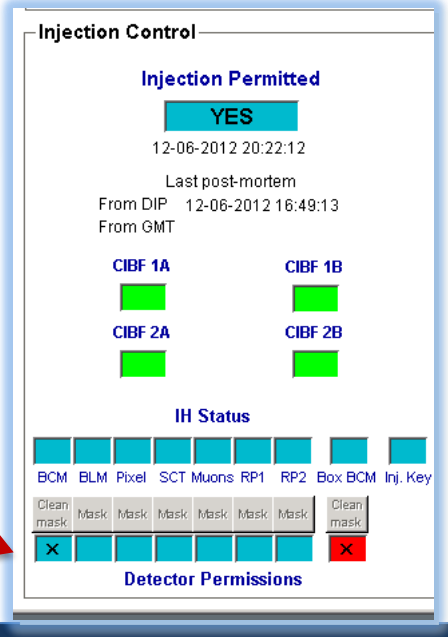
- Remove the injection permit if CCC anounces there is no beam for a longer period (> 2h)
- Remove the injection permit if either Muons, or SCT or PIX announce they want to put nominal HV for tests when there is no beam
- Before turning the injection key, shift leader must check with the SLIMOS that it is ok, especially after an access to the cavern

Masking Injection Permits

- The injection permit signal of a sub-detector to the ATLAS IPS system can be masked (faked to TRUE)
  - If there is a temporary problem preventing the system to provide the permit, while at the same time being sure the system is in safe state
  - In case of very special tests or runs, eg „Splash Events“ (expected in March)
  - If a system being in a specific state no longer is deemed required for injection
- Masking/unmasking any injection permit can only be done by the ATLAS run coordinator and deputy, in agreement with the sub-system run coordinator !

- The default injection permit mask is specified on the shift leader whiteboard
- The injection permit mask can be checked from DCS under ATLAS → LHC → LHC Interfaces → Detector BIS





Handshake between ATLAS and LHC

LHC Handshakes: Basics

- Before LHC can
  - Start injecting beam into the machine
  - Leave Stable Beams and go to Adjust Mode for beam manipulations
  - Carry out a planned (scheduled) beam dump

  a handshake with the 4 experiments must take place.

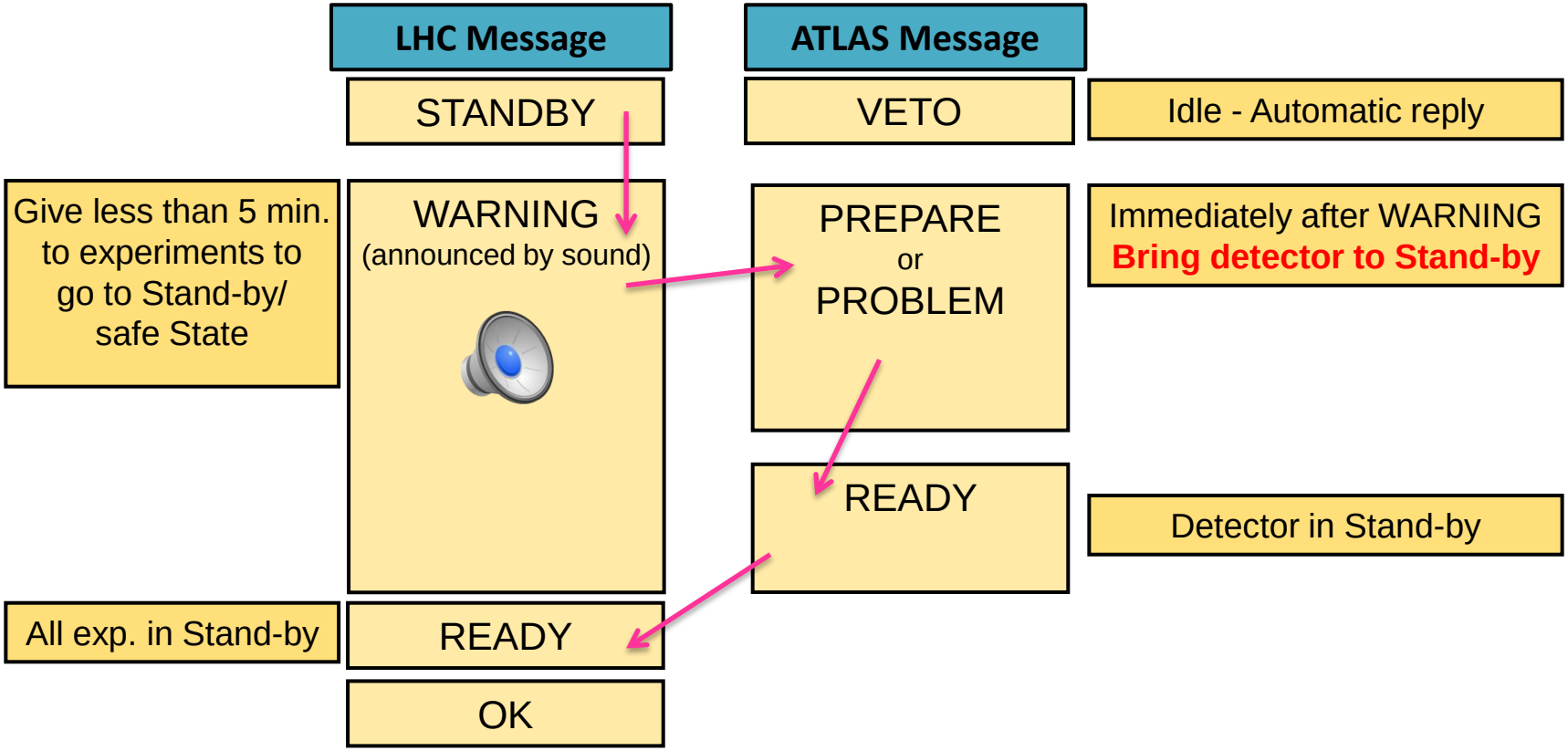
- In more abstract terms, the Handshake was introduced to prepare certain Beam Mode transitions
  - SETUP ➔ **INJECTION** …
  - STABLE BEAMS / UNSTABLE BEAMS ➔ **ADJUST**
  - STABLE BEAMS / UNSTABLE BEAMS ➔ **BEAM DUMP**

3 types of handshakes

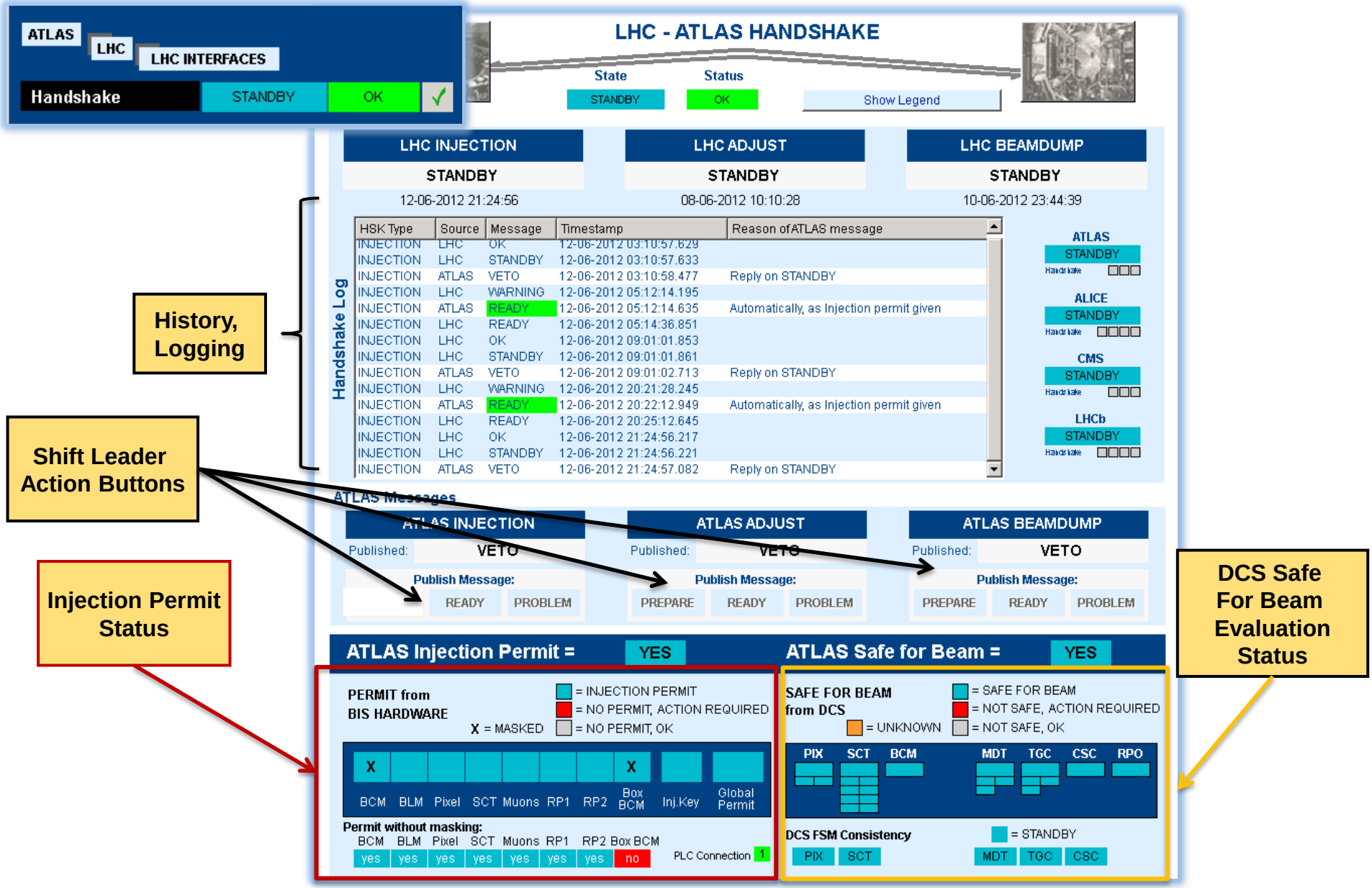
- The handshake is an exchange of a series of pre-defined messages between the CCC and the experiments, ensuring experiments are in a safe state and ready for **Injection, Dump, Adjust**.
- Messages are exchanged via DIP (Data Interchange Protocol)
- On ATLAS side, the handshake is controlled from DCS

Handshake Sequence and Messages

General handshake sequence and possible messages:



DCS Handshake Panel



History, Logging

Shift Leader Action Buttons

Injection Permit Status

DCS Safe For Beam Evaluation Status

DCS Handshake Panel

Handshake buttons became enabled when some action is requested or available

(1) Injection Handshake

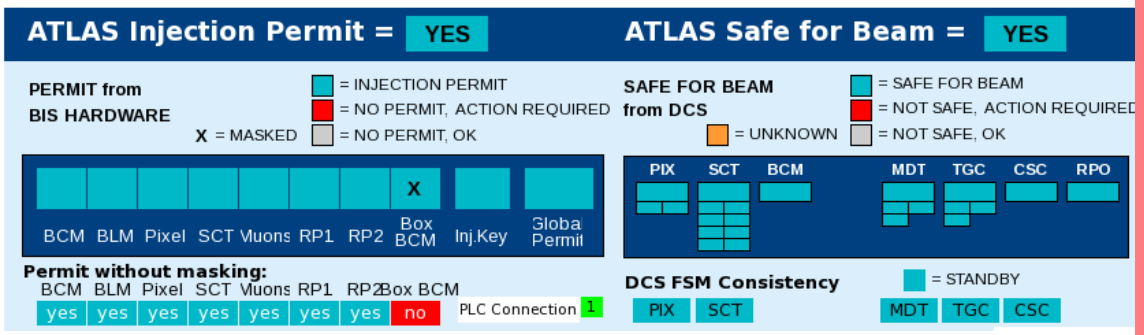
LHC

- Handshake starts, LHC publishes WARNING

- Shift Leader acknowledges Injection warning by publishing PREPARE
- Shift leader asks/checks with sub-detector shifters that Muons (MDT, TGC, CSC), PIX and SCT are in safe state (STANDBY), and the SLIMOS
- Shift leader checks all sub-detector hardware injection permits are TRUE
- Shift Leader turns the injection key
- READY is published automatically once key is turned

ATLAS

- Once all experiements have published READY, LHC goes for injection



Problems:

- Publish PROBLEM if a sub-det can not go to safe state, inform the CCC and run manager
- If READY is not published within 5 mins after PREPARE, PROBLEM is published automatically
- Once injection key is turned, PROBLEM → READY is autom.

(2) Adjust Handshake

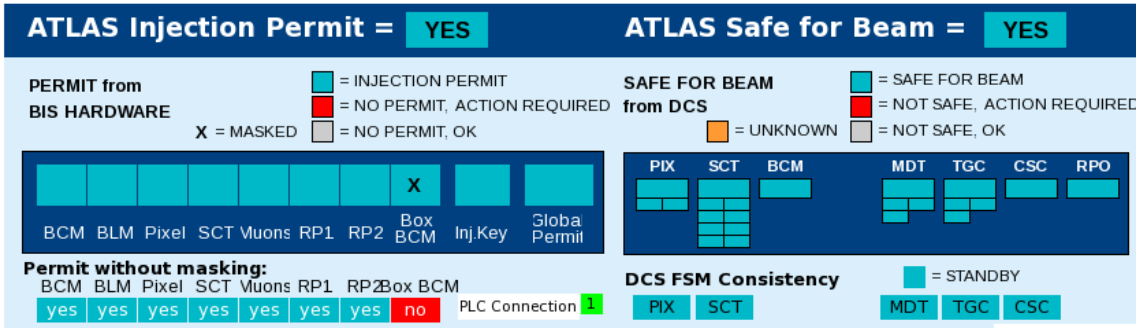
LHC

- Handshake starts, LHC publishes WARNING

- Adjust warning is acknowledged by the shift leader by publishing PREPARE
- Shift leader asks/checks with sub-detector shifters that Muons (MDT, TGC, CSC), PIX and SCT go to safe state (STANDBY), and waits until this is the case – check DCS Safe for Beam flags
- Shift leader checks hardware injection permits are TRUE for PIX, Muons, SCT
- Shift leader publishes READY

ATLAS

- Once all experiements have published READY, LHC goes to Adjust mode



Problems:

- Publish PROBLEM if a sub-det can not go to safe state, inform the CCC and run manager
- If READY is not published within 5 mins after PREPARE, PROBLEM is published automatically

Note: READY can not be published if subdet injection permits are false !

(3) Dump Handshake

LHC

- Handshake starts, LHC publishes WARNING

- Dump warning is acknowledged <u>automatically</u> by DCS by publishing PREPARE
- Shift leader checks PIX and SCT go to safe state (STANDBY) -- Muons stay ON until stable beams flag is lost !
- If PIX and SCT are in safe state, publish READY
- Beams are dumped anyway after 5mins except PROBLEM is explicitly published, by the shift leader or by DCS (on PIX problems to ramp down)

- Once all experiements have published READY, sequence continues

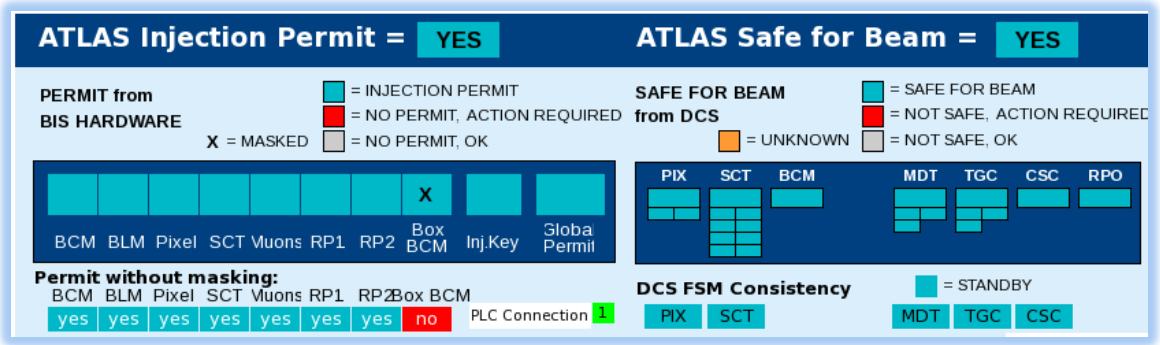
- Once beams are dumped and stable beams flag is gone, muons ramp automatically to STANDBY

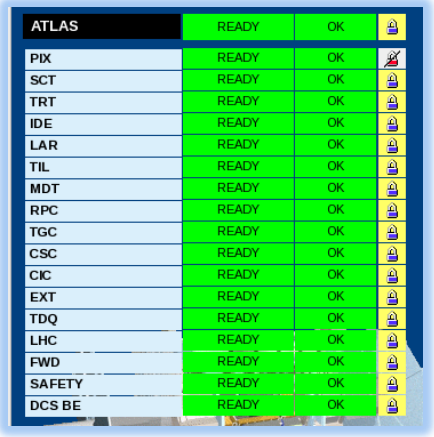
ATLAS

Problems:

- If „PIX ramp down to safe state/switch off of pre-amps“ does not work (PROBLEM is published), call the CCC and run manager to explain the problems, make sure experts are called

What is the relevant info that a det. is safe !





- The relevant information that a detector is in safe state is
  - The hardware injection permit state for Injection and Adjust Handshake
  - The DCS „Safe for Beam“ flags

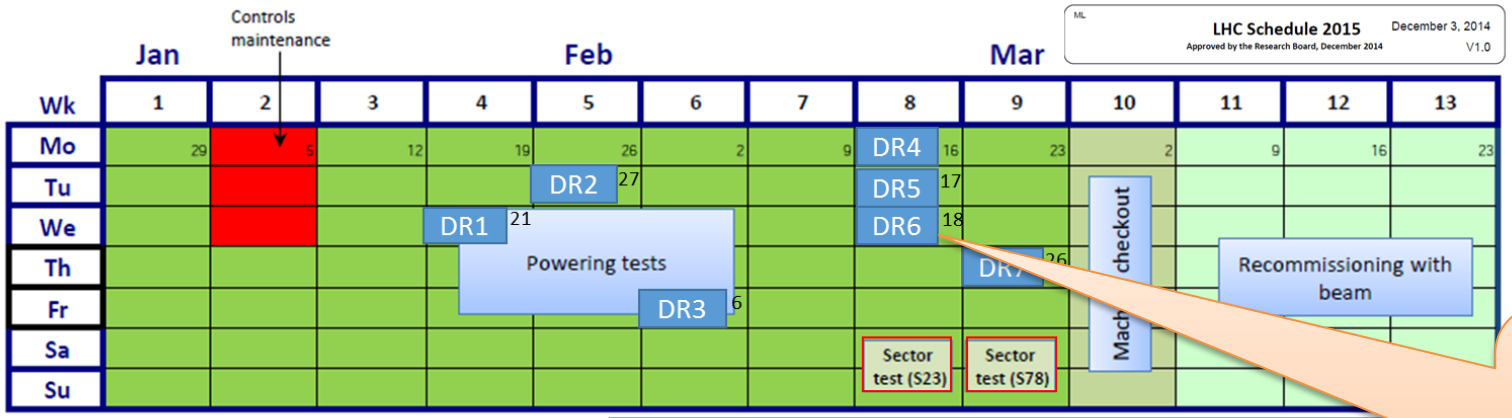
  To be checked on the **Handshake Panel** !!

The Handshake panel „DCS FSM consistency“ info is for information

- Normally, you expect **STANDBY** during Inject, Adjust, Dump
- Don‘t worry on a **NOT_READY** when checking if things are safe for injection, Adjust, Dump. It may come from something completely else, eg the infrastructure ....
- Do worry if the FSM state says **READY**, check/ask !!

Do not judge whether a sub-det is in safe state from the FSM state, nodes may be disabled ..

Addendum: LHC Dry Runs



Confirmed for full Dry Run Feb 18th (Second week of M8) This afternoon Jan 27th Post Mortem

Aim: **two beams** during the **same weekend,**
Keep the other weekend as contingency

We have already planned the Dry Runs based on these two dates:

Nevertheless, around the end of January, those dates will be reviewed to be in line with the advancement of the Powering Test

To be scheduled: (partial) Access System and DSO test

DR1 √ Timing System (release of new functionality ➔ instabilities trigger).
√ PM reception by the experiments

DR2 √ Triggered acquisition: BPMs (SYNC and FIFO) and BLMs (continuous acquisitio
XPOC, PM, IQC and 1 Hz)
√ LBDS
√ MKI
√ Inject and Dump
√ Timing system
√ PM reception by the experiments

DR3 √ Timing: LHC mastership, dynamic destination, injection request.
√ MKQA & AC dipole (new PLCs and FESA 3): trigger, OASIS, multiturn acquisition.
√ Experiments: Beam modes, Handshakes, PM reception(if not done before), SMP flags, Internal to LHC Clock switch, RF ramp, Injection permits, New DIP variables for automatic scan application.

DR4 √ Transfer Line equipment and instrumentation
√ LHC-SPS synchronization

DR5 √ Repeat DR2 with relevant sector test user inputs to BIC(+ALICE & LHCb inputs)

DR6 √ ADT (+ EMC measurements) + Experiments (ATLAS)

DR7 √ WS and BRANS

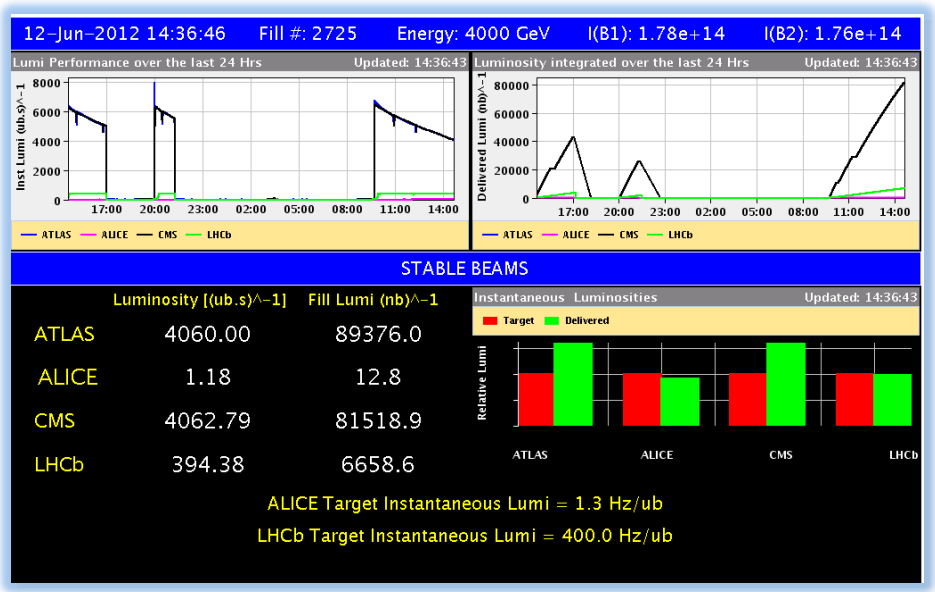
26/01/2015

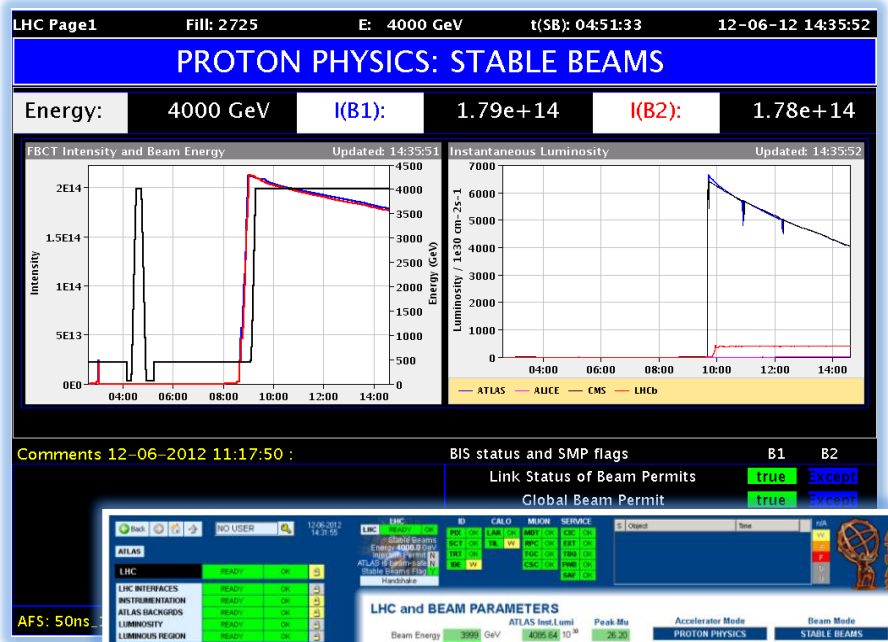
Luminosity Information

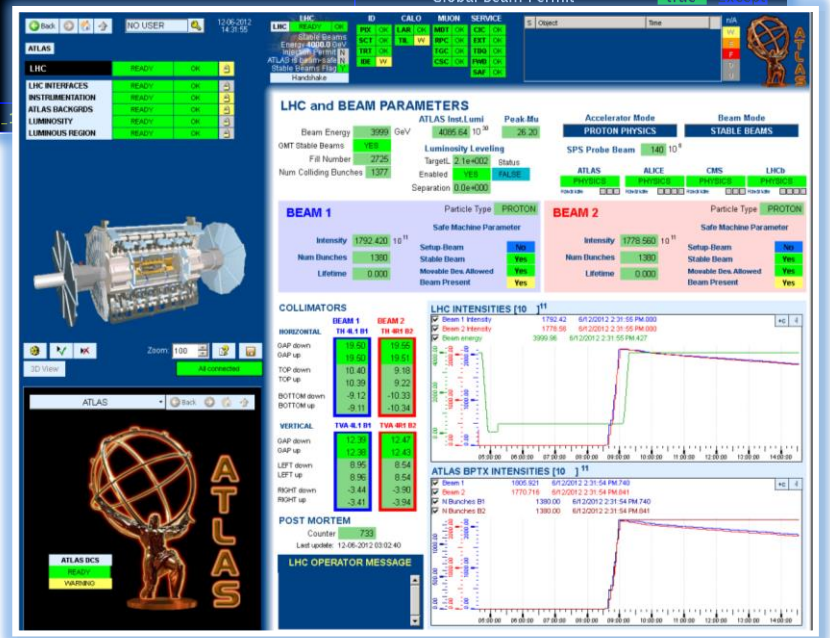
Where to find luminosity information

2 main places for luminosity related information

- LHC Luminosity page, LHC page 1



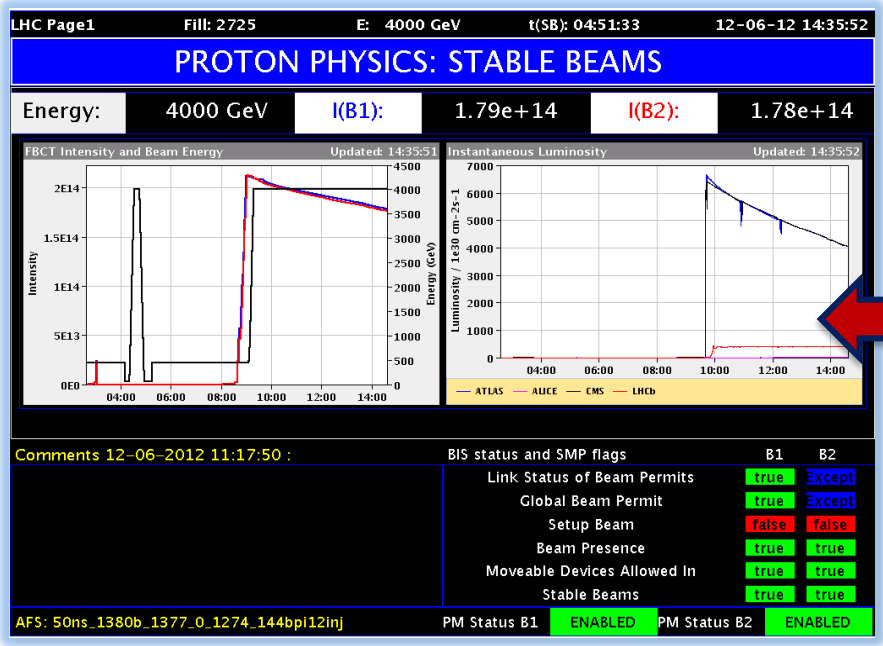




- ATLAS Luminosity information in DCS

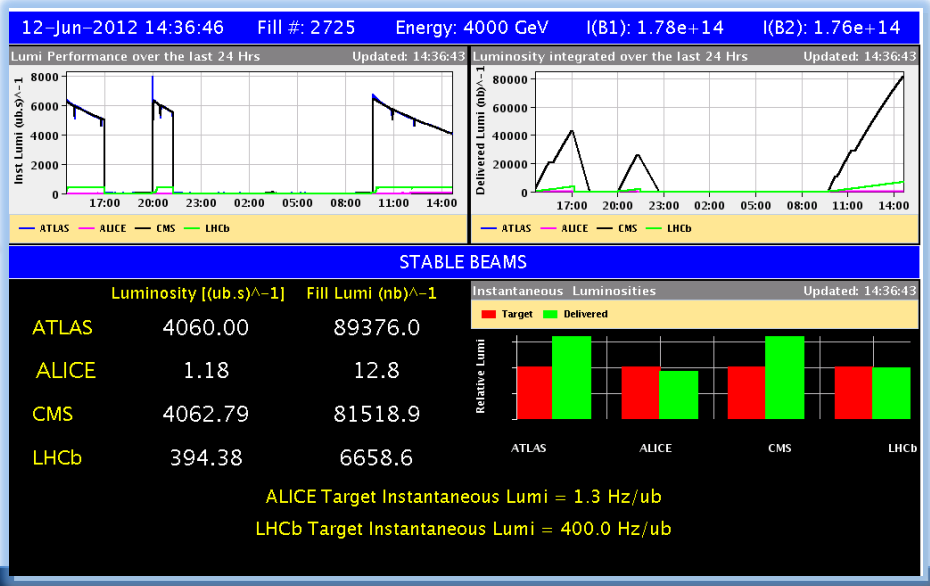
  ATLAS → LHC → LUMINOSITY

What to find on LHC page 1/lumi page



- Instantaneous total luminosity of the 4 LHC experiments, as transmitted to the CCC
- Little dips indicate a luminosity optimization or mini lumi scan
- ATLAS and CMS lumi should be equal within +- 2%
- If ATLAS lumi is significantly lower than CMS, call the CCC and request a lumi optimization **at <u>both</u> IP1 and IP5**
- Request a lumi optimization every ~2hours (both IP1 and 5) if not done anyway by the CCC

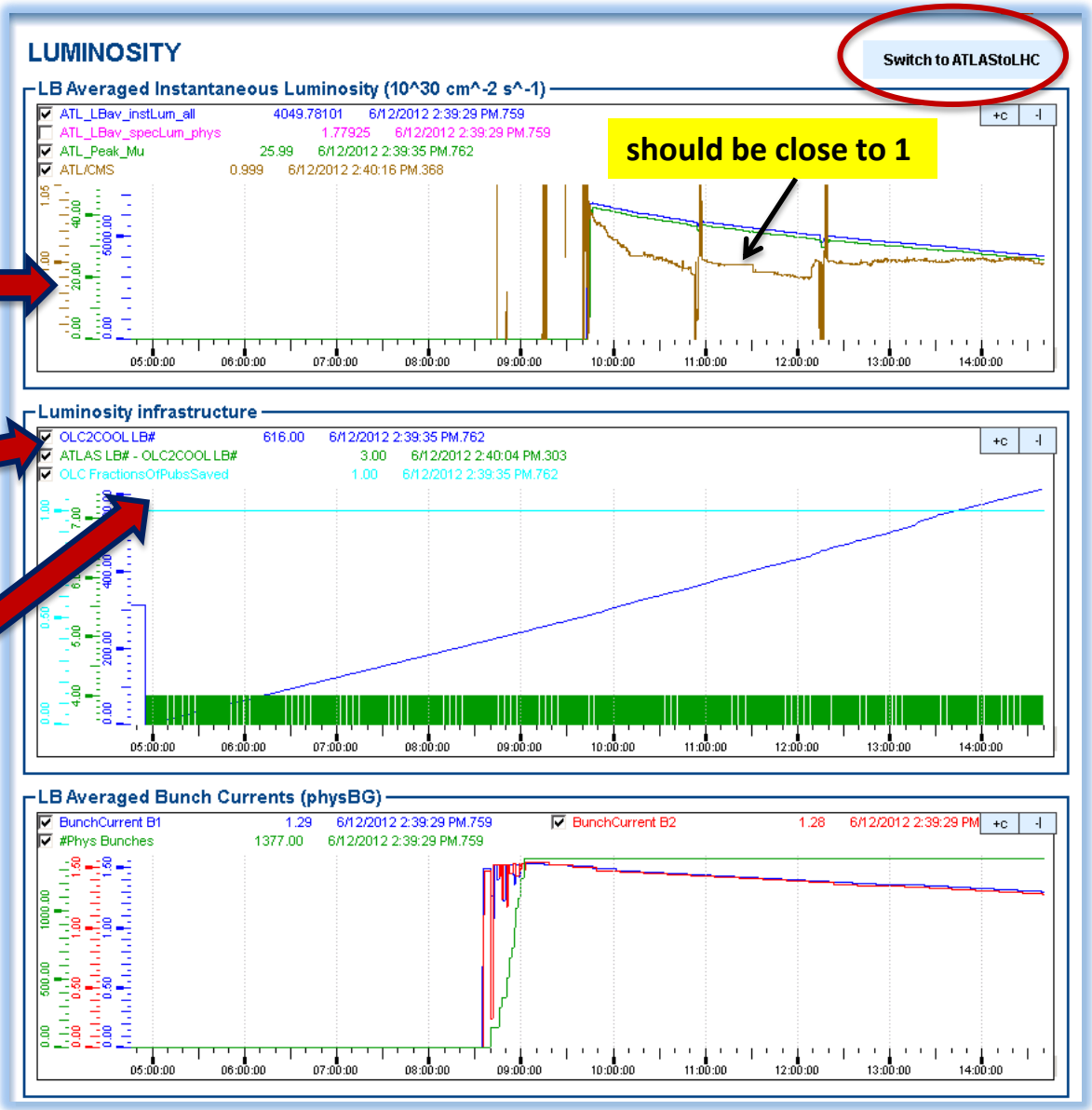
- ATLAS and CMS instantaneous and fill luminosity in numbers
- Useful in particular for comparison ...



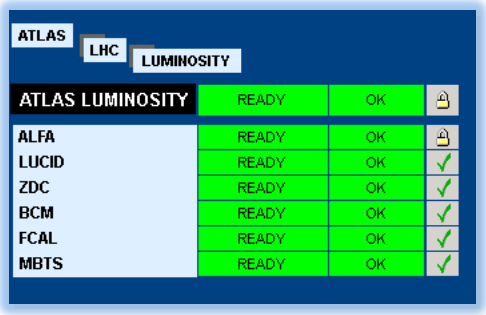
Luminosity Information in DCS (i)

„Top“ Luminosity panel:

- Instantenous lumi, averaged over BCIDs
- Ratio between ATLAS and CMS
- Lumi Infrastructure:
- OLC2COOL LB number, must continously increase during a fill, if not lumi on call must be alerted immediately
- OLC FractionOfPubsSaved, must be 1 during stable beams, otherwise one or the other lumi data does not make it into the database
- “SwitchToATLAStoLHC“: shows data we transmit to LHC for page 1 etc, in particular integrated lumi per fill

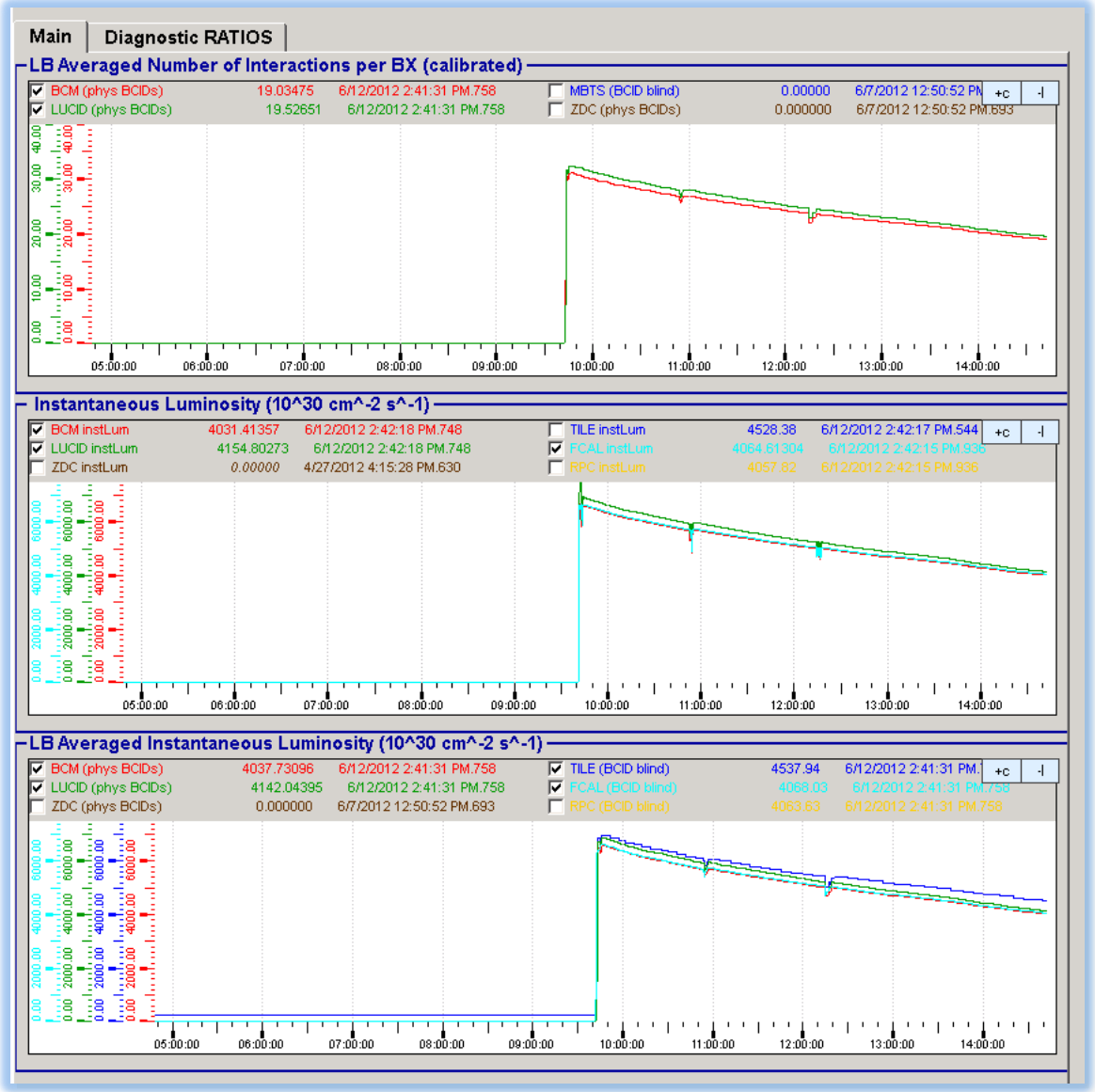


Luminosity Information in DCS (ii)



„ATLAS Luminosity“ panel

- Instantaneous luminosity for the various ATLAS lumi detectors
- Dedicated ATLAS Lumi detectors are BCM and LUCID
- At the moment, „preferred“ lumi send to LHC and used for data summary page etc. is from new (DEV) BCM
- Doubts about LUCID or BCM lumi → immediate follow-up!



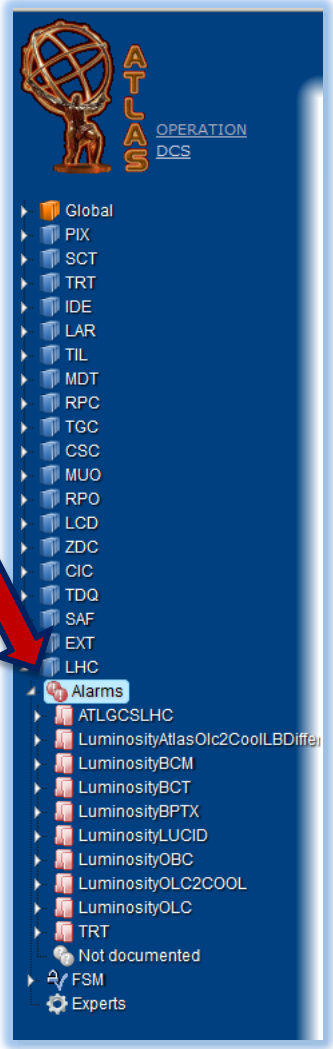
Luminosity Alarms

- Problems with the luminosity infrastructure are signalled by DCS alarms – follow up any ERRORs immediately if during physics

- Alarms are explained under https://atlasop.cern.ch/dcs/doc/ selecting LHC → Alarms, or directly via the right click AlarmHelp feature from the DCS alarm screen

- Luminosity infrastructure monitoring is the responsibility of the DQ shifter, in case there is no DQ shifter, you will be asked to keep an eye on it.
- In case of any lumi related problems, ask the DQ shifter to investigate, if in doubt make sure the lumi on call is called.

- Detailed instructions and further information on luminosity monitoring can be found under https://atlasop.cern.ch/twiki/bin/view/Main/DQManualShifterOnline#Luminosity_and_beam_conditions_m



Thank You!