Machine Protection Panel
April 2022

LHC BLM:
STATUS OF MP SYSTEM COMMISSIONING BEFORE FIRST BEAM

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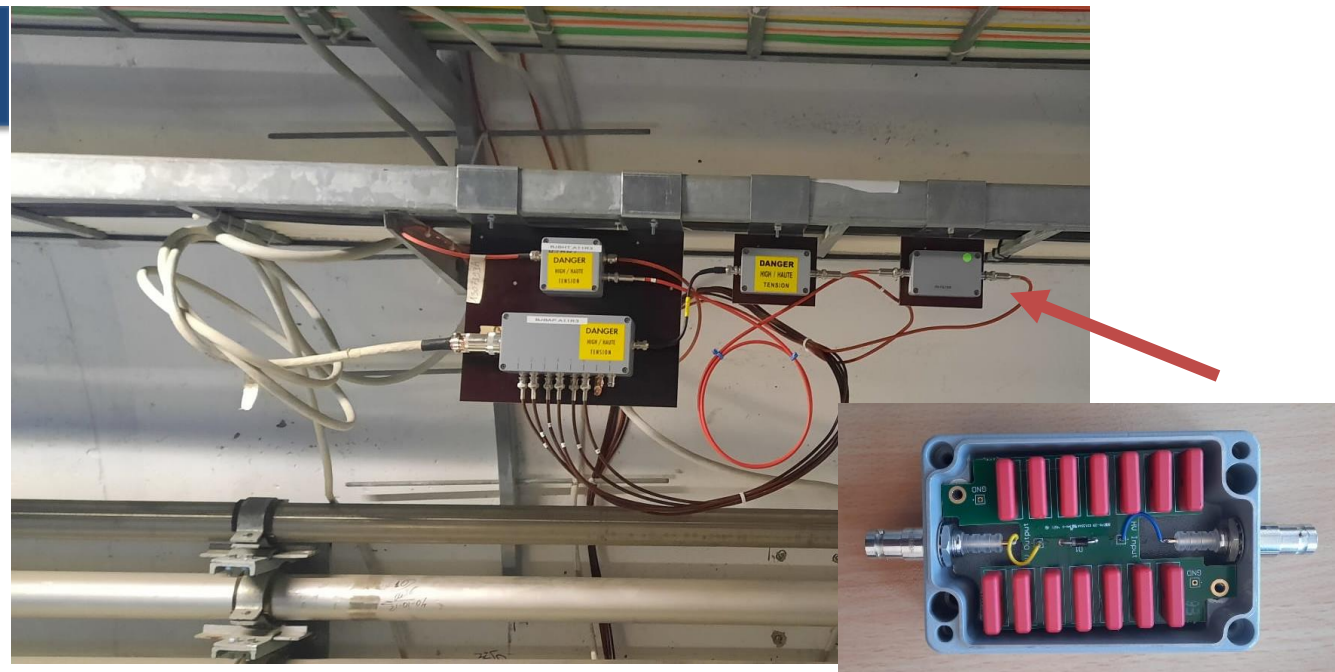
UPDATE ON NEW INSTALLATIONS

21/04/2022

- Installed 36 Diode boxes in LSS3

- Validated at the lab and

- Tested with modulation of the detector's bias supply at LHC installation.

Additional Signal Filters

- **Filters added to the following detectors:**
  - On top of the QBBI interconnects (cell 8/9 left of IR2), i.e.
    - BLMBI.08L2.B0T10_MBB-MBA_07L2
    - BLMBI.09L2.B0T10_MBB-MBA_08L2

- **Filters prepared for future installation (if needed):**
  - For Beam 1 detectors on Q7/Q8 right of IR8, i.e.
    - BLMQI.07R8.B1I10_MQM
    - BLMQI.07R8.B1I20_MQM
    - BLMQI.07R8.B1I30_MQM

    - BLMQI.08R8.B1I10_MQML
    - BLMQI.08R8.B1I20_MQML
    - BLMQI.08R8.B1I30_MQML

# CryoBLM Installation at 9L5 and 9R7

- Installation completed with two CryoBLM detectors per point

- Additional external Diamond detectors for cross-check

- All detectors in DC measurement mode with standard LHC electronics
  - BLECF modules integrating at 40 µs

- Could be modified in the future for AC measurements
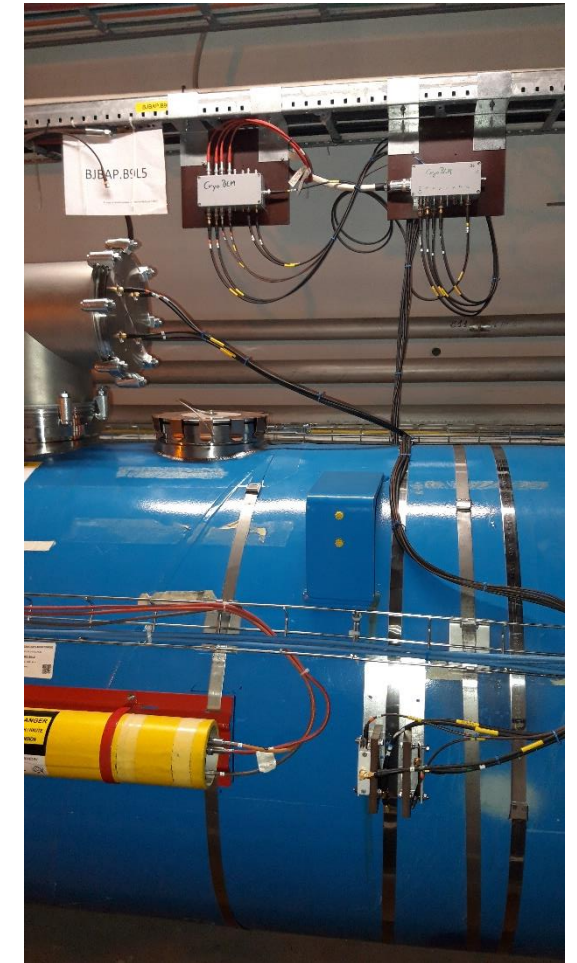
INTERLOCK INHIBIT AT INJECTION

21/04/2022

Interlock Inhibit Firmware
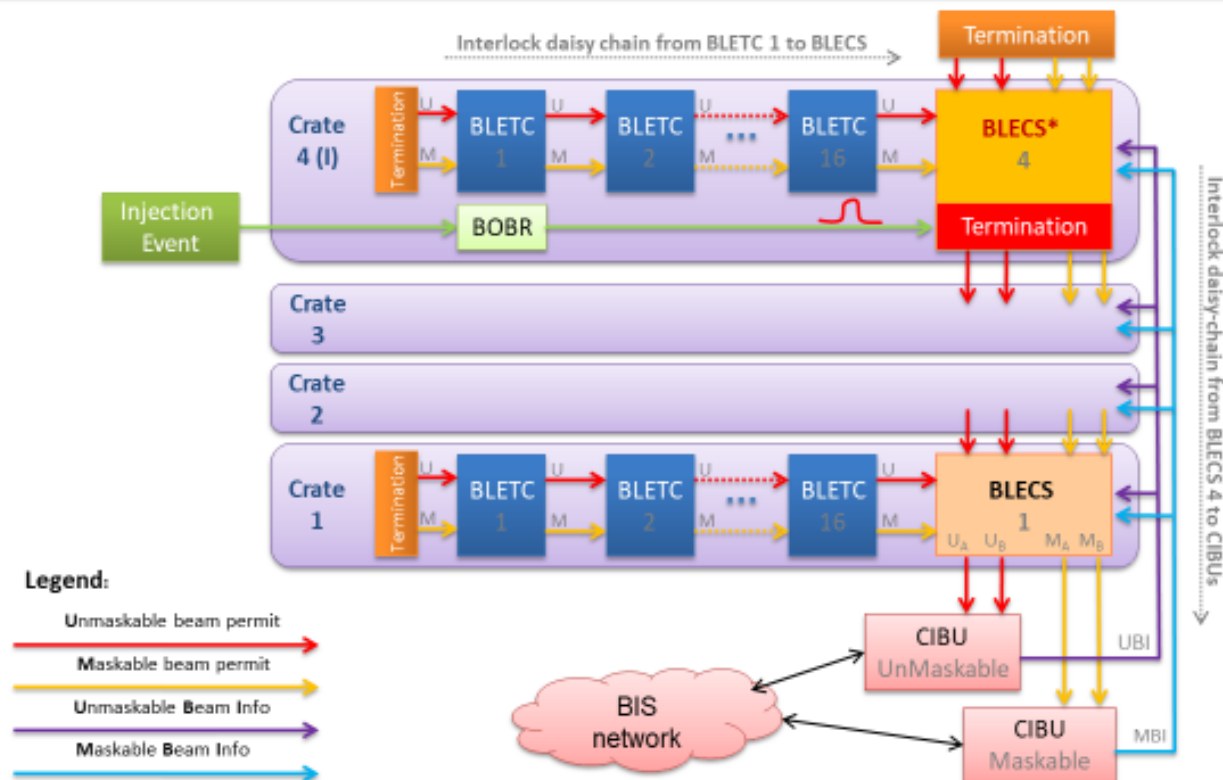
- **Run 2**
 - Special firmware version at two 'injection' crates
  - Would be active only if
    - Energy < 491 GeV, i.e. first two energy levels
    - Timer is set > 0
    - Injection event received
  - Would act only to the channels defined as 'MASKABLE'

- **Run 3**
  - Deployed in all LHCBLM crates
    - Same firmware version/binary since 2015
  - Newer version under development;
    - mostly ready, some issues with the 'Sanity Checks' holding us back
  - Conditions to become active remain the same
  - Roll-back to version without this functionality is very quick, i.e. link old version and reboot.

Interlock Inhibit Software
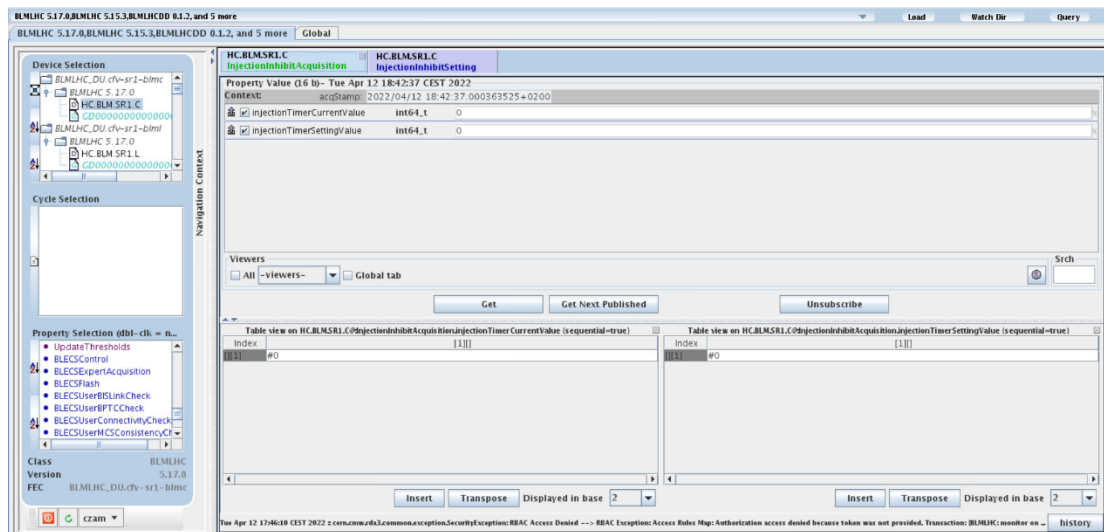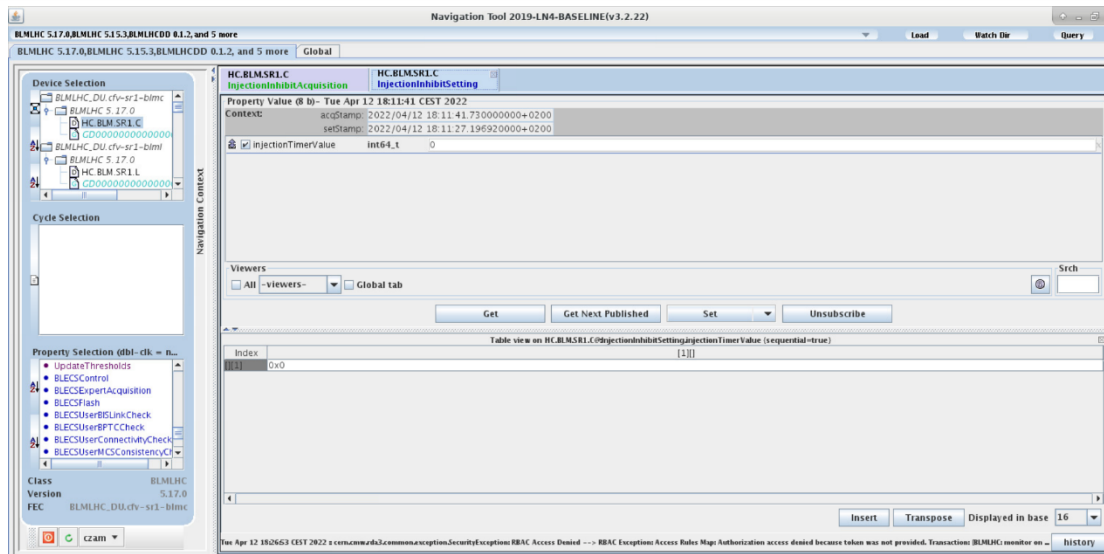
■ Two new properties to set and monitor the function

■ *InjectionInhibitSetting*

  ■ Set the timer value for the inhibit

■ *InjectionInhibitAcquisition*

  ■ Timer Setting

    ▶ Shows the value configured for this crate

  ■ Timer Countdown

    ▶ MSB is high when the function is active

    ▶ The remaining bits show the value of the timer as it decreases

Injection Interlock Inhibit

■ **Prerequisite before any test**
  ▪ Decide which crates & detectors need the functionality
  ▪ For the identified crates:
    ‣ Set Timer (some value other than zero) to those crates
    ‣ Change flag of all channels that should not be blindable to 'UNMASKABLE'
    ‣ Change flag of all channels that should be blindable to 'MASKABLE'

■ Tests with pilot beam
  ▪ During commissioning of injection protection system
  ▪ Create losses above dump threshold
  ▪ Modify blindout time
  ▪ Record interlock input from blindable/non-blindable crates
  ▪ If losses above dump threshold cannot be reached, lower the monitor factor of blindable crates BLMs

■ Tests with trains
  ▪ 288 b or what is being used for scrubbing
  ▪ Tighten TCDIs from 5 sig to 4.5 sig (likely settings for Hilumi)
  ▪ Tighten monitor factor

Criteria for successful test:

■ Functionality: 'blindable' detectors DO NOT interlock within given blindout time and losses above threshold

■ Redundancy: 'non-blindable' detectors DO interlock in case losses go above threshold on those, while blindable ones do not interlock

■ Inhibit time: setup the necessary blindout time – not critical, can be adjusted later

KNOWN ISSUES

Crate Missing Messages

- **Fixed display warns regularly with messages that one of the crates is 'down'**
  - Frequency ~ 5-6 messages per 24h
  - Crates are random

- **Data in NXCALS do not have gaps**

- **Could not find correlation with any activity/action**
  - Not a critical issue but could mislead
  - Will continue investigation
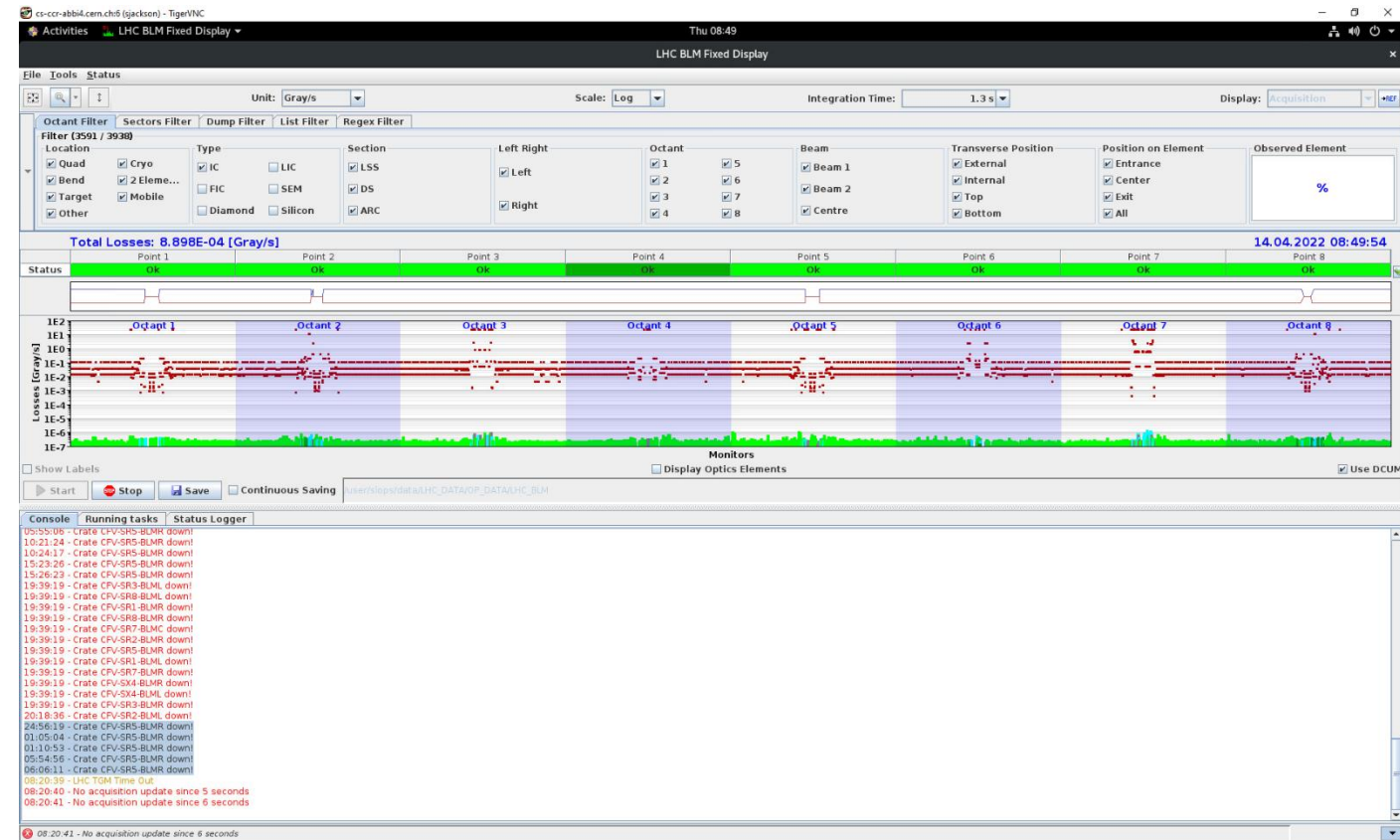
XPOC & PM Buffers

- **XPOC and PM buffers remain frozen or do not get restarted causing missing data**

- **Functionality (simplified):**
  - Two memories serve XPOC-b1, XPOC-b2 and PM
  - BeamDumped1 & 2 freeze the buffers
  - Server waits if there is also a GPM1 before restarting them to read the additional data
  - Buffers are restarted if all actions completed or wait time reached.

- **Issue seems like a 'race condition'**

- **Did not manage to reproduce it**
  - Additional debugging info added to the design

Collimation Data

- Few packets are missing regularly from the 100 Hz data
- Issue identified to be with the readout and validation of all the settings
  - VME bus is occupied for 20-30 ms reading the flash memory contents
  - Part of the new functionality that checks everything at 1 Hz
- New version to be deployed
  - Will remove (for now) the check for the BLECS settings; settings will continue to be checked before each injection
  - Keep this function only for the BLETC, i.e. thresholds, names, flags and all critical parameters
- Need deployment window from OP
  - Could be today or any of the next days

SYSTEM CHECKOUT

21/04/2022

Hardware Checkout completed:

■ All detector connection vs LSA verified

■ Thresholds & flags have been updated
  ▪ Verified all settings & tools are in good state

■ Energy level distribution in the crate
  ▪ Ramps show correct threshold selection

■ Interlocks are generated & propagate to the CIBUs
  ▪ All bypass for LS2 development removed

Machine Checkout parts pending:

■ SIS interlocks for missing HV, crate or corrupted settings
  ▪ Need an hour in the CCC with help from OP

THANK YOU

Special systems (modified LHCBLM types)

- **CMS: Beam Condition Monitoring**
  - Complete system w/ LHC interlocks to be supported
  - Support threshold management
  - Outside the LHC Controls environment with add. complexity to diagnose issues

- **ATLAS: Beam Condition Monitoring**
  - Processing electronics
  - Support threshold management
  - Custom firmware (circa 2011 – unmaintainable)

- **SPS: detectors and electronics are deployed mostly for MDs**
  - Detectors at LSS2, LSS4 and LSS5
  - Electronics at BA2 and BA5

- **CHARM: detectors and electronics for spill monitoring**
  - Complete system to maintain
  - Not interlocked