

# **Preliminary Summary of MD 6949: Validation of bunch-by-bunch diamond detectors functionalities**

**S.Morales and E.Calvo for SY-BI-BL**

MD Participants: E.Calvo, M.Gonzalez, J.Martinez, S.Morales,  
B.Salvachua, C.Zamantzas

21/07/2022 LSWG meeting on Floating MD results

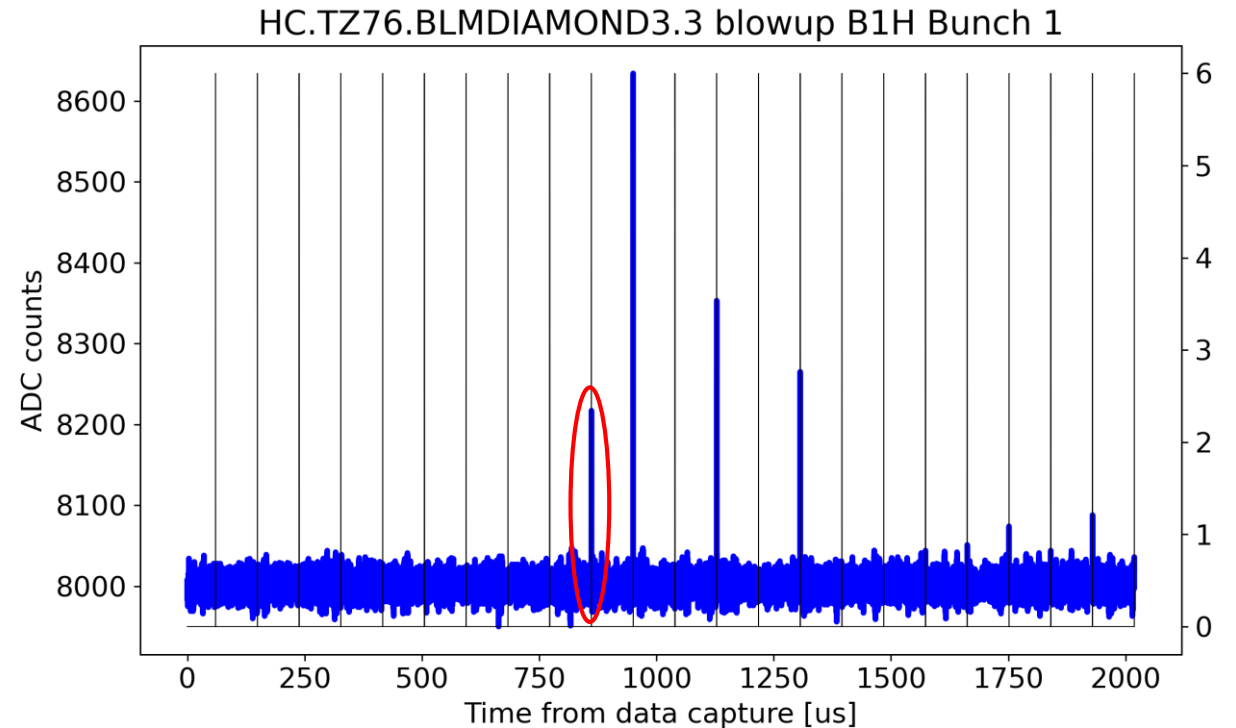
# Introduction – Diamond Beam Loss Monitors

- pCVD diamond detectors (dBLMs)
  - 12 detectors in the LHC: 6 in betatron collimation area, 4 in injection lines, 2 in extraction lines



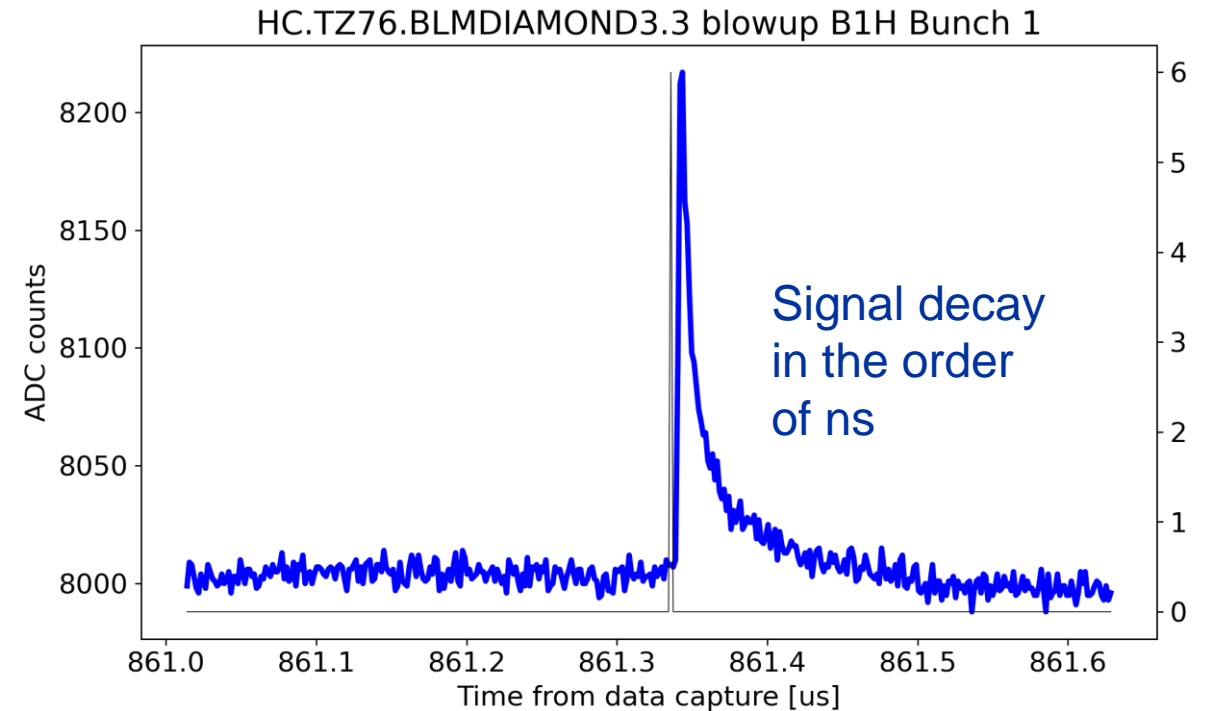
# Introduction – Diamond Beam Loss Monitors

- pCVD diamond detectors (dBLMs)
  - Signal every **1.54 ns** -> **Bunch-by-bunch losses**
    - NXCALS capture data subscription on demand (max ~ 23 LHC turns)



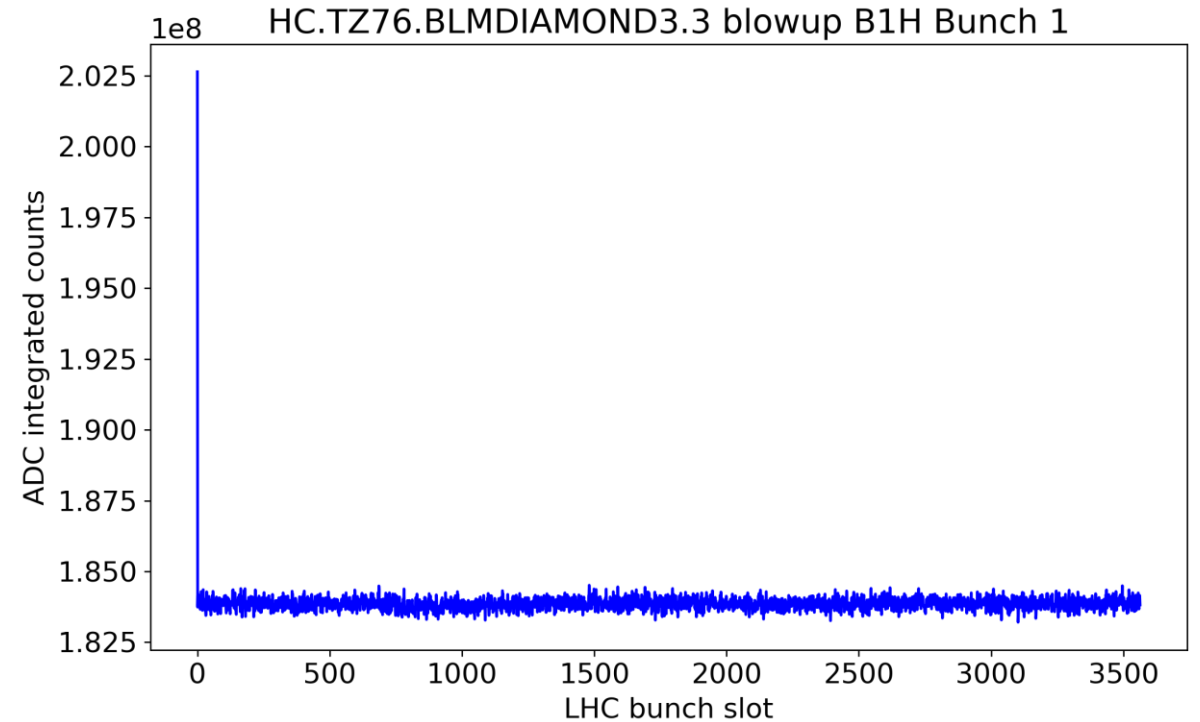
# Introduction – Diamond Beam Loss Monitors

- pCVD diamond detectors (dBLMs)
  - Signal every 1.54 ns -> Bunch-by-bunch losses
    - NXCALS capture data subscription on demand (max ~ 23 LHC turns)



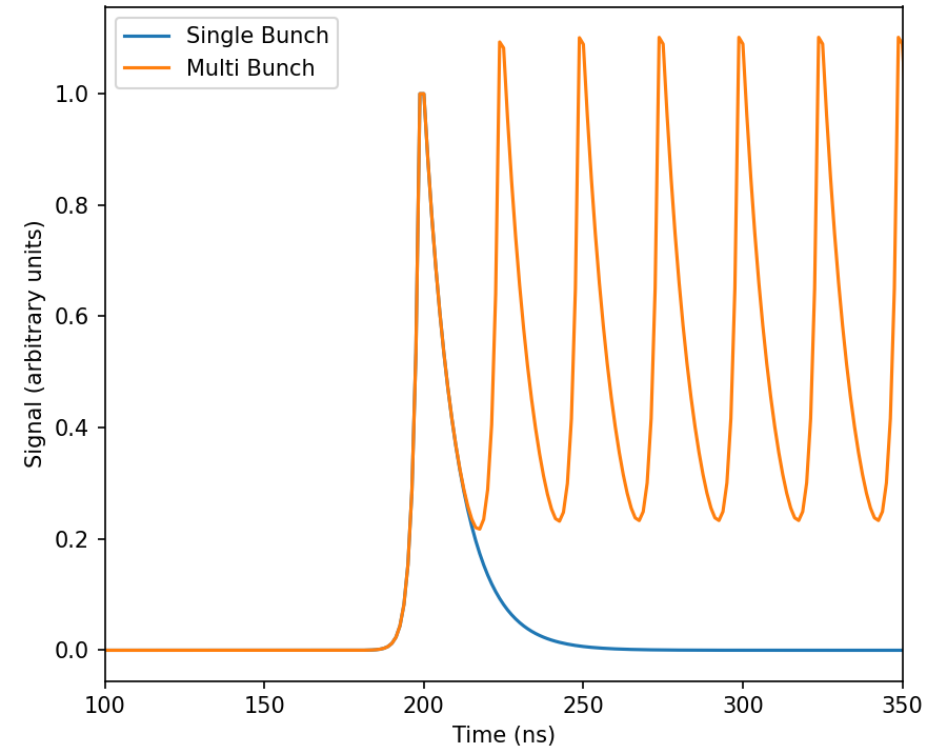
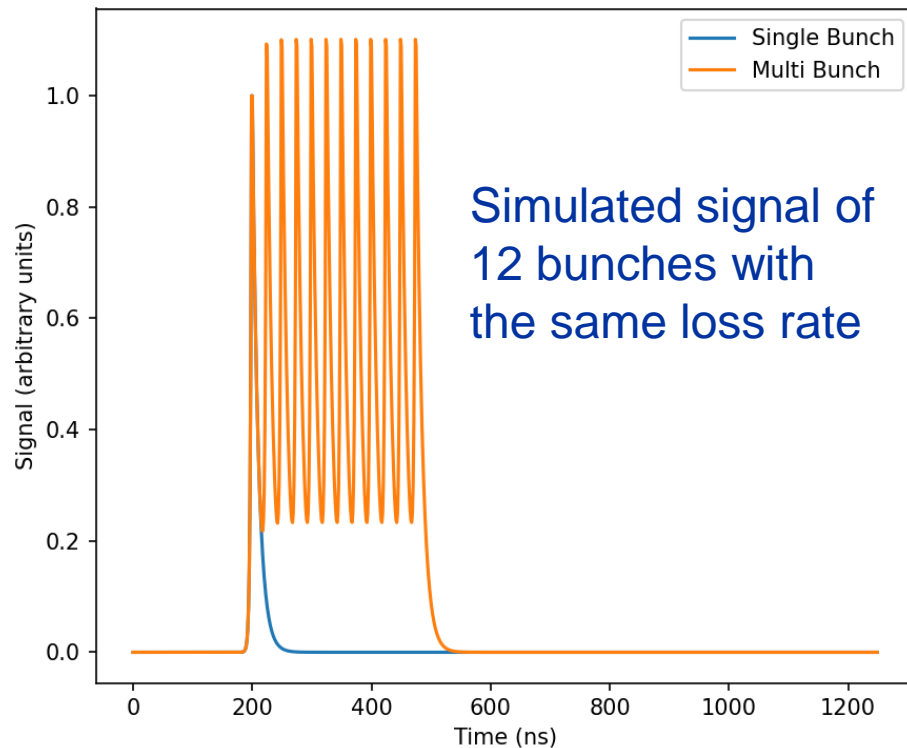
# Introduction – Diamond Beam Loss Monitors

- pCVD diamond detectors (dBLMs)
  - Signal every 1.54 ns -> Bunch-by-bunch losses
    - NXCALS capture data subscription on demand (max ~ 23 LHC turns)
  - Firmware -> Integral measurement mode -> bunch-by-bunch loss integration every 1s



# Introduction – Aim of the MD

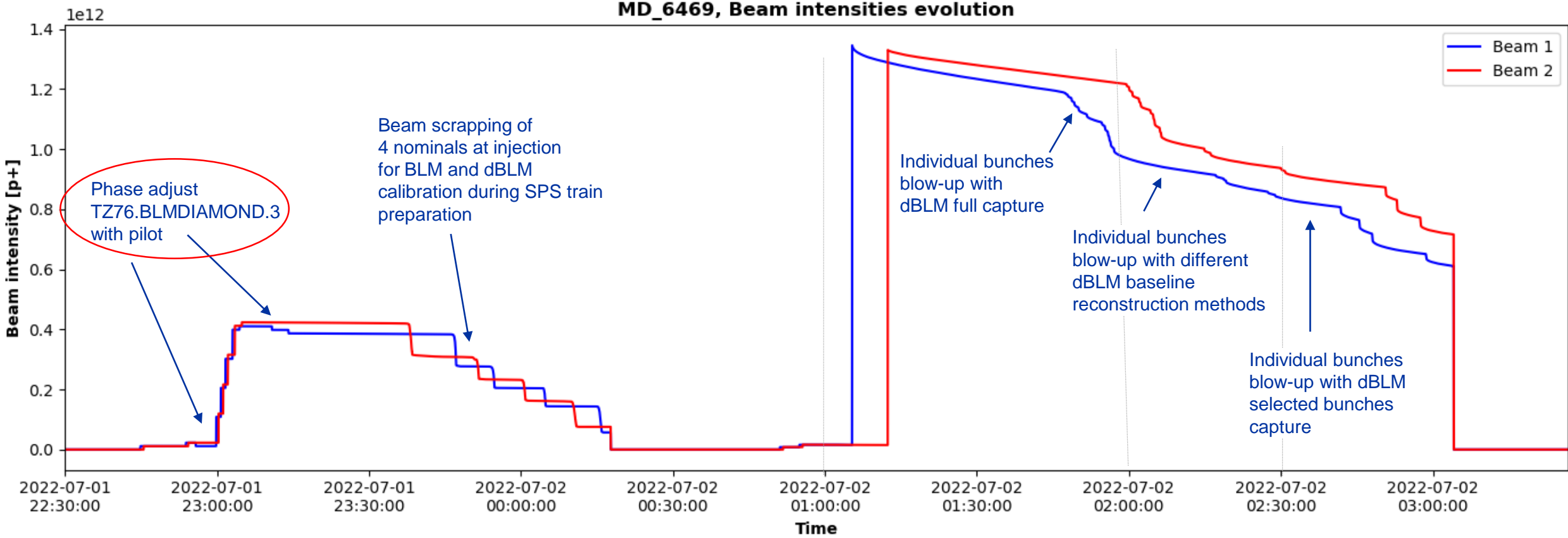
- pCVD diamond detectors (dBLMs)
  - dBLMs have a rise/decay time in the order of ns -> for 25 ns bunch spacing signals overlap



B.Salvachua | rMPP MD1 on [link](#)

Firmware provides various baseline correction methods – Which one is best?

# Summary



Thanks to the coordinators and OP for their help and flexibility!

# Phase adjust TZ76.BLMDIAMOND.3

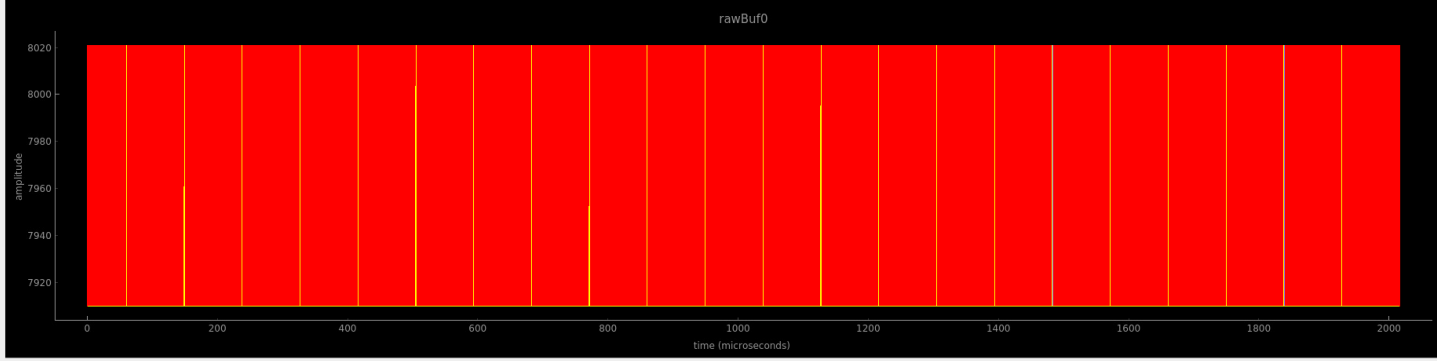
- Phase adjust of dBLMs in Point 7 performed on 02-06-2022
  - OK for all except for one (TZ76.BLMDIAMOND.3, close to TCPC)
  - Not enough losses, not enough signal to adjust the phase
  - In later analysis signal seemed ~ 31 bunches off phase
- Retried phase adjust on this monitor
  - BLMs masked
  - IR3 and IR7 TCPs thresholds changed
  - Injection of pilot bunches
  - Horizontal blowup with the lossmap application by D.Mirarchi



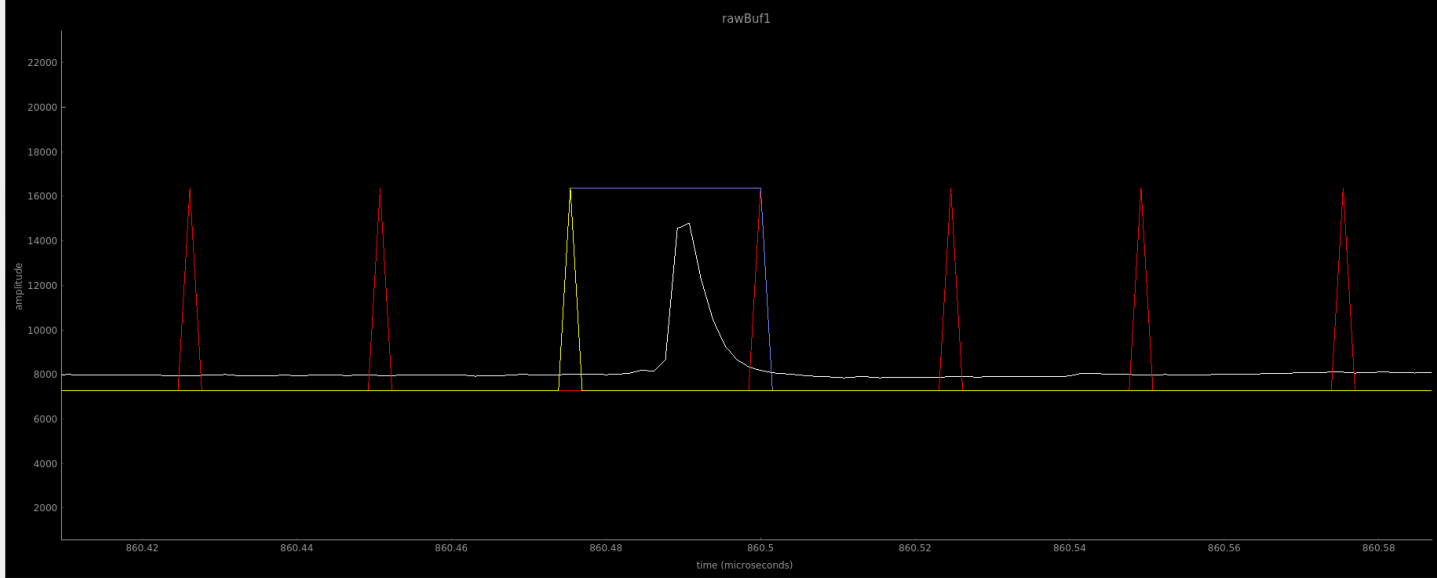
# Phase adjust TZ76.BLMDIAMOND.3

Phase-In Panel (LHC:HC.TZ76.BLMDIAMOND.3@)

acqStamp: 01/07/2022 22:54:21 UTC cycleName: no-selector



rawBuf0



rawBuf1

Turns
  Bunches
  BCT
  Datapoints (Hover)

GET SUBS

Signal in the correct bunch!

Verified correct phase in the rest of dBLMs too

**BCT**

LHC.BCTFR.A6R4.B1 Apply

Insert custom BCT device name... Apply

**Zooming**

from (microseconds) to (microseconds) Apply 1

from (turns) to (turns) Apply 2

from (bunches) to (bunches) Apply 2

**Commands**

TriggerCapture

ResetCapture

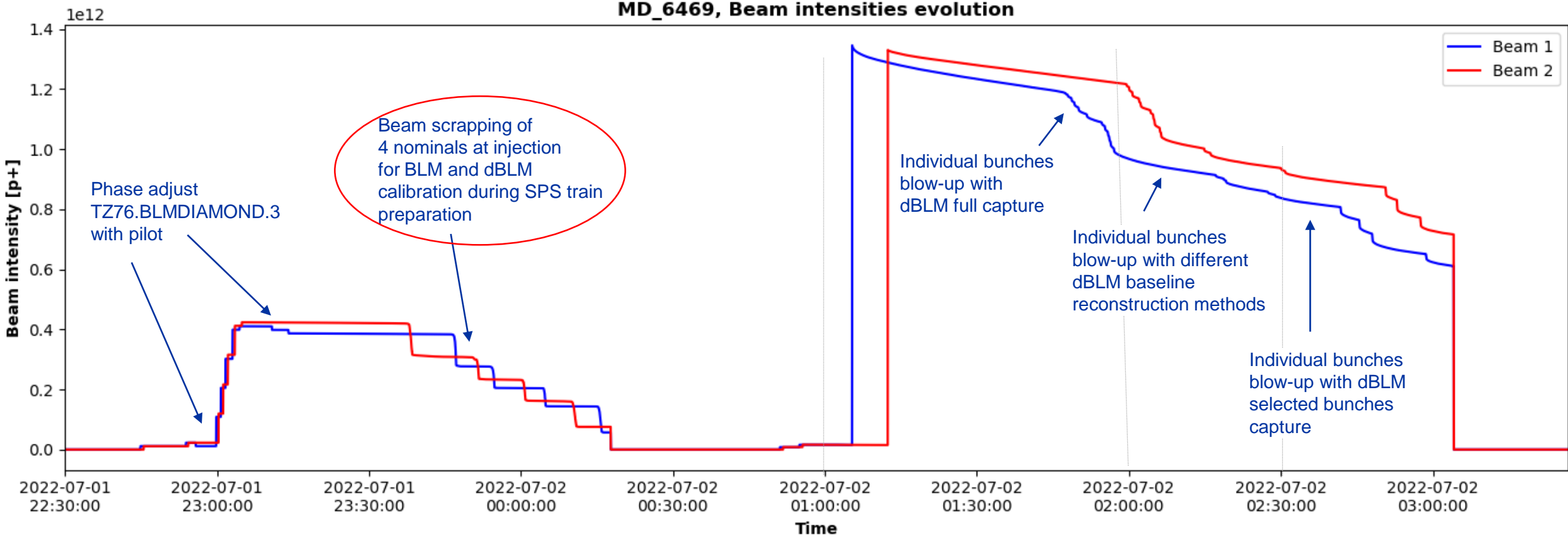
AutoPhaseIn

**ExpertSetting (acqStamp: 01/07/2022 22:54:21 UTC)**

BST	Steps	Old Value	New Value
Thin delay	+1.53ns	36	36
Coarse delay	-25.0ns	2177	2177
Thin skew (buf0)	+1.53ns	0	0
Thin skew (buf1)	+1.53ns	0	0

GET SET

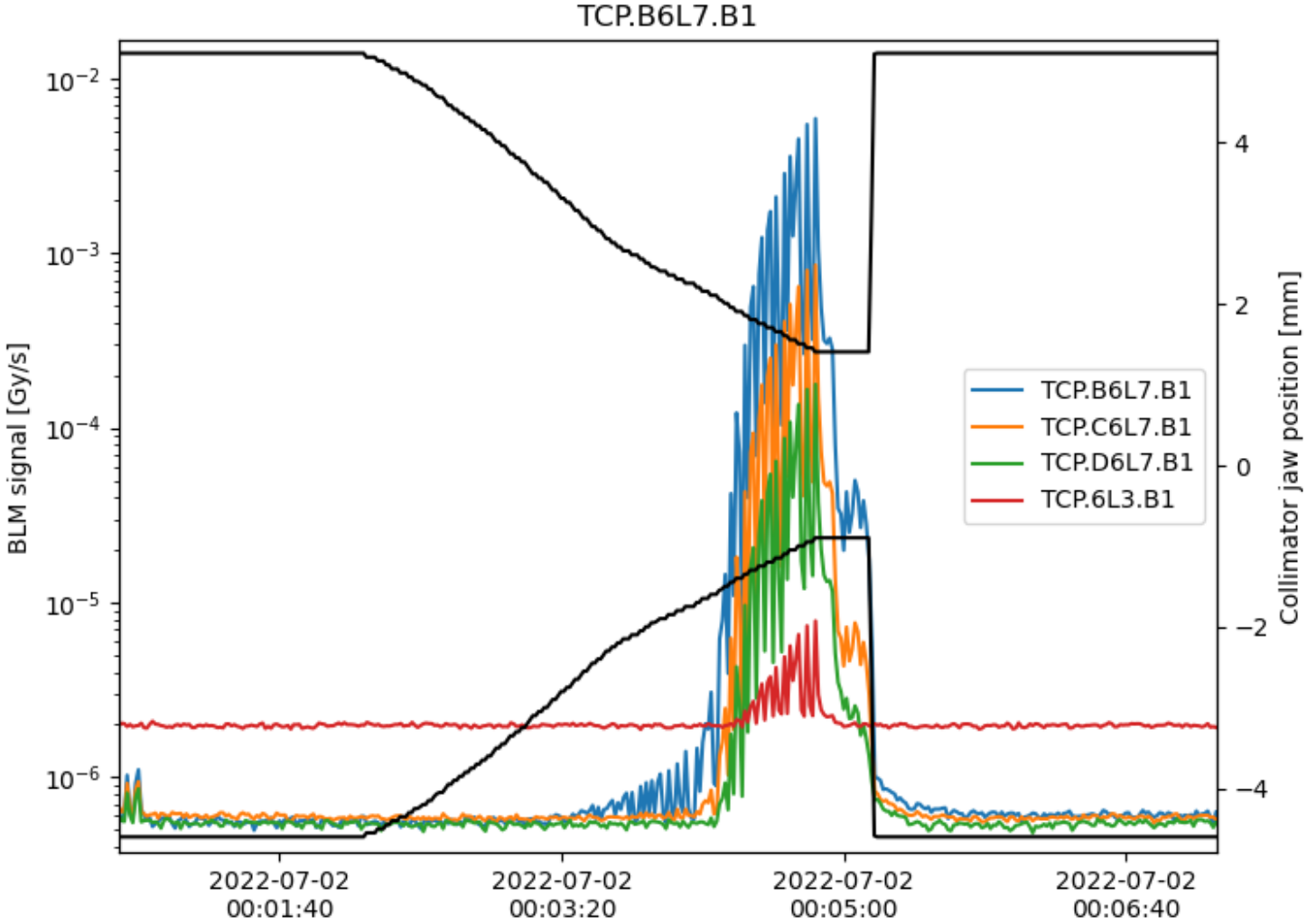
# Summary



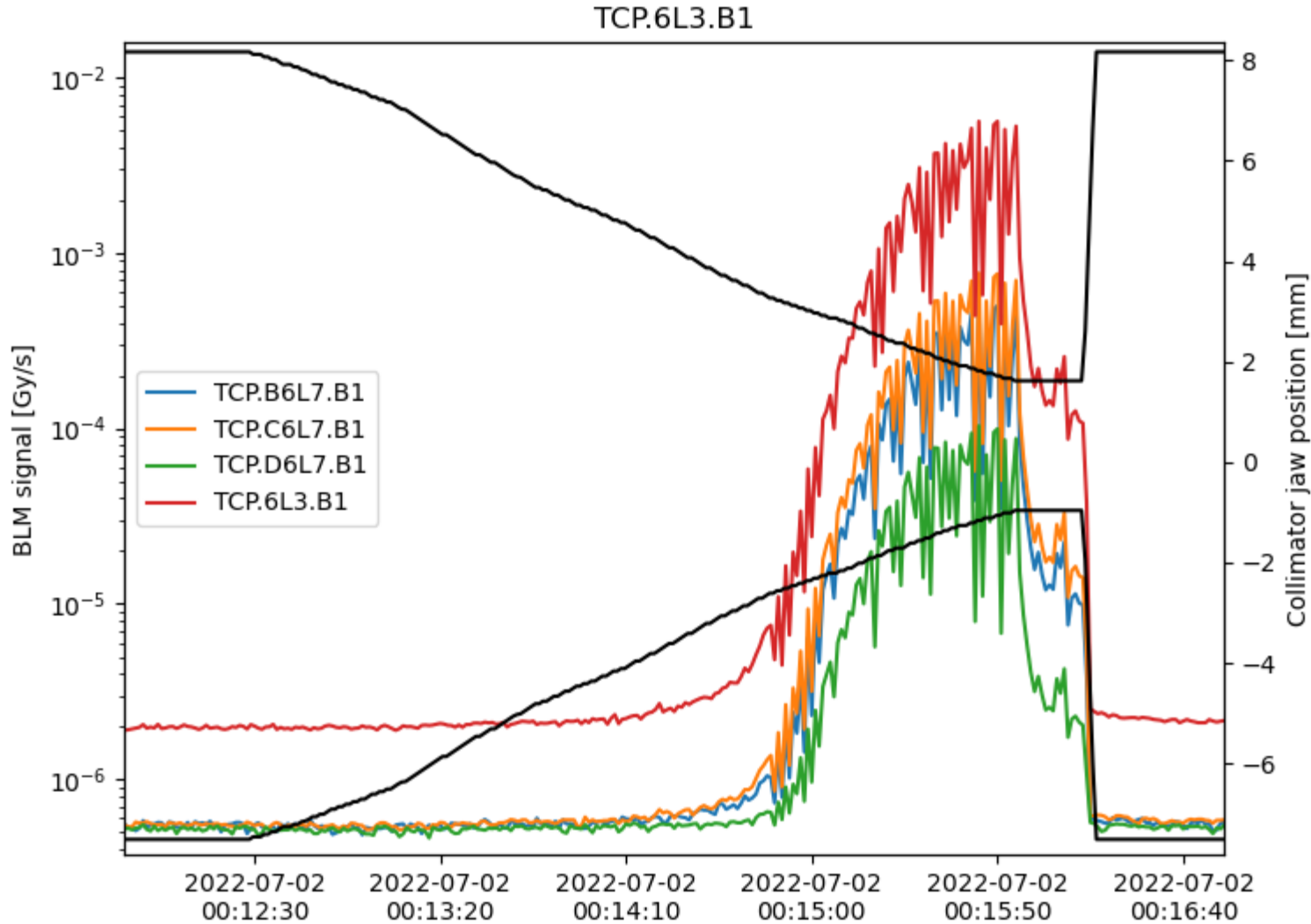
# Beam scraping at injection

- Had to wait for the SPS to prepare the train of 12 nominal bunches
  - Decided to inject 4 nominals (to stay below SBF) and go for scraping
  - IR3 and IR7 TCPs independently one after the other
  - Both jaws moved in steps of 50  $\mu\text{m}$
  - Calibration of IC BLMs and dBLMs at injection energy

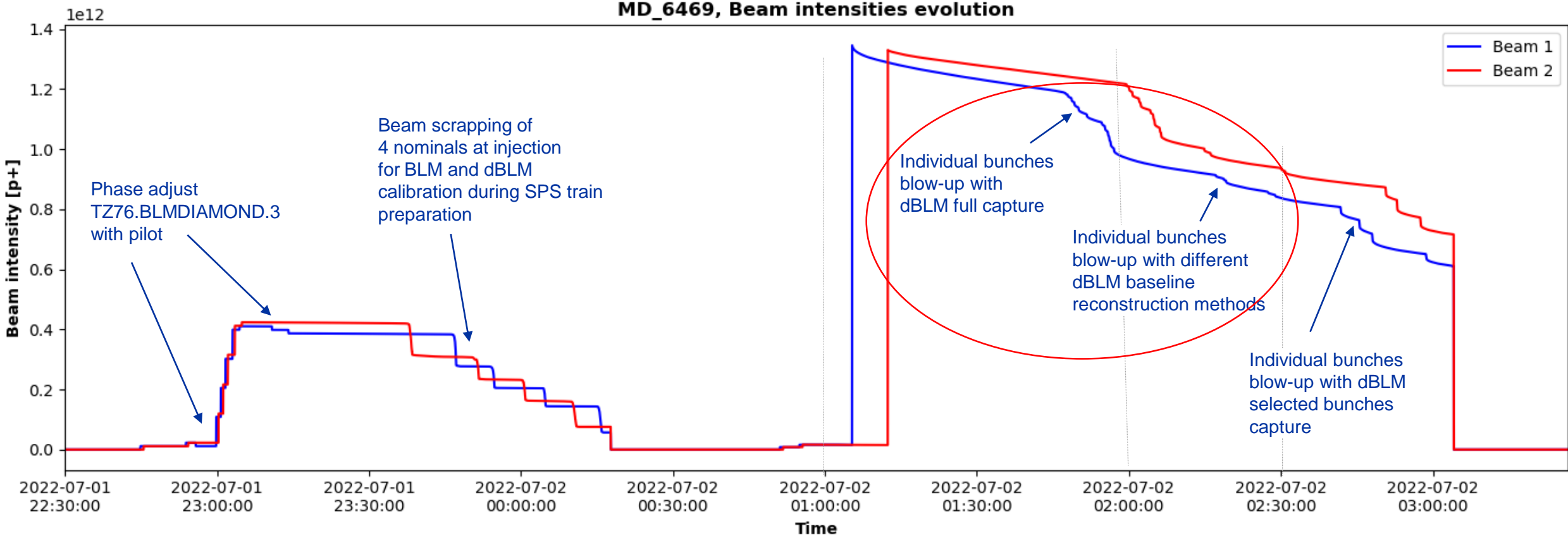
# Beam scraping at injection



# Beam scraping at injection

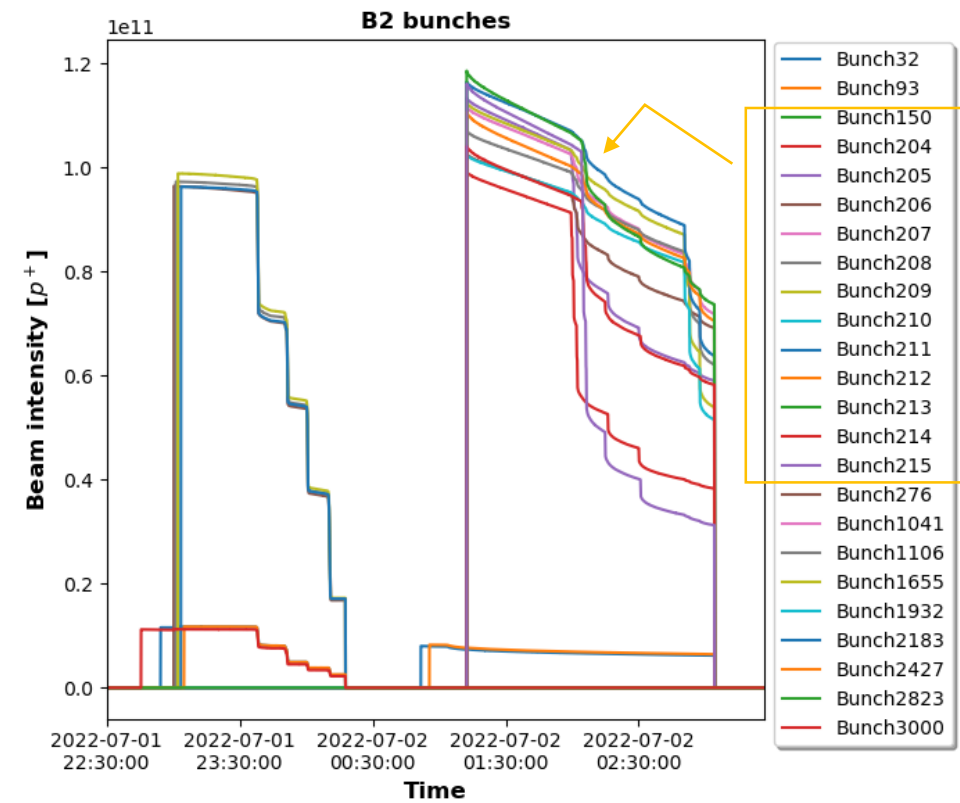
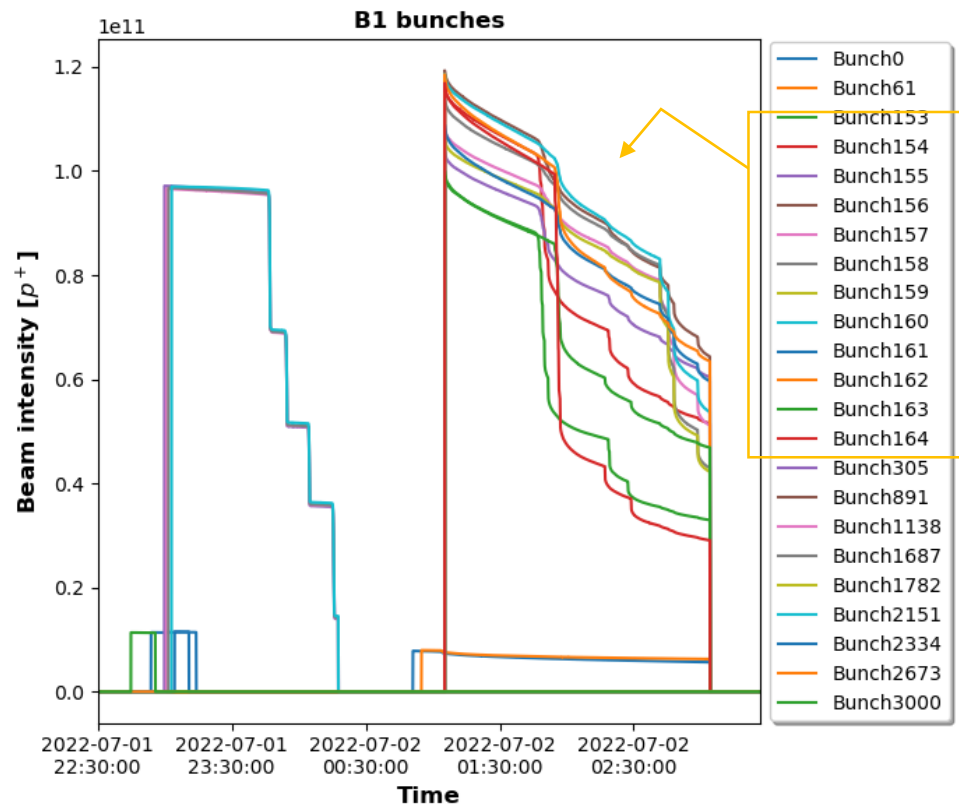


# Summary



# Blowup of single bunches in 12-bunch train

- BLMs unmasked
- Injected train of 12 nominal bunches in B1 and B2

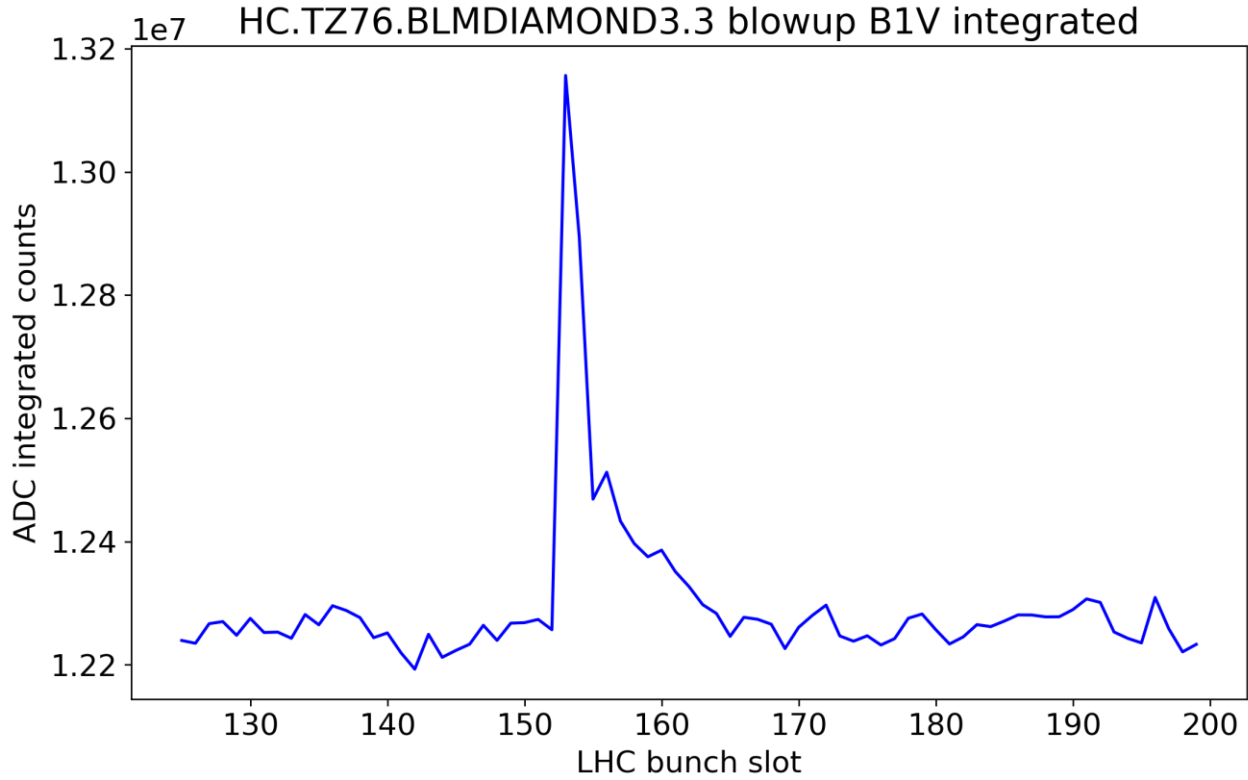
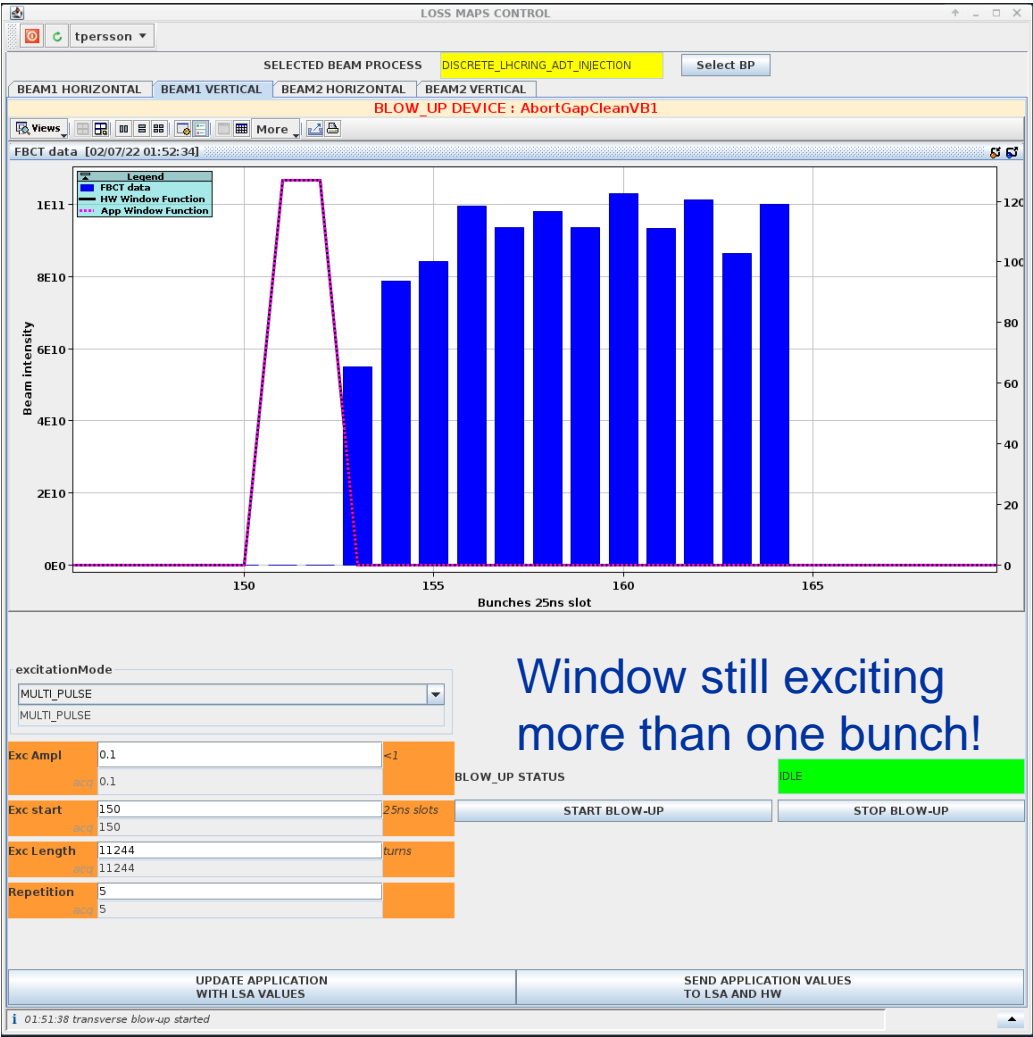


# Blowup of single bunches in 12-bunch train

- BLMs unmasked
- Injected train of 12 nominal bunches in B1 and B2
- Could not use lossmaps application
  - Used ADT application -> Window too wide, managed to change it
  - Excited bunches at the beginning and the end of the train



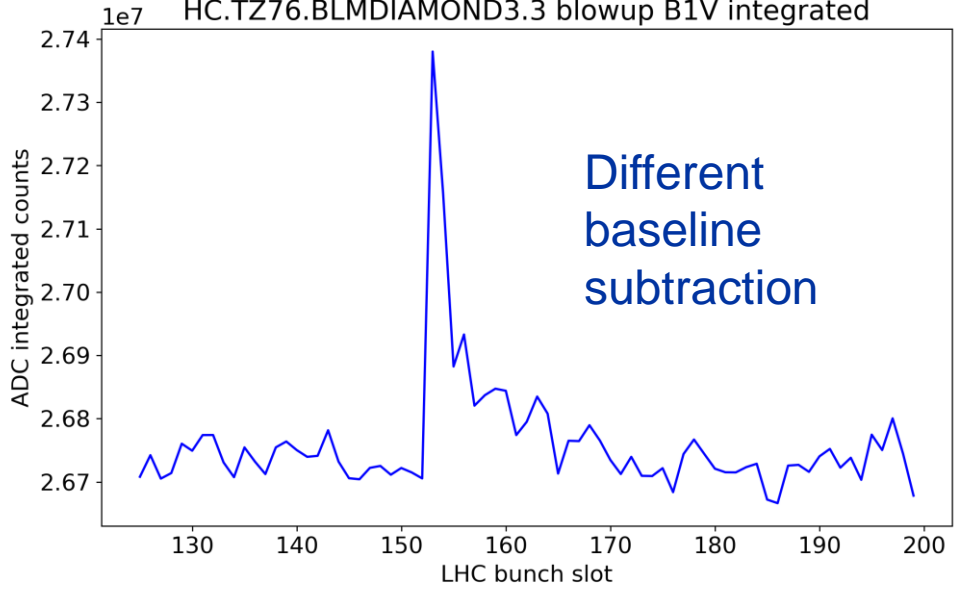
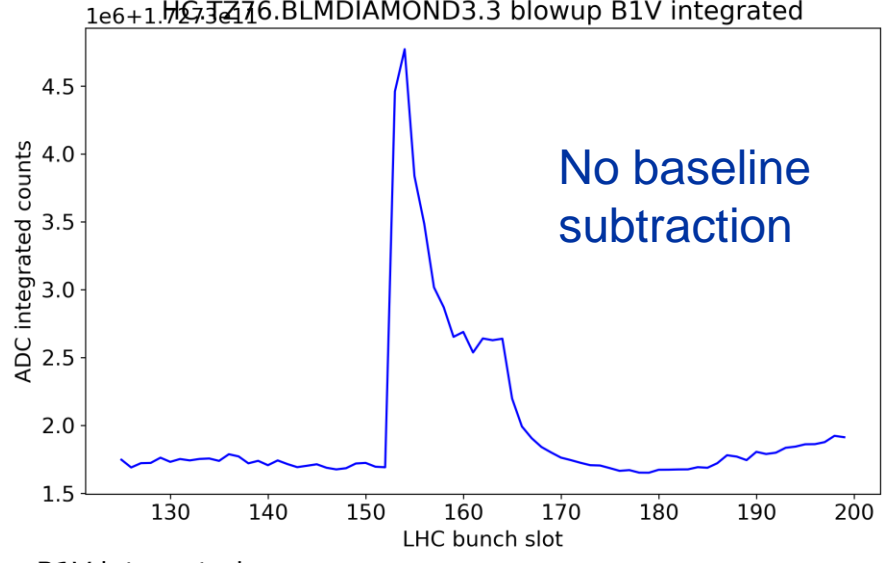
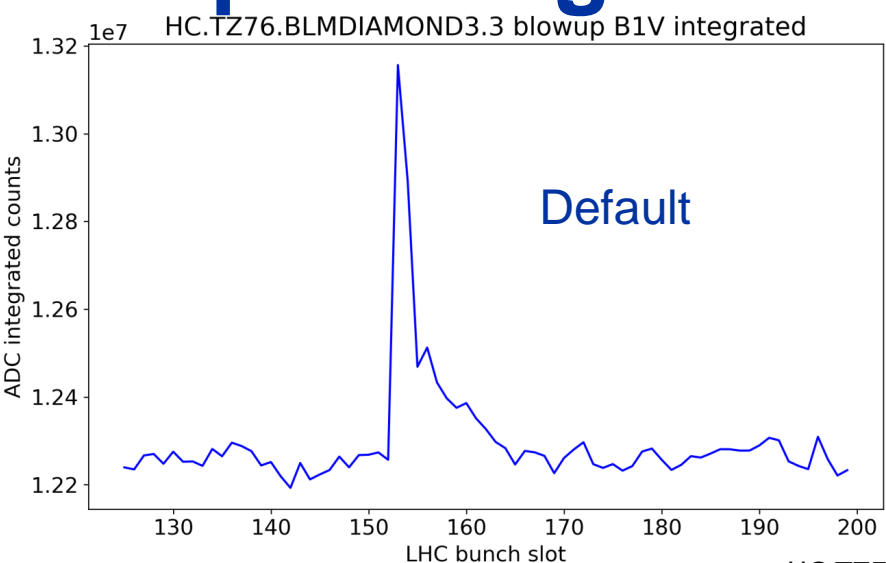
# Blowup of single bunches in 12-bunch train



# Blowup of single bunches in 12-bunch train

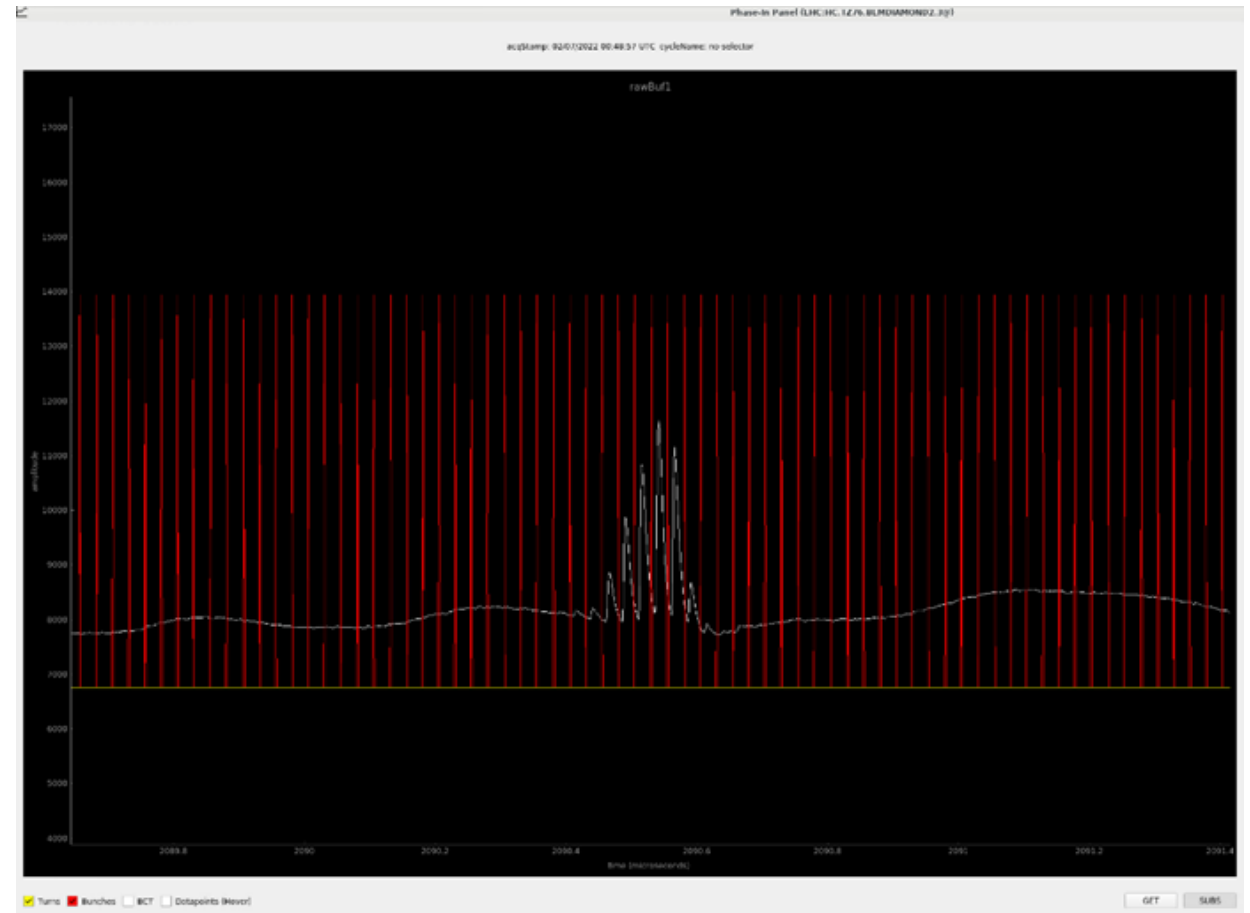
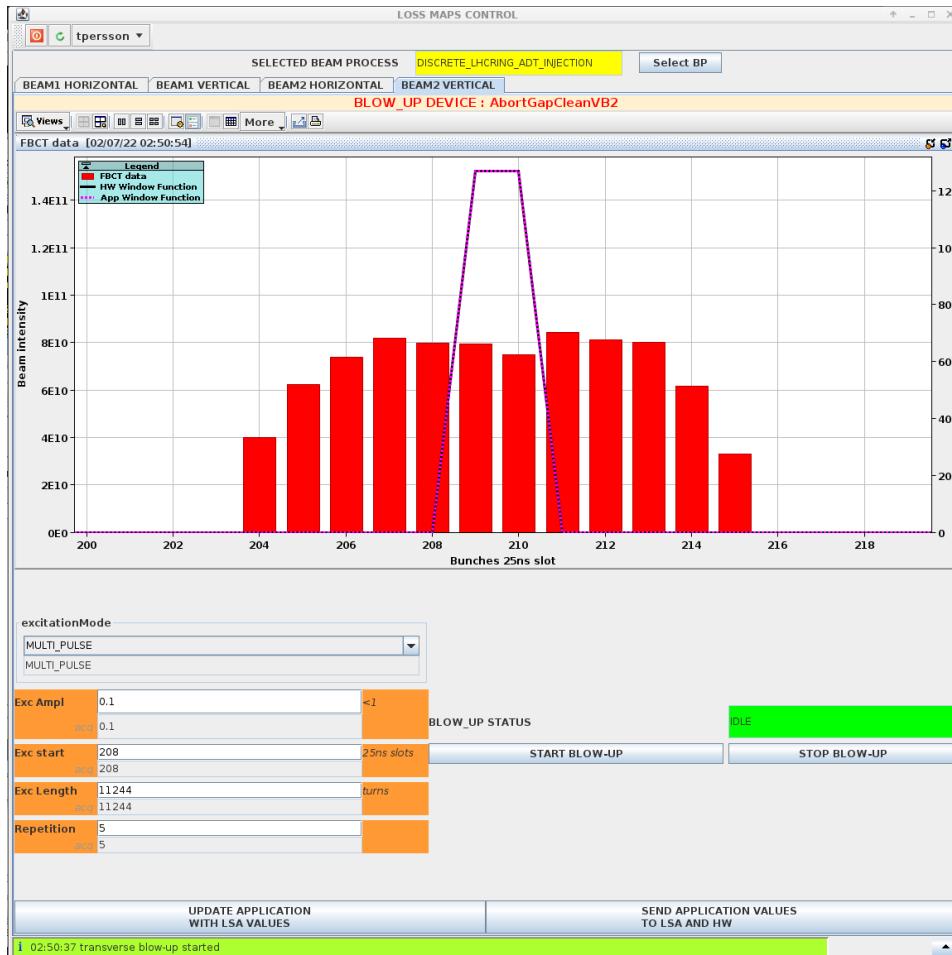
- BLMs unmasked
- Injected train of 12 nominal bunches in B1 and B2
- Could not use lossmaps application
  - Used ADT application, window too wide, managed to change it
  - Excited bunches at the beginning and the end of the train
- Disabled baseline subtraction and repeated
- Changed baseline subtraction firmware and repeat

# Blowup of single bunches in 12-bunch train



# BST Bunch selection

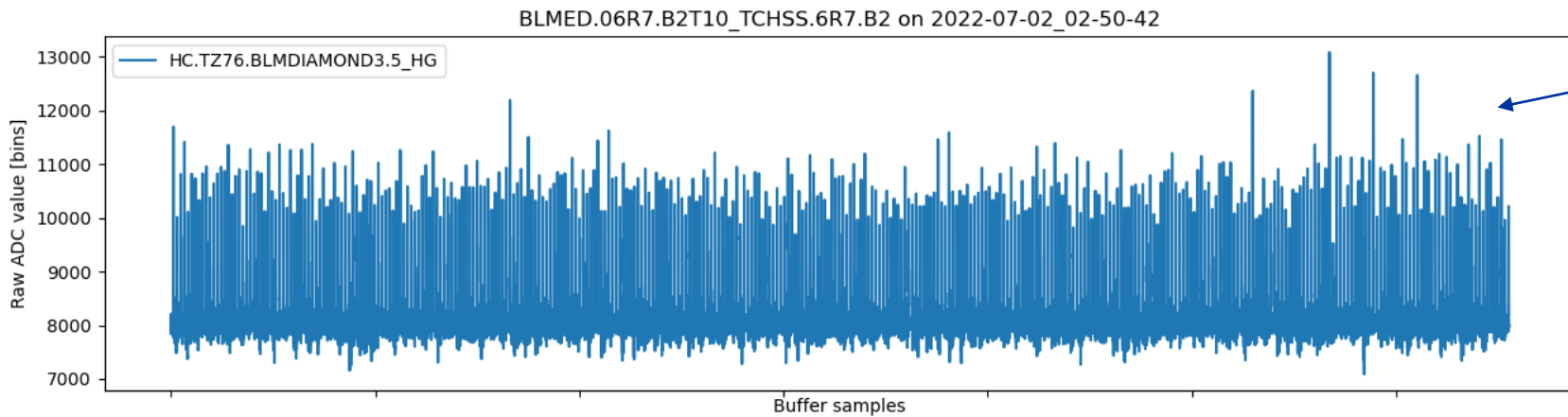
- Possibility to capture only a selected range of bunches -> More turns recorded



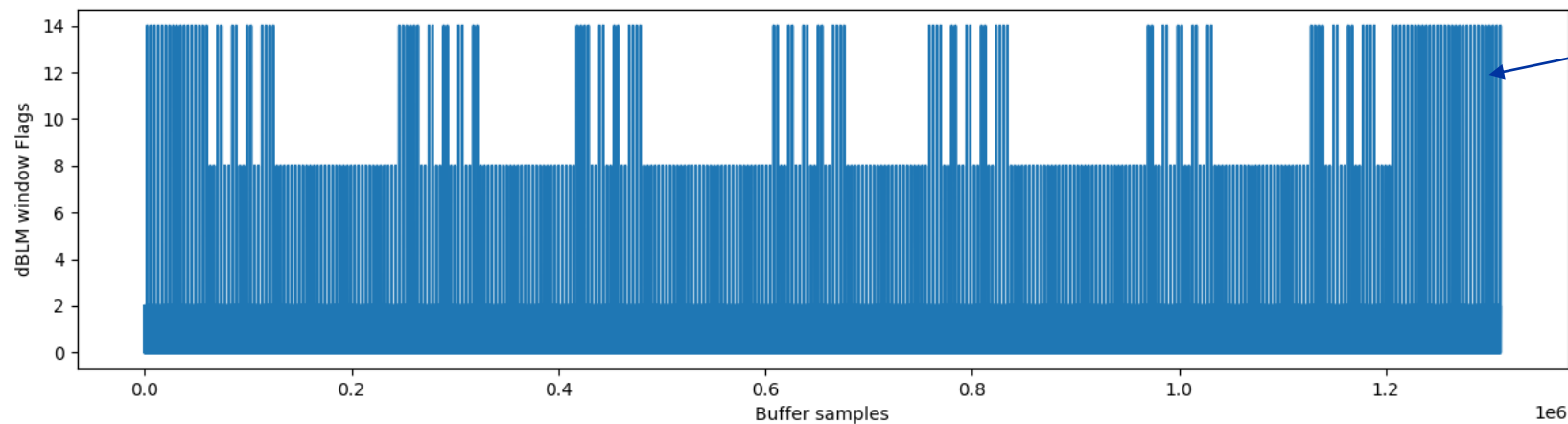
dBLM expert Application, zoom on captured losses

# BST Bunch selection

dBLM capture configured to record data from bunches 0 to 220 only



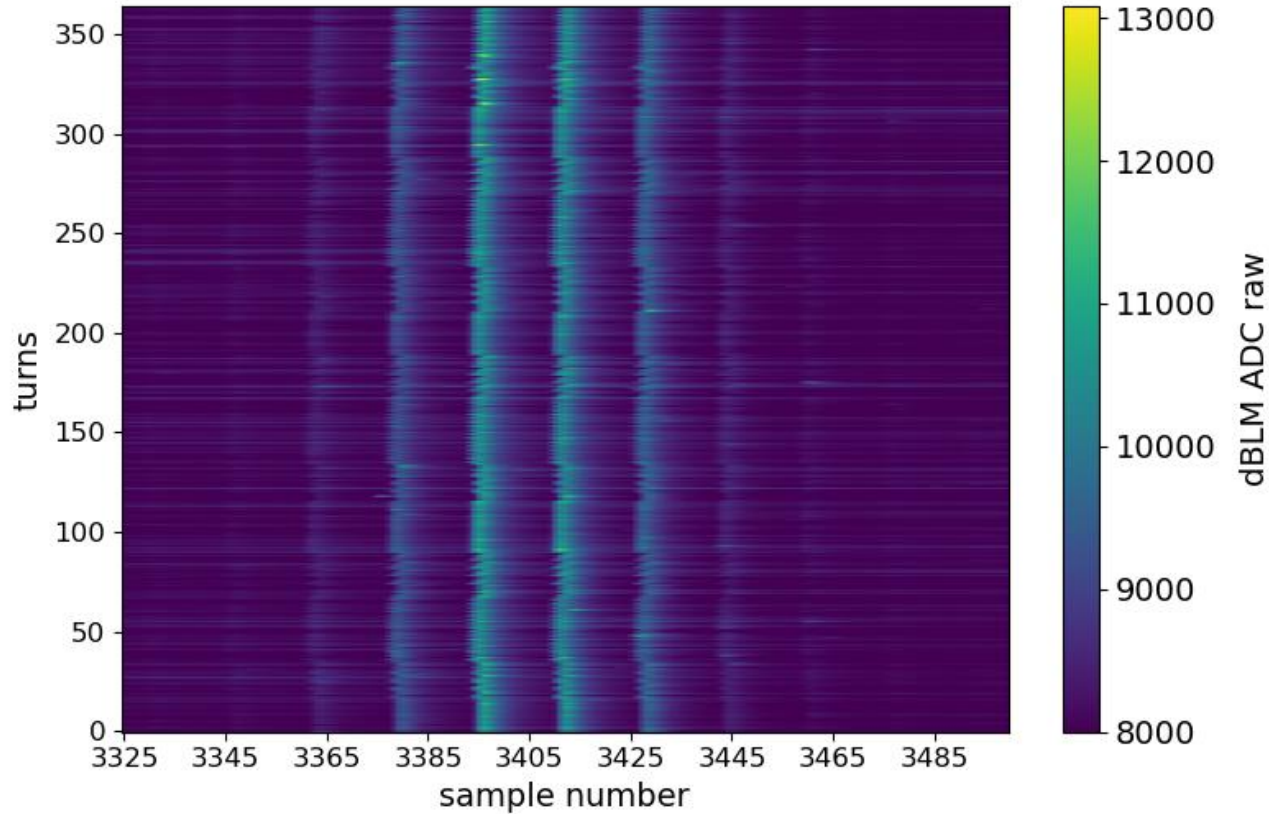
Captured data on selected bunches



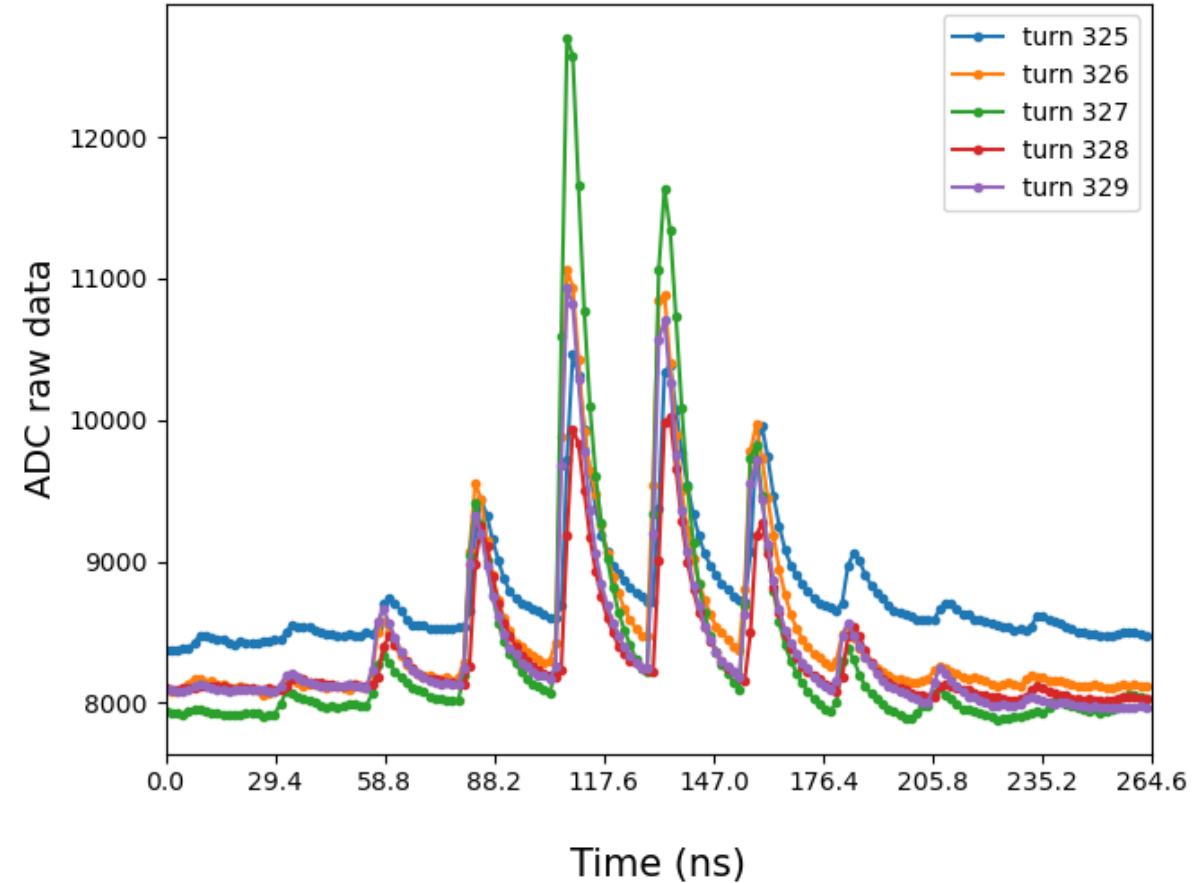
Window flags indicate when every capture window started

# BST Bunch selection

Captured losses using BST bunch selection  
HC.TZ76.BLMDIAMOND3.5 on 2022-07-02 02:50:42



Captured losses using BST bunch selection  
HC.TZ76.BLMDIAMOND3.5 on 2022-07-02 02:50:42



367 turns captured, instead of ~23 if captured the full turn  
(Current limitation : NXCALS max. data per publication)

# Recovery

- dBLM capture settings reverted to the default configuration
- ADT excitation windows reverted to the configuration pre-MD

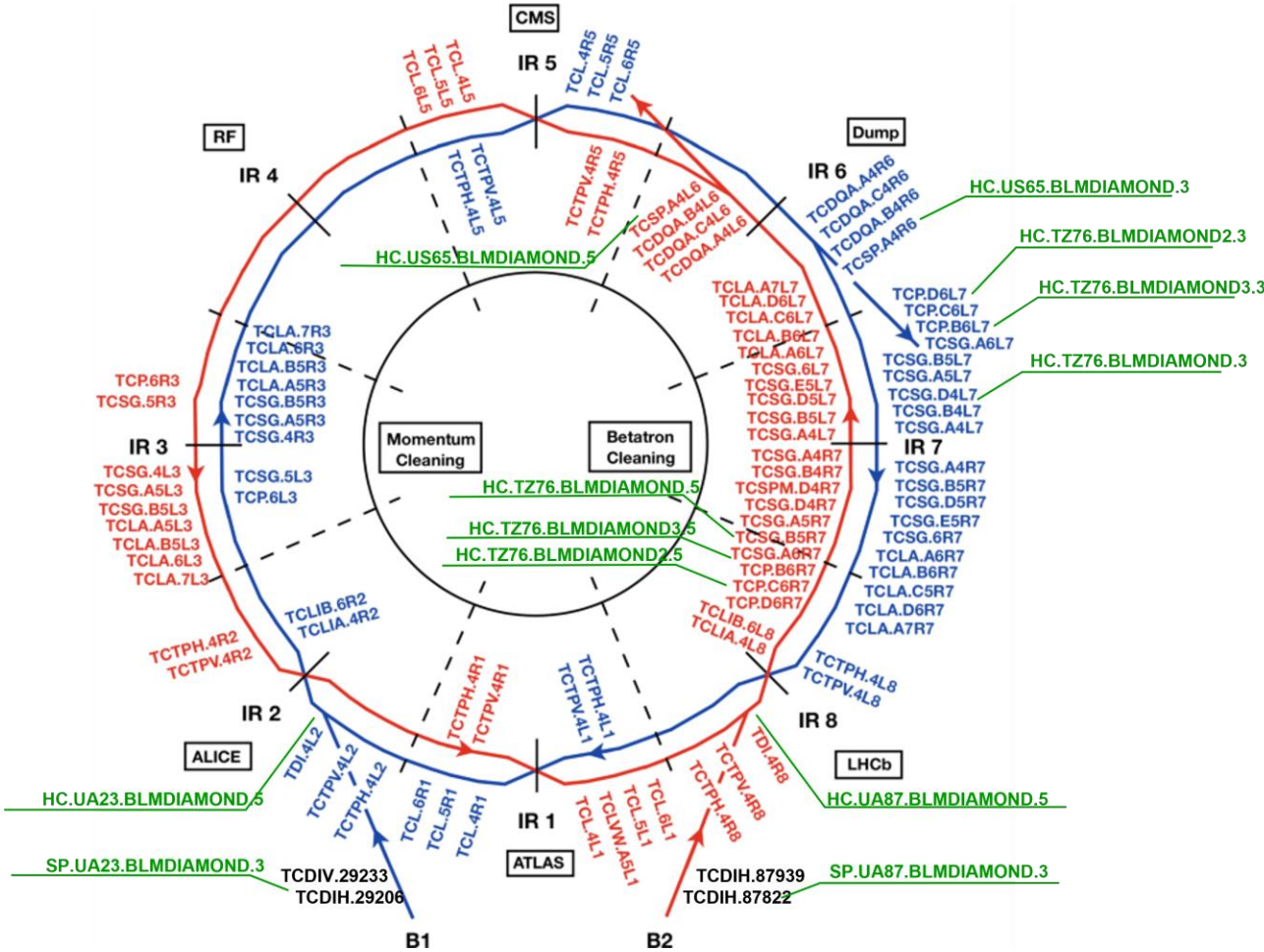
Happy with the test, would like to have a second session to test improvements on the firmware and other functionalities-> Two sessions requested for the MD

# Backup slides



# Introduction – Diamond Beam Loss Monitors

- pCVD diamond detectors (dBLMs)
  - 12 detectors in the LHC: 6 in betatron collimation area, 4 in injection lines, 2 in extraction lines



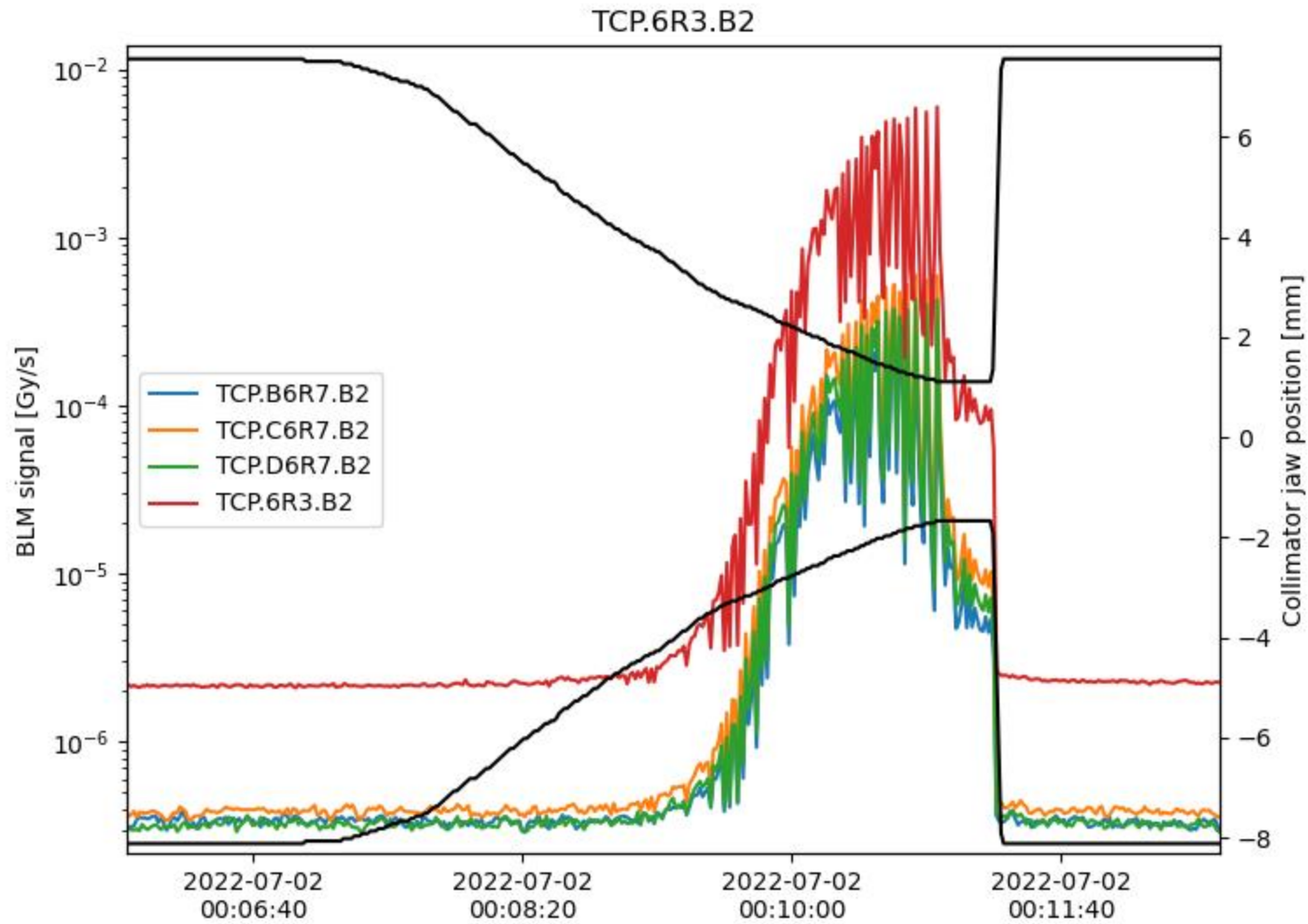
# IR3 and IR7 TCPs thresholds changed

The screenshot shows the 'Equip State' application window. The main interface is divided into several sections:

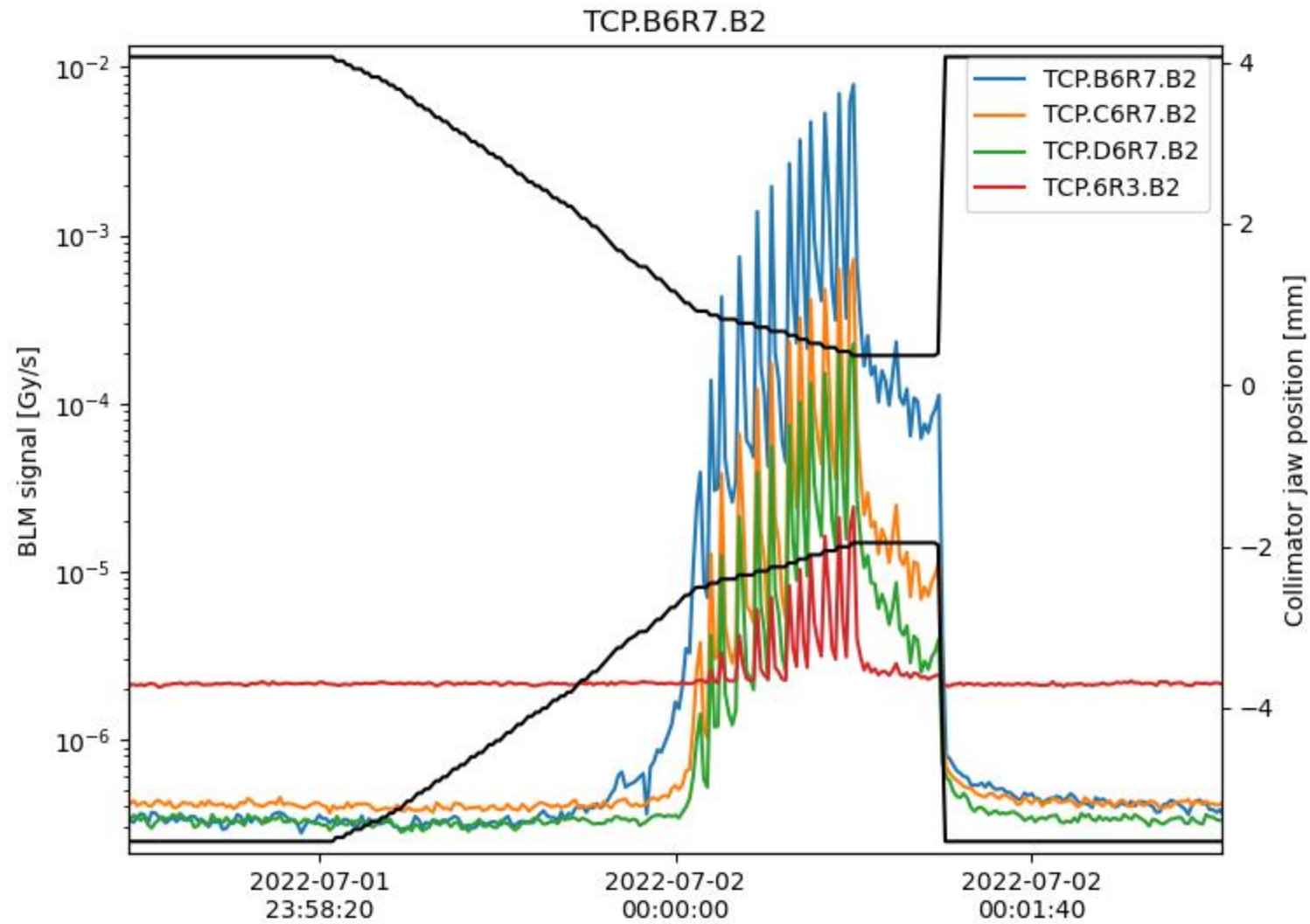
- Context Selection:** Shows 'EquipState' and 'Filtering on Partide Transfer: LHCRING Context: CollimatorBP-Parking'.
- Device Selection:** A tree view on the left shows 'LHCCollimator' and 'LhcTCDQ' selected. A 'Filter: TCP' is applied.
- Table:** A table lists TCPs and their load thresholds. All are currently 'OK'.
 

HWName	LOAD THRESHOLDS
TCP.6L3.B1	OK
TCP.6R3.B2	OK
TCP.B6L7.B1	OK
TCP.B6R7.B2	OK
TCP.C6L7.B1	OK
TCP.C6R7.B2	OK
TCP.D6L7.B1	OK
TCP.D6R7.B2	OK
- Commands:**
  - Read commands:** Includes 'HalfGap\_DUMP\_IN', 'HalfGap\_DUMP\_OUT', 'HalfGap\_WARN\_OUT', 'InterlockThreshold', 'InterlockThresholdSubFuncnt', 'JAW', 'JAW\_DUMP\_IN', 'JAW\_DUMP\_OUT', 'JAW\_WARN\_IN', 'JAW\_WARN\_OUT', 'MeasuredCornerPositons', 'MeasuredVerticalQuota', 'NSIGMA', 'NSIGMA\_DUMP\_IN', 'NSIGMA\_DUMP\_OUT', 'NSIGMA\_WARN\_IN'.
  - Write commands:** Includes 'LOAD SETTINGS', 'LOAD THRESHOLDS', 'LOAD ENERGY THRESHOLDS', 'LOAD BETASTAR THRESHOLDS', 'DISARM', 'LOAD BETASTAR ACTIVE IP', 'BBCentre', 'BBOptics', 'BBParam', 'BetastarActiveIP', 'BetastarThreshold', 'CollimatorLvdtOffset'.
- Parameters:** A table on the right shows 'Property' with values 'InterlockThresholdFuncnt', 'Segment Start' with 'Undefined', and 'Segment End' with 'Undefined'.
- Console:** Shows a log entry: 'DS on [TCP.6L3.B1, TCP.6R3.B2, TCP.B6L7.B1, TCP.B6R7.B2, TCP.C6L7.B1, TCP.C6R7.B2, TCP.D6L7.B1, TCP.D6R7.B2] on context(s)[CollimatorBP-Parking] with user(s) [LHC.USER.PARKING] .DS' completed'. Below it, a status bar says '23:29:59 Command 'LHC\_COLL\_LOAD\_THRESHOLDS' completed'.

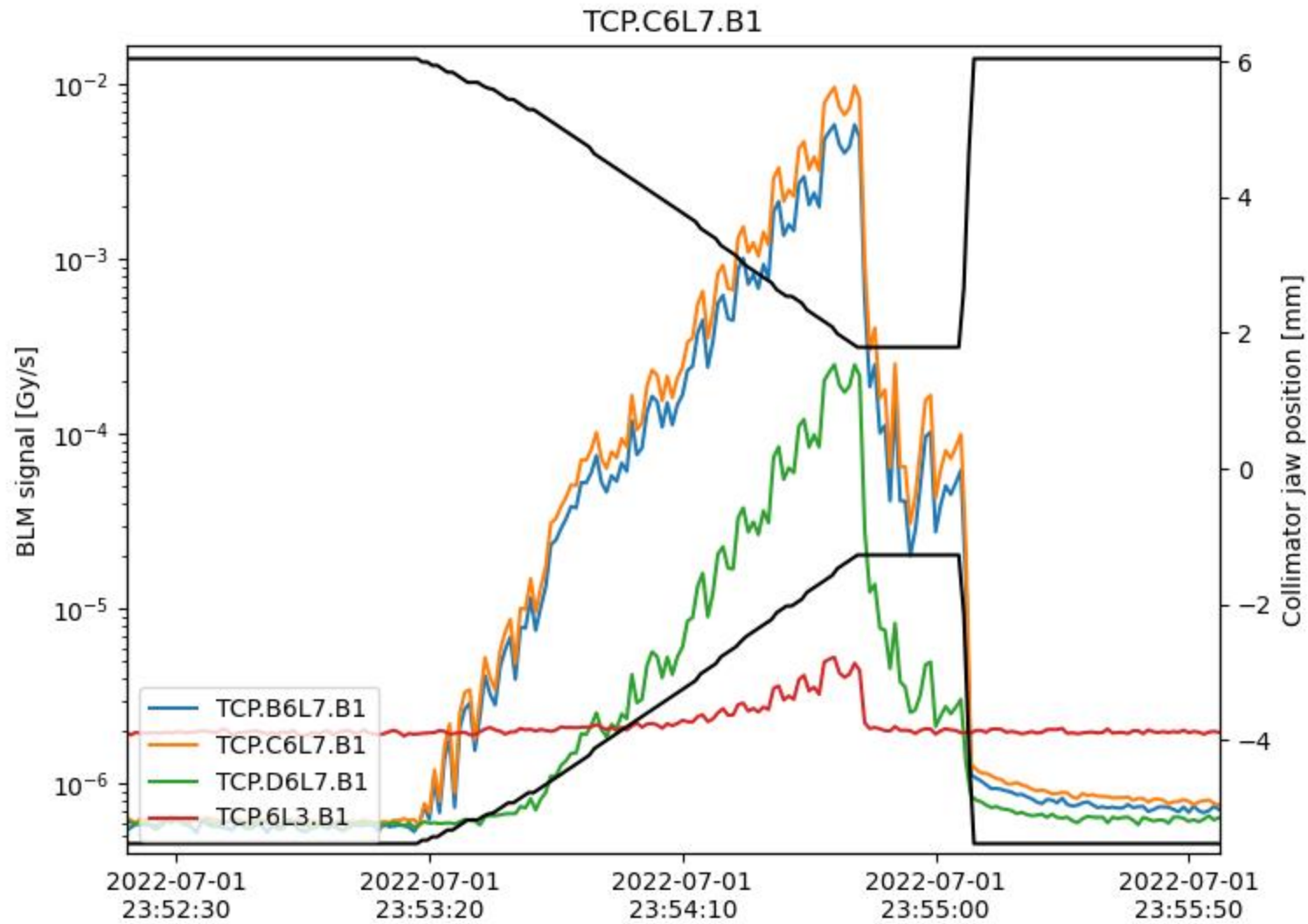
# Beam commissioning



# Beam commissioning

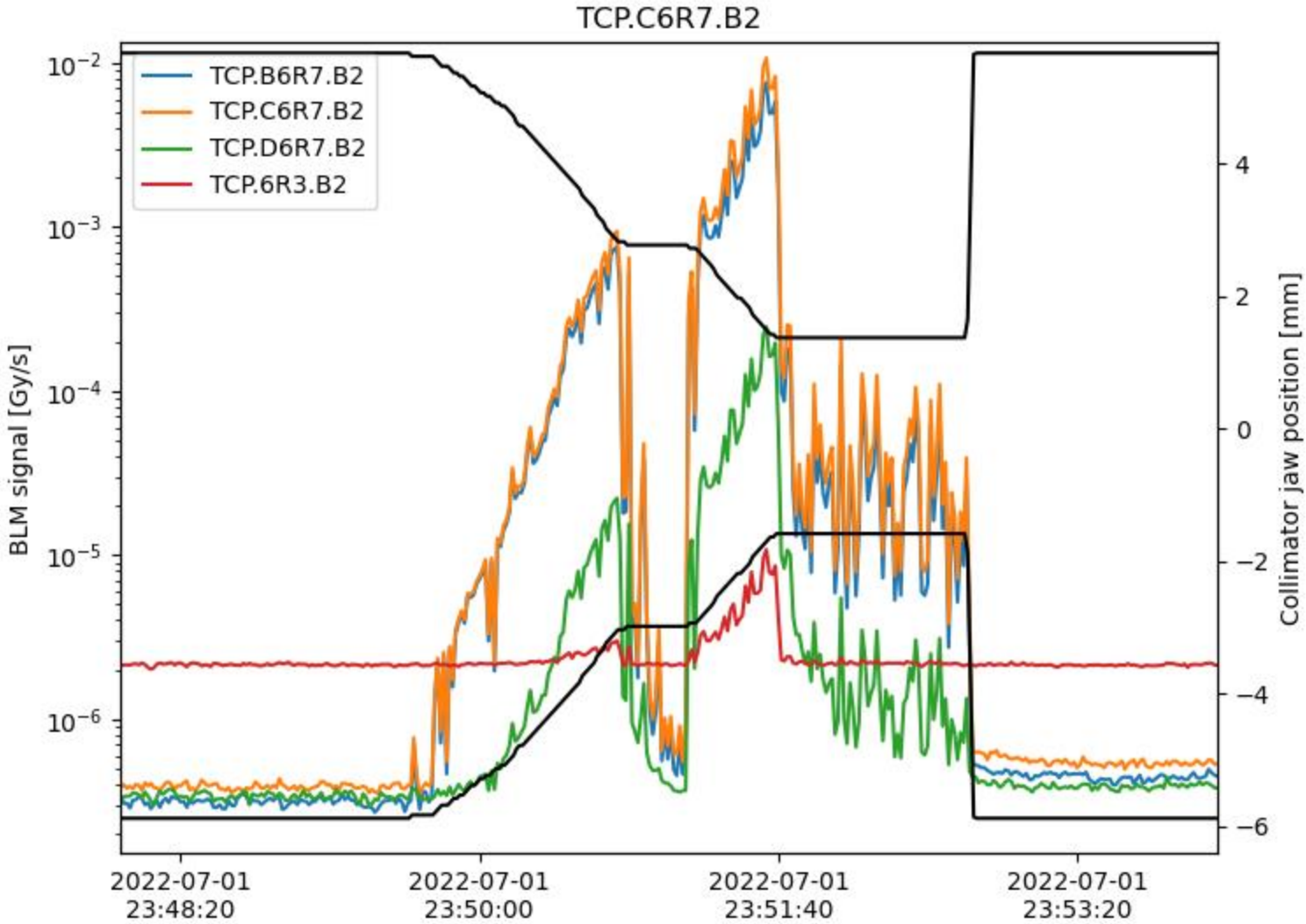


# Beam commissioning

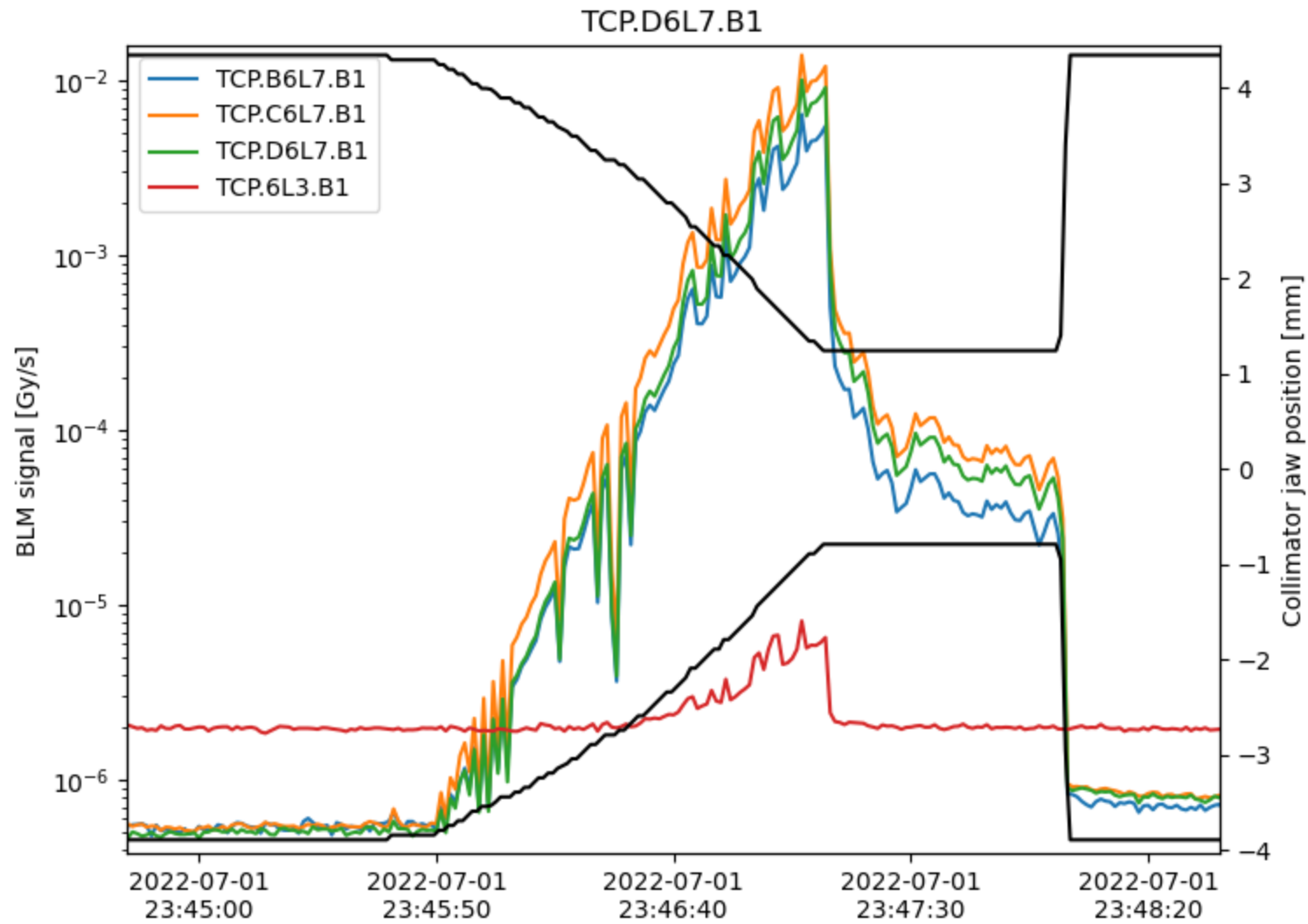




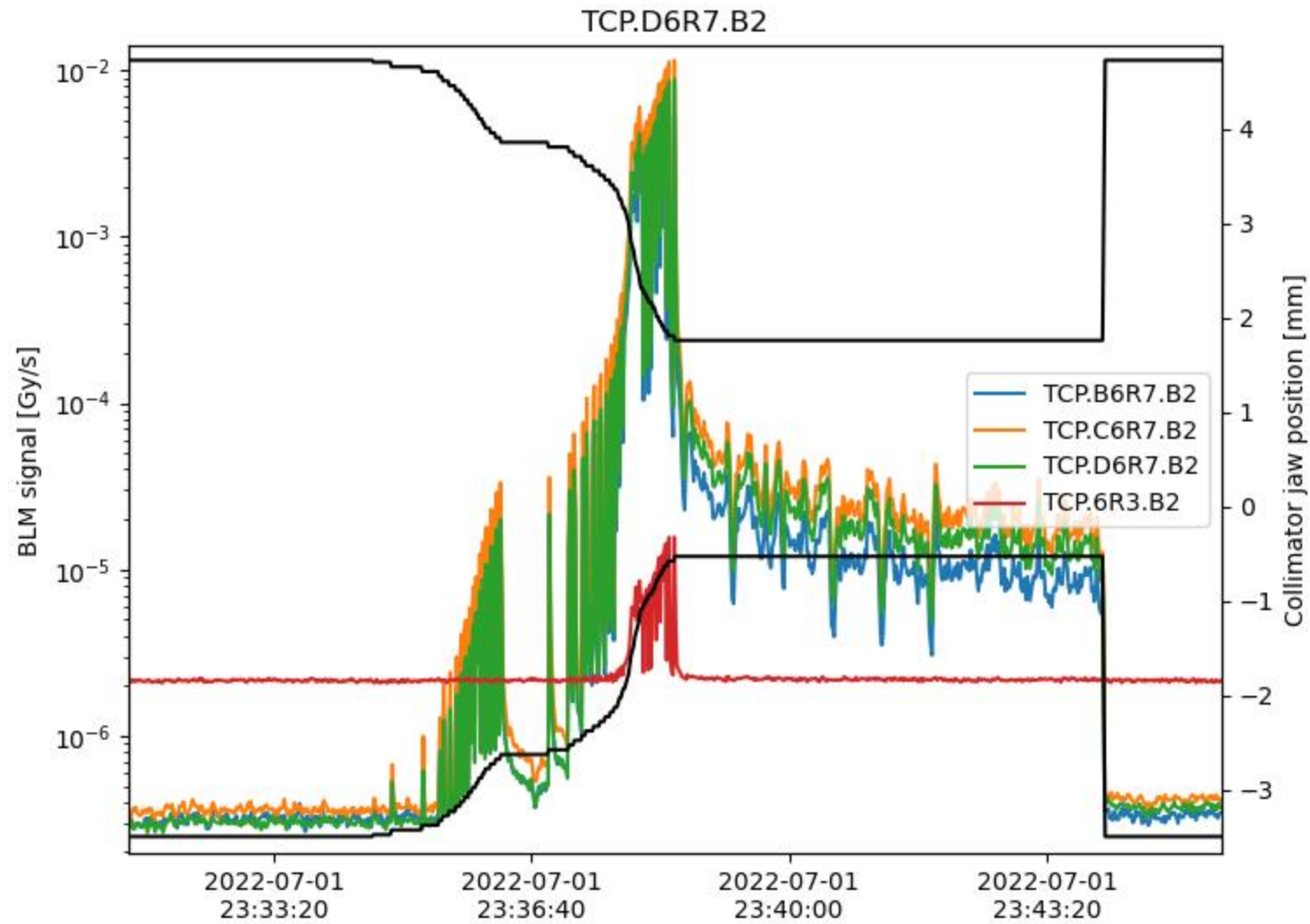
# Beam commissioning



# Beam commissioning

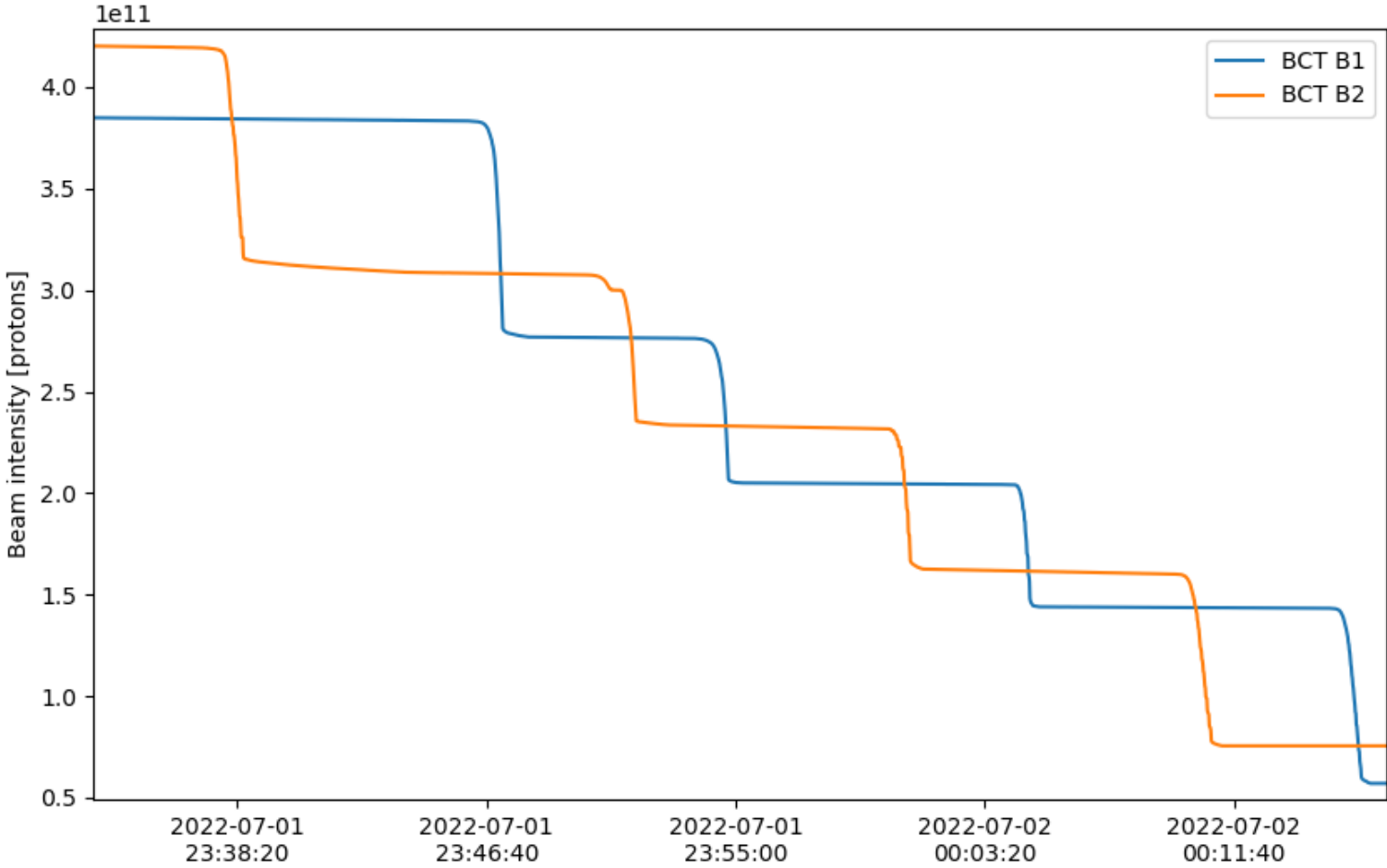


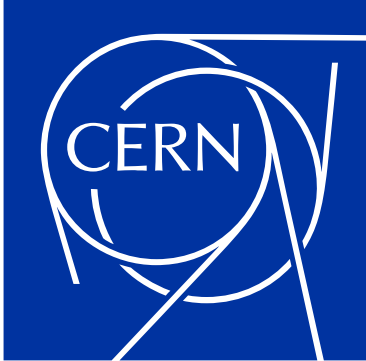
# Beam centering





# Beam scraping





[home.cern](http://home.cern)