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

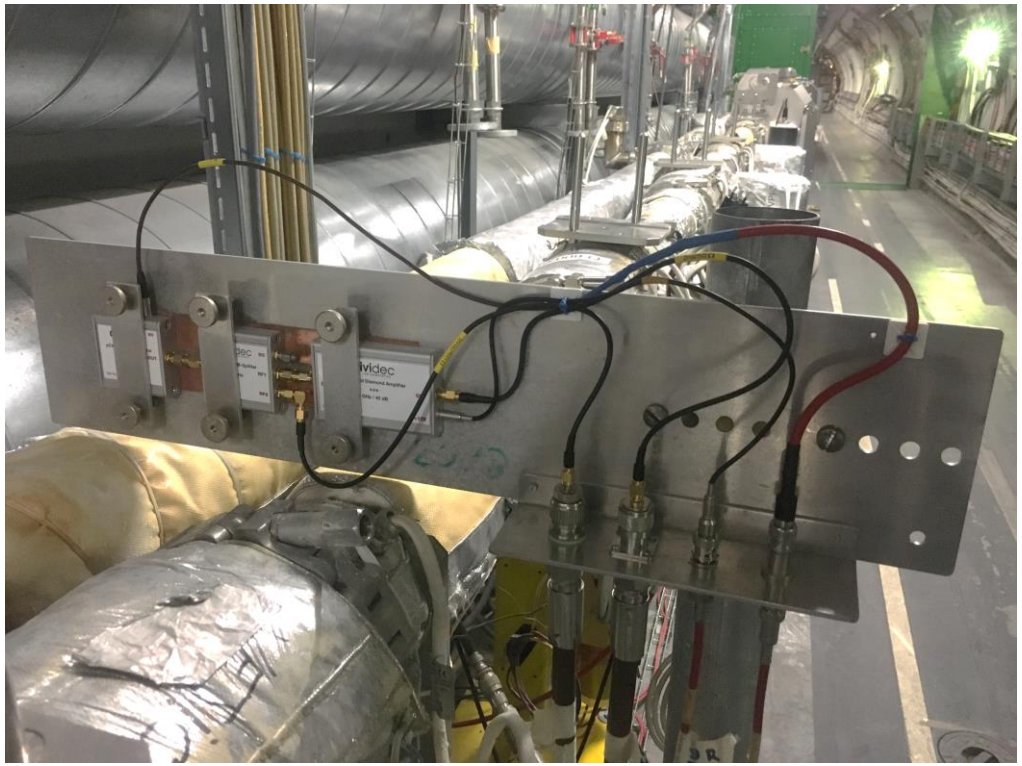
S.Morales and E.Calvo for SY-BI-BL

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

21/07/2022 LSWG meeting on Floating MD results

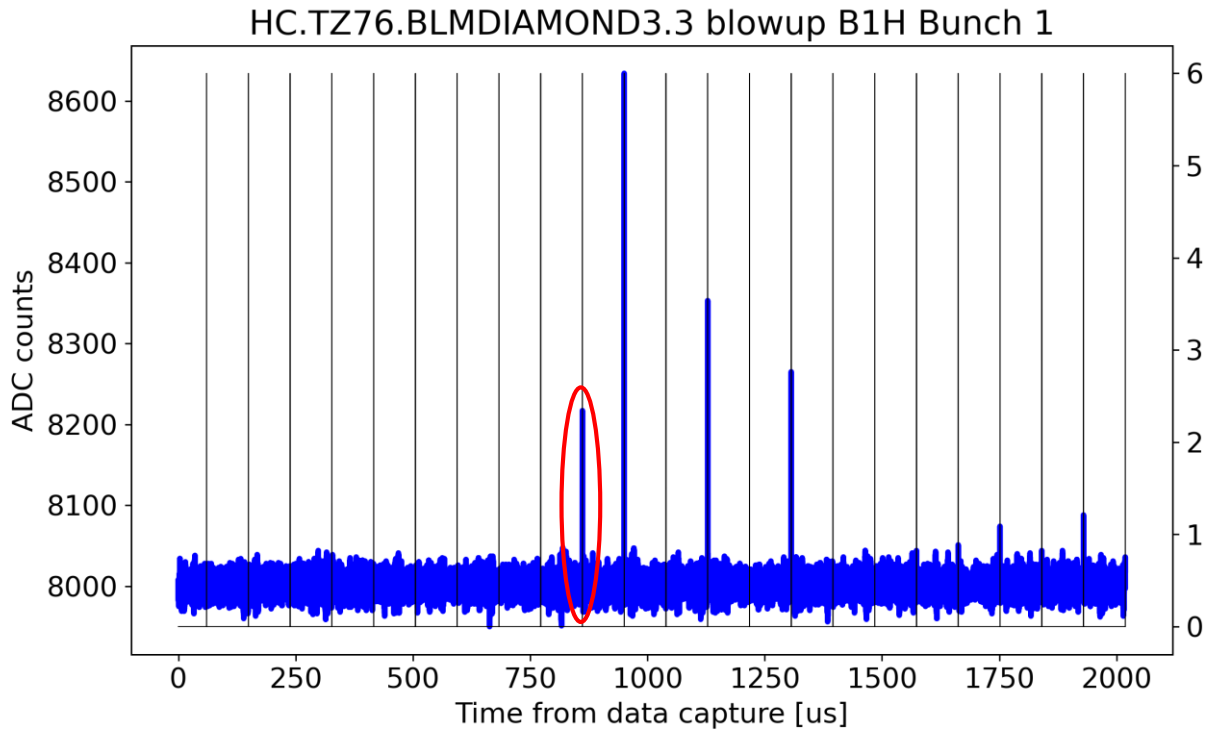
Introduction – Diamond Beam Loss Monitors

- 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)



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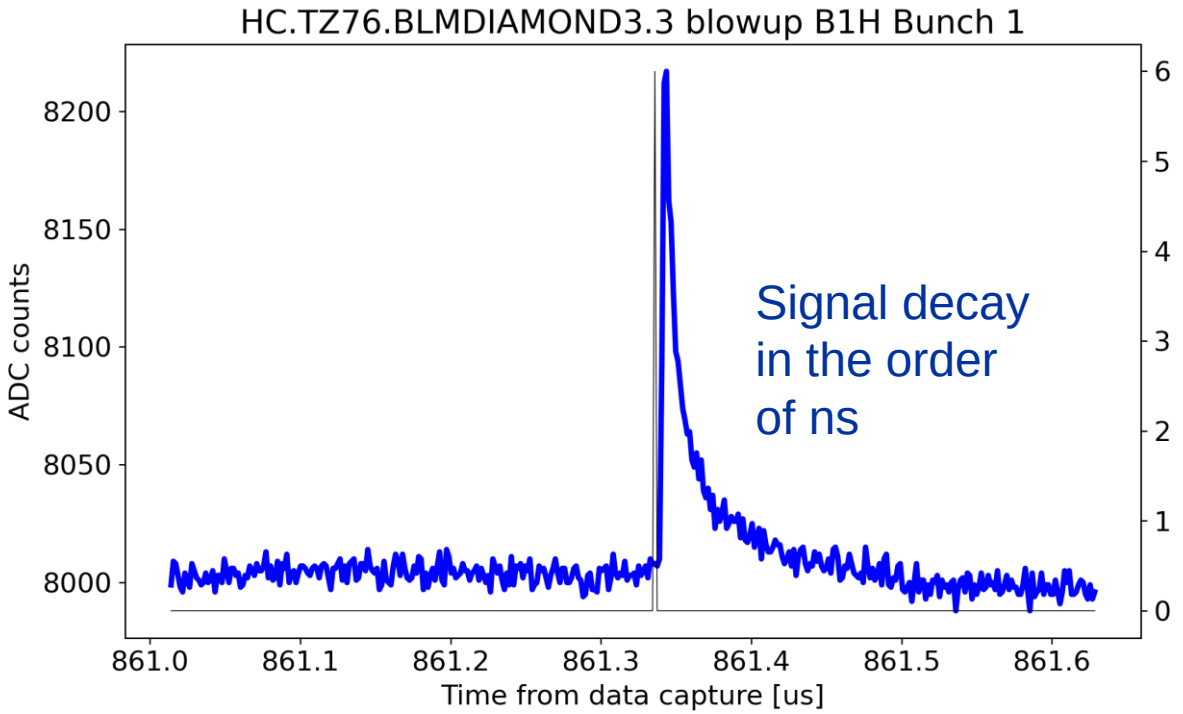

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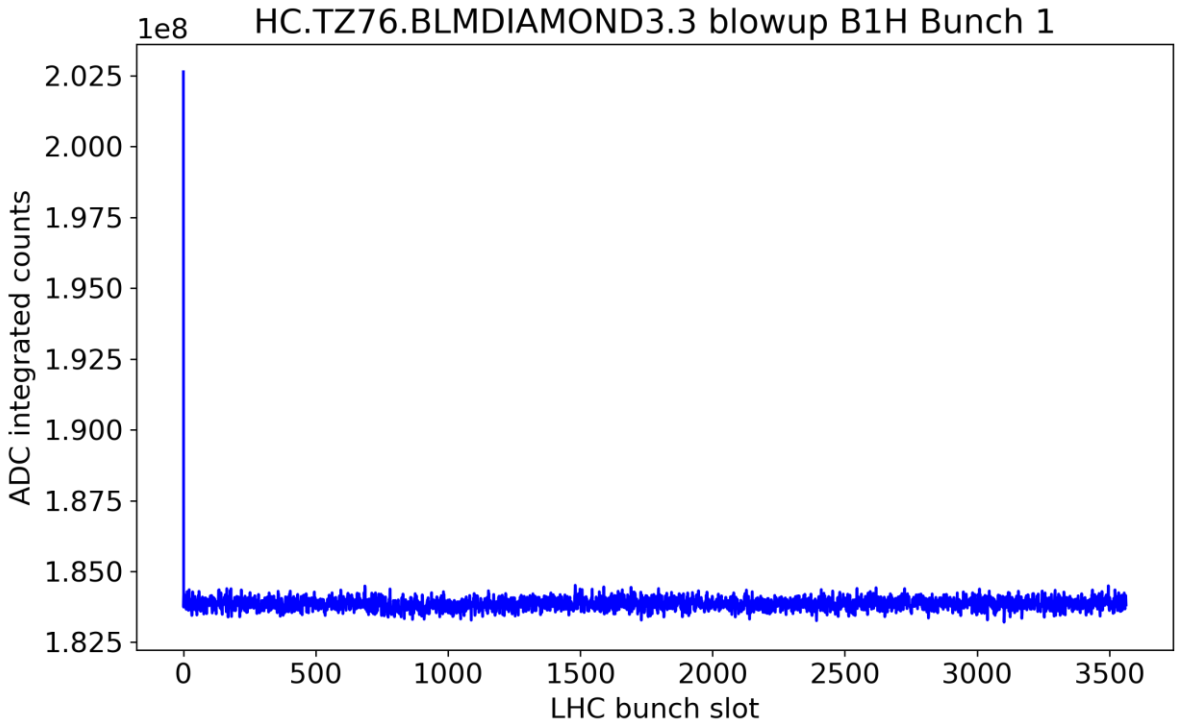
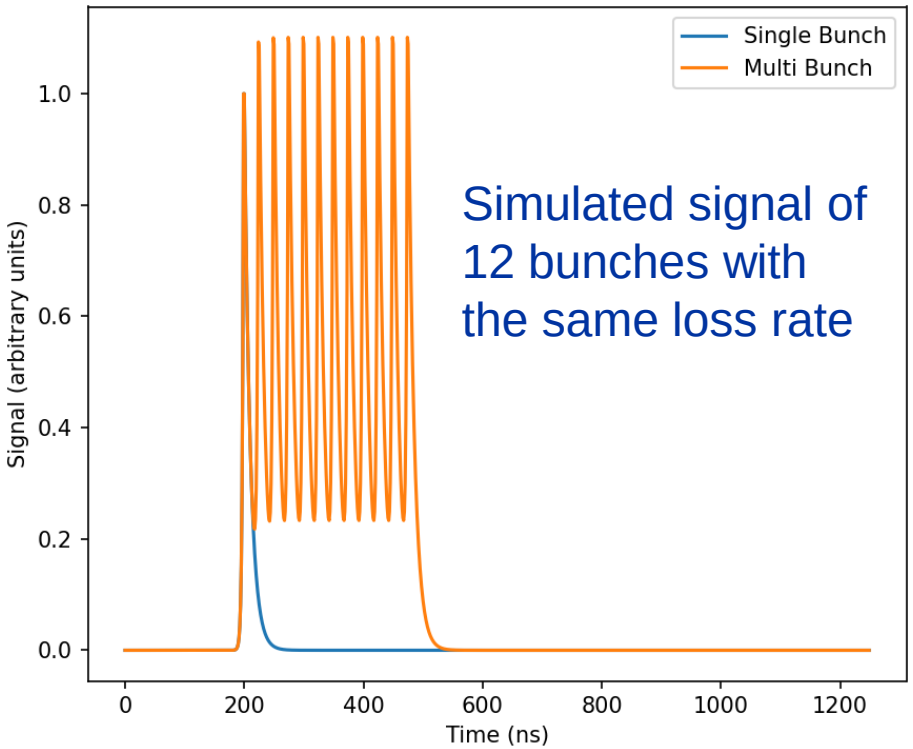
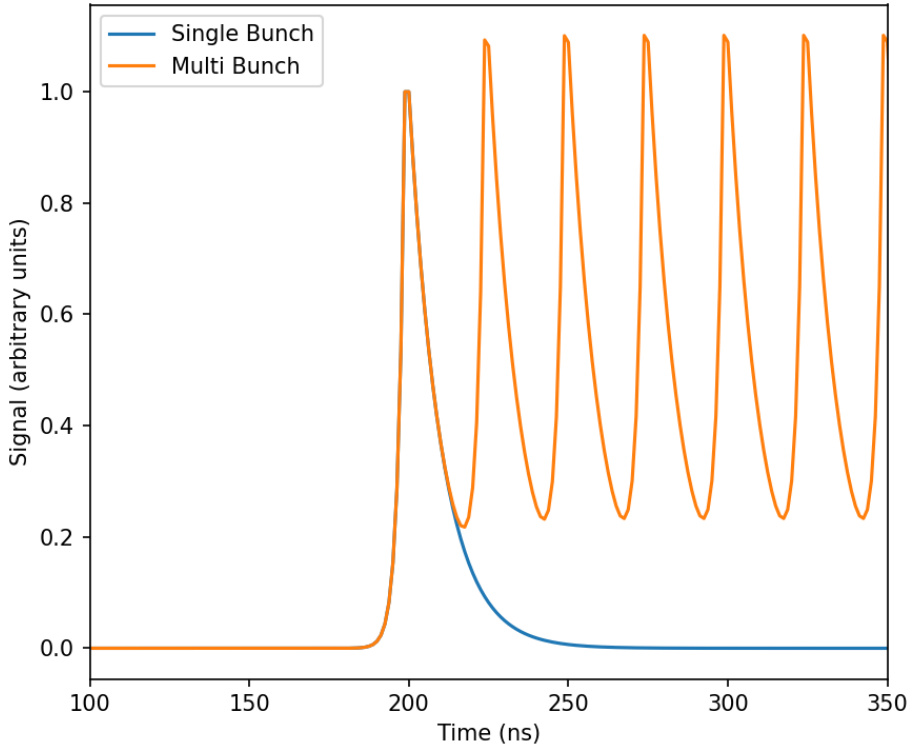
- pCVD diamond detectors (dBLMs)
  - Signal every 1.54 ns -> Bunch-by-bunch losses
    - ➢ NXCALS capture data subscription on demand (max ~ 23 LHC turns)
  - Firmware -> Integral measurement mode -> bunch-by-bunch loss integration every 1s



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

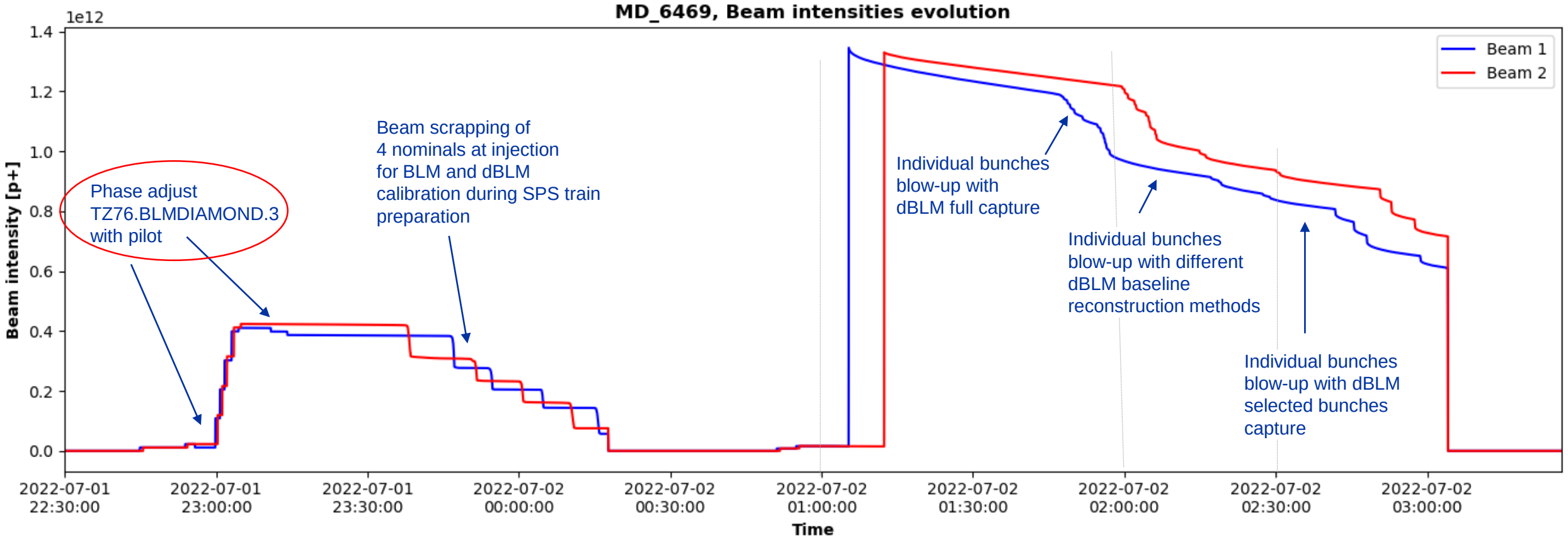




B.Salvachua | rMPP MD1 on link

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

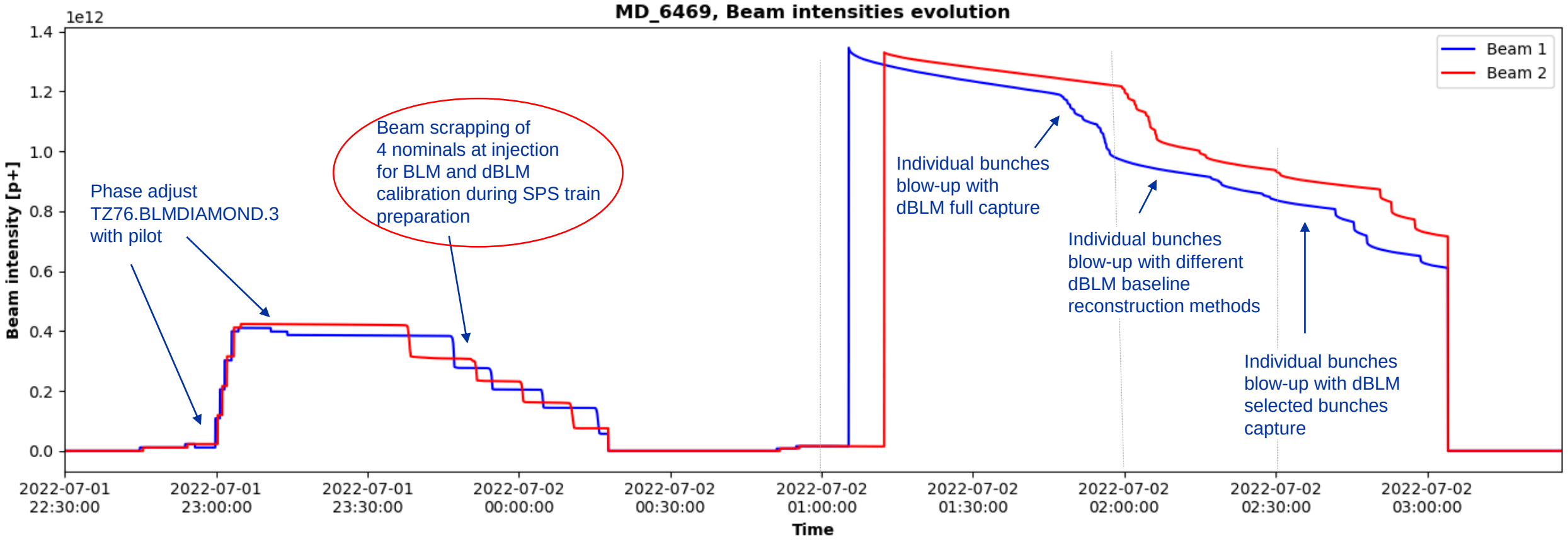
- Phase adjust of dBLMs in Point 7 performed on 02-06-2022
  - OK for all except for one (TZ76.BLMDIAMOND.3, close to TCPC)
  - Not enough losses, not enough signal to adjust the phase
  - In later analysis signal seemed ~ 31 bunches off phase
- Retried phase adjust on this monitor
  - BLMs masked
 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

Phase adjust TZ76.BLMDIAMOND.3

Signal in the correct bunch!

Verified correct phase in the rest of dBLMs too

Summary


MD_6469, Beam intensities evolution
1e12
Beam intensity [p+]
Time
Beam 1
Beam 2
Phase adjust
TZ76.BLMDIAMOND.3
with pilot
Beam scrapping of
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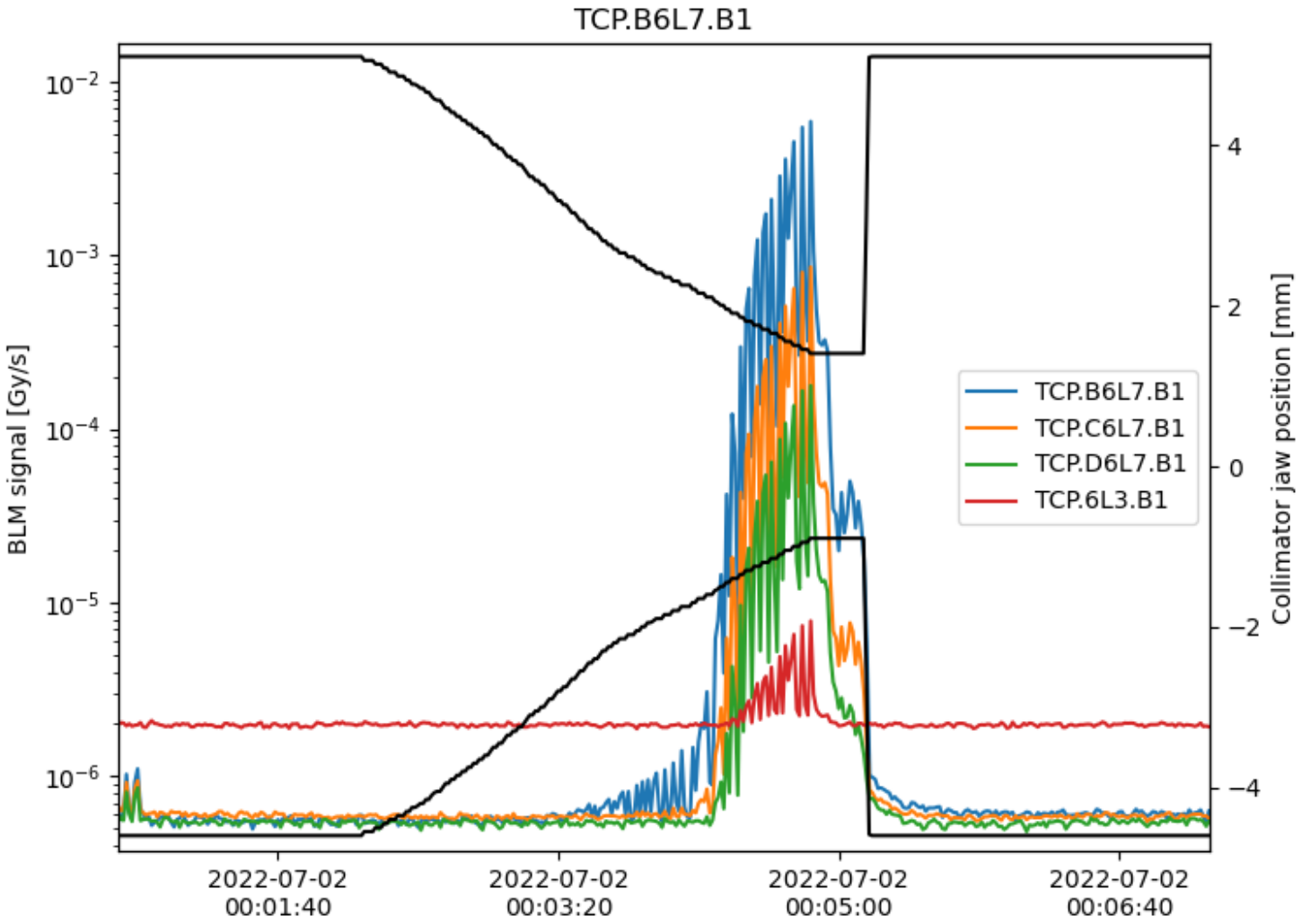
capture

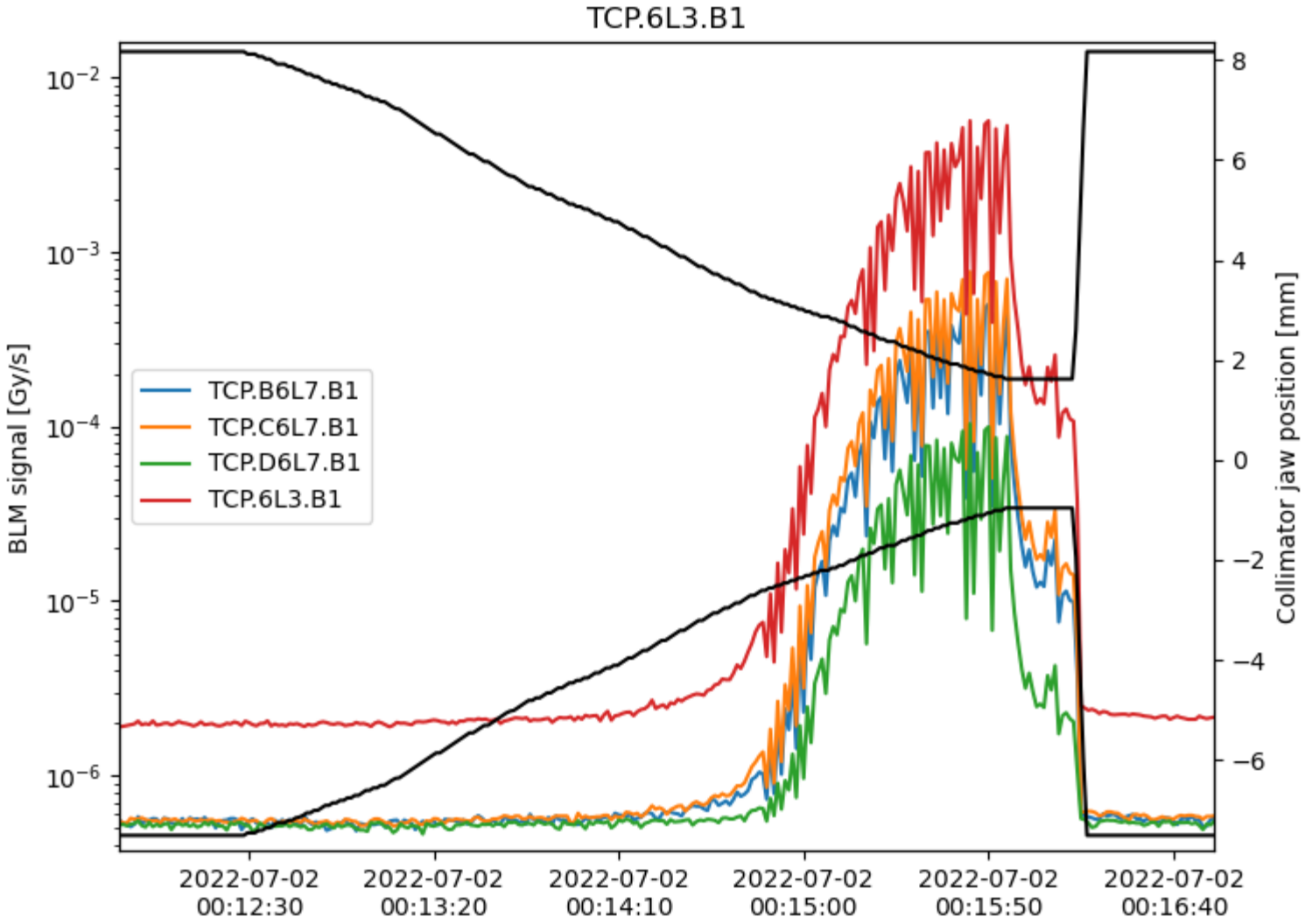
Beam scraping at injection

- 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 um
  - ➢ Calibration of IC BLMs and dBLMs at injection energy

Beam scraping at injection



Beam scraping at injection



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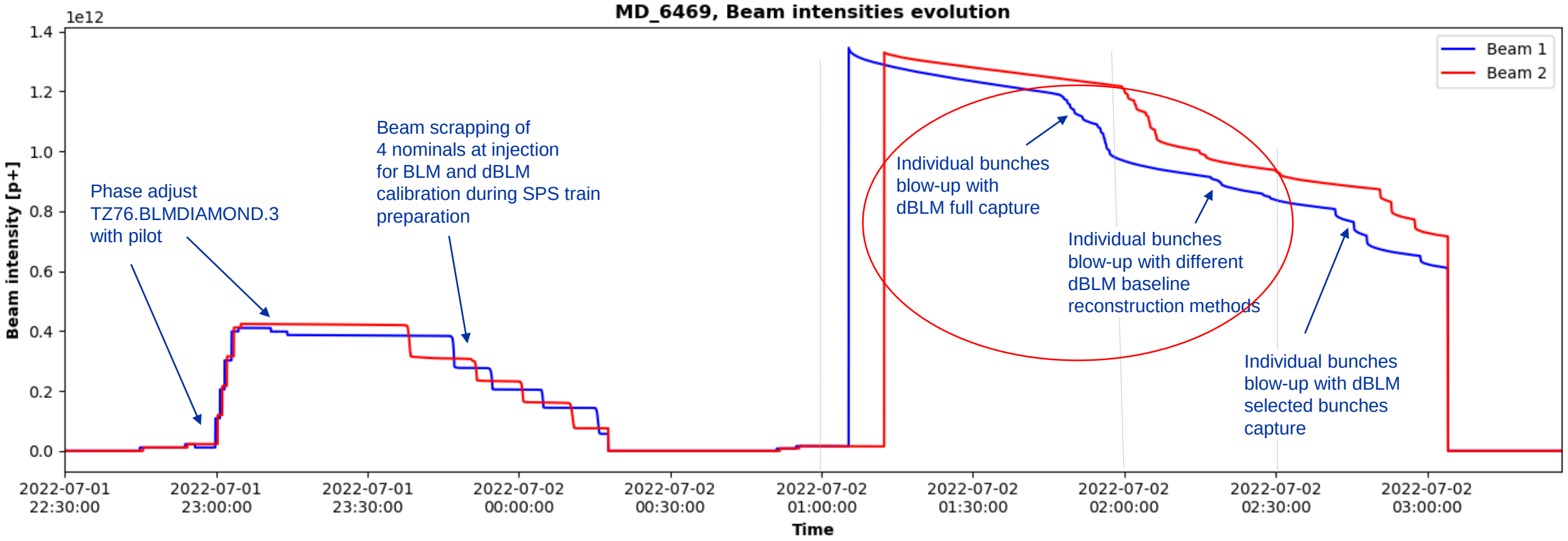
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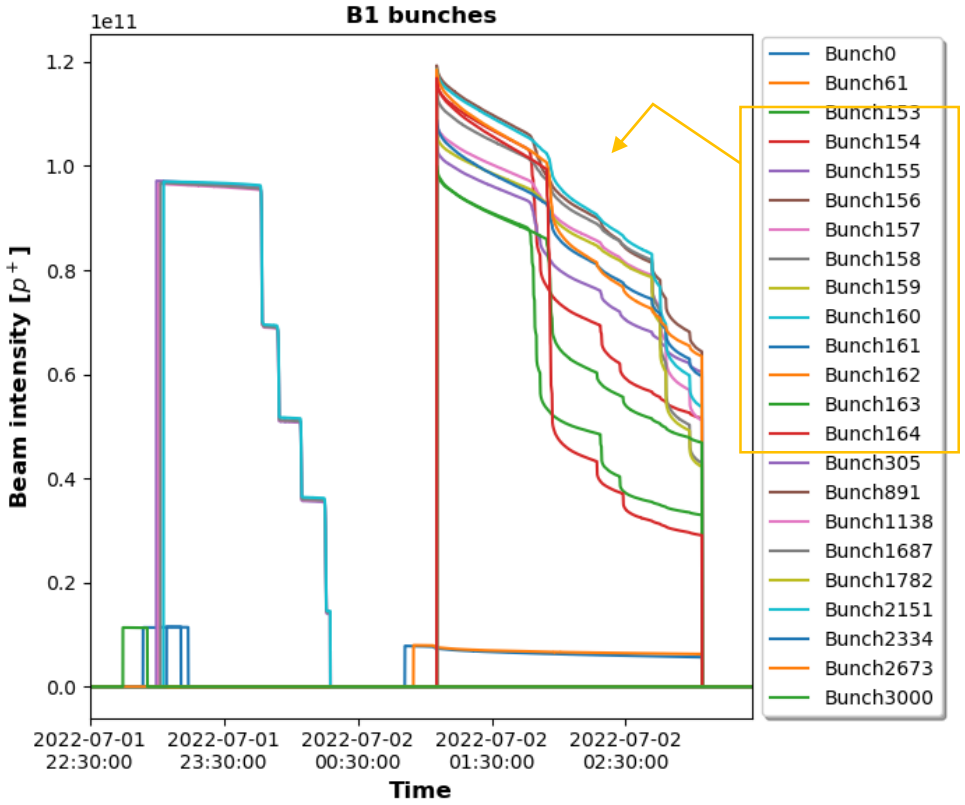
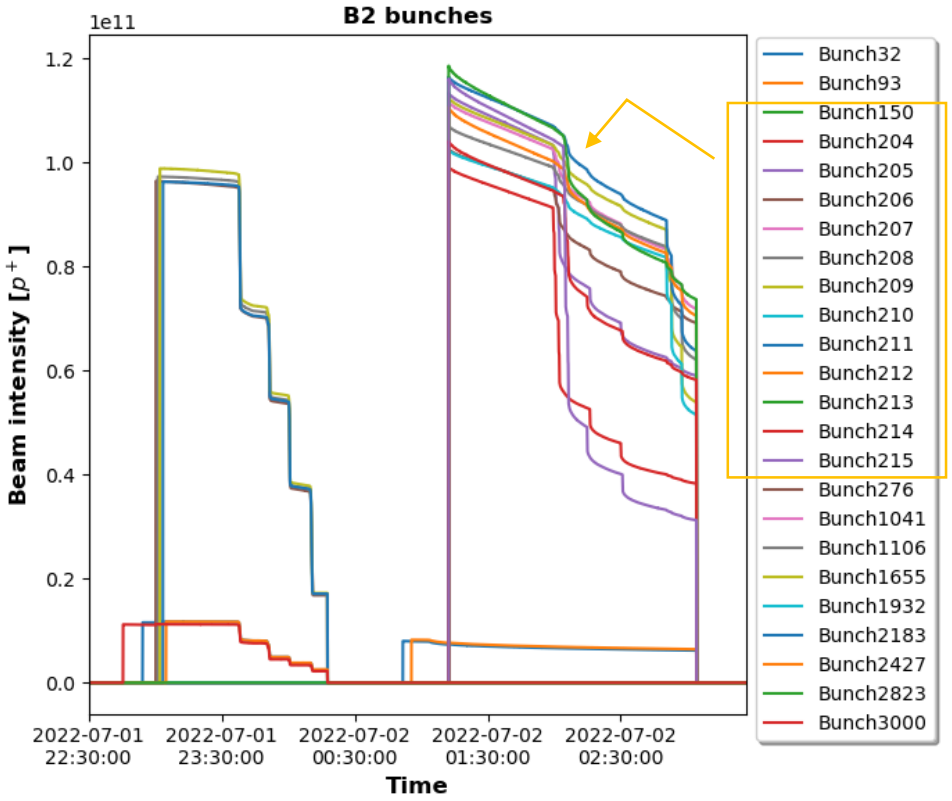
Blowup of single bunches in 12-bunch train

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

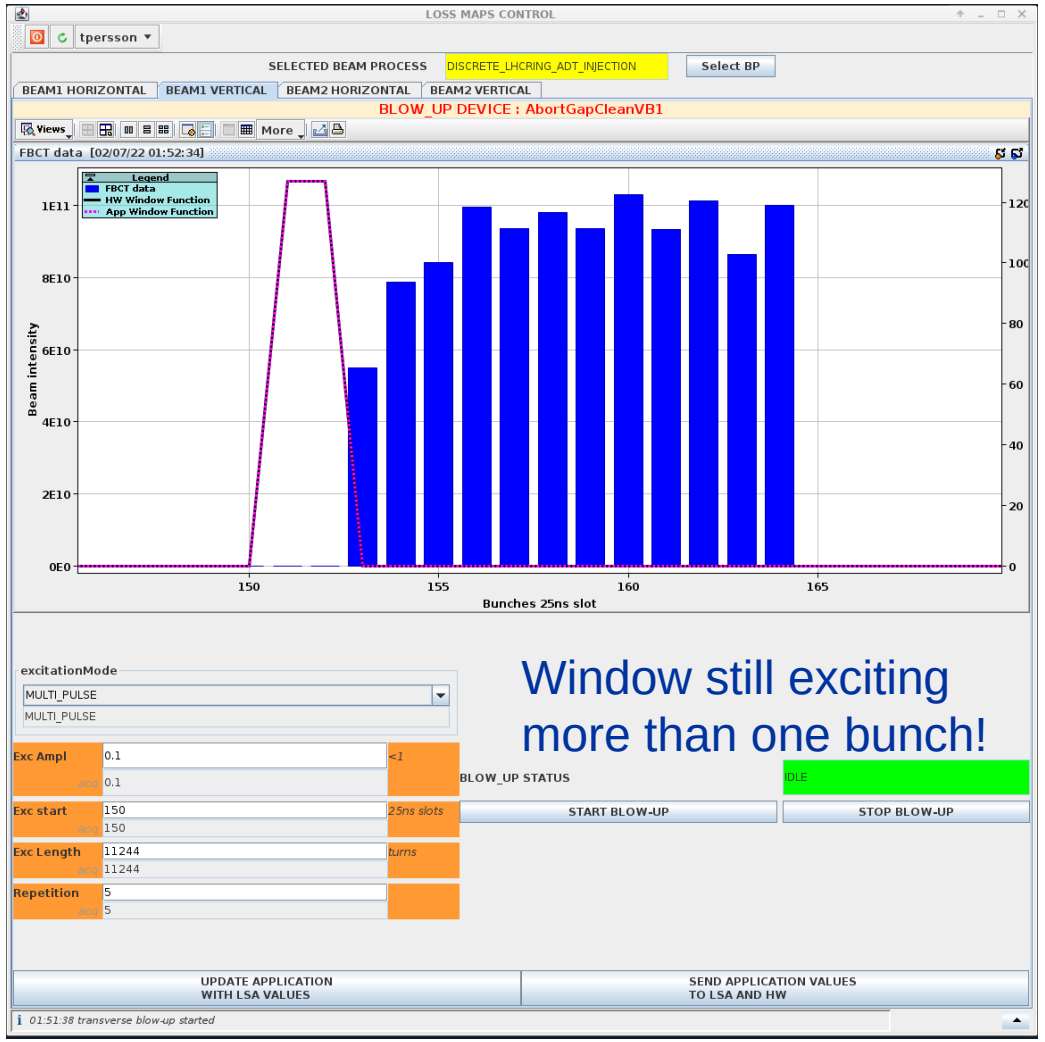




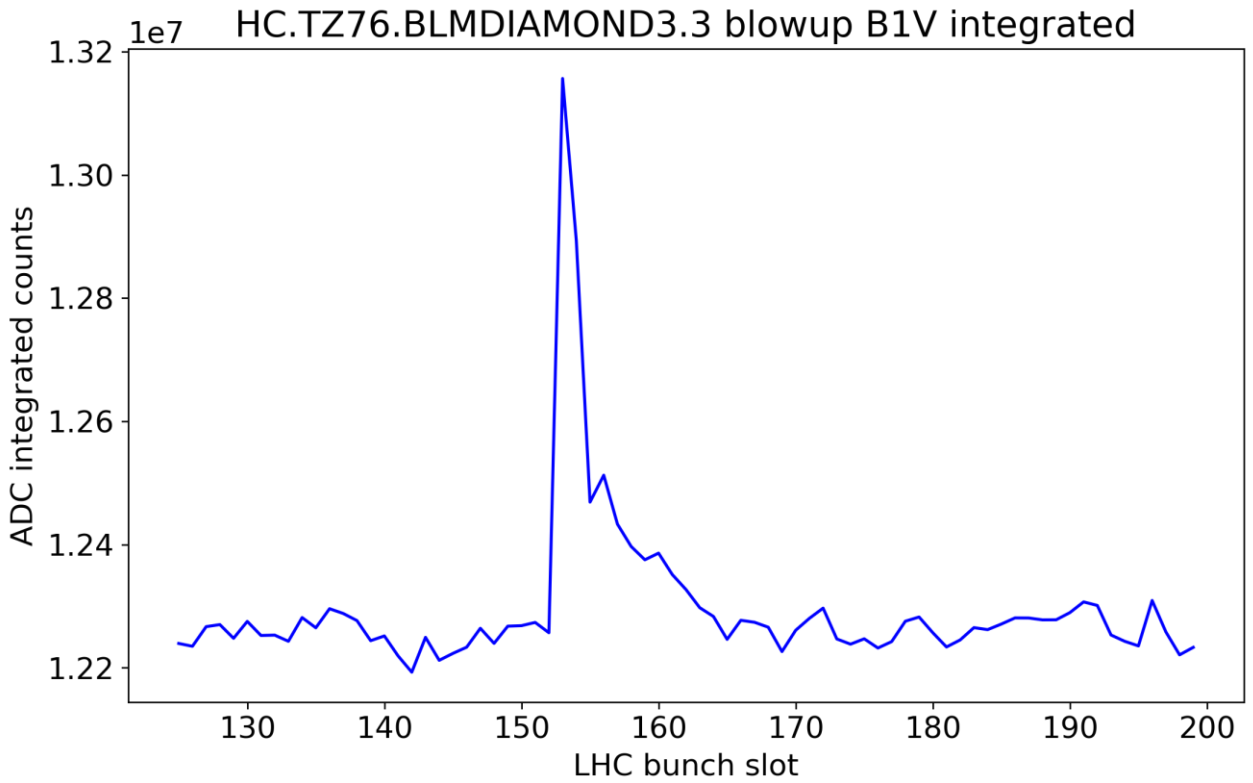
Blowup of single bunches in 12-bunch train

- 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



Window still exciting more than one bunch!



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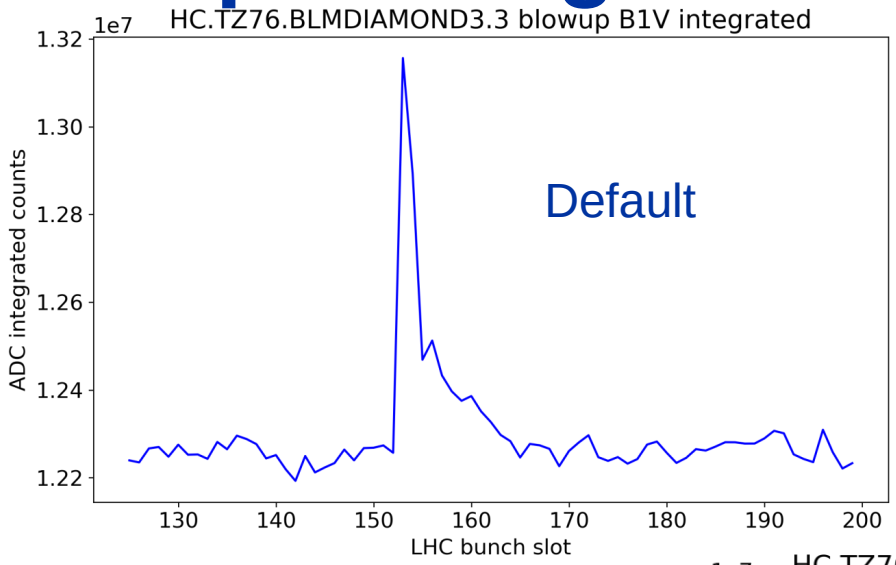
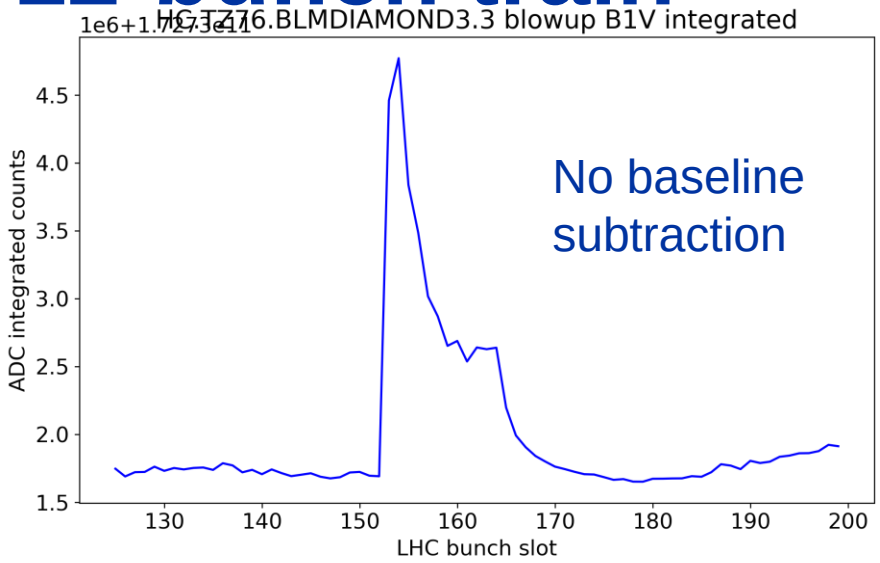
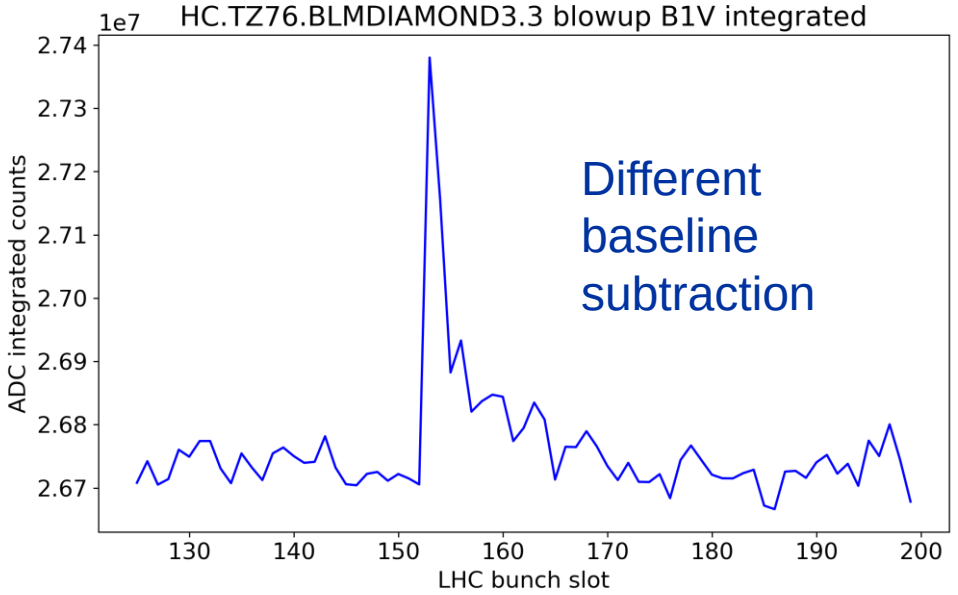
- BLMs unmasked
- Injected train of 12 nominal bunches in B1 and B2
- Could not use lossmaps application
  - ➢ Used ADT application, window too wide, managed to change it
  - ➢ Excited bunches at the beginning and the end of the train
- Disabled baseline subtraction and repeated
- Changed baseline subtraction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

Blowup of single bunches in 12-bunch train

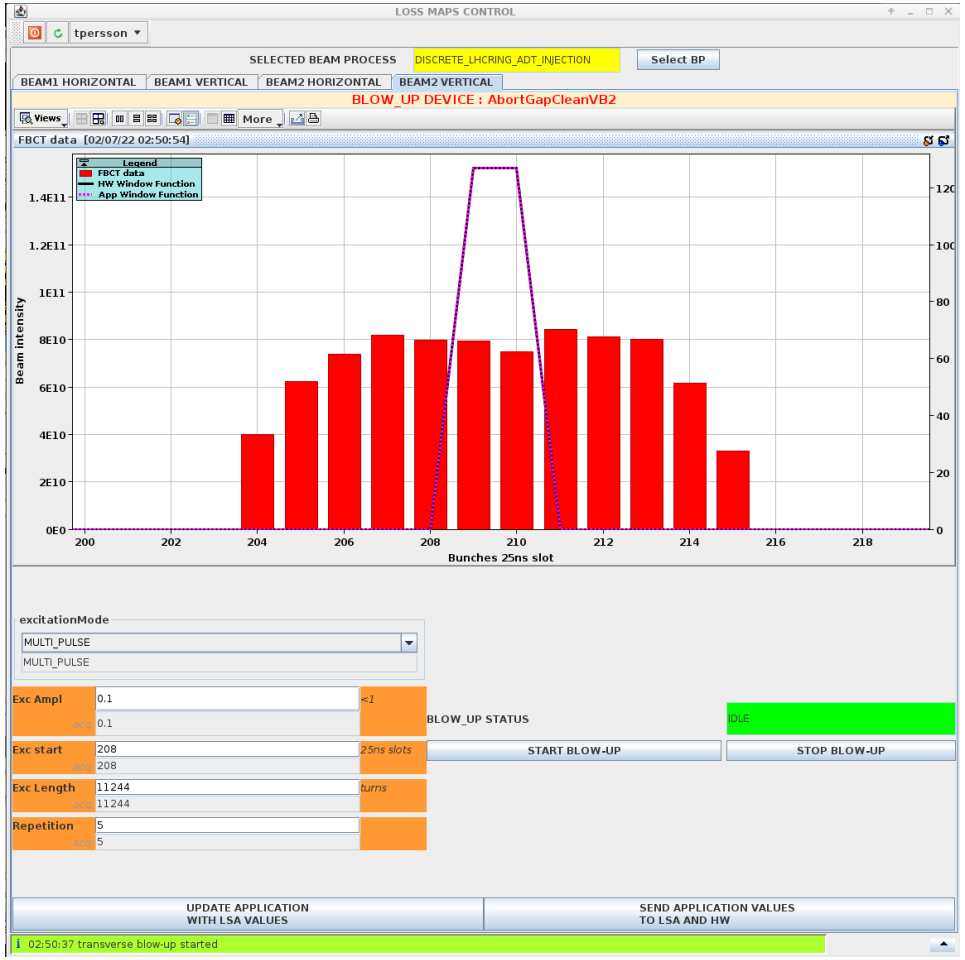


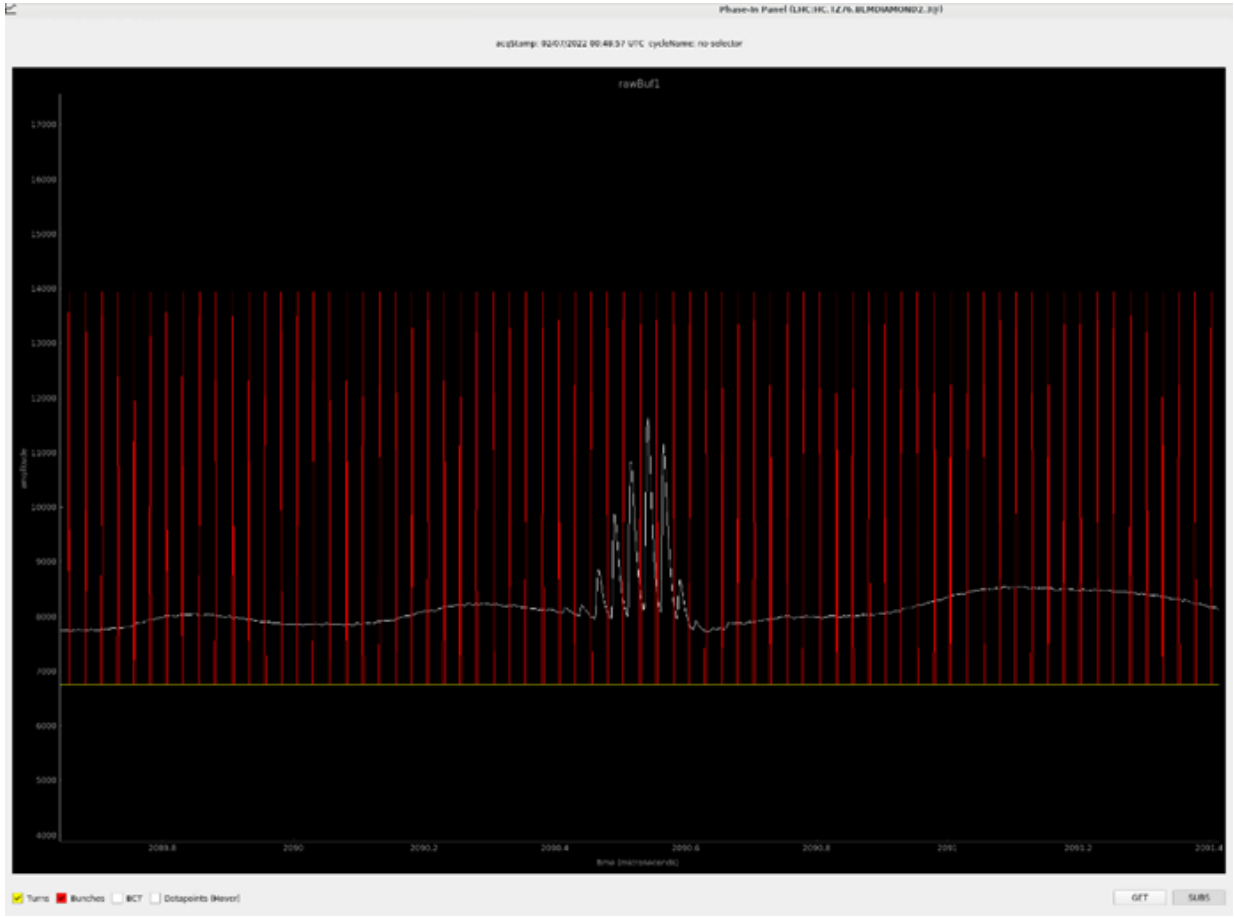




BST Bunch selection

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

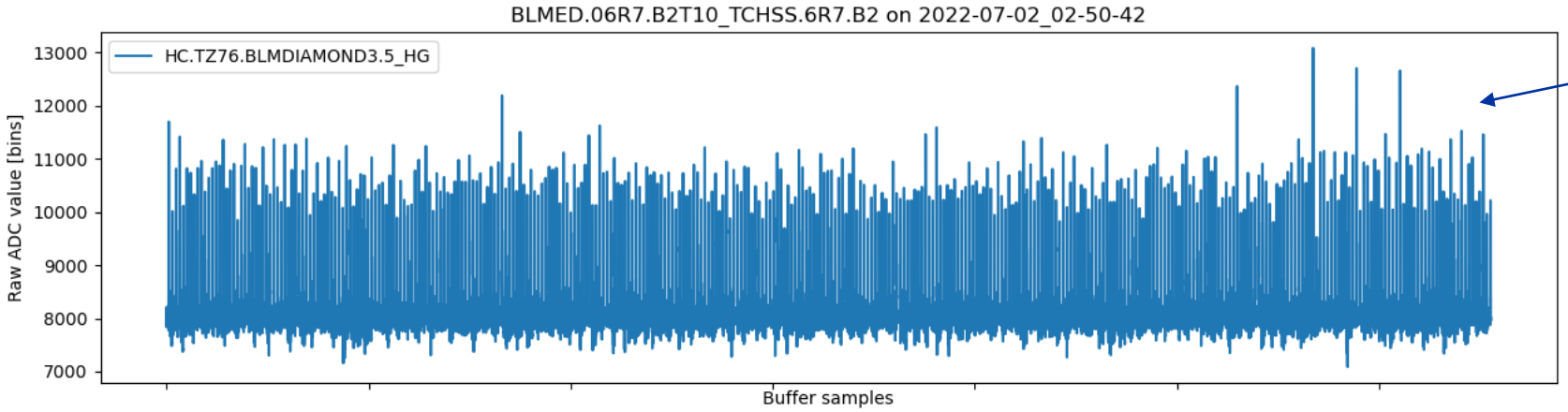




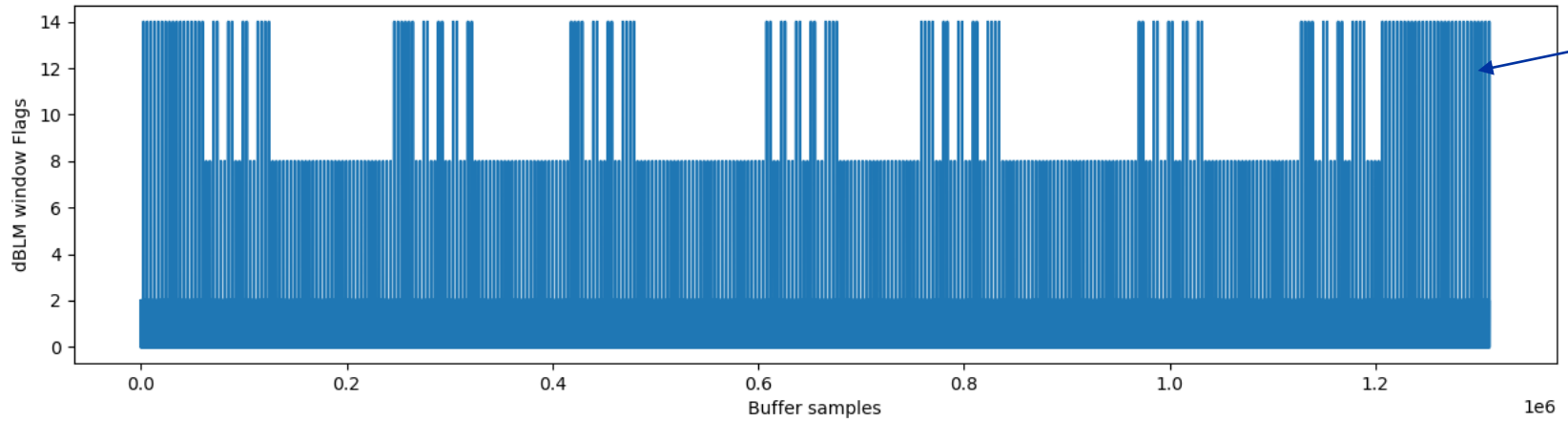
dBLM expert Application, zoom on captured losses

BST Bunch selection

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

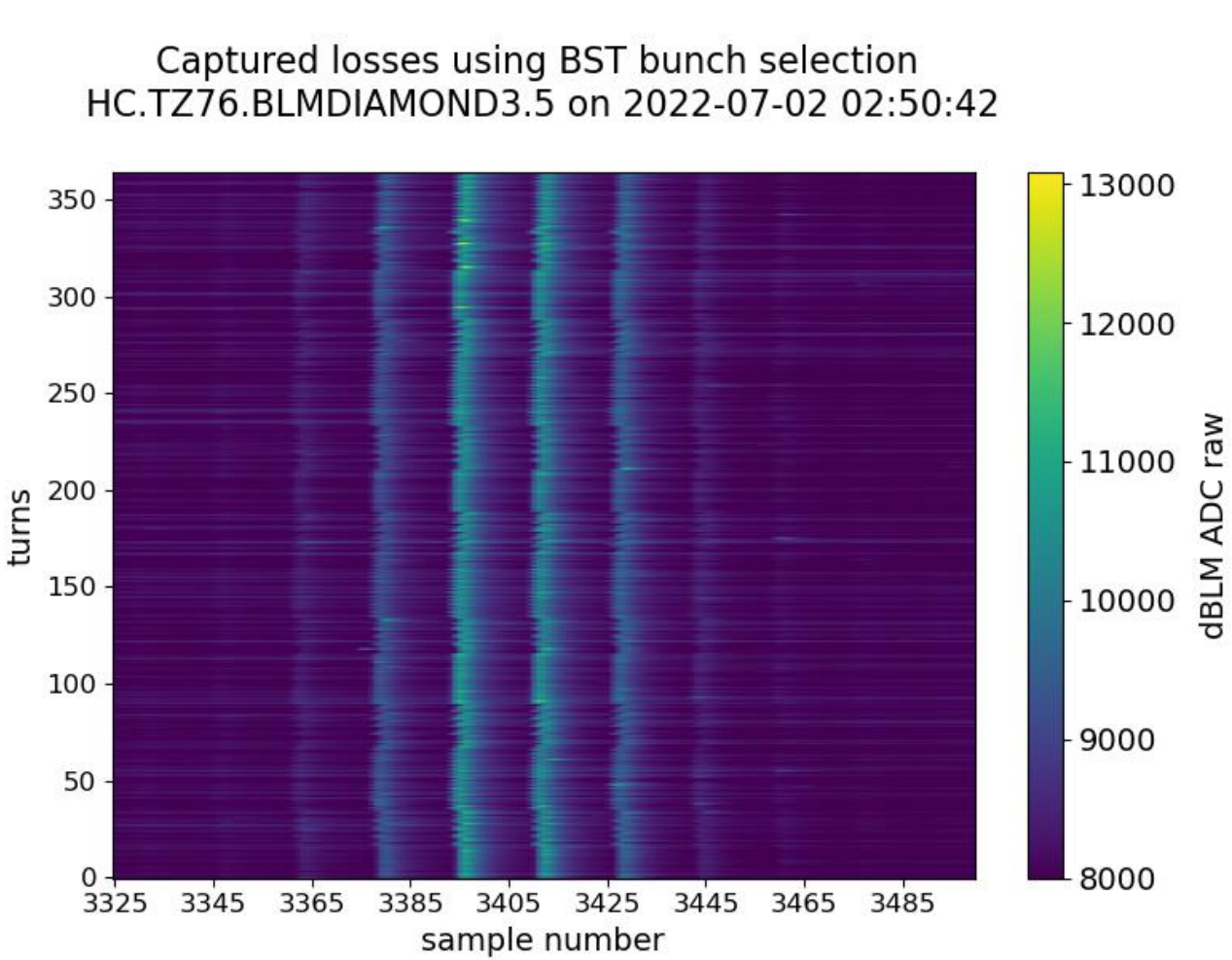


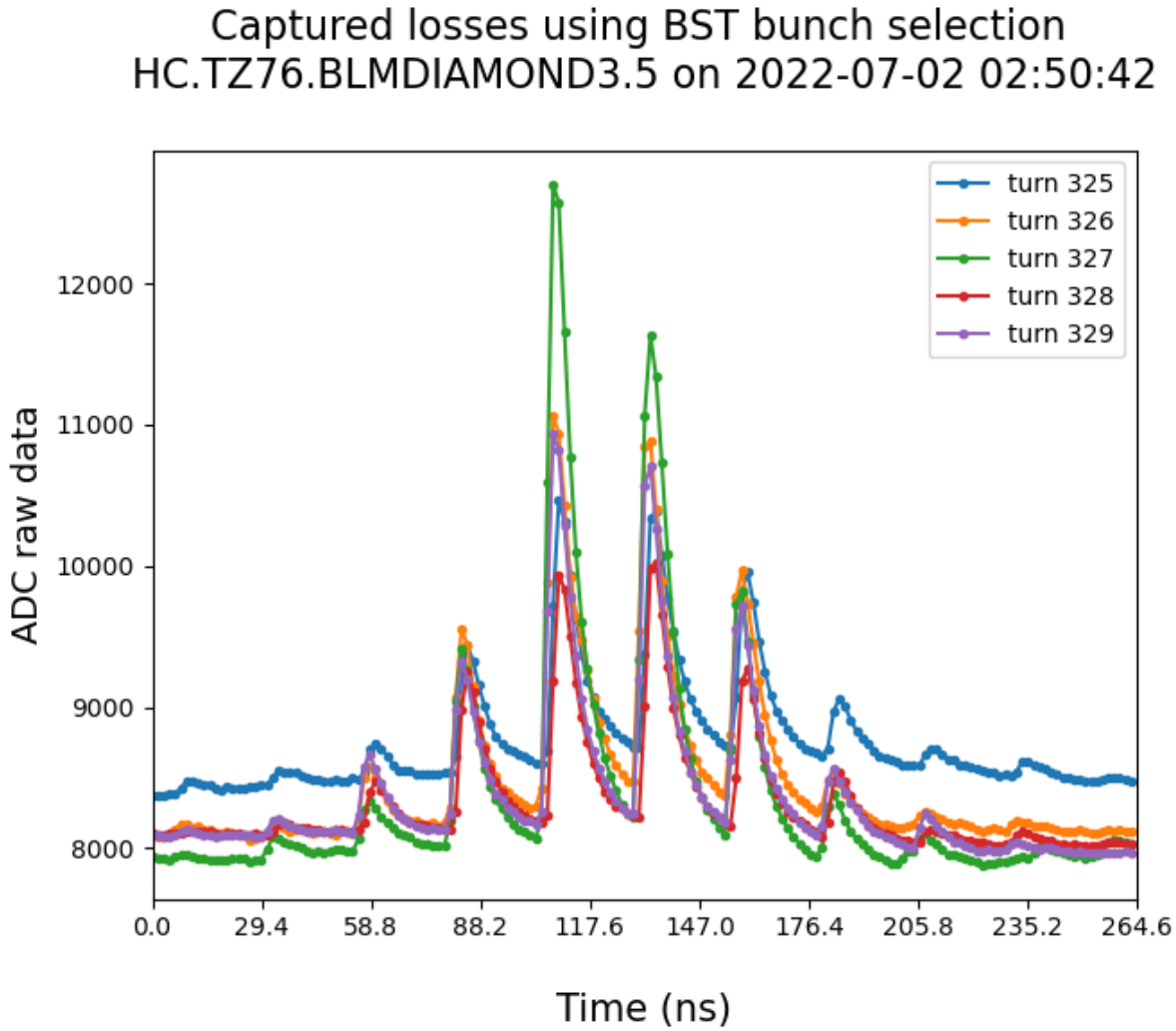
Captured data on selected bunches



Window flags indicate when every capture window started

BST Bunch selection





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

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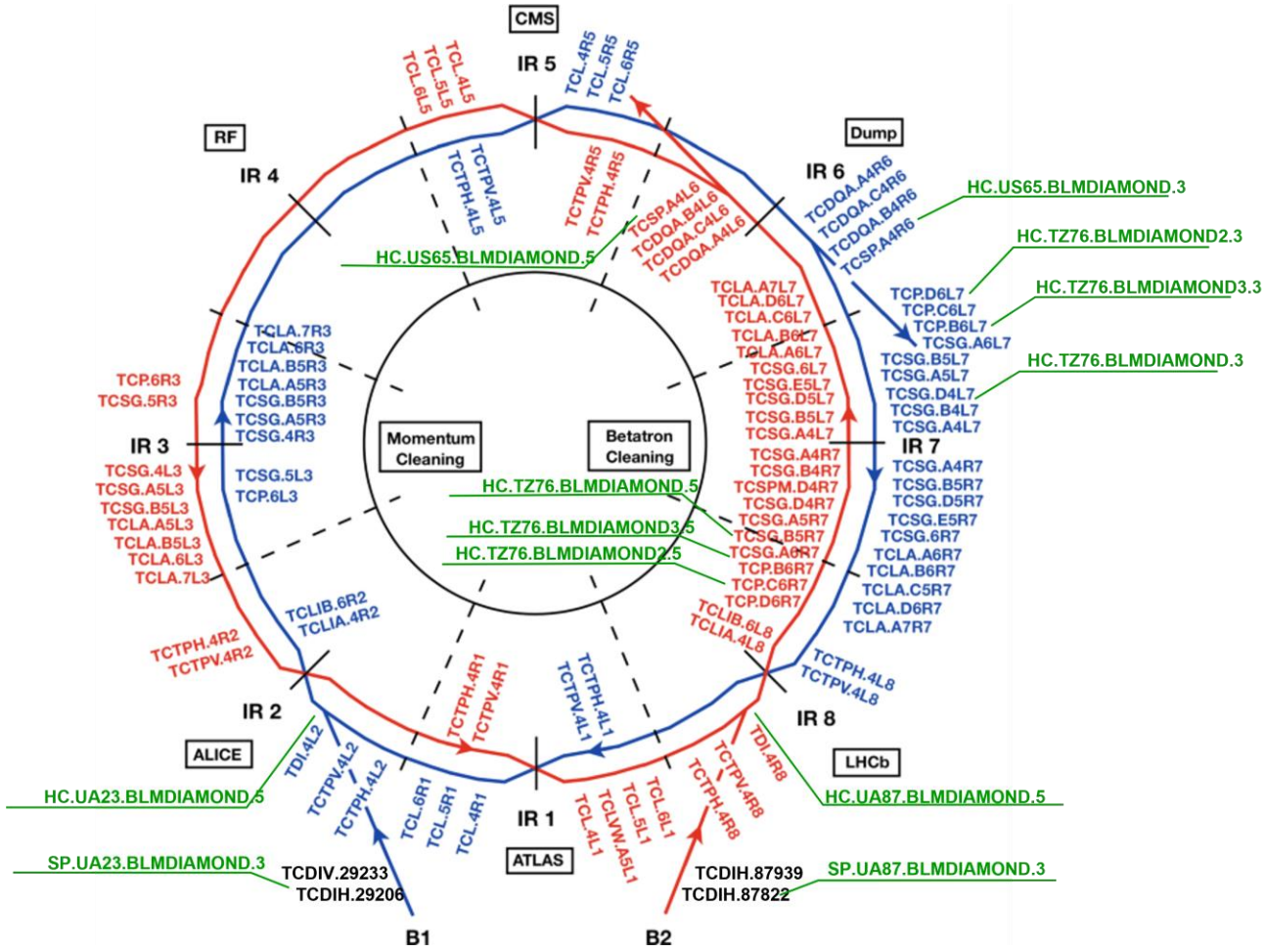
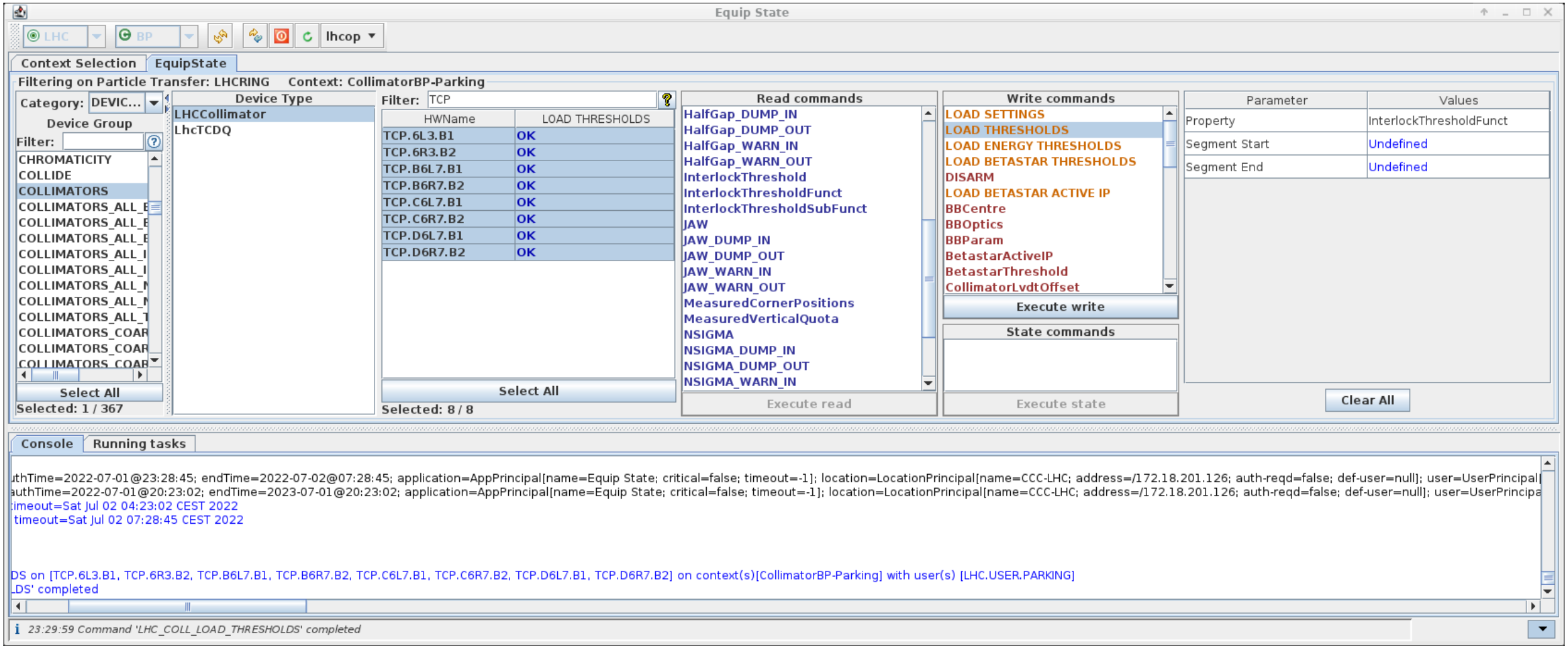
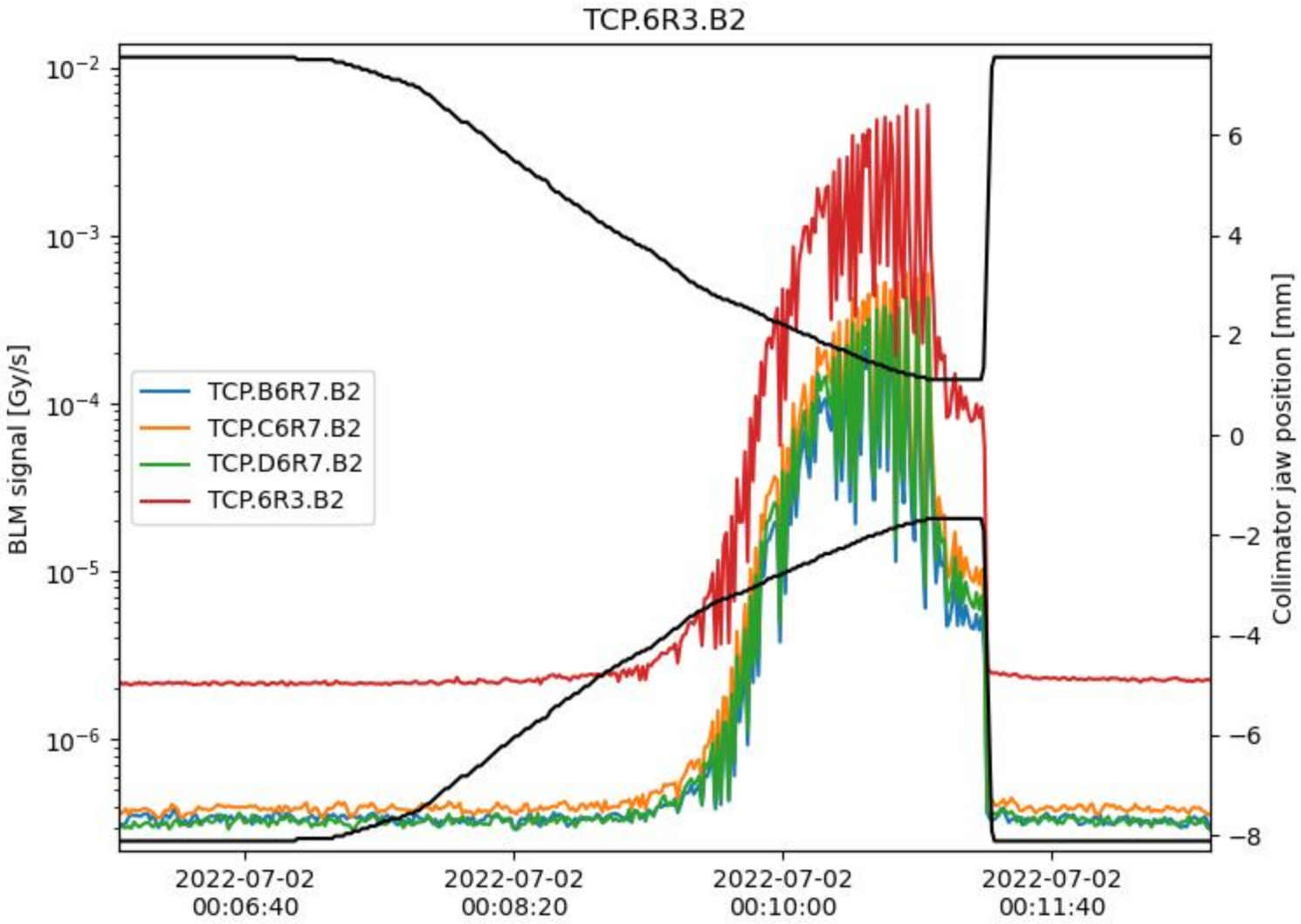


IR3 and IR7 TCPs thresholds changed



Beam scraping



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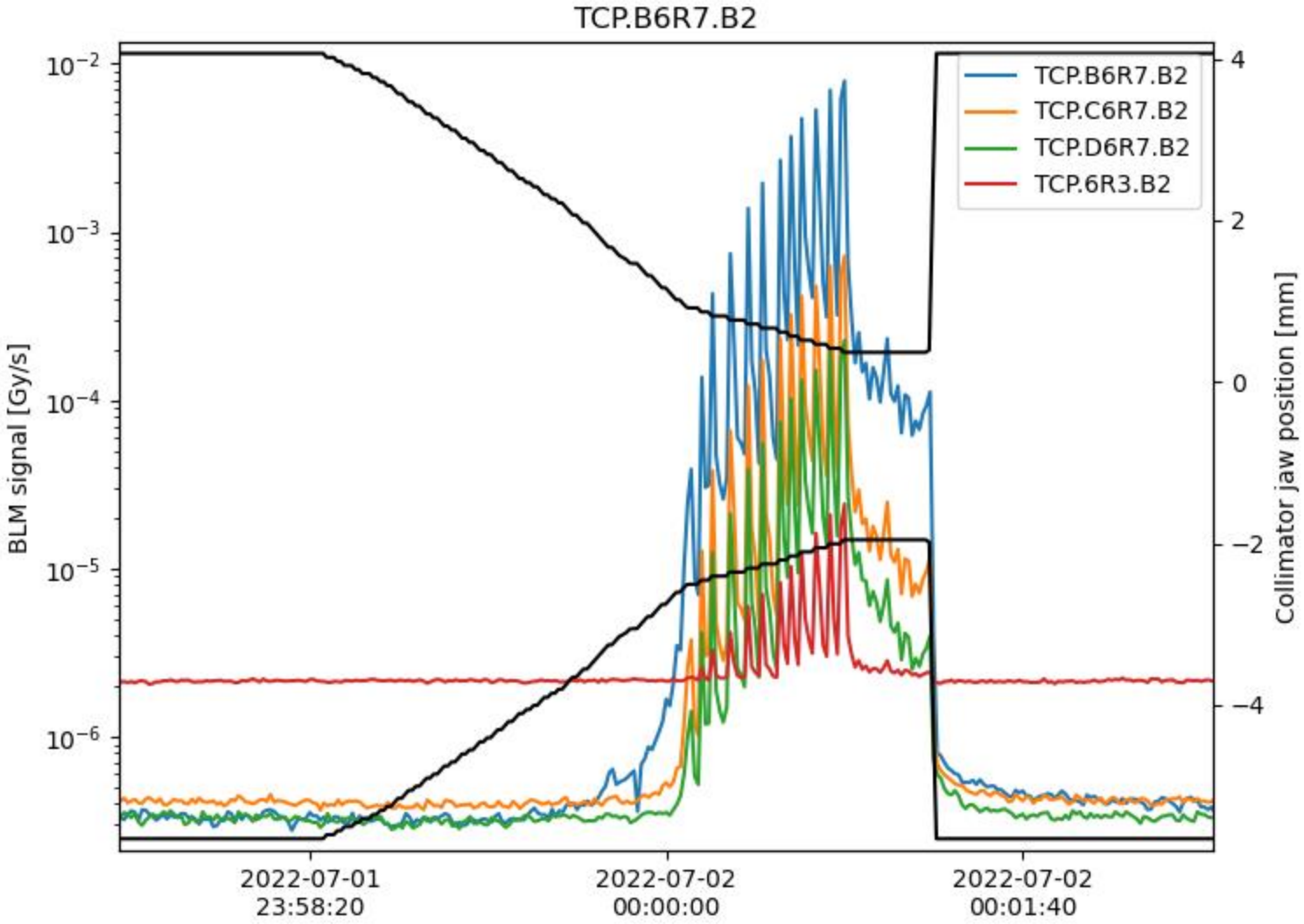

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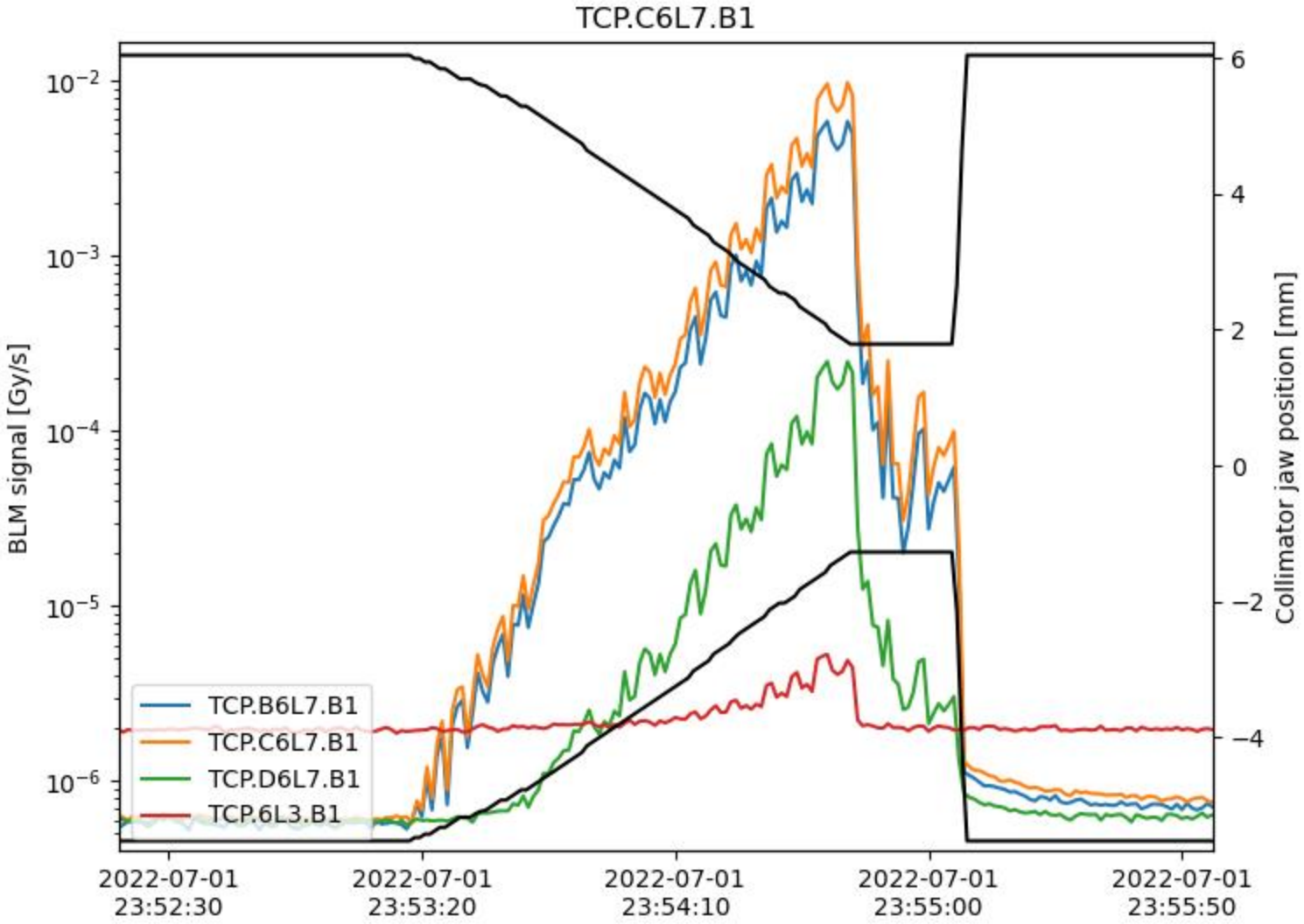

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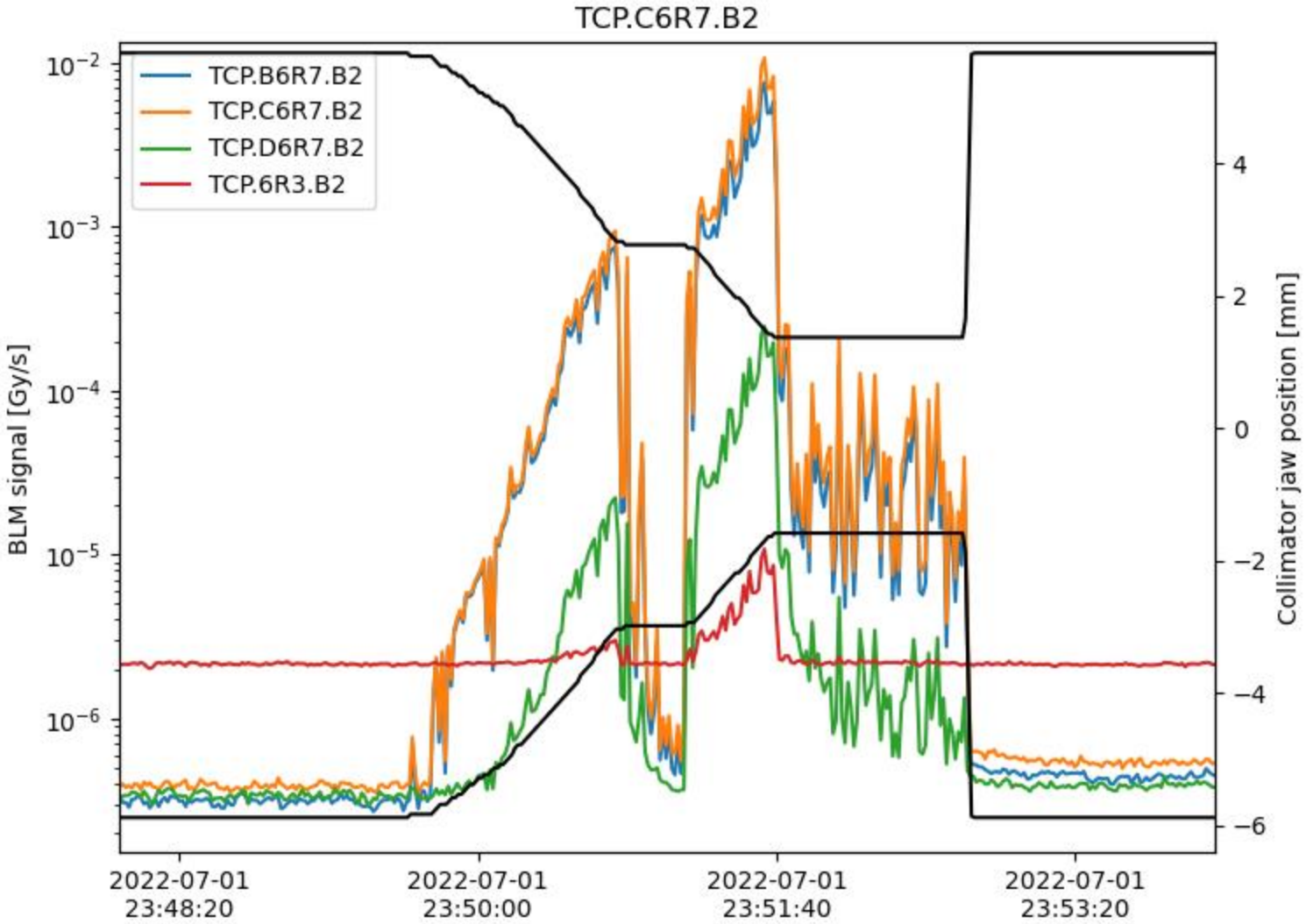

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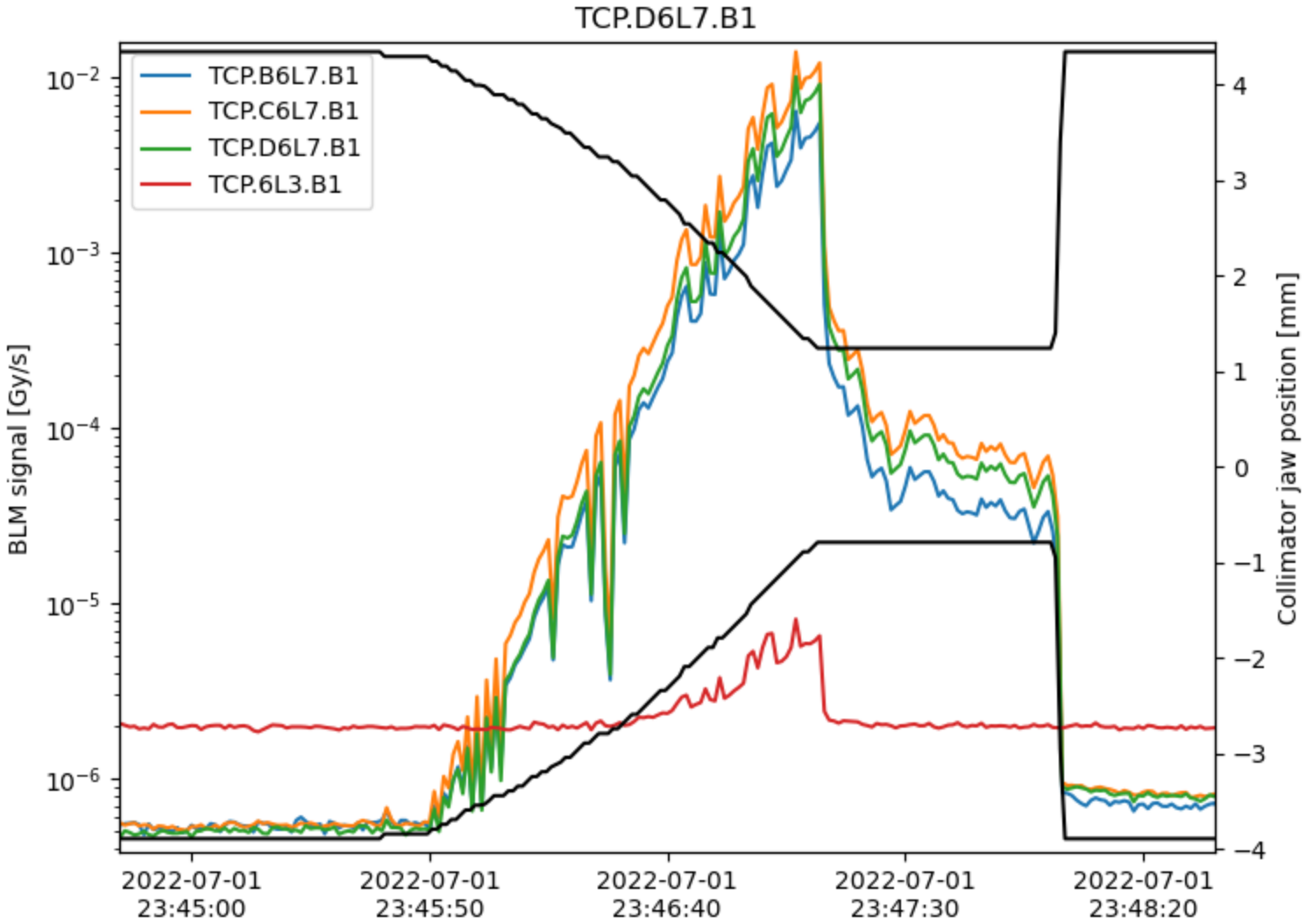

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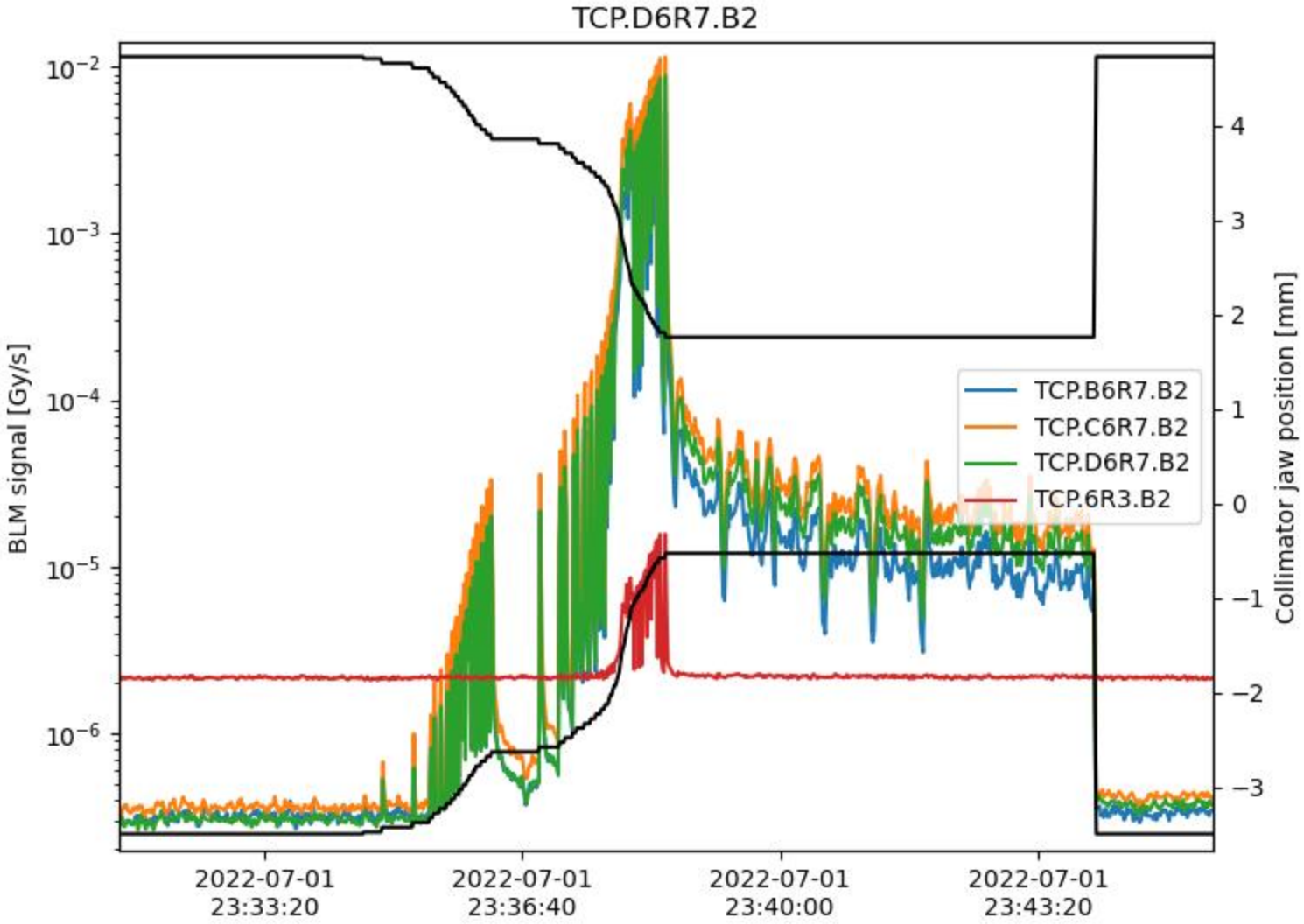

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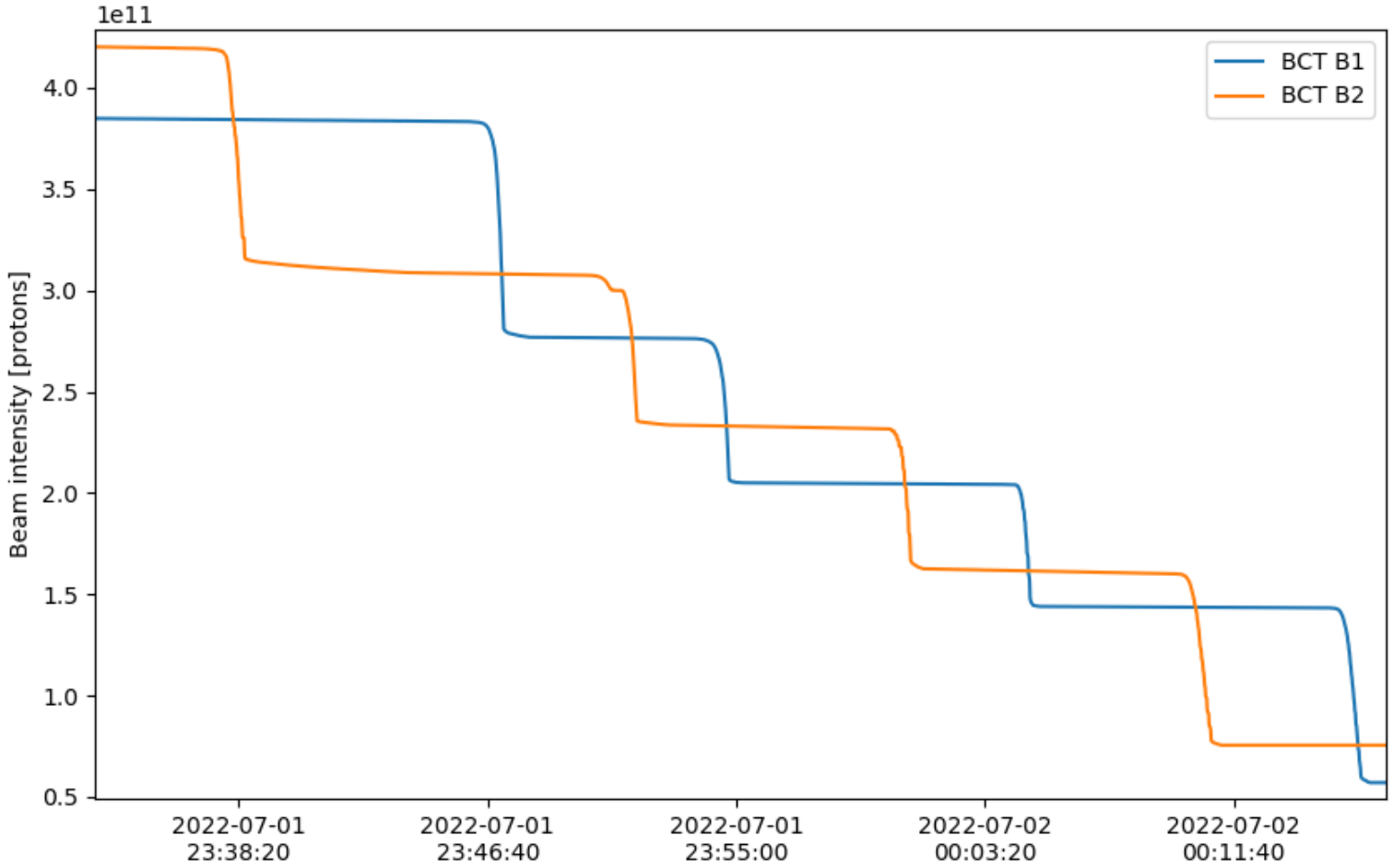

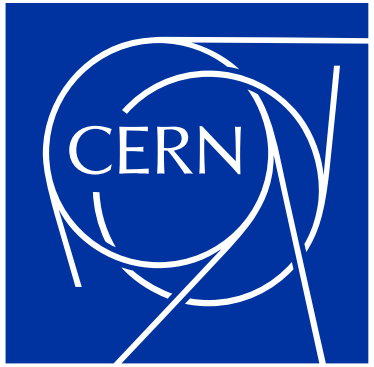

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