

Online Longitudinal Beam Measurement on OP/MD cycles

Beam Current Wall Longitudinal Beam Observation (BCWLBO) FESA Class

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How the FESA class works

- **Fully multiplexed class & high flexibility of use-cases**
 - Every trace can be set differently
- **Start Acquisition Event**
 - Timing / On-demand event that starts one acquisition
- **End Acquisition Event**
 - Timing / On-demand event from which we abort the “wait” acquisition
- **The device publishes as soon as data is available**
- **FESA Class directly linked to the HW cards for acquisitions**
 - Rely on **OASIS Scope (on the FESA layer) & COHAL Layer** (for generic purposes) (@Martin & Dimitris)
 - **But fully independent from the OASIS server (removing master/slave)**

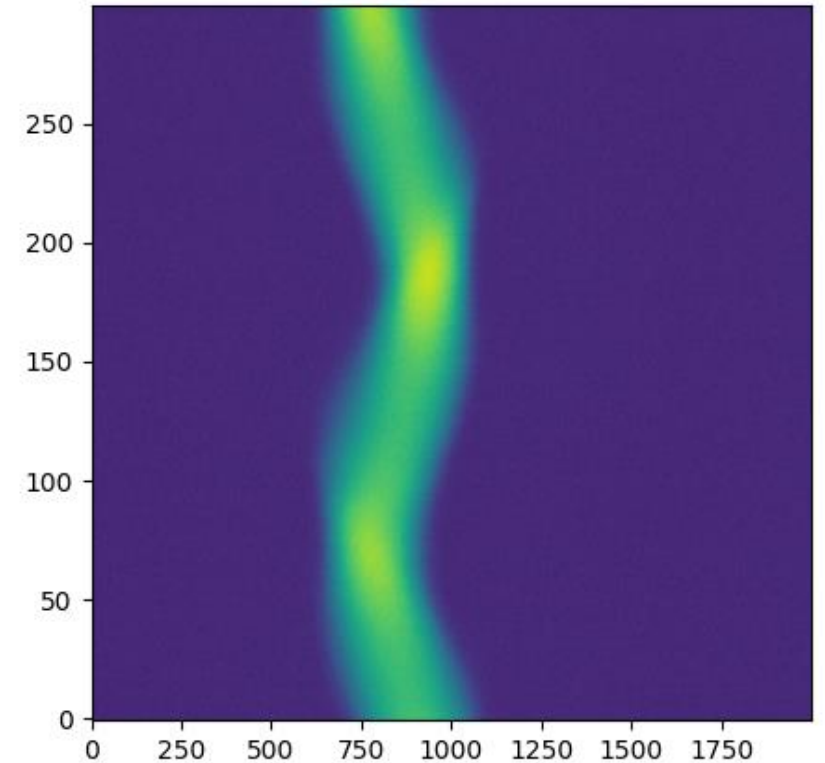
Input interface

Each trace is associated with:

- One group: Publication of the FESA Class is done by groups
- One burst:
 - Corresponds to 1 burst LTIM settings (@PS & @PSB)
 - Corresponds to 1 train of triggers VTU settings (@SPS & @LHC)

Each trace has its settings:

- Sampling interval
- Trigger delays
- Number of samples

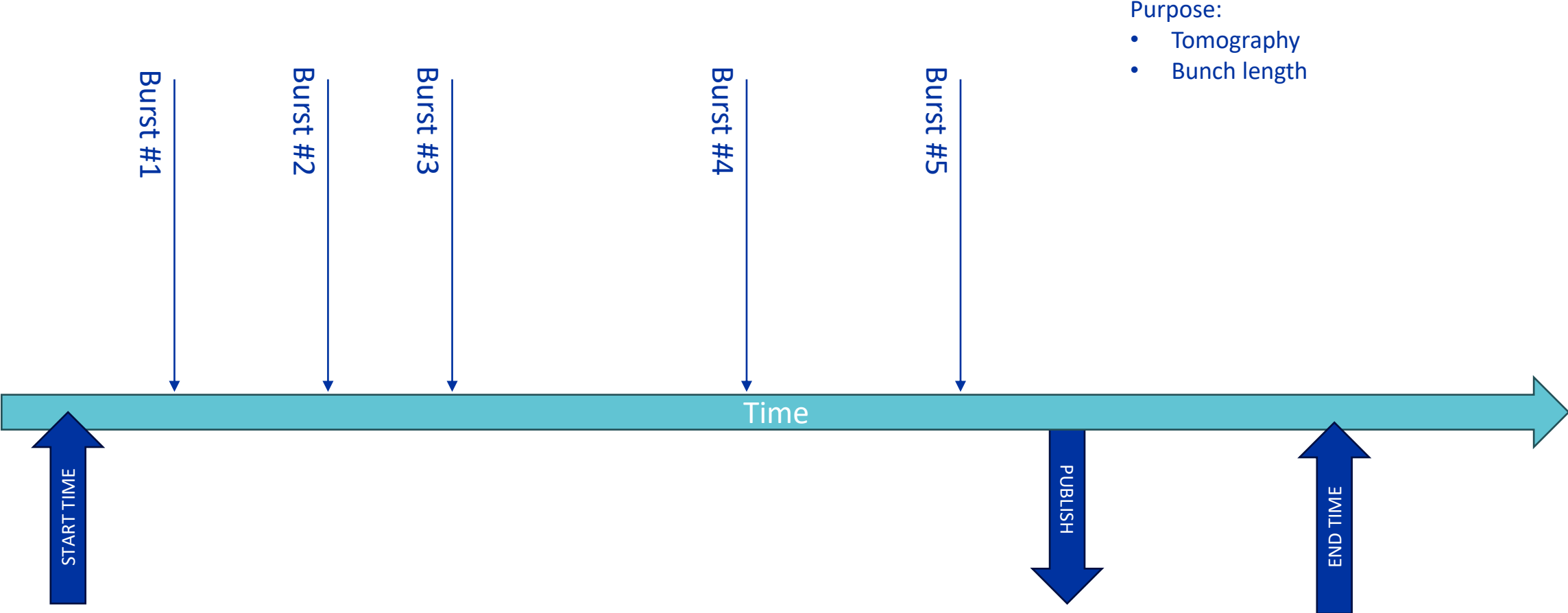


Acquisition modes

Burst vs trace vs continuous acquisition

Burst/Trace Mode

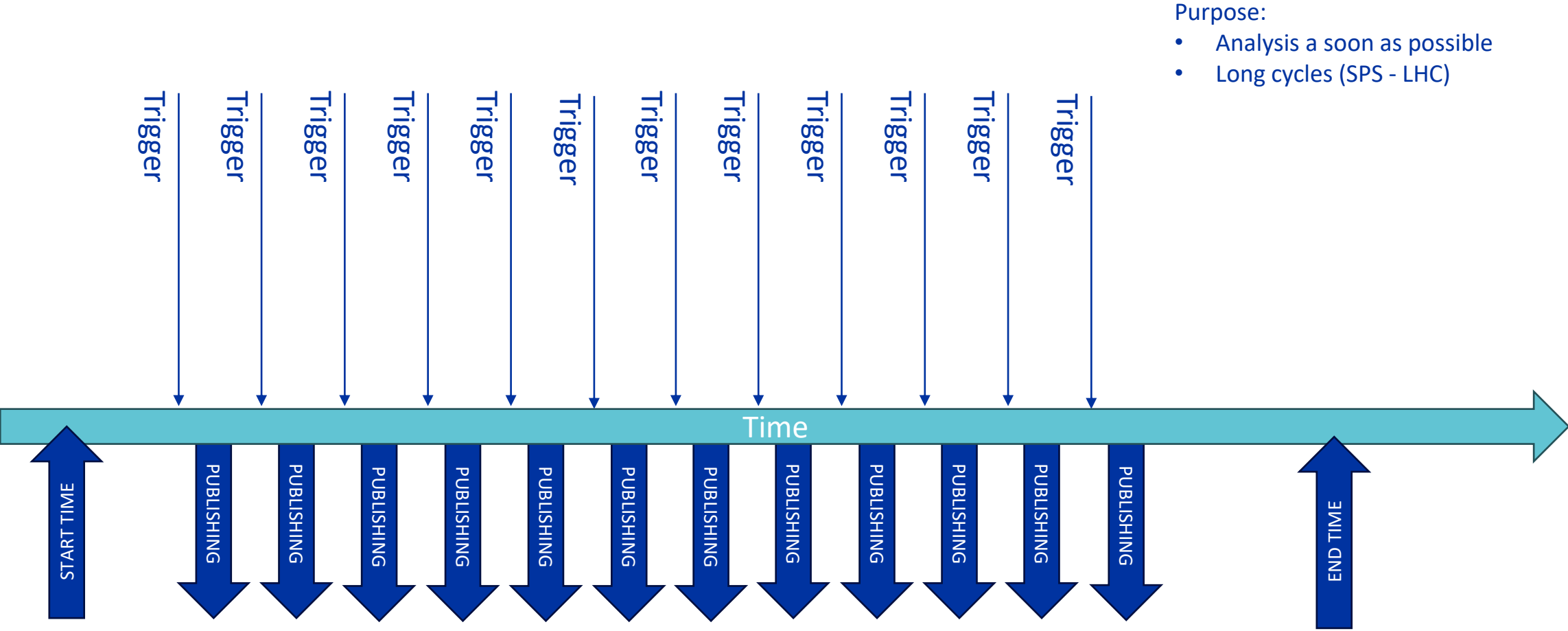
Publishing at end of acquisition



- Purpose:
- Tomography
 - Bunch length

Continuous Mode

Publishing the same set of traces every x ms within a cycle



Integration in the OP environment

In the @CPS (expected to be extended in the PSB and SPS)

WCM application

Settings

CPS 2024-10-09 14:42:42

WCM Ctrl

Acq. stamp: 14:42:07 || Freeze acquisition

Acq. state: OK ^ Analyze acquisition

Trigger collisions: None suspected

Trigger settings: Synced ↻ Synchronize

HW Setup Tomography Settings

Disable global % Disable all Clear all

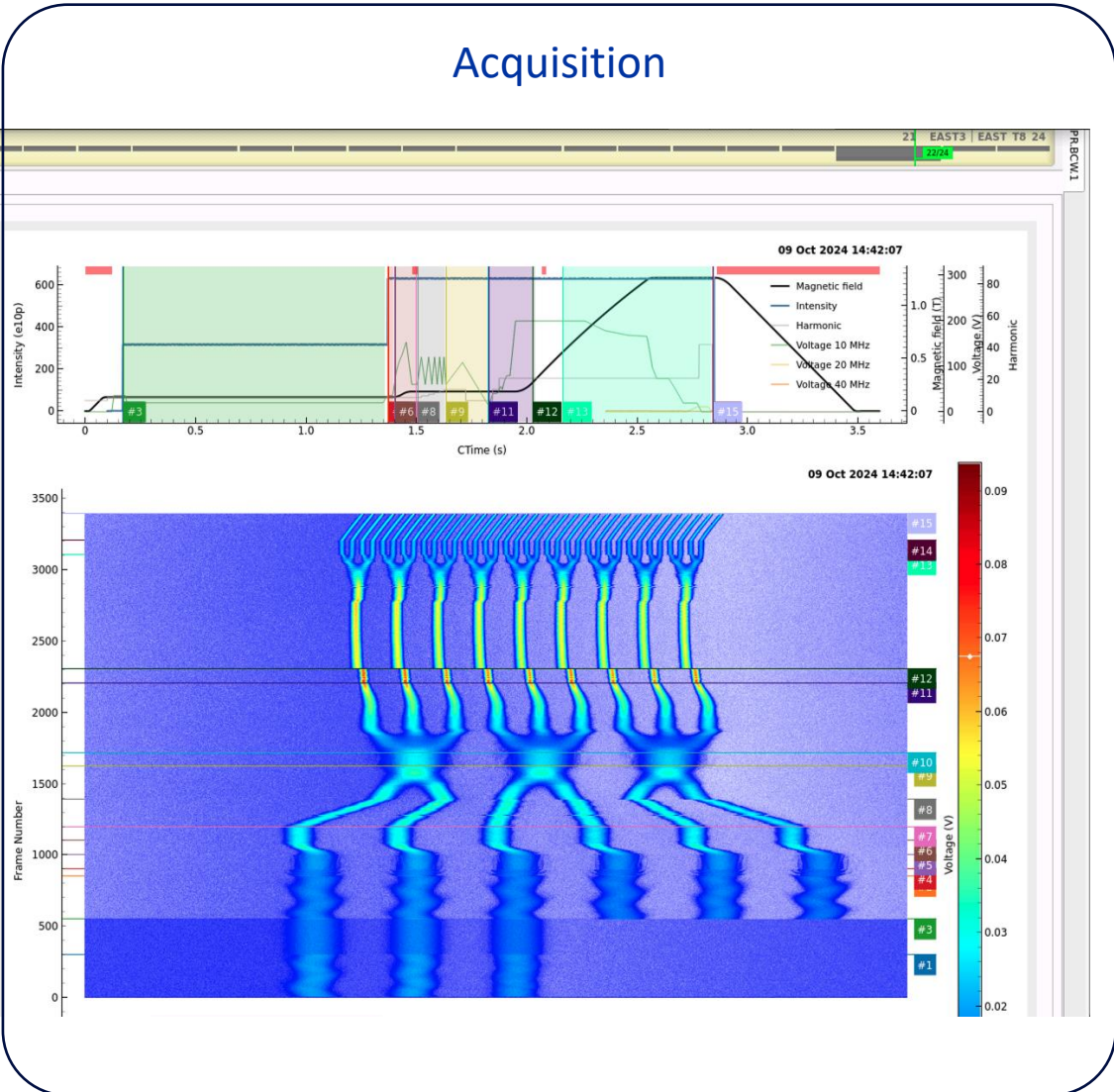
Autoconfig injection / extraction (1, 2, 15, 16)

ALL

Enable	C Time	Δ Turns	N Traces	N Samples	Sample (ns)	Δ Trig. (ns)
Burst #1	169	6	300	16000	0.125	0.000
Burst #2	1369	6	300	16000	0.125	0.000
Burst #3	175	2140	250	16000	0.125	0.000
Burst #4	1375	200	50	16000	0.125	0.000
Burst #5	1400	4	100	16000	0.125	0.000
Burst #6	1405	430	100	16000	0.125	0.000
Burst #7	1500	12	100	16000	0.125	0.000
Burst #8	1505	300	190	16000	0.125	0.000
Burst #9	1635	380	233	16000	0.125	0.000
Burst #10	1827	10	95	16000	0.125	0.000
Burst #11	1830	185	490	16000	0.125	0.000
Burst #12	2028	50	100	16000	0.125	0.000
Burst #13	2165	400	798	16000	0.125	0.000
Burst #14	2842	10	100	16000	0.125	1110.000
Burst #15	2847	5	190	16000	0.125	1160.000
Burst #16	0	0	0	16000	0.125	0.000

Card setup Burst setup Trace setup Card info

Sampling interval (ns) 0.125



WCM application

Settings Configuration

- **Bursts 1 & 2: injection timing**
- **Bursts 3 to 14: setup by user**
 - Bunch length evolution
 - Tomography reconstruction
- **Bursts 15 & 16: extraction timing**
- **Directly linked to**
 - Trigger card
 - BCWLBO class

Disable global Disable all Clear all

Autoconfig injection / extraction (1, 2, 15, 16)

ALL

Enable	C Time	Δ Turns	N Traces	N Samples	Sample (ns)	Δ Trig. (ns)
Burst #1	169	6	300	16000	0.125	0.000
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Burst #16	0	0	0	16000	0.125	0.000

Card setup Burst setup Trace setup Card info

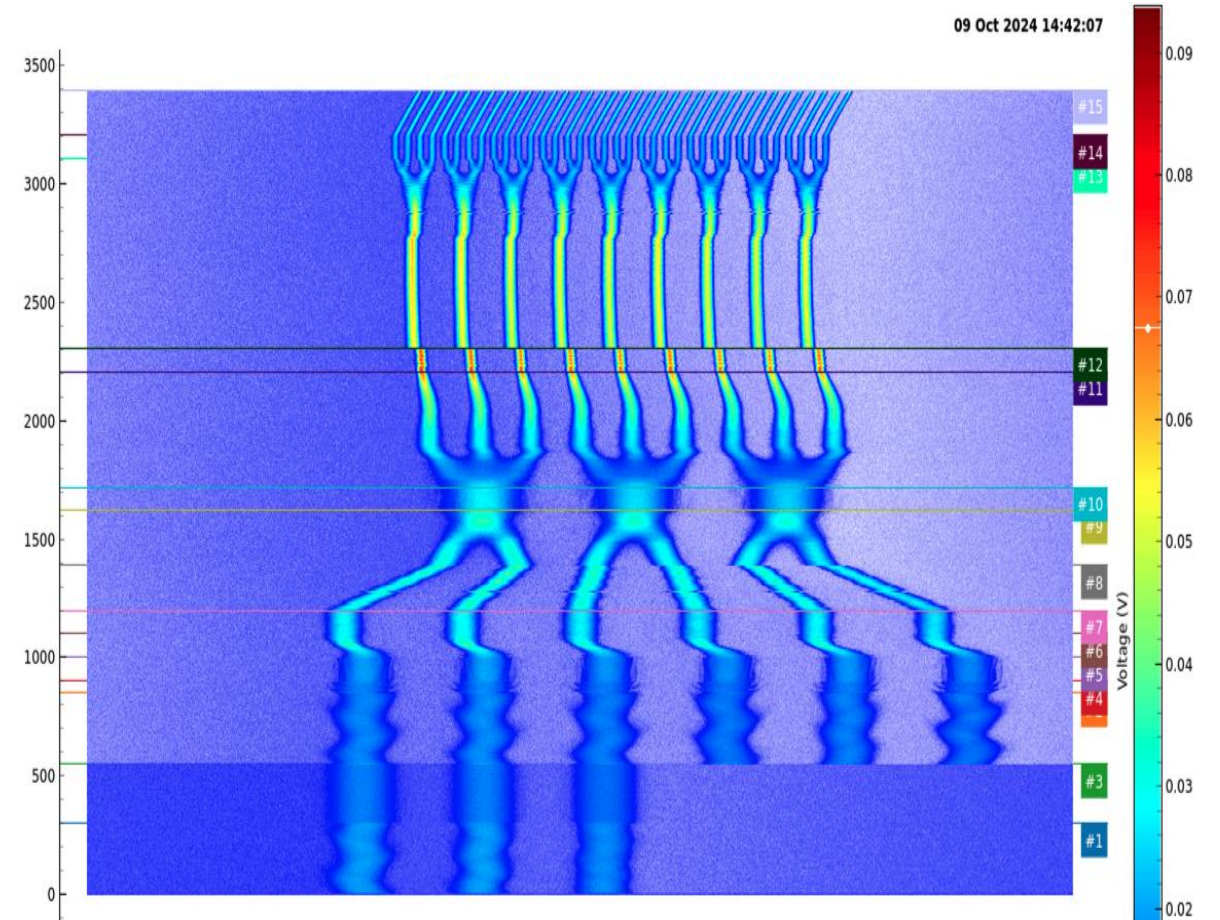
Sampling interval (ns) 0.125

Full scale (V) 1.000

WCM application

Acquisition Measurement

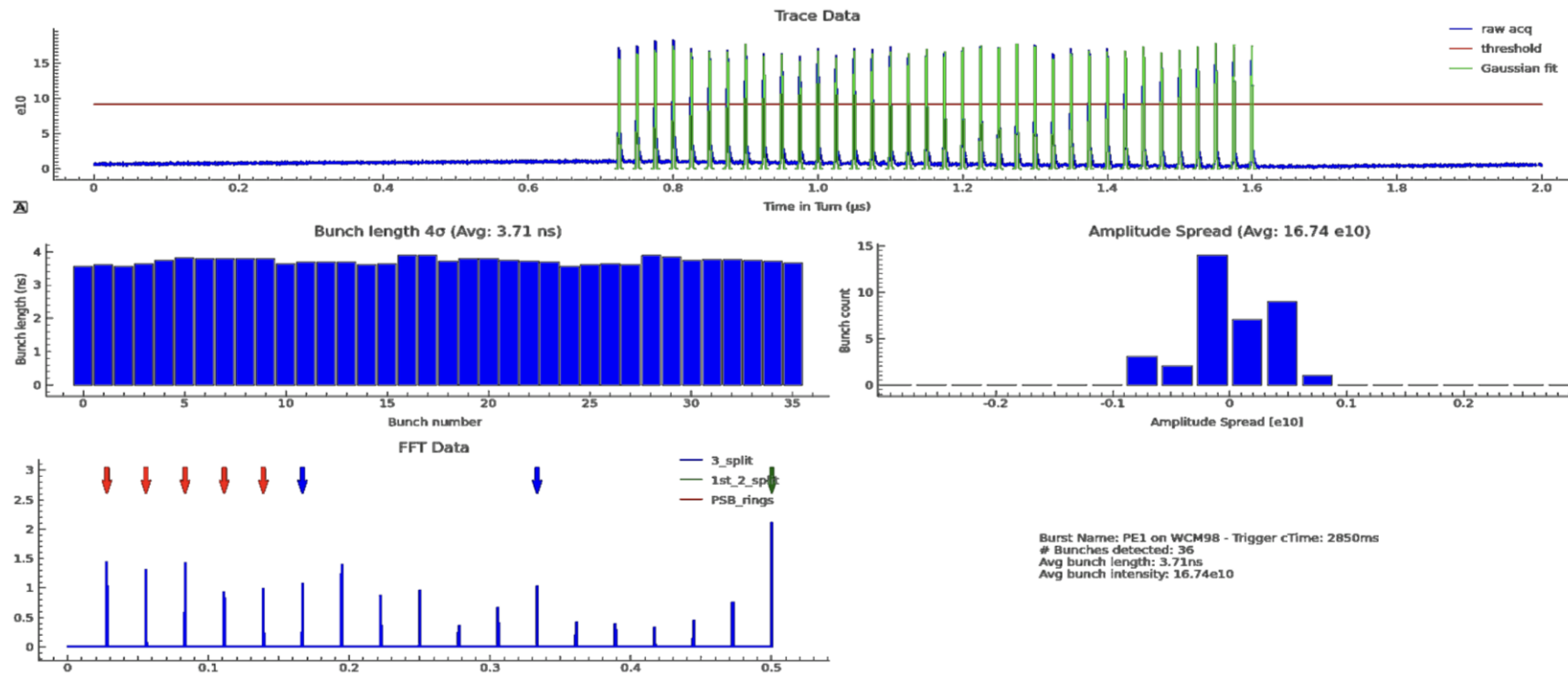
- Cycle-by-cycle observation update
- Bursts are highlighted
- Will replace the Tomoscope application



WCM application

Raw acquisition post-processing (via UCAP)

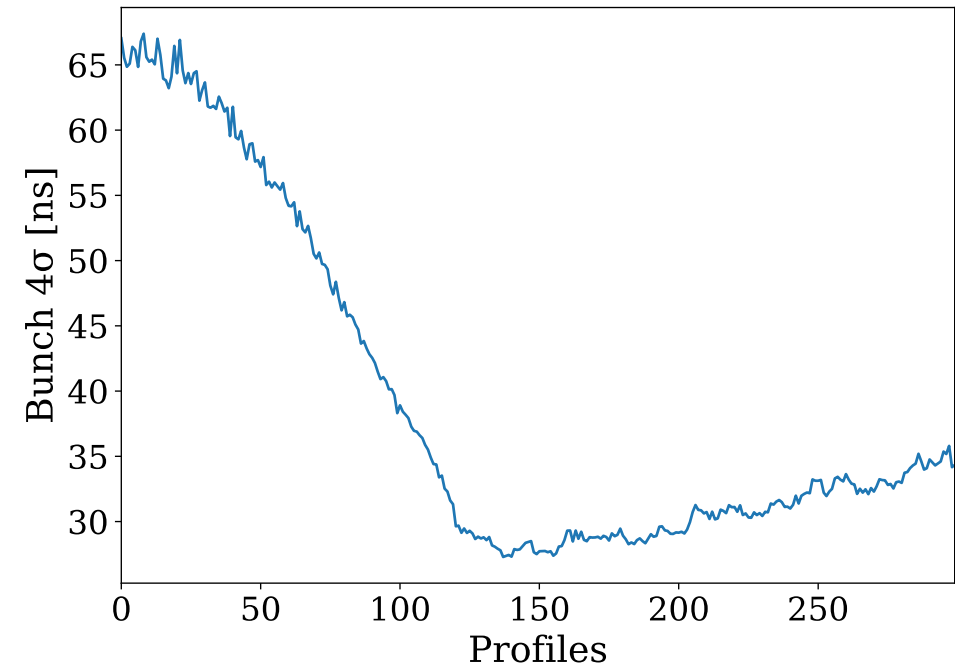
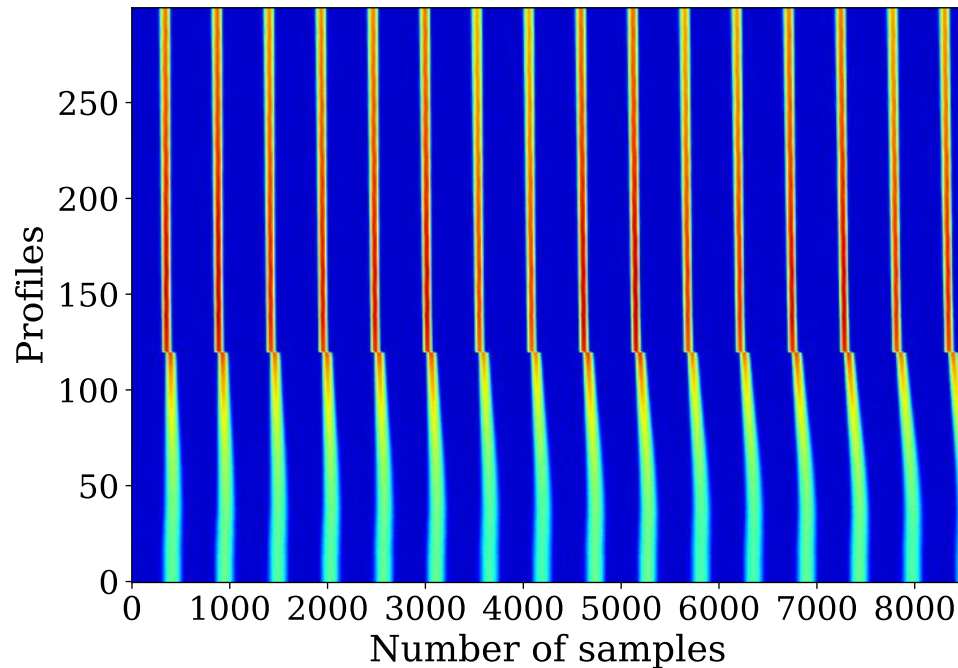
- Use of this BCWLBO class for the last-turn logging (replacement of the BSM app)



WCM application

Raw acquisition post-processing (via UCAP)

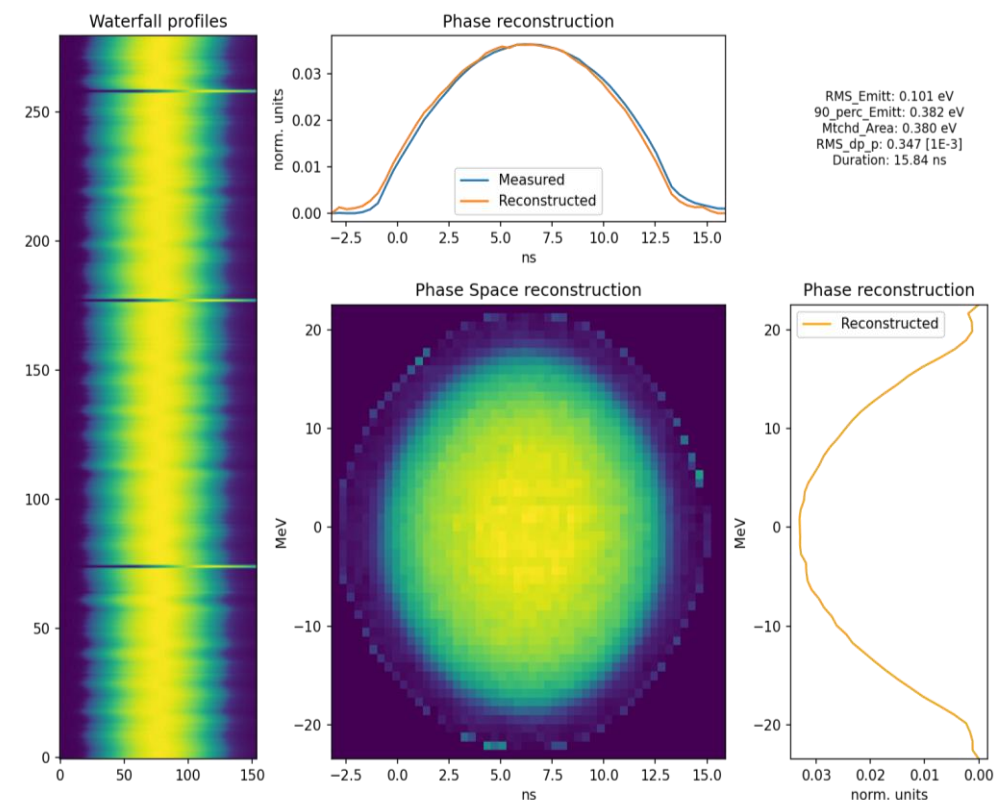
- Use of this BCWLBO class for measuring bunch length evolution, bunch by bunch intensity evolution, etc.



WCM application

Raw acquisition post-processing (via UCAP)

- **Use of this BCWLBO class for automated tomography reconstruction**
 - Gathering of machine parameters
 - Tracking reused between similar cycles
 - Tomographic reconstruction
- **Available capabilities in the application**
 - Setup of the tomography parameters
 - Display results of the reconstruction



Outlook

- **New FESA Class for online acquisition available in PSB, PS, SPS & LHC**
 - Enables permanent longitudinal beam data acquisition (with PPM settings)
 - **OP application available in the PS**
 - **Post-processing layers (UCAP)**
 - Bunch length analysis
 - Bunch by bunch intensity
 - Tomographic reconstruction
- To be extended operationally to the PSB & SPS**
- **One card is available for MD configuration in the PS !!**
 - **More information:**
 - [IPP meeting \(Oct 2024\)](#)
 - [JAPW 2024](#)

Thank you for listening
Any questions

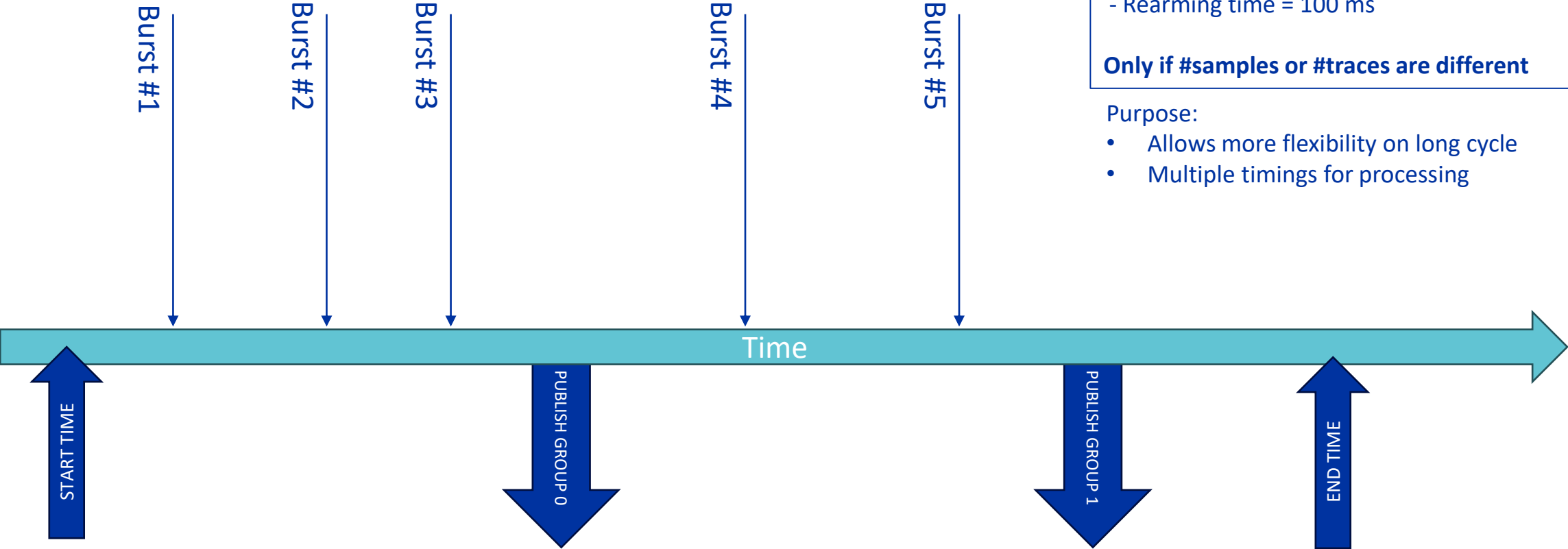


home.cern

Burst/Trace Mode

Multiple publications within the same cycle

Bursts 1-3 are in group Id 0, bursts 4-5 are in group Id 1:



Between group 0 publication and next acquisition start:
- Rearming time = 100 ms

Only if #samples or #traces are different

- Purpose:
- Allows more flexibility on long cycle
 - Multiple timings for processing

Class interface (Multiplexed)

	Burst Acquisition	Trace Acquisition	Continuous acquisition
GroupId	✓	✓	✗
BurstId	✓	✓	✗
NumberOfSamples	✓	✓	✓
TriggerDelayNs	✓	✓	✓
SampleIntervalNs	✓	✓	✓
NumberOfTraces	✓	✗	✗

All traces in a burst
have same settings

Card Sampling interval (Multiplexed)

Change device sampling interval

PR.BCW98 / **CardSettings** AD

- ▼ acq. ctx. 18:35:32.360 238 [CPS.USER.AD]
- ▼ isMultiRecordReading
- ▼ cardVerticalOffset
- ▼ cardFullScale
- ▼ cardSamplingIntervalNs

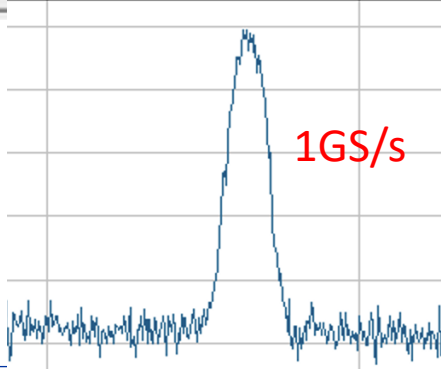
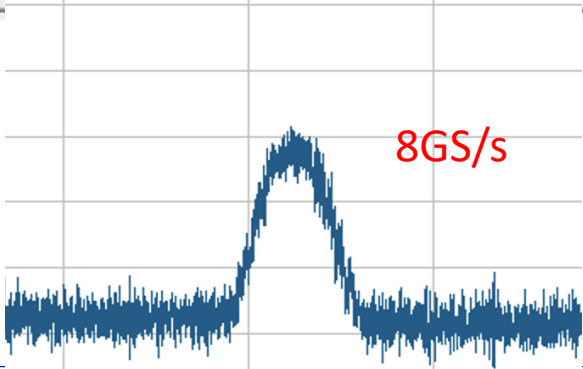
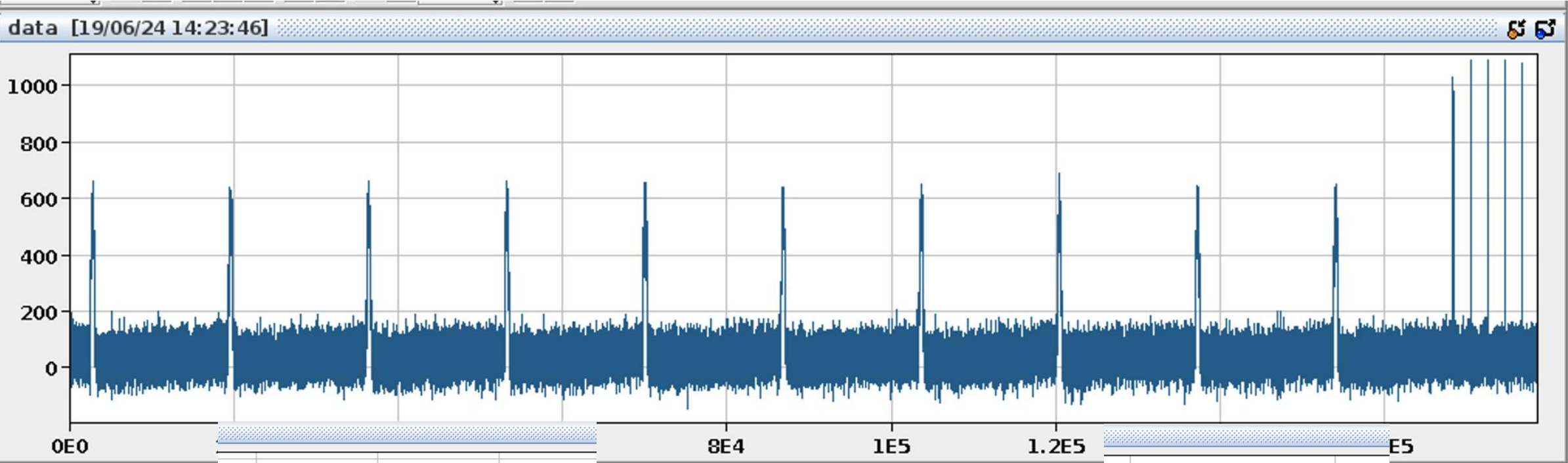
It changes the max sampling rate of the card

- Decimation

Then the samplingIntervalNs cannot go higher than this value

- Averaging

FESA average sampling Interval



Acquisition data

PR.BCW98 / Acquisition SFTPRO1 ↓ Get Unsubscribe

- acq.ctx. 18:38:14.738 081 [CPS.USER.SFTPRO1 @ 18:38:13.900 000]
- triggerDelayNs 0.0,...
- acqTimestampsNs 1723055894071074873, 1723055894071085926, 1723055894071096979, 1723055894071108031,...
- sampleIntervalNs 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125,...
- acqStatus OK
- acqStatusText no data
- publishedGroupId 0
- data** 37, 63, 77, 21, 4, 80, 97, 15, -21, -4, 5, 45, 70, -16, -54, 65, 106, -5, 1, 102, 69, 12, 39, 45, 23,...
- burstId 10,...
- numberOfSamples 000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000,...
- acqMode PerBurstMode
- loggingString {"otherTime": 3804, "groupId": 0, "cycleName": "CPS.USER.SFTPRO1", "cycleStamp": 1723055893900000000 }
- acqCycleTimeMs 171.07487, 171.08592, 171.09697, 171.10803, 171.1191, 171.13014, 171.14119, 171.15224, 171.1633,...

[1D data array](#)

Acquisition data

Size depending on the settings
(number of traces)

The screenshot displays a web-based interface for viewing acquisition data. The window title is "PR.BCW98 / Acquisition" and it shows a dropdown menu for "SFTPRO1", a "Get" button, and an "Unsubscribe" button. The data is organized into a list of expandable sections, each with a dropdown arrow on the left and a set of icons on the right. The sections and their values are:

- acq. ctx.** 18:38:14.738 081 [CPS.USER.SFTPRO1 @ 18:38:13.900 000]
- triggerDelayNs** 0.0,...
- acqTimestampsNs** 1723055894071074873, 1723055894071085926, 1723055894071096979, 1723055894071108031,...
- sampleIntervalNs** 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125,...
- acqStatus** OK
- acqStatusText** no data
- publishedGroupId** 0
- data** 37, 63, 77, 21, 4, 80, 97, 15, -21, -4, 5, 45, 70, -16, -54, 65, 106, -5, 1, 102, 69, 12, 39, 45, 23,...
- burstId** 10,...
- numberOfSamples** 000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000,...
- acqMode** PerBurstMode
- loggingString** {"otherTime": 3804, "groupId": 0, "cycleName": "CPS.USER.SFTPRO1", "cycleStamp": 1723055893900000000 }
- acqCycleTimeMs** 171.07487, 171.08592, 171.09697, 171.10803, 171.1191, 171.13014, 171.14119, 171.15224, 171.1633,...

Acquisition data

Size depending on the number of traces acquired

The screenshot shows a web-based interface for monitoring acquisition data. The title bar reads "PR.BCW98 / Acquisition SFTPRO1" and includes controls for "Get", "Unsubscribe", and a filter icon. The main content area is a list of acquisition parameters, each with a value field and a set of icons (copy, edit, delete). The parameters and their values are:



- acq. ctx. 18:38:14.738 081 [CPS.USER.SFTPRO1 @ 18:38:13.900 000]
- triggerDelayNs: 0.0, ...
- acqTimestampsNs: 1723055894071074873, 1723055894071085926, 1723055894071096979, 1723055894071108031, ...
- sampleIntervalNs: 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, ...
- acqStatus: OK
- acqStatusText: no data
- publishedGroupId: 0
- data: 37, 63, 77, 21, 4, 80, 97, 15, -21, -4, 5, 45, 70, -16, -54, 65, 106, -5, 1, 102, 69, 12, 39, 45, 23, ...
- burstId: 10, ...
- numberOfSamples: 000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, 16000, ...
- acqMode: PerBurstMode
- loggingString: { "otherTime" : 3804, "groupId": 0, "cycleName" : "CPS.USER.SFTPRO1", "cycleStamp" : 1723055893900000000 }
- acqCycleTimeMs: 171.07487, 171.08592, 171.09697, 171.10803, 171.1191, 171.13014, 171.14119, 171.15224, 171.1633, ...



























Acquisition data

Acquisition Status

- **OK**
- **WARNING**
 - Not all traces have been recorded
- **ERROR**
 - Error in the acquisition process
 - Like no data in the buffer of the cards

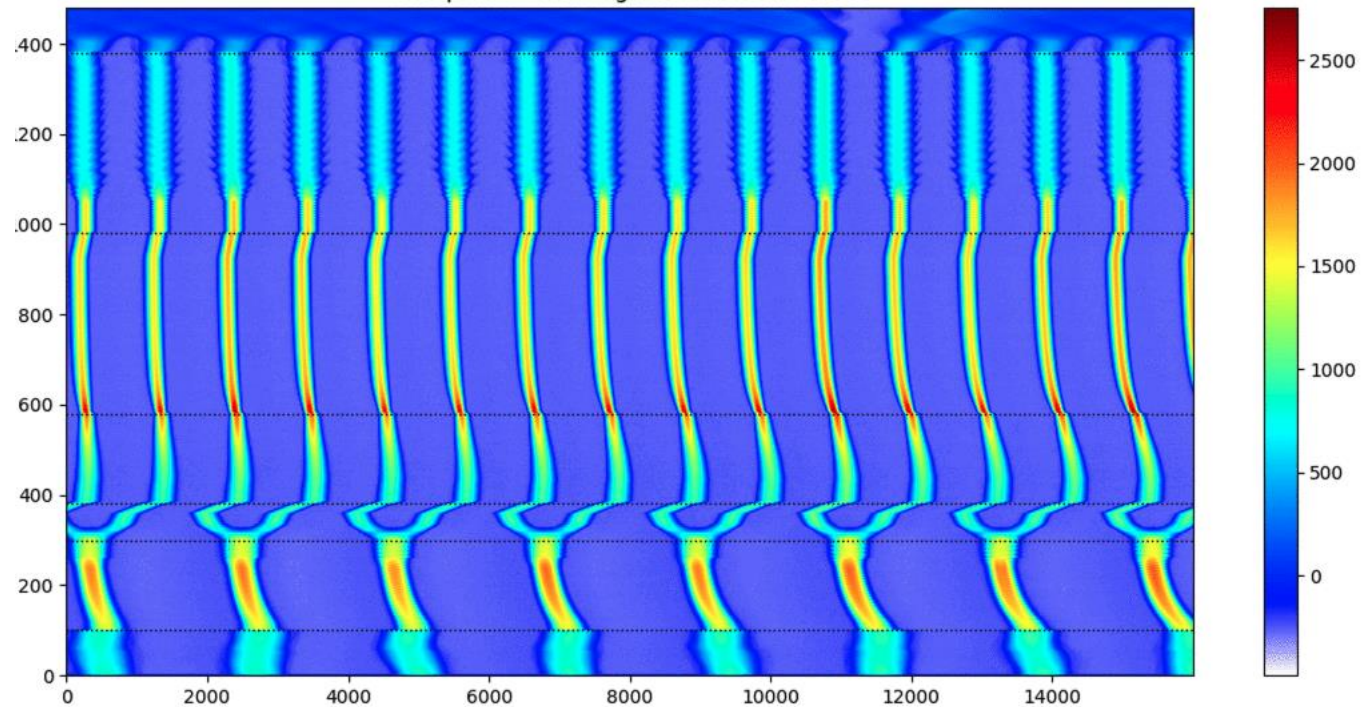
Device data

PR.BCW98 / DeviceSettings ↓ Get ● Subscribe  

- acq. ctx. 2024-08-07 18:38:59.500 238 275
- serialNo  
- channelCount  
- name  
- bitResolution  
- fullScaleValues  
- maxMemory  
- LUN  
- maxOffset  
- hwOptions  
- samplingIntervalValues  
- maxNumberSegments  
- maxSampleRate  
- hwType  

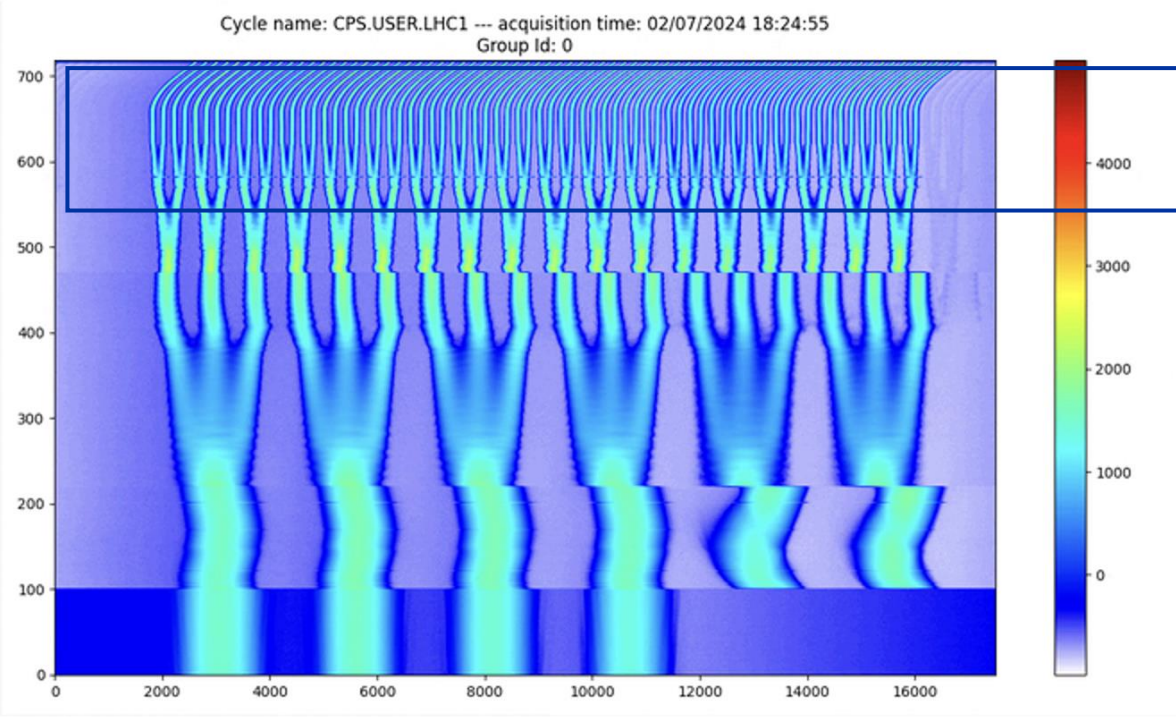
Online Acquisition

Cycle name: CPS.USER.SFTPRO1 --- acquisition time: 21/08/2024 19:49:36
Group Id: 0 - Working Mode: PerBurstMode



LHC Beam (extraction bump correction)

Settings without correction
Burst mode



Extraction bump delay correction
Trace Mode

