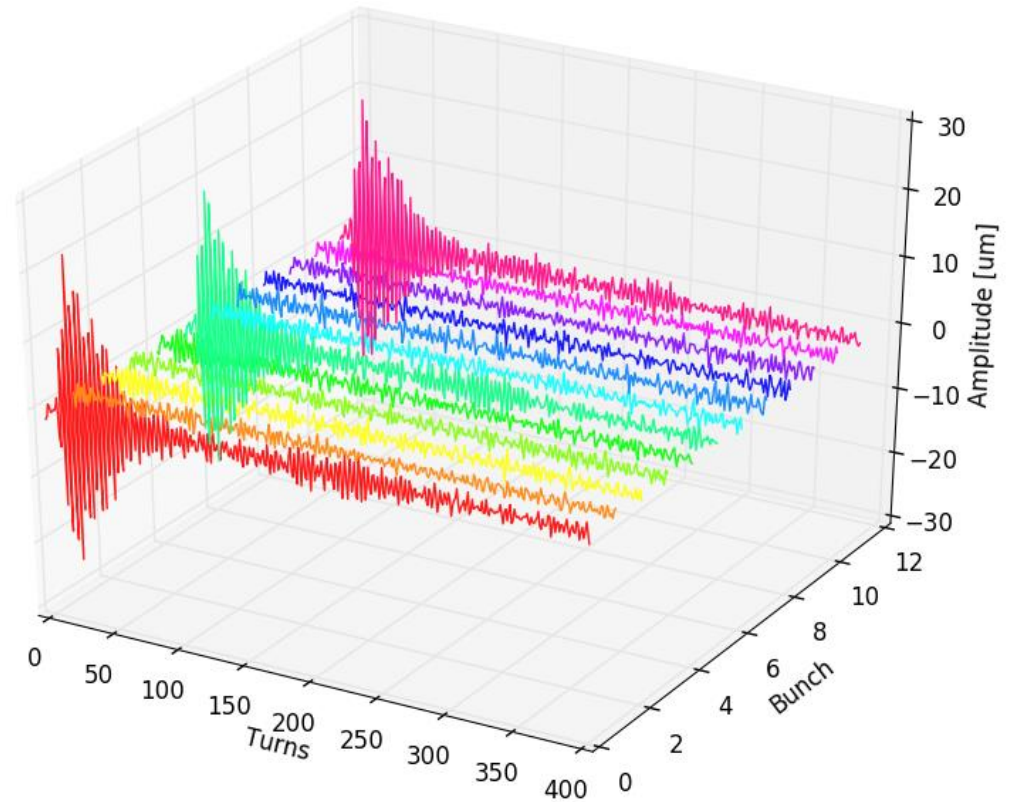


ADT and ObsBox in 2016

W. Hofle,
M. Jaussi,
G. Kotzian,
S. Rains,
M. Ojeda Sandonis,
M. Soderen,
D. Valuch

Thanks for valuable support:
ABP colleagues,
the operations team





2016 performance

- Very smooth year, only few blocking failures
 - DAC hanging after a major power outage at point 4 (3hr)
 - Optical link problem (1hr)
 - Bad synchronization caused by missing RF clock after LLRF VCXO intervention. Prevented performing loss maps (1hr)
- Power system failures are typically not blocking (redundancy)
 - Making up 9 out of the 13 AFT hours
 - Spare power amplifiers are prepared in the tunnel

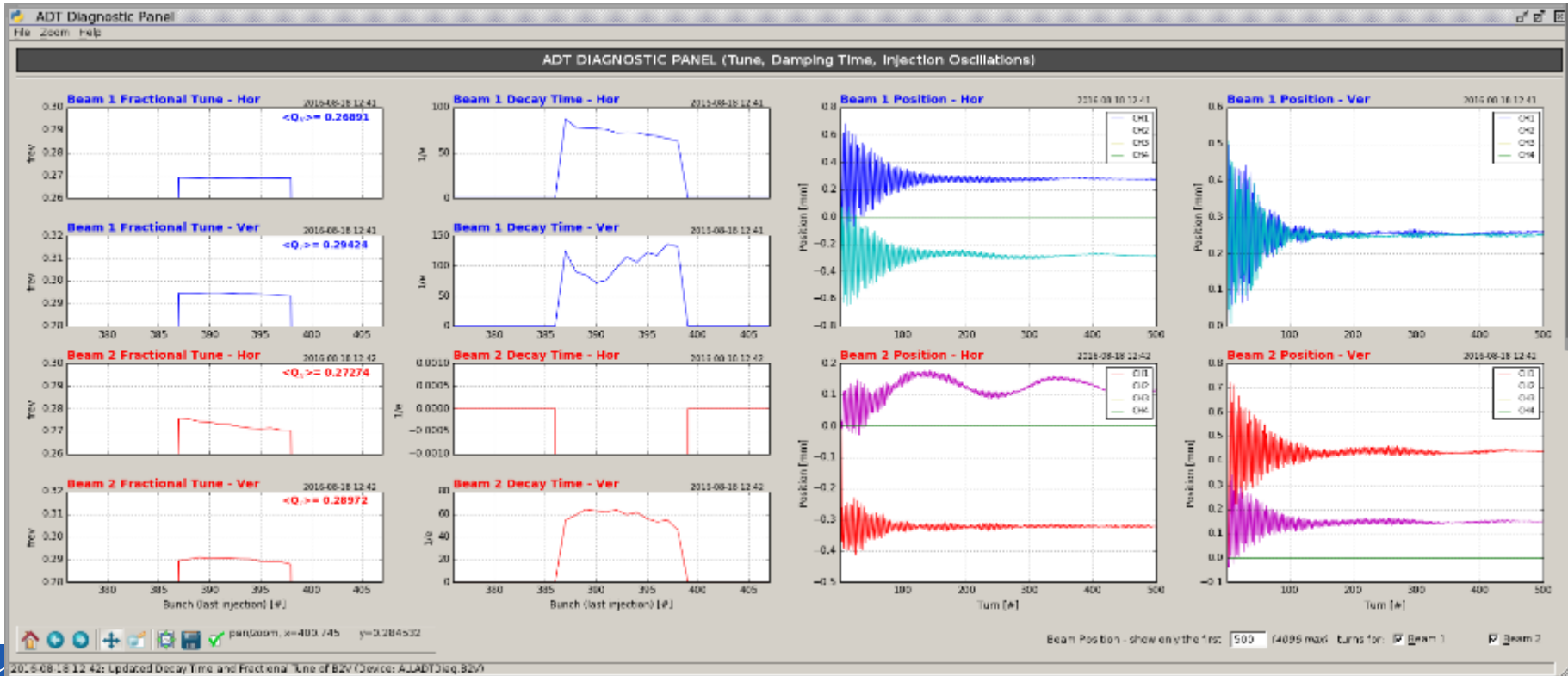
To do's: Is the damper working?

- More diagnostics requested: *a new tool was put in place in April 2016*
- FESA class ALLADTDiag running in ADTObsBox
- Fixed display accessible from CCM



To do's: Is the damper working?

- It computes and publishes bunch by bunch damping time and tune (every injection, or on demand).
- Data are logged in Timber



To do's: Is the damper working?

- More details on the method:
 - G. Kotzian - Feedback parameter extraction: an alternative approach. LBOC 8.12.2015
- Full details with all math (also full reference for the “Kotzian algorithm”)
 - G. Kotzian: Transverse Feedback Parameter Extraction from Excitation Data. IPAC 2016
 - G. Kotzian: Possibilities for Feedback Phase Adjustment by Means of Digital Filters. IPAC 2016

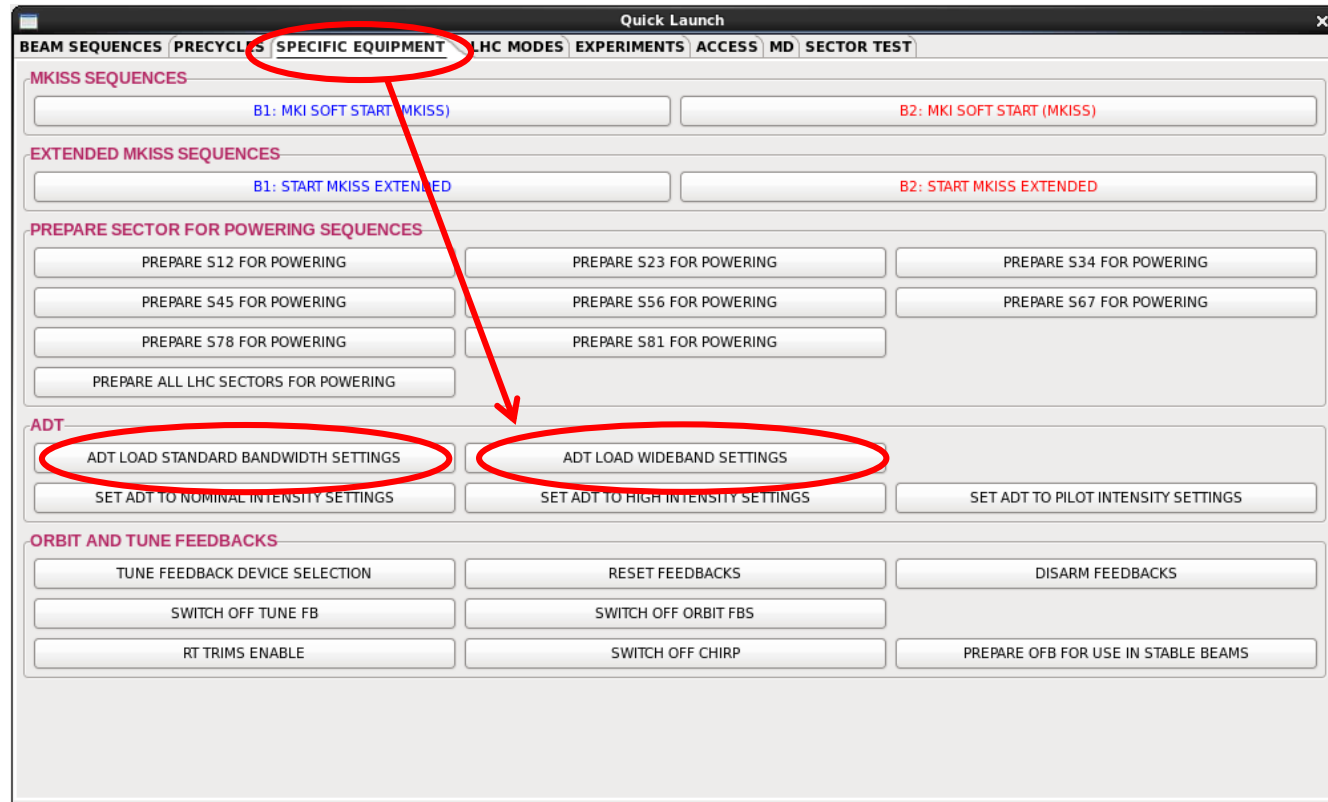
To do's: reduce need for expert interventions

- Beam position module Intensity setting switching. ***A sequence introduced early 2016***

The screenshot shows the 'Quick Launch' control interface. The 'SPECIFIC EQUIPMENT' tab is selected and circled in red. A red arrow points from this tab to the 'SET ADT TO HIGH INTENSITY SETTINGS' button, which is also circled in red. Other buttons in the 'ADT' section, 'SET ADT TO NOMINAL INTENSITY SETTINGS' and 'SET ADT TO PILOT INTENSITY SETTINGS', are also circled in red. The interface includes sections for MKISS SEQUENCES, EXTENDED MKISS SEQUENCES, PREPARE SECTOR FOR POWERING SEQUENCES, ADT, and ORBIT AND TUNE FEEDBACKS.

To do's: reduce need for expert interventions

- Setting the system frequency response (standard/enhanced). ***A sequence introduced early 2016***



To do's: Give more insight to the OP team

- Comment from the OP team: the damper is getting more and more “black-boxy”
- A lecture presented at LBOC on 24.5.2016




https://indico.cern.ch/event/527889/contributions/2168749/attachments/1278254/1897561/ADT_operation.pdf

To do's: Give more insight to the OP team

- Should help with cases like this:

72 12:56 MEAS

Increase all damper gains by a factor 2. Not possible for B2 due to limit in LSA set to .357 (does this limit make sense?).



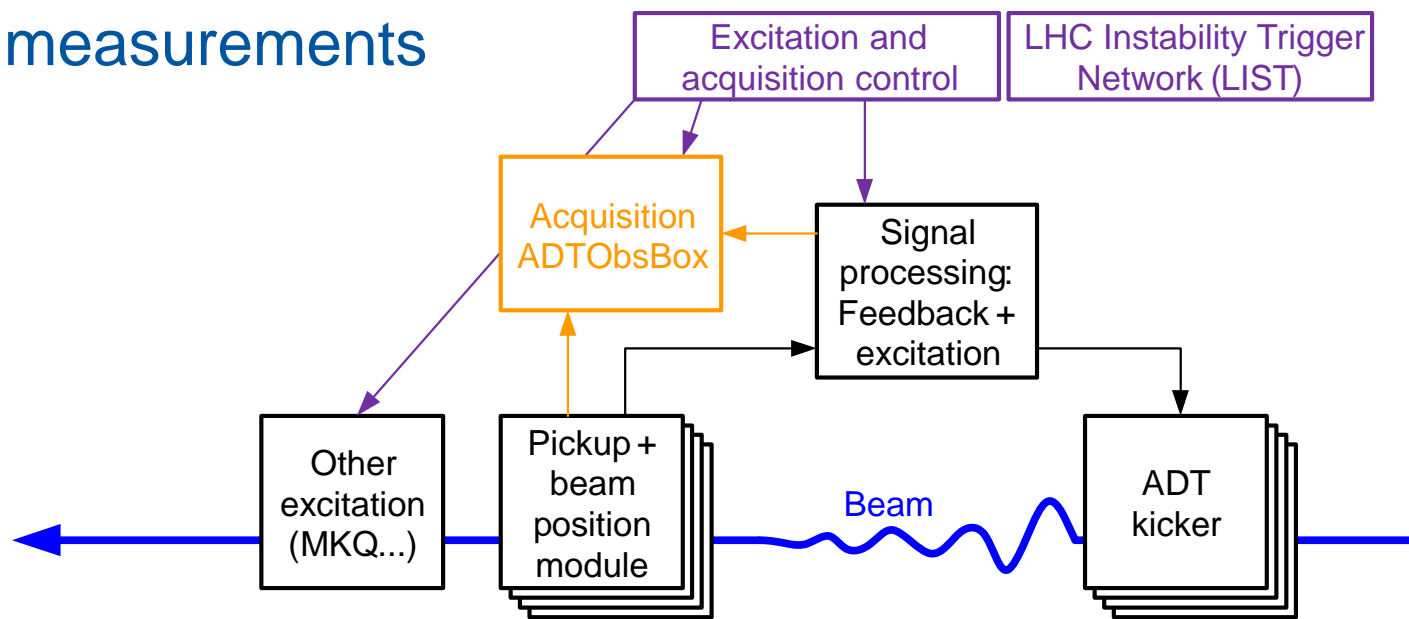
20160818125804.png 20160818125850.png

created by lhcop on CWO-CCC-DTLX

- OP Wikis updated...

New features for the 2017 season

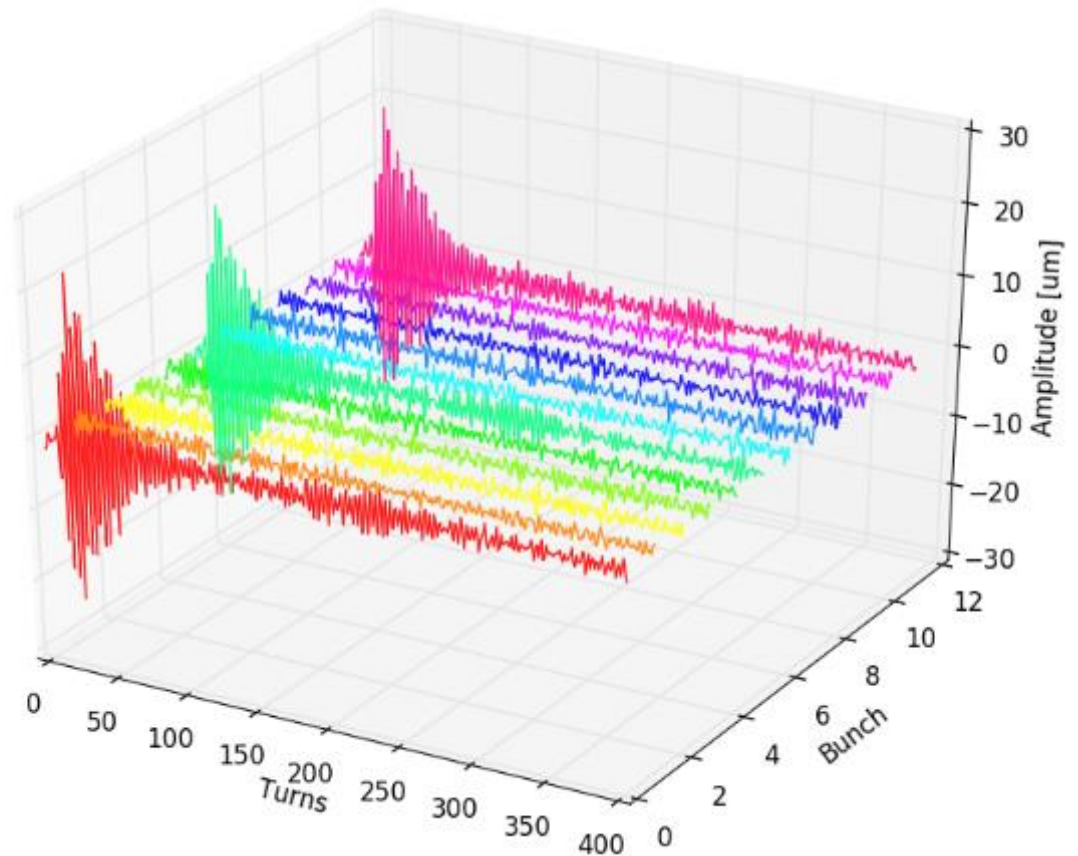
- New mode of controlled excitation ADT-AC dipole
- Tune measurement along trains
- Precision tune shift measurements
- Optics measurements
- Coupling measurements



New features for the 2017 season

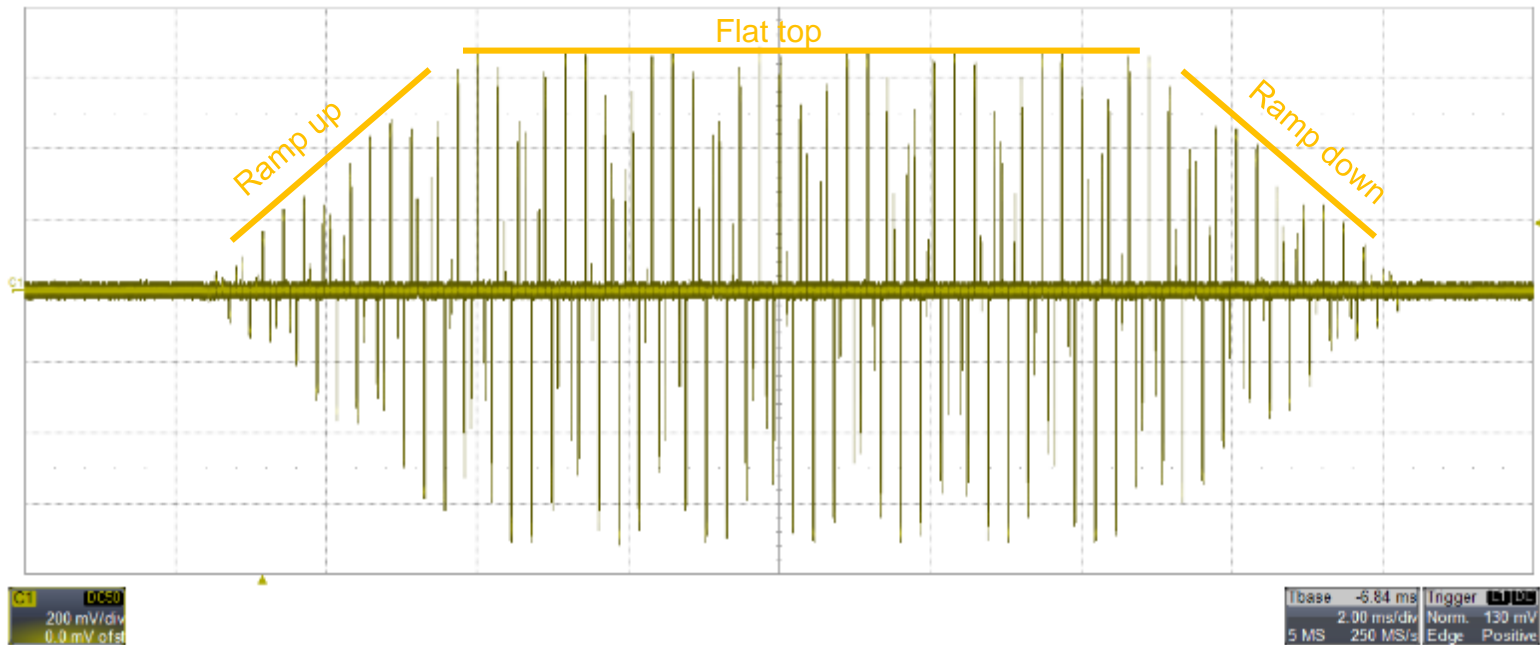
- Can target anything from individual bunches within a train to a full beam

3 Bunch Excitation in B2V



New features for 2017 season

- Excitation length from 1 turn to four days
- Programmable ramps

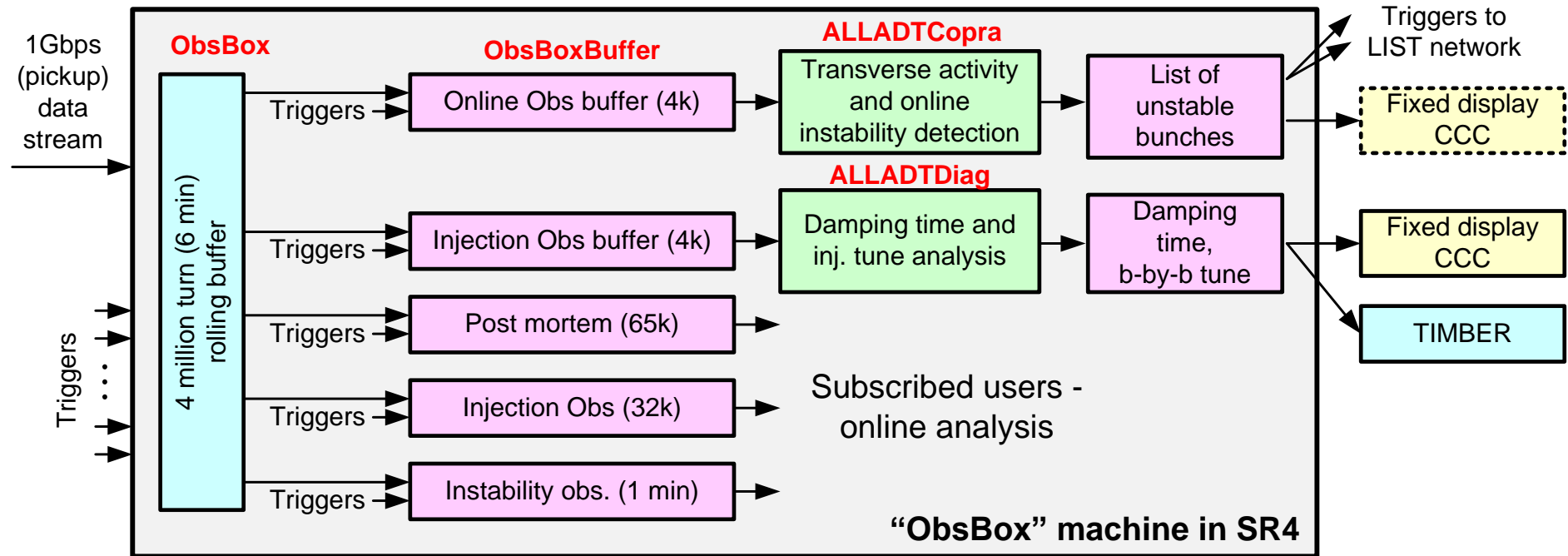


ADTObsBox

- A very powerful computer system capable of recording data from the ADT LLRF system gigabit links
- Access to the b-b-b position, all pickups, planes, beams
- Routinely used by BE/RF and BE/ABP
 - Injection oscillation transient for ADT diagnostics, saving the whole year data – drift observation
 - Instrumental for MDs
- Produces enormous amounts of valuable data – collaboration with BE/CO (J. Wozniak) to find proper solution for storage and analysis – new acc. logging system

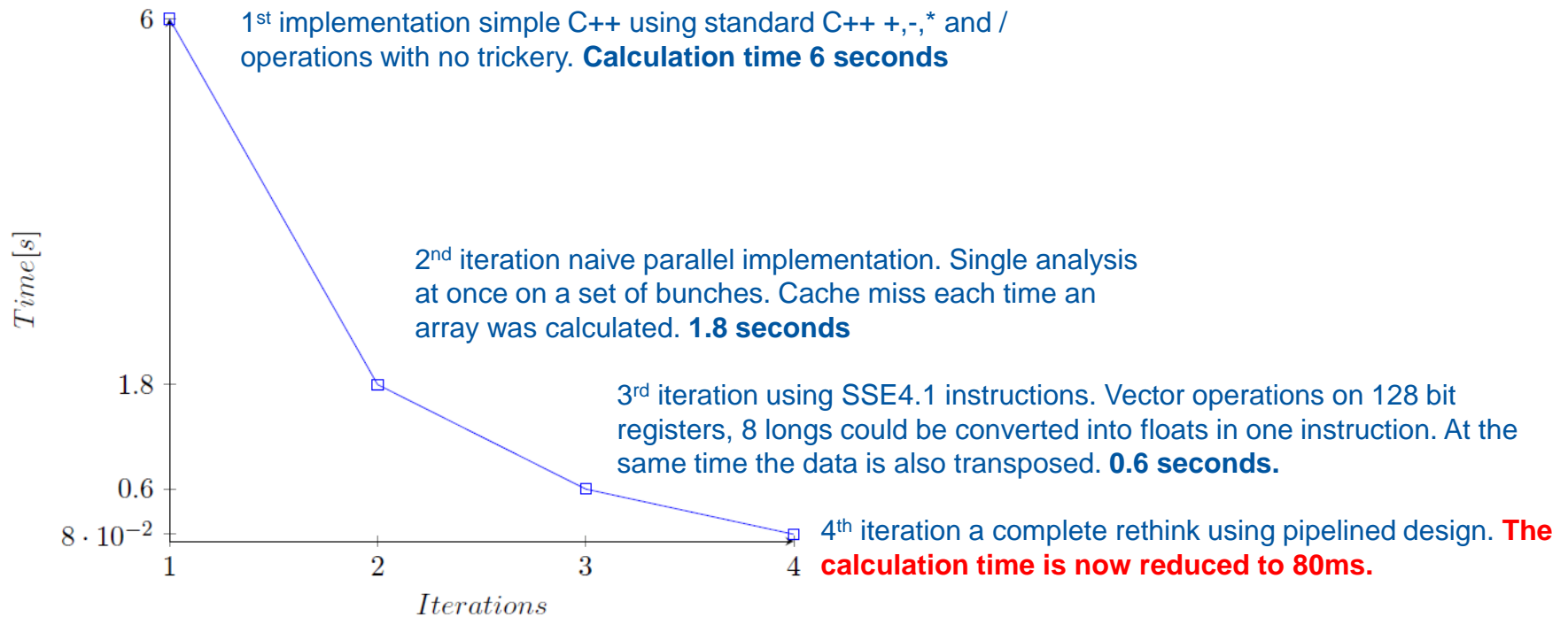
ADTObsBox

- Work on the online transverse instability detection is very advanced, prototype FESA class is already operational in LHC



Online instability detection

- Online analysis of 4096 turn long buffers, provides list of unstable bunches (...and a trigger)



More details: Online bunch by bunch transverse instability detection in LHC. IPAC 2016

Online instability detection

The screenshot displays the 'Navigation Tool 2016-NOV-TS (v3.0.143)' interface. The main window is titled 'ObsBoxE.LHC.ADT.B2V.Q7.ObseAll ALL DataAcquisition'. The interface is divided into several panels:

- Device Selection:** A tree view on the left showing various detector components like 'ObsBoxE.LHC.ADT.B2V.Q7.ObseAll'.
- Property Value (750 B):** A central panel showing properties such as 'argStamp', 'cycleName', 'cycleStamp', 'data', 'eventRate', 'triggerStamp', and 'runCounters'.
- Filter (510 B):** A panel on the right showing filter settings like 'numbers' and 'time'.
- Table View:** A table at the bottom showing data points with columns for 'Index', 'Time', and various data values.
- Views:** A panel on the right showing 'Property Value (0.477 B)' and 'Views'.

The table view shows a sequence of data points with the following structure:

Index	Time	...
117	0.00	...
118	0.00	...
119	0.00	...
120	0.00	...
121	0.00	...
122	0.00	...
123	0.00	...
124	0.00	...
125	0.00	...
126	0.00	...
127	0.00	...
128	0.00	...
129	0.00	...
130	0.00	...
131	0.00	...
132	0.00	...
133	0.00	...
134	0.00	...
135	0.00	...
136	0.00	...
137	0.00	...
138	0.00	...
139	0.00	...
140	0.00	...

Online instability detection

Navigation Tool 2016-NOV-TS (v3.0.143)

ObsBox.LHC.ADT.B2V.Q7.Obse4.ALL
AcquisitionSubtree

Property Value (750 b) - Wed Nov 23 11:32:55 CET 2016

Filter (510 b) - Wed Nov 23 11:32:55 CET 2016

Views: All -viewers- Global tab

Index	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
117	3496	3494	3477	3471	3450	3477	3474	3466	3485
118	0	0	0	0	0	0	0	0	0
119	0	0	0	0	0	0	0	0	0
120	0	0	0	0	0	0	0	0	0
121	3533	3526	3503	3523	3538	3553	3522	3527	3527
122	0	0	0	0	0	0	0	0	0
123	0	0	0	0	0	0	0	0	0
124	0	0	0	0	0	0	0	0	0
125	3552	3591	3467	3479	3524	3491	3471	3500	3492
126	0	0	0	0	0	0	0	0	0
127	0	0	0	0	0	0	0	0	0
128	0	0	0	0	0	0	0	0	0
129	3523	3500	3495	3508	3494	3517	3500	3521	3526
130	0	0	0	0	0	0	0	0	0
131	0	0	0	0	0	0	0	0	0
132	0	0	0	0	0	0	0	0	0

Copra.LHC.ADT.B2V.Q7.Obse4.ALL DataAcquisition

Property Value (5,117 b) - Wed Nov 23 11:32:55 CET 2016

Views: All -viewers- Global tab

Table view on Copra.LHC.ADT.B2V.Q7.Obse4.ALL DataAcquisition (sequential view)

Index	Value
117	3552
118	3550
119	3495
120	3508
121	3494
122	3517
123	3500
124	3521
125	3526
126	0
127	0
128	0
129	0
130	0
131	0
132	0

Online instability detection

The screenshot displays the 'Navigation Tool 2016-NOV-TS (v3.0.143)' interface. The main window shows the 'ObsBox.LHC.ADT.B2V.Q7.Obs4k.ALL' acquisition setup. The 'Property Value' section lists various parameters such as 'argStamp', 'cycleName', 'cycleStamp', 'data', 'rateRtc', 'triggerStamp', and 'runCounters'. The 'Filter' section shows 'bunches: 1783 1810' and 'turns: 0.10'. The 'Views' section includes 'All -viewers-' and 'Global tab'. The 'Table view on ObsBox.LHC.ADT.B2V.Q7.Obs4k.ALL DataAcquisitionSubstr' is displayed, showing a table of data points with columns for 'Index', 'Time', and 'Value'. The 'Table view on Copra.LHC.ADT.B2V.Q7.Obs4k.ALL DataAcquisition' is also visible, showing a table of data points with columns for 'Index', 'Time', and 'Value'. The 'Table view on Copra.LHC.ADT.B2V.Q7.Obs4k.ALL DataAcquisition' shows a table of data points with columns for 'Index', 'Time', and 'Value'. The 'Table view on Copra.LHC.ADT.B2V.Q7.Obs4k.ALL DataAcquisition' shows a table of data points with columns for 'Index', 'Time', and 'Value'. The 'Table view on Copra.LHC.ADT.B2V.Q7.Obs4k.ALL DataAcquisition' shows a table of data points with columns for 'Index', 'Time', and 'Value'.

Online instability detection

The screenshot displays the 'Navigation Tool 2016-NOV-TS (v3.0.143)' interface. The main window shows the 'ObsBox.LHC.ADT.B2V.Q7.Obs4k.ALL' acquisition. The 'Property Value' section lists various parameters such as 'argStamp', 'cycleName', 'data', 'readRate', 'triggerStamp', and 'runCounters'. The 'Filter' section shows 'bundles: 1783' and 'turns: 0.10'. The 'Views' section includes 'All -viewers-' and 'Global tab'. The 'Table view on ObsBox.LHC.ADT.B2V.Q7.Obs4k.ALL' shows a table with columns for 'Index', 'L1', 'L2', 'L3', 'L4', 'L5', 'L6', 'L7', 'L8', 'L9', and 'L10'. The table contains data for various indices, with some cells containing '0' and others containing numerical values. The 'Table view on Copra.LHC.ADT.B2V.Q7.Obs4k.ALL DataAcquisition' shows a table with columns for 'Index', 'L1', 'L2', 'L3', 'L4', 'L5', 'L6', 'L7', 'L8', 'L9', and 'L10'. The table contains data for various indices, with some cells containing '0' and others containing numerical values. The 'Table view on Copra.LHC.ADT.B2V.Q7.Obs4k.ALL' also shows a table with columns for 'Index', 'L1', 'L2', 'L3', 'L4', 'L5', 'L6', 'L7', 'L8', 'L9', and 'L10'. The table contains data for various indices, with some cells containing '0' and others containing numerical values.

Index	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
001	3275	3277	3268	3286	3290	3267	3281	3285	3266	0
002	0	0	0	0	0	0	0	0	0	0
003	0	0	0	0	0	0	0	0	0	0
004	0	0	0	0	0	0	0	0	0	0
005	3335	3331	3324	3324	3332	3309	3330	3317	3320	0
006	0	0	0	0	0	0	0	0	0	0
007	0	0	0	0	0	0	0	0	0	0
008	0	0	0	0	0	0	0	0	0	0
009	3272	3279	3276	3269	3295	3280	3279	3269	3250	0
010	0	0	0	0	0	0	0	0	0	0
011	0	0	0	0	0	0	0	0	0	0
012	0	0	0	0	0	0	0	0	0	0
013	3321	3317	3321	3308	3318	3300	3320	3323	3323	0
014	0	0	0	0	0	0	0	0	0	0
015	0	0	0	0	0	0	0	0	0	0

Online instability detection

The screenshot displays the 'Navigation Tool 2016-NOV-TS (v3.0.143)' interface. The main window shows the 'ObsBoxBuffer version 1.3.0' and 'Copra.LHC.ADT.B2V.Q7.Obs4k ALL DataAcquisition'.

Property Value (750 bytes - Wed Nov 23 11:32:00 CET 2016)

- argStamp: 1475897180819576000
- cycleName: [empty]
- cycleStamp: 0
- data: array[0..6126]
- readRate: array[1500]
- triggerStamp: 1475897180847151900
- runCounters: array[1500]

Filter (510 bytes - Wed Nov 23 11:32:00 CET 2016)

- bunches: 1782, 1810
- turns: 0..10

Property Selection (481 bytes - Wed Nov 23 11:32:00 CET 2016)

- argStamp
- cycleName
- cycleStamp
- data
- readRate
- triggerStamp
- runCounters

Table view on Copra.LHC.ADT.B2V.Q7.Obs4k ALL DataAcquisition (sequential=true)

Index	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
[1]	3493	3480	3504	3492	3508	3478	3489	3505	3490
[2]	0	0	0	0	0	0	0	0	0
[3]	0	0	0	0	0	0	0	0	0
[4]	0	0	0	0	0	0	0	0	0
[5]	3518	3525	3508	3510	3531	3510	3514	3524	3523
[6]	0	0	0	0	0	0	0	0	0
[7]	0	0	0	0	0	0	0	0	0
[8]	0	0	0	0	0	0	0	0	0
[9]	3572	3510	3499	3488	3494	3492	3488	3485	3496
[10]	0	0	0	0	0	0	0	0	0
[11]	0	0	0	0	0	0	0	0	0
[12]	0	0	0	0	0	0	0	0	0
[13]	3523	3507	3508	3508	3522	3514	3514	3541	3523
[14]	0	0	0	0	0	0	0	0	0
[15]	0	0	0	0	0	0	0	0	0

Table view on Copra.LHC.ADT.B2V.Q7.Obs4k ALL DataAcquisition (sequential=true)

Index	[1]
[1]	0.55
[2]	0.55
[3]	0.55
[4]	0.55
[5]	0.55
[6]	0.55
[7]	0.55
[8]	0.55
[9]	0.55
[10]	0.55
[11]	0.55
[12]	0.55
[13]	0.55
[14]	0.55
[15]	0.55
[16]	0.55
[17]	0.55
[18]	0.55
[19]	0.55
[20]	0.55



Online instability detection

The screenshot displays the Navigation Tool 2016-NOV-TS (v3.0.143) interface. The main window is titled "Copra.LHC.ADT.B2V.Q7.Obs4k.ALL DataAcquisition". The interface is divided into several panels:

- Device Selection:** A tree view on the left showing various detector components like "ObsBox1.LHC.ADT.B2V.Q7.0bs4k".
- Cycle Selection:** A dropdown menu currently set to "All".
- Property Value (750 Hz):** A table showing acquisition parameters for "Wed Nov 23 11:32:01 CET 2016".
- Filter (510 Hz):** A table showing filter parameters for "Wed Nov 23 11:32:01 CET 2016".
- Views:** A section with "All -viewers-" and "Global tab" options, and buttons for "Get", "Get Next Published", and "Unsubscribe".
- Table View:** A table titled "Table view on Copra.LHC.ADT.B2V.Q7.Obs4k.All.ObsBox4k.SubscriberData (sequential=true)".

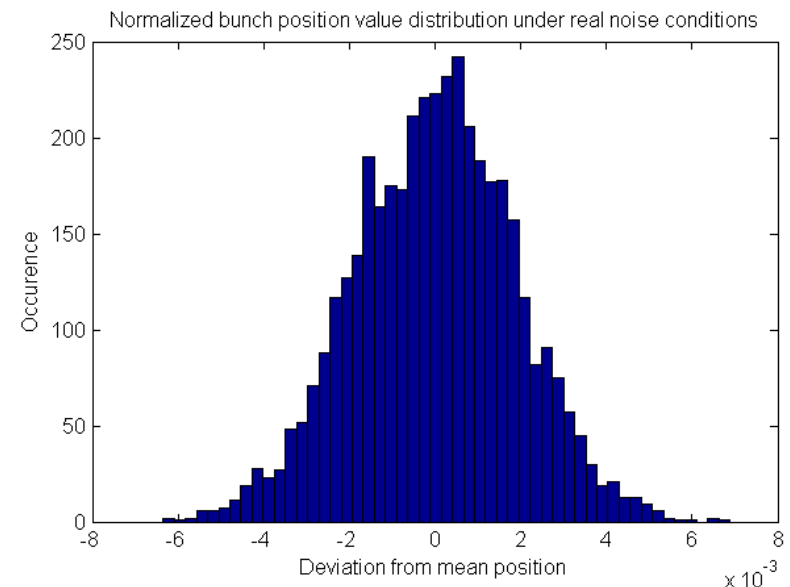
The table view displays data for various cycles and indices. The columns represent different data points or indices, and the rows represent individual data points. The table shows a sequence of values, with some cells containing "0" and others containing numerical values. The table is displayed in base 10.

Index	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
[1]	3433	3460	3447	3448	3477	3447	3452	3437	3462	3451
[2]	0	0	0	0	0	0	0	0	0	0
[3]	0	0	0	0	0	0	0	0	0	0
[4]	0	0	0	0	0	0	0	0	0	0
[5]	3502	3496	3514	3487	3501	3502	3493	3501	3506	3496
[6]	0	0	0	0	0	0	0	0	0	0
[7]	0	0	0	0	0	0	0	0	0	0
[8]	0	0	0	0	0	0	0	0	0	0
[9]	3457	3457	3445	3469	3425	3450	3458	3445	3428	3458
[10]	0	0	0	0	0	0	0	0	0	0
[11]	0	0	0	0	0	0	0	0	0	0
[12]	0	0	0	0	0	0	0	0	0	0
[13]	3453	3455	3465	3457	3457	3465	3463	3447	3450	3450
[14]	0	0	0	0	0	0	0	0	0	0
[15]	0	0	0	0	0	0	0	0	0	0

Noise performance

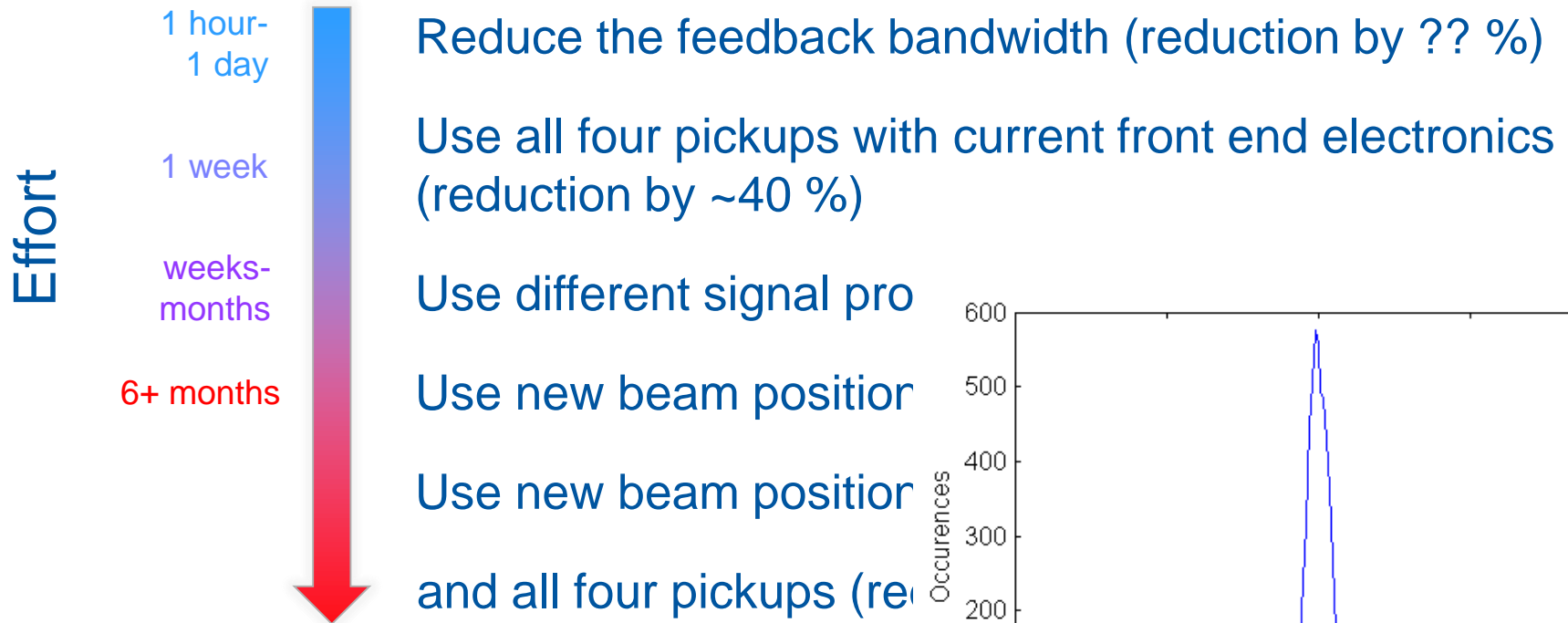
- Series of MDs conducted together with the ABP colleagues to study the impact of noise injected by ADT to the beam. Some open questions (see X. Buffat talk)
- Dominant noise source is the Beam Position module
 - Typical noise performance* @2mm $\sigma=1.9 \mu\text{m}$, $13.2 \mu\text{m}_{\text{pk-pk}}$
 - Resolution $<0.1 \mu\text{m}/\text{LSB}$
 - “Total noise” seen by the beam is further shaped by the signal processing and the system response

* Simulated Σ/Δ signals for nominal intensity and 2mm displacement, I-Q components at 45° . Real, measured front-end noise superimposed to all four input ADC channels

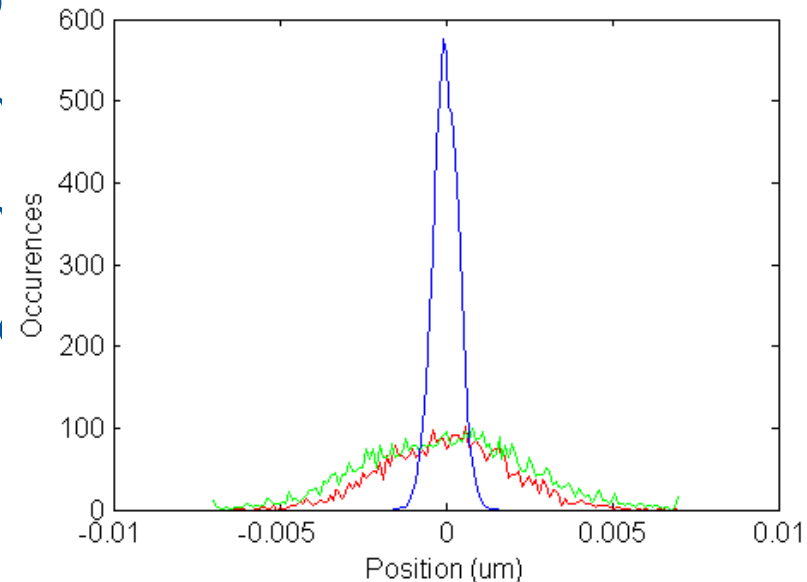


Noise performance

- Available/possible mitigation measures



* Simulated Σ/Δ signals for nominal intensity and 2mm displacement, I-Q components at 45°. Real, measured front-end noise superimposed to all ADC channels, novel signal processing scheme



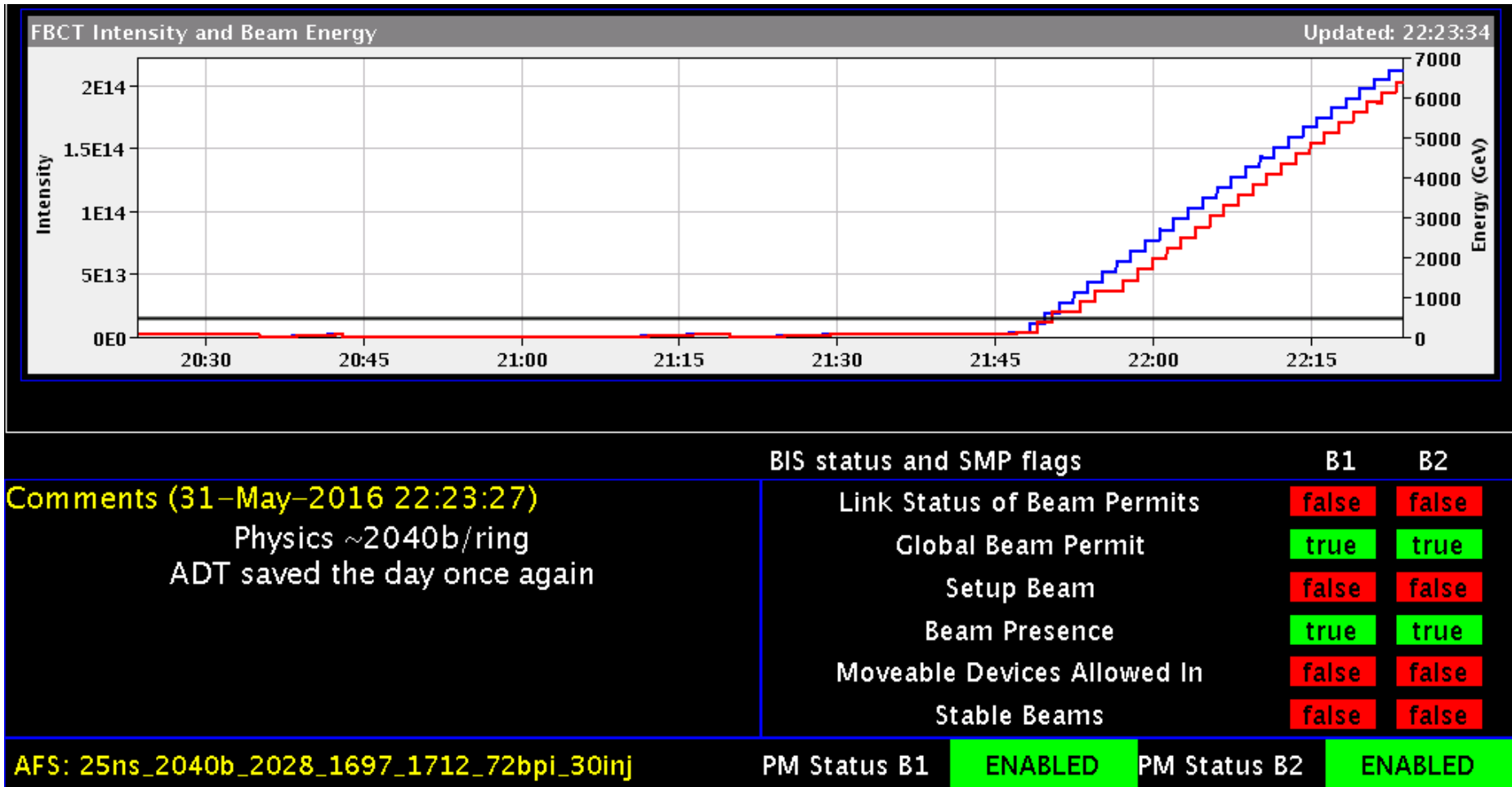
Summary

- New diagnostics tools are available from the CCC
- Reduced need for expert interventions and handed more control to the OP crews
- New features: ADT-AC dipole excitation for MDs and operational measurements – very promising “market”
- Work on the online instability detection is very advanced
- Shall the ADT noise performance be revisited we have foreseen solutions, however they require a major effort
- Precise input on desired performance will be needed from ABP

Summary

- ADT is a mature system and in general it works well...
- ... and that is a problem...
- Obtaining time to test new features, developments, improvements is getting increasingly difficult (read impossible)
- In order to stay responsive to new, unforeseen requests, we need machine time to “put cards up to our sleeves”
- In order to tune up the system to its best performance we need machine time

Thank you for your attention!



...and you are very welcome 😊

ADT Power System

- Rather stable with few occasional trips. No problem for operation due to redundancy
- LHC, two spare amplifiers in the tunnel and two spare in 867. Eight tubes were changed during TS2 in the LHC. Short intervention time in case of amplifier failure
- Average tube age 7000 hours

ADT Power System

- Major achievement: replacement of the Pulzer anode resistor developed in house. Waiting for the delivery of more samples to equip one ADT amplifier (4 resistors)

