Latest Results & Performance with Libera Brilliance at the ESRF

- The **classical survey & control** of the 'slow' beam position stability, some words on **hardware failure**
- Using the **ADCs** for verifications on the Kickers
- Using the T-b-T output with **Standard** & **MAF** T.b.T filter for Injection-Trajectory studies & H.Q. lattice studies
- The SA-**Sum** output for :
  1) **H.Q. Lifetime & 'beam-drop' monitoring**
  2) **monitoring Bunch-Length fluctuations** and other RF related variations
  3) fine, fast & sensitive **Current Control** in the Ring
- Preparing the installation of the **"2011" firmware**, but getting rid of some final aberrations before
- The near-future's use in Fast/Slow full global orbit stabilization will be covered by Eric's talk

The **classical survey & control** of the 'slow' **beam position stability**,

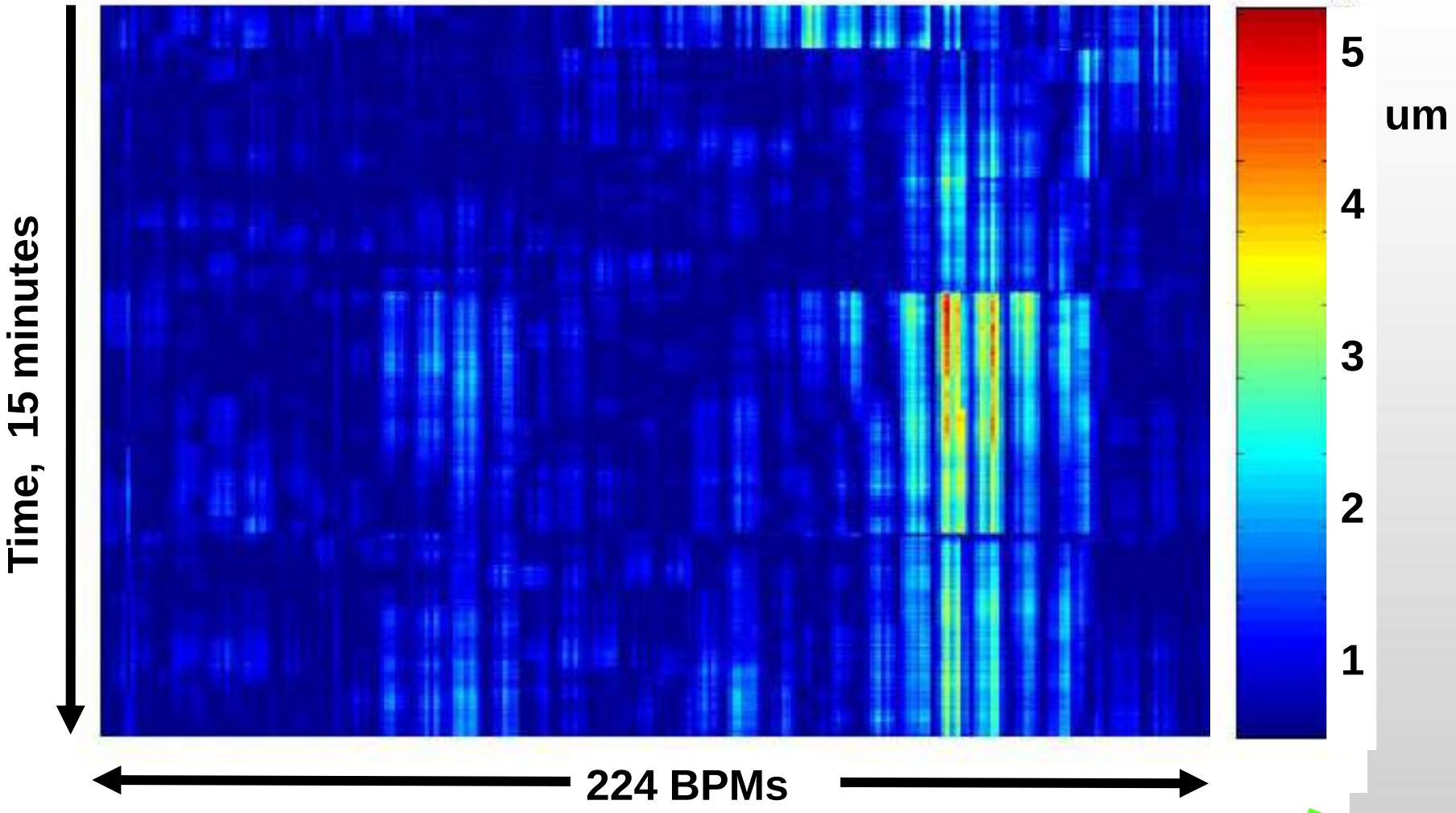
See examples in the next slides

nothing really new,
the system works reliably,
in case of a crazy BPM or a crazy Orbit Steerer, certain routines are available to Operation Crew to locate & discard the crazy equipment

hardware failure :

Much better than in 2009 & 2010,
Failure rate reduced to a few per year sofar in 2011,
Warranty extension covers upto April 2013

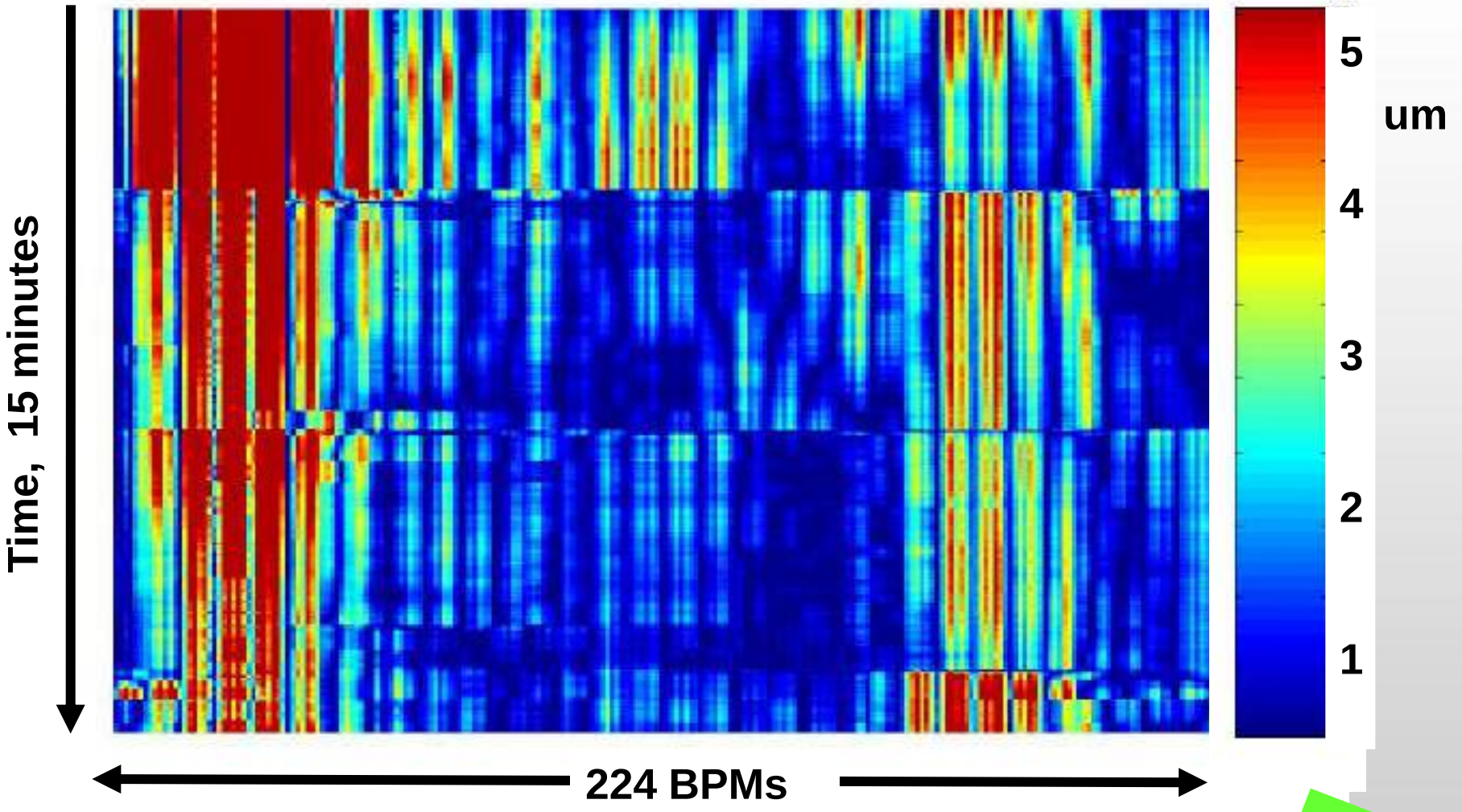
Stability in an intermediate time domain, 0.5sec to 15min



Stability judgment : typical, not too bad . . .

10 Hz

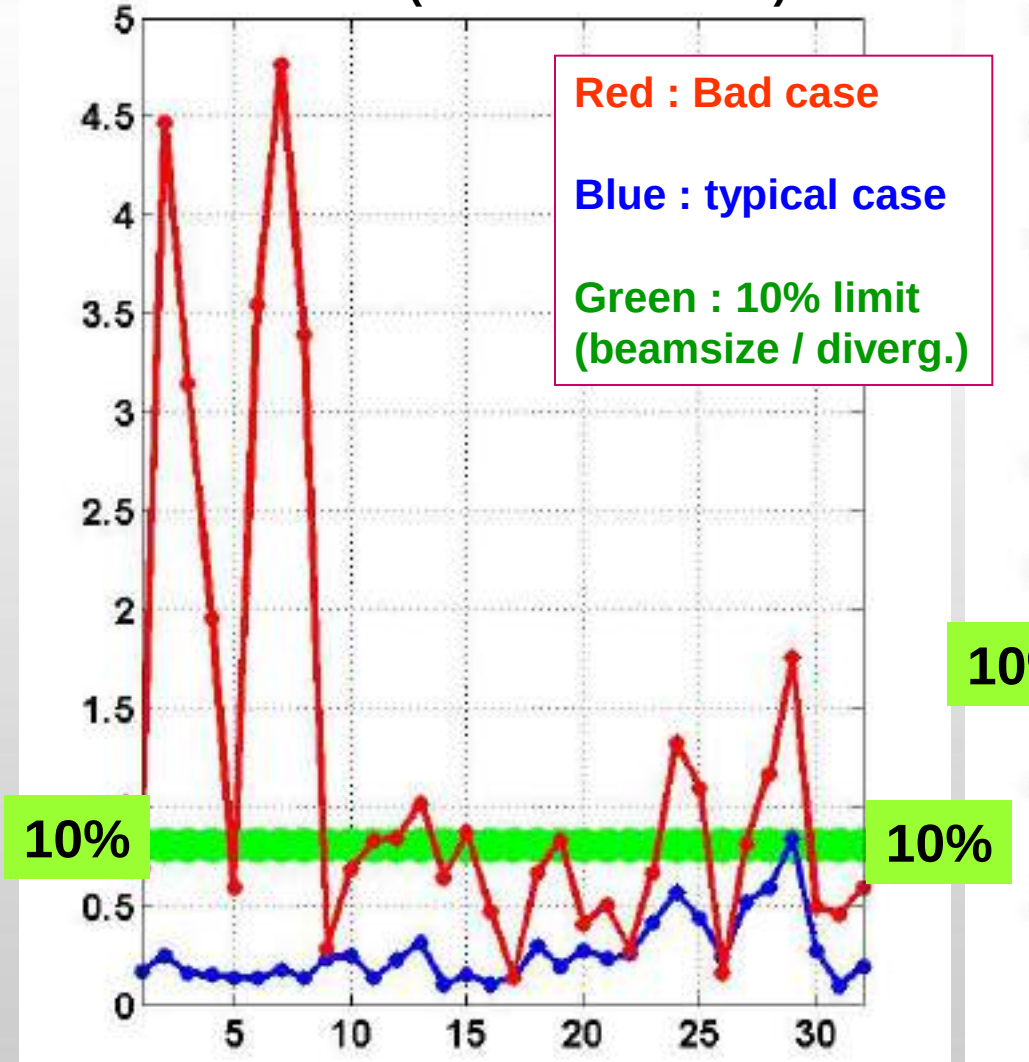
Stability in an intermediate time domain, 0.5sec to 15min



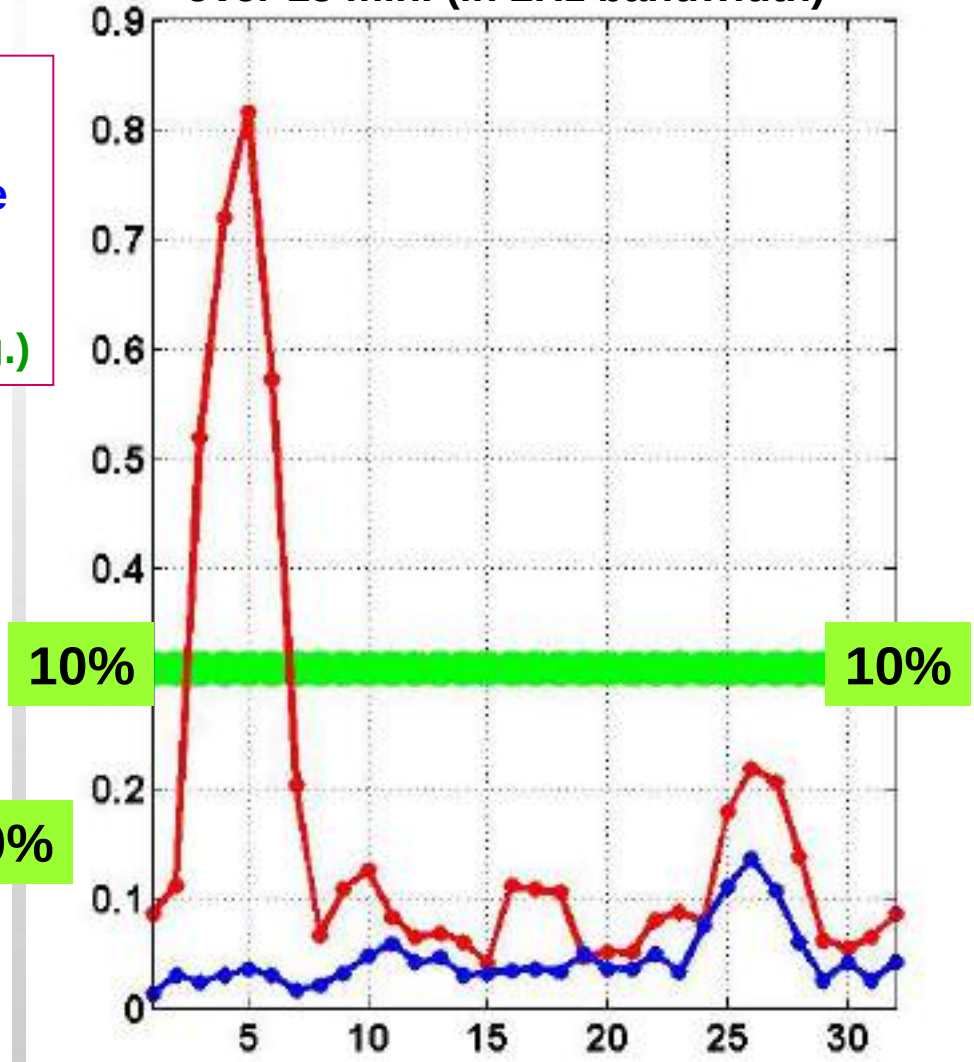
10 Hz

Stability judgment : BAD

IDs Vert. position stability [um rms] over 15 min. (in 2Hz bandwidth)



IDs Vert. angle stability [urad rms] over 15 min. (in 2Hz bandwidth)



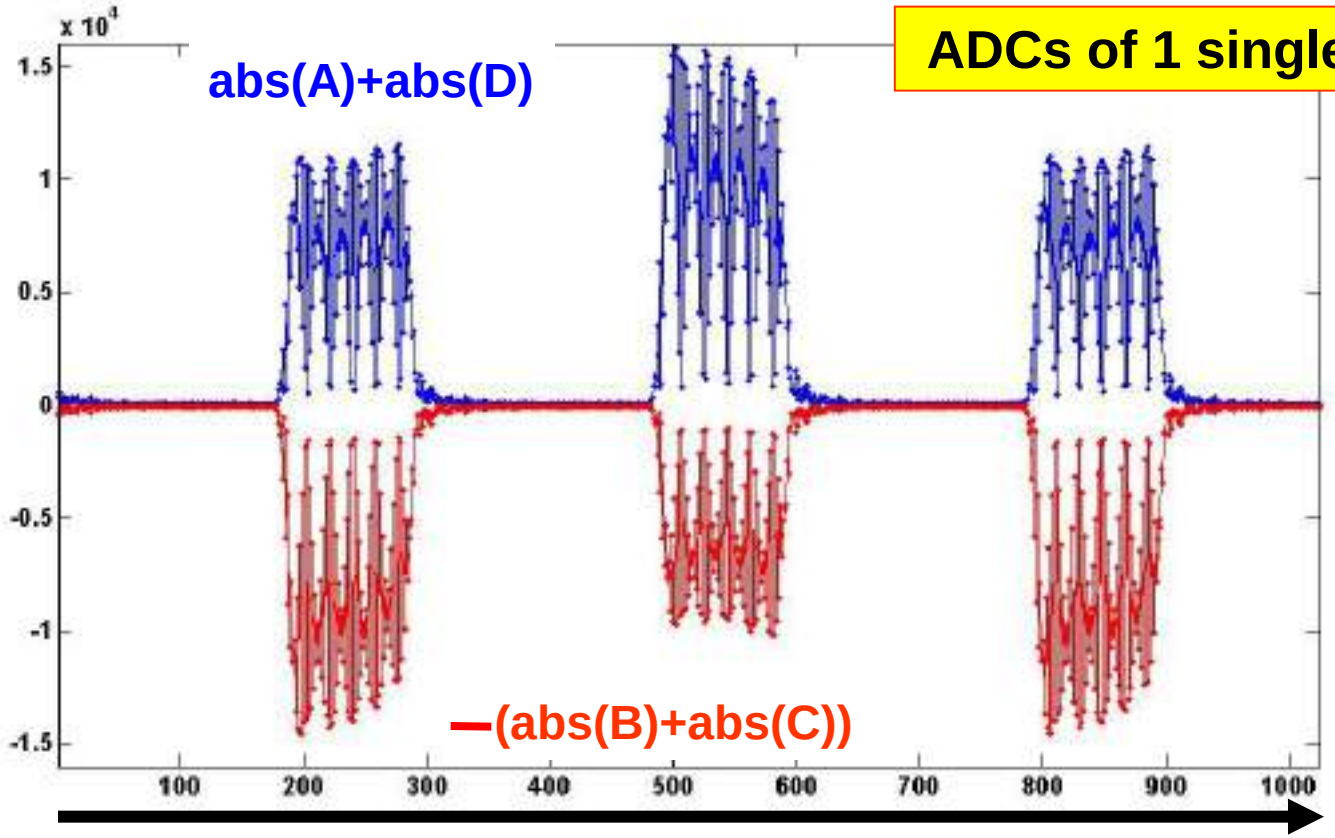
Future : the combined **Slow-Fast**-Orbit-Stabilization system uses :

Now : the **Fast**-Orbit Stabilization is limited in number of components

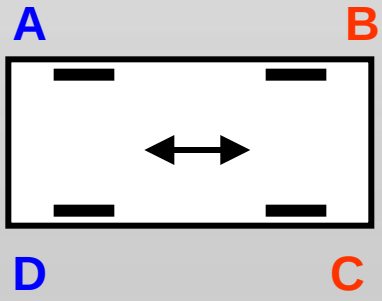
224 Libera BPMs	32 Hor-Fast-BPMs 32 Vert-Fast-BPMs)
96 AC-DC Steerers	32 AC Hor-Steerers 16 AC Vert-Steerers

Using the **ADCs** for verifications on the Kickers

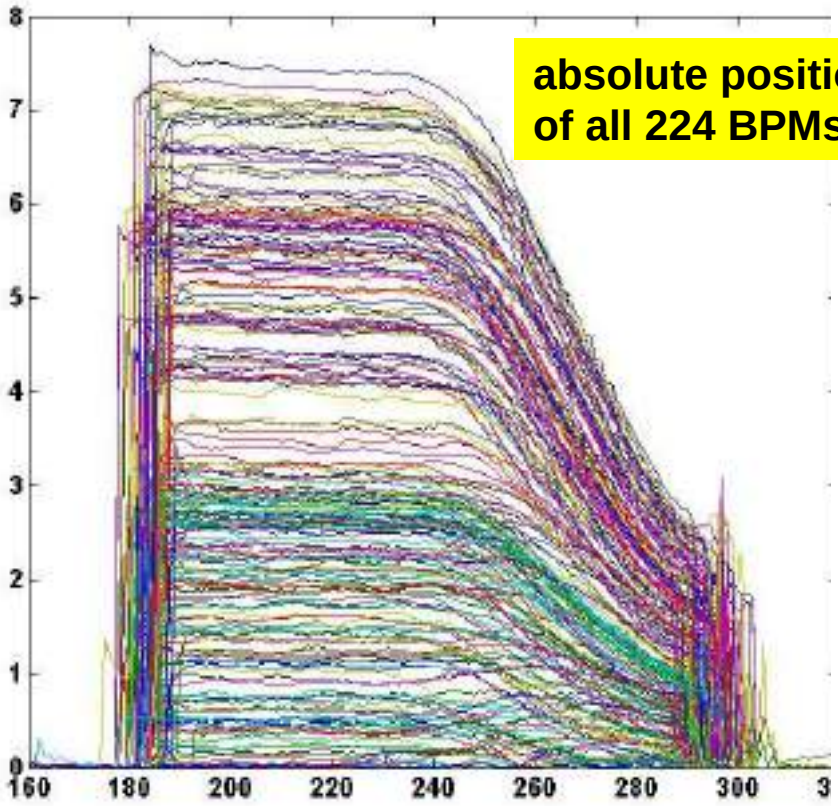
ADCs of 1 single BPM

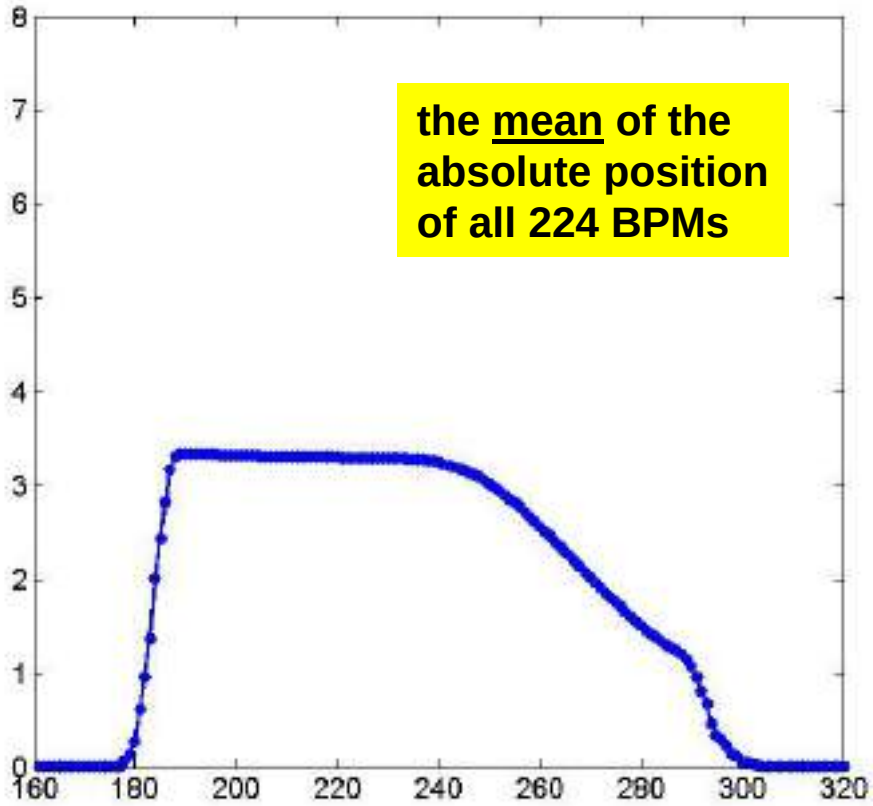


1024 ADC samples (~10nS) → see 3 Turns (~10uS)



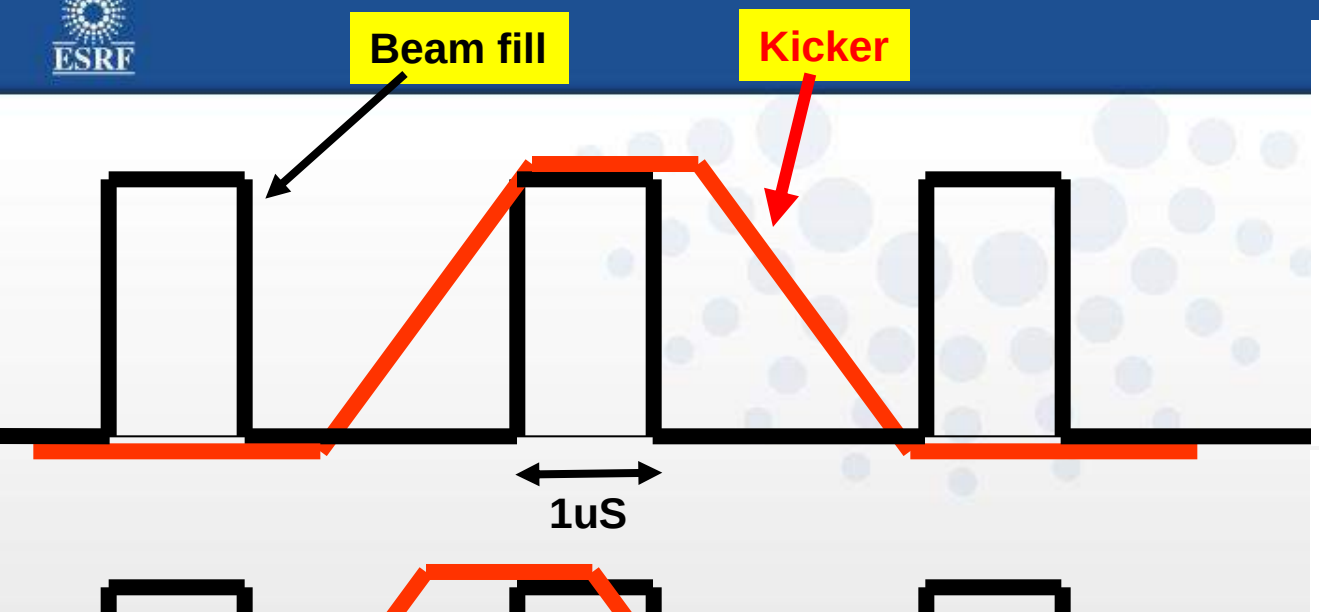
Beam being (single-Turn) kicked,
by 1 single injection kicker
but the kick is NOT flat,
but skewed . . .

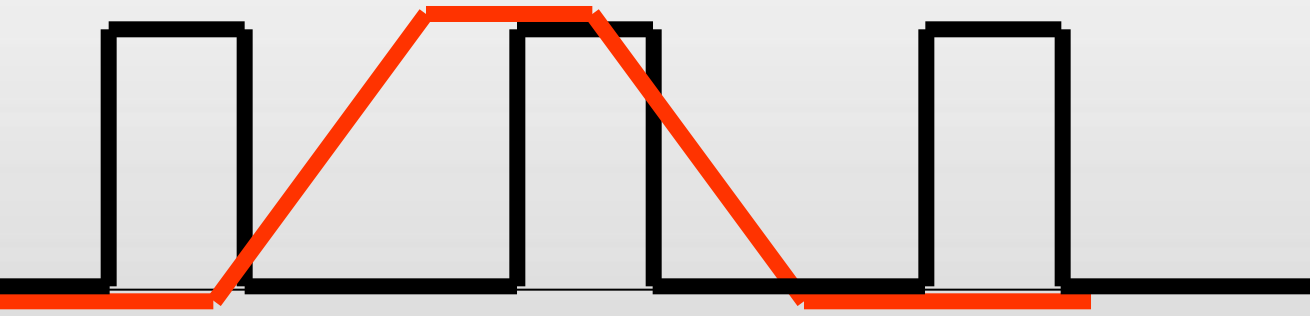


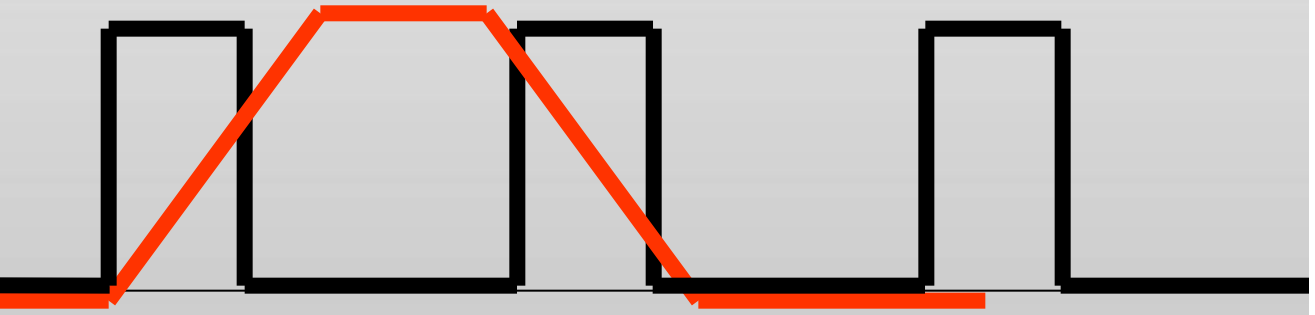


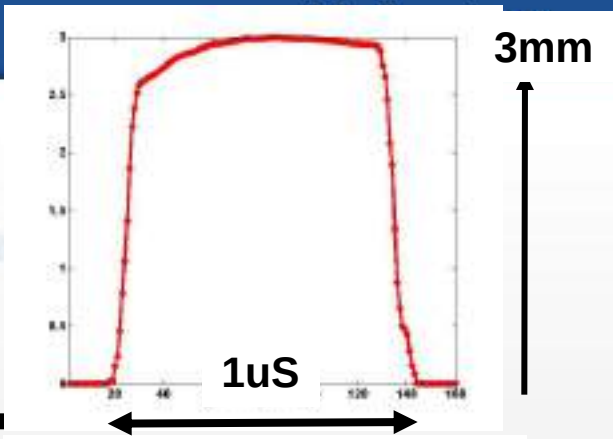
~100 ADC samples (~10nS)
(= 1 uS = 1/3 fill)

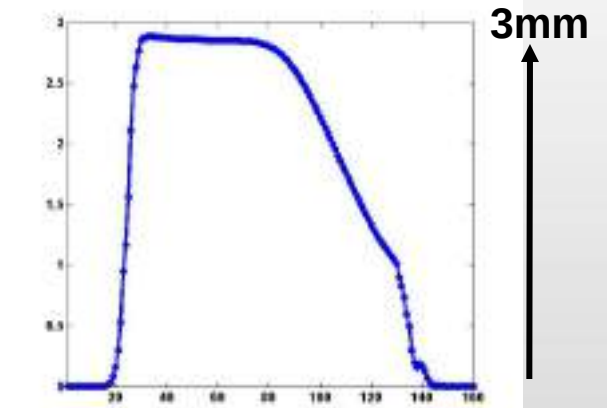
~100 ADC samples (~10nS)
(= 1 uS = 1/3 fill)

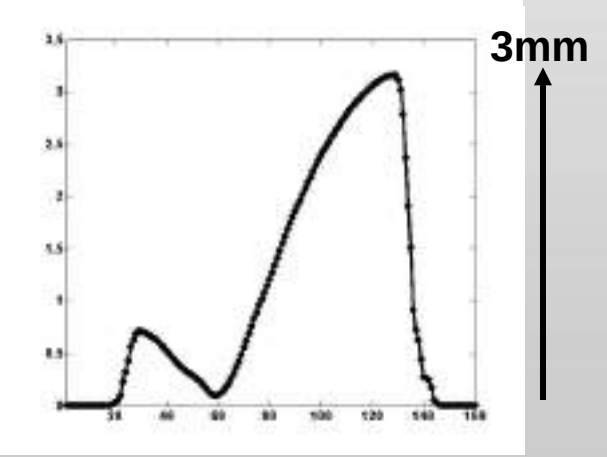

Beam fill
Kicker
1uS



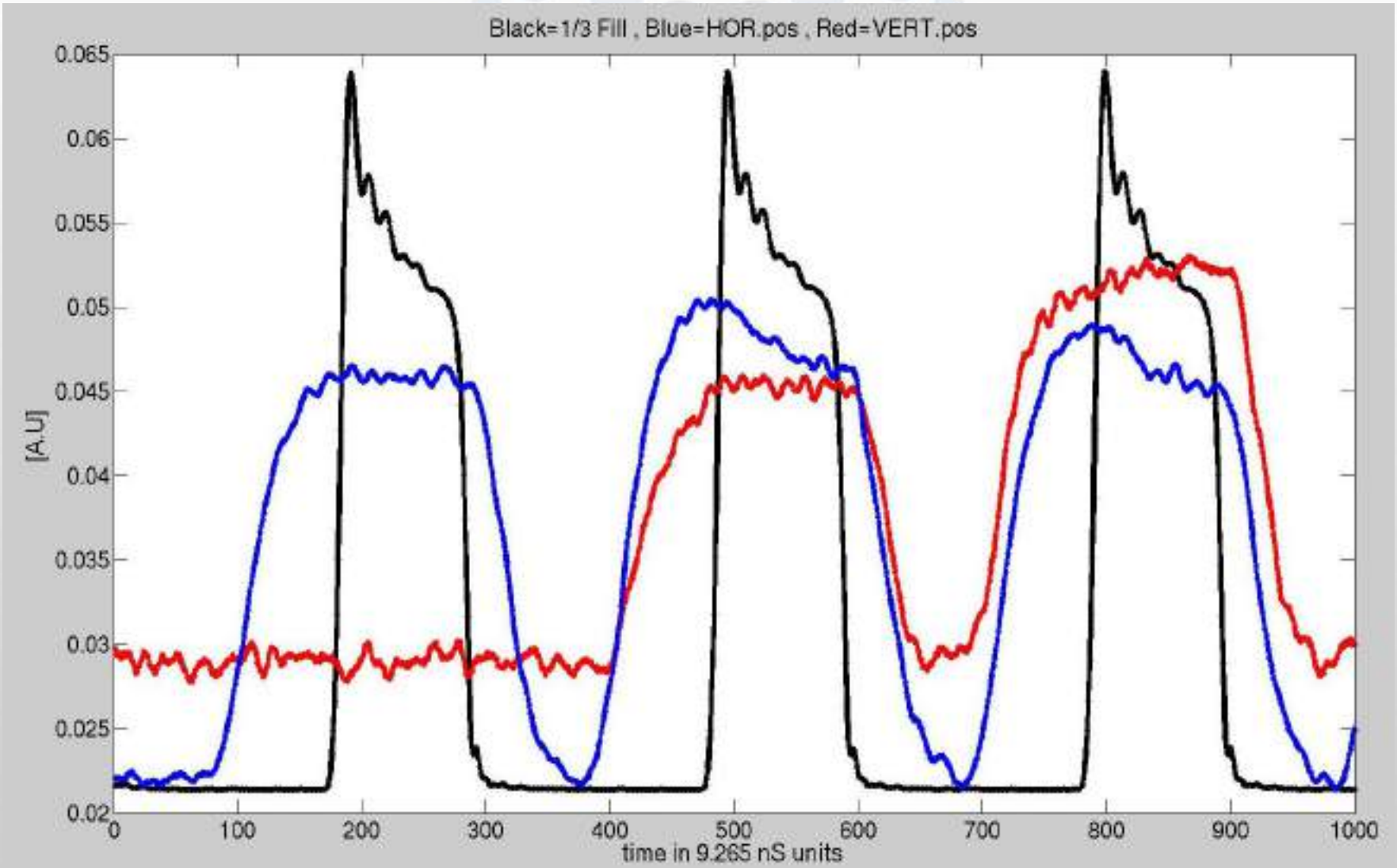



3mm
1uS

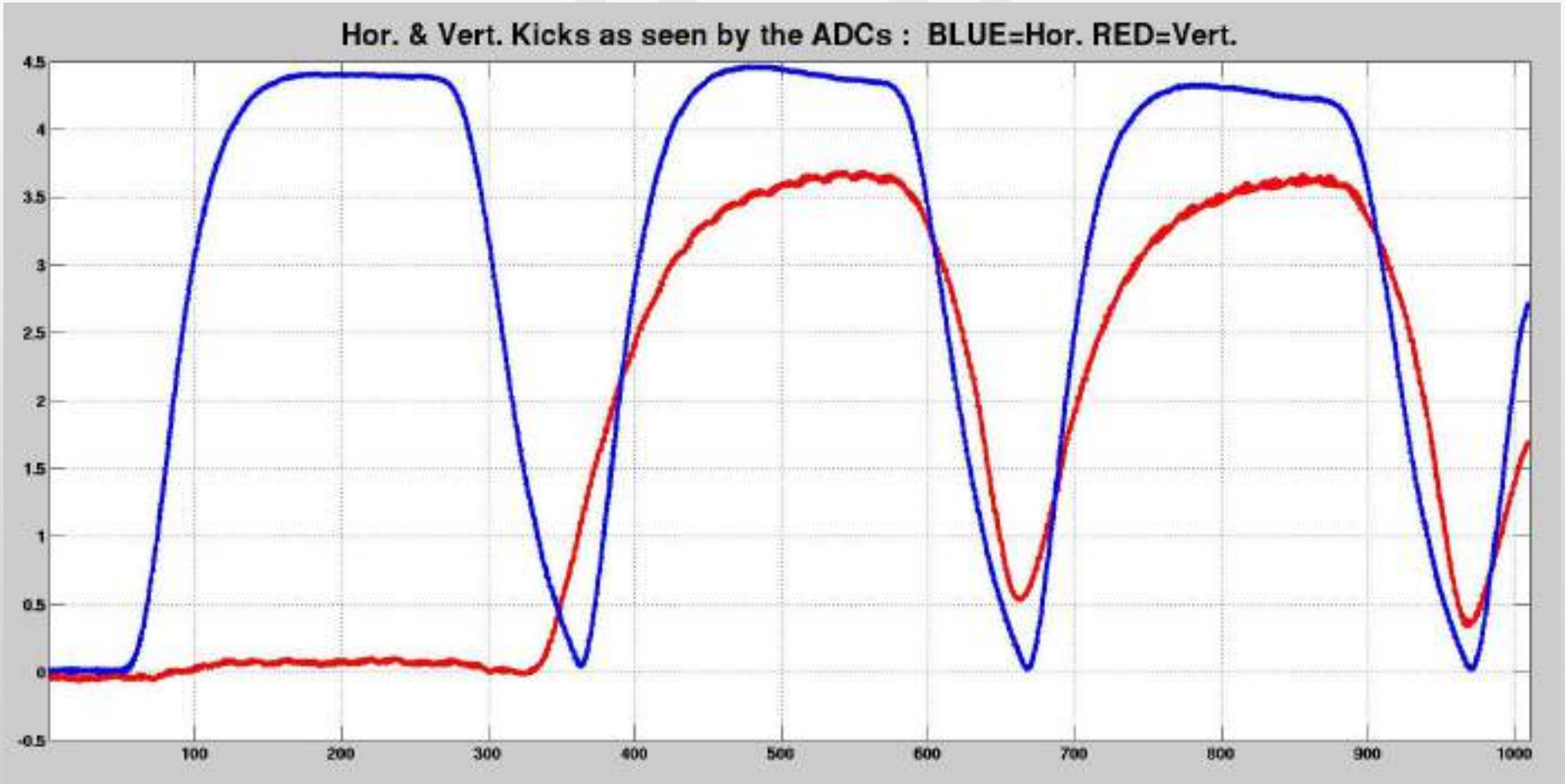

3mm


3mm

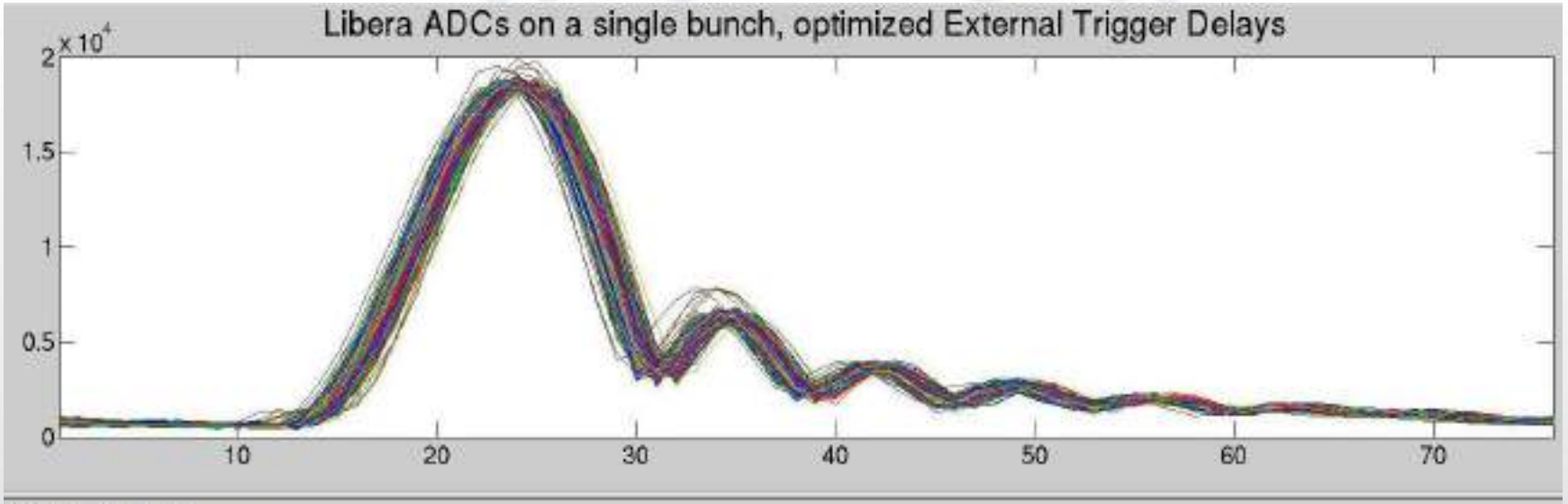
In 2011 the ADCs still serve e.g. for adjusting both the Hor. & a Vert. Kickers with respect to the 1/3 fill pattern

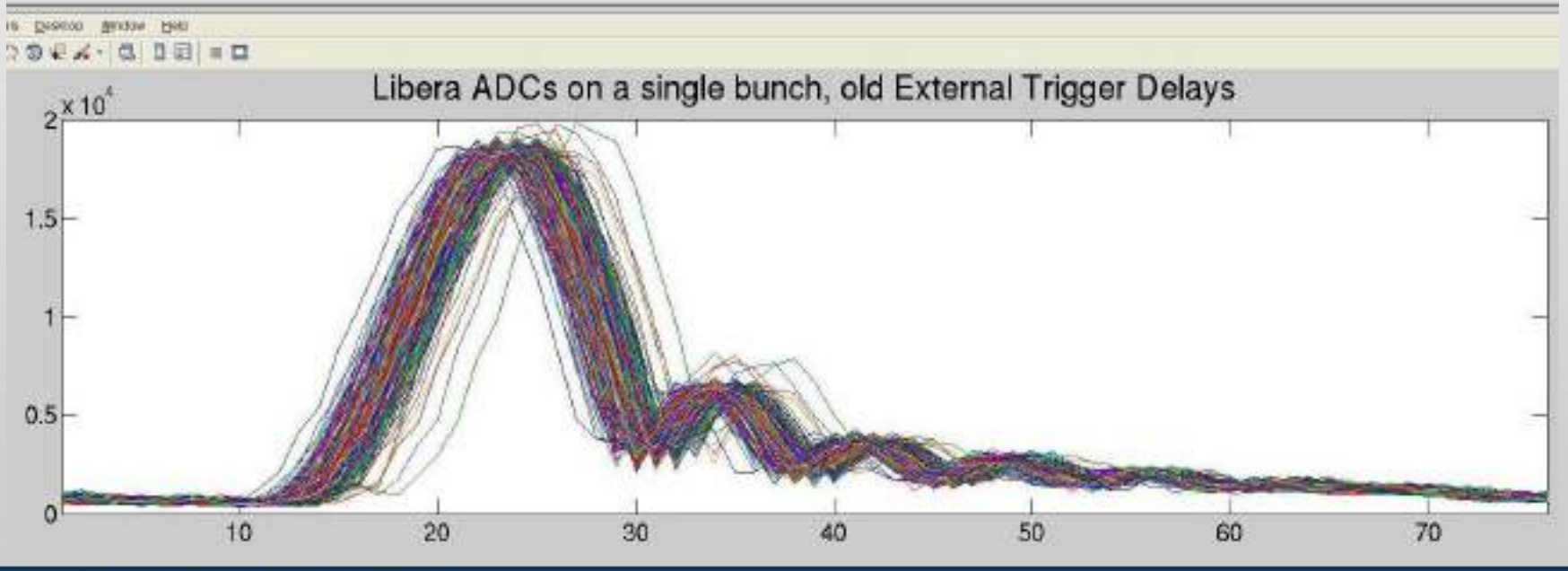


In 2011 the ADCs still serve e.g. for adjusting both the Hor. & a Vert. Kickers and not only the timing but also the shape of the kicker pulse can be verified



also using the ADCs to optimize the External Trigger Delays for optimimum Turn-by-Turn data performance





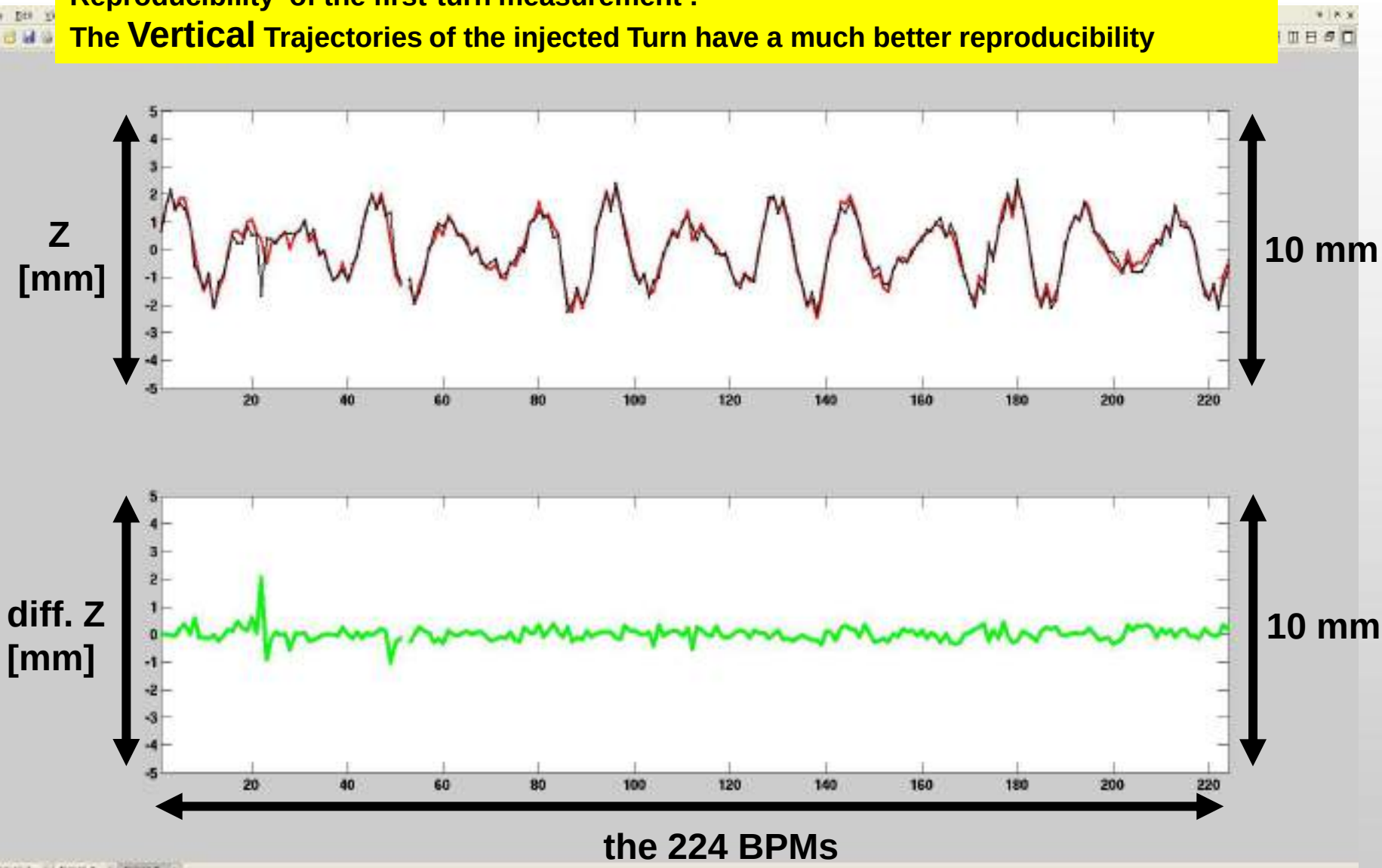
Using the T-b-T output with **Standard** & **MAF** T.b.T filter
for Injection-Trajectory studies & H.Q. lattice studies

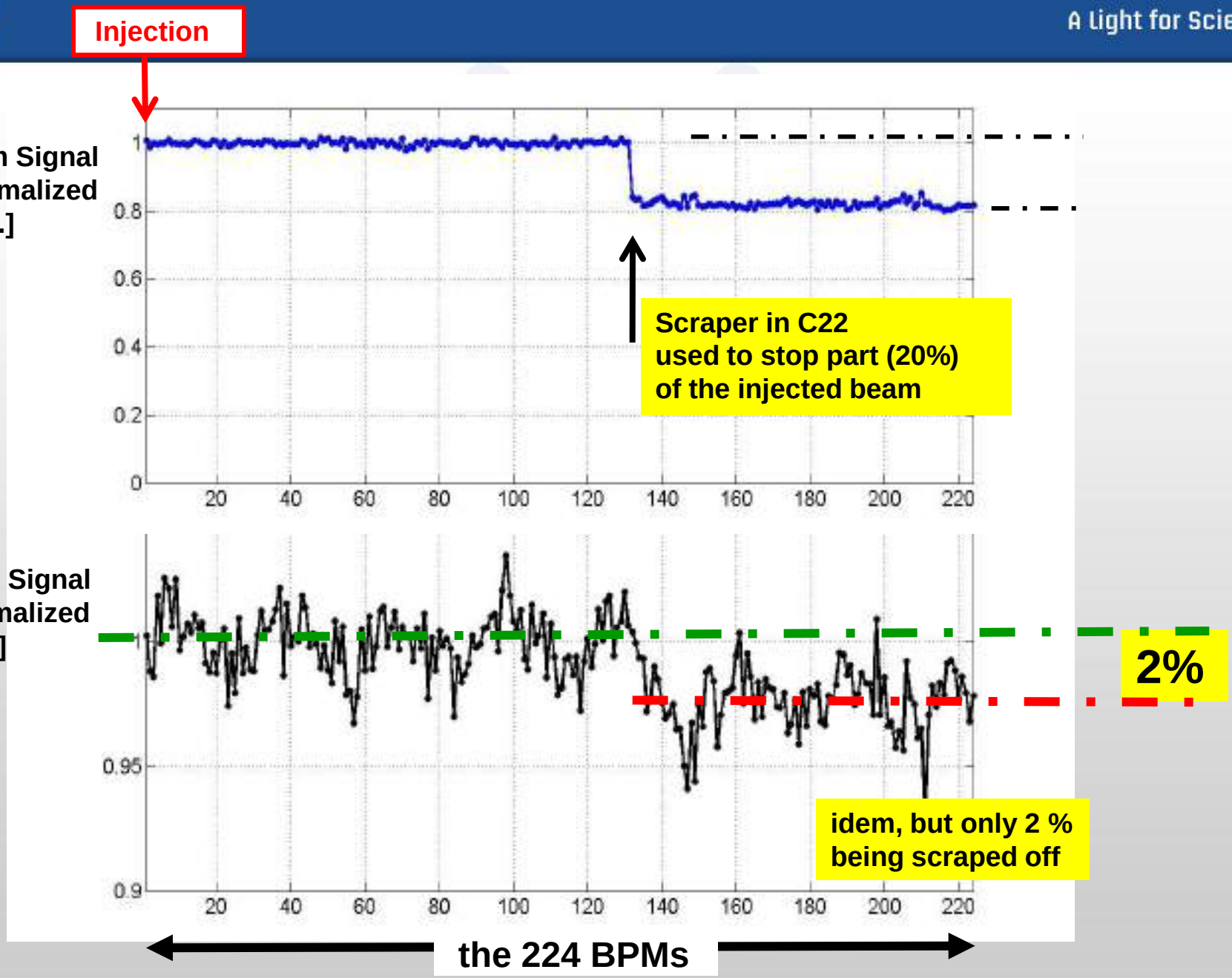
Both intensively used for 2 different reasons :

1) Injection-Trajectory is essential for rapidly getting the beam back stored after the 5 months shut-down (starting Dec.2011) due to extensive work on site and in the accelerator

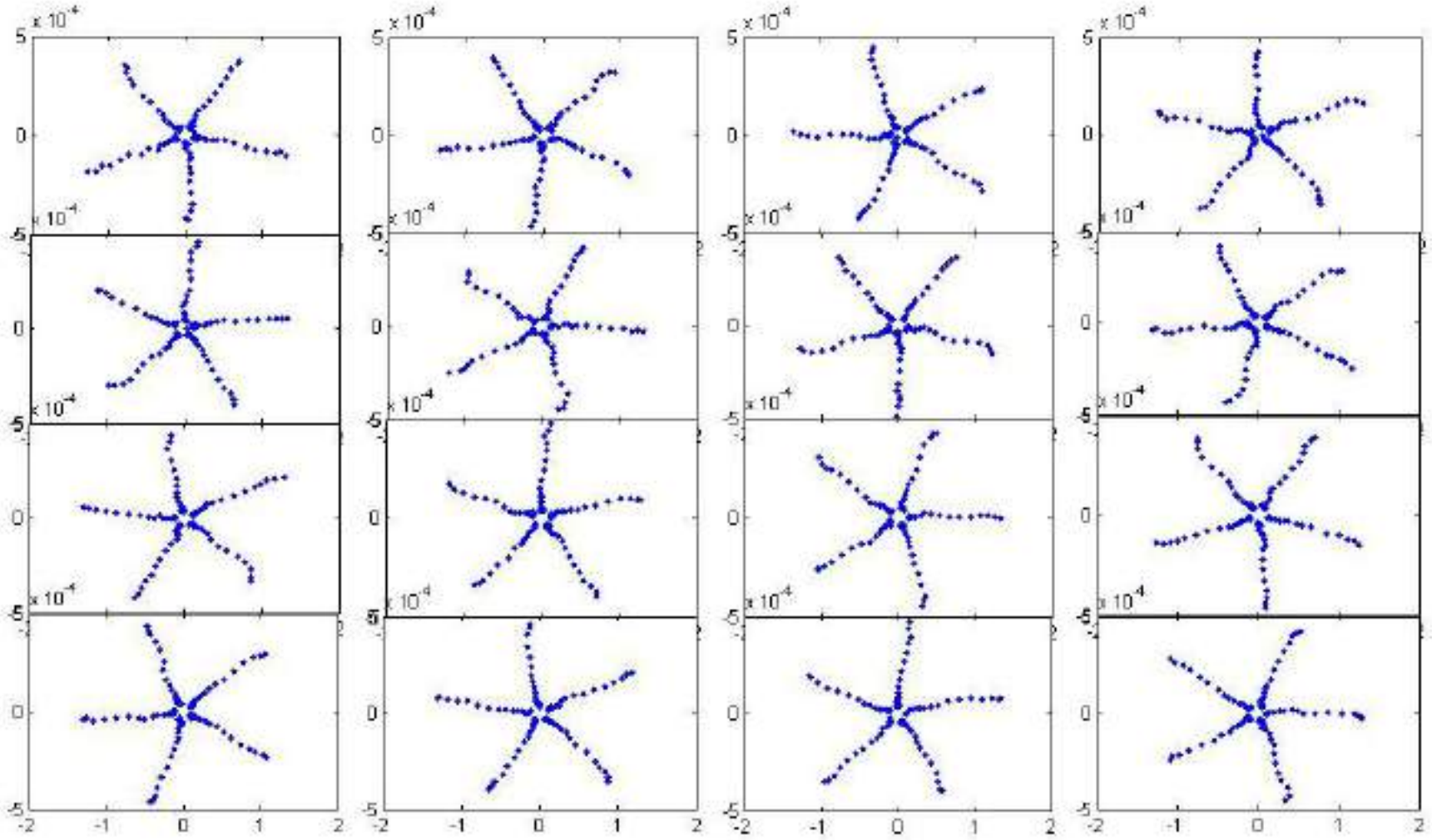
2) High-Quality lattice studies to assess & locate sextupole field errors that presently limit improvements in the lifetime of the beam

Reproducibility of the first-turn measurement :
The Vertical Trajectories of the injected Turn have a much better reproducibility




Injection
Sum Signal Normalized [a.u.]
1
0.8
0.6
0.4
0.2
0
20
40
60
80
100
120
140
160
180
200
220
Scraper in C22
used to stop part (20%)
of the injected beam
Sum Signal Normalized [a.u.]
0.95
0.9
2%
idem, but only 2 %
being scraped off
the 224 BPMs

Just an example of T-b-T measurements :



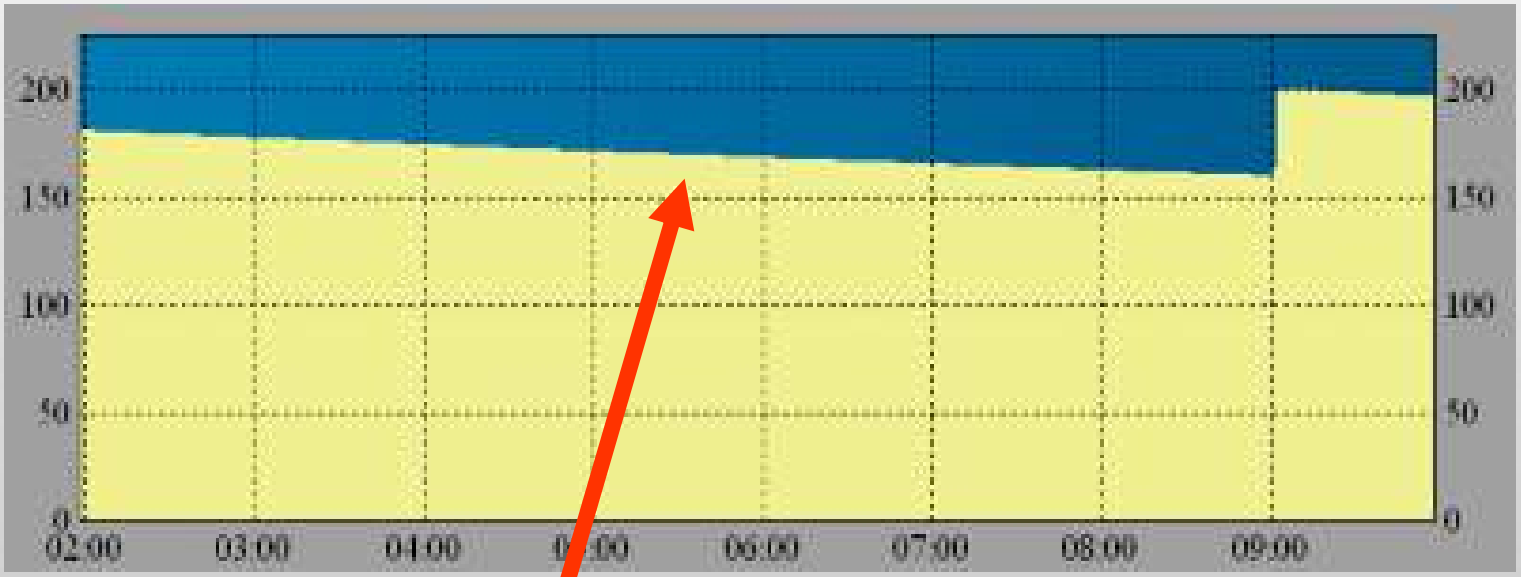
Vertical phase-space plot in 16 (even) strait sections

The SA-**Sum** output for :

1) **H.Q. Lifetime & 'beam-drop' monitoring**

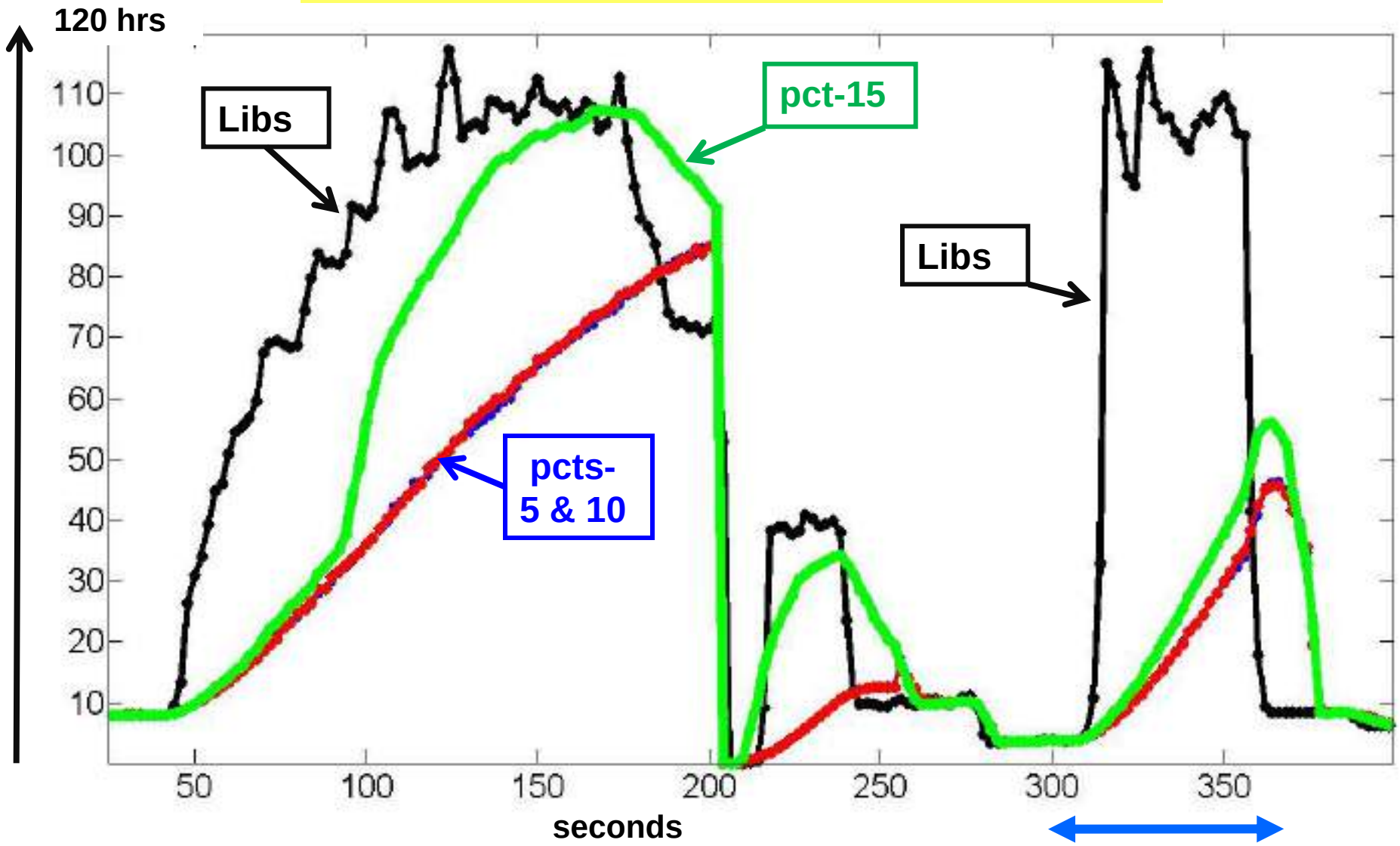
2) **monitoring Bunch-Length fluctuations**
and other RF related variations

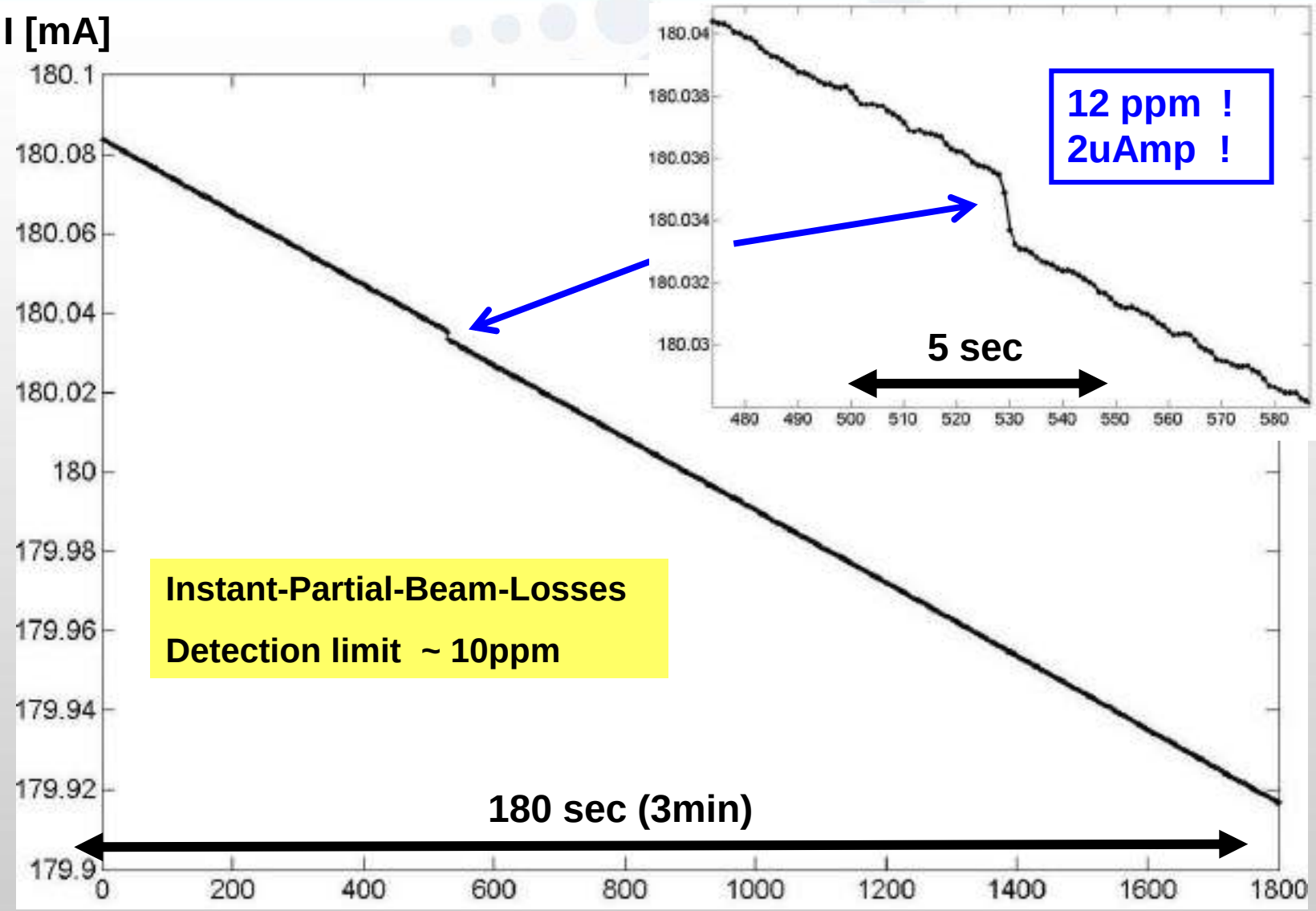
3) fine, fast & sensitive **Current Control** in the Ring



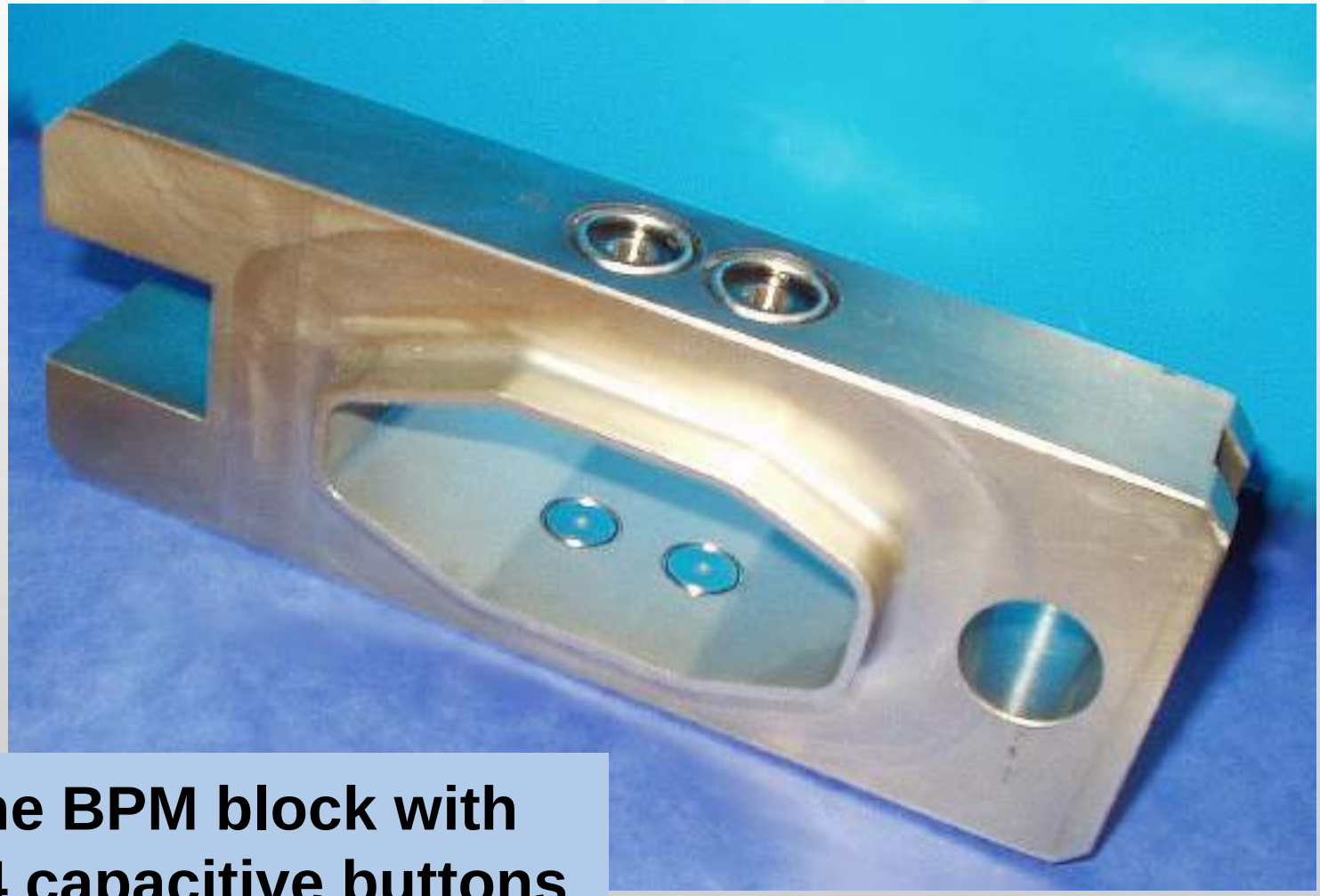
Lifetime is this slope

Lifetime measurements during special studies : response times of 3 PCTs and the Liberas



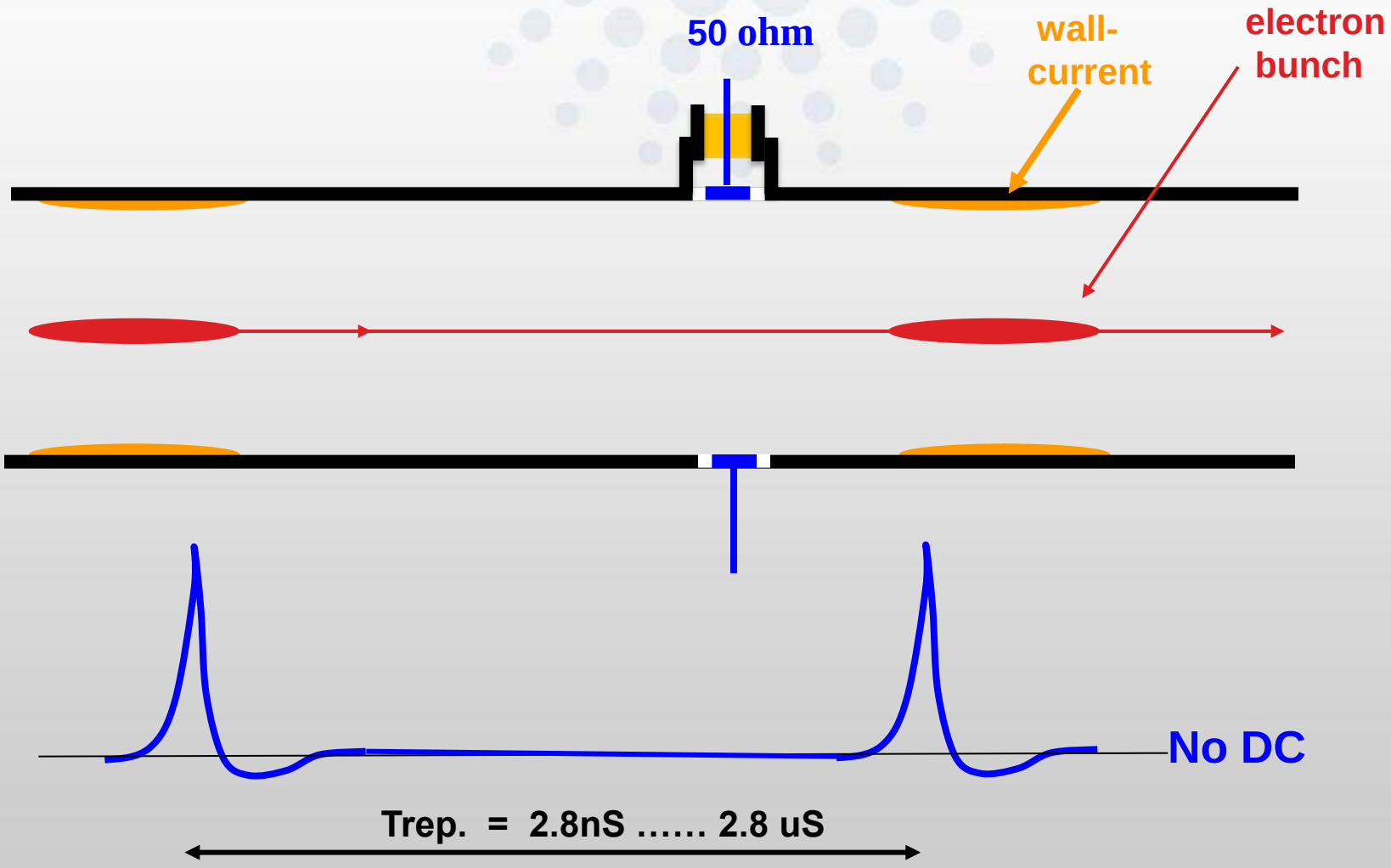

I [mA]
180.1
180.08
180.06
180.04
180.02
180
179.98
179.96
179.94
179.92
179.9
0
200
400
600
800
1000
1200
1400
1600
1800
180 sec (3min)
Instant-Partial-Beam-Losses
Detection limit ~ 10ppm
180.04
180.038
180.036
180.034
180.032
180.03
480
490
500
510
520
530
540
550
560
570
580
5 sec
12 ppm !
2uAmp !

monitoring **Bunch-Length fluctuations** and other RF related variations

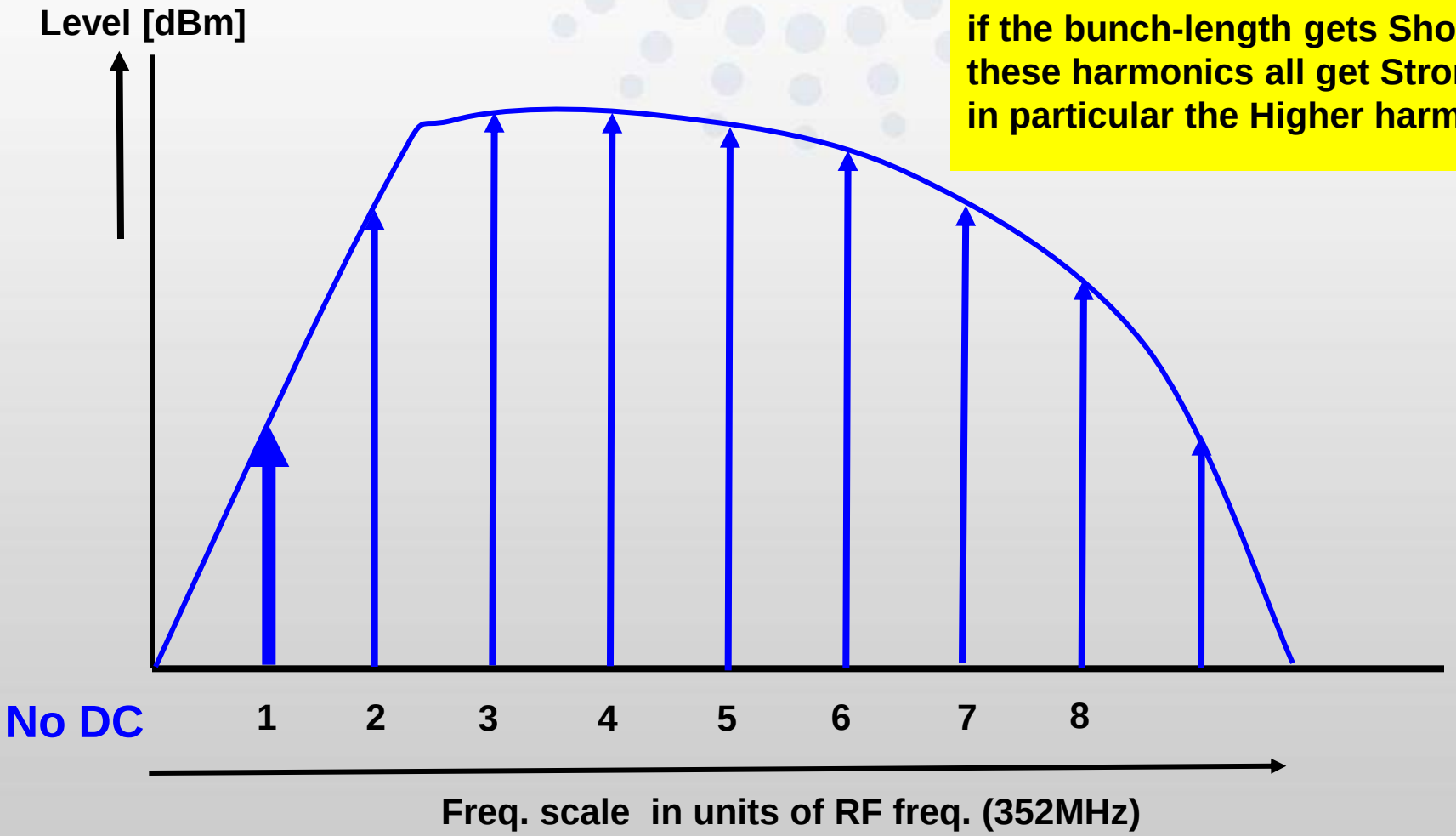


The BPM block with its 4 capacitive buttons

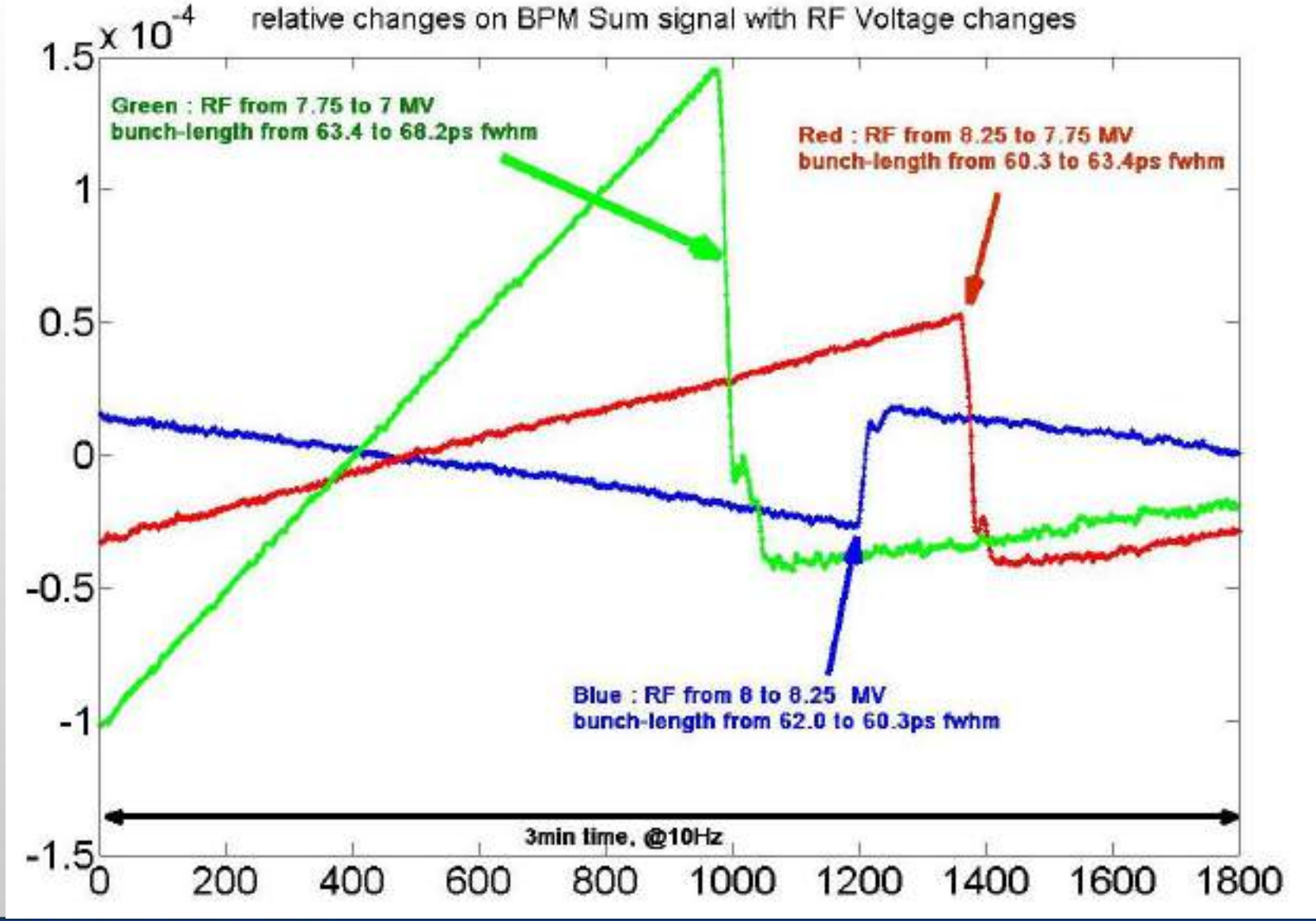
The RF signal from a button, the longitudinal view



The RF signal from a button in frequency domain, with complete multi-bunch fill (992, i.e. uniform)



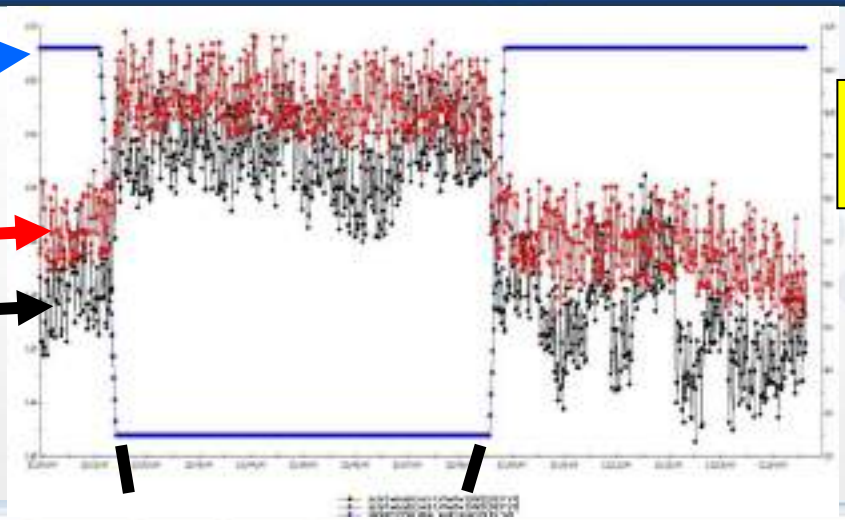
Comparing : Libera-Sum with Streak-Camera results, while changing the Acceleration Voltage of the Cavity



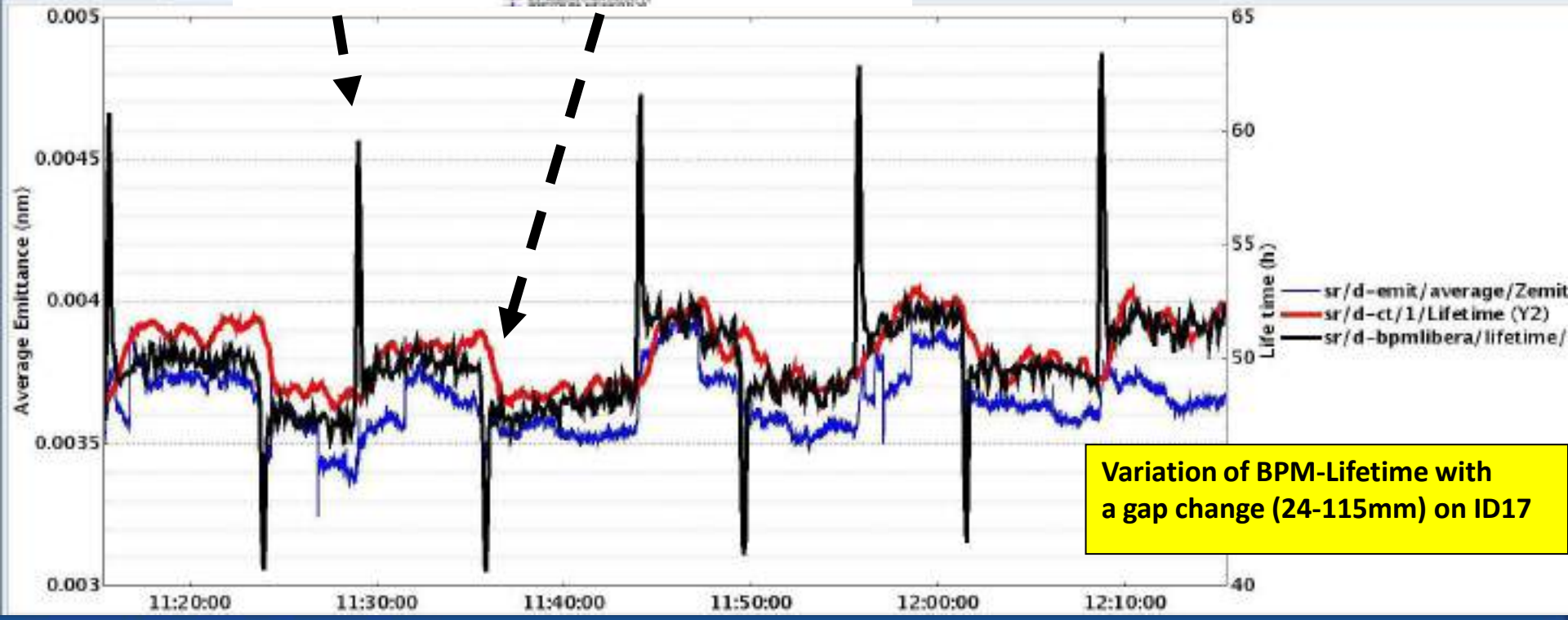
ID17gap change

Power Cav.1

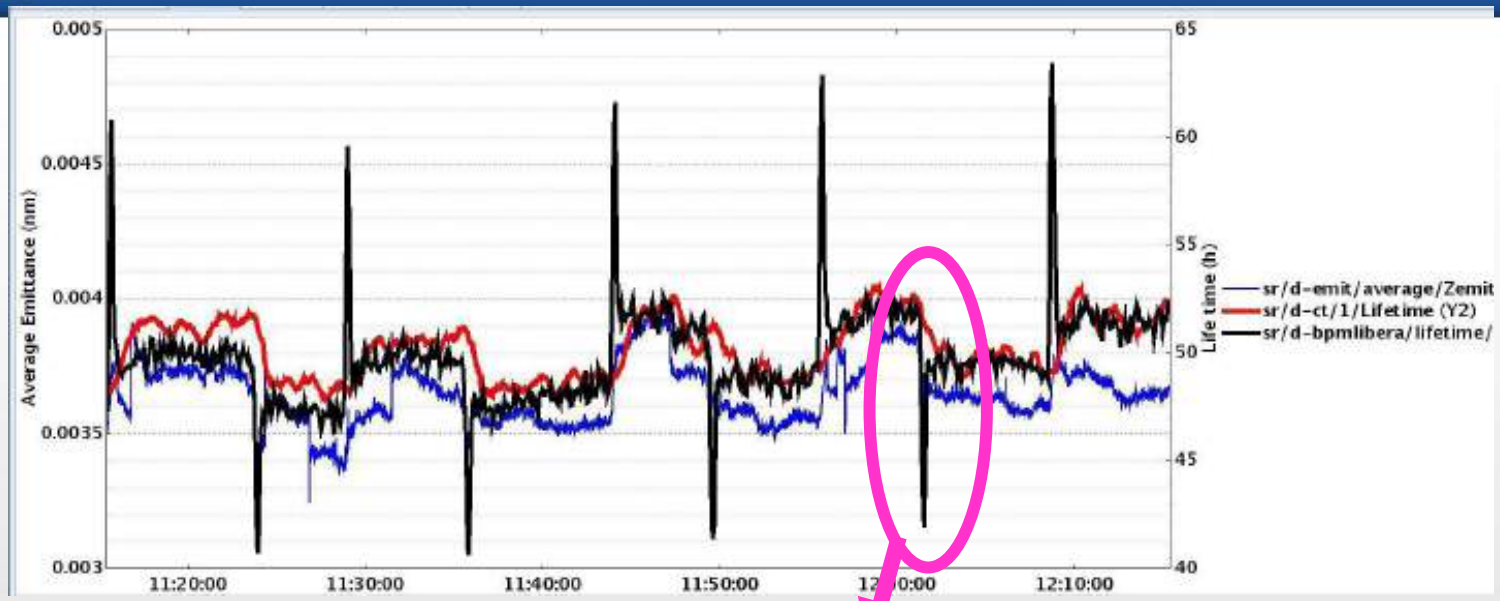
Power Cav.2

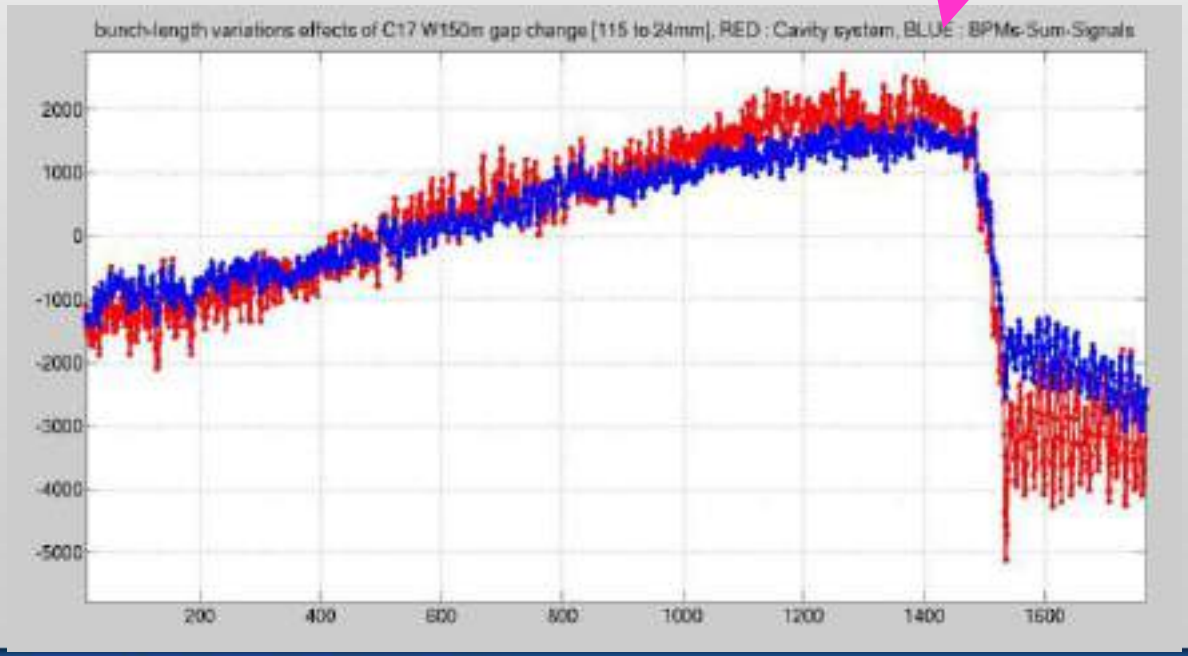


Variation of forward power Cav1 & Cav2 with a gap change (24-115mm) on ID17



Variation of BPM-Lifetime with a gap change (24-115mm) on ID17

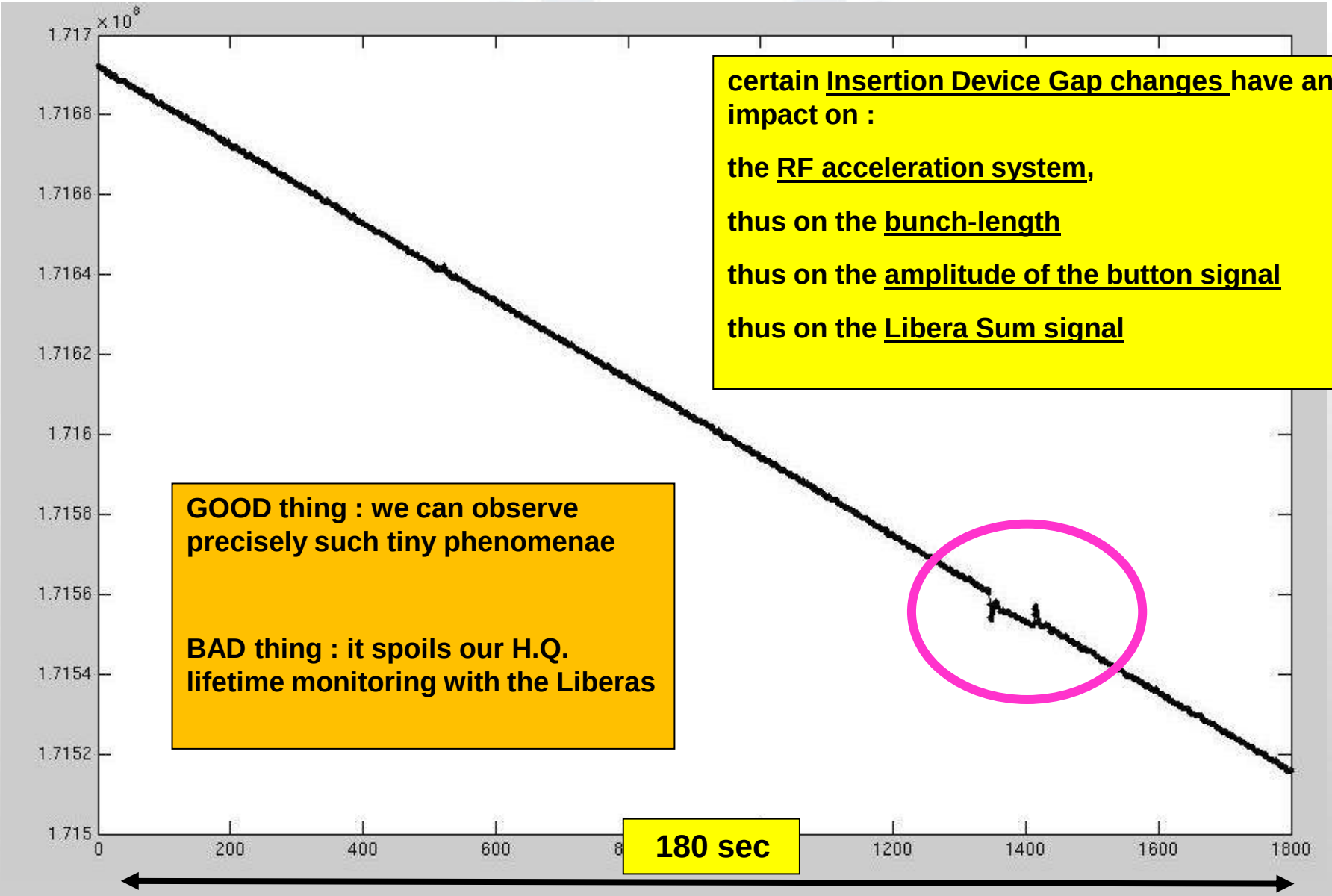




Variation of Bunch-Length with a gap change on ID17 seen by 2 independent devices :

RED : 15GHz BPM-cavity signal

BLUE : SUM-signals BPMs (@352MHZ)



certain Insertion Device Gap changes have an impact on :

the RF acceleration system,

thus on the bunch-length

thus on the amplitude of the button signal

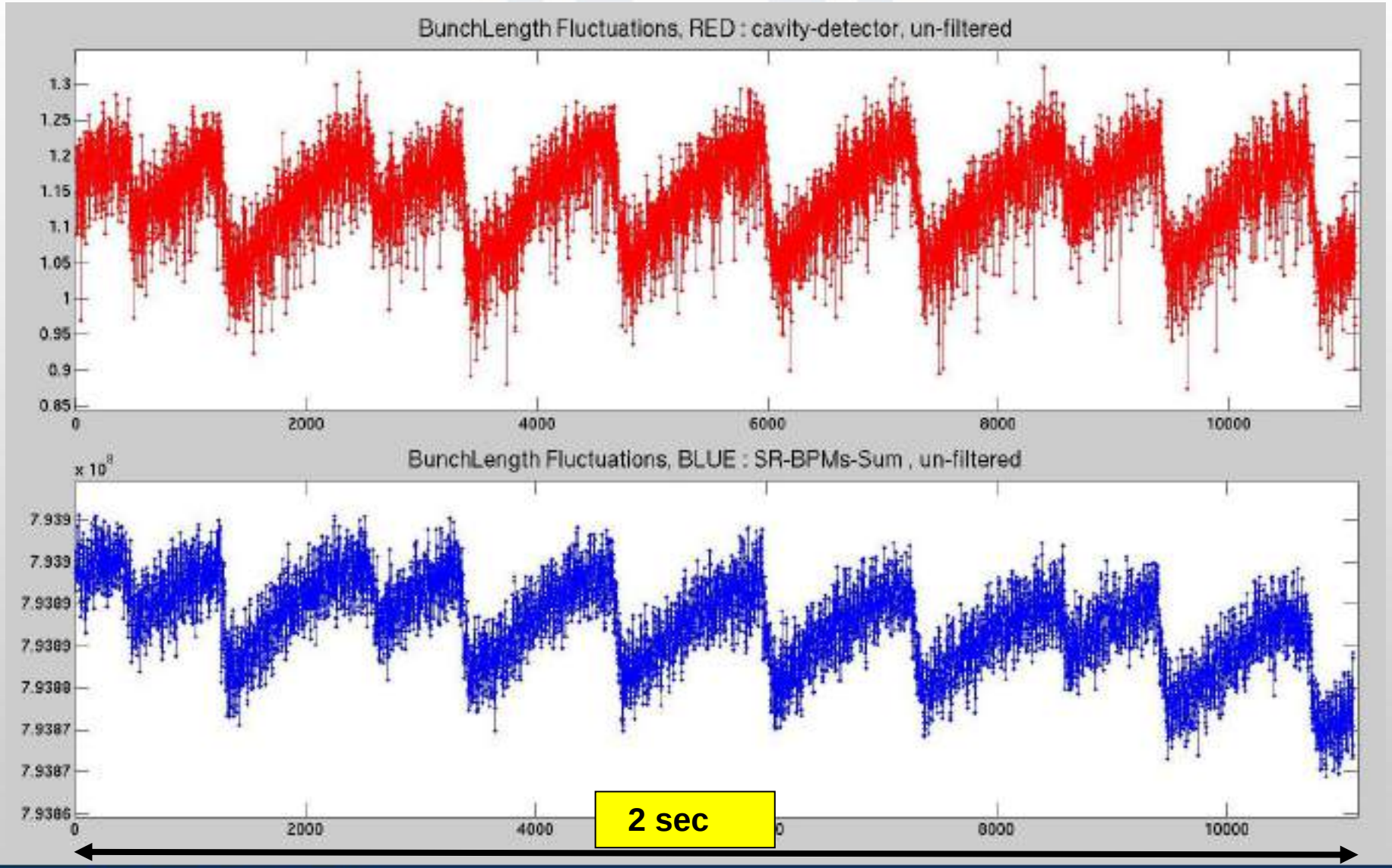
thus on the Libera Sum signal

GOOD thing : we can observe precisely such tiny phenomenae

BAD thing : it spoils our H.Q. lifetime monitoring with the Liberas

other & faster bunch-length fluctuations :

now using the DD-Sum buffer (5.5KHz sampling, 2 sec. record) :

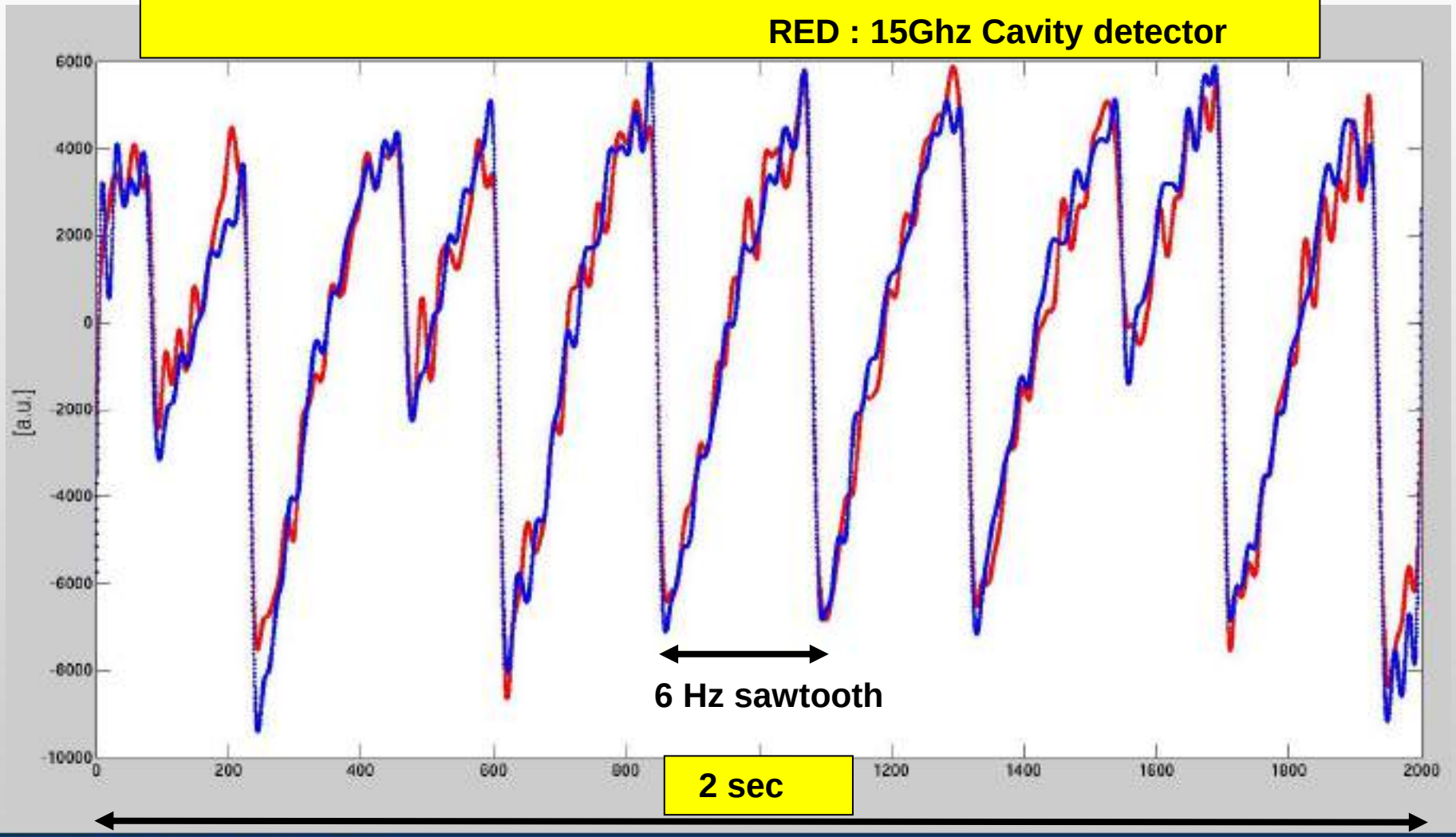


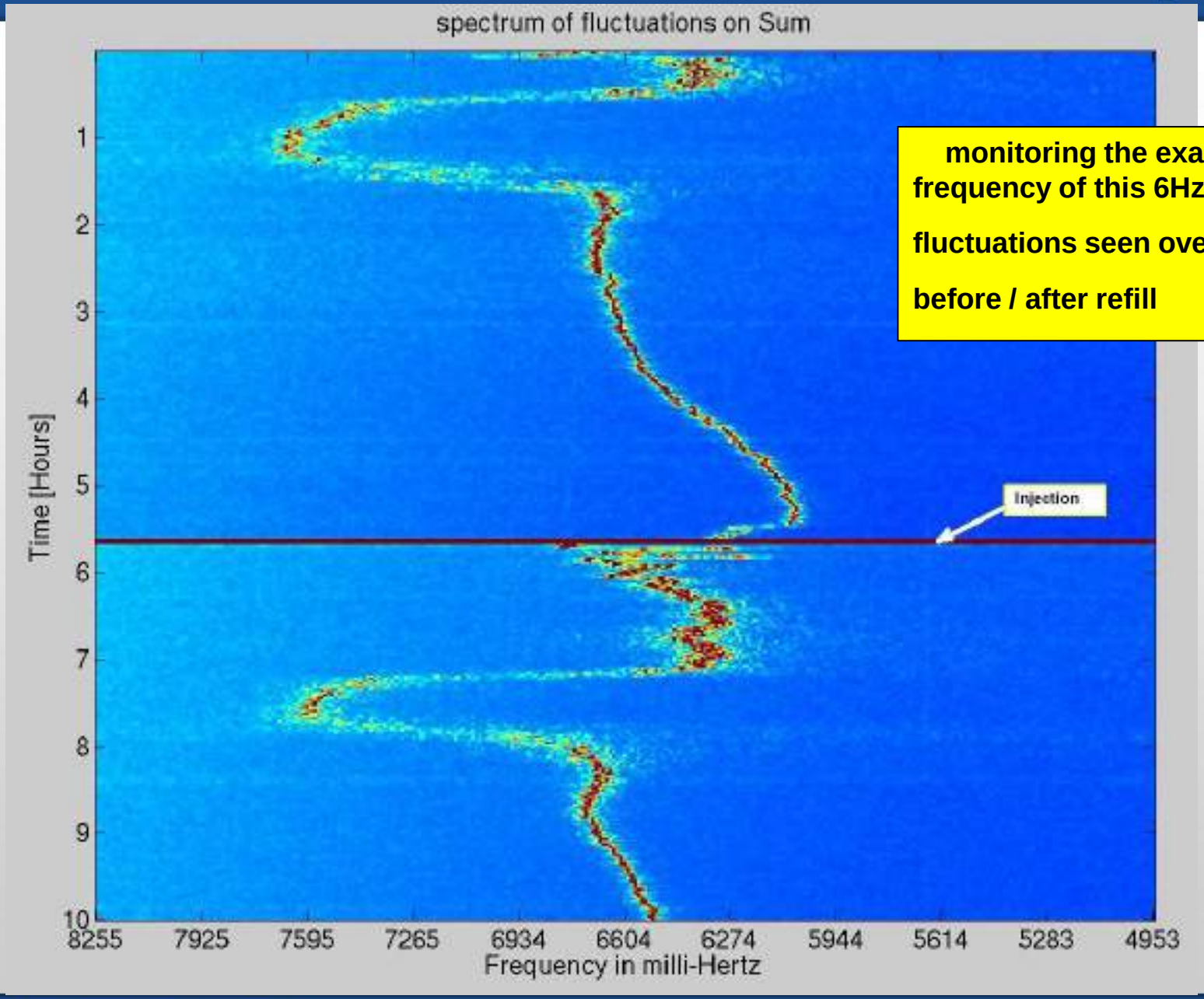
other & faster bunch-length fluctuations :

now using the DD-Sum buffer (5.5KHz sampling, 2 sec. record) :

filtered & normalized data of the : BLUE : 224 Liberas (352MHz)

RED : 15Ghz Cavity detector





monitoring the exact frequency of this 6Hz line :

fluctuations seen over hours,

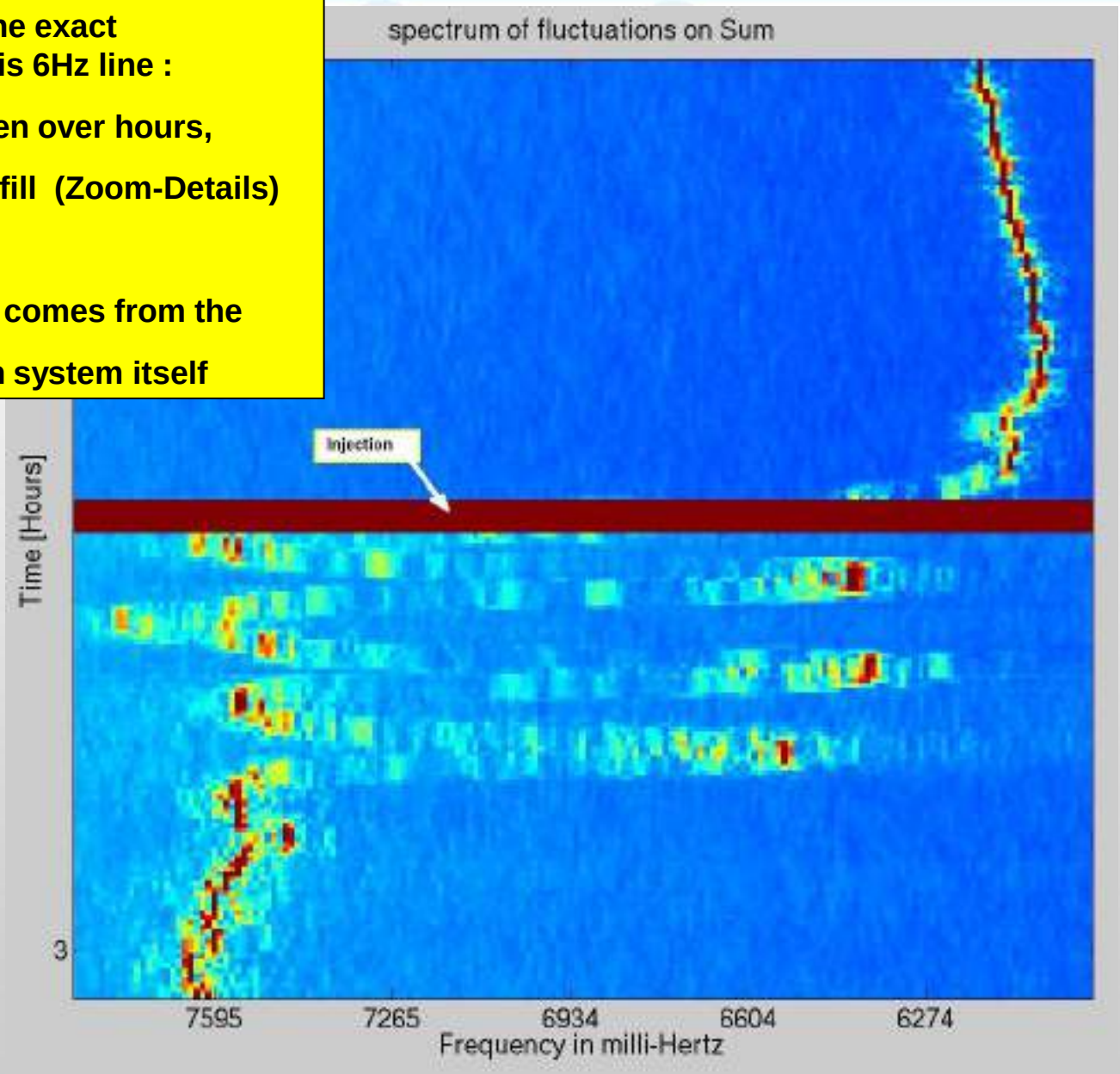
before / after refill

monitoring the exact frequency of this 6Hz line :

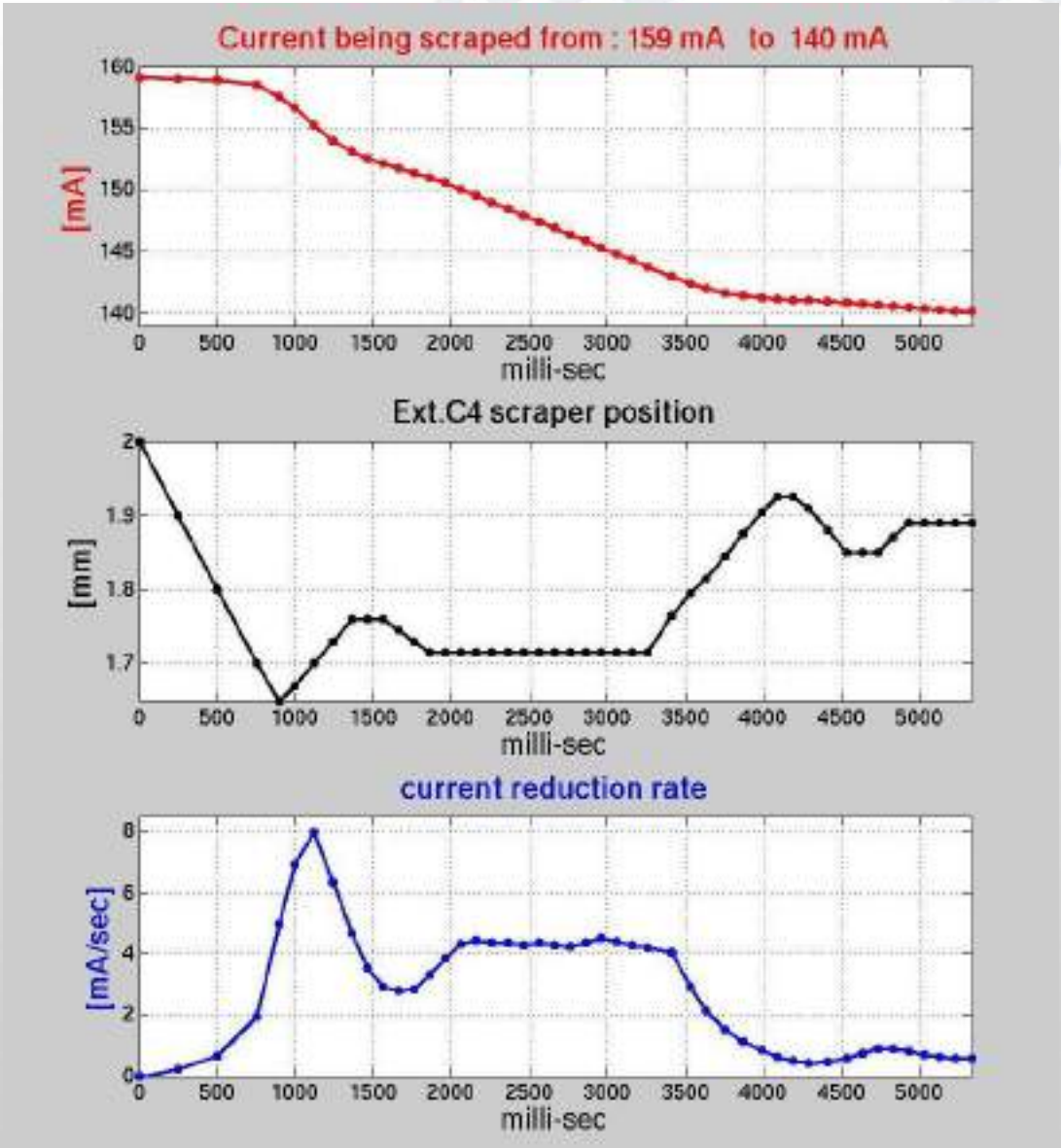
fluctuations seen over hours,

before / after refill (Zoom-Details)

this fluctuation comes from the RF acceleration system itself



fine, fast & sensitive **Current Control** in the Ring

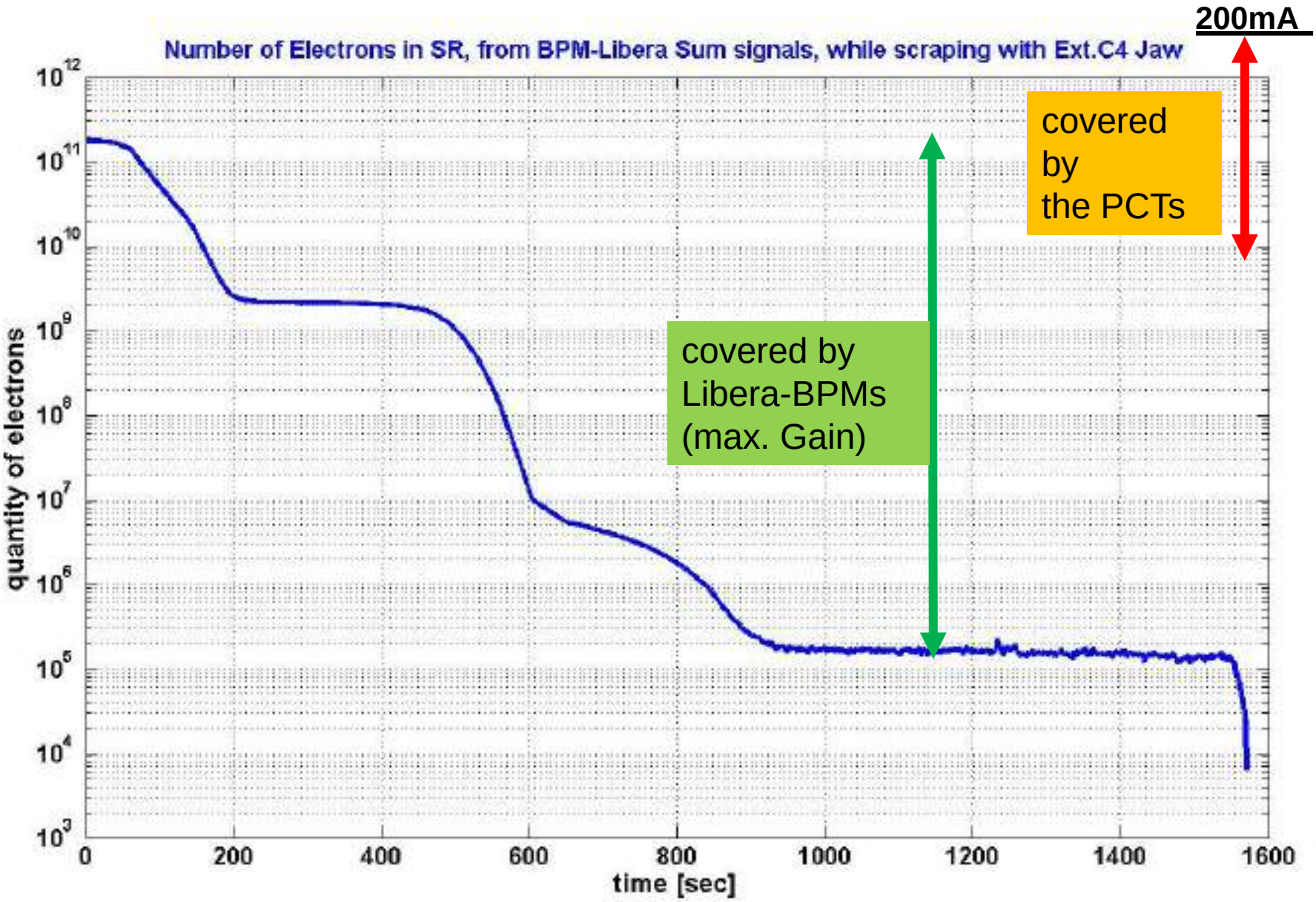


the 10Hz Sum of all **Liberas** for **current measurement**

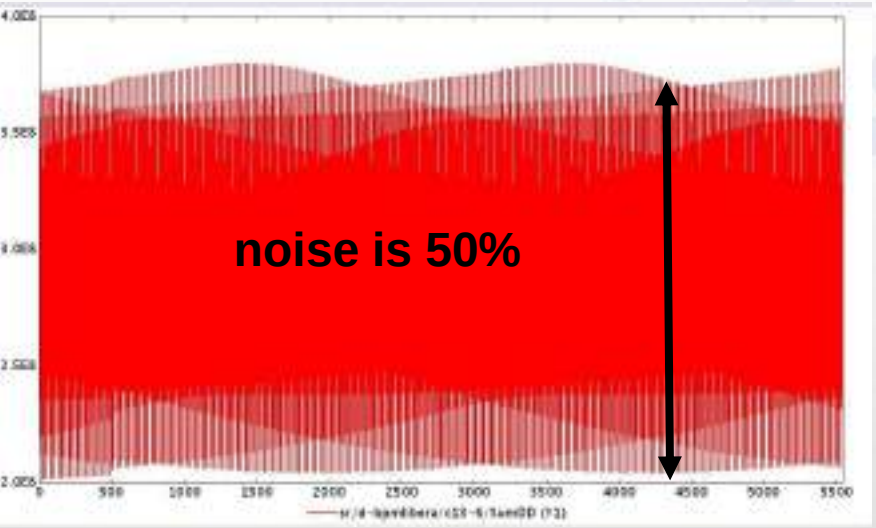
a **scraper** to **reduce** the **beam current**

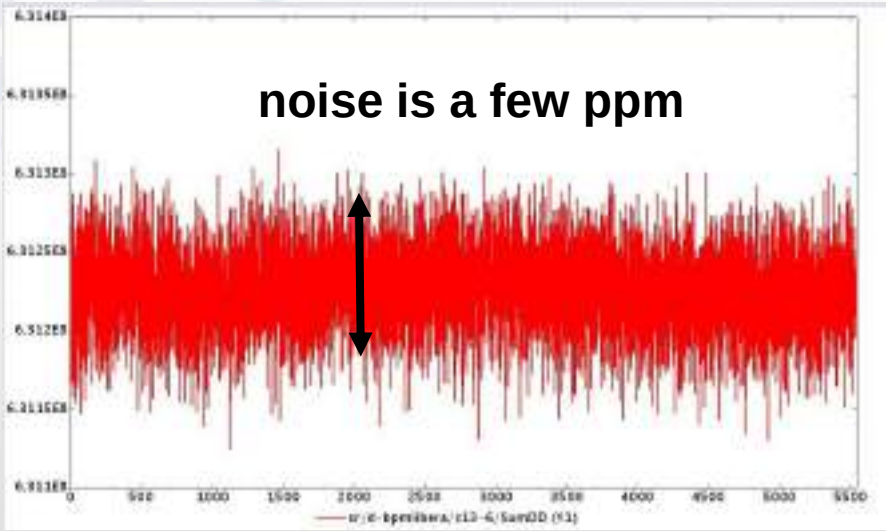
a simple matlab routine for the **control loop** at ~5Hz

in typ. 5 seconds the desired beam current is obtained


200mA
Number of Electrons in SR, from BPM-Libera Sum signals, while scraping with Ext.C4 Jaw
covered by the PCTs
covered by Libera-BPMs (max. Gain)
quantity of electrons
time [sec]
10^12
10^11
10^10
10^9
10^8
10^7
10^6
10^5
10^4
10^3
0
200
400
600
800
1000
1200
1400
1600

Preparing the installation of the **“2011” firmware**,
but getting rid of some final aberrations before :

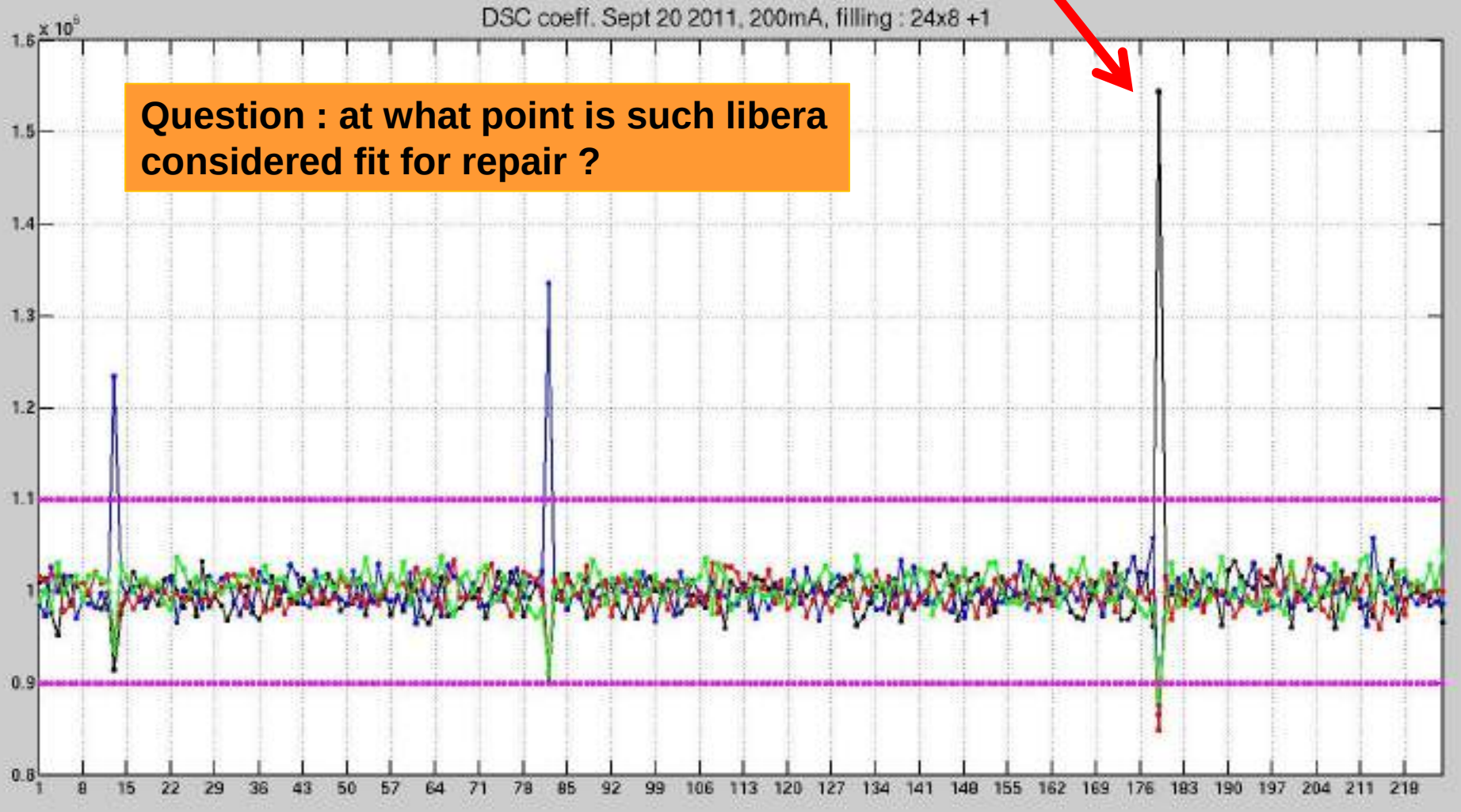




Huge Noise on the Sum (and A,B,C,D) signals, but not on position,
DSC-phase coefficients corrupted,
Changing 1 power Level (1dB) [but no change in attenuator setting] cures it …..,

Cause found : Some hidden parameter [DSCD_MINTBT_LEARN_LIMIT] not correct,
It corrupts the DSC functioning, which I do still do not understand, ...

Drifting DSC ampl. coeff, some reaching >60% dispersion in relative gain between the 4 channels

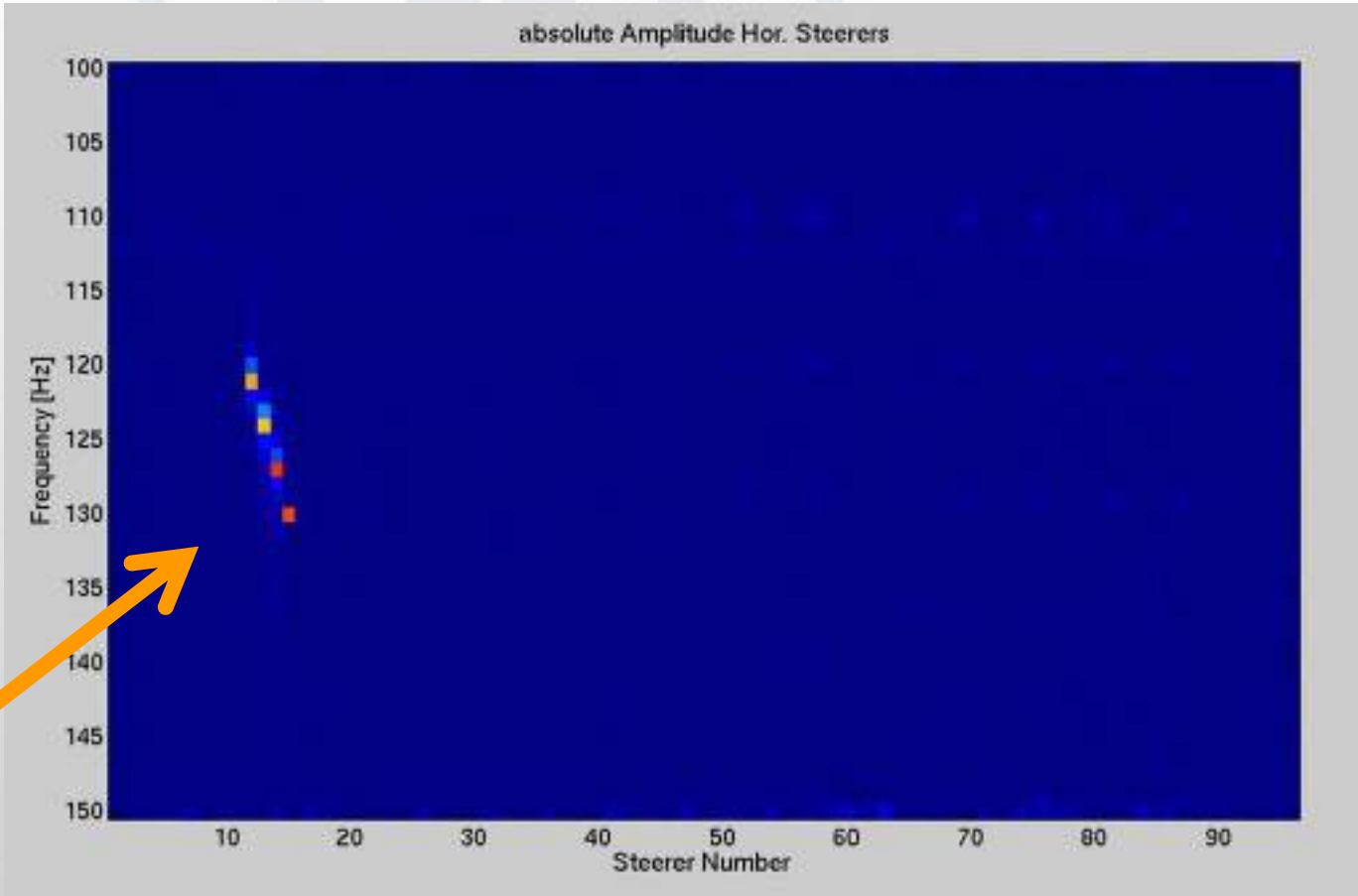


Question : at what point is such libera considered fit for repair ?

the near-future's use in the Fast/Slow full global orbit stabilization

see Eric's talk

Good results with the 10KHz network & the C.C. & the 'sniffer' acquisition card :



4 different steerers at 4 different frequencies

The problem of some occasional lost-packets in certain particular conditions (reported last year) is alleviated by slightly different configuration of interconnections (avoiding 4 SFP ports per Libera)

Latest Results & Performance with Libera Brilliance at the ESRF

many thanks !

for your hospitality

and your attention