

# 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**,

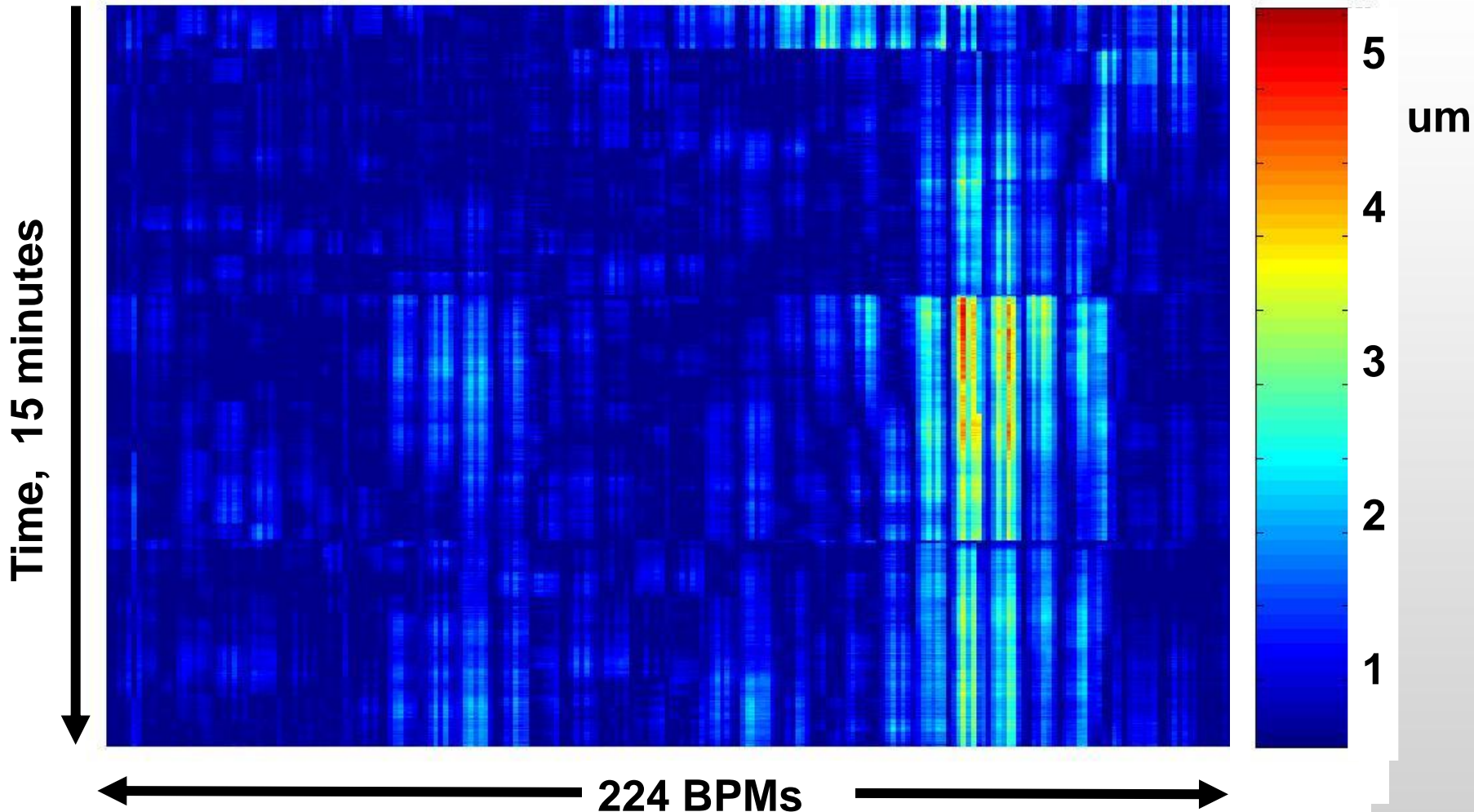
See examples in the next slides

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

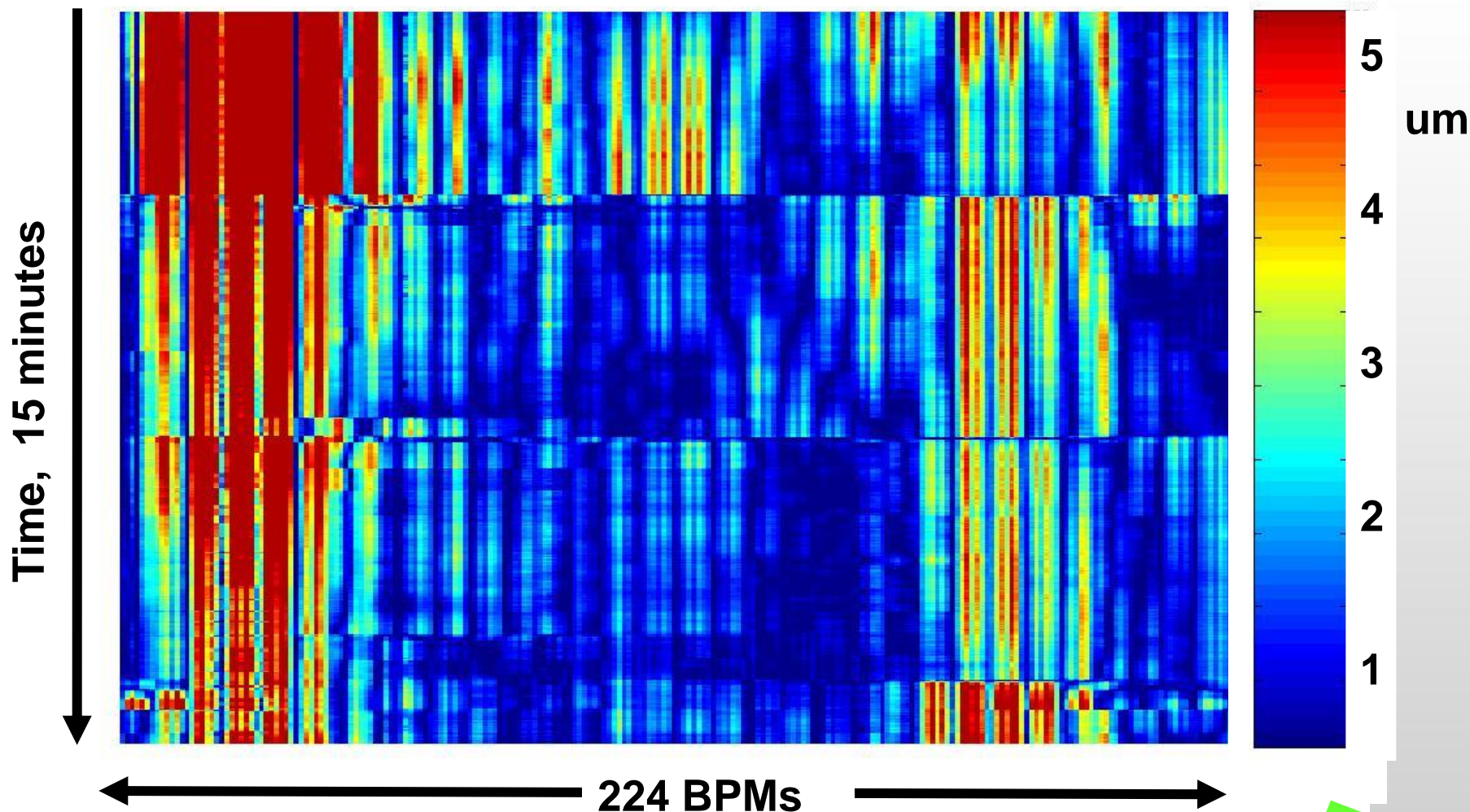
# Stability in an intermediate time domain, 0.5sec to 15min



**Stability judgment : typical, not too bad . . .**

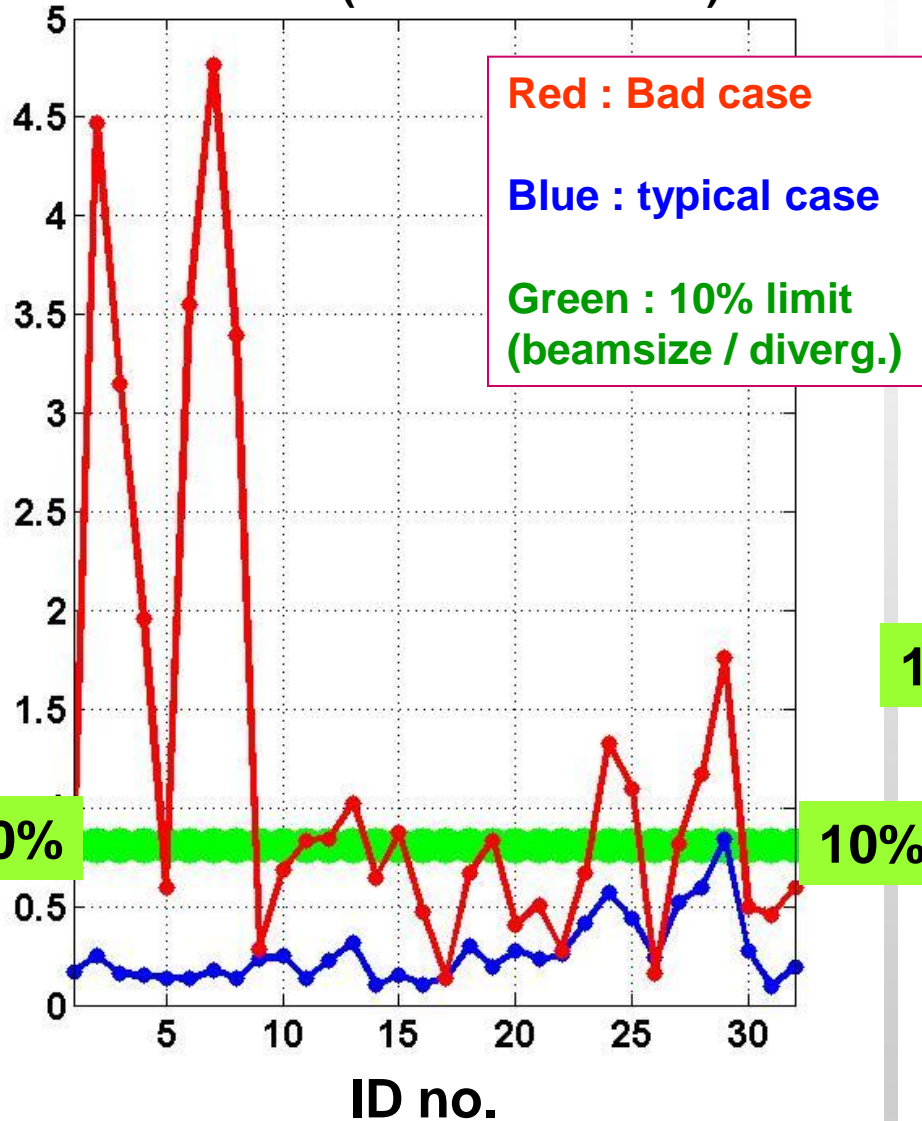
**10 Hz**

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

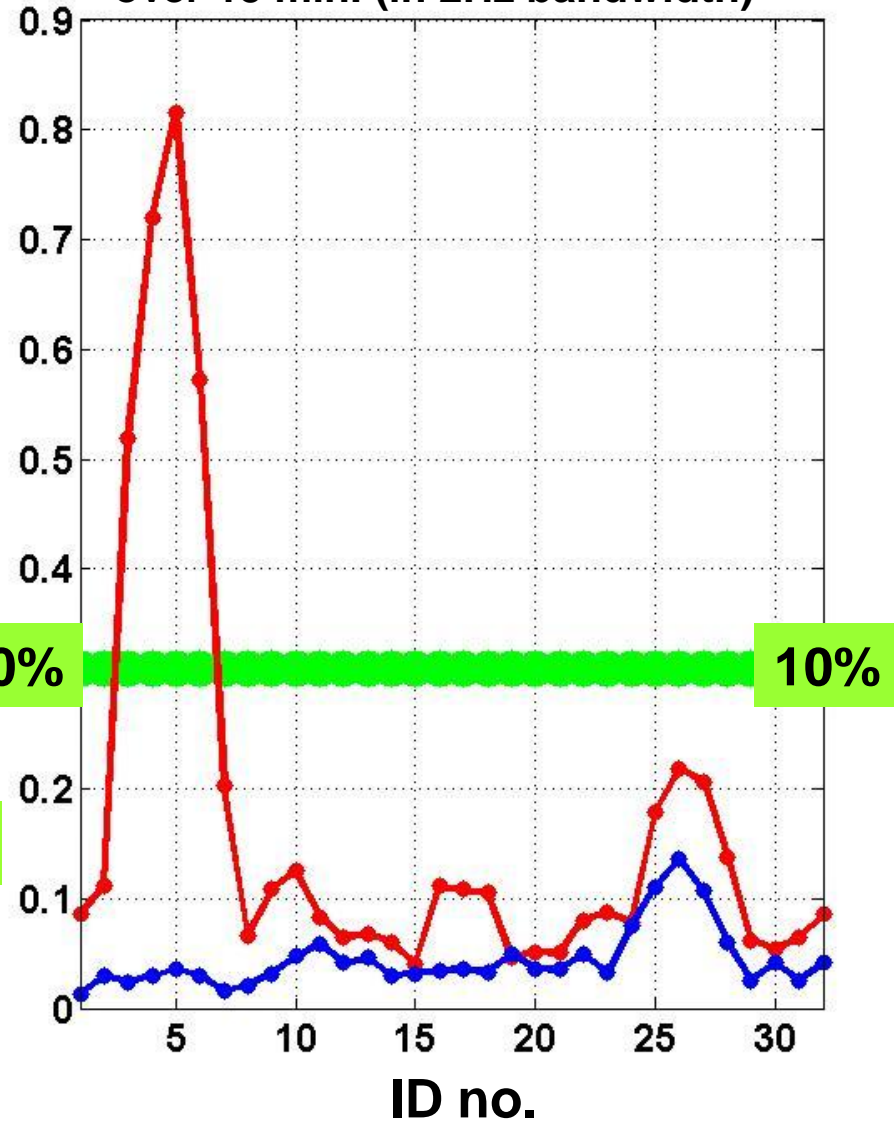


**Stability judgment : BAD**

IDs Vert. position stability [ $\mu\text{m rms}$ ]  
over 15 min. (in 2Hz bandwidth)



IDs Vert. angle stability [ $\mu\text{rad rms}$ ]  
over 15 min. (in 2Hz bandwidth)



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

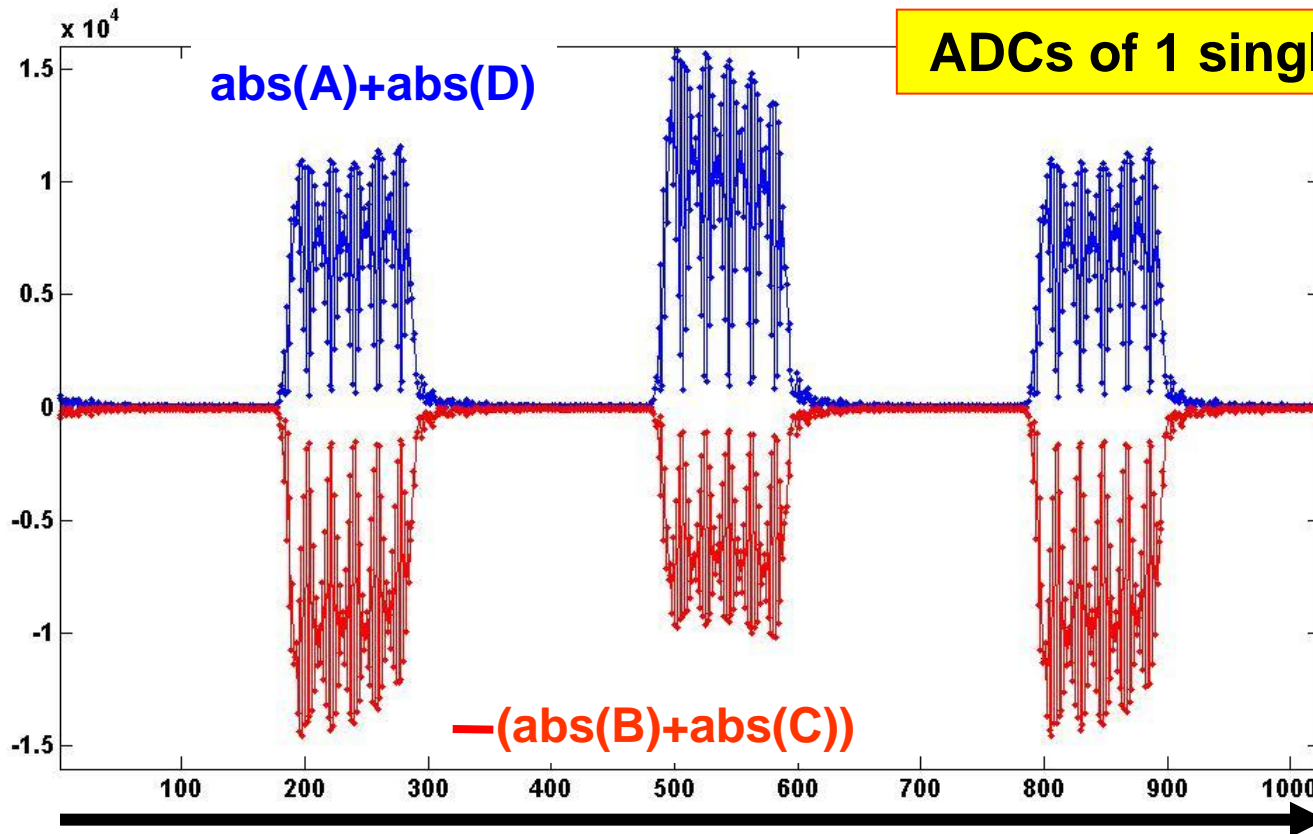


<p><b>224 Libera BPMs</b></p>
<p><b>96 AC-DC Steerers</b></p>

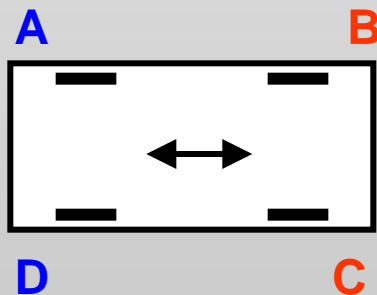
**Now** : the **Fast-Orbit** Stabilization is limited in number of components



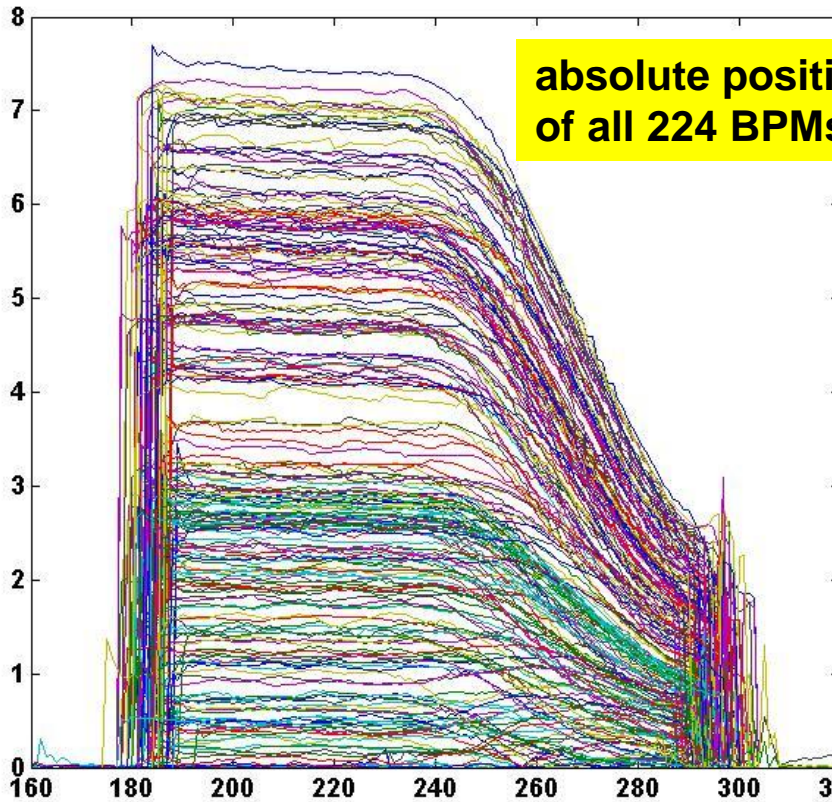
<p>32 Hor-Fast-BPMs 32 Vert-Fast-BPMs)</p>
<p>32 AC Hor-Steerers 16 AC Vert-Steerers</p>



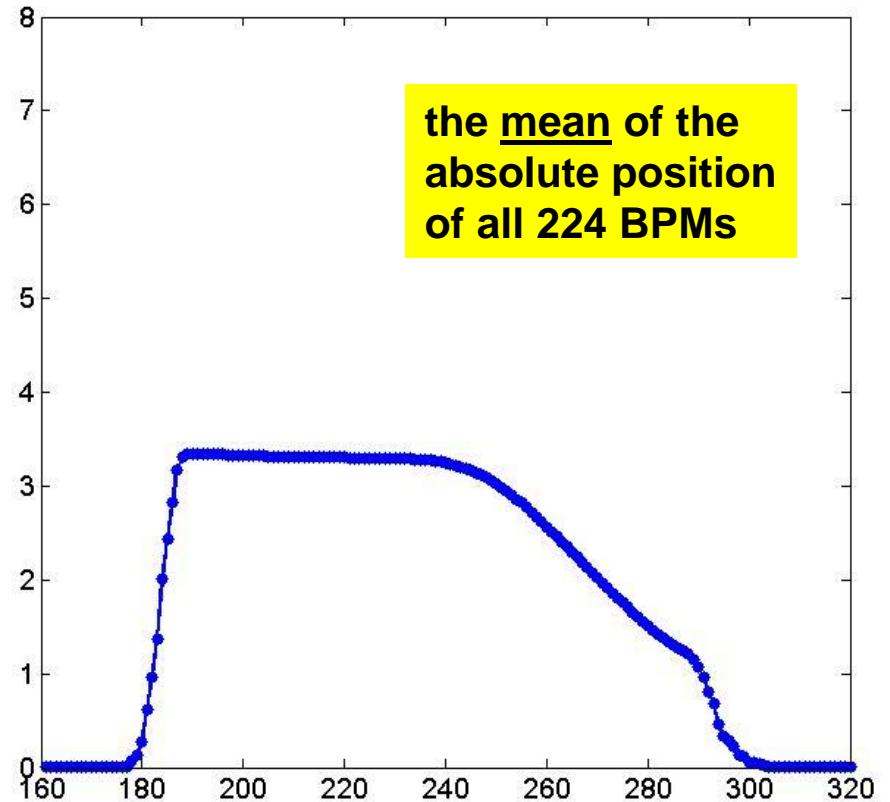
1024 ADC samples (~10nS) → see 3 Turns (~10uS)



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



absolute position  
of all 224 BPMs



the mean of the  
absolute position  
of all 224 BPMs



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

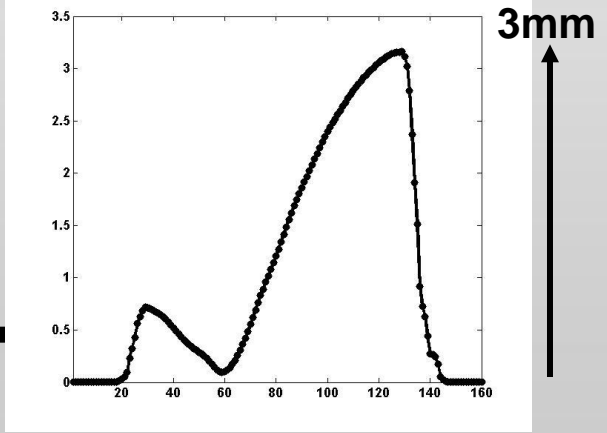
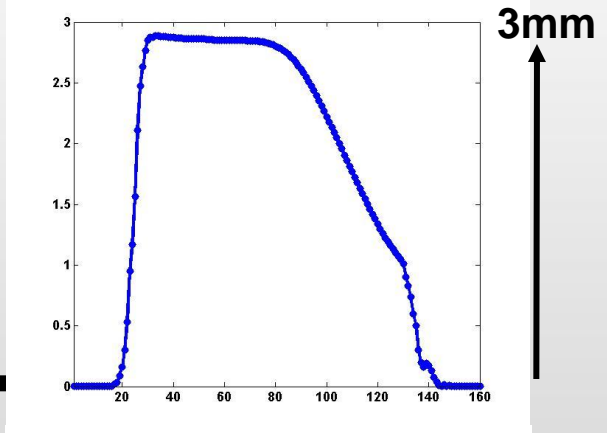
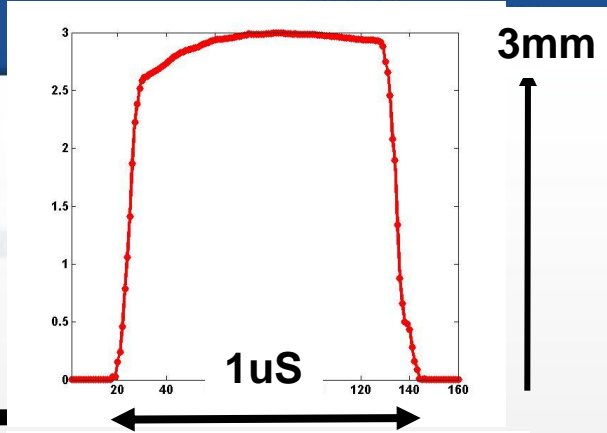
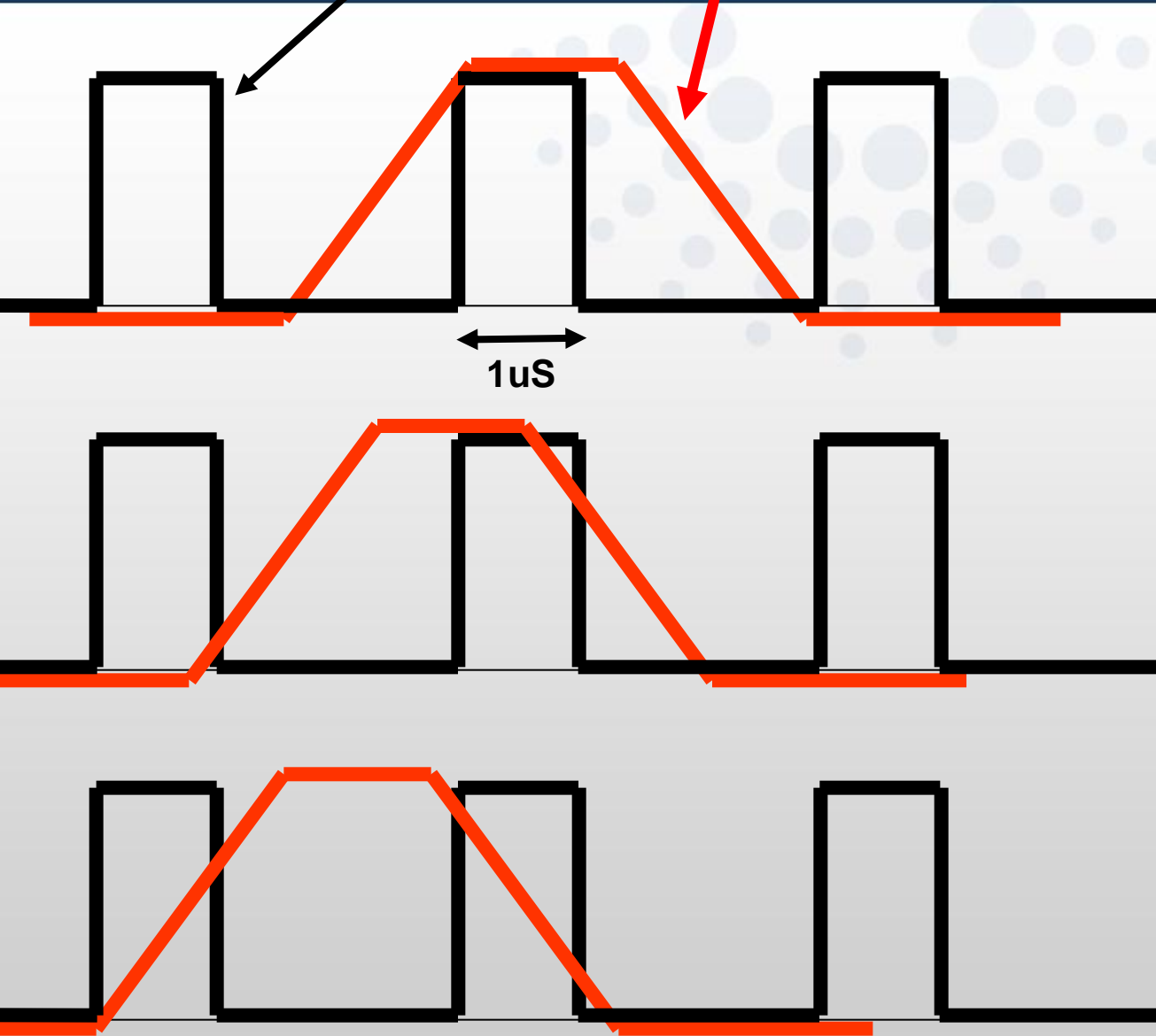


~100 ADC samples (~10nS)  
( = 1 uS = 1/3 fill )

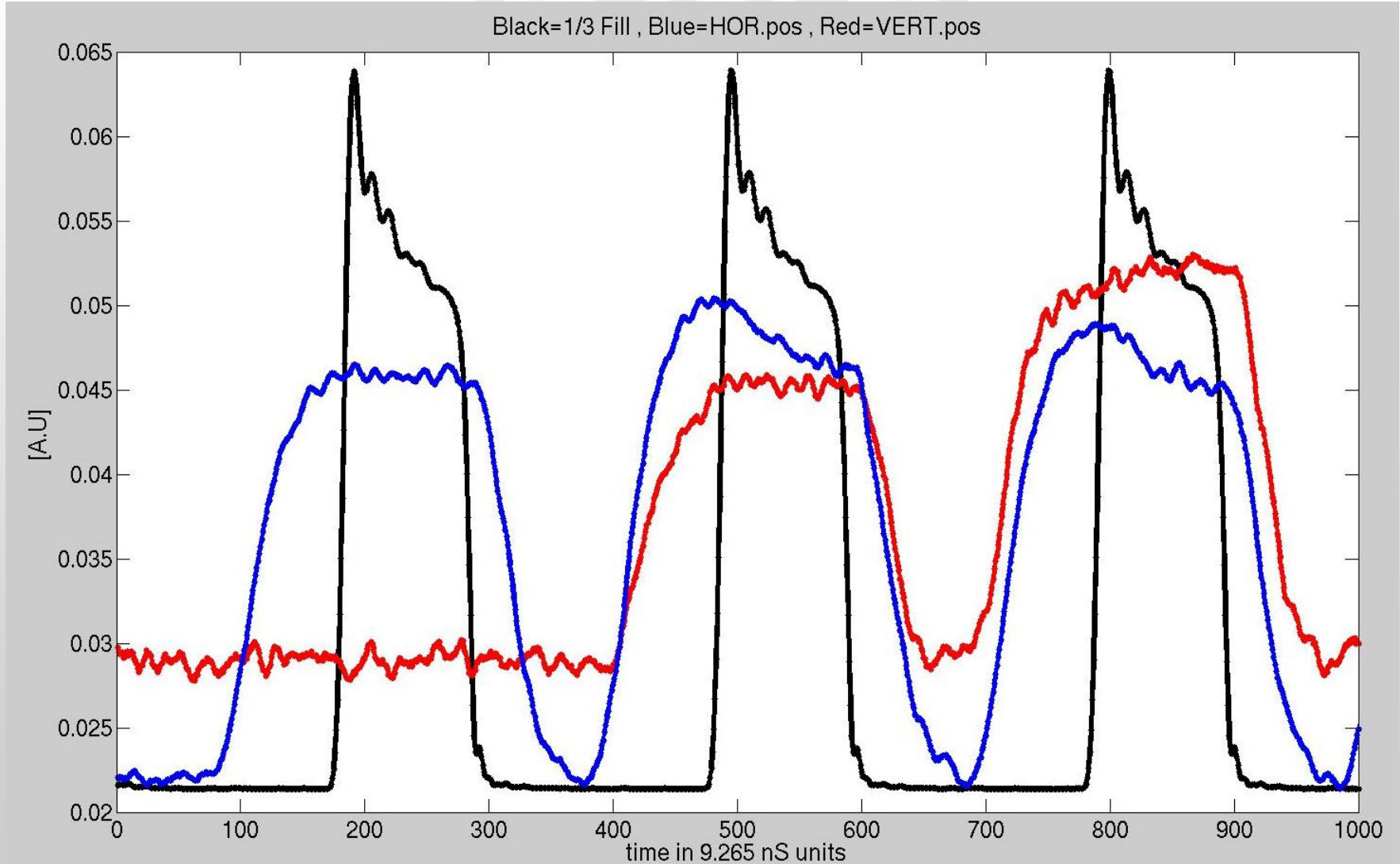


**Beam fill**

**Kicker**

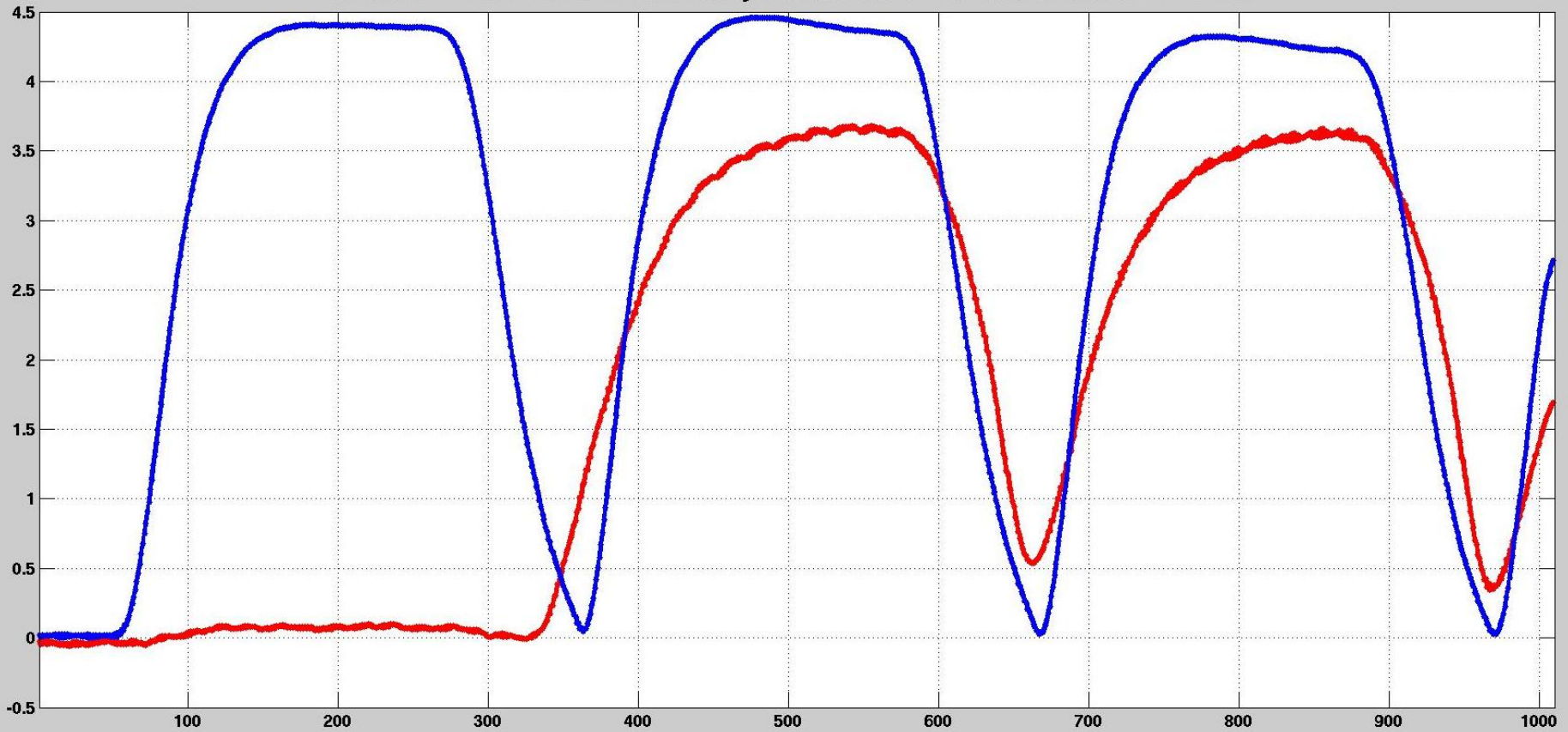


## In 2011 the ADCs still serve e.g. for adjusting both the Hor. & a Vert. Kickers with respect to the 1/3 fill pattern

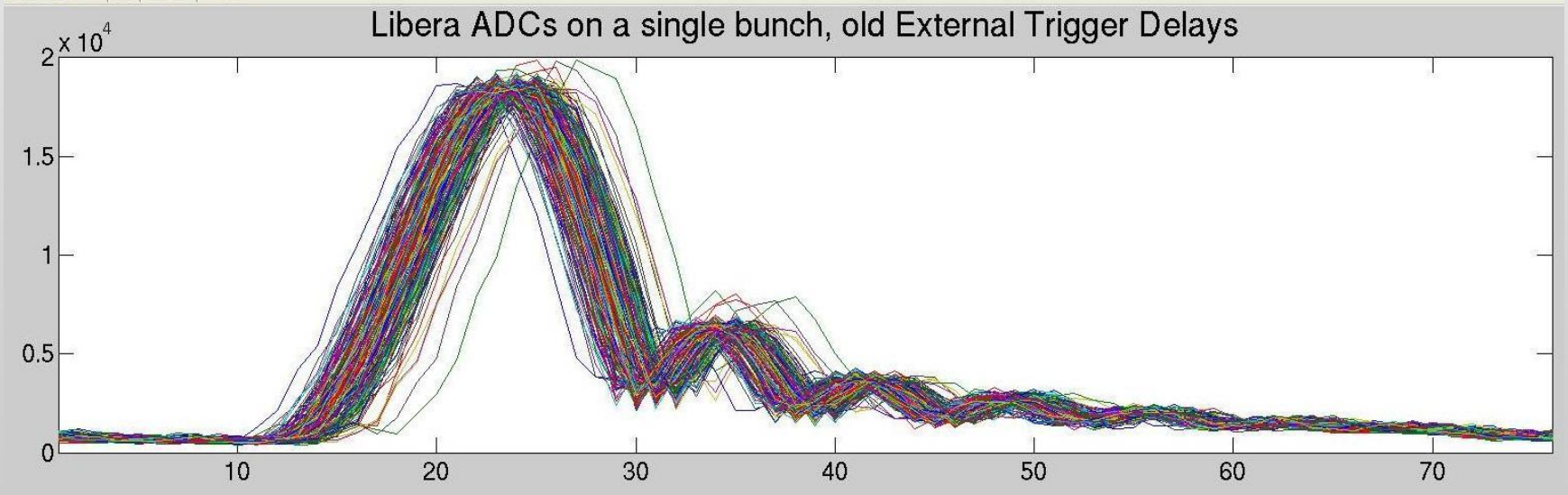
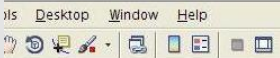
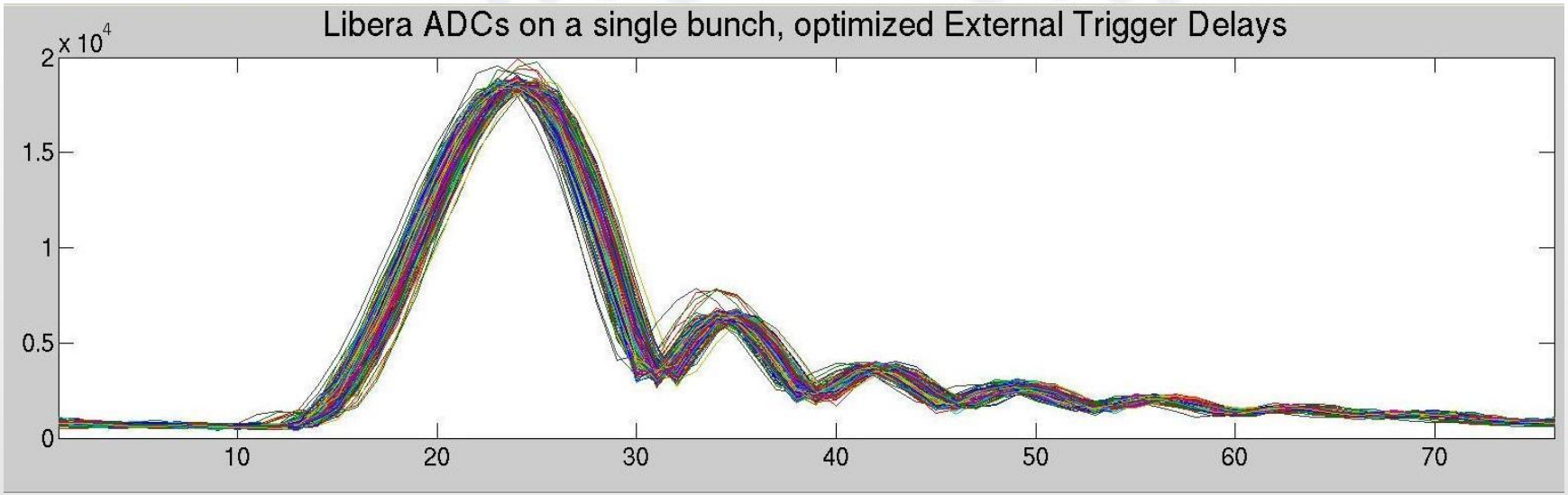


In 2011 the ADCs still serve e.g. for adjusting both the Hor. & a Vert. Kickers and not only the timing but also the shape of the kicker pulse can be verified

Hor. & Vert. Kicks as seen by the ADCs : BLUE=Hor. RED=Vert.



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

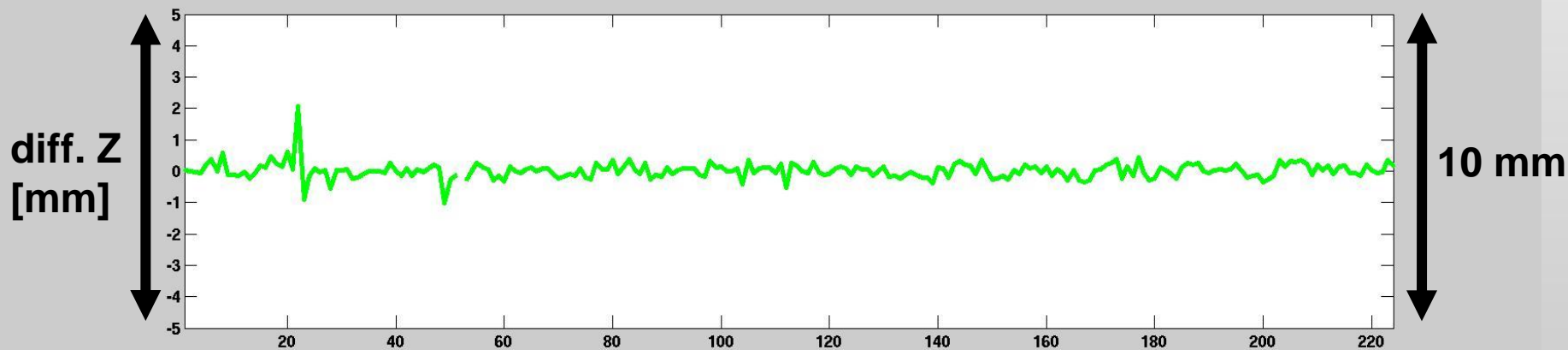
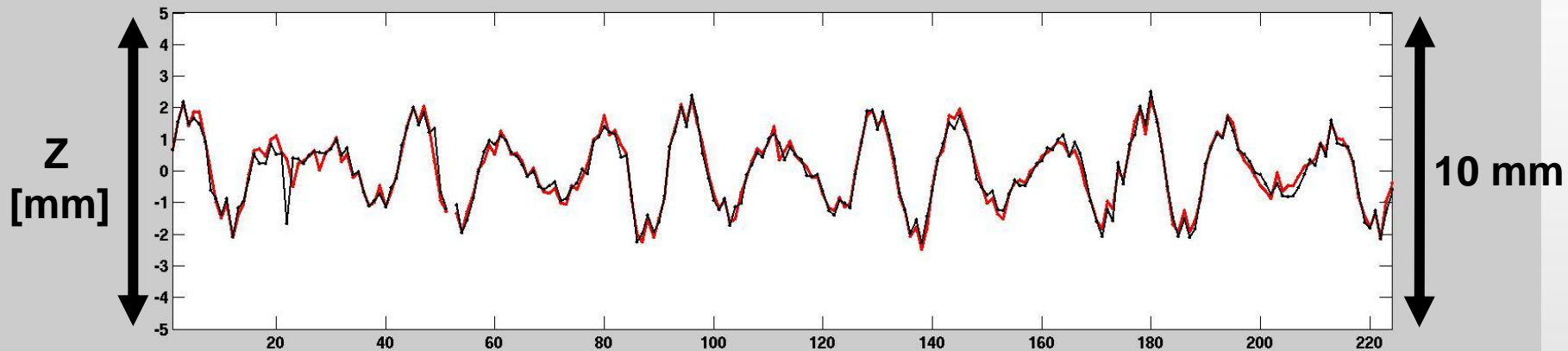


Using the T-b-T output with **Standard** & **MAF** T.b.T filter  
for Injection-Trajectory studies & H.Q. lattice studies

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

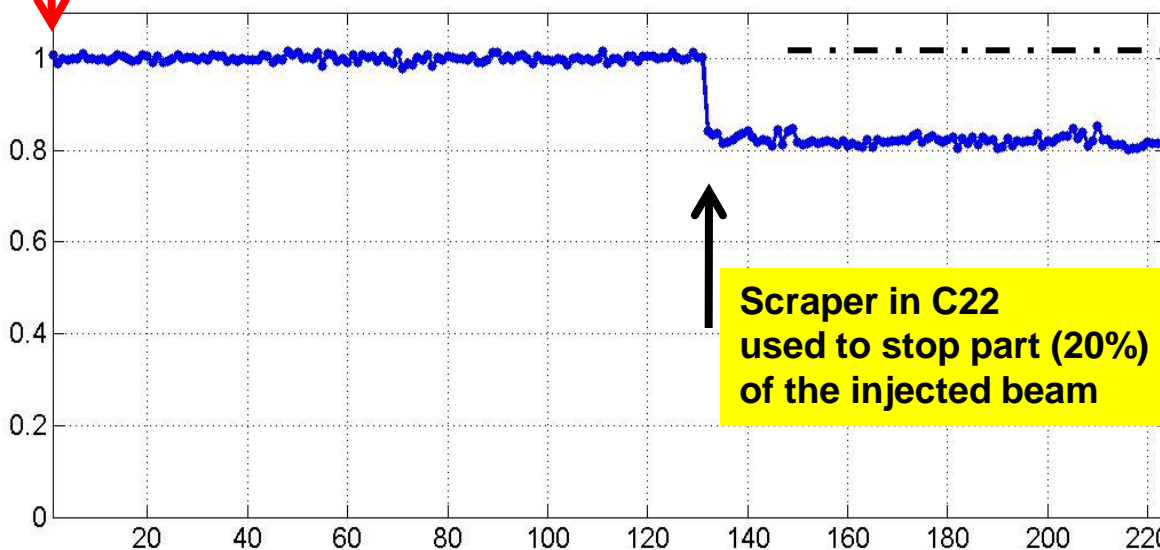
**Reproducibility of the first-turn measurement :**  
**The Vertical Trajectories of the injected Turn have a much better reproducibility**



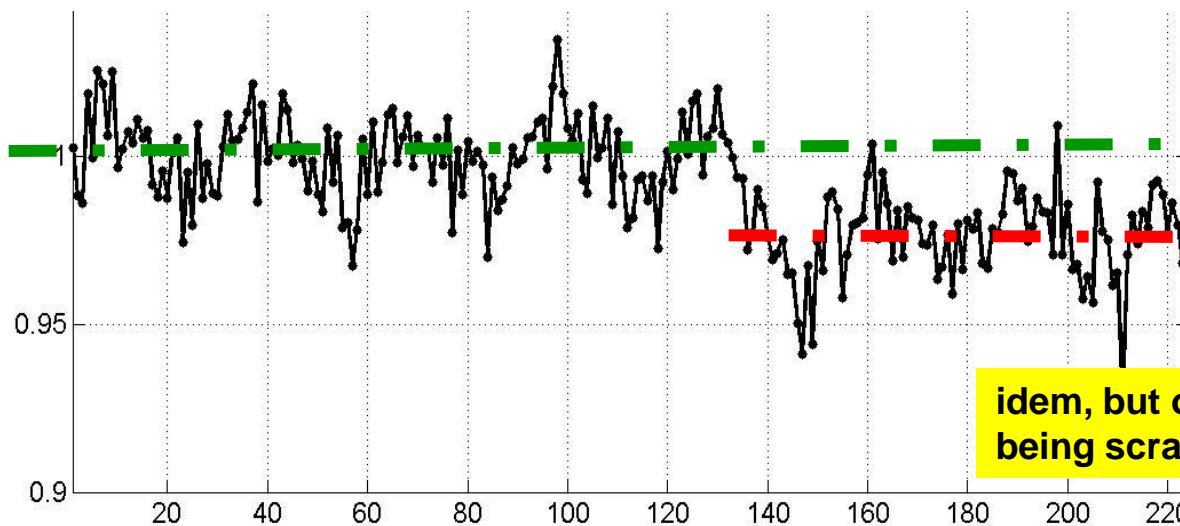
the 224 BPMs

**Injection**

Sum Signal  
Normalized  
[a.u.]



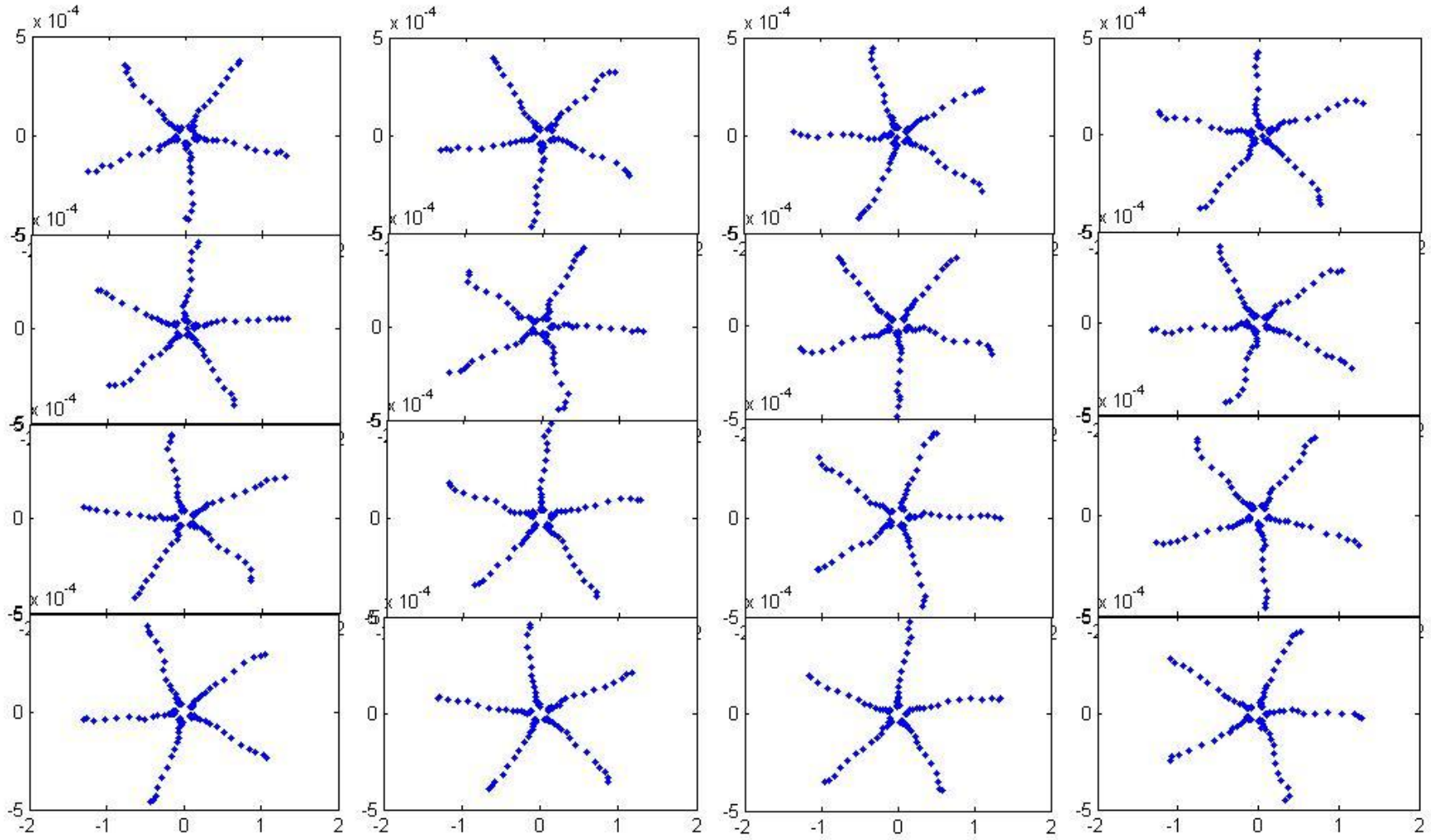
Sum Signal  
Normalized  
[a.u.]



**2%**

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

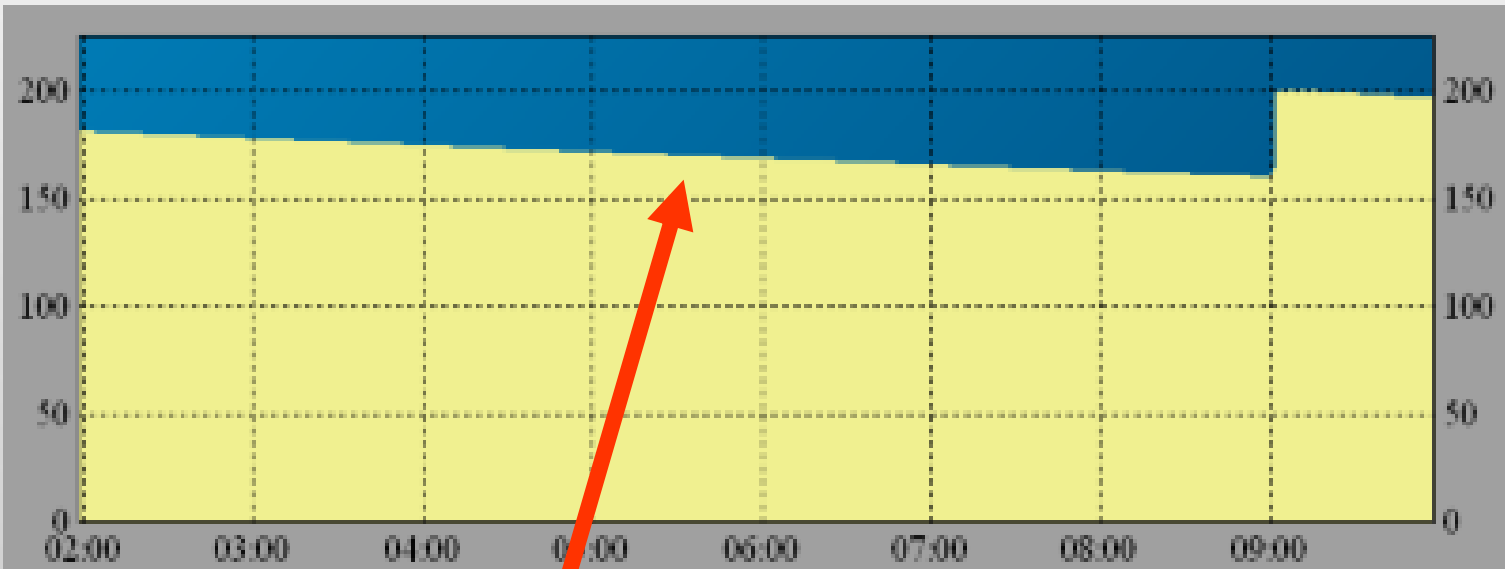
**196.81 mA**

Filling mode **7/8 multibunch**

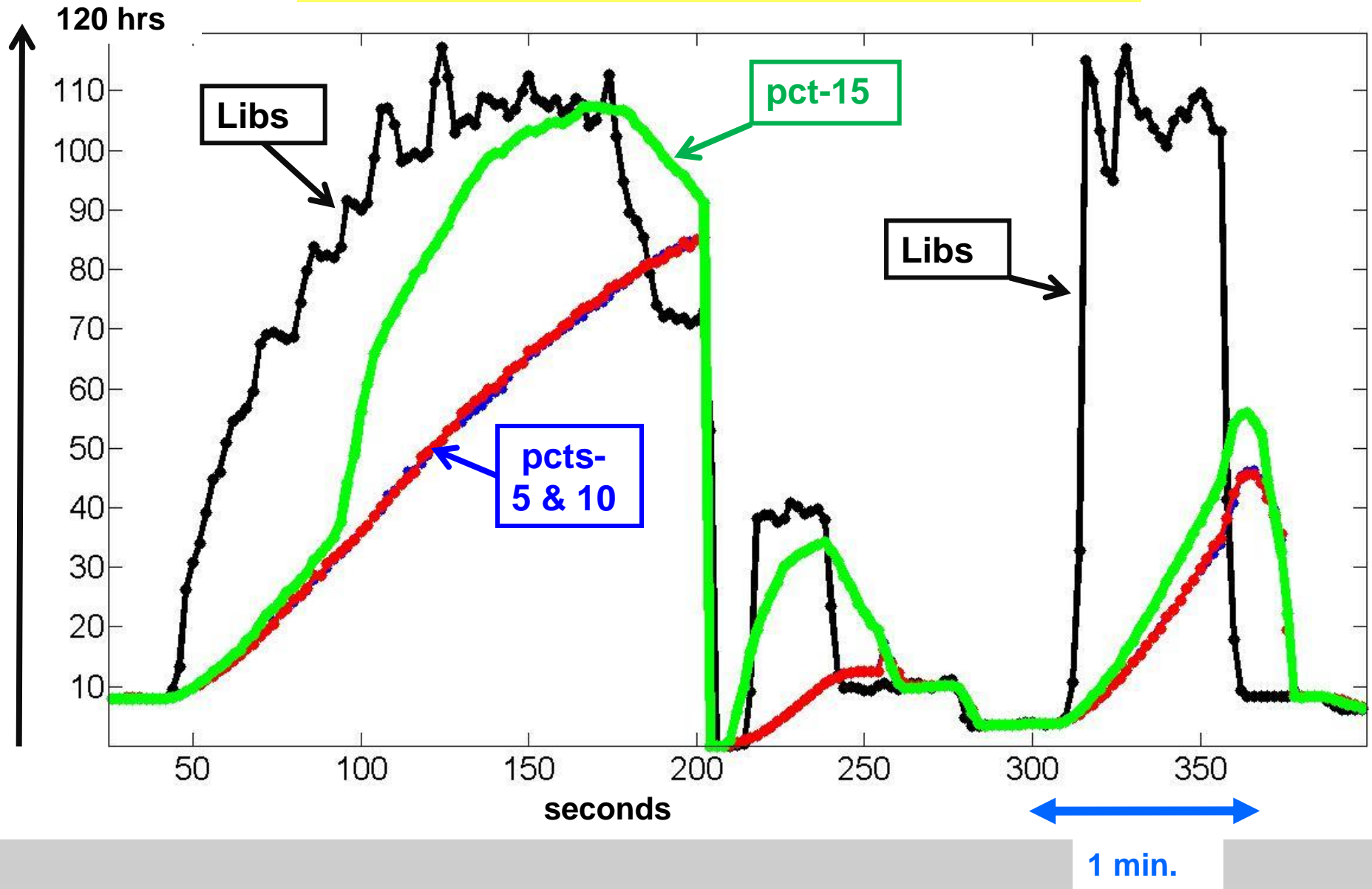
Lifetime **48h 55mn**

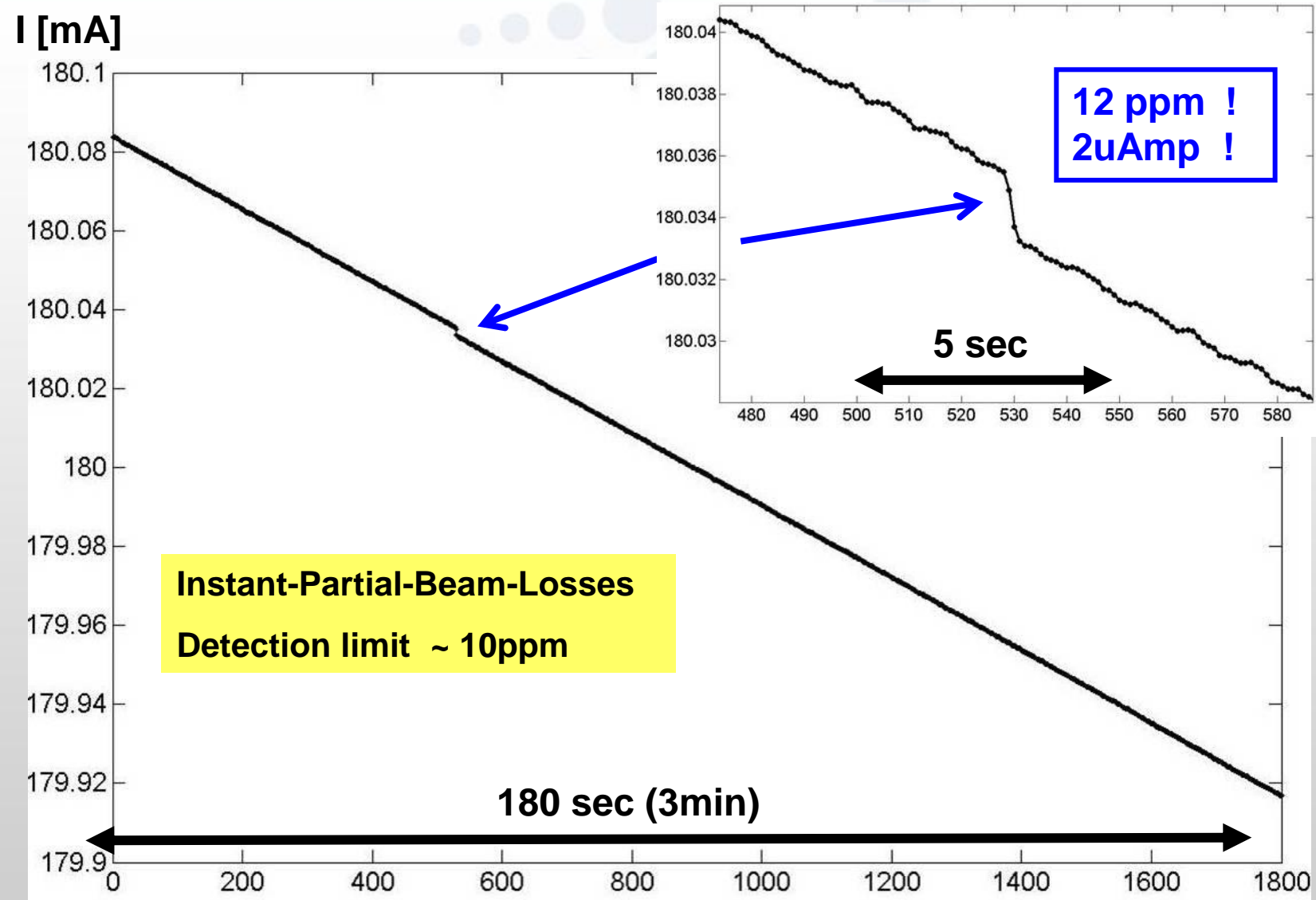
**Delivery since 09:06**

ID				Bendings			
1	2	3		1	2		
	6		8	5			8
9	10	11	12				
13	14	15	16		14	15	16
17	18	19	20				20
21	22	23	24				
	26	27	28	25	26		28
29	30	31	32	29	30	31	32

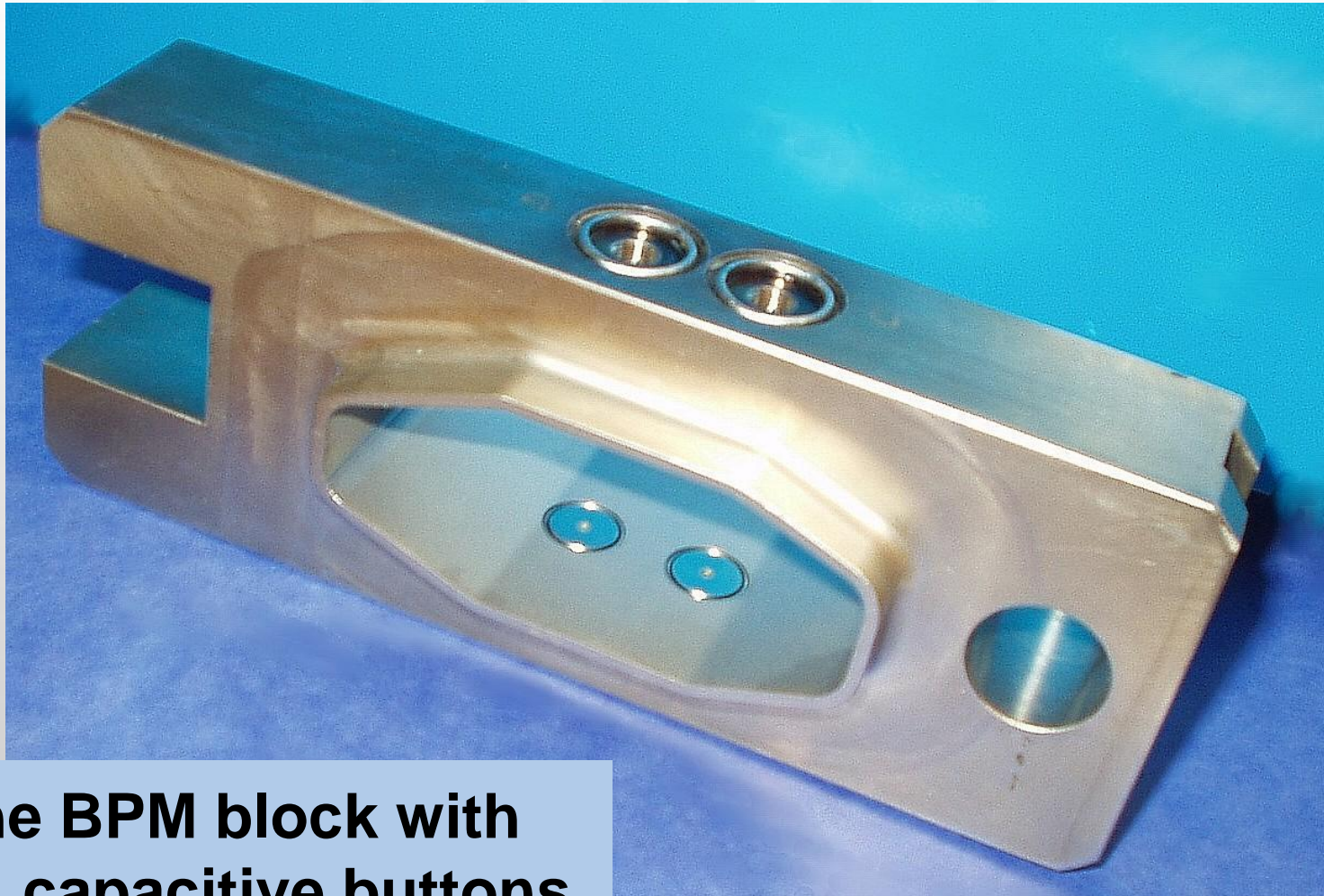


**Lifetime is this slope**



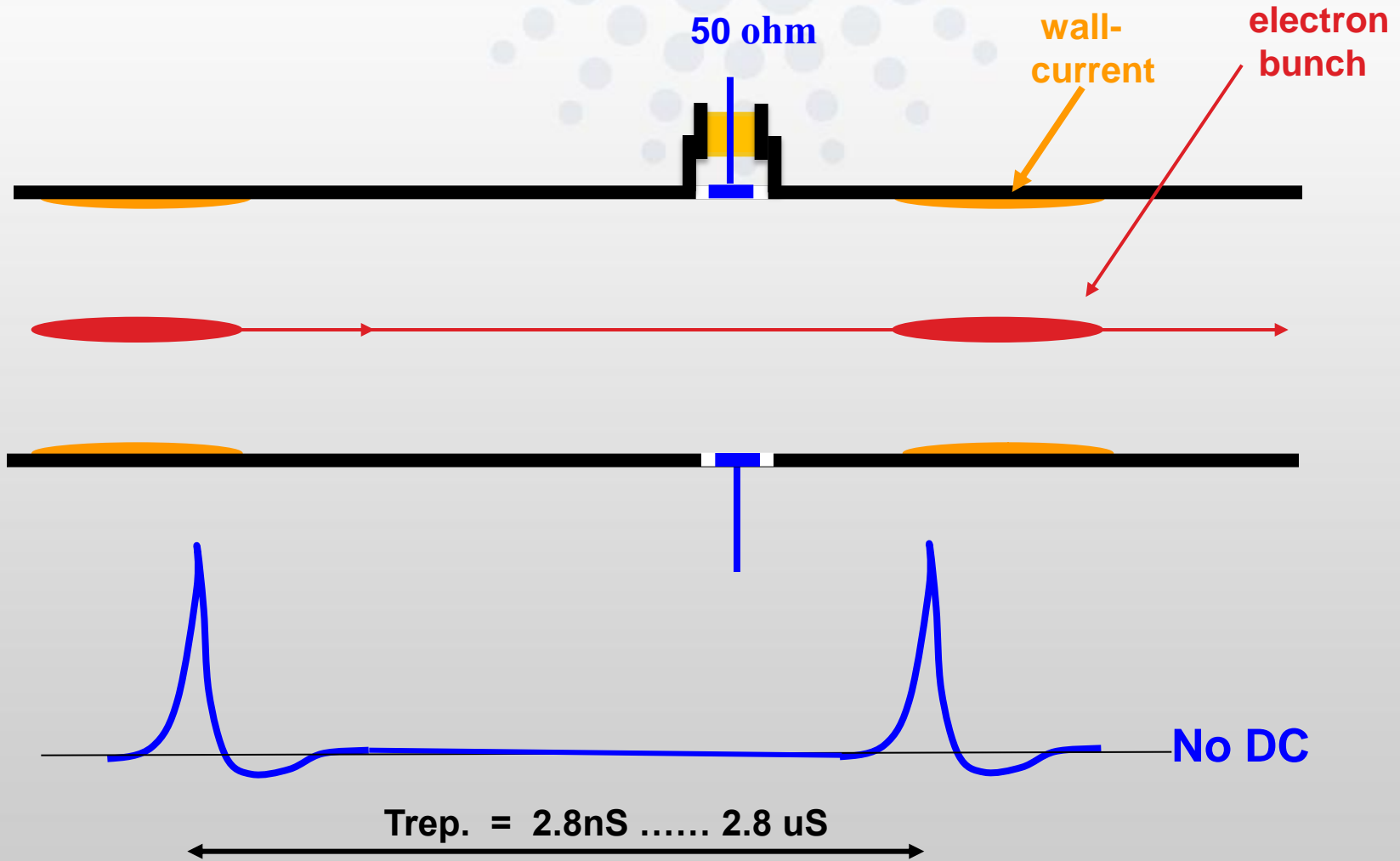


# monitoring **Bunch-Length fluctuations** and other RF related variations

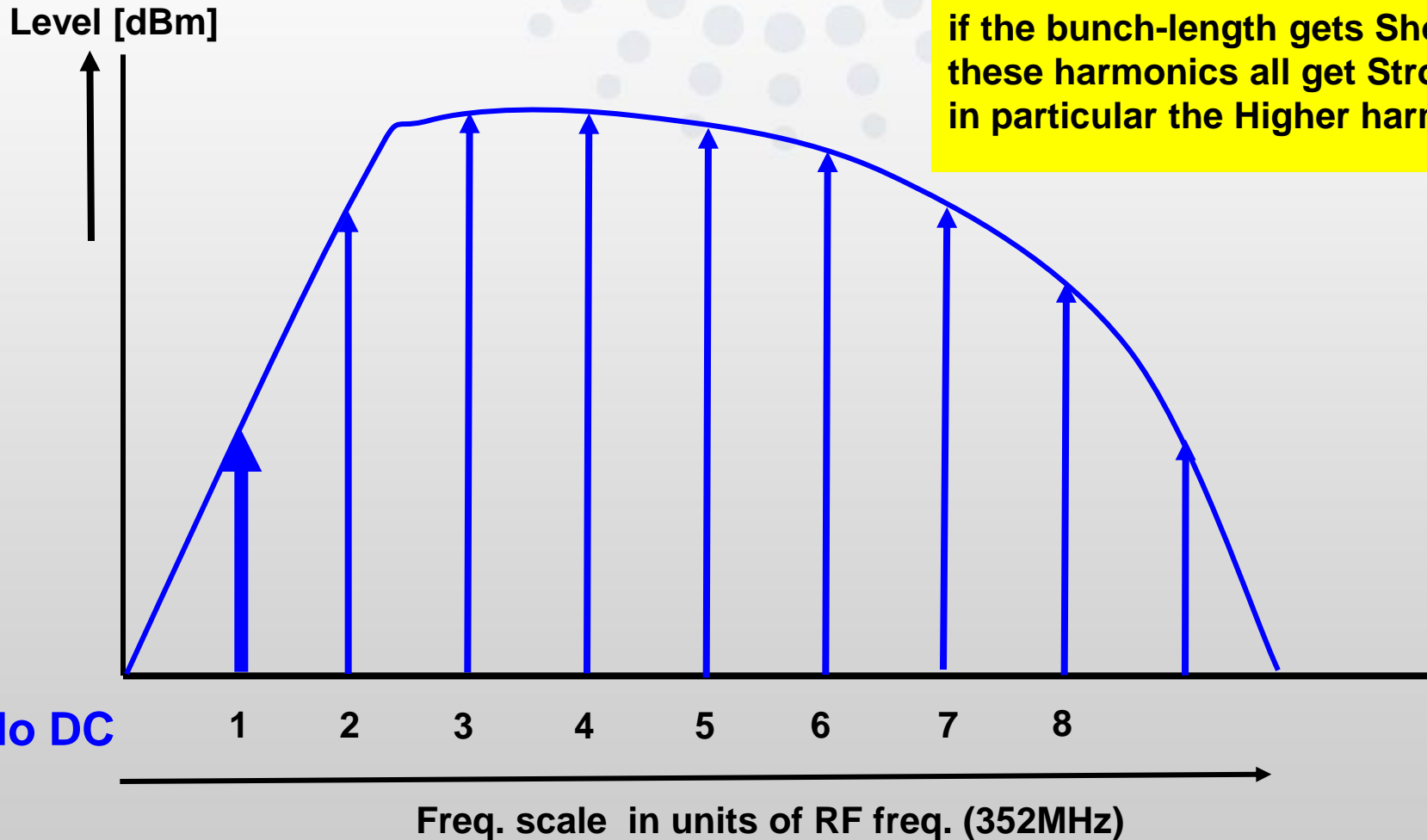


**The BPM block with its 4 capacitive buttons**

# The RF signal from a button, the longitudinal view



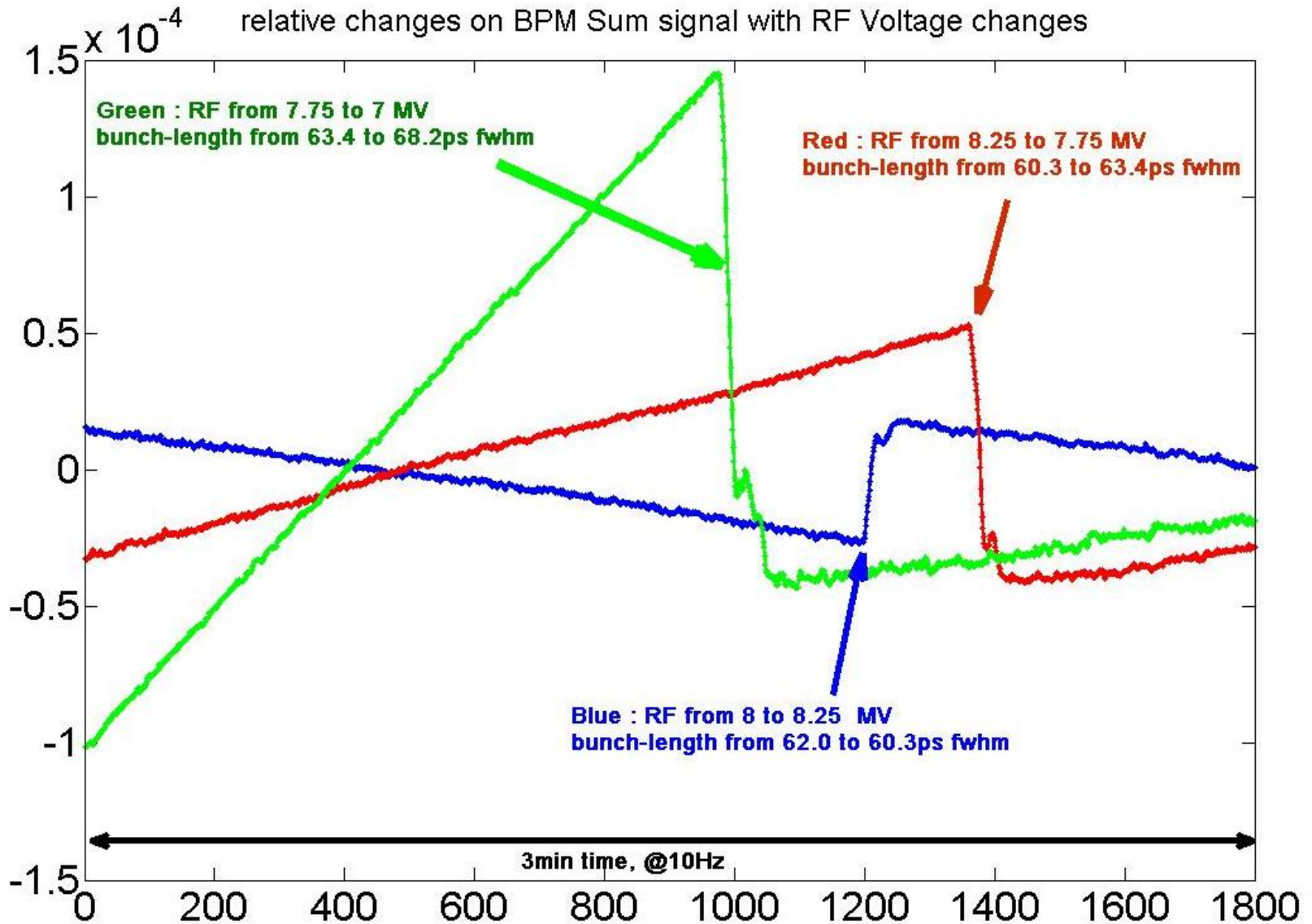
# The RF signal from a button in frequency domain, with complete multi-bunch fill (992, i.e. uniform)



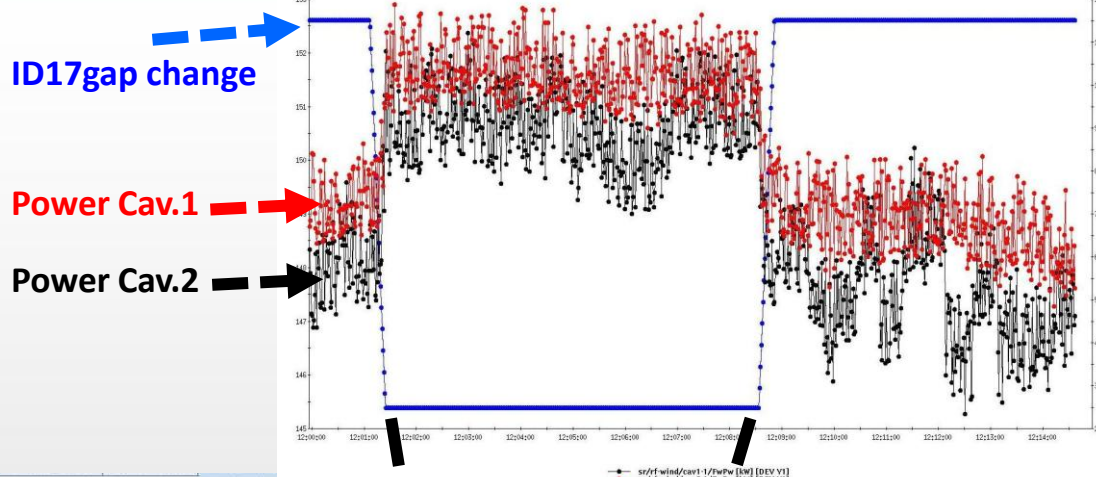
if the bunch-length gets Shorter,  
these harmonics all get Stronger,  
in particular the Higher harmonics

No DC

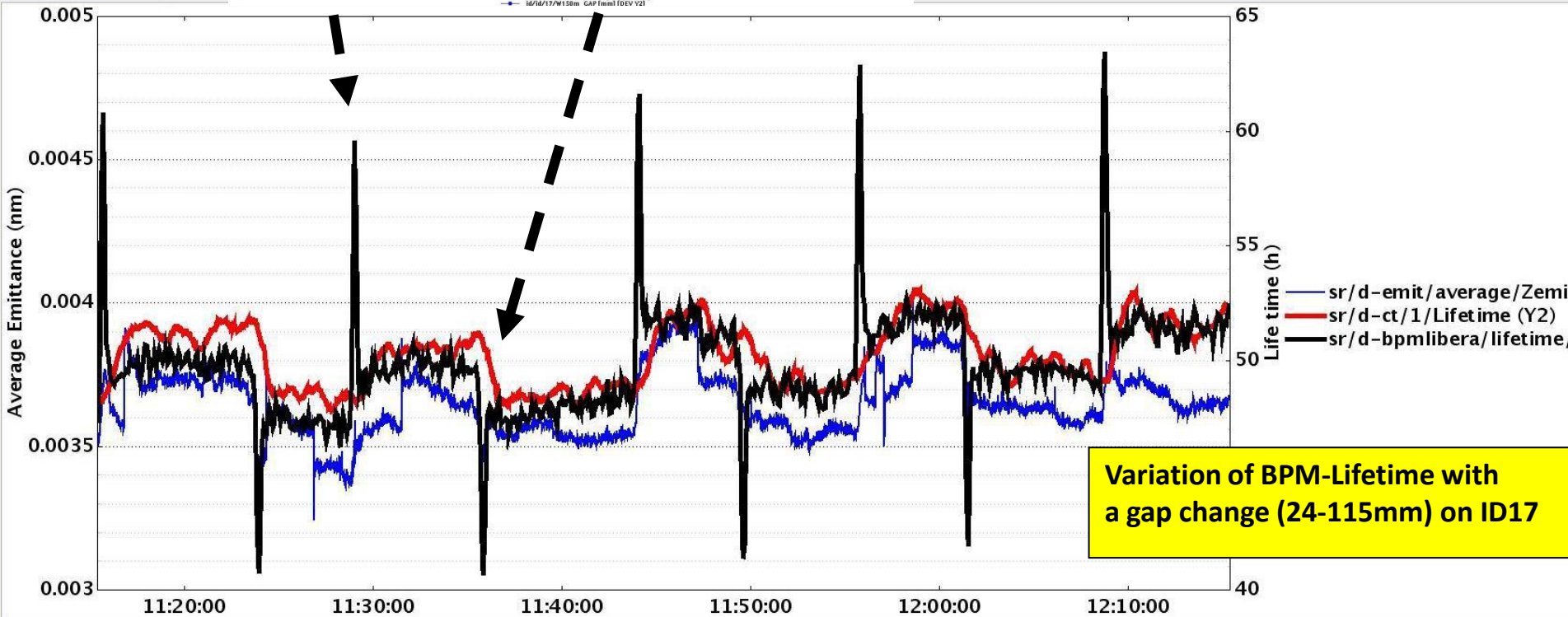
**Comparing : Libera-Sum with Streak-Camera results, while changing the Acceleration Voltage of the Cavity**



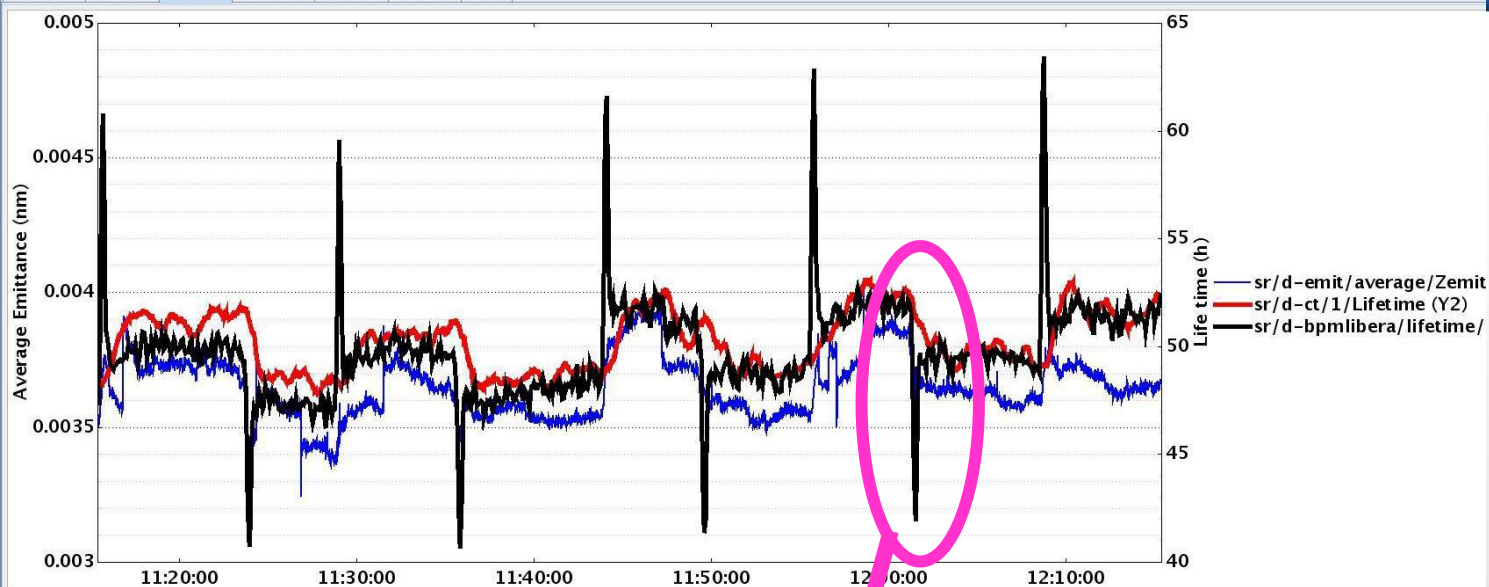




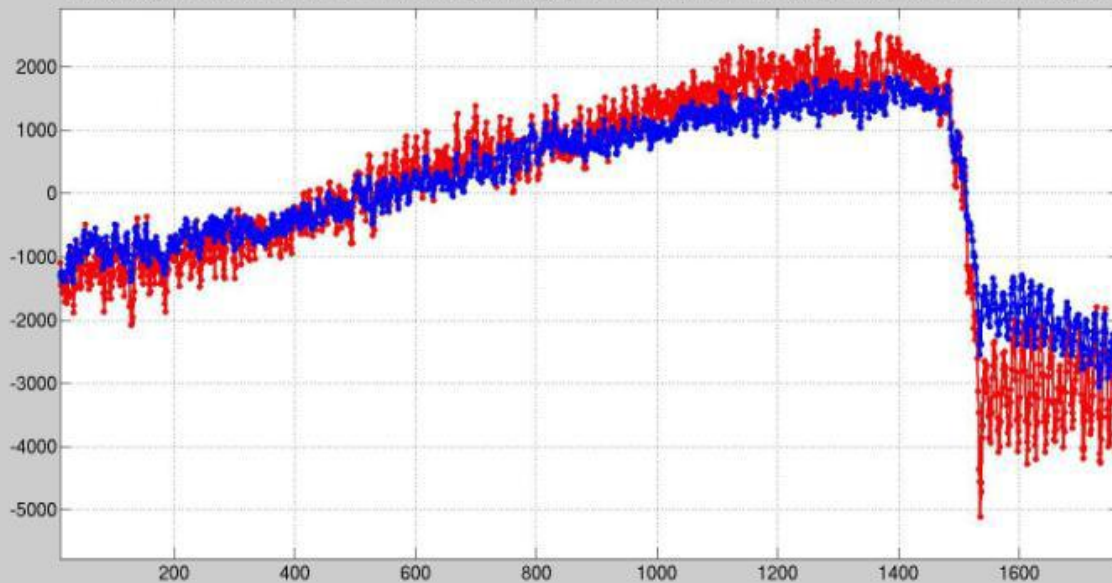
Variation of forward power Cav1 & Cav2 with a gap change (24-115mm) on ID17



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



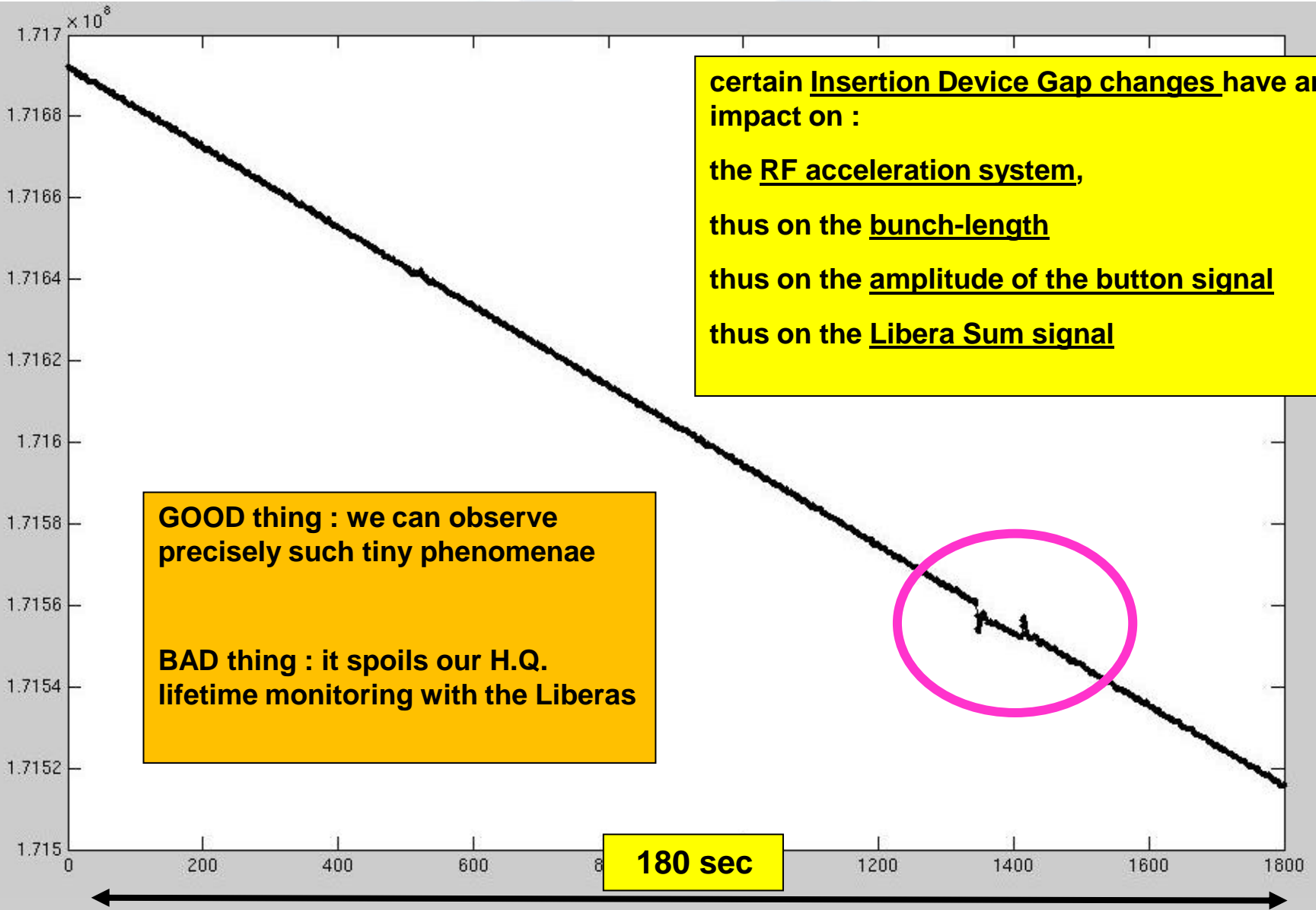
bunch-length variations effects of C17 W150m gap change [115 to 24mm], RED : Cavity system, BLUE : BPMs-Sum-Signals



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 :

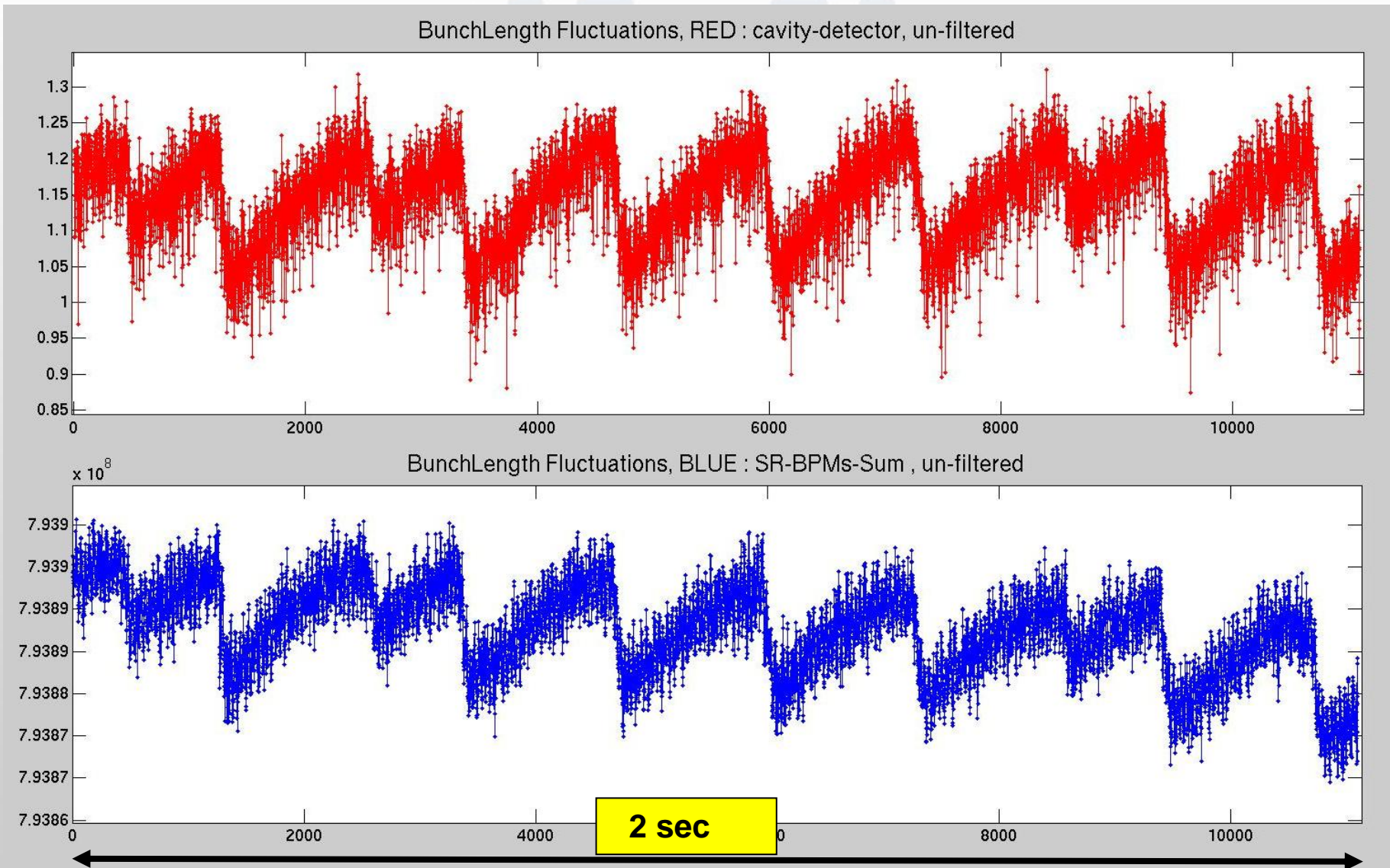
- the RF acceleration system,
- thus on the bunch-length
- thus on the amplitude of the button signal
- thus on the Libera Sum signal

**GOOD thing** : we can observe precisely such tiny phenomenae

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

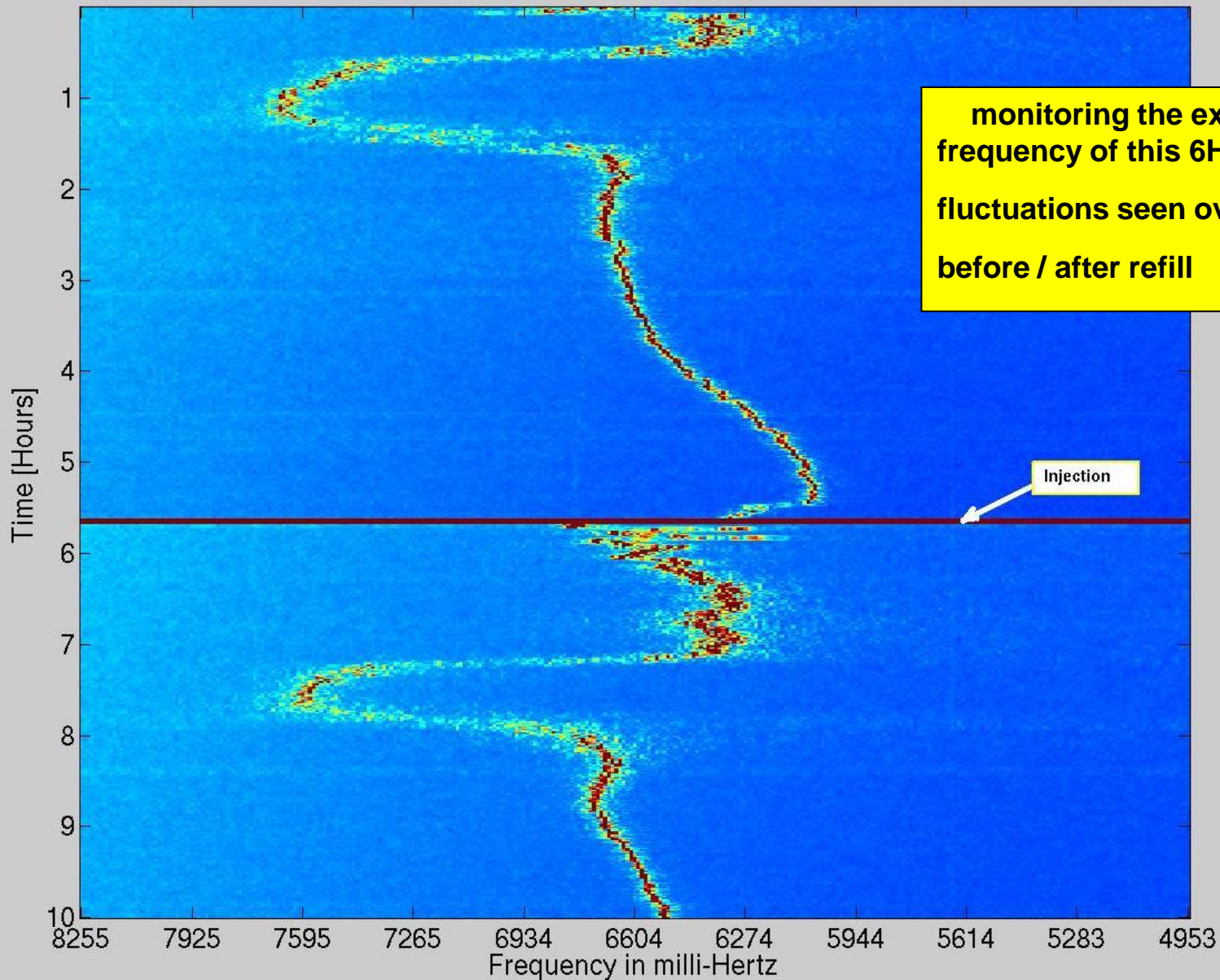
**180 sec**

**other & faster bunch-length fluctuations :**  
**now using the DD-Sum buffer (5.5KHz sampling, 2 sec. record) :**





spectrum of fluctuations on Sum



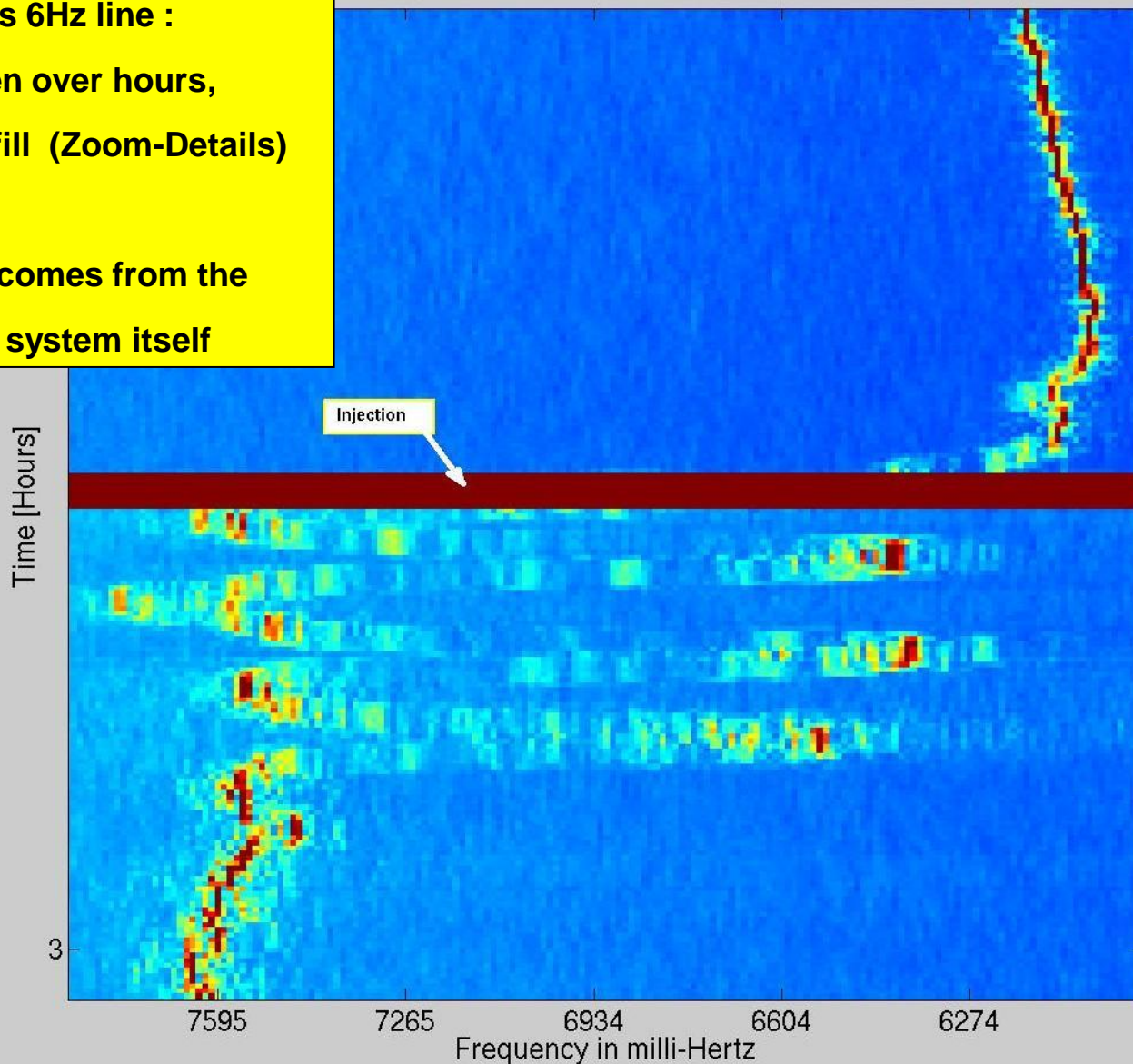
monitoring the exact frequency of this 6Hz line :  
 fluctuations seen over hours,  
 before / after refill

Injection

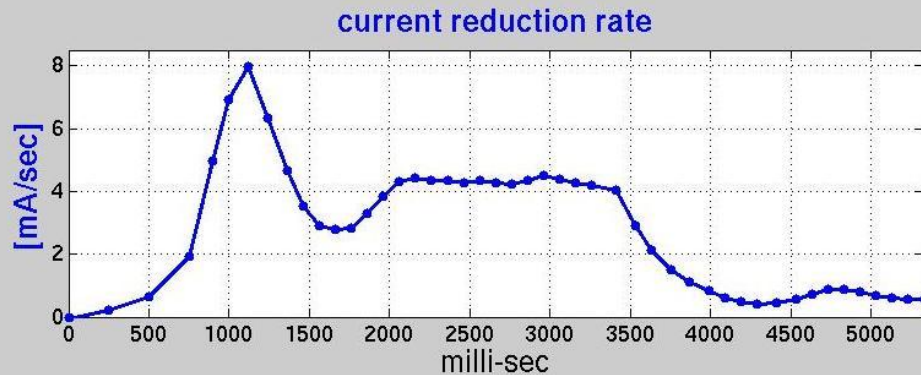
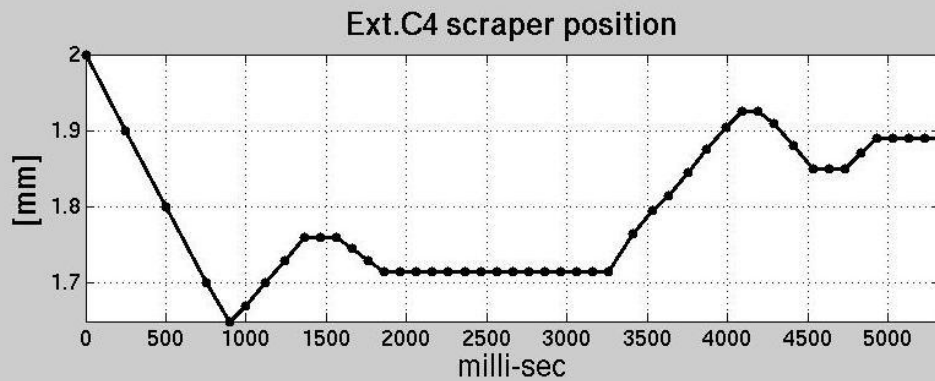
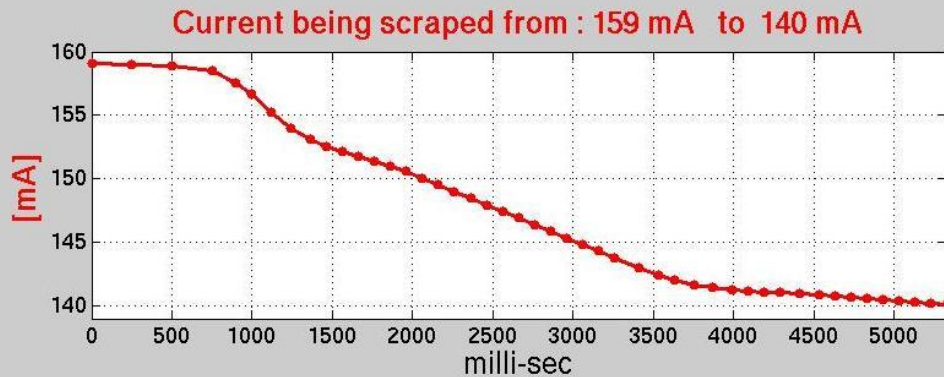
monitoring the exact frequency of this 6Hz line :  
 fluctuations seen over hours,  
 before / after refill (Zoom-Details)

this fluctuation comes from the  
 RF acceleration system itself

spectrum of fluctuations on Sum



# fine, fast & sensitive Current Control in the Ring



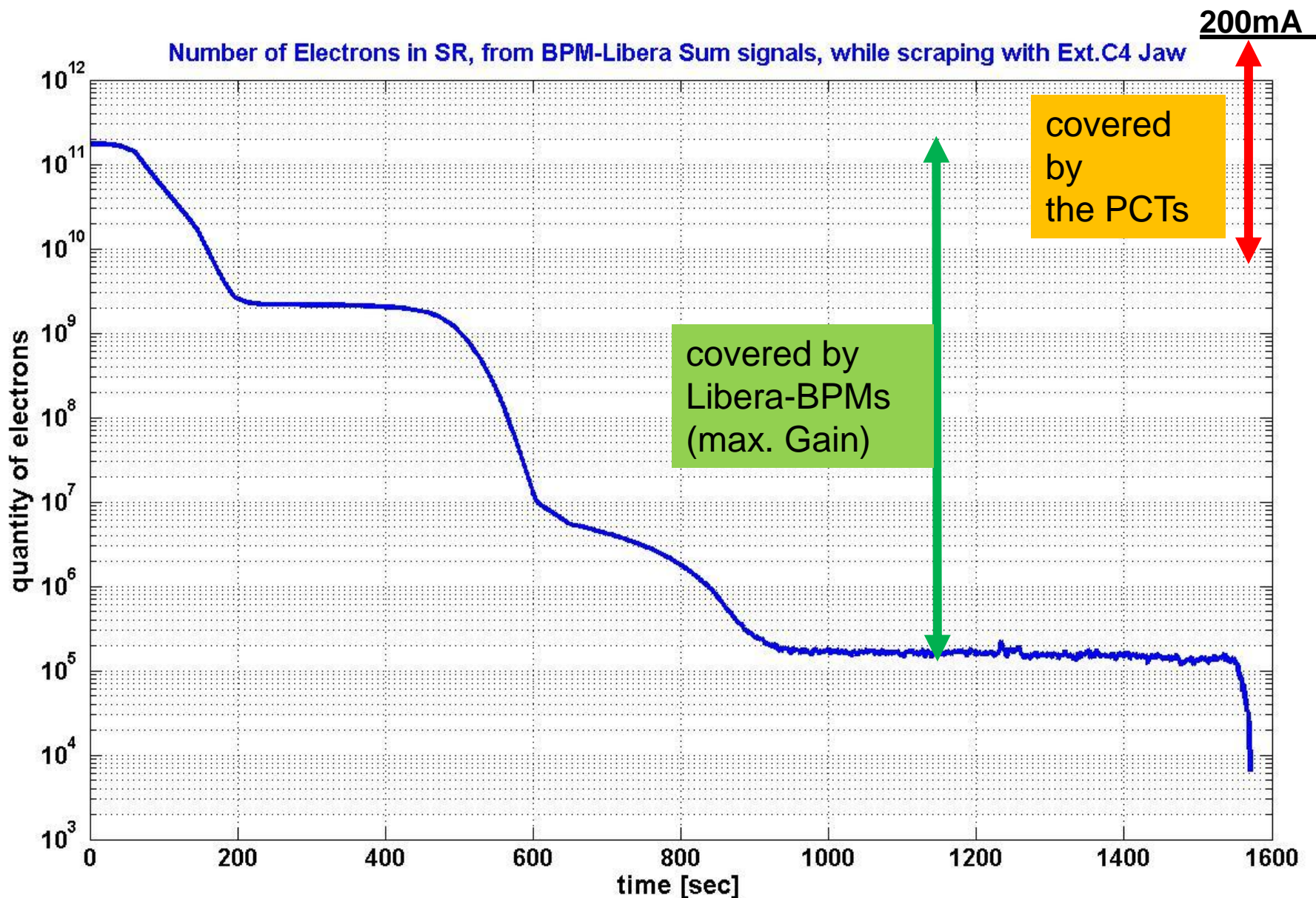
the 10Hz Sum of all **Liberas** for **current measurement**

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

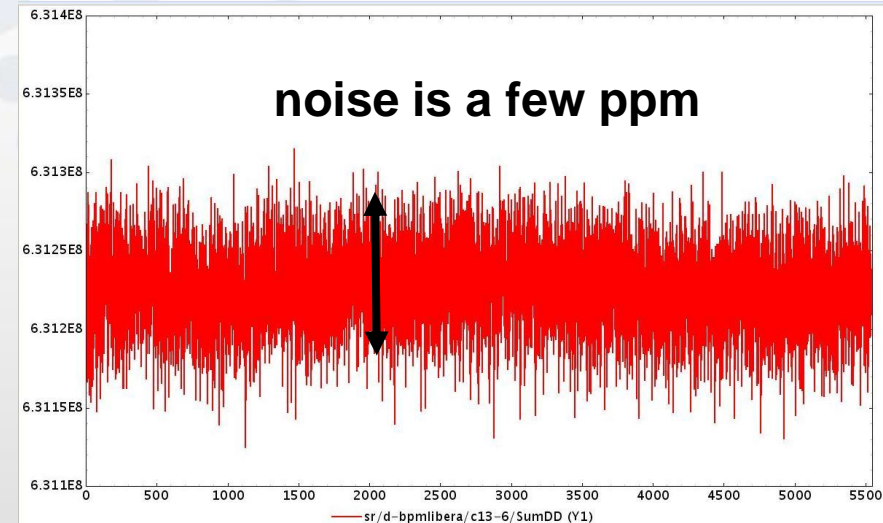
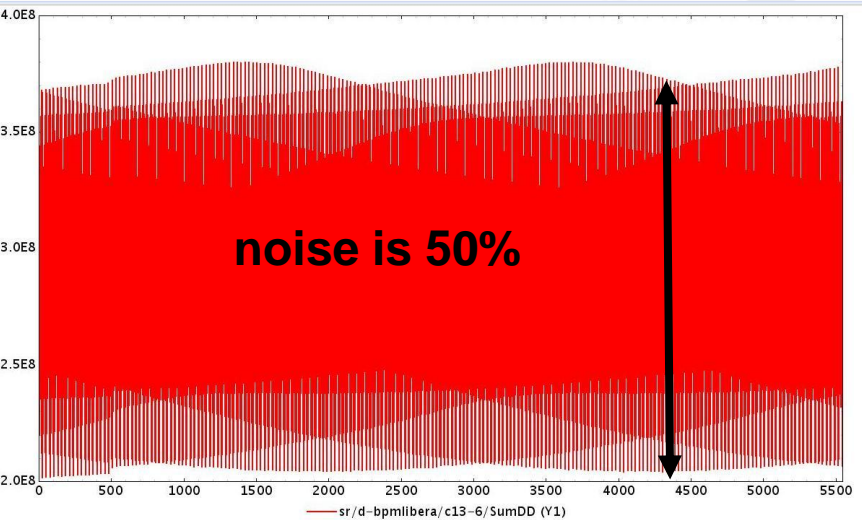
a simple matlab routine for the **control loop** at ~5Hz

in typ. 5 seconds the desired beam current is obtained





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



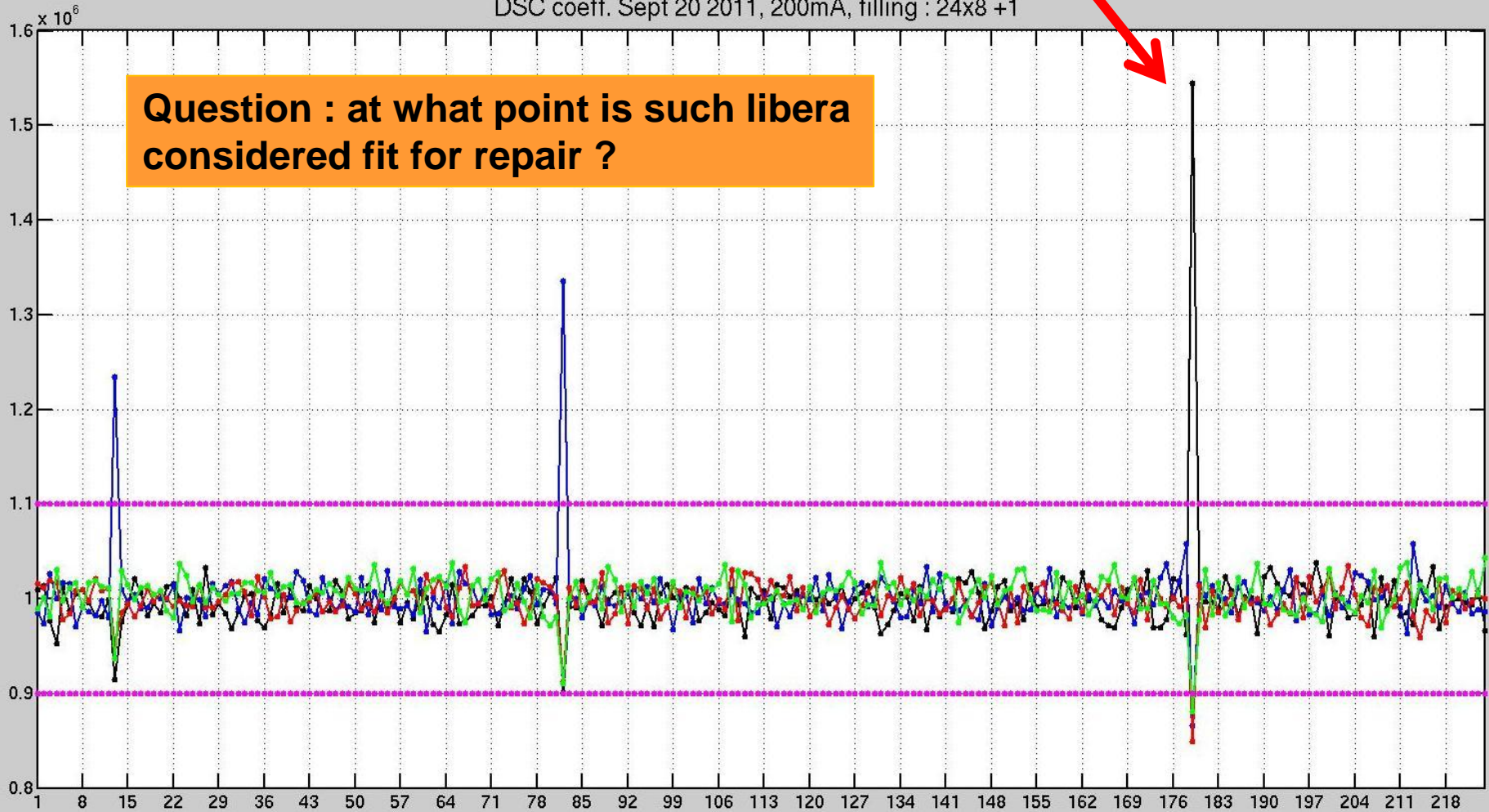
Huge Noise on the Sum (and A,B,C,D) signals, but not on position,  
DSC-phase coefficients corrupted,  
Changing 1 power Level (1dB) [ but no change in attenuator setting ] cures it .....

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**

DSC coeff. Sept 20 2011, 200mA, filling : 24x8 +1

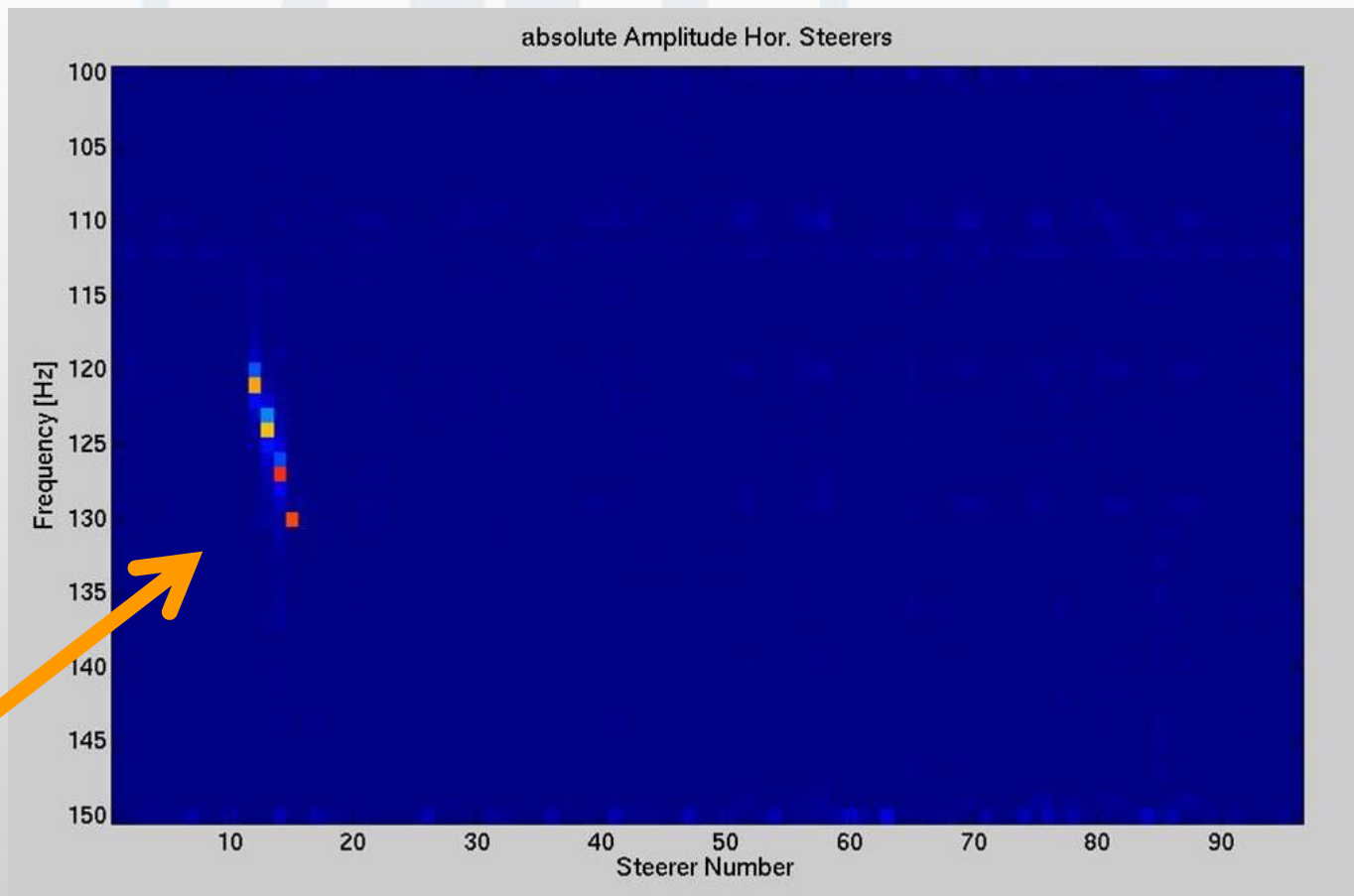
**Question : at what point is such libera considered fit for repair ?**



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**

