



**1 year experience with  
8 Liberas-Brilliance  
at the ESRF**

**Confirming the Liberas' compatibility to cope  
with all ESRF conditions & requirements**

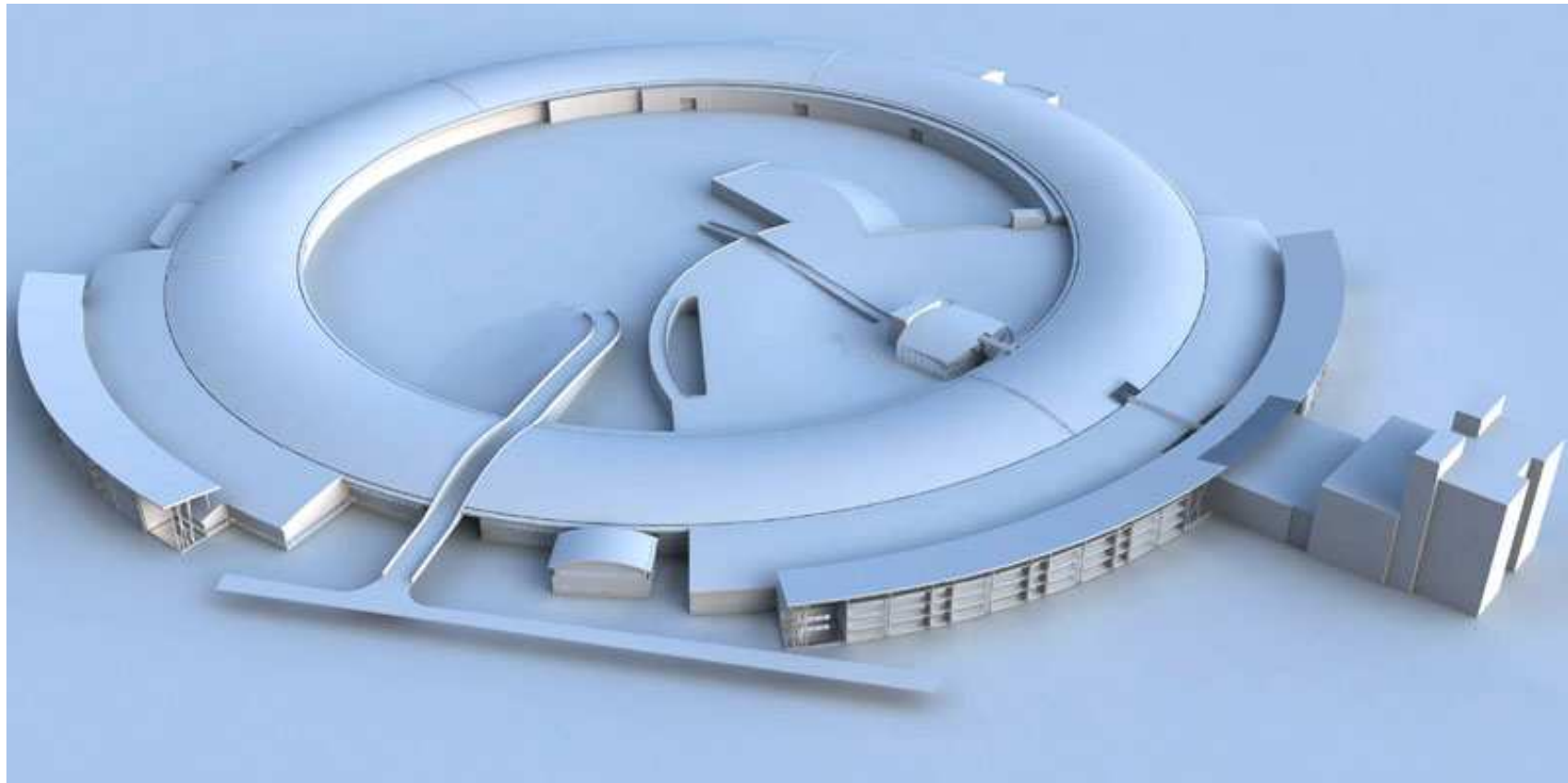
**Revealing a number of characteristics of the Liberas  
that can be worked-round if  
you know what's happening**

**Stock-markets crash , banks go broke , economic recession ahead ??**

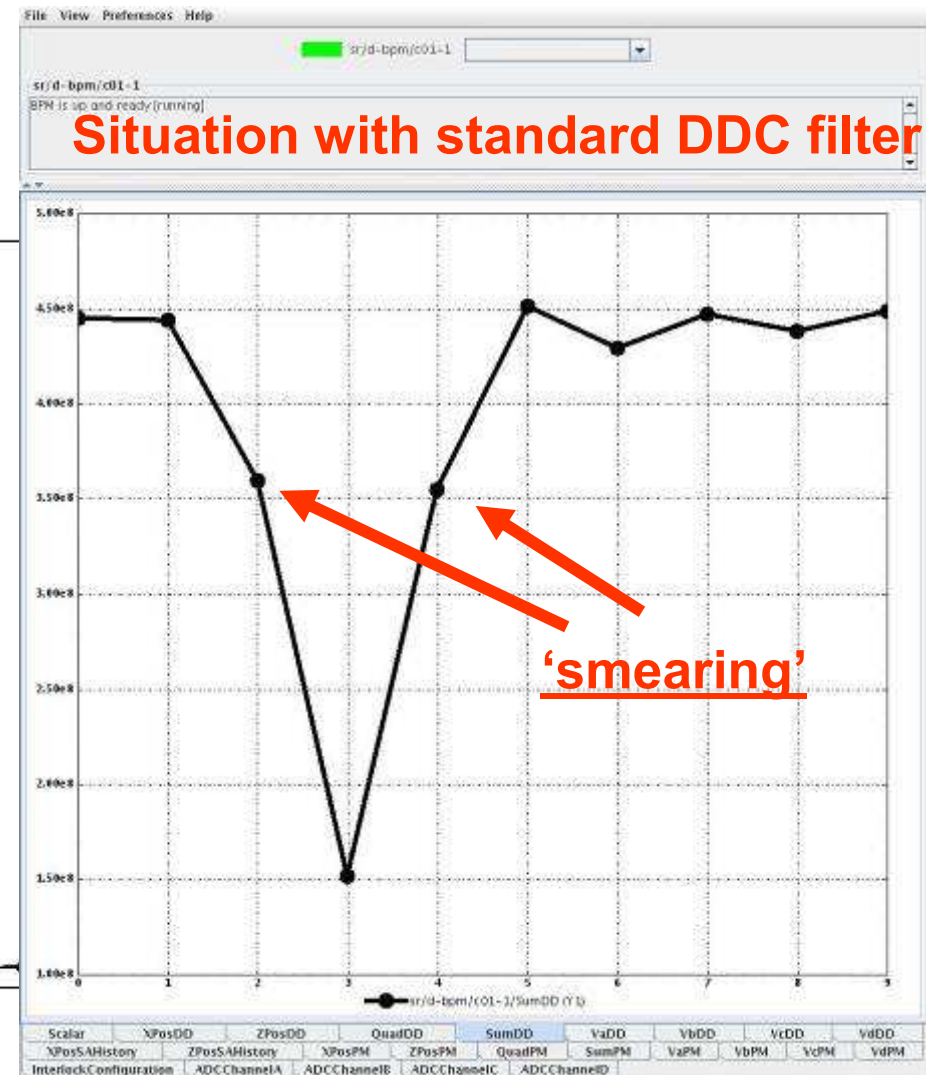
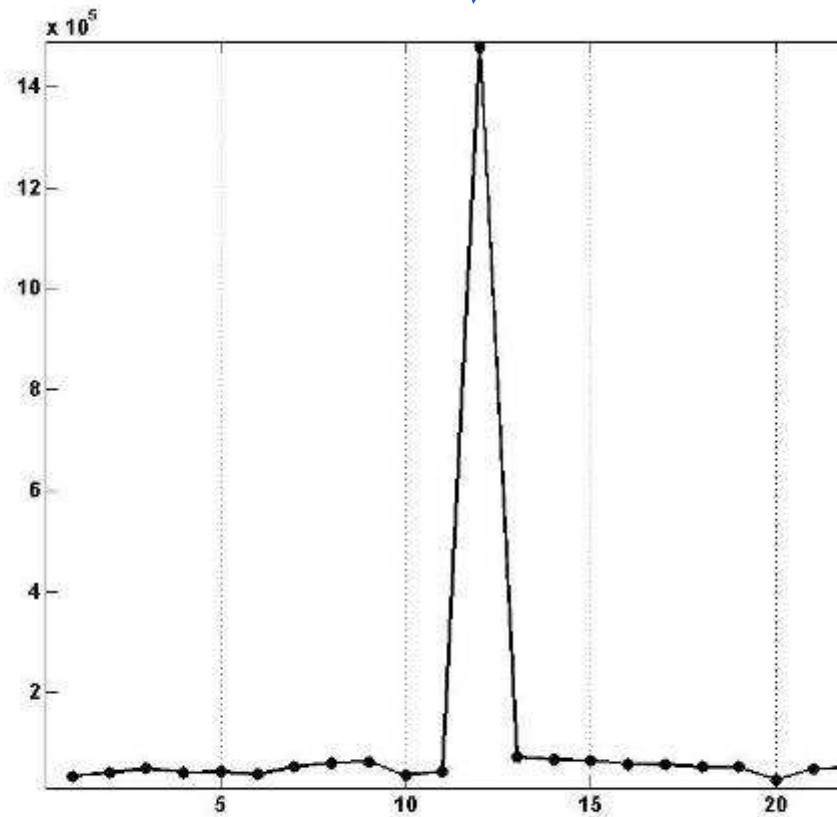
**But : the ESRF Upgrade Programme has been approved,**

**So : the Upgrade of our BPM systems will go ahead**

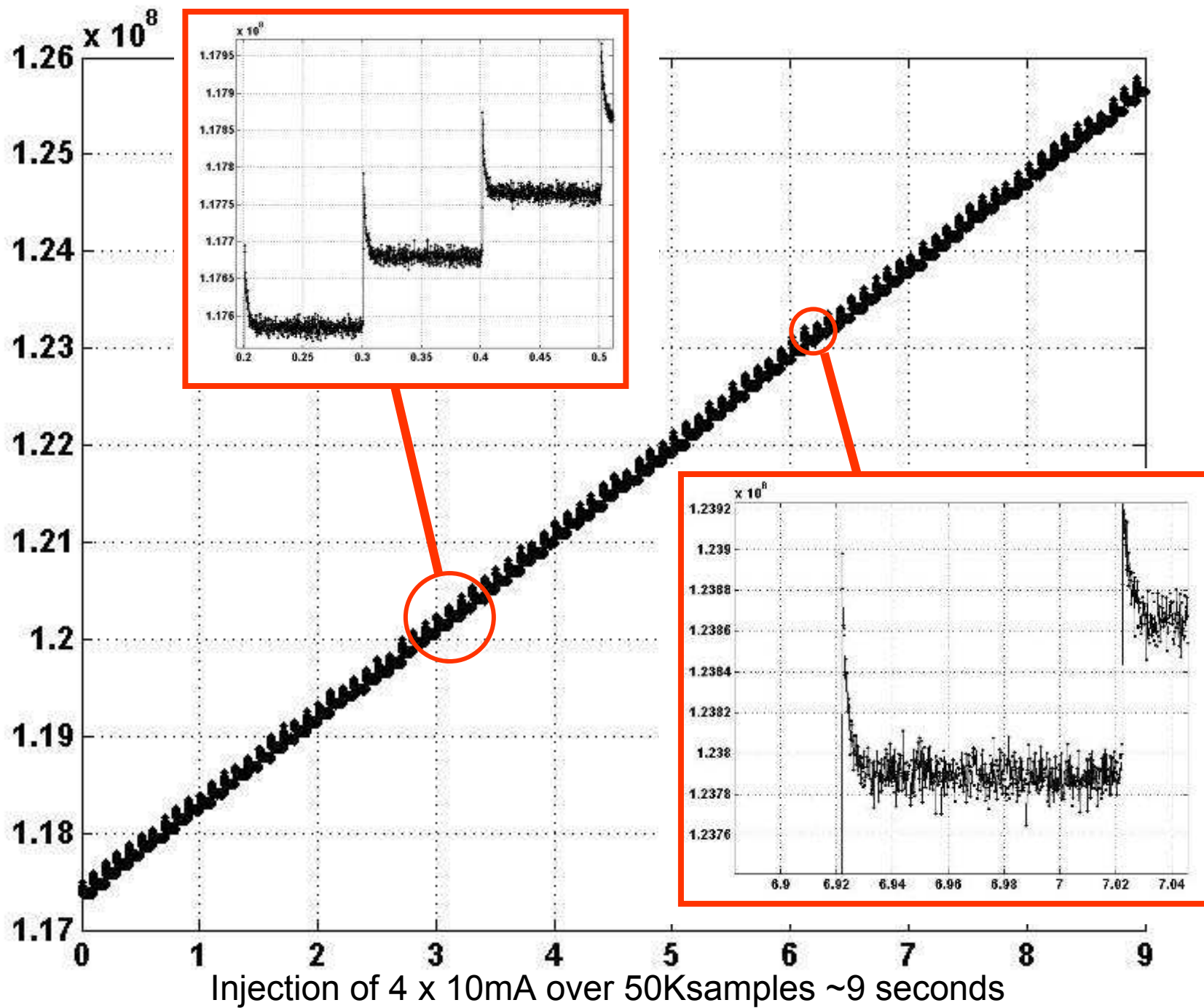
**Final (positive) decision (from ESRF AFC) expected this week (Oct.15)**



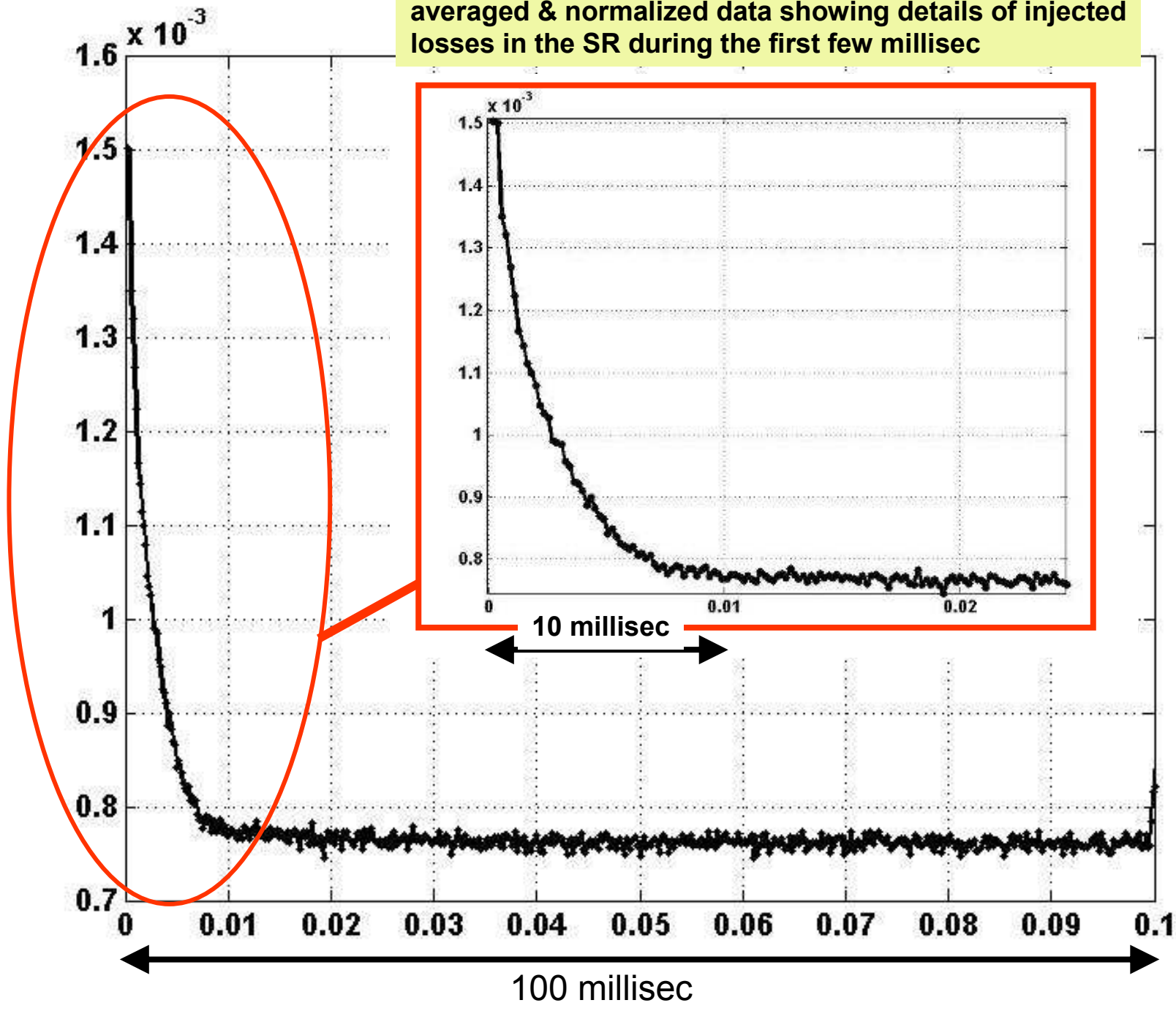
the modified DDC filter works well i.e. the MAF design



but only one design can be installed at a time . . .

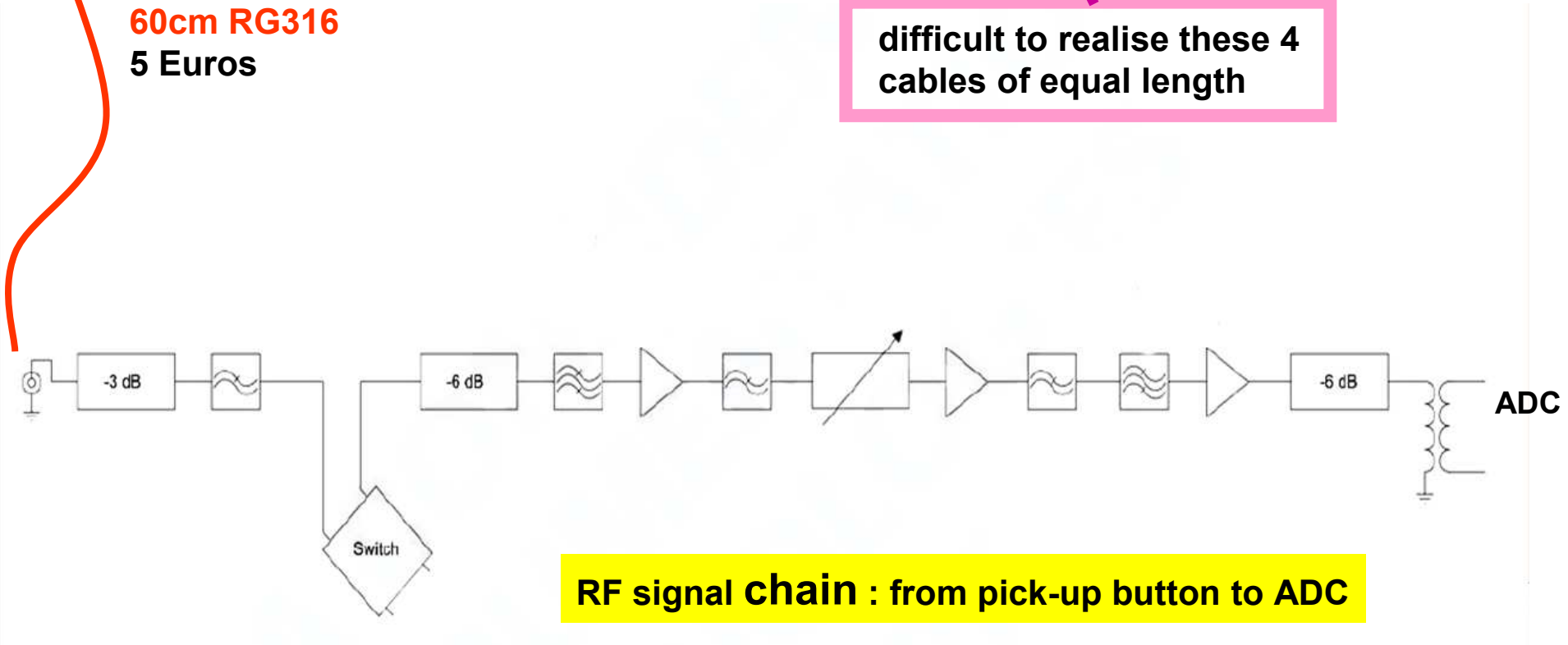


averaged & normalized data showing details of injected losses in the SR during the first few millisecond



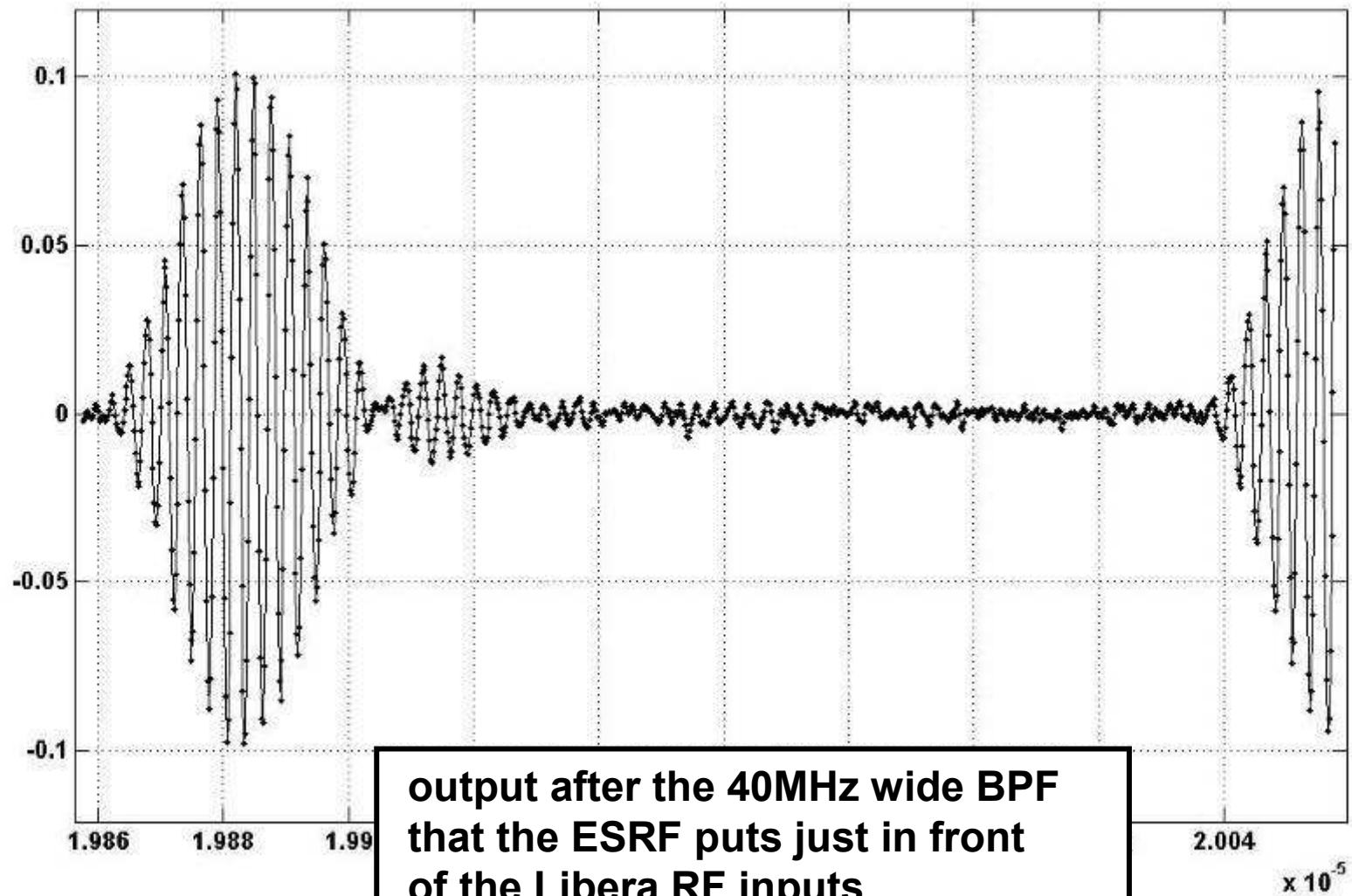


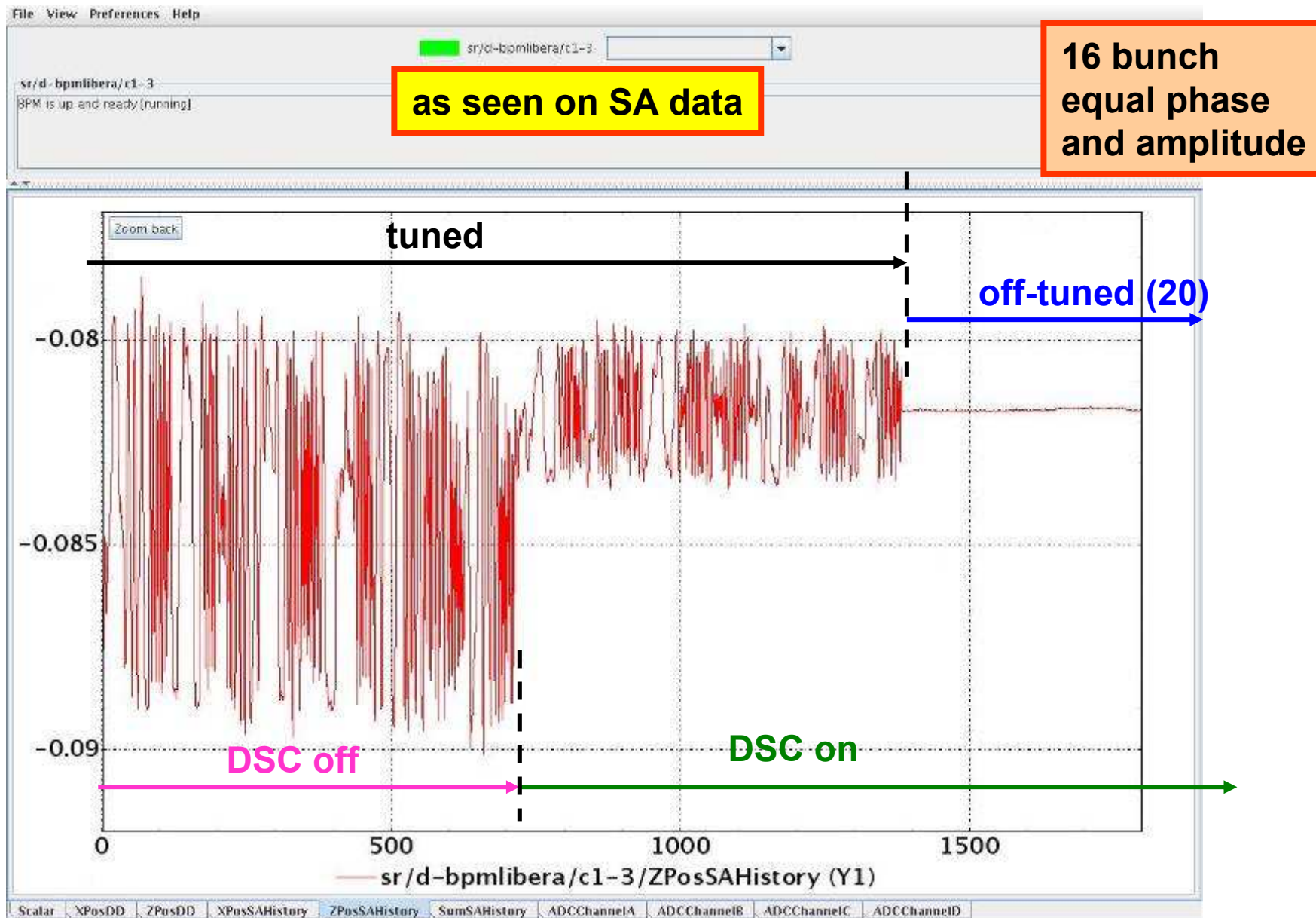
difficult to realise these 4 cables of equal length



RF signal chain : from pick-up button to ADC

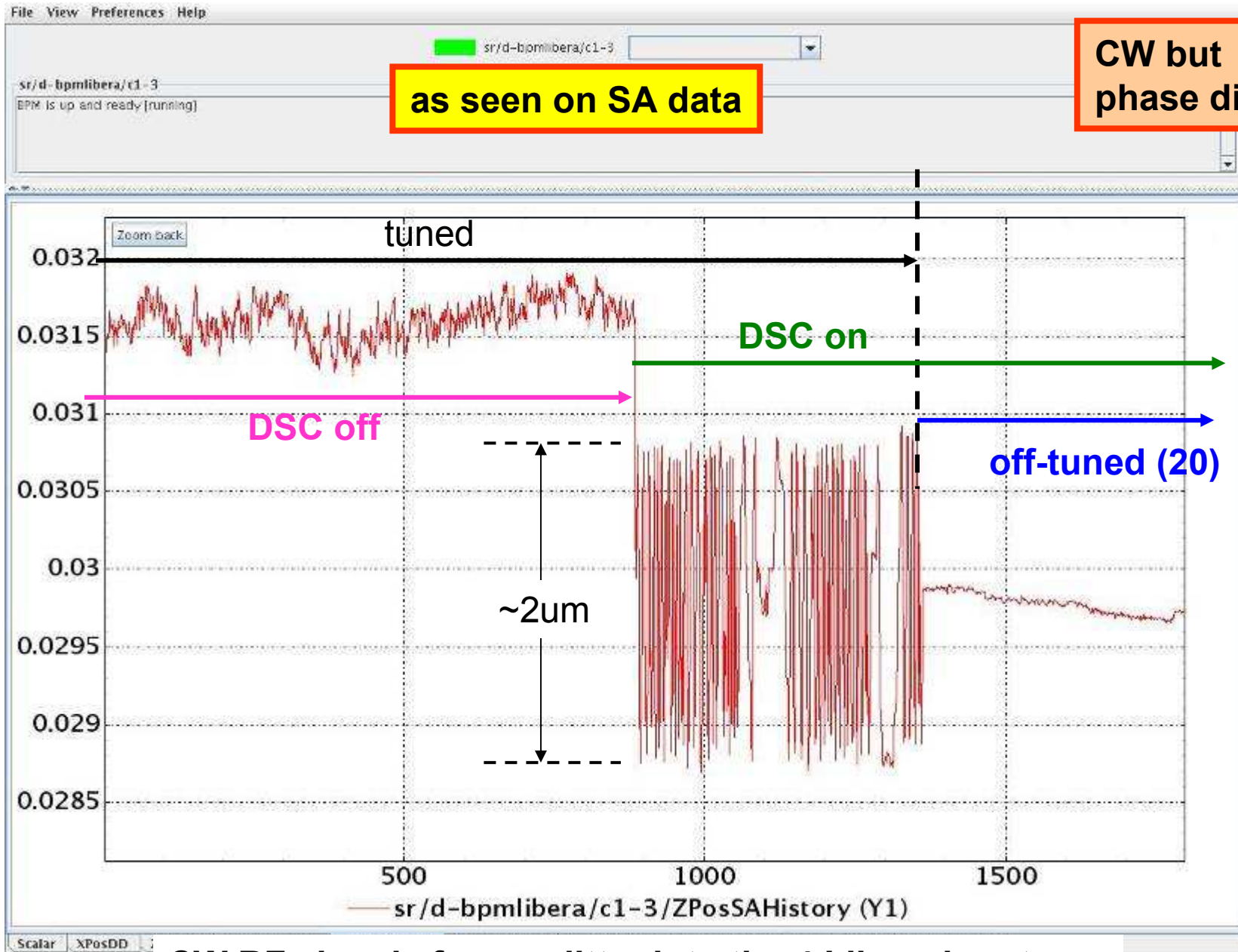
# Degradation with partial fill and 1, 4, 16 bunch fills



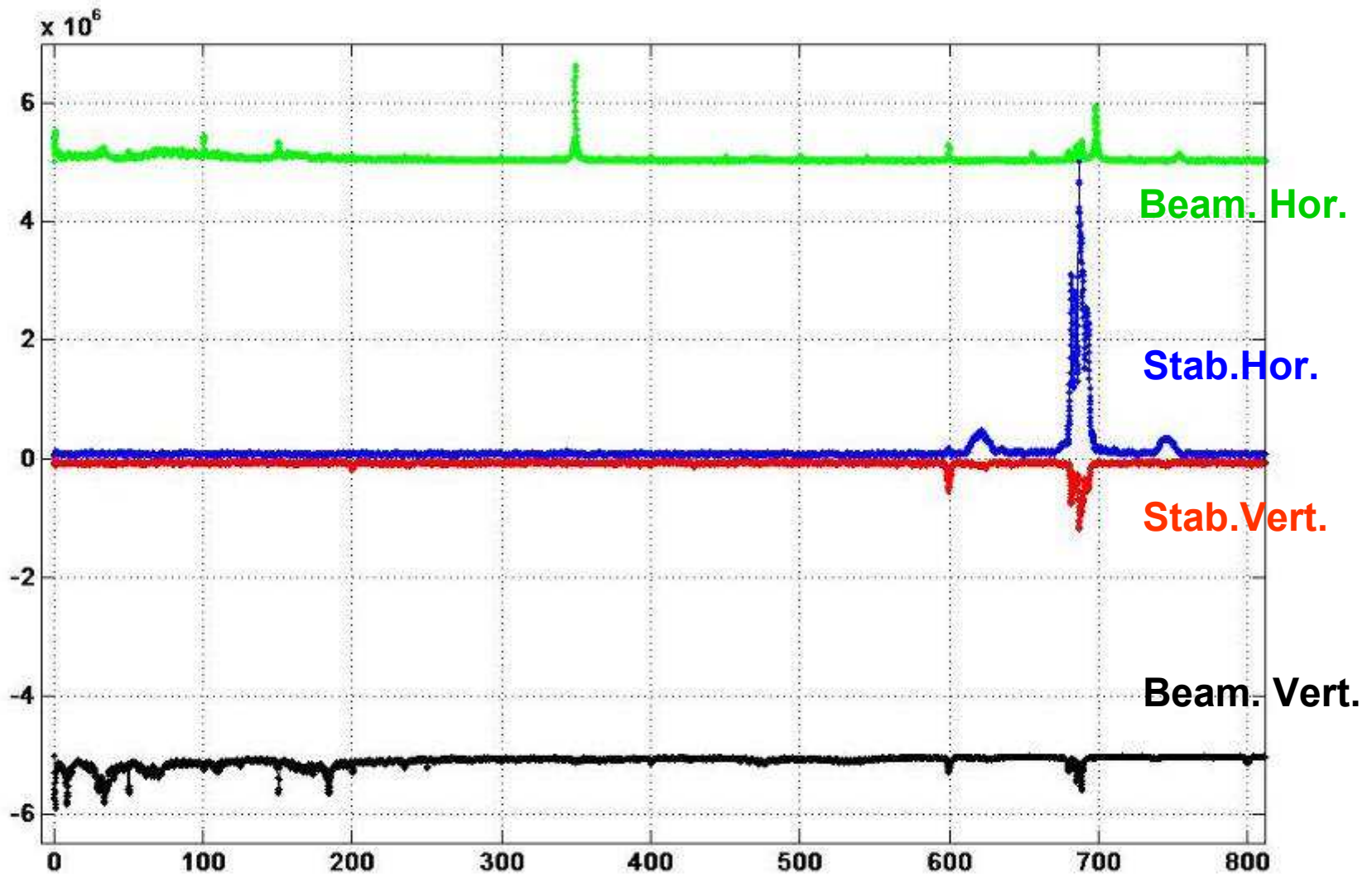


Libera fed with button & beam signals in 16 bunch fill, but going through Sum & Split. (i.e. stable beam) after 40MHz BPFs the max. ADC values are strong but well below saturation (i.e. <30K)

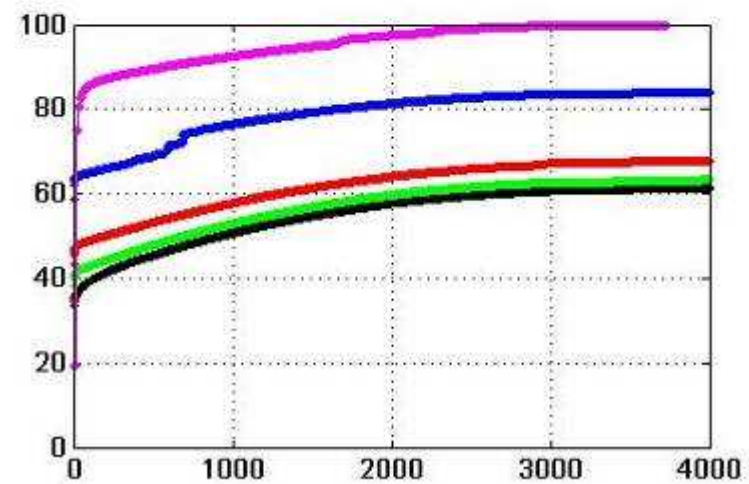
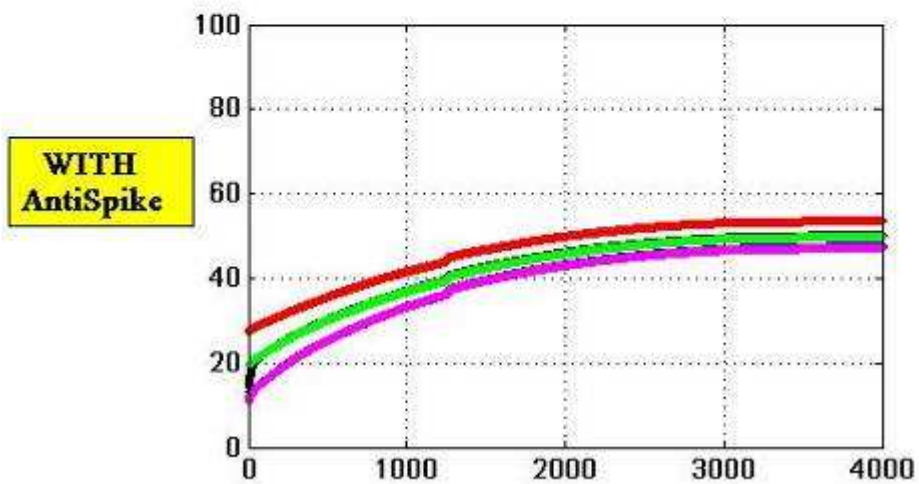
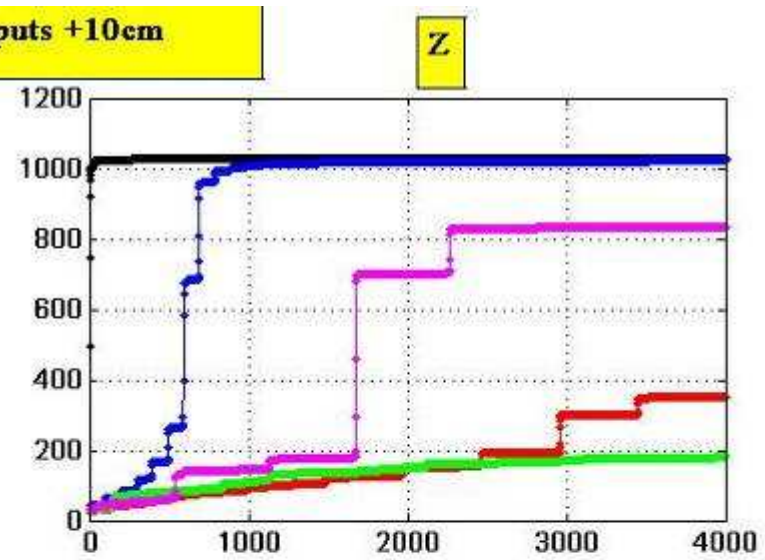
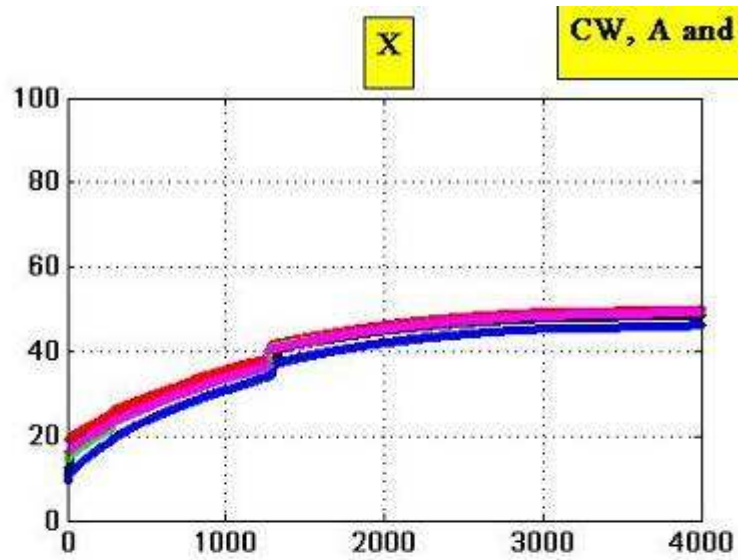




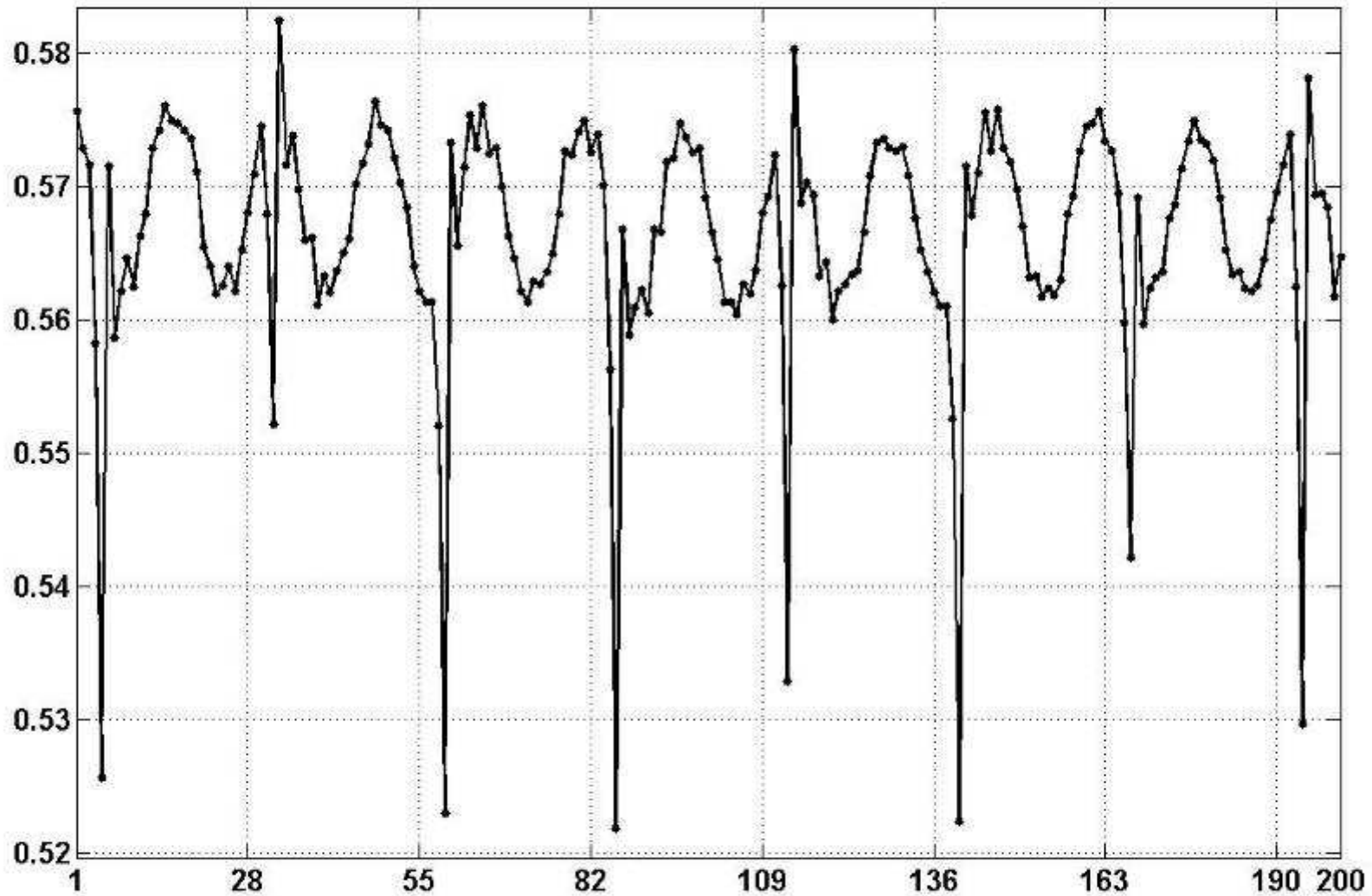
CW RF signals from splitter into the 4 Libera inputs,  
but with 11cm extra cable for D



Spectrum from FA output  
16 bunch, offset-tune=20



black=tuned, blue=10, red=50, green=100, purple=400



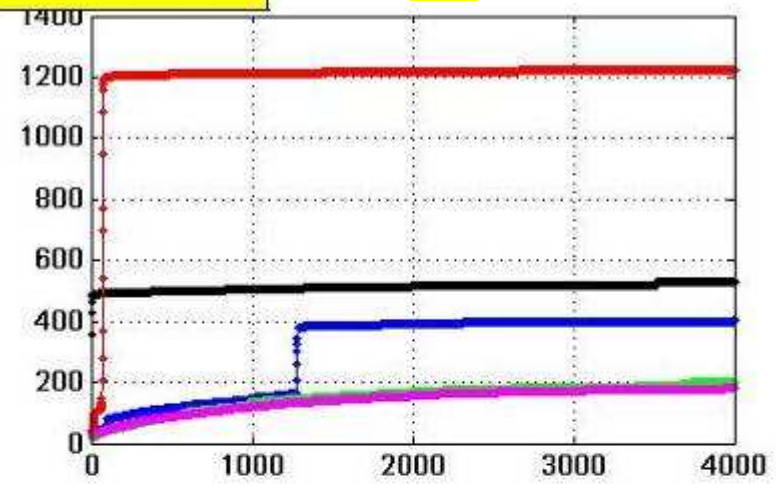
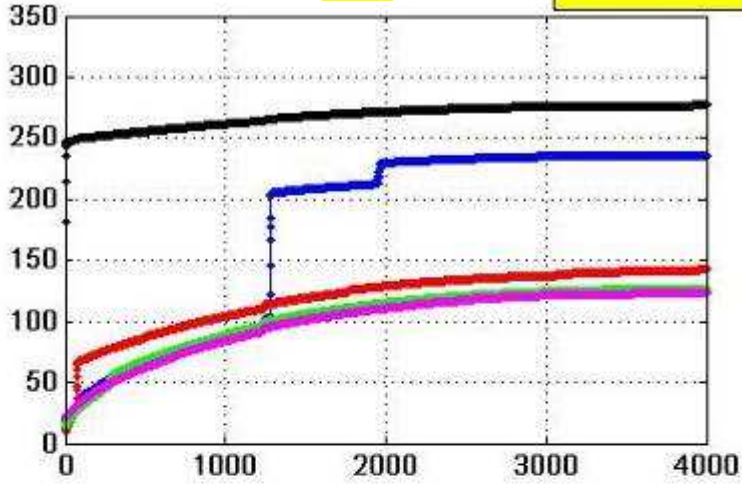
**22KHz component of ~15um pk-p in Vert. Plane,**

**+ strong DSC Libera-switching (at 27 TbT-intervals) (C8)**

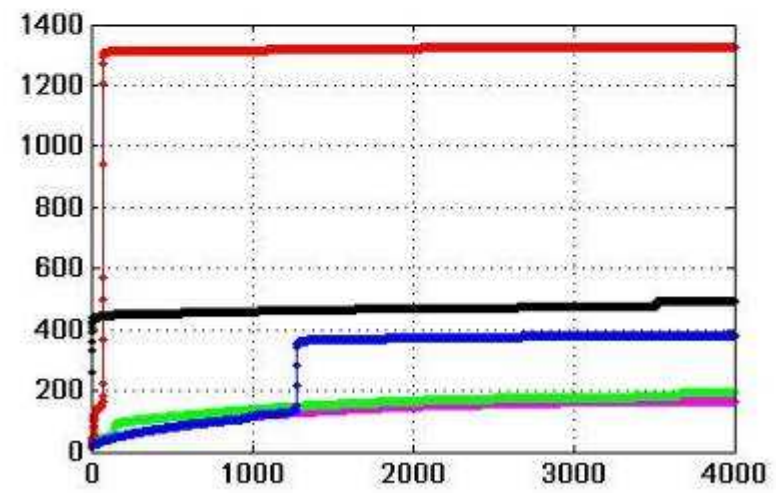
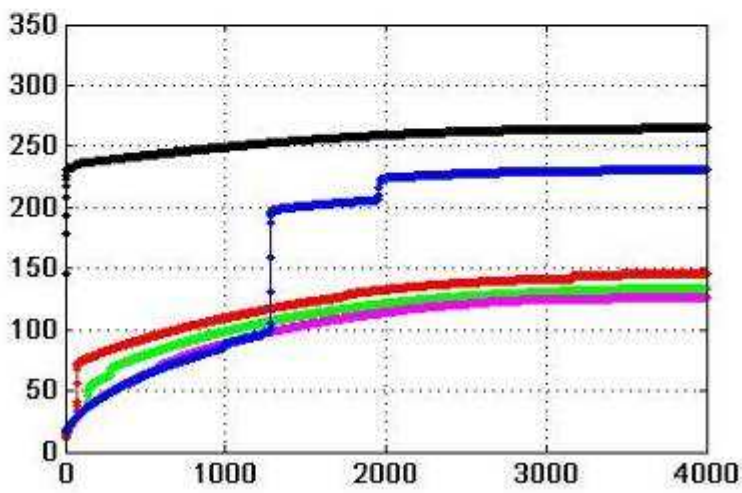
X

16 bunch, 4 RF inputs in phase

Z



with anti spike



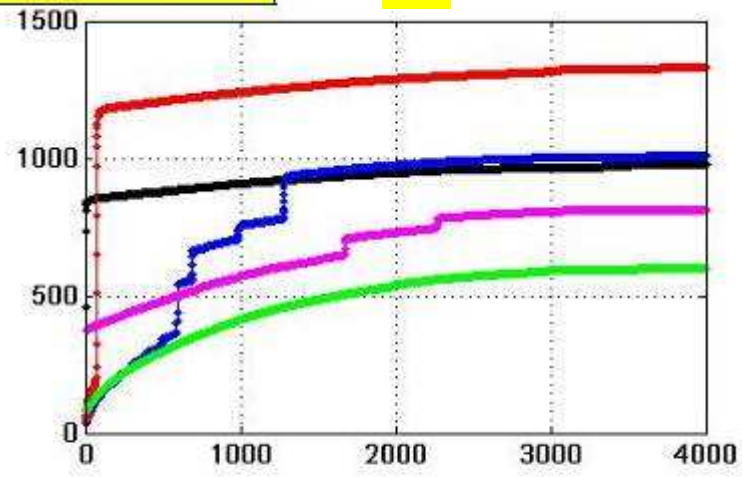
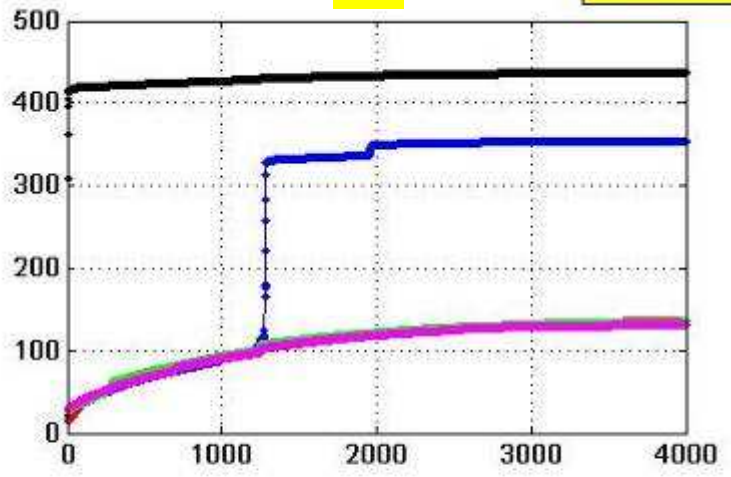
black=tuned, blue=10, red=50, green=100, purple=400

**Conclusion**      Antispikes do not help anymore  
 Offset tune does the job but high values needed

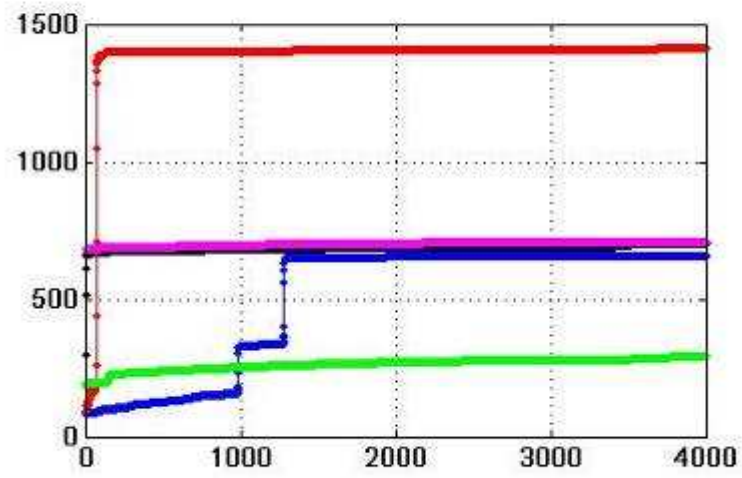
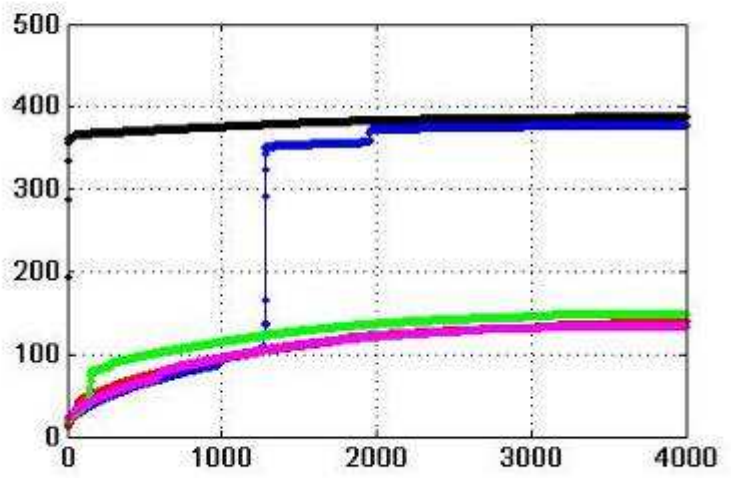
X

16 bunch , A & B inputs +10cm

Z



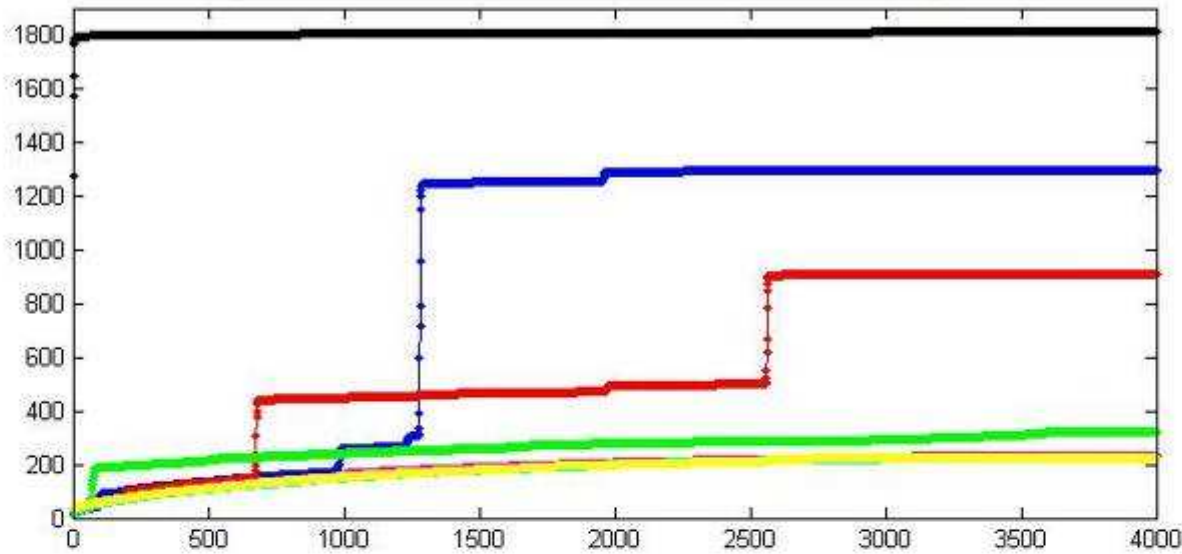
with anti spike



black=tuned, blue=10, red=50, green=100, purple=400

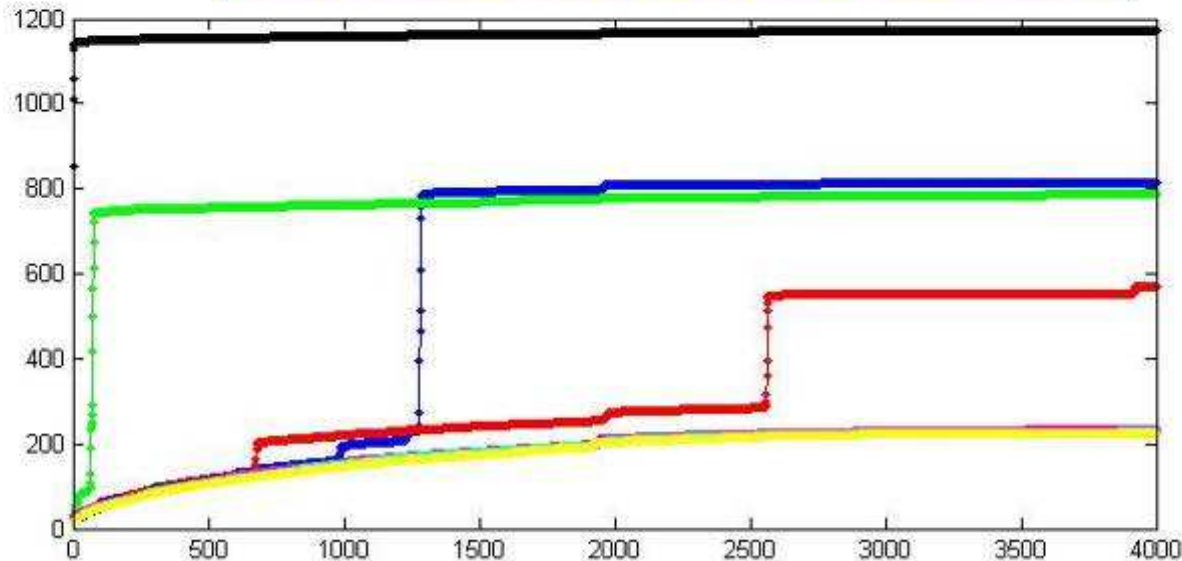
**Conclusion**      Antispikes help marginally  
 Offset tune does the job but high values needed

16bu, A=2cm+, top=X, bottom=Z, C1-1



X

offsettune=0, 10, 20, 50, 100, 200, 400  
for blk, blue, red, green, purp, cyan, yellow, top=X, bottom=Z



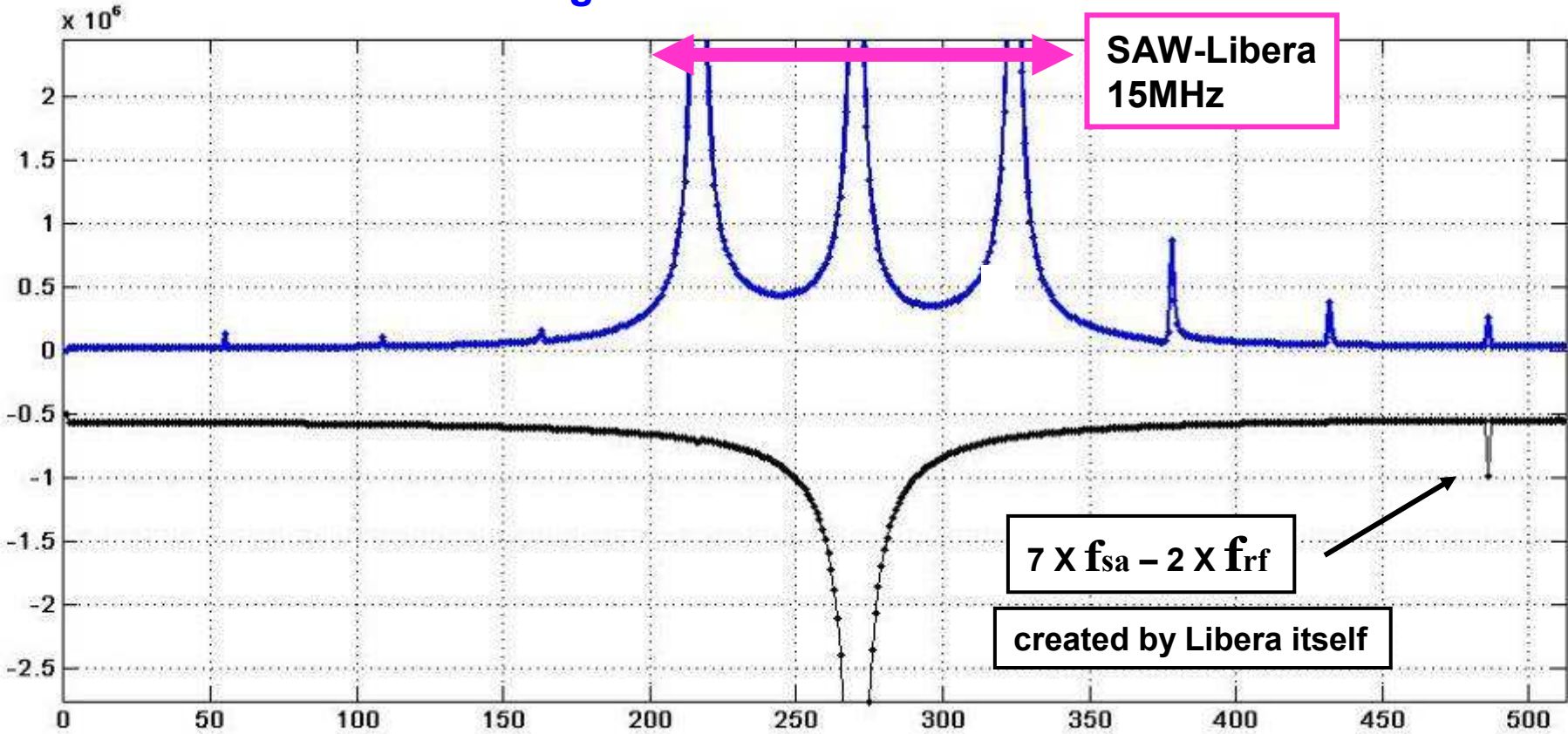
Z

**Conclusion**

**Offset tune  
does the job  
but high values  
are needed**

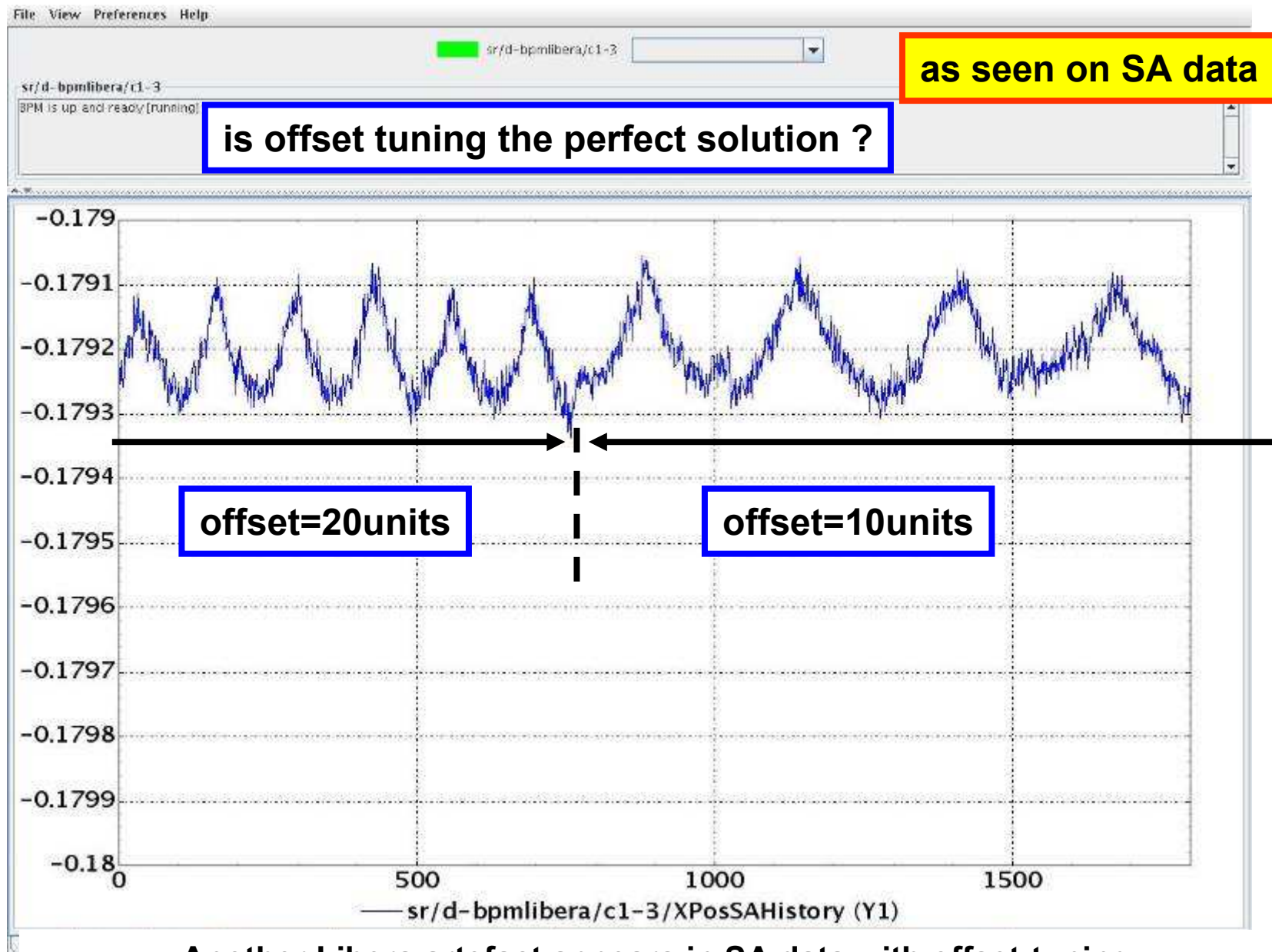
the main cause of these imperfections are the dis-linearities in the 2nd half of the ADC range

Blue : 16 Bunch filling



Black : CW RF

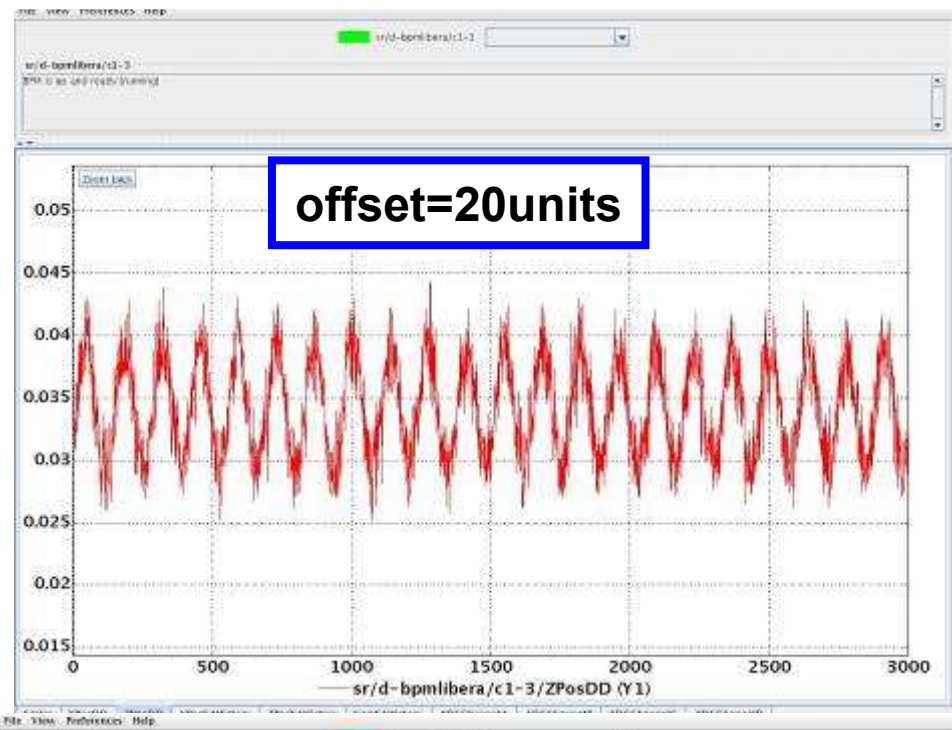
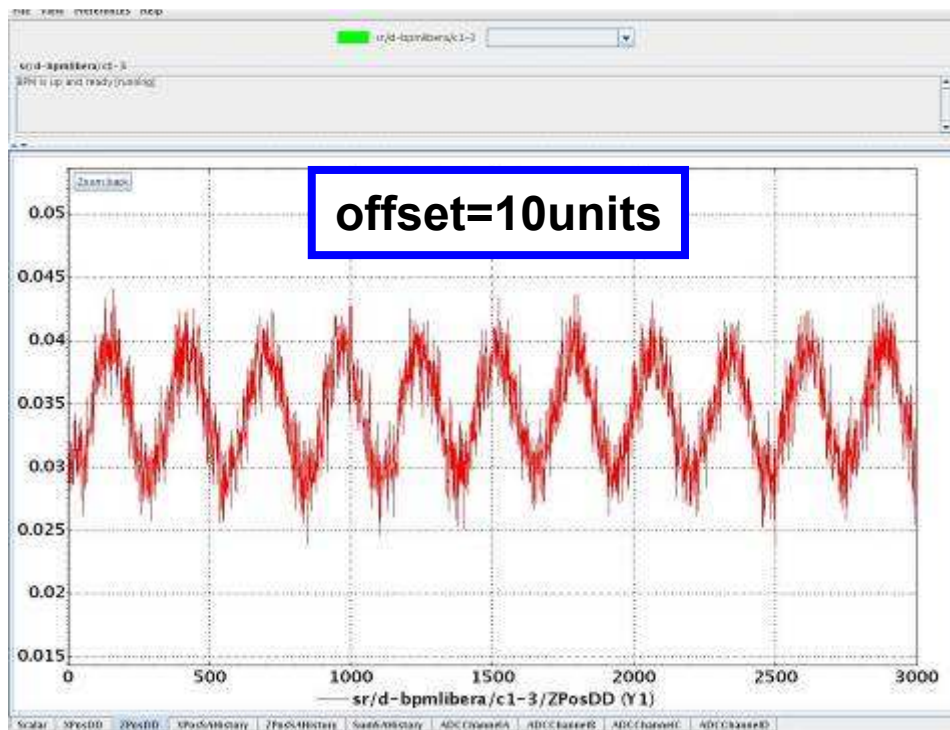




**Another Libera artefact appears in SA data with offset-tuning :  
a slow 200nm pk-pk oscillation, the period is determined by the value of the offset  
data taken under 16 bunch, 'perfect stable' beam (Sum & Split)**



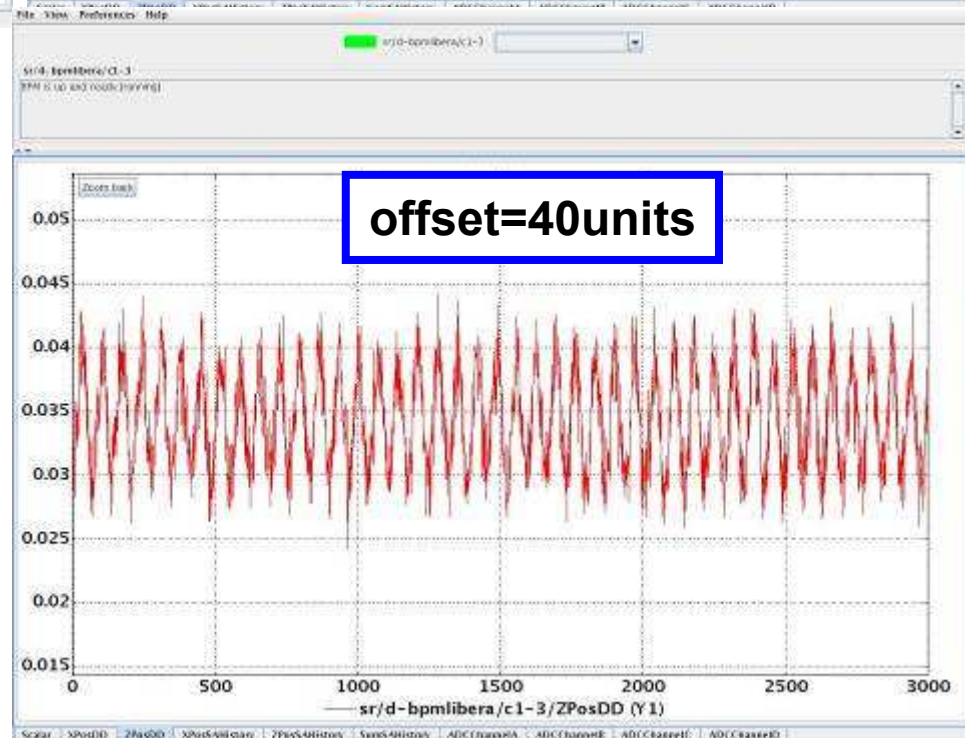
The slow 200nm pk-pk oscillation in SA data can be minimized by playing with the switching delay parameter, data taken under 16 bunch, 'perfect stable' beam (Sum & Split)



Another Libera artefact appears in DD t-b-t data with offset-tuning :

~ 12um pk-pk oscillation in vert. plane, the period is determined by the value of the offset

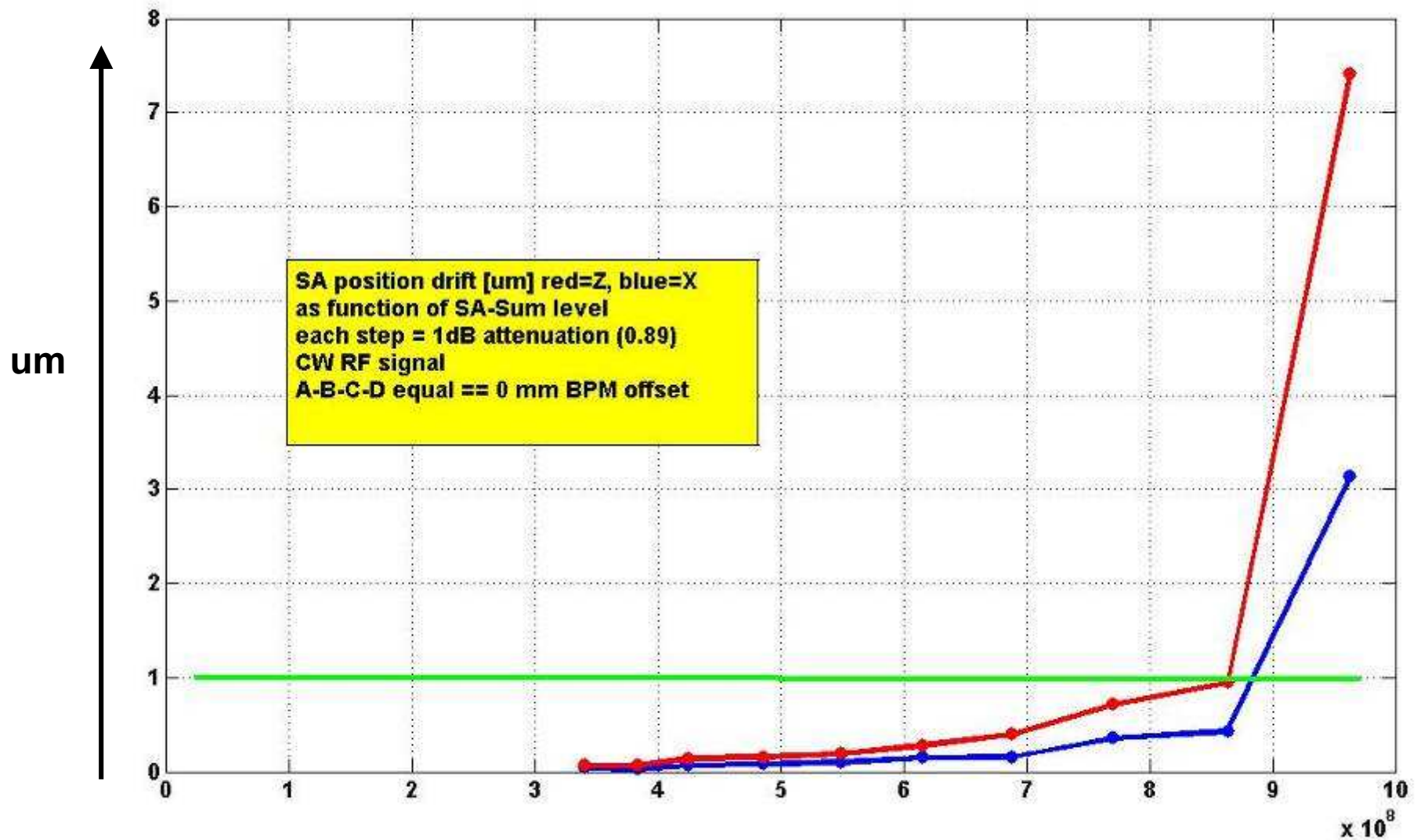
data taken under 16 bunch, with 'perfect stable' beam (Sum & Split)



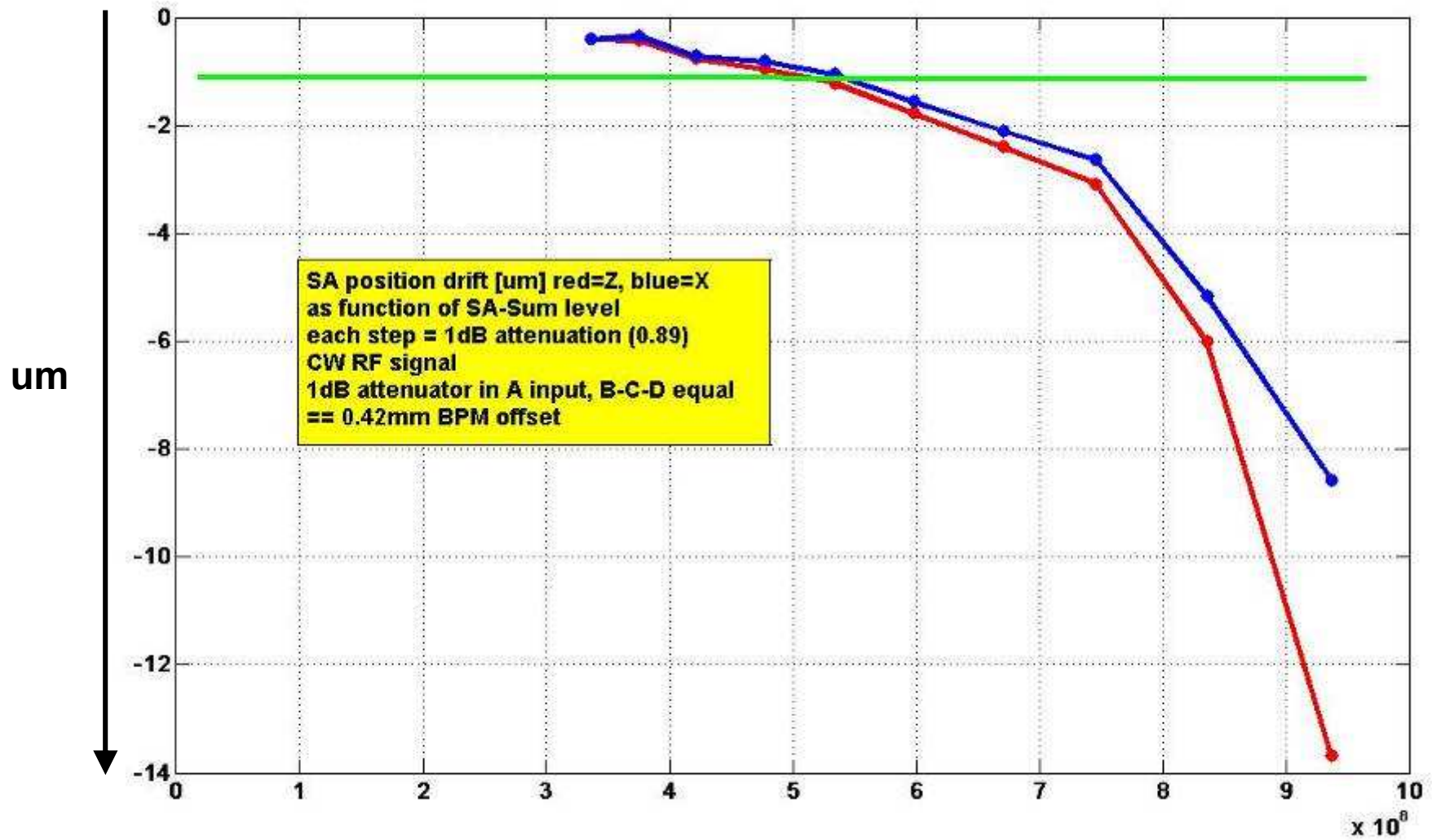
## Conclusions :

- 1) equal phase of the 4 RF input signals is very important, it helps a lot to avoid complications
- 2) the offset tuning does the job for all filling patterns, its value is best large (>300)
- 3) the switching delay value is less critical if RF inputs have equal phase, can be further optimized for each filling pattern if needed
- 4) the anti-spike feature needs further & complete investigation, helps a lot in case of non-equal RF input phases, BUT only for CW . . .
- 5) the FIR filters in the FA chain seem OK
- 6) Adjust Libera attenuation so to keep ADC counts below 16K so in the lower half of the total range of 32K

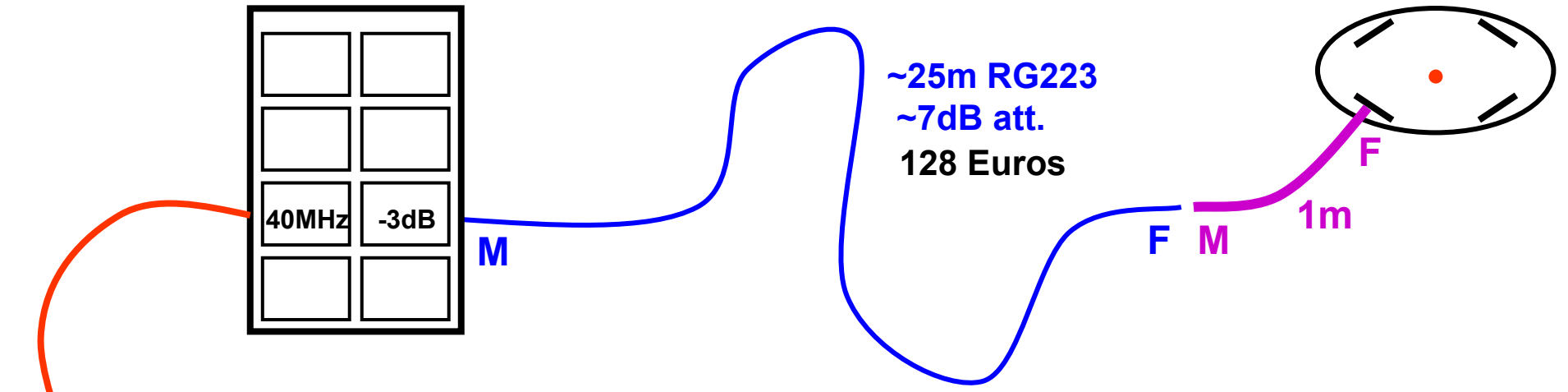
The final design is '304', '27', '35' (and not '36' since  $4 \times 27 = 3 \times 36$  . . .)



**Beam Current Dependence, as function of ADC counts or SA Sum signal**

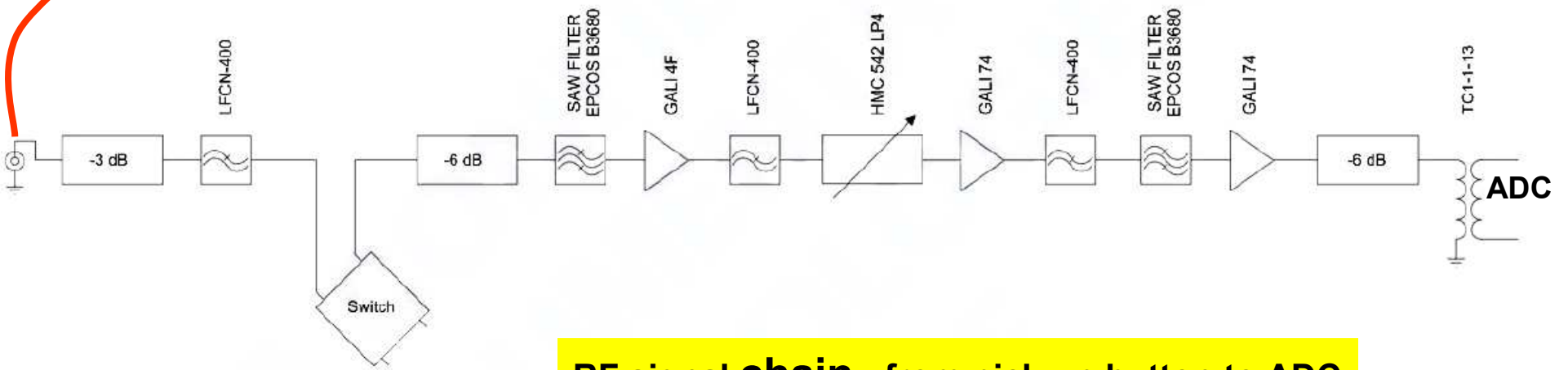


do not use the Libera with the ADCs in the upper half of their 16 bits range



**60cm RG316**  
5 Euros

The Libera can nicely be used to measure the precise cable length differences, I and Q of TbT data  
We will use that to then compensate on the **small 60cm** cable later after full installation



**RF signal chain : from pick-up button to ADC**

quantity [cells]	when		total done / total remaining [cells]	
1 (cell 9)	9 / 9 / 2008		1 / 31	
1	2 / 12 / 2008		2 / 30	
1	9 / 12 / 2008		3 / 29	
13	15 / 12 - 15 / 1	●	16 / 16	payment of 100 units
1	19 / 1 / 2009		17 / 15	
2	27 / 1 / 2009		19 / 13	
3	3&4 / 2 / 2009		22 / 10	
2	10 / 2 / 2009		24 / 8	
2	17 / 2 / 2009	●	26 / 6	payment of 65 units
2	24 / 2 / 2009		28 / 4	
2	3 / 3 / 2009		30 / 2	
2	10 / 3 / 2009	●	32 / 0 !!	payment of 65 units

- the cell 9 of sept. 9 will be done with Liberas already in-house
- the 2 & 9 dec. 'switch-over' will allow a good estimation of a good rhythm for the rest
- after restart in jan. a rhythm of 2 cells per day of MDT should be possible
- this proposal allows to finish **Site-Acceptance-Tests**, **'Transfer-of-Property'** and **payment** in a (reasonable) period of about 3 months after first delivery
- this schedule is based on doing SATs in the Liberas' real & final destination racks, NOT in a separate laboratory environment



## **Conclusion & the situation :**

- Complete tests on Libera characteristics & performances finished :
  - certain imperfections found but these can be worked-round or lived with
  - convinced to satisfy the ESRF requirements
- 230 Libera units to be procured to replace the old SR-BPM Electronics
- procurement hoped & expected end-Oct, with full delivery before mid-Dec
- installation & commissioning ('switch-over') is spread-out over ~3 months
- only the slow (SA 10Hz) output & the T-b-T functionality will be used in 2009
- the fast (FA 10KHz) outputs will serve in a modernized fast-orbit feedback system once other major procurements (AC correctors) will have been realized (2010)
- the (Ring-round) distribution of the FA data will be done using the so-called 'Communication Controller' developed by Diamond Light Source , but licensed to & serviced by & procured from Instrumentation Technologies