STORM 21/5/2015 : tests of a new SY → SR transfer-efficiency measurement monitor

1) **Hardware involved :**
   - all (75) BPMs in Booster (Sparks)
   - all (224) BPMs in SR (Liberas)

2) **Signals & buffers involved :**
   - Sum (of the 4 buttons)
   - contains the amplitude of (ONLY) the 352.2MHz
   - triggerable buffers of typically 300ms long

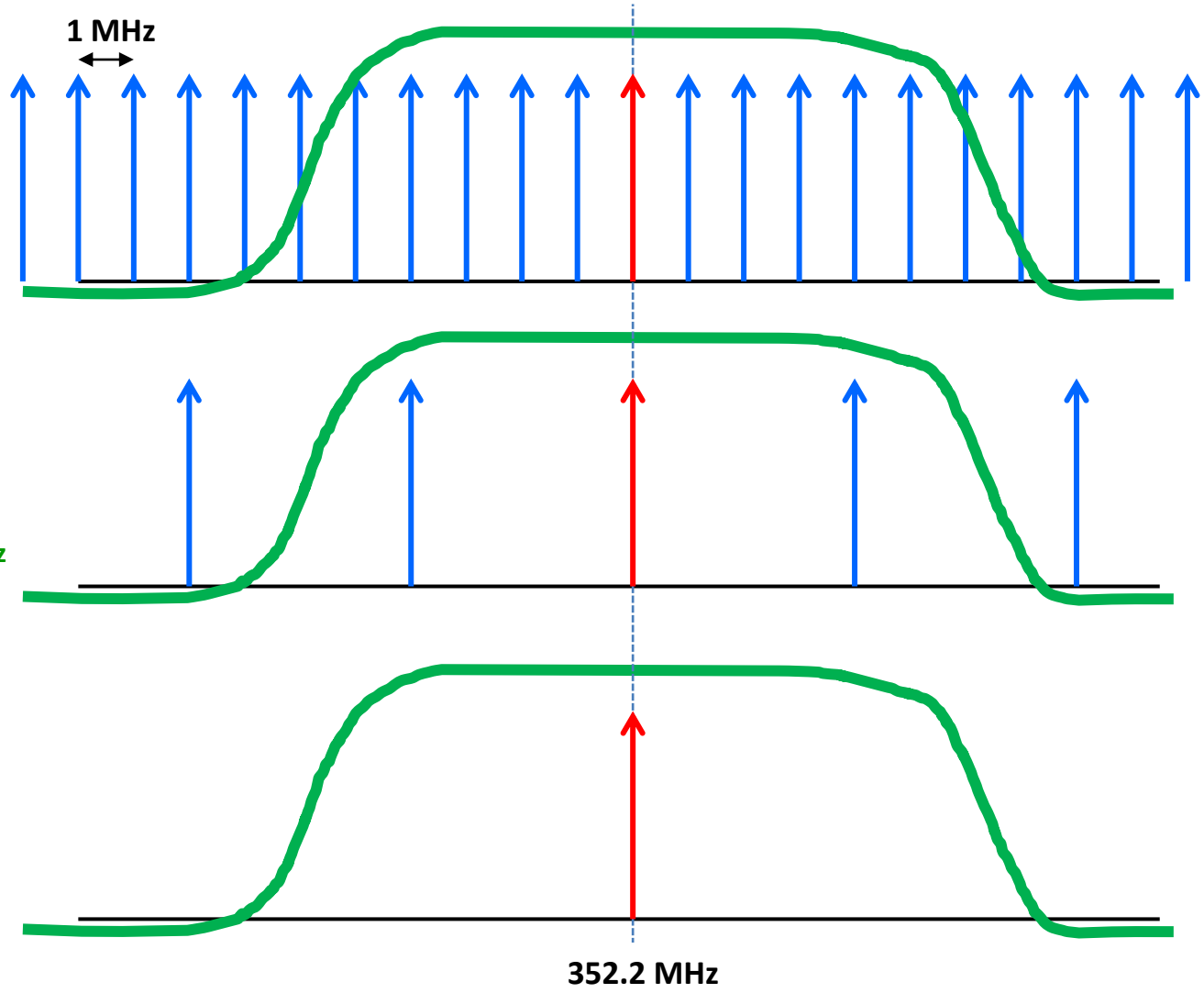
3) **Synchronization :**
   - all units (buffers) triggered by the same (pre-injection) trigger
   - at a rate/period of 0.5Hz (2sec)
   - read-out via the Tango "all"-servers

4) **Calibration :**
   - the Sums of Booster BPMs are calibrated with the SY-current monitor
   - the Sums of SR BPMs are calibrated with the SR-current monitors

5) **Performance :**
   speed : @10Hz : 3 measurements per 2 sec (3 out-of-20 injections)
   @ 1Hz : 1 measurement per sec

   resolution rms :
   SY : 0.01uA on typ. 400uA SY current in 5 bunch mode
   SR : 0.05uA on typ. 60uA injected SR current in 16 bunch mode

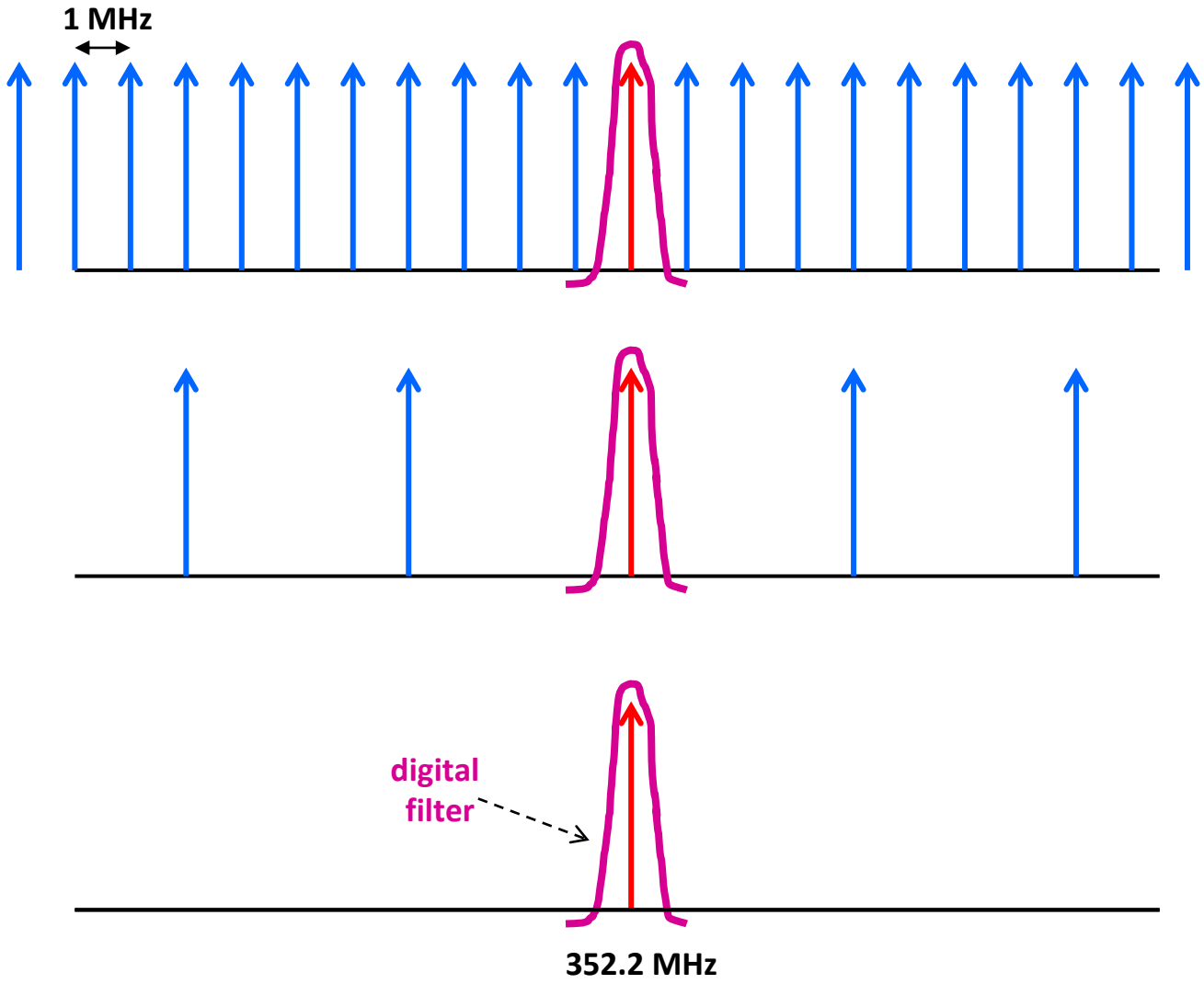
6) **Conclusion & next steps**



frequency spectrum from a capacitive button of BPMs :
the amplitude of the 352.2MHz spectral line is :

-- always present

-- <u>proportional</u> to the Current in the Ring



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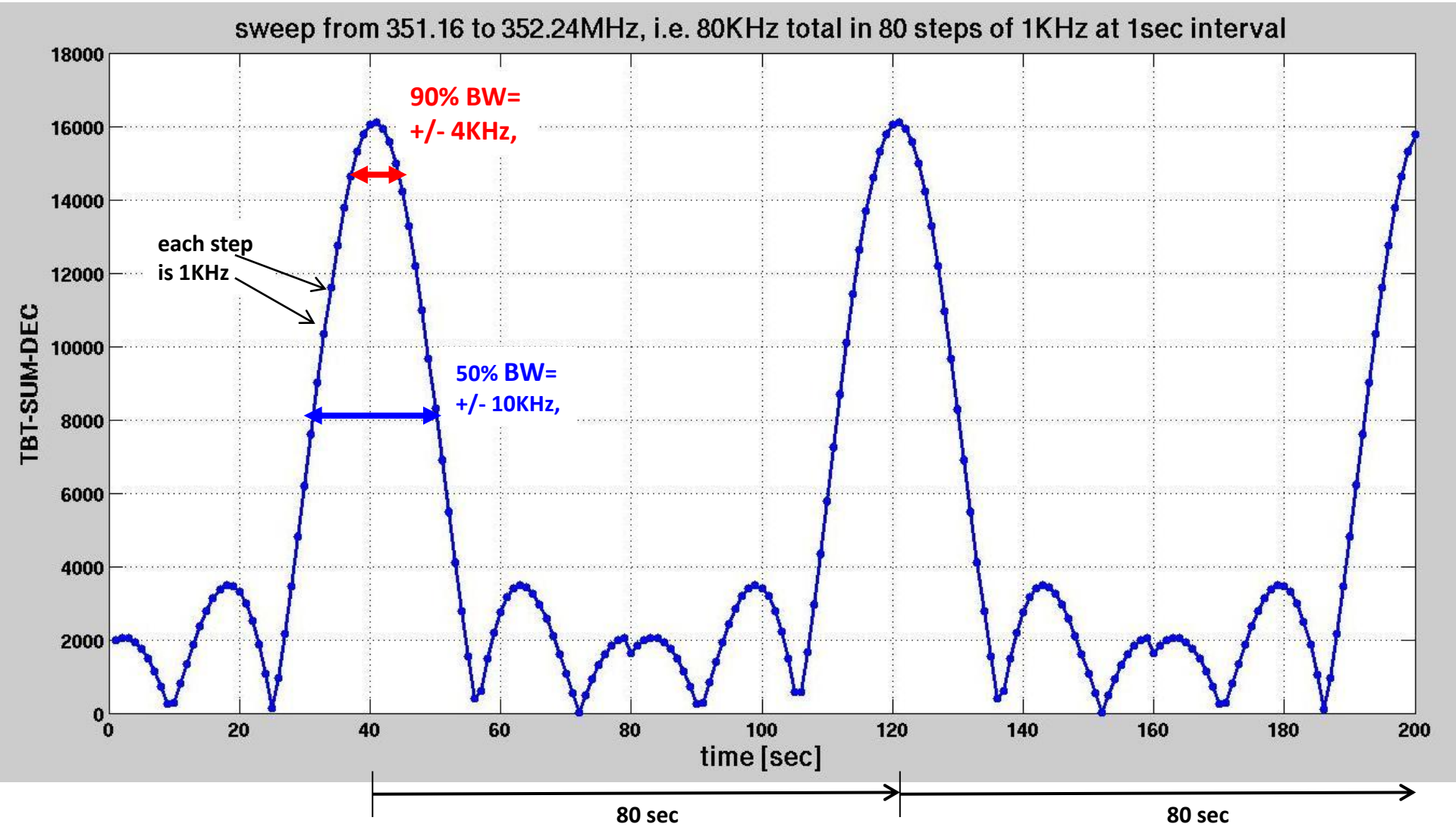
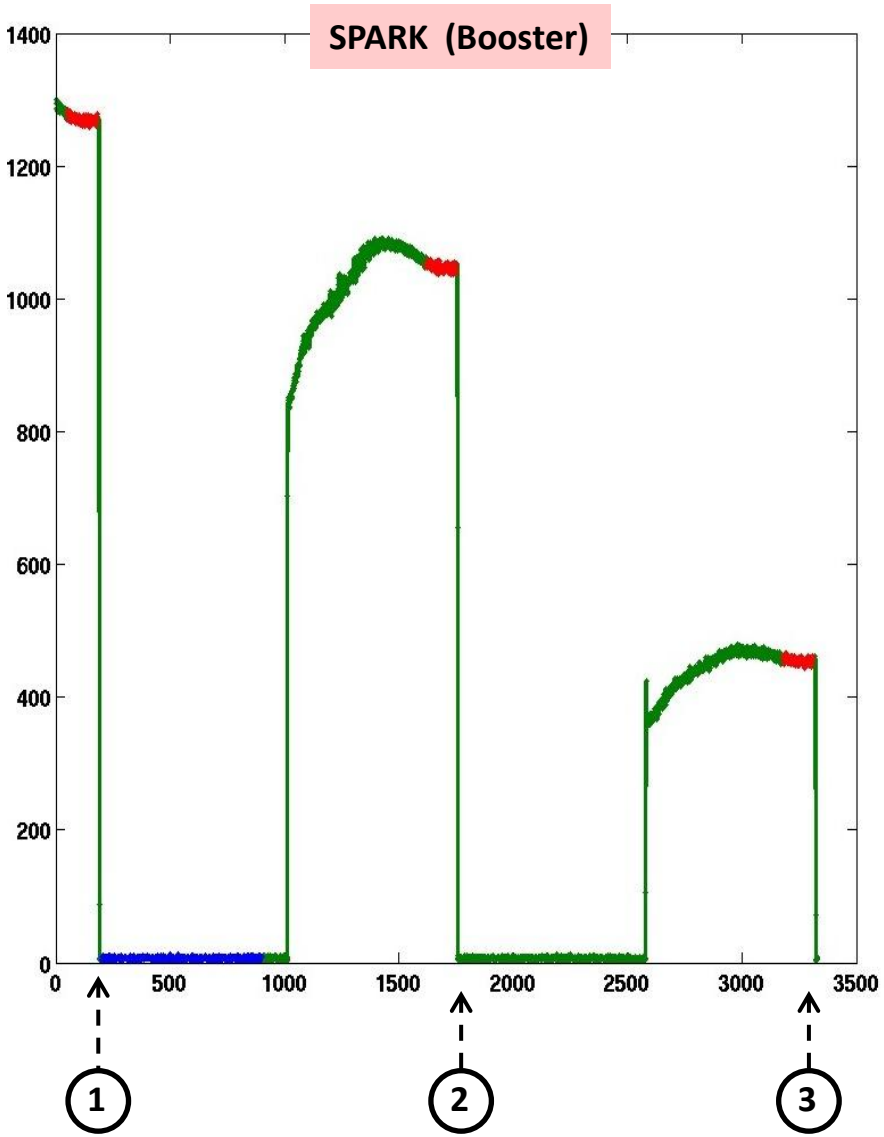
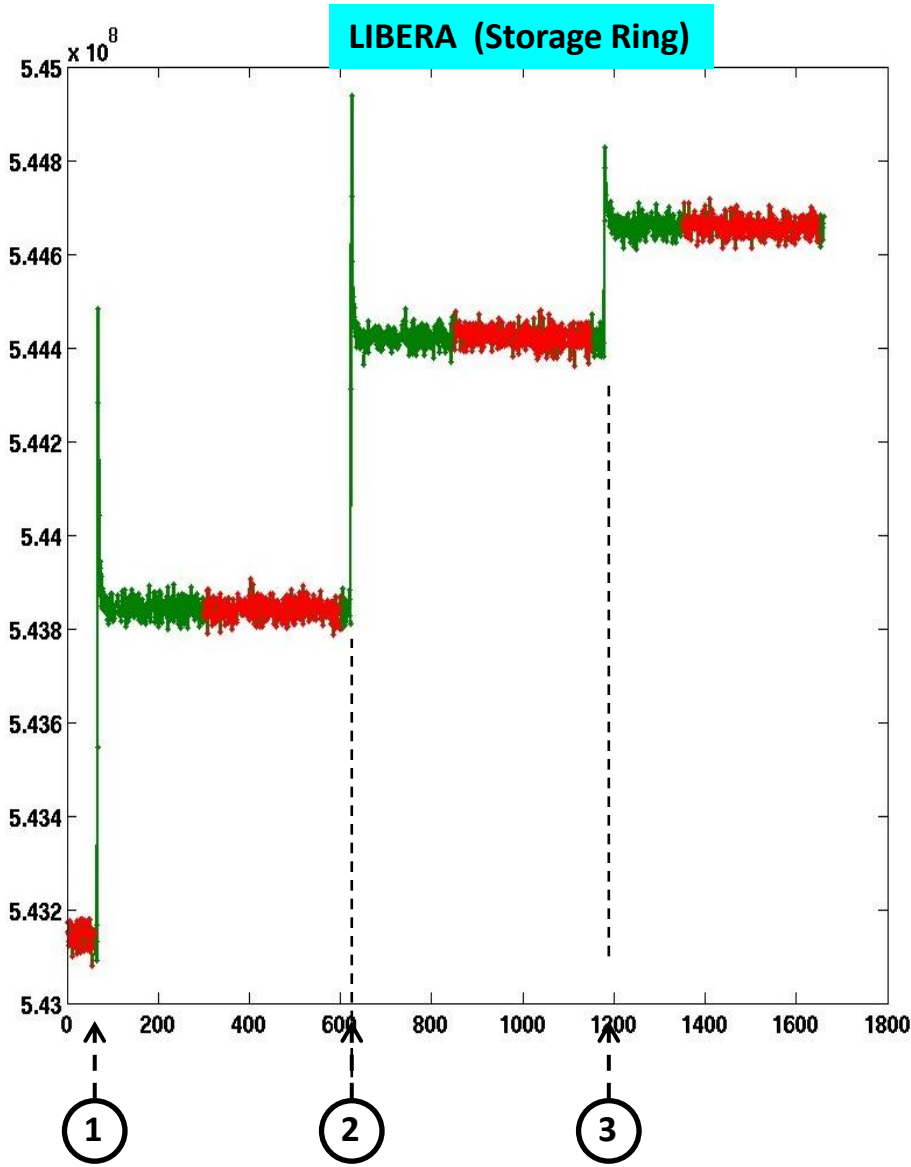


RF input frequency sweep from 351.16 to 352.24MHz,
i.e. 352.2MHz +/- 40KHz,
in 80 steps of 1 KHz, at 1 sec interval
Spark-ADC frequency is fixed at 108.062.532Hz

buffer data of a single BPM station

green dots : raw data
red dots : data used for averaging & measurement
blue dots : data used for offset measurement/compensated





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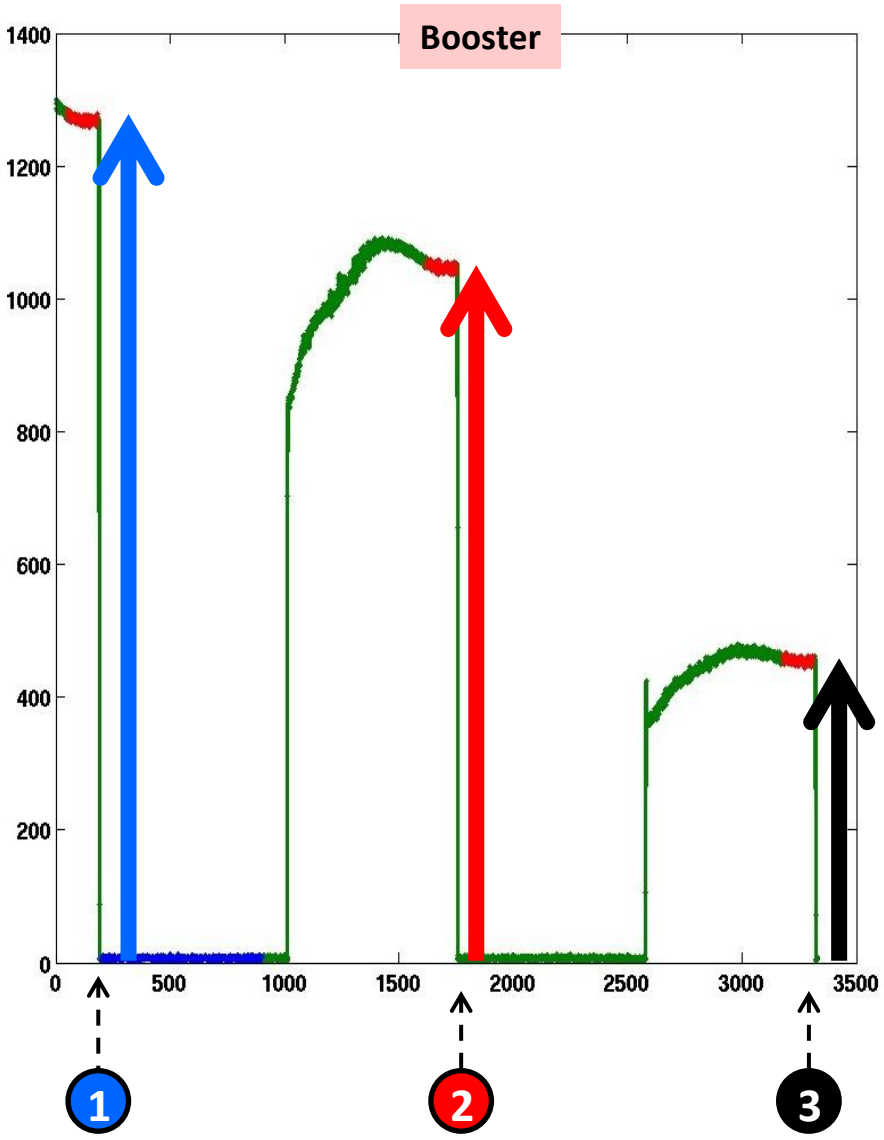
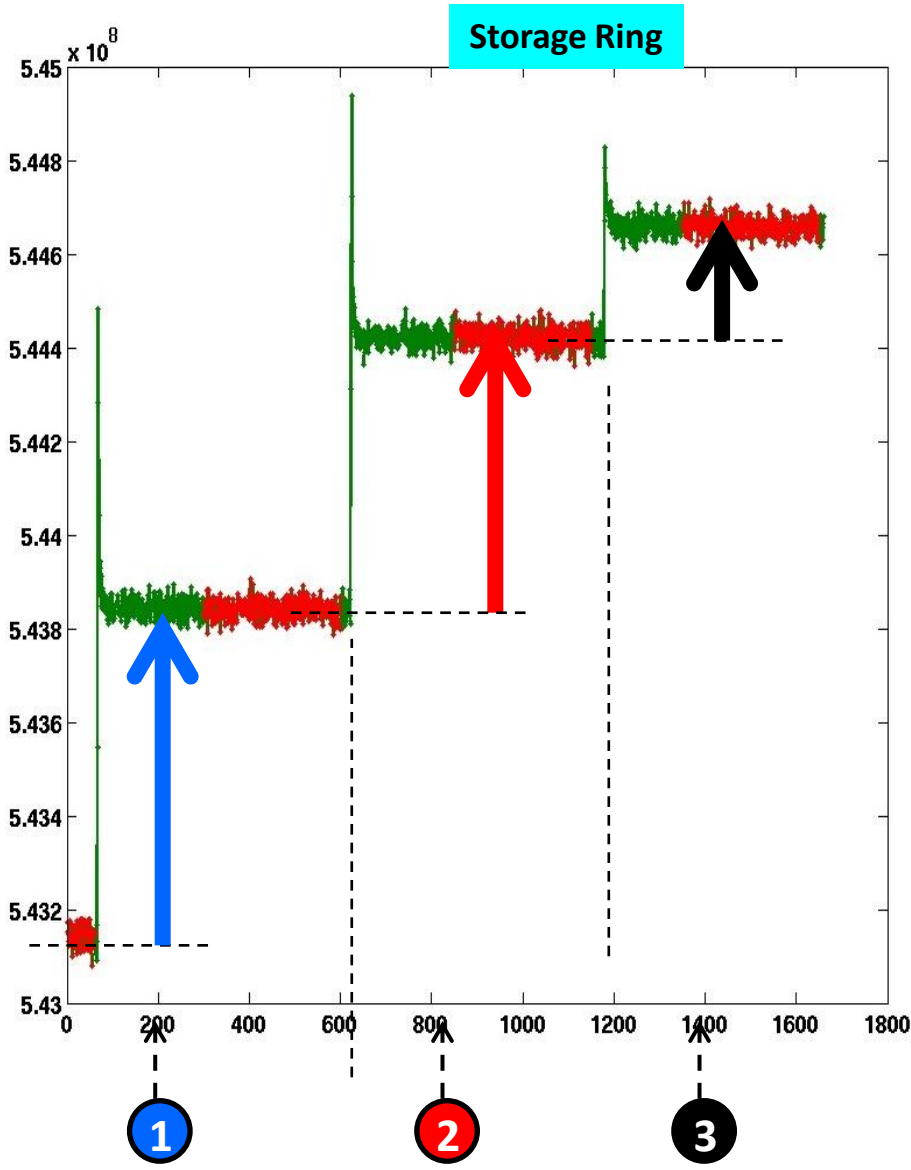
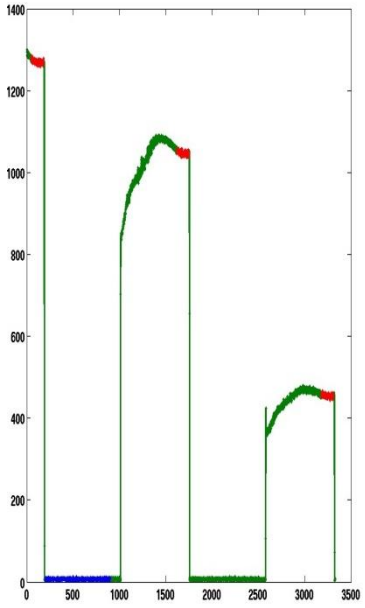
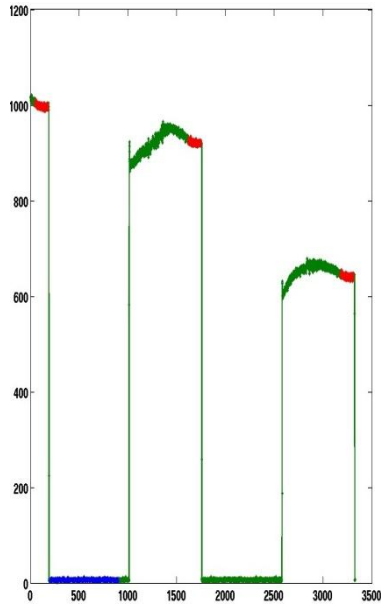
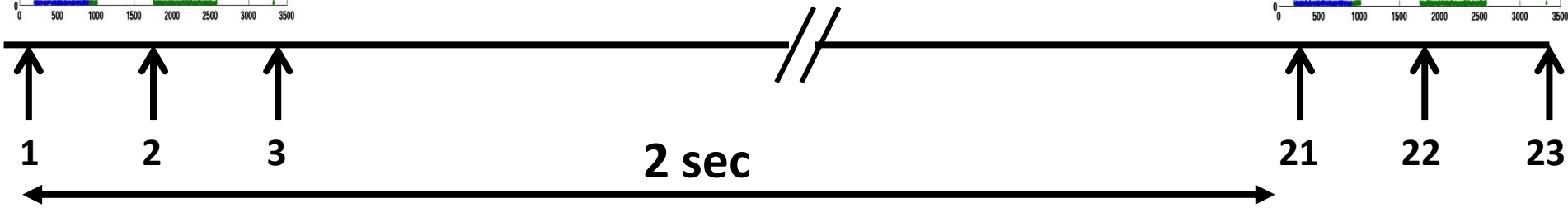




Update rate = 0.5Hz (2sec)
Measurements : 3 per 20 shots



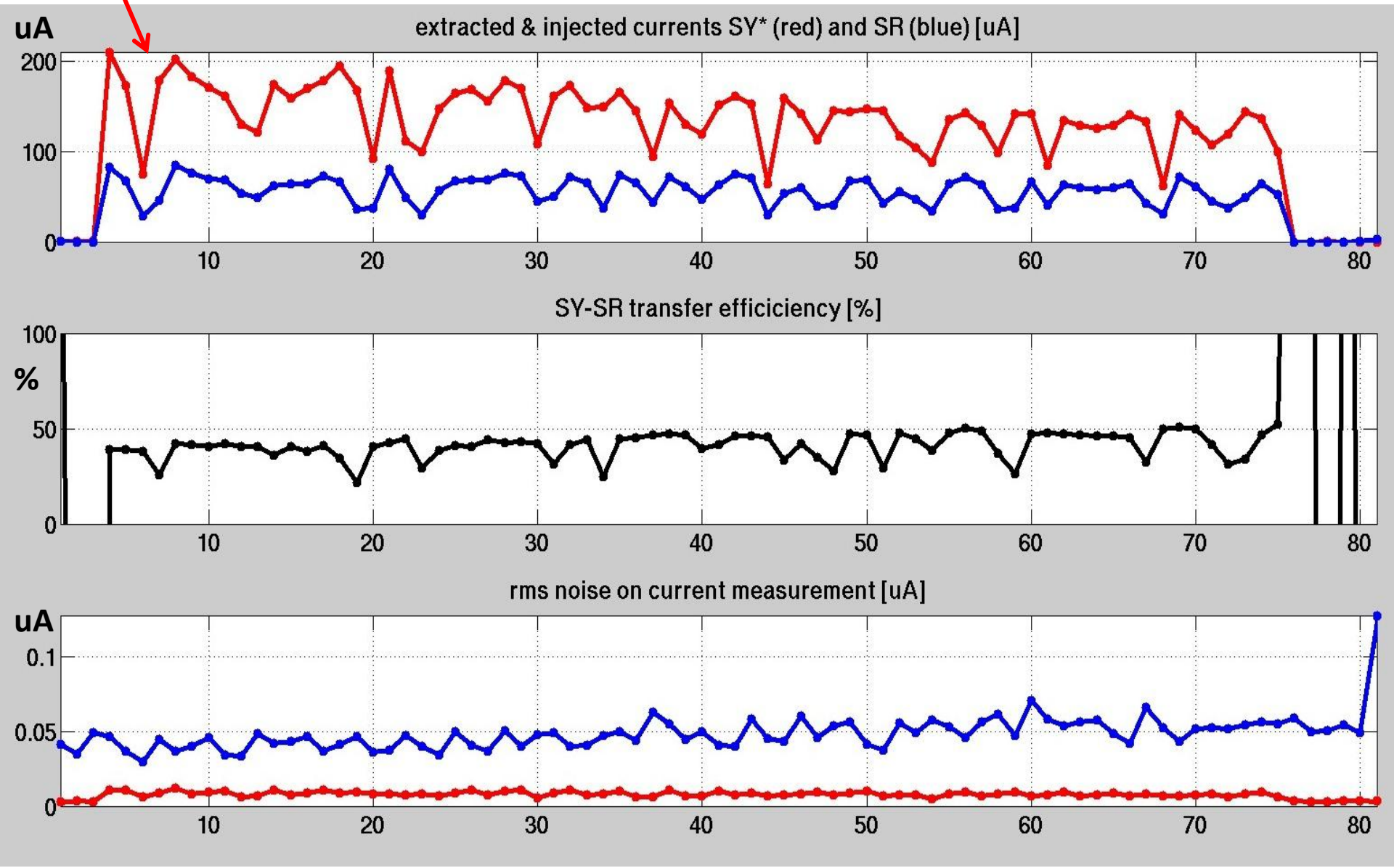




The transfer of all that data via Tango
75 x 3330 (Sparks) and 224 x 1660 (Liberas)
can not be handled at a few Hz → loss of synchro
0.5Hz (2sec) looks feasible so far
perhaps improvements possible . . .

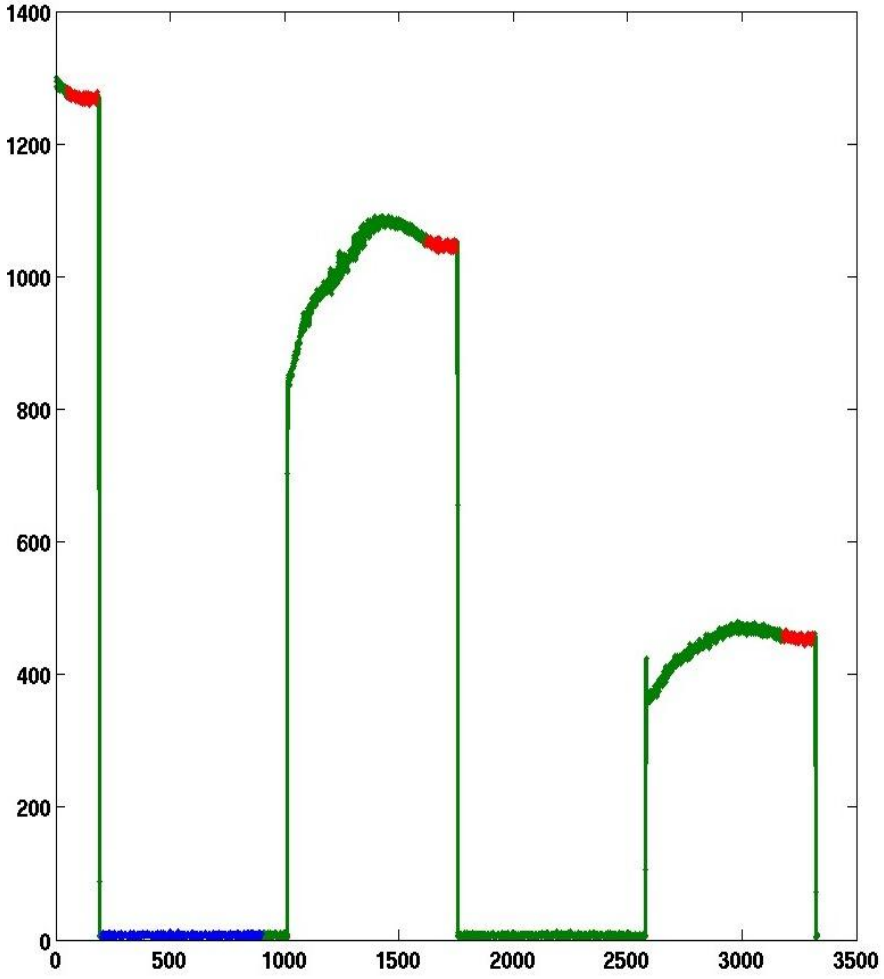
Booster* current

typical result during USM refill with 5bu SY & 16bu SR



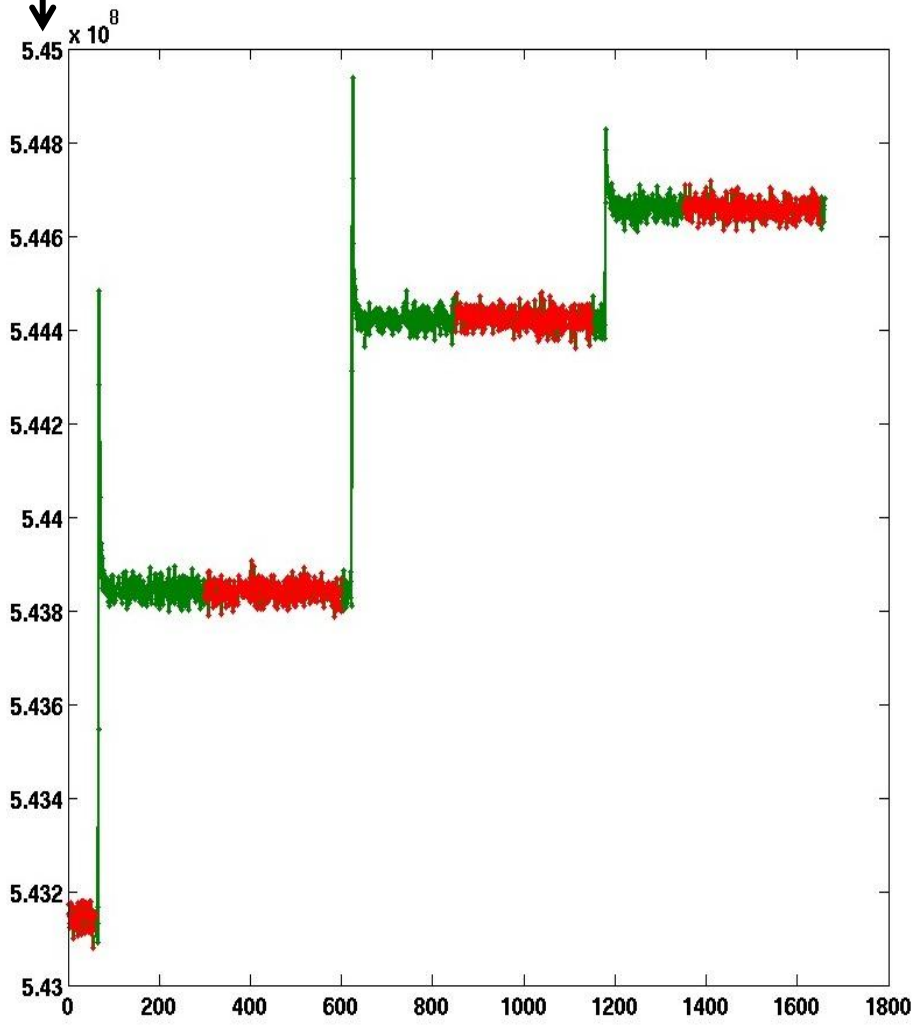
Calibration of the Sum signals [a.u.] to real current values [mA]

A.U.



use the Booster Current Monitor

A.U.



use the SR Current Monitor

Calibration of the Sum signals [a.u.] to real current values [mA]

for the SR is very easy :

- current is very stable,
- no need for a very strict synchronization
- 3 PCTs are available, low noise, good linearity

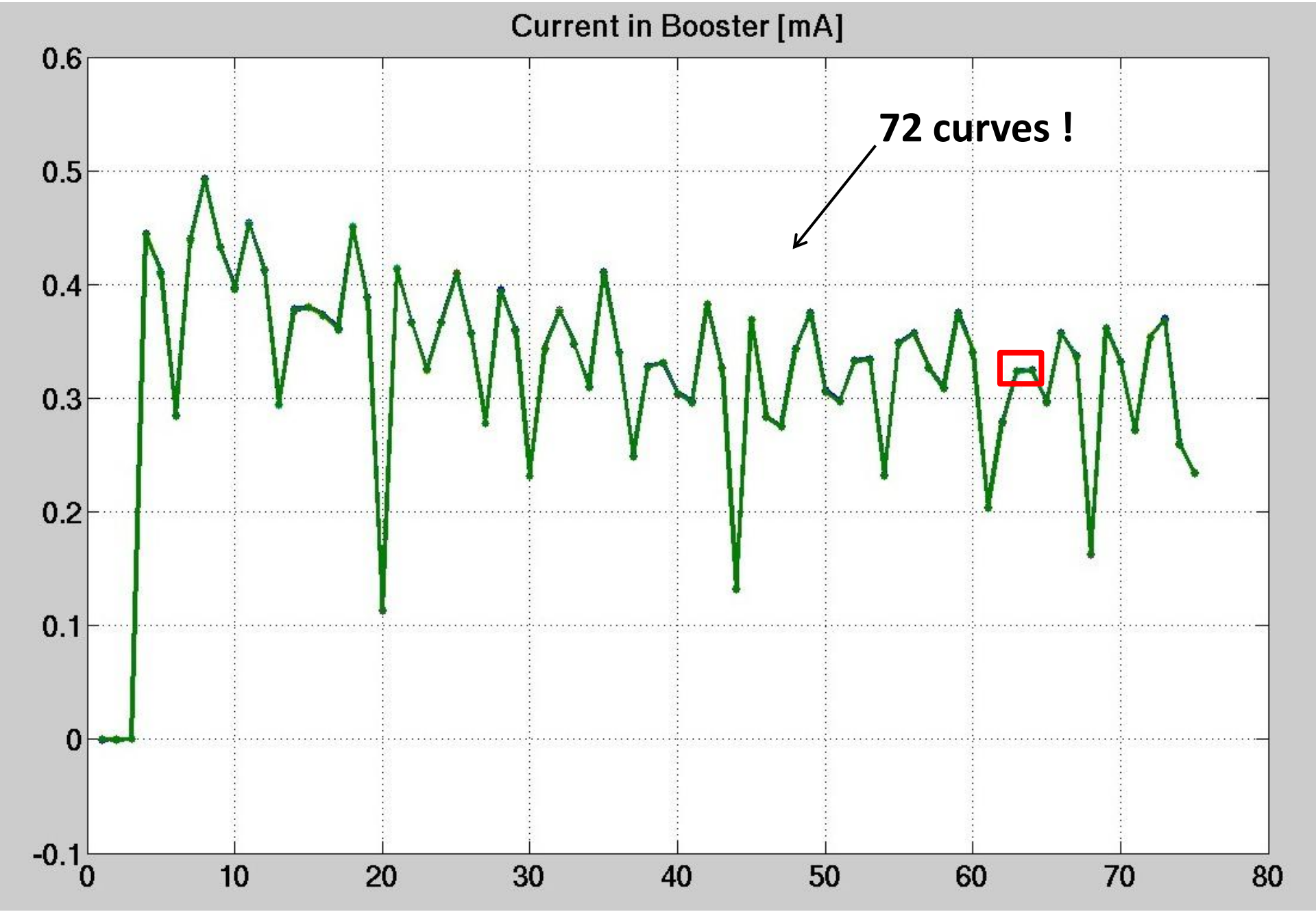
for the Booster it is more tricky :

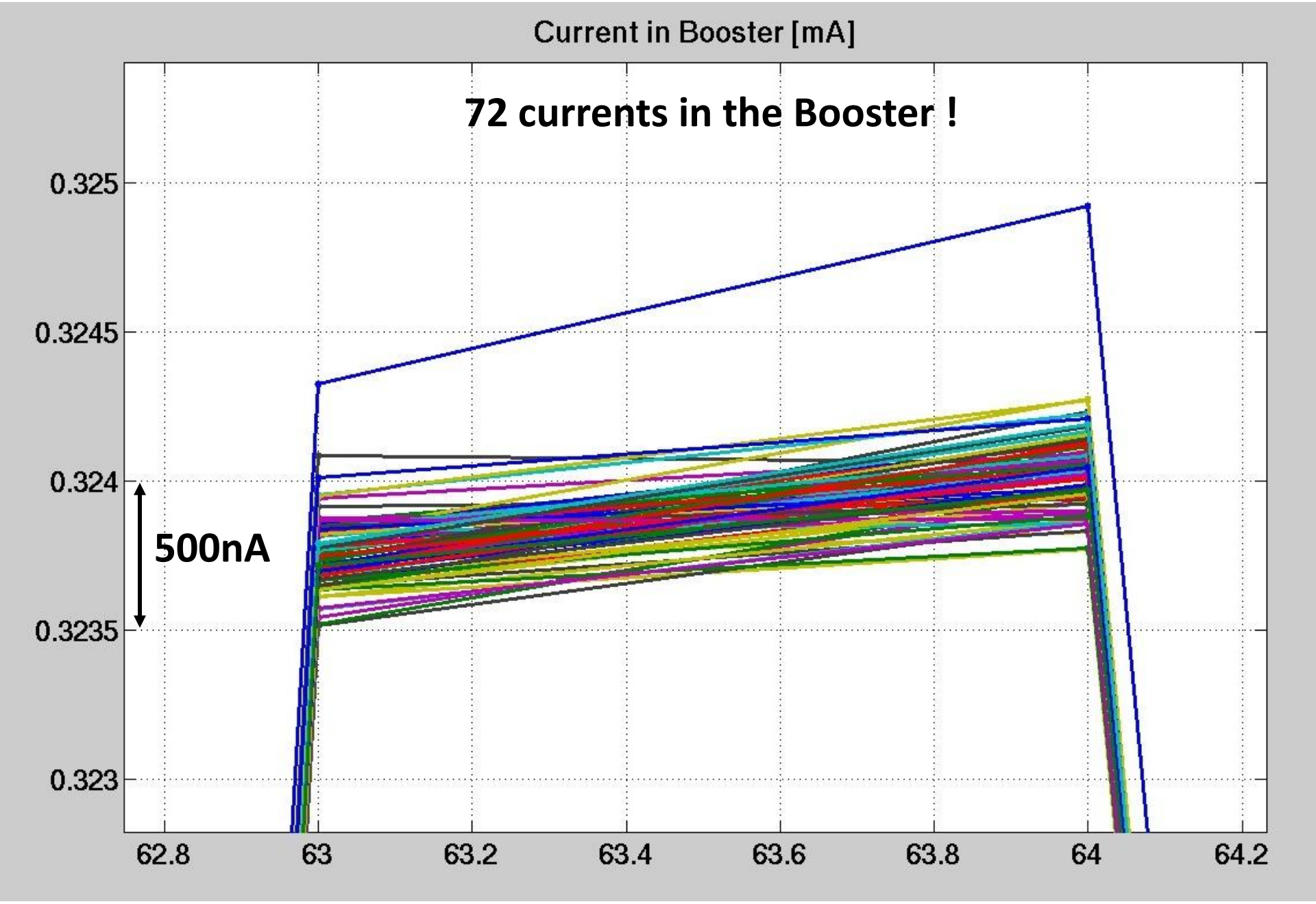
- the real SY current fluctuates a lot (from shot-to-shot)
- the SY-current monitor output is (so far) not synchronisable with the BPMs (0.5Hz trigger)
- the SY-current monitor has limited precision/resolution

empiric solution : measurement sequence over many, many shots,

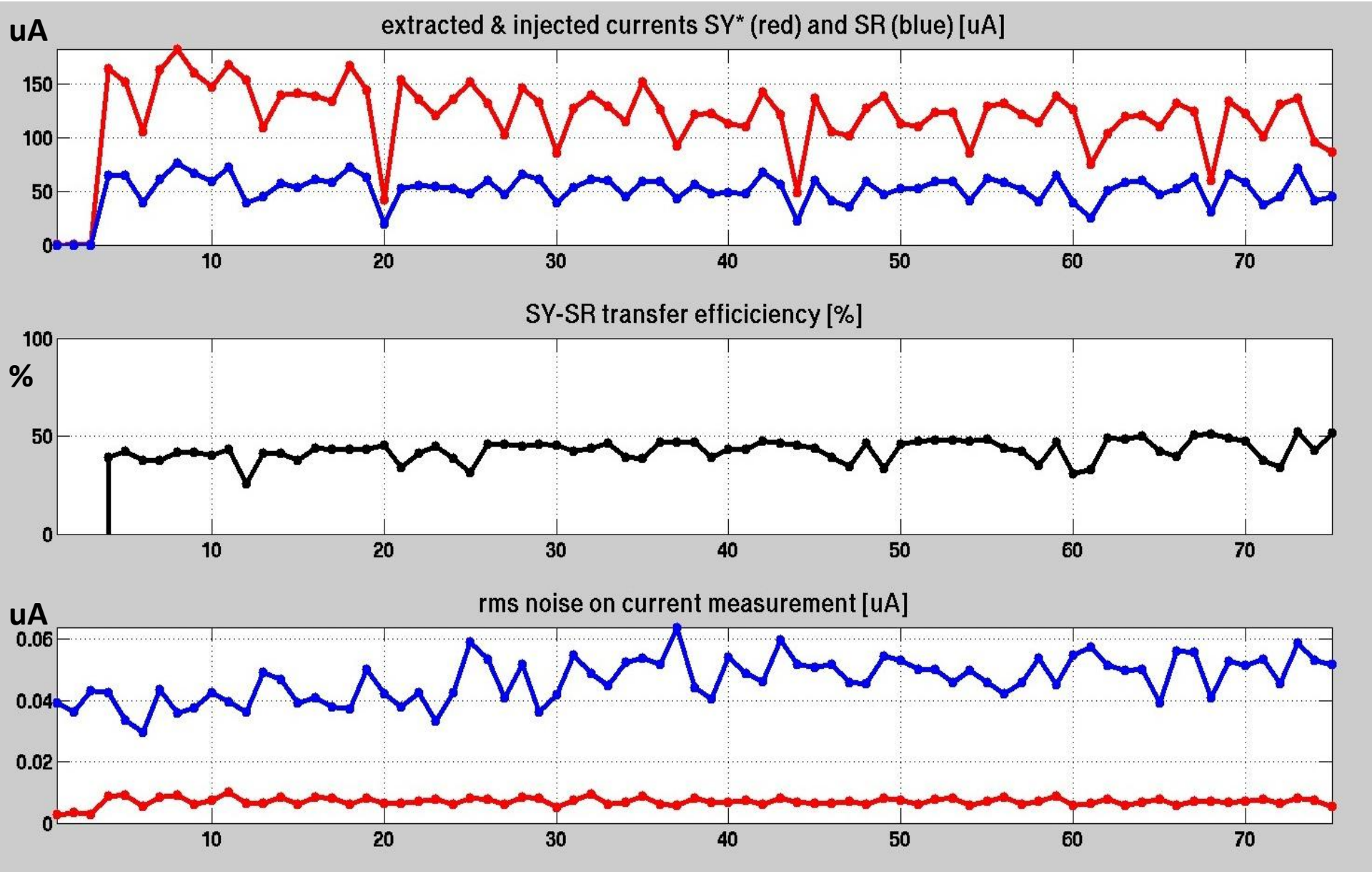
take the average of all the SY-current readings
take the average of all the values of the SY-BPMs

} division : 440 nA / a.u


Current in Booster [mA]
72 curves !
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
10
20
30
40
50
60
70
80


Current in Booster [mA]
72 currents in the Booster !
0.325
0.3245
0.324
0.3235
0.323
500nA
62.8
63
63.2
63.4
63.6
63.8
64
64.2

another result during USM refill with 5bu SY & 16bu SR



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Next steps :

- tests with different filling modes
- tests with very small currents
- "life" matlab routine with graphics & figures (for operator)
- real application (ACU group)
- optimizing speed and repetition rate (?)