first measurements with Libera Spark

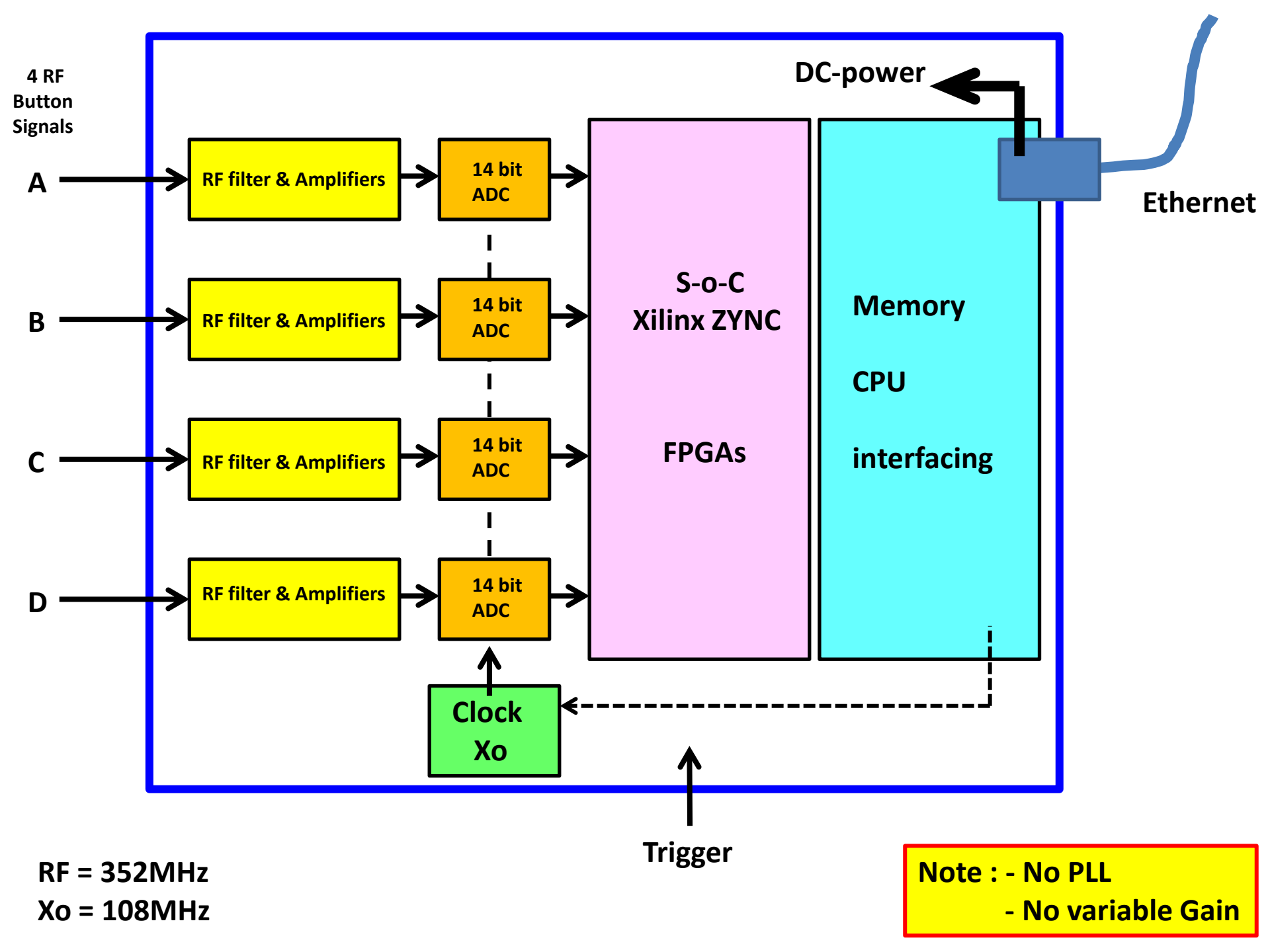
collaboration between ESRF and I-Tech in development of Libera Spark

Motivation : replacement of the 25years old ESRF's Booster BPM system (electronics)

Goals & Aims : modern system with maximum sensitivity & lowest noise capable of Turn-by-Turn measurements

Other considerations :
- simplicity
- low costs
- self-contained system

The Spark, product definition :
- 4 channel digitizer for weak RF signals
- adequate signal processing for data-rate reduction
- efficient interface for control & read-out via Ethernet
- suitable chassis & housing, with Power-over-Ethernet


4 RF Button Signals
A
B
C
D
RF filter & Amplifiers
RF filter & Amplifiers
RF filter & Amplifiers
RF filter & Amplifiers
14 bit ADC
14 bit ADC
14 bit ADC
14 bit ADC
S-o-C Xilinx ZYNC
FPGAs
Memory
CPU
interfacing
DC-power
Ethernet
Clock Xo
Trigger
RF = 352MHz
Xo = 108MHz
Note : - No PLL
- No variable Gain

ESRF-Booster

Circumference=300m

Orbit time = 1us

Harmonic No. 352

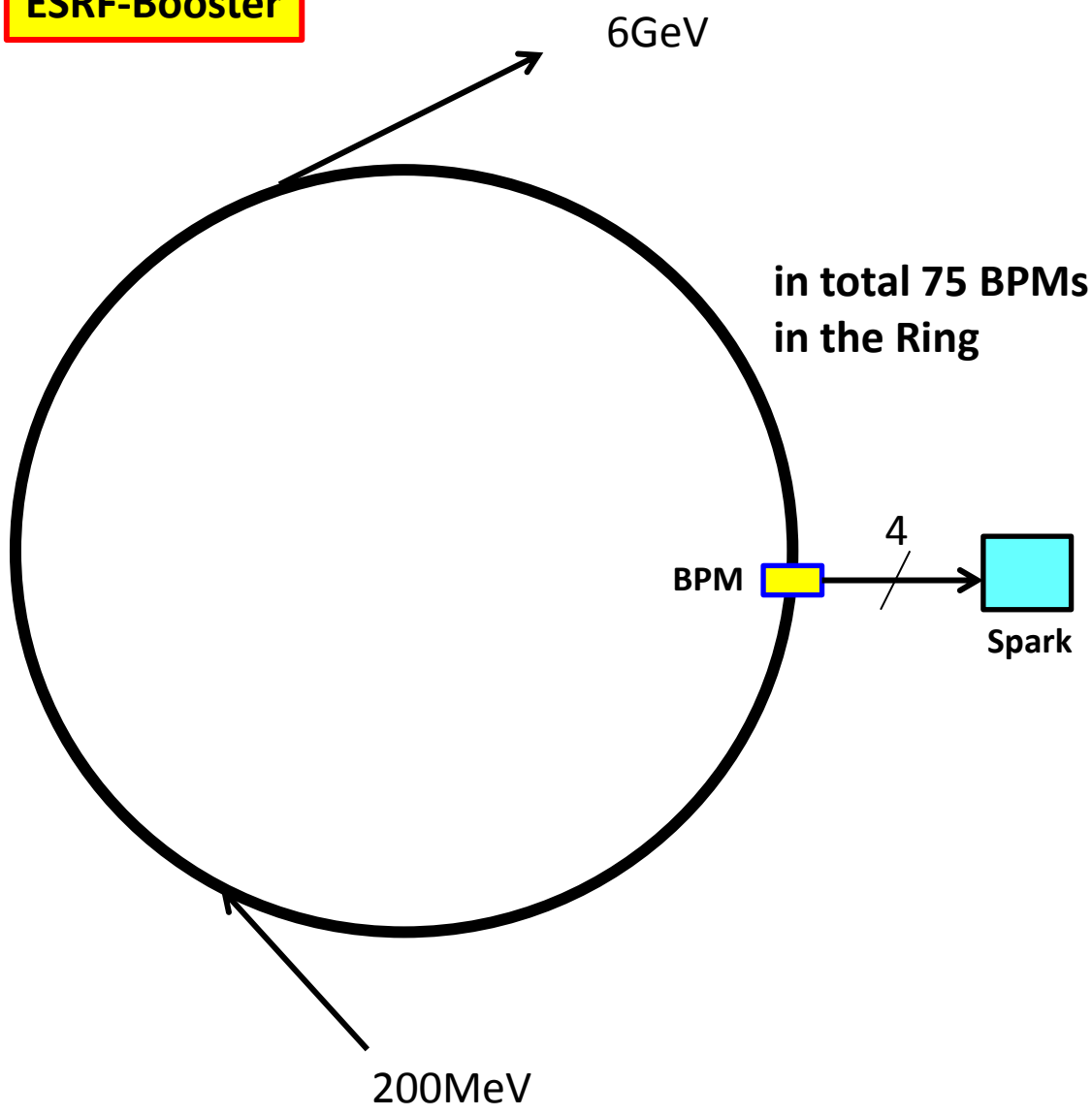
RF-freq. =352.202 MHz

Acceleration cycle = 50ms

after Injection, the beam makes about 50 000 Turns

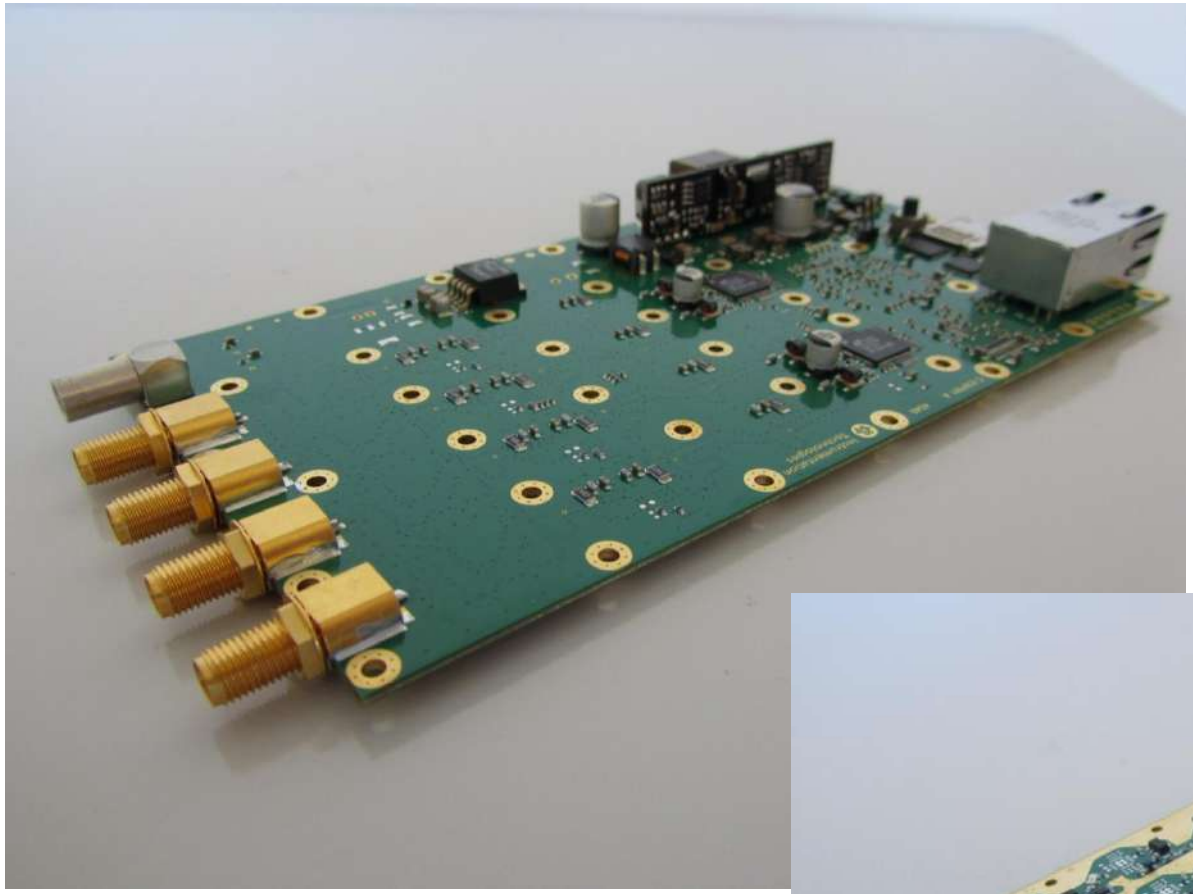
BPM requirement : measure at <u>Turn-by-Turn rate</u>

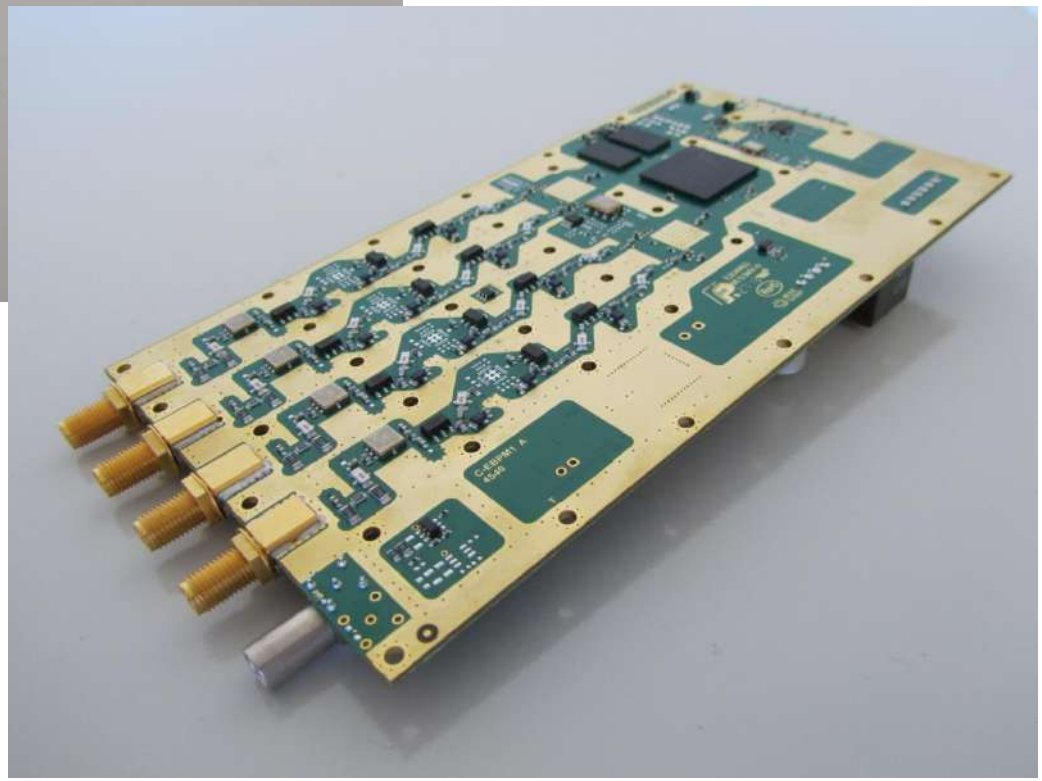
The Spark takes 108 samples/Turn i.e. 108MHz

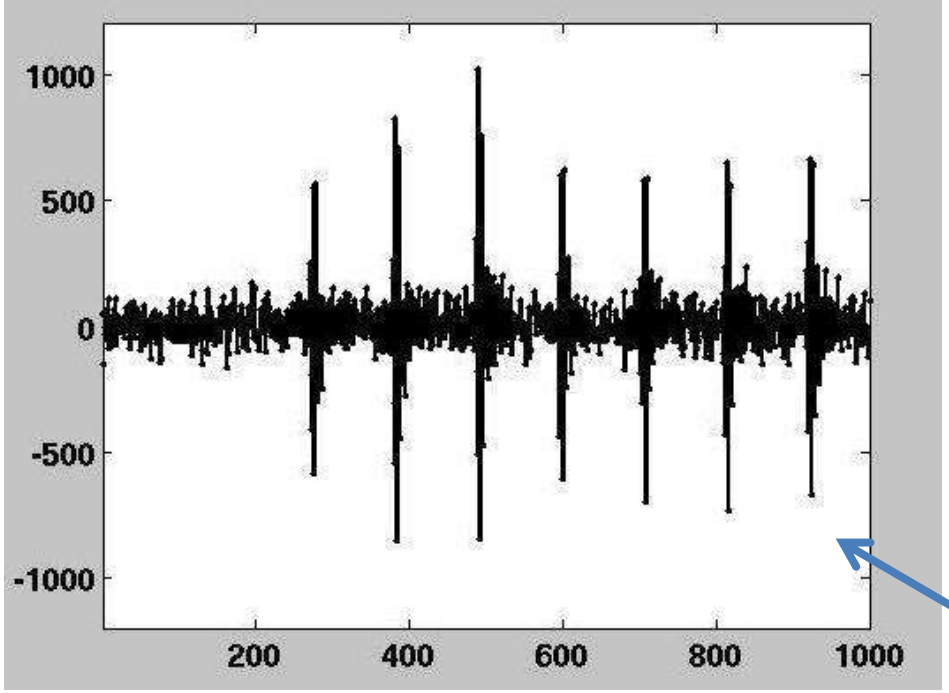


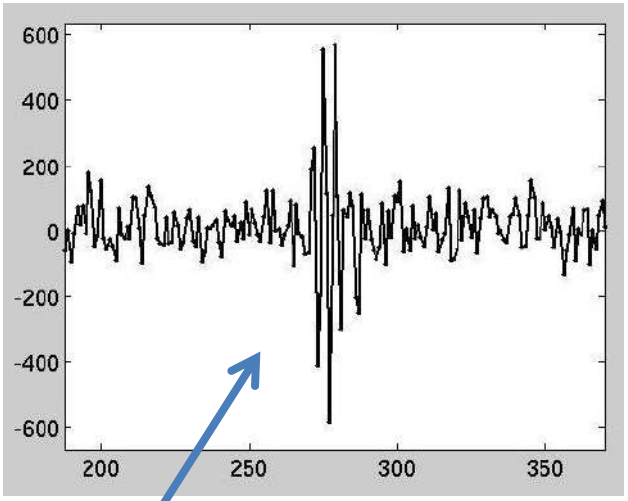
Libera-Spark

Libera-Spark

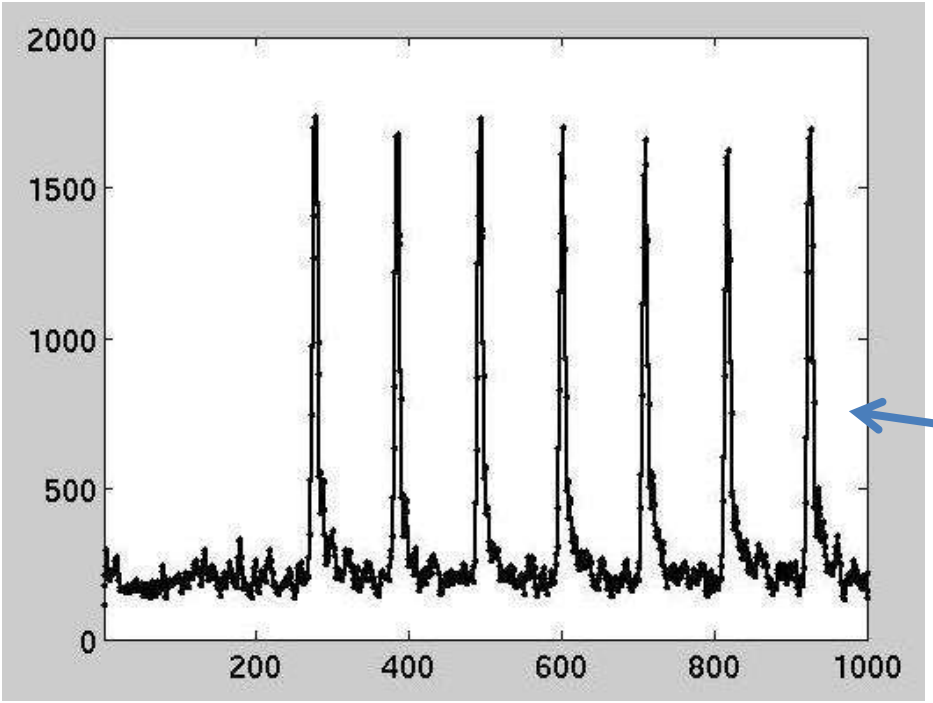








Raw ADC signals with only a single bunch in the Ring



Summed & Filtered ADC signals with only a single bunch in the Ring

ESRF-Booster

Circumference=300m

Orbit time = 1us

Harmonic No. 352

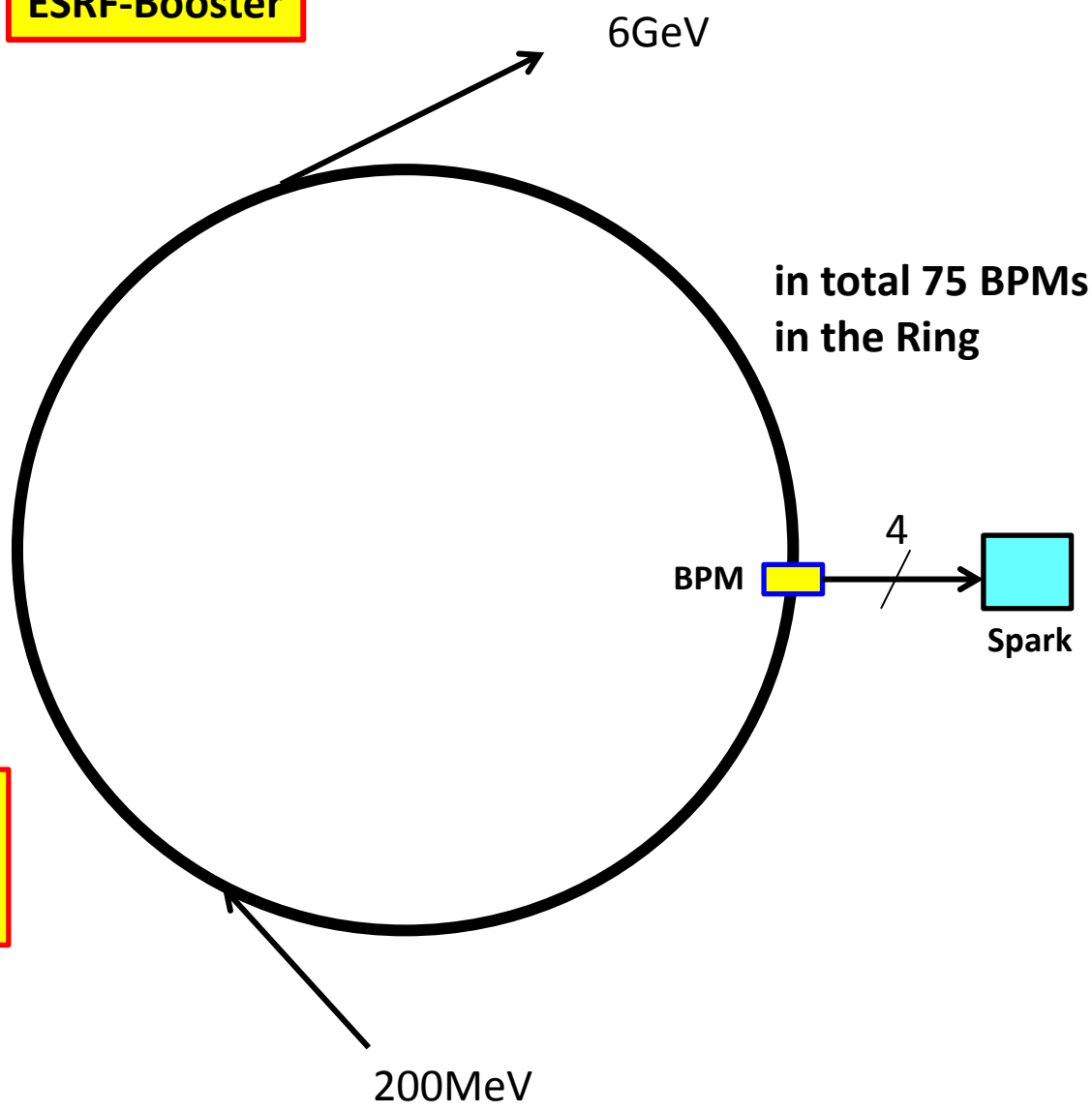
RF-freq. =352.202 MHz

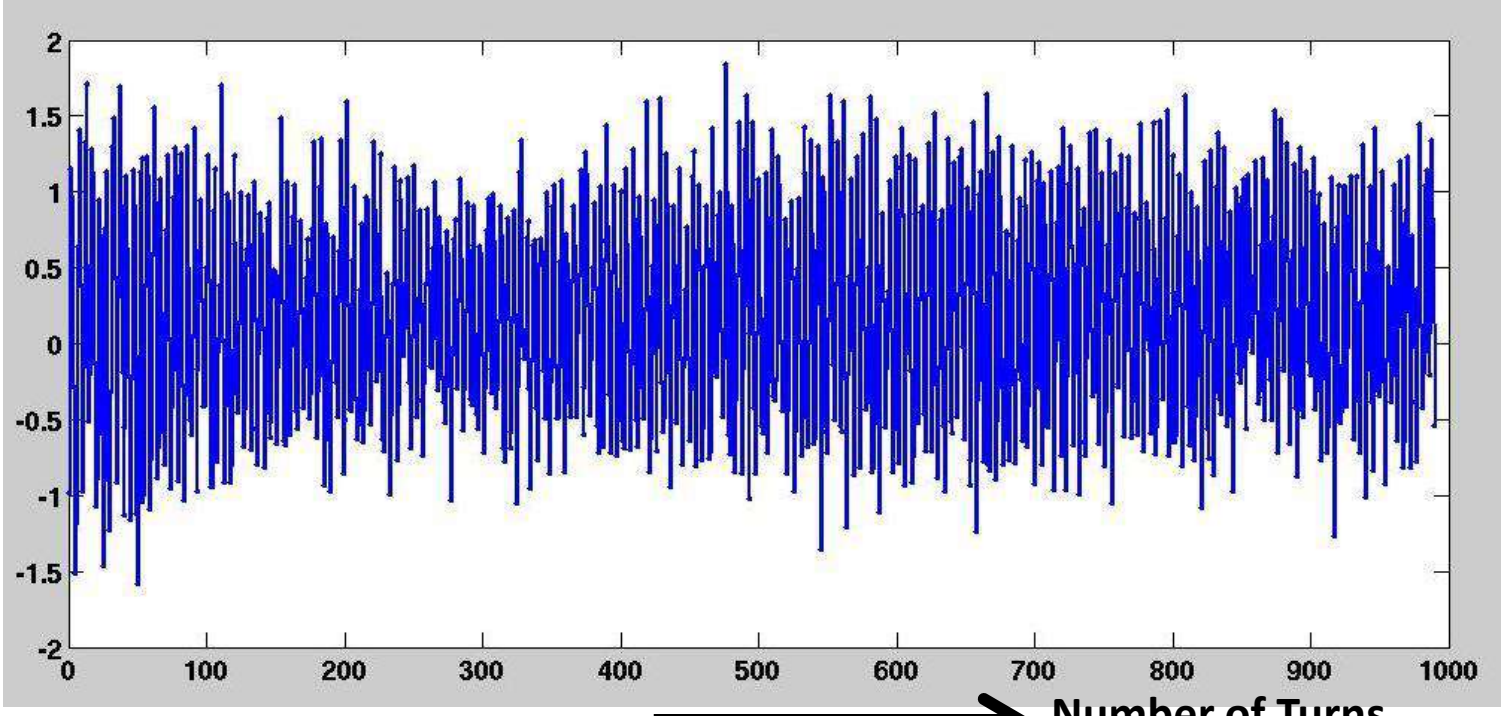
Acceleration cycle = 50ms

after Injection, the beam makes about 50 000 Turns

BPM requirement : measure at <u>Turn-by-Turn rate</u>

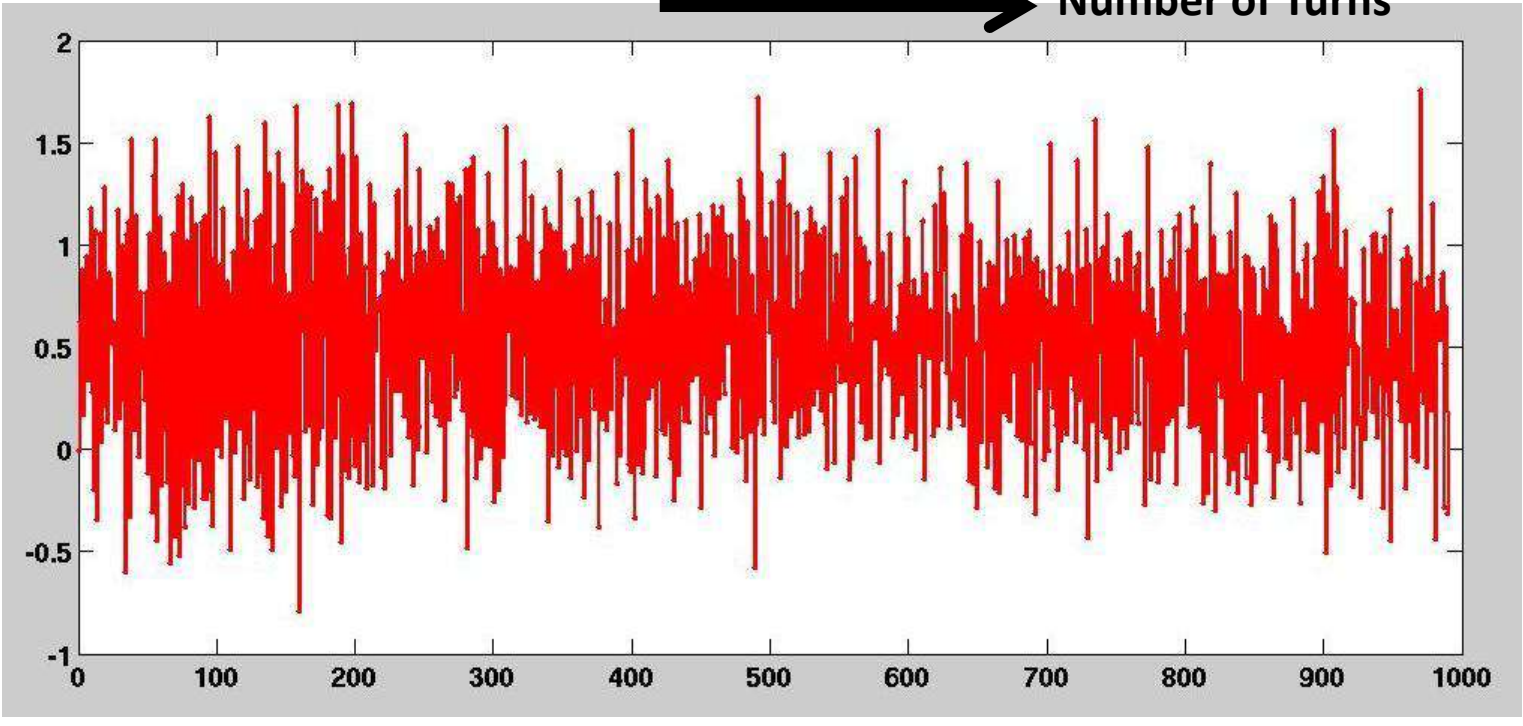
The Spark takes 108 samples/Turn i.e. 108MHz



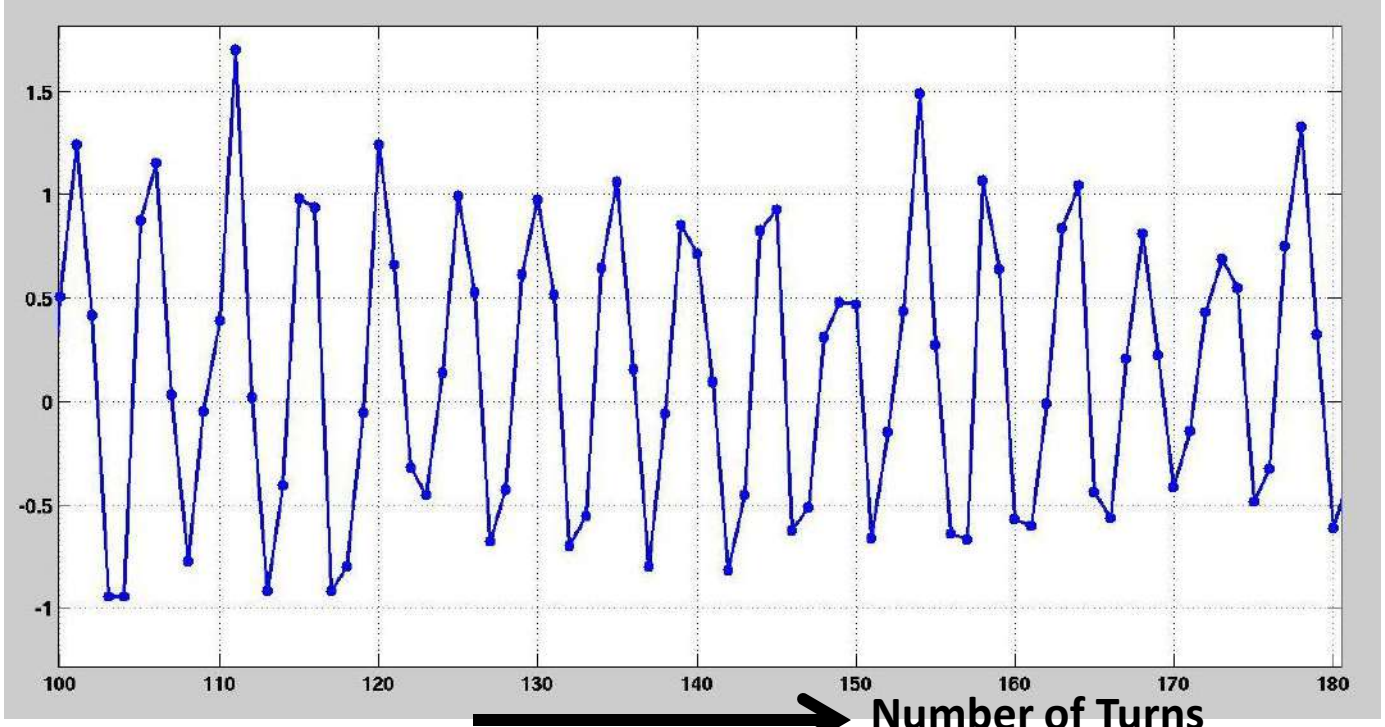


Hor. Position

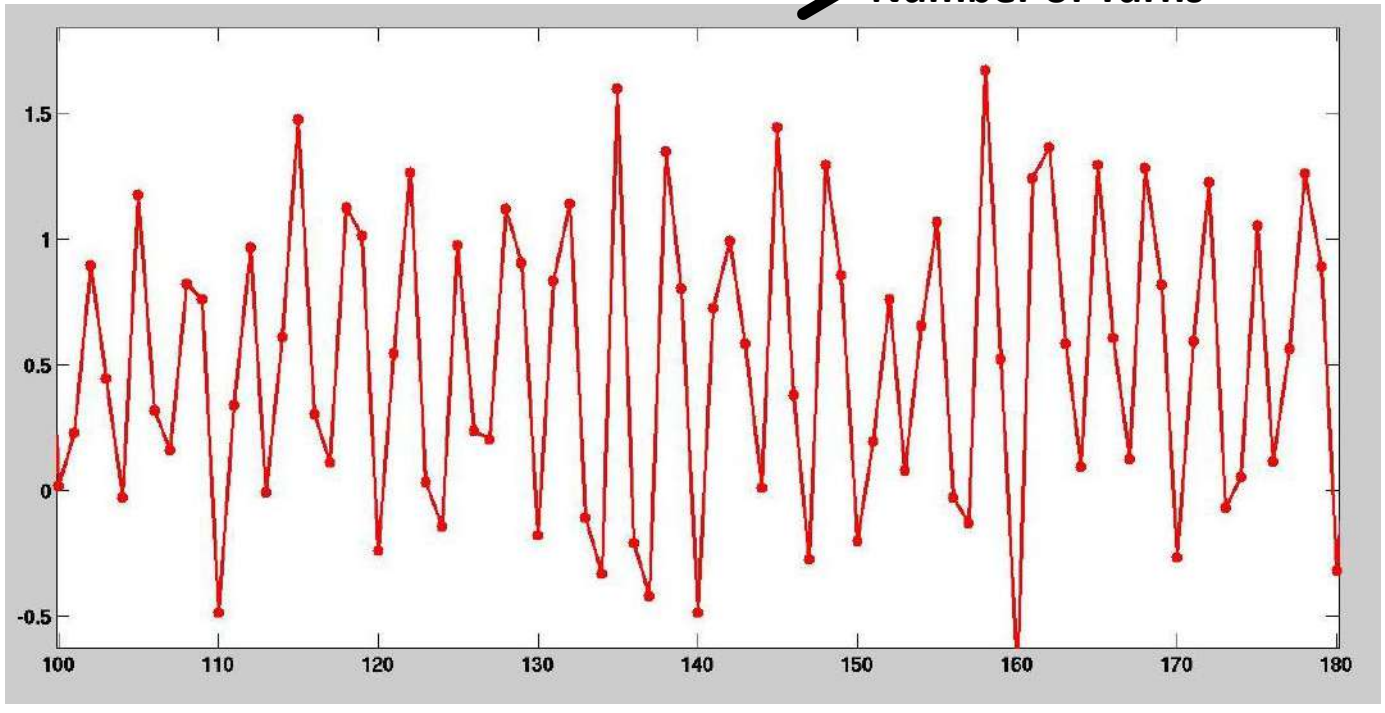
Number of Turns



Vert. Position



Number of Turns



Hor. Position

17 oscillations

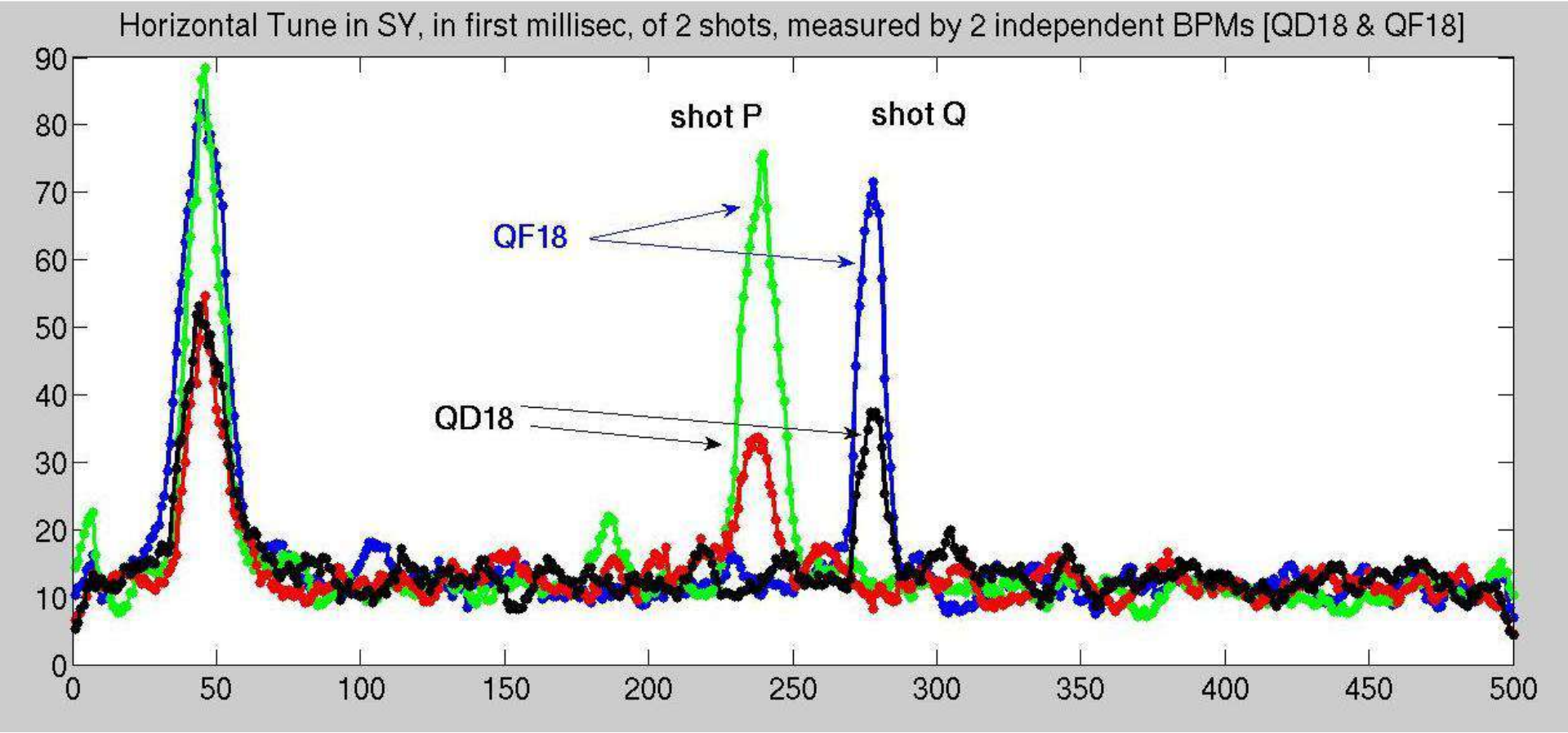
Time-Domain Processing on the ADCs

Vert. Position

24 oscillations

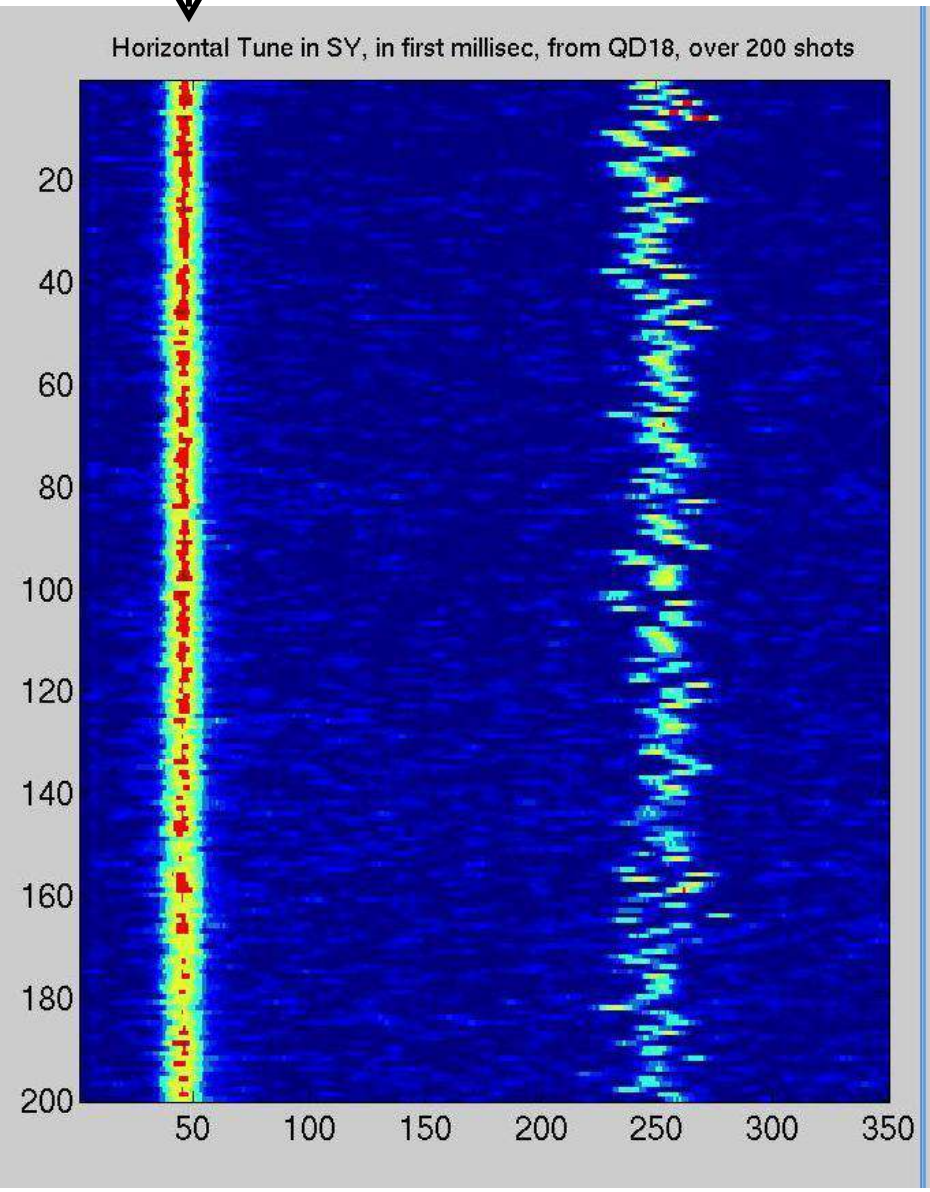
Hor. Beam oscillation
at 46KHz

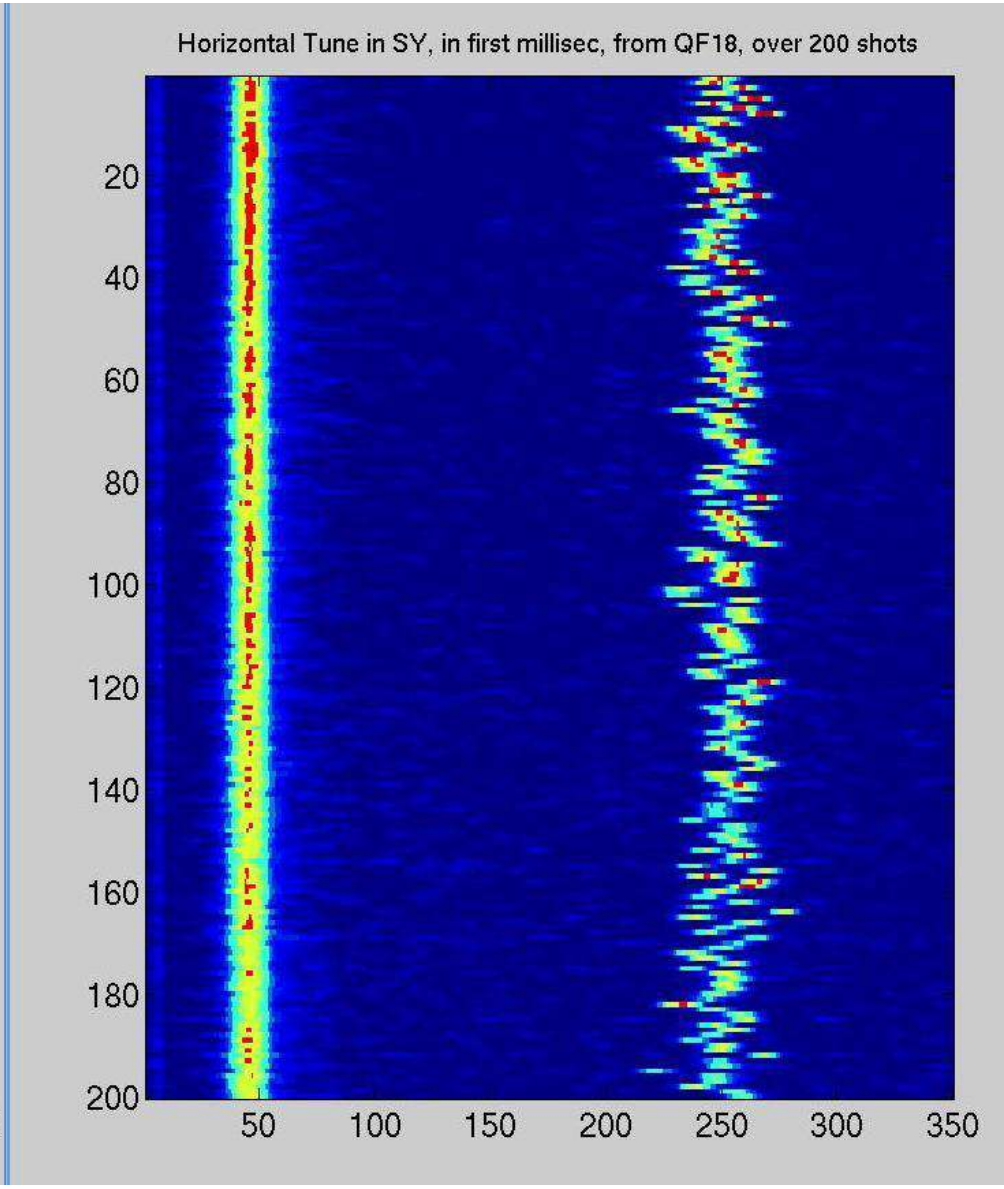
2 shots of Hor. Booster Tune



Hor. Beam oscillation at 46KHz

200 shots of Hor. Booster Tune, showing strong fluctuations

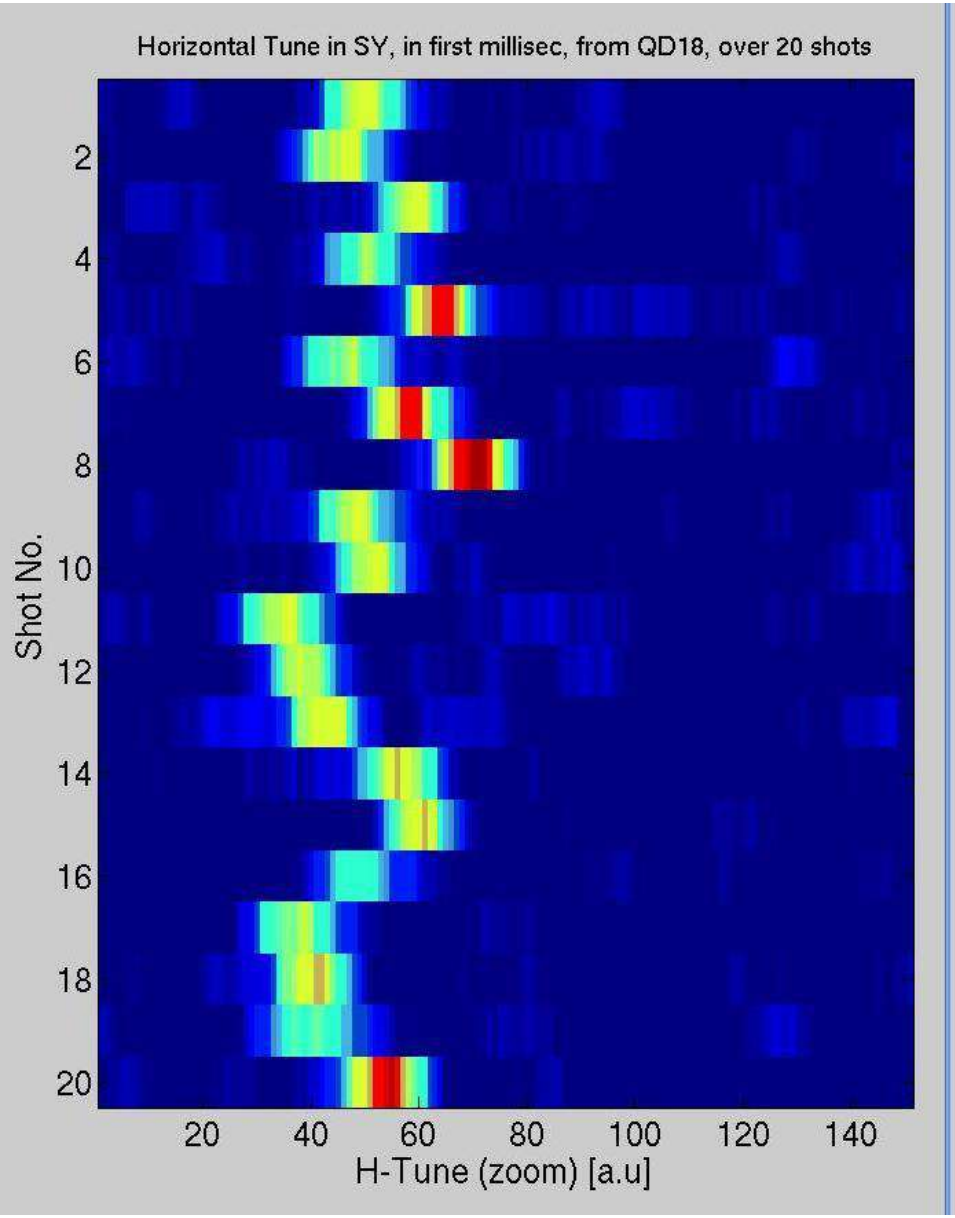


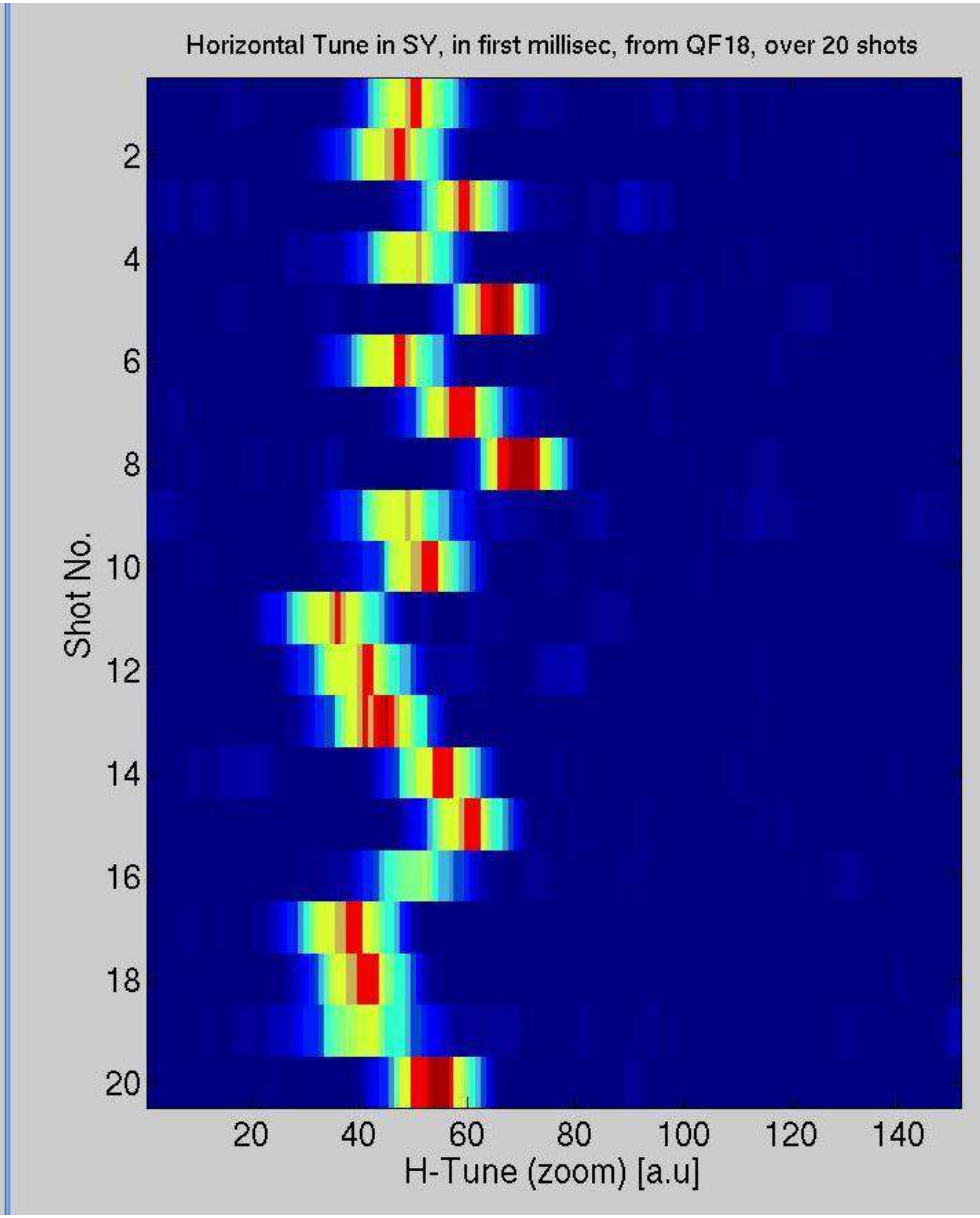


Left picture : from BPM QD18

Right picture : from BPM QF18

20 shots of Hor. Booster Tune, showing strong fluctuations

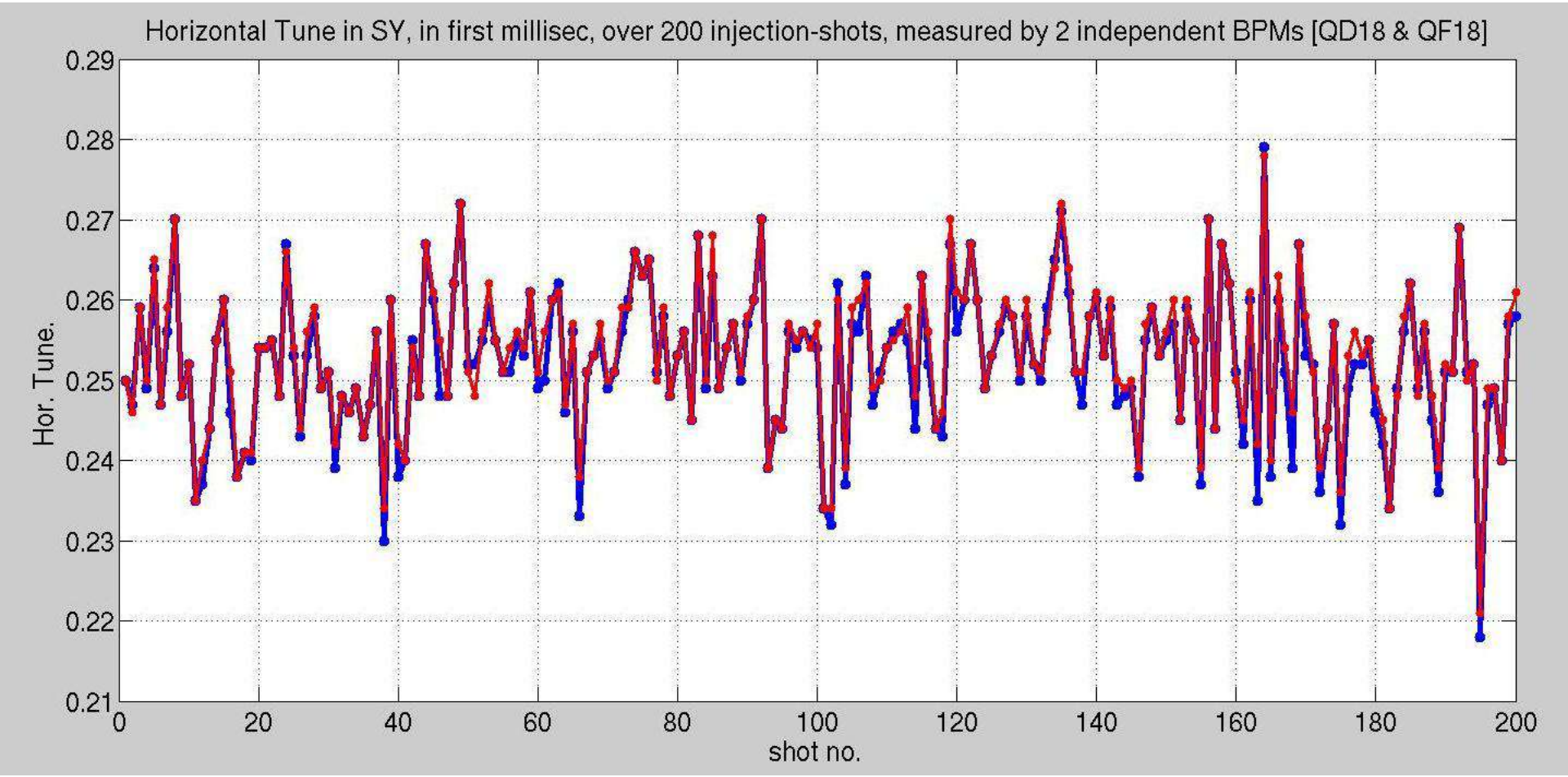




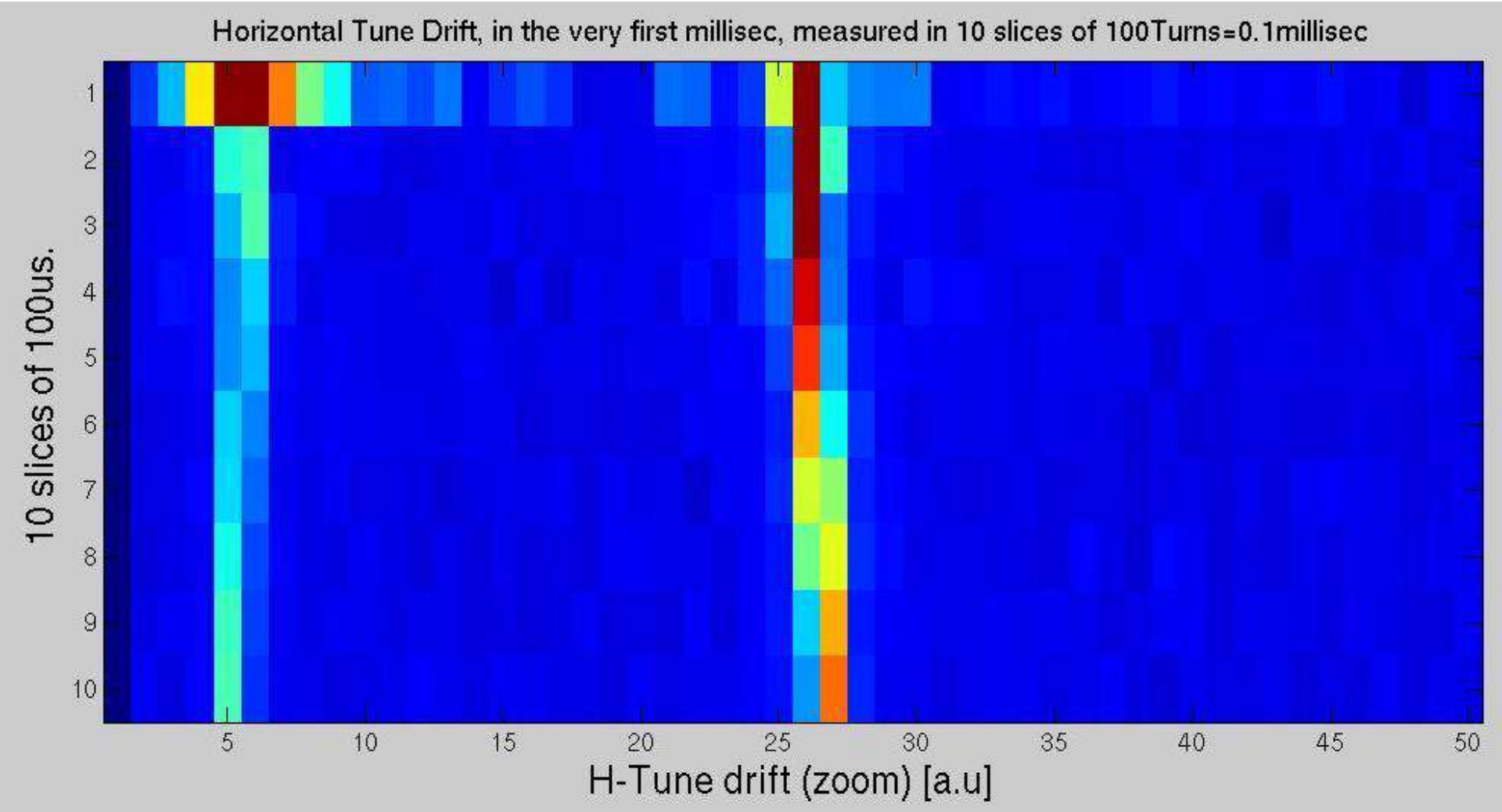
Left picture : from BPM QD18

Right picture : from BPM QF18

200 shots of Hor. Booster Tune, Red & Blue curves from 2 independent BPMs



Horizontal Tune drift in the very first millisec after injection



first measurements with Libera Spark

conclusion :

maximum sensitivity & lowest noise

clean & pure Turn-by-Turn measurements

} Clever & Optimized Treatment of the signals is required

Other considerations :
- simplicity
- low costs
- self-contained system

OK

The Spark :
- 4 channel digitizer for weak RF signals
- adequate signal processing for data-rate reduction
- efficient interface for control & read-out via Ethernet
- suitable chassis & housing, with Power-over-Ethernet

OK