test results of the Spark-ERXR for full suitability for the extra BPMs in the EBS

Recall :

today : 224 BPMs = Liberas (>7 years old)

EBS :	320 BPMs	192 with Liberas (and 32 extra spares of Liberas)	6/cell
	10/cell	128 with new electronics (Spark-ERXR)	4/cell

Spark-ERXR - is a **good** but not perfect BPM system, but perfection not needed,

- costs about 50% of a Libera
- not contributing to **FOC**



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Spark =

Electronics for ESRF Booster BPMs developed in 2014, 75 installed in 2015, inside Tunnel ... still alive in 2016 ... ! and so are the Red-Pitayas (nearly grilled)







This **Spark** was extremely simple, but perfect for our Booster BPMs

It was further developed at request of the ESRF :

- variable attenuators (but only 31dB range ...)
- PLL + offset-tune
- 32bit processing & nanometer output
- SA output (40Hz)

We now have 12 units mainly used for TL-2 BPMs (see Benoit's talk)

but the purpose was to see if it could be made good enough for a Storage Ring BPM :

 \rightarrow see results in next slides

set-up of comparative measurements of noise, resolution and stability between the Libera and the Spark (-ERXR)



Beam :

- filling patterns

- current

Libera :

- DSC/switching
- offset-tune
- attenuator settings

Spark :

- DDC / TDP
- offset-tune
- attenuator settings

first discovery : **common-mode effect** on Y (Z) but NOT on X and Q

due to common-mode(s) on

- **A & B**
- **C & D**

common-mode effect on Y (Z) but NOT on X and Q



X = A + D - B - C Y = A + B - C - D !! Q = A + C - B - D





X=blue	= OK
Y=red	= bad
Q=green	= OK

time record = 3min (180 sec)

common-mode effects : Solution

Cross **B** & **C** to transfer them :

- A&C - B&D
- Then : common-mode effect now on Q - but NOT on X and Y (Z)



X = A + D - B - C Y = A + B - C - DQ = A + C - B - D !!







Conclusion : Libera ~50% better than Spark in 1Hz bandwidth



Libera is 2 − 3 times better then Spark in **long term** stability (drift) → the benefits of RF-multiplexing/calibration

500 horizontal 400 nanometer rms in 1Hz bw 300 200 100 0 -100 vertical -200 100 200 300 400 500 600 O

ESRF beam spectrum, average of all 224 BPMs, data from DD_64 buffers

ESRF beam spectrum, average of all 224 BPMs, data from DD_64 buffers



all data obtained with high beam current, quasi uniform filling (CW) and both devices in optimum conditions (offset tune, etc.)

Spark-ERXR-V1 :		Spark-ERXR-platform-C :
SCPI interface		MCI interface + Tango
SAW bandpass filter aaa	\longrightarrow	SAW bandpass filter bbb
RF-amplifiers ccc	\longrightarrow	RF-amplifiers ddd

so I-Tech had to redesign that RF-chain, to keep roughly same Gain & NF characteristics but components are different, so re-testing is necessary

5 units expected in September

Spark has 14bits ADC (+/- 8192), was designed for close-to- full-range of the ADCs at -40dBm (better stay below 5000 for the ADC max. counts)

was later equipped with a variable attenuator <u>1dB step, 31dB</u> max this is enough in a Libera (that has 16bit ADCs) but not in ESRF EBS in particular rare filling modes (4x 10mA)

we prefer a <u>0-45dB</u> attenuator with <u>3dB step</u>

test results of the Spark-ERXR for full suitability for the extra BPMs in the EBS

Conclusion : - performance is OK but new tests needed on a new platform with new RF-components

- planned for Sept-Dec period
- not contributing to FOC but perhaps still with an FA-output ?

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Extra & back-up slides

Name	Geometry	Libera/Spark	S	Beta_X	Beta_Z	Disp.
BPM_01	Large	Libera	2.651	7.919	5.303	0.002
BPM_02	Large	Libera	6.479	9.498	7.173	0.080
BPM_03	Large	Spark	7.515	7.824	6.543	0.073
BPM_04	Small	Spark	10.292	1.926	2.326	0.013
BPM_05	Small	Libera	12.731	1.134	3.391	0.015
BPM_06	Small	Libera	13.643	1.134	3.391	0.015
BPM_07	Small	Spark	16.082	1.926	2.326	0.013
BPM_08	Large	Spark	18.859	7.824	6.543	0.073
BPM_09	Large	Libera	19.895	9.498	7.173	0.080
BPM_10	Large	Libera	23.723	7.919	5.303	0.002