

New line of Libera products

Matjaz Znidarcic, Libera Workshop, June 2016, Solkan

Content

- **Instruments based on ZYNQ7020**
- **Building blocks and interfaces**
- **Installations and tests**
- **Ongoing developments and plans**

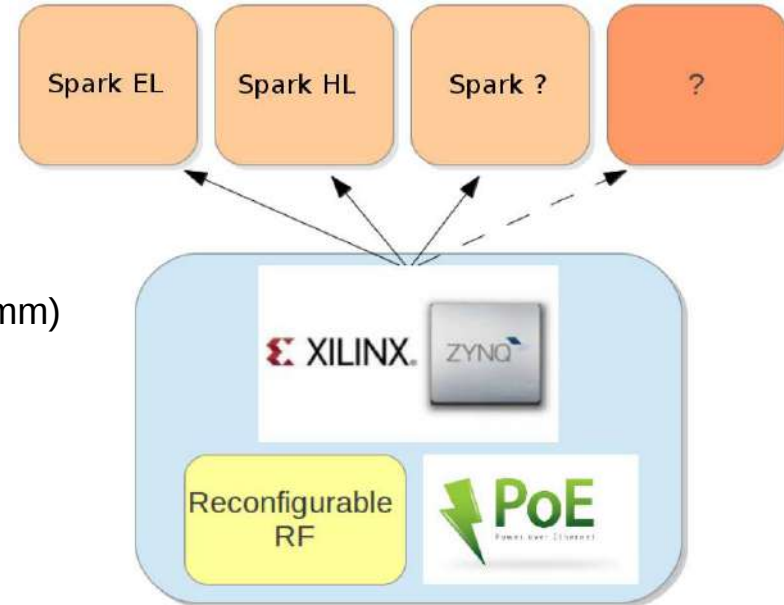
Instruments based on ZYNQ 7020

Main Idea:

- Digital part with reconfigurable RF front-end and HW extension slot
- Various applications

Benefits:

- Compact and robust design (210 x 210 x 44 mm)
- Simple to install and use
- No maintenance required
- Power over Ethernet
- Source code available
- EPICS & Tango & Matlab ready



Instruments



Libera

- Zynq-7020
- 4 input channels
- 1 GB data storage
- USB storage

- 125 MHz / 14 bit ADC

- 2.5 MHz / 18 bit ADC

Beam Position Monitors (Electron / Proton)

- Libera Spark EL (Linear electron machines)
- Libera Spark HL (Linear proton machines)
- Libera Spark ER (Electron rings)
- Libera Spark HR (Proton rings)



Beam Loss Monitor

- Libera BLM



Presentation: Beam Loss Measurements at the ESRF with different BL detectors and new 4 channel Libera BLM, Kees Scheidt, ESRF

Beam Position Monitor (Photon)

- Libera Photon



Presentation: The new Libera Photon, Peter Leban, Instrumentation Technologies

Digitizers

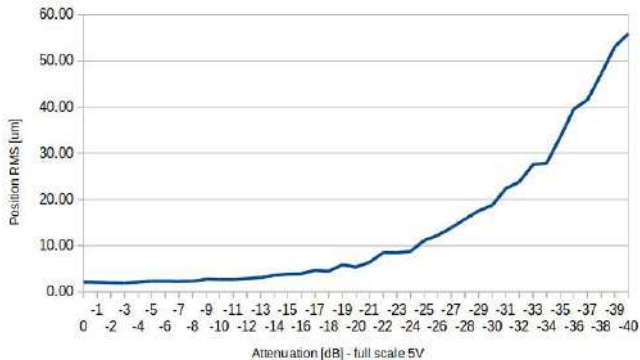
- Libera Digit AC (AC coupled digitizer)
- Libera Digit DC (DC coupled digitizer)



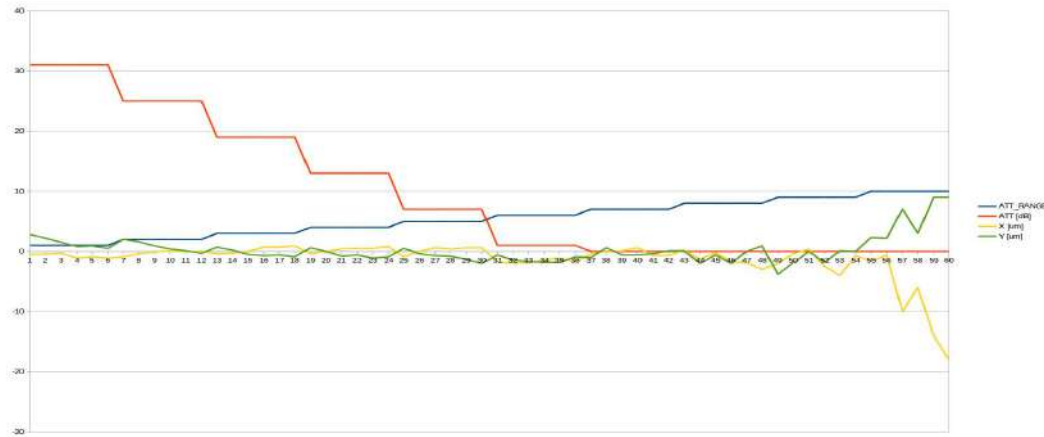
BPMs - Libera Spark (EL, HL, HR, ER)

- Data paths: ADC, Turn-by-Turn, TDP, SA ...
 - Position, Charge, Sync data
- Performances
 - Single bunch position RMS = **~ 3 μm**
 - Macro-pulse position RMS = **< 1 μm**
 - TbT position RMS on prototype (RF=499.654 MHz / TBT= 0.53 MHz) = **~ 0.5 μm**
 - Temperature drift 2 $\mu\text{m}/^\circ\text{C}$

Position RMS (Spark EL)

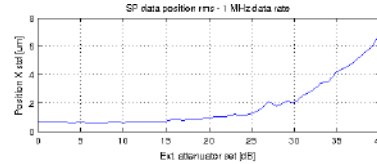
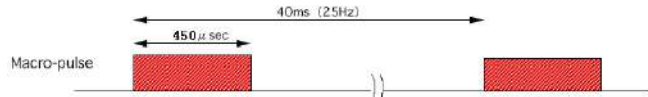


Beam current dependence - 60 dB range (Spark HL)

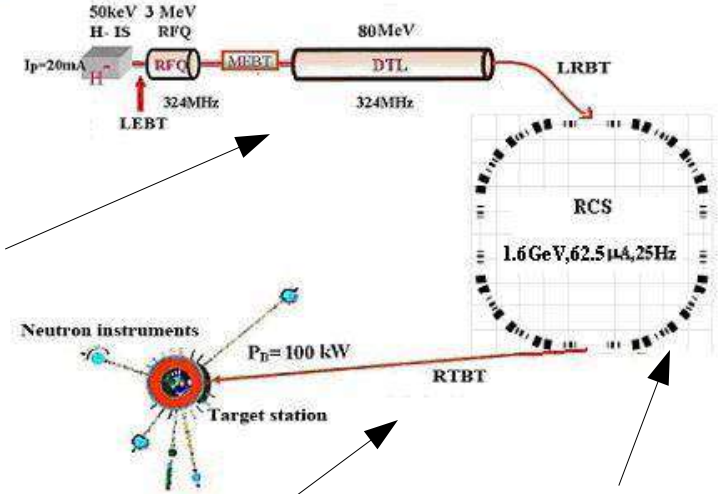
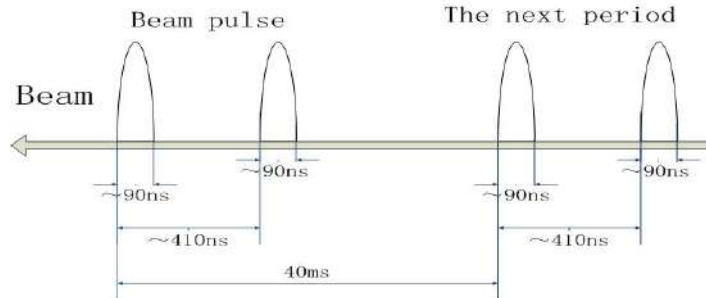


Libera Spark HL – CSNS

- Libera Spark HL together with Libera single Pass H
 - 320 MHz linac



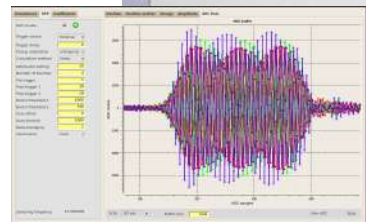
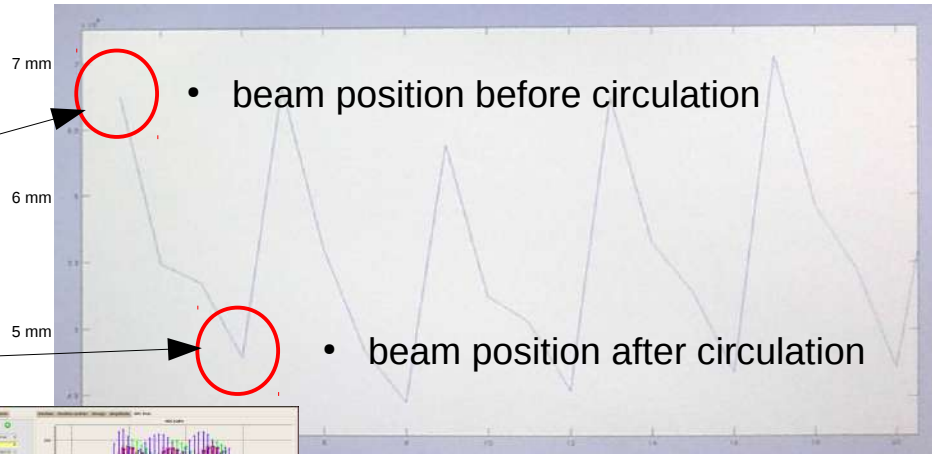
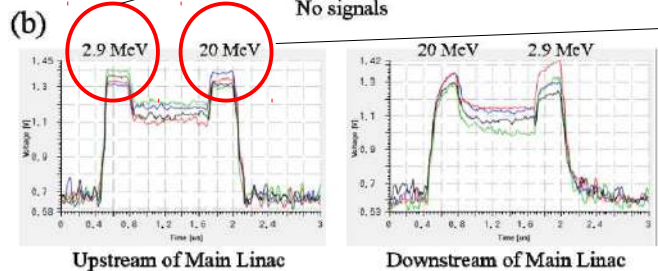
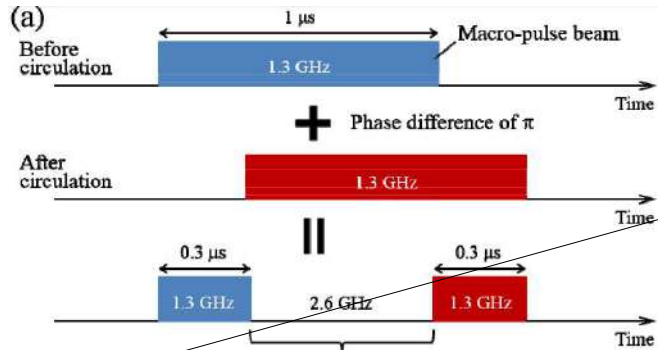
- 33 Libera Spark HL – custom
 - Individual processing of two bunches
 - Beam arrival detection



- Libera Hadron

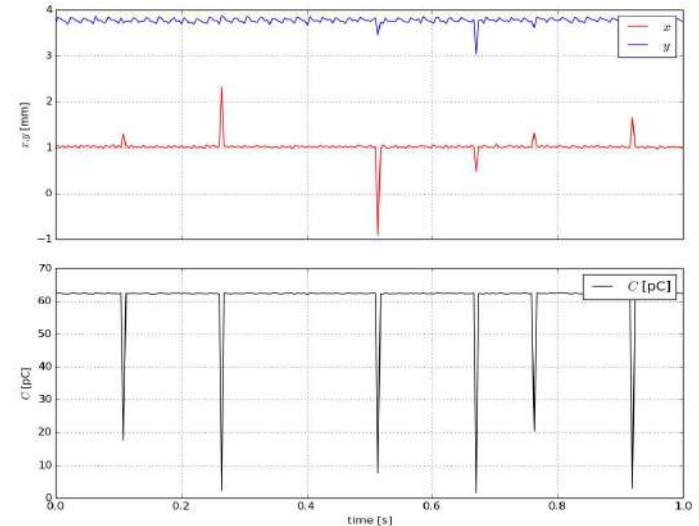
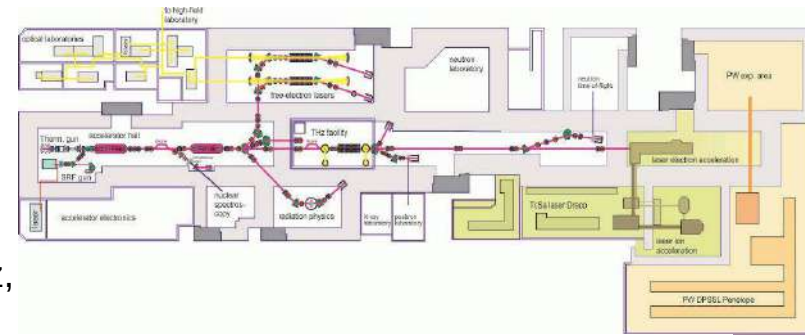
Libera Spark EL – KEK Compact ERL

- Measurements of beam at 1.3 GHz ERL
- 1 μ s macro-pulse
- Down conversion to 500 MHz



Libera Spark EL – HZDR ELBE

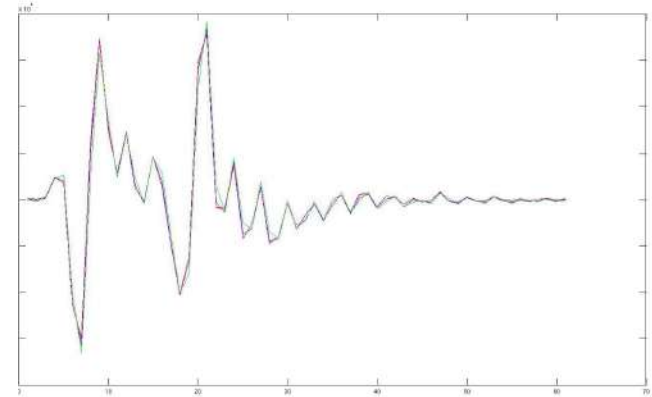
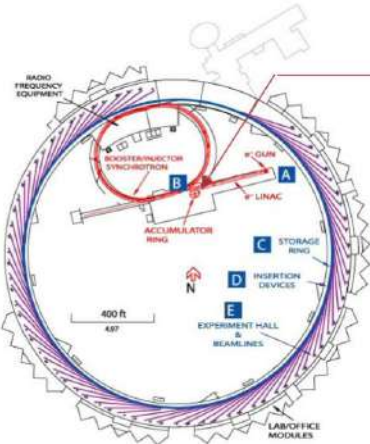
- OPC-UA server on the device. Stream out data as UDP
- Several experiments: 26 MHz, 13 MHz, 100 kHz, 10 kHz, kHz beam
- Beam tests at 25 kHz bunch frequency / 60 pC beam
 - 250 Hz random trigger
 - 10 μm rms on position
- 13 MHz CW beam (26 MHz)
 - Filter at 416 MHz



Libera Spark ER – APS Particle Accumulator Ring

- Position / Charge measurement of individual bunches
- Charge 0 to 2.7 nC
- Revolution frequency is 9.77 MHz
 - Individual processing of bunches
- Striplines with 352 MHz resonant frequency

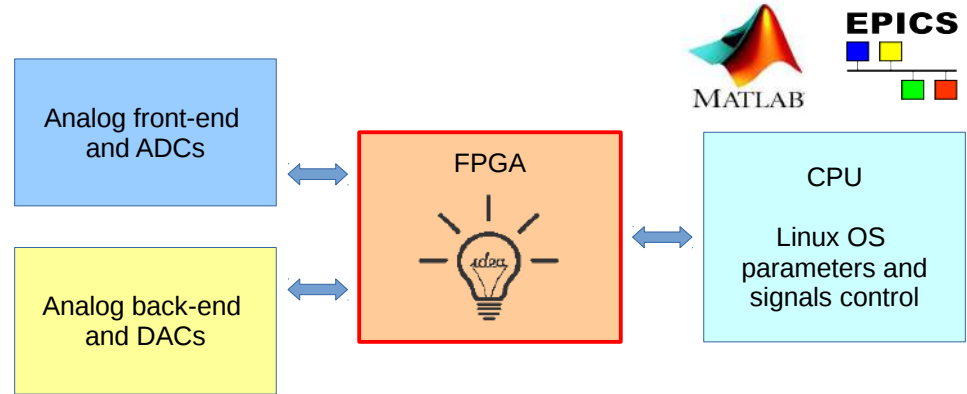
- The APS particle accumulator ring (PAR) is a 325-MeV storage ring that collects and compresses linac pulse trains into a single bunch for booster injection. The cycle time of the PAR is 500 ms.



- Wide filtering - short ringing
 - 520 MHz
- Expected position RMS = < 5 μm

Digitizers - Libera DIGIT (AC, DC)

- 125 MS/s digitizer
- DC digitizer
 - Analog BW: DC to 50 MHz
 - 50 Ohm / 1 MOhm
- AC digitizer
 - Analog BW: 10 MHz to 700 MHz
- Peking University – ICT readout
- Kirams – faraday cup readout, wire scanner readout



- IO blocks available
 - Interface to FPGA and RAM
 - Data acquisition module
 - EPICS interface with simple GUI

Developments, plans, challenges ...

- Applications for circular machines on ZYNQ 7020
- Instruments on ZYNQ 7035
 - Cavity BPM (*Presentation: Cavity BPM electronics, Manuel Cargnelutti, Instrumentation Technologies*)
 - 4 channel - 500 MHz digitizer
 - 8 channel - 250 MHz digitizer
- **Your ideas ...**

