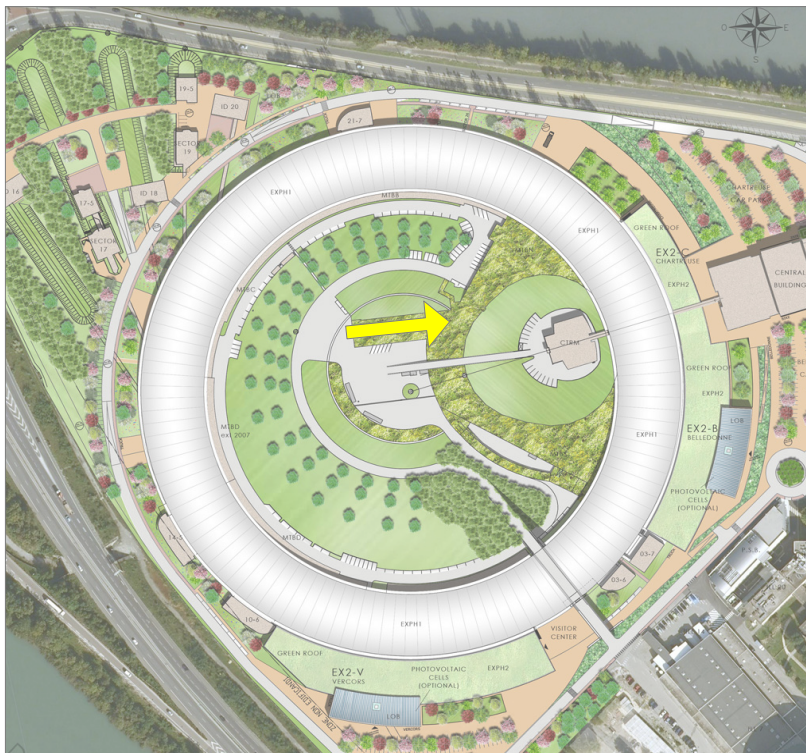# Commissioning Results of the new BPM Electronics of the ESRF booster Synchrotron

Manuel Cargnelutti, Instrumentation Technologies
Kees Bertus Scheidt, ESRF
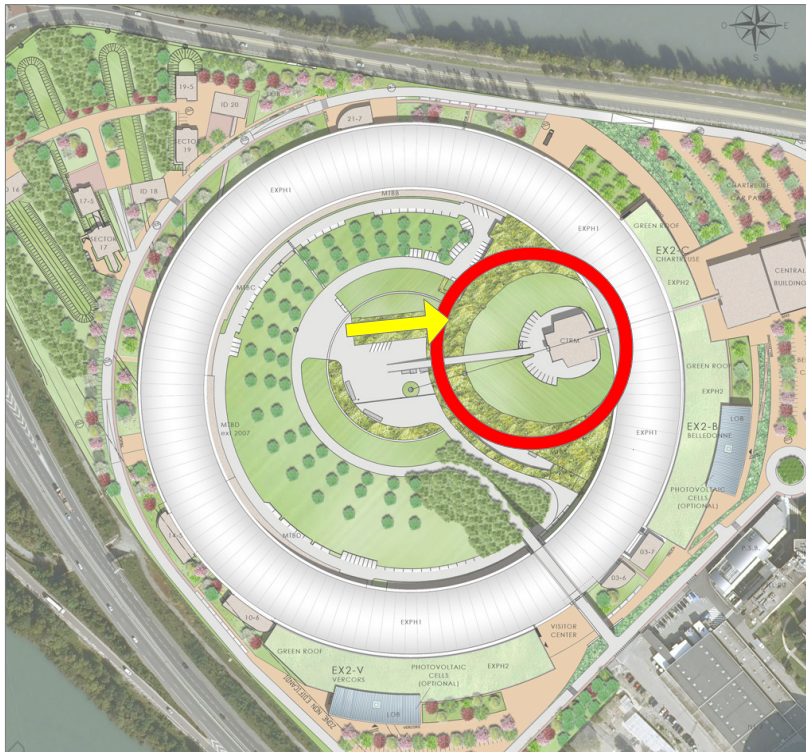
Presentation outline

- The ESRF Booster Ring

- Installation of the new BPM electronics

- Commissioning results

- Conclusions

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The ESRF Booster Ring

Pre-Injector LINAC

from **0 to 200 MeV**

Instrumentation
Technologies

The ESRF Booster Ring

Pre-Injector LINAC

from **0 to 200 MeV**

Booster Synchrotron

200 MeV → 6 GeV

50 ms (50000 turns) acceleration cycle

1 µs orbit time

current from **2.5 mA** down to **µA**

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Instrumentation
Technologies

The ESRF Booster Ring

Pre-Injector LINAC

from **0 to 200 MeV**

Booster Synchrotron

200 MeV → 6 GeV

50 ms (50000 turns) acceleration cycle

1 µs orbit time

current from **2.5 mA** down to **µA**

Storage Ring (200 mA)

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Instrumentation Technologies
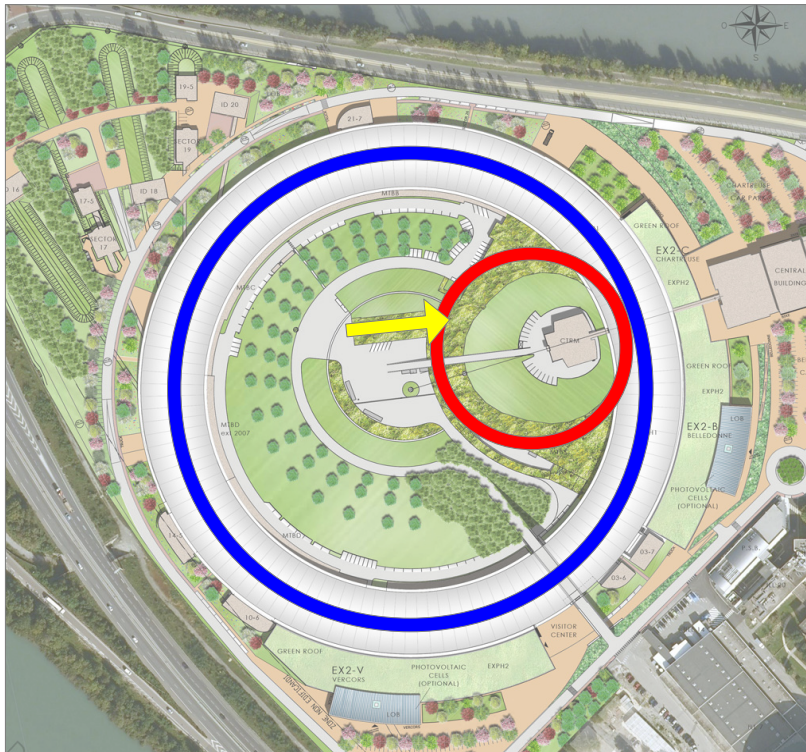
The ESRF Booster Ring
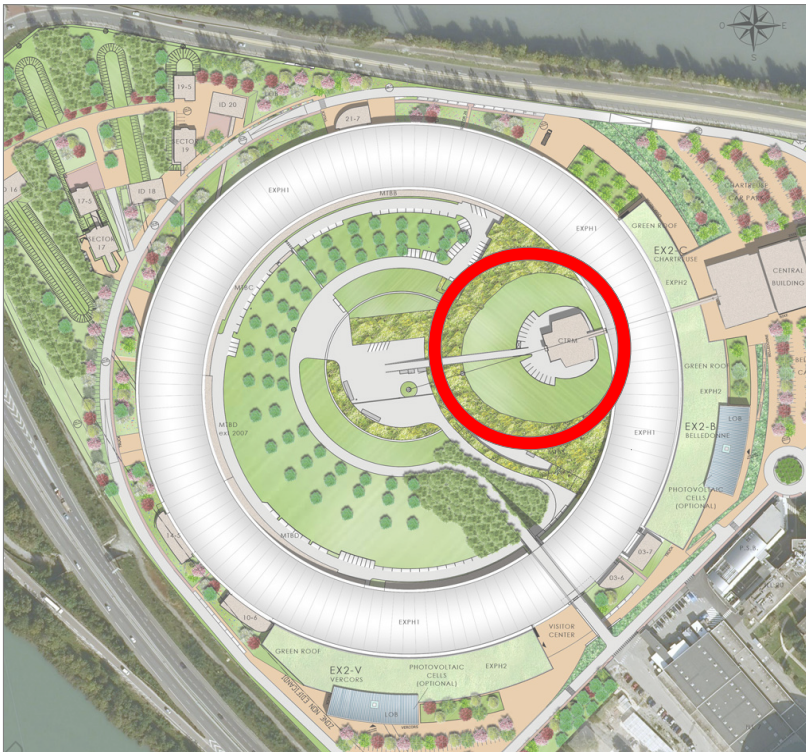
75 BPM blocks
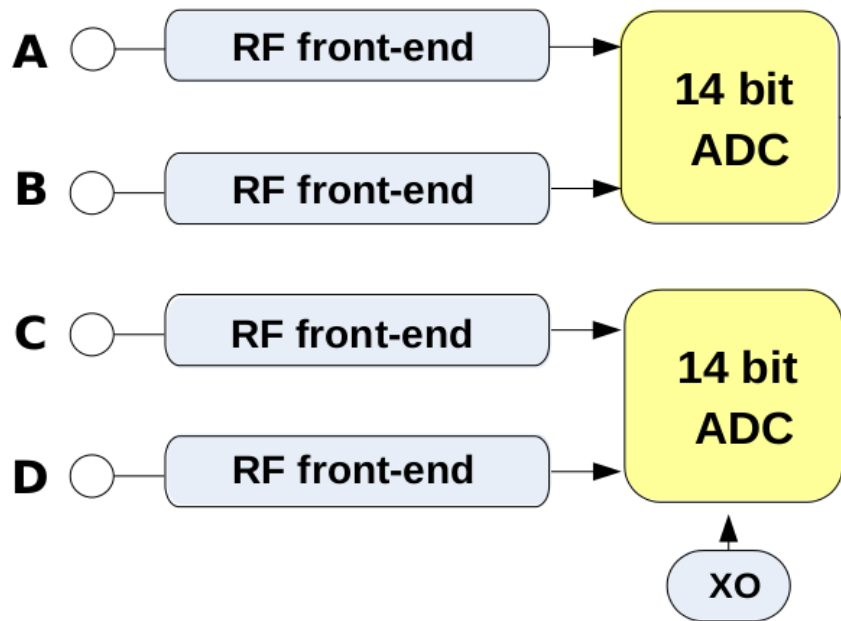
25 years old electronics

Need new BPM electronics

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What kind of electronics?

+ Good Price/Performance

+ Turn-By-Turn data

+ Easy to use

+ No maintenance required

What kind of electronics?

+ Good Price/Performance

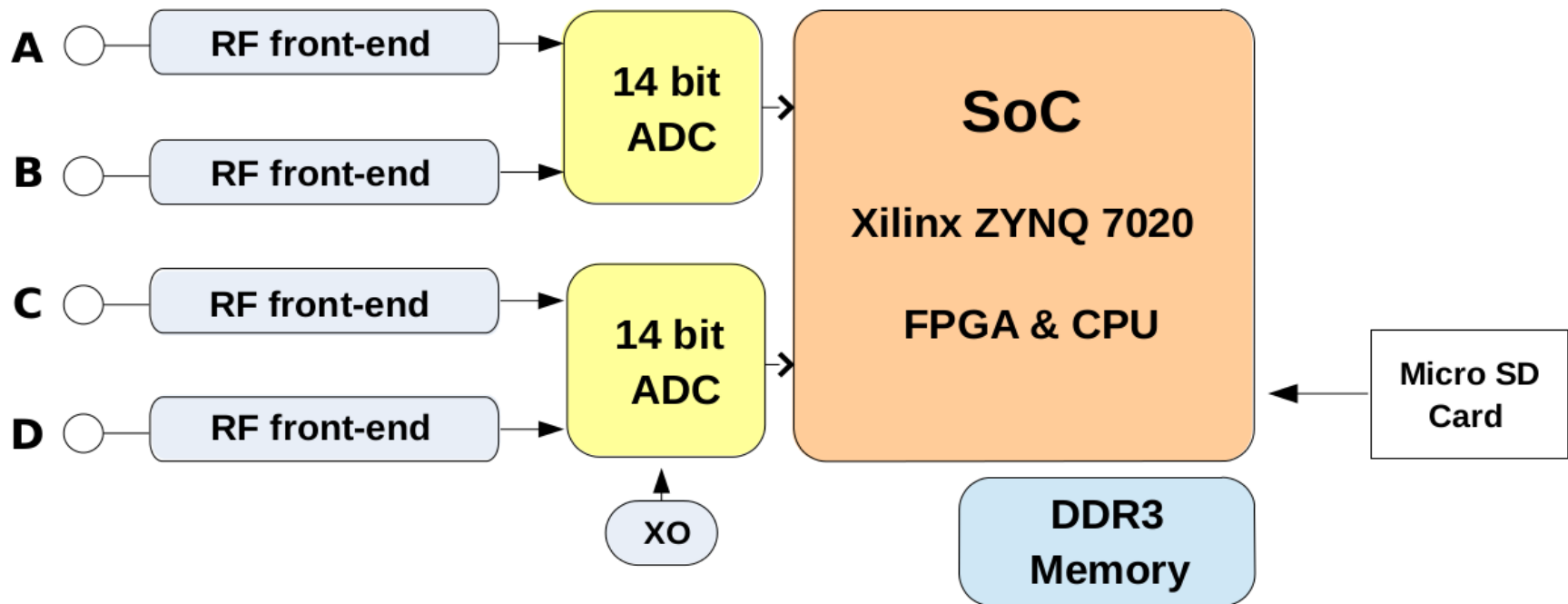+ Turn-By-Turn data
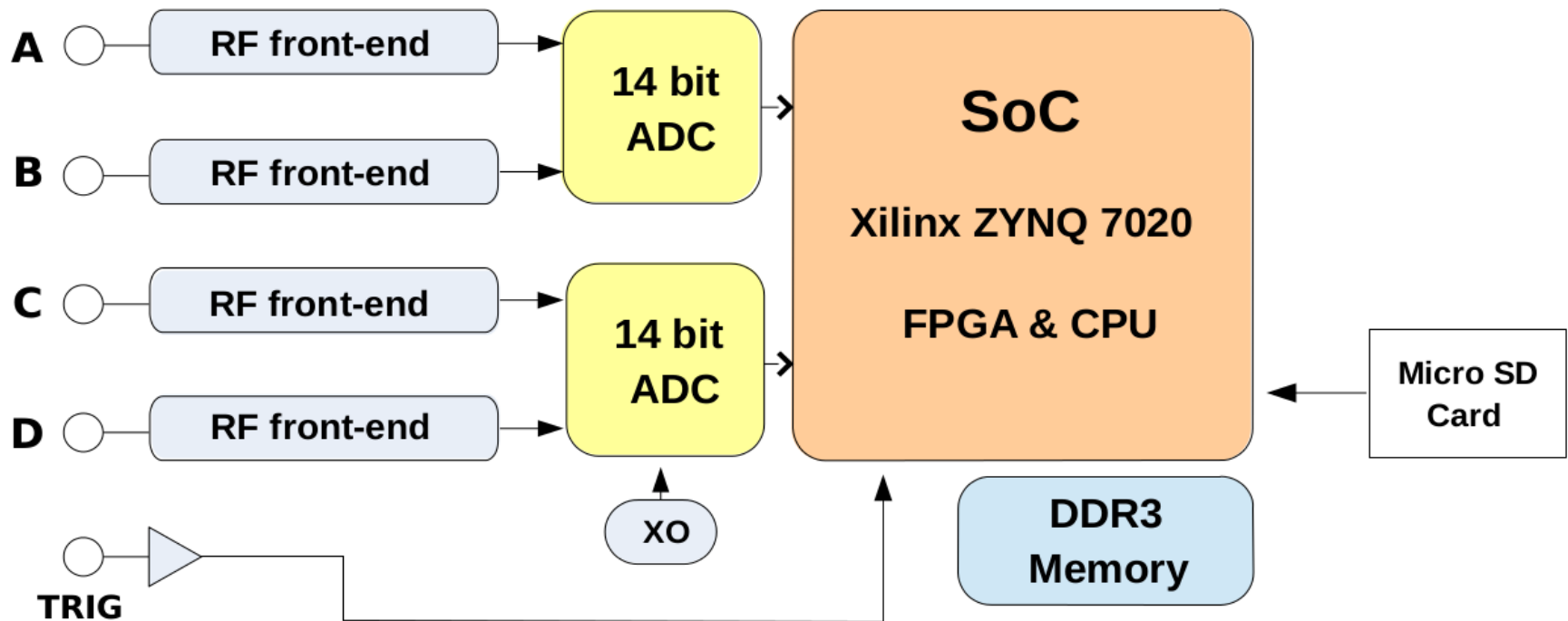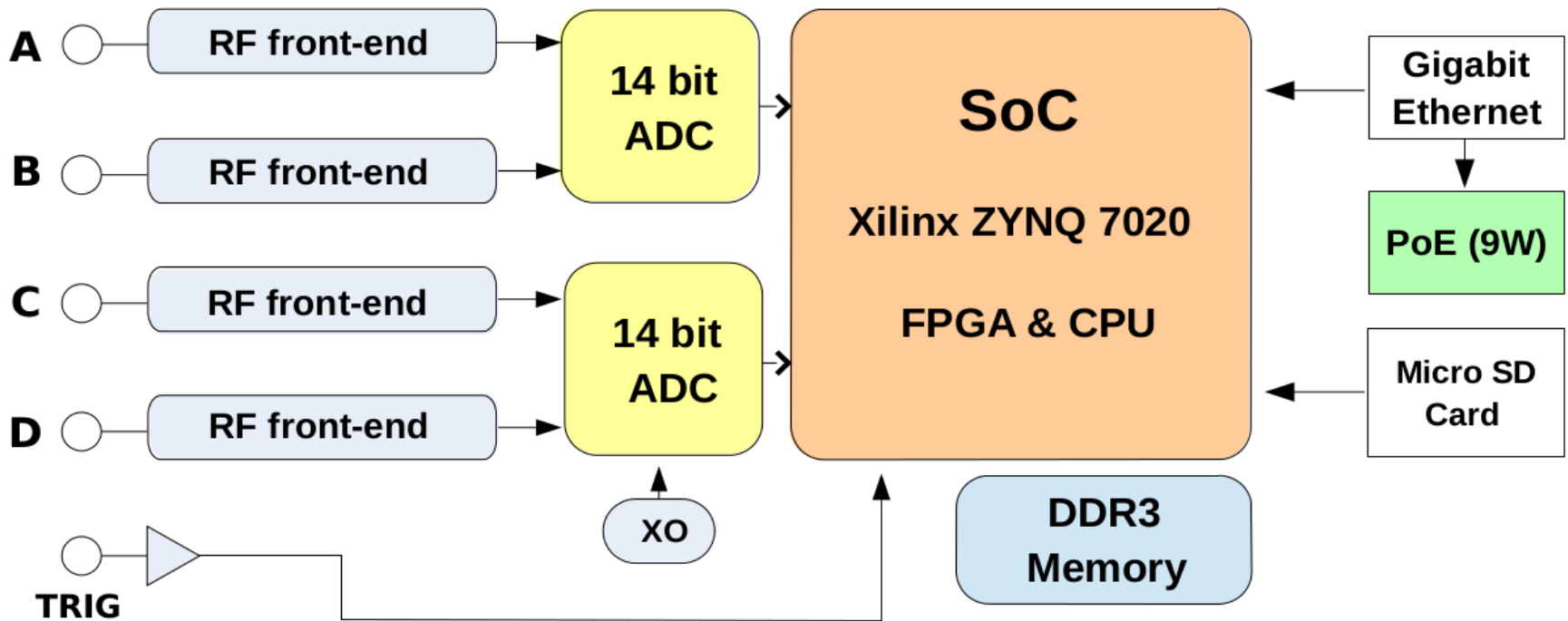
+ Easy to use

+ No maintenance required

Libera **Spark**

Instrumentation
Technologies

What kind of electronics?

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Instrumentation Technologies

What kind of electronics?

Instrumentation
Technologies

What kind of electronics?

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What kind of electronics?

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Installation

- Installation in the tunnel

- Radiation dosimetry tests (>6 months) shown very low radiation dose
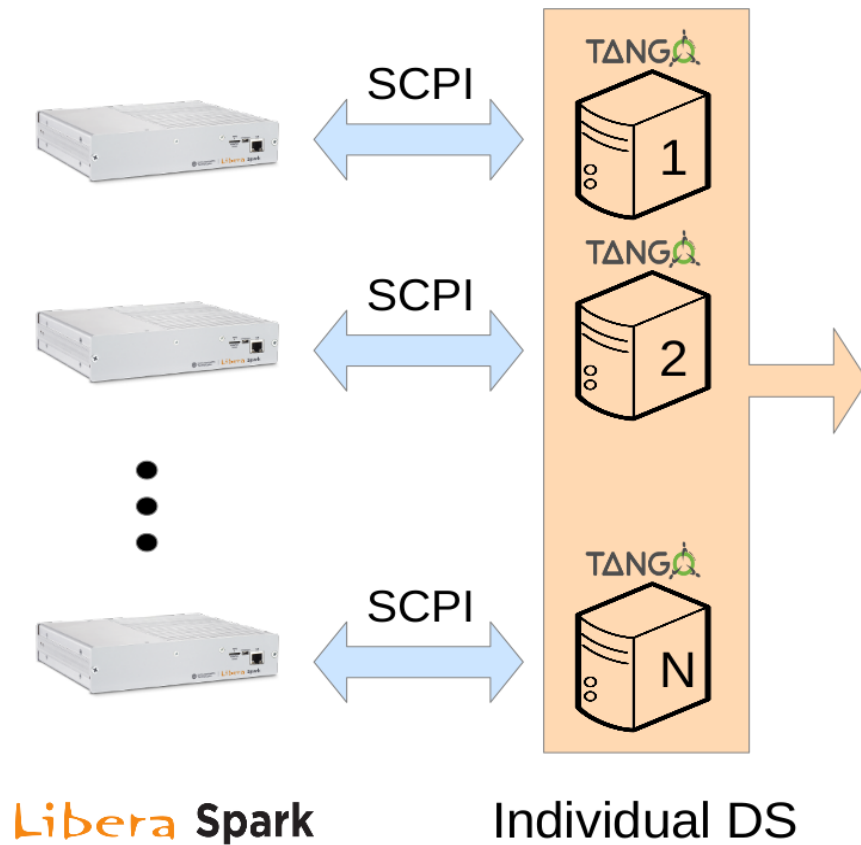
- 3 m long RF cables

- Powered with Ethernet cable

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Instrumentation
Technologies
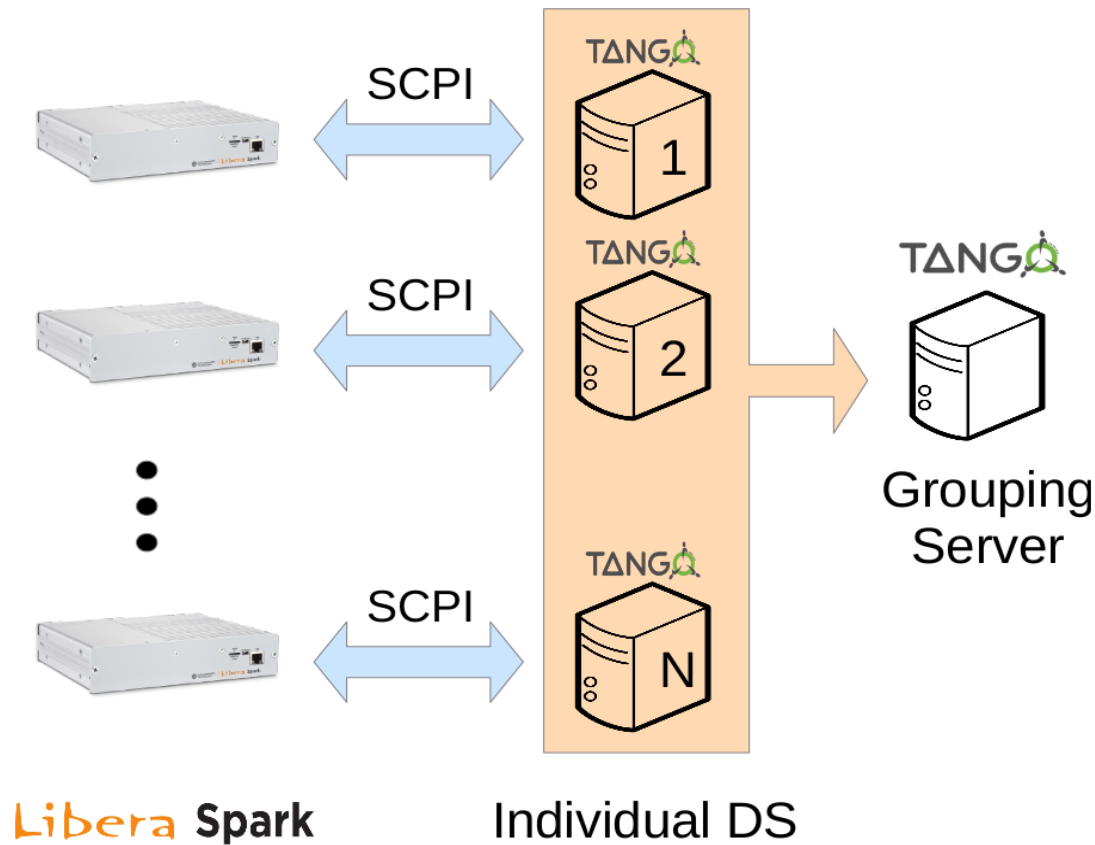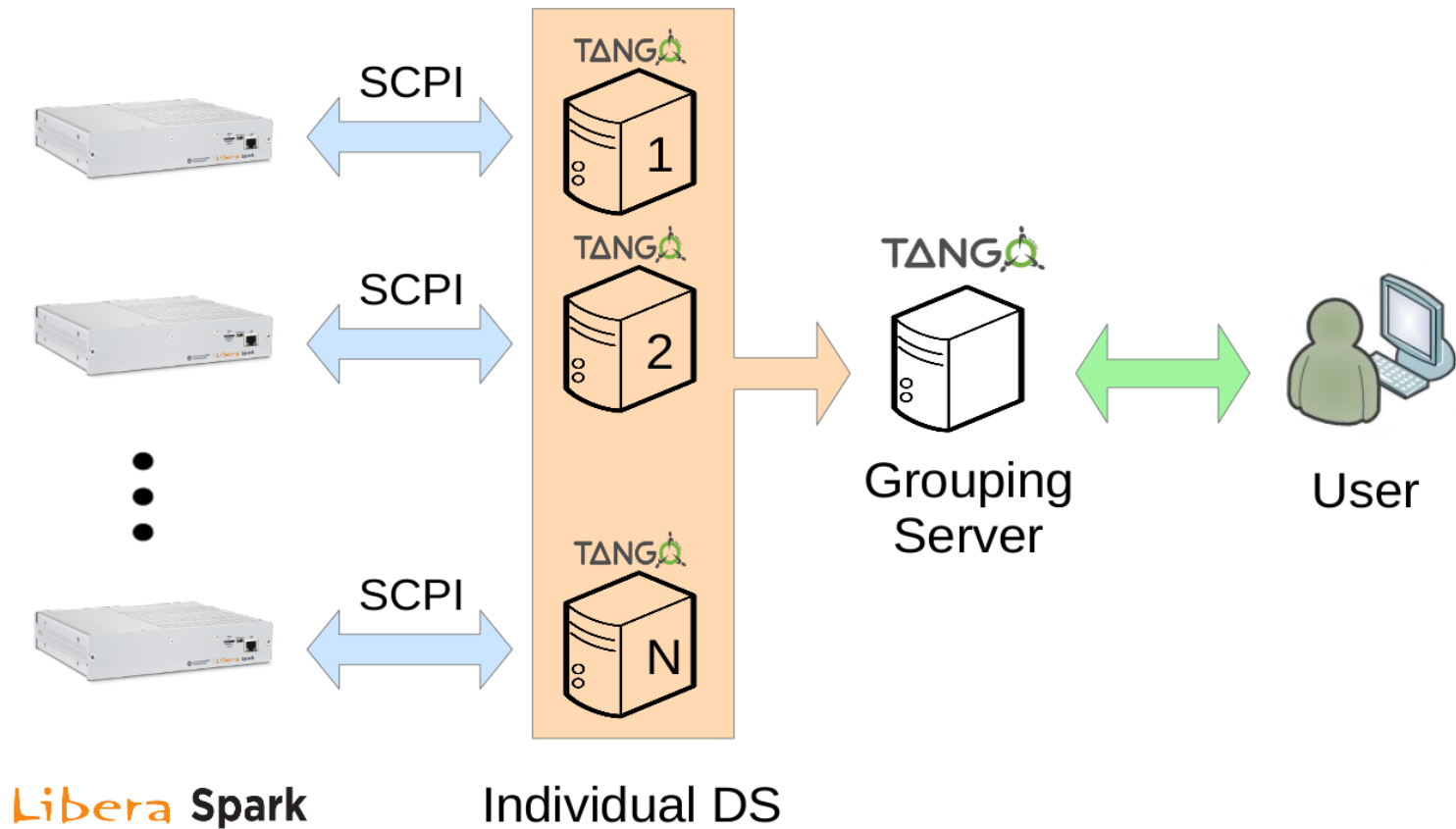
Integration in the Control System

Libera **Spark**

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Instrumentation
Technologies

Integration in the Control System

Libera **Spark**   Individual DS

15   IPAC'15

Integration in the Control System

Integration in the Control System

Libera **Spark**   Individual DS

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Commissioning Results

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Instrumentation
Technologies

1) Synchronization with the beam arrival

- Trigger is the same signal which goes around the ring

- 2 µs difference between fist and last unit (2 turns)
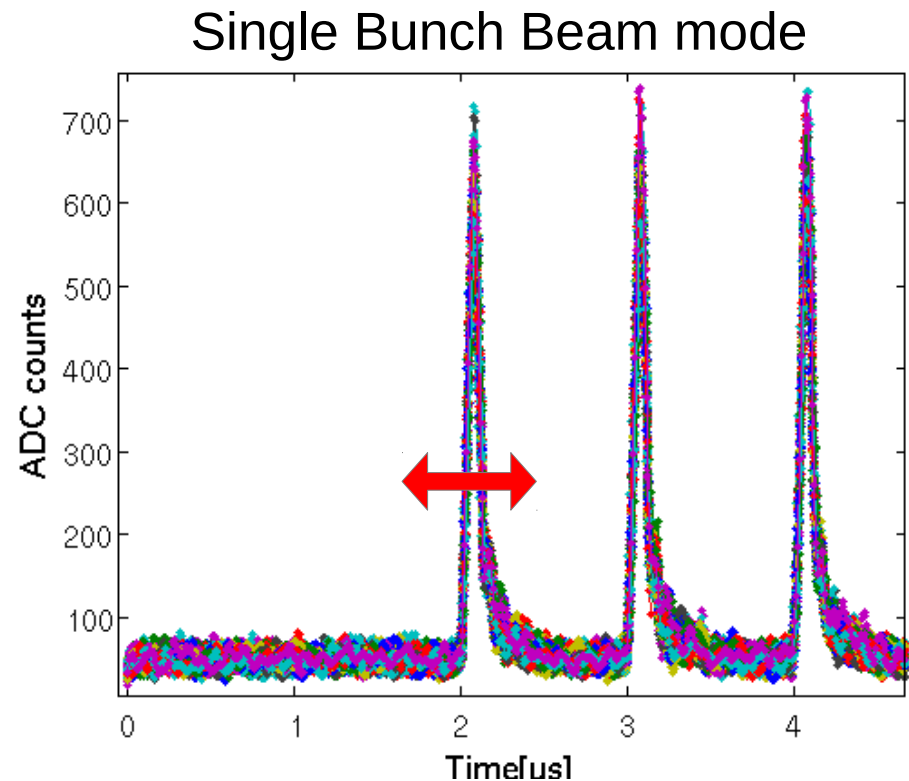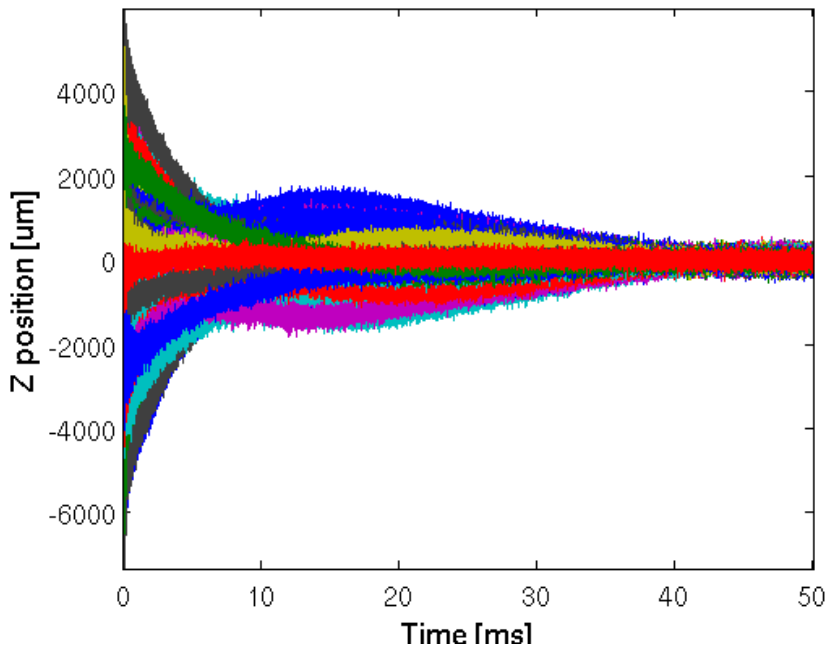
Single Bunch Beam mode

IPAC'15
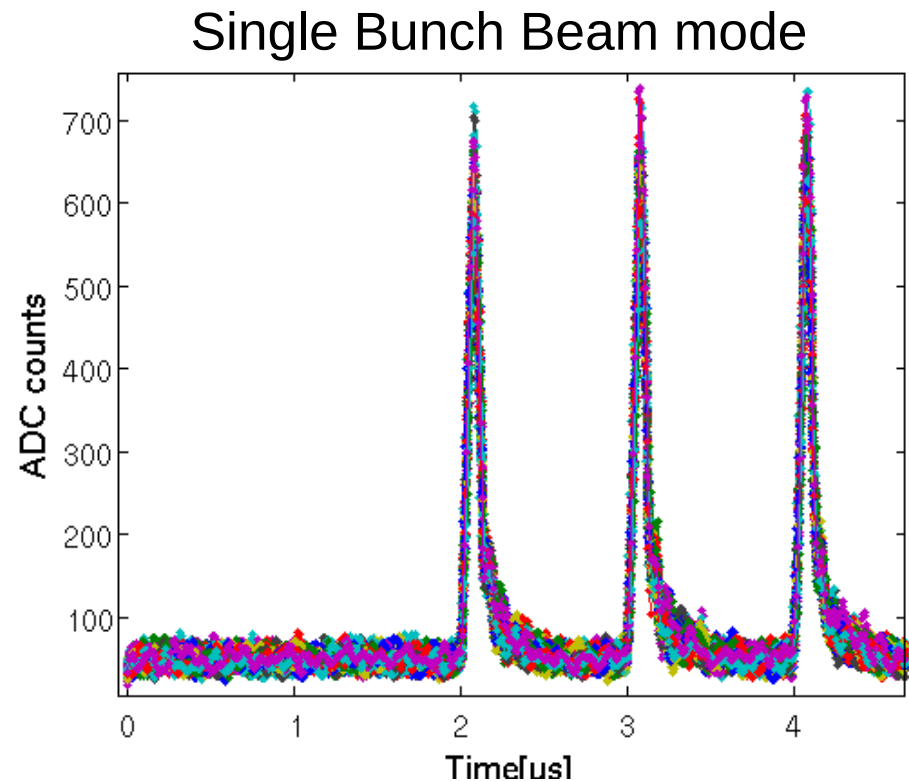
1) Synchronization with the beam arrival

- Trigger is the same signal which goes around the ring

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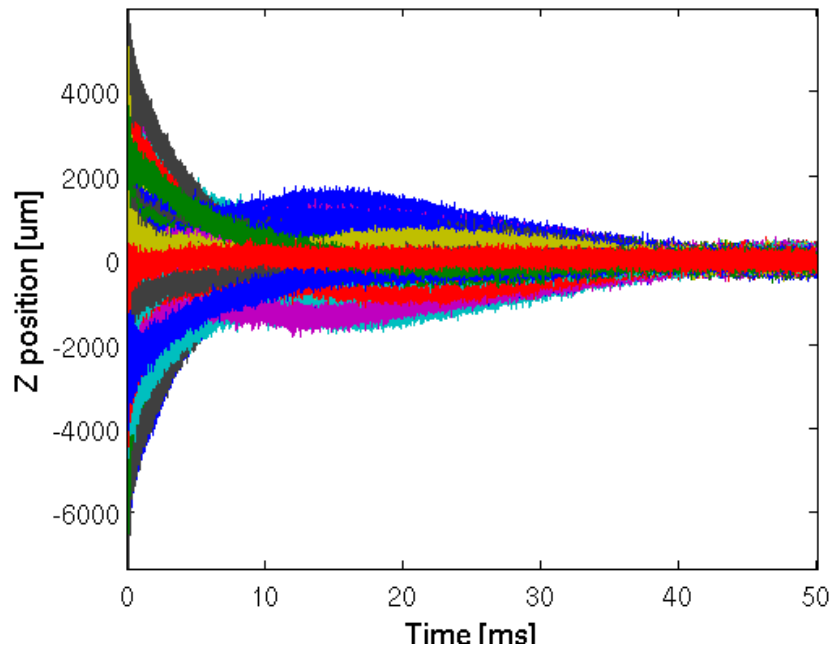- Adjusted with each unit Trigger Delay on the ADC buffer

Single Bunch Beam mode

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Instrumentation
Technologies

2) Tune monitor with Turn-by-Turn data

Turn-by-Turn position (1 µs)
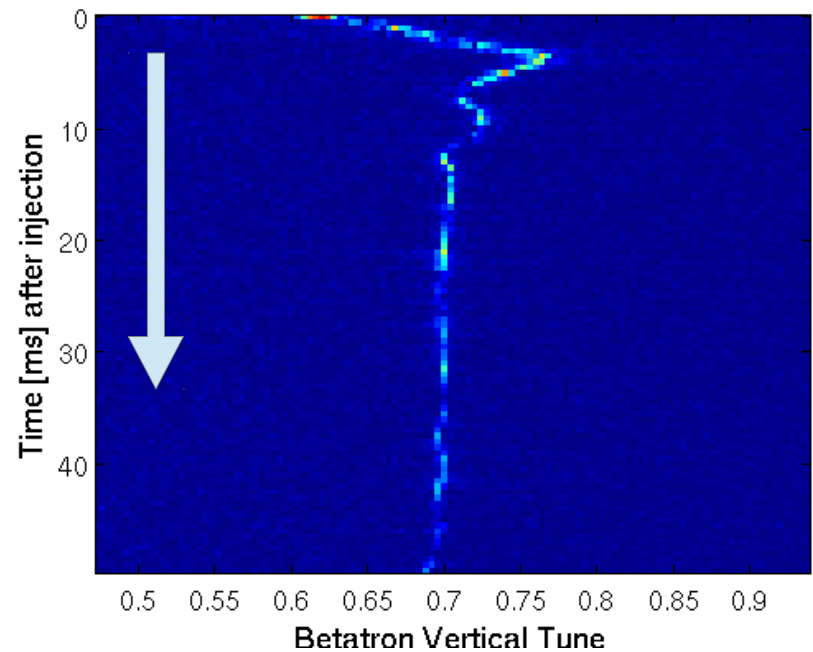
IPAC'15

Instrumentation
Technologies

2) Tune monitor with Turn-by-Turn data

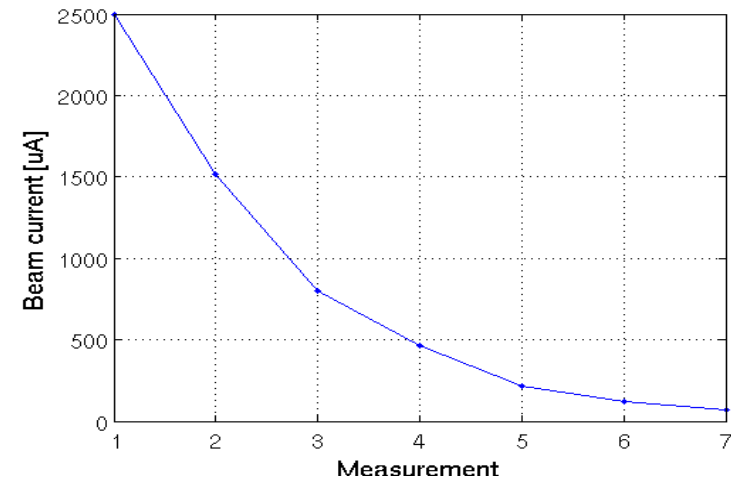Turn-by-Turn position (1 µs)

Vertical Tune monitor

FFT in 0.5 ms data slices

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3) Position resolution vs Beam current

- Booster operating with long-pulse mode (80% fill pattern)

- Current was reduced in steps from **2.5 mA** to **μA**

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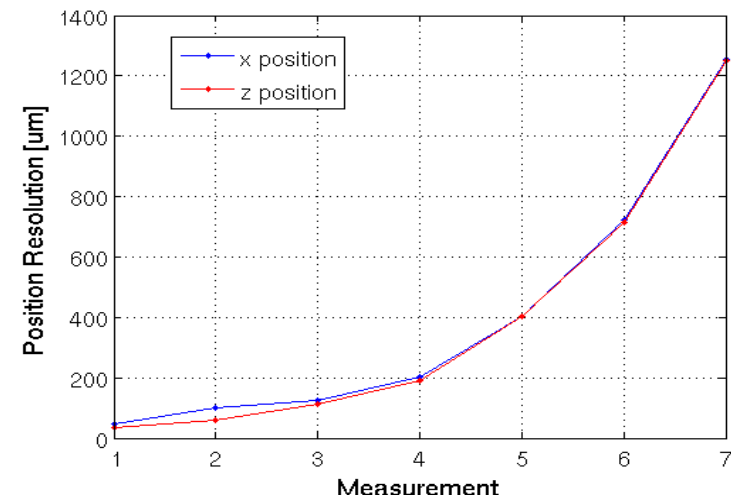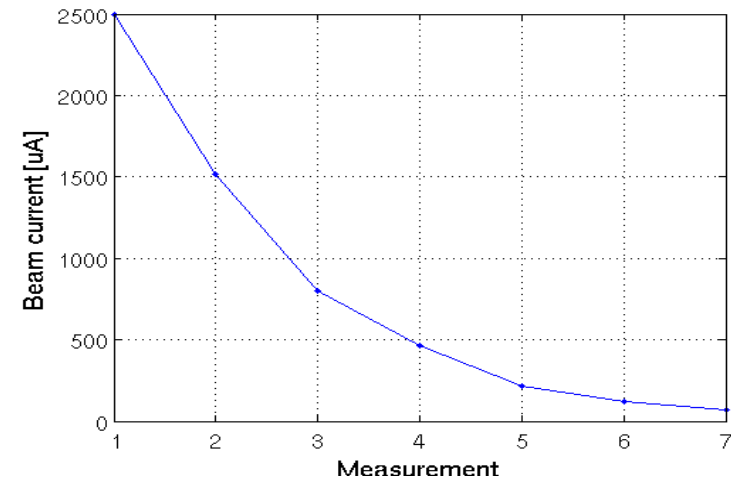Instrumentation
Technologies

3) Position resolution vs Beam current

- Booster operating with long-pulse mode (80% fill pattern)

- Current was reduced in steps from **2.5 mA** to **µA**

- **Sum signal**: estimate real current intensity
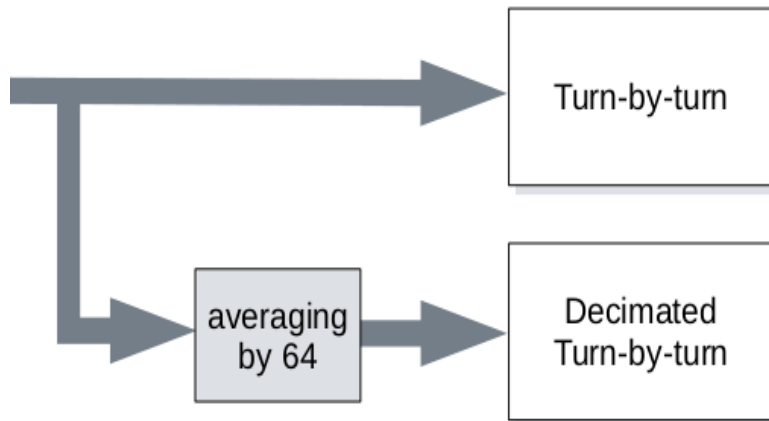

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Instrumentation
Technologies

3) Position resolution vs Beam current

- Booster operating with long-pulse mode (80% fill pattern)

- Current was reduced in steps from **2.5 mA** to **µA**

- **Sum signal**: estimate real current intensity
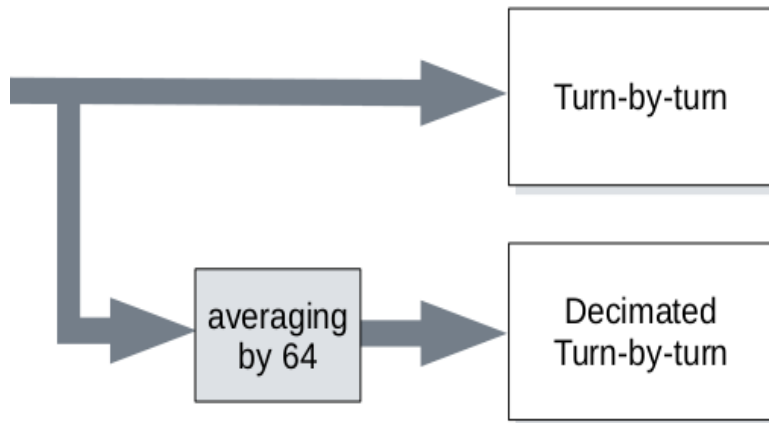
- **X Z position**: estimate resolution with RMS

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Decimated T-b-T data

Turn-by-turn

1 sample = 1 turn = 1 μs

averaging
by 64 → Decimated
Turn-by-turn

1 sample = 64 turns = 64 μs

Instrumentation
Technologies

Decimated T-b-T data

Turn-by-turn

1 sample = 1 turn = 1 µs

averaging by 64

Decimated Turn-by-turn

1 sample = 64 turns = 64 µs

Motivation?
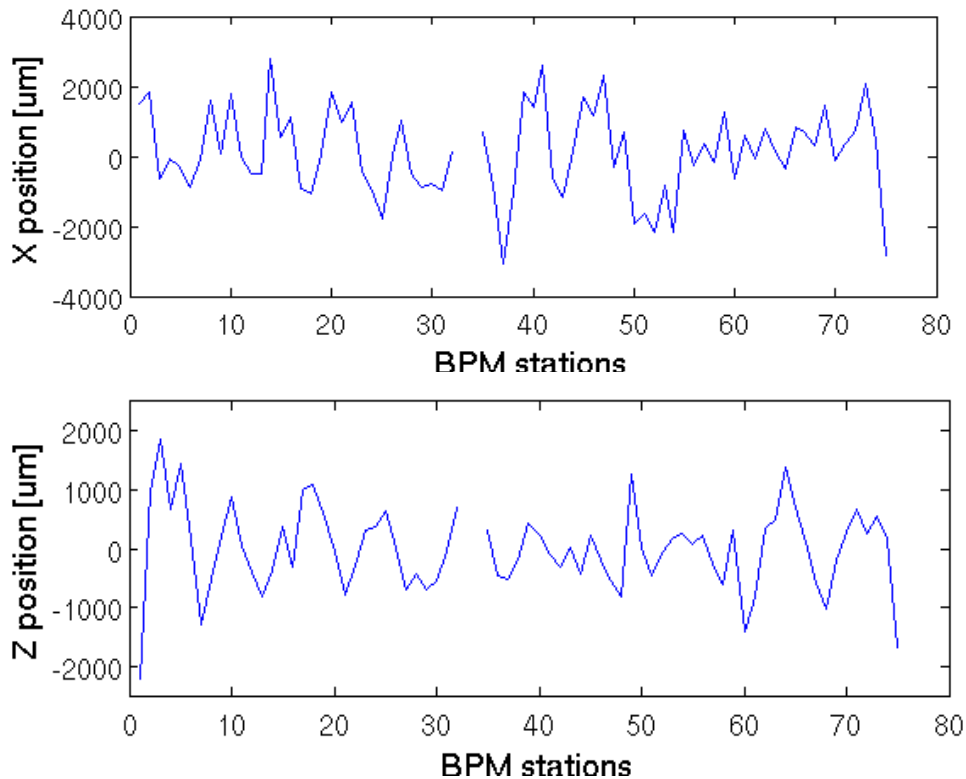
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Instrumentation
Technologies

4) Position measurements
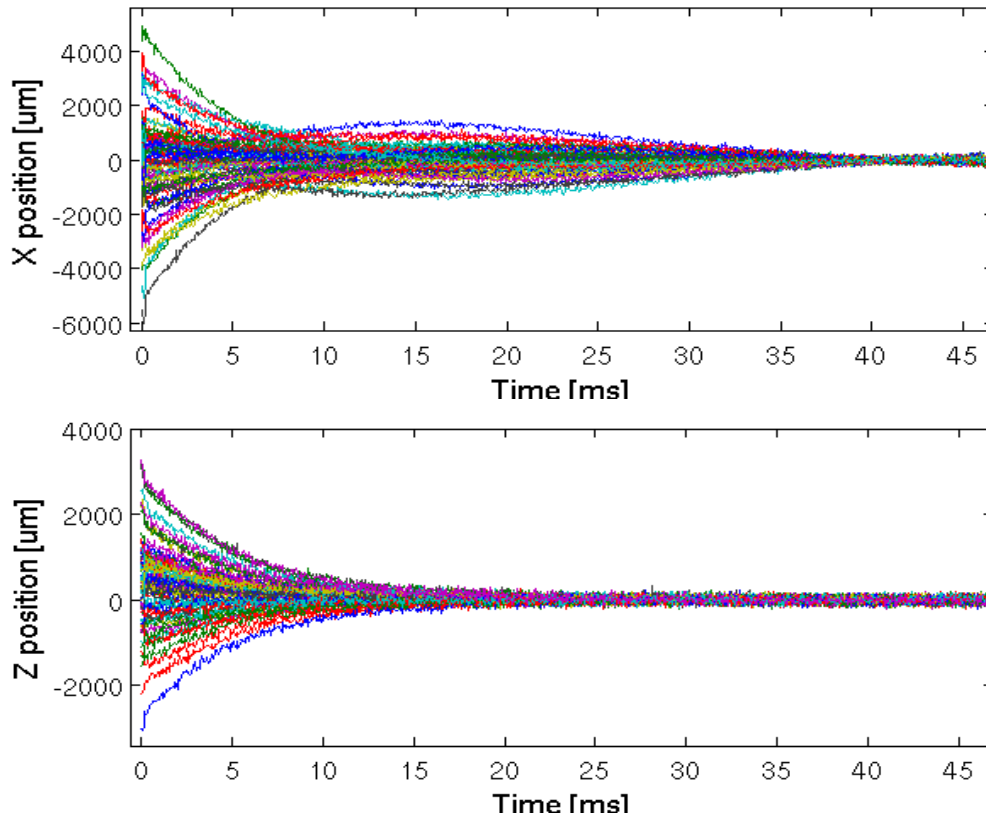
Motivation?

Reduced bandwidth means reduced noise contribution
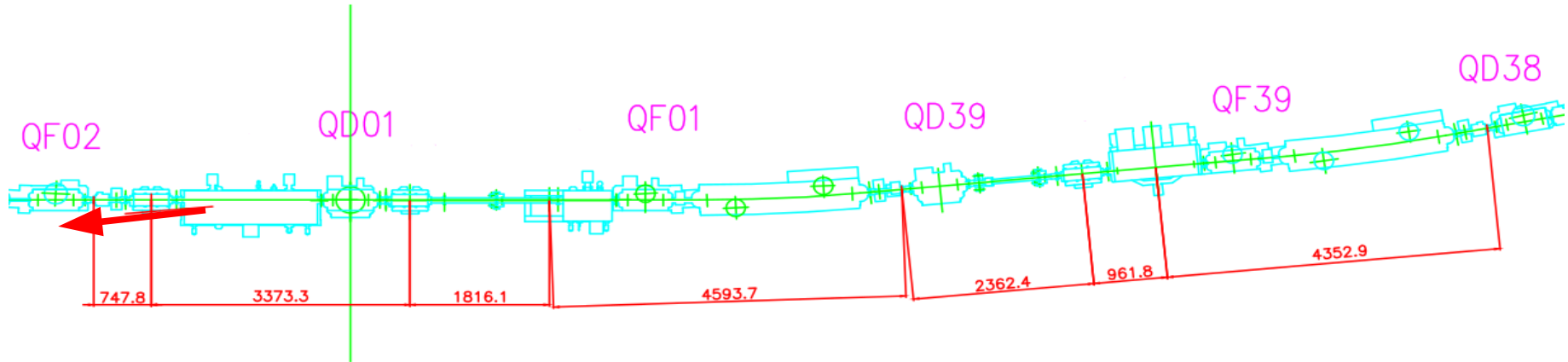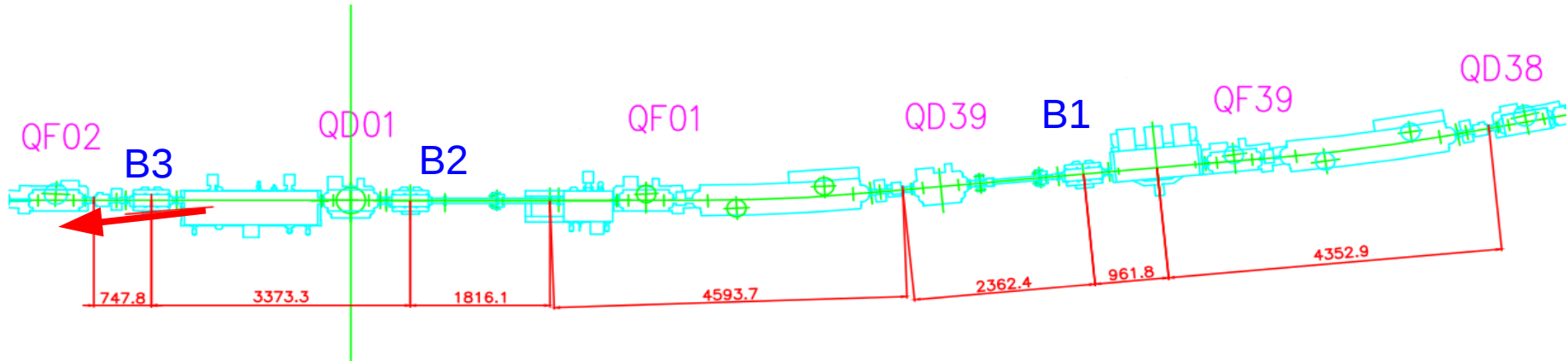
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5) Orbit measurements

Motivation?

Reduced amount of
data to be transferred
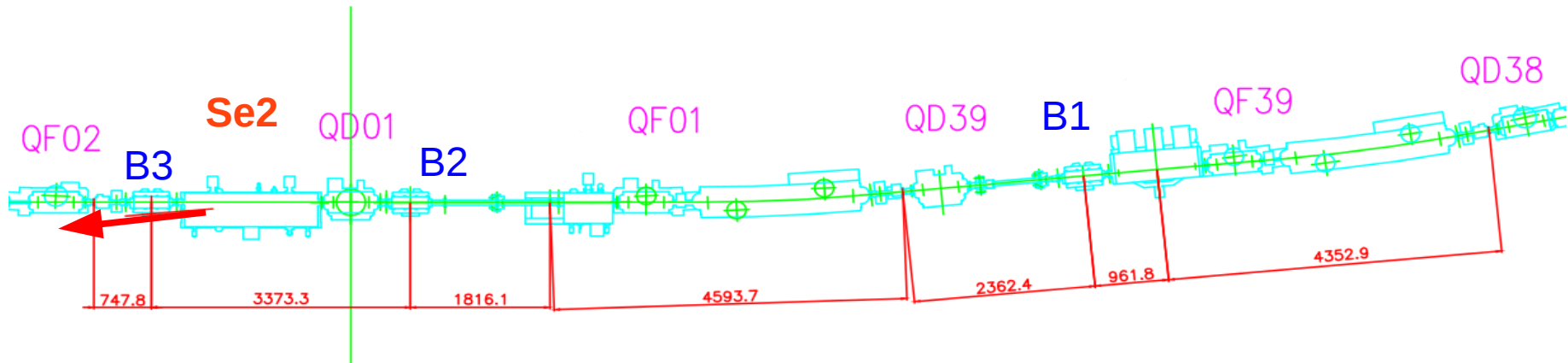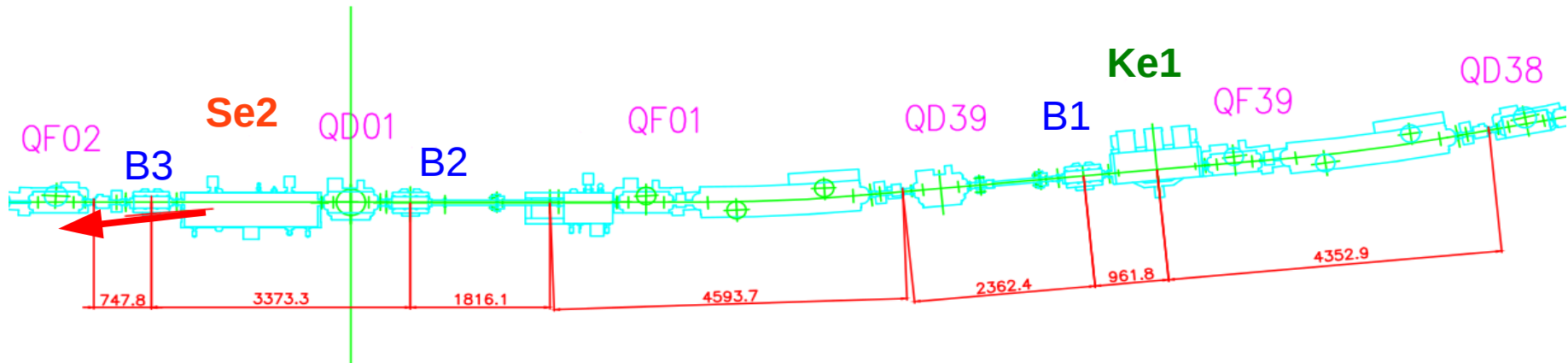over the network

6) Extraction process

6) Extraction process

- Three bumpers (B1, B2 and B3) create an horizontal bump 1.5 ms before extraction

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6) Extraction process

- Three bumpers (B1, B2 and B3) create an horizontal bump 1.5 ms before extraction
- This moves the beam closer to the extraction septum magnet **Se2**

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6) Extraction process

- Three bumpers (B1, B2 and B3) create an horizontal bump 1.5 ms before extraction
- This moves the beam closer to the extraction septum magnet **Se2**
- The fast kicker **Ke1** extracts the beam in one turn

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Instrumentation
Technologies

6) Extraction process
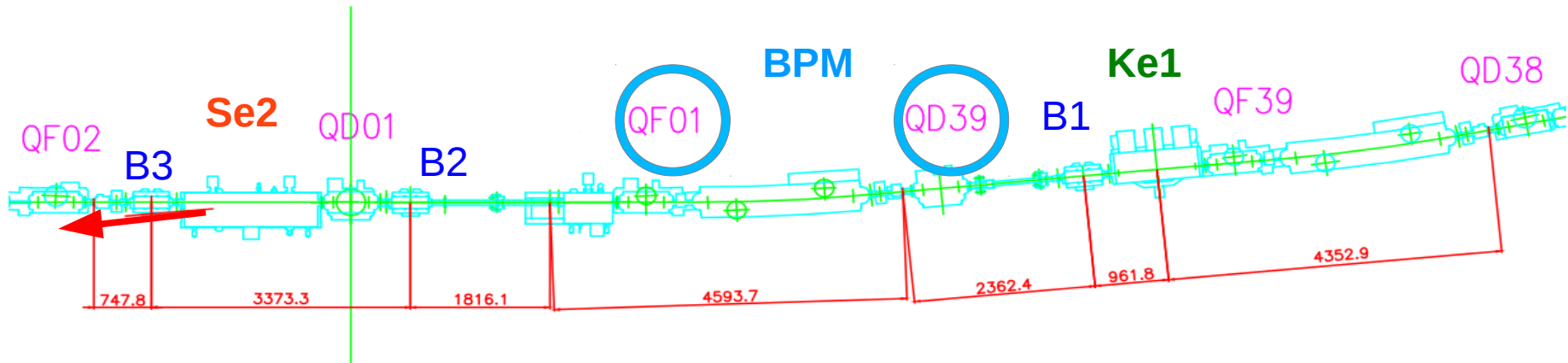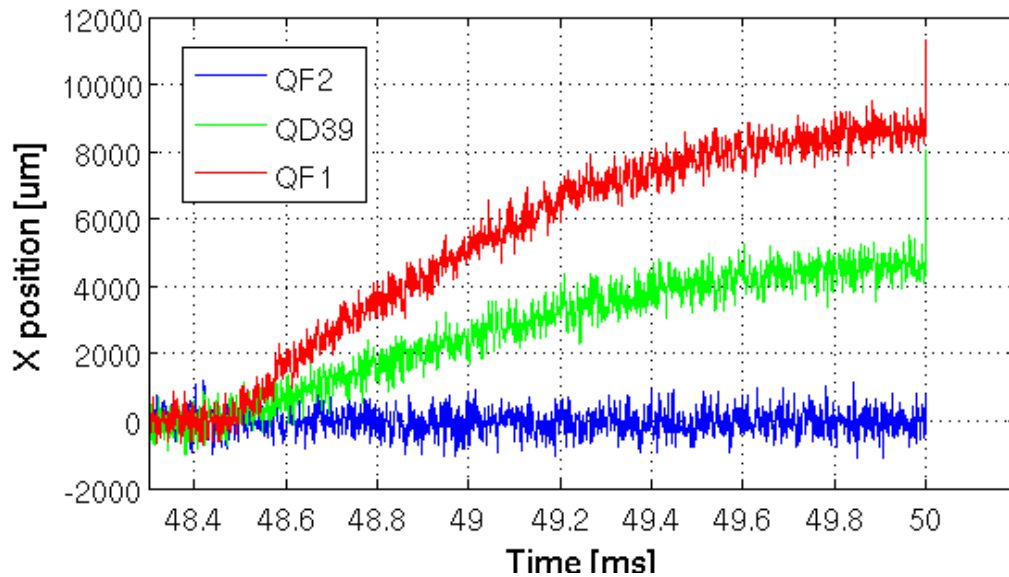

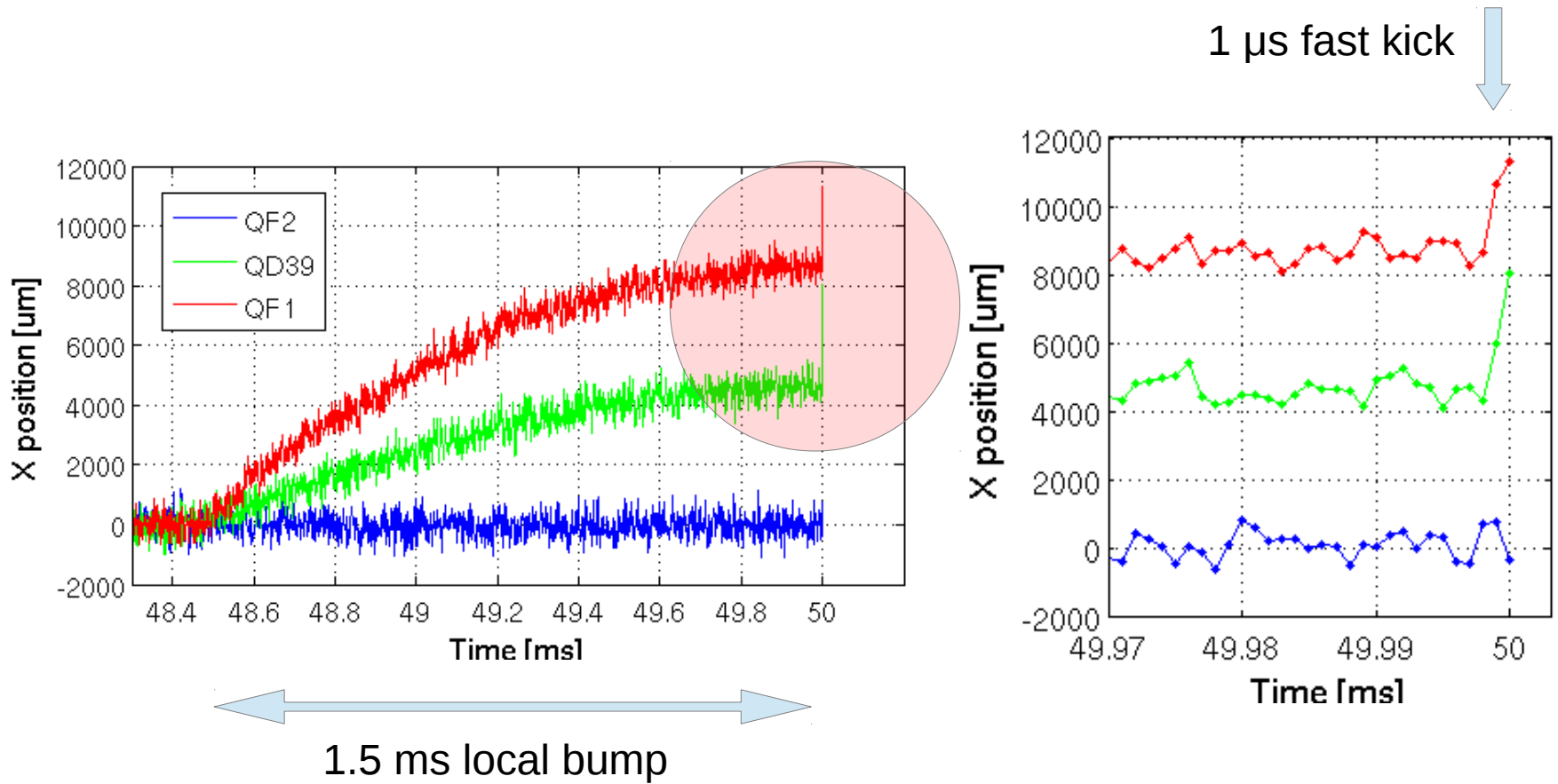
- Three bumpers (B1, B2 and B3) create an horizontal bump 1.5 ms before extraction
- This moves the beam closer to the extraction septum magnet **Se2**
- The fast kicker **Ke1** extracts the beam in one turn

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6) Extraction process

1.5 ms local bump

IPAC'15

6) Extraction process

1 µs fast kick

1.5 ms local bump

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Conclusions

- Commissioning of **75** new BPM electronics

- Installation, Integration and Measurements: **2 weeks**

- ADC, T-b-T and Decimated data proven to be very useful

- Libera Spark is a cost-effective and valuable solution

Libera **Spark**

IPAC'15

Thanks for your attention!

manuel.cargnelutti@i-tech.com