ALBA

Source: Javier Sanchez Rios

Measurement and diagnostic of Kickers pulses through ADC systems

Nuria Ayala

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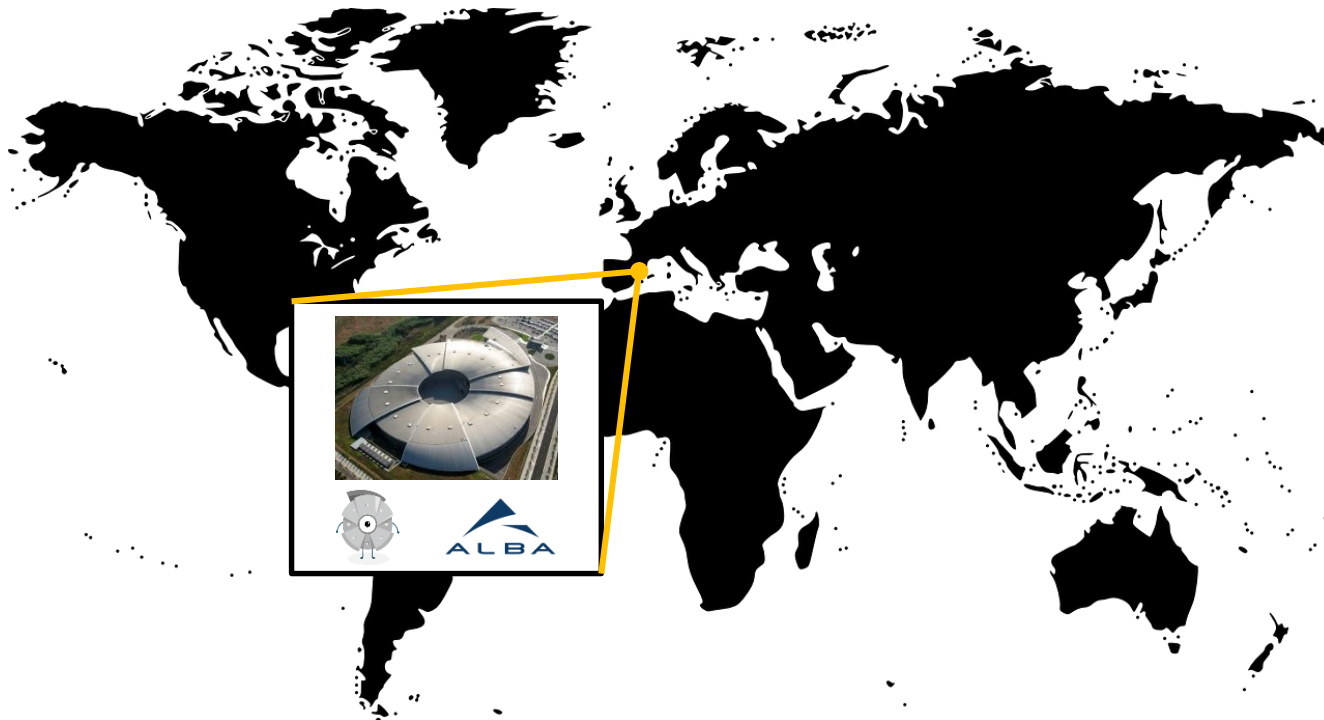
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ALBA Accelerator

**ALBA is a 3rd generation Synchrotron Light Source located in Barcelona**

ALBA Accelerators

- ✓ **3 Accelerators**
  - • Linac
  - • Booster
  - • Storage Ring (SR)

- ✓ **Beam stored at 3GeV**

- ✓ **Top-up mode up to 200mA**
  - • Injection every 20min

- ✓ **8 BLs running**

- ✓ **4 BLs in construction**

- ✓ **6000 h of operation/year**

STORAGE RING
E = 3GeV

LINAC
E = from 0 to 110MeV

BOOSTER
E = from 110MeV to 3GeV
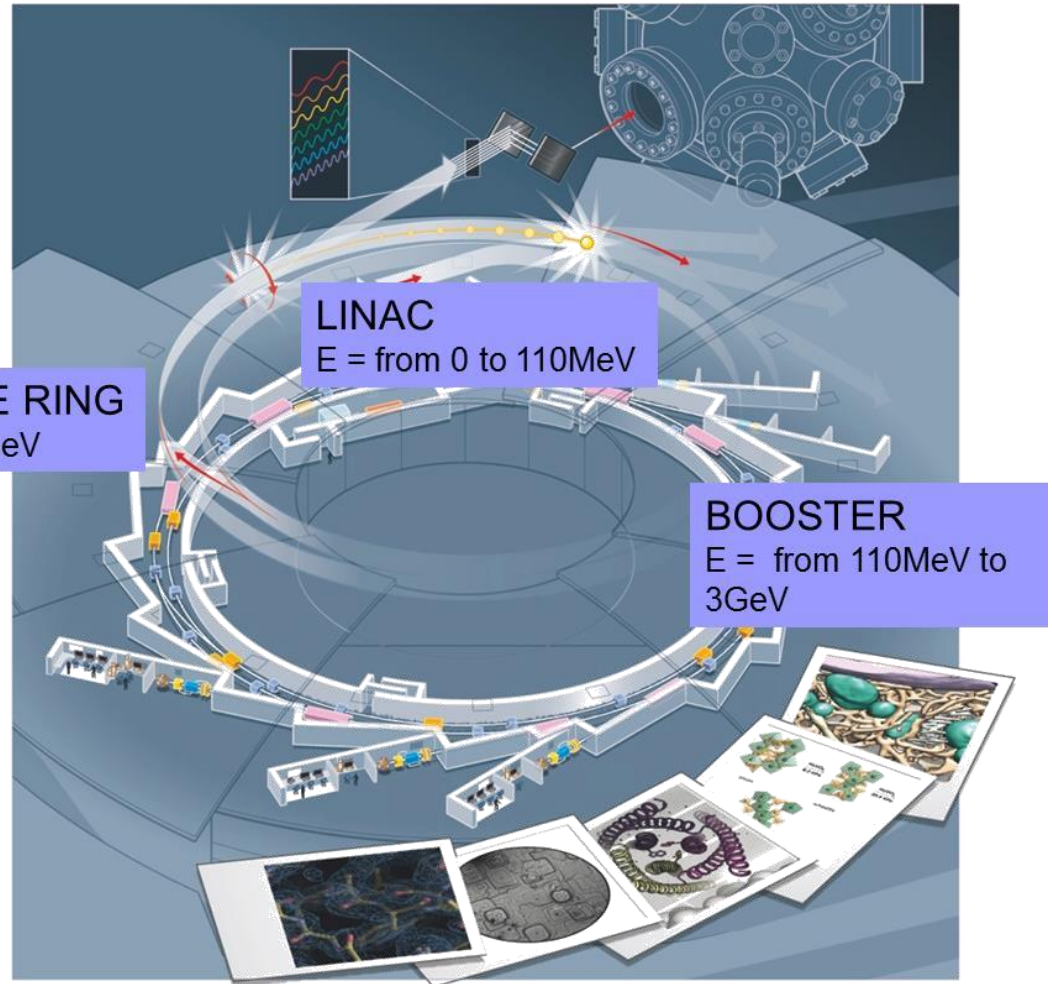
Pulsed elements at ALBA

Processes that required pulsed elements at ALBA
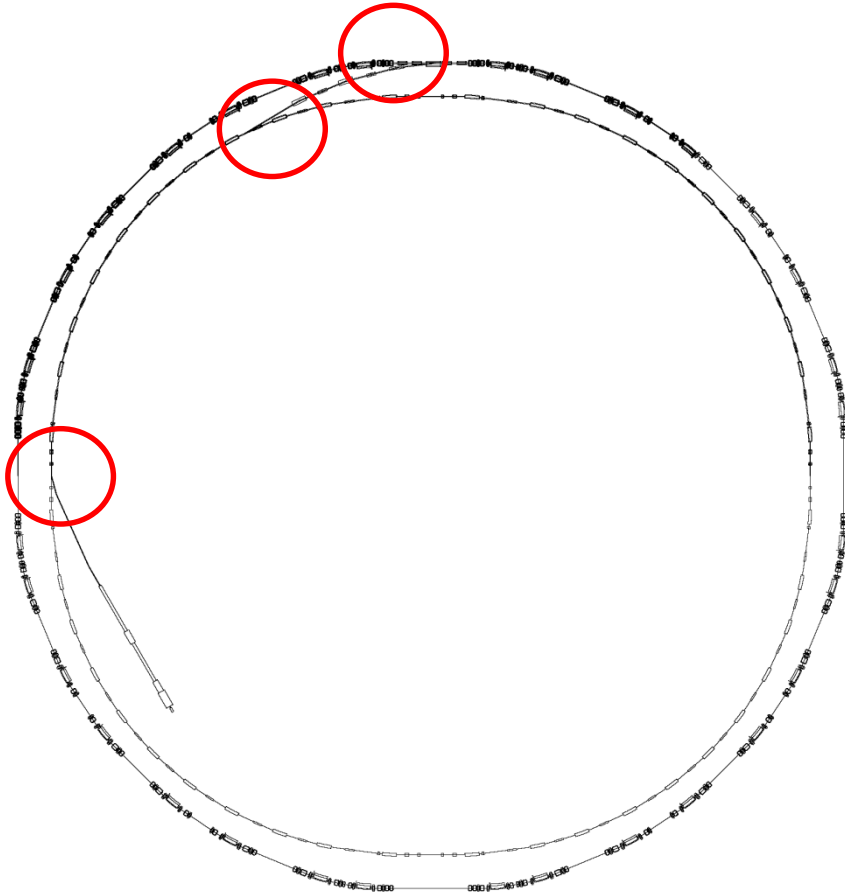
Injection from Linac to Booster
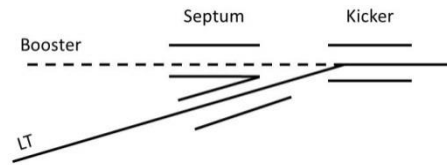
Extraction from Booster

Injection to Storage Ring

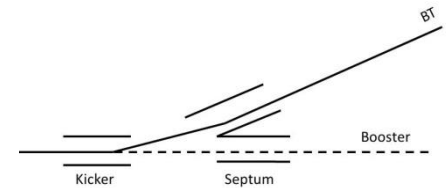# Booster pulsed elements

Injection to Booster & Extraction from Booster:

✓ On-axis processes
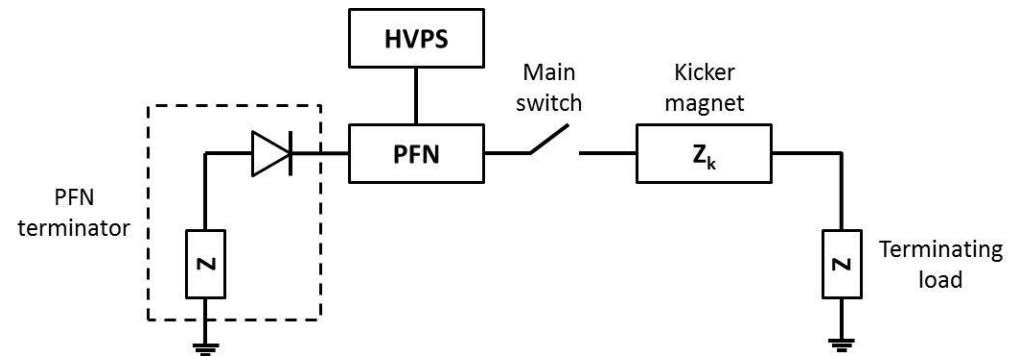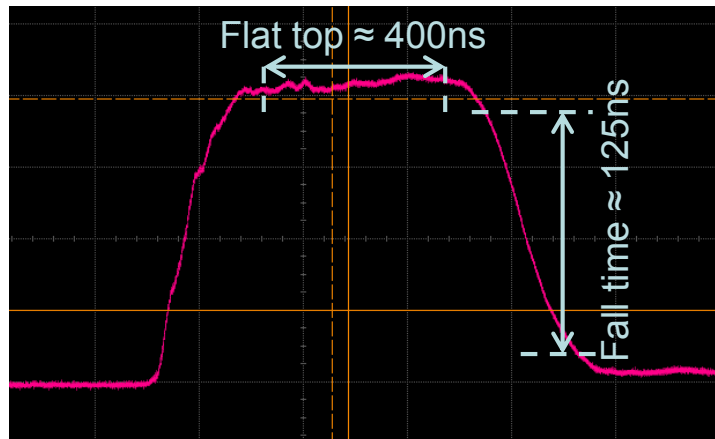
Injection to Booster

Extraction from Booster

✓ Fast switching kickers are needed to keep the beam after one turn

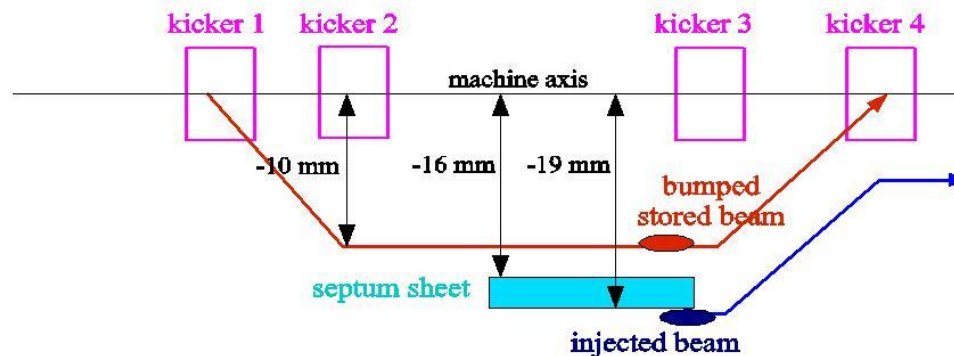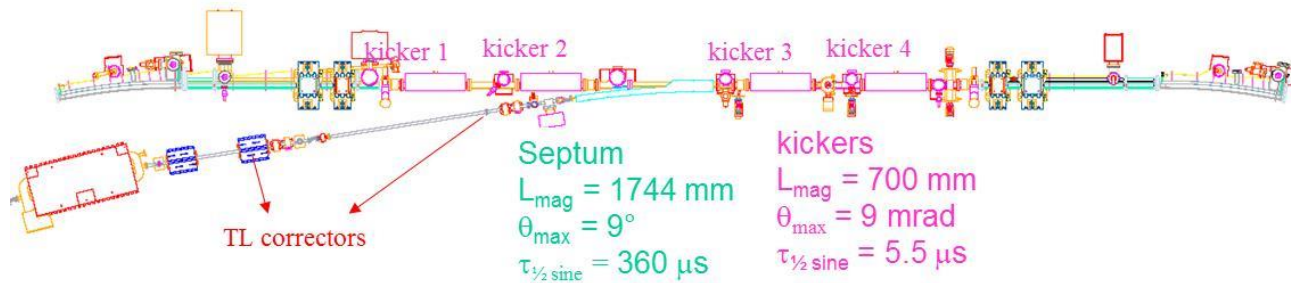✓ Pulse forming circuit: PFN, Thyratron CX2610 from E2V and kicker magnet ($Z_k < 20\Omega$)

✓ Ripple (flat top): ±5%

Flat top ≈ 400ns

Fall time ≈ 125ns

SR Injection Process

Injection to Storage Ring:

- ✓ Because of the stored beam on-axis injection cannot be used

- ✓ A set of 4 kickers create a local bump and the injected beam oscillates around this new orbit.

Septum
$L_{mag} = 1744$ mm
$\theta_{max} = 9°$
$\tau_{½\,sine} = 360$ μs

kickers
$L_{mag} = 700$ mm
$\theta_{max} = 9$ mrad
$\tau_{½\,sine} = 5.5$ μs

SR Injection Process

Injection to Storage Ring:

✓ Resonant discharge LC circuit: Uses GCT switches, a capacitor bank, and kicker magnet ($Z_k < 2\Omega$).

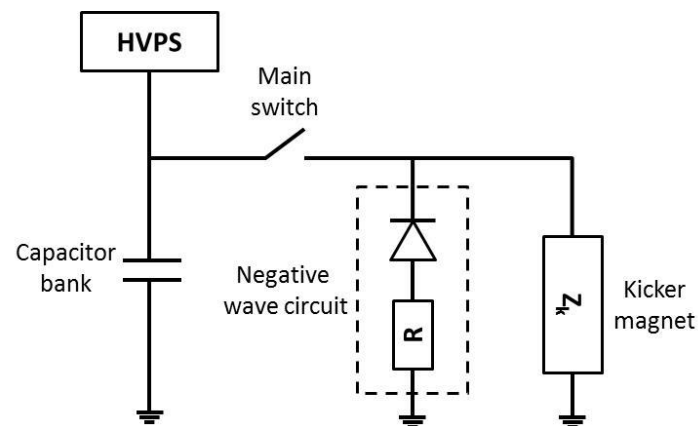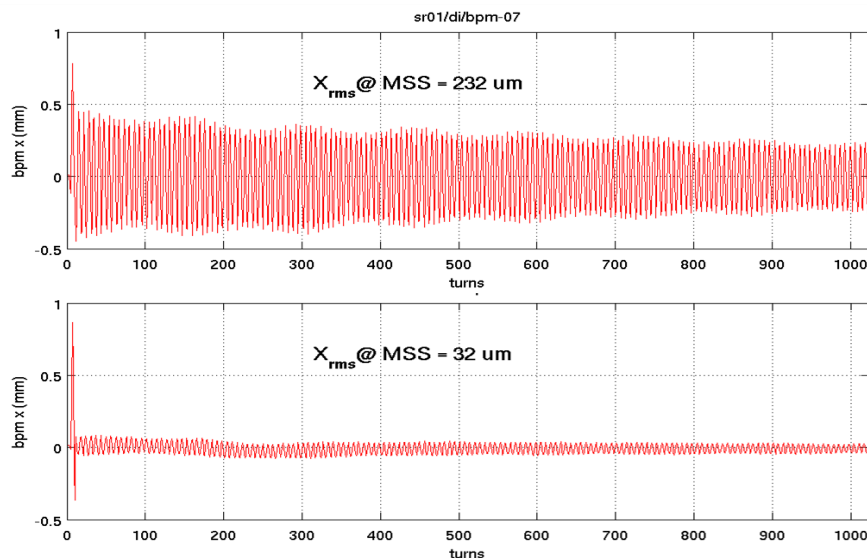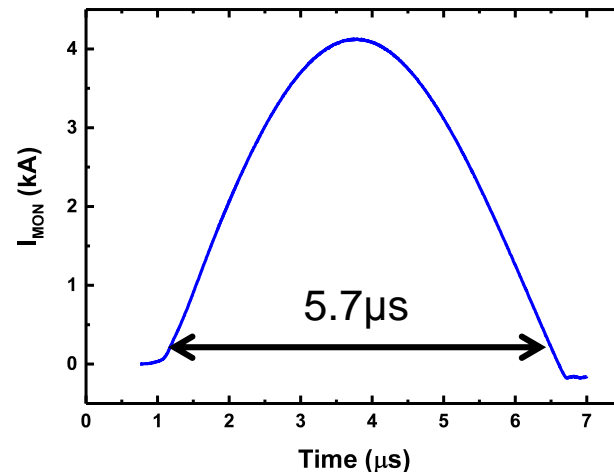✓ Injection bump has to be as closed as possible to avoid residual orbit distortions that can affect the stored beam

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Present diagnostic hardware

✓ LeCroy 425Zi scope with 20GS/s and 8 bits resolution

✓ Configured to measure the peak amplitudes and pulses delay

✓ Data saved as attributes in TANGO control system

✓ **BUT** depends on operator to start recording
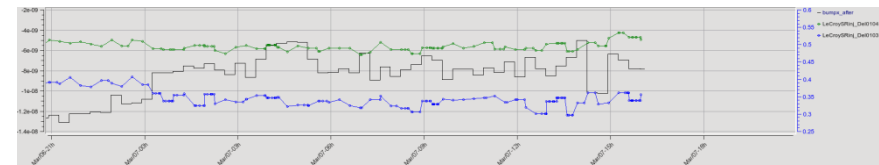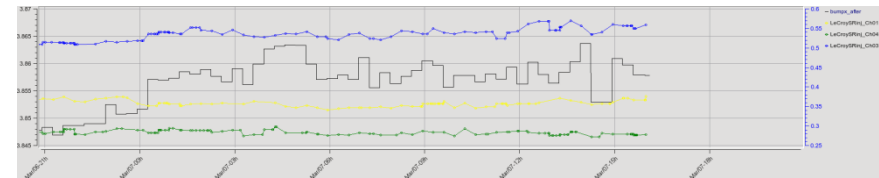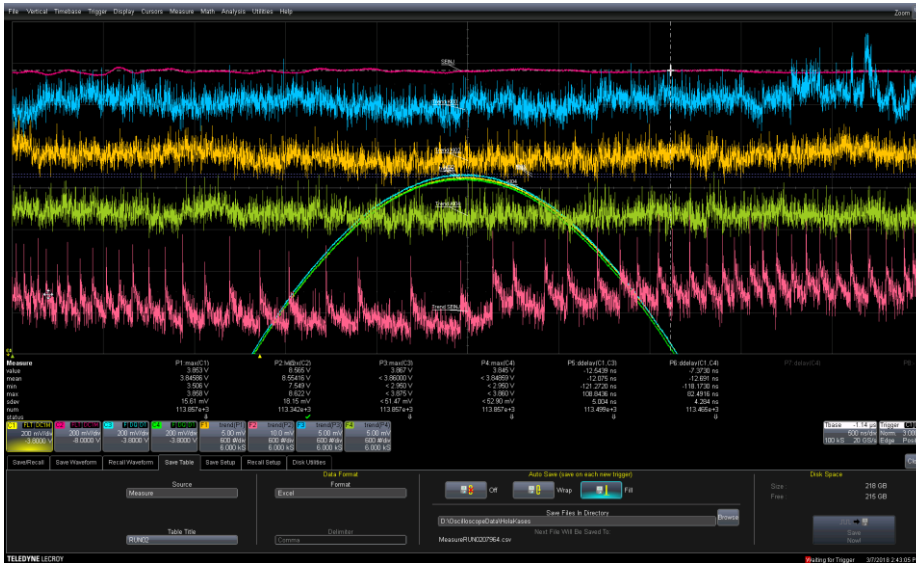
Diagnostic hardware

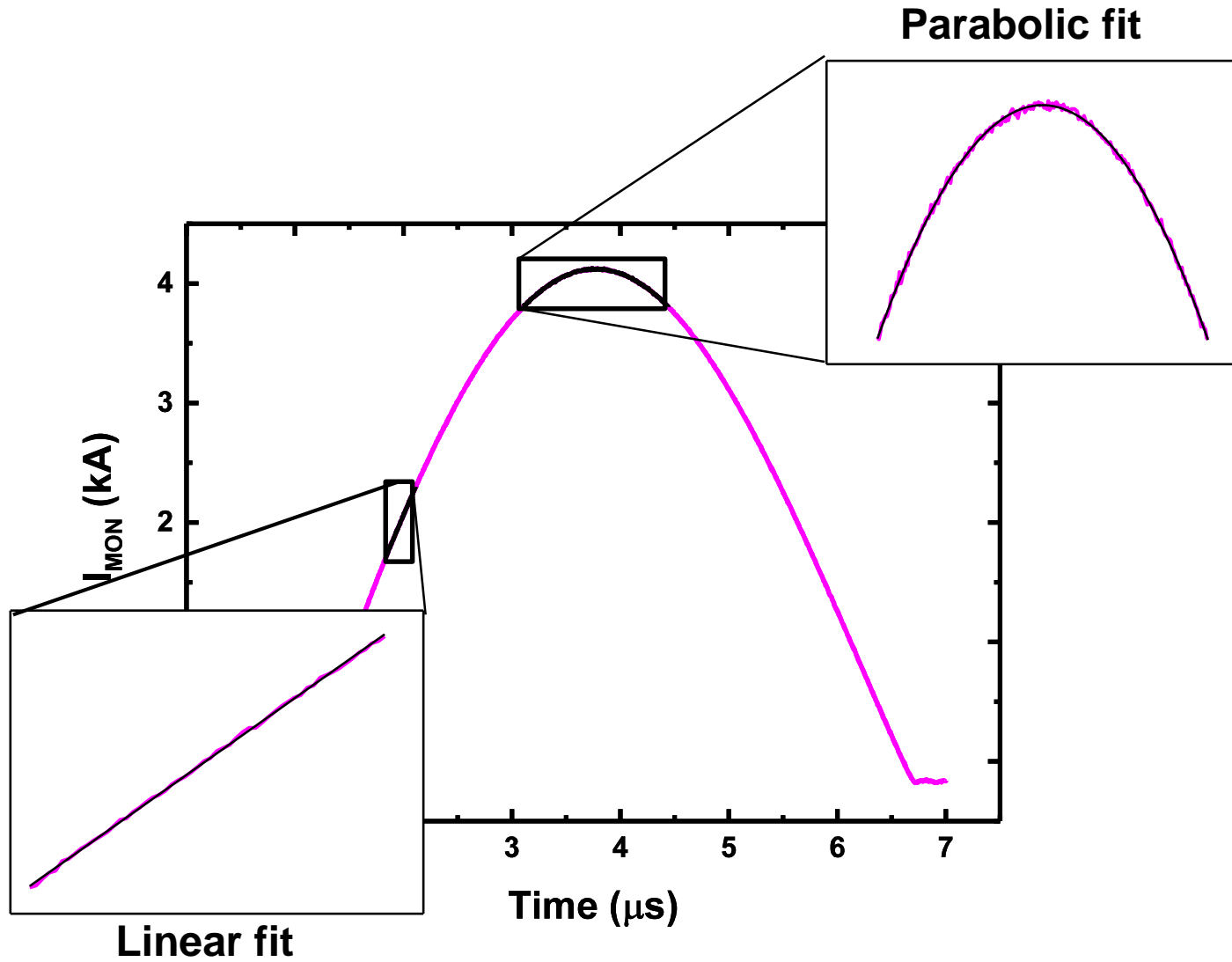|	Scopes	AD Converters
Speed	✓	✓
Resolution	✓	✓
Price	🤔	🤔
Flexibility	✗	✓
User friendly	✗	✓

Diagnostic hardware

ADLINK PCIe-9852 Digitizer

- ✓ 14-bit resolution

- ✓ Sampling rate 200MS/s

- ✓ Up to 90MHz Bandwidth

- ✓ 50Ω or 1MΩ impedance

- ✓ Offset error ±1mV

- ✓ 2 channels per card

Resolution

Parabolic fit

Linear fit

I_{MON} (kA)

Time (μs)

Resolution

✓ Comparable resolution to the LeCroy scope

✓ Vertical resolution: 0.03%

✓ Time resolution: 1ns
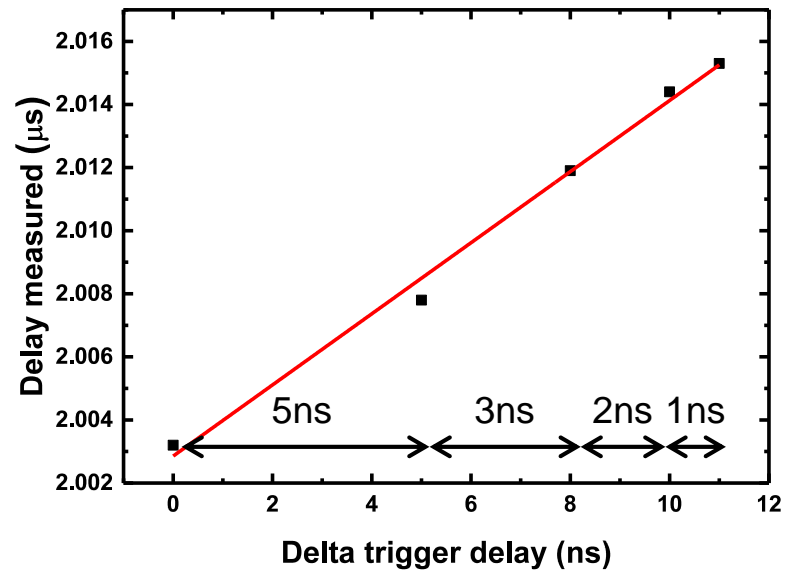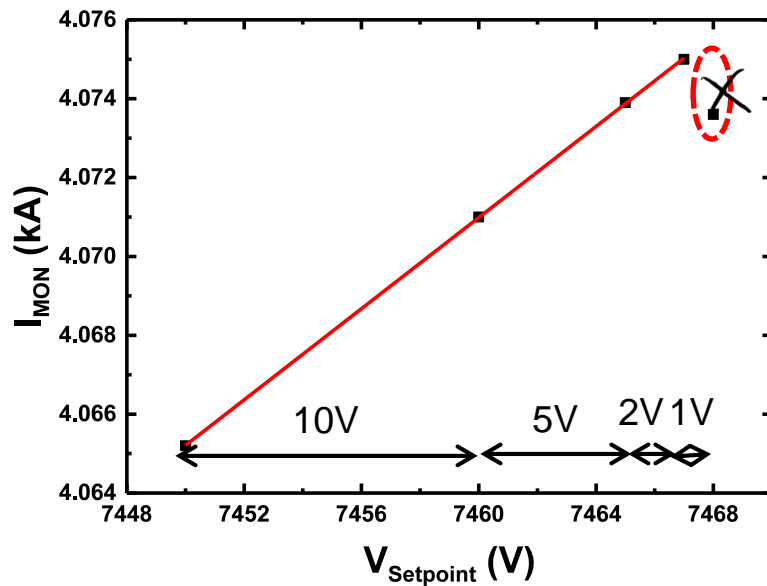
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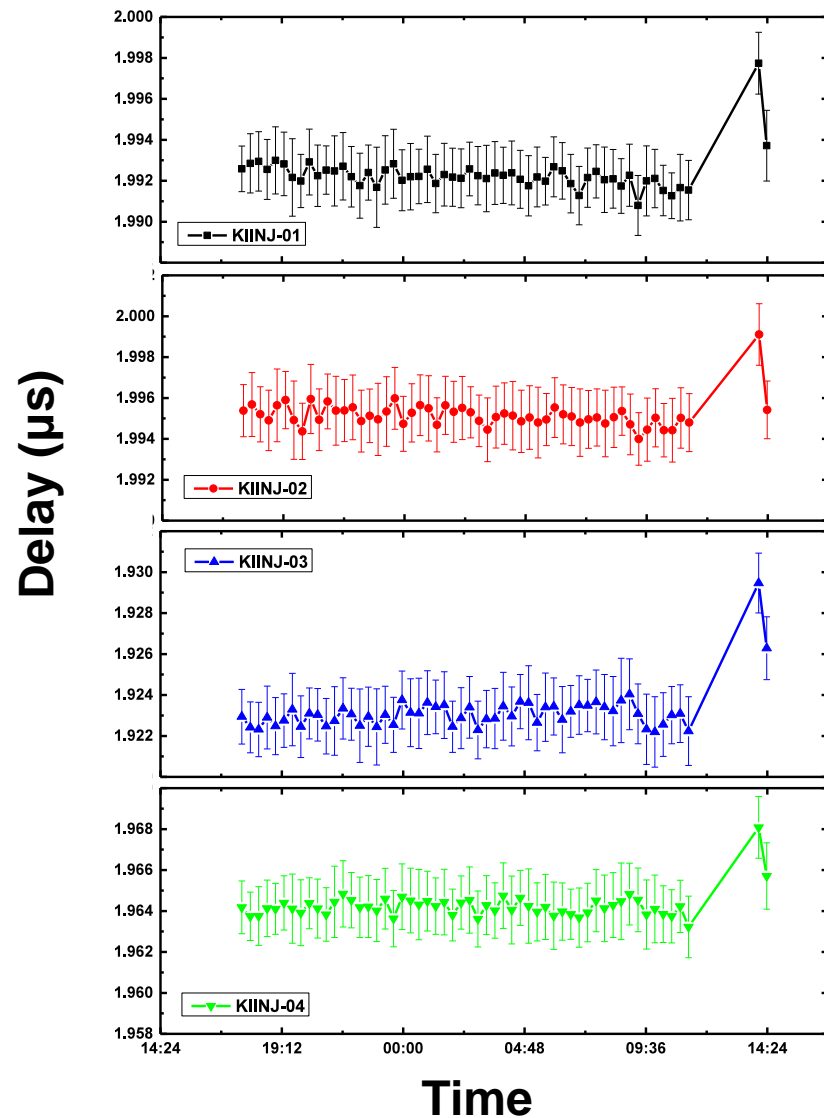# Measurements during operation
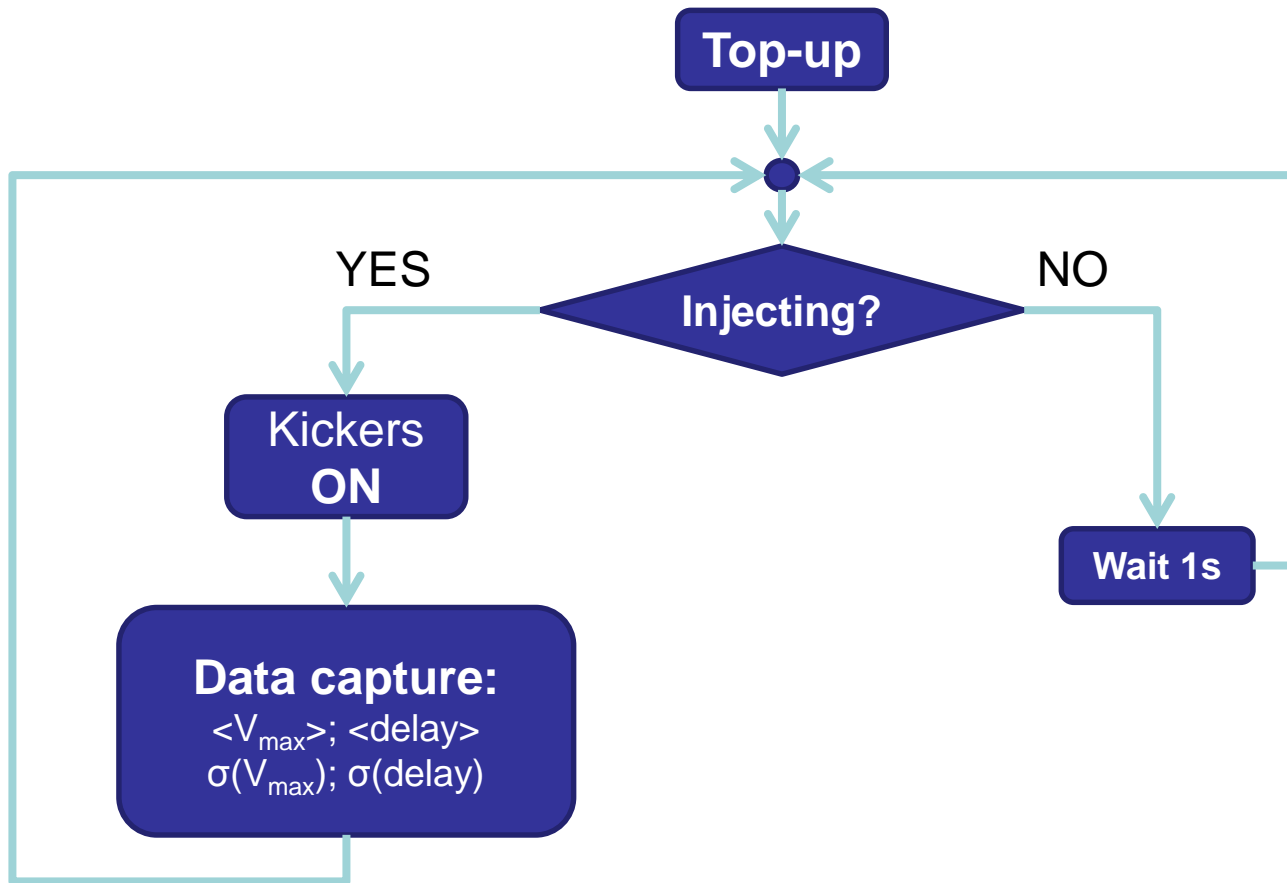
✓ 30 pulses per MBM_injection and per magnet

✓ Data averaging per injection and per magnet of pulse peak and delay

Measurements
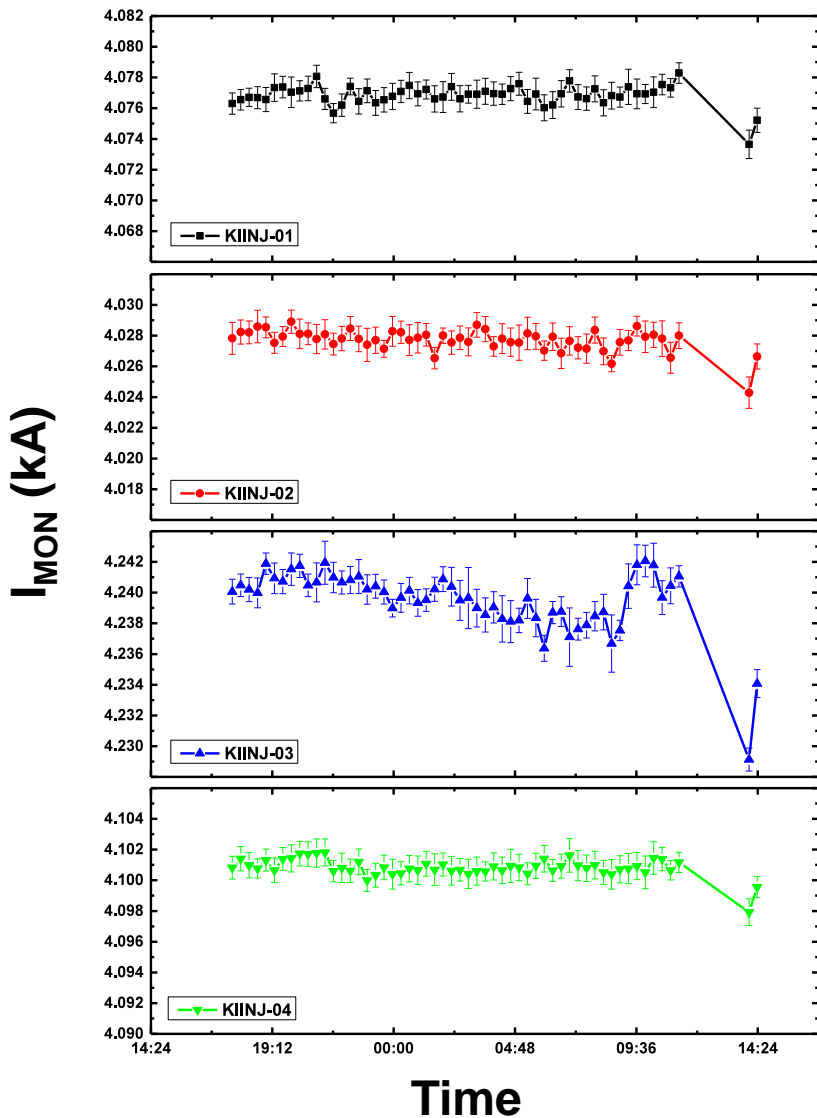
Measurements

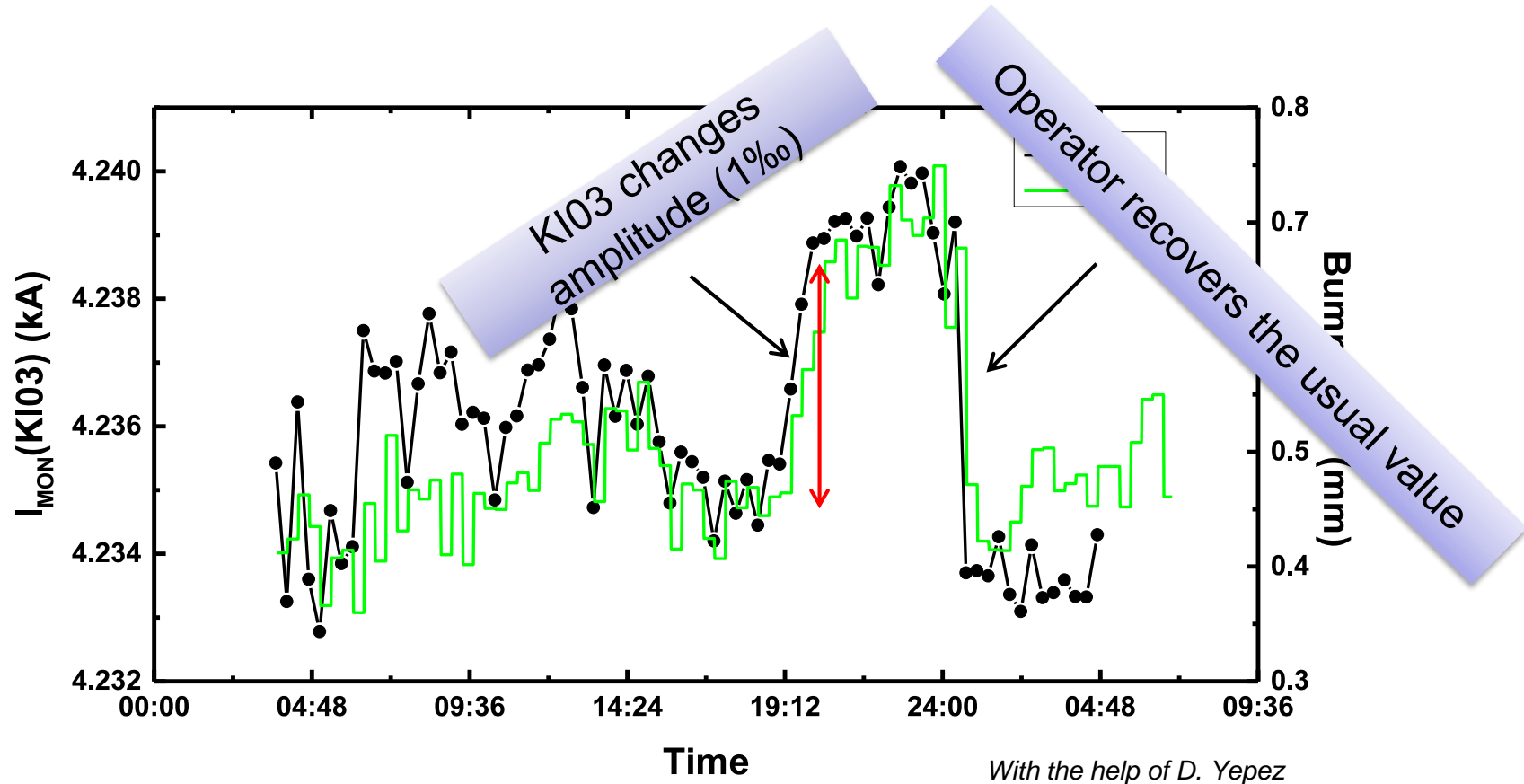**Changes in KI03's amplitude caused a bump increment**

With the help of D. Yepez

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Summary

- ✓ A new diagnostic system is proposed to measure the SR Kickers in the ALBA synchrotron.

- ✓ The system is based on ADCs: **ADLINK PCIe-9852 Digitizer**.

- ✓ The resolution is 0.03% in amplitude and 1ns in time.

- ✓ The ADCs will allow continuous monitoring of the kickers and correlation with the injection bump.

- ✓ Integration into TANGO control system under development.

- ✓ Next step: allow automatic correction of kickers amplitudes & delays

Thanks!

Questions?