ALBA RF Status
Francis Perez

The RF Group: *Paco Sanchez*

Angela Salom

Bea Bravo (since Oct. 2009)

Support Engineering Division
Support Computing Division
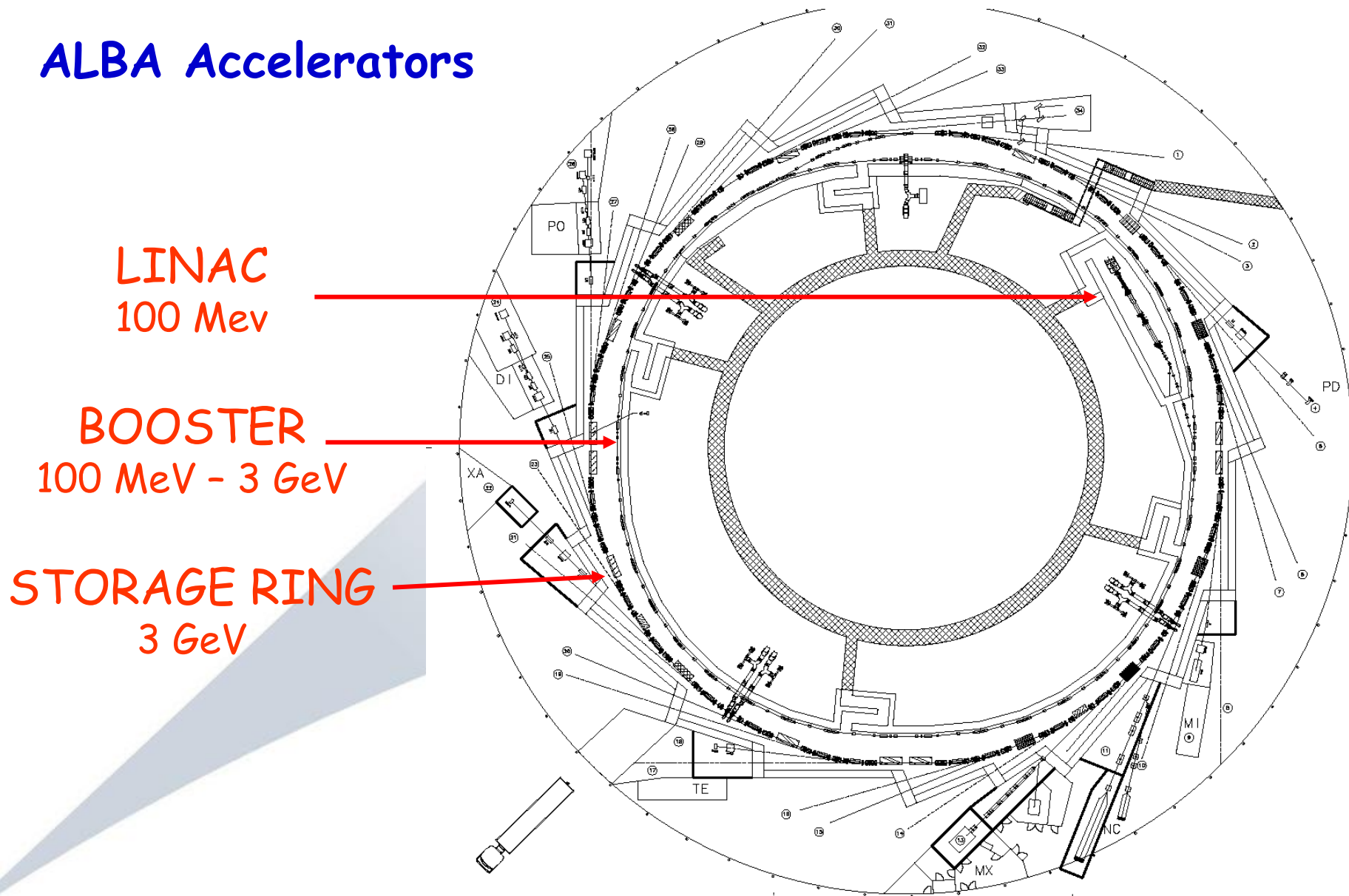**Support Operators Group**

- ALBA overview and status

- Booster RF System

- Storage Ring RF System

- Next

Synchrotron Light Source in Cerdanyola (Barcelona, Spain)

December 2009

ALBA Accelerators

LINAC
100 Mev

BOOSTER
100 MeV – 3 GeV

STORAGE RING
3 GeV

Booster commissioning started:
- 2 weeks in January
- 2 weeks in July
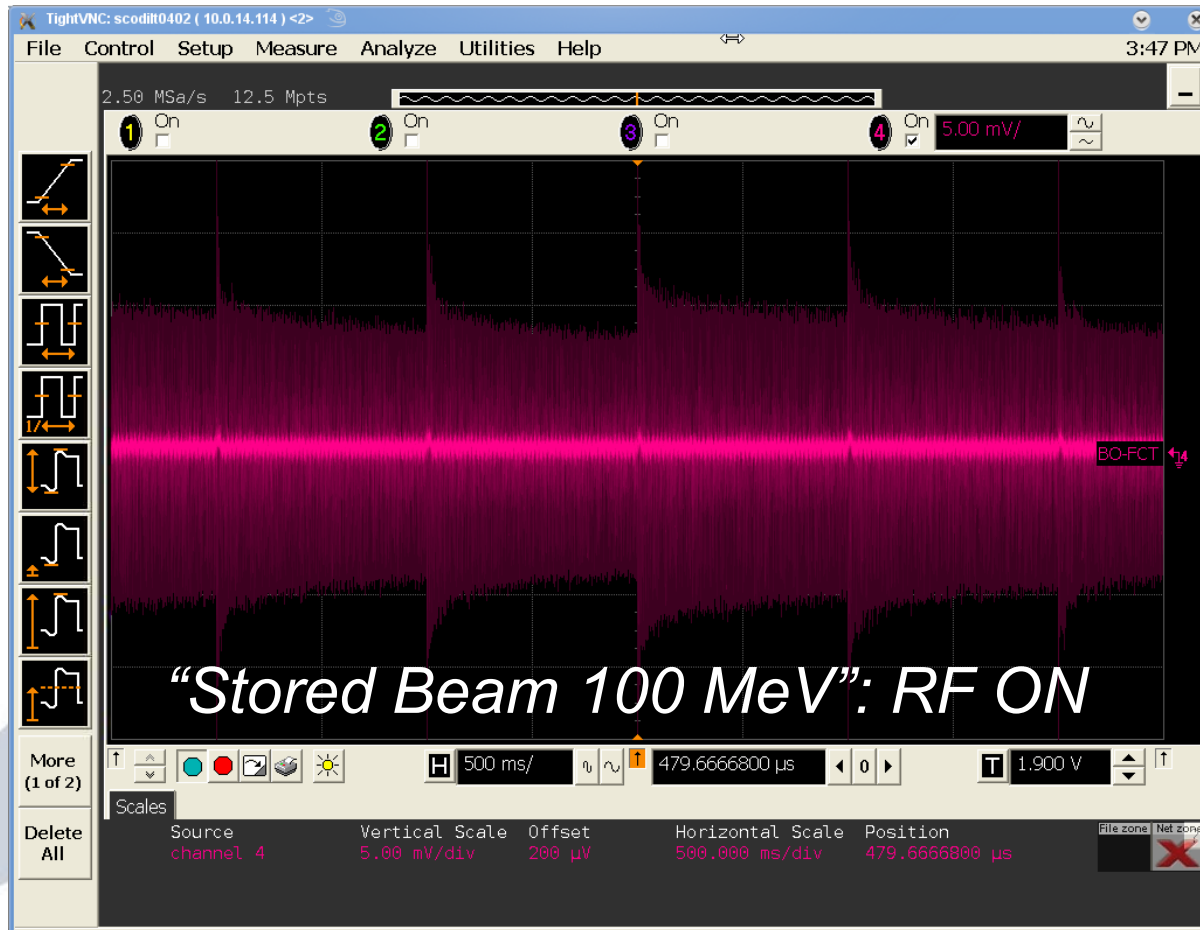- Afternoons since Monday 27.09

SR installation completed. Some testing of subsystems pending.

SR commissioning starts November 2010 without IDs.

SR commissioning with IDs by March 2011

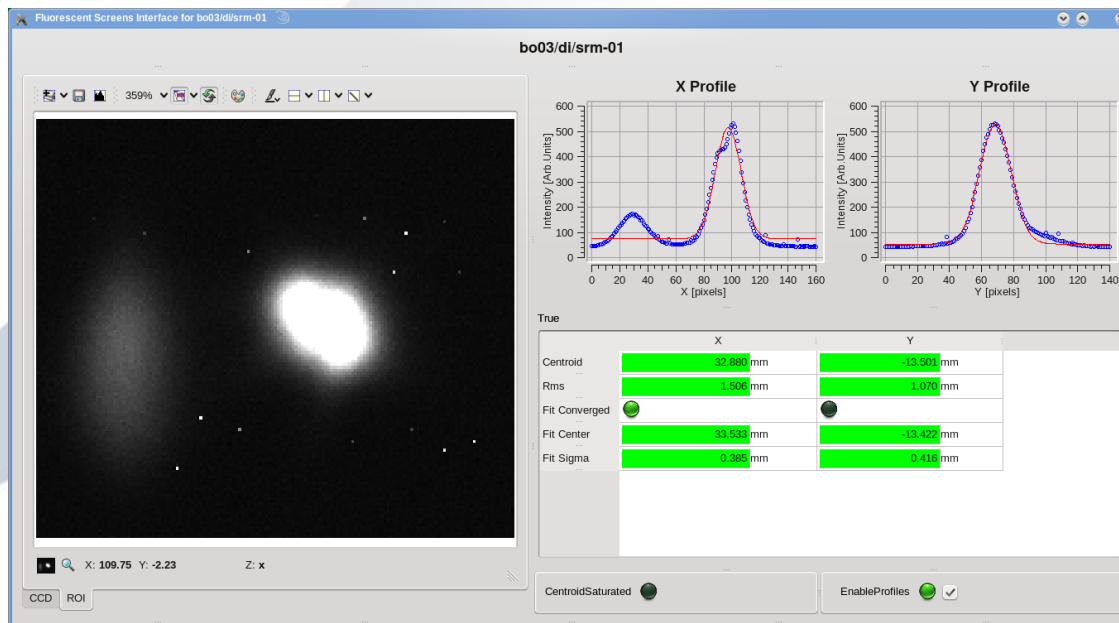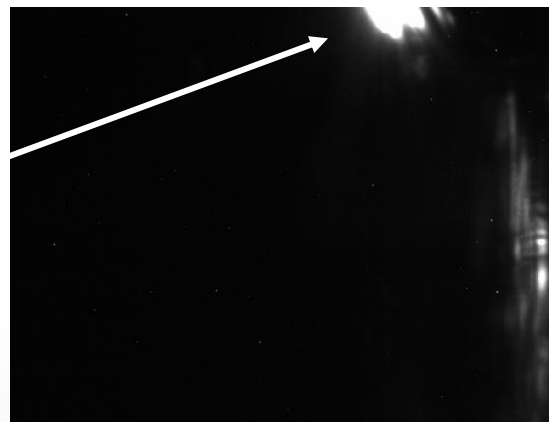1st beam for beamlines commissioning April 2011

BOOSTER COMMISSIONING
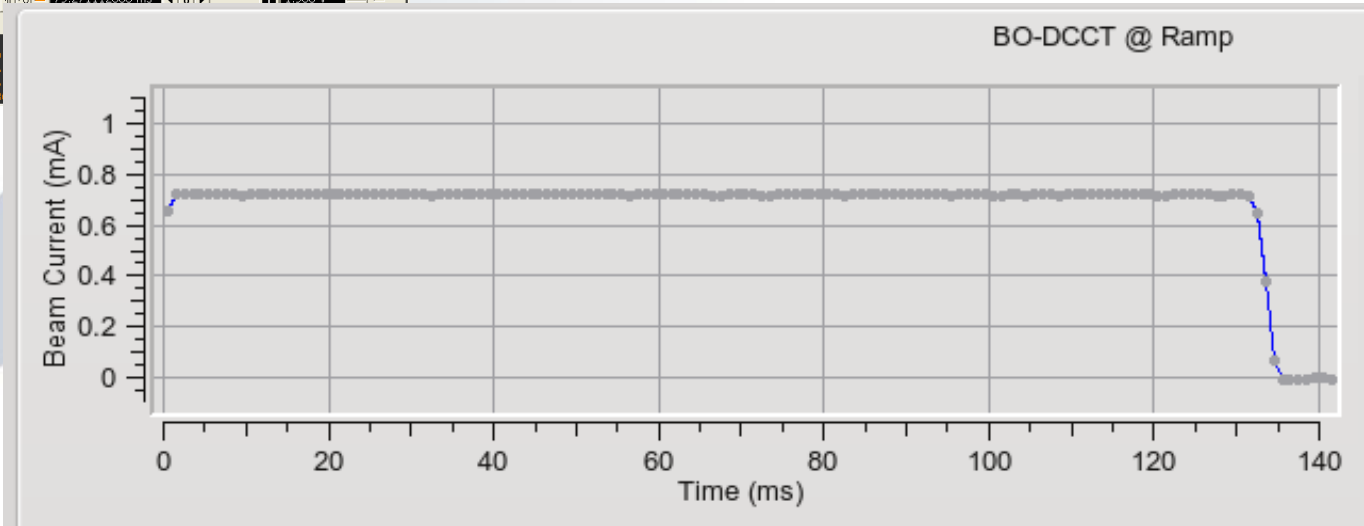

5 seconds,
5 injections
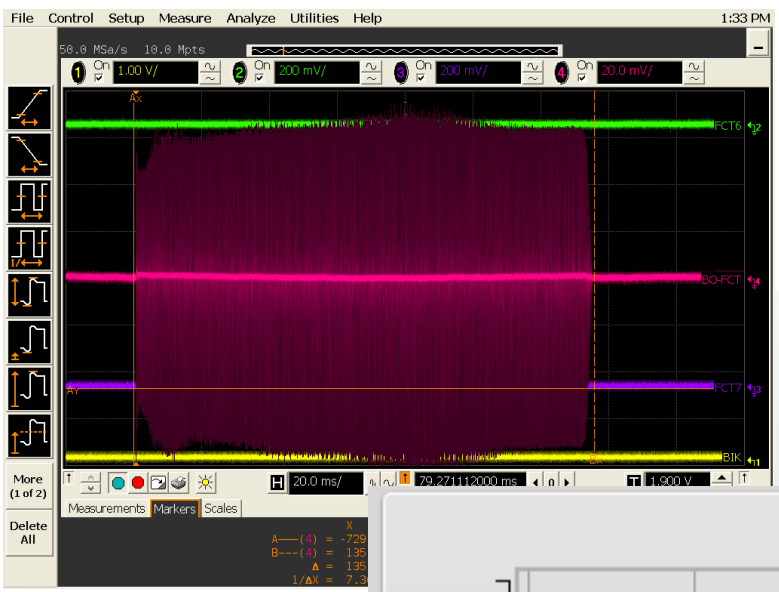
BOOSTER COMMISSIONING

1st Synchrotron Light in Spain

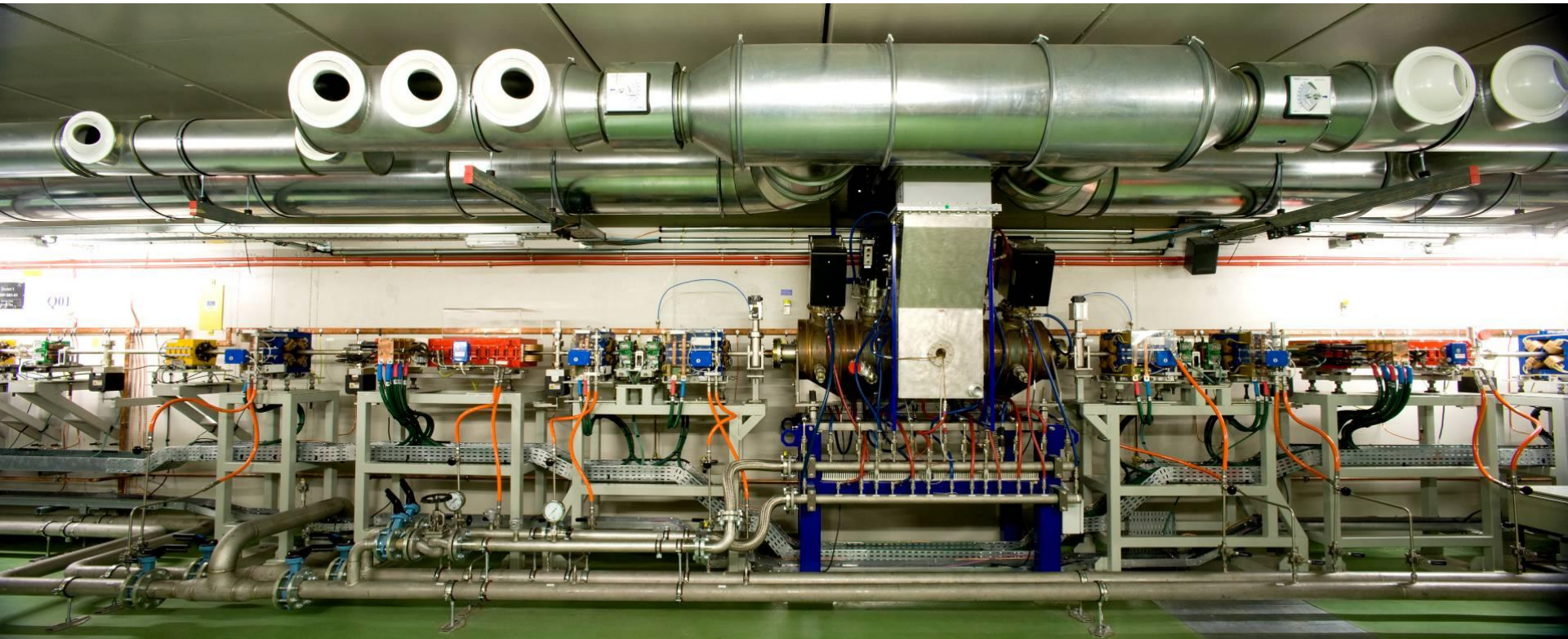# BOOSTER COMMISSIONING

2.7 GeV with 0.7 mA

90 % Energy

and

70% current

of nominal values

January 2010

Booster RF System

Booster Transmitter

Spring 2009:

✓ DC Commissioning
(with Thomson)

Oct - Nov 2009:

✓ RF Power Commissioning (with Thomson)
-RF shutter closed and full RF power on load-

✓ SAT passed on **November 5th, 2009**

Booster Cavity

November 2009:

✓ Cavity installed and aligned

✓ Vacuum OK

✓ Cabling and Sensors installed

✓ Water cooling connected

✓Air cooling (RF window and WATRAX)

✓ EPS and interlock OK

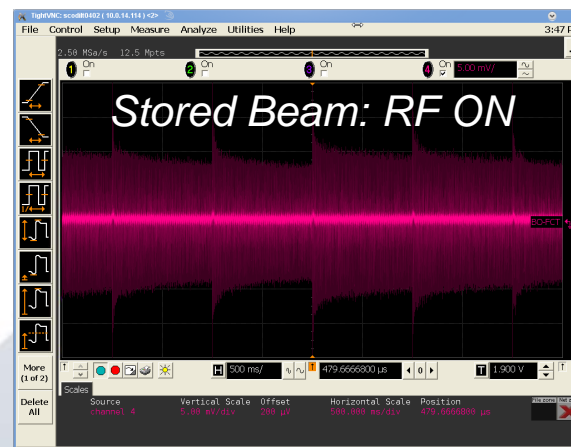# Booster LLRF: Conditioning and Calibration

Nov – Dec 2009:

✓ Full RF Plant ready
✓ Tunnel closed (Operation in parallel with the Bo PS testing)
✓ 60 kW in the cavity (35 kW used during Booster commissioning)
✓ Calibration done

Closed Loop Calibration
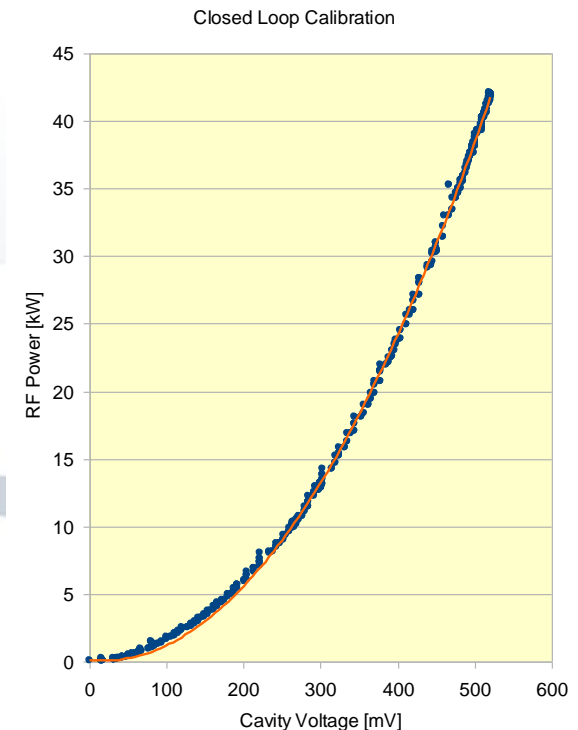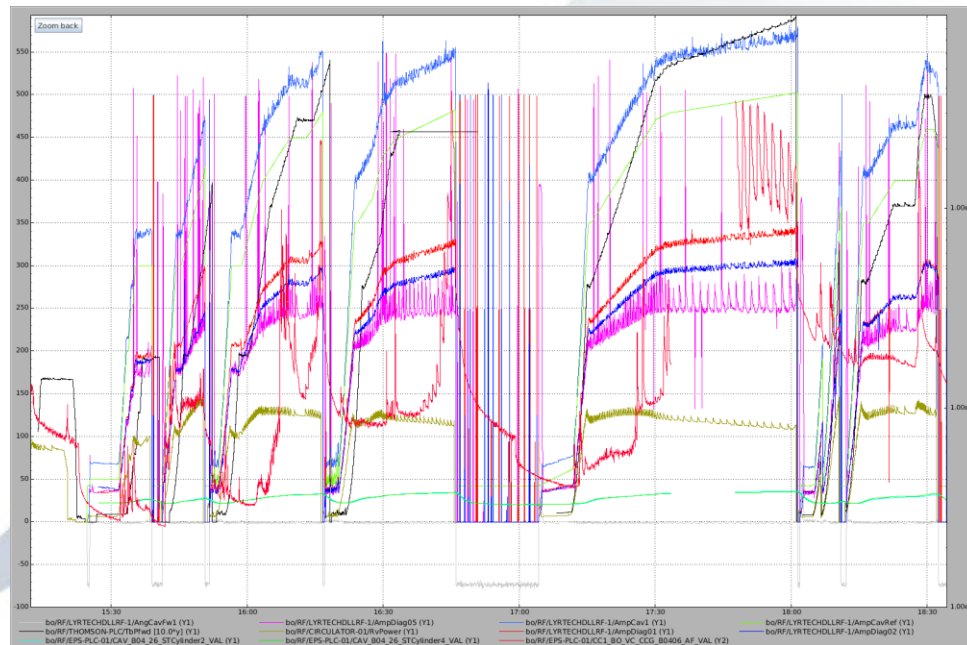
LLRF: Automatic Start up

Feb 2010:

✓ After the experience during the Booster commissioning

Stored Beam: RF ON

✓ To easy the recovery after a trip
✓ To avoid operator errors

✓ **Automatic Start up:**

✓ Automatic Start up:

- After a trip LLRF set all parameters to minimum:
  - *Low RF drive*
  - *Disable tuning*
  - *Open loops (I&Q)*
- Operator reset the interlock and switch on the transmitter
- LLRF detect the presence of RF power at cavity input
- LLRF tune the cavity before allowing high power
- LLRF close the loops and check loops stability
- Smooth power increase
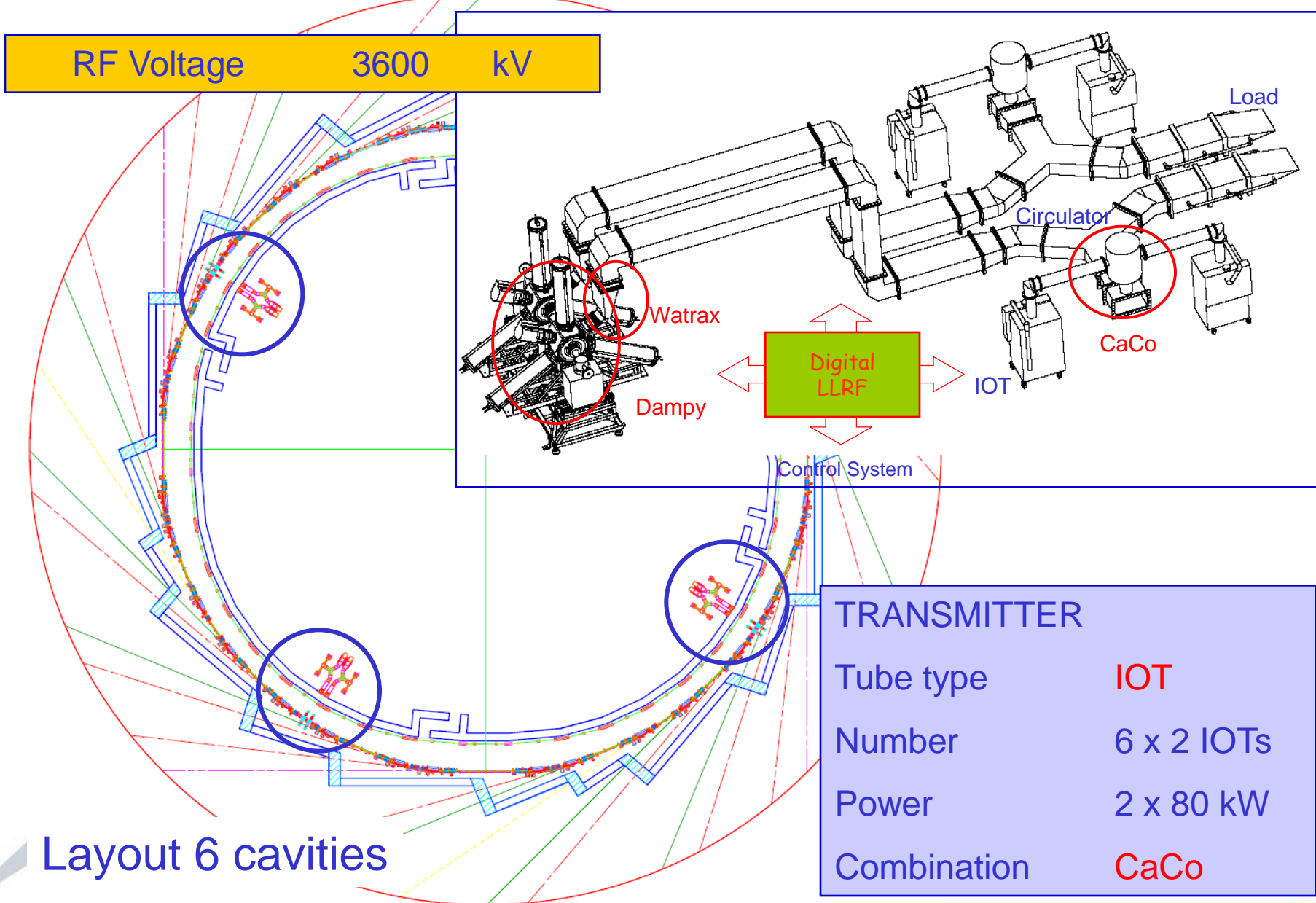- *Message RF ready for beam*

RF Power →

Tuning pulses →

Plungers direction
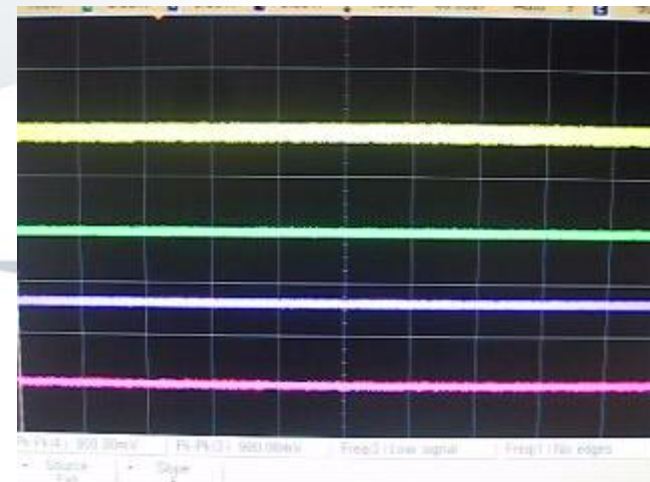
Storage Ring RF System

RF Voltage   3600   kV

Load

Circulator

Watrax

Dampy

Digital LLRF

IOT

CaCo

Control System

TRANSMITTER

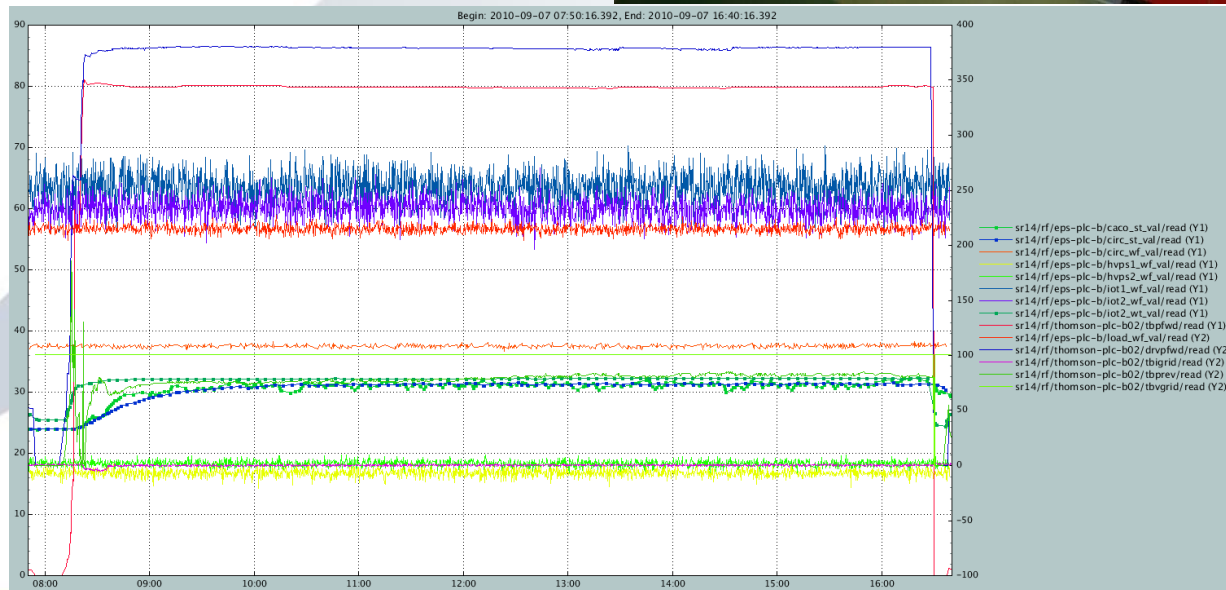| Tube type	IOT
Number	6 x 2 IOTs
Power	2 x 80 kW
Combination	CaCo

Layout 6 cavities

SR Transmitters

March - September 2010:

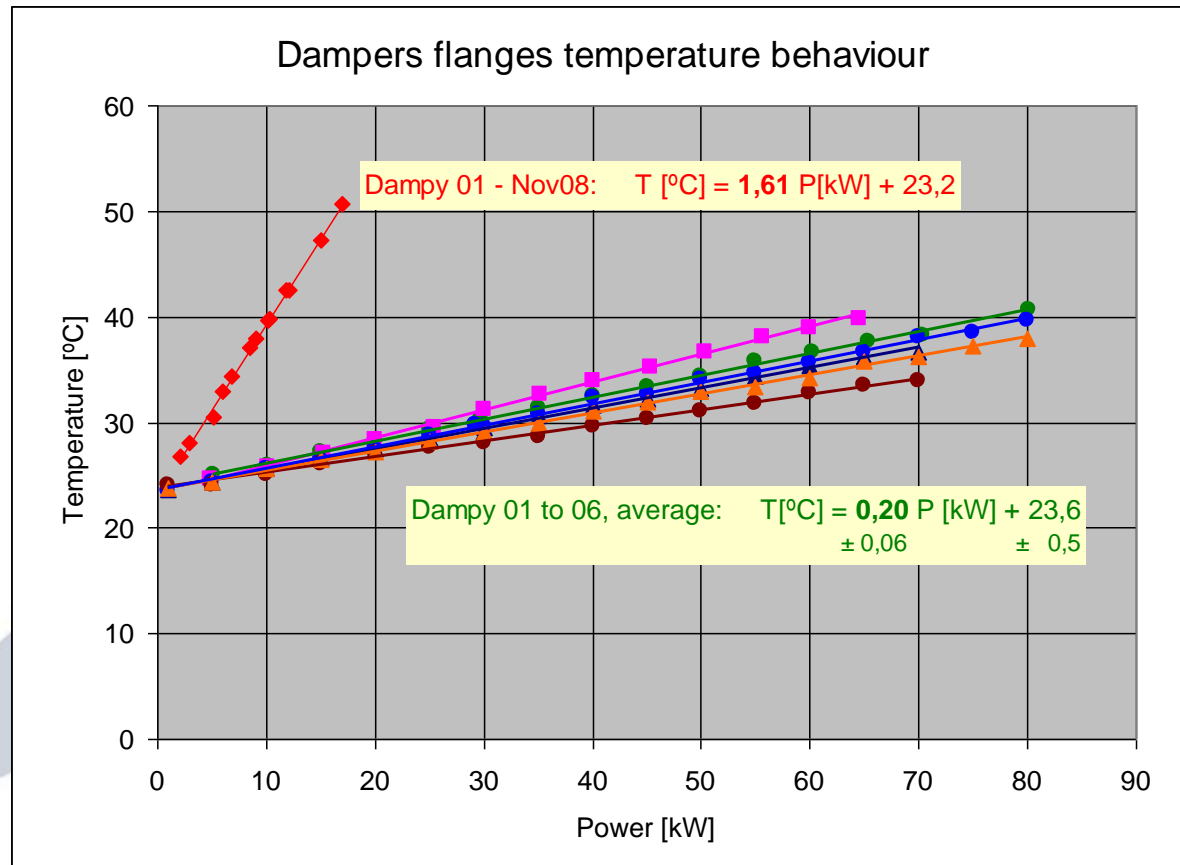✓ RF Commissioning (with Thomson)

12 SR transmitters has passed the SAT
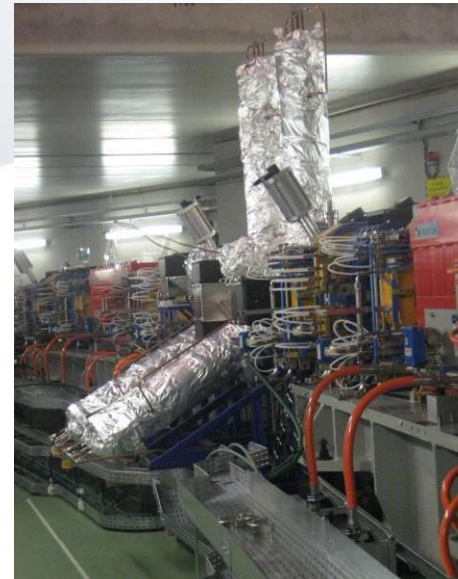
Details by Paco Sanchez

SR Dampy Cavities

Conditioning at RF lab

Dampers flanges temperature behaviour

Dampy 01 - Nov08:   T [ºC] = **1,61** P[kW] + 23,2

Dampy 01 to 06, average: T[ºC] = **0,20** P [kW] + 23,6
± 0,06   ±   0,5

April 2009 to January 2010

SR Dampy Cavities

- ✓ All 6 performing well
- ✓ Installed and bake-out in situ
- ✓ Alignment, cabling and cooling ready

Waveguide system: Circulator problems

*Ferrite Inc. (USA)*

Control by minimising the VSWR:

- Measure forward and reflected power

- Compute VSWR

- Act on the PS of the circulator

Problems during cavity conditioning:

Pulsed conditioning: No responding due to slow control

CW conditioning: During autotune it changes slightly the IOT load, i.e. IOT power, so sudden increase of power to the cavity and (ussualy) a vacuum trip.

Waveguide system: Circulator problems
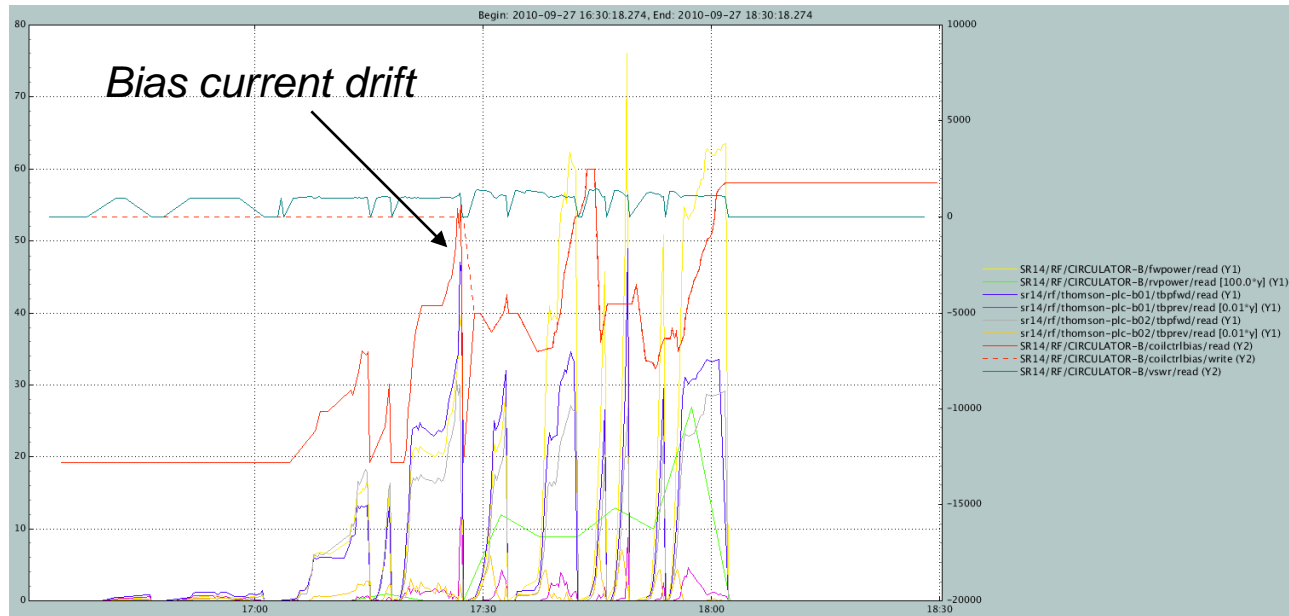
Solution:

Condition the cavities with the circulator on <u>Manual Mode</u>
(no very convenient, but ok)

In addition we have to send a circulator back to Ferrite since it was wrongly adjusted to cope with 160 kW of power.

Digital LLRF System

All modules installed:

- ✓ Analogue Front ends

- ✓ Amplitude and Phase Control Loop

- ✓ Tuning loop

- ✓ Timing system

- ✓ RF detectors

- ✓ Arc detector

- ✓ Fast Interlock Modules (FIM)

Conditioning and Calibration

June – September 2010:

✓ All RF Plants ready
✓ Cavities:
  ✓ Four cavities conditioned up to 70 kW
  ✓ One cavity under conditioning this week
  ✓ Last cavity under cooling reparation (flowmeters)
✓ Calibration on going
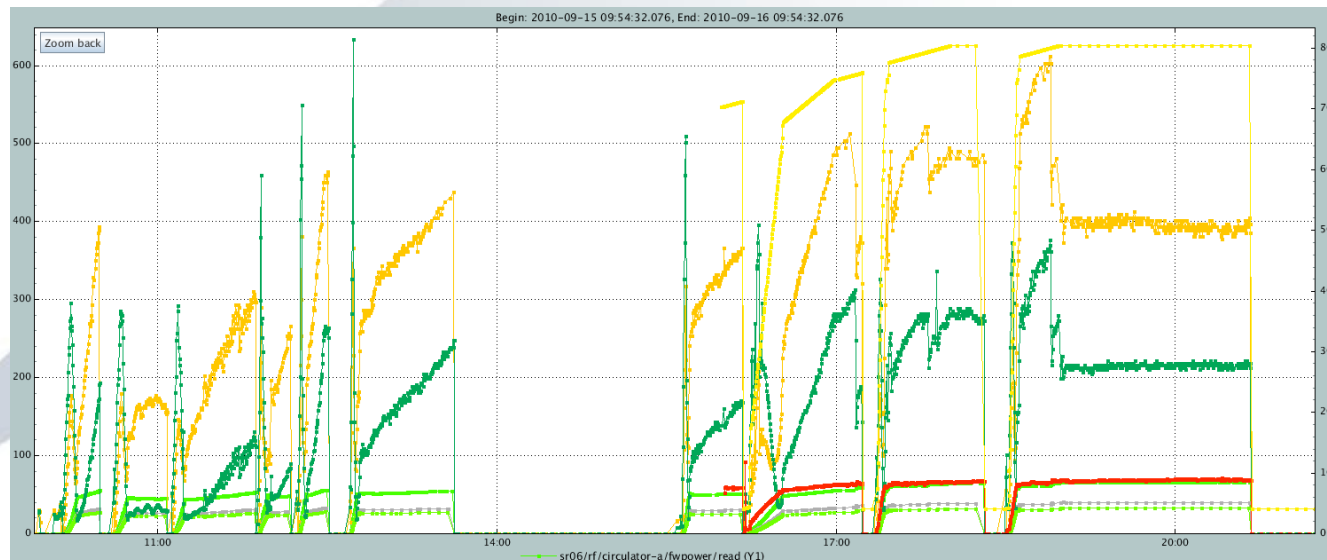
NEXT:

ALBA commissioning:

✓ Linac + Booster + SR + Beamlines

CaCo improvement:

✓ *See Bea presentation*

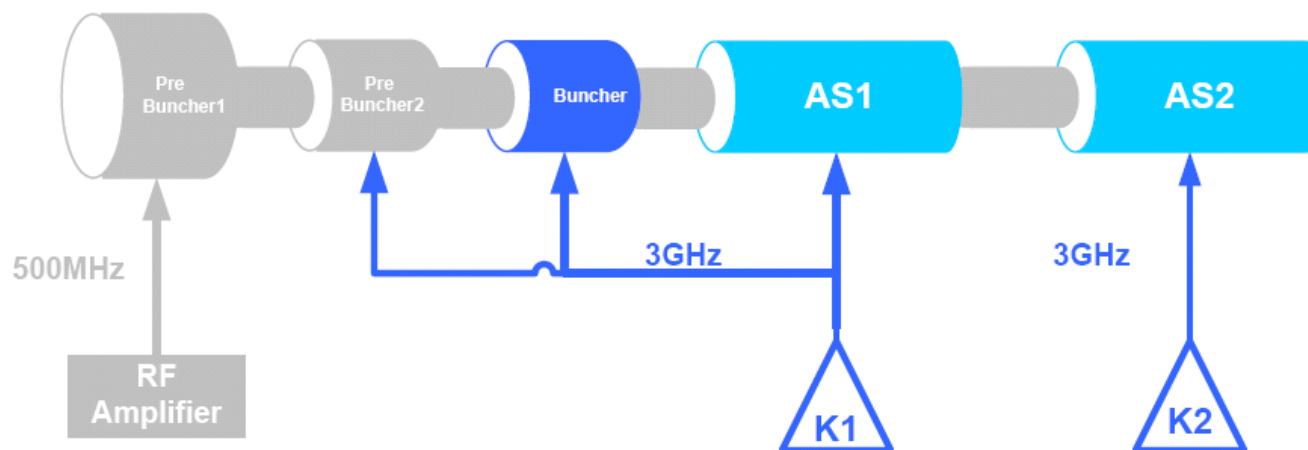### *Linac RF pulse digitalisation:*

✓ …

Linac RF pulse digitalisation

RF Linac Pulses Characteristics

- ✓ RF Frequency: 500MHz & 3GHz
- ✓ Pulse width: 4µs
- ✓ Repetition rate: 1Hz – 3Hz

Available RF Signals

- ✓Fw PB1, FwPB2 & FwB, FwK1 & FwK2, FwAS1 & FwAS2

Front End

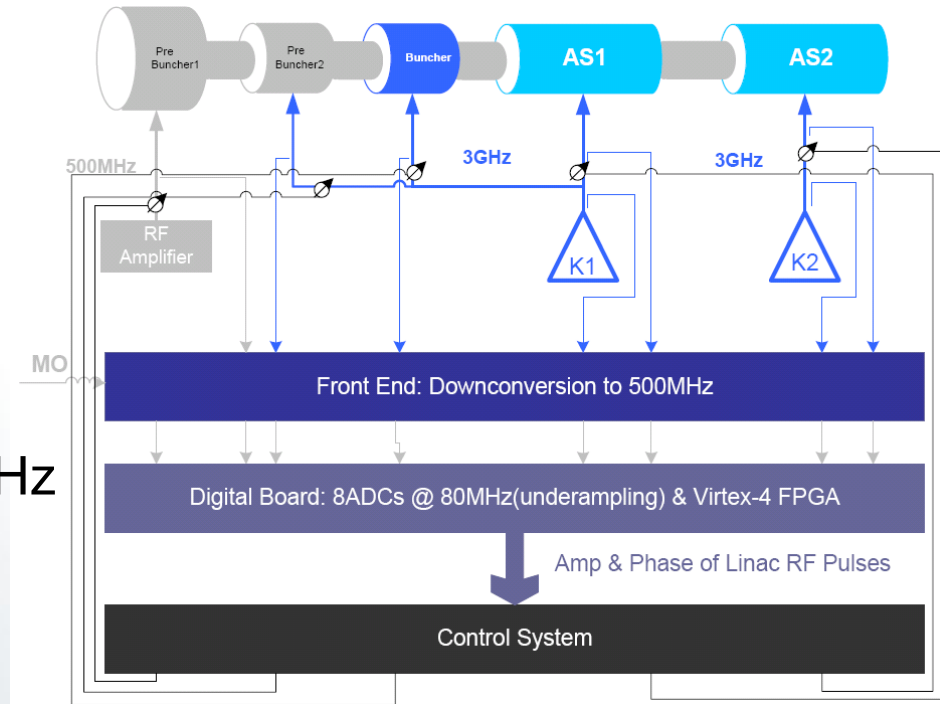✓Downconversion of 3GHz signals to 500MHz (IF)

✓LO: 3.5GHz

Digital Board

✓ 8 ADCs and Virtex-4

✓ IF signals undersampled at 80MHz
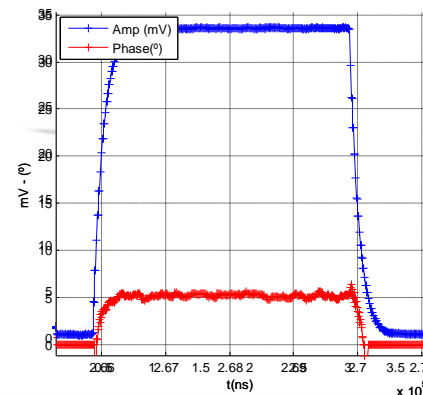
✓ Amp & Ph information to CS

Control System (CS)

✓At present: Manual Phase adjustment of RF signals

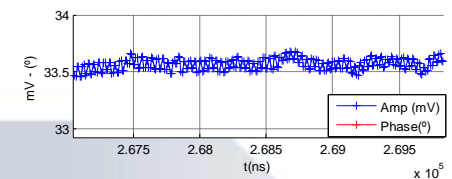✓ Next Step: Automatic phase adjustment

First Tests (4us pulse)
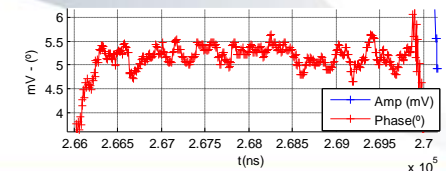
✓Amp Error: $0.2mV_{pp}$

✓ Phase error : 0.6^0_{pp}

Pulse 4us

Amplitude Resolution

Phase Resolution

Thank you