



# ALBA RF System

F. Perez

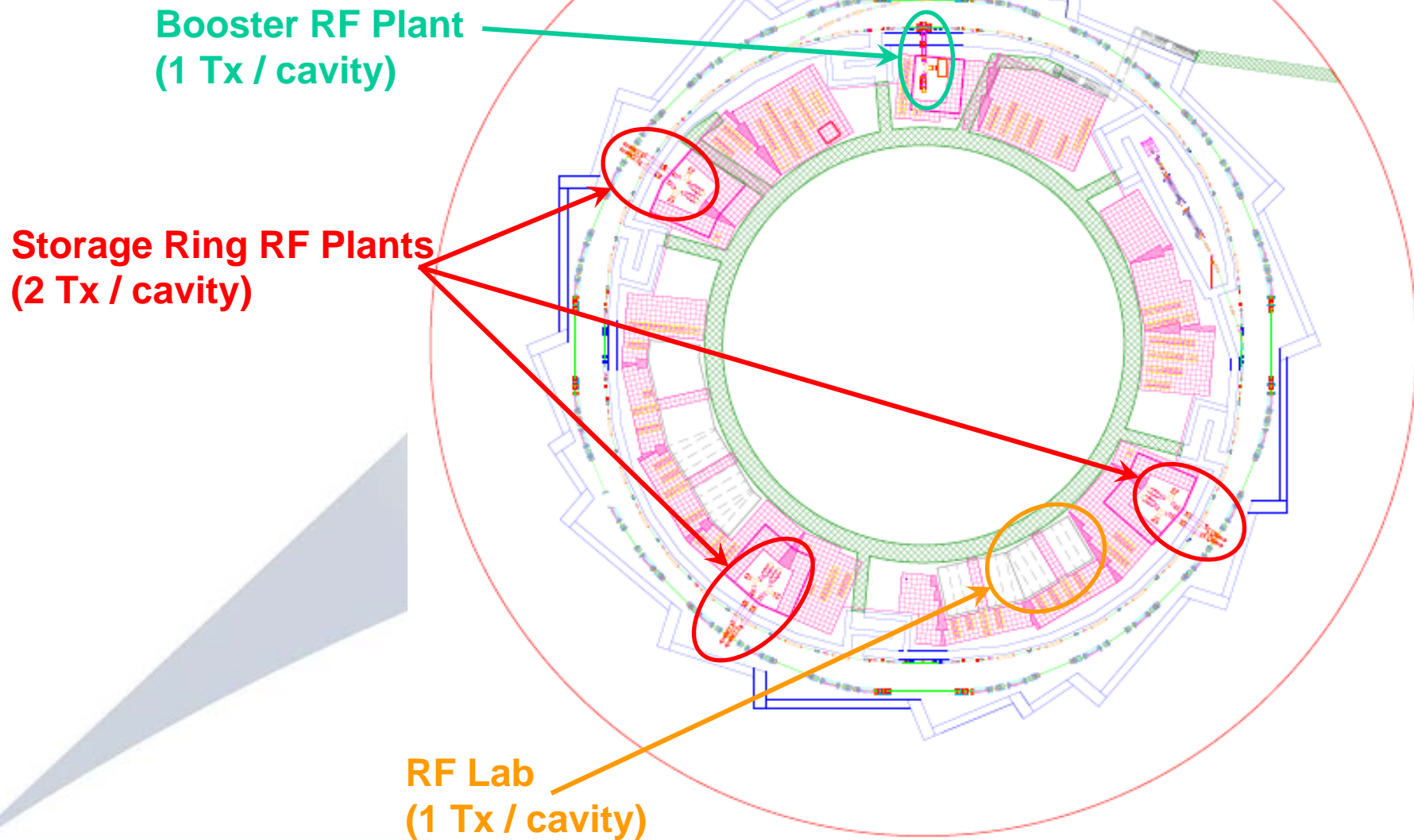
on behalf of the ALBA RF Group

## Synchrotron Light Source in Cerdanyola (Barcelona, Spain)

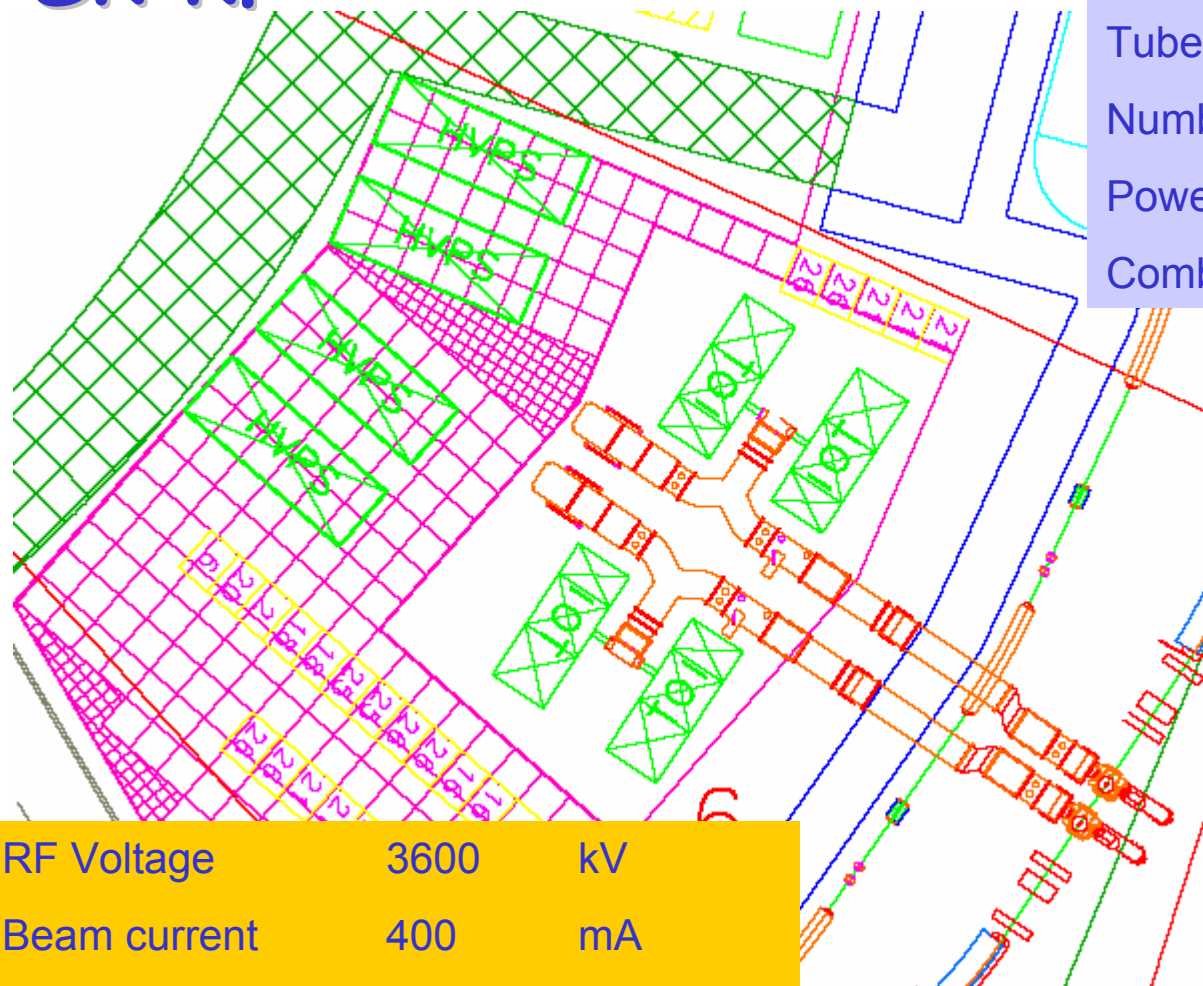


July 27th, 2006: Oficial start of the building work

# General Layout



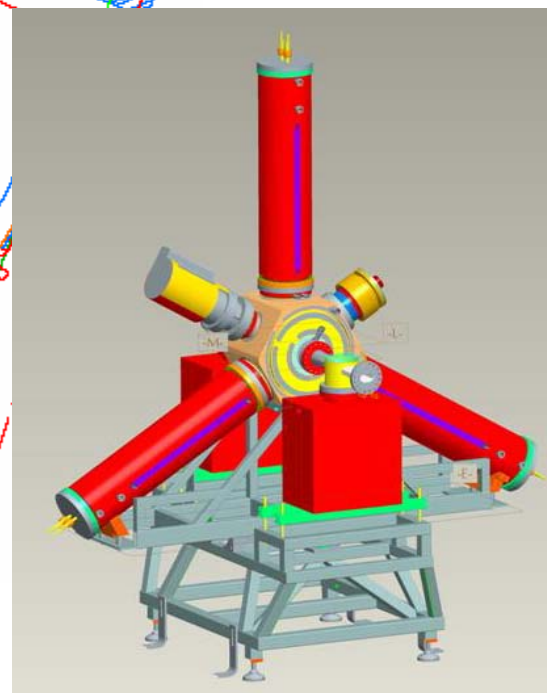
# SR RF



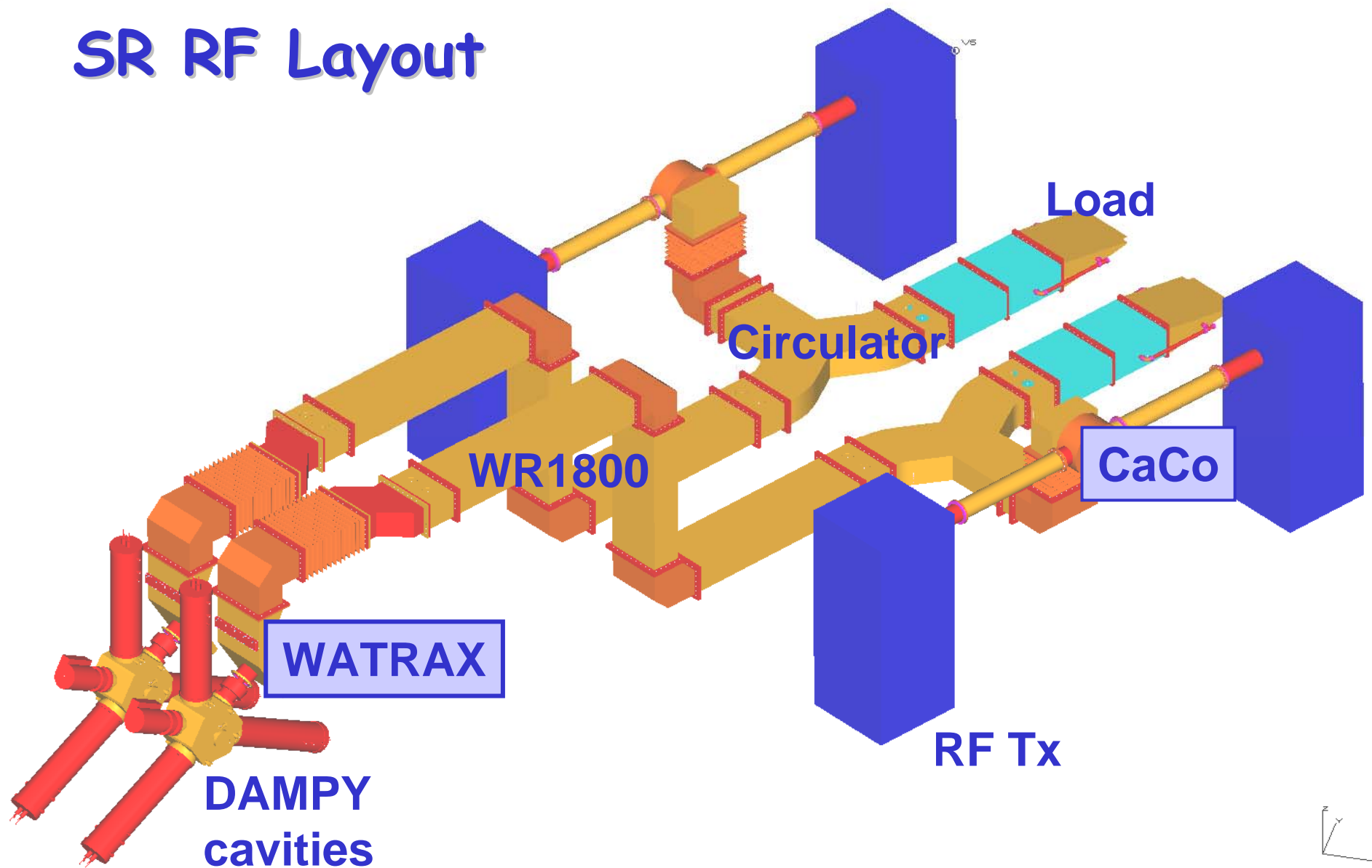
## TRANSMITTER

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

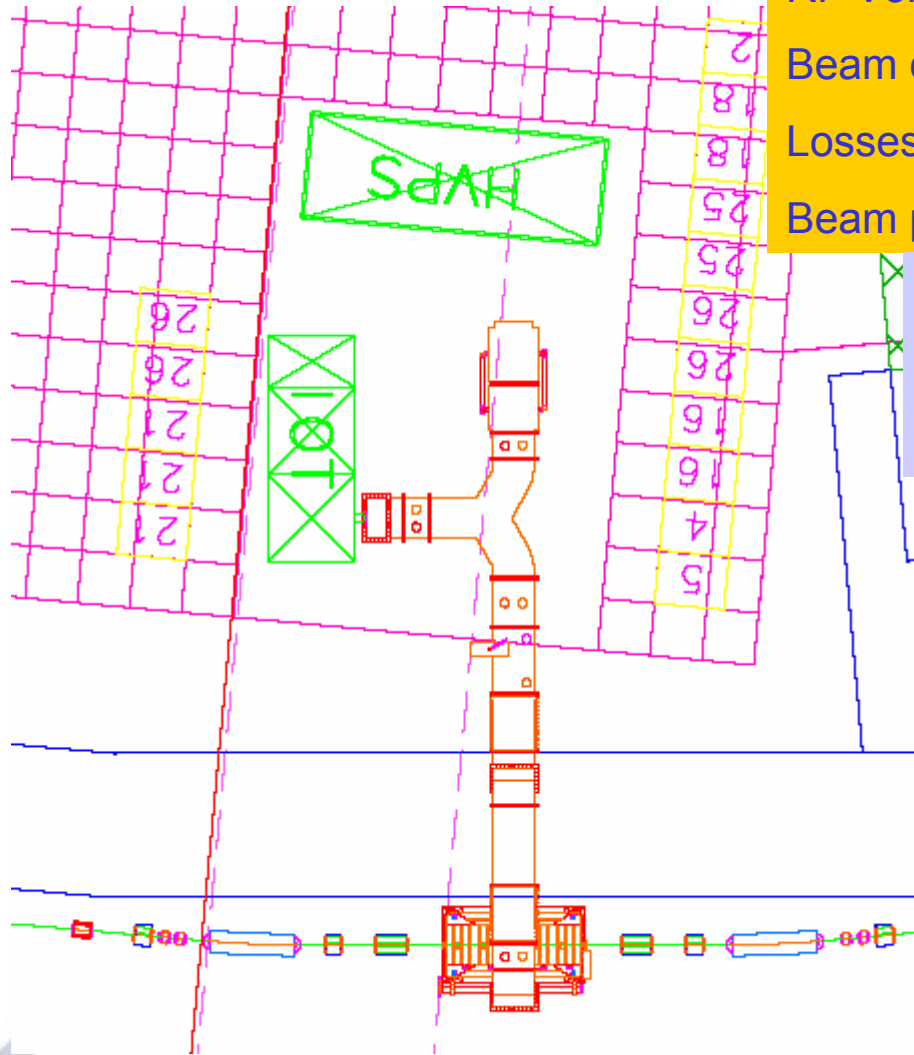
RF Voltage	3600	kV
Beam current	400	mA
Losses (inc. IDs)	1300	keV/turn
Beam power	520	kW



# SR RF Layout



# Booster RF

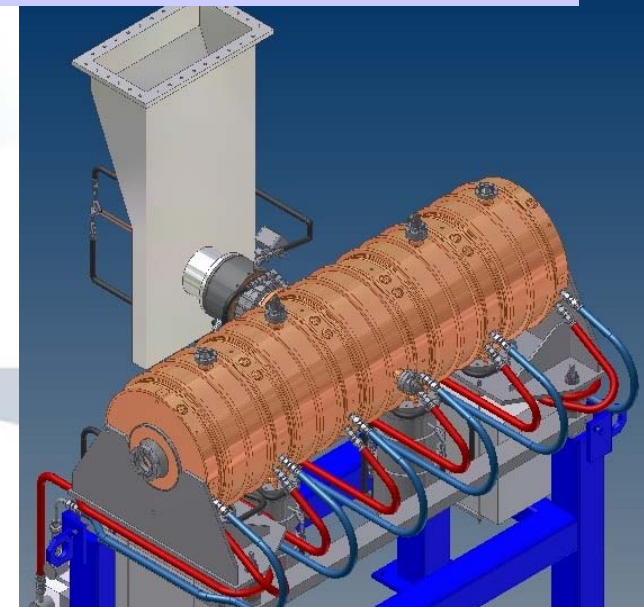


At 3 GeV

RF Voltage	900	kV
Beam current	2	mA
Losses (inc. IDs)	627	keV/turn
Beam power	1.3	kW

## TRANSMITTER

Tube type	1	IOT
Power	80	kW

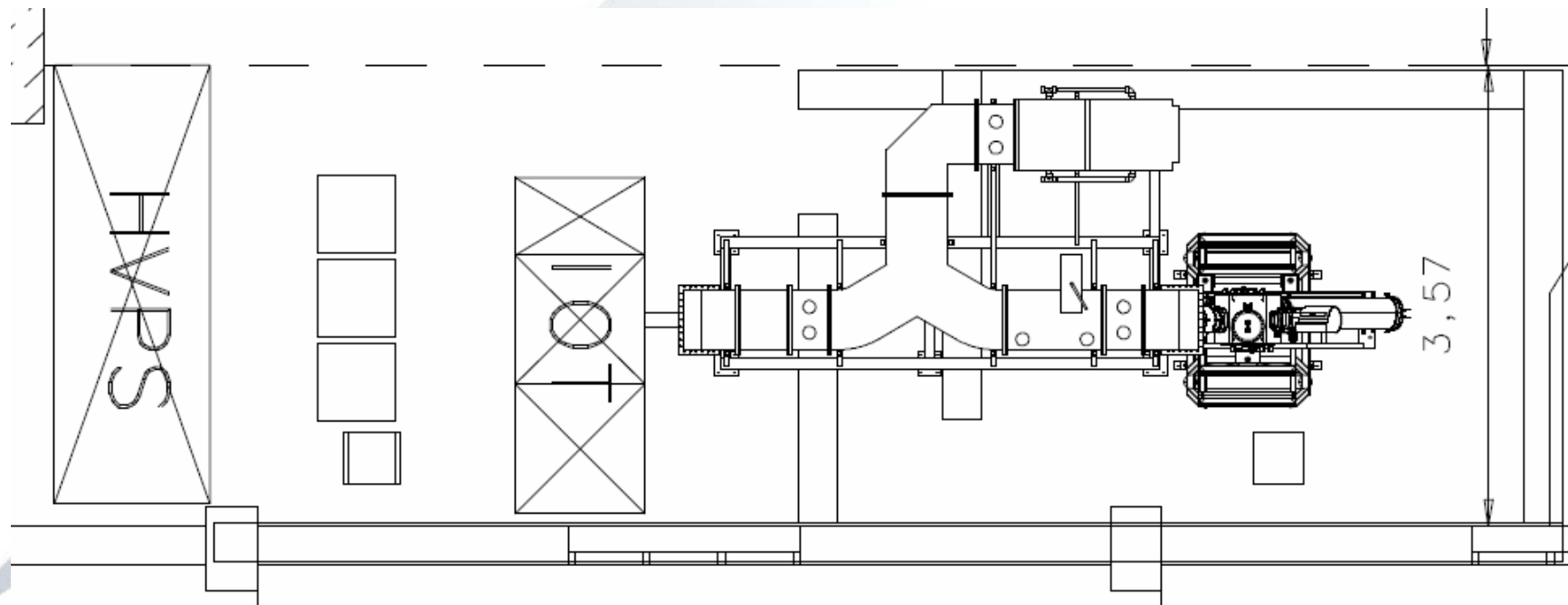


# RF Lab

Up to 80 kW

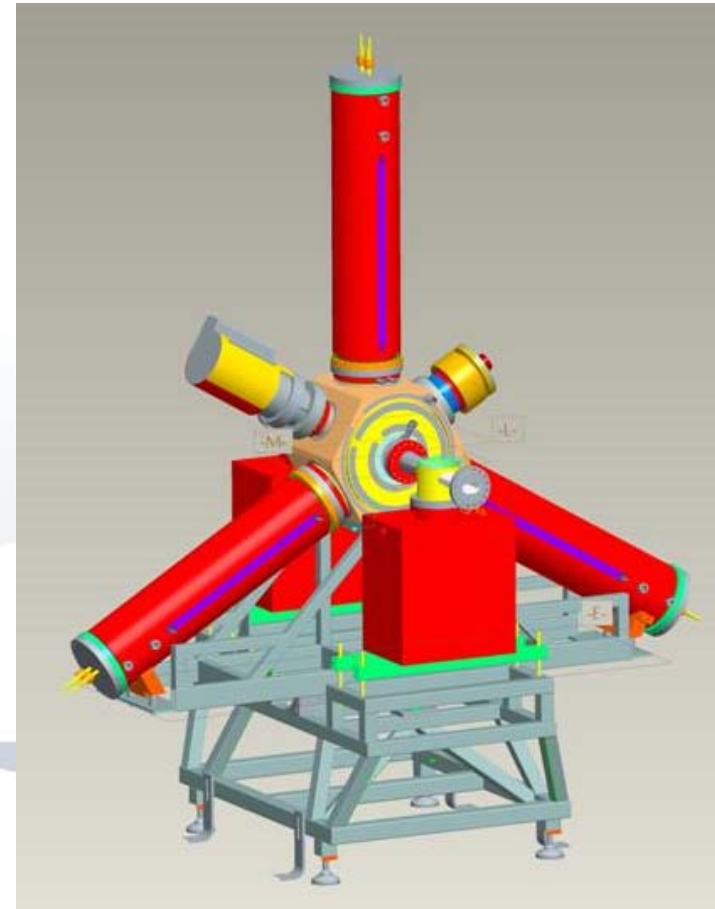
In Spring 2007 installed provisionally in University Campus

In Autumn 2008 will be translated to the new building



# Storage ring cavities : DAMPY

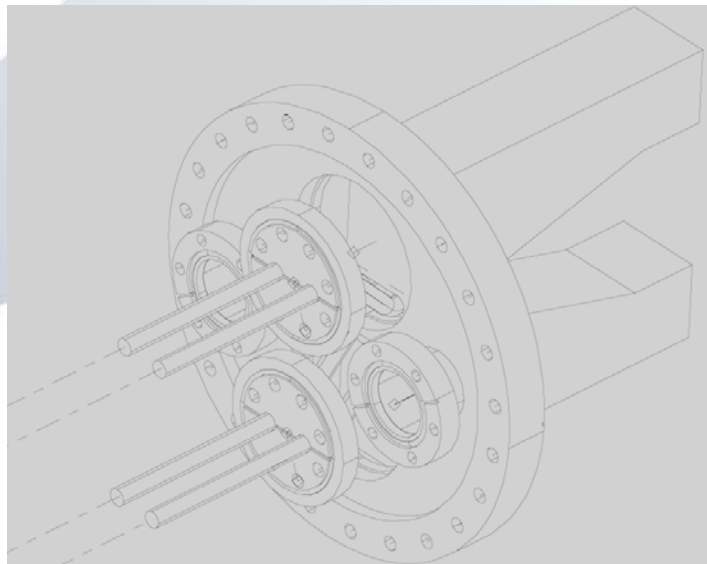
- Nose cones cavity with ferrite loaded dampers.
- The contract was signed in April 2006 with ACCEL for 7 identical pieces including girders, dampers, input windows and tuners.
- The CELLS prototype delivery is scheduled for January 2007.





# Dampy : modifications

- 2 spacers have been added to the girder to support the ridged waveguides.
- The wedges on which ferrite tiles are brazed can be taken apart without removing the whole damper.
- Vacuum gauge and a sapphire window at the end of one waveguide

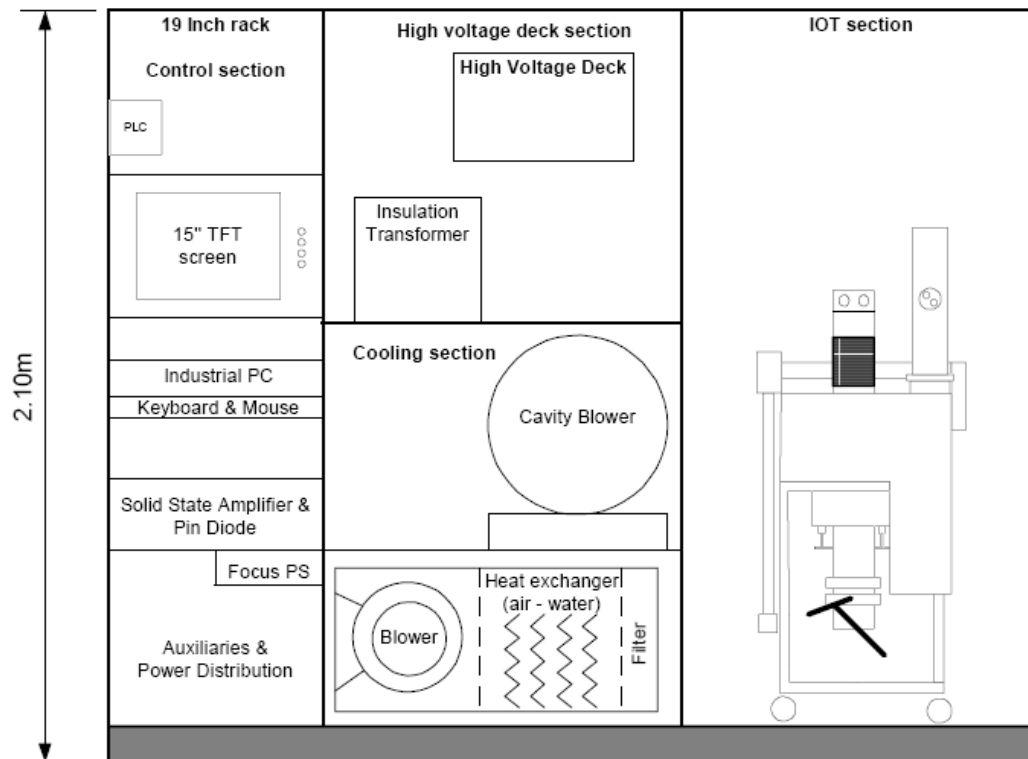


# Booster cavity

- 5 cells cavity operating in  $\pi$  mode very similar to PETRA cavities.
- The contract was signed in April with ACCEL.
- The design report was approved in September 2007.
- Delivery is scheduled for January 2007.

# RF Transmitter awarded to Thomson :

## IOT Cabinet



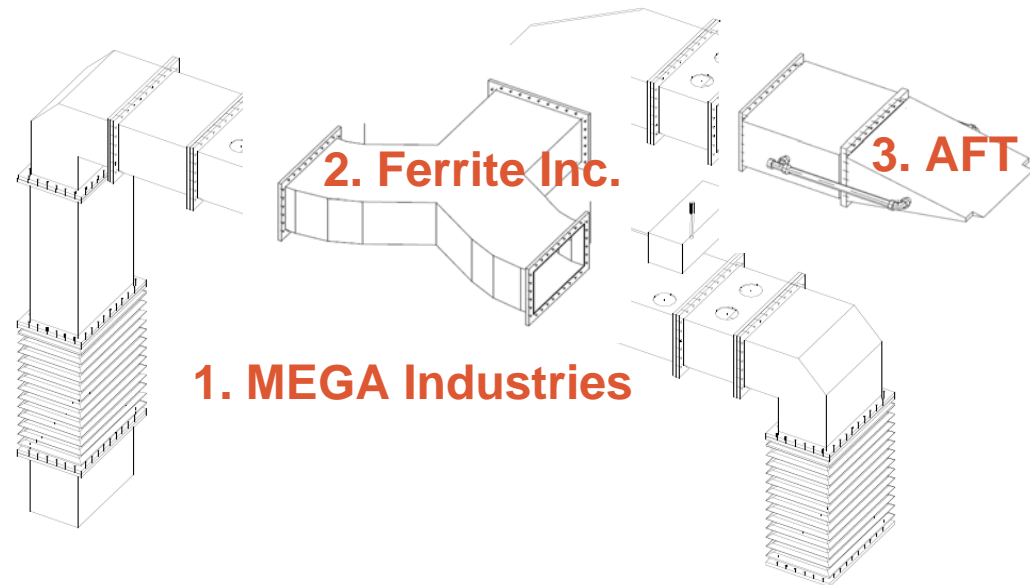
- Delivery and installation of 14 transmitters (80 kW cw):
  - IOT
  - HVPS
  - SSA
  - Aux. PS
  - Control system
- Kick-off meeting by next weeks with Thomson
- 1<sup>st</sup> unit by May 2007 for the RF High Power Lab
- Following units from mid 2008

# WG Systems

- Tendering done in 3 batches:
  - BATCH 1 : Standard Waveguide lines (WR1800)
    - ❖ Straights, Bends, bellows, bidirectional couplers, transitions
  - BATCH 2 : Circulators
  - BATCH 3 : Dry Loads

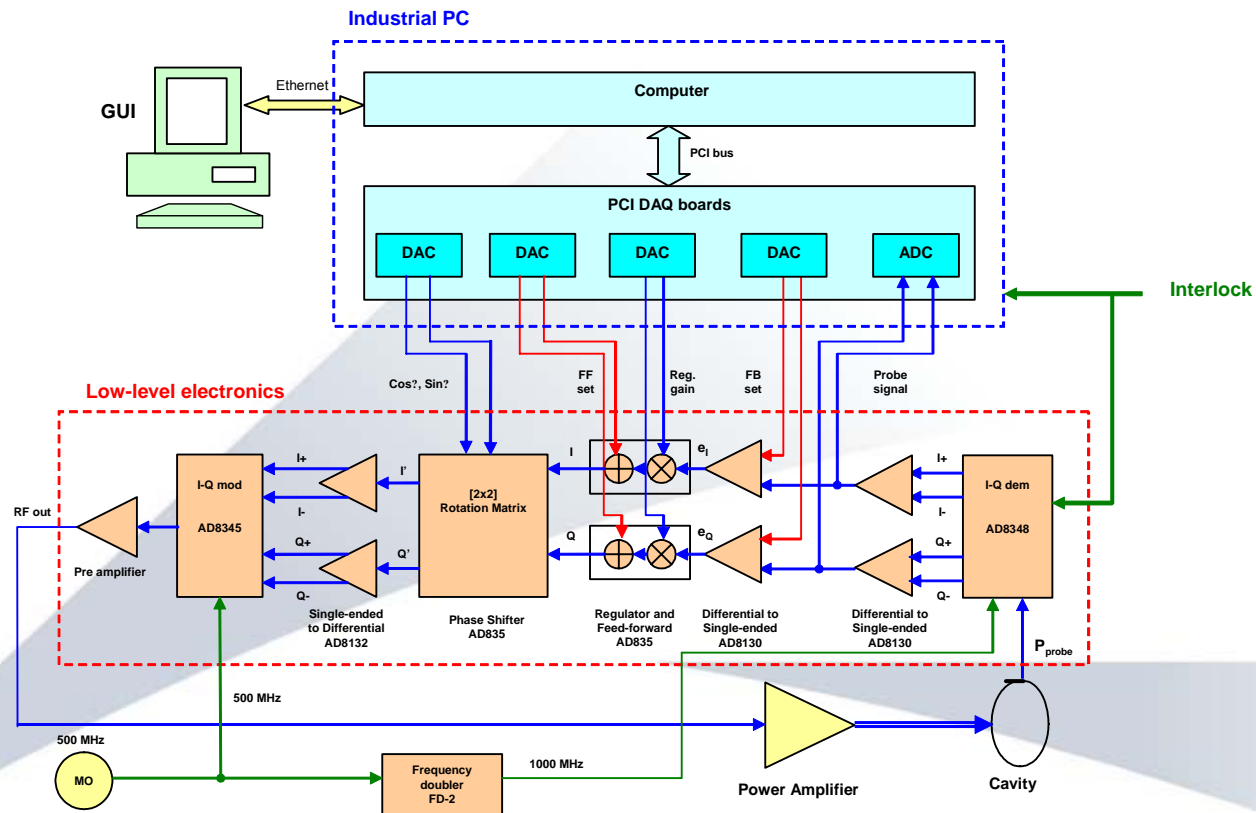
- 3 Companies in the tendering:
  - AFT
  - Ferrite Inc.
  - MEGA Industries

- Decision to be validated



# Low Level RF Analogue Prototype

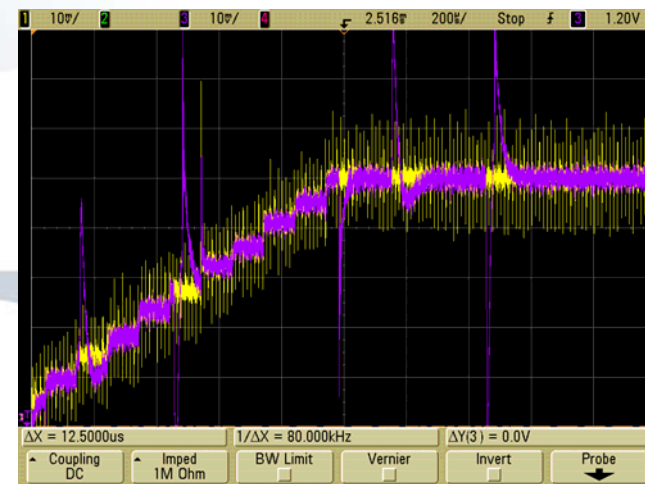
## I/Q Modulation / Demodulation



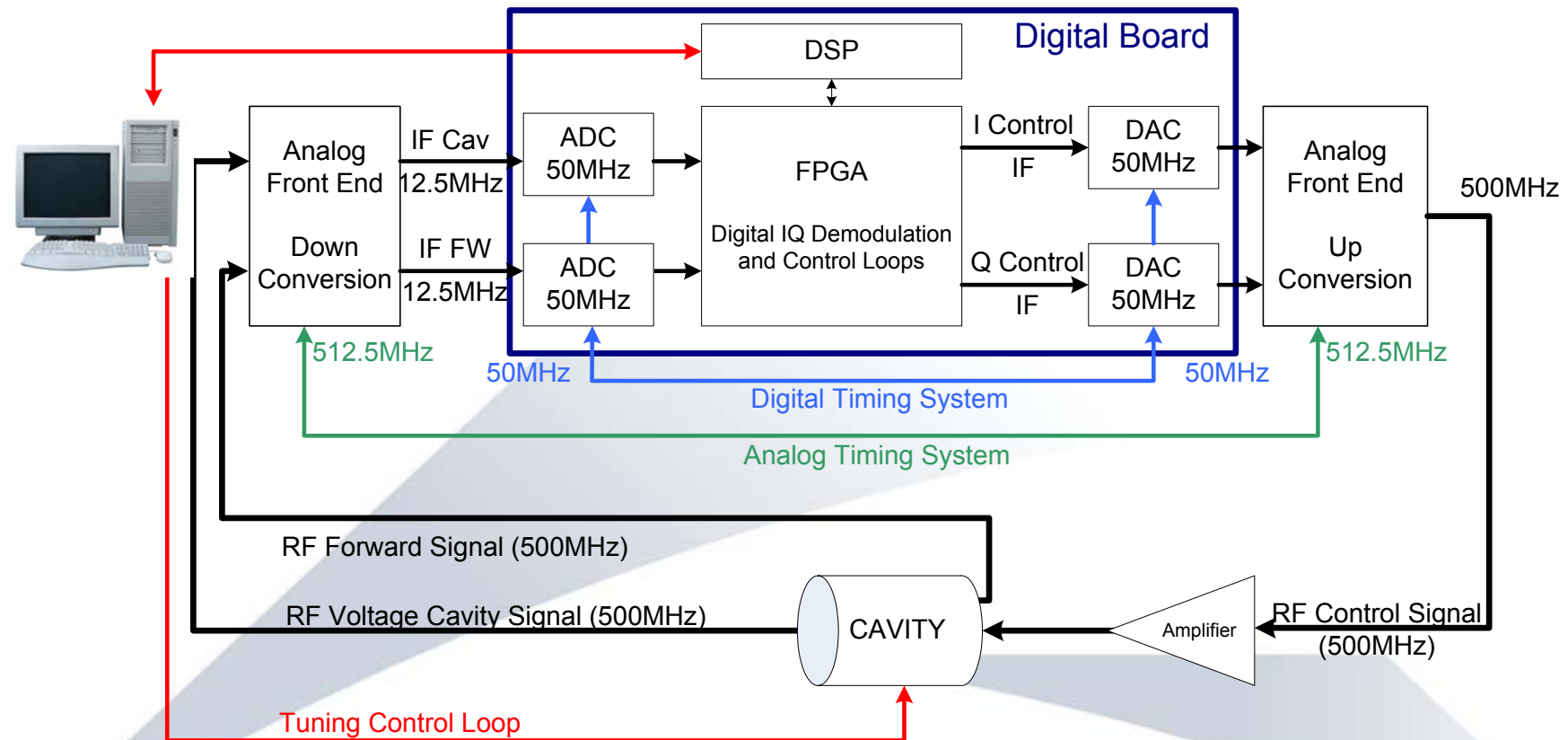
# LLRF Analog prototype



- The ALLRF prototype has been successfully tested with a mock-up cavity.
- The measured group delay of the low-level electronics is 500 ns.
- The noise level is better than what we had specified (i.e. 1% and 1°).
- A LLRF bandwidth of 1 MHz and a dynamic range of >23 dB have been achieved.



# Low Level RF Digital Prototype

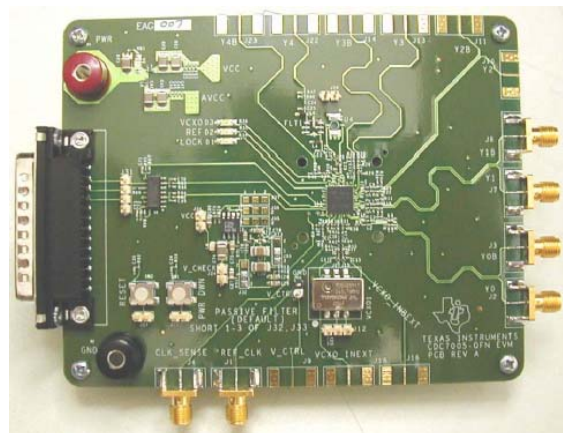


# Analog Front Ends and Timing System

-Up/Down conversion from RF to IF: Mixers and low pass filters from Mini-Circuits

-Digital clocks for ADCs and DACs: Clock synchronizer board from Texas Instruments

-Reference Signal (RF + 12.5MHz) for down and up conversion.

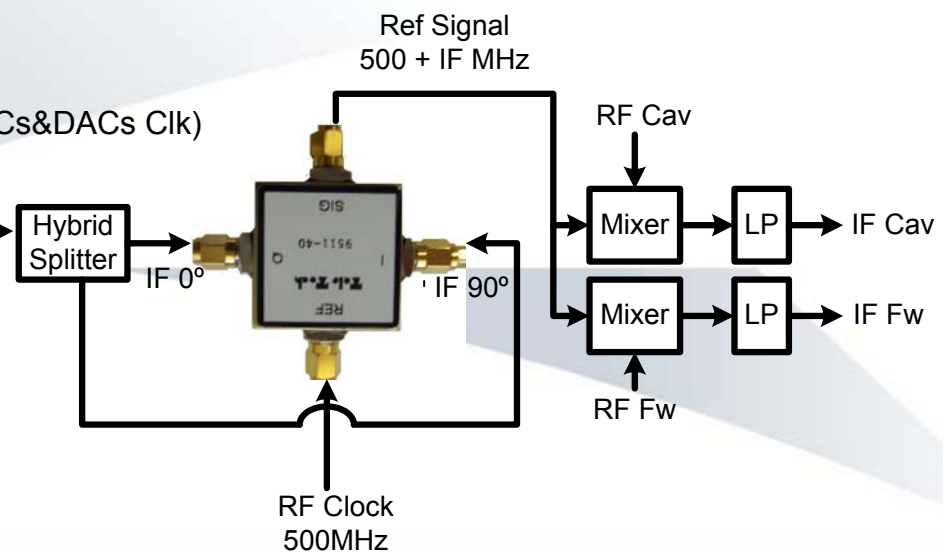


Outputs:

- 100MHz
- 50MHz (ADCs&DACs Clk)
- 25MHz
- 12.5MHz

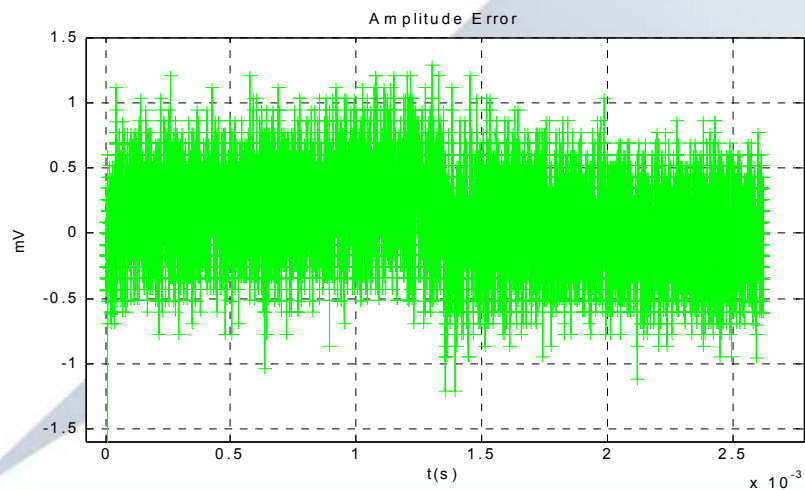
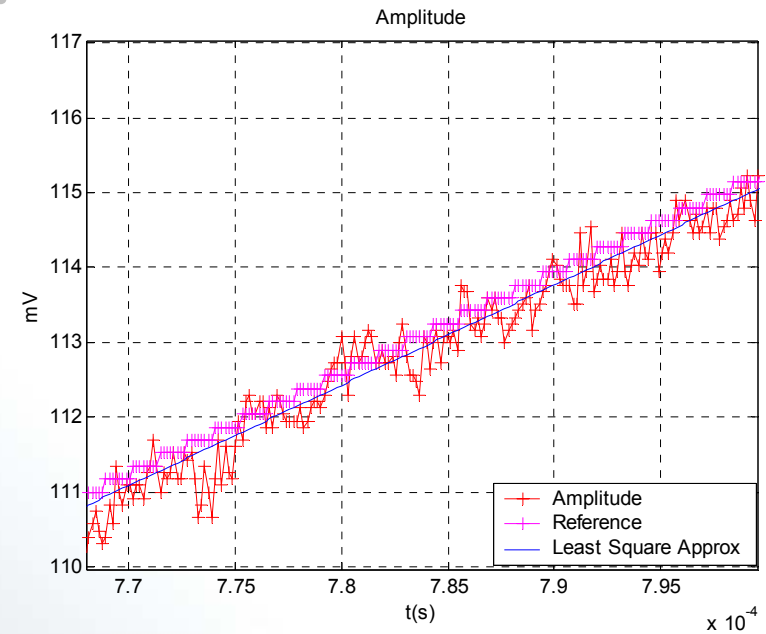
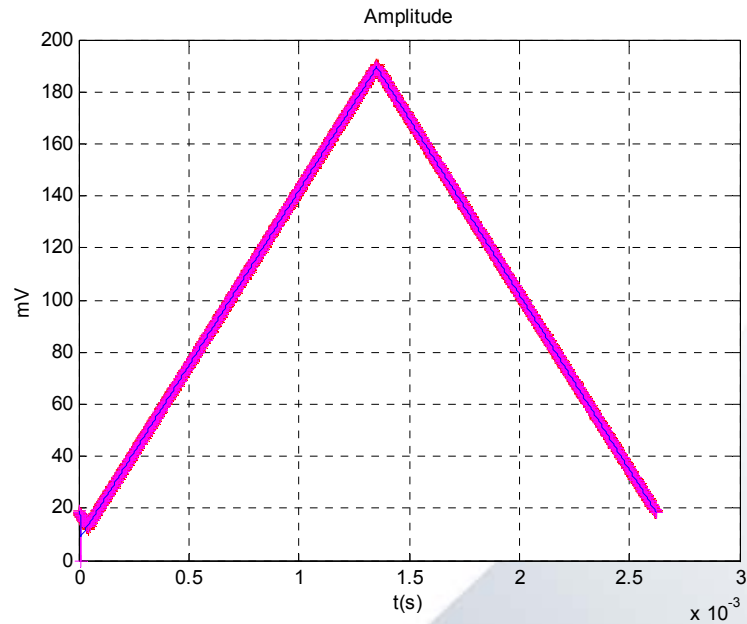
Input

External Reference (10MHz)





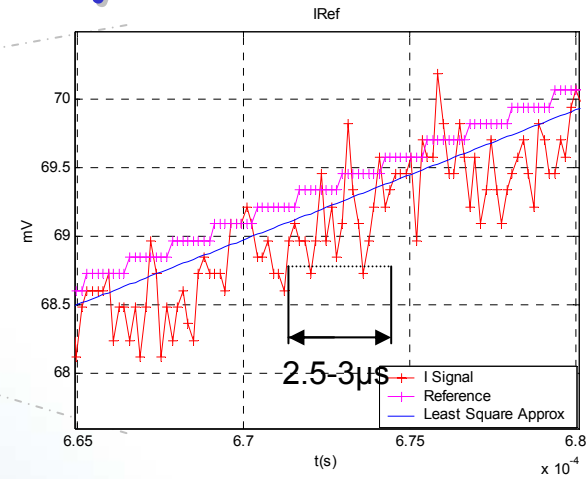
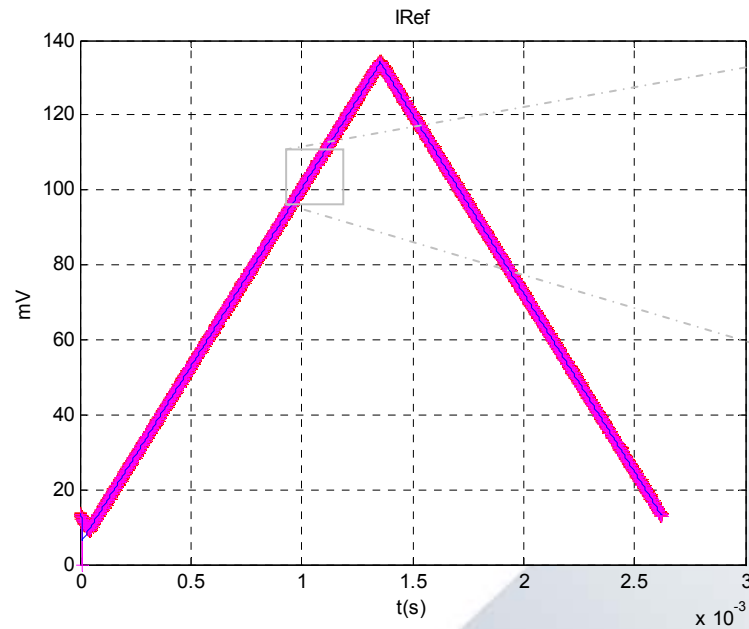
# IQ Control Loops: Amplitude



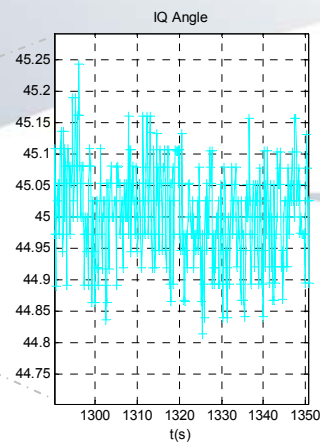
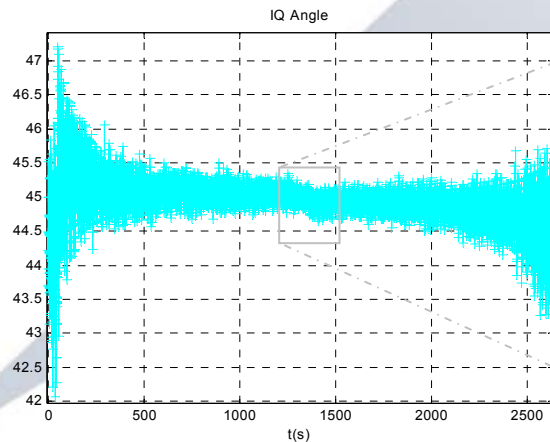
$$\text{Amplitude} = \sqrt{I^2 + Q^2}$$

$$\text{Total Amplitude Stability} = \frac{\pm 1.2\text{mV}}{134.55 \cdot \sqrt{2}} = 0.63\%$$

# IQ Control Loops: Delay and Phase



**Group Delay:** Around 2.5 - 3 $\mu$ s



**Phase Stability:**

- $\pm 0.2^\circ$  at top of the ramp
- $\pm 3^\circ$  at bottom of the ramp

## Analog/Digital LLRF comparison - Performance

	ALLRF	DLLRF
Group delay	500 ns	3 $\mu$ s
Bandwidth	1 MHz	-
Ripple removal up to	30 kHz	2 kHz
Phase stability	$\pm 0.5^\circ$	$\pm 0.2^\circ$
Amplitude stability	$\pm 0.5\%$	$\pm 0.75\%$
Dynamic range	23 dB	20 dB

The stability, speed and dynamic range of the DLLRF is supposed to improve after analogue front end improvements.

# Summary

- 1) SR Dampy Cavity: 1st unit in January 2007
- 2) Booster Cavity: 1st unit in January 2007
- 3) RF Transmitter: 1st unit in May 2007
- 4) Waveguide: Awarding in the following weeks
- 5) LLRF: Prototypes ready  
Tests at ELETTRA with cavity next week
- 6) RF Lab: Foreseen for May 2007

## The RF Group

Francis Perez  
Paco Sanchez  
Michel Langlois  
Hooman Hassanzadegan  
Angela Salom

Marc Cornelis (support Eng. Div.)  
Roberto Ranz (support Comp. Div.)