ALBA RF Systems

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ALBA Synchrotron Light Source

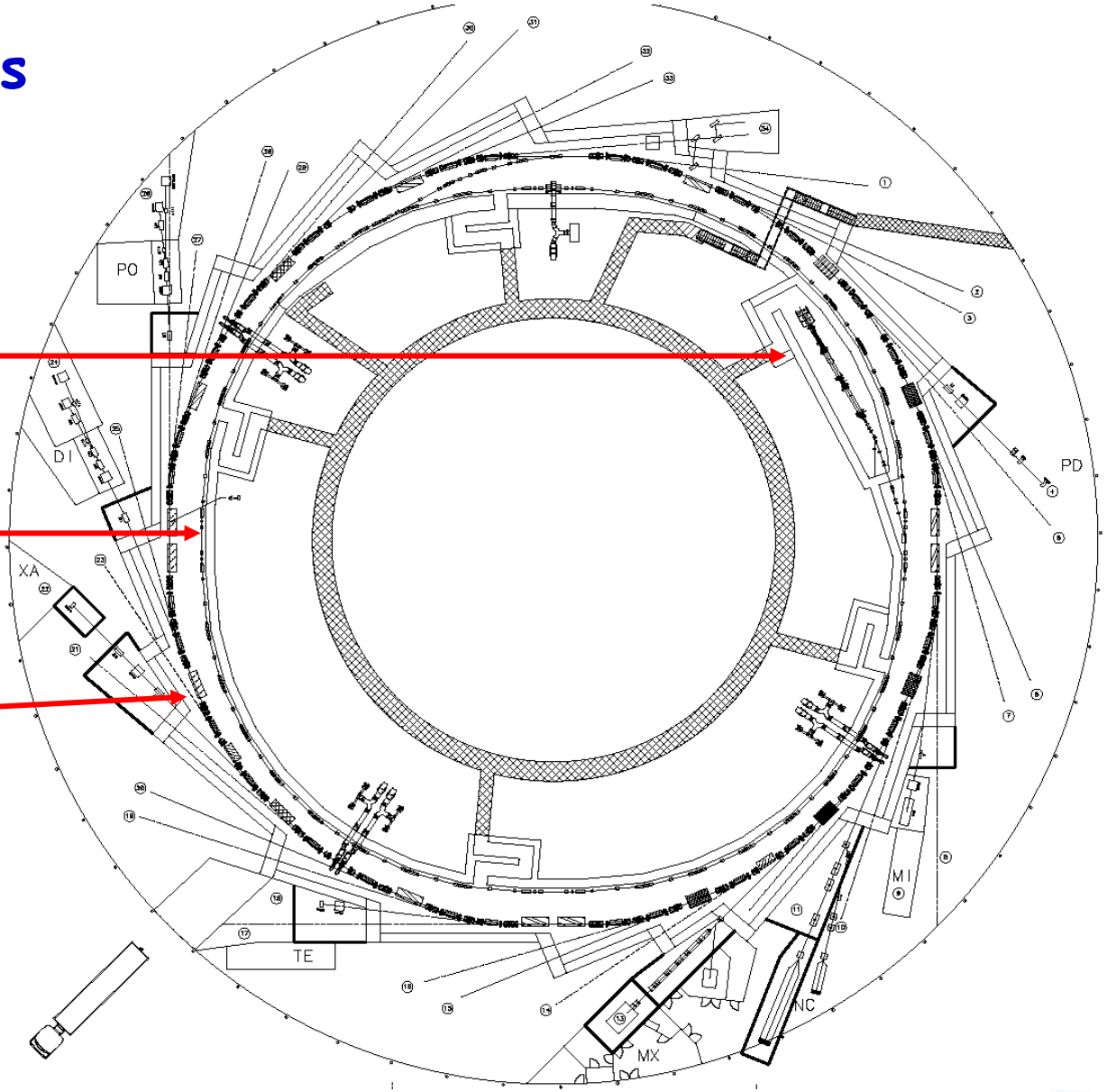
- ✓ 3 GeV electron accelerator
- ✓ 30 beamlines (7 on day one)
- ✓ Funding is 50% Spanish – 50% Catalan Governments
- ✓ First beam for users 2011

ALBA Accelerators

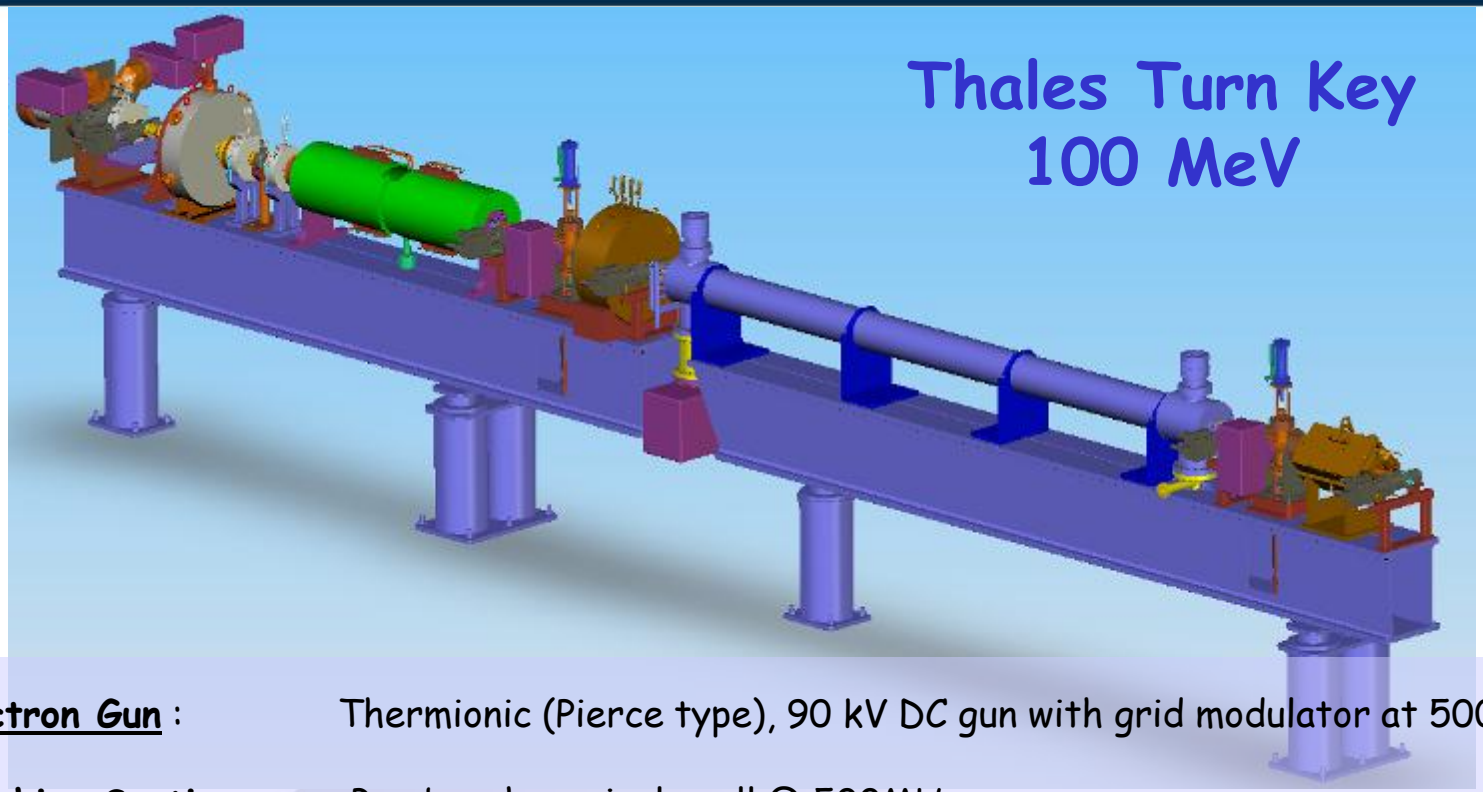
LINAC
100 Mev

BOOSTER
100 MeV – 3 GeV

STORAGE RING
3 GeV

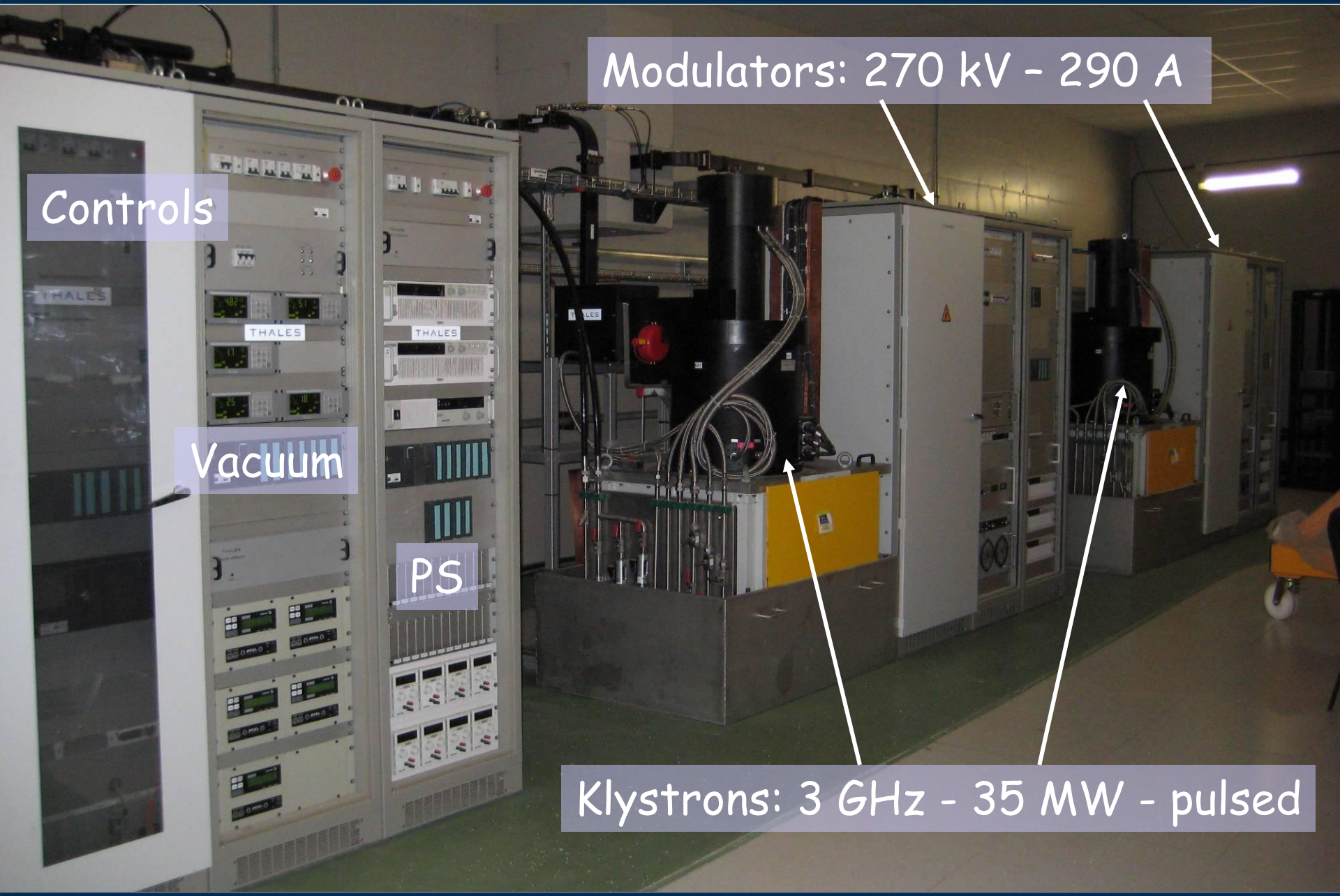


LINAC RF System



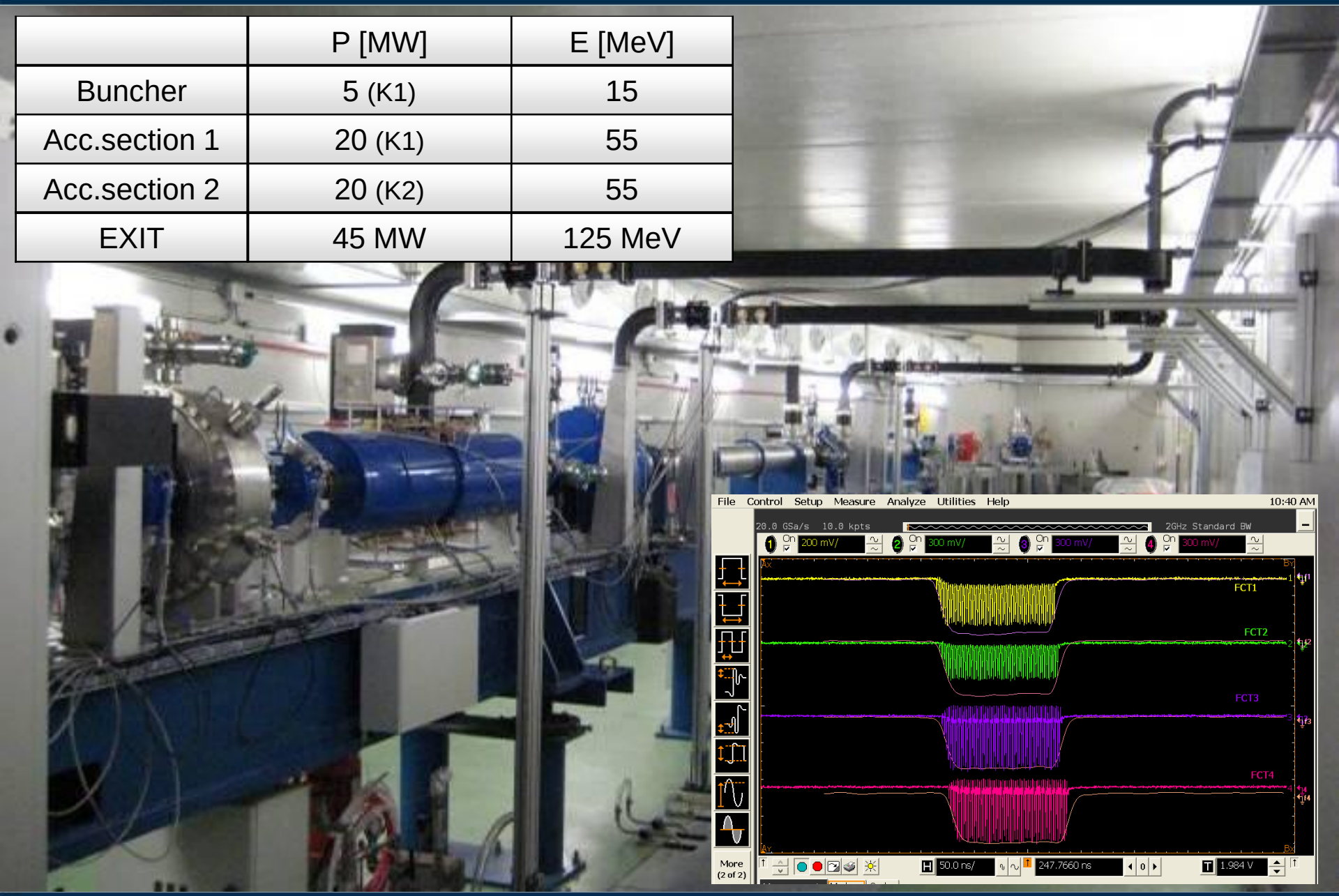
- **Electron Gun** : Thermionic (Pierce type), 90 kV DC gun with grid modulator at 500 MHz
- **Bunching Section**: Pre-buncher: single cell @ 500MHz
  Buncher: 1 SW bunching section @ 3GHz
  Energy at the bunching section output = **16 MeV**
- **2 Acc. sections**: TW 2/3π Constant Gradient 3 GHz.
  Energy gain= **55 MeV** @ 20MW nominal input power.
- **2 Klystron modulators**: 35 MW each klystron at 3GHz.
  The first one feeds the 3 GHz bunching section and the 1st acc. structure.
  The second one feeds the second accelerating structure

Linac RF

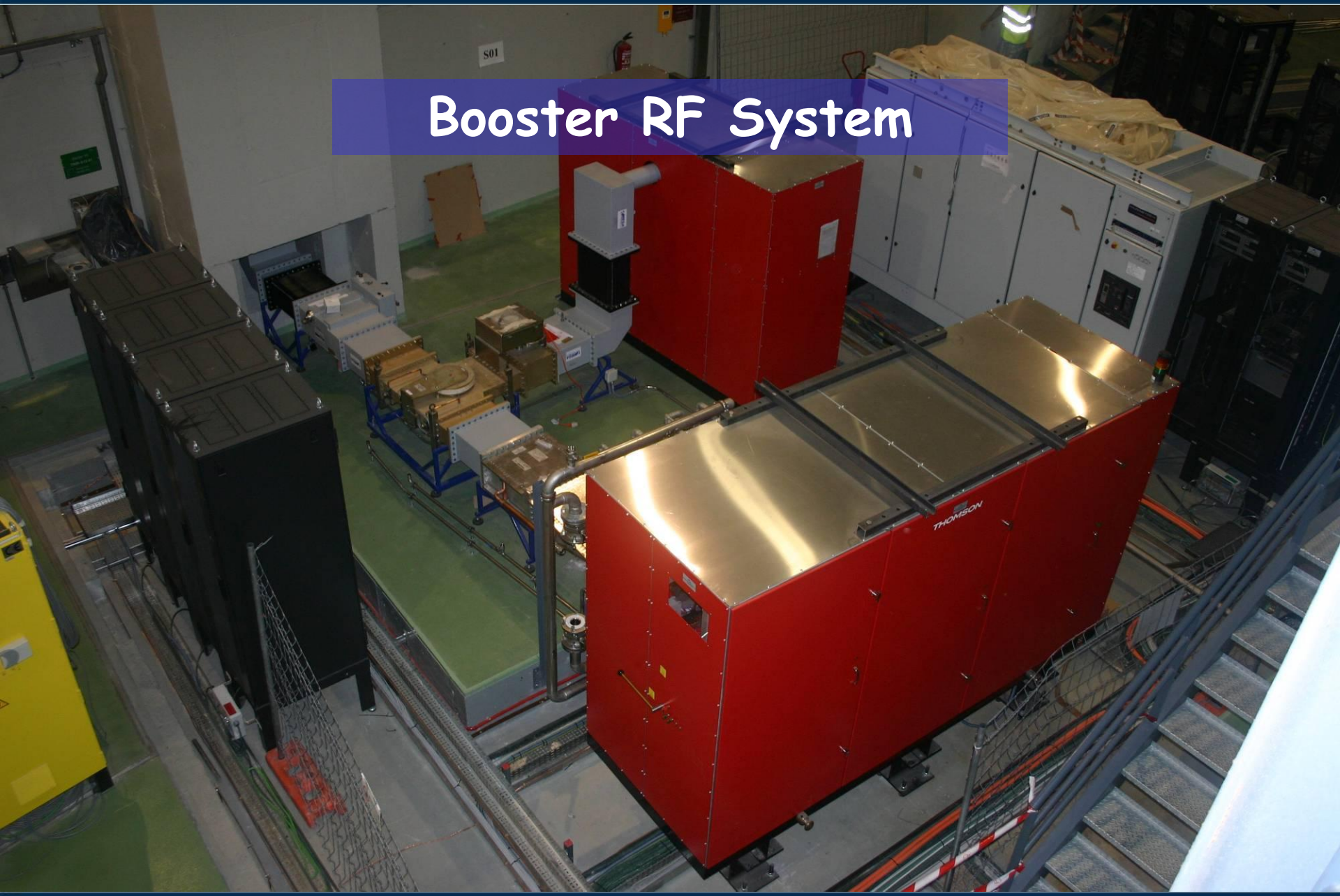

Modulators: 270 kV - 290 A
Controls
Vacuum
PS
Klystrons: 3 GHz - 35 MW - pulsed

Linac RF

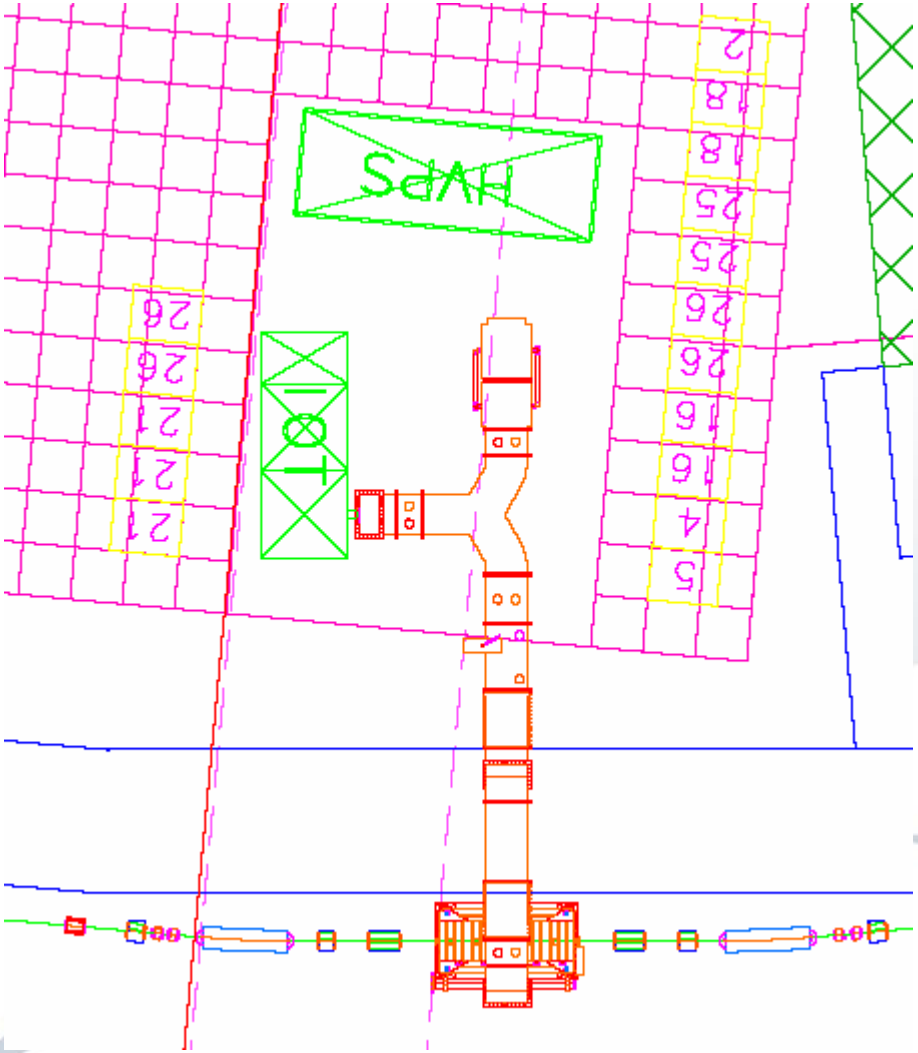
	P [MW]	E [MeV]
Buncher	5 (K1)	15
Acc.section 1	20 (K1)	55
Acc.section 2	20 (K2)	55
EXIT	45 MW	125 MeV



Booster RF System



Booster RF



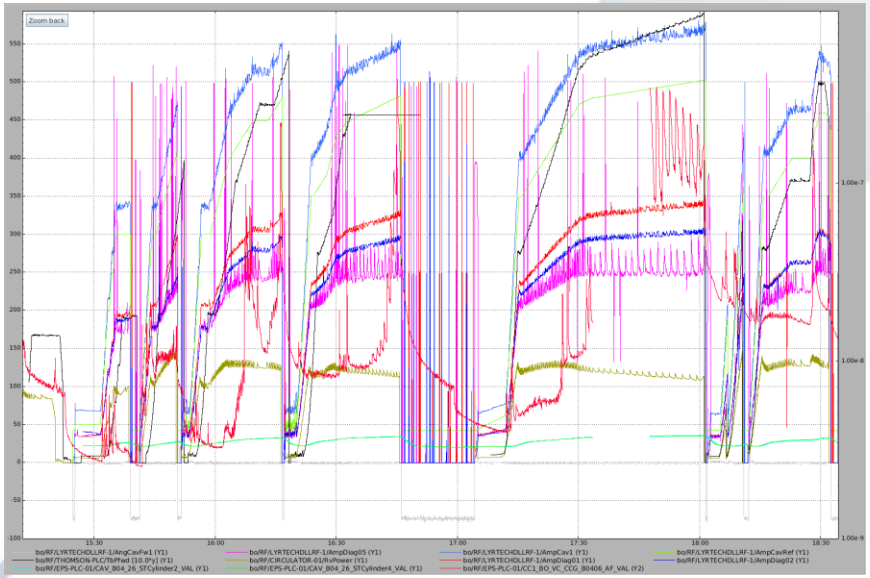
At 3 GeV:	
RF Voltage	1000 kV
Beam current	4 mA
Losses	627 keV/turn
Beam power	2.5 kW
Cavity power	34.5 kW

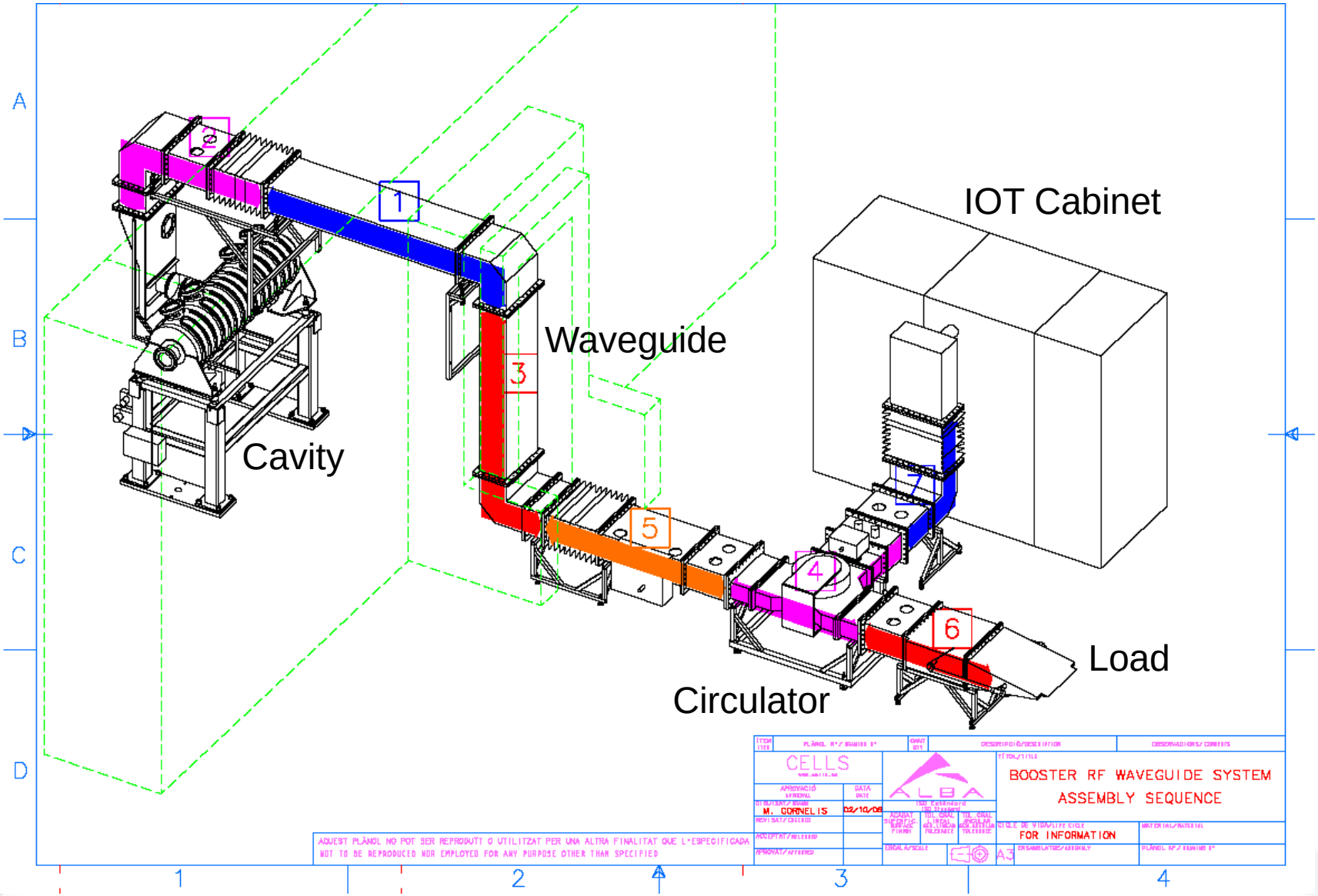
TRANSMITTER	
Tube type	IOT
HVPS	36 kV / 4 A
RF Power	80 kW
Efficiency	> 60%

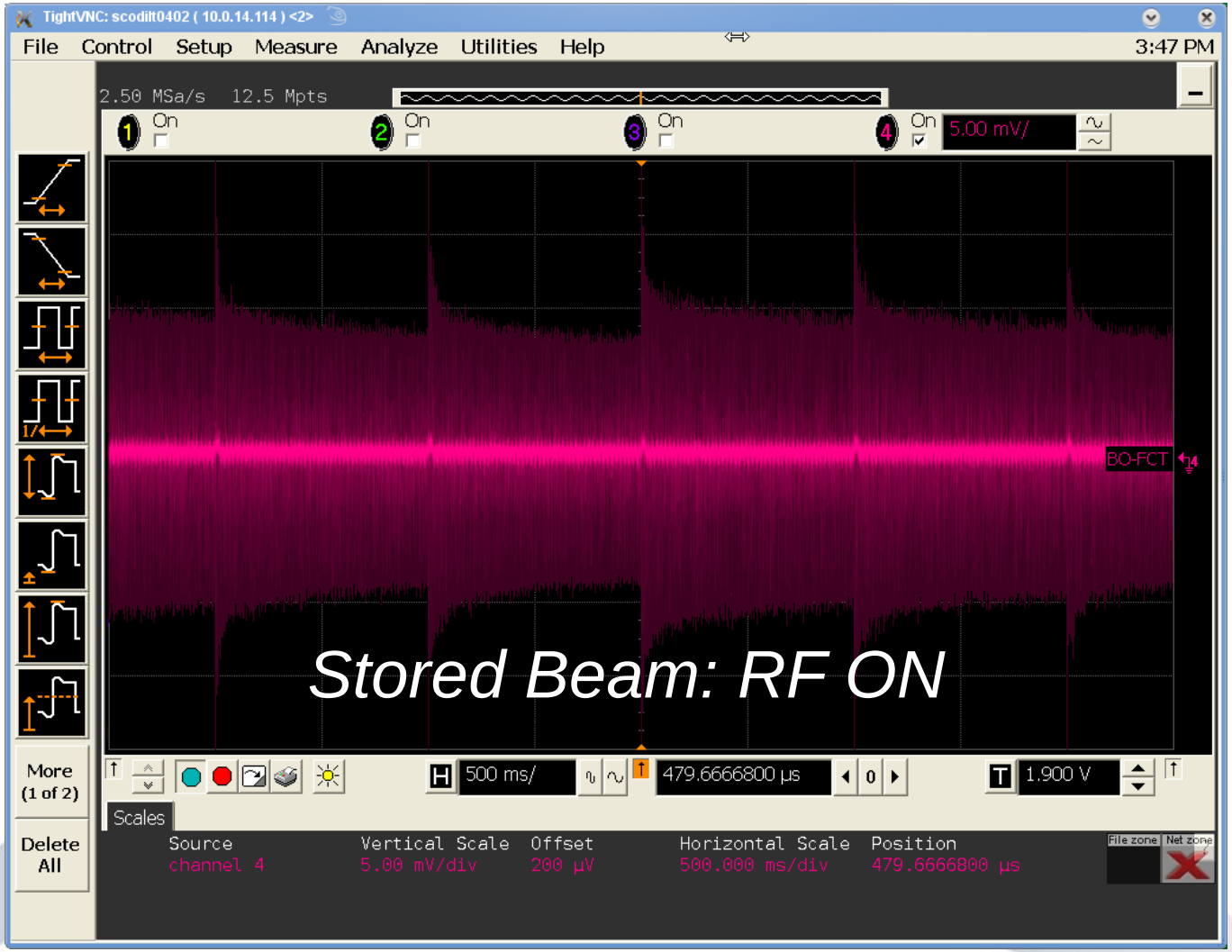
Cavity: 5 cell Petra type

Basic Parameters

Rshunt	**15.4 MΩ**
Maximum Power	**75 kW**
Length	**1,65 m**




IOT Cabinet
Waveguide
Cavity
Load
Circulator
1
2
3
4
5
6
7
CELLS
BOOSTER RF WAVEGUIDE SYSTEM
ASSEMBLY SEQUENCE
M. GORNELIS
02/10/08
FOR INFORMATION
A3
AQUEST PLÀNOL NO POT SER REPRODUÏT O UTILITZAT PER UNA ALTRA FINALITAT QUE L'ESPECIFICADA
NOT TO BE REPRODUCED NOR EMPLOYED FOR ANY PURPOSE OTHER THAN SPECIFIED



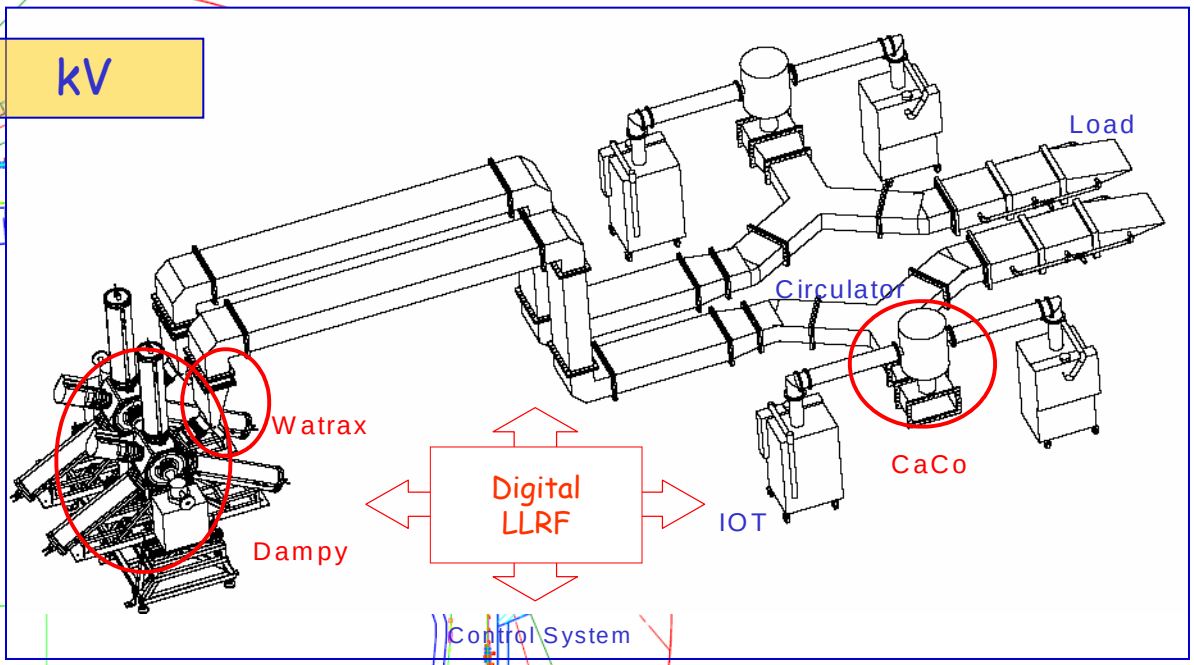
5 seconds,
5 injections

Storage Ring RF System

Power Requirements

Beam current	400	mA
Bending losses	1000	keV/turn
ID losses	300	keV/turn
Other losses	50	keV/turn
Total losses	1350	keV/turn
Beam power	**540**	**kW**
Energy Acceptance	**3**	**%**

RF Voltage	3600	kV



Layout 6 cavities

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

Transmitter (*Thomson*)

HVPS Cabinet:

36 kV – 4 A power supply
60 Pulse Step Modulation Cards

New PSM card 700V – 4A

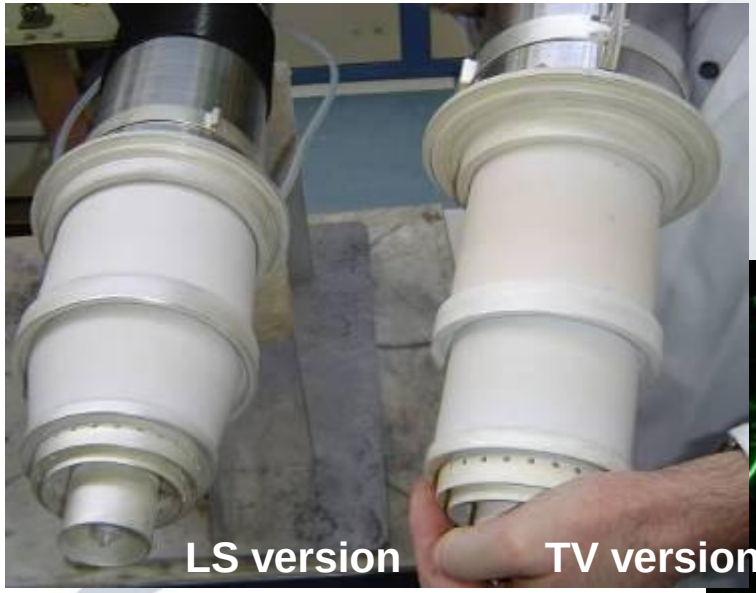
IOT Cabinet:

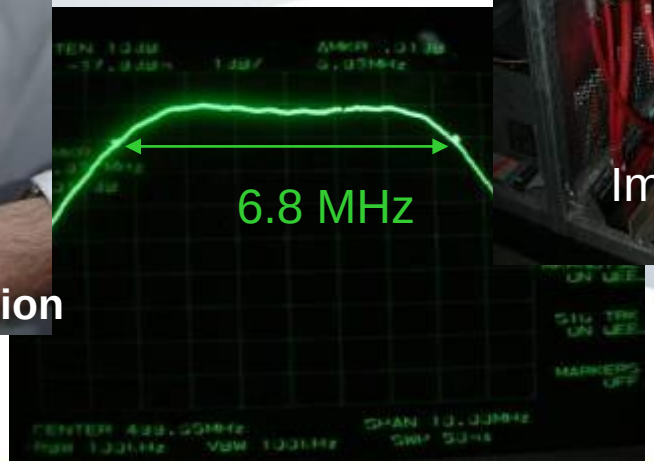
80 kW IOT
400 W SSA
Auxiliaries
Controls PLC

LS-IOT (Light Source IOT in collaboration with *Thales*)

New cavities with 6 1/8' coaxial output
Tube with wider ceramics

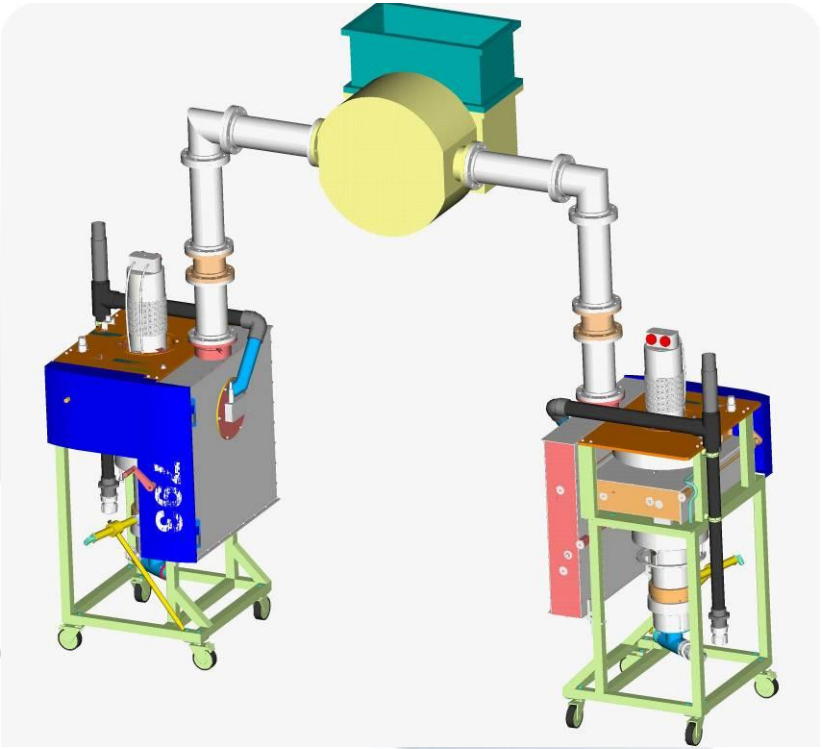
Tested in factory at 80 kW for more than 24 h
and at 90 kW for 1/2 h



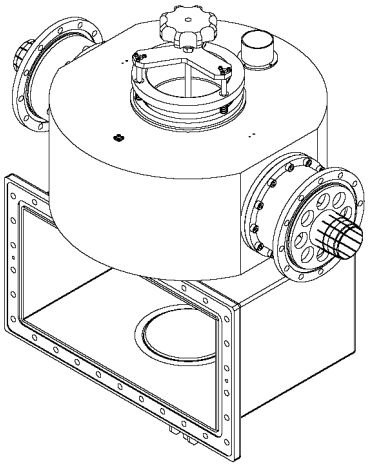


CaCo: Cavity Combiner

1) Combine 2 IOTs
2) Filter Harmonics
3) Operation with faulty IOT



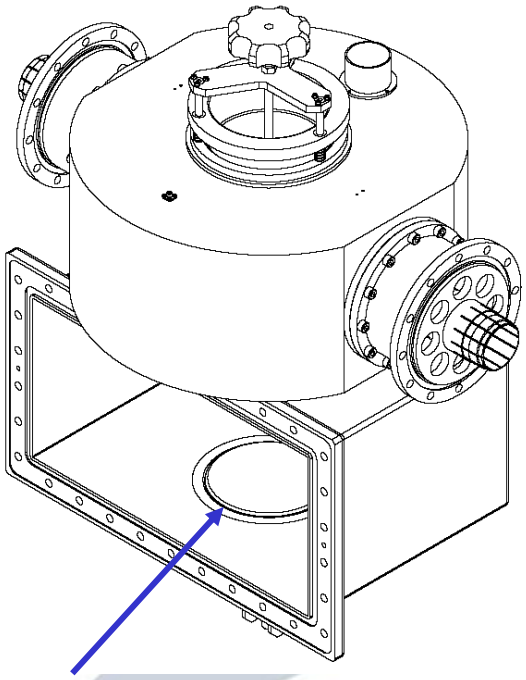
CaCo



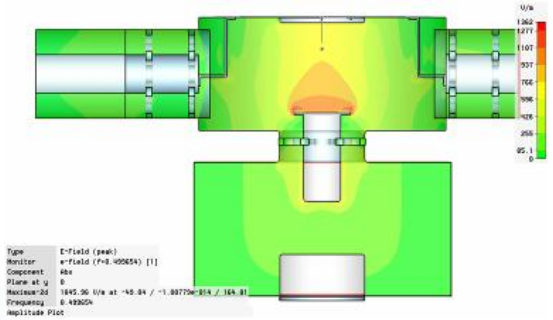
	IOT1			OUTPUT	IOT2		
	efficiency	reflected	calorimetric	POWER	calorimetric	reflected	efficiency
	%	kW	kW	kW	kW	kW	%
both IOTs on	72,0	3,5	82,8	154,2	71,4	3,1	67,0
IOT 2 off	48,8	5,6	54,2	52,2	-2	10	0
IOT 1 off	0	6	-0,1	31,0	31,1	3,9	33,7

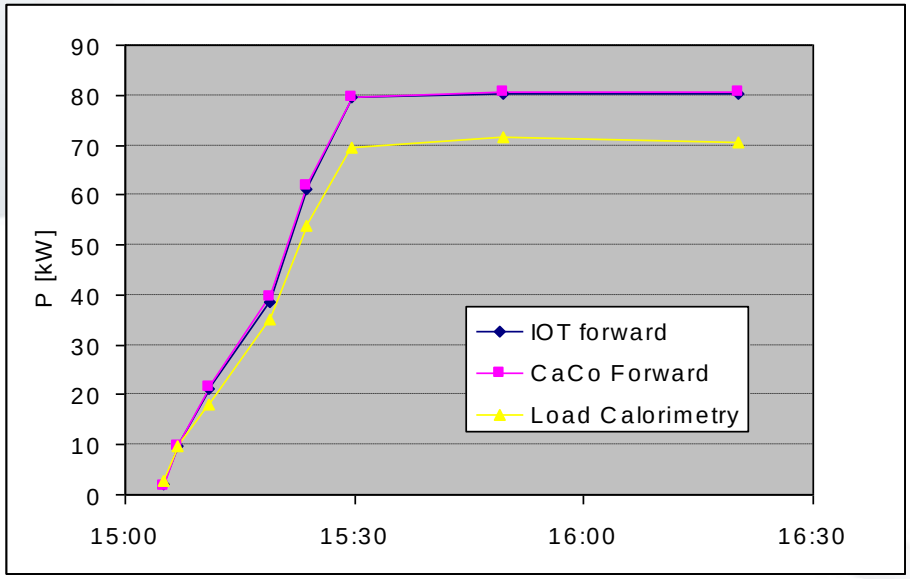
CaCo

80 kW operation in single IOT



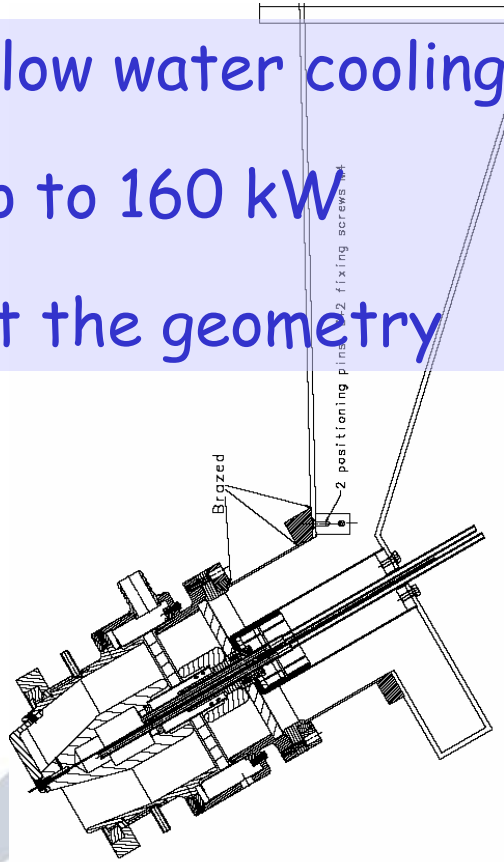
Plunger for single IOT operation
(actuated with a piston)

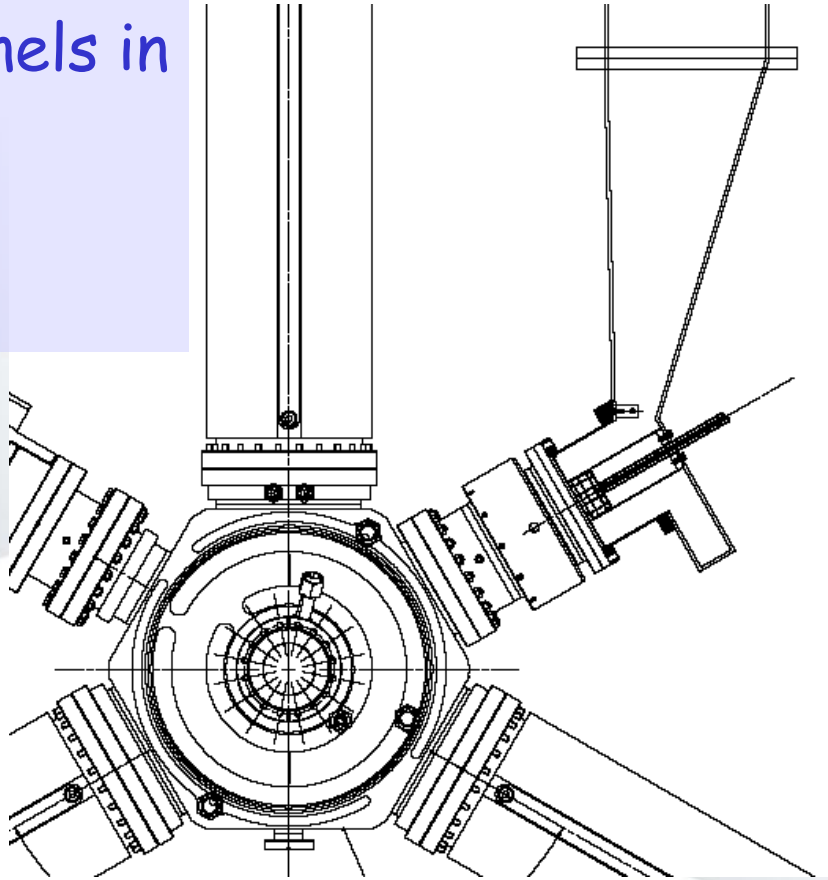




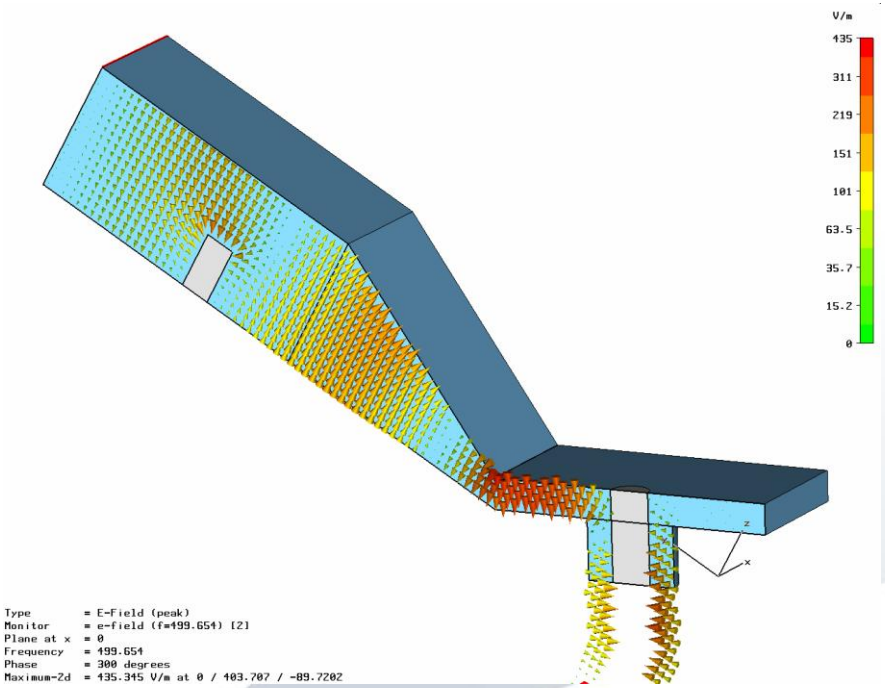
Watrax: Waveguide to Coaxial transition

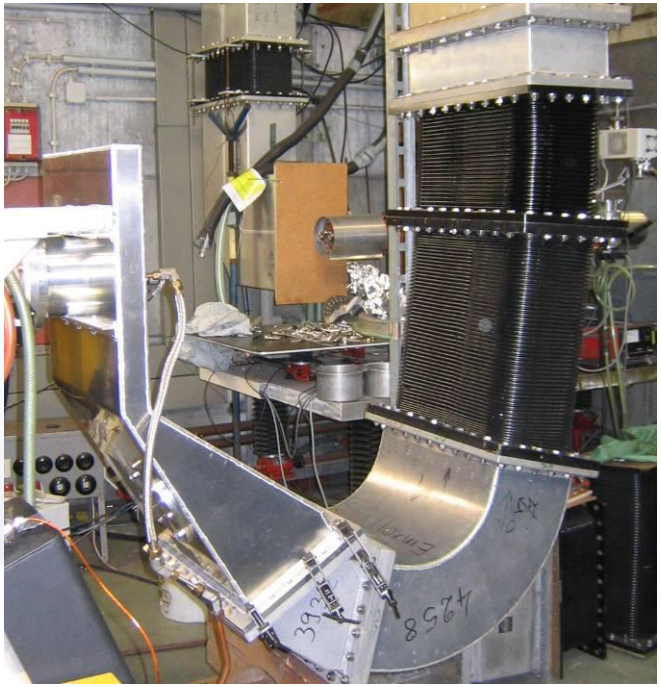
1) Allow water cooling channels in
2) Up to 160 kW
3) Fit the geometry





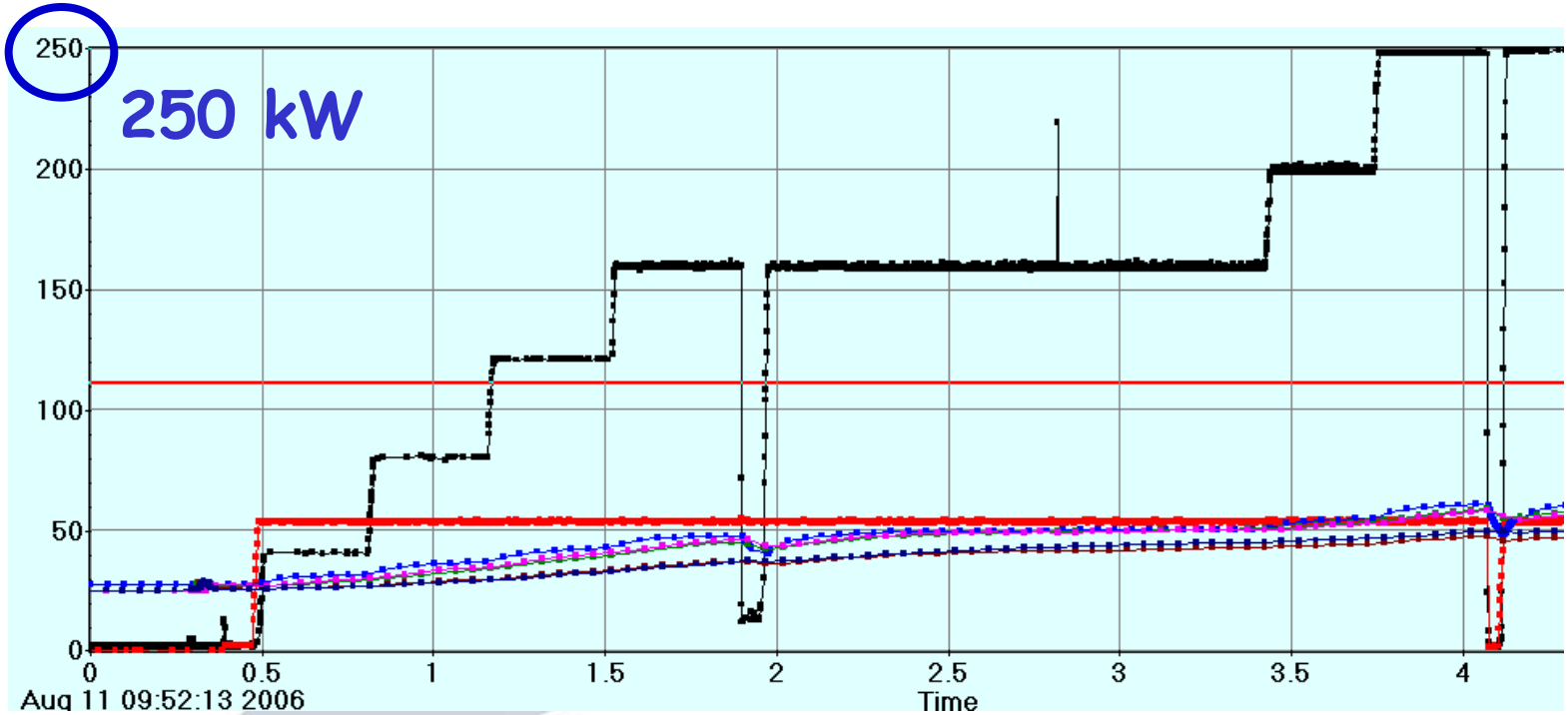
Watrax





Maximum CW power:	160 kW
VSWR:	1.061
Max. peak electric field:	239 kV/m
Power dissipated:	74.1 W

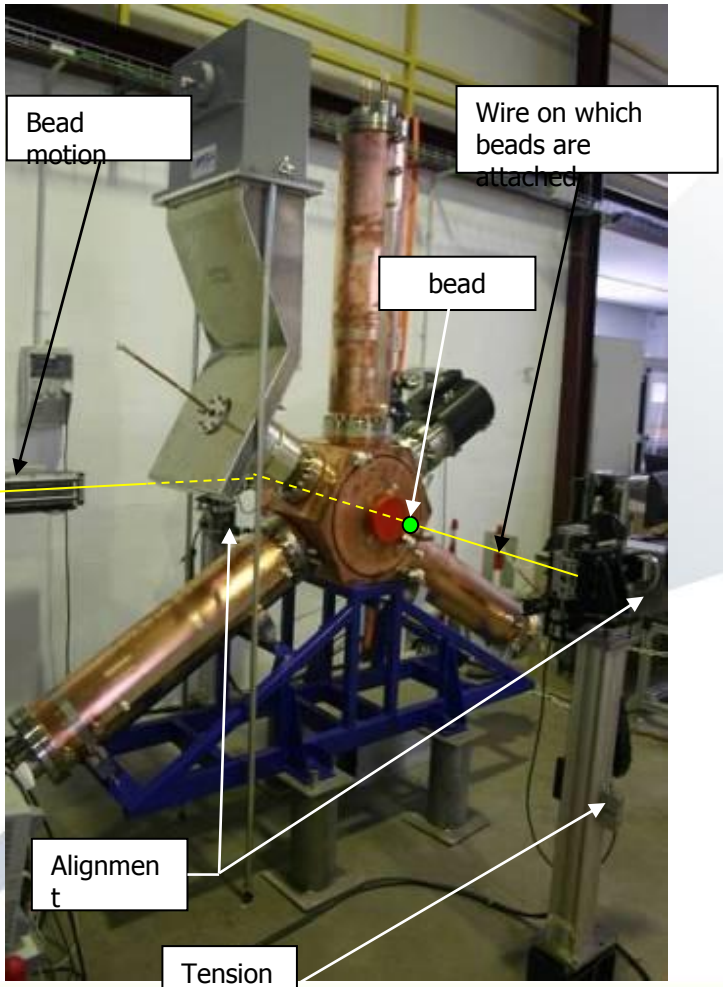
Watrax: Power test at DESY

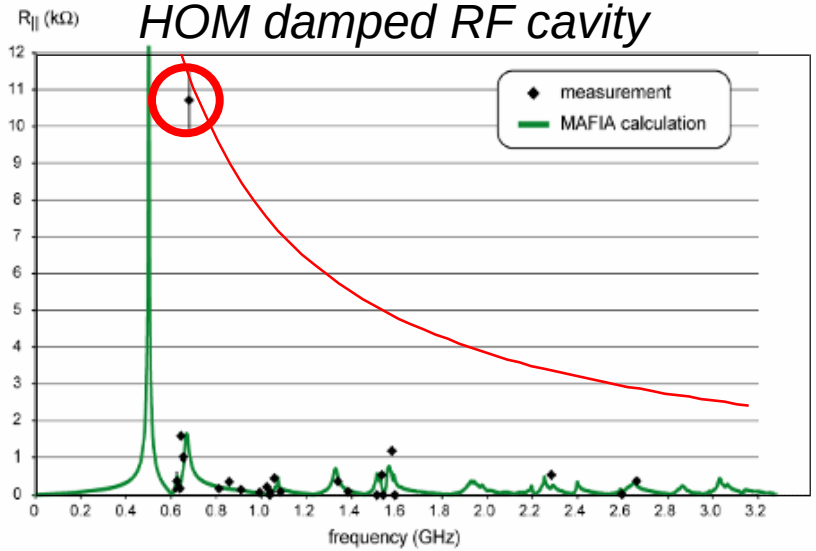


Time	Klystron power [kW]	Klystron power [kW]	Power forward [kW]	Power Reflected [kW]	S11 [dB]	Z1 [ºC]	Z2 [ºC]	Z3 [ºC]	Z4 [ºC]	Luft [ºC]
13:15	160	183,5	172,4	11,1	-11,9	51,8	44	51,3	46,1	51,5
14:15	250	286,3	267,8	18,6	-11,6	60	49	59,1	51,7	62,5

RF cavity: DAMPY

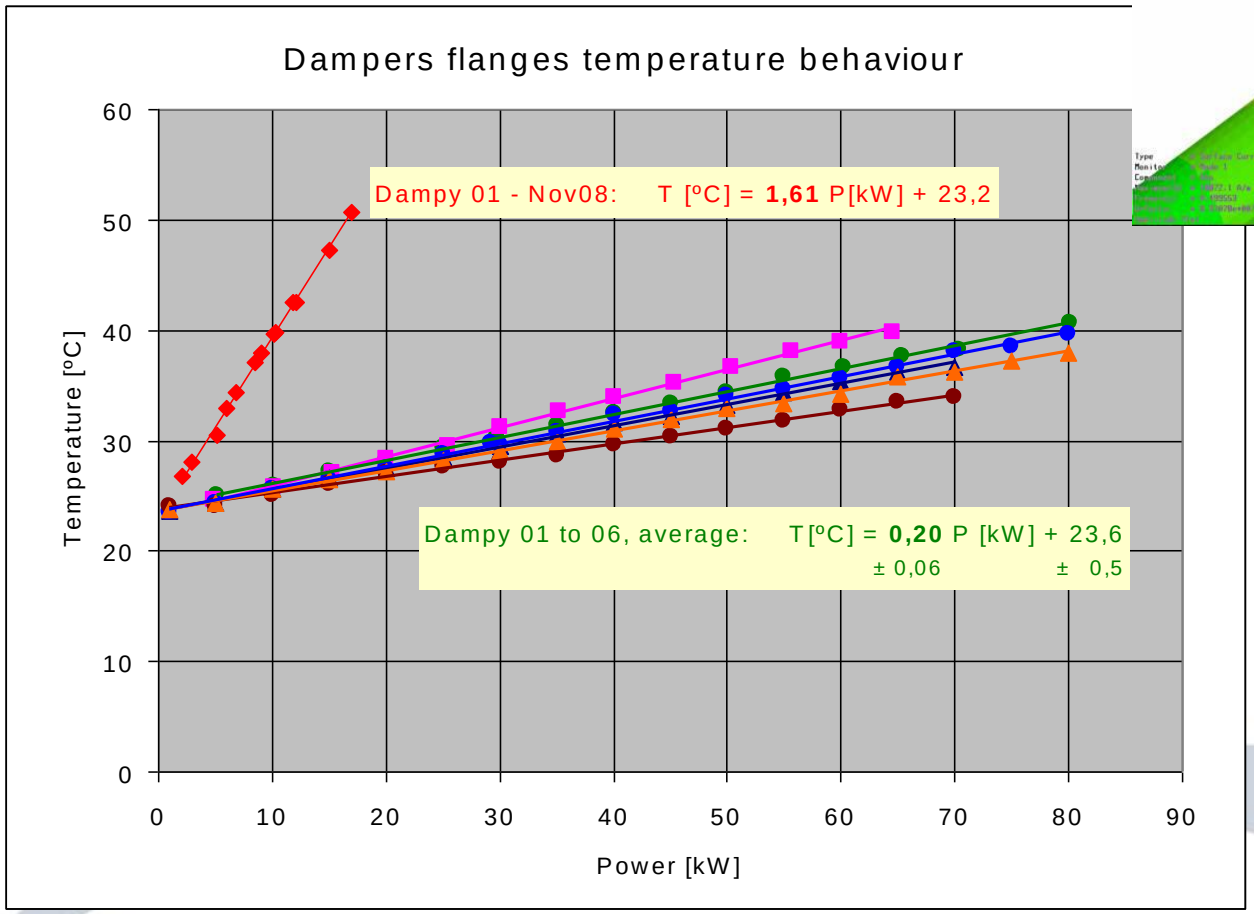
(in collaboration with Bessy)

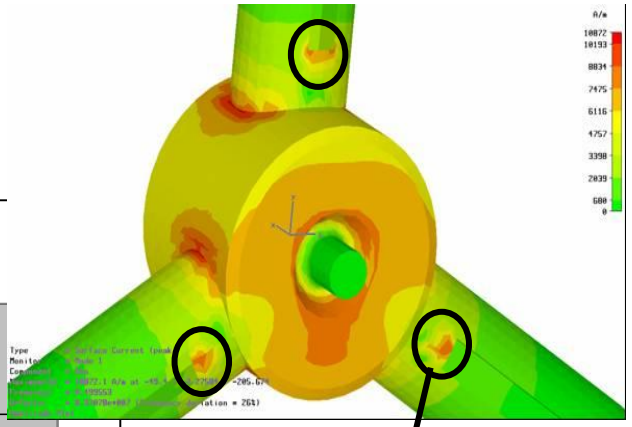


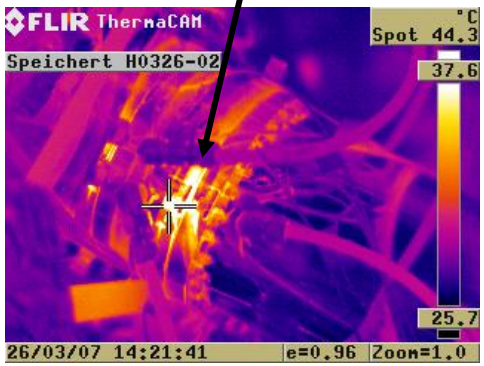


CAVITY	DAMPY	
Type	single-cell	
Number	6	
Frequency	500	MHz
Rsh	3.3	Mohm

SR Dampy 01 to 06 Power tests







All cavities operational and installed

Digital Low Level RF

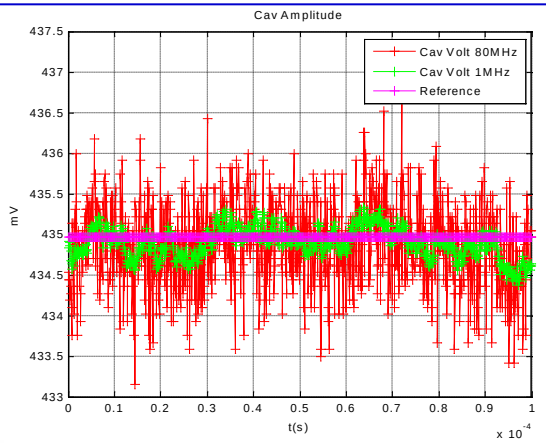
- ✓Based on a commercial FPGA board (Lyrtech VHS-ADAC)
- ✓Analog Front Ends for pre-processing of RF signals
- ✓Amplitude, phase and tuning loops implemented
- ✓ Diagnostics and extra capabilities

Lyrtech Digital Board

Analog Front End

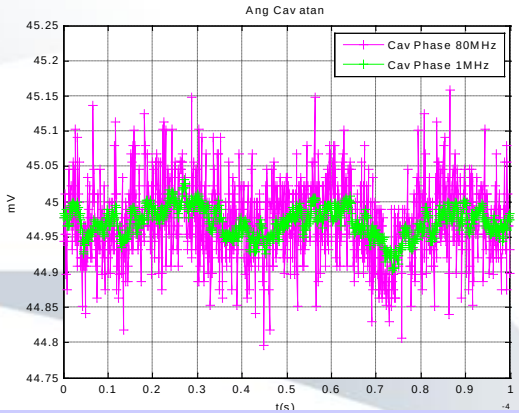
DLLRF Power test

Tests at 75 kW



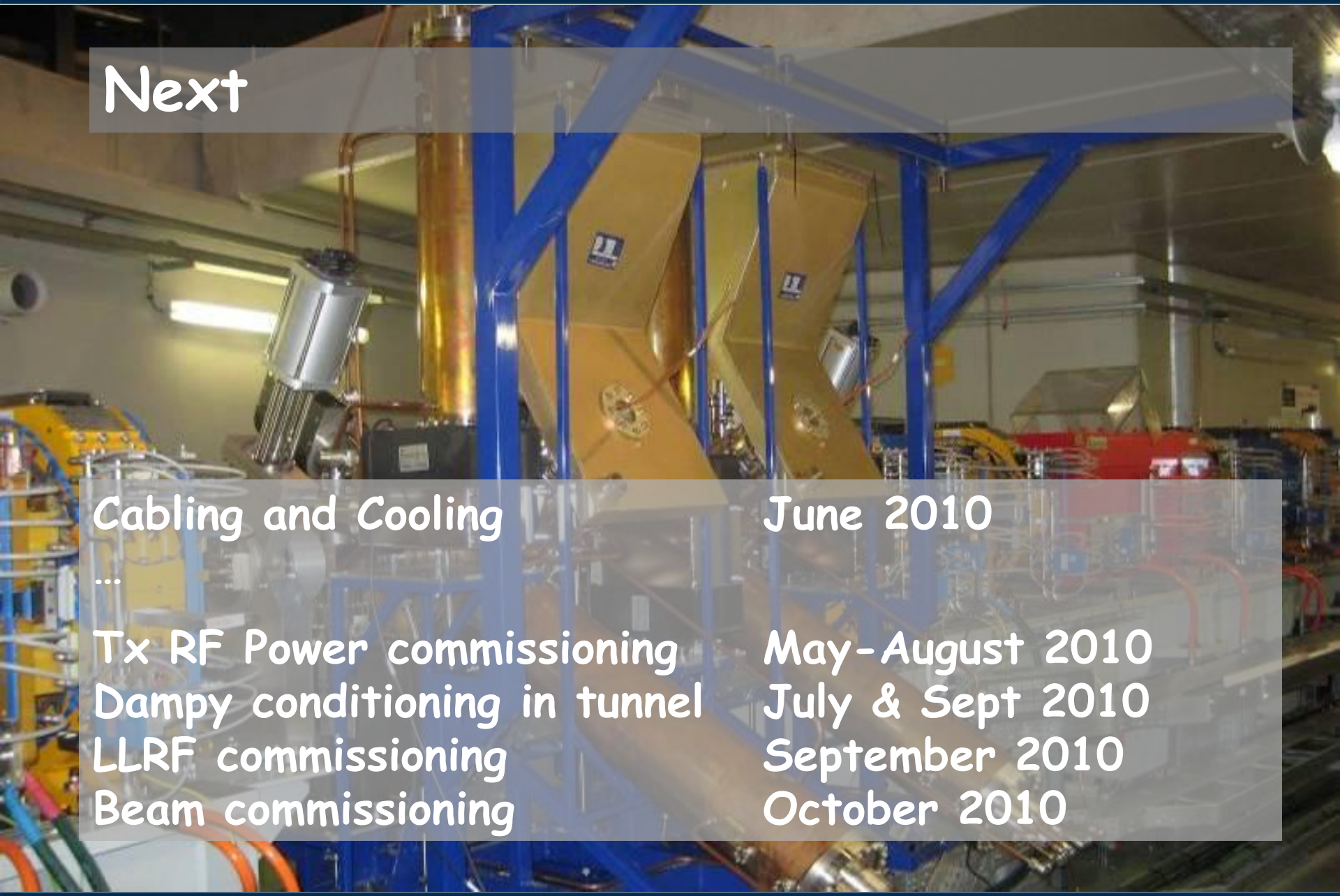
Amplitude RMS Errors: 0.11% @ 80MHz

0.03% @ 1MHz



Phase RMS Errors: 0.05º @ 80MHz

0.02º @ 1MHz



Next

Cabling and Cooling	June 2010
…	
Tx RF Power commissioning	May-August 2010
Dampy conditioning in tunnel	July & Sept 2010
LLRF commissioning	September 2010
Beam commissioning	October 2010

Thank you