Status and operation of the ALBA RF system

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- Status of the RF system
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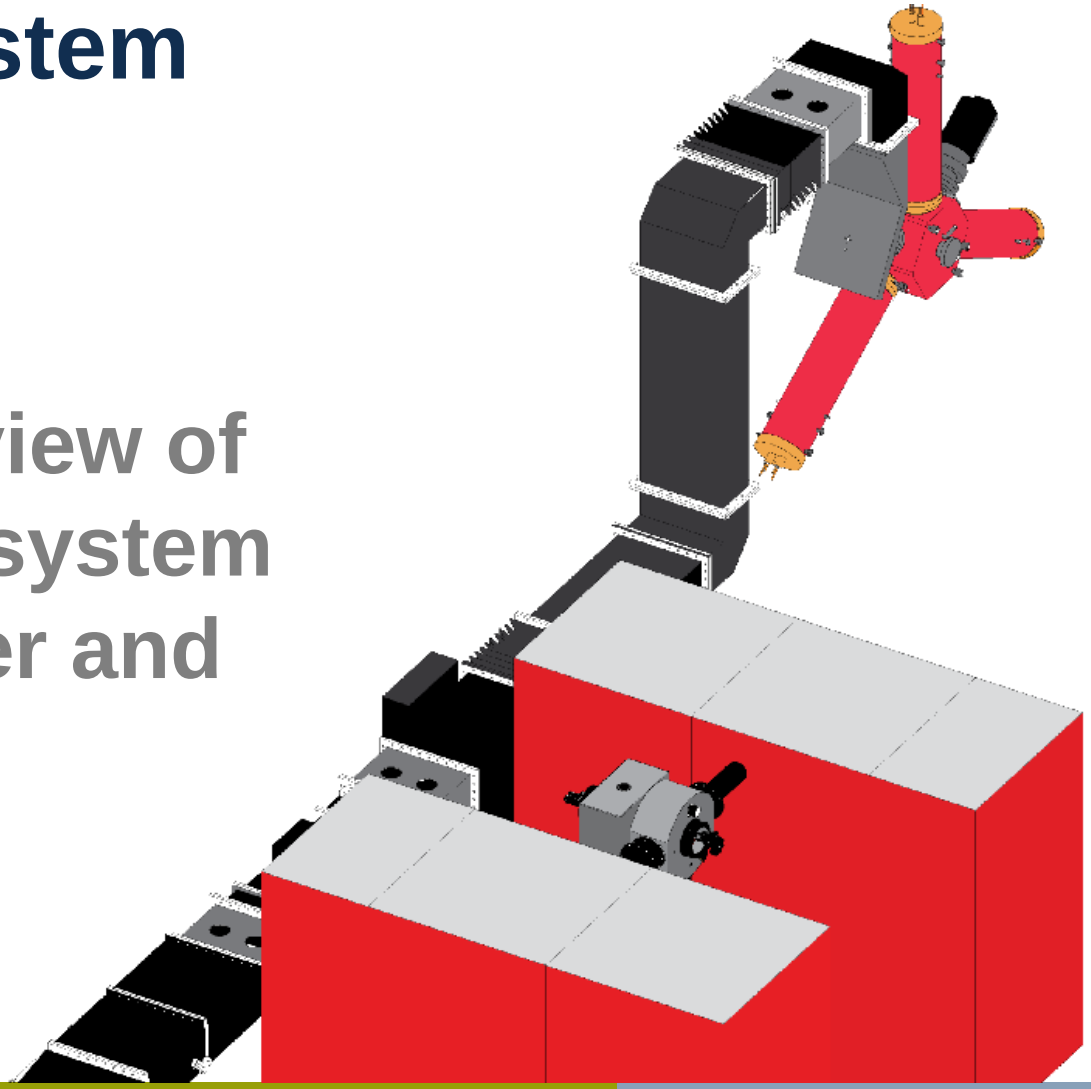
ALBA RF system

General overview of the ALBA RF system for the Booster and Storage Ring

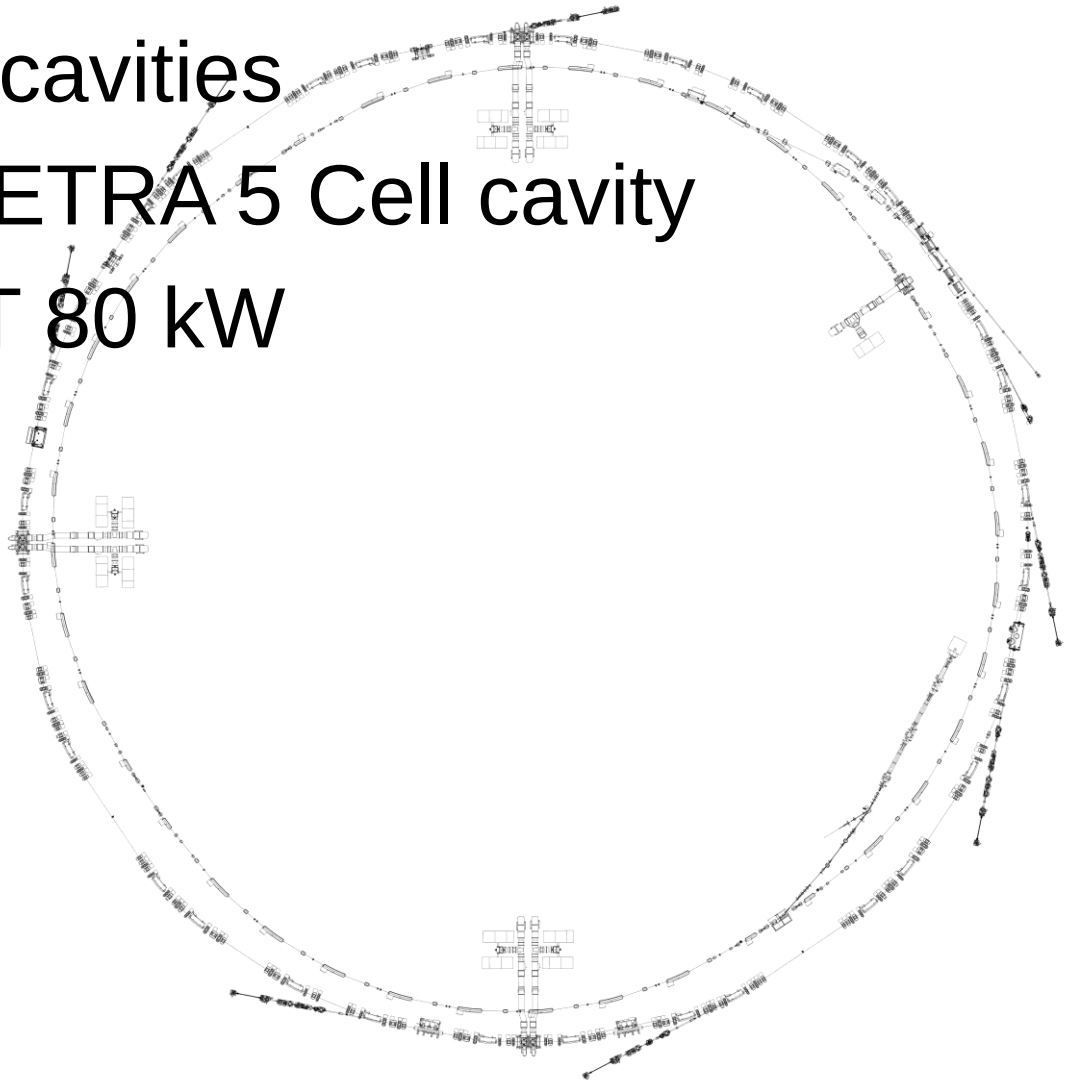


RF Overview

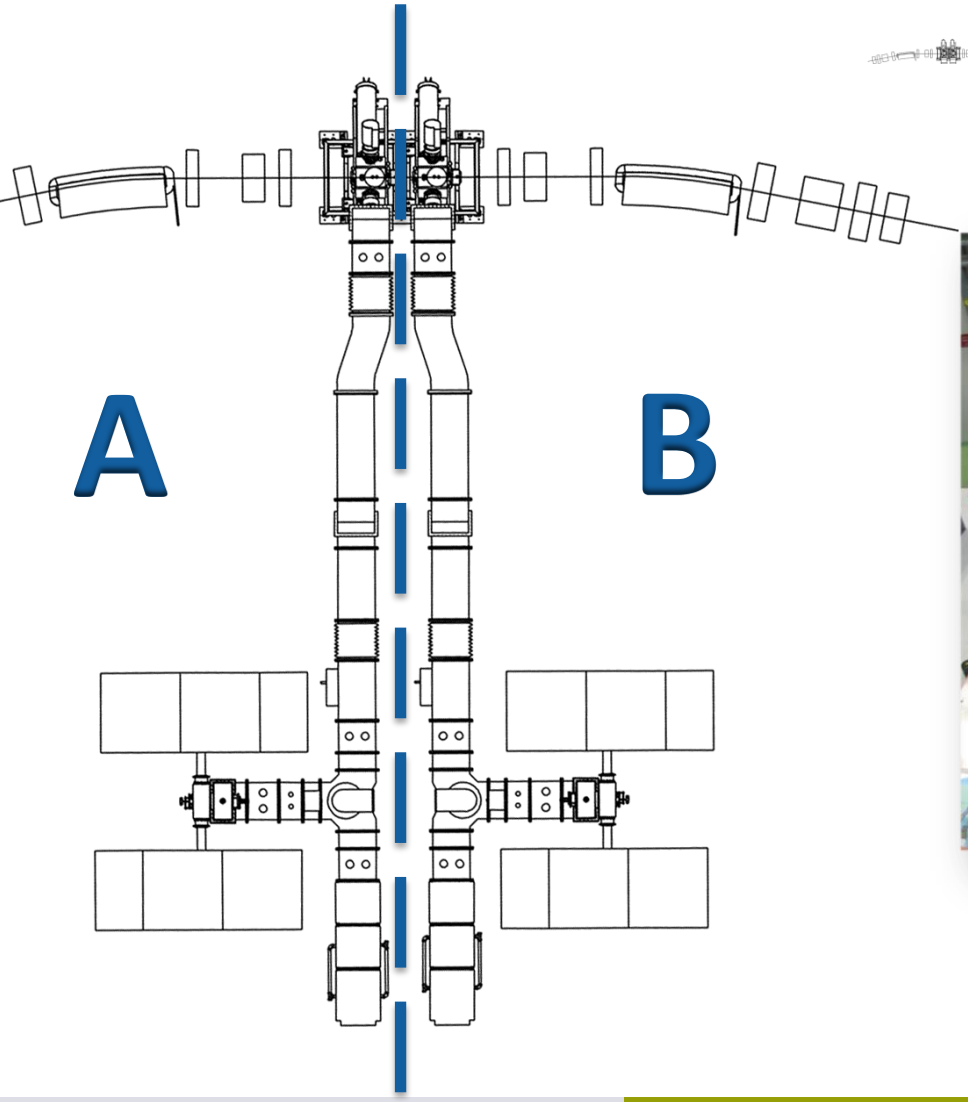
	STORAGE RING	BOOSTER (@ 3 GeV)
Frequency	499.654 MHz	
RF total Voltage	3600 kV	900 kV
Beam Current	400 mA	2 mA
Total Beam Power	540 kW	1.3 kW
Losses (including IDs)	1300 keV/turn	627 keV/turn
Type of cavity	NC EU-Cav (DAMPY)	NC 5-cell
Number of cavities	6	1
RF Voltage per cavity	600 kV	1000 kV
RF Power per cavity	150 kW	35 kW
RF Transmitter	2 x 80 kW	1 x 80 kW
Synchrotron frequency	9.3 kHz	8.6 kHz

ALBA RF System

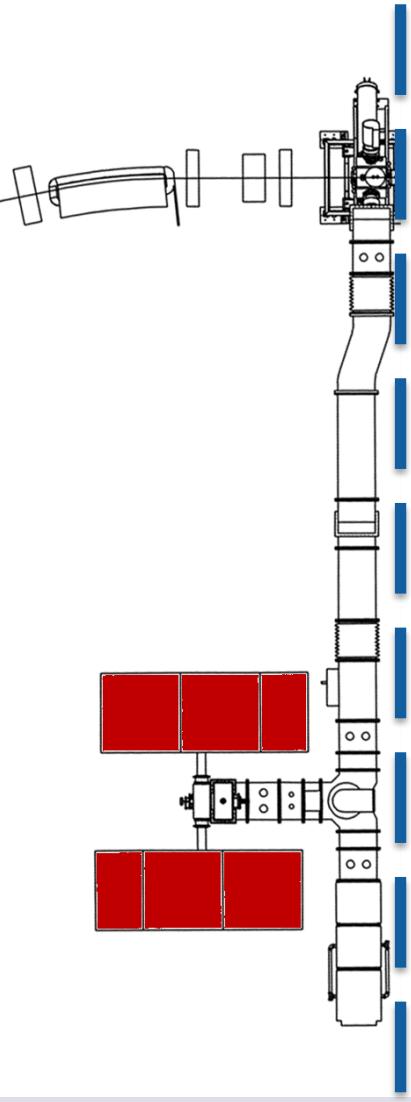
- SR: 6 cavities
- BO: PETRA 5 Cell cavity
- 13 IOT 80 kW



Storage Ring RF

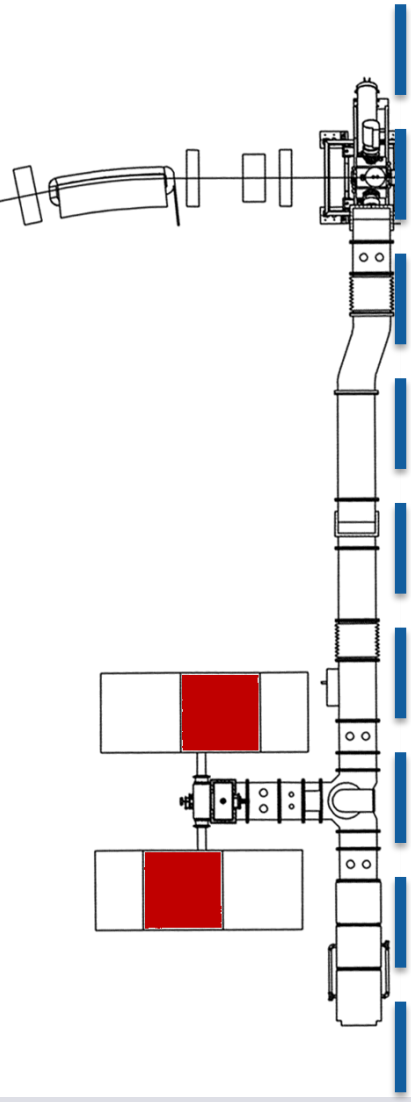


Transmitters



- HVPS
  - 38kV
  - 4A
  - PSM technology
- IOT Amplifier
  - 80kW CW
  - TH794 IOT

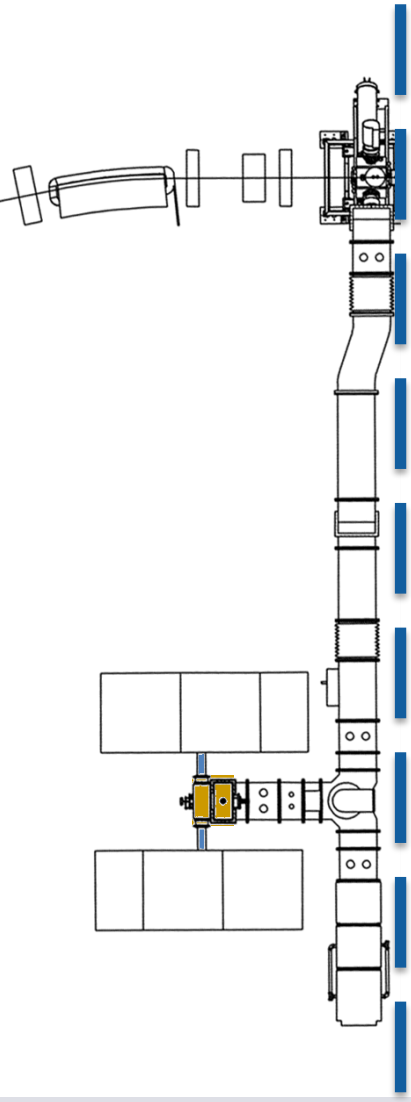
TH-794 IOT's



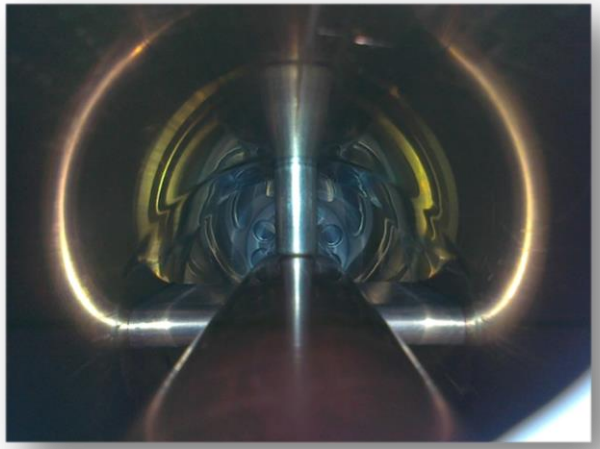
- Operation configurations

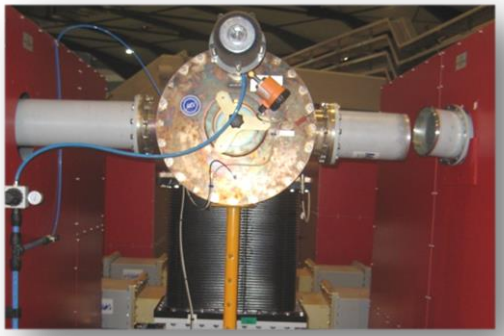
	Conf. 50 kW	Conf. 80 kW
Cathode voltage	-32 kV	-36 kV
DC beam current	0.15 A	0.2 A
Gain	22.9 dB	23.4 dB
Efficiency	59,3 % 50 kW	70,4 % 80 kW

CoStub & CaCo

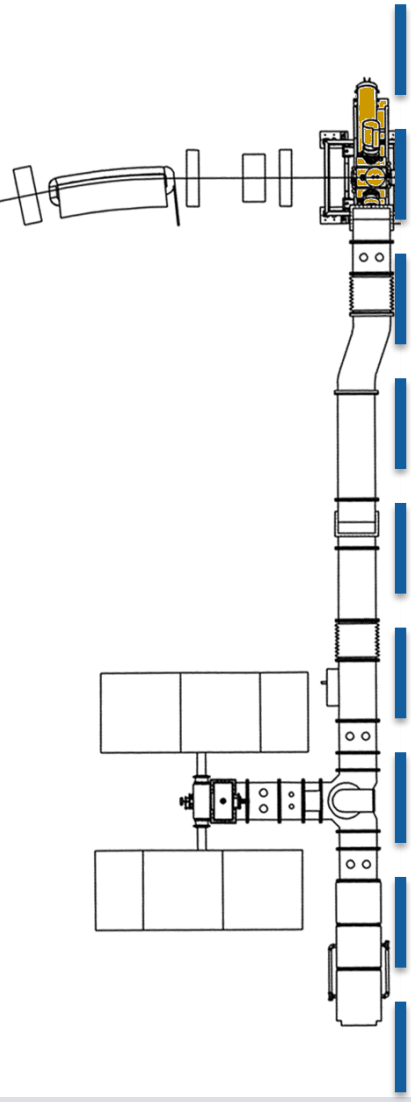


- CaCo: Cavity Combiner
- CoStub: Quickly isolate 1 IOT from CaCo

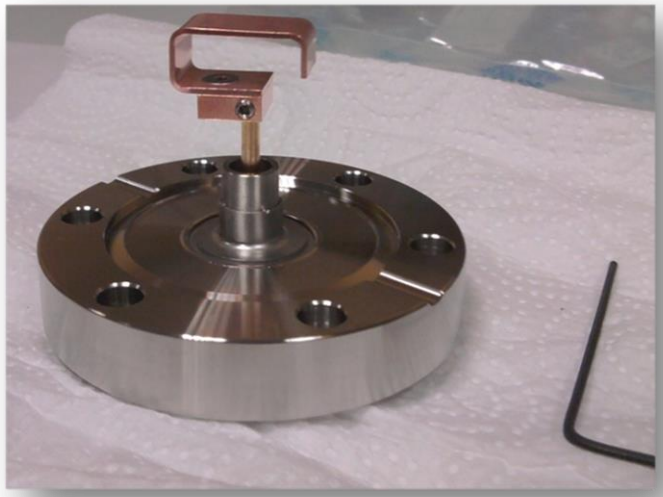




DAMPY cavities

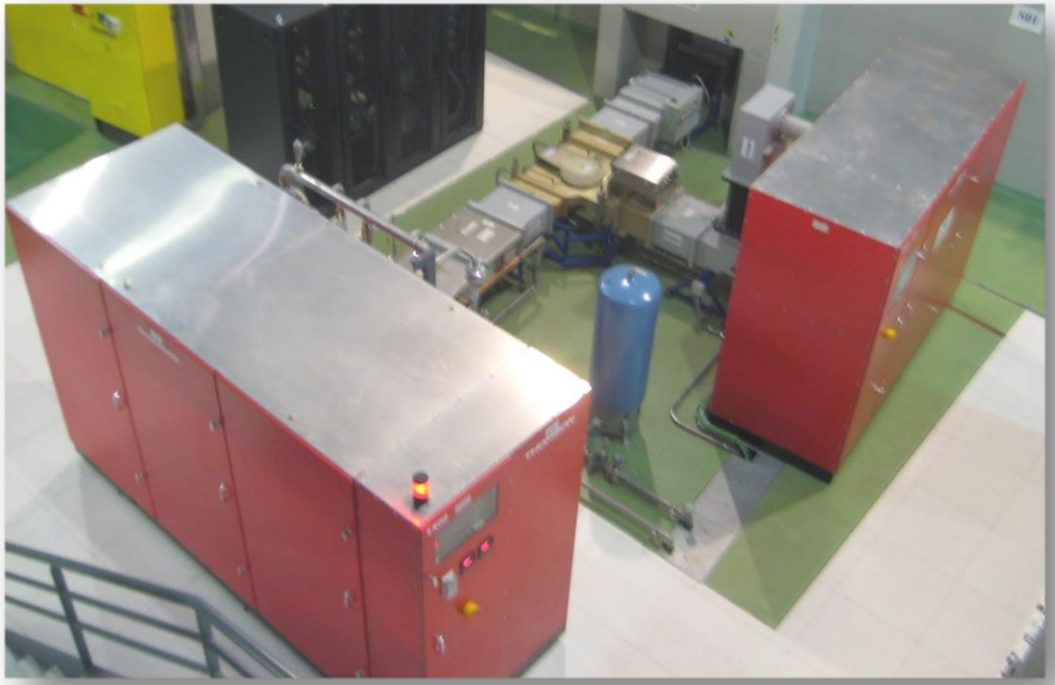


- Normal conducting
- New pick-up loops



Booster cavity

- 80kW single IOT
- 5 Cell PETRA Cavity



Digital LLRF

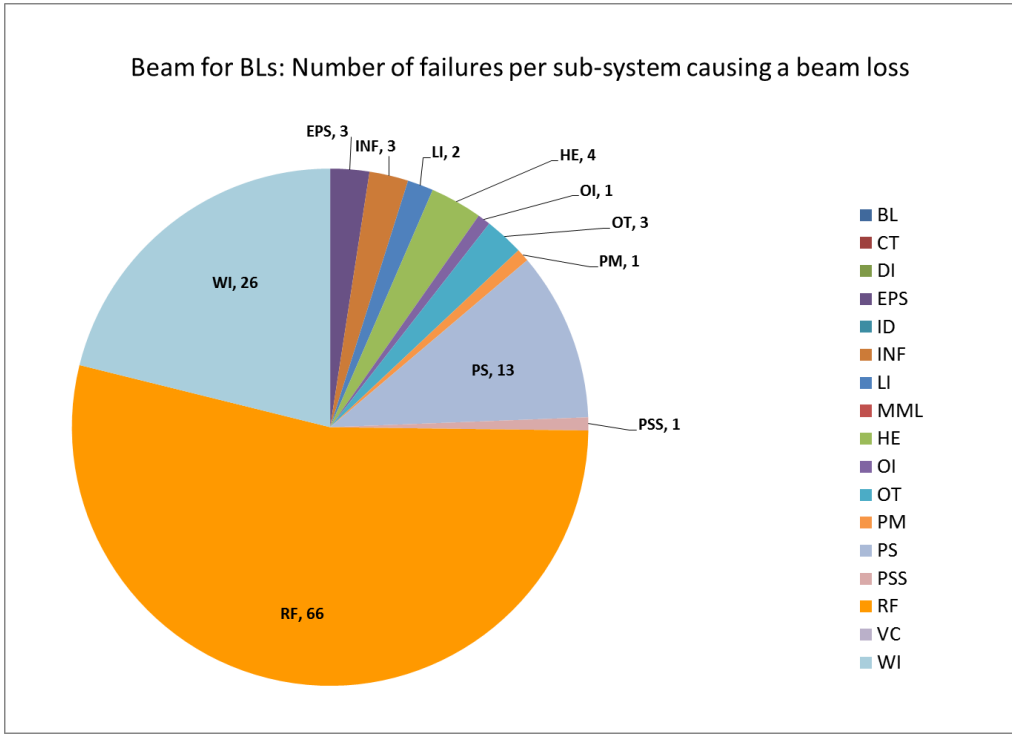
- In-house design
- Built with commercial components

	Resolution	Bandwith	Dynamic range
Amplitude loop	< 0.1% rms	[0.1, 50] kHz	30 dB
Phase loop	< 0.1º rms	[0.1, 50] kHz	60º
Tuning	< ±0.5º	100 Hz	< ±75º

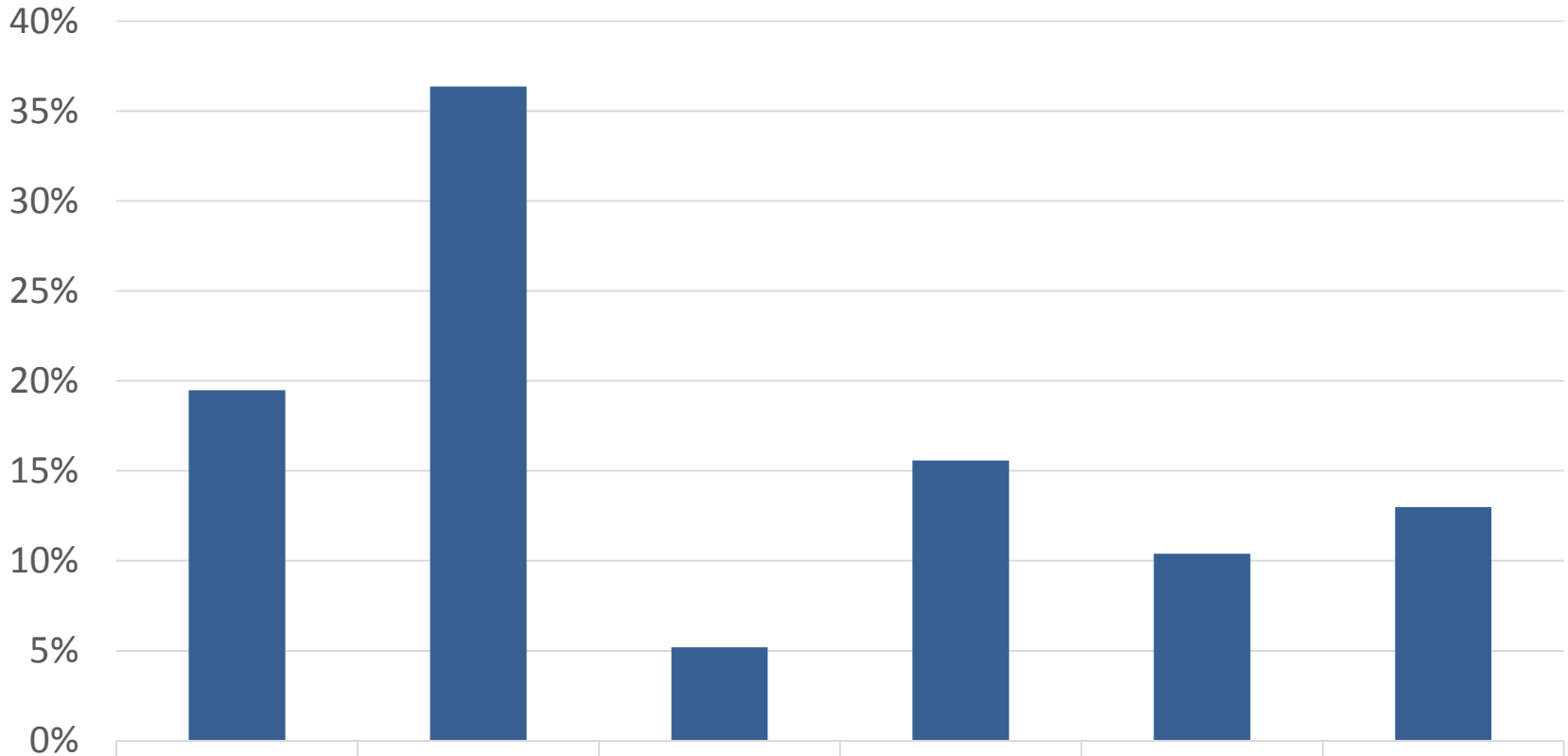
ALBA operation & Status of the RF

2013 ALBA operation

- 96,8 beam availability
- MTBF 25 hours
- MTTR 0.8 hours
- 123 beam dumps
- RF responsable of 53% of beam dumps

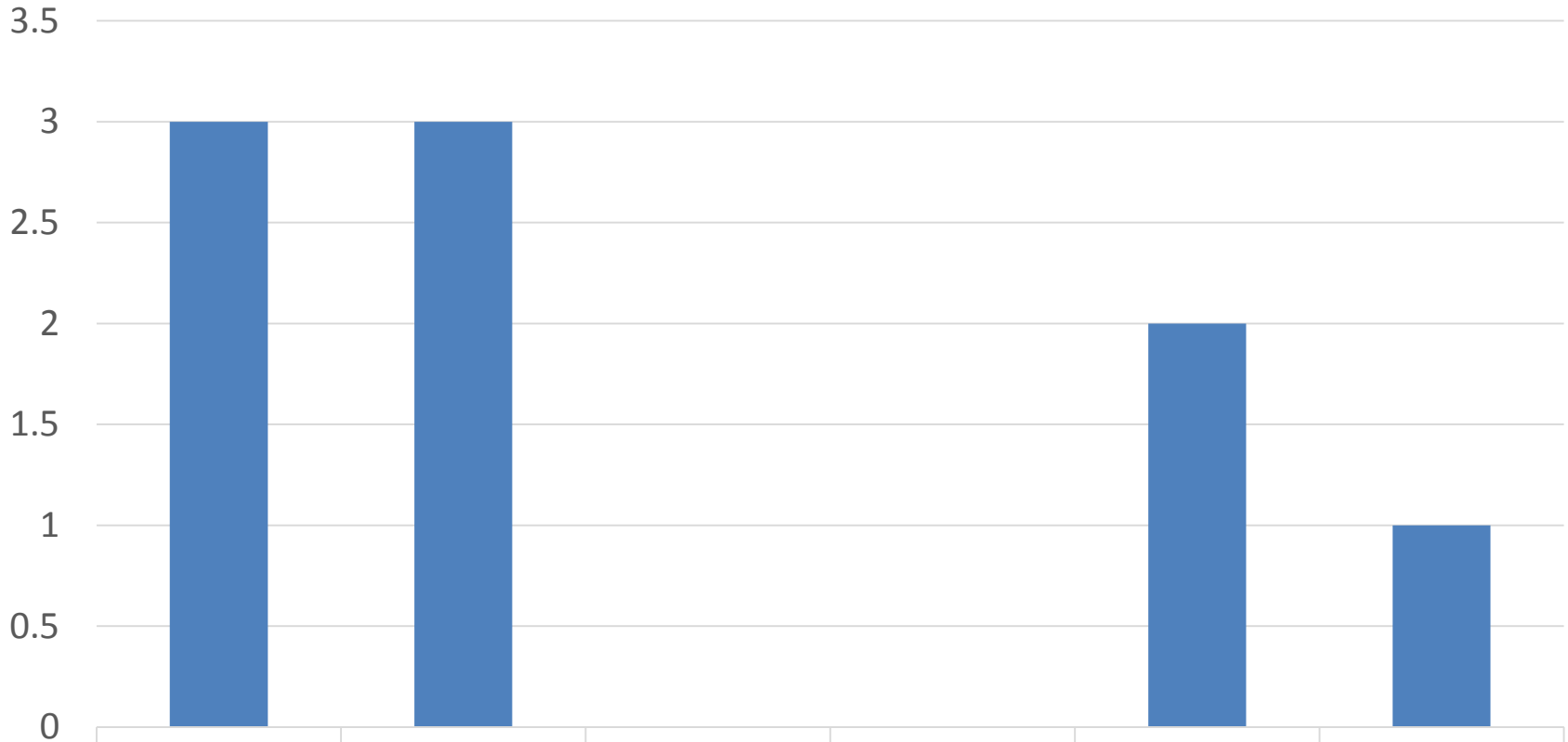


2013 RF beam dumps



	Cavity arc	IOT arc	Damaged component	Cavity Rv power	Water	Other
Partial	19.48%	36.36%	5.19%	15.58%	10.39%	12.99%

2014 RF beam dumps



	Cavity arc	IOT arc	Damaged component	Cavity Rv power	Water	Other
Full	3	3	0	0	2	1

13,5 active IOT's

Last TX	Fil hours	HV hours	Comment
TX02	21.652	15.436	Booster.
TX09	19.304	14.433	10B1. Original
TX08	18.864	14.282	10A2. Original
TX05	17.795	13.230	06B1
TX07	16.891	13.900	10A1
TX03	16.622	12.006	06A1
TX14	9.456	7.399	14B1
TX10	7.410	5.961	10B2
TX04	4.875	4.071	06A2
TX11	718	695	14A1
	0	0	
TX01	~300	~150	RF-LAB: 75kW Ok
TX14	~48	~24	

Total		Average		St. Dev.	
Fil	HV	Fil	HV	Fil	HV
133.587	101.413	13.359	10.141	7.146	5.184

11,5 damaged IOT's

Last TX	Date	FIL hours	HV hours	Comment
TX01		1.714	1.088	Damaged during transportation
TX07	19/09/2011	2.316	515	Damaged after 3 months shutdown
TX01	07/10/2011	1.639	1.101	Only functional up to 20kW
TX04	21/05/2012	7.468	4.851	Water leak in IOT carriage
TX06	20/08/2012	7.828	5.080	Spontaneous arc
TX10	08/11/2012	10.296	6.970	Arc at 50kW
TX03	17/01/2013	10.627	7.585	Spontaneous arc
TX04	26/01/2013	4.221	3.324	Spontaneous arc
TX13	25/10/2013	15.456	12.004	Spontaneous arc
TX11	**12/02/2014**	18.257	13.250	Spontaneous arc
TX13	**02/03/2014**	8.203	6.501	Spontaneous arc
TX12	**24/02/2014**	17.039	12.395	Impossible to recover after December shutdown

Total		Average		St. Dev.	
FIL	HV	FIL	HV	FIL	HV
105.064	74.664	8.755	6.222	5.837	4.474

Since 2010

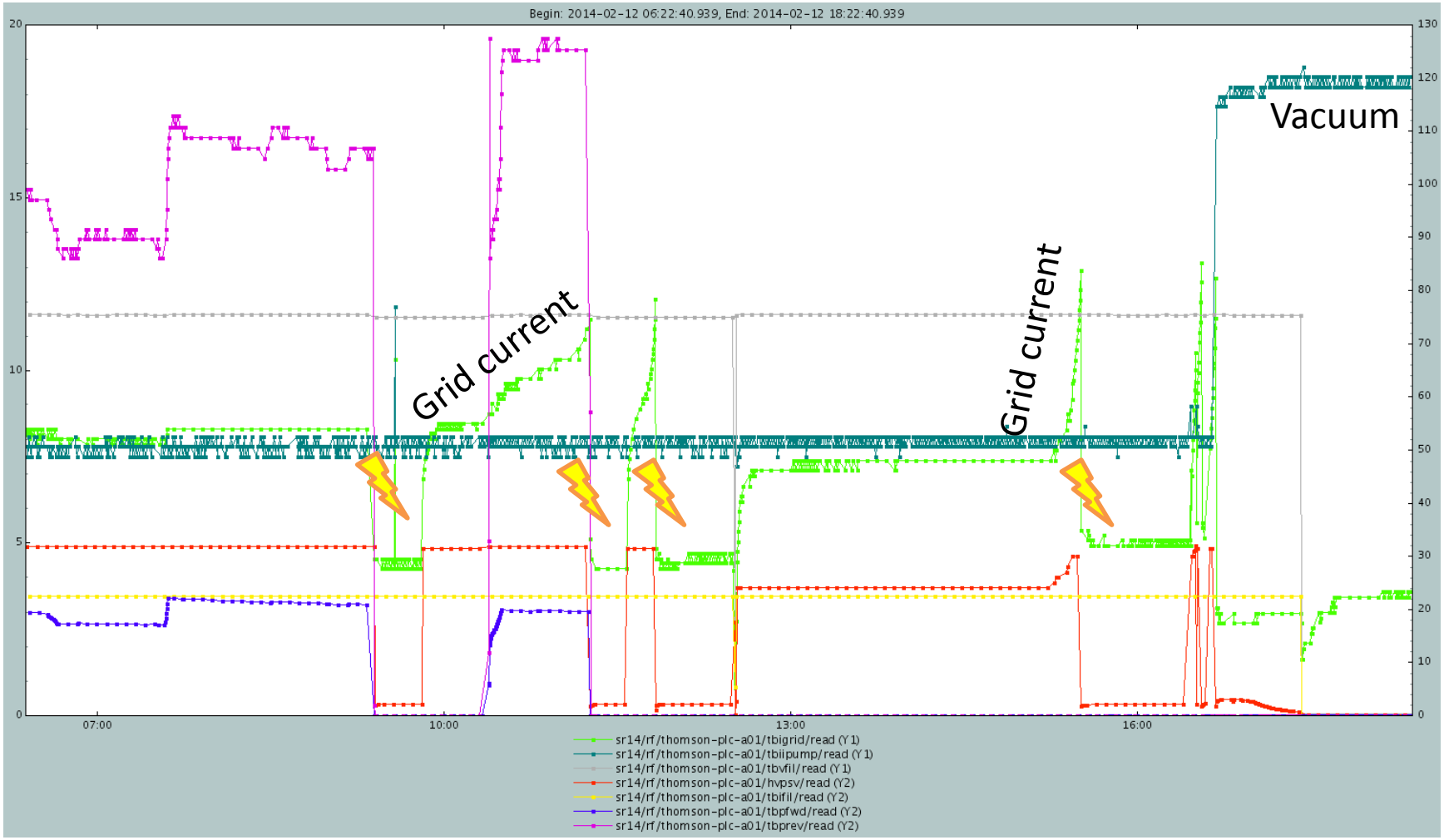
Damaged IOT's

- 2 damaged IOT's in 2014
- 1 IOT undergoing high voltage conditioning

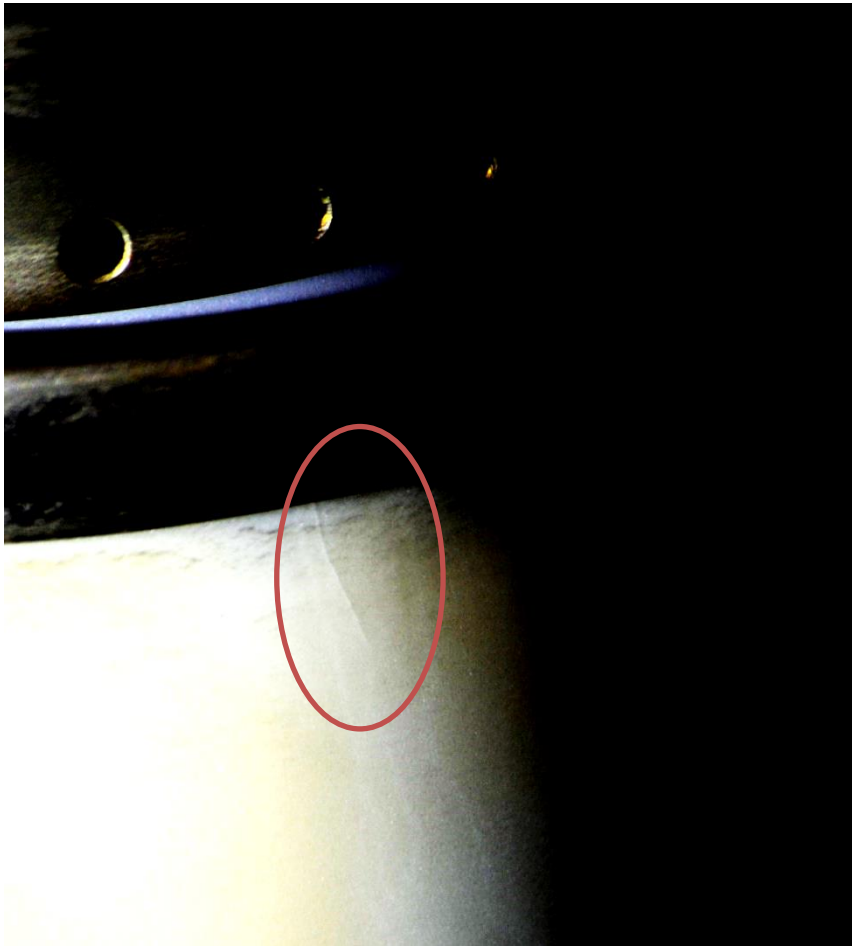
620408

- 17.039 hours of operation
- External arching
- Grid current increase with only DC HV applied

620408


Begin: 2014-02-12 06:22:40.939, End: 2014-02-12 18:22:40.939
Grid current
Grid current
Vacuum
07:00
10:00
13:00
16:00
sr14/rf/thomson-plc-a01/tbigrid/read (Y1)
sr14/rf/thomson-plc-a01/tbiipump/read (Y1)
sr14/rf/thomson-plc-a01/tbvfil/read (Y1)
sr14/rf/thomson-plc-a01/hvpsv/read (Y2)
sr14/rf/thomson-plc-a01/tbifil/read (Y2)
sr14/rf/thomson-plc-a01/tbpfwd/read (Y2)
sr14/rf/thomson-plc-a01/tbprev/read (Y2)

Ceramics detail



Take it easy!

- Remove the IOT and look for defects
- High voltage conditioning in transmitter up to 40kV
- HVON 32kV

RF-Lab

80kW amplifier

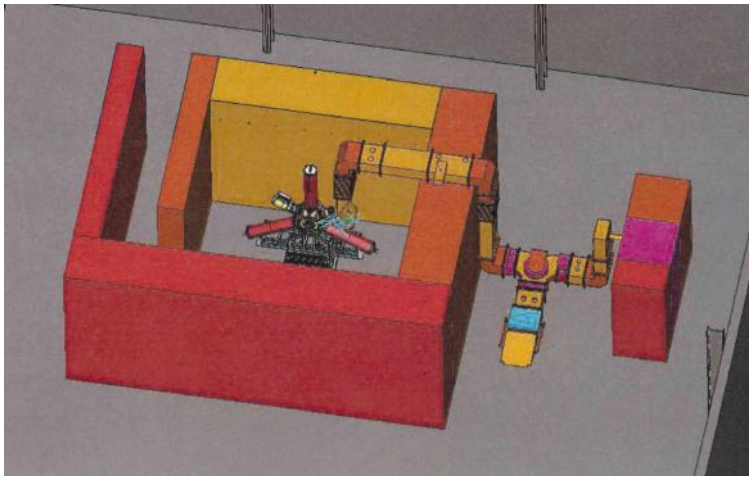
SR & BO cavities

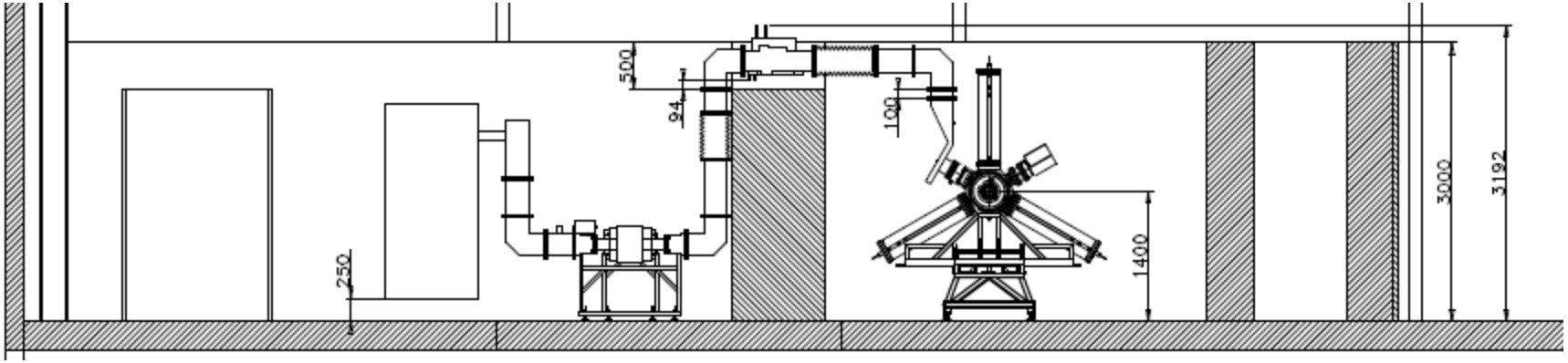
External collaborations

Purpose

- IOT testing
- Cavity conditioning and testing
- Prototype test
- Collaboration with other institutions
  - CIEMAT: Conditioning of buncher cavities for IFMIF

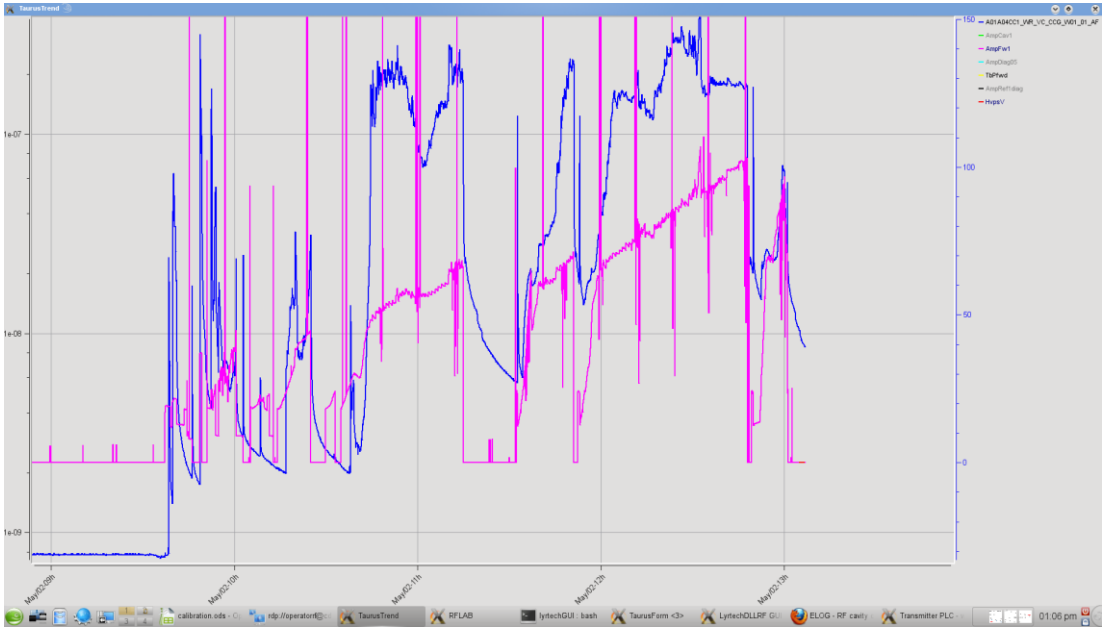
Layout





Operation

- Amplifier tested up to 75kW CW
- Conditioning spare Dampy cavity
  - 40kW, 20% duty cycle



Status and operation of the ALBA RF system

Thank you for your attention