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Commissioning of the ALBA IOT-Transmitters
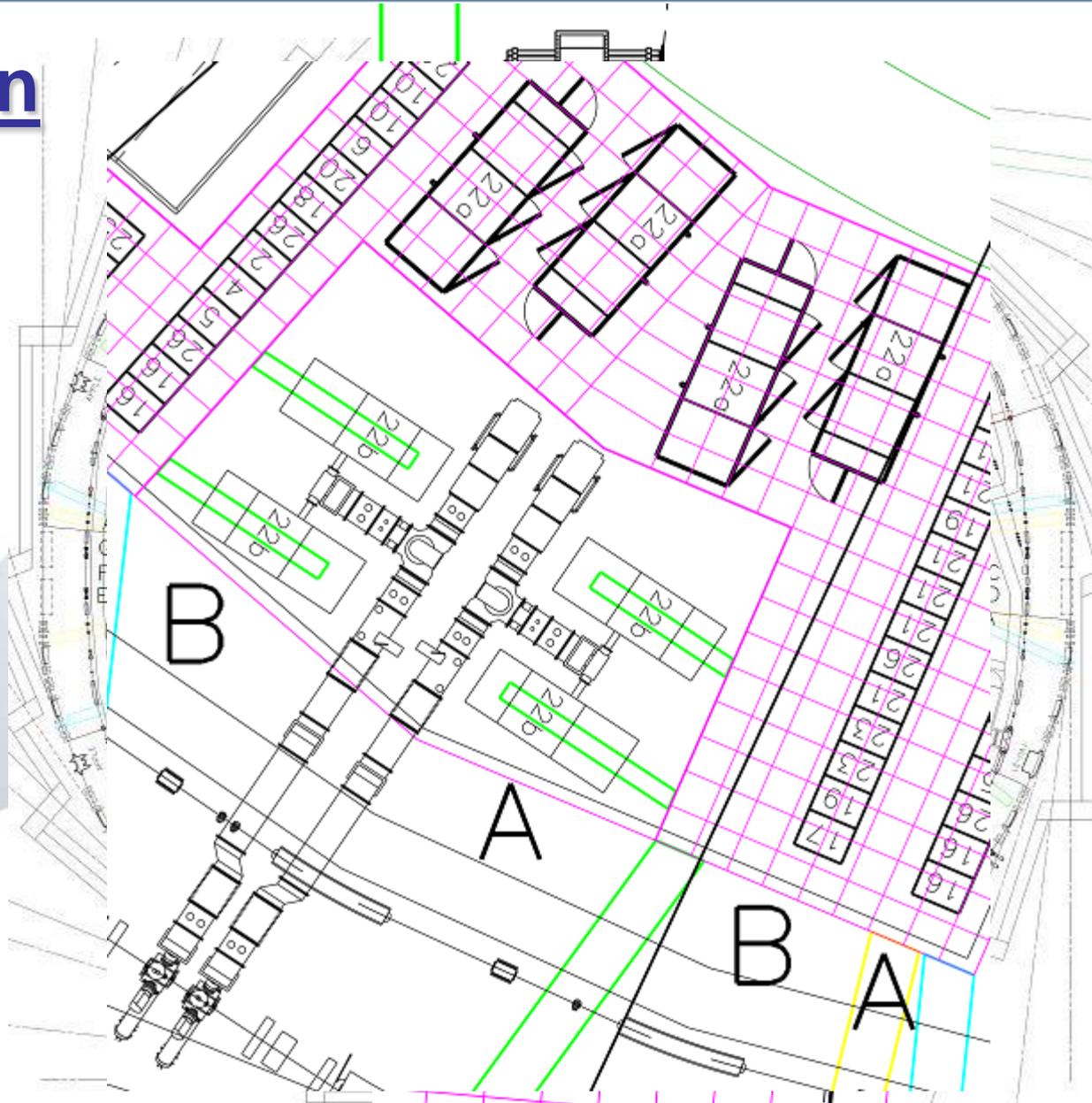
A. Introduction

ALBA TXs concept:

➢ **TX-IOT based**

 ✓ **HVPS -36 kV, 4 A**

 ✓ P_{max} = 80 kW cw

 ✓ f_0 = 500 MHz

➢ **TX = HVPS + IOT**

➢ **1 TX ➜ RF Lab**

➢ **1 TX ➜ Booster**

➢ **12 TXs ➜ SR**

B. Schedule

Technical Specs (ver 1.0)		Nov – 2005	
Call For Tender publication		Feb – 2006	
CONTRACT		30 – Nov – 2006	
Delivery / Installation (TX02 – TX14 installed in Jan-2009, because of the building delays)	TX01	Jun – 2007	Aug – 2007
	TX02-TX06	Jun – 2008	*Jul – 2008*
	TX07-TX10	Sept – 2008	*Oct – 2008*
	TX11-TX14	Oct – 2008	*Oct – 2008*
Acceptance (TX02 – TX14 commissioning split in DC and RF due to delays in the water cooling installation) (*)	TX01	Aug – 2007	Oct – 2007
	TX02	Sept – 2008	*Nov – 2009*
	TX03-TX06		*Jul – 2010*
	TX07-TX10	Nov – 2008	*Jun – 2010*
	TX11-TX14	Dec – 2008	*Sept – 2010*
(*) *DC-Commissioning completed in 6 weeks (Jul – 2009), RF in 6 months (13 TXs)*			

C. Installation

➢ **Placing cabinets**

➢ **Water cooling plants delayed**

➢ **Cabling trenches and trays**

D. DC Commissioning

✓ **Visual inspection of cabinets and connection between them**

☒ Grounding plates, cabling and water piping

✓ **Safety and interlock system**

☒ Emergency stop for a complete Sector (8 cabinets)

✓ **Control and settings**

✓ **HVPS wire test (diameter 0.15 mm, length 380 mm)**

✓ **Ripple, stability, accuracy**

✓ **Auxiliary PS**

✓ **Withstand test (1h at 36 kV, w/o breakdown or corona)**

E. RF Commissioning - PROBLEMS

1. **IOT oxidation during long storage periods**

   - Ion pump current too high ➔ 72 hours conditioning
   - HV idle current decreased ➔ operate at HV for one night

   ☒ For each Booster shutdown, operate IOT in HV for 8-10 hours

2. **Passive IOT connected through CaCo without supervision**

   - Ceramic broken due to multiple arcs ➔ Isolate passive IOT, coax short!

For future improvements, see Bea's presentation.

E. RF Commissioning - PROBLEMS

2. **Passive IOT connected through CaCo without supervision**

☒ Investigations on broken IOT (THALES, THOMSON, ALBA):

- Provoke arcs in the 16 mm with a HV power supply
  (arcs seen at 32 kV)

- Glue and reinstall IOT as passive (air instead of vacuum)
  (arcs detected at around 30 kW)

- At 80 kW, arcs at around 50 kV

- Active IOT ➔ HV 50 kV in passive IOT

Bea's simulations (Microwave Studio) confirm these HV levels in the passive IOT.

E. RF Commissioning - PROBLEMS

3. **High Harmonic content (2nd H)**

   ☒ Several IOTs presented very high level in the 2nd Harmonic (-18 dB)

   ☒ THALES proposal: Install a ring to shift down resonances from 2nd H

   - Ring to be placed in the primary output cavity
   - Screwed to the upper disk of the cavity

   ☒ Acceptable level of the 2nd Harmonic (-54.5 dB) ➔ **ring to all IOTs**
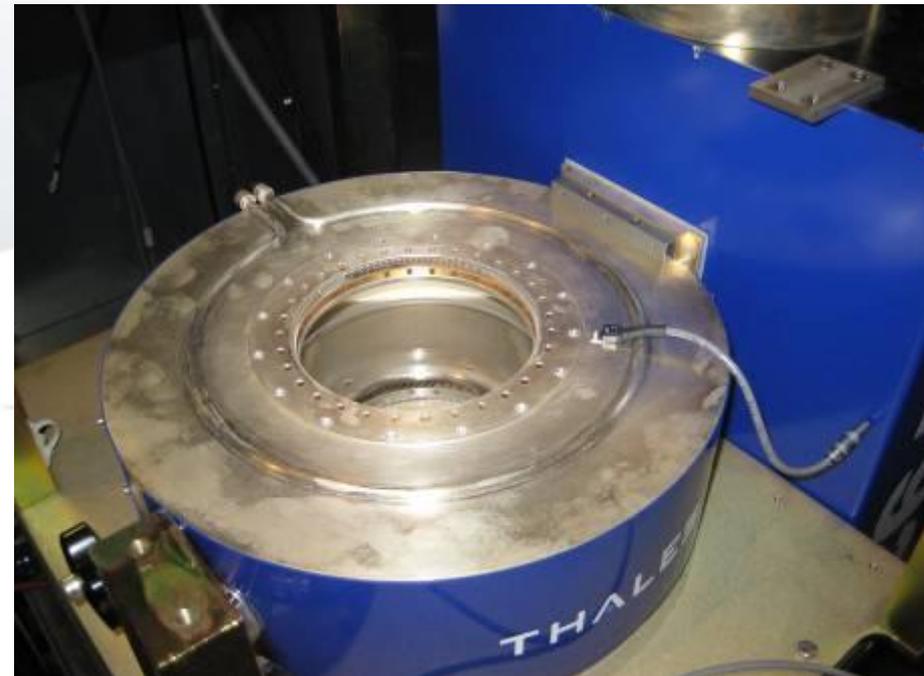
E. RF Commissioning - PROBLEMS

4.   IOT ceramic broken

- ☒   Several arcs detected, no explanation
- ☒   THALES investigation (warranty)
    - ▪   due to the broken glass?
    - ▪ 2nd harmonic content?

Color changed to make the crack visible !!
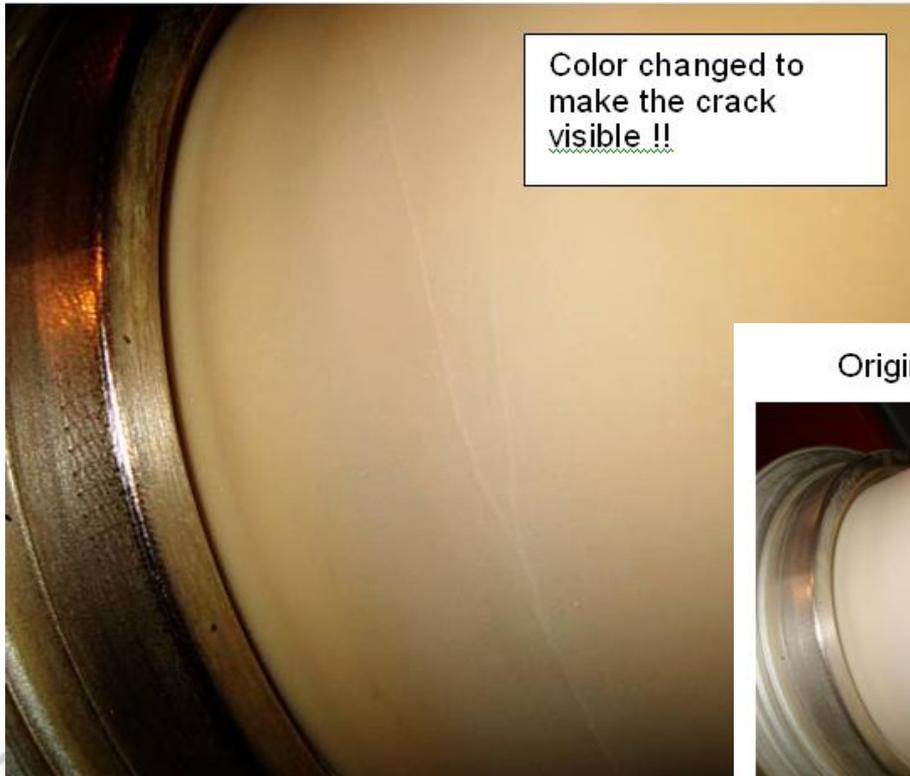
Original color

E. RF Commissioning - PROBLEMS

5. IOT showed strange behavior

- ☒ Multiple arcs, but still in operation. Needed further investigation
- ☒ Sent back to THALES for THALES refurbishment (warranty)

6. Others

- ☒ Multiple trips "Voltage/Current grid out of range"
    - ▪ Grid parameters were correct (seemed noise)
    - ▪ THALES suggests modifying the filters in the PLC ➔ **solved**
    - ▪ Measurement filter updated in all PLCs
- ☒ Driver gain too low (43 dB instead of 53)
    - ▪ Capacitor broken
- ☒ Driver gains differences too high for CaCo
    - ▪ Readjust all gains around nominal (53 dB)
- ☒ PSM modules failure (without trips)
    - ▪ 21 modules failed (out of 840)
    - ▪ Replaced and repaired in THOMSON

serial capacitor cracked

E. RF Commissioning - SUMMARY

Total TXs / IOTs CONTRACT		14 / 17 (14 + 3 spare)	
IOTs Status	**RF Lab**	**1**	**Operation**
	Booster	**1**	***Operation***
	SR Sector 06	**4**	***Operation (2 spares used)***
	SR Sector 10	**4**	***Operation (1 spare used)***
	SR Sector 14	**4**	***Operation***
	Spare #1	*1*	*Installed in sector 10*
	Spare #2	*1*	*Installed in sector 06*
	Spare #3	*1*	*Installed in sector 06*
14 TX / IOTs in operation. 3 spares IOTs used (1 broke, 2 under warranty)			

➢ **Operation Time / Maintenance:**

CELLS Intranet Application

F. Summary and Outlook

➢ **Modifications for the asymmetrical operation:**

  ❑ **Mechanical prototype (Bea's presentation)**

  ❑ **Cooling and Ion Pump ON (passive IOT)**

  ❑ **PLC logic (Passive IOT interlocks ON)**

➢ **RF operation for DAMPYs conditioning**

➢ **RF operation for Booster and SR commissioning**

➢ **Planning for Transmitters / IOTs Maintenance:**
  CELLS Intranet Application

➢ **New contract for Spare IOTs**

Many Thanks for your attention

Commissioning of the ALBA IOT-Transmitters

CELLS Maintenances Tool

Summary | IOTs | Transmitters | Logs | Reports

Summary

IOT Name	Last TX	Serial number	Status	Total filament hours	Total HV hours	HV > 150hrs.	HV > 2000hrs.
499413	TX01	499413	Active	588.0	521.0	ⓘ	
610735	TX04	610735	Active	626.0	280.0	ⓘ	
499443	TX02	499443	Active	1230.0	243.0	ⓘ	
608802	TX03	608802	Active	759.0	215.0	ⓘ	
623097	TX07	623097	Active	604.0	191.0	ⓘ	
617551	TX05	617551	Active	499.0	173.0	ⓘ	
617302	TX08	617302	Active	499.0	167.0	ⓘ	
629734	TX06	629734	Active	361.0	153.0	ⓘ	
617550	TX10	617550	Active	566.0	119.0		
591095	TX01	591095	Returned	150.0	106.0		
617549	TX09	617549	Active	587.0	101.0		
610737	TX06	610737	Refurbishment	360.0	76.0		
623096	TX12	623096	Active	100.0	76.0		
620408	TX11	620408	Active	135.0	51.0		
623098	TX13	623098	Active	190.0	47.0		
611024	TX02	611024	Broken	58.0	34.0		
623099	TX14	623099	Active	241.0	34.0		
610736	TX05	610736	Broken	200.0	25.0		
				7753.0	2612.0		

CELLS Maintenances Tool

Summary | **IOTs** | Transmitters | Logs | Reports

Add IOT

IOTs

S/N	Name	Description	Type	Manufacturer	Status	P Avg (kW)
591095	591095	TV type returned back; operated in TX01	TH793	TED	Returned	80
499413	499413	Installed in TX01	TH793-1	TED	Active	65
499443	499443	Installed in TX02	TH793-1	TED	Active	57
608802	608802	Installed in TX03	TH793-1	TED	Active	50
610735	610735	Installed in TX04	TH793-1	TED	Active	51
610736	610736	Ceramic broken, operated in TX05	TH793-1	TED	Broken	0
610737	610737	Multiple trips, sent to TED; operated in TX06	TH793-1	TED	Refurbishment	76
611024	611024	Broken as passive IOT; operated in TX07	TH793-1	TED	Broken	0
617302	617302	Installed in TX08	TH793-1	TED	Active	46
617549	617549	Installed in TX09	TH793-1	TED	Active	42
617550	617550	Installed in TX10	TH793-1	TED	Active	53
617551	617551	Installed in TX05	TH793-1	TED	Active	48
620408	620408	Installed in TX11	TH793-1	TED	Active	58
623096	623096	Installed in TX12	TH793-1	TED	Active	63
623097	623097	Installed in TX07	TH793-1	TED	Active	53
623098	623098	Installed in TX13	TH793-1	TED	Active	44
623099	623099	Installed in TX14	TH793-1	TED	Active	71
629734	629734	Installed in TX06	TH793-1	TED	Active	57

CELLS Maintenances Tool

| Summary | IOTs | Transmitters | Logs | Reports |

Last Logs

IOT	Transmitter	Since	Fil Hours	HV Hours	Until	Fil Hours	HV Hours	P avg (kW)	Comments
499413	TX01	04/04/2008	264.0	196.0	09/02/2010	738.0	627.0	80.0	DAMPYs conditioning
499443	TX02	30/07/2010	930.0	268.0	23/09/2010	1213.0	274.0	40.0	Booster Commissionin(…)
608802	TX03	30/07/2010	421.0	117.0	23/09/2010	759.0	215.0	40.0	DAMPY cond. through (…)
610735	TX04	30/07/2010	422.0	166.0	23/09/2010	626.0	280.0	40.0	DAMPY cond. through (…)
617551	TX05	30/07/2010	436.0	120.0	23/09/2010	631.0	173.0	40.0	DAMPY cond. through (…)
629734	TX06	30/07/2010	503.0	173.0	23/09/2010	721.0	229.0	40.0	DAMPY cond. through (…)
623097	TX07	30/07/2010	488.0	187.0	23/09/2010	614.0	194.0	40.0	DAMPY cond. through (…)
617302	TX08	30/07/2010	422.0	160.0	23/09/2010	499.0	167.0	40.0	DAMPY cond. through (…)
617549	TX09	30/07/2010	502.0	90.0	23/09/2010	587.0	101.0	40.0	DAMPY cond. through (…)
617550	TX10	30/07/2010	550.0	133.0	23/09/2010	634.0	144.0	40.0	DAMPY cond. through (…)
620408	TX11	30/07/2010	79.0	28.0	23/09/2010	135.0	51.0	80.0	RF commissioning
623096	TX12	30/07/2010	114.0	28.0	23/09/2010	165.0	76.0	80.0	RF commissioning
623098	TX13	30/07/2010	45.0	24.0	23/09/2010	190.0	47.0	80.0	RF commissioning
623099	TX14	30/07/2010	33.0	3.0	23/09/2010	241.0	34.0	80.0	RF commissioning
						7753.0	2612.0		

CELLS Maintenances Tool

Summary | IOTs | **Transmitters** | Logs | Reports

Last Logs

View Logs

IOT	Transmitter	Since	Fil Hours	HV Hours	Until	Fil Hours	HV Hours	P avg (kW)	Comments
617550	TX10	29/04/2010	0.0	0.0	17/05/2010	150.0	22.0	20.0	First tests
617551	TX10	17/05/2010	150.0	22.0	09/06/2010	218.0	47.0	20.0	First tests
617550	TX10	09/06/2010	218.0	47.0	30/06/2010	276.0	84.0	80.0	Commissioning
617550	TX10	30/06/2010	276.0	84.0	30/07/2010	550.0	133.0	60.0	SAT & DAMPY Conditio(…)
617550	TX10	30/07/2010	550.0	133.0	23/09/2010	634.0	144.0	40.0	DAMPY cond. through (…)

IOT	Transmit		omments
499413	TX01		s conditioning
499443	TX02		ommissionin(…)
608802	TX03		nd. through (…)
610735	TX04		nd. through (…)
617551	TX05		nd. through (…)
629734	TX06		nd. through (…)
623097	TX07		nd. through (…)
617302	TX08		nd. through (…)
617549	TX09		nd. through (…)
617550	TX10		nd. through (…)
620408	TX11		mmissioning
623096	TX12		mmissioning
623098	TX13		mmissioning
623099	TX14		mmissioning