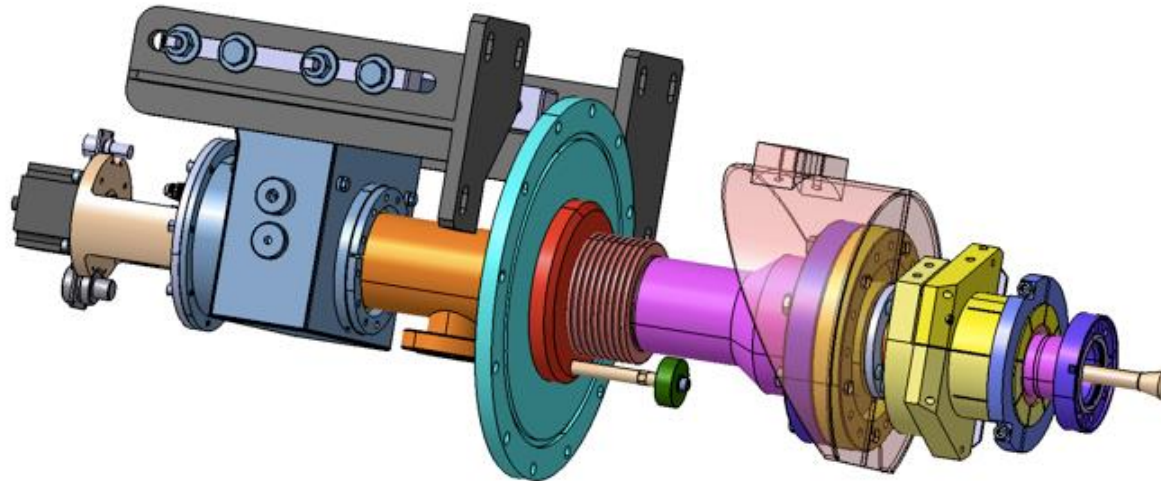


## Issues faced during the XFEL mass production



Walid KAABI- LAL/CNRS

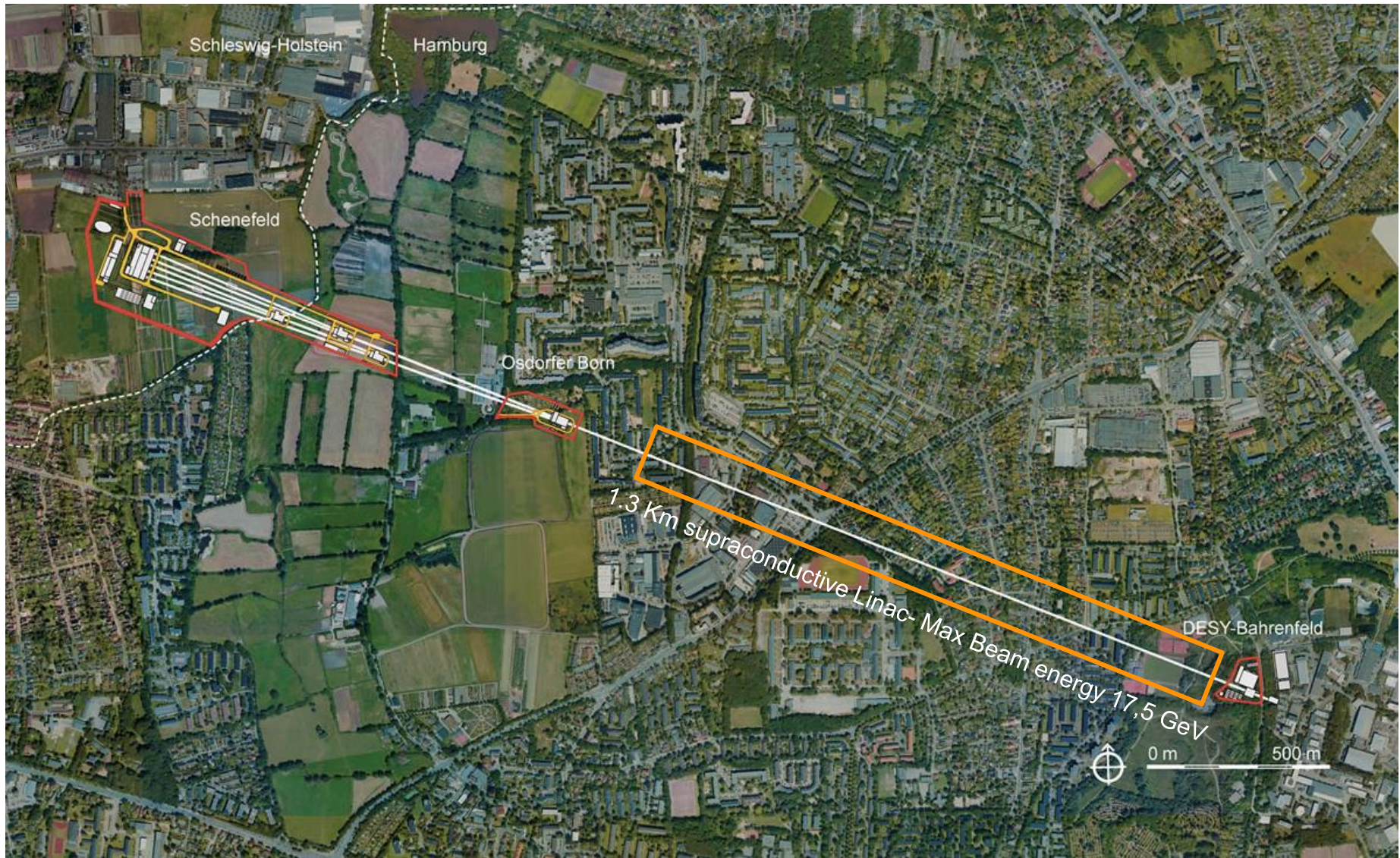
CERN, June 27<sup>th</sup> 2017

## Outlines:



- **Introduction**
- **Fabrication process**
- **RF conditioning at LAL**
- **Troubles on the track**

# Introduction:



## Introduction:

Linac of **101 Cryomodules**, equipped with **8 couplers** each → Need of **808 Couplers** **1,3 GHz**.





**800 power couplers** 1.3 GHz are needed to equip **100 XFEL cryomodules**.

XFEL couplers are produced by 2 suppliers at 3 production sites:

- **Consortium Thales-RI** (Thonon les bains-France and Koln-Germany): **670** units.
- **CPI** (Beverly-Massachusetts-USA): **150** units.

Supported by DESY, LAL-Orsay has in charge:

- The **production monitoring** and the **quality control** at Thales-RI sites.
- The **RF conditioning** of all the couplers at Orsay and the weekly **delivery of 8 couplers/week** to IRFU-CEA (increased rate to **10 couplers/Week** since **January 2015**) .

## Challenges:

- First experience in industrial monitoring at a such big scale,
- Successful know-how transfer to company: The clean room process & acceptance criteria,
- Rescaling the RF process at LAL to ensure the conditioning of 8 couplers per week,
- Respect of the overall project schedule.

# Fabrication process:

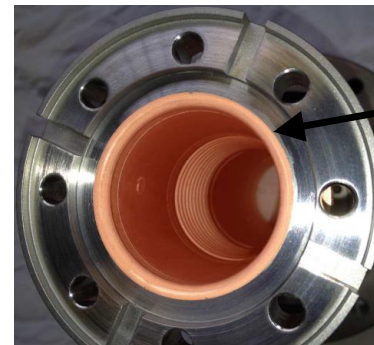
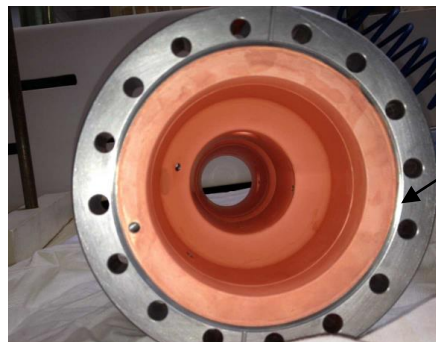


## @ Thales-Thonon les bains production site:

- Step 1: Brazing of the inner and outer conductors:



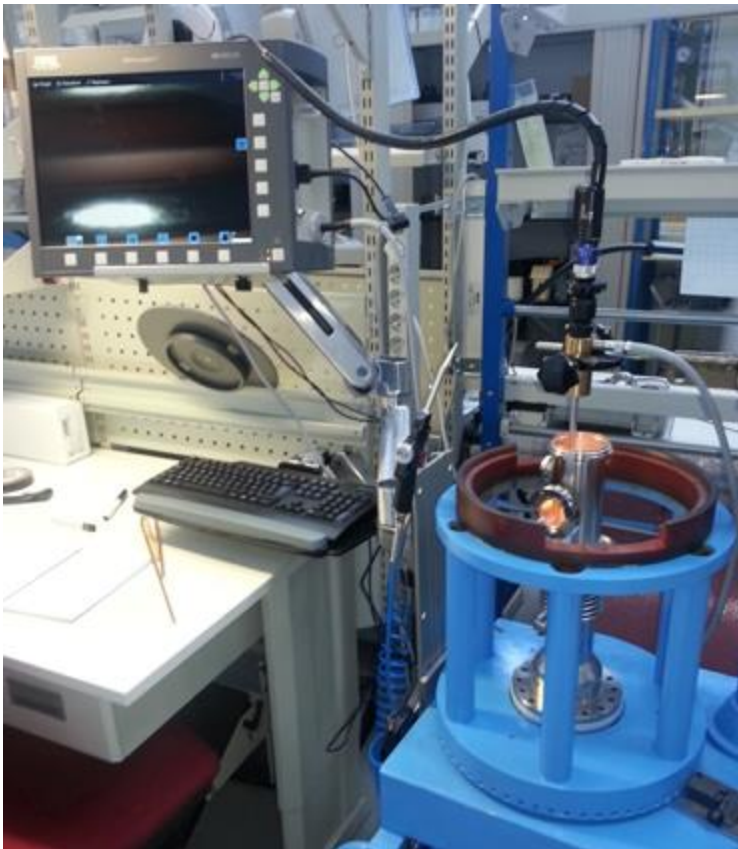
- Step 2: Copper plating of the inner surfaces:



# Fabrication process:



**Inspection & control of all the produced parts at Thales-Thonon site.**  
**Double check during the reception at RI site under the same inspection criteria.**



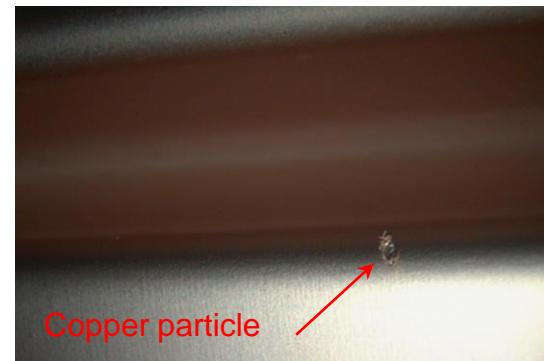
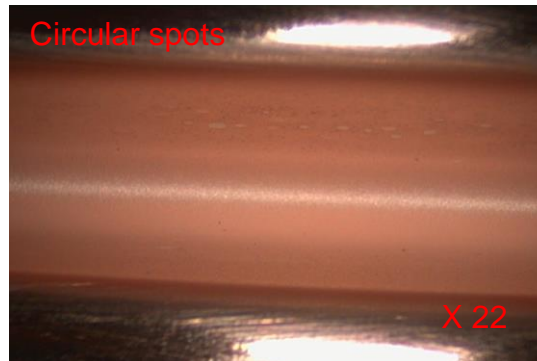
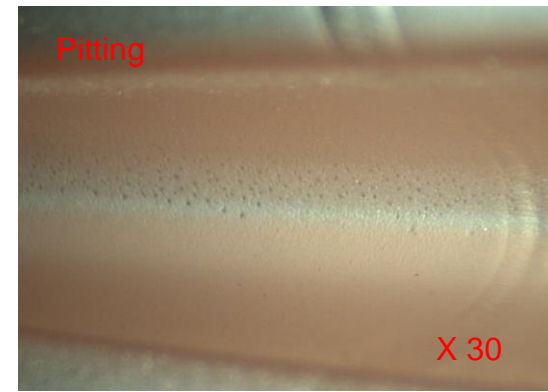
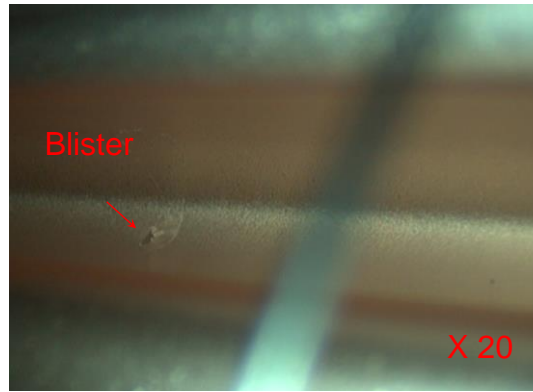
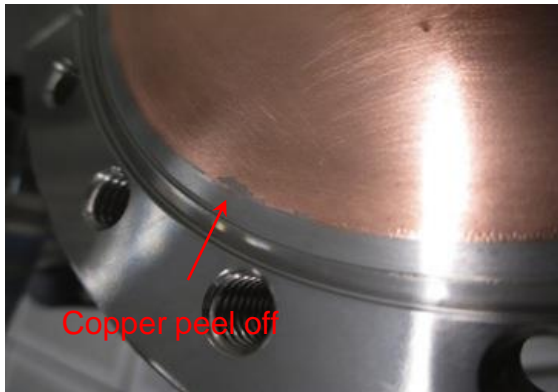
Warm Conductor

Cold conductor



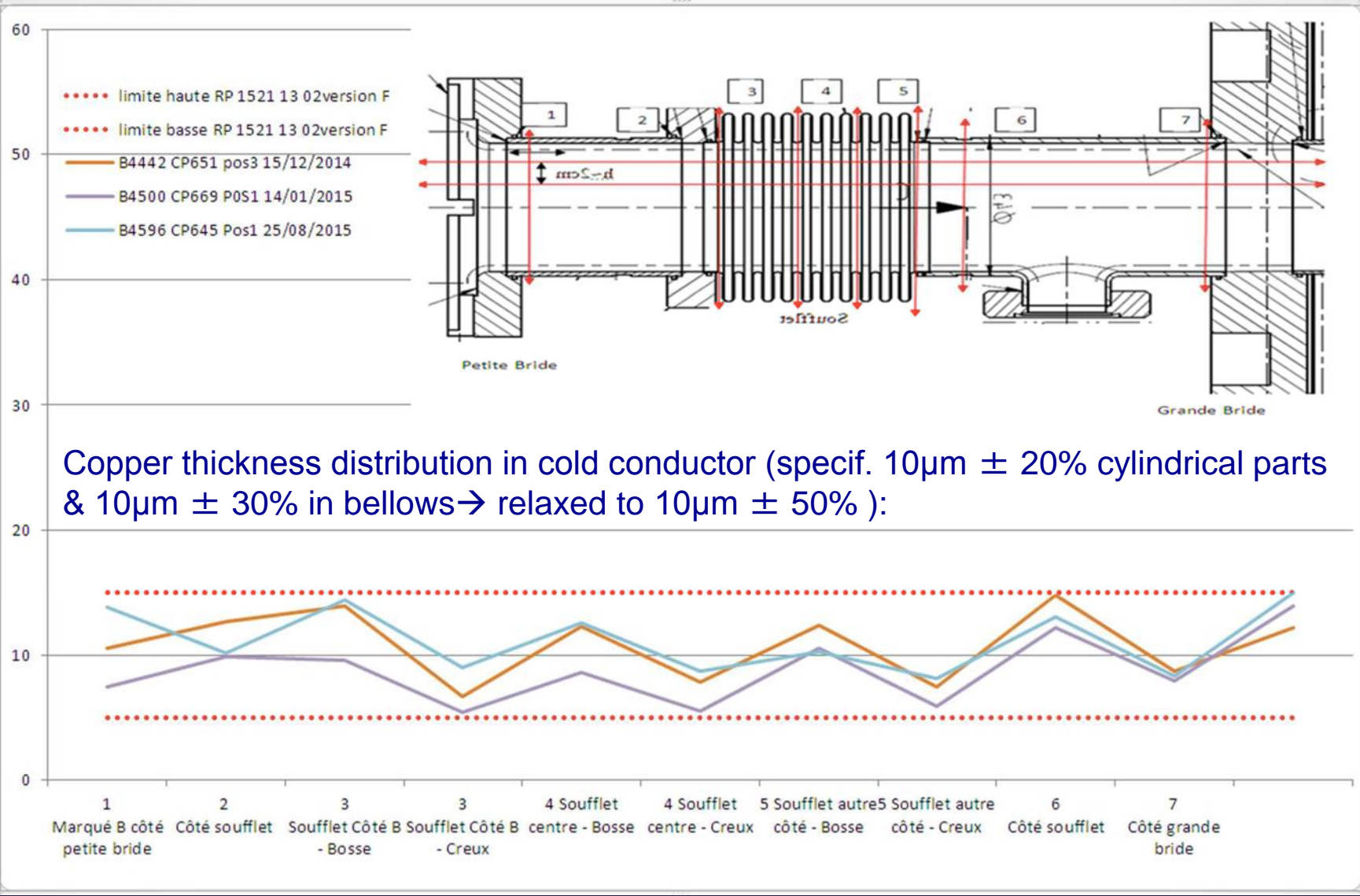


## Examples of observed copper defects:



→ Qualitative & quantitative acceptance criteria definition: defects classified per types, dimensions et number. Agreement on corrective actions and validation tests.

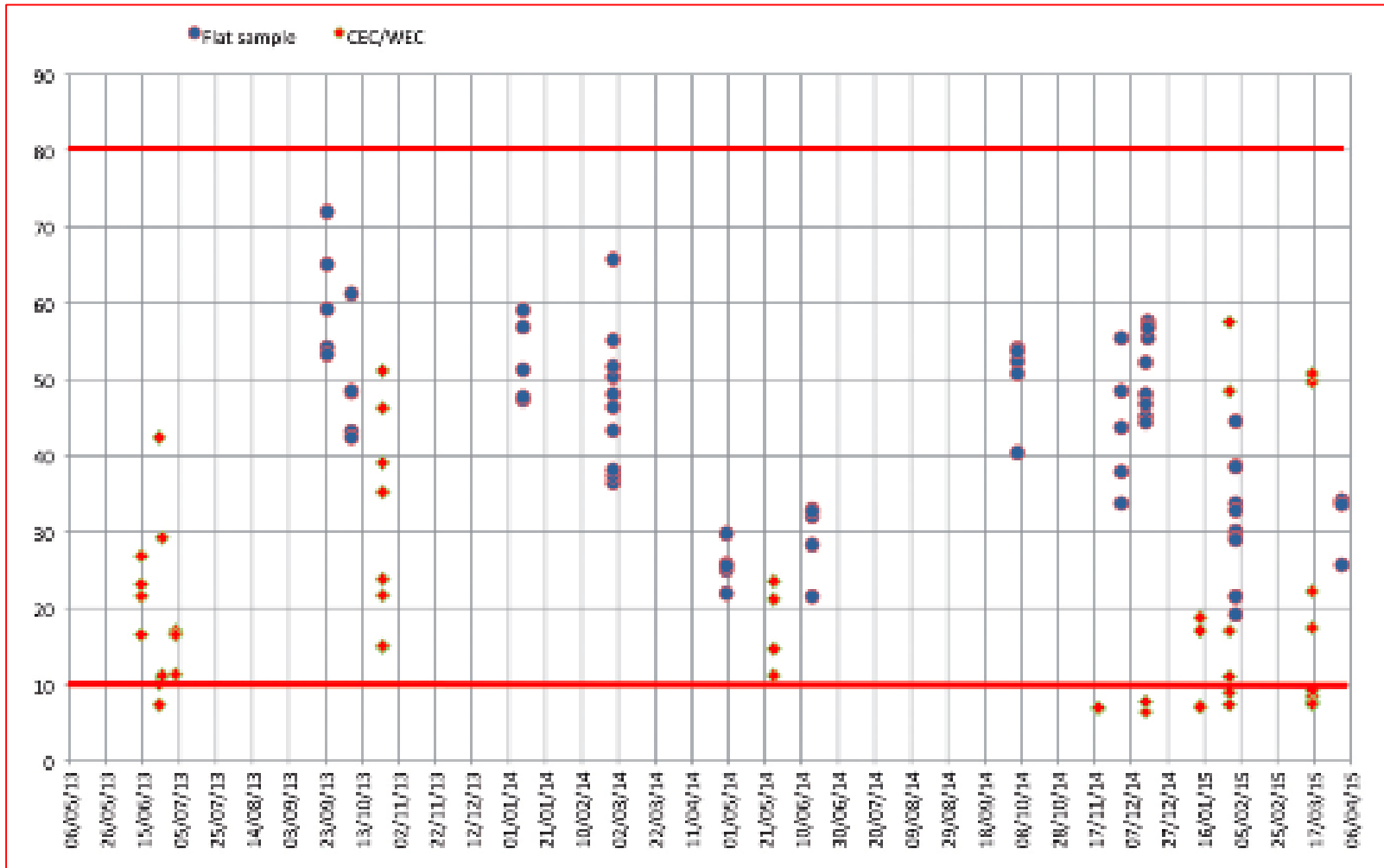
# Fabrication process:



# Fabrication process:



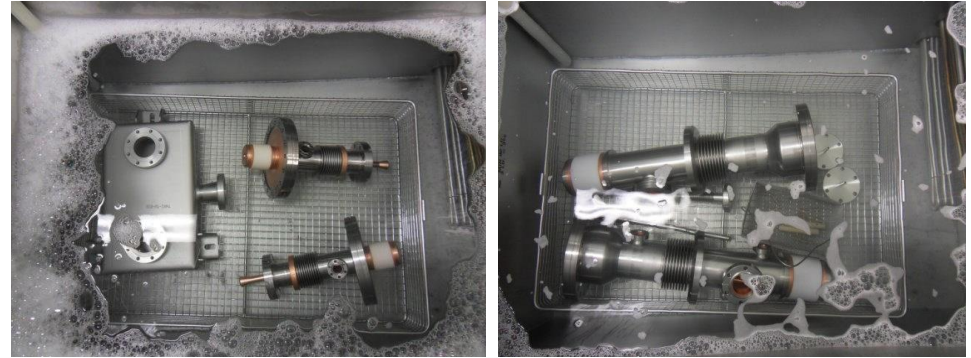
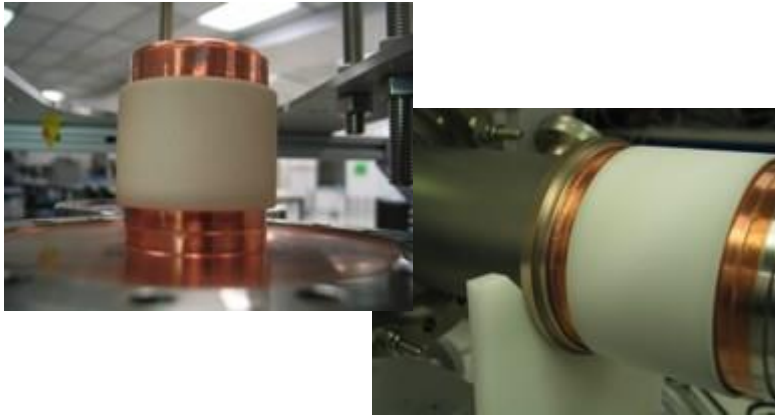
RRR measurements (Specif.  $10 < RRR < 80$ )



# Fabrication process:

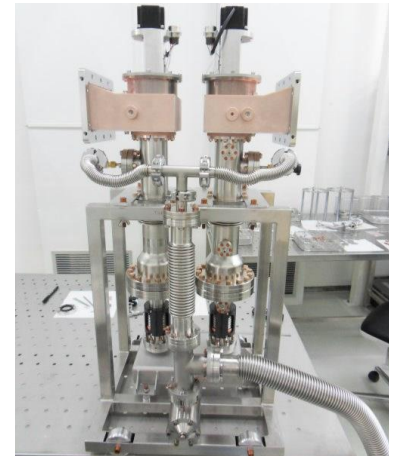
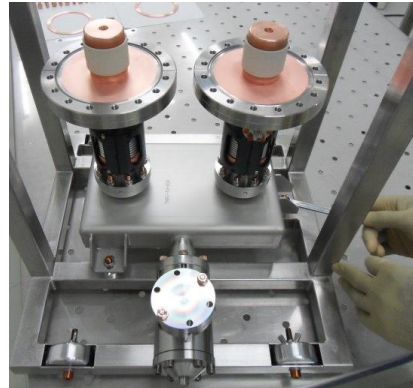
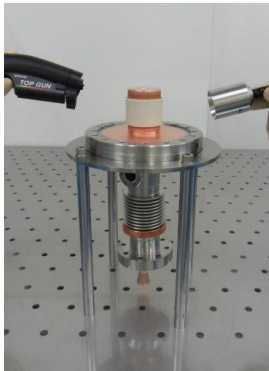


@ RI production site:



- TiN coating on ceramics
- ceramics EB welding of cold & warm parts

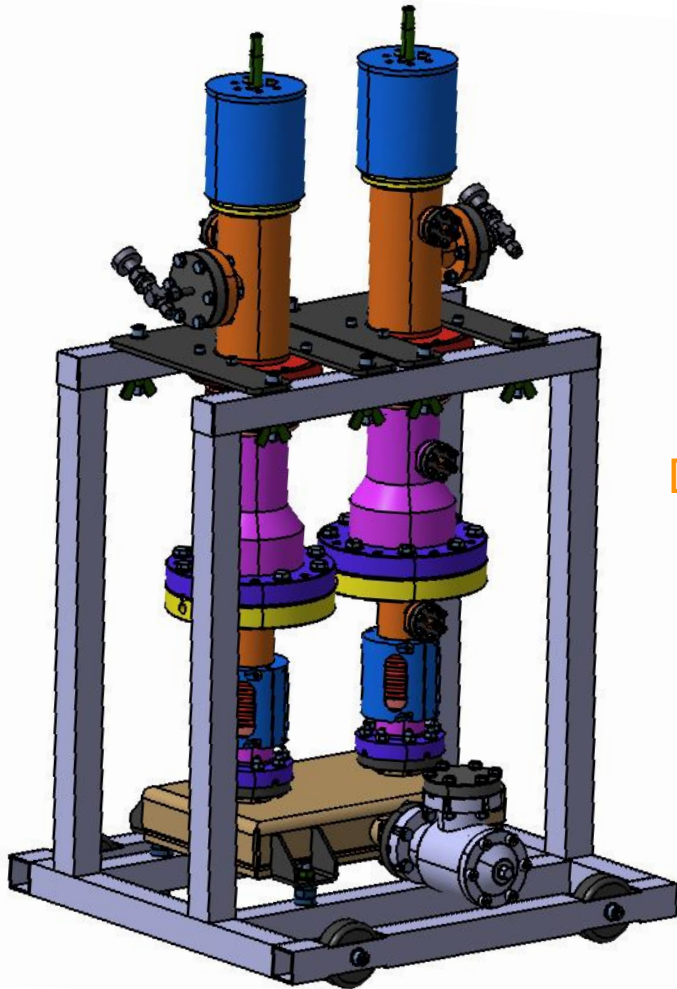
US degreasing of parts



particle counting

coupler pair clean room assembly,  
leak and actuator displacement test

# Fabrication process:



Delivery to LAL



# Fabrication process:



My Teams: XFEL\_WP05\_THALES\_RI\_Team: Final Reports of THRI pairs (LAL)

You are here: XFEL\_WP05\_THALES\_RI\_Team: Final Reports of THRI pairs (LAL)

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<input type="checkbox"/>	EDMS-ID	Name	Description	Work Status	Access Scheme in Use	Item Type	Creator	Last Update	Superseded?
<input type="checkbox"/>	<a href="#">D00000006642591.A.1.1</a>	Final Report THRI-PA-004 (upstr. THRI-CO-007, downstr. THRI-CO-008)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	03.02.2016 13:33:04	False
<input type="checkbox"/>	<a href="#">D00000006670811.A.1.1</a>	Final Report THRI-PA-006C (upstr. THRI-CO-011, downstr. THRI-CO-012)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	03.02.2016 13:33:06	False
<input type="checkbox"/>	<a href="#">D00000006668151.A.1.1</a>	Final Report THRI-PA-007B (upstr. THRI-CO-013, downstr. THRI-CO-014)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	03.02.2016 13:33:06	False
<input type="checkbox"/>	<a href="#">D000000065443681.A.1.1</a>	Final Report THRI-PA-008 (upstr. THRI-CO-015, downstr. THRI-CO-016)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	03.02.2016 13:31:46	False
<input type="checkbox"/>	<a href="#">D00000006670801.A.1.1</a>	Final Report THRI-PA-014B (upstr. THRI-CO-027, downstr. THRI-CO-028)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	03.02.2016 13:33:06	False
<input type="checkbox"/>	<a href="#">D00000006667831.A.1.1</a>	Final Report THRI-PA-015B (upstr. THRI-CO-029, downstr. THRI-CO-030)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	03.02.2016 13:33:05	False
<input type="checkbox"/>	<a href="#">D00000006677191.A.1.1</a>	Final Report THRI-PA-017B (upstr. THRI-CO-033, downstr. THRI-CO-034)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	06.02.2016 04:01:00	False
<input type="checkbox"/>	<a href="#">D00000006677231.A.1.1</a>	Final Report THRI-PA-018B (upstr. THRI-CO-035, downstr. THRI-CO-036)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	06.02.2016 04:01:01	False
<input type="checkbox"/>	<a href="#">D00000006677241.A.1.1</a>	Final Report THRI-PA-019B (upstr. THRI-CO-037, downstr. THRI-CO-038)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	06.02.2016 04:01:01	False
<input type="checkbox"/>	<a href="#">D000000065443671.A.1.1</a>	Final Report THRI-PA-020 (upstr. THRI-CO-039, downstr. THRI-CO-040)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	03.02.2016 13:31:46	False
<input type="checkbox"/>	<a href="#">D00000006677251.A.1.1</a>	Final Report THRI-PA-025B (upstr. THRI-CO-049, downstr. THRI-CO-050)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	10.02.2016 09:23:15	False
<input type="checkbox"/>		Final Report THRI-PA-039 (upstr.							

< Back Create and Add

# RF conditioning at LAL:



Anritsu 03/29/2013 05:51:56 am

Points: 801

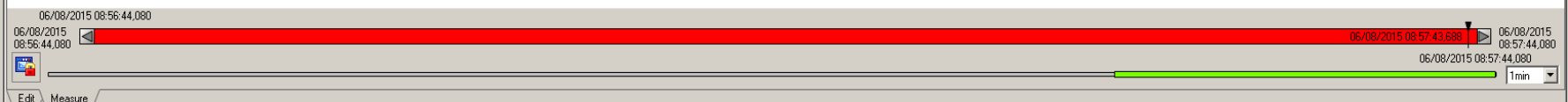
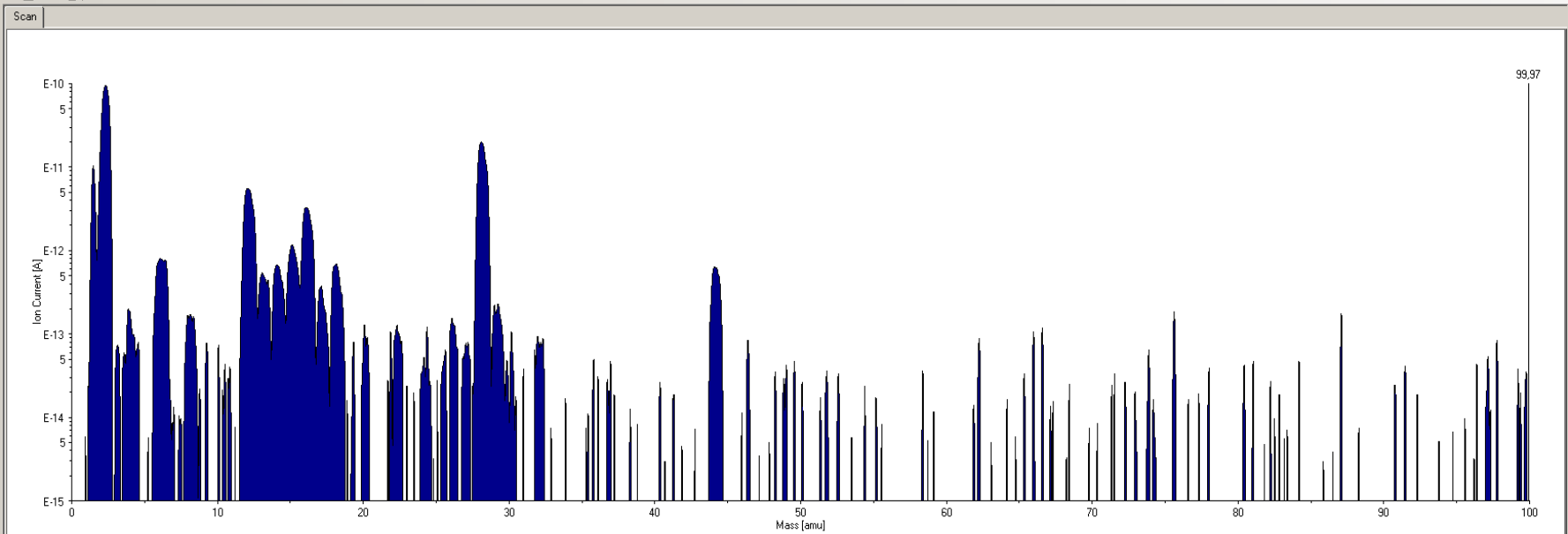
IFBW: 10 kHz

AVG: --

Power: High

Save

a b c



<p>TR4: S22</p> <p>Log Mag</p> <p>Smooth: 0 %</p> <p>CAL: ON (OK)</p> <p>10.00 dB/</p> <p>Ref 0.00 dB</p>	-50.0	-50.0	-50.0	-50.0	-50.0	<p>Change</p> <p>Save</p> <p>Location</p> <p>Change Type</p> <p>Setup/JPEG/...</p>
	-60.0	-60.0	-60.0	-60.0	-60.0	
	-70.0	-70.0	-70.0	-70.0	-70.0	
	-80.0	-80.0	-80.0	-80.0	-80.0	
	1.200 GHz	TR3	1.400 GHz	1.200 GHz	TR4	
MK1 TR1: 1.300 GHz,LM:-51.93 dB		MK2 TR2: 1.300 GHz,LM:-0.10 dB		MK3 TR3: 1.300 GHz,LM:-0.11 dB		MK4 TR4: 1.300 GHz,LM:-46.08 dB
Freq	Scale	Sweep	Measure	Marker		

# RF conditioning at LAL:



LAL\_Final\_Report\_THRI\_PA\_062B\_2014-05-16\_dk.xlsx

Rechercher dans la feuille

Accueil Mise en page Tableaux Graphiques SmartArt Formules Données Révision

Modifier Remplir Arial 10 Pourcentage 2

### Coupler production record sheet

Composition of the paire of coupler

Paire de coupler ref	THRI-PL	062 B
Test frame ref	THRI-TF	0241076103
WVG ref	THRI-TV	036

Upstream		Downstream	
Coupler ref	THRI-CO	123	124
Cold Part ref	THRI-CP	594	437
Warm Part ref	THRI-WP	249	234
Push rod ref	THRI-PR	580	582
Capacitor ref	THRI-CA	163	165
Actuator Assembly	THRI-AC		
Wave Guide Box ref	THRI-WG	173	180

Date of reception	16/05/14
Date of leak test	16/05/14
Date of baking start	16/05/14
Date of baking end	20/05/14
Date of antenna tuning	20/05/14
Date of conditioning start	21/05/14
Date of conditioning end	27/05/14
Date of cooling	11/06/14

Comments

THRI-CP-594  
The ceramic is bi-color

THRI-WP-249  
One scratch on the CP40 flange

Rapport de  
Non-Conformité

EDMS

My Teams: XFEL\_WP05\_Team: ...

https://teamcenter.desy.de/TC90PRD/controller/home

Les plus visités Débuter avec Fire...

Search

Home Exit DESY

Advanced Search...

Walid Kaabi

Main Menu Classification Check Out From Team Put to WIP Vault Make Available To Team Submit Route More Actions...

My Teams: XFEL\_WP05\_Team: Final Reports (LAL)

You are here: XFEL\_WP05\_Team: Final Reports (LAL)

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ID	Report Name	Final Report	Status	Project	Quality Management	Admin	Date
00000000642821.A.1.1	Final Report CPI-PA-009 (upstr: CPI-CO-016, downstr: CPI-CO-020)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	admin_List_Benno	02.02.2016 20:44
000000006471701.A.1.2	Final Report CPI-PA-010 (upstr: CPI-CO-021, downstr: CPI-CO-001)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Kaefer_Daniela	02.02.2016 20:44
000000006531251.A.1.1	Final Report CPI-PA-011 (upstr: CPI-CO-023, downstr: CPI-CO-024)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	02.02.2016 20:44
000000006598341.A.1.1	Final Report CPI-PA-012 (upstr: CPI-CO-025, downstr: CPI-CO-026)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	02.02.2016 20:44
000000006644081.C.1.2	Final Report CPI-PA-013-B (upstr: CPI-CO-022, downstr: CPI-CO-027)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	01.03.2016 11:11
000000006202141.C.1.2	Final Report CPI-PA-014 (Rev. B)	final report with test and conditioning results (correct THRI Actuators references)	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	02.02.2016 20:44
000000006642801.B.1.2	Final Report CPI-PA-015 (upstr: CPI-CO-031, downstr: CPI-CO-036)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	02.02.2016 20:44
000000006421751.B.1.2	Final Report CPI-PA-016 (upstr: CPI-CO-040, downstr: CPI-CO-041)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	02.02.2016 20:44
000000006387331.C.1.4	Final Report CPI-PA-017 (Rev. B)	final report with test and conditioning results (correct THRI Actuators references)	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	02.02.2016 20:44
000000006387341.F.1.2	Final Report CPI-PA-018 (upstr: CPI-CO-038, downstr: CPI-CO-039, Rev. B)	final report with test and conditioning results (correct THRI Actuators references)	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	02.02.2016 20:44
000000006401591.B.1.2	Final Report CPI-PA-019 (upstr: CPI-CO-034, downstr: CPI-CO-035)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	02.02.2016 20:44
000000006432091.B.1.2	Final Report CPI-PA-020 (upstr: CPI-CO-042, downstr: CPI-CO-043)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	02.02.2016 20:44
000000006470291.A.1.1	Final Report CPI-PA-021 (upstr: CPI-CO-012, downstr: CPI-CO-047)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Kaefer_Daniela	02.02.2016 20:44
000000006658111.B.1.2	Final Report CPI-PA-022 (upstr: ...)	final report with test and conditioning results	Released	Project: XFEL_WP05	Quality Management	Verguet_Alexis	19.02.2016 13:55

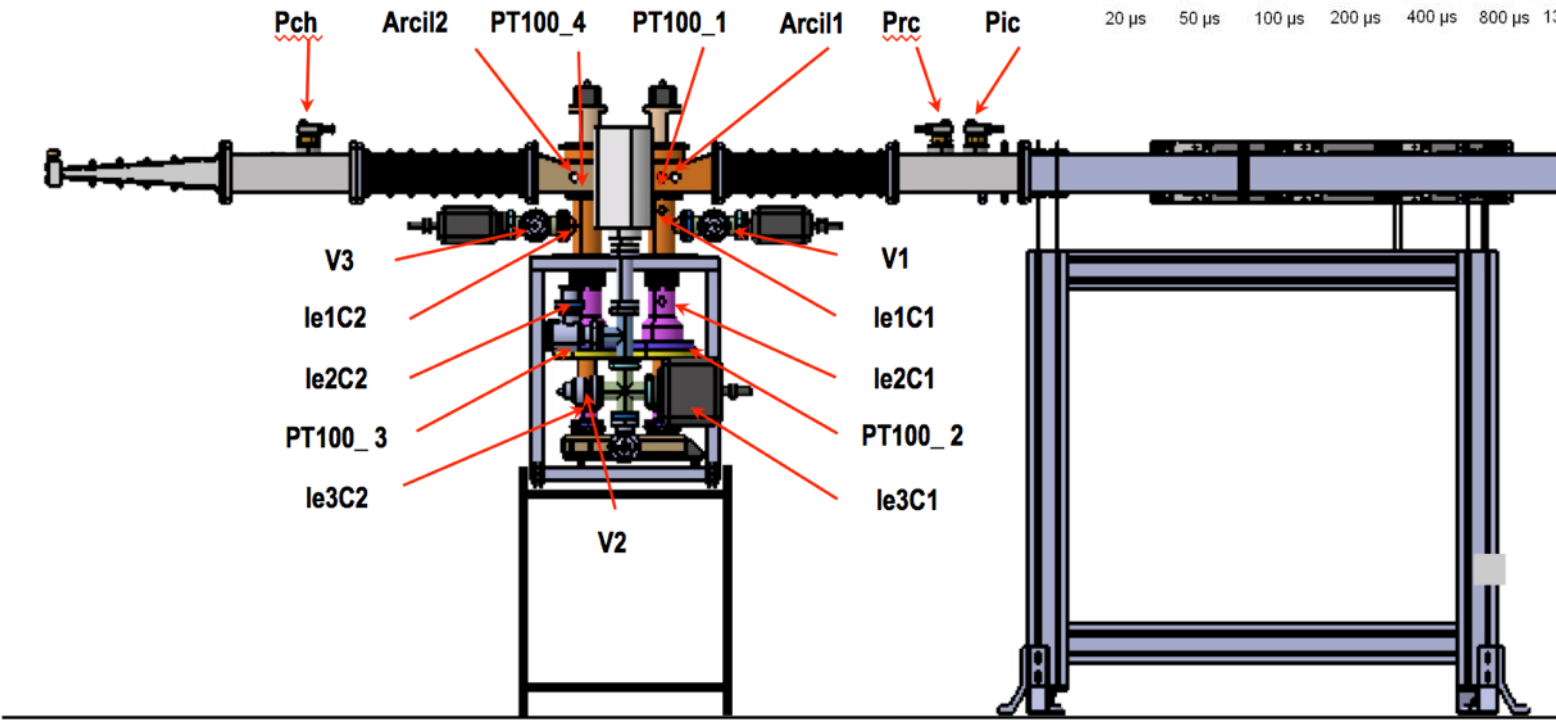
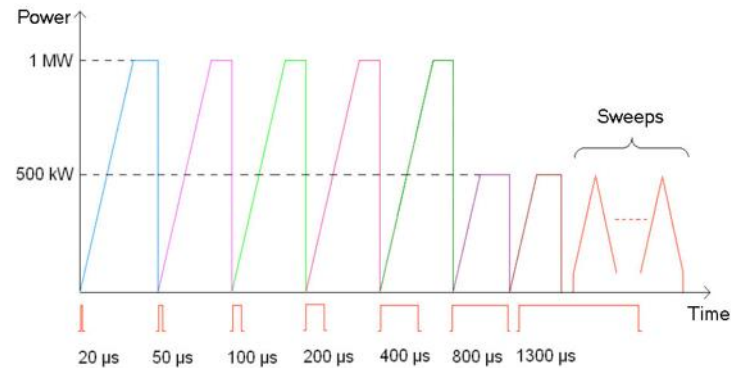
EDMS Help EDMS-FAQ EDMS-Info Downloads DESY imports Copyright 2012



# RF conditioning at LAL:



Vacuum	1 <sup>st</sup> threshold ( 0.1 dB): SV1	6.10 <sup>-7</sup> mbar
	2 <sup>nd</sup> threshold ( 0.4 dB): SV2	2.10 <sup>-6</sup> mbar
	Interlock: IL	5.10 <sup>-6</sup> mbar
e- current IL	8 mA	
Light IL	none	
Ceramic Temperature IL	60°C	
WG arc IL	If any	
Control loop duration( 0.1 dB )	15 s	



# RF conditioning at LAL:



STATION DE CONDITIONNEMENT DES COUPLEURS XFEL

\*\*\* POSTE DE SUPERVISION \*\*\*

Mode Expert

Commande Mode Station

Etat Mode Station

PULSING

PULSING

Version 5.0 du 06/06/2014

Alimentations Alarmes Modulateur HT Paramètres Station Conditionnement Coupleurs XFEL Graphes Graphes Temp. Interlock Image

N° Séquence: 271, N° d'étape: 4, N° de balayage: 0

Etat Station: PULSING, MAPR: Reprise

Etat Conditionnement: Reprise, Type\_Echec: RAS

Temps de l'étape: 137 mn, Temps du Conditionnement: 775 mn

Niveau de puissance Synthé RF: -5,6 dBm

Fr: 4 Hz, Largeur Impulsion: 200 us, Pi\_max: 1000 kW

Nb Interlock Coupleurs: 0, Nb Interlock Station: 0

Niveau de Puissance avant Interlock: -13,15 dBm, N° étape avant Interlock: 0, dPil (dB): 0,2875

Puissance Klystron

Psi\_K (kW): 3792,98, Ros\_K: 1,16, Psi\_K (dBm): 95,79

Psr\_K (kW): 21,13, Psr\_K (dBm): 73,25

Reset Graphe

Choix Courbe 2: vides, Choix Courbe 1: Pic

Choix\_voie: A

Num\_P: 147, Pic: 1007,3 kW, Pch: 980,5 kW, Prc: 4,5 kW

Pickup: 1,4, 1,1, 1,7, 2,1, 1,8, 0,3, V: 2,1

Vides: 2,3E-7, 1,4E-7, 4,8E-7, mBar, Vide Max: 4,8E-7

Valeurs max des x mesures

D: 3023,7 V, C: 4,8E-7 mBar

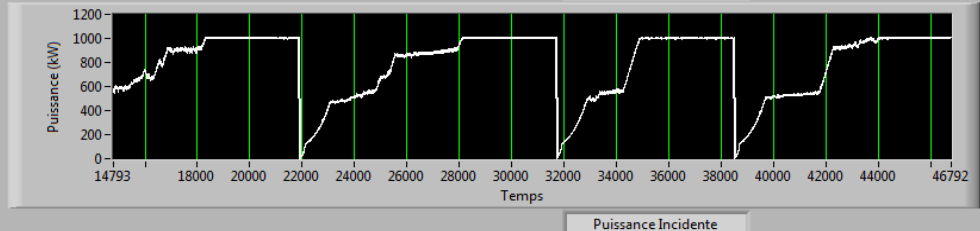
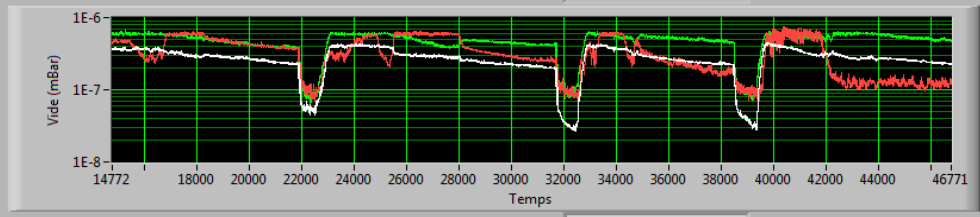
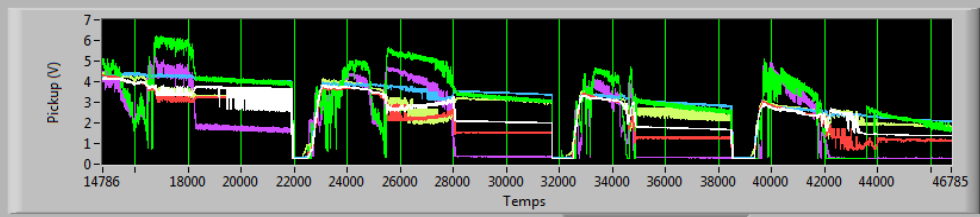
Vide lent Klystron (µA): 0,582

Raz Defaults Servitudes Klystron

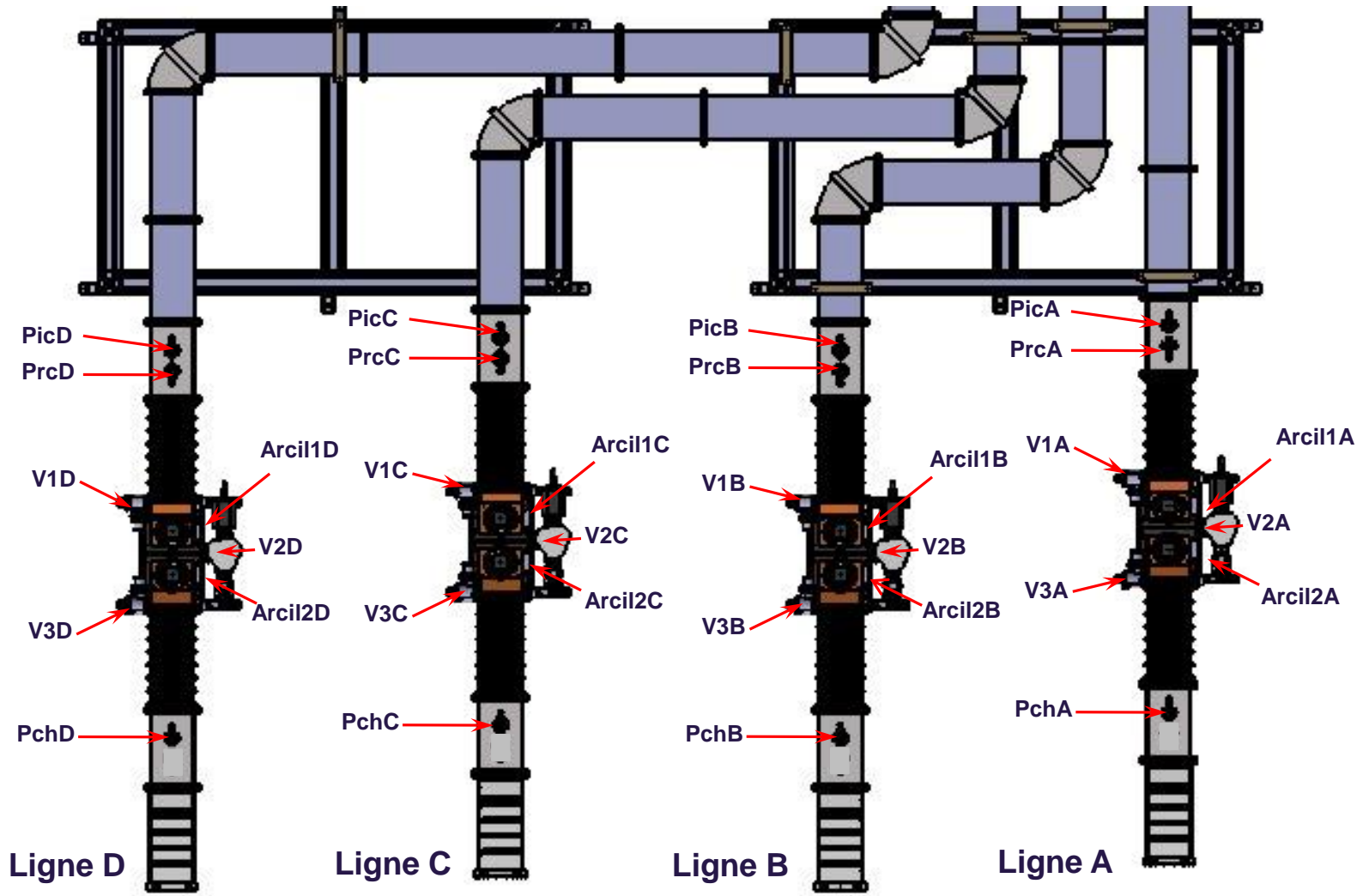
- Alims ON
- Défaut alimentations
- Défaut Modulateur
- Défaut Détecteurs d'Arc
- Défaut Klystron
- Défaut Sécurités Batiment
- Défaut Températures
- Défaut liaison Modulateur HT
- Défaut Coupleur

Niveau\_RF (dBm): -30,0

**STOP SUPERVISION**



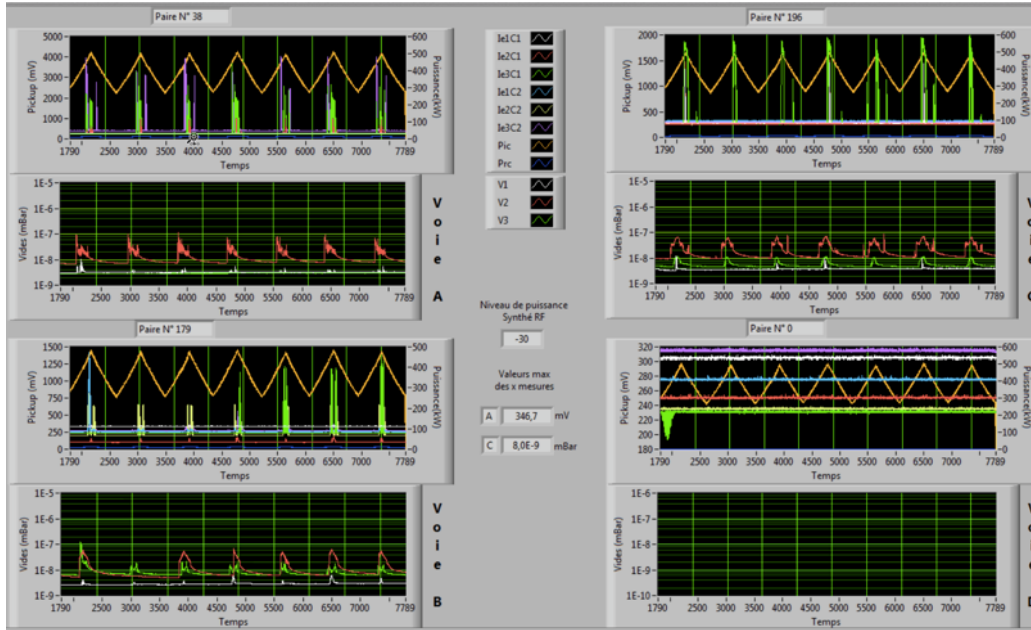
# RF conditioning at LAL:



# RF conditioning at LAL:



# RF conditioning at LAL:



Shipment to IRFU-CEA



Coupler pair disassembly  
& final inspection

# RF conditioning at LAL:



THRI-WP-246		CONTRÔLE DEMONTAGE PARTIE CHAUDE		27/05/14
Point to check	Status		Comments	
	Ok	Nok		
1 Knife	Ok		Sharp edges, scratches	
2 Contact surface with the capacitor	Ok		Sharp edges, scratches	
3 Welding aspect (regularity, smoot et centering)	Ok		According to specification	
4 Copper ring : centering, shape, smoothness	Ok		According to specification	
5 ceramic coating and TIN deposite (color, spot, no splinter or particles)	Ok		Projection, decoloring, metallic scratches	
6 Copper ring : centering, shape, smoothness	Ok		According to specification	
7 RF surface with the WGB	Ok		Sharp edges, scratches	
8 Pumping flange (radius, regularity and smoothness)	Ok		Sharp edges, right angle	
9 Knife, holes orientation		Nok	scratches	
10 Rounded inner angle	Ok		Sharp edges	
11 Roughness	Ok		Scratches	
12 Outer bellows : deformation, penetration of the end seal	Ok		According to specification	
13 Knife	Ok		Scratches	
14 Limit of the copper deposit	Ok		According to specification	
15 Contact	Ok		Sharp edges, scratches	
16 Solder joint: regularity, smoothness	Ok		According to specification	
Calculation : if result OK: value = 10 if result NOK: value = 0 total of points = sum = S Total = line sum X 10= P ( NA no applicable) Final status		Ok	Nok	Remark(s): One scratch on the CF40 flange
		150		
		160		
		N/A		
		93.8%		

THRI-CP-594		CONTRÔLE DEMONTAGE PARTIE FROIDE		27/05/14
Point to check	Status		Comments	
	Ok	Nok		
1 RF contact surface : smoothness, regularity of the chamfer	Ok		Sharp edges, scratches	
2 ceramic coating and TIN deposite (color, spot, no splinter or particles)		Nok	Projection, decoloring, metallic scratches	
3 Welding aspect (regularity, smoot et centering)	Ok		According to specification	
4 Knife	Ok		Arêtes vives, rauyres	
5 Orientation of the big flange and the cavity	Ok		According to specification	
6 Correct orientation of the 6 M4 holes and of the 2 Ø3 holes	Ok		According to specification	
7 Groove depth, axial position	Ok		According to specification	
8 Bellows : deformation, penetration of the end seal	Ok		According to specification	
9 La qualité du trou fileté	Ok		Presence of metallic particles	
Calculation : if result OK: value = 10 if result NOK: value = 0 total of points = sum = S Total = line sum X 10= P ( NA no applicable) Final status		Ok	Nok	The ceramic is bi-color
		80		
		90		
		N/A		
		88.9%		

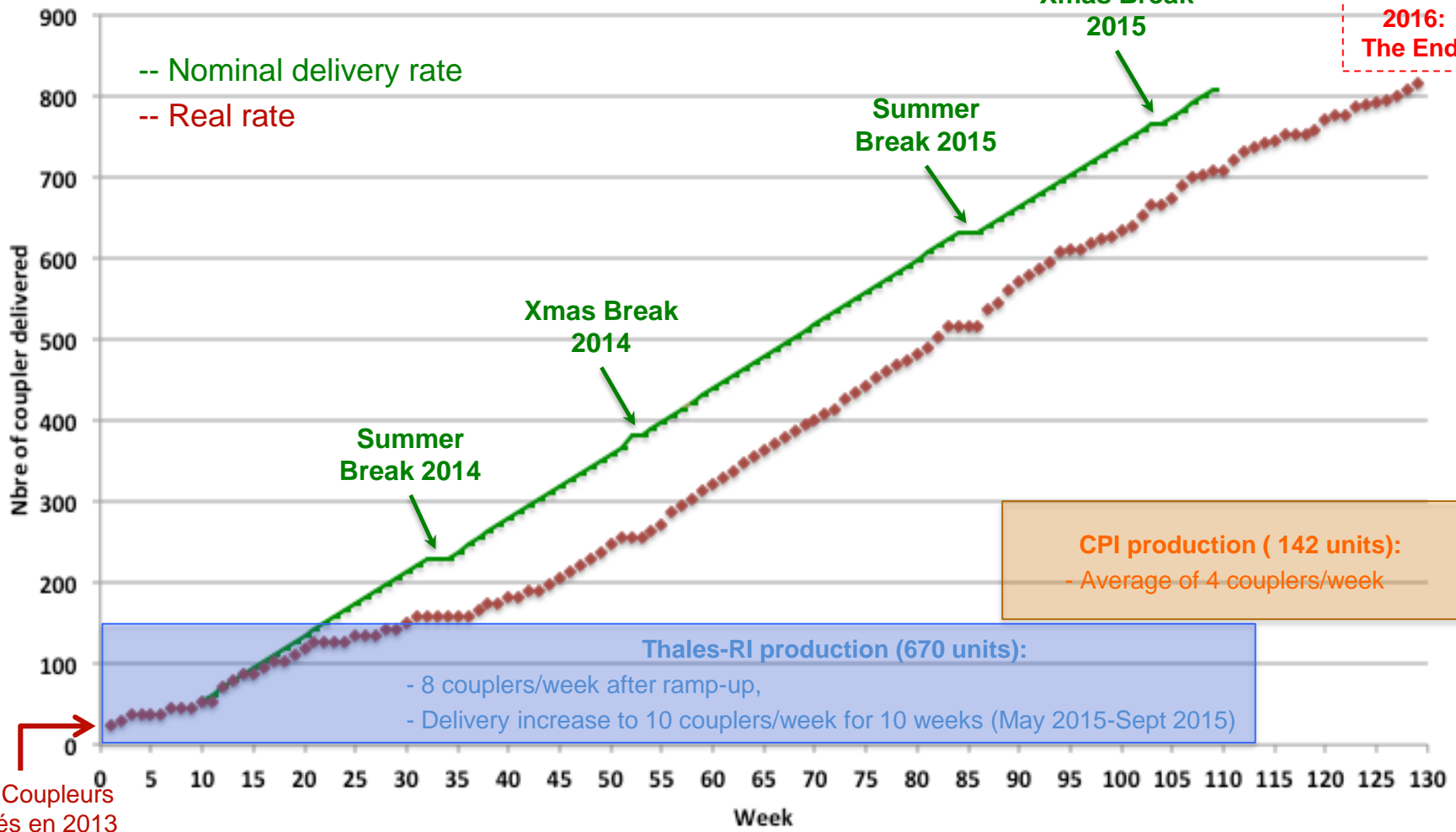
EDMS

Rapport de Non-Conformité

# RF conditioning at LAL:

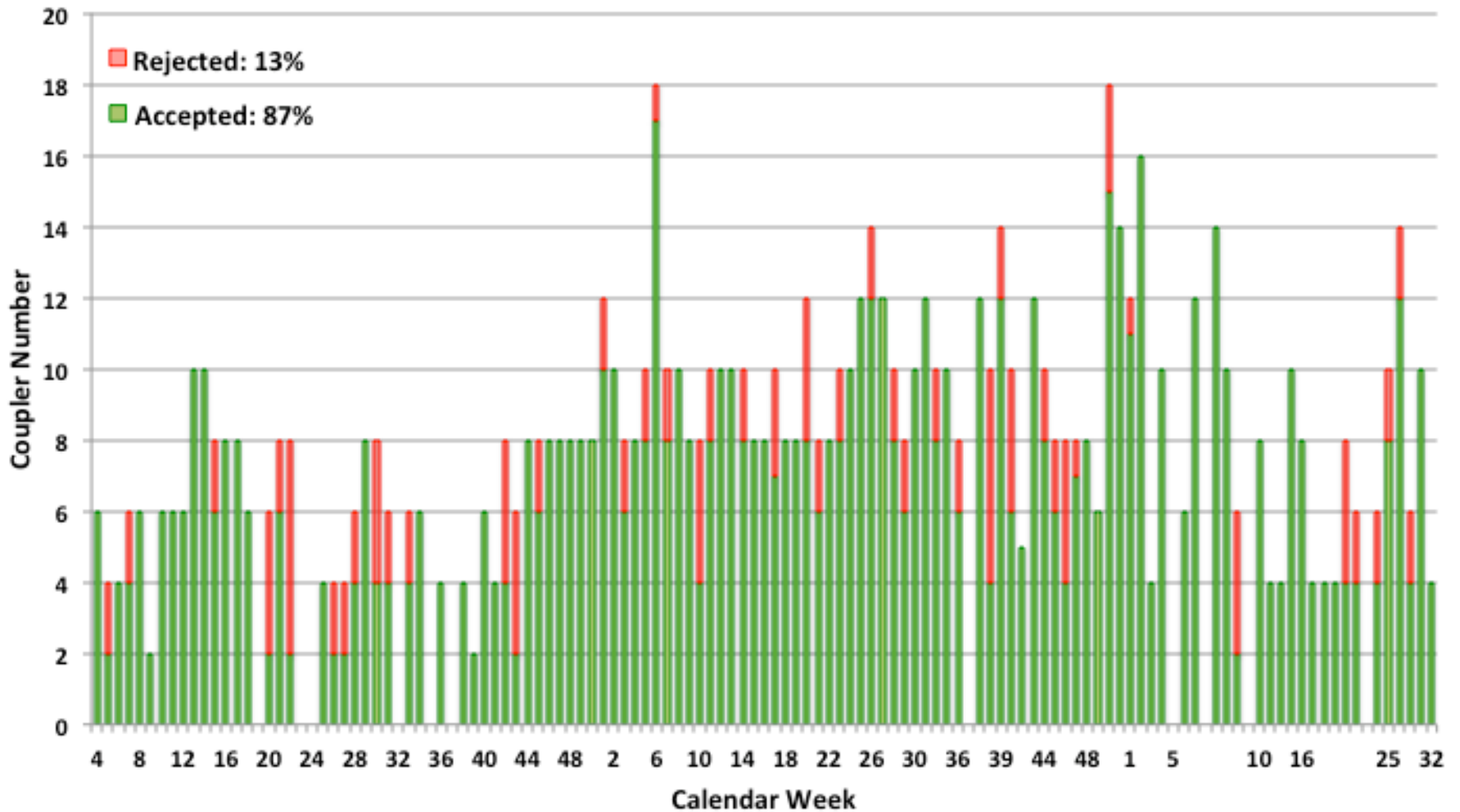


LAL to IRFU deliveries (2014-2015-2016)



# RF conditioning at LAL:

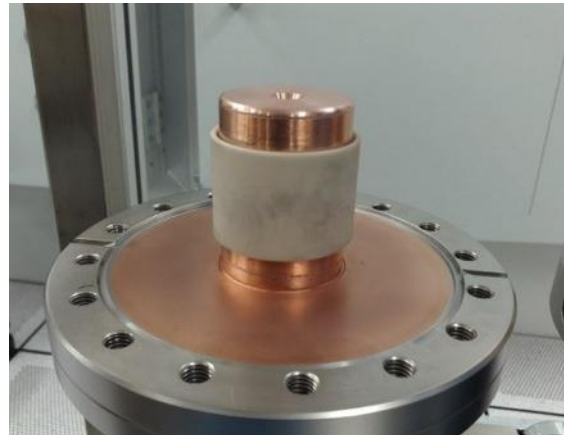
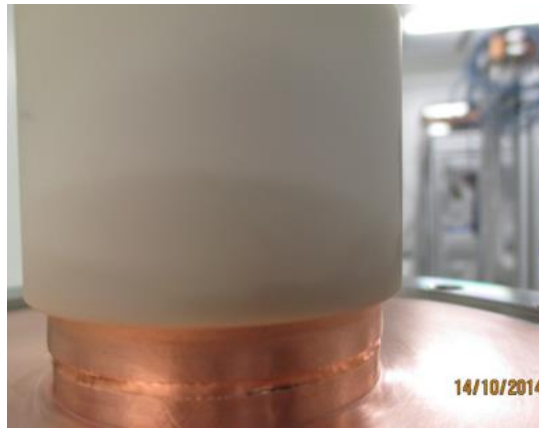
### Couplers weekly processed (2014-2015-2016)



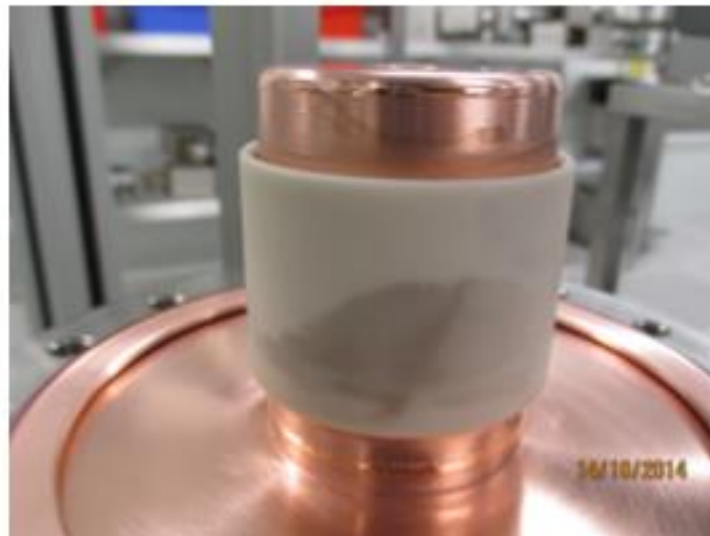


# Troubles on the track: Dark layer on cold ceramic

Main defect discovered during the final inspection: **Dark layer in cold ceramic window**

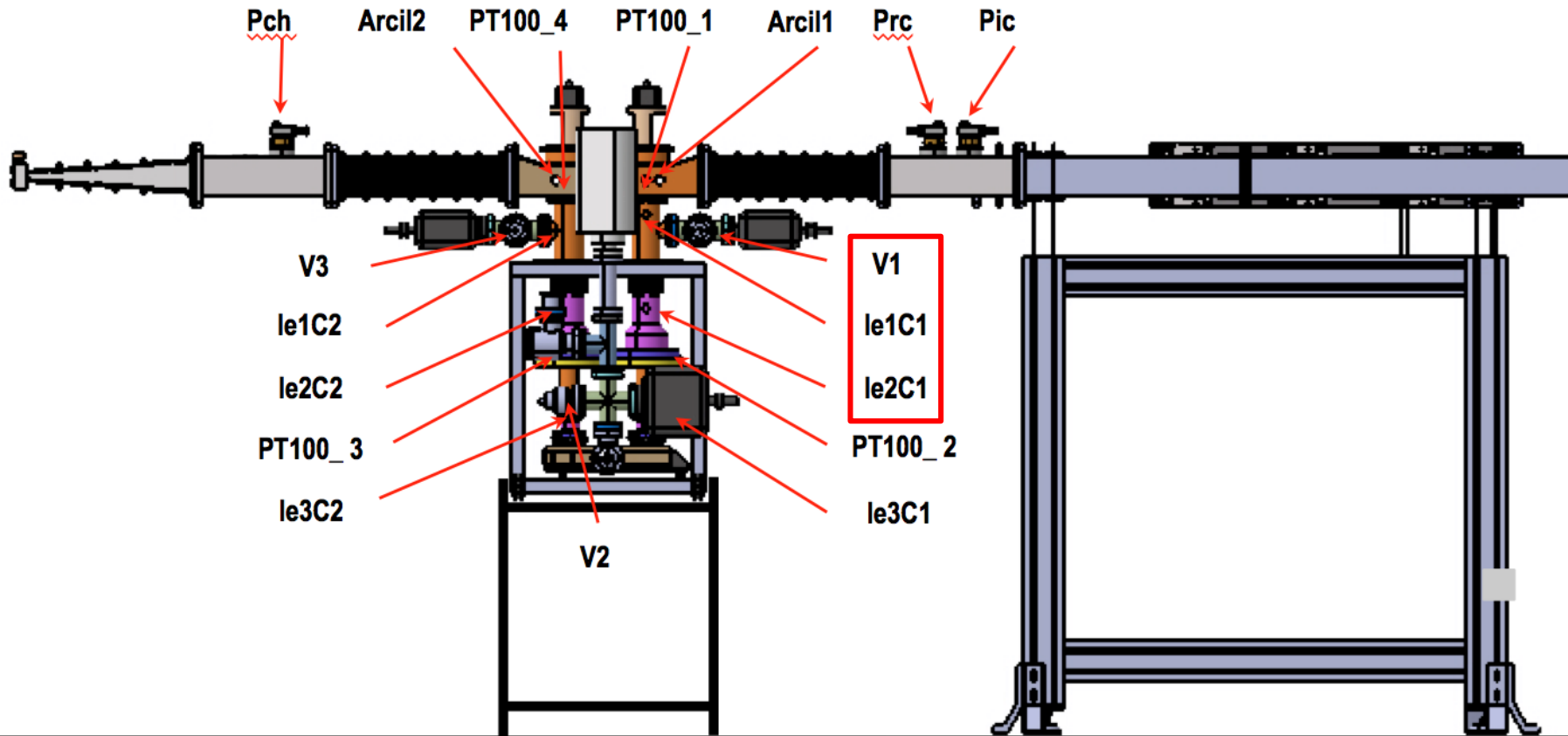


# Troubles on the track: Dark layer on cold ceramic

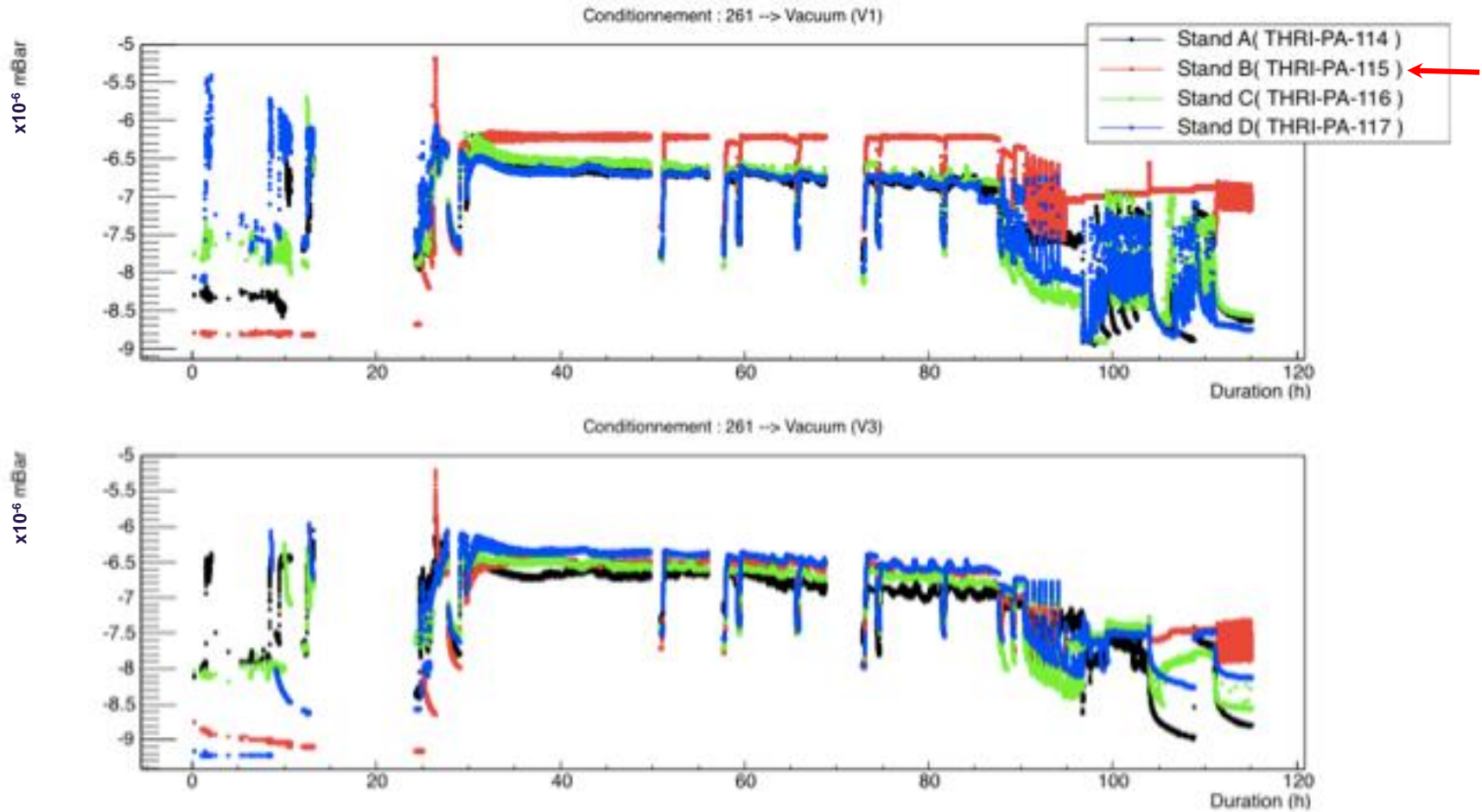


CP 331\_Pair 115  
Upstream coupler

# Troubles on the track: Dark layer on cold ceramic



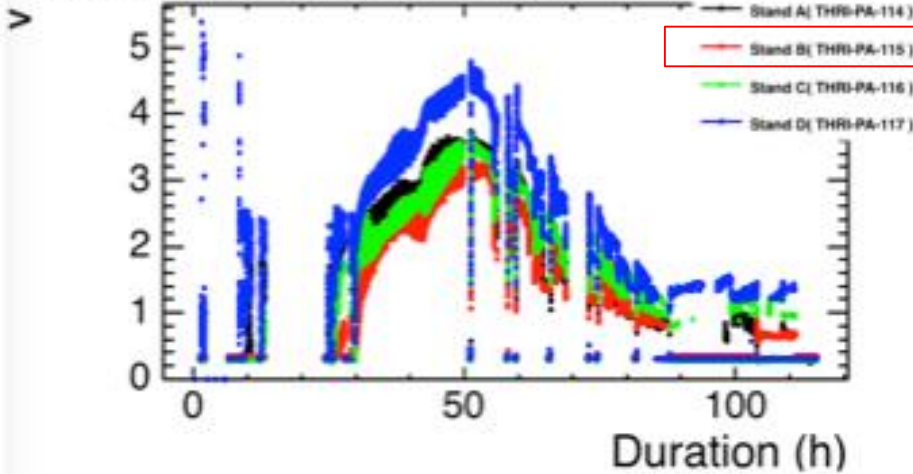
# Troubles on the track: Dark layer on cold ceramic



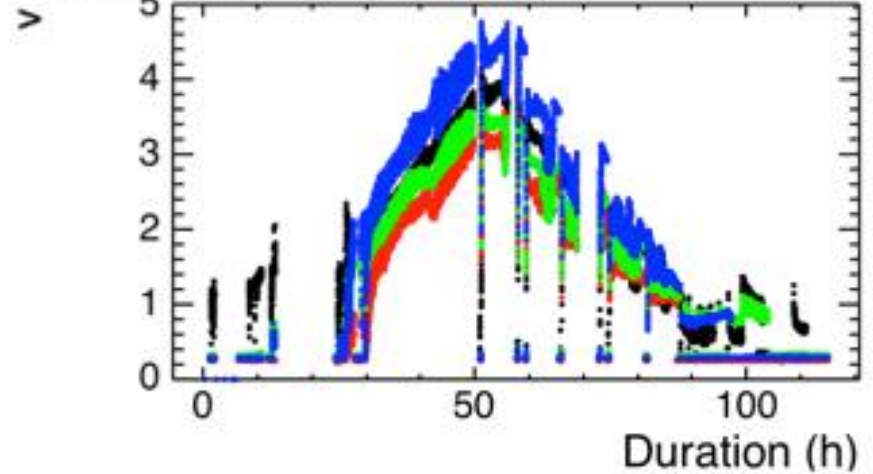
# Troubles on the track: Dark layer on cold ceramic



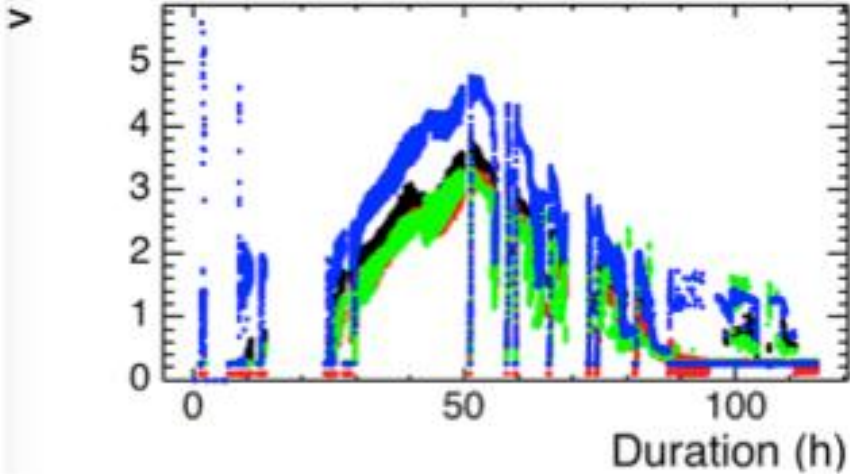
Conditionnement : 261 → Pickup (le1C1), All steps



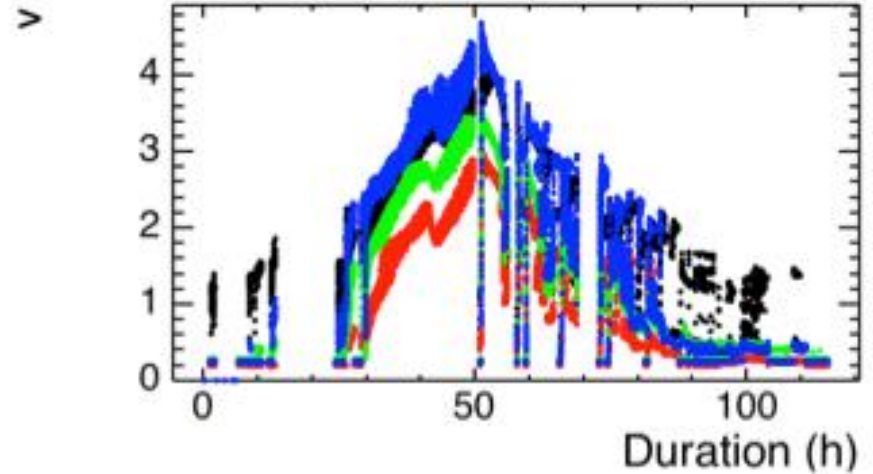
Conditionnement : 261 → Pickup (le1C2), All steps



Conditionnement : 261 → Pickup (le2C1), All steps



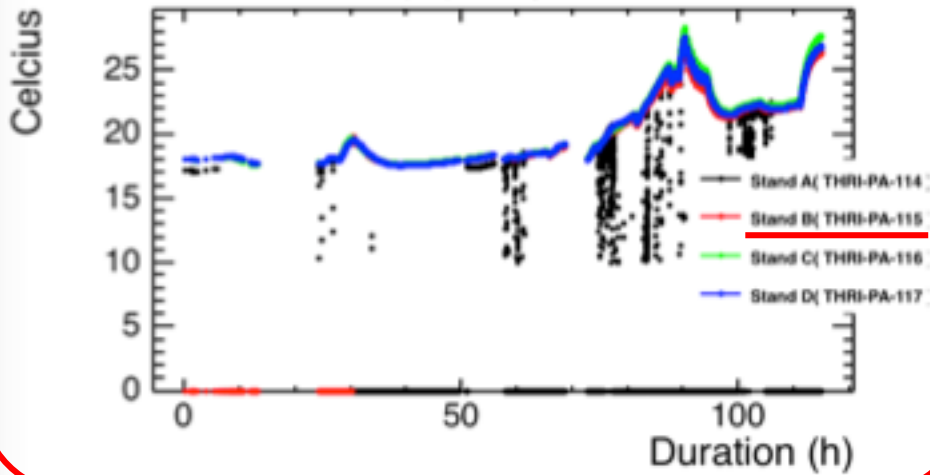
Conditionnement : 261 → Pickup (le2C2), All steps



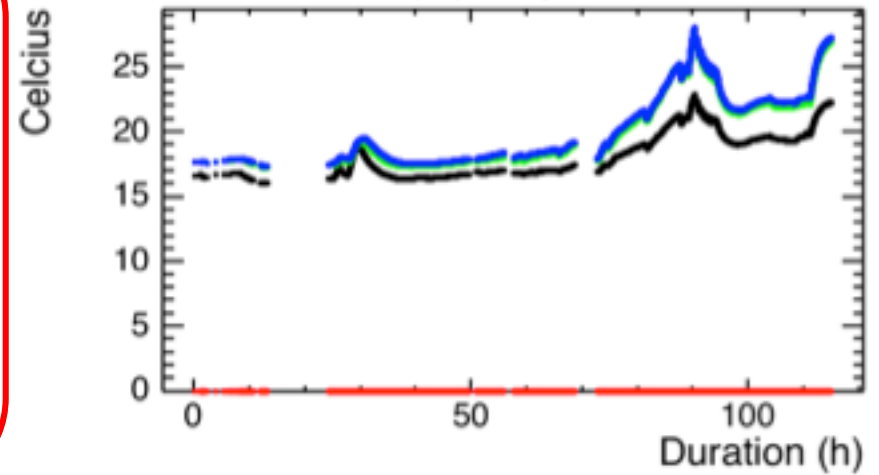
# Troubles on the track: Dark layer on cold ceramic



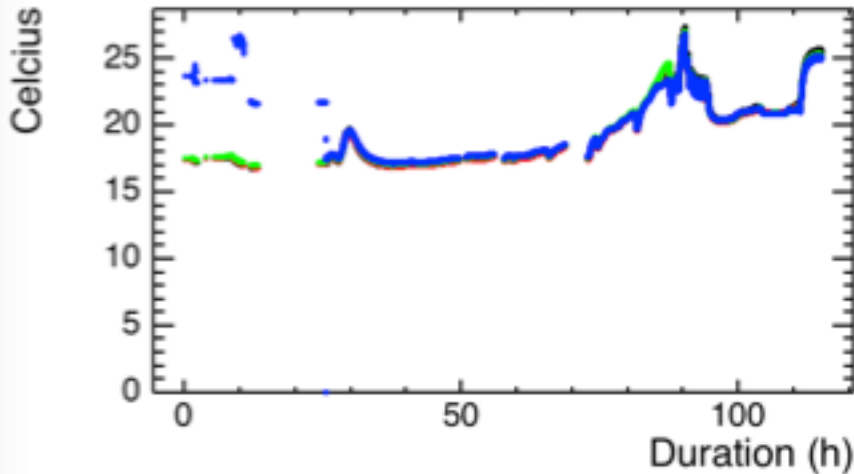
Conditionnement : 261 -> Vacuum (T1c), All steps



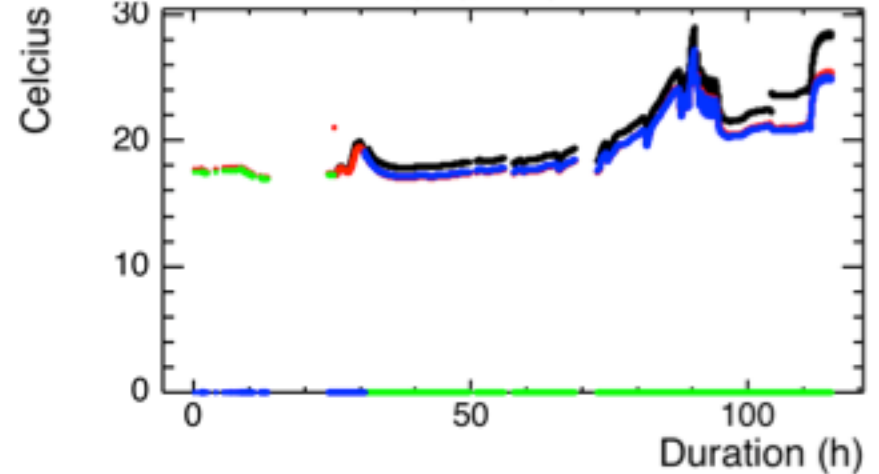
Conditionnement : 261 -> Vacuum (T2c), All steps



Conditionnement : 261 -> Vacuum (T1w), All steps



Conditionnement : 261 -> Vacuum (T2w), All steps



# Troubles on the track: Dark layer on cold ceramic

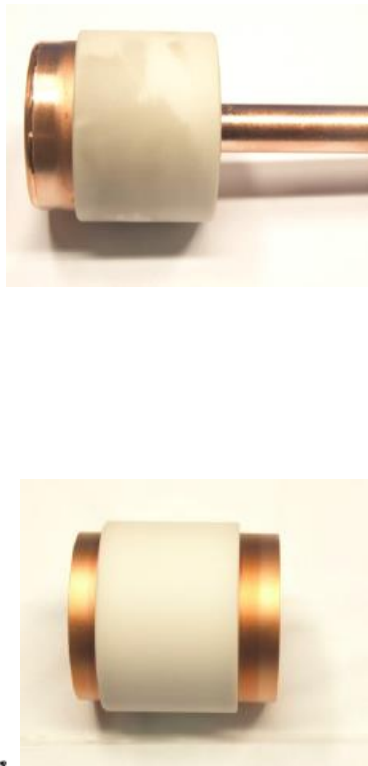
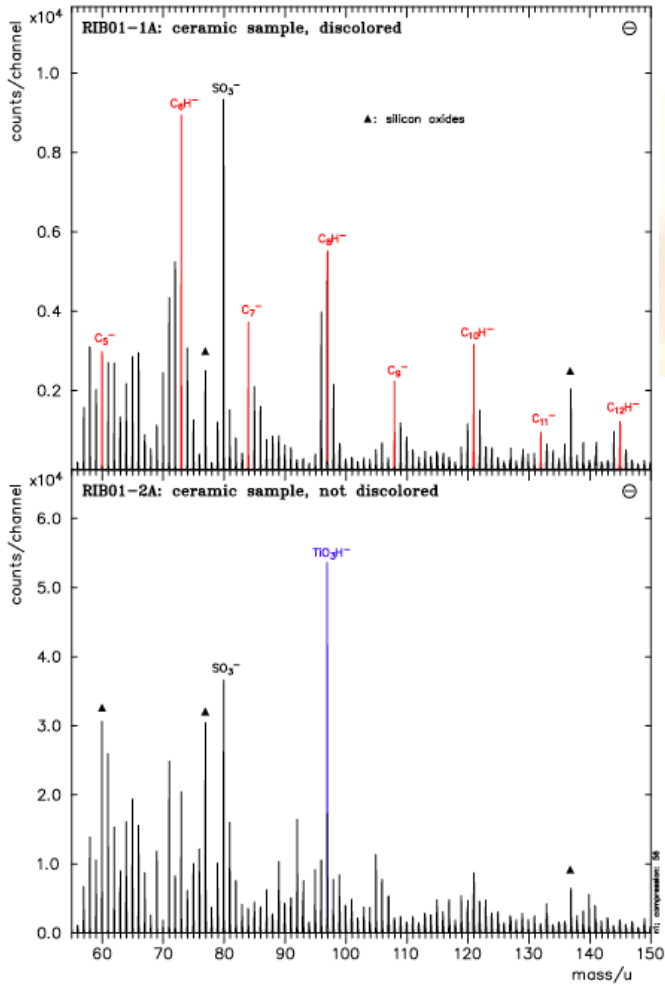


Figure 4: Details of the TOF-SIMS spectra of negative secondary ions

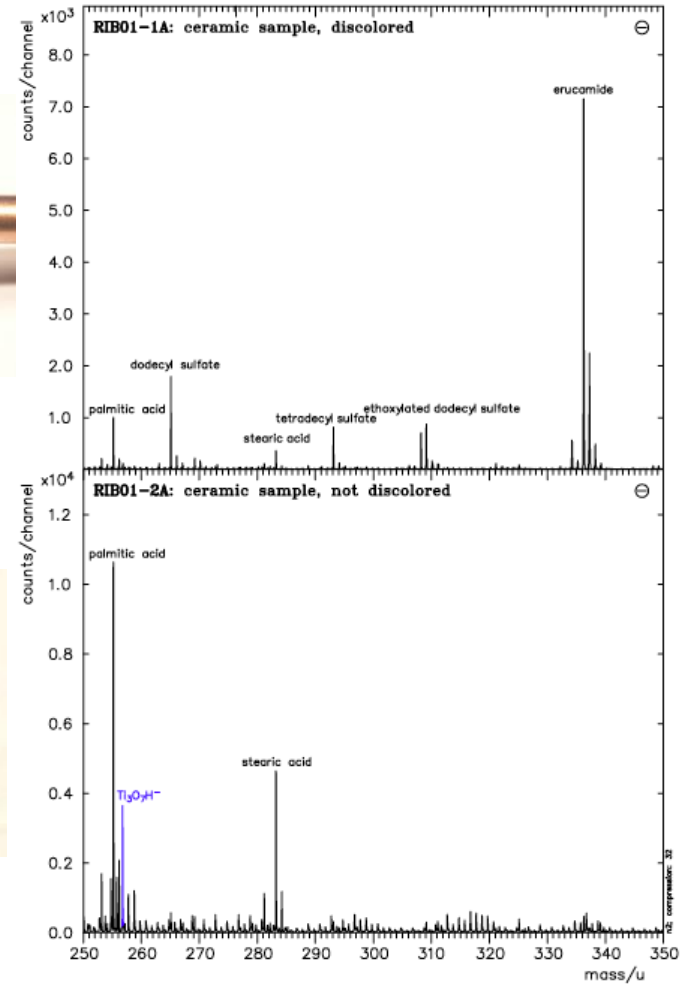


Figure 5: Details of the TOF-SIMS spectra of negative secondary ions

# Troubles on the track: Dark layer on cold ceramic



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## 5. Results of the TOF-SIMS Analyses

### 5.1. Summary

The main results are<sup>1,2</sup>:

- In the spectra of sample 2 (not discolored) mass signals of **titanium**, **titanium oxides** and **silicon oxides** as well as mixed **silicon/titanium oxides** are distinctly observed (look at figures 4 and 5 on pages 8 and 9). Moreover **chlorine**, **higher fatty acids** (figure 5 on page 9) and the additive **4,4'-Bis(diethylamino)benzophenone** are detected with high signal intensities.
- In the spectra of both preparations **sodium**, **potassium**, **calcium** and **CN/CNO-** as well as **SO<sub>2</sub> anions** are identified with high signal intensities.
- Only in the spectra of the discolored sample 1 the lubricant **erucamide** (figure 5 on page 9) and **soot-like carbon anions** (C<sub>2</sub>H<sup>-</sup>, figure 4 on page 8) as well as **alkylsulfates** (figure 5 on page 9) are clearly detected.

Further elements and compounds are detected mostly with low intensities, partly in the range of the detection limit. Table 1 gives a qualitative survey of the detected elements and compounds.

### 5.2. Comment

While in the spectra of the not discolored sample the ceramic material is distinctly observed, particularly erucamide and soot-like carbon anions are detected in the spectra of the discolored surface. The former compound can probably be attributed to the plastic wrapping of this sample (→ as-received condition). However the soot-like carbon anions (→ carbon black) can possibly be associated with the observed discoloration.

### 5.3. List of established elements / compounds

The specified elements / compounds are established with different intensities on the sample surfaces. Meaning of: — → not detected, □ → near the detection limit, ■ → very small intensity, ■■■ → medium intensity and ■■■■■ → very high intensity relative to basepeaks, substrate signals, signals of hydrocarbons or signals in comparable reference-spectra.

substance	prep. (RIB01-)					
	1A	2A				
<b>additives:</b>						
4,4'-Bis(diethylamino)benzophenone	■	■■■■■				
Irgafos 168	■	□				
<b>alkaline/alkaline earth metals:</b>						
calcium/calcium hydroxide	■■■	■■■				
potassium	■	■■■				
magnesium	□	■				
sodium	■■■	■■■				
sodium hydroxide	□	■				
sodium sulfate	□	■				
<b>anions (semipositive):</b>						
CN <sup>-</sup> /CNO <sup>-</sup>	■■■	■■■				
NO <sub>2</sub> <sup>-</sup>	■	■				
PO <sub>4</sub> <sup>-</sup>	□	■				
SO <sub>2</sub> <sup>-</sup>	■	■				
<b>half metals:</b>						
silicon	■	■				
silicon oxides	■	■■■				
silicon/titanium oxides	—	■■■				
<b>fatty acid amides:</b>						
erucamide	■■■■■	—				
<b>diglycerides</b>	□	—				
<b>fatty acids:</b>						
higher fatty acids	■	■■■				
<b>halogens:</b>						
fluorine	■	■				
chlorine	■	■				
<b>metals / metal compounds:</b>						
aluminium	—	■				
chrom	—	□				
copper	□	□				
mangan	□	□				
titanium/titanium dioxide	□	■■■				
tin	—	□				
<b>silicones:</b>						
poly(dimethyl siloxane)	■	■				
<b>anionic surfactants:</b>						
alkylsulfates	■	□				
sulfur	□	□				
C <sub>2</sub> H anions (→ soot/carbon black)	■■■■■	—				

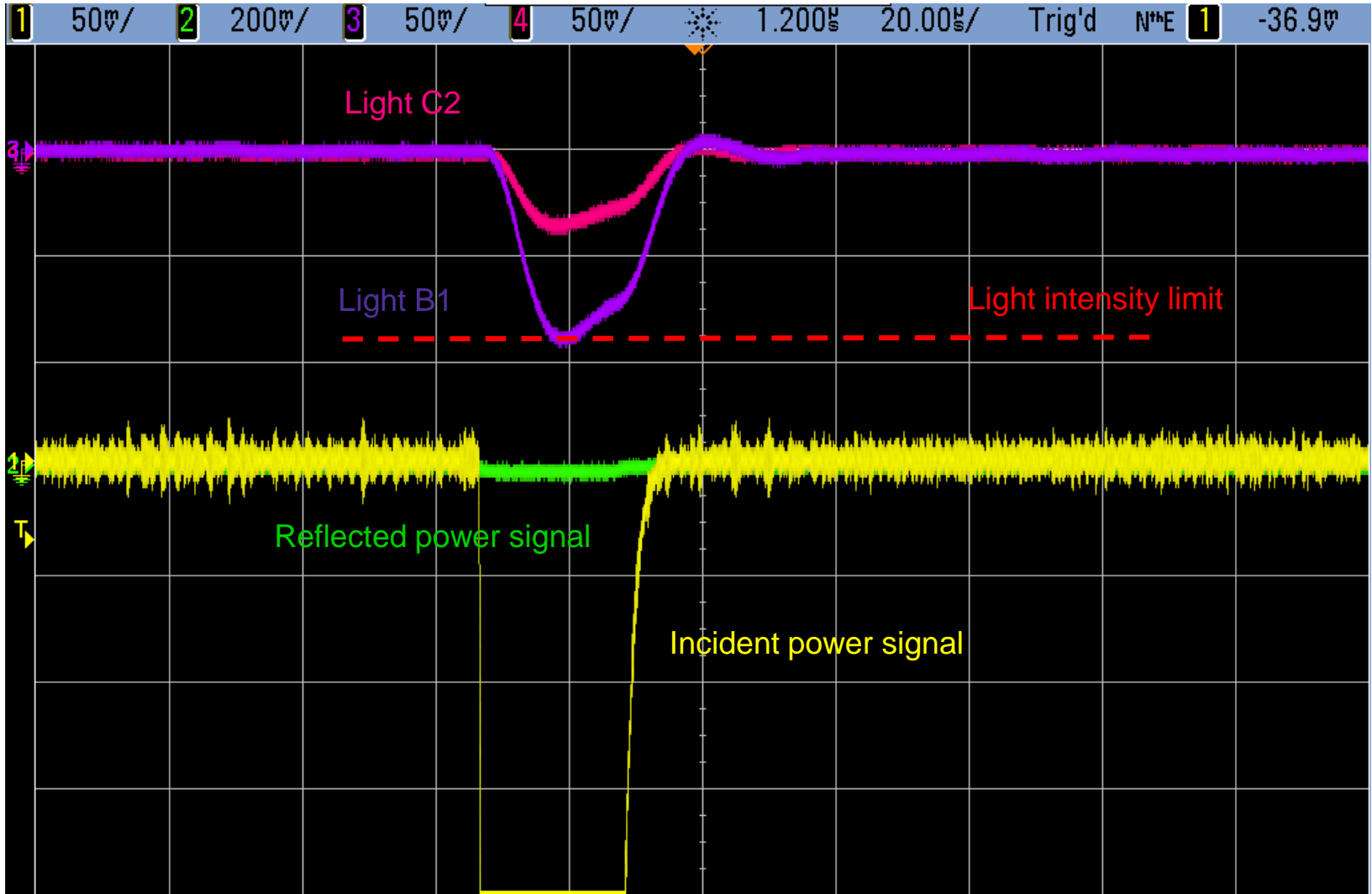
Table 1: Relative intensities of representative signal peaks for the investigated samples (Note: intensities within a single column are not comparable).

<sup>1</sup>The analyses were carried out according to procedure OFG-P1. The results were obtained by comparison with databases.

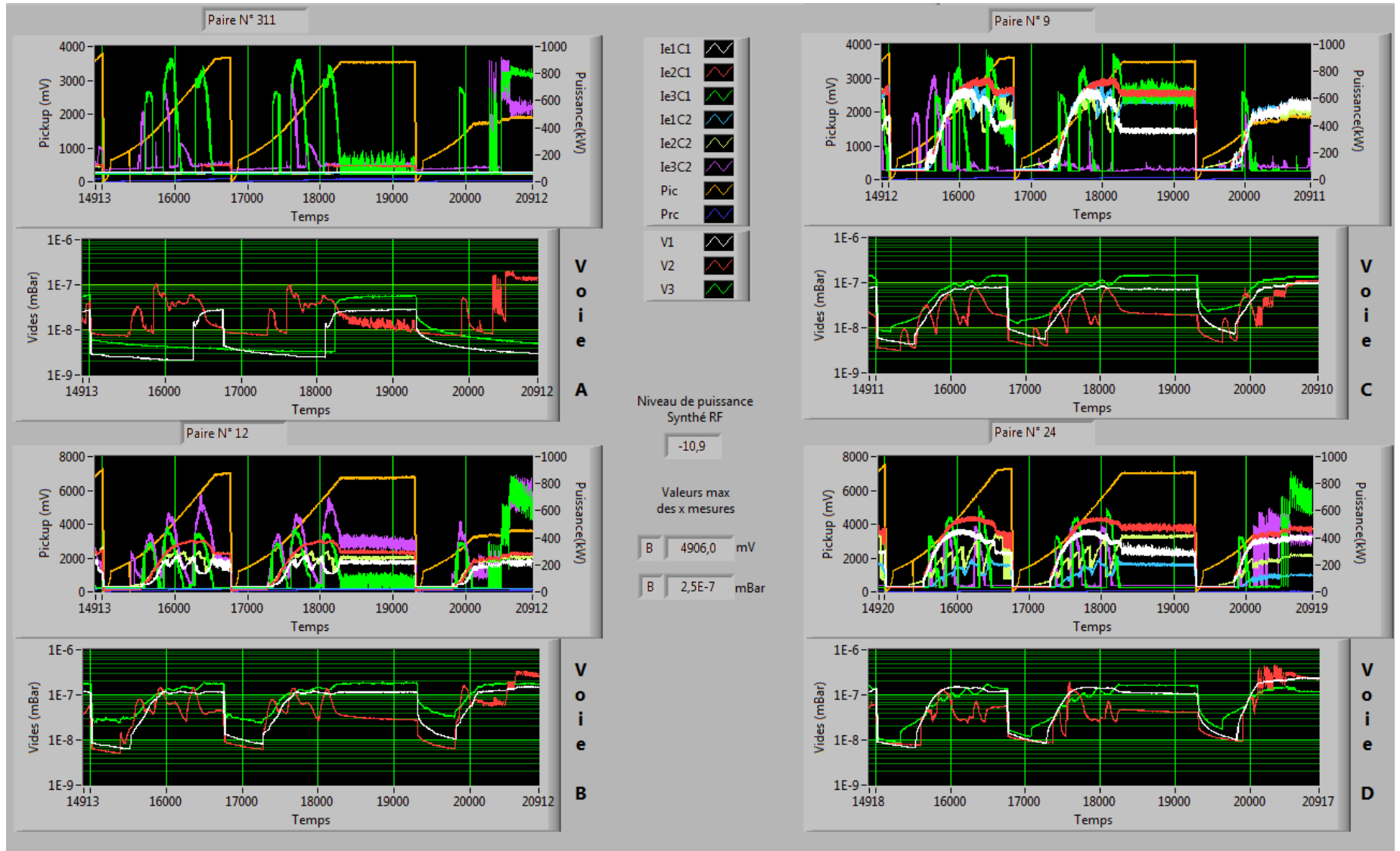
<sup>2</sup>Comments are set in italic text.



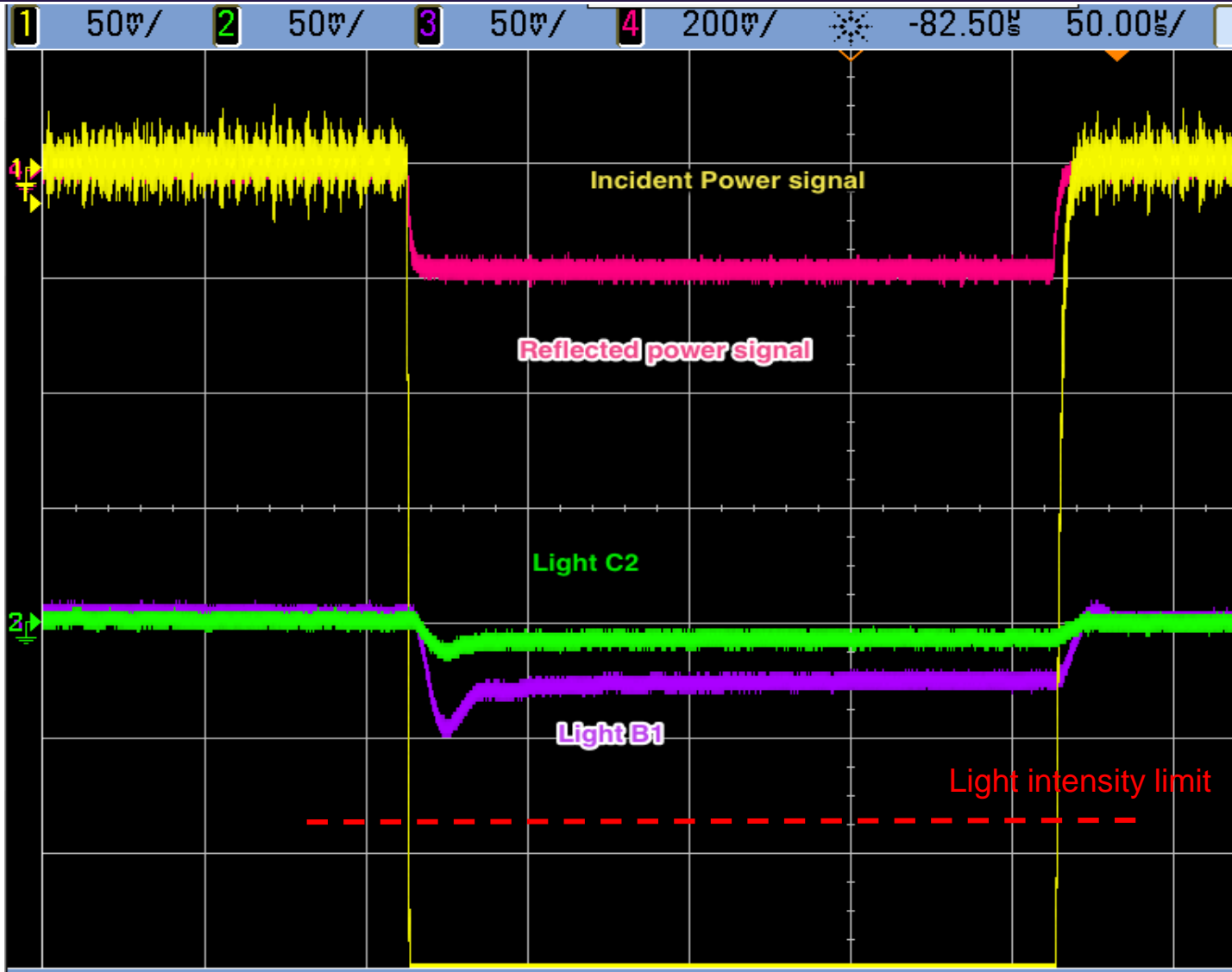
# Troubles on the track: Light & arcing in the warm windows



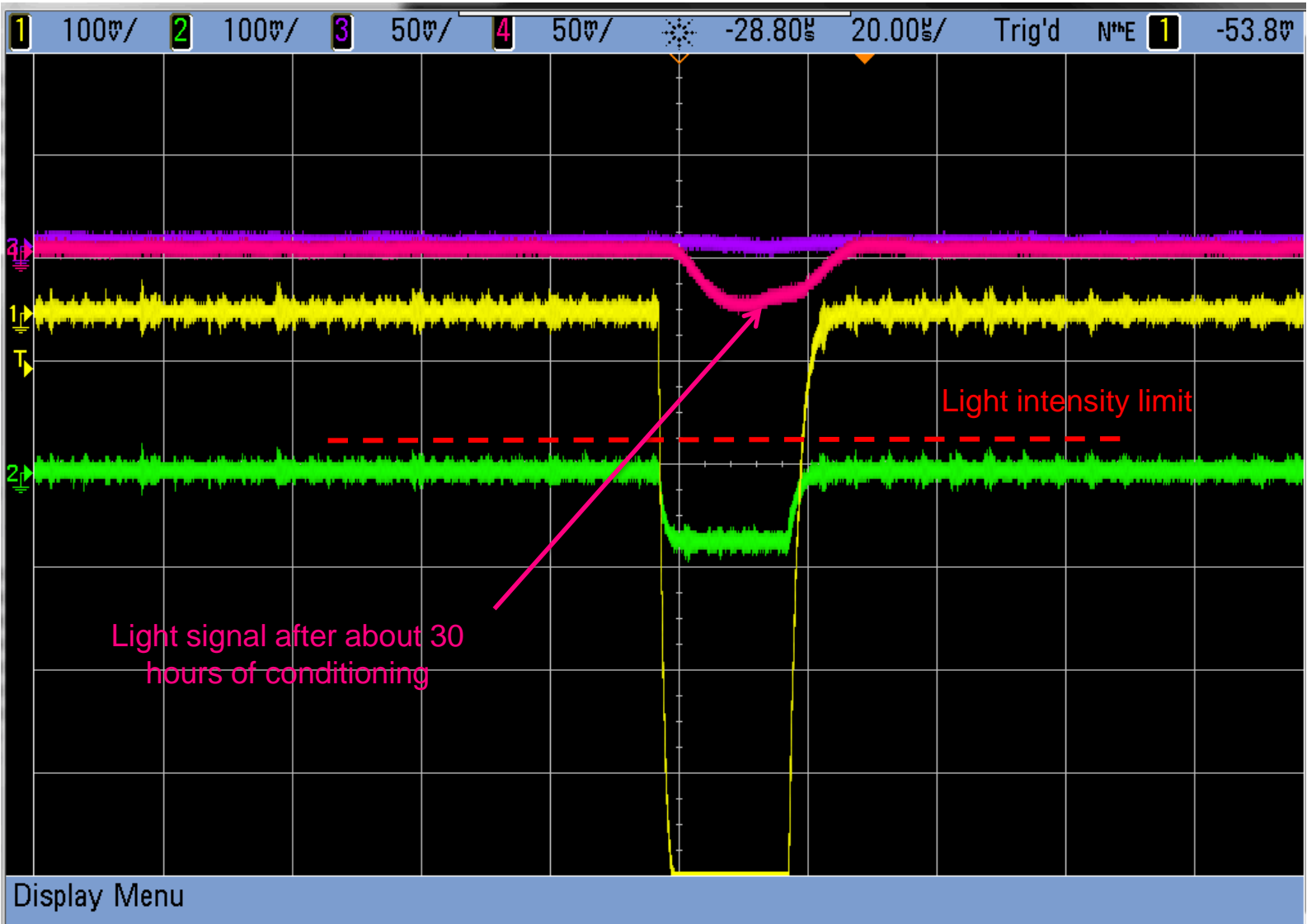
# Troubles on the track: Light & arcing in the warm windows



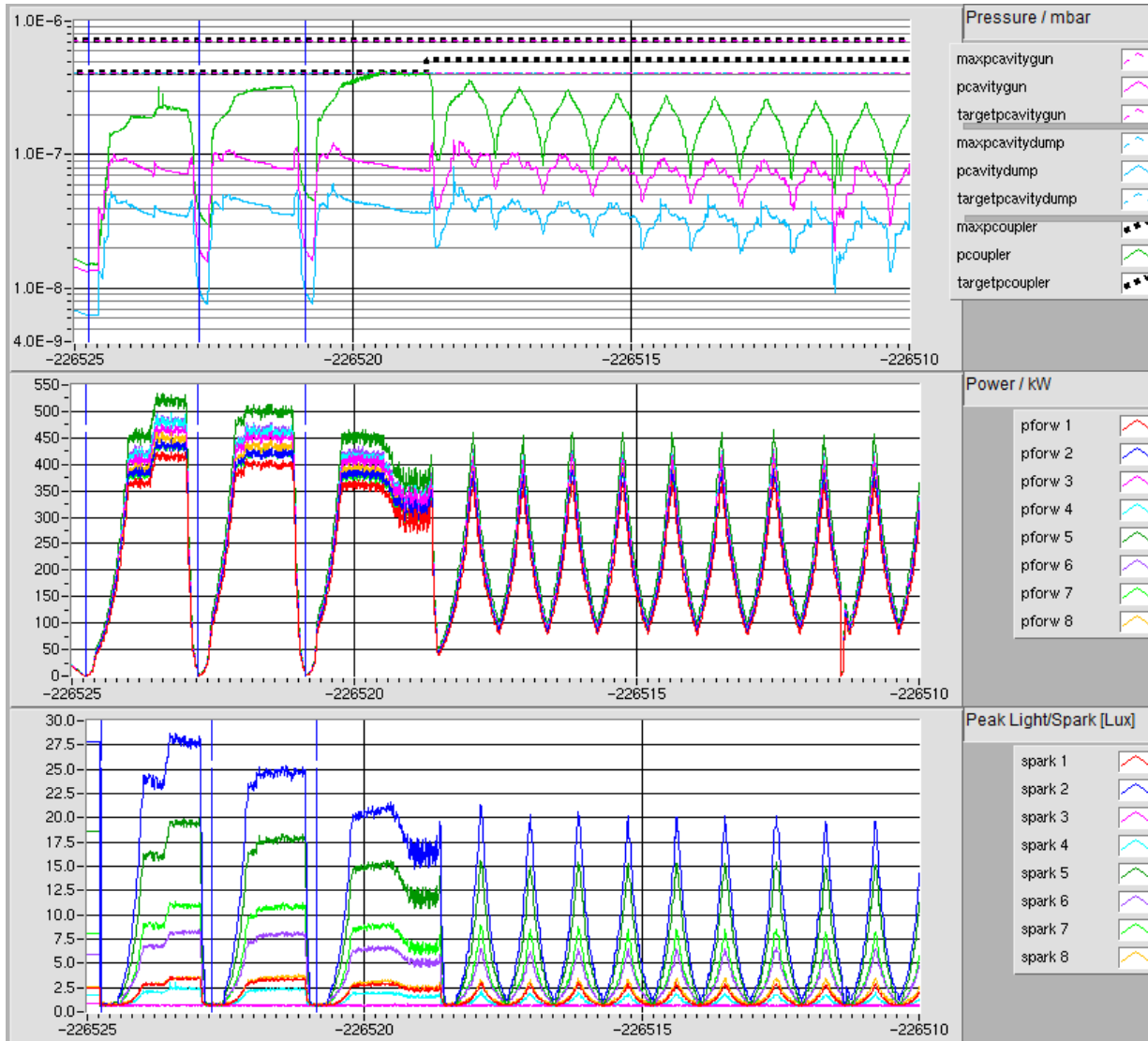
# Troubles on the track: Light & arcing in the warm windows



# Troubles on the track: Light & arcing in the warm windows



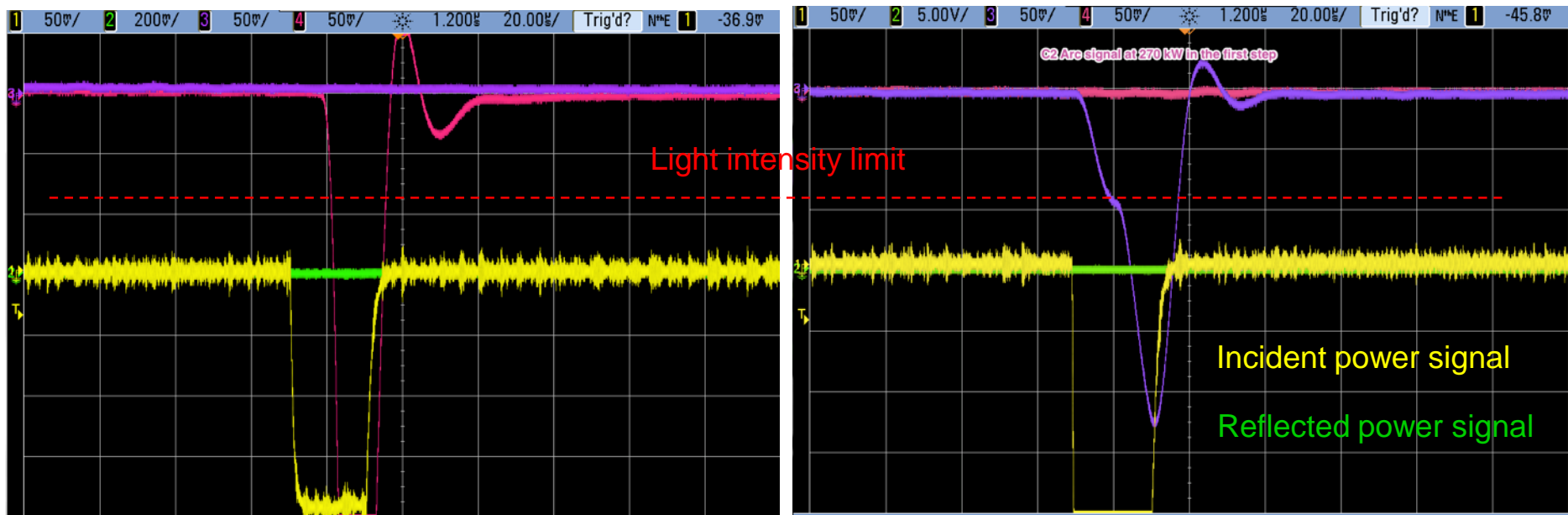
# Troubles on the track: Light & arcing in the warm windows



Module XM-1 couplers conditioning:  
Light signal on spark sensors

Denis Kostin, MHF-sl, DESY

## Troubles on the track: Light &amp; arcing in the warm windows



Sudden increase of the light intensity causing arc interlock: generally occurs at low power (under 250 kW) at the shortest pulse (20us) → impossible to go further: the pair is removed from the test stand.

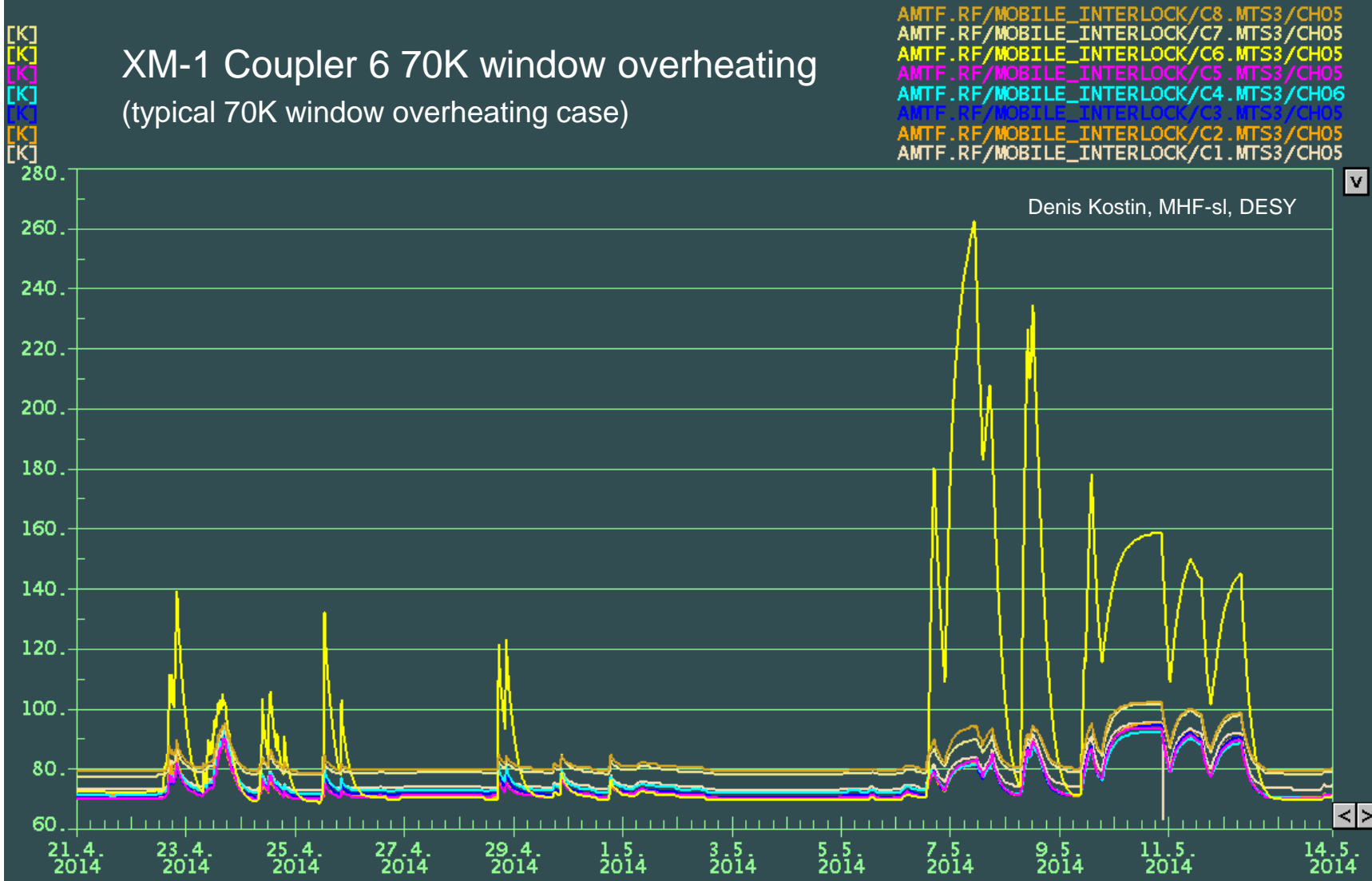
# Troubles on the track: Light & arcing in the warm windows



# Troubles on the track: Overheating during RF test



XM-1 Coupler 6 70K window overheating  
(typical 70K window overheating case)

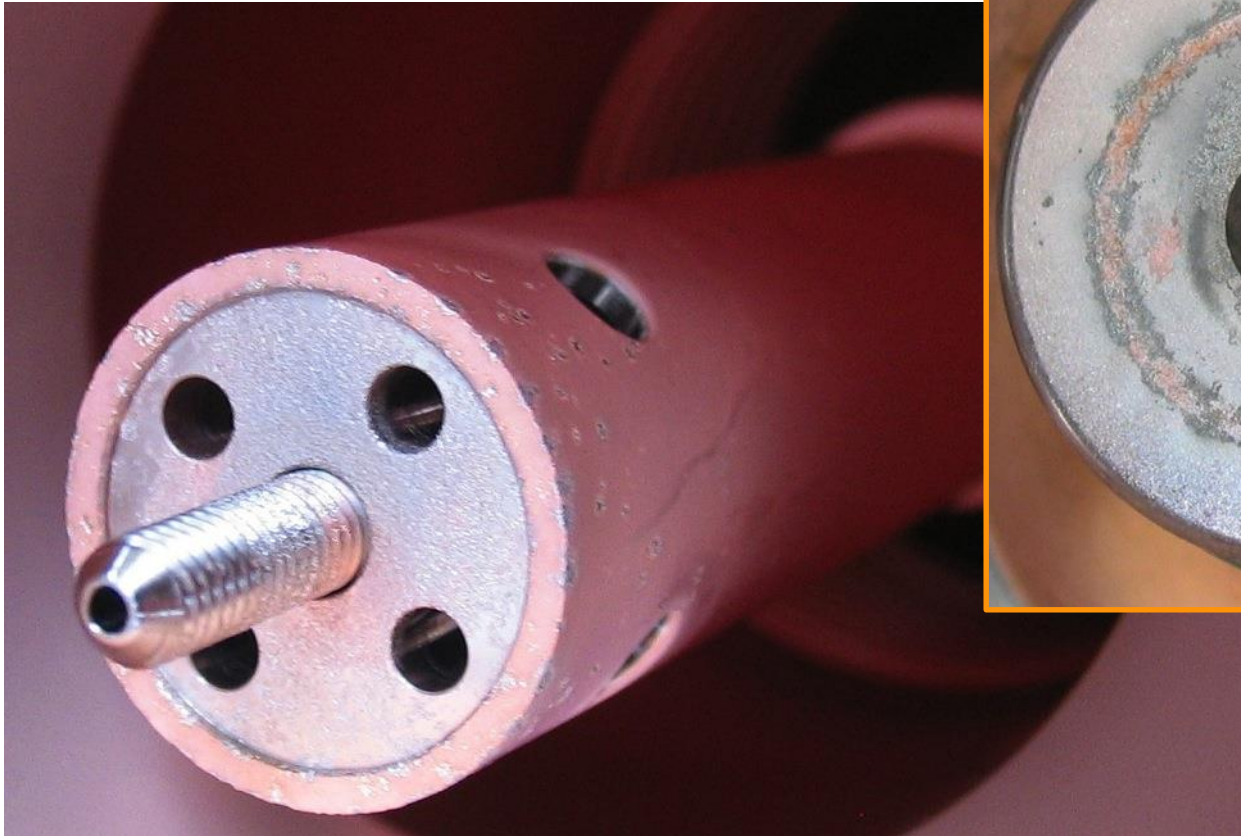




## Troubles on the track: Overheating during RF test

Coupler 70K window overheating due to loose connection between the WIC and the CP. Cold part must be grinded and cleaned. The WP must be changed.

Re-conditioning takes long time: cleaning is difficult, no baking, no US-wash...

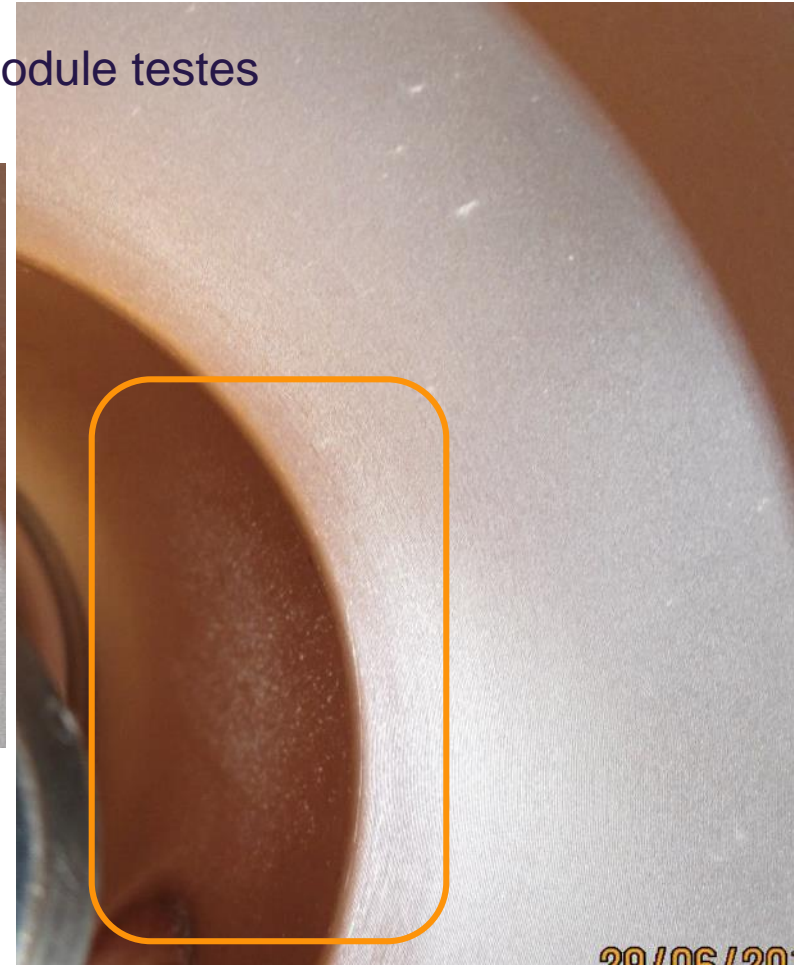
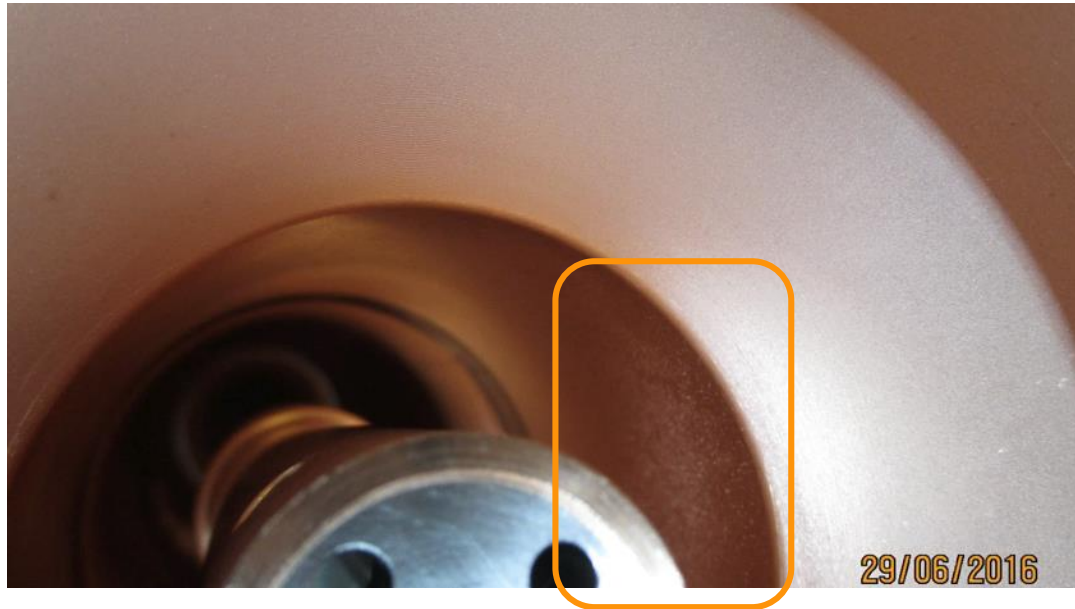


Denis Kostin, MHF-sl, DESY

# Troubles on the track: Overheating during RF test

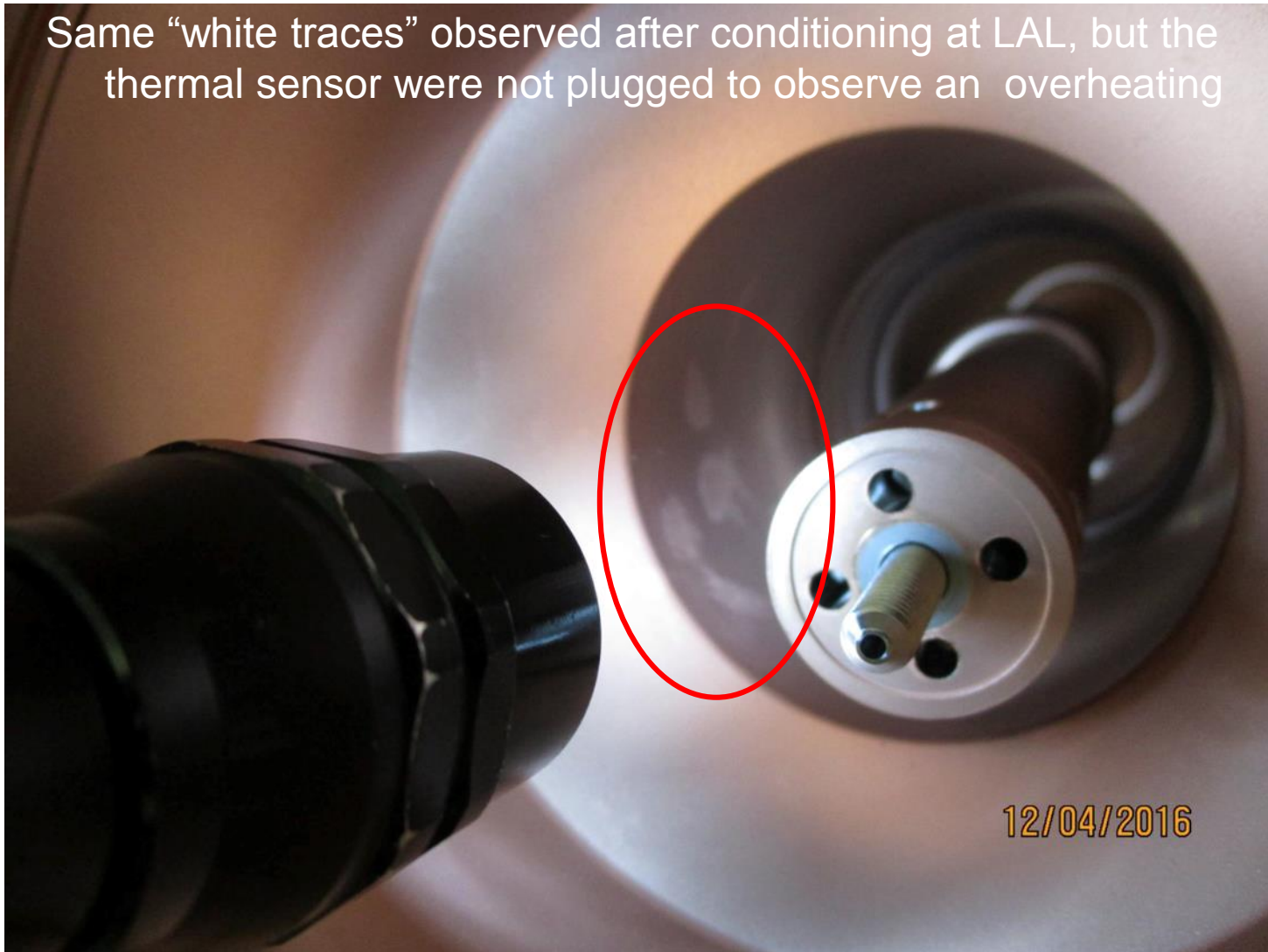


WPs inspection after observed Overheating in module testes



# Troubles on the track: Overheating during RF test

Same “white traces” observed after conditioning at LAL, but the thermal sensor were not plugged to observe an overheating



# Troubles on the track: Overheating during RF test



VQ lis\_lmj1 - VNC Viewer  
on 5.0 du 06/06/2014

Alimentations Alarms Modulateur HT Paramètres Station Conditionnement **Coupleurs XFEL** Graphes Graphes Temp. Interlock Image

Voix\_voie A

Num\_P 41 Pic 394,2 kW Pch 427,9 kW Prc 16,3 kW

Pickup 0,5 1 1,7 8,9 4,8 0,4 V 8,5 A 8526,6 V

Vides 4,0E-8 1,9E-8 6,2E-7 mBar Vide Max 6,2E-7 A 6,2E-7 mBar

Valeurs max des x mesures Vide le 0,644

Raz Defaults Servitudes K

Alims ON  
Défaut alin  
Défaut Mo  
Défaut Dét  
Défaut Klys  
Défaut Séc  
Défaut Te  
Défaut liais  
Défaut Cou

Niveau\_RF -30,0

STOP SU

White circular spots  
Cu lack?

20/03/2016

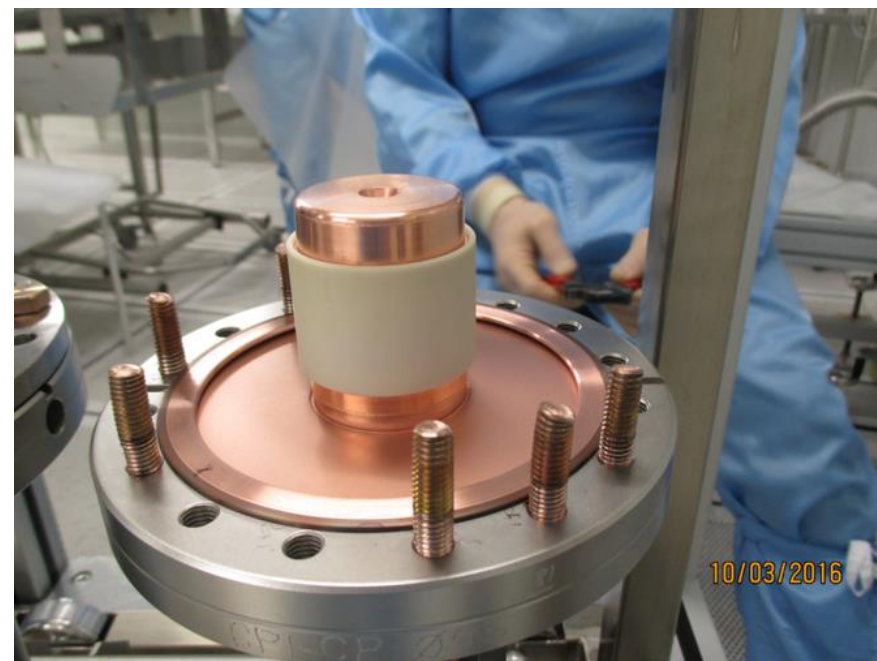
High pick-up signal le1C2 (near the warm window). Increasing during the time.

Vacuum level at the threshold limit

Power level blocked around 400 kW for hours (limiting vacuum) & even decrease.

Step 5  
Step 7

# Troubles on the track: Other minor issue



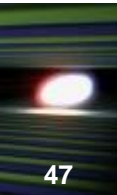
First, we faced difficulties to remove the WP because of the tilted threaded rods, blocked in the flange.

## Troubles on the track: Other minor issue



The 7 rods were then removed with a pliers, with the risk to heat the cold ceramic in case of bad handling, and to contaminate the parts with metallic particles.

## Troubles on the track: Other minor issue



Once the rods removed, we started to rework the tapped holes. However, the quality of the original thread was so bad, that the tool was broken inside one hole.





Thanks for your attention.