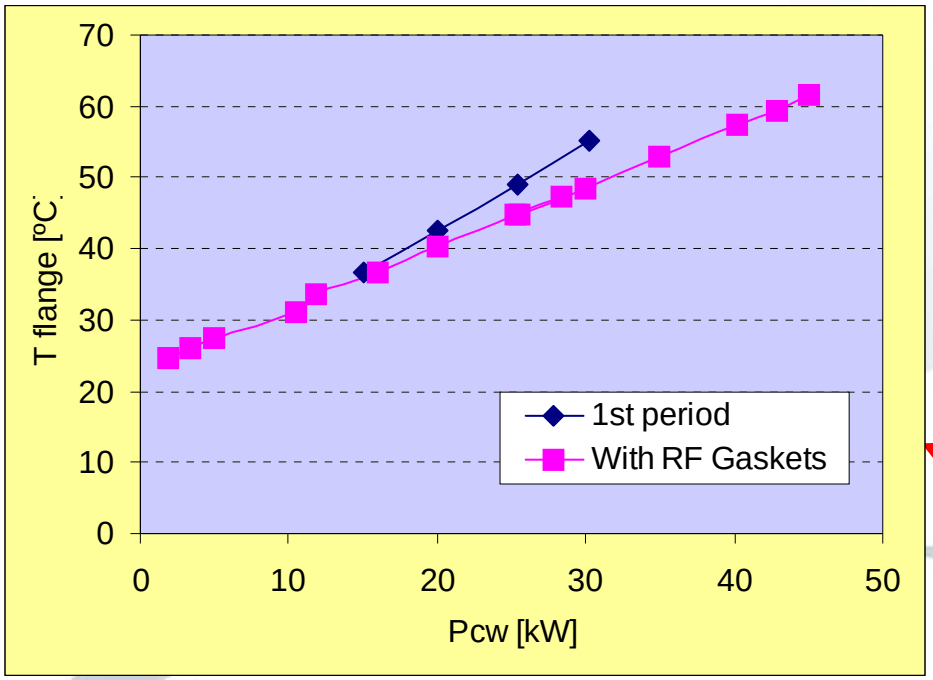
80 kW at Dampy

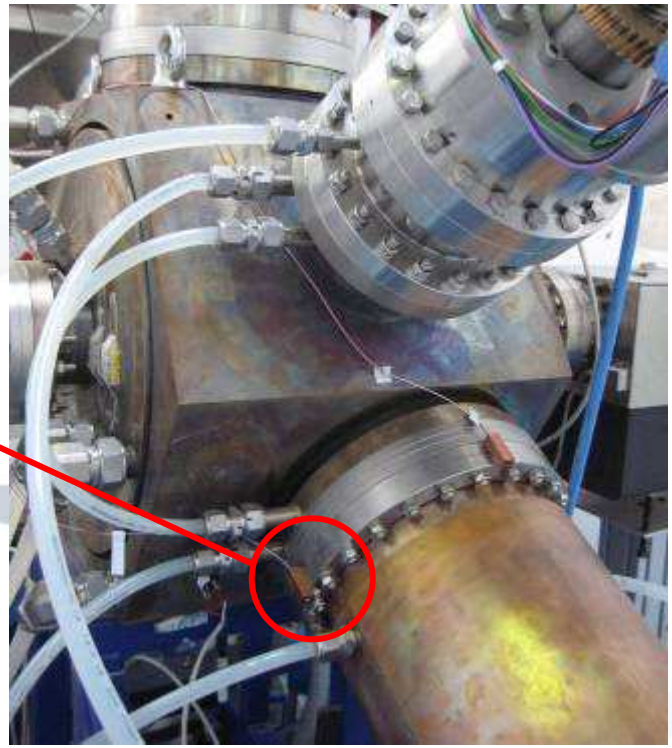
Francis Perez

- Reminder
- Dampy 01 November 08
- Dampy 00 - Bridged January 09
- Dampy 01 Repaired April 09
- Dampy 02 & 03 September 09
- Measurements
- Next

Flange local overheating

which develops in a vacuum leak

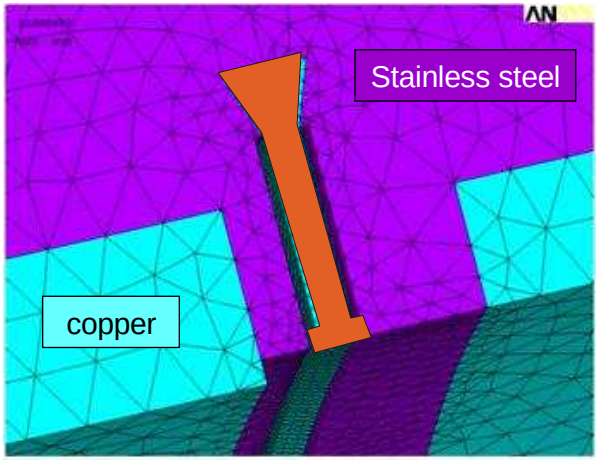




Solutions

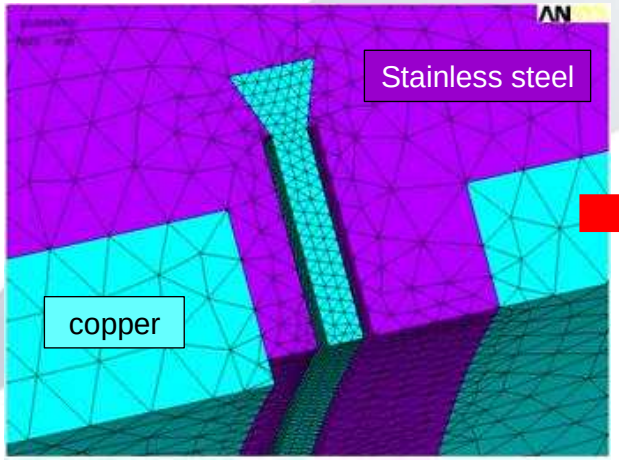
1) *Thick RF Gasket to short cut the RF path*

Soft Copper gasket

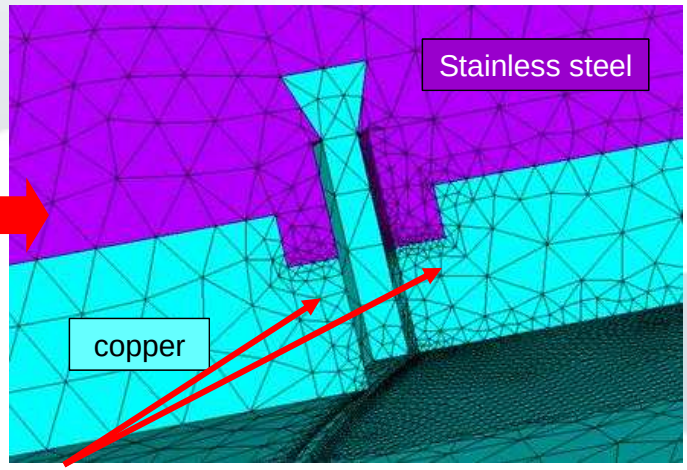


2) *Flange modification with added Copper*

original design

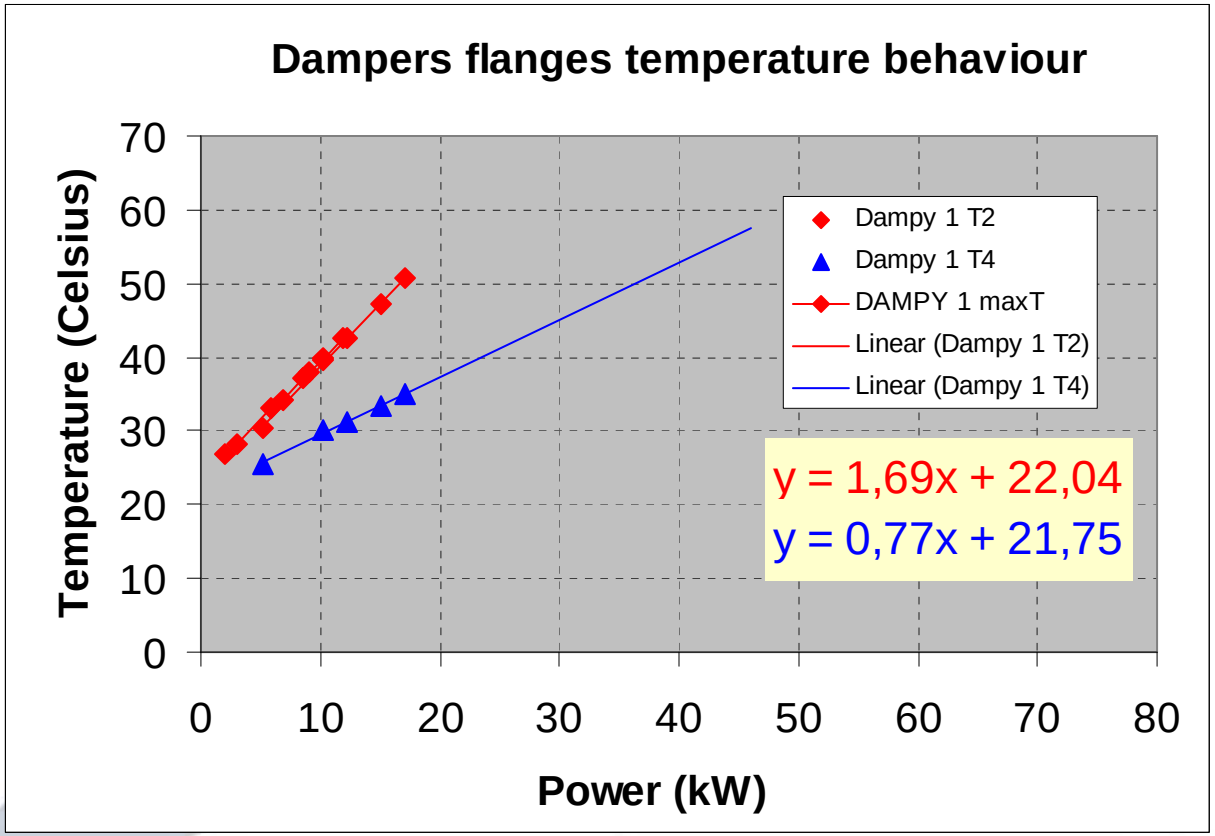


modified design



Added copper to better dissipate the heat

Dampy 01 in November 2008



Even worse overheating, 50ºC at 15 kW!!
Leak at less than 20 kW

Dampy 01 in November 2008

Two problems detected:

Mechanical error

Overfloading welding material

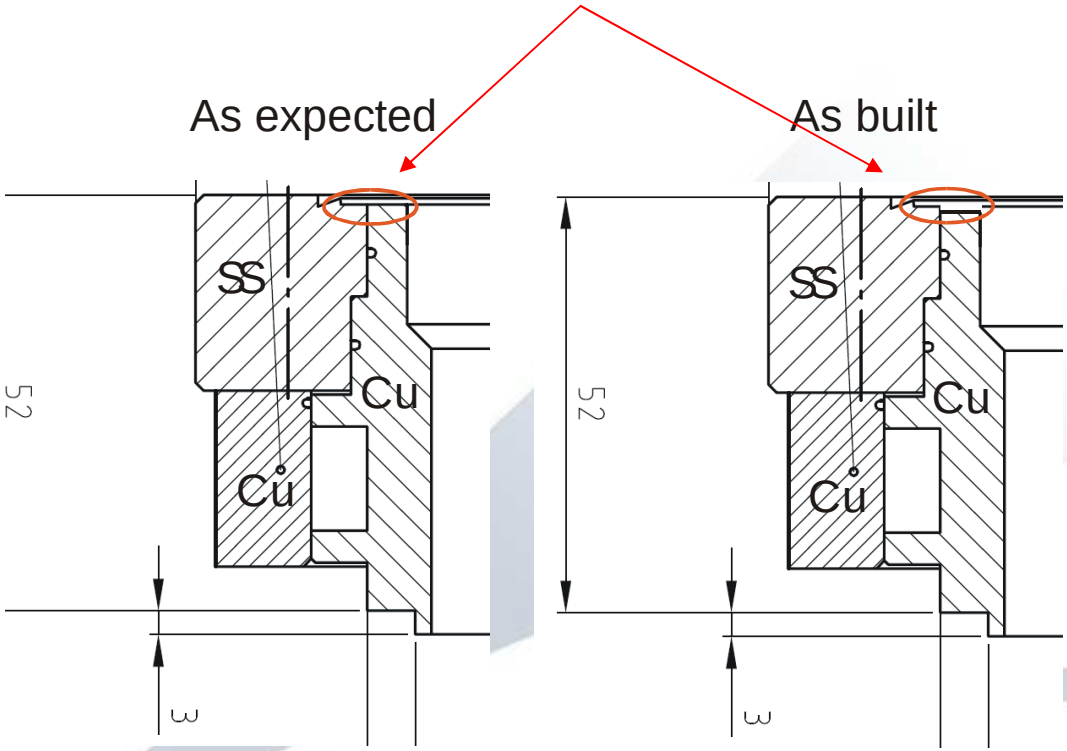


Figure 3: Unexpected step in the SS-Cu joint

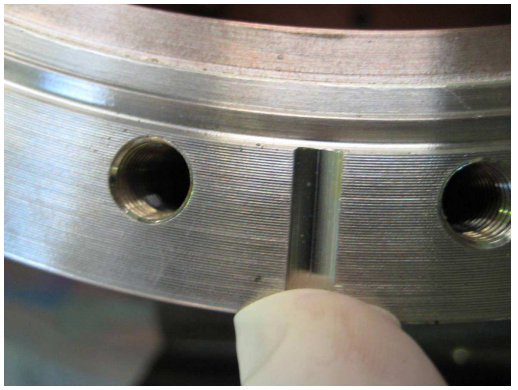


Figure 1: Cavity flange for top-damper. Good quality.

Figure 2: Cavity flange for window damper. Bad quality: bumpy

RF gaskets userless!!

Approach followed

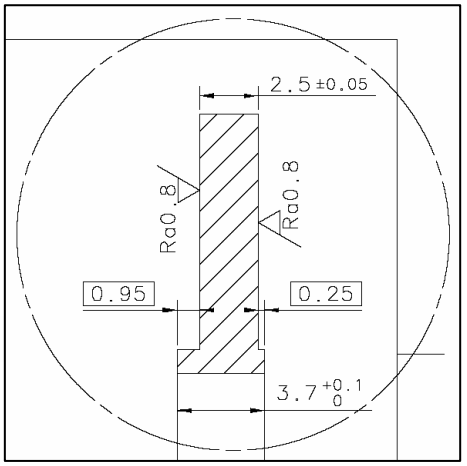
1) Sent back to ACCEL to:

Remachine flange's step to a defined dimension:

Table 1	SS-Cu Step [mm]
TOP damper	0,60
COUPLER damper	0,55
TUNER damper	0,22

→ *0.7 mm*

Built new thick RF gaskets →



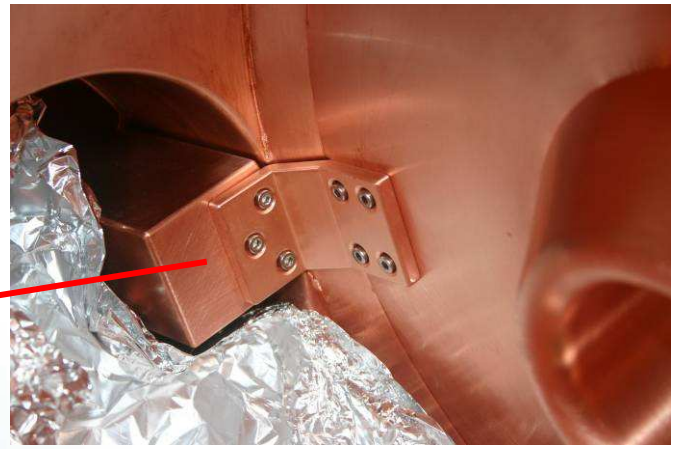
2) Power tests again Dampy 01 after repair

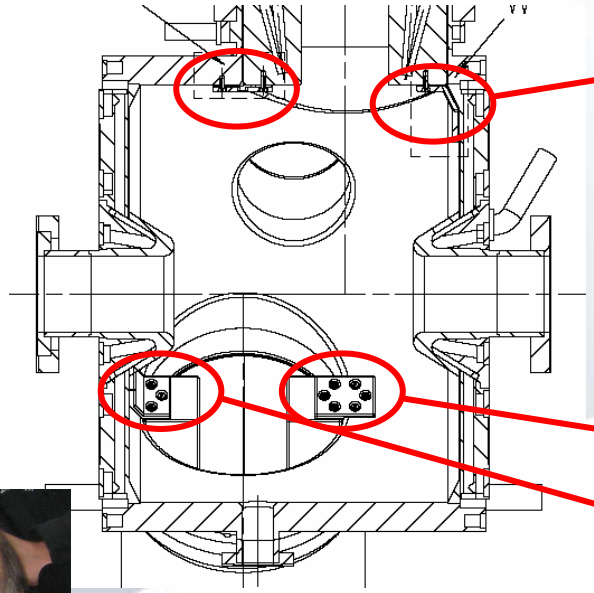
3) Decide then if apply the same solution at the rest of cavities

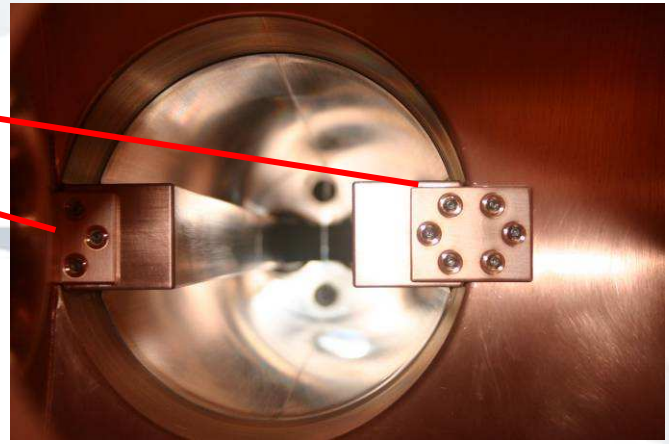
But in the mean time…

SR Dampy 00-B (Bridged)

Gap bridge performed at CELLS
(José Ferrer expertise!)

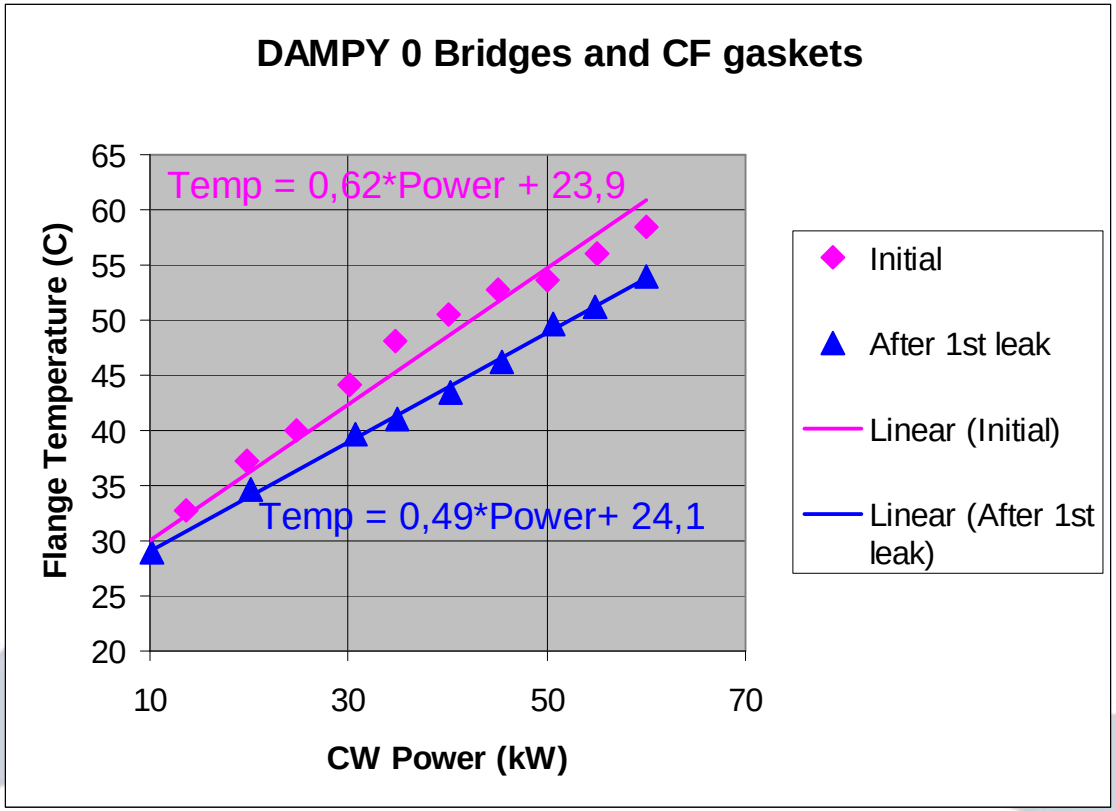






SR Dampy 00-B , January 2009

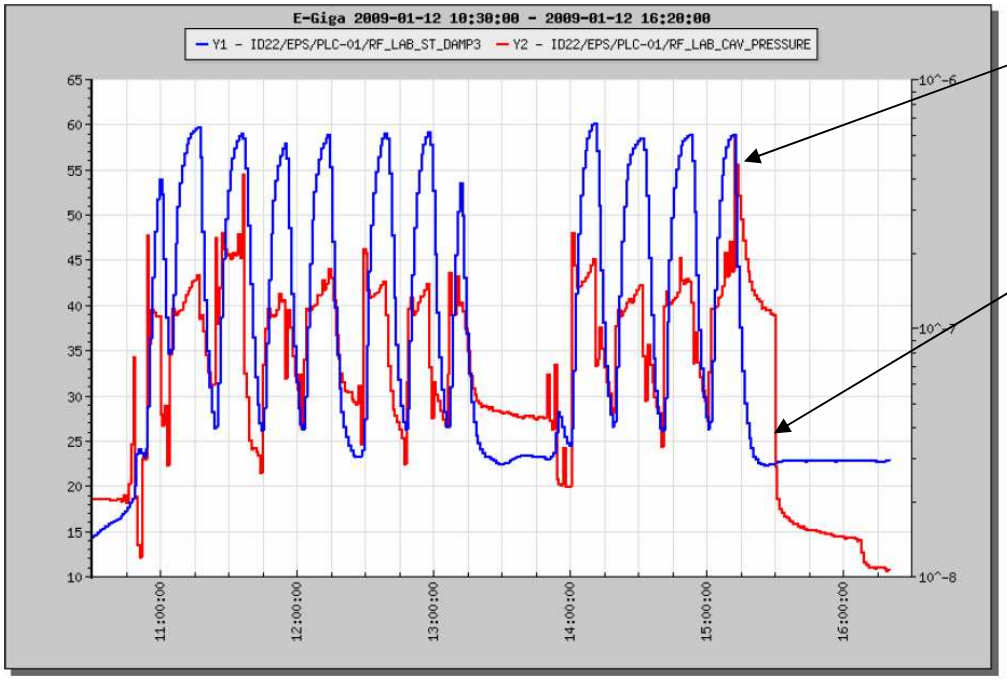
Successful power test up to 60 kW



But still temperatures high, 55ºC at 60 kW!!

SR Dampy 00-B , January 2009

But, after ten 60 kW cycles…
a small vacuum leak developed in the same spot



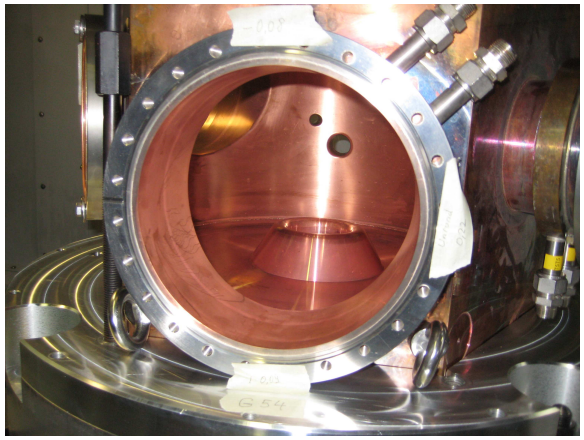
Leak

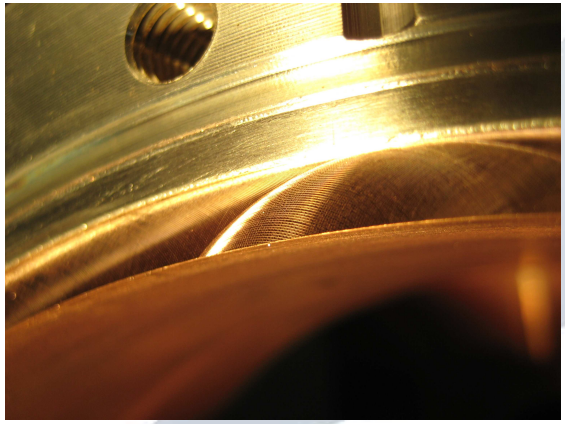
Vacuum recover after retightening screws

because the bridge is not 100% effective
and no RF gasket was installed

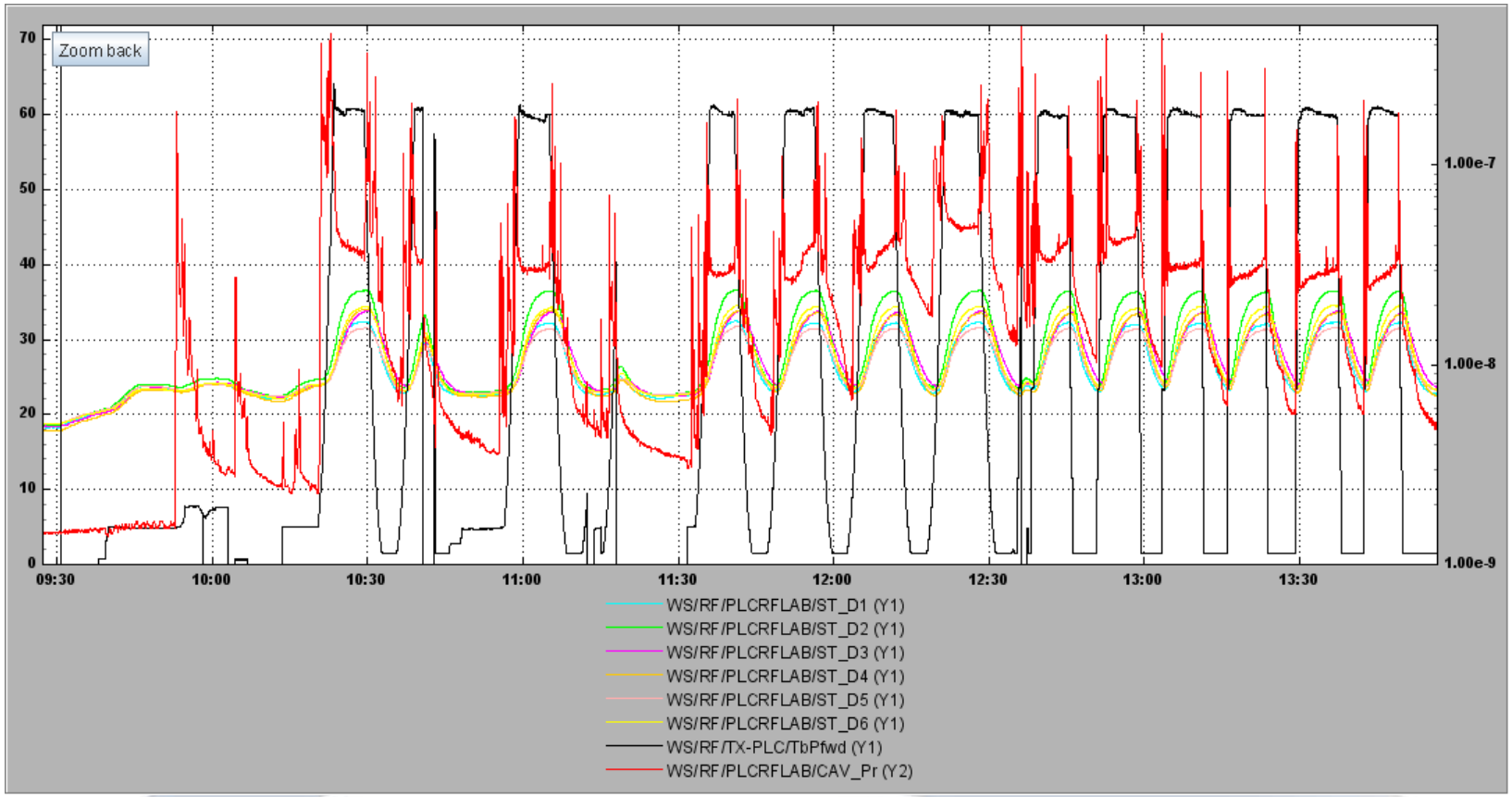
Dampy 01 (repaired) in April 2009

- We performed extra quality checks
  - Measure the gap
  - Check all the weldings
  - Check the installation of the gaskets



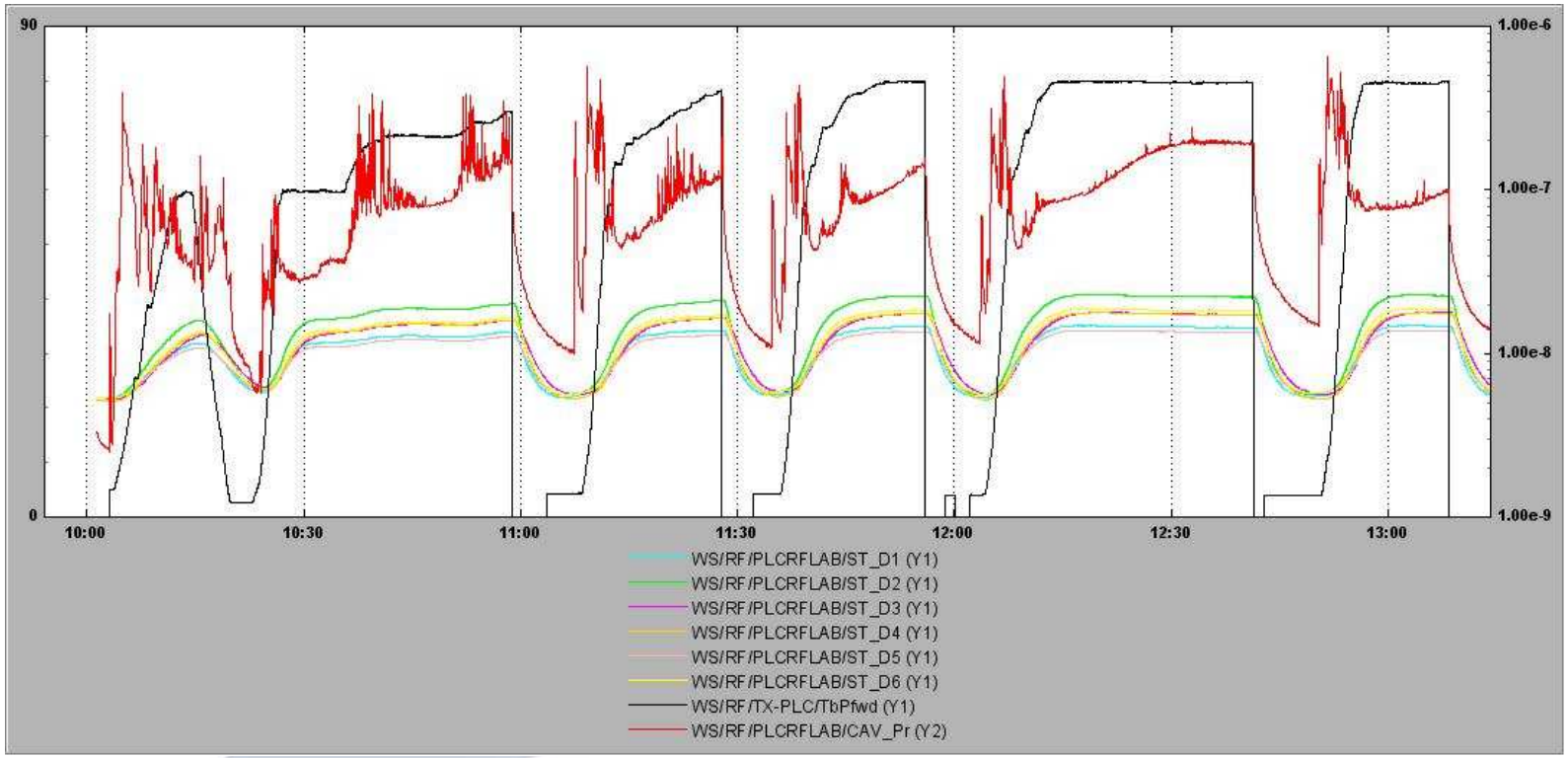


Dampy 01 (repaired) in April 2009



The 21st of April, 10 cycles at 60 kW,
with maximum temperature < 40ºC

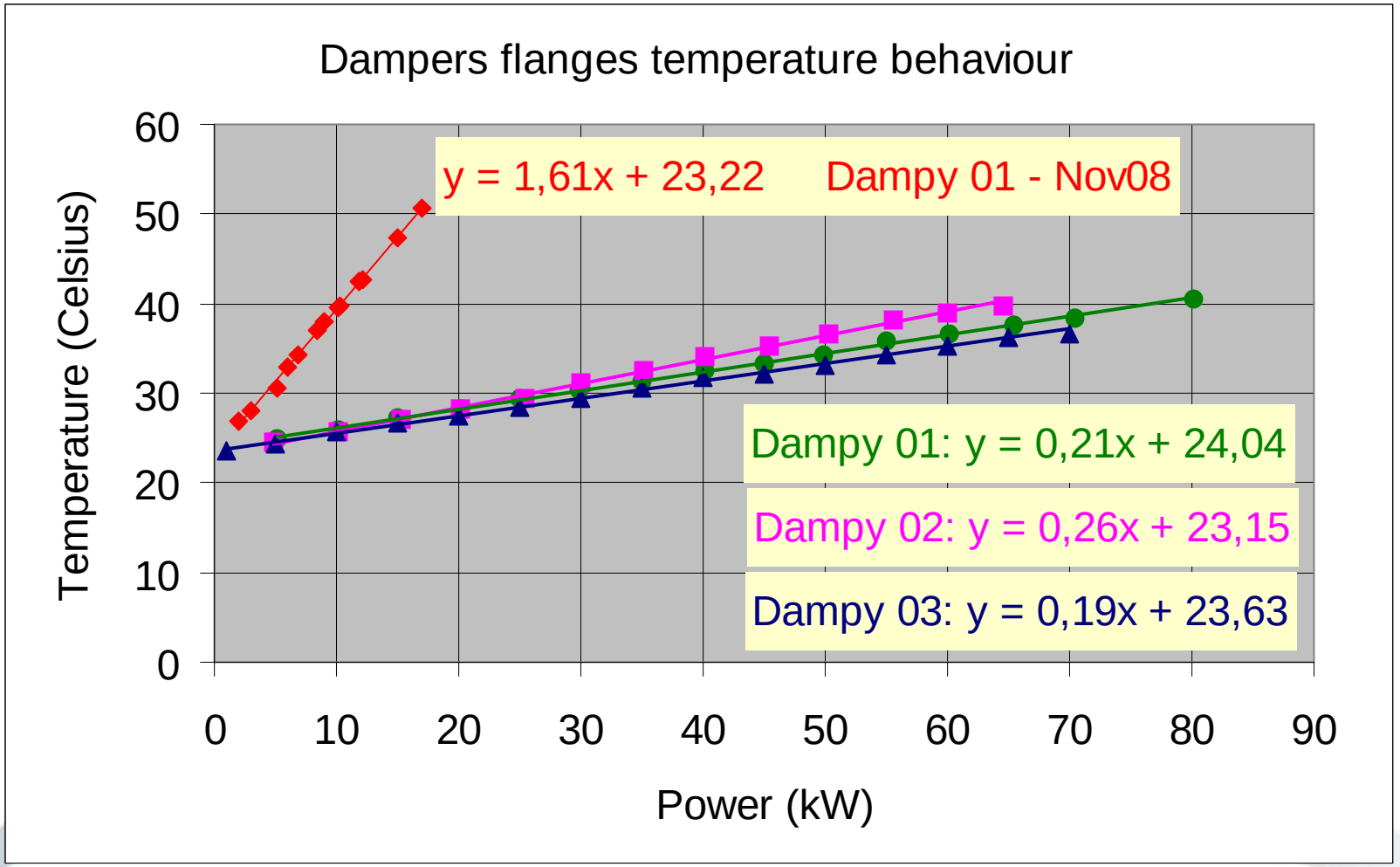
Dampy 01 (repaired) in April 2009



The 23rd of April, 80 kW with maximum temperature 41ºC

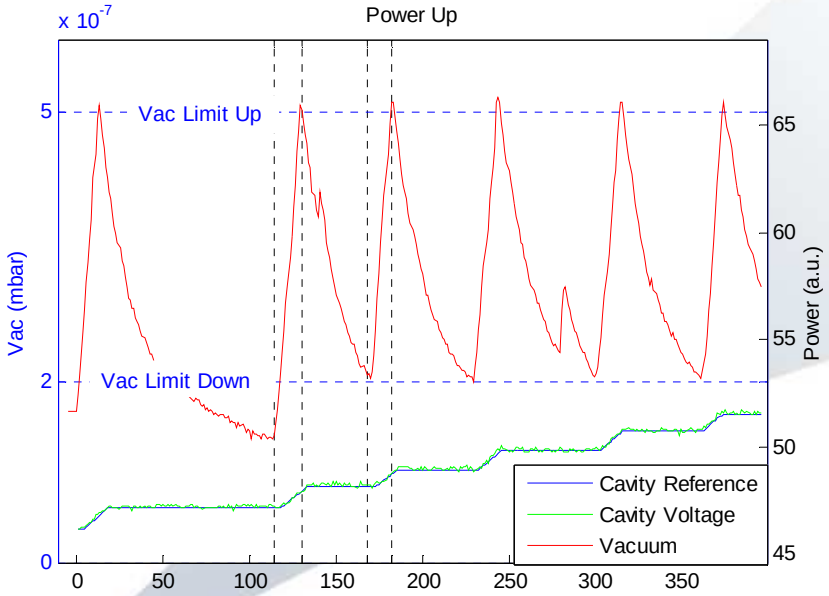
We decided to make the same modification on the rest 5 cavities

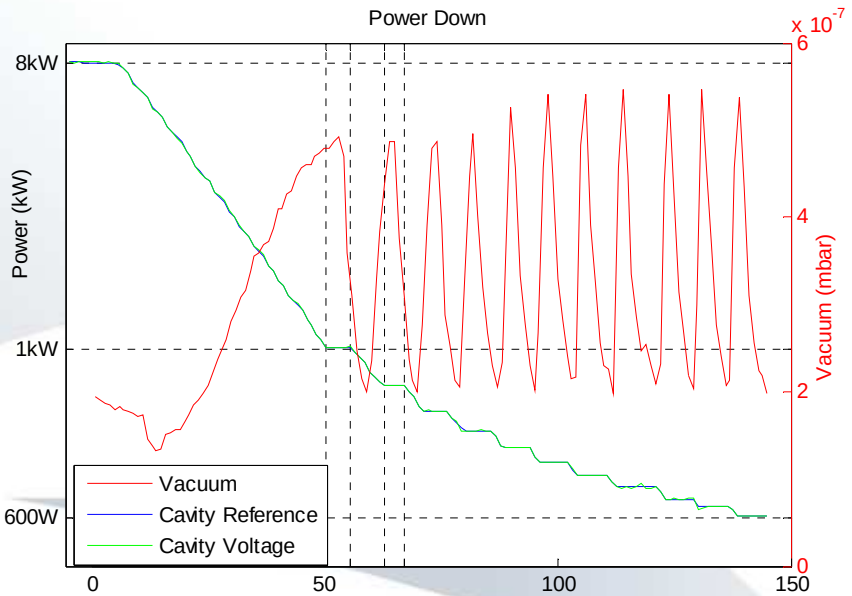
Dampy 02 & 03 tested in September 2009



Auto Conditioning

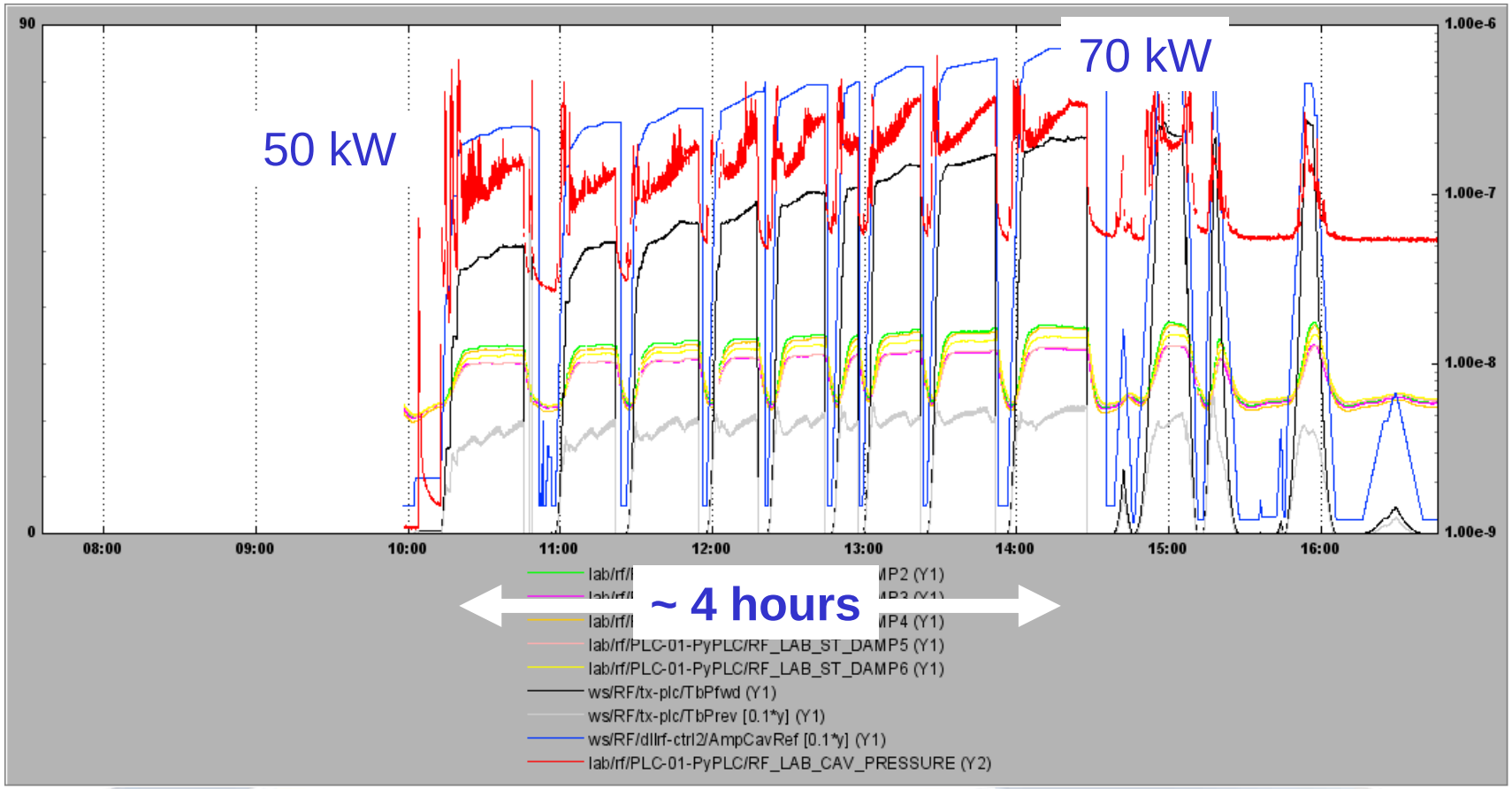
- ✓ Implemented in the Digital LLRF, in each RF plant
- ✓ Amplitude and duty cycle depending on vacuum levels
- ✓ Amplitude increase rate (slope): adjusted by operator
- ✓ Vacuum signal connected to LLRF





- Vacuum < Limit Down → Voltage Amplitude Increases/Decreases
- Vacuum > Limit Up → Voltage Amplitude remains constant until vacuum is below limit down

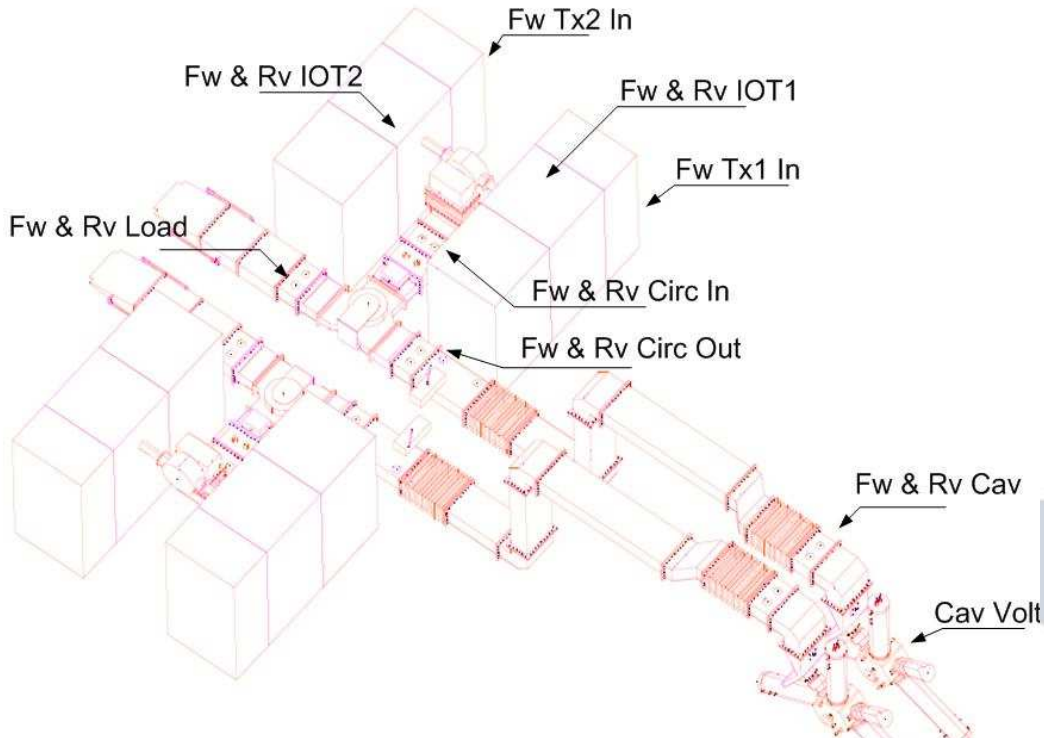
Auto Conditioning



From 0 to 70 kW in ~16 hours

Fast Data Logger

- ✓ Implemented in the Digital LLRF, in each RF plant
- ✓ All RF signals of the RF plant
- ✓ Triggered by the Fast Interlock Unit
- ✓ Store up to 400 ms at 5 MHz sampling per channel



Vacuum trip

Reflected Power (Arc) Trip

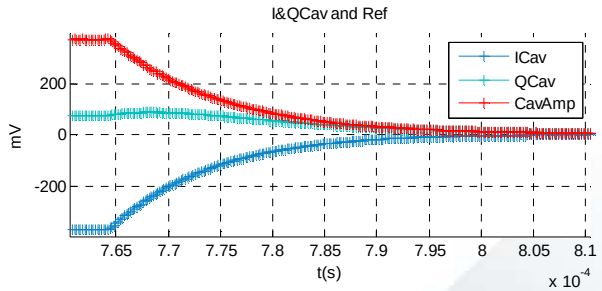
~ 30 us

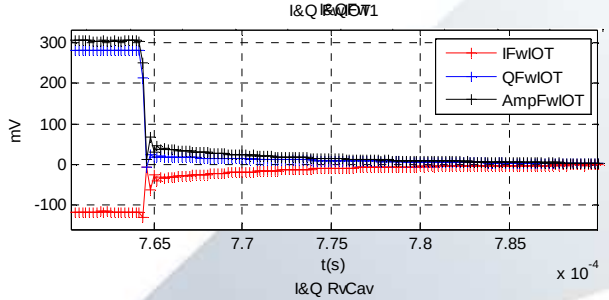
~ 1.5 us

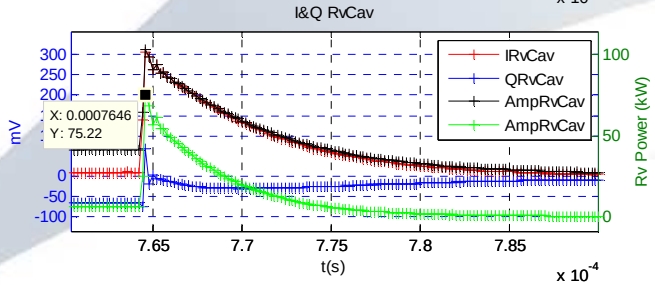
Cavity Voltage

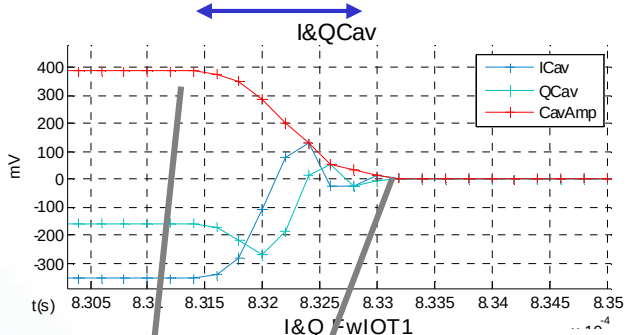
IOT Power

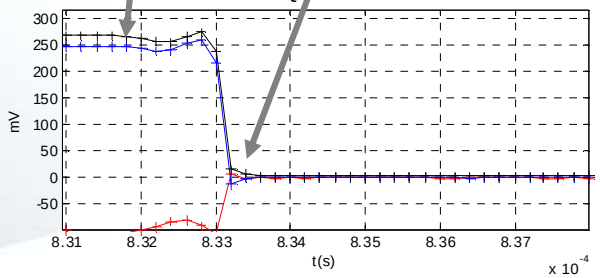
Reflected Power

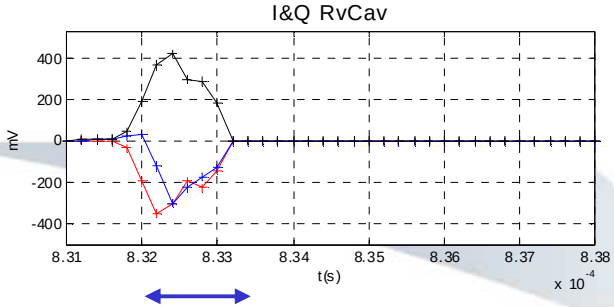






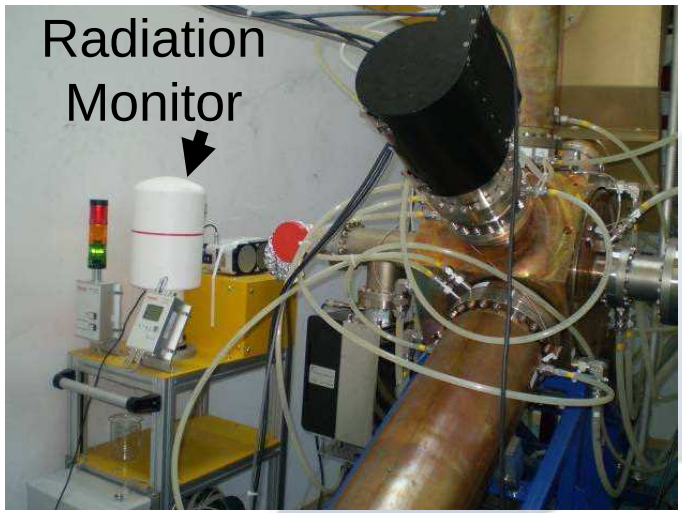


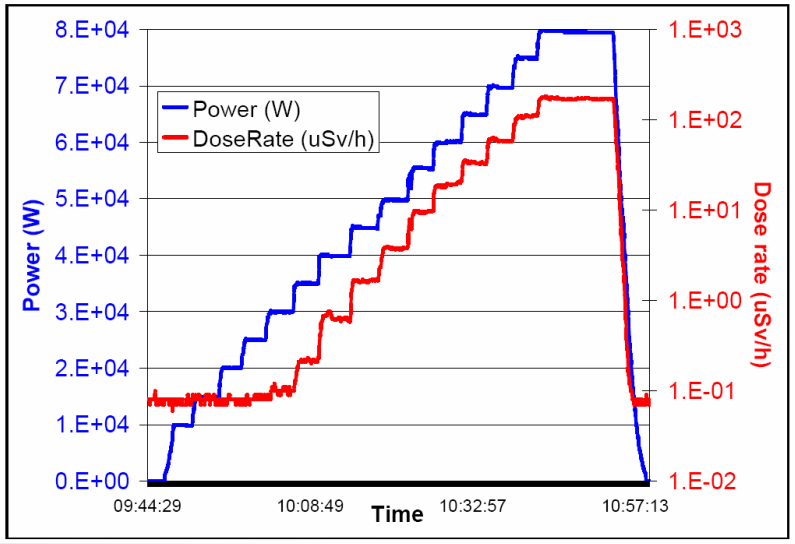


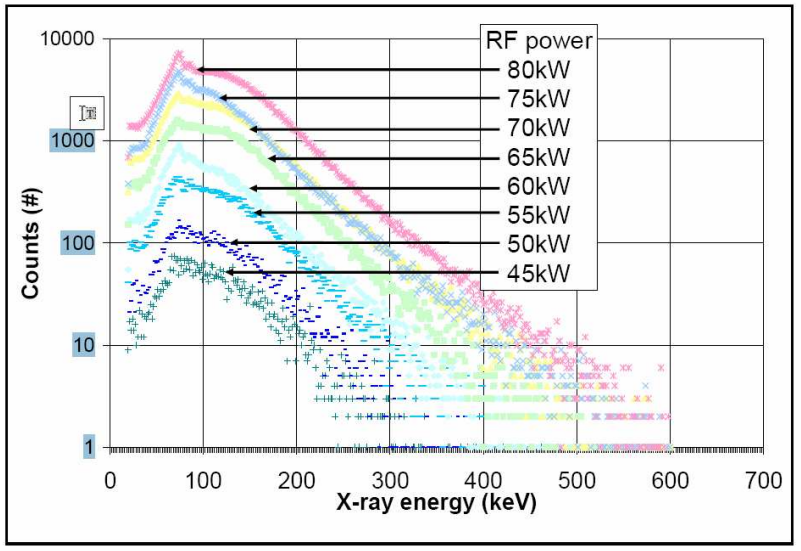


~ 1.5 us

Radiation measurements (Safety Group)







At 80 kW:

Dose Rate up to 15 mSv/h

XR energy up to 600 keV

NEXT STEPS

- Conditioning in RF Lab
  - Dampy 04
  - Dampy 05
  - Dampy 06

- Installation in the ring in March 2010.

THANK YOU

Vacuum trip

Arc Detector Trip

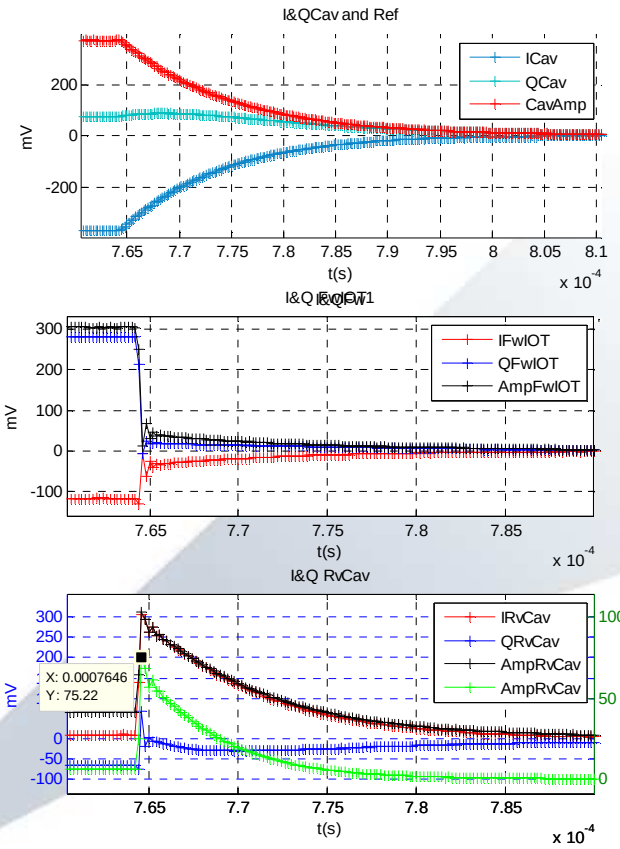
~ 30 us

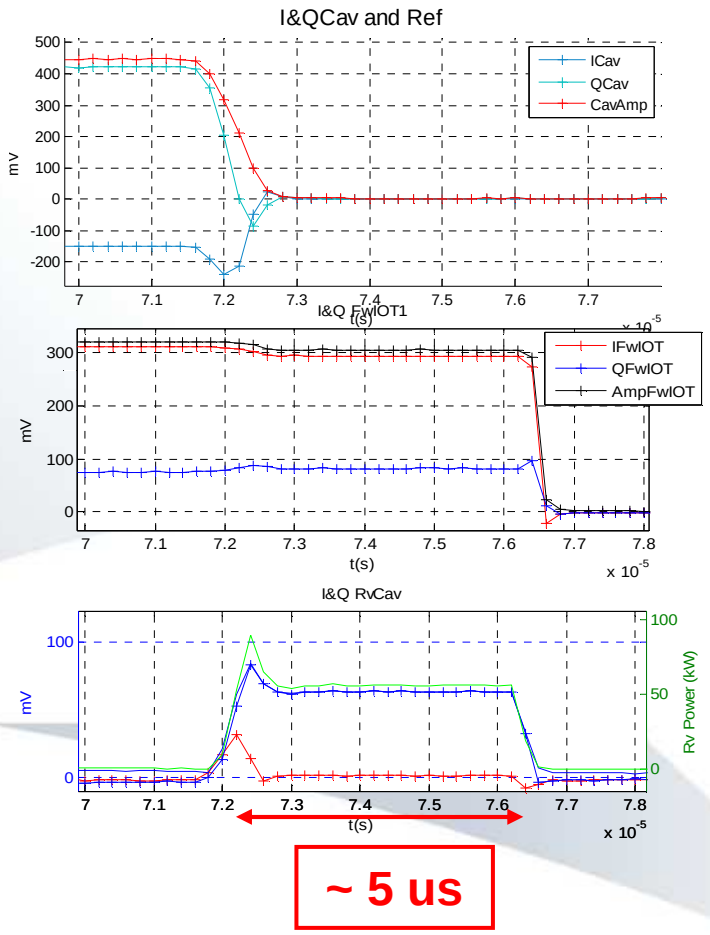
~ 1.5 us

Cavity Voltage

IOT Power

Reflected Power



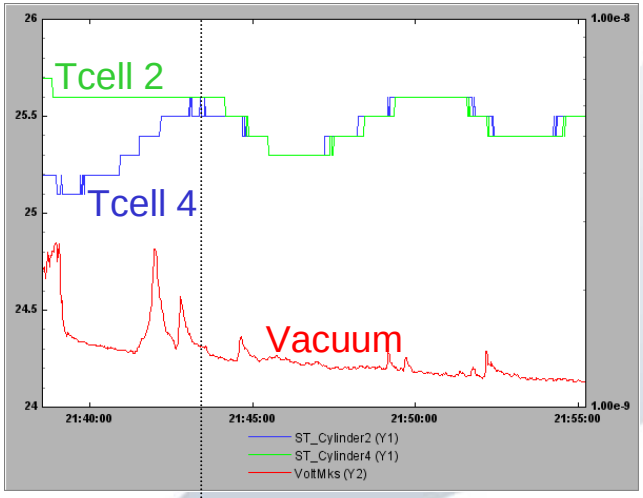


~ 5 us

LLRF (new implementations into the FPGA)

Booster Field flatness loop

Maintain voltage field homogeneous along the 5-cell cavity

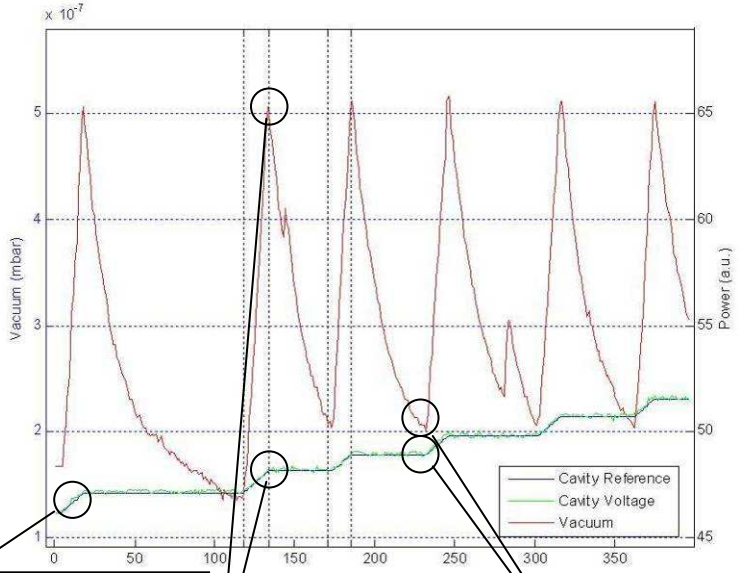


Tuning OFF

Tuning ON

Automatic Conditioning

Speed up conditioning and release of tedious work



User defined ramping

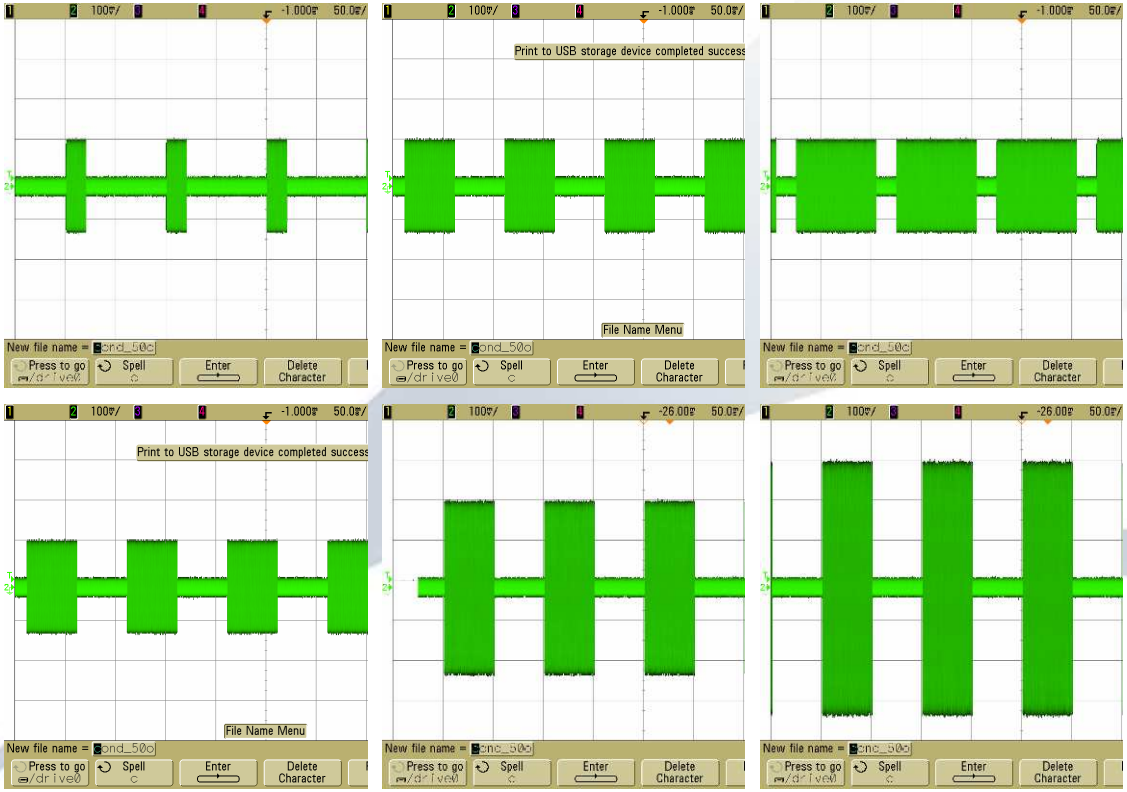
Stop ramping when vacuum > 5e-7 mbar

Resume ramping when vacuum < 2e-7 mbar

Manual Conditioning

RF Drive square modulated

- ✓Duty Cycle of pulses adjustable (1-100%)
- ✓Amplitude adjustable
- ✓Time between pulses = 100ms (10Hz)
- ✓ Tuning Loop only enable at top of the pulses



Drawbacks

- ✓Operator needed to adjust amplitude and duty cycle
- ✓Vacuum levels not considered by LLRF → frequent interlocks