

Status of 704 MHz developments at CEA-Saclay

Outline

Status of components for high beta cavities

- ⇒ Helium tanks
- ⇒ Tuners

Status of equipments for preparation and test

- ⇒ Vertical EP
- ⇒ 2nd Sound system
- ⇒ RF power test stand

Introduction

CEA-Saclay is involved in programs aiming at designing and prototyping 700 MHz sc cavities and components

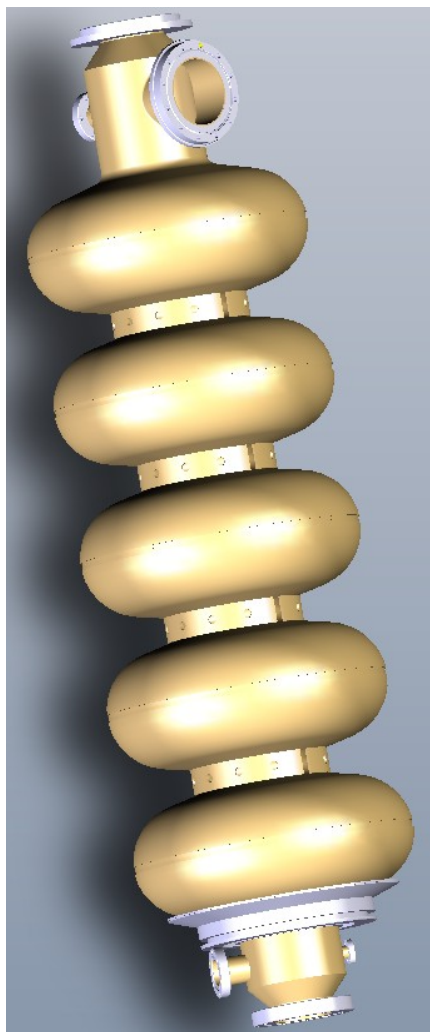
- European program FP7 (EuCARD, CNI-PP-SLHC)
- Contribution Exceptionnelle de la France au CERN
- ESS collaboration (MoU to be signed)

We participate in several tasks consisting in:

- the design of 704 MHz cavity, He tank, frequency tuner
- the prototyping of 704 MHz cavity(ies)
- the construction of equipments needed for preparation and test of components (vertical EP station, HPR station, vertical and horizontal cryostats)
- the RF tests at cold of components (power couplers, tuners) and optimization of algorithm for LFD compensation
- the processing of 704 MHz power couplers up to 1MW
- the fabrication of sets of He tank and frequency tuners

Optimized design of 704 MHz $\beta=1$ cavity

Presented at the
last meeting



With this optimized design, prototypes would fit on our frames for surface preparation (BCP, VEP, HPR) and test in vertical cryostat

- ☑ assymmetric cavity
 - beam tube $\varnothing 140$ mm with a $\varnothing 100$ mm port for power coupler
 - beam tube $\varnothing 130$ mm with a $\varnothing 10$ mm port for pick-up probe
- ☑ stiffening rings between adjacent cells
- ☑ inner diameter of the cavity flanges fixed to 80 mm

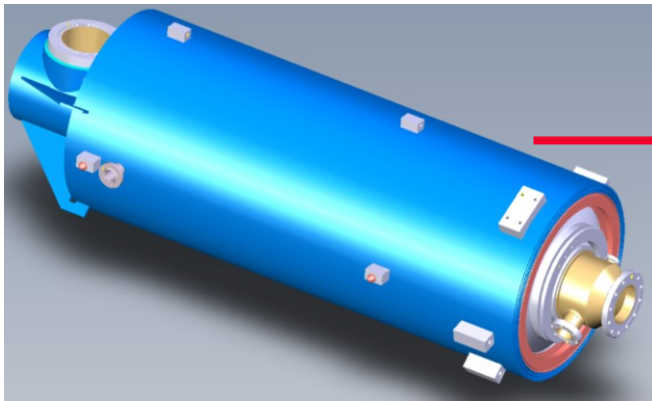
To perform qualification tests in horizontal cryostat or cryomodule, study of a fully equipped cavity (tuner, coupler, tank, ...) is necessary

- power coupler port cooled by LHe
- lateral frequency tuner (similar to Saclay IV)
- each beam tube equipped with one $\varnothing 40$ mm HOM port
- fabrication of cavity and He tank without brazing
 - Helium tank made of Ti ; flanges made of NbTi

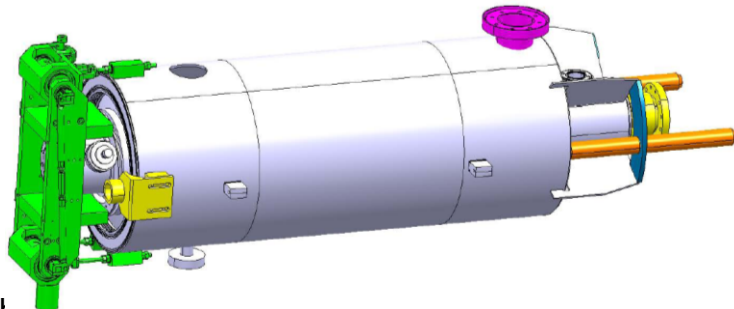
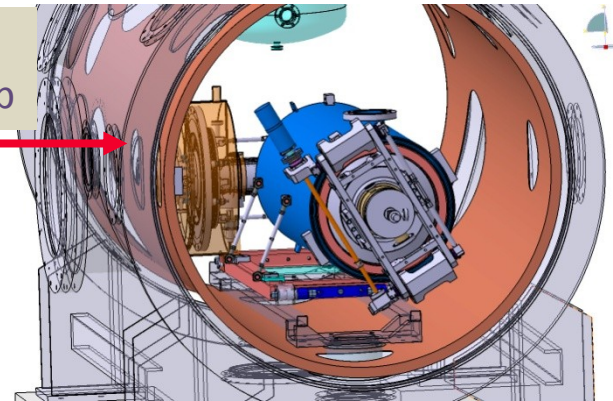
Helium tanks for 704 MHz $\beta=1$ cavities

Since the 4th SPL Collaboration meeting

- Completion of the design compatible with the Saclay 704 MHz $\beta=1$ cavity
- Assessment of modifications for integration in the “short cryomodule”
 - ⇒ several pieces of interface have to be modified
- Two models of tanks are studied in parallel
(validated at CEA/CERN/IN2P3 meeting held at IPN-Orsay (15/10/ 2010))



Tank designed for the tests in CryHoLab

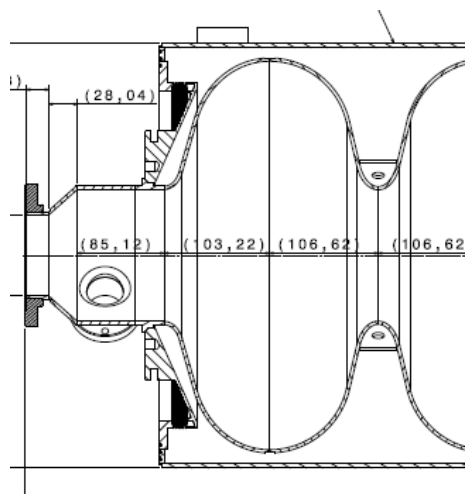


Tank designed for integration of cavity string in short cryomodule (CERN concept)

Helium tanks for 704 MHz $\beta=1$ cavities

Modification of Ti bellow

- Ti bellow to be welded on the Helium tank made out of Titanium
- axial stroke of +/- 3 mm w/o plastic deformation (tuning range)
- small stiffness with respect to the cavity



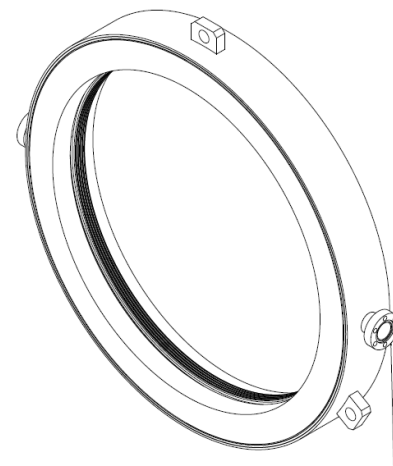
Hydroformed Ti waves

- Easy to clean
- Stiffness with wall thickness 0.25mm: 700 N /mm
- Cheapest option

Offer received from Skodock GmbH for a 2 waves bellow :

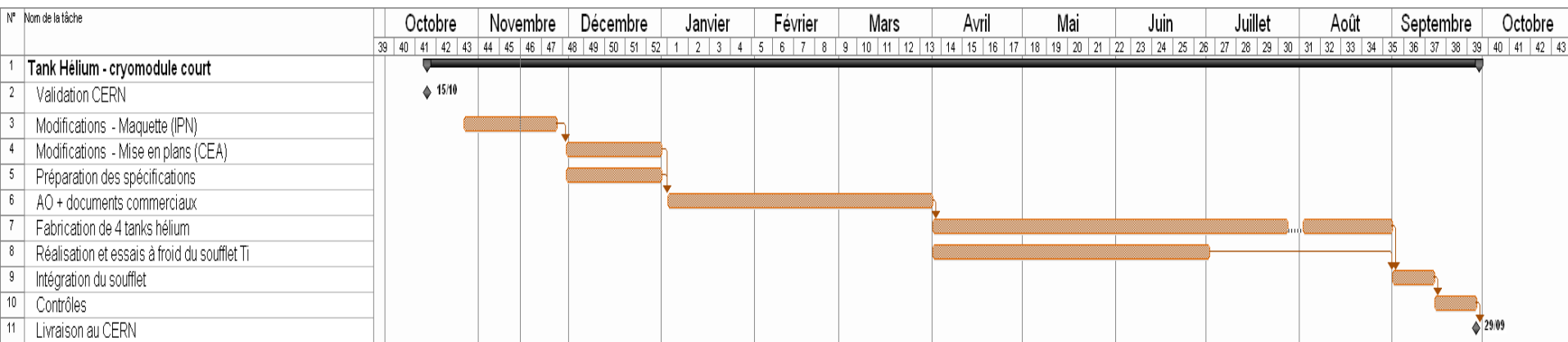
Ti bellow qualified at 3 bars in a temperature range +50/-271 °C

If needed, we are ready to prepare a test at Saclay
(mechanical measurements, thermal cycling, tightness,
deformation under pressure forces)



Helium tanks for 704 MHz $\beta=1$ cavities

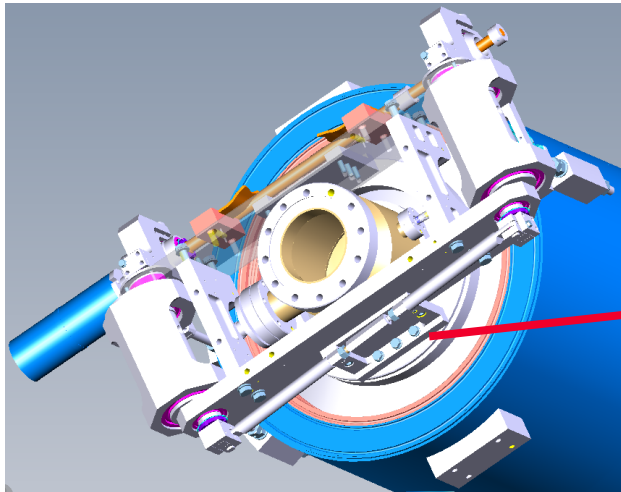
- Drawings almost completed
(3D model done by IPN and detailed drawings by CEA)
- To be submitted to CERN for validation
- Technical specifications ongoing



Frequency Tuners for 704 MHz $\beta=1$ cavities

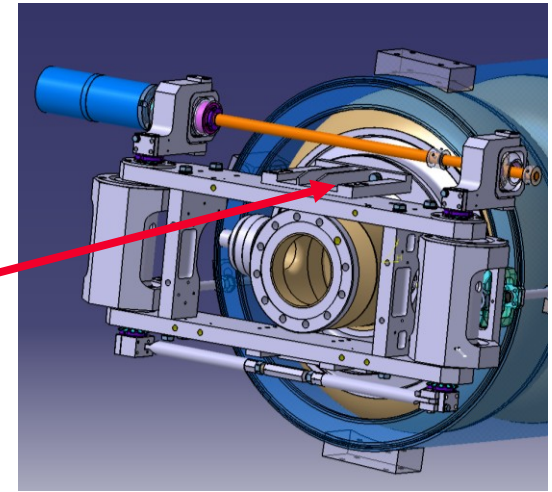
Since the 4th SPL Collaboration meeting

- Completion of the tuner design compatible with the Saclay 704 MHz $\beta=1$ cavity
- Assessment of necessary modifications for integration in the “short cryomodule”
 - ⇒ *Only one piece of tuner has to be modified*
- Validation by CERN at CEA/CERN/IN2P3 meeting held at IPN-Orsay (15/10/ 2010)

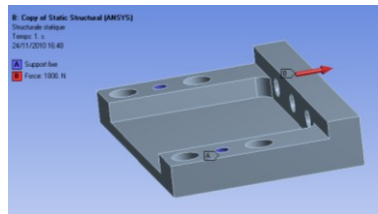


*Tuner Saclay V
(with one piezo actuator)*

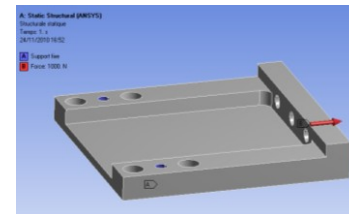
Lengthening of the connecting piece of 45mm



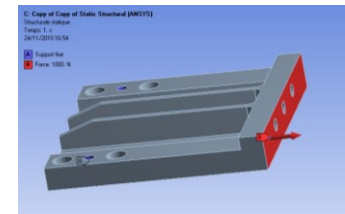
Optimization of the connecting piece to recover an acceptable stiffness



>100 kN/mm



60 kN/mm



90 kN/mm

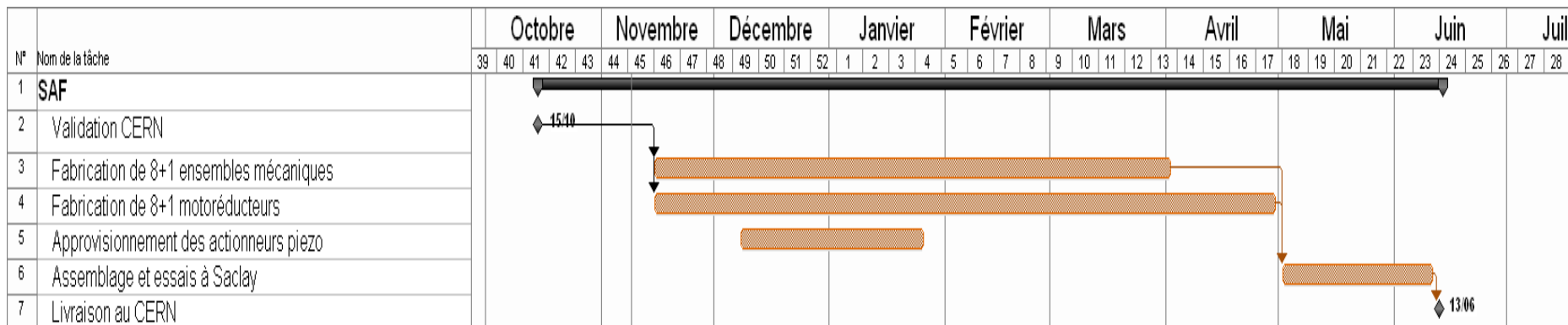
Frequency Tuners for 704 MHz $\beta=1$ cavities

- ❑ Call for offers launched in June and commercial offers received:
 - in August for the mechanical set of pieces
 - in September for the Phytron motor+gear box

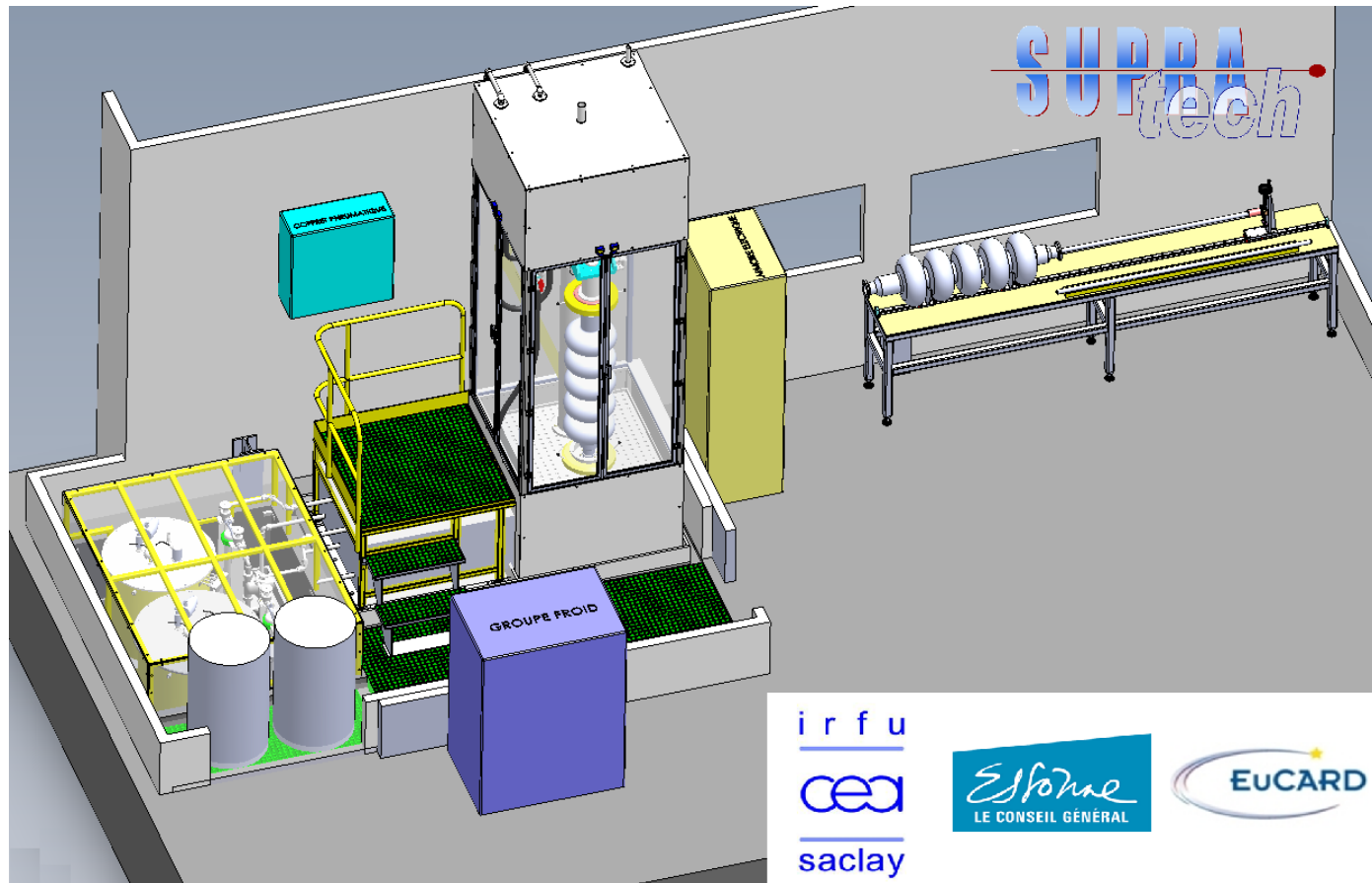
- ❑ Contracts for fabrication/delivery of 9 tuners are ready (signature expected for next week)

- ❑ Piezo assembly, final assembly and test to be done at Saclay

- ❑ Delivery to CERN in June 2011



Vertical EP station



Fabrication starts (contract signed in Nov. 2010)

VEP station should be tested in *April 2011*

F. Eozéno

Quench localization by 2nd sound detection

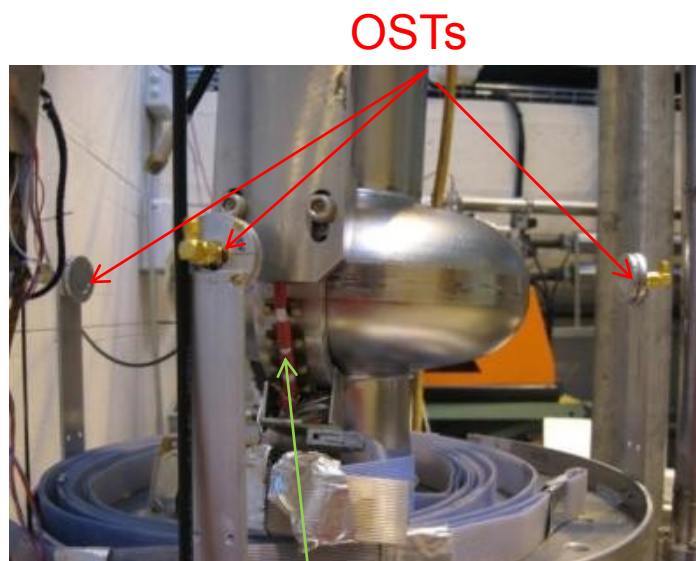
Sensors:

- 8 Oscillating Superleak Transducers (OST) received from Cornell
- 1 prototype electronics circuit developed at Saclay



Tests in VC with a 1-Cell 1.3 GHz cavity were undertaken:

- With a T-mapping system for quench localisation
- With 3 OST sensors for qualification of the instrumentation and acquisition



T map sensors

Unfortunately, no signal was measured from the OST sensors due cavity FE

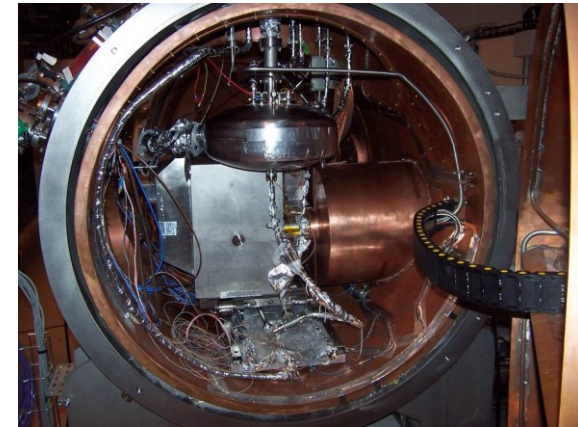
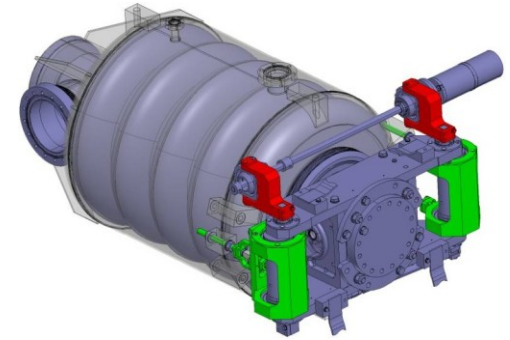
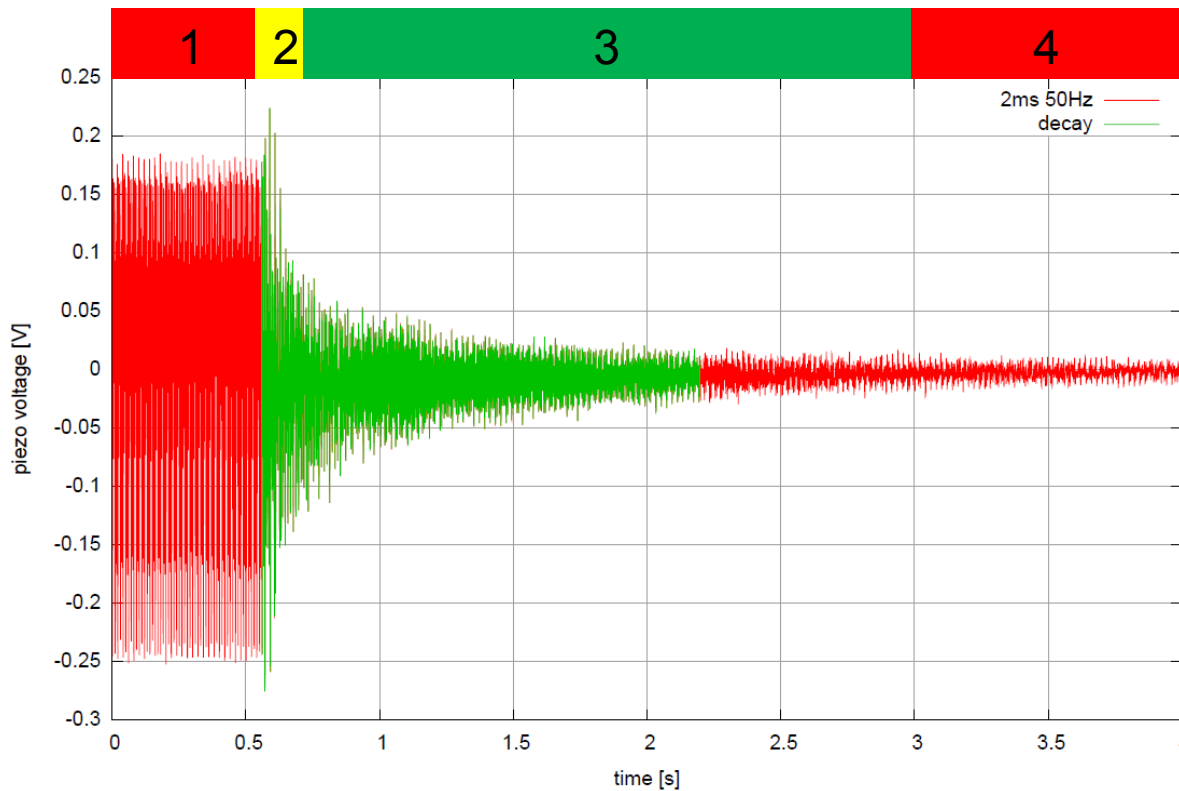
New BCP & VT in progress



J. Plouin

SLHC-PP: test in pulsed mode

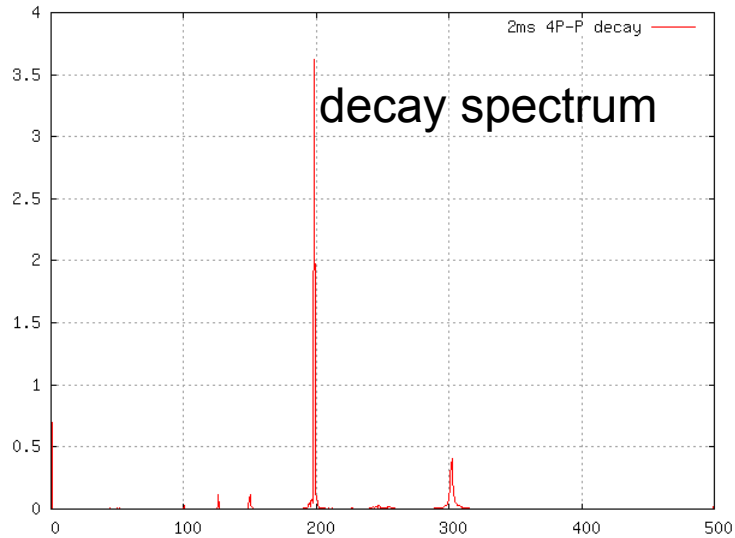
- Test done on « HIPPI » cavity (beta=0.5 – 704 MHz – 5cells) in CryHolab
- Piezo signal used as a sensor



- 1 : Mechanical excitation due to LFD ; RF pulses 50 Hz, 2 ms, Eacc = 14.5 MV/m
Only stable oscillation observed ; 20 ms between pulses is too short for the modes to decay.
- 2 : RF is switched off
- 3 : mechanical modes decay for approx. 2 s
- 4 : mechanical vibration due to the environment

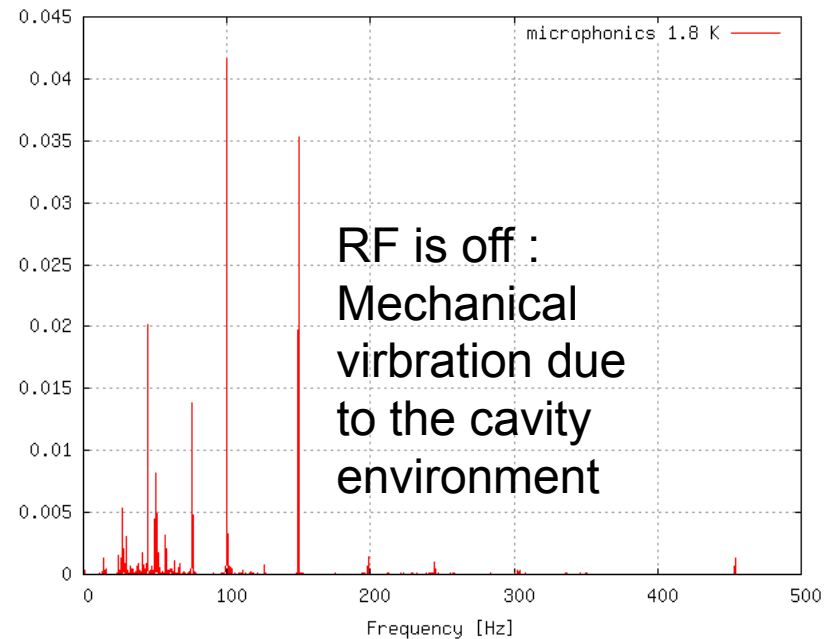
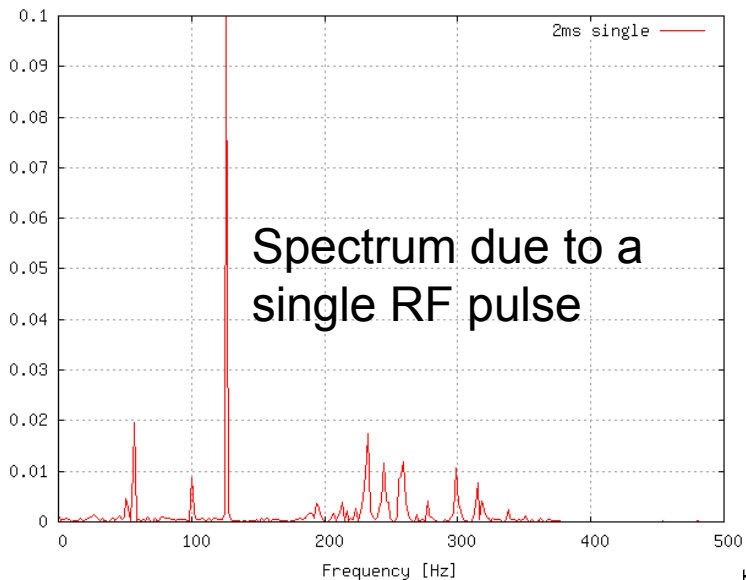
SLHC-PP: test in pulsed mode

Analysis of piezo signals from the previous slide:



Q estimates:

- 400 for 198 Hz mode
- 300 for 301 Hz mode

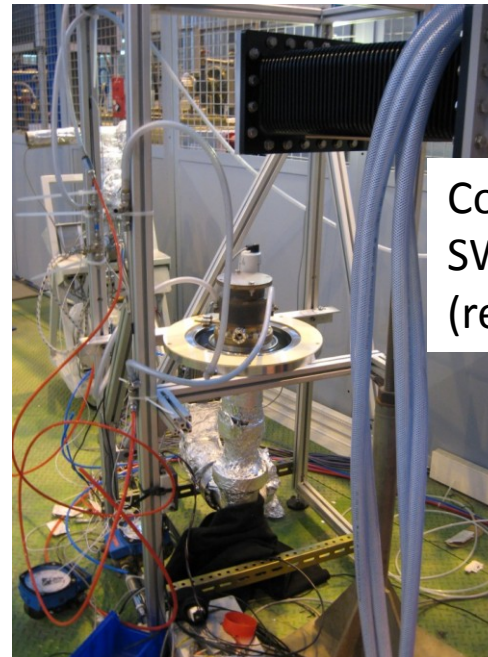


SLHC-PP: preparation of tuner test

- INFN cavity (beta=0.5 – 704 MHz – 5cells) with a blade tuner in preparation
- 700 MHz-1MW coupler from CEA with a modified manchette



Diameter of the cavity flange (80 mm)
NbTi flange with Al hexagonal gasket



Coupler processing:
SW - 500 kW @ 50 Hz – 2ms
(reached in 2 days)

- Tests with INFN cavity scheduled in January 2011
- Availability of the RF power test area in April 2011
 - ⇒ Processing of pairs of couplers (E. Montessinos presentation)

Summary

- Fabrication of tuners started
- Design of tank completed, drawings & specs in progress
- Equipments for surface preparation and vertical test of 704MHz cavities should be ready mid-2011
- High power RF tests are going on in the frame of the SLHC-PP program ; processing of new couplers from CERN will follow
- ❖ Proposal for power upgrade (2MW) is in preparation

**Thank you
for your attention**



Cavity string in front of the CEA-Saclay CR



Assembly and alignment workstation

Wagon used for transport between workstations



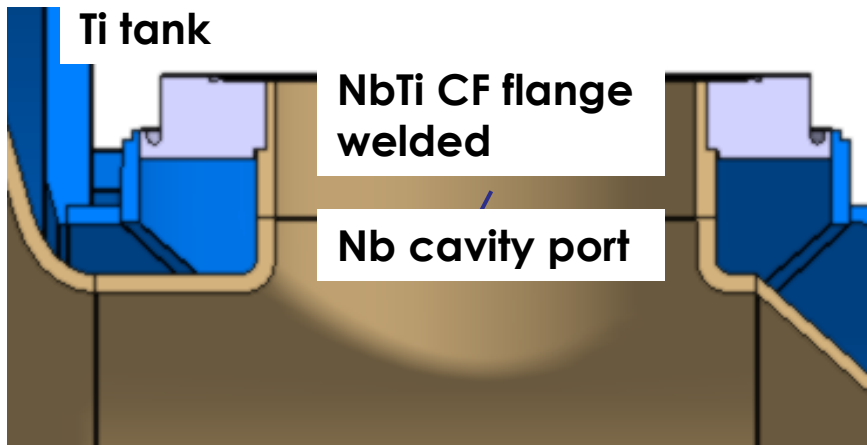
Cantilever used for assembly

cavity/helium tank interfaces

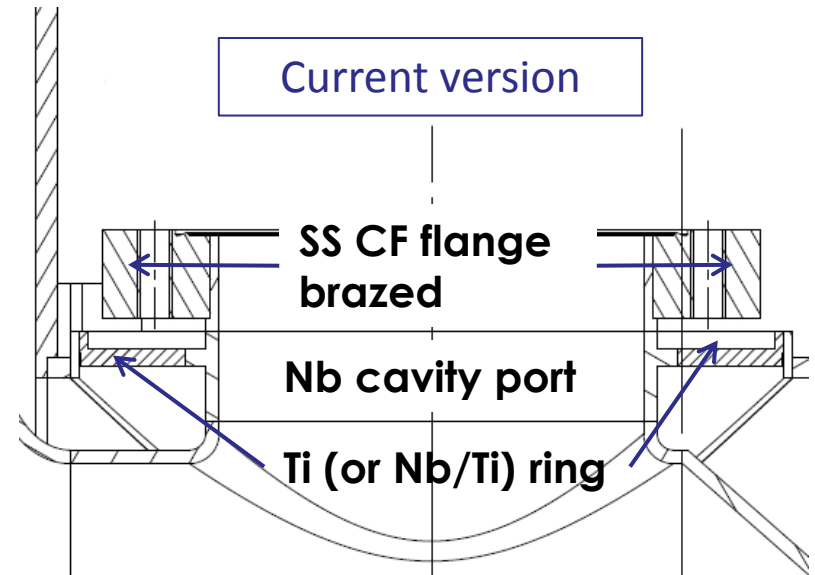
Risk of leaks after cooldown of Nb/Ti CF flange and copper gasket

⇒ New design with a SS flange

Previous version



Current version



Direct welding (Nb-Ti): connection piece redesigned

