# Summary of WG 2 - cavities

W. Weingarten

# Recent organisational developments

- CERN management had the SPL – study approved and allocated resources in the Medium Term Plan
- This fact allowed us to establish an ambitious but achievable planning with the aim to test a fully equipped (short) cryo-module in mid 2013
- CERN is now member of the TTC (TESLA Technical Collaboration) and more specifically in its Proton Accelerator Working Group
- CERN prepared participation in the recent FP7 “CRISP”*) proposal to the EU (SPL cavities diagnostics and SRF staff training linked with XFEL, ESS, DESY)
- TRIUMF withdrew from the SPL collaboration

- *) Cluster of Research Infrastructures for Synergies in Physics

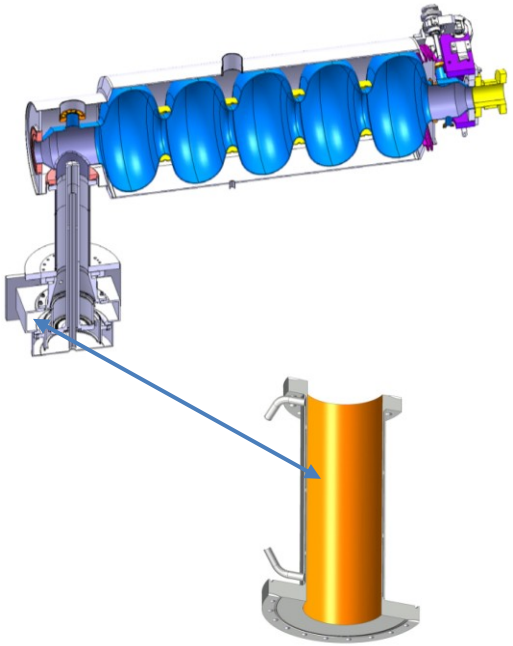
# Recent technical achievements 1

- HOM damping requirements
  - From the beam stability point of view, a damping corresponding to $Q_{ext} < 10^5$ is recommended, if all possible chopping schemes shall be coped with.
  - The previous requirement of $Q_{ext} < 10^4$, valid for resonant excitation of HOMs, corresponding to a maximum extracted RF power less than 100 W, can be avoided by tuning the resonant frequency of the specific HOM.

# Recent technical achievements 2

## Power coupler

We are within the construction process, and not so much more to report right now…



'Clean room lines' identified
Design stage completed
Raw material ordered
Prototyping underway
Machining has started
March 2011: 'vacuum lines'
- 4 SPL-LHC couplers
- 4 SPL-SPS couplers
- 8 Double walled tubes
- 4 tests cavities

April 2011 :
- Assembly of 2 x 4 couplers in DESY facilities

June 2011 :
- RF power Tests at CEA

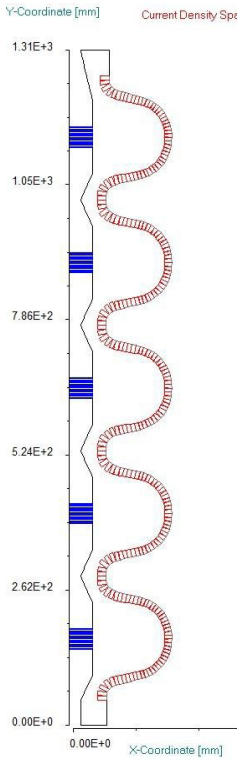
# Recent technical achievements 3

- Electro-polishing equipment

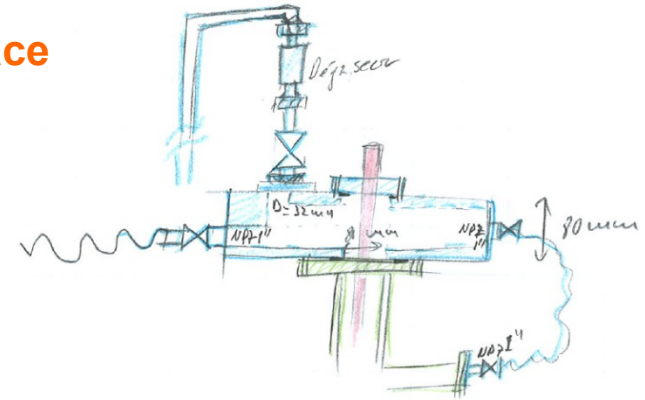
Still missing...

Main equipment

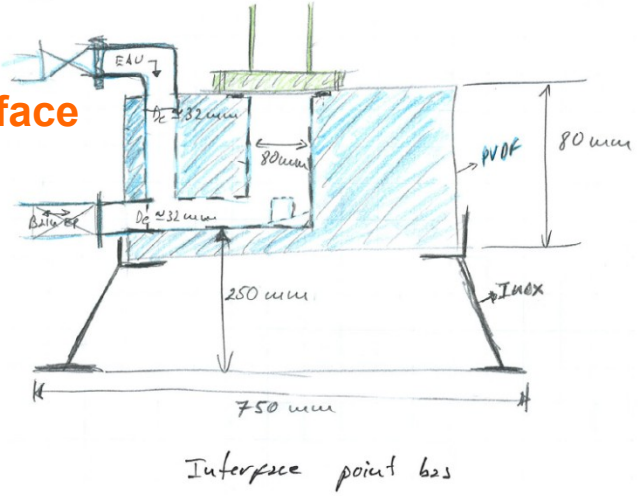
Cathode(s)




Top interface

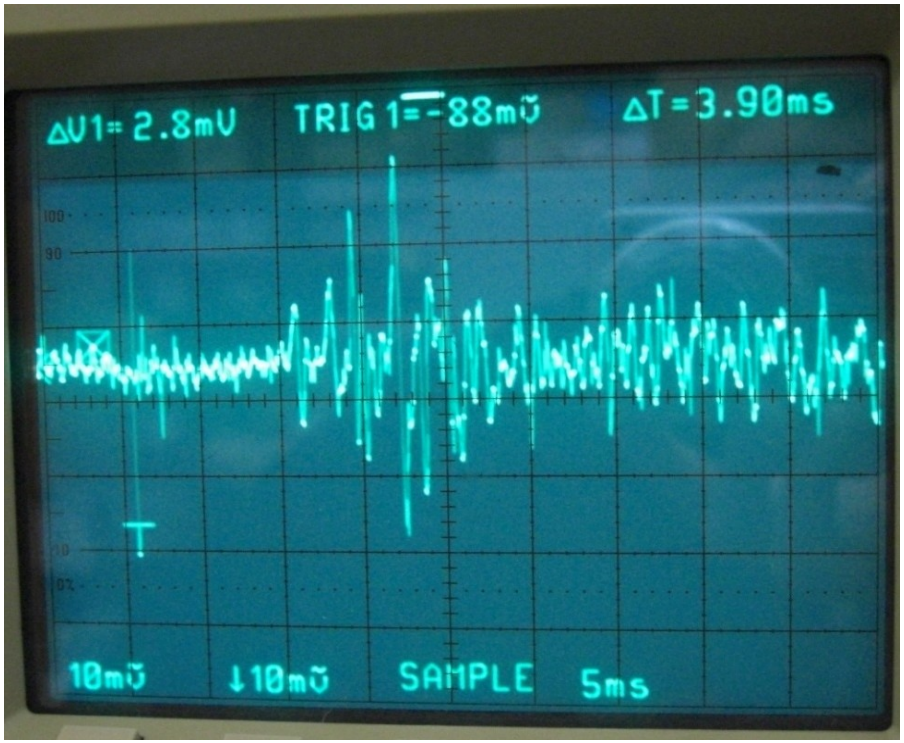



Bottom interface

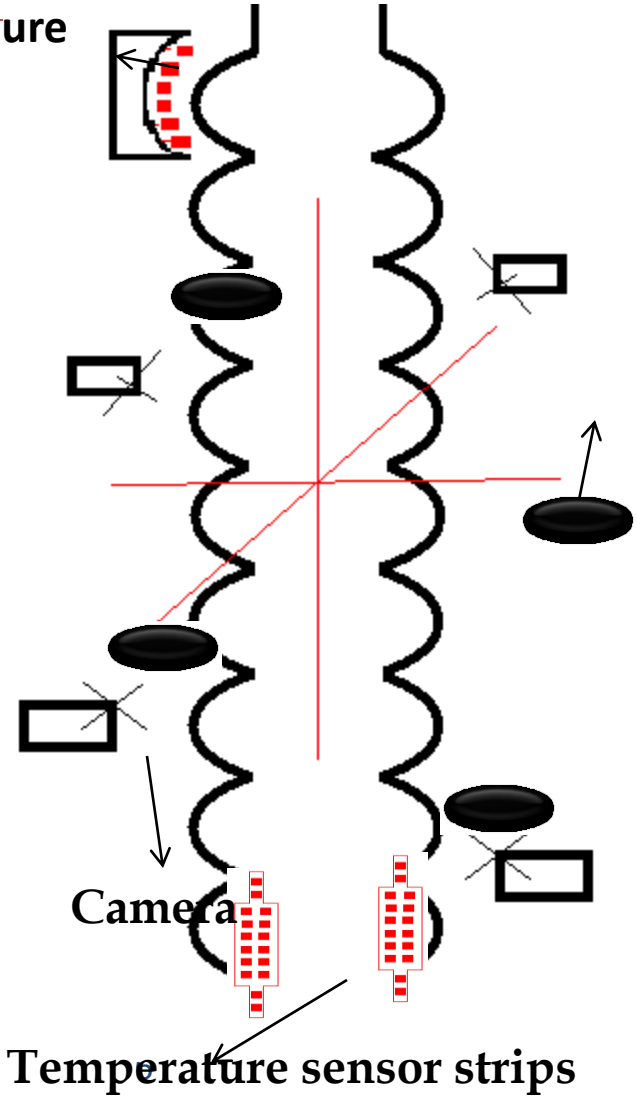


# Recent technical achievements 4

- Diagnostics
  - Required equipment defined

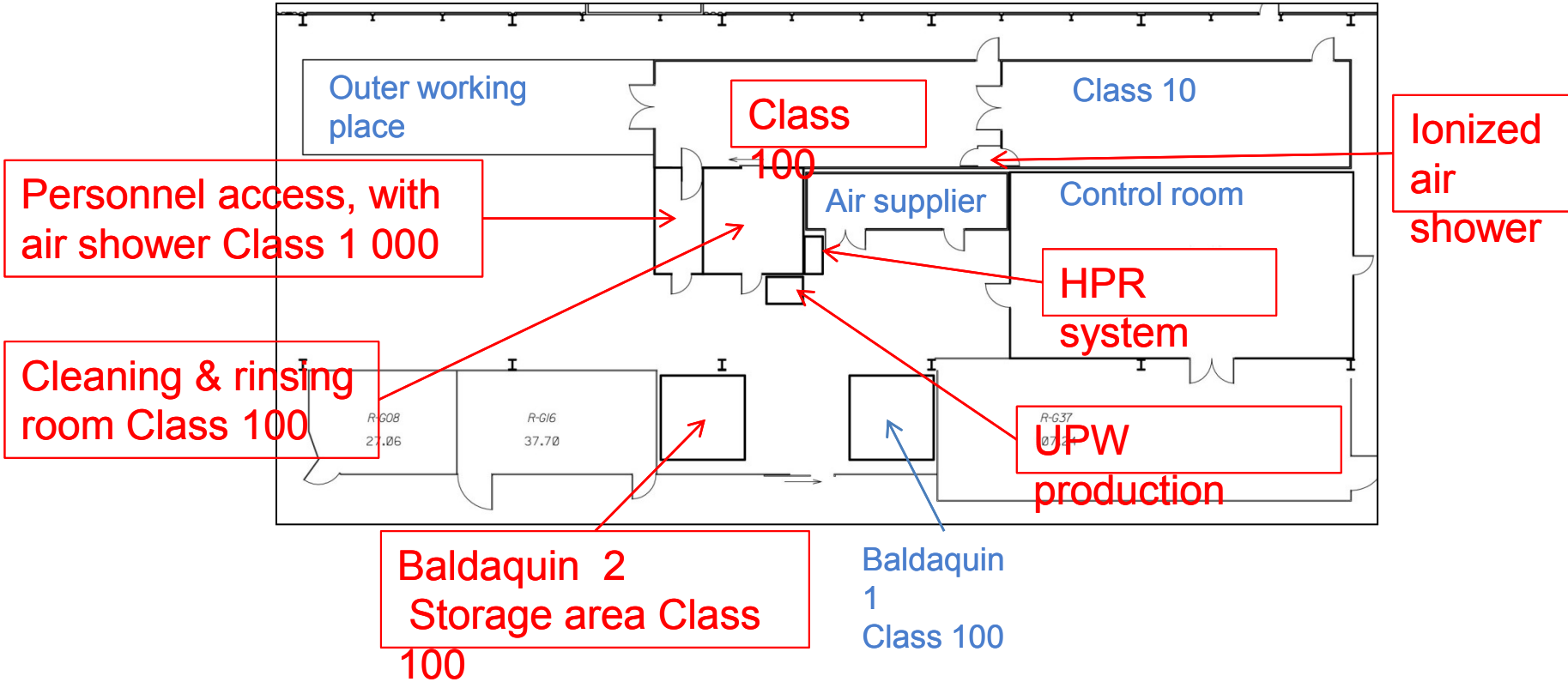



**Photodiodes & temperature sensors**



# Recent technical achievements 5

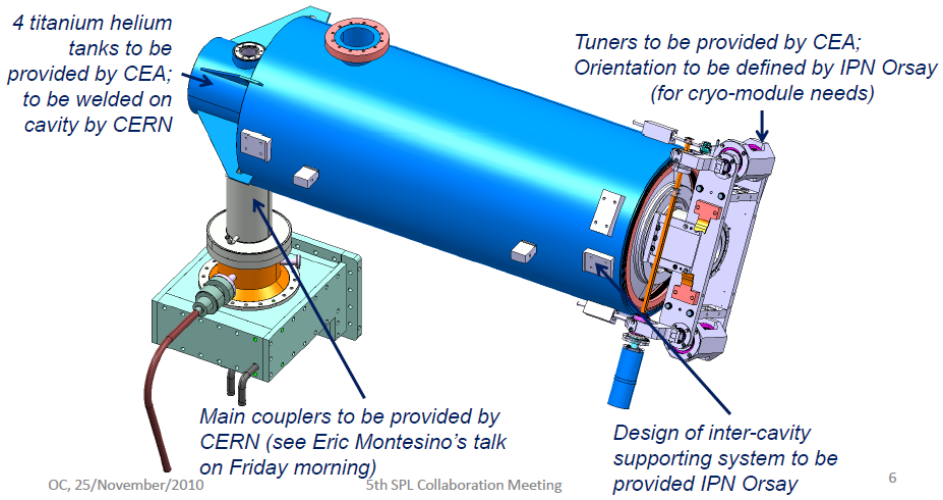
- Clean work & post mortem inspection
  - Upgrade proposal and cost estimation for cleean room finished;
  - attention: useful space < 13 m



# Recent technical achievements 6

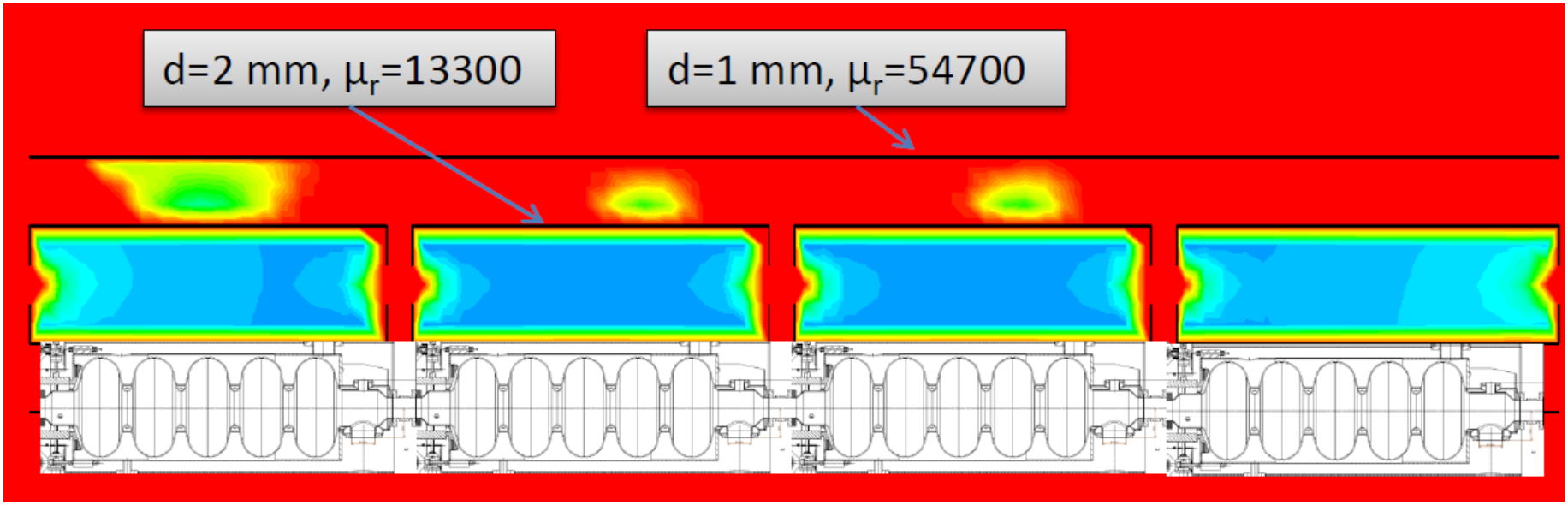
- Mechanical issues
  - A lot of coordination work needed – “copy-paste solution are an illusion” – still some mechanical tests at cryogenic temperatures to be understood (Ti - Cu gasket – SS flange) – interfaces is an issue – stainless steel tank could be the baseline for the future – Nb procurement underway – cavity manufacture market survey launched – Ti/Nb welding preferred wrt Nb/NbTi/Ti – manufacture and treatment sequence defined (including 800 °C annealing) – manufacturing by industry foreseen Feb. 2011 - delivery end 2011

- SPL beta = 1 cavity + helium tank + tuner + main coupler to be installed and tested in cryo-module at CERN



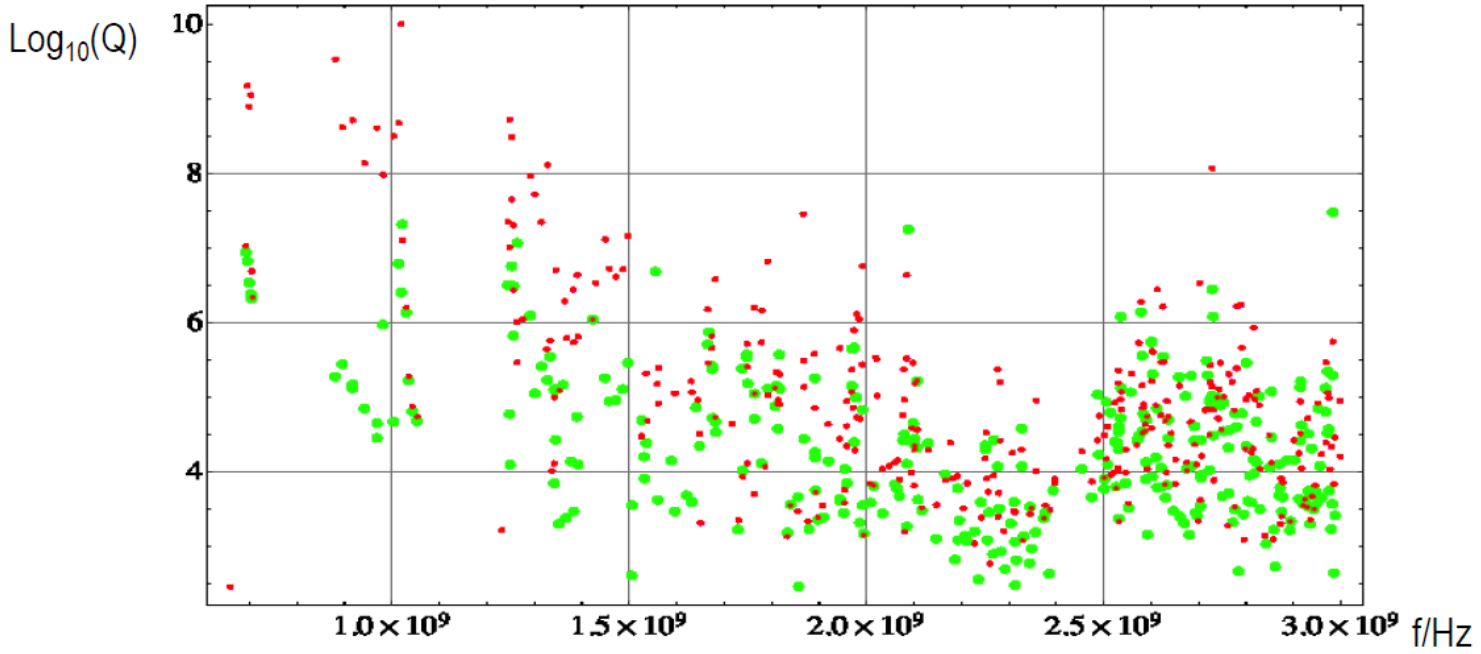
# Recent technical achievements 7

- Mechanical issues
  - Magnetic shielding:
    - active shielding discarded
    - conclusion achieved on design proposal



# Recent technical achievements 8

- **HOM coupler design**



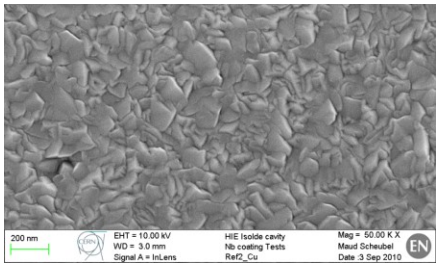

- red: HOM coupler only, green with matched power coupler
- main power coupler helps significantly below 2 GHz; still Qs > 10^6 found

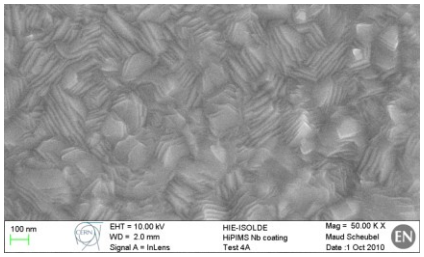
- **CERN-Saclay-Rostock hook coupler vs. band stop filter coupler**

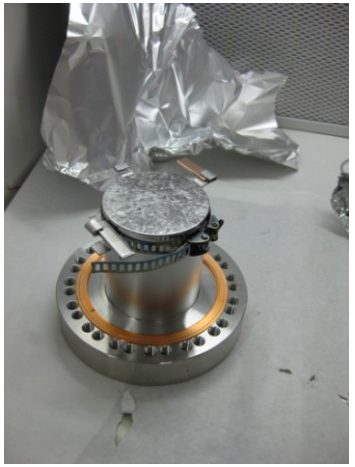
# Recent technical achievements 9

- Other issues and outlook for future work
  - Necessity of taper in cavity string
    - FM coupling only weakly sensitive to taper
    - HOM coupling increases without taper
    - To be balanced against increased impact energy of field emitted electron current
  - HIPIMS
    - coating with ions preferred

First sample coated yesterday by biased HIPIMS, for RF test with the quadrupole resonator



# Recent technical achievements 10

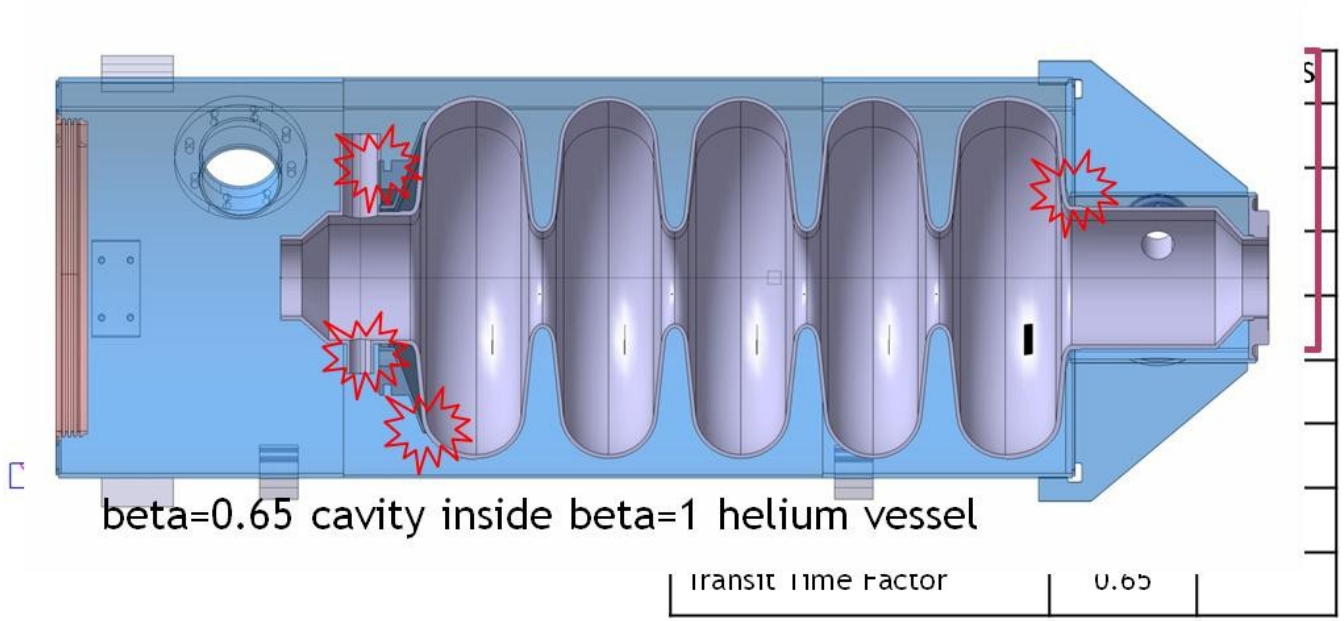
- **News from partner institutes**
  - **CEA – Saclay**
    - Fabrication of tuners started
    - Design of tank completed, drawings & specs in progress
    - High power RF tests are going on in the frame of the SLHC-PP program ; processing of new couplers from CERN will follow
    - Impressive new SRF processing and assembly area

Cavity string in front of the CEA-Saclay CR

Assembly and alignment workstation

# Recent technical achievements 11

## News from partner institutes – CNRS - Orsay




*15th Oct '10: CERN-CEA-CNRS major decision* → **Beta=1 and Beta=0.65 cavities will be tested in CRYHOLAB only!**

→ Helium vessel design: free from CERN cryomodule requests

# Open issues for guiding future work

- **Fine tuning of planning with external partners:**

Planning rev. 5th SPL collaboration meeting 26 Nov. 2010

| | 2010 | | 2011 | | | | 2012 | | | | 2013 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 |
| **SM18 - 2K Cryogenics** (vertical cryostats) | | | | | x | | | | | | | |
| SM18 - 2K Cryogenics (bunker) | | | | | | | | | | x | | |
| **Accessories**<br>High Power RF couplers | | | | | | | 4(8) | | | | | |
| HOM coupler design | | x | | | | | | | | | | |
| Tuner | | | | | | | | 4 | | | | |
| **Diagnostics**<br>2nd sound | | x | | | | | | | | | | |
| T-mapping/inspection equiment | | | | | | x | | | | | | |
| **High pressure rinsing eq't** | | x | | | | | | | | | | |
| **Ultrapure water equipment (252)** | x | | | | | | | | | | | |
| **Electro-polishing eq't** | | | | x | | | | | | | | |
| **Clean room refurbishment** | | | | | | x | | | | | | |
| **Superconducting Cavities + HOM couplers + tank He** (Industry, CERN) | | | | | | 2 | 2 | | | | | |
| Manufacture SC cavities | | | | | | 2 | 2 | | | | | |
| Manufacture tank He (Ti) | | | | | | 2 | 2 | | | | | |
| SC cavities vertical tests | | | | | | | | x | | | | |
| Assembled string of 4 cavities + He tank | | | | | | | | | x | | | |
| **Short cryomodule** (4 cavities) | | | | | | | | x | | | | |
| Equipped short cryomodule | | | | | | | | | | x | | |
| High power RF tests in short cryomodule | | | | | | | | | | | | x |