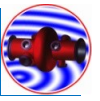


Status of SPL RF power coupler development



- Already reported in June at Lund by Ed and Wolfgang, Several decisions have been taken
- Since March we work to integrate all the advice and to finalize the studies
- Still keep open the three possible designs:
 - SPL-CEA HIPPI coaxial disk water cooled window (to be modified for SPL needs)
 - SPL-SPS coaxial disk air cooled window
 - SPL-LHC cylindrical air cooled window
- All use the same double walled tube
- All use the same vacuum gauge, electron monitor and arc detector
- All designed to be compatible without modifying the cryomodule

Coupler definition

Single window coupler

Fixed coupler

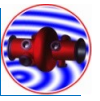
With a Double Walled Tube

Mounted in clean room with its double walled tube horizontally in only one operation

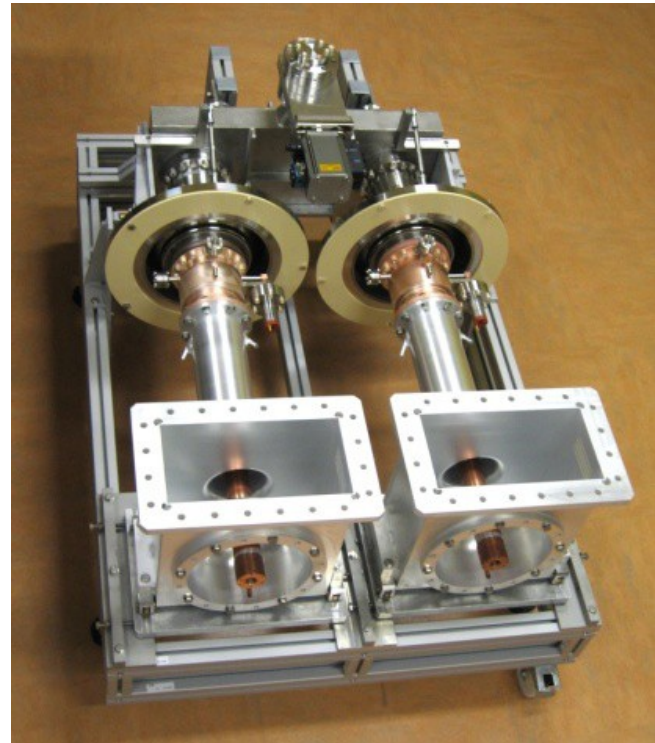
With its final position vertically below the cavity

With a HV DC biasing capacitor

Air cooled



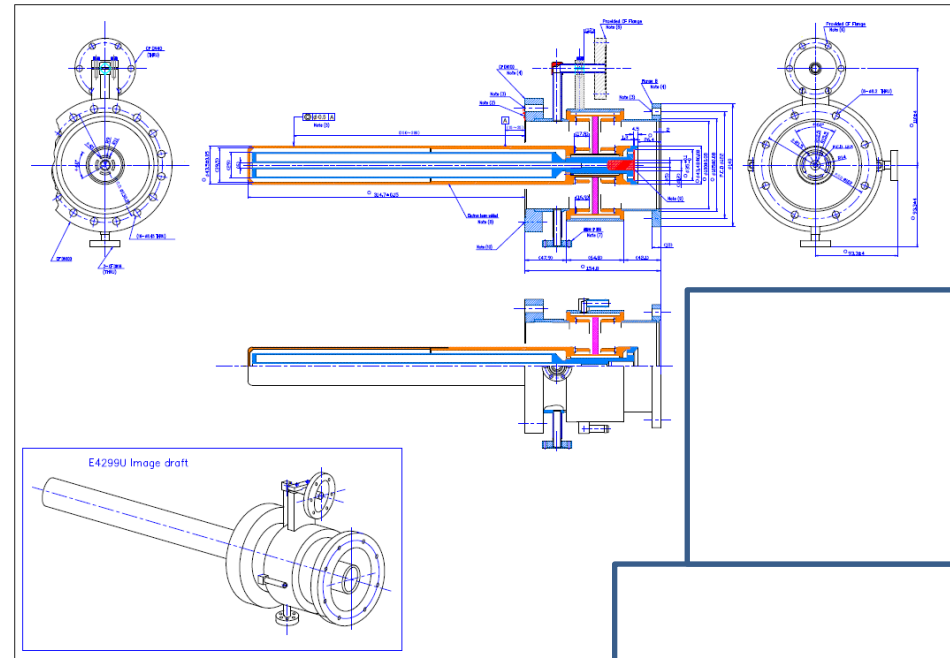
- One pair of couplers has been built, conditioned up to 1.2 MW 10% duty cycle on the room temperature test stand in TW, and 1 MW in SW
- One of the coupler has been assembled on a cryo cavity and operated at a maximum forward power of 1 MW using 2 ms pulses repeated at 50 Hz. This regime was sustained for several hours
- To be available for SPL, this coupler should be slightly modified:
 - antenna length
 - Cryomodule interface



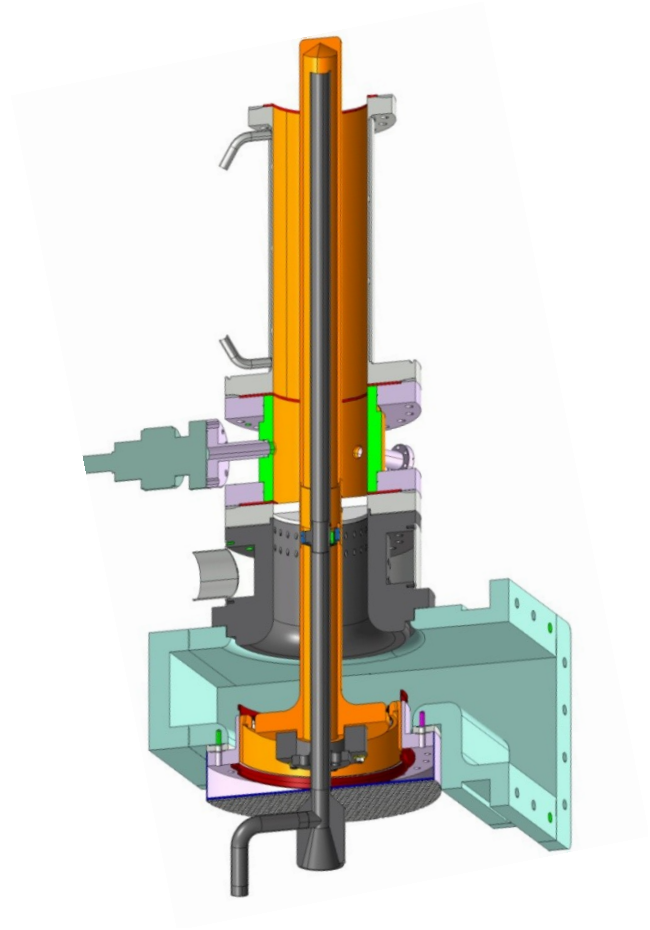
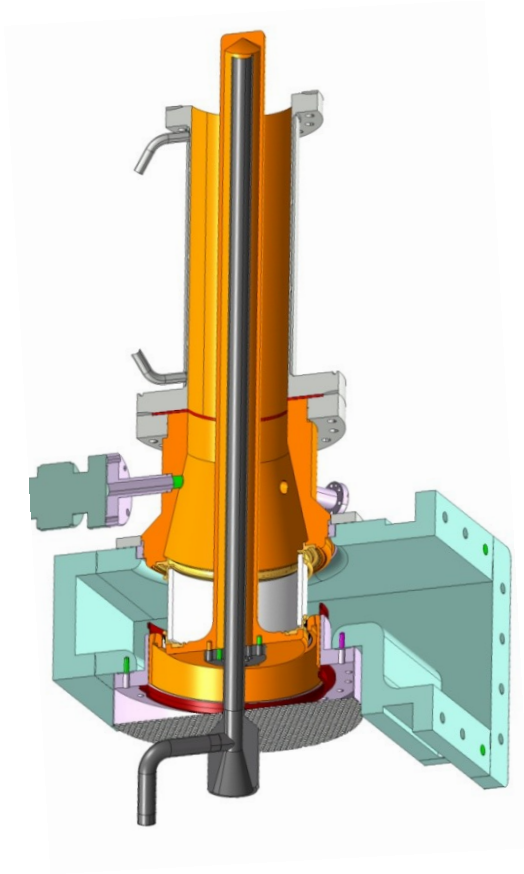
CEA-Saclay 704.4 MHz pair of coupler mounted with their double walled tube onto their test cavity

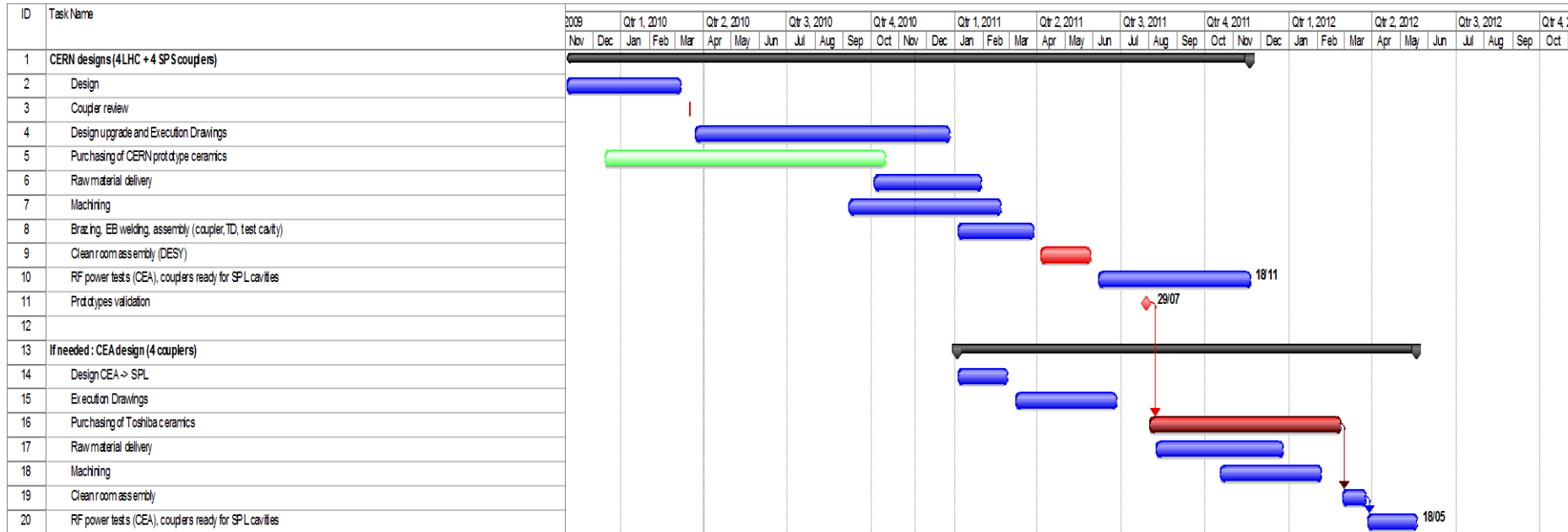


- One of the coupler review recommendation was to avoid any liquid/vacuum brazing/soldering
- If needed, we will have to either modify it to be a gas cooled coupler or to accept it as water cooled coupler
- The day after the meeting, we received the quotation from the window supplier:
 - 45'500 € per unit -> very expensive (but it works !)
 - 6.5 month delivery time

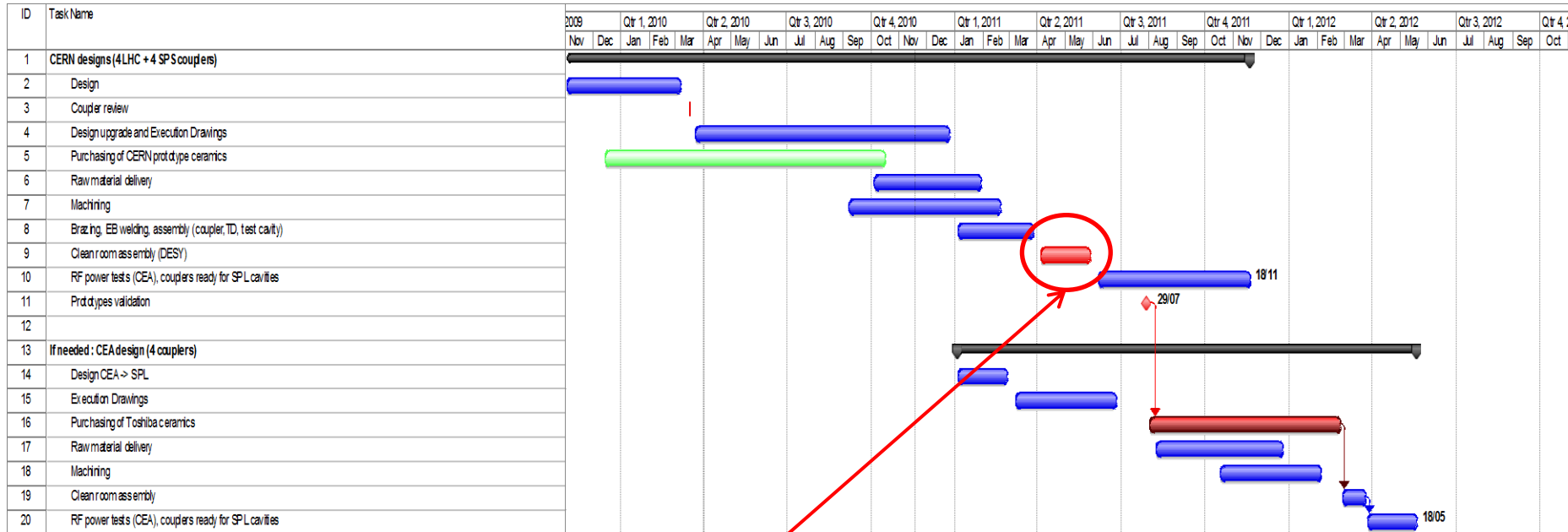


Alternative solutions

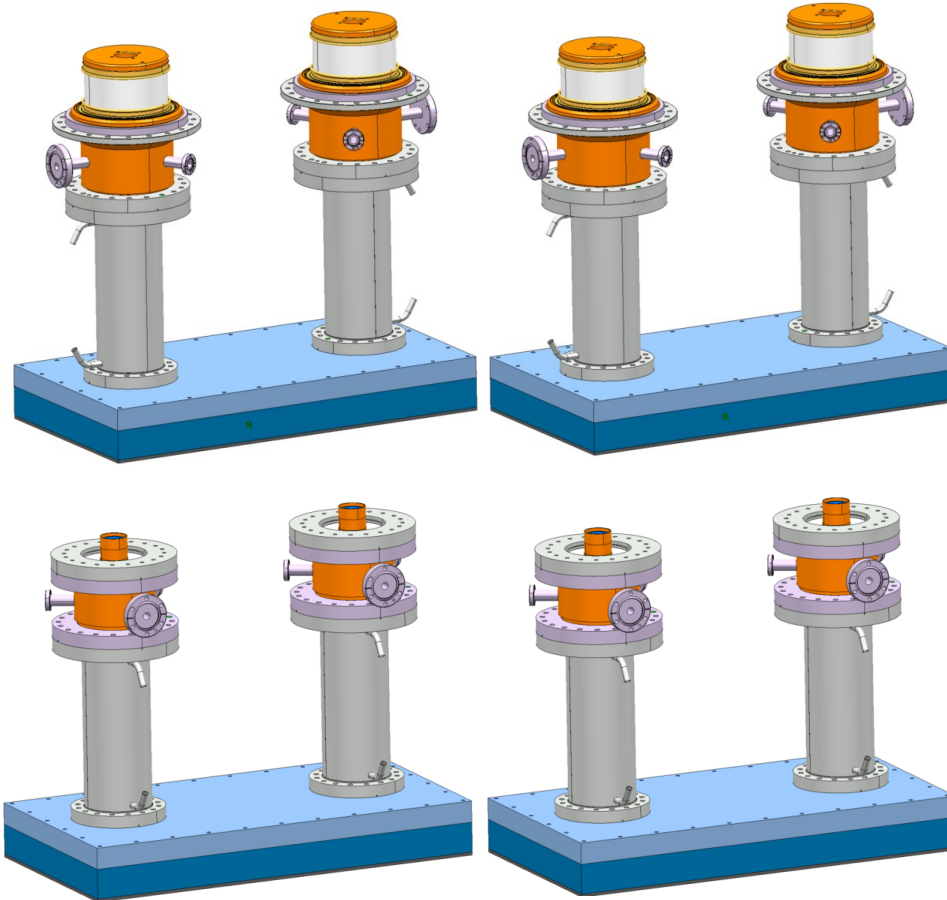




- All our activities are schedule driven
- One of the main advice we received within the coupler review was that our clean room facilities were not at “the state of the art” for such a gradient field cavity,... and power coupler
- Even if we launched an important clean room upgrade program (as Janic shown you), if we want to have the coupler on time (March 2012 the latest !), we have to find other clean room facilities



- Wolf-Dietrich Moeller and Axel Mathaisen, DESY, have accepted to help us (**with of course, DESY - XFEL program remaining absolute priority**), and if we are ready we can have a possibility to assemble the coupler in April next spring!
- So, we concentrated all our efforts in having the “clean room lines” ready on time



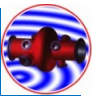
- A clean room line is :
 - A pair of couplers
 - Two Double walled Tubes
 - A test cavity

- Because of the tight planning, and in case one design is wrong, the second one could do the job, we decided to build 4 lines, i.e.:
 - 4 SPL-LHC couplers
 - 4 SPL-SPS couplers
 - 8 Double walled Tubes
 - 4 test cavities

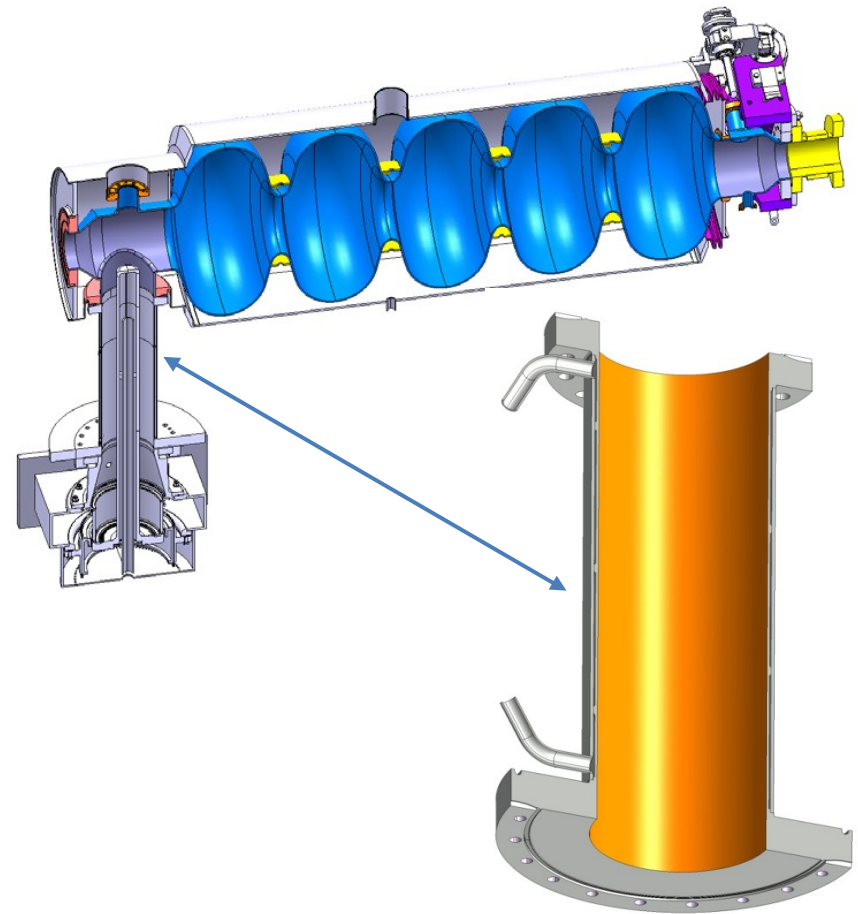
- The goal is to be ready for assembly at DESY next spring in order to be ready for RF tests at CEA beginning next summer

- This should allow us to move to HIPPI window purchasing process, in case none of the two designs do the job

- And still be ready with an HIPPI coupler just on time

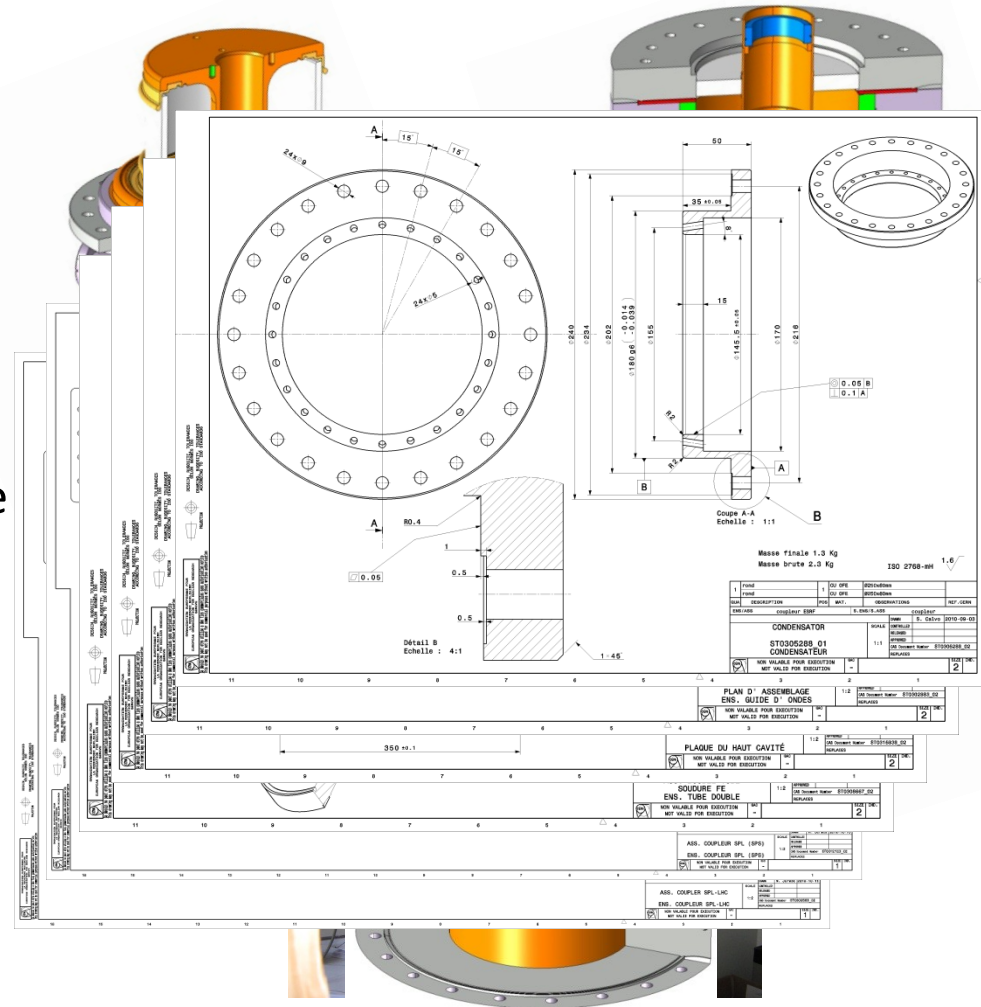


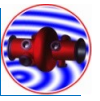
- All RF simulations have been done, mainly SPS design modified with a 10 mm thickness ceramic instead of 18 mm to follow coupler reviewers recommendation -> less losses
- Distance of flange to beam axis has been defined to be 125 mm
- The double walled Tube has been calculated to be able to be a support for the cavity
- Q_{ext} will be given by the antenna penetration length into the cavity
-> $Q_{\text{ext}} = 1.22 \times 10^6$ is the goal value





- 3D studies :
 - Couplers, Double walled Tube, WG, HV capacitor -> done
 - Test cavity, nearly completed
- 2D drawings :
 - Couplers, Double walled Tube -> done
 - Test cavity, nearly completed
 - WG, HV capacitor will come later
- Still to be done:
 - EDMS validation full process prior machining

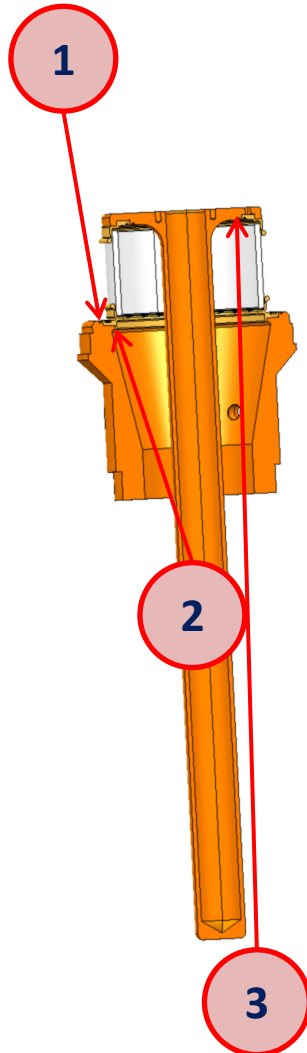




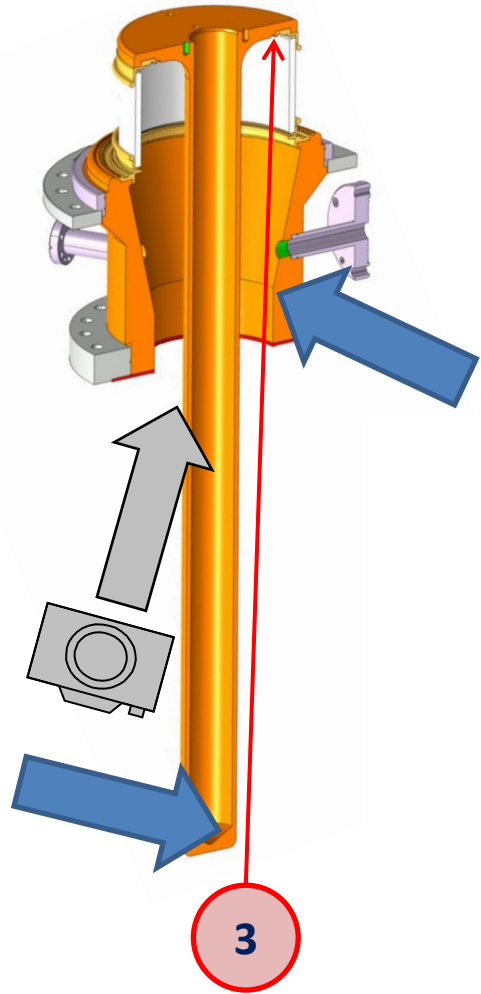
- All raw material (mainly specific material) for vacuum lines have been ordered, and mainly delivered:
 - 3D forged copper
 - Titanium
 - 316 LN stainless steel

- Long delivery delay (up to 10 weeks)





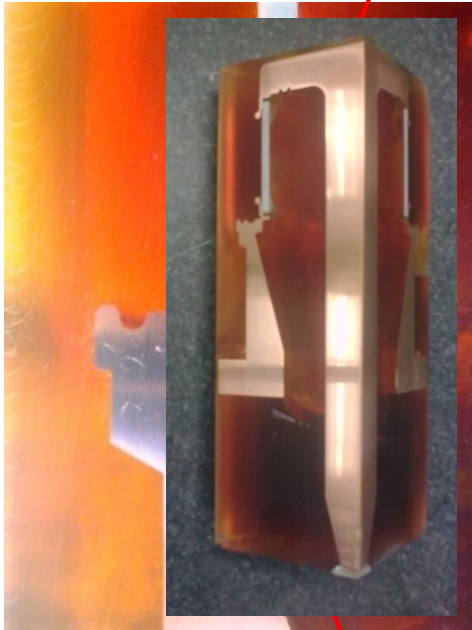
- In parallel, tests have been made to validate several key processes:
 - LHC Brazing validated
 - previously industry -> in House
 - EB validated
 - slightly different than LHC because of the outer conical line
 - Long antenna



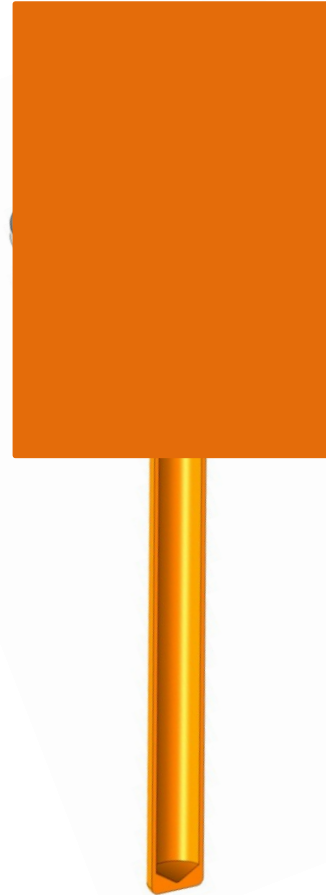
- In parallel, tests have been made to validate several key processes:
 - LHC Brazing validated
 - previously industry -> in House
 - EB validated
 - slightly different than LHC because of the outer conical line
 - Long antenna



No
cracks



EB
No leak



- In parallel, tests have been made to validate several key processes:
 - LHC Brazing validated
 - previously industry -> in House
 - EB validated
 - slightly different than LHC because of the outer conical line
 - Long antenna
 - LHC molding/cutting process



- In the mean time, with the Polymers laboratory we also tried 3D printing for mechanical testing before launching the workshop machining
 - Allow us to make any parts from a Catia design
 - The part are Impregnated with resin to give them the desire mechanicals performance
 - Several different pieces made on the 3 D printer and impregnated were used to check the design

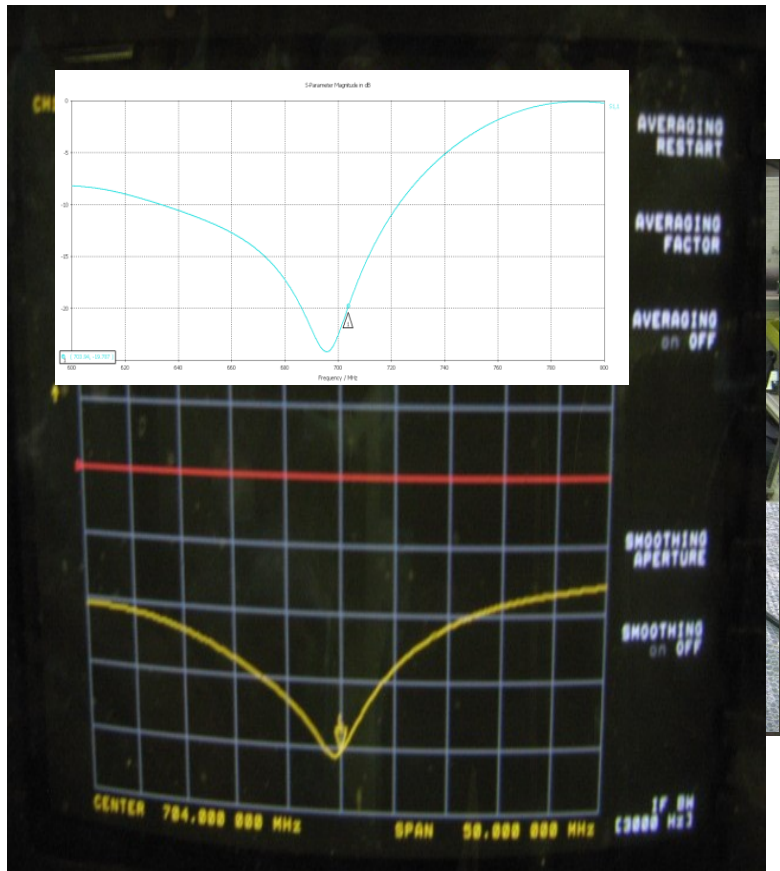


- Doing this, we also decided to try it for RF:
 - Copper painting (easy, 10 minutes)
 - Copper plating (more complex and expensive)

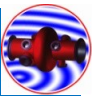
- Unfortunately, as foreseen, copper paint does not work



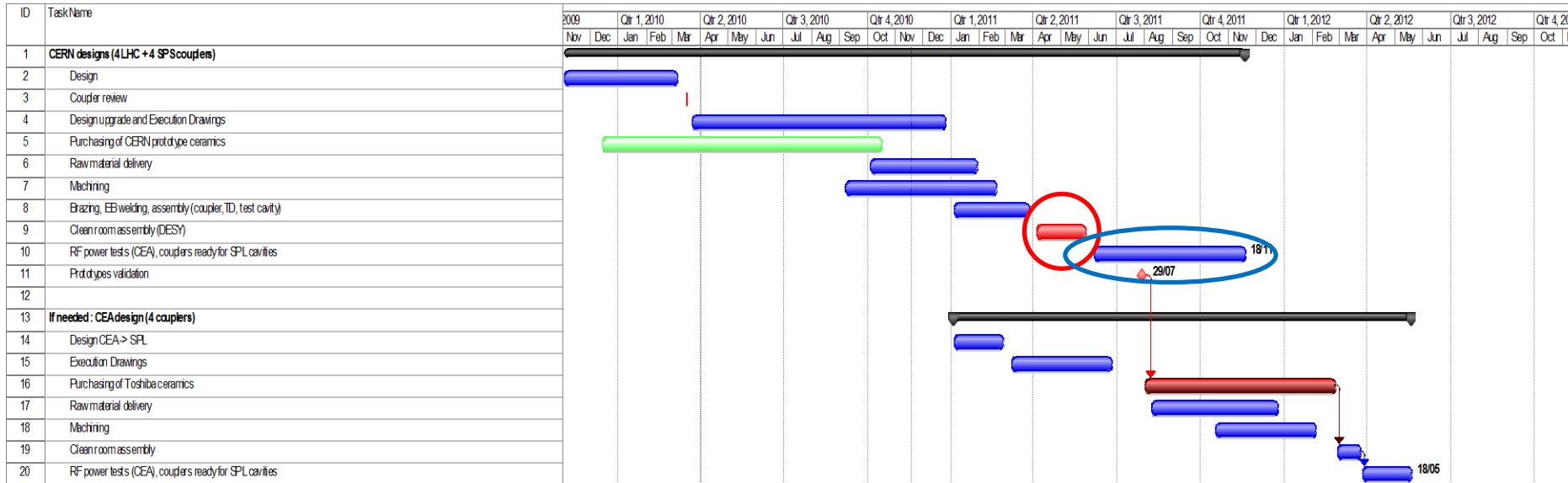
- We are now awaiting some copper plating results to validate or un-validate RF measurements
- If this works, we can image to build mockup really quickly (less than a week) whatever the complexity of the geometry !



- Mockups have been built and low power RF tests validated the two designs
- Reflection (S_{11}) and Transmission (S_{21}) measurements are as expected by simulations for SPL-LHC AND SPL-SPS couplers
- This is a very important milestone for us

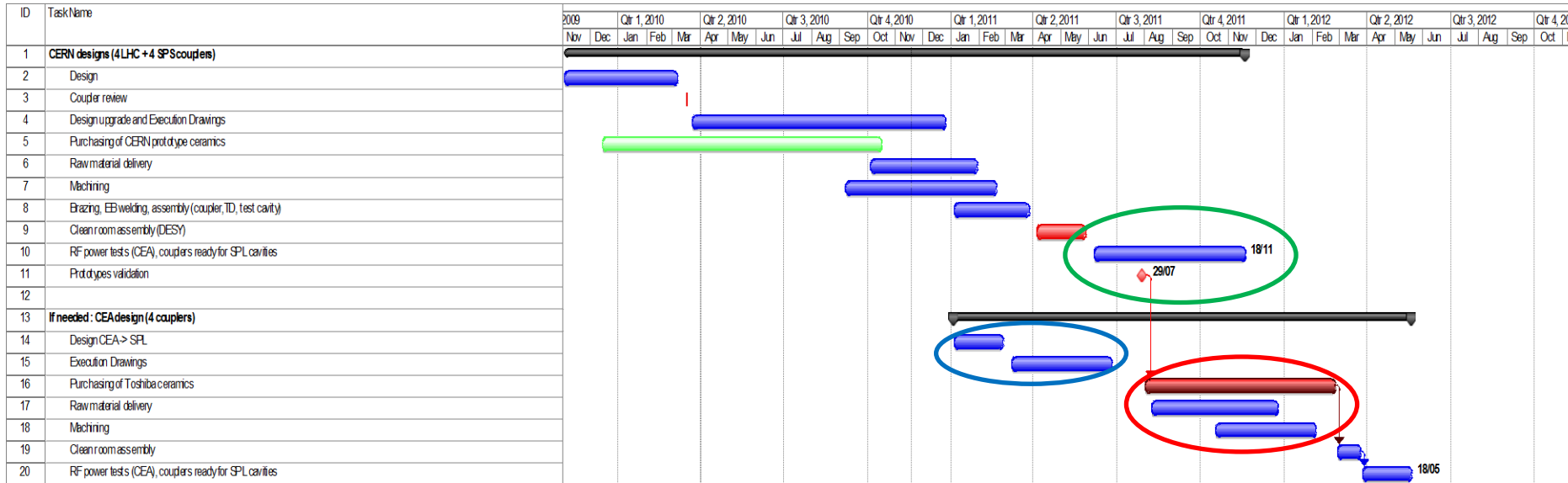


- Machining has started
- We machine some items ourselves mainly for the mockups
- But now, we mainly need the Main Workshop full support to be on time



- **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



- In the mean time, from January to June : CEA-HIPPI to SPL studies and execution drawings
- If Summer tests conclusive : we will be ready with eight (four) couplers

- If not, we will order the CEA-HIPPI windows type and repeat the process, to be ready with four CEA-HIPPI style couplers May 2012

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

Many thanks for your attention