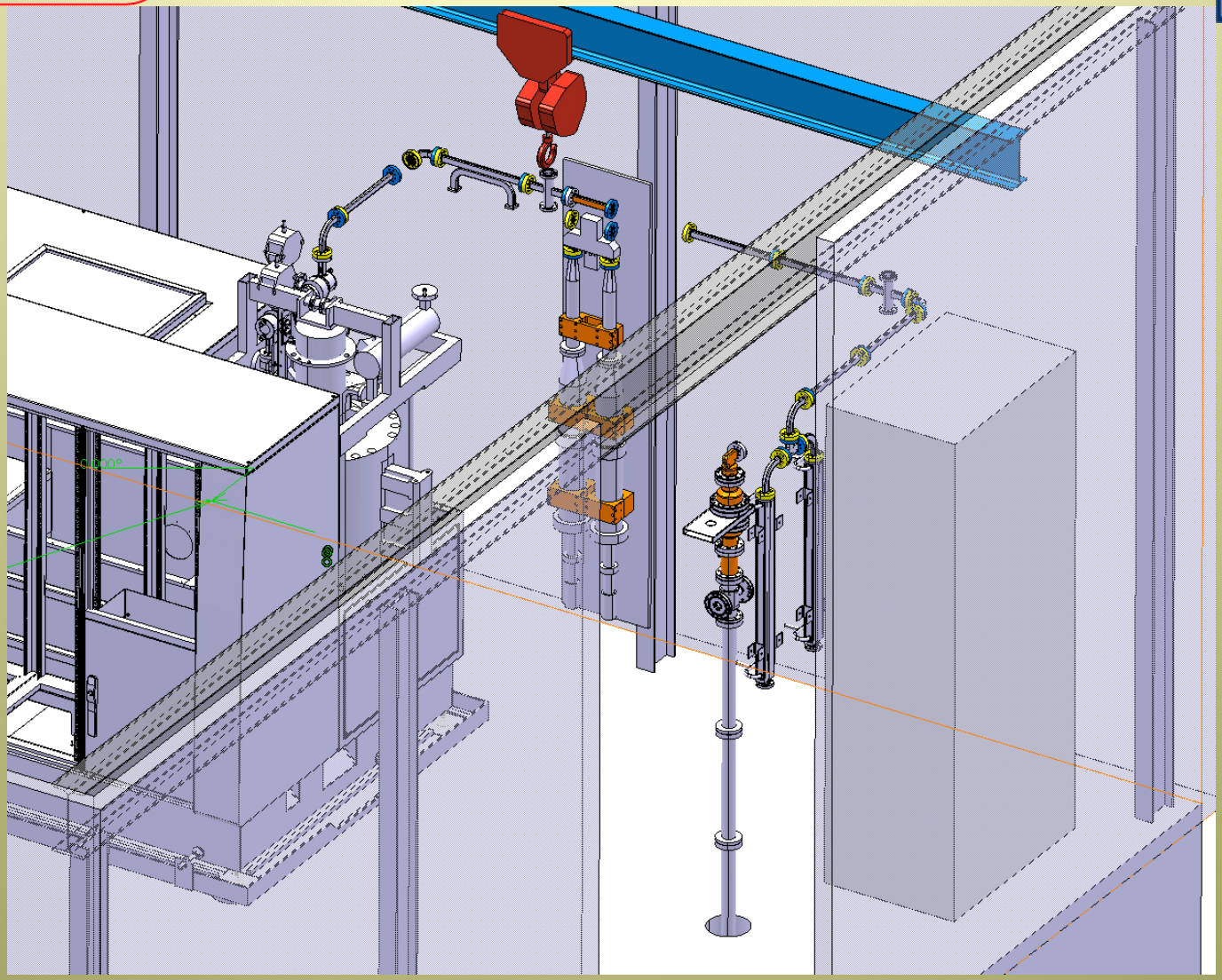
CERN X-band Test-Stand

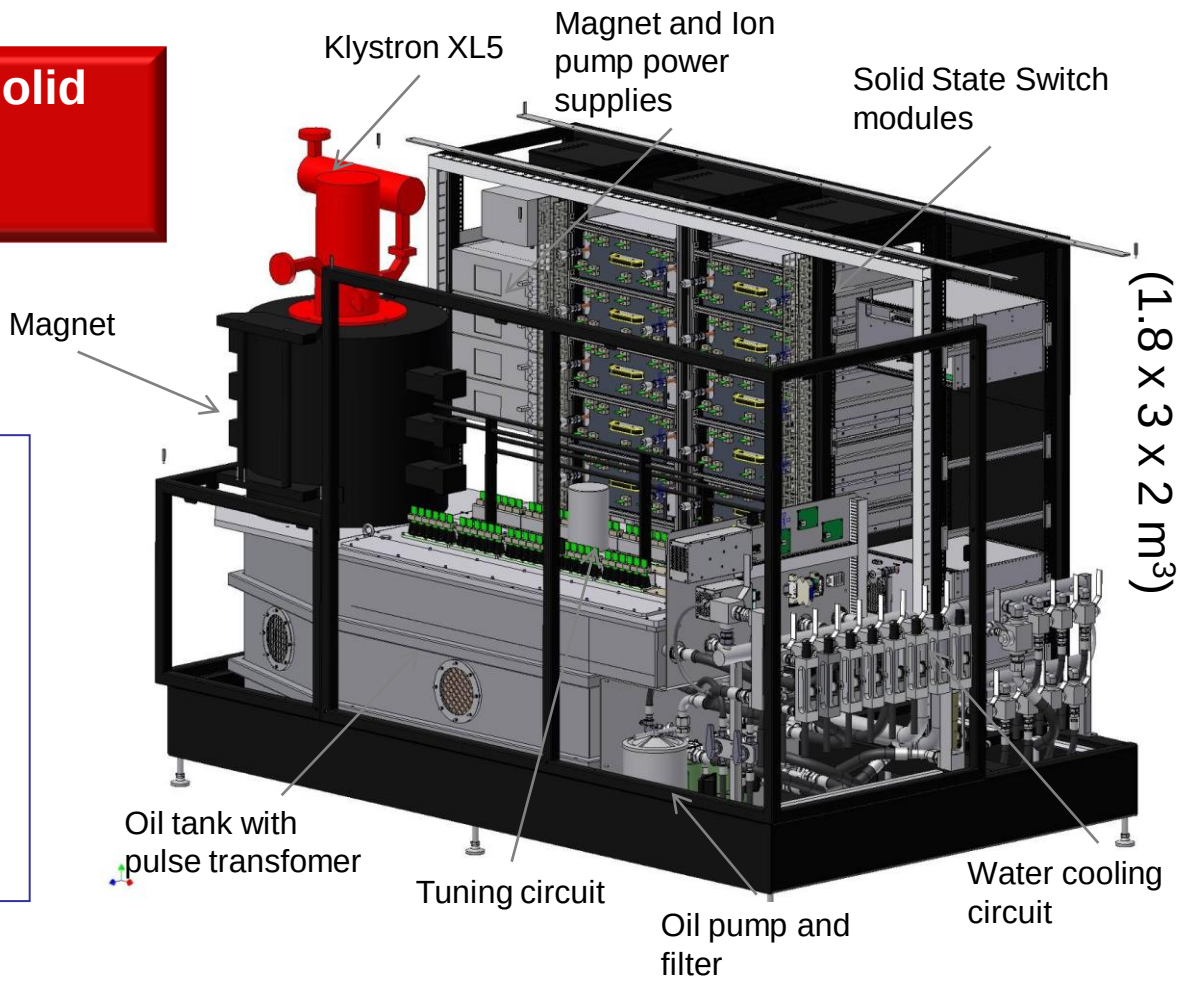


CERN - CEA – PSI – SLAC

LUCKY US WE DIDN'T INSTALL BEFORE MARCH 5TH.....

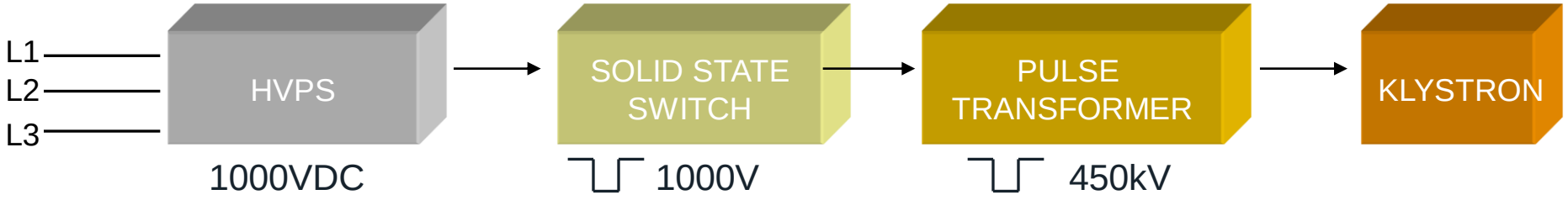
High Voltage Modulator

Development of a new solid state modulator by SCANDINOVA



Specification :

High Voltage :	**450 kV**
Current :	**335 A**
Flat pulse length:	**1.5 µs**
Pulse length at 50%:	**2.3 µs**
Repetition rate:	**50 Hz**
HV ripple:	**0.25 %**
Pulse to pulse stability:	**0.1 %**



Modulator Status for the X band Test Stand

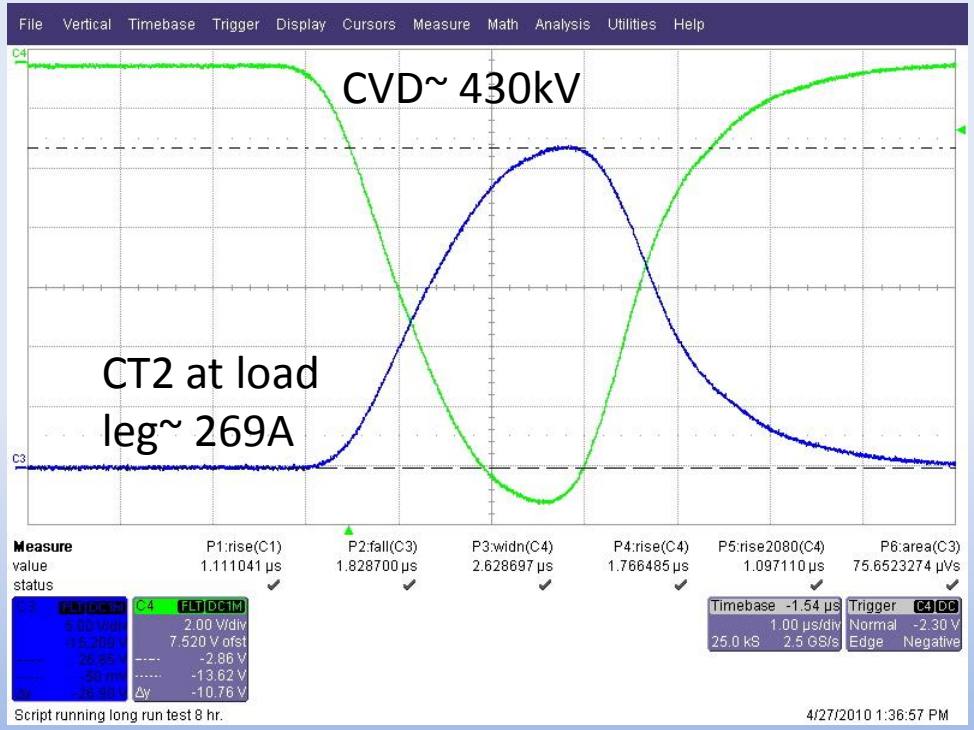
Modulator under test at Uppsala

Modulator finished to be assembled : beginning of April but only missing the bucking coil power supply for the klystron

Modulator Status for the X band Test Stand

Factory Acceptance Test

- ✓ Test performed with a resistive load
- ✓ Long run Test at 430kV/270A 1.3µs/50pps
- ✓ Test during few minutes at 450kV
- ✓ At nominal point, FWHM is 2.6µs
- ✓ Flat top ripple and pulse to pulse stability measurement will be achieved with the load at CERN



Shipping and Installation

- Modulator already shipped, should be at CERN in few days.
- Installation to be foreseen with CLIC colleagues at CERN

☞ **Installation and Site Acceptance**

Test with klystron ? Summer 2010

SLAC XL5

CERN Supplied Components

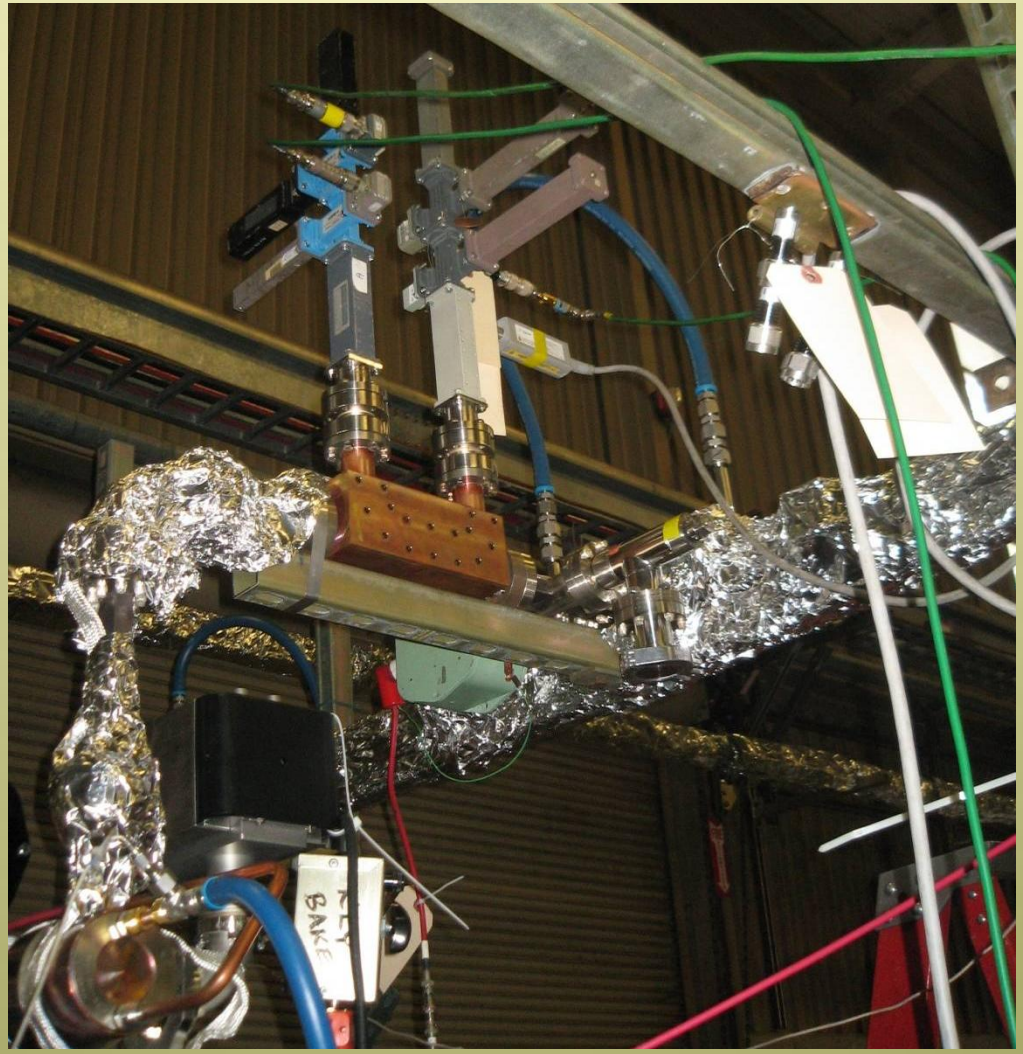
General Performance Observations

The tube operated quietly in terms of gun arcs and tube vacuum spikes during the initial run-up, perhaps better than most. The majority of activity was in the external waveguide system.

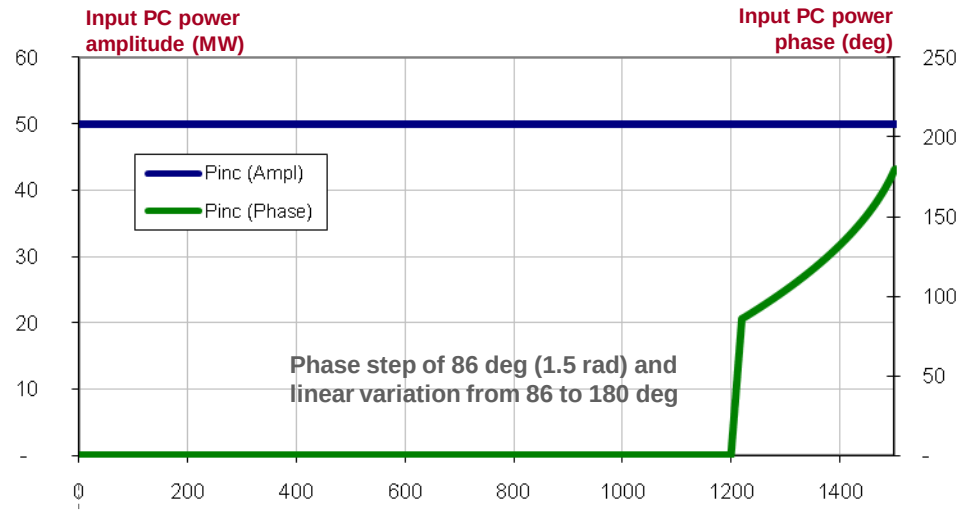
The external waveguide system suffered from outgassing, breakdown and multipactor; this was believed to be in the rf coupler and splitter, with normal(?) processing of the loads. Multipactor was noted always above ~1-3MW. These issues severely limited tube operation.

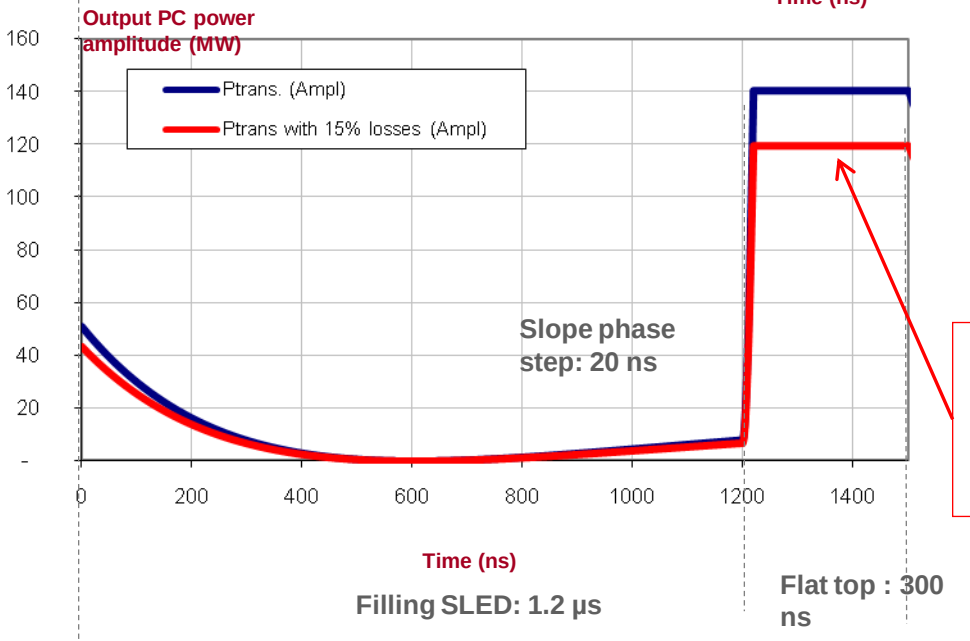
Gain, bandwidth and power output met or exceeded spec.

RF network for test



Pulse waveform after SLED compression





Q0 = 150000

QL = 25000

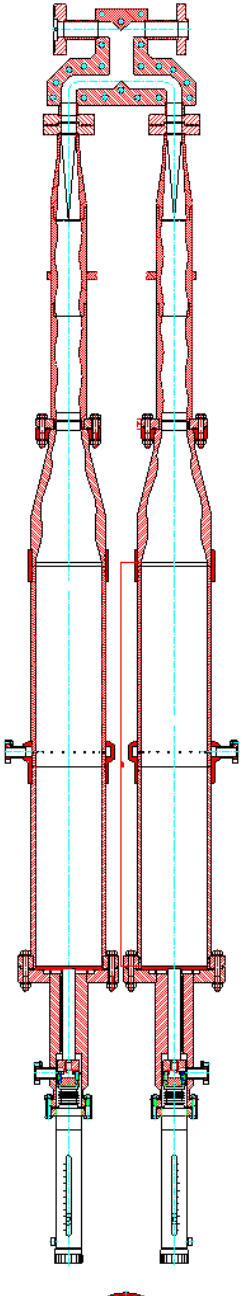
β=Q0/Qx = 5

Reflexion coef = 0.67

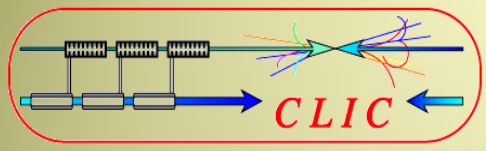
SLED Filling time = 0.663 µs

Power multiplication factor = 2.75

120 MW, 300 ns assuming 15% of losses in the RF network



Pulse Compressor (Gycom)



EVM: from 10% to 80%

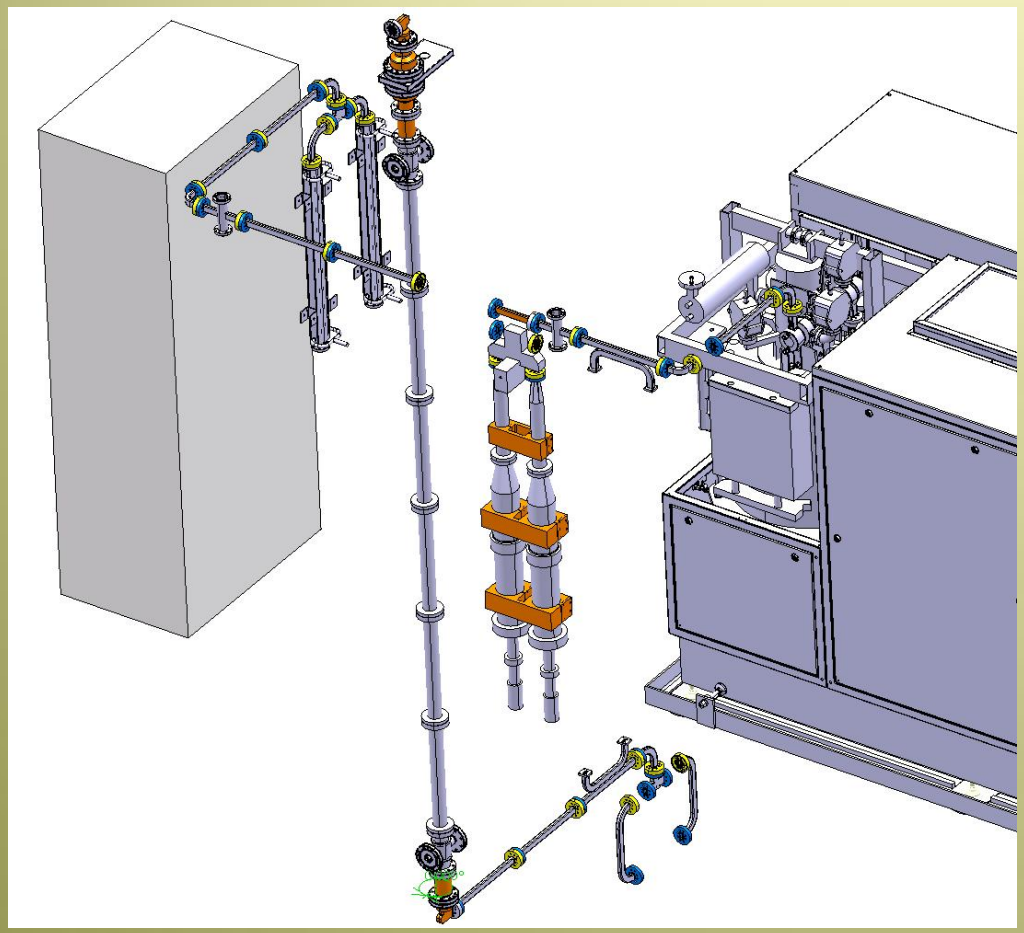
- **12 GHz klystron design and production: performance up-to expectations; SLAC**

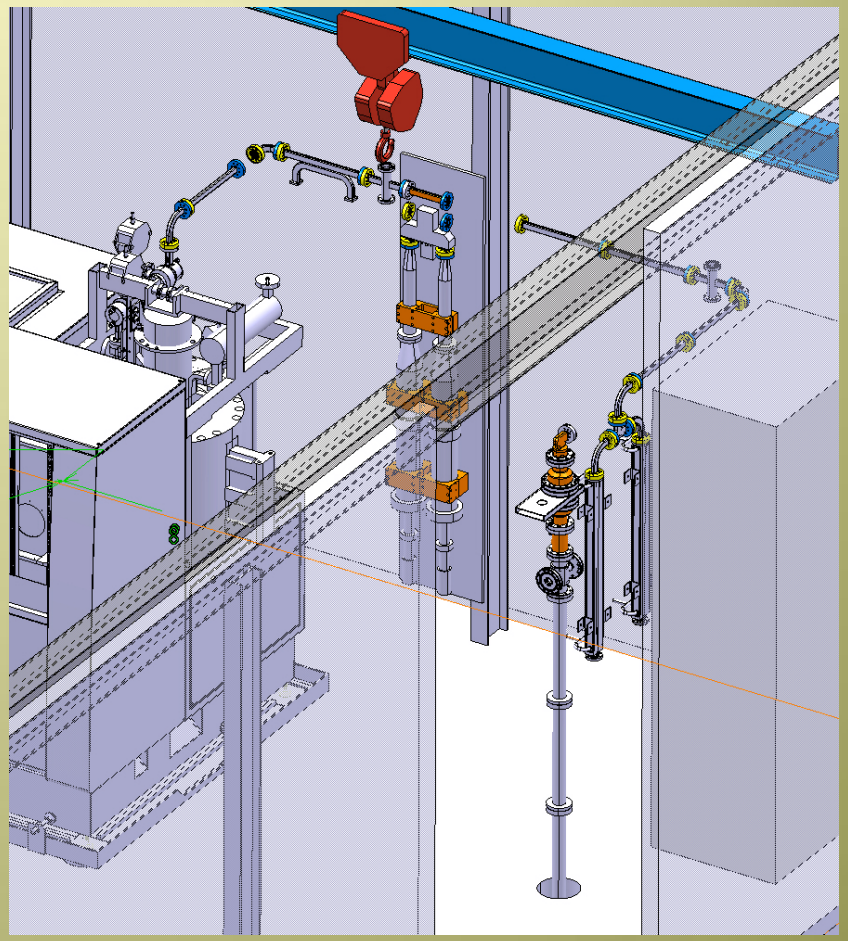
- **Solid State Modulator: from order to delivery 11 m; performance o.k.; SCANDINOVA; CEA; PSI**

- **Pulse Compressor: compact design; fast production; cheap; some performance issues; GYCOM**

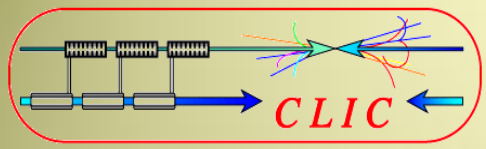
CERN Participants (minimum): Gerry, Ghislain, Stephane and Igor

Layout Phase 1





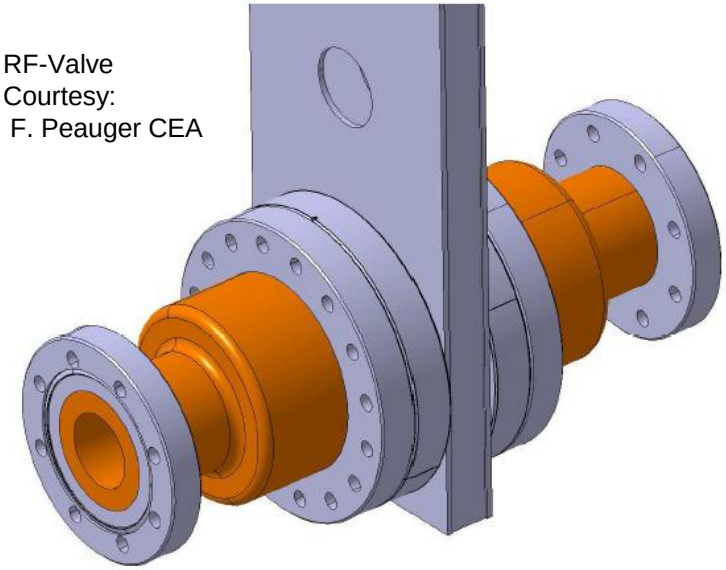
Stand alone Test Stand in CTFII

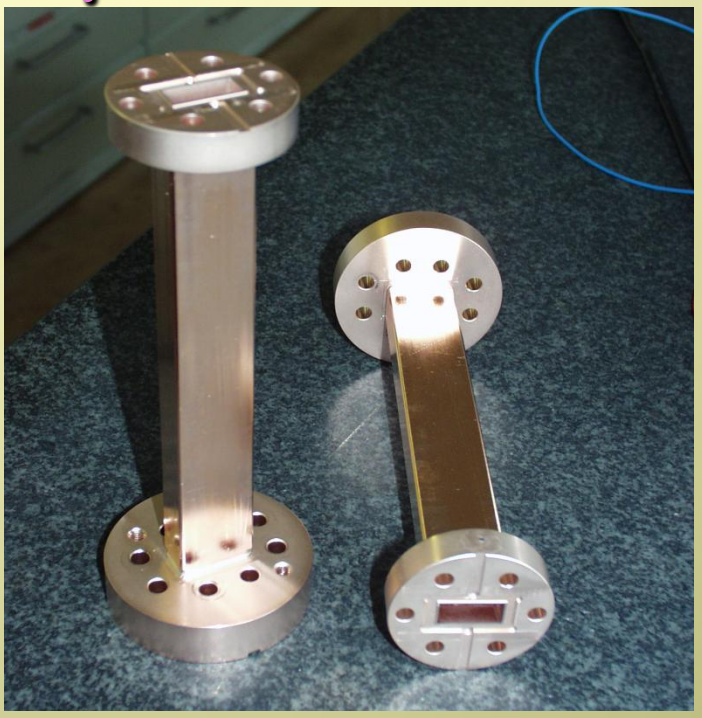


Courtesy: S. Doebert

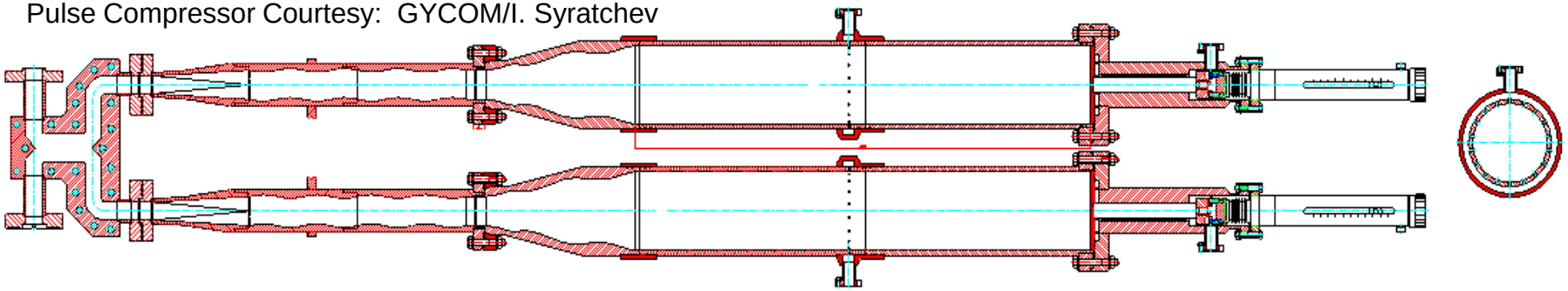
Components

RF-Valve
Courtesy:
F. Peauger CEA





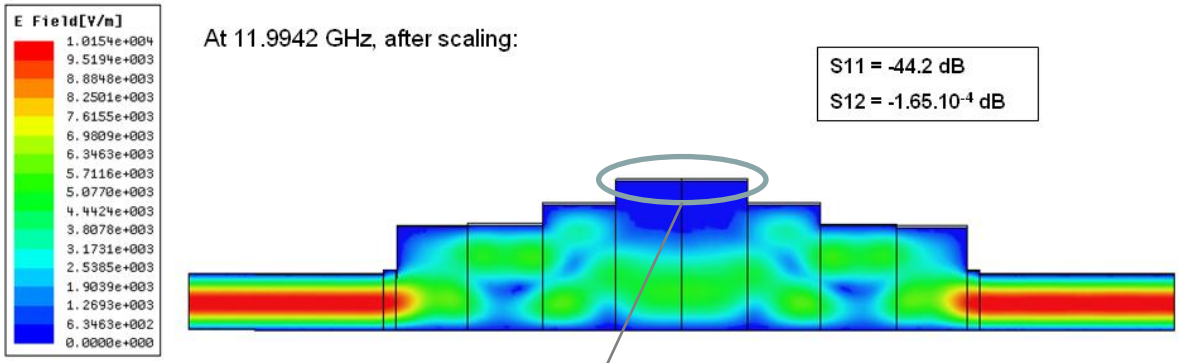
Pulse Compressor Courtesy: GYCOM/I. Syratchev

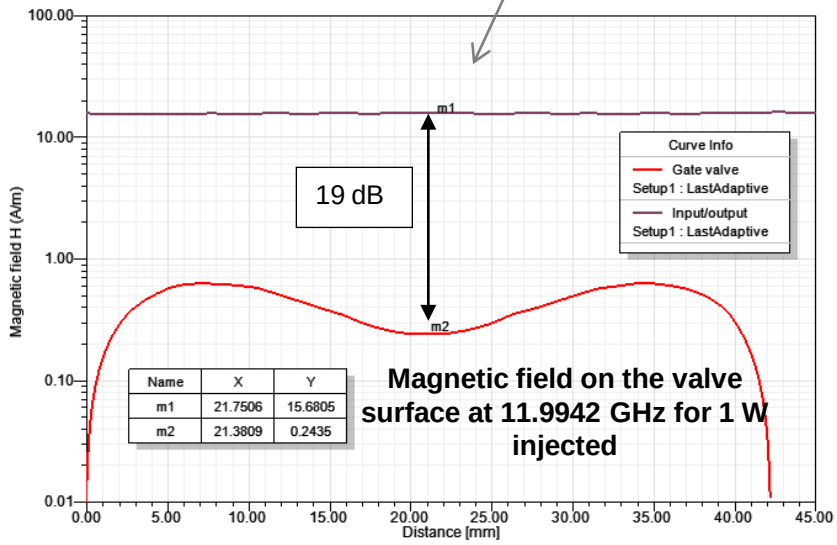


RF Valve

Design and fabrication by CEA/CERN

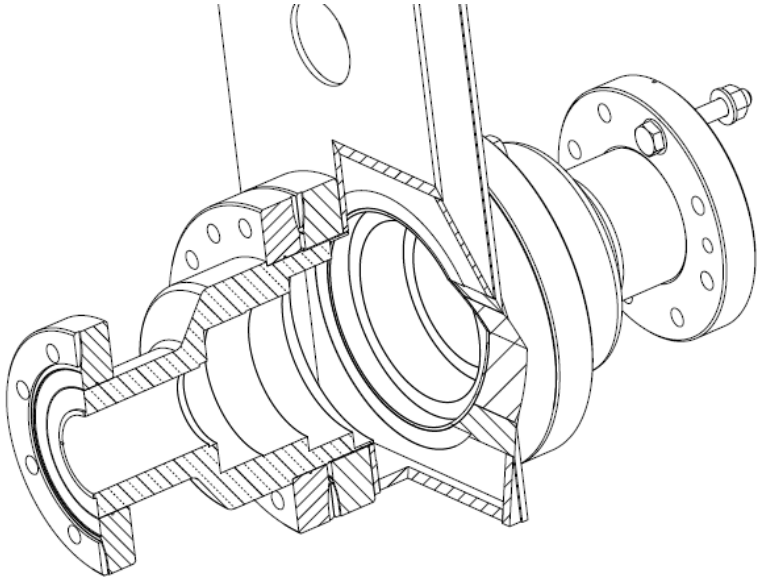
The RF valve has been introduced by A. Grudiev (CERN) in the CTF3 30 GHz test stand. It works on the circular mode $TE_{01}{}^{o}$ mainly to avoid surface electric field and have steps in diameter to “focus” the wave in the center of the guide. Based on the same principle, RF valves working at 11.4 GHz have also been developed at SLAC for accelerating structure testing. The 12 GHz RF valve is a scaled version of the SLAC one.





Magnetic field on the valve surface at 11.9942 GHz for 1 W injected

Frequency:	**11.994 GHz**
Peak power:	**120 MW**
Pulse length:	**300 ns**
Repetition rate :	**50 Hz**

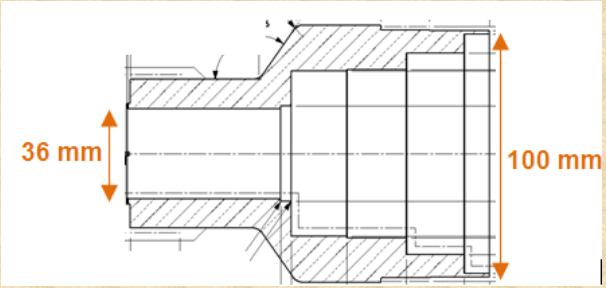


CLIC Test Stand 12 GHz

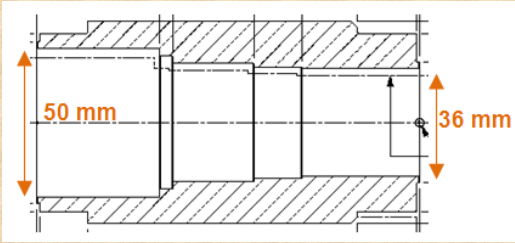
12 GHz RF valve and circular taper status

- Fabrication of two RF Valves and four circular tapers
- Raw material CUC2 ready
- Call for tender for machining of CUC2 pieces to be done quickly

-> Objective: CuC2 pieces ready for cleaning in April 2010



CTFAPWPX0003
Qty=4



CTFAPWPX0006
Qty=4

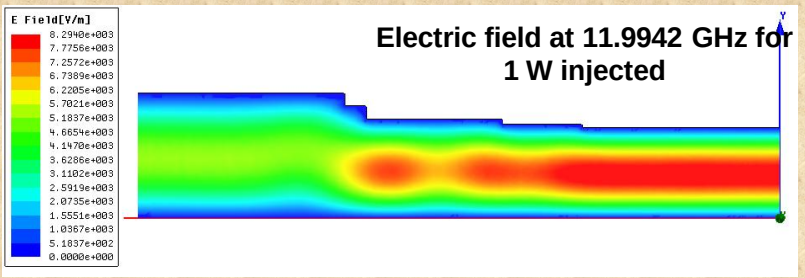
To be done at CERN (same as mode converter)

- Fabrication of circ. and rect. Stainless Steel flanges (raw material, machining)
- Cleaning
- Brazing, machining, brazing, machining, brazing…

CLIC Test Stand 12 GHz

Circular taper design

A circular taper is needed to connect the existing circular waveguides (50 mm diameter) with the RF valve and the mode converter calculated previously (with a diameter of 36.27 mm). It is composed of different steps of diameters with various lengths optimized for matching on a large bandwidth. It has been scaled from part of the 3 GHz power phase shifter of CALIFES.



Frequency:	**11.994 GHz**
Peak power:	**120 MW**
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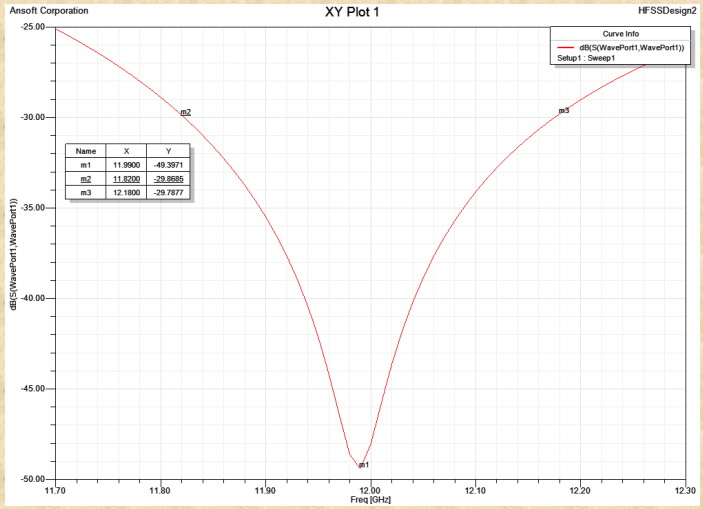
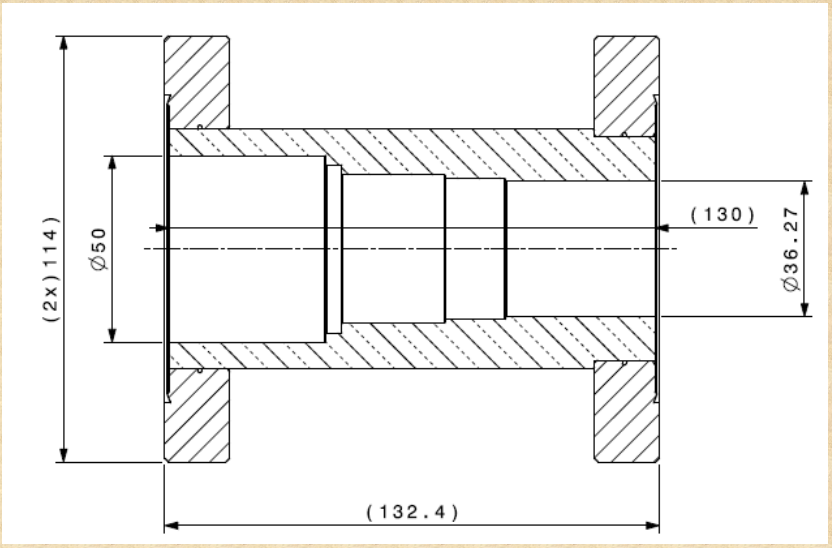
Repetition rate :	**50 Hz**



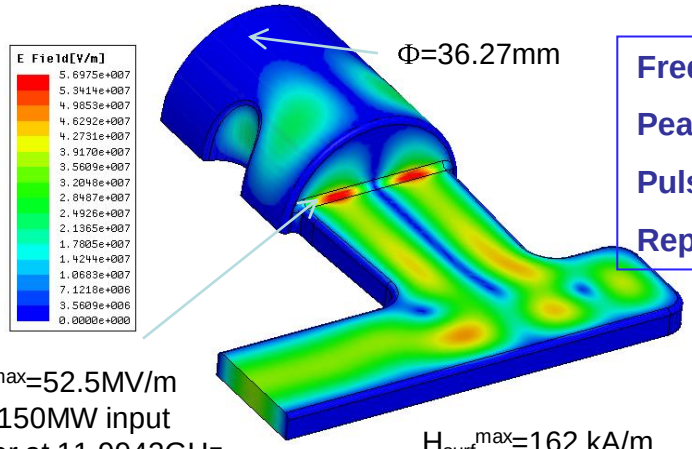


The reflection is less than -30 dB between 11.82 and 12.18 GHz, which gives a bandwidth of 360 MHz

Mode converter

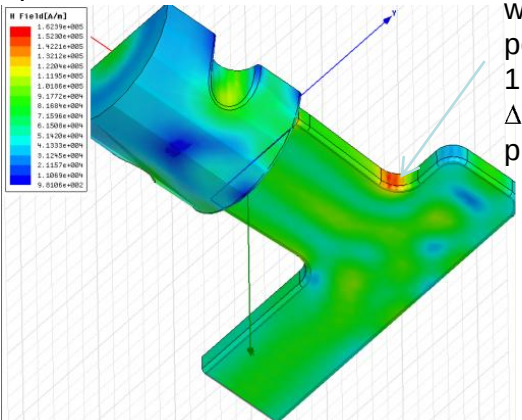
Design and fabrication by CEA/CERN

The mode converter is made in two parts. The first part is a rectangular waveguide bend on H plane. It converts the TE_{10}□ mode into a TE_{20}□ mode. The second part is a circular waveguide with two posts positioned at 180 ° at a certain distance of the rectangular section. This design is based on an original idea of S. Kazakov (KEK). It is compact and relatively easy to fabricate

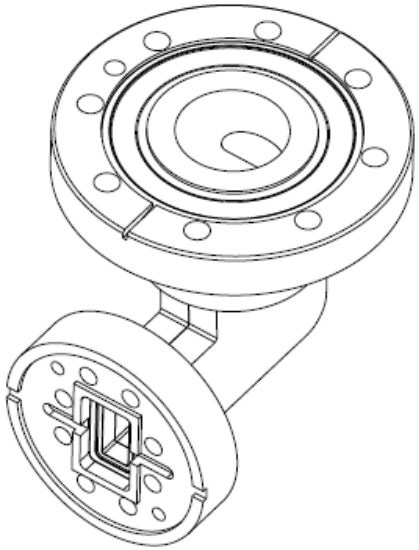


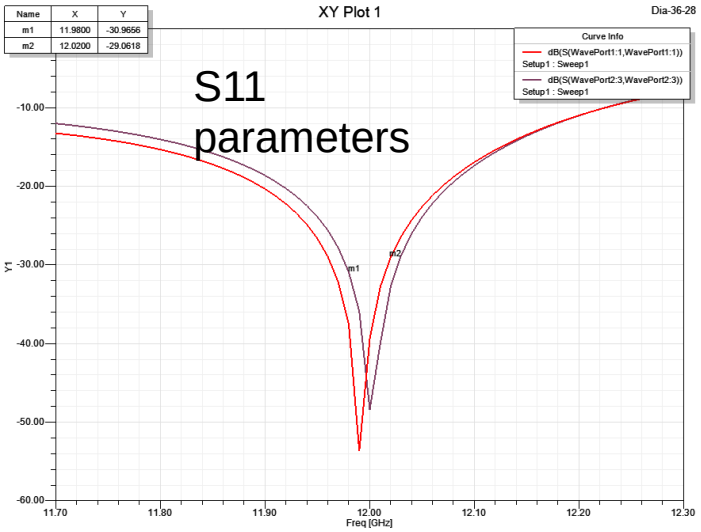
E_{surf}^{max}=52.5MV/m with 150MW input power at 11.9942GHz

Frequency:	**11.994 GHz**
Peak power:	**120 MW**
Pulse length:	**300 ns**
Repetition rate :	**50 Hz**



H_{surf}^{max}=162 kA/m with 150MW input power at 11.9942GHz giving ΔT=5.8° with 250 ns pulse length

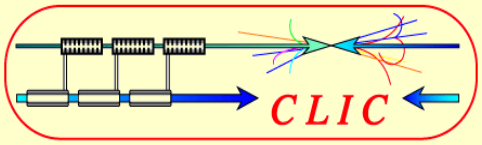


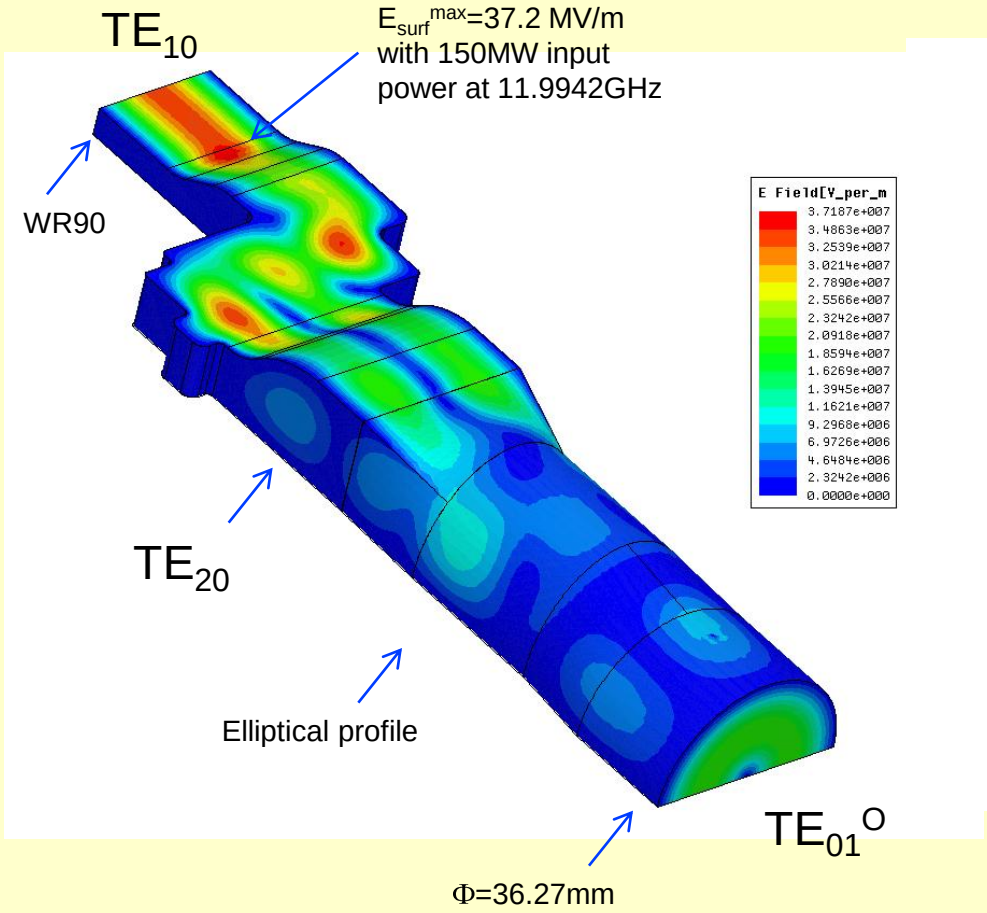


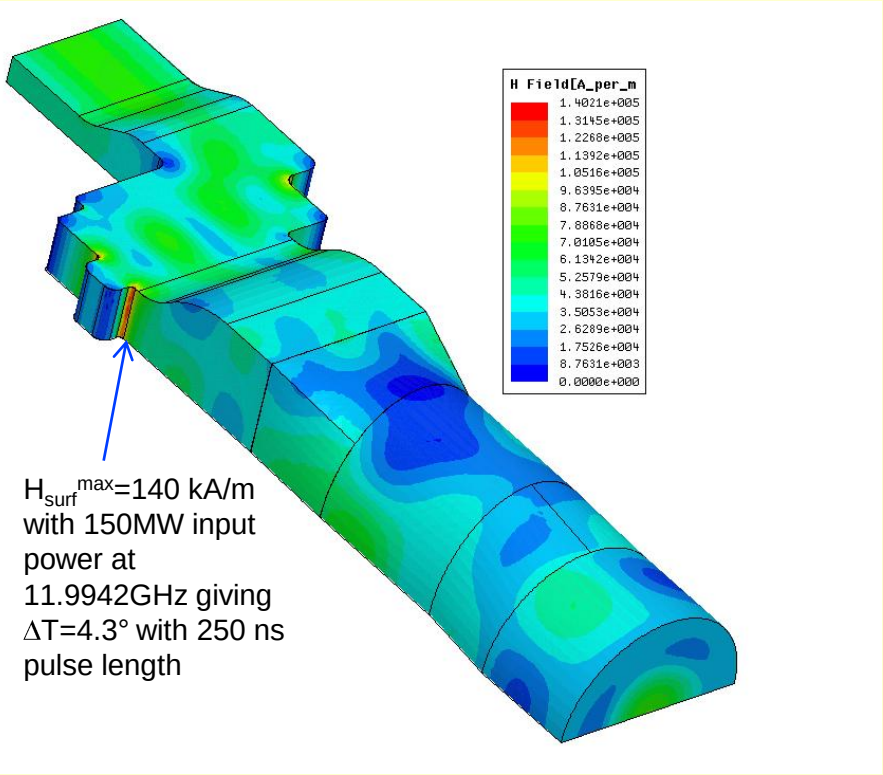
Bandwidth of 150 MHz @ -20dB reflection and -0.0618 dB transmission at 11.994 GHz giving 98.6% conversion efficiency in power

The fabrication technology is based on classical high temperature vacuum brazing of machined CuC2 and 316LN pieces. First the two half parts of the bend and the circ. waveguide with the two posts are brazed separetly. The stainless steel flanges are brased in a second step after re-machining. The third brazing concerns the two sub-assemblies and an intermediate round base used for the transition between the rect. and the circ. Parts.

12 GHz Bayonet Mode converter



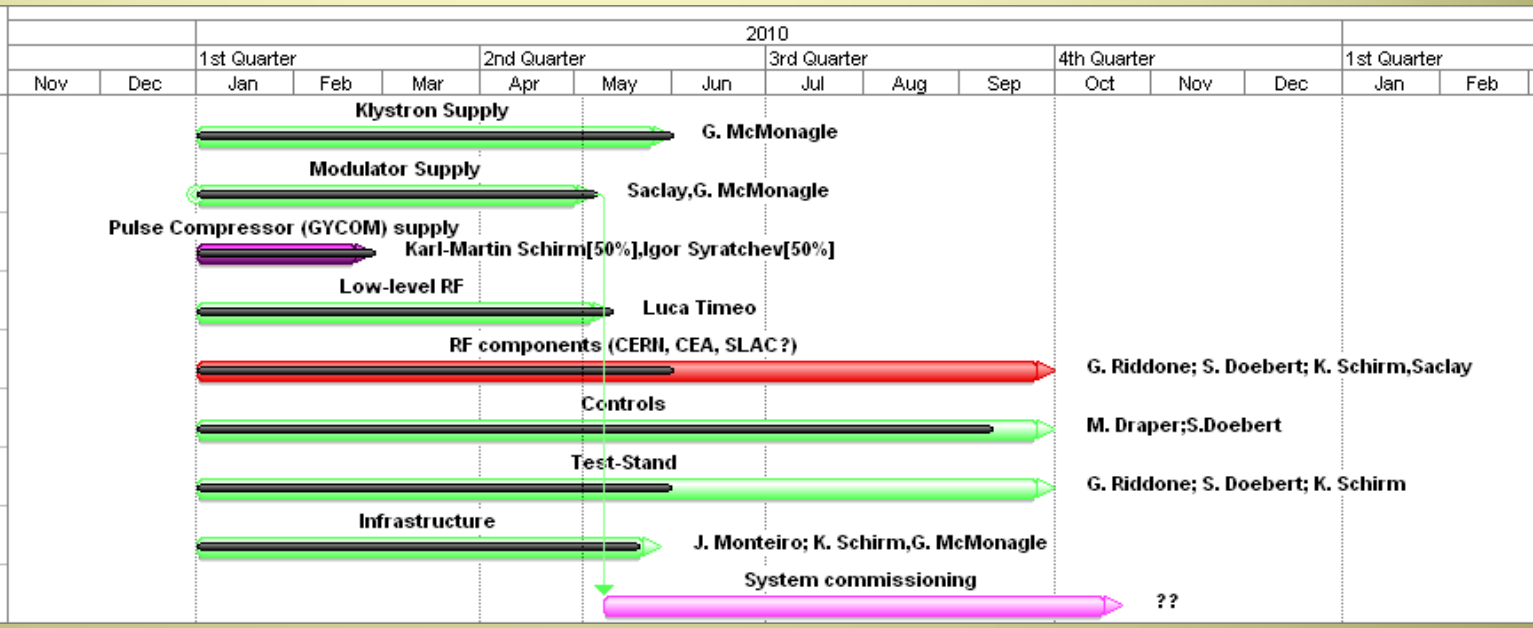




- Half of the structure is represented
- Total length = 175 mm

Schedule (05/2010)

ID	Task Name
1	Klystron Supply
2	Modulator Supply
3	Pulse Compressor (GYCOM) supply
4	Low-level RF
5	RF components (CERN, CEA, SLAC?)
6	Controls
7	Test-Stand
8	Infrastructure
9	System commissioning

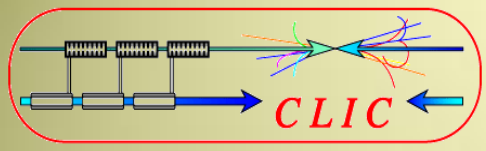


! Klystron and Modulator scheduled to arrive at CERN!

!RF components and network require new strategy and more efforts!

! ~~12 GHz power (without compression) should be available in CTF2 in May 2010~~

!12 GHz power (without compression) is available in the gallery in May 2010!



Conclusion

- Installation is started and main supplies are at CERN (in time and in budget)
- Performance of power source better than specs
- RF component issues will cost time and money
- Structure testing still for CDR?? Needs help (SLAC?)
- The coming months will be extremely busy with the re-starting of CTF3 – will we have enough resources for commissioning the test-stand in parallel??