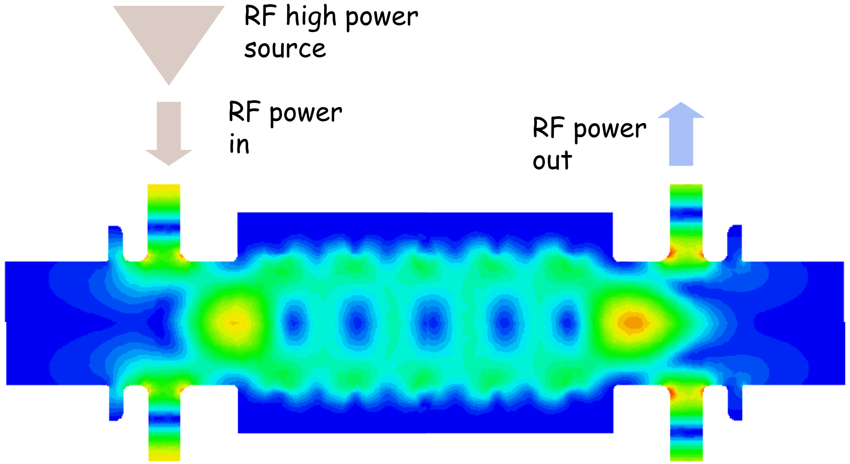
TBTS status.
PETS testing program and installation status.

Igor Syratchev & Germana Riddone for the CLIC team

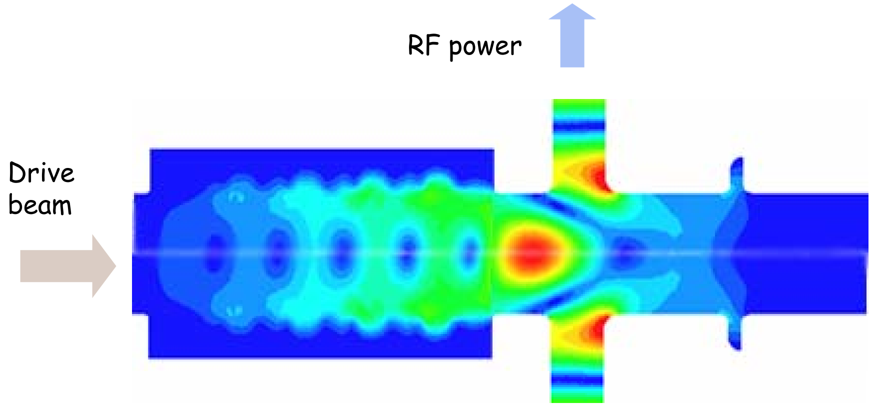
PETS testing in "waveguide mode" (SLAC)



Objective: to understand the limiting factors for the PETS ultimate performance.

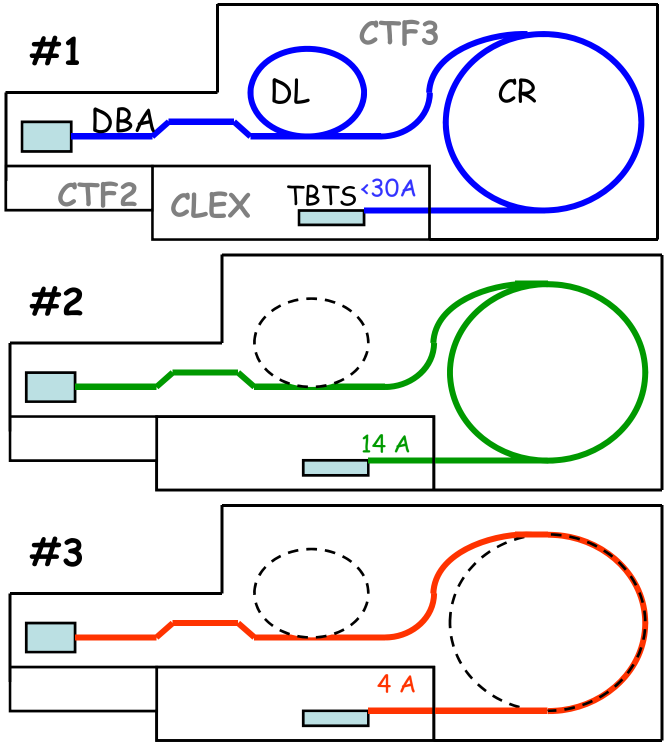
- Access to the very high power levels (300 MW) and nominal CLIC pulse length.
- High repetition rate – 60 Hz.

PETS power production from the drive beam (CERN)



Objective: to demonstrate the reliable production of the nominal CLIC RF power level throughout the deceleration of the drive beam.

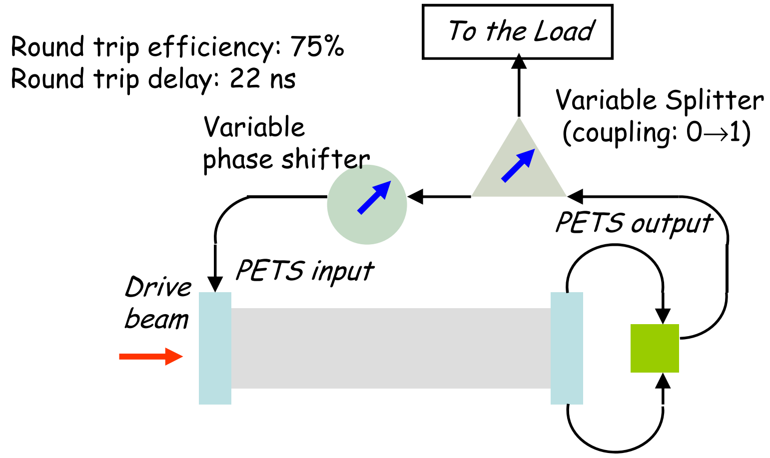
• Different scenarios of the drive beam generation in the CTF3



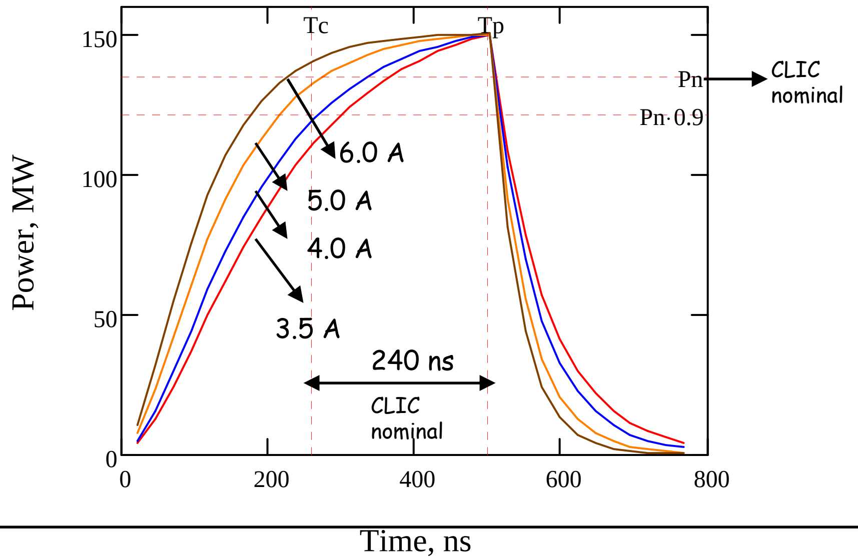
• To compensate for the lack of current, the active TBTS PETS length was significantly increased: from the original 0.215 m to 1 m.

Operation mode	#1	#2	#3	CLIC
Current, A	<30	14	4	101
Pulse length, ns	140	<240	<1200	240
Bunch Frequency, GHz	12	12	3	12
PETS power (12 GHz), MW	<280	61	5	135

• In order to demonstrate the nominal CLIC power level and pulse length, it was decided to implement a different PETS configuration – PETS with external re-circulation.



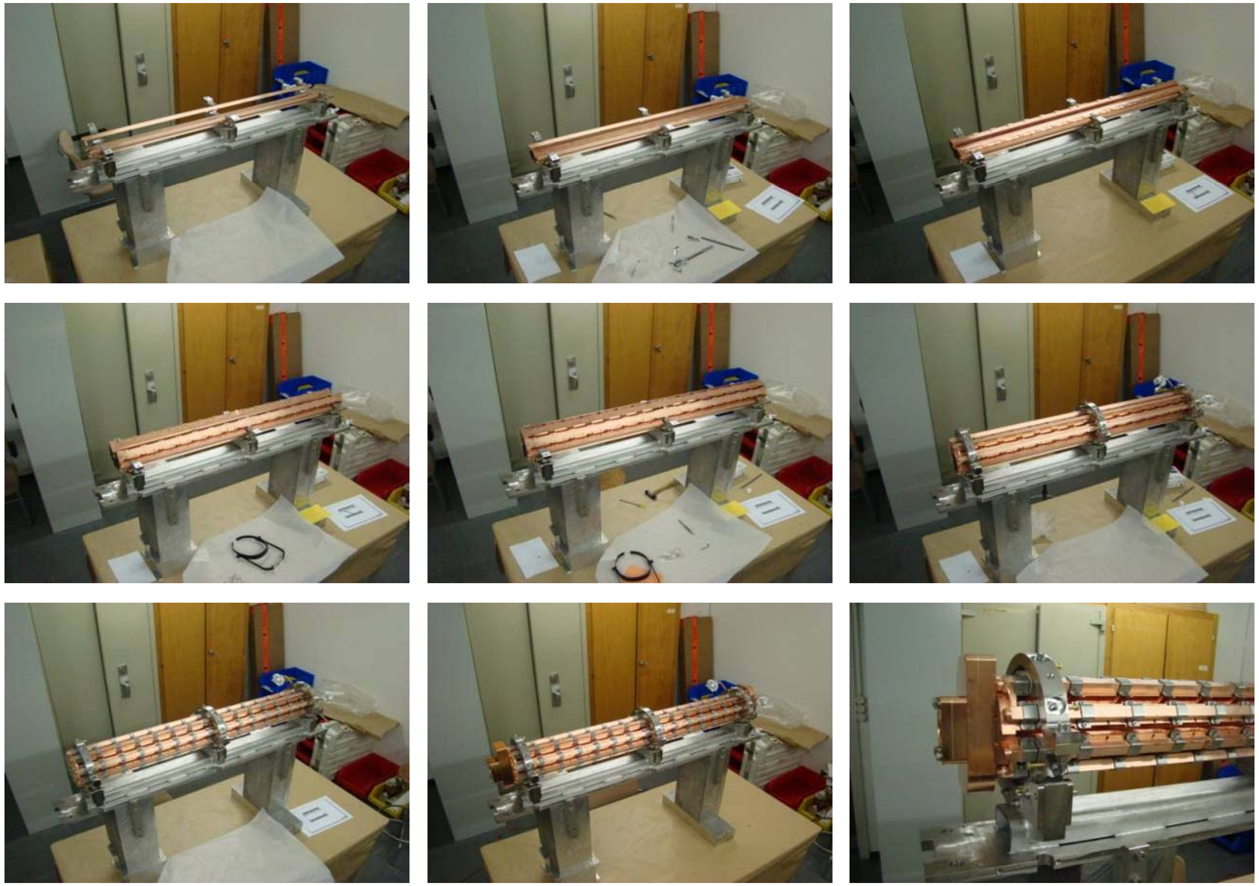
Expected PETS power production with re-circulation.
The calculation followed the measured performance of all the components

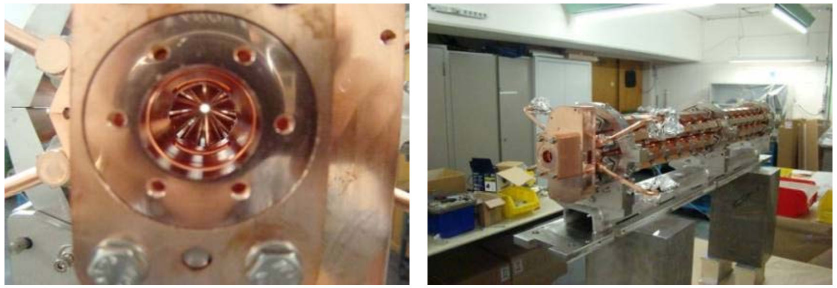


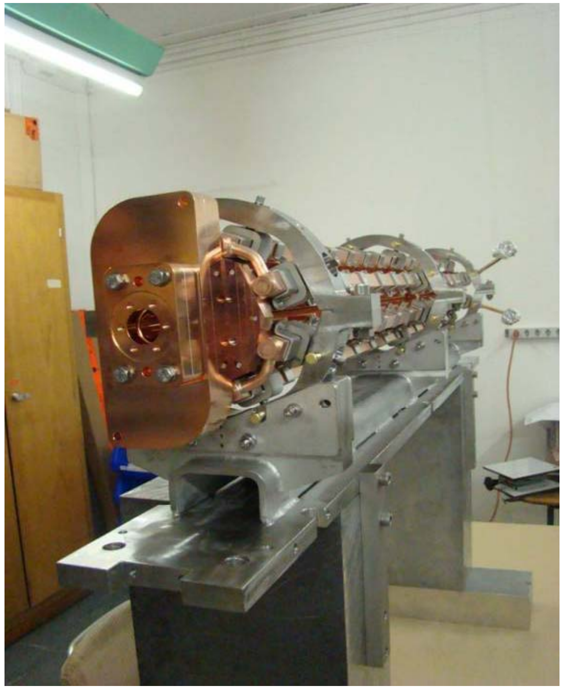
The PETS only

Target: RF power generation

Phase 1



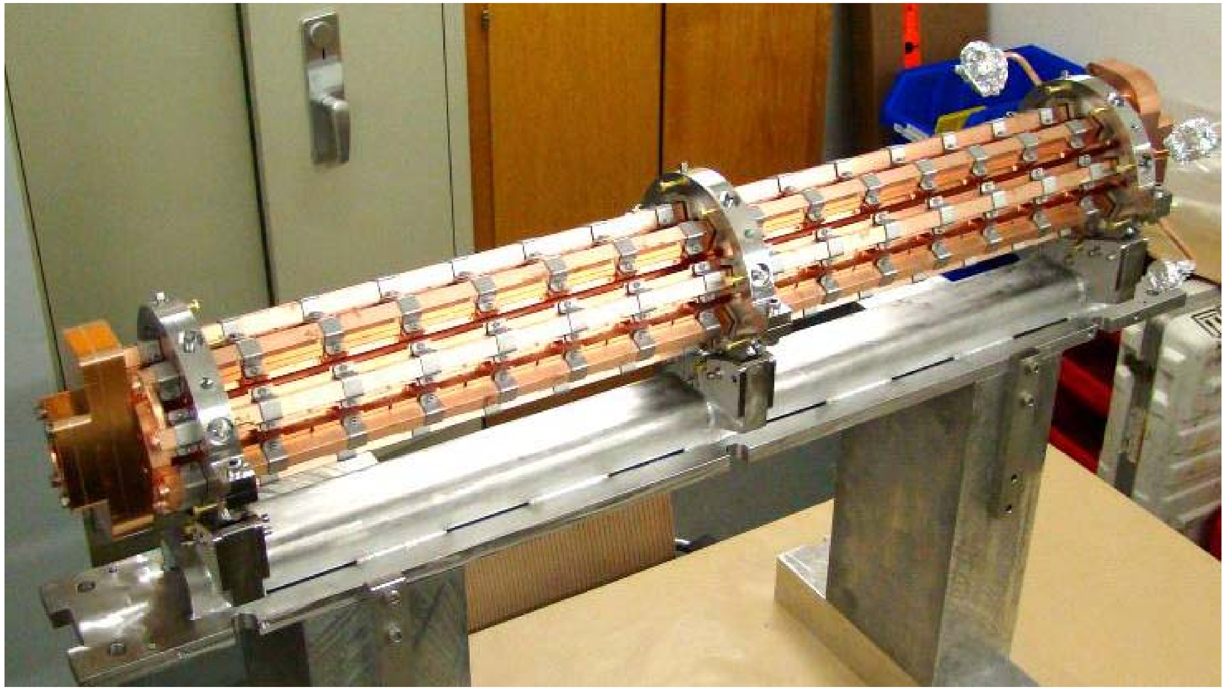


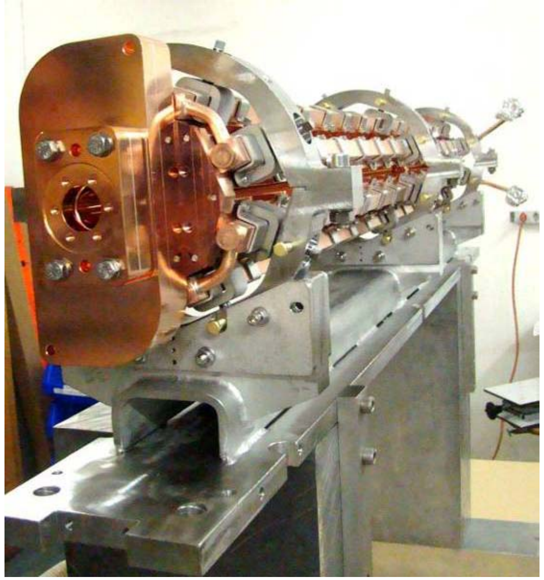


- PETS bars fabricated at VDL
- assembly on girder at CERN

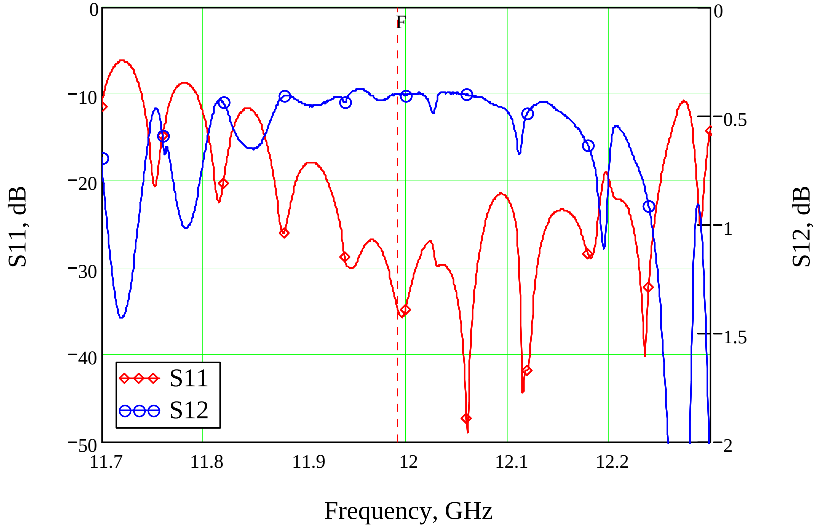
(successful assembly procedure)

12 GHz TBTS PETS final assembly





TBTS PETS RF Measurement results after final assembly



Ohmic efficiency budget:

$$\eta_{meas} = \exp\left[\frac{-\omega L_{PETS}}{Q v_{group}}\right] \times \eta^2_{coupler}$$

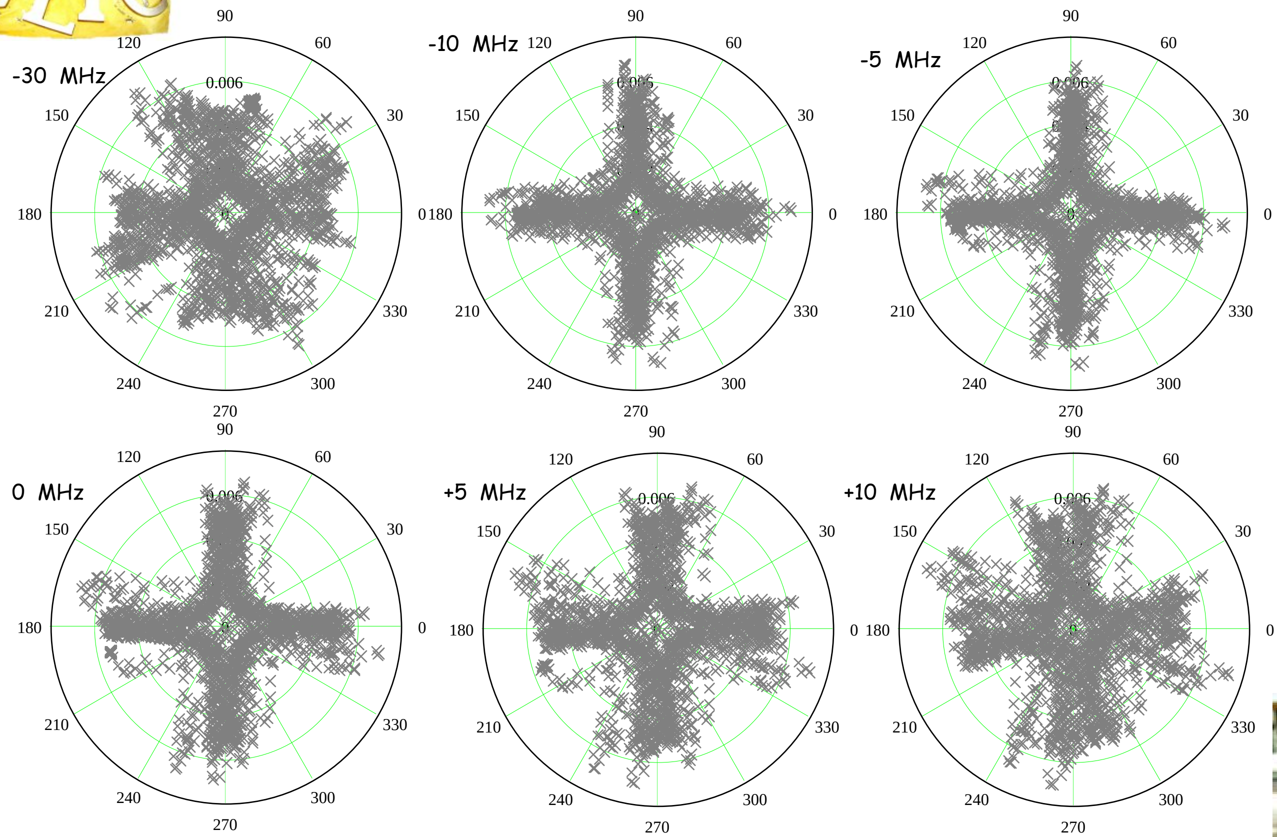
$$0.912 = 0.927 \times 0.992^2$$

Assuming theoretical losses in the PETS regular part, the power coupler ohmic efficiency is 0.992 (cf HFSS results - 0.99).

Group delay:

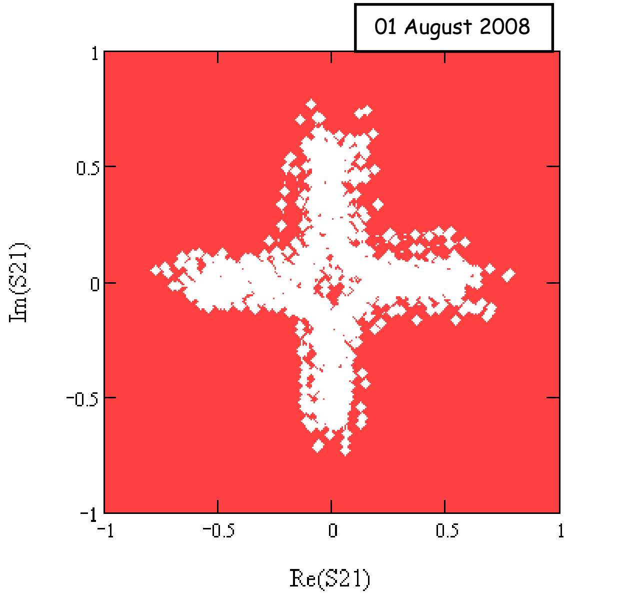
Measured:
Coupler-to-coupler, D_C = 2.0 ns
The whole PETS D_P = 10.05 ns
Active length: D_p-D_C = 7.47 ns
Calculated:
D=L $_{active}$/(βC) = 1.015/(0.459*C)= 7.35 ns

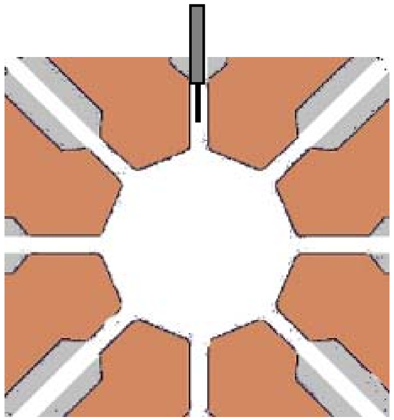
The S21 vector readings measured during the antenna movement.

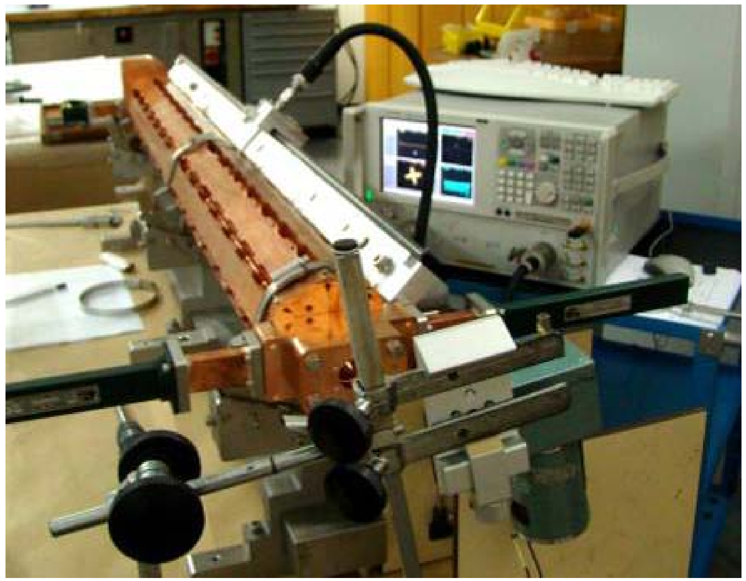


Sliding antenna raw data

Sliding antenna measurements (F=11.992 GHz)



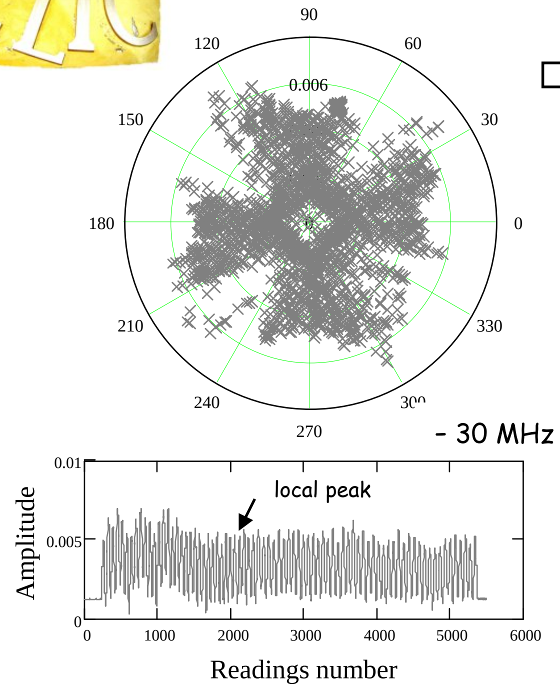




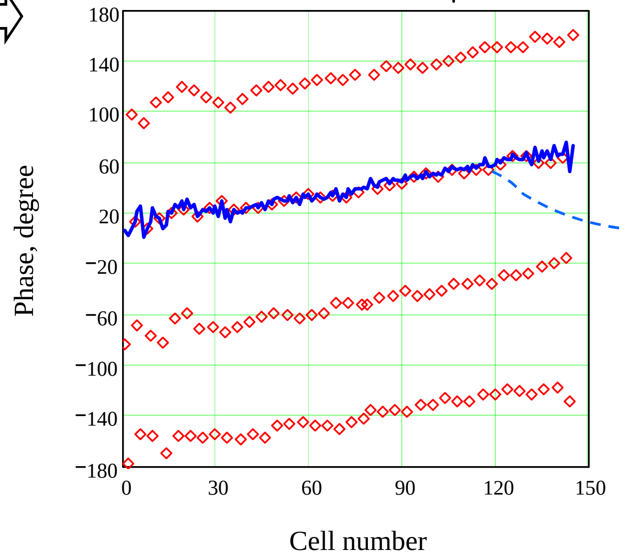
Antenna (loop) is positioned at the centre of one of the eight slot. The distance between the edge of antenna and the slot opening is ~ 0.5 mm.
Coupling: -50 dB

Sliding antenna results

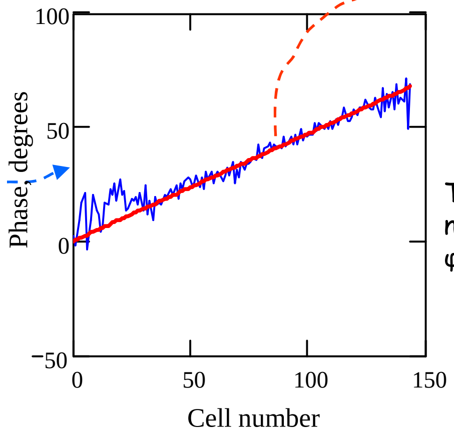
Raw data (example)



The phase at the position of each of the measured local peak



The interleaved (all cells) phase slope

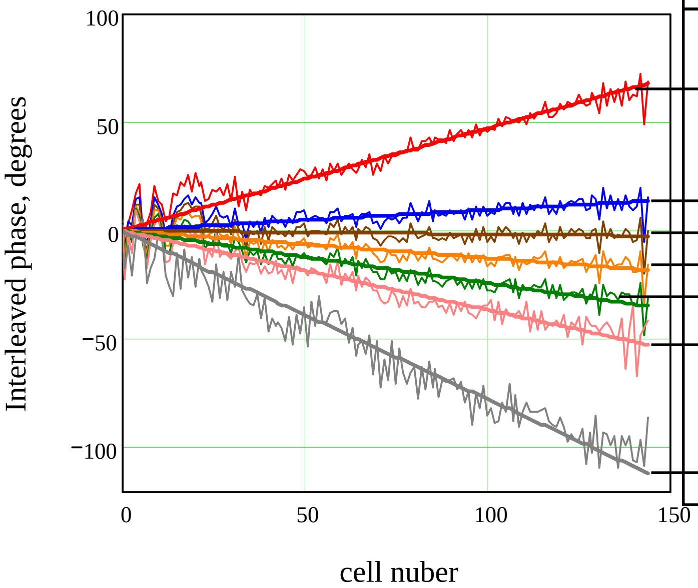


The phase slope linear fit:

$$Ph(n_c) = \varphi_0 + \Delta\phi \times n_c$$

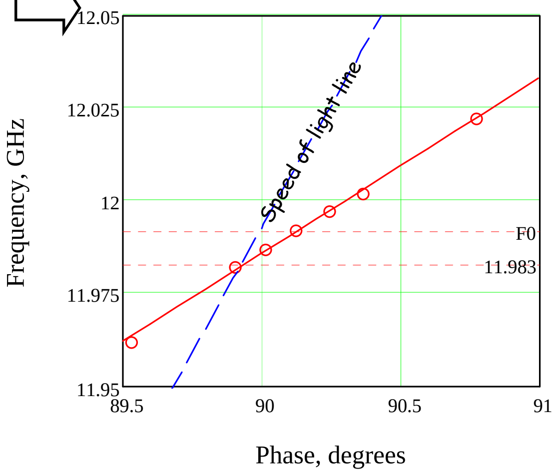
The phase advance per cell now can be calculated as:

$\varphi_{cell} = 90 - \Delta\varphi;$

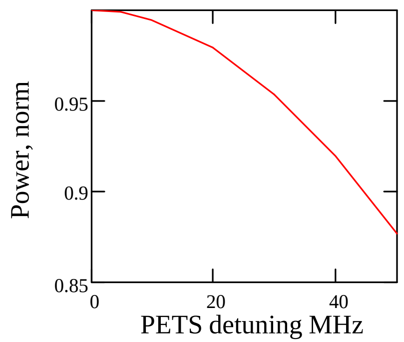


ΔF, MHz	φ/cell
-30	89.53
-10	89.91
-5	90.02
0	90.13
+5	90.24
+10	90.37
+30	90.78

Reconstructed 'local' dispersion curve



$$P = I^2 F_b^{\,2} \omega_0 \frac{R/Q}{V_g\, 4} \left| \int_0^L \exp\left(i \frac{\Delta\omega}{2\, c} \frac{1-\beta}{\beta} z \right) dz \right|^2$$

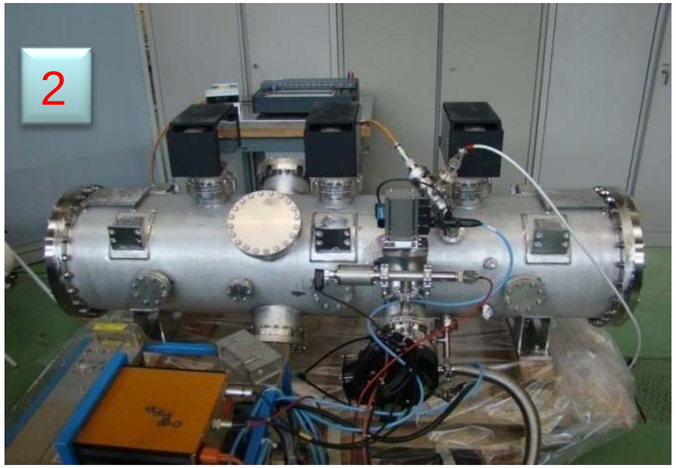


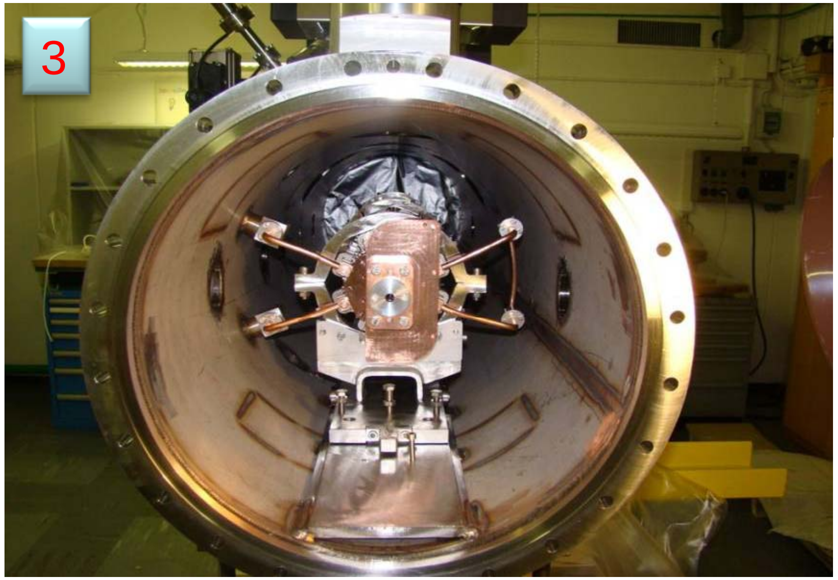
The measured synchronous frequency of the TBTS PETS is **11.983 GHz** at air and 25 °C (9 MHz lower the nominal one)

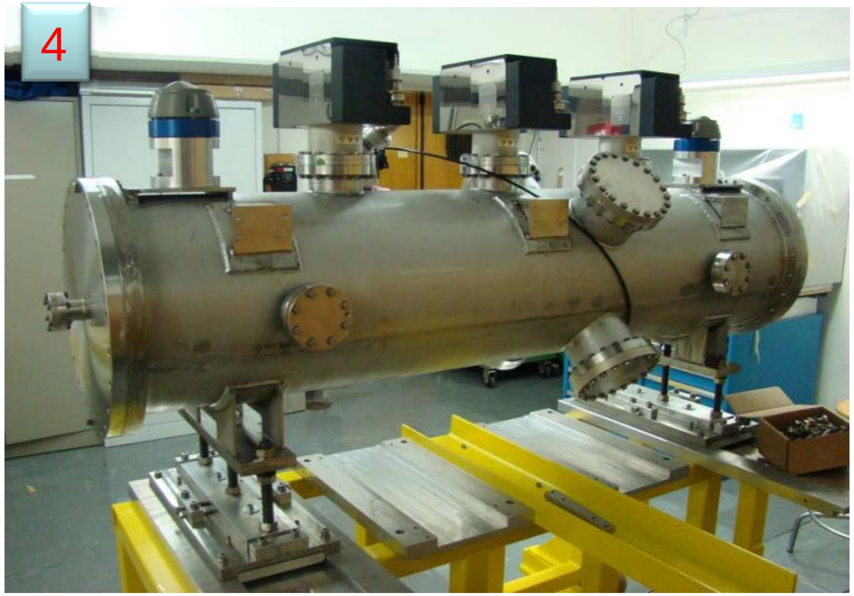
For the measured TBTS PETS detuning (9 MHz), the power production efficiency of **99.6%** is expected.

Phase 1 - Tank

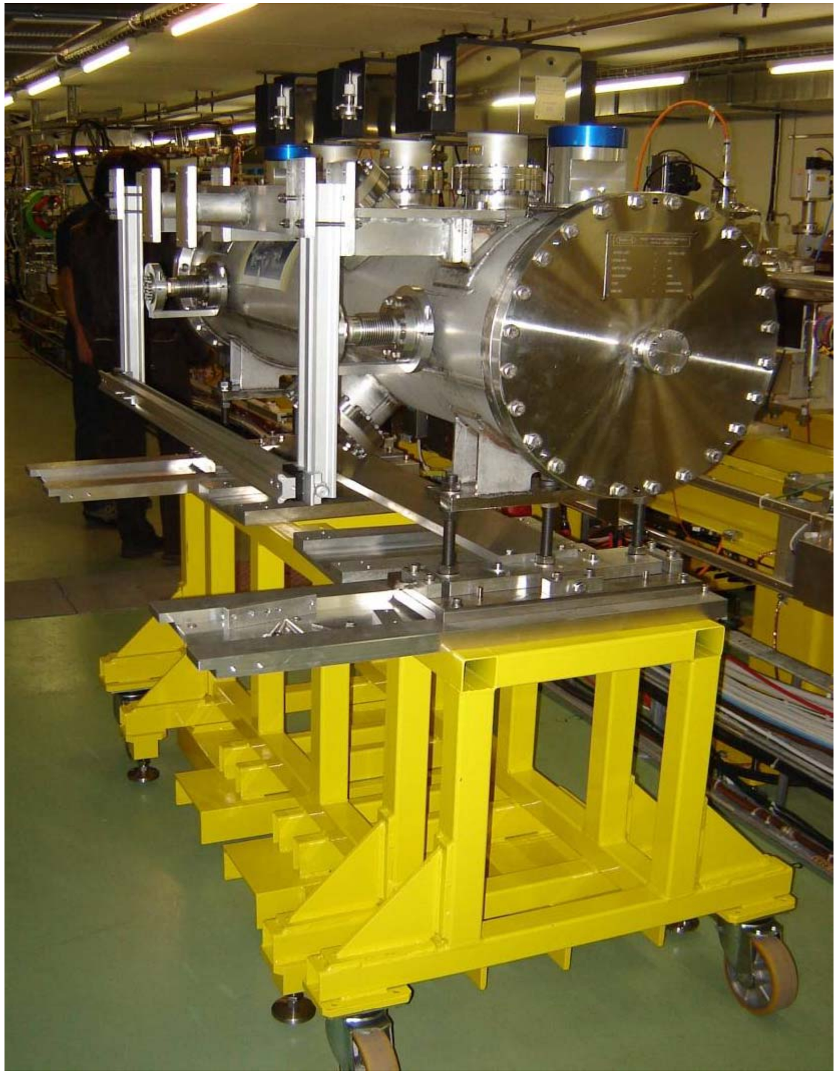
1. Tank designed at CERN and manufactured in Pakistan NCP Islamabad (two units)
2. Leak tightness test at CERN
3. PETS assembly with girder slided inside tank
4. Tank with PETS transported to CLEX

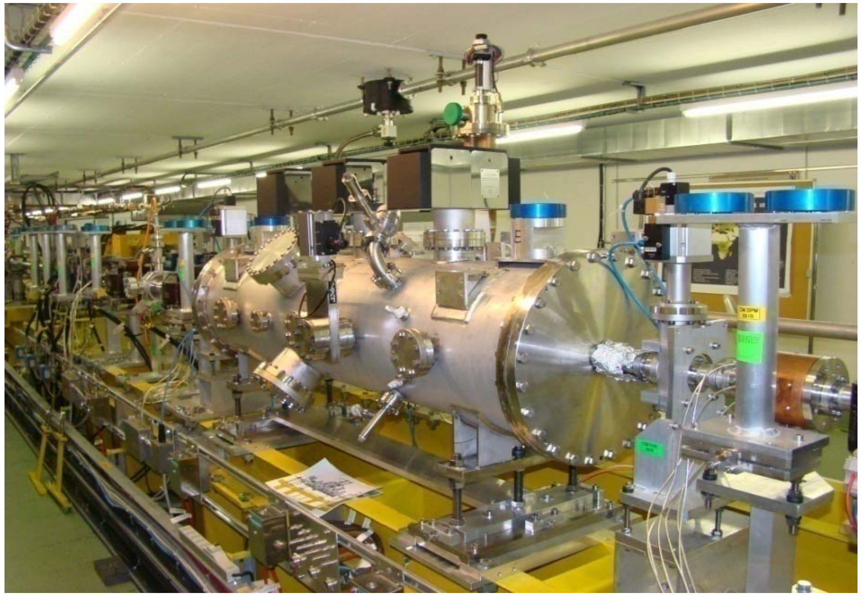






Phase 1 - CLEX





Picture of the day (16.10.2008)