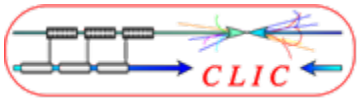

HIGH-POWER TESTING OF X-BAND CLIC POWER GENERATING STRUCTURES

E. Adli, A. Cappelletti, S. Doebert, G. Riddone, I. Syratchev, W.Wuensch, CERN, Geneva, Switzerland
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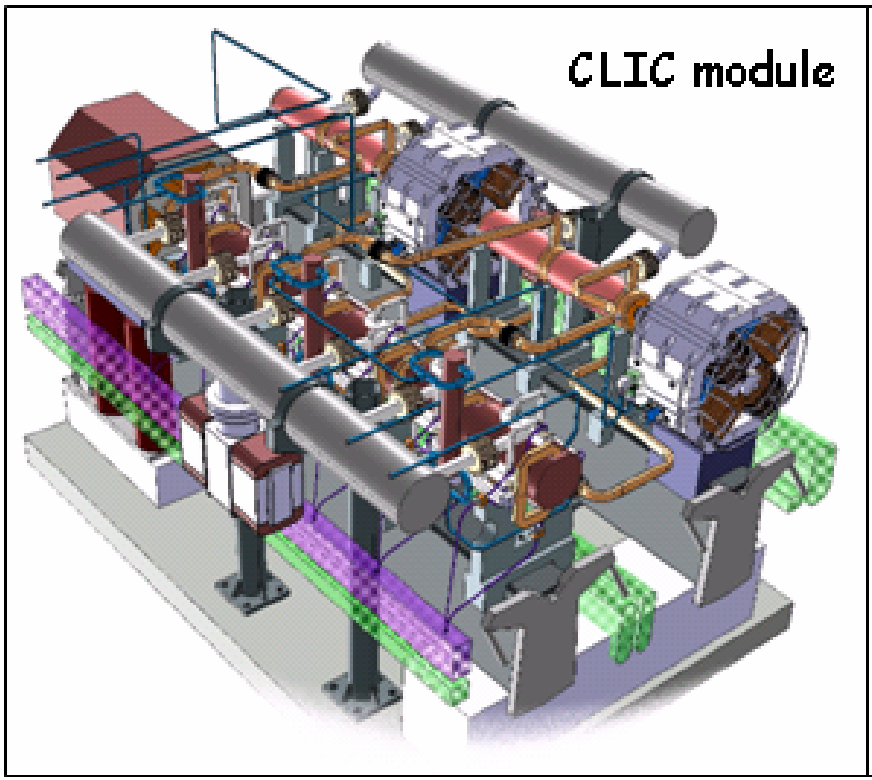
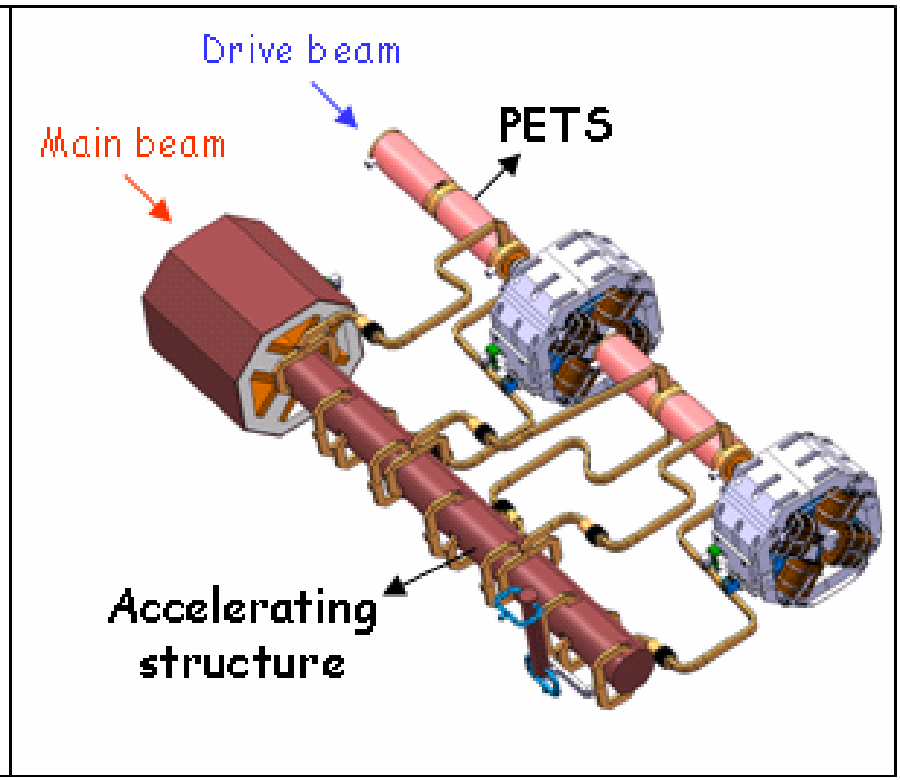
S. Tantawi, V. Dolgashev, J. Lewandowski SLAC, Stanford, CA, U.S.A

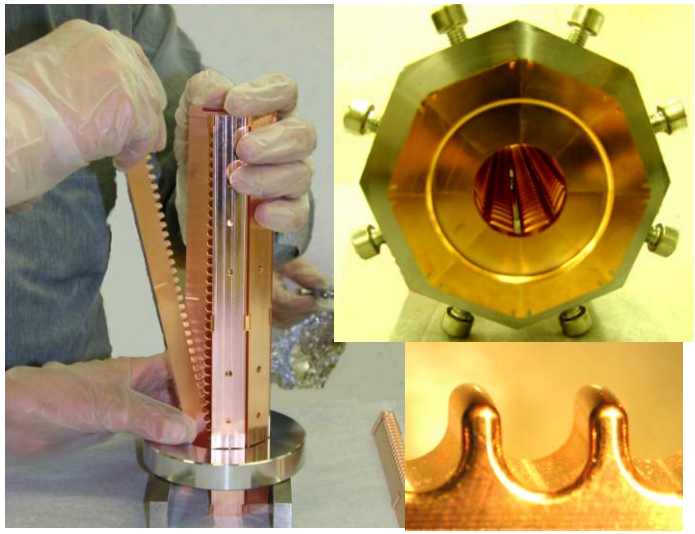
A fundamental element of the CLIC concept is two-beam acceleration, where RF power is extracted from a high-current and low-energy beam in order to accelerate the low-current main beam to high energy.

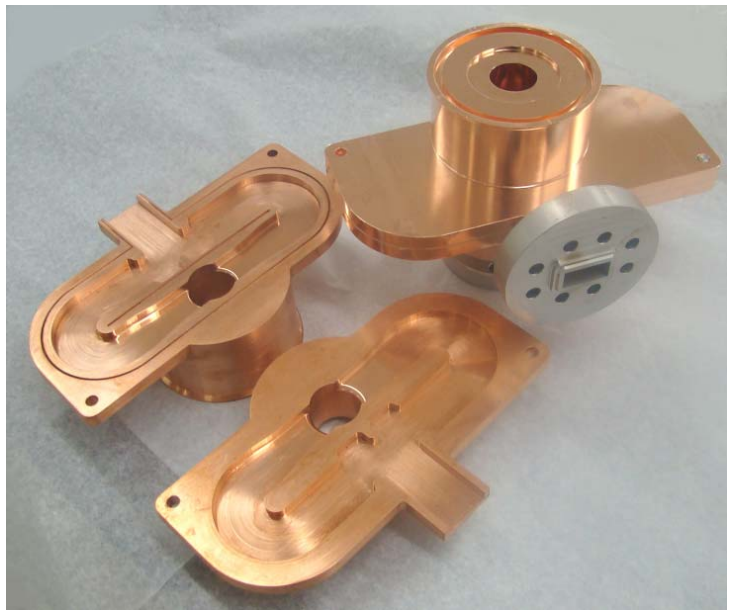


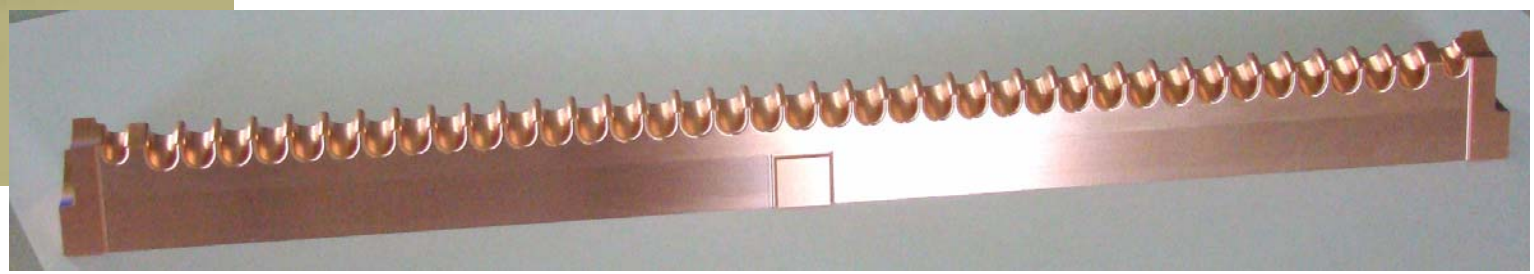


The PETS is large aperture, high-group velocity and overmoded periodic structure. In its final configuration, PETS comprises eight octants separated by 2.2 mm wide HOM damping slots.

PETS should generate 135 MWx240 ns 12 GHz RF pulses from 100 A drive beam

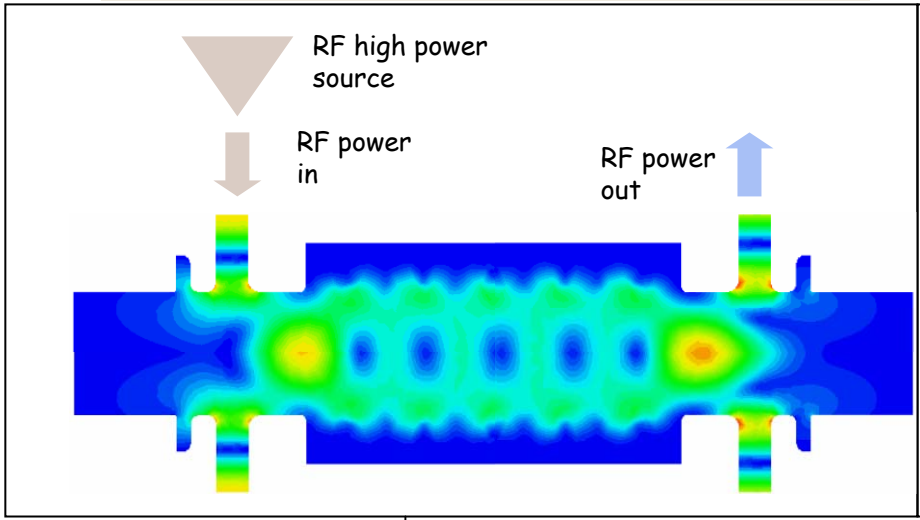




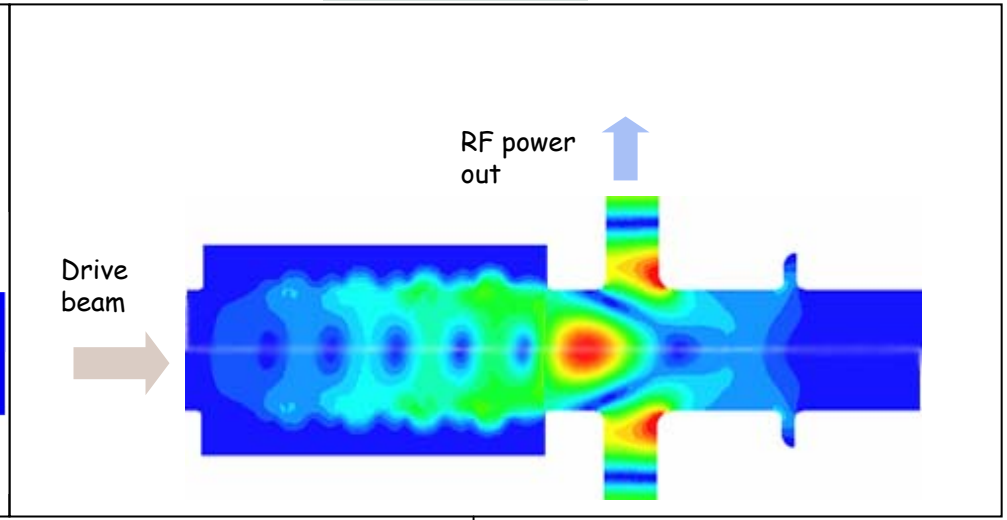


RF power sources

External RF power source



Drive beam



ASTA (SLAC)

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

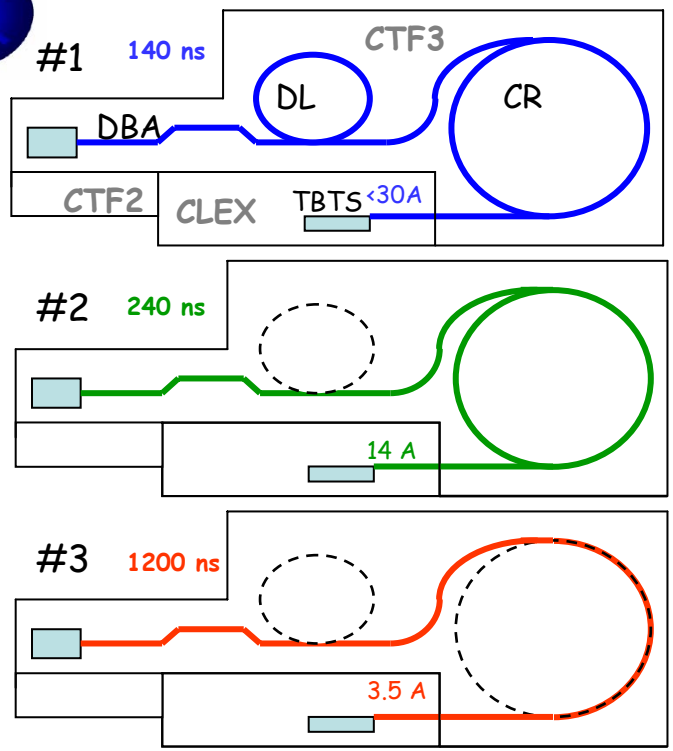
- Access to the very high power levels (300 MW) and nominal CLIC pulse length.
- High repetition rate – 60 Hz.

CTF3 (CERN + Collaborations)

Two beam test stand (CERN + Collaborations)

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

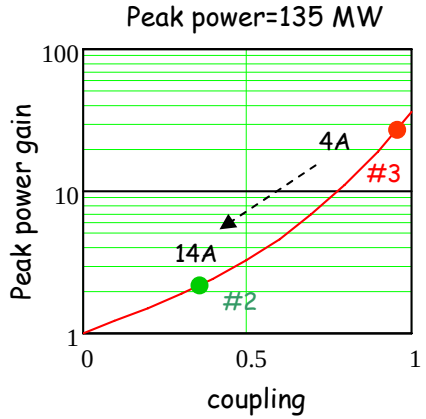
• Different scenarios of the drive beam generation in the CTF3

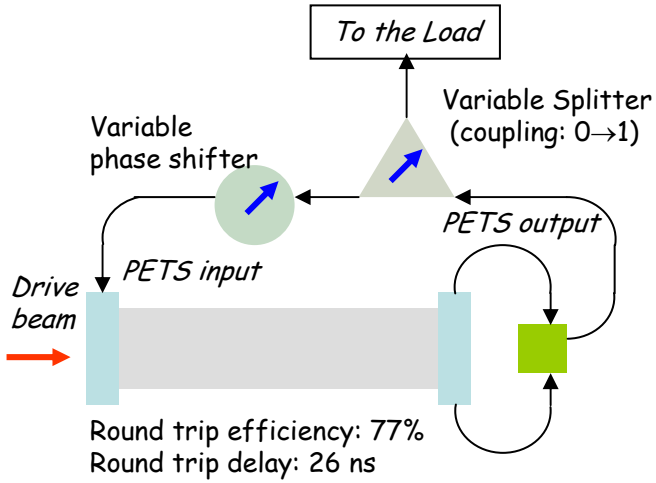


• To compensate for the lack of current, the active TBTS PETS length was significantly increased: from the original 0.215 m to 1 m.

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

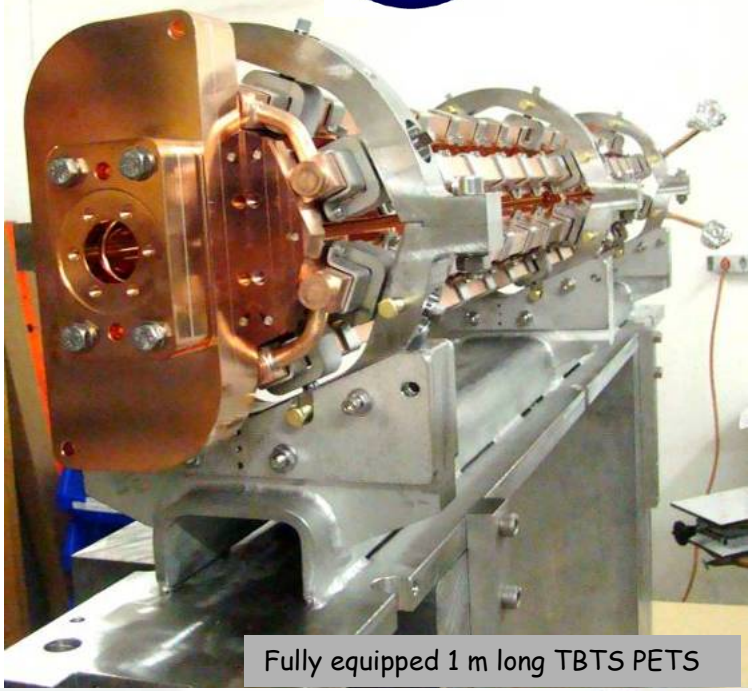
• In order to demonstrate the nominal CLIC power level and pulse length, it was decided to implement a different PETS configuration – PETS with re-circulation.





The new CLIC experimental area (CLEX) has been partially completed as part of the CTF3. When fully equipped, the CLEX will comprise a number of experiments. One of them is the Two Beam Test Stand (TBTS). The TBTS is unique and versatile facility where the two-beam acceleration is planned to be demonstrated in 2009

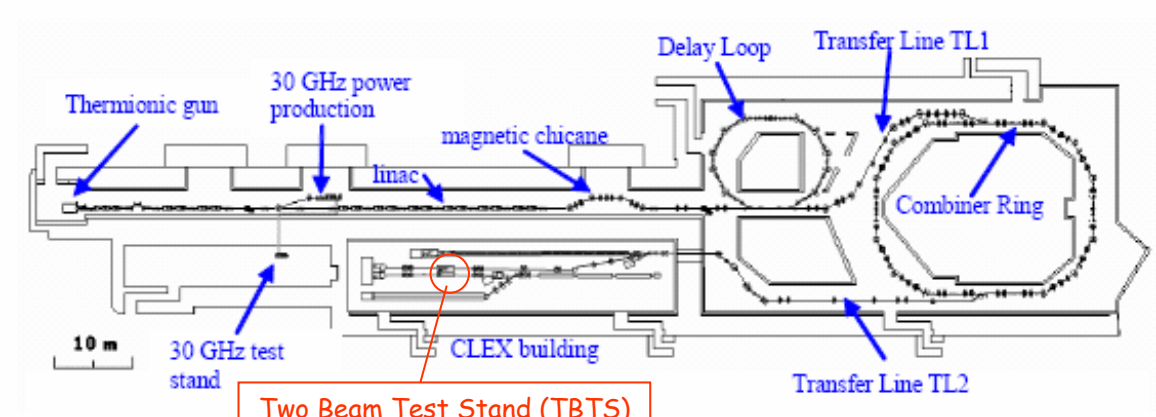
PETS tank installed in TBTS (October 2008)

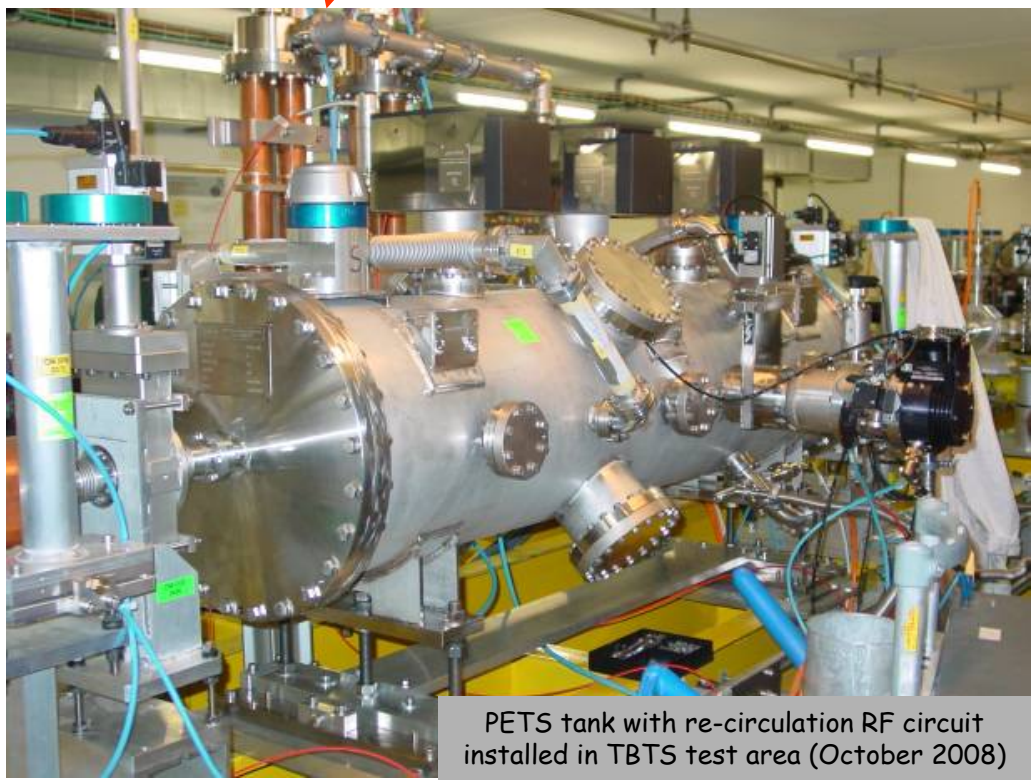


Fully equipped 1 m long TBTS PETS

Variable high power RF power splitter

Variable high power RF phase shifter

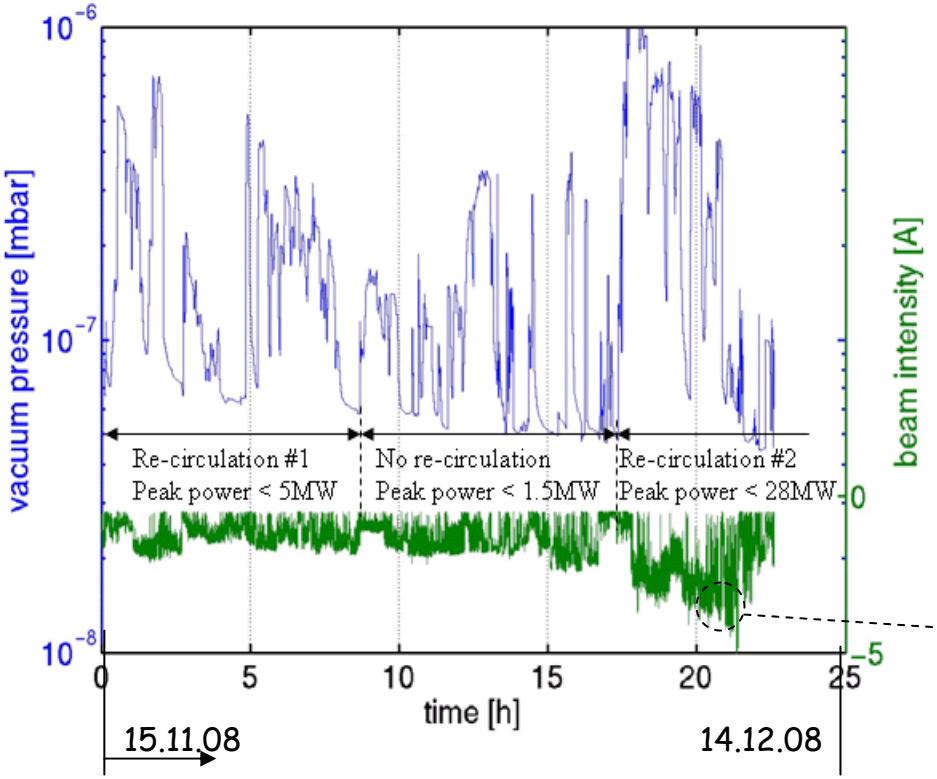


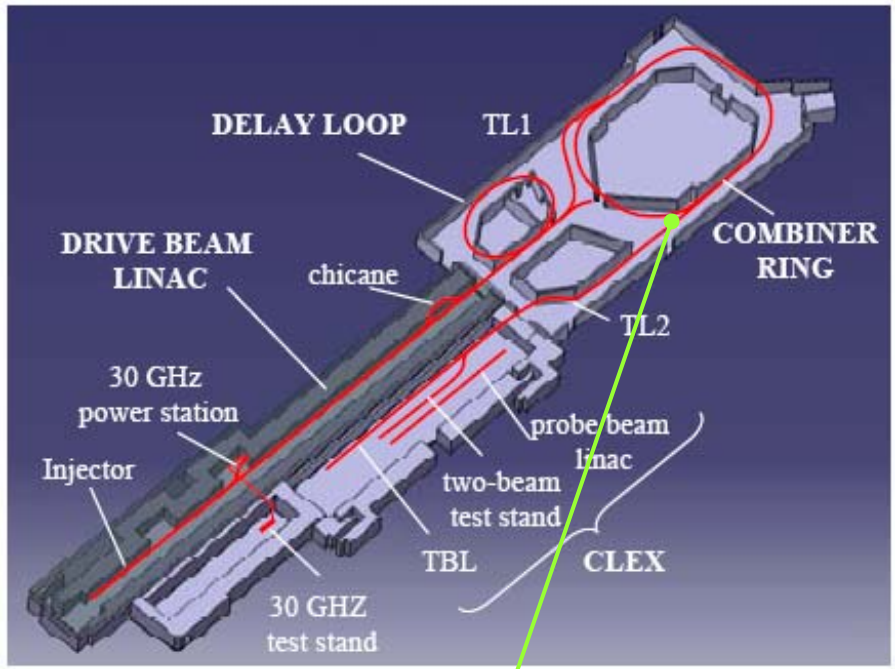


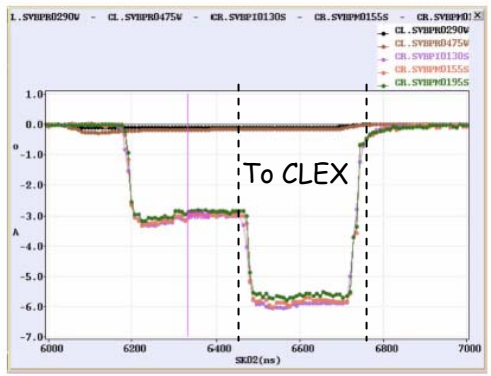
PETS tank with re-circulation RF circuit installed in TBTS test area (October 2008)

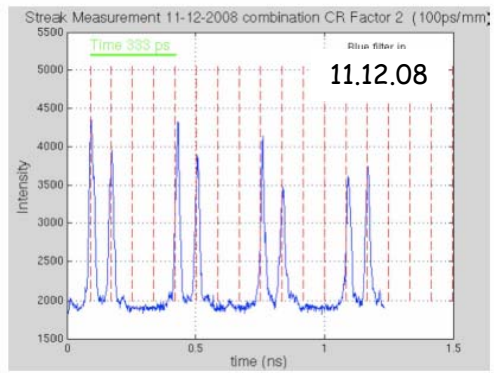
Drive beam current in TBTS (2008)

PETS processing history in 2008

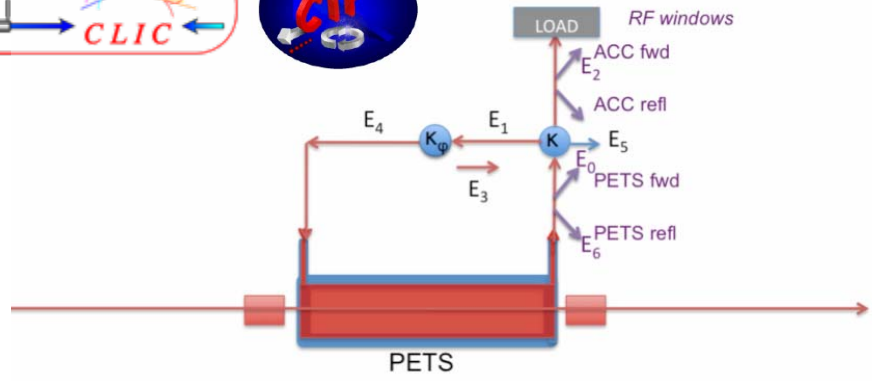




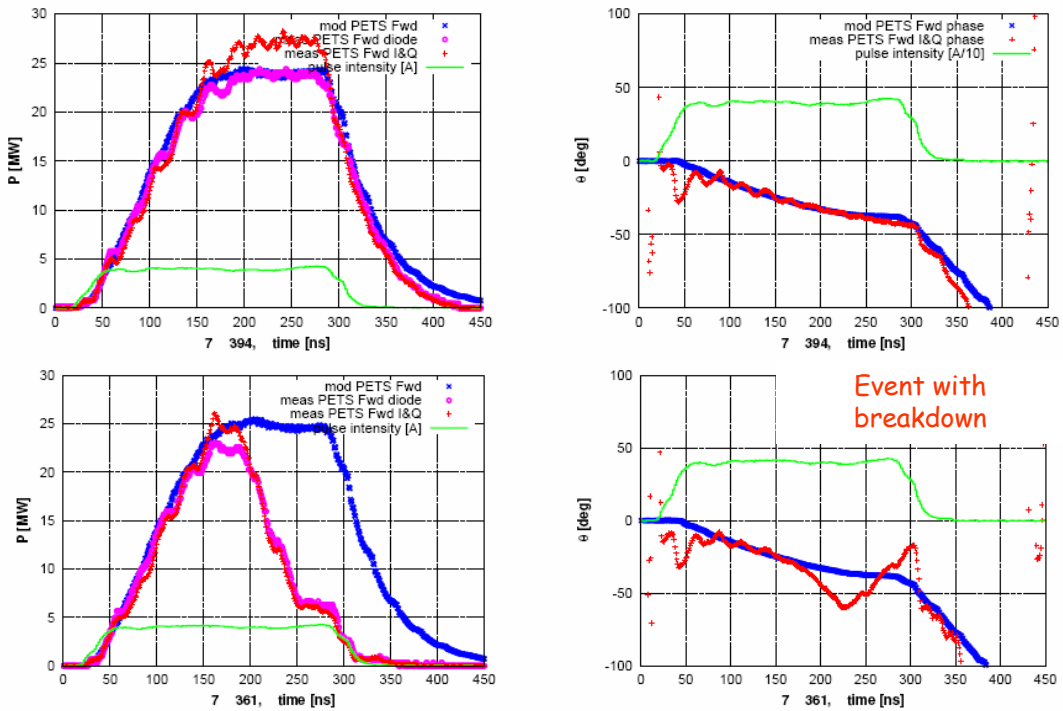




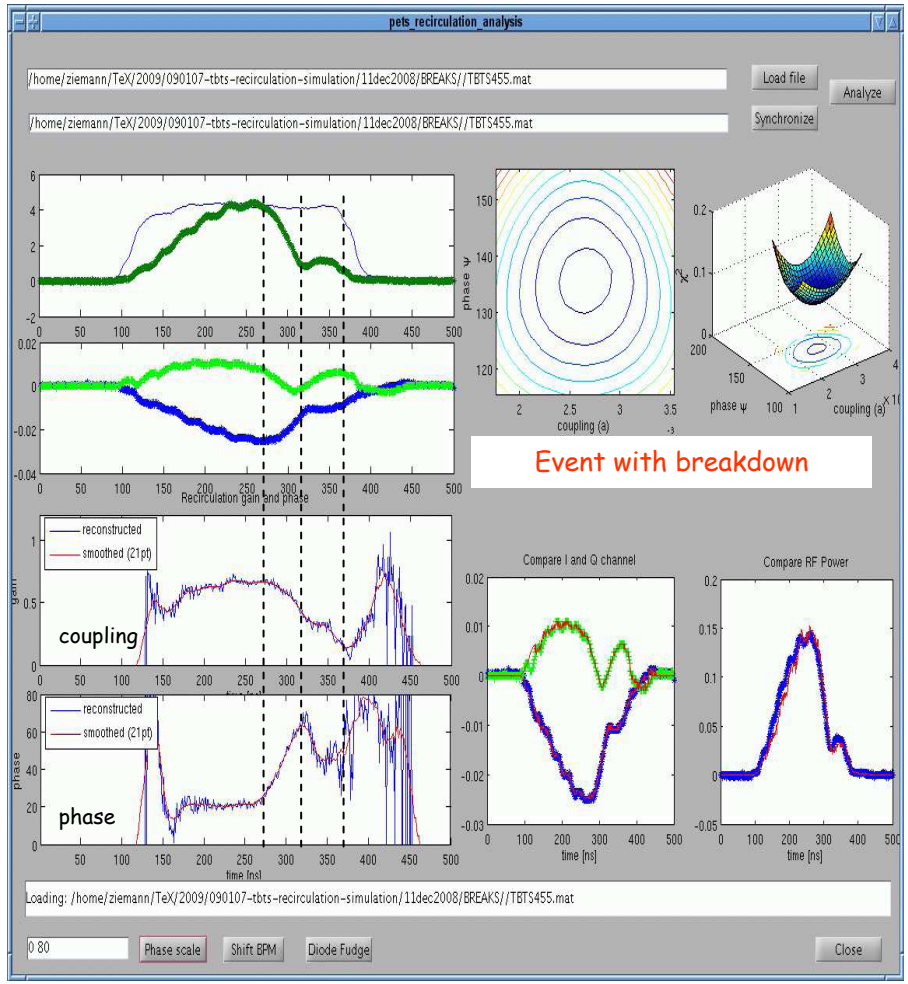
Example of the beam intensity and bunch train time structure after combination x2 in the Combiner Ring



Model with constant coupling and phase

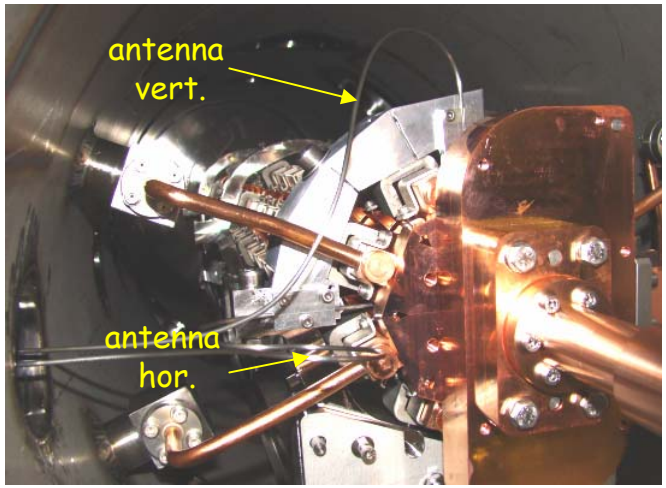


Model with time dependant coupling and phase



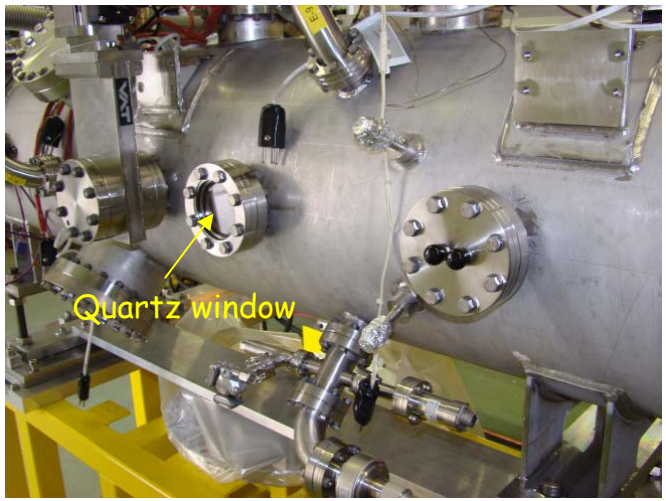
E. Adli, 'Analysis of the first 12 GHz PETS tests with beam using a constant parameter recirculation model', CTF3-Note 095, Geneva, CERN, 2009.

V. Ziemann, 'Data Analysis for PETS Recirculation', CTF3-Note 094, Geneva, CERN, 2009.



Two RF pick-ups were installed into the damping slots:

- Will allow monitoring of the beam position inside the PETS
- If happened, to measure RF signals in the slots during breakdown event.

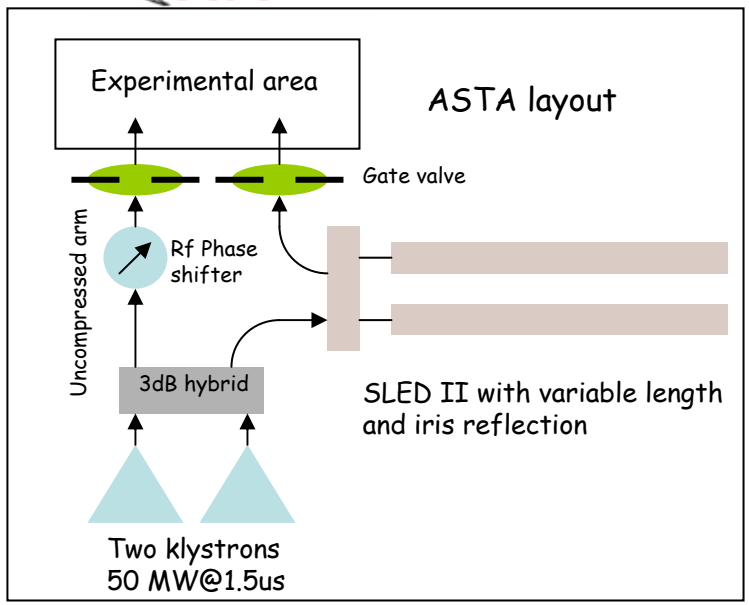


The quartz window was installed on the PETS tank to register the light emission during breakdown event.

PETS testing in ASTA

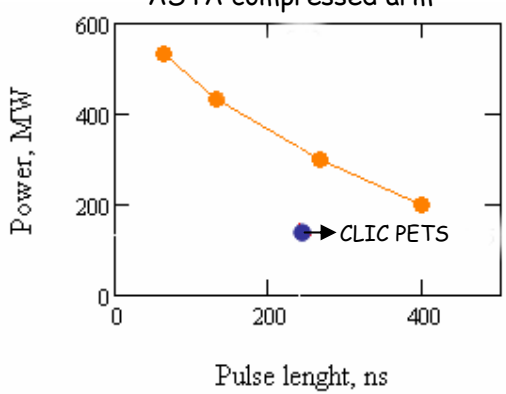
The ASTA pulse compressor with variable delay in delay-lines

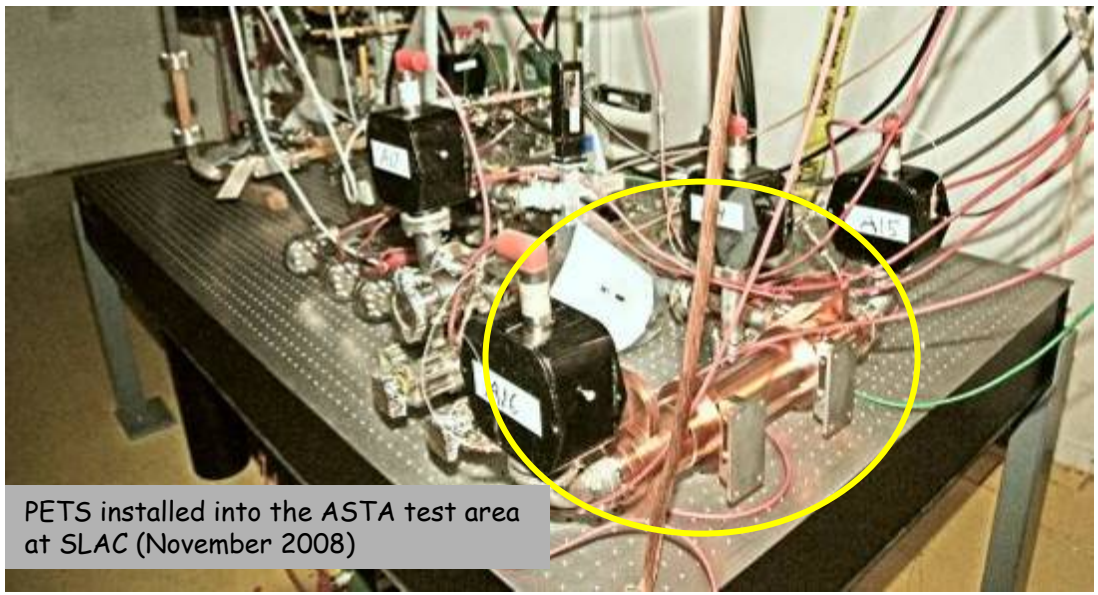
The ASTA pulse compressor with variable iris



ASTA is a new generation general purpose test stand, which will allow processing the various types of the high power RF equipment at X-band. The facility can provide a very versatile pulse length and power level.

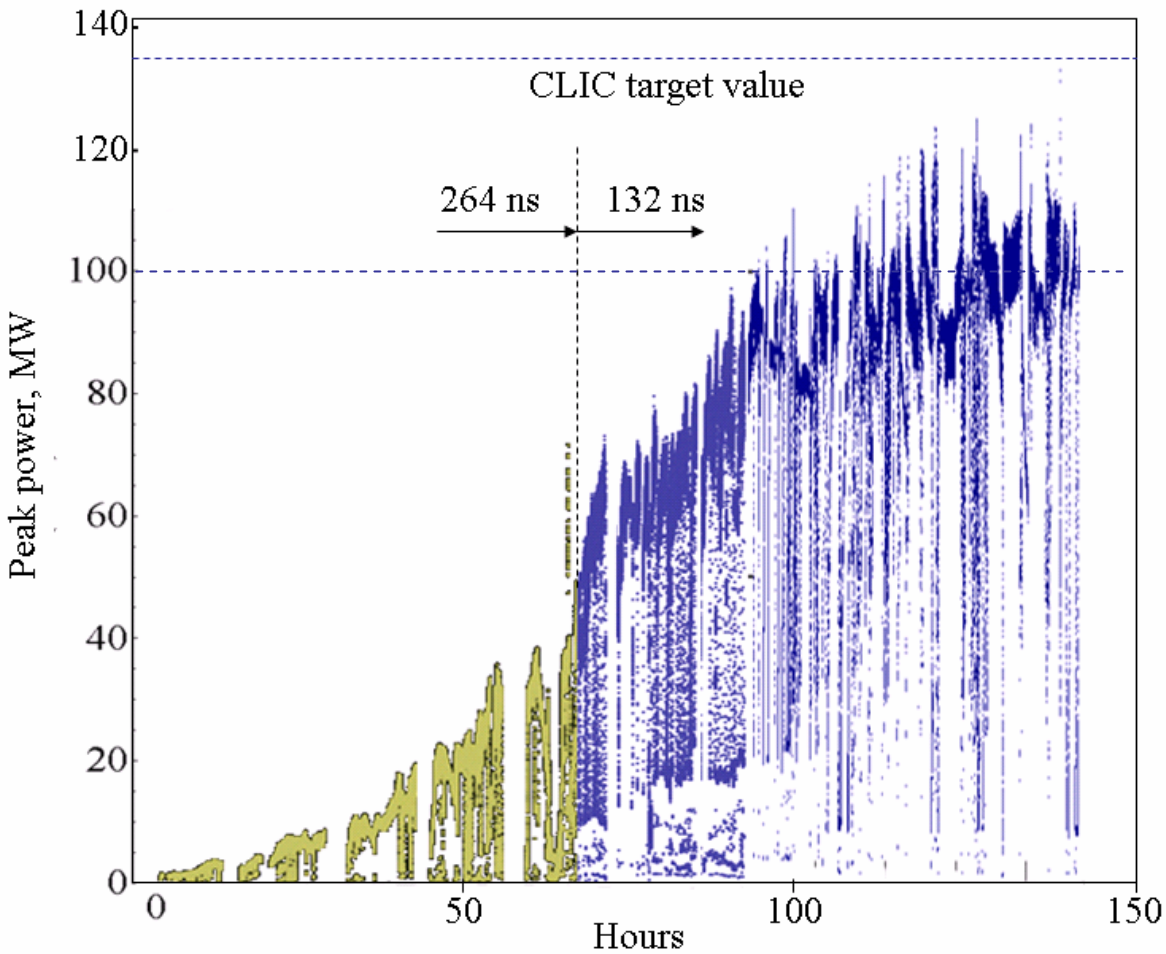
RF pulse @ power in the ASTA compressed arm





PETS installed into the ASTA test area at SLAC (November 2008)

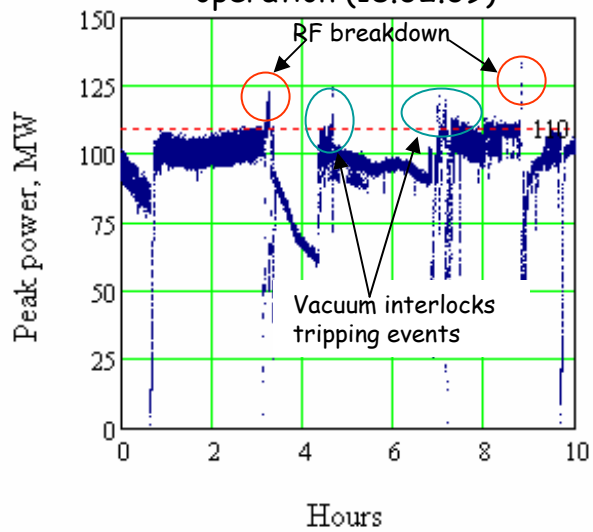
The winter 2008/09 PETS processing history in ASTA

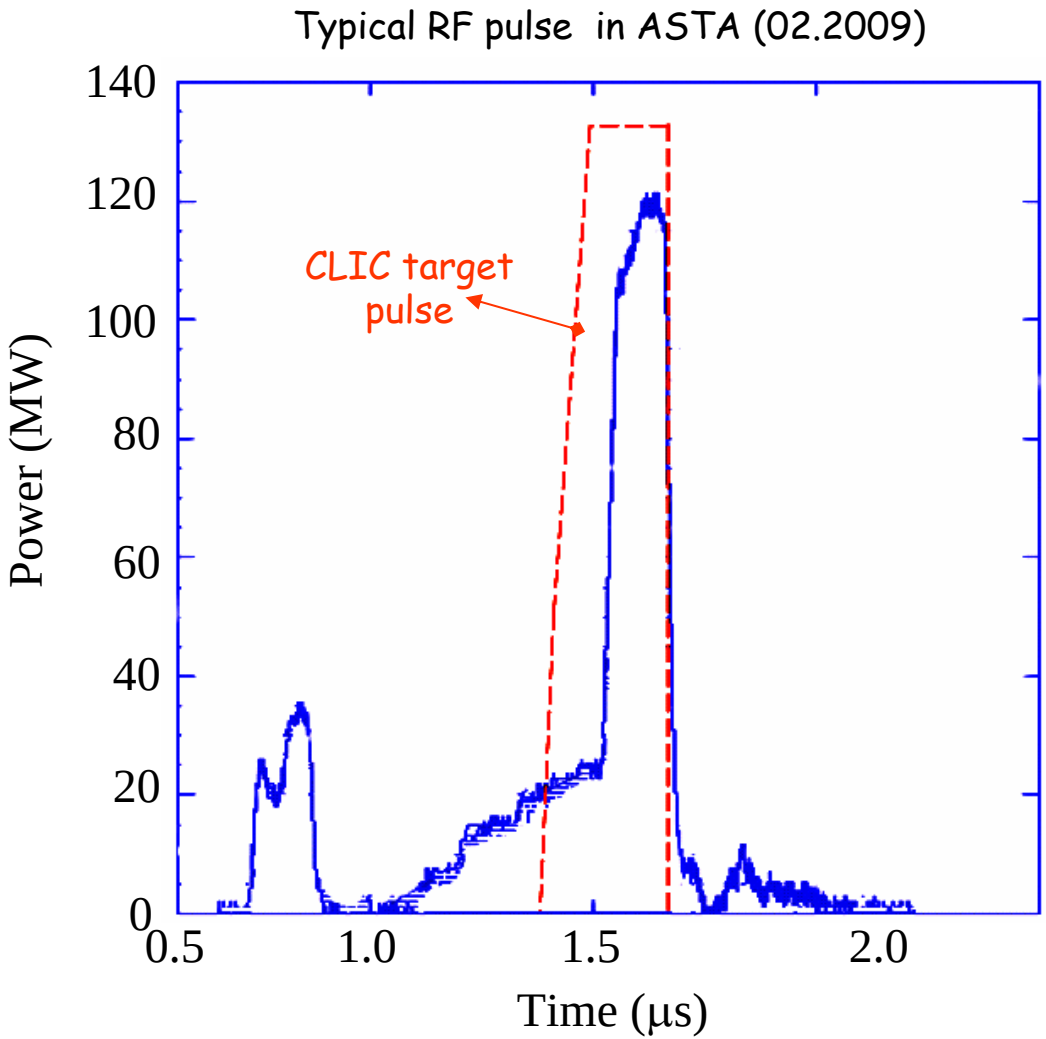


At a peak power level above 110 MW, the processing speed was practically saturated, mostly limited by vacuum interlocks on the ion pumps, especially after the breakdown event .

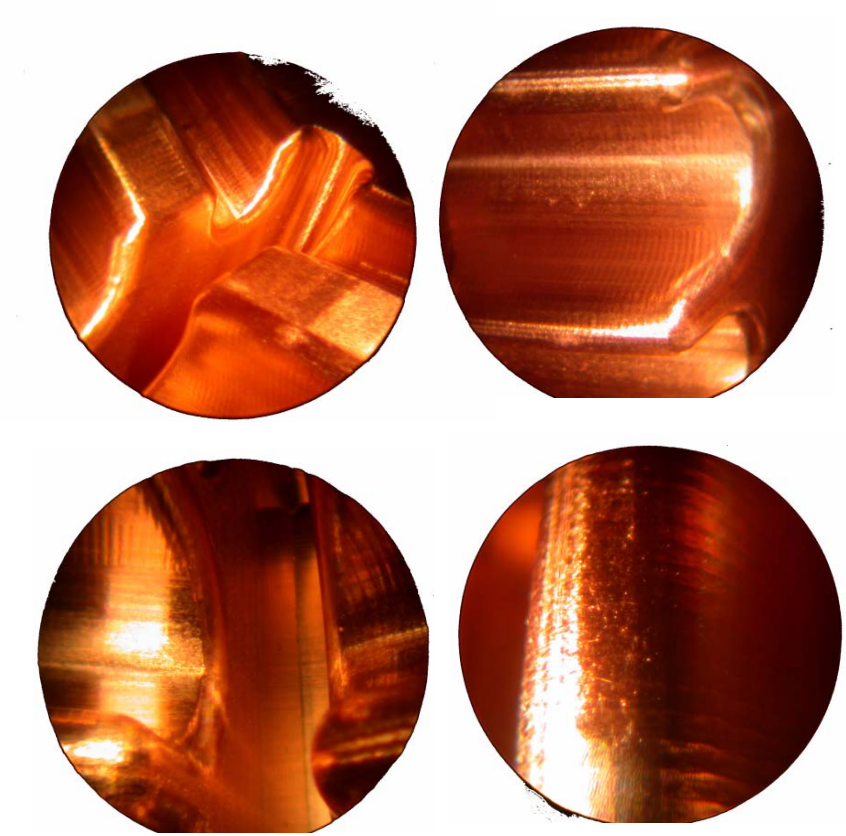
In April 2008, the PETS was removed and RF/vacuum screens were installed at the PETS extremities to avoid possible virtual vacuum activity in the pumps themselves inspired by the RF power leakage out through the PETS power couplers into the pumps.

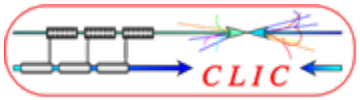
Zoom into the last 10 hours of operation (18.02.09)





There we no traces of damage or surface degradation observed during visual inspection.





SUMMARY

- The two PETS prototypes have been fabricated and installed in the TBTS tests area at CERN and ASTA at SLAC.
- The processing of the scaled 11.424 GHz PETS is underway at SLAC. To date, the structure arrived at ~ 120 MW x 132 ns (cf. 135 MW x 240 ns in CLIC).
- The 12 GHz power generation in the PETS with re-circulation has been first demonstrated at CERN, yet at a moderate (~ 30 MW) RF power level. The new drive beam will be available in TBTS early summer 2009.