TBL as a 12 GHz power source, overview and first results from commissioning

- Current status of TBL
- Status of series production
- First results form commissioning
- What's next ? TBL upgrade

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TBL vs CLIC

Parameter	Symbol	TBL	CLIC
Number of PETS [-]	N_{PETS}	16	1492
Length of PETS [m]	L_{PETS}	0.80	0.21
Initial average current [A]	I_0	28	101
Power per PETS [MW]	P	$\sim$138	135
Initial energy [MeV]	E_0	150	2400
Mean energy extracted [%]	η_{extr}	$\sim$54	84
PETS sync. freq. [GHz]	f_{rf}	12	12
Number of FODO cells [-]	N_{FODO}	8	524
Length of FODO cells [m]	L_{FODO}	2.82	2.01
Pulse length [ns]	t_{pulse}	140	240
Transient length [ns]	t_{fill}	3	1
Bunch rms length [mm]	σ_z	1.0	1.0
Init. norm. emittance [μm]	$\epsilon_{\mathrm{N\,x,y}}$	150	150
Beam pipe radius [mm]	a_0	11.5	11.5

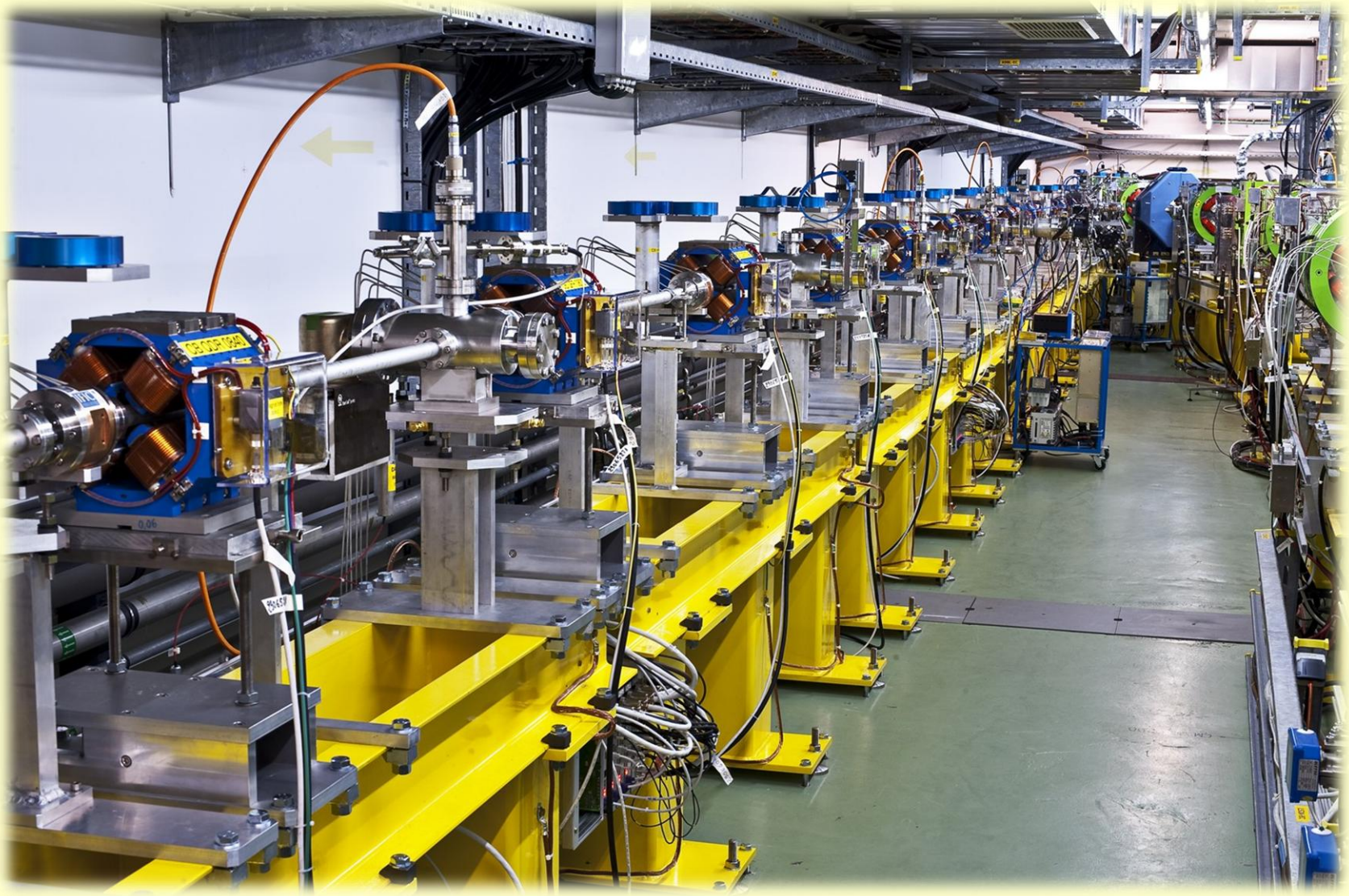
PETS are designed to produce nominal CLIC power of 135 MW for nominal 28 A CTF3 current

TBL status

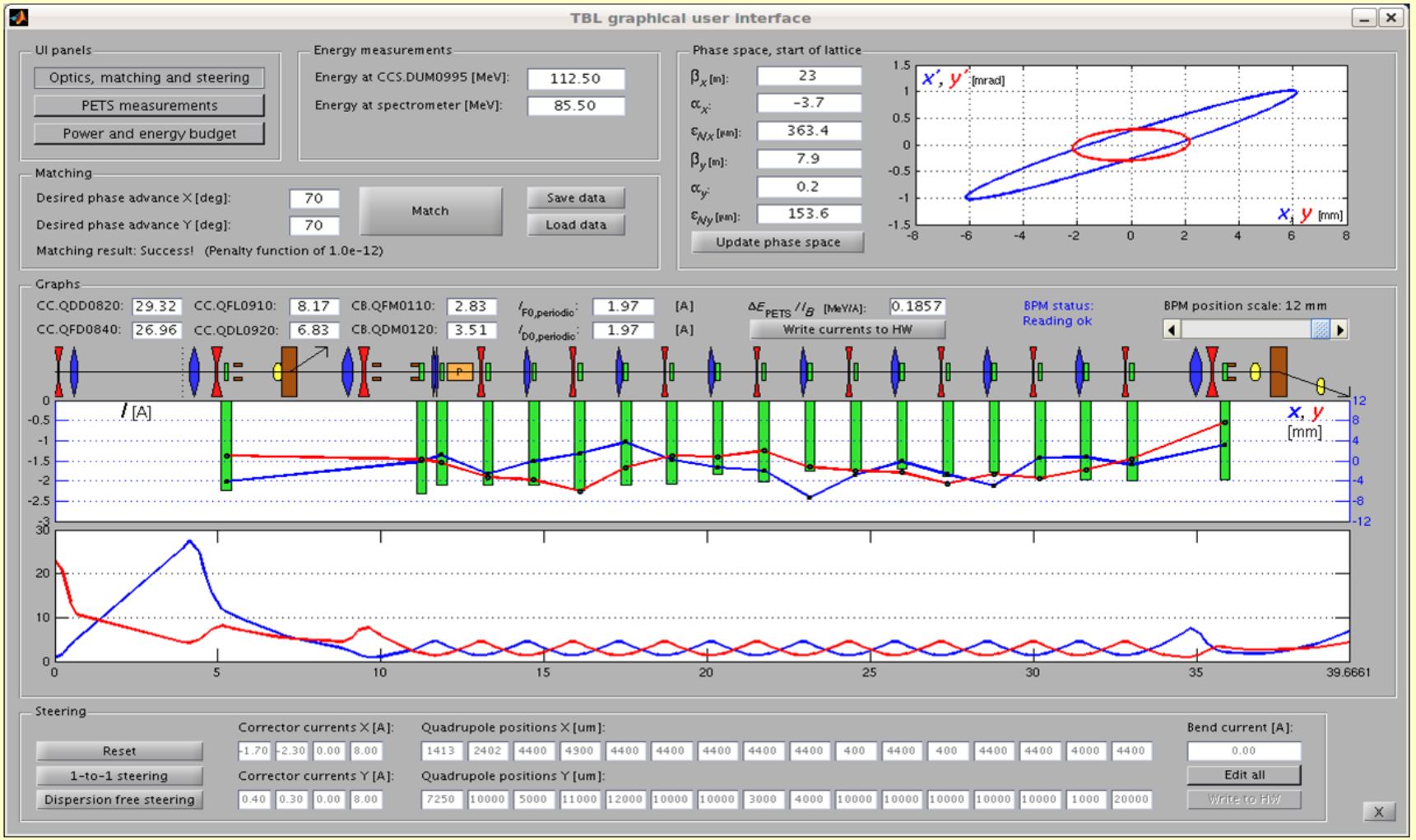
- Beam line including PETS prototype installed
  all Quads on movers,
  BPM's with new read out electronics,
  diagnostic section with emittance meter and time resolved spectrometer

- First commissioning and measurements performed
  PETS qualified and found consistent up to 20 MW
  beam matching and transport performed
  end of line spectrometer tested
  BPM resolution measured
  Magnet movers tested

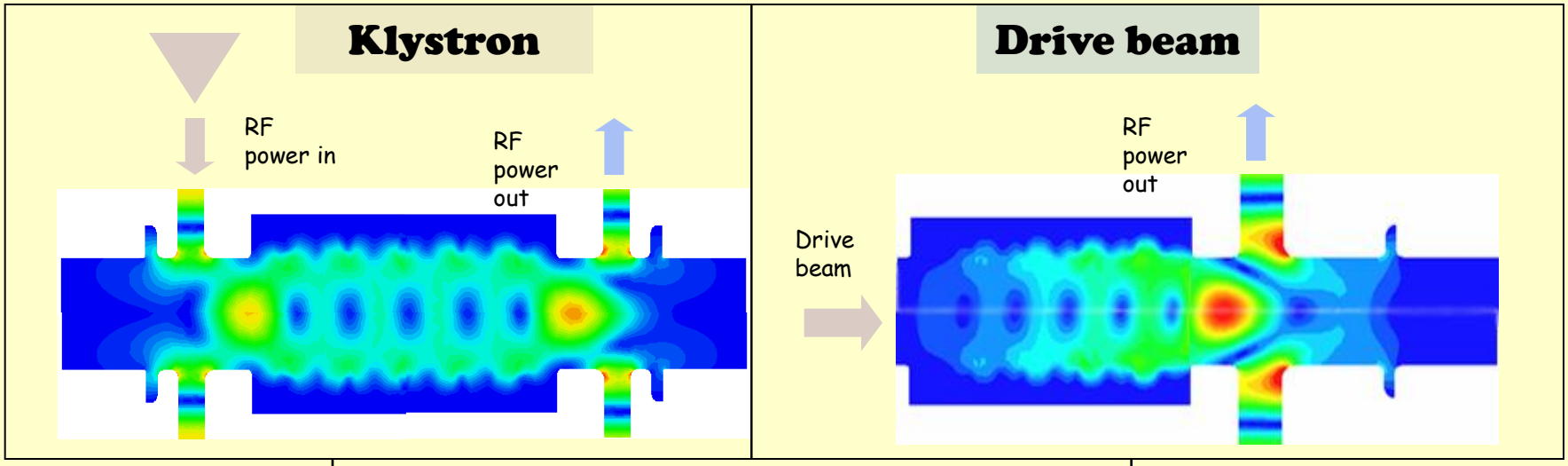
TBL in CLEX



TBL commissioning



PETS testing



ASTA (SLAC)

Objective: to understand the limiting factors for the PETS ultimate performce

What matters is the output section !

CTF3 (CERN + Collaborations)

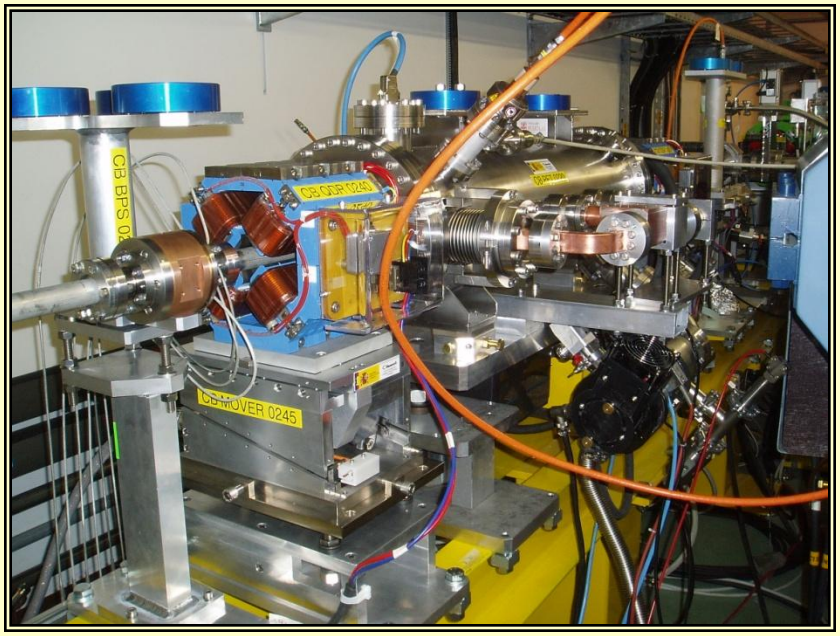
Two beam test stand (CERN + Collaborations)

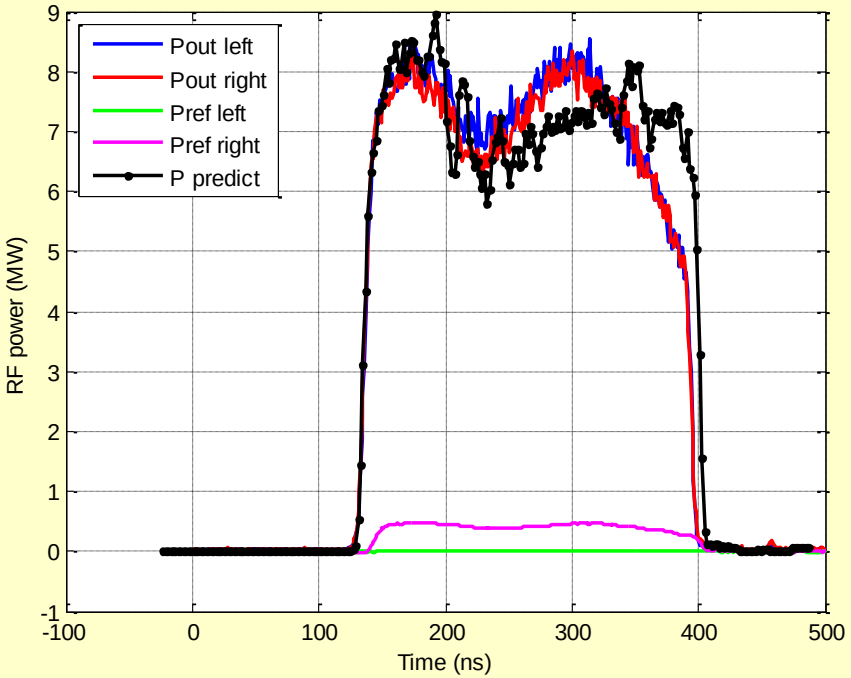
Objective: to demonstrate design rf parameters at the output of the PETS

Test beam line (CERN + Collaborations)

Objective: to demonstrate the beam transportation without looses and ~ 50% deceleration.

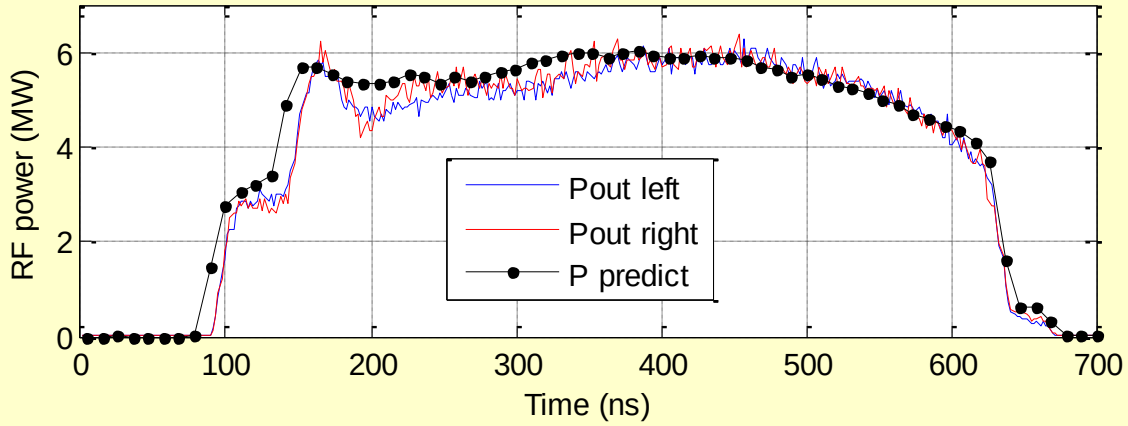
PETS, beam driven test TBL

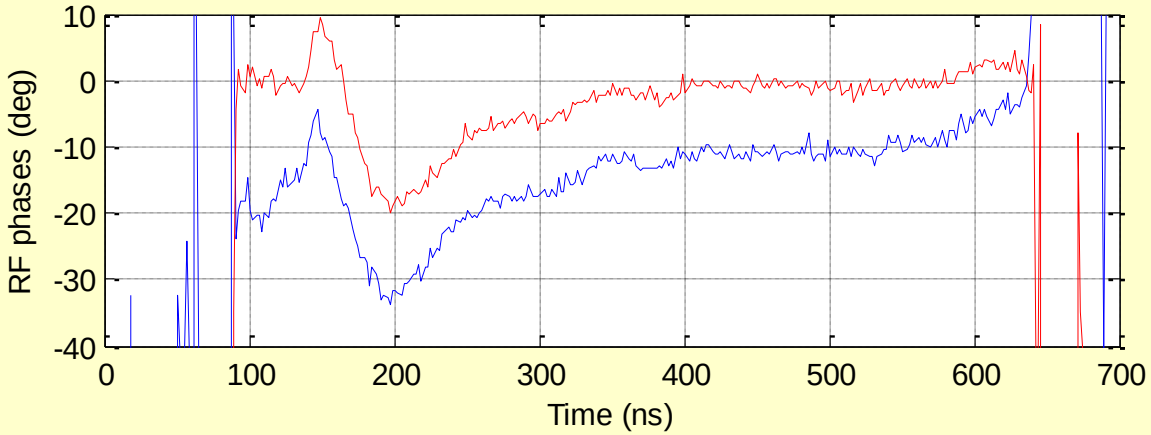




20 MW power produced with a 10A beam according to predictions, form factor 0.9

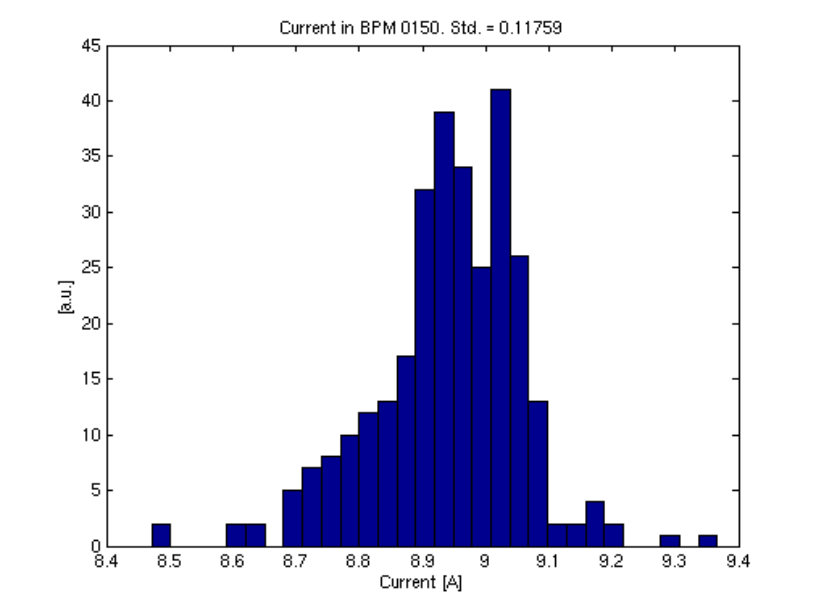
PETS, power production

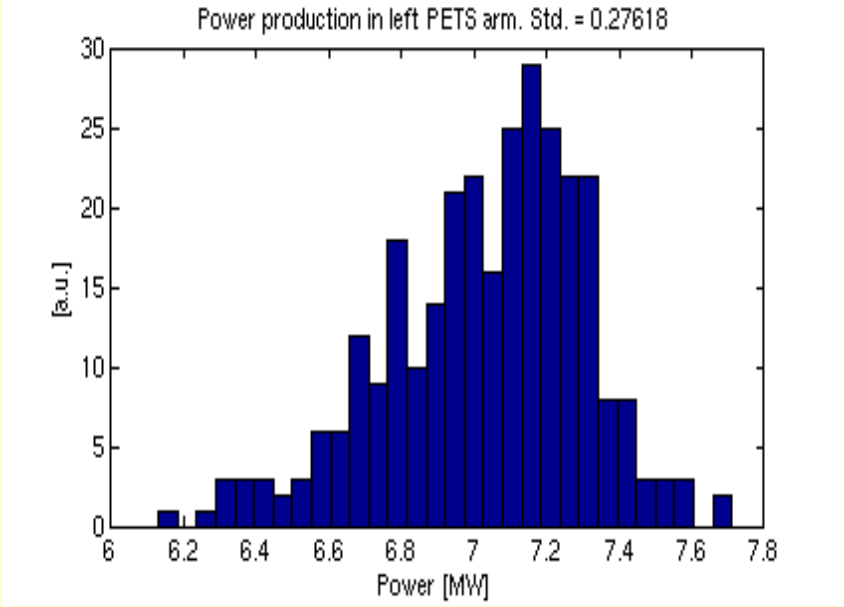




PETS is a very sensitive diagnostics for the longitudinal beam structure,
IQ-detectors used for power measurements

PETS, power production stability

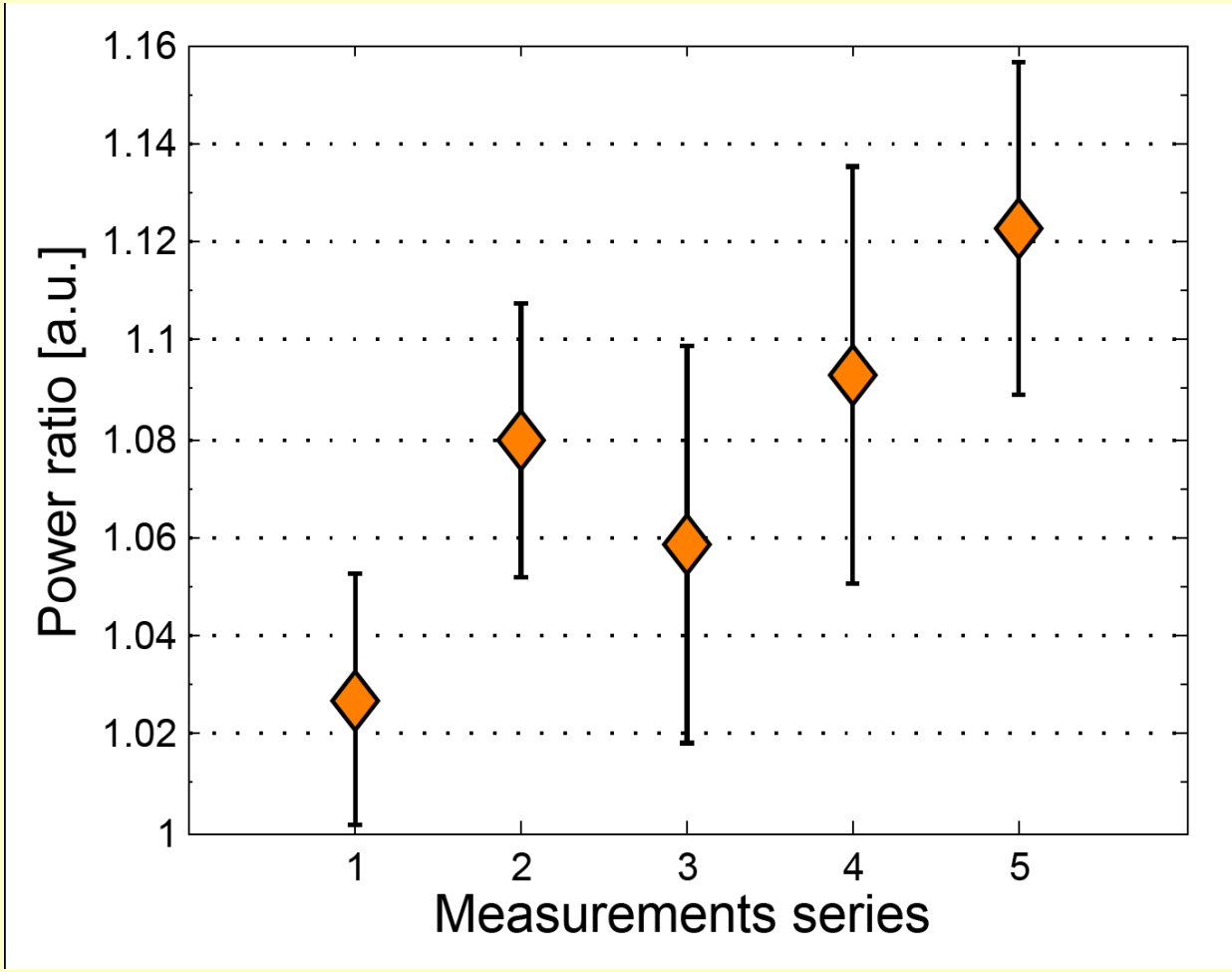




Current stability ~ 1.3%; $P \sim I^2$

Measured current stability in the CTF3 linac 9×10^{-4}

PETS, power production position correlation



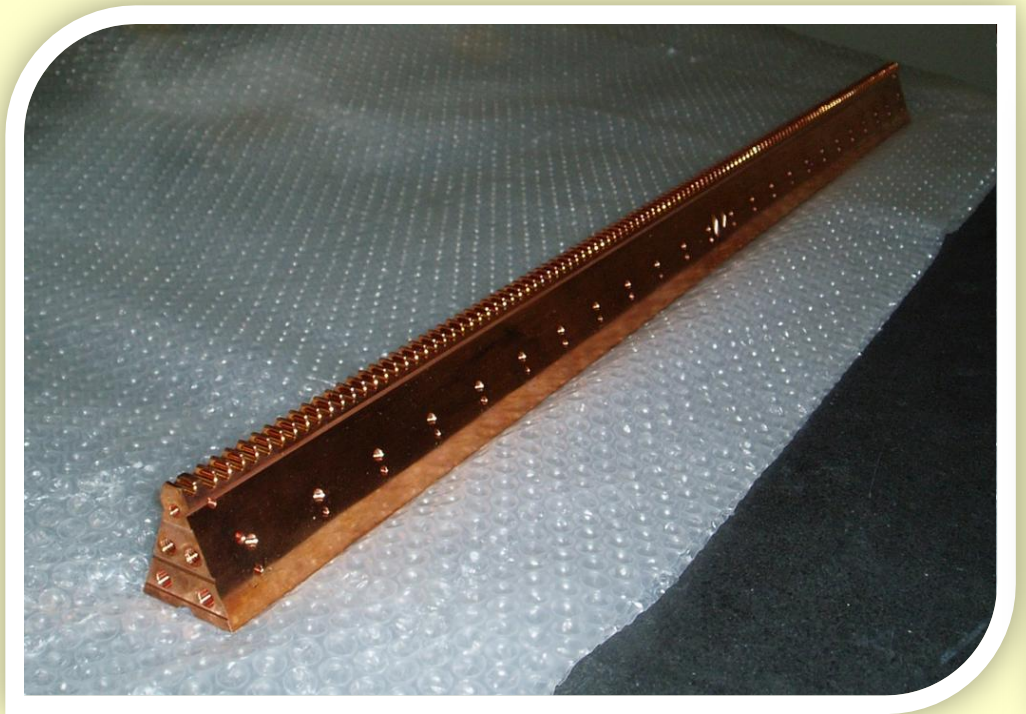
Offset: -5 mm;h -3 mm;v 0 mm; +2 mm;v +5 mm;h

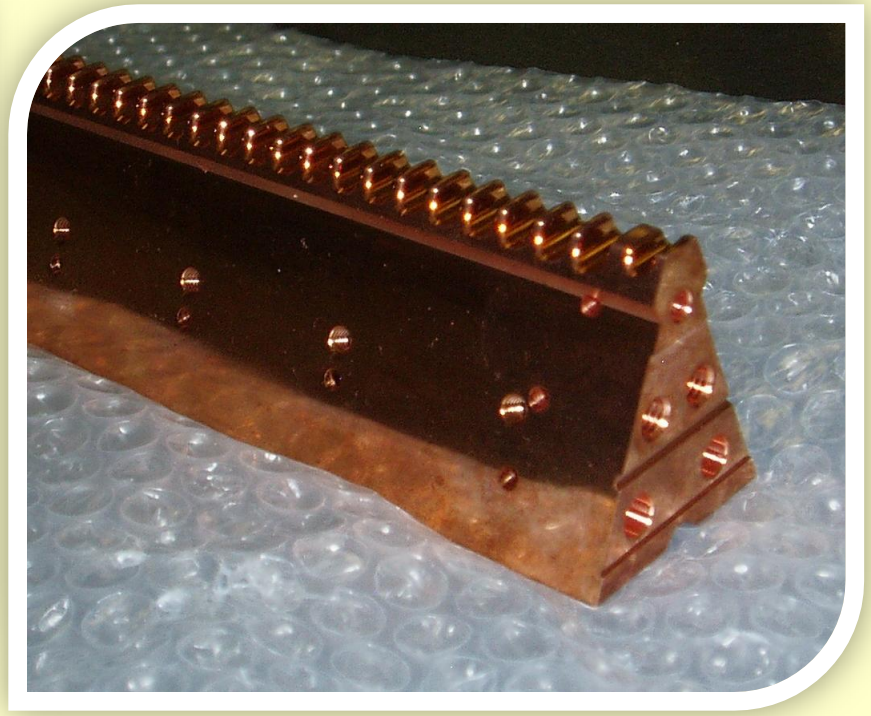
Status of series production

- Well defined program to produce next 8 tanks
  3 by CIEMAT, 5 by CERN
- Pacing item is the PETS itself
- First set of 8 received (last week)
- At CERN we prepared for clean room assembly
- Hope to have 4 tanks installed in January,
  8 tanks in summer 2011, 16 in 2012
- India and BINP both made PETS prototypes as well
  (option for second series)

Status of series production

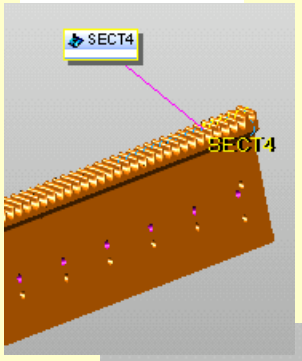
First conform PETS bar for series production

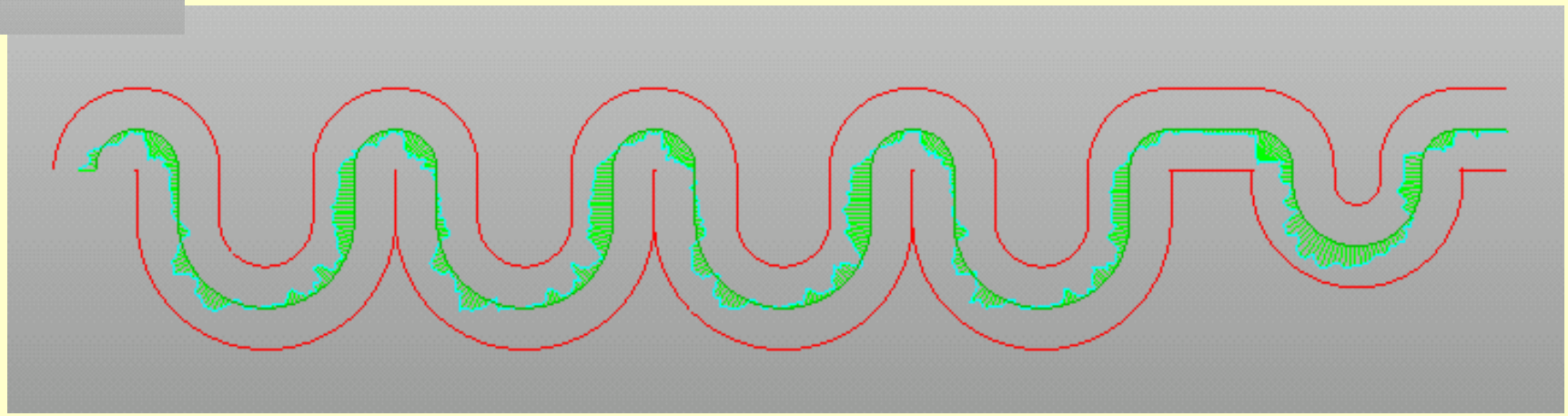




Status of series production

First conform PETS bar for series production

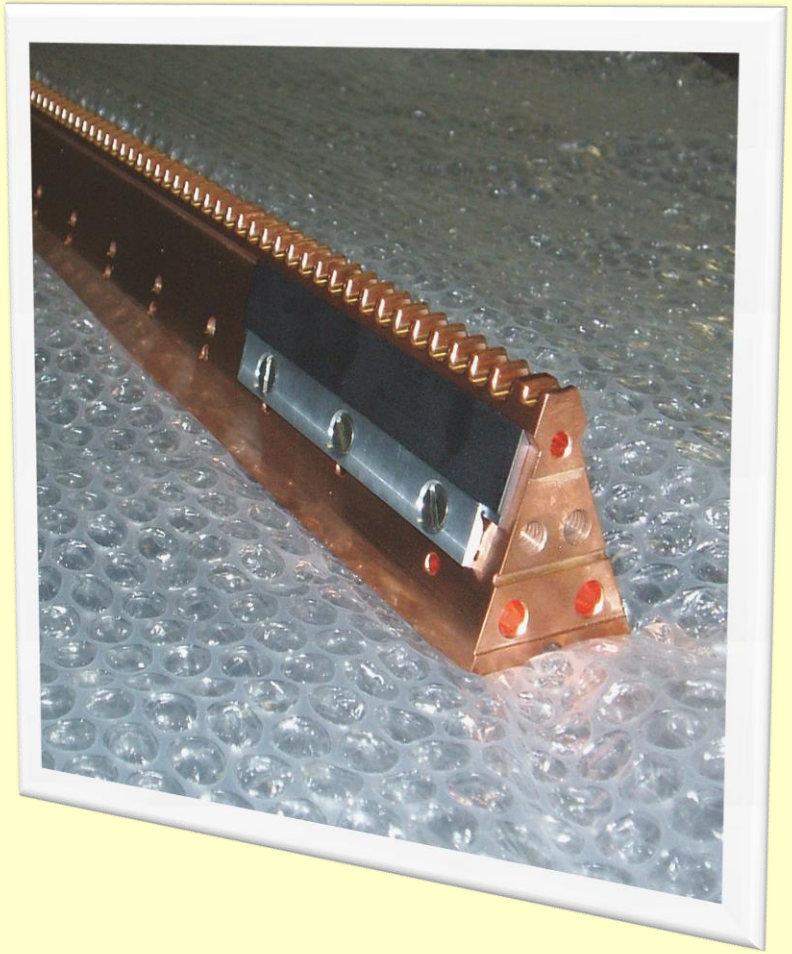




		Mesuré	Nominal	Iso	Tol -	Tol +	Ec.	Tendance	Hors tol.
✔	MAX	0.014	0.000		-0.020	0.020	0.014		
✔	MIN	-0.016	0.000		-0.020	0.020	-0.016		
✔	MoyS	-0.000					-0.000		
✔	MoyA	0.005					0.005		
✔	E.F.	0.029					0.029		

Status of series production

SiC dampers for HOM installed on a PETS bar



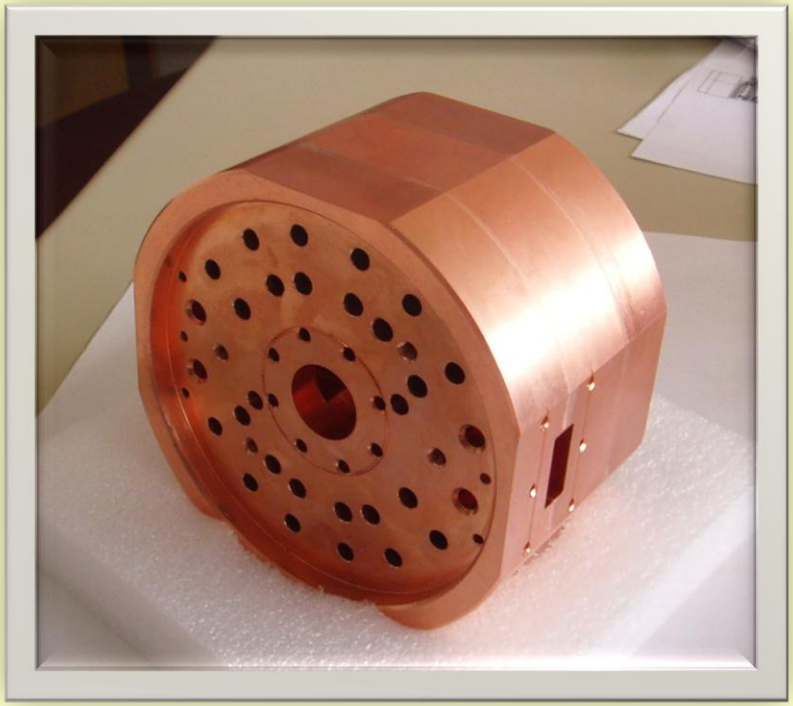
SiC prepared for baking at 950 deg C

Status of series production

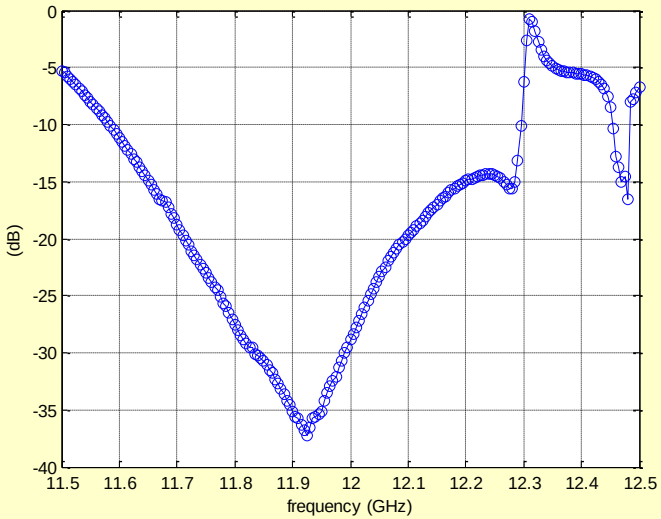
Two PETS bar's from India

Status of series production

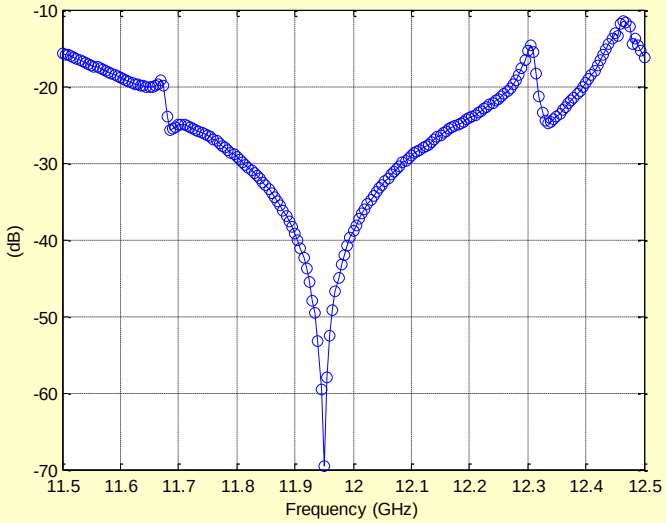
Several couplers
brazed and cold tested at CERN
Series in production



S11



S12



Plans for completion and feasibility demonstration

- Goal to have 4 tanks installed in January 2011
- Demonstration with 8 until summer 2011,

  >30% deceleration
- Complete TBL with 16 PETS in 2012
- Perform full experimental program afterwards

  >50% deceleration
- Detailed program, see talks in DB working group

Plans for TBL beyond 2012

- Upgrade TBL to a test facility relevant for CLIC TDR work
- 12 GHz power production for structure conditioning
- Working experience with a real decelerator
- Beam dynamics studies, pulse shaping, feedbacks, etc

What can be done ? What is reasonable ?

Plans for TBL beyond 2012

TBL versus klystrons, additional value of TBL

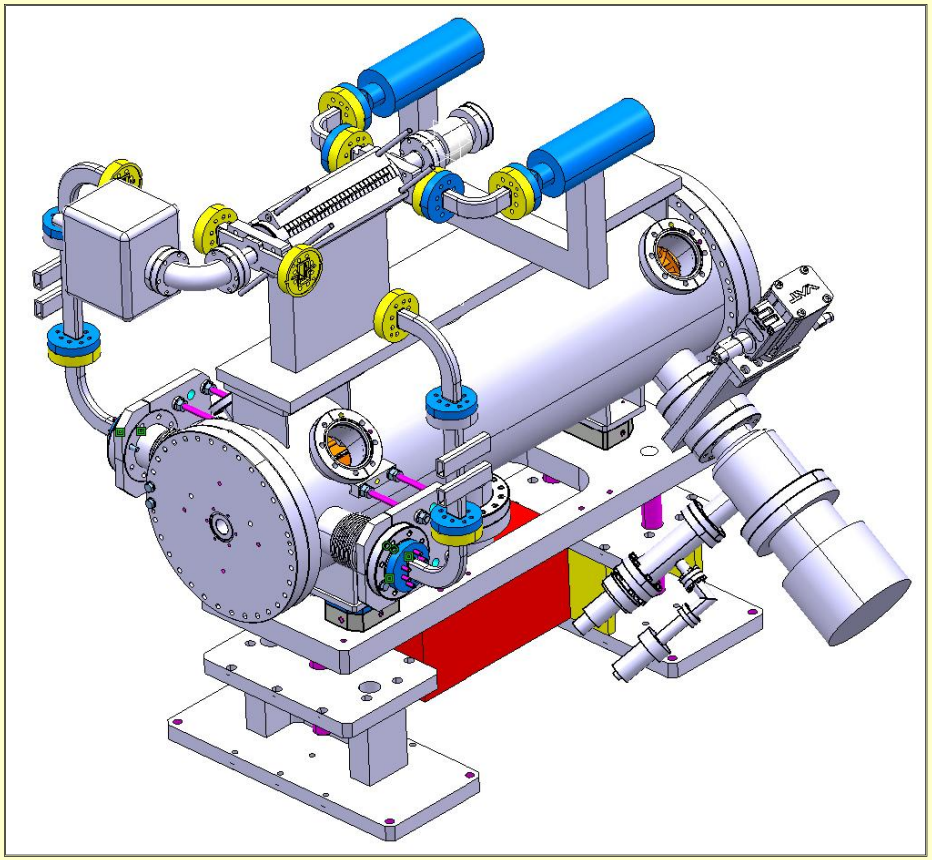
	Klystron	Klystron	TBL+	TBL+
Rep rate (Hz)	50	100	10	5
slots	2	2	1	1
Number of units	2	2	16	8
hours/day	24	24	24	12
days/year	300	300	300	180
Rf-pulses/year	5E+09	1E+10	4E+09	3E+08

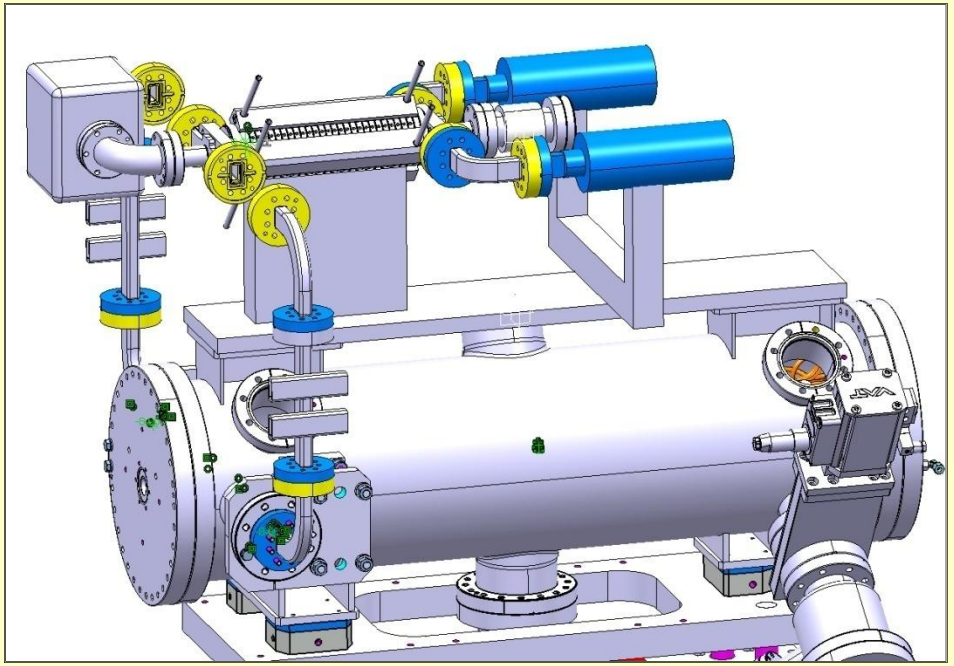
TBL: Test of PETS and structure possible
Closer to CLIC situation
Less flexible for frequent changes in the set up

28 A needed for 135 MW/PETS
20 A for 70 MW/PETS
15 A for 70 MW/ for two PETS

Plans for TBL beyond 2012

How could it look like





Plans for TBL beyond 2012

Possible scenario to be studied further

- TBL seem not ideal for around the clock conditioning facility (klystrons seem more suited)
- But, TBL is a unique facility for conditioning R&D specific to CLIC

- Create a limited number of testing slots (4-8) to do this kind of experiments, limited run time

Plans for TBL beyond 2012

What can be done with TBL+

- **Develop conditioning scenario for CLIC**

  conditioning with beam / use of ON/OFF mechanism of PETS

  precondition with klystron and then with beam

  conditioning of PETS

- **Test bed for PETS development, ON/OFF, new designs, etc**
- **Power production as a function of beam parameters**

  alignment, stability, pulse shape, phase stability, beam loses, failure modes

- **Continue decelerator beam dynamics studies**

Conclusion

- TBL commissioning ongoing, feasibility demonstration can be started in 2011 with 8 PETS and finished with 16 in 2012

- TBL+ - upgrade useful as a facility dedicated to conditioning experiments, essential for CLIC TDR phase

- Working horse conditioning facility based on klystrons is needed in addition to support the structure development