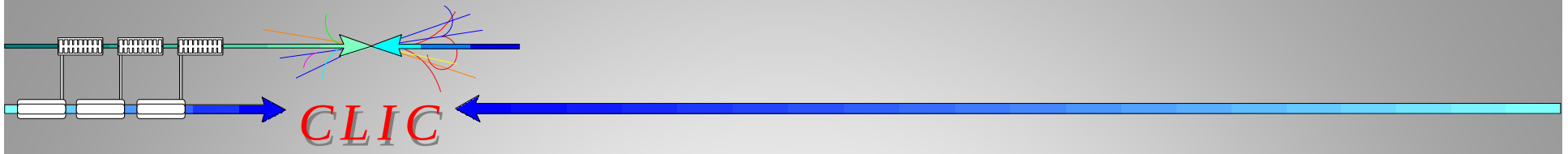
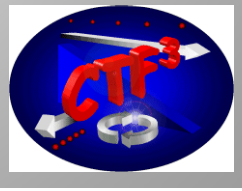


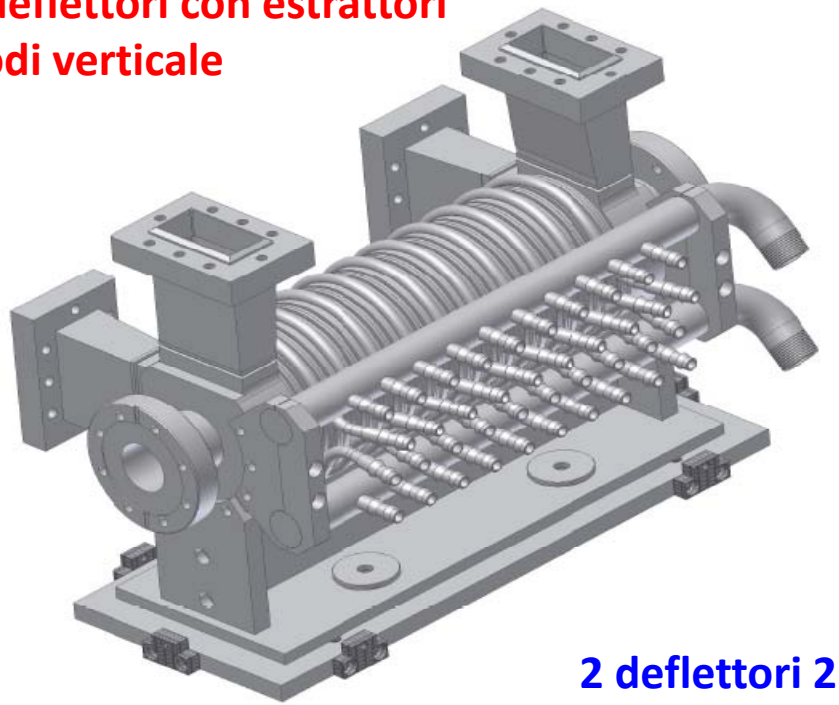
CLIC Test Facility - CTF3

Andrea Ghigo for the CLIC Collaboration

NTA Meeting Roma 22 Settembre 2009



Due deflettori con estrattori di modi verticale

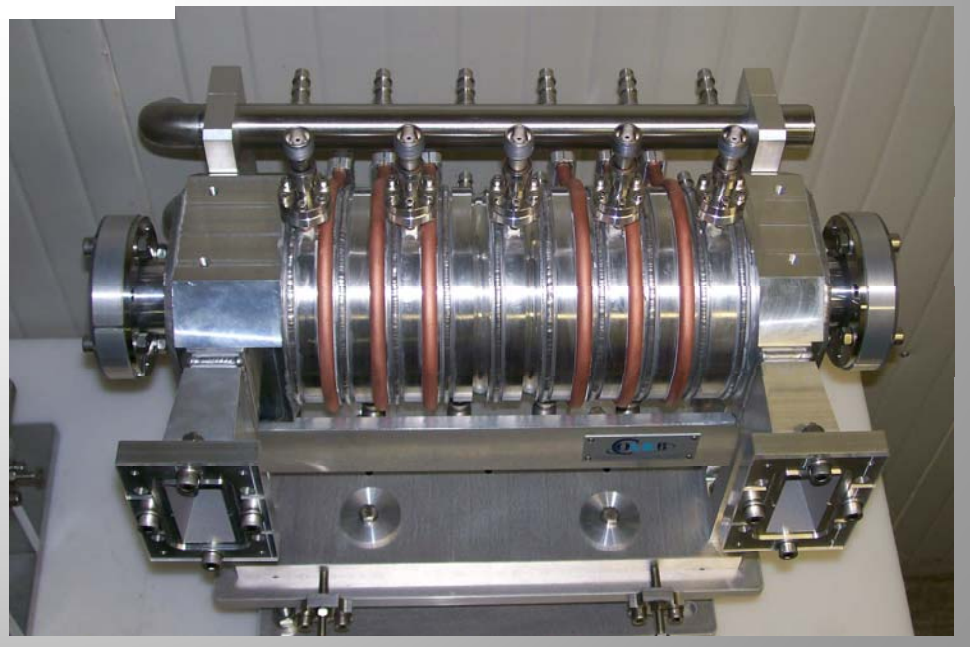


2 deflettori 25 KEuro

NEW RF DEFLECTORS REALIZATION

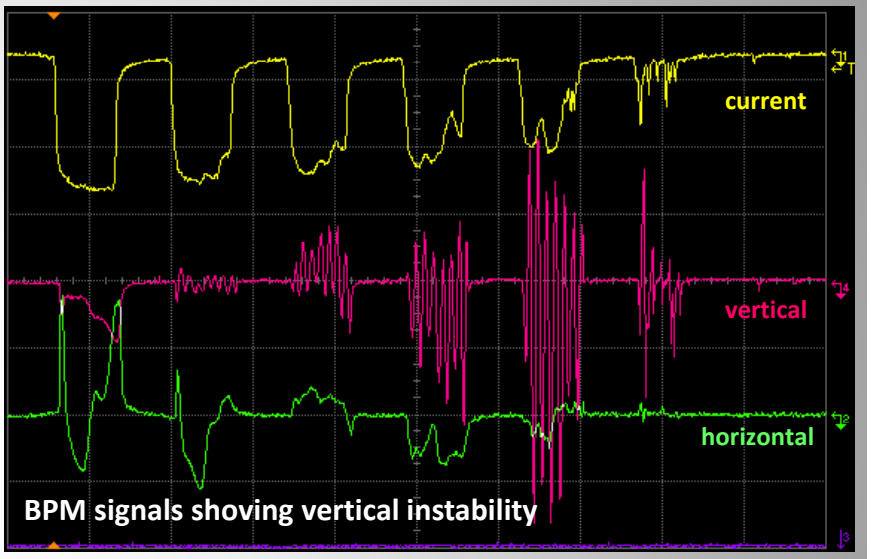
I nuovi deflettori sono stati realizzati con fondi NTA assegnati fine 2007

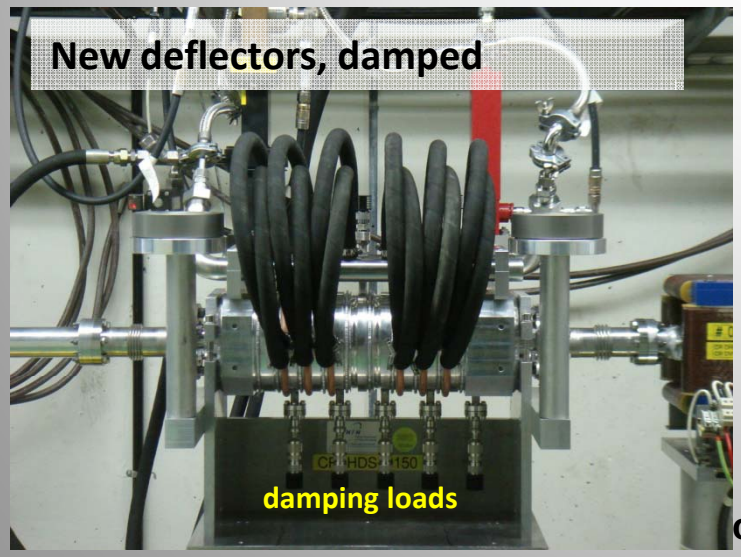
To reduce the cost and the delivery time of the device we decided to built the new RF Deflectors in *aluminium*. The cells have been machined, clamped together with tie rod to guarantee the RF contacts and welded.



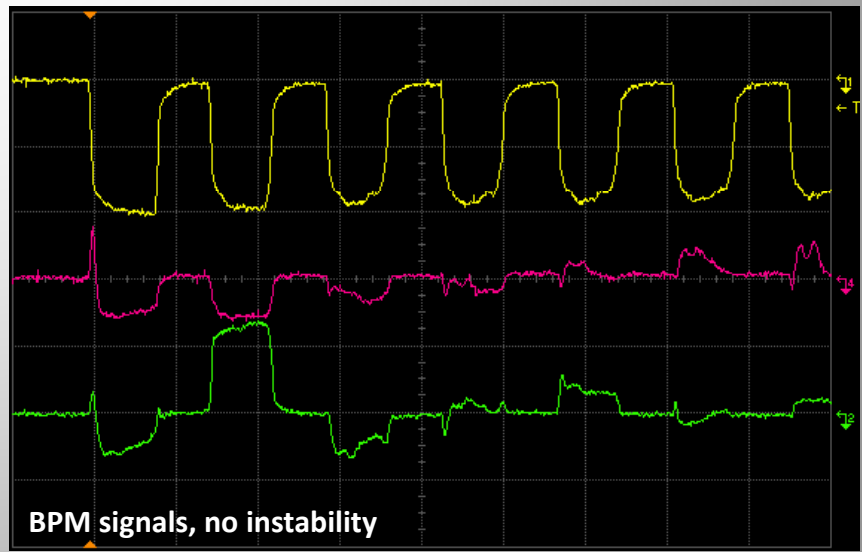
Combiner Ring Commissioning 2008
Instability Solved

Old deflectors, undamped



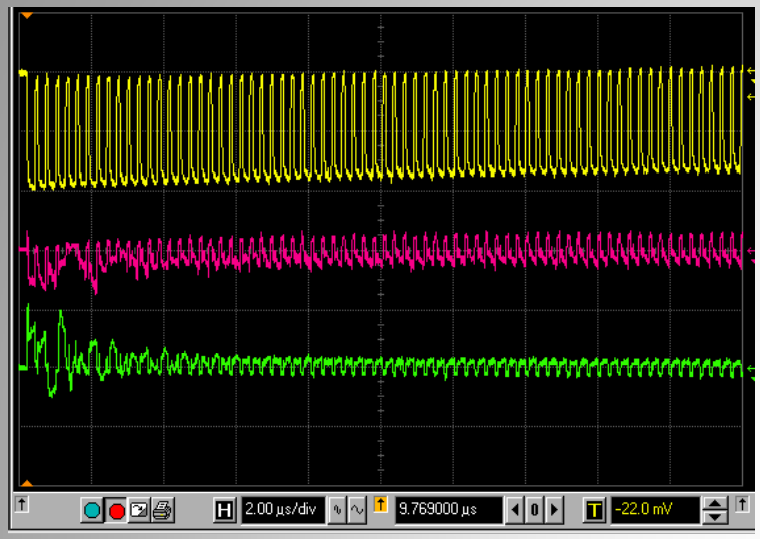


New deflectors, damped



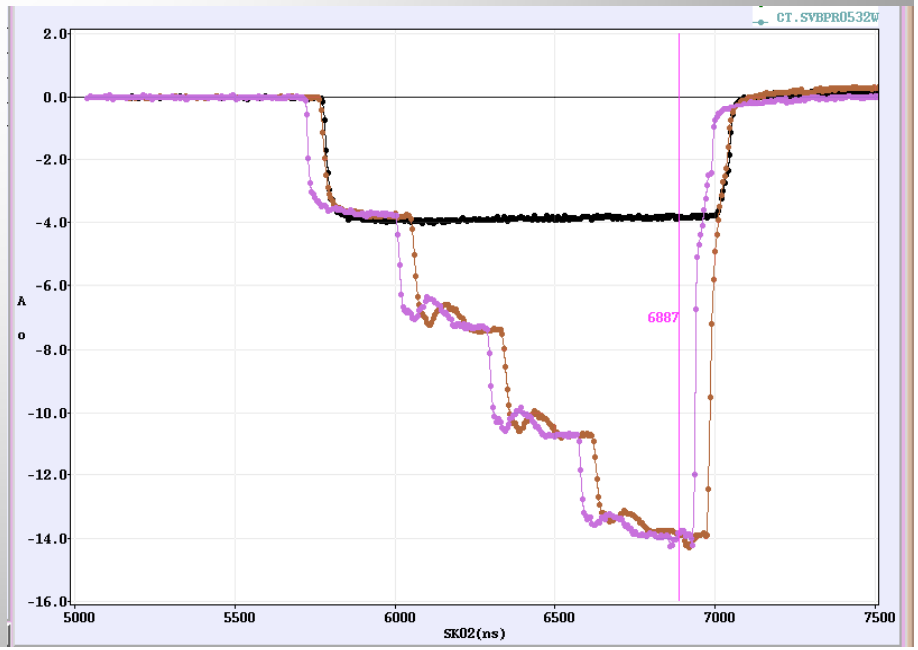
op

Combiner Ring Commissioning



Thousand turns without observing beam losses!

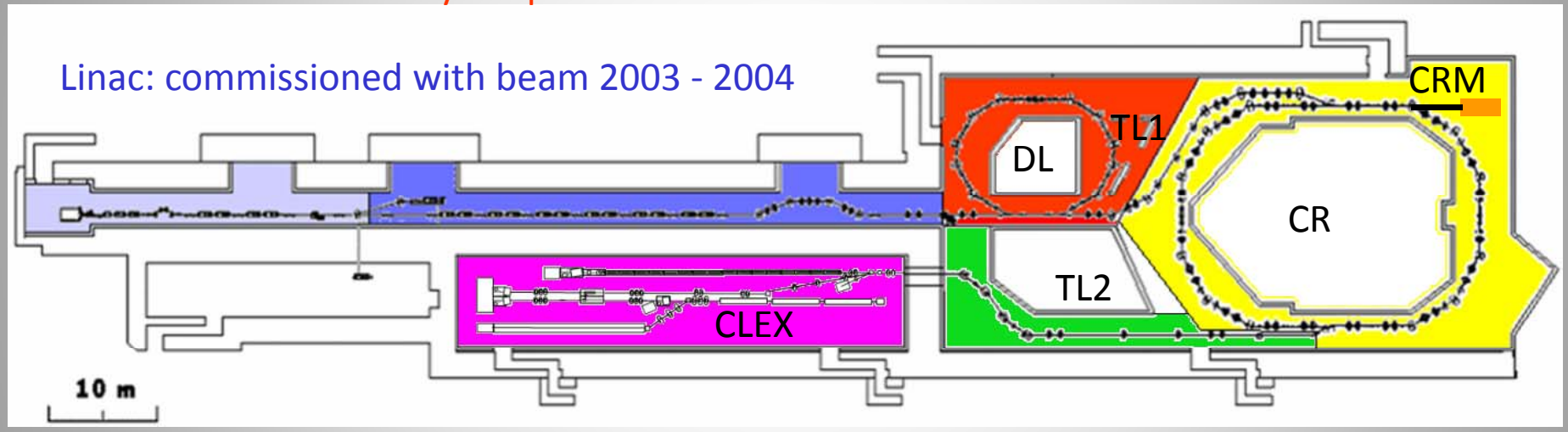
- We solved many of the problems of which the most important was the instability
  - New deflectors were installed mid of September
  - Gun seems to be stable now
- This brought immediate effect in form of the full recombination factor 4



CLIC Test Facility 3

TL1 & CRM commissioned fall 2006

Delay Loop: commissioned with beam 2005-2006



CR commissioning 2007-2008

2009: 3A beam to the end of Two Beam Test Stand
- Linac del Probe beam commissioning
- First test of two-beam lines

TL2 and TBTS commissioning started August 2008

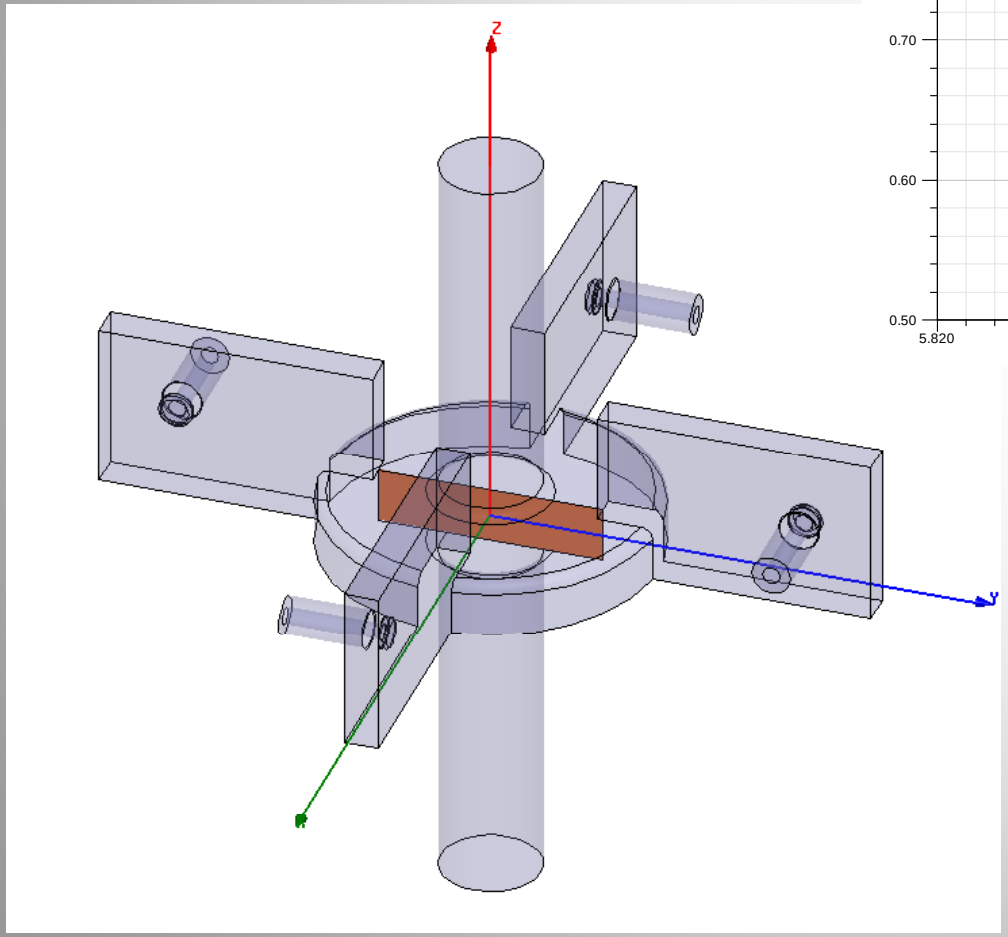
INFN-LNF contribution to CTF3 Project

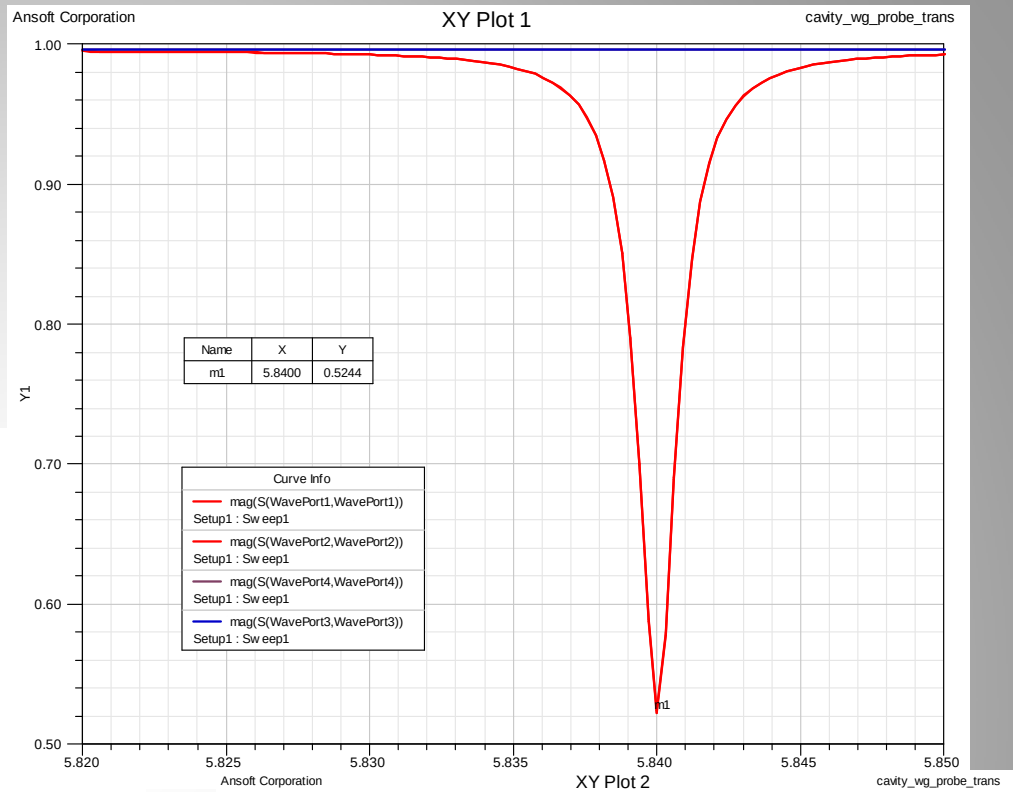
year	2001	2002	2003	2004	2005	2006	2007	2008	TOT
components realisation (Euro)	273	42	972	800	244	655	14	15	3015
Travel - Installation (Euro)	30	50	55	100	100	66	48	40	489
TOTAL (Euro)	303	92	1027	900	344	721	62	55	3504
Person year	4	4	5	7	7	7	6	6	46

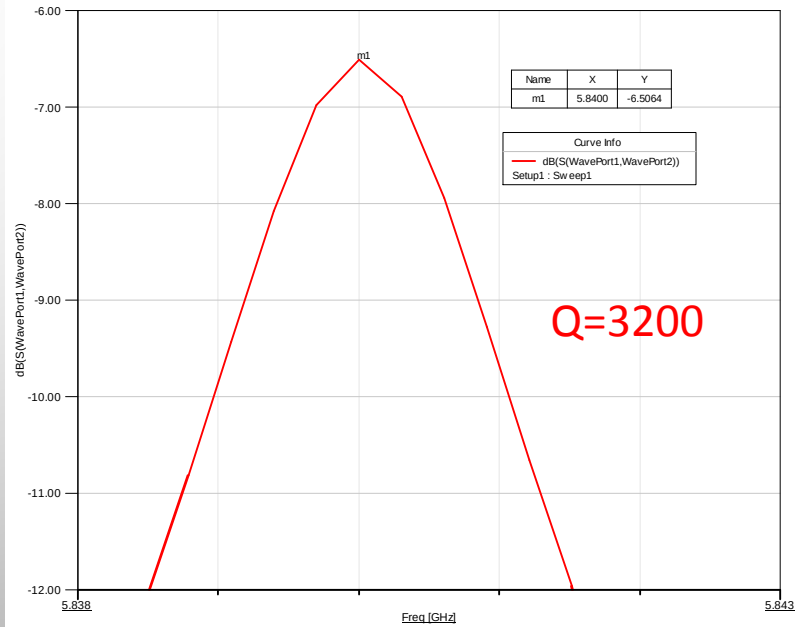
Contributions (September 2008)

				FTE	CHF
CERN	CERN	CERN		125	14'815
FINLAND		Helsinki Inst of Phys (HIP)	specialist in micro machining technologies for CLIC structure developments, establish dedicated project for development of technology with industrial and academic partners	3	
FRANCE	CEA/DSM-Saclay	IRFU (DAPNIA)			
			Probe Beam linac	30.00	1'950
	CNRS/IN2P3	LAL, LURE	32 quadrupoles, Thermionic guns, photo injector guns	18	300
		LAPP			
			BPM read-out electronics, stabilisation studies	5	150
INDIA*	Indian DAE	RRCAT, Indore	TL2 design, Alu vacuum chambers, dipole magnets, software		274
ITALY	INFN	LNF	Delay Loop, vacuum chamber TL1 and CR, CTF3 commissioning, operation	33.00	4'900
NORWAY	The Research Council of Norway	University of Oslo	Beam dynamics calculations, TBL calculations	3	
PAKISTAN		National Centre for Physics (NCP)	Beam diagnostics elements for CTF3, CLIC design		800
RUSSIA		Budker Inst (BINP)	11 quadrupoles, 26 sextupoles, 16 TBL quadrupoles		350
		IAP	30 GHz power source		1024
	Dubna	JINR	manpower for programming of automatic conditioning		114
SPAIN	Ministry of Education & Science (MEC)	CIEMAT	precision tables, 2 septa, extraction kicker, HV pulser, 23 corrector magnets, PETS prototype, BPM for TBL, tail clipper kicker,	4	2000
		UPC	front-end electronics for TBL BPMs		
		IFIC	TBL BPM prototype and series		410
SWEDEN	Swedish Research Council	Uppsala Univ and Svedberg Lab (TSL)	preliminary phase participation, phase monitor, Two Beam Test Stand	3	2650
	Wallenberg Foundation		Celsius magnets		150
SWITZERLAND		Paul Scherrer Inst	modulator components		200
TURKEY		Ankara Univ & Gazi	manpower for CTF3 operation, FLUKA, CLIC beam dynamics	5.25	
UKRAINE	National Academy of Sciences of Ukraine	Institute of Applied Physics (IAP NASU)	study of plasma ionization in RF breakdown	3	
UNITED-KINGDOM	STFC	J. Adams Institute for Accelerator Science, Royal Holloway, Univ of London	radiative processes in CTF3, design of ITB,		640
USA	DOE	Northwestern Univ Illinois (NWU)	accelerating structure, beam loss monitor, bunch length monitor	3	400
		SLAC	electron gun triode (long-term loan, injector design and commissioning	3	320
		Jefferson Laboratory (JLAB)	CTF3 commissioning, beam diagnostics, Probe beam laser commissioning. Design of: CLIC beam line, pol.3-sourcs beam dump,	4.7	

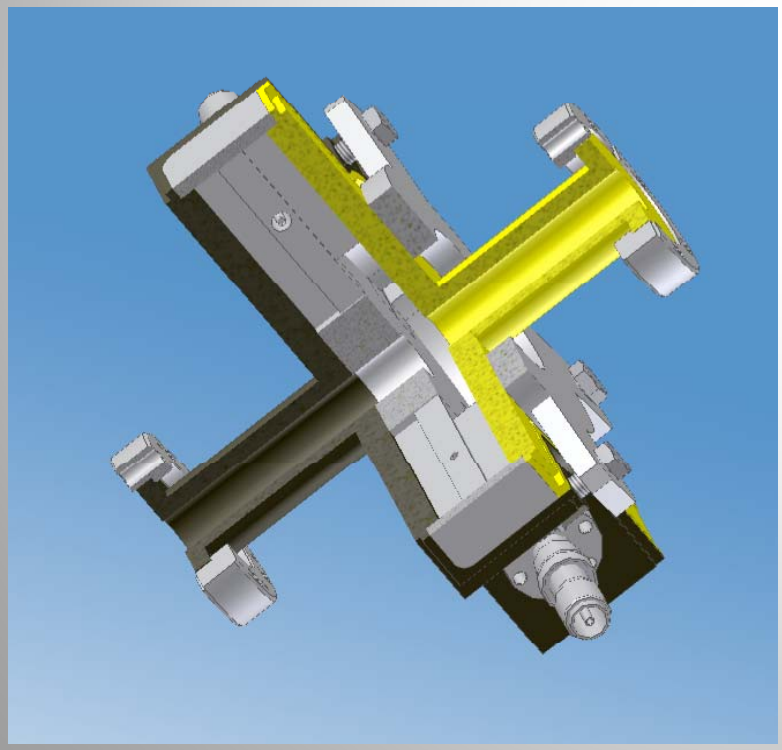
Beam Position Monitor RF

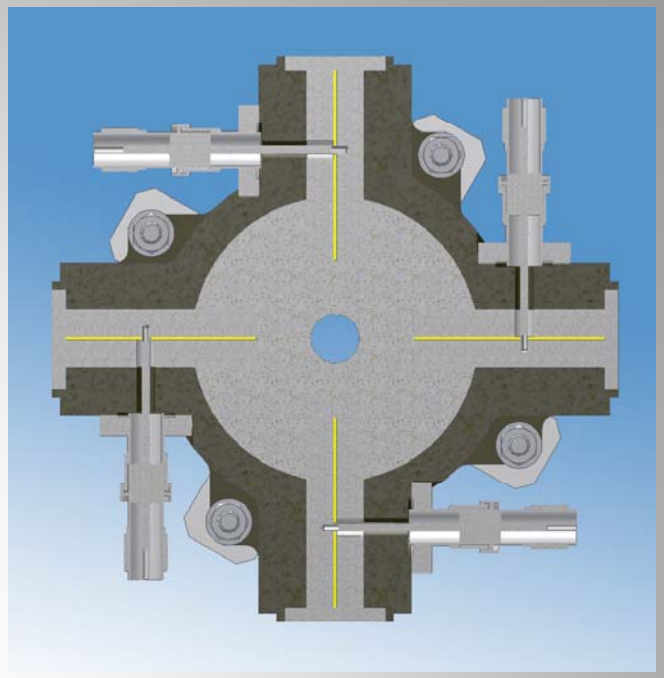


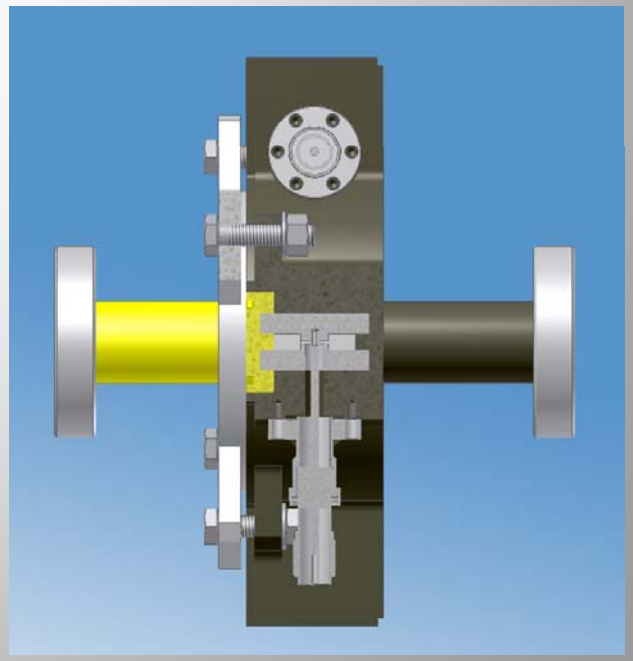


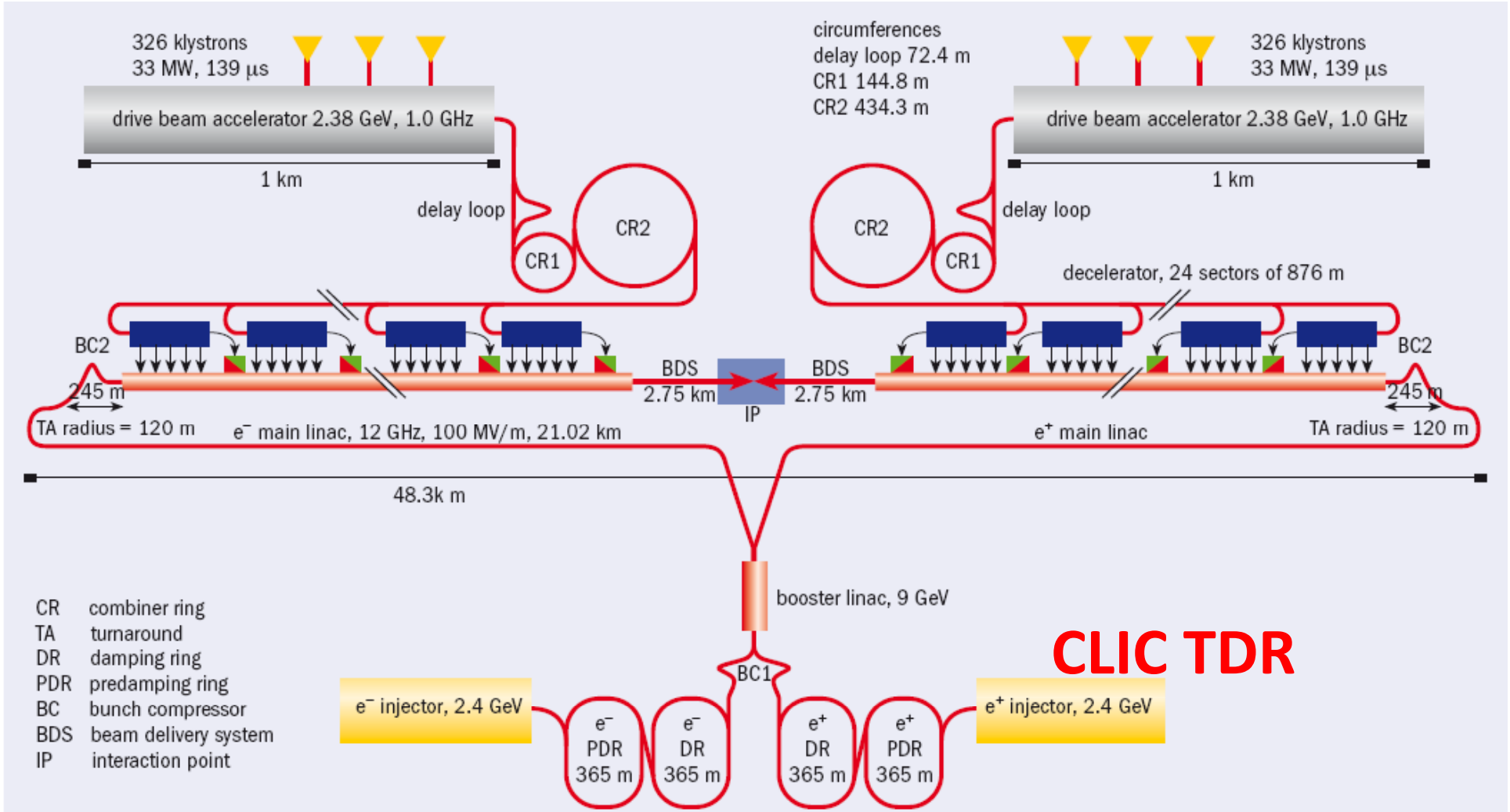


RF Beam Position Monitor









CLIC TDR

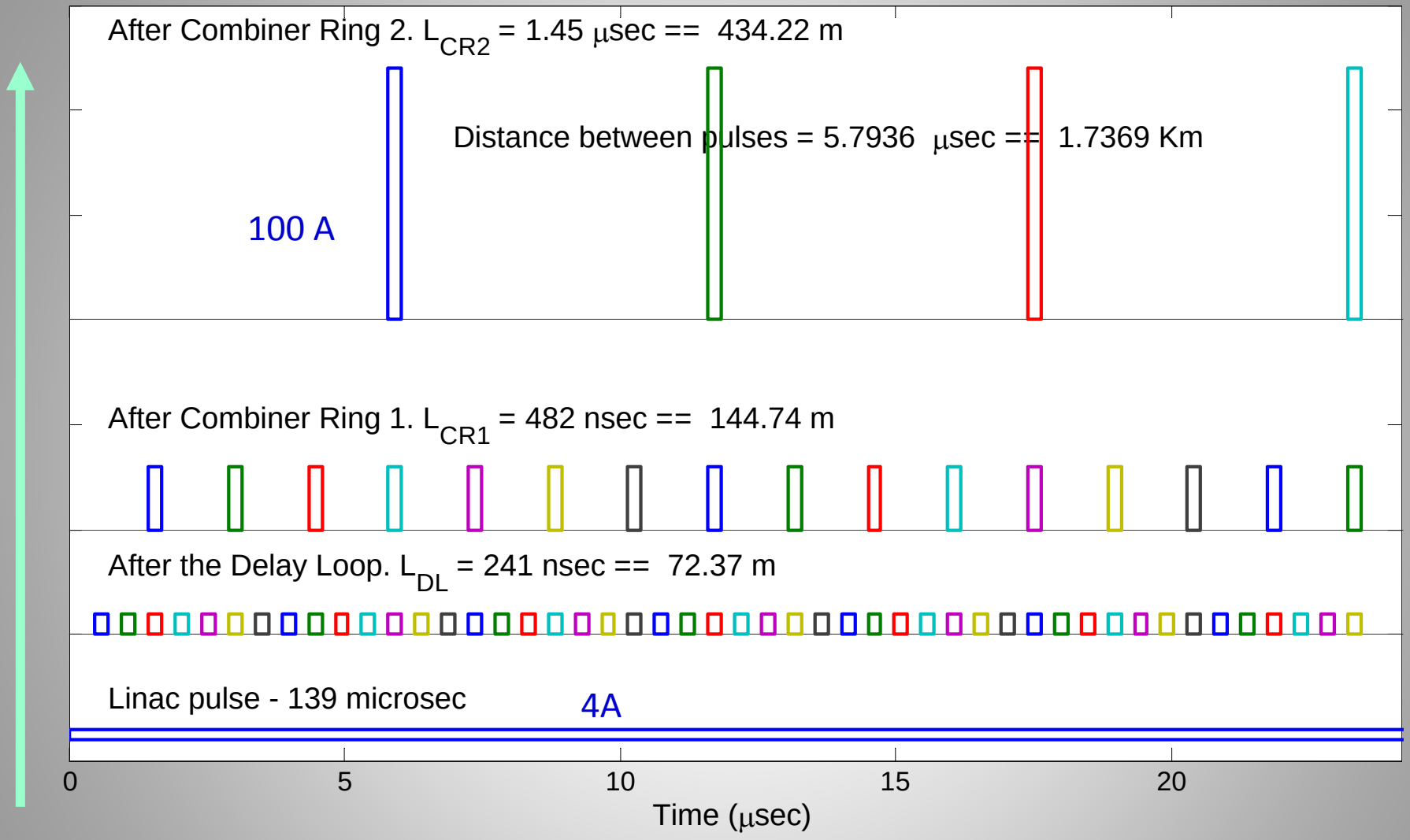
Per il TDR di CLIC INFN intende partecipare alla stesura delle parti

- **Ottica dei Combiner Ring**
- **Deflettori RF**
- **Studi di dinamica**
- **e beam loading**

Temi comuni con ILC

- **Monitor di fase drive beam**
- **kicker dei damping ring**
- **Ottica damping ring**

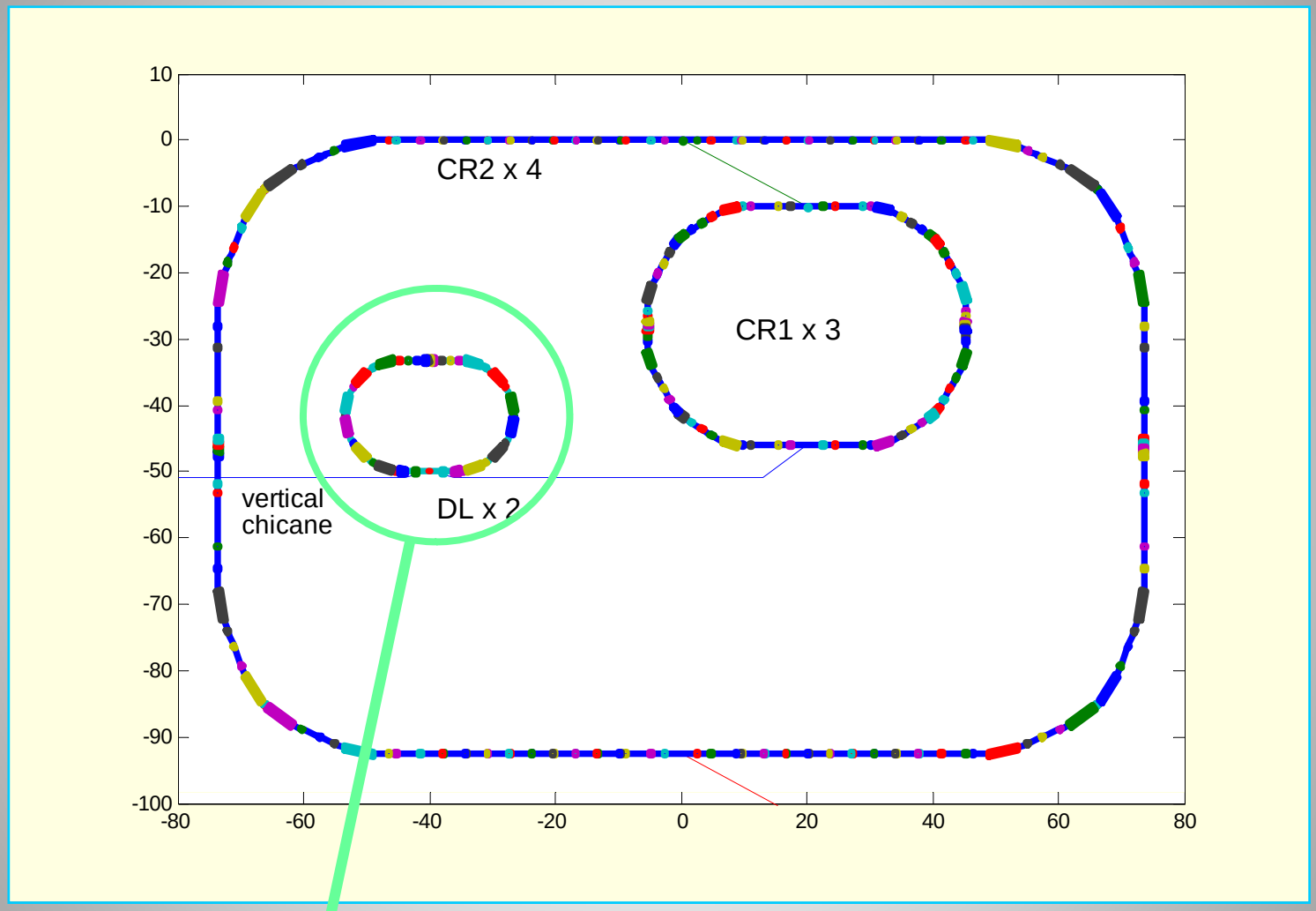
Beam temporal structure along the frequency multiplication system



E=2.37 GeV,
Energy spread < 1%,
Bunch charge = 8.4 nC

Emittance ~ 100 μm rad
Bunch length 2mm
Final bunch separation = 2.5 cm

FMS layout



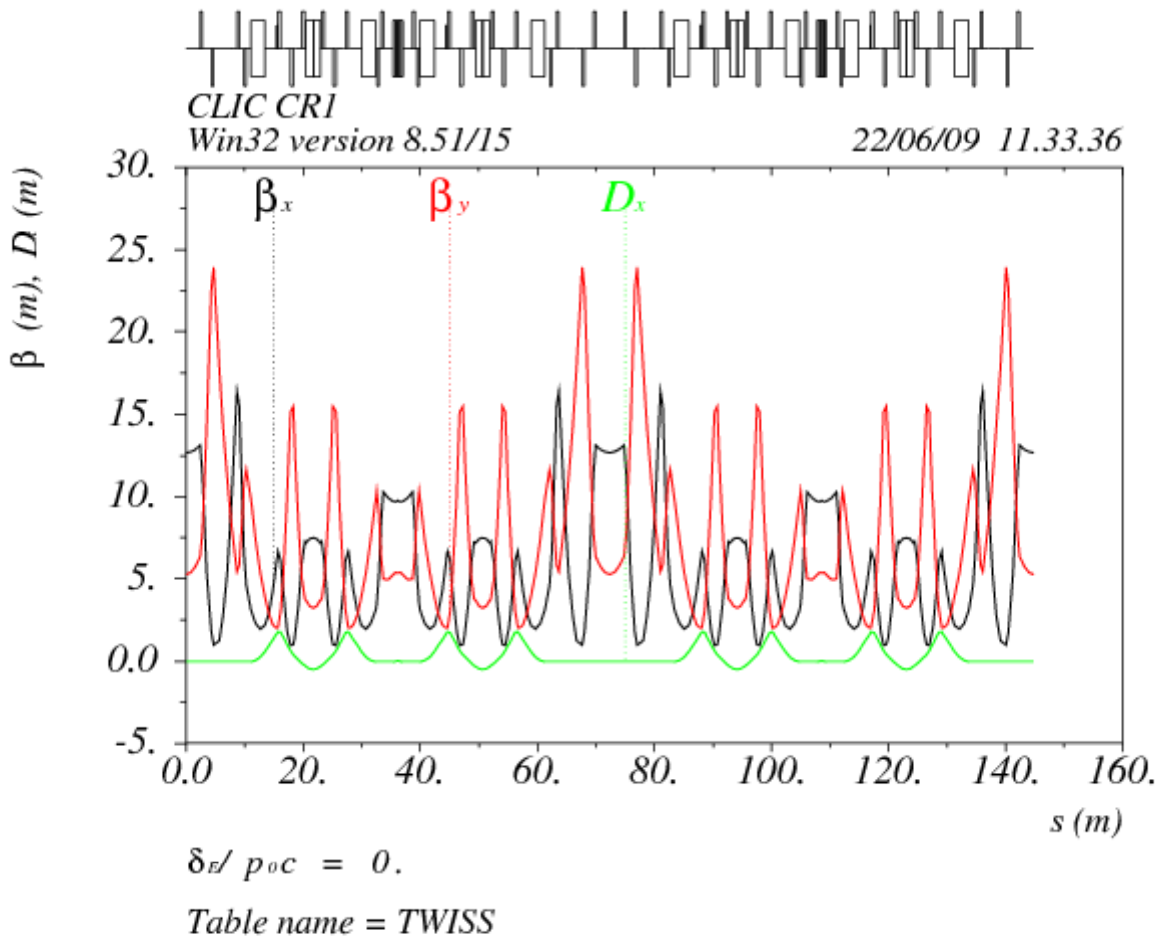
Delay Loop as in CTF3

May 09

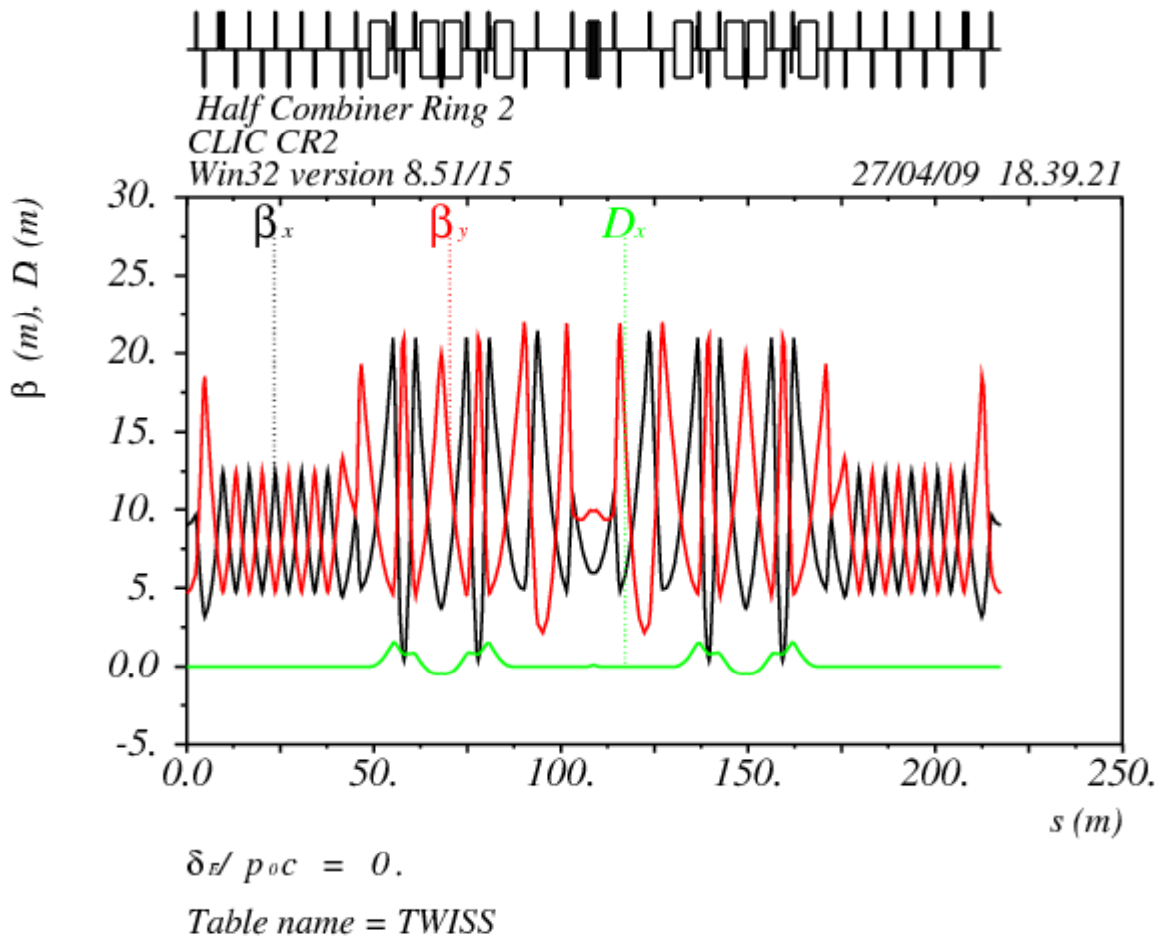
Main parameters of the rings

Parameter		**DL**	**TA**	**CR1**	**CR2**
L	m	**73.05**	**146 + 73**	**146.09**	**438.28**
Combination factor		**2**	**2**	**3**	**4**
RF deflector frequency	GHz	**1.5**	**1.5**	**2.**	**3.**
N of dipoles		**12**	**12**	**12**	**16**
ρ	m	**4.7**	**4.7**	**4.7**	**12**
B	T	**1.7**	**1.7**	**1.7**	**0.7**
N of quadrupoles / families		**18 / 9**	**44/17**	**48 / 9**	**64 + fodo quads**
l_{q*} dB/dx max	T	**10**	**11**	**6**	**6**

1° combiner ring



2° combiner ring



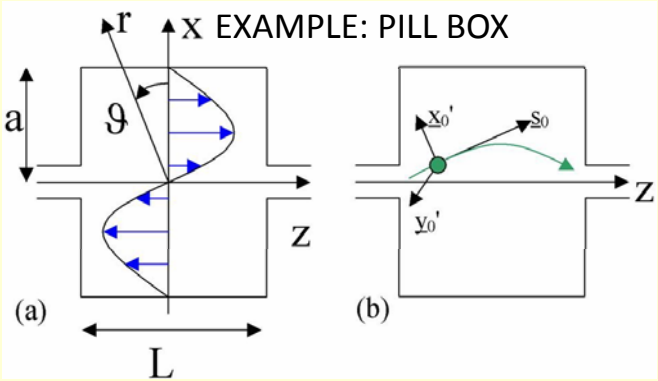
DEFLECTING FIELD EXCITED BY THE BEAM IN RF DEFLECTORS

Unwanted deflecting field can be ***excited by the beam if the pass off-axis*** into the deflectors both in the horizontal than in the vertical plane.

This is due to the fact that the ***deflecting field has longitudinal electric field*** off-axis.

$$\underline{E}_D = \begin{cases} E_{Dz} = E_0 J_1(p_{11} x/a) \\ E_{Dx} = E_{Dy} = 0 \end{cases}$$

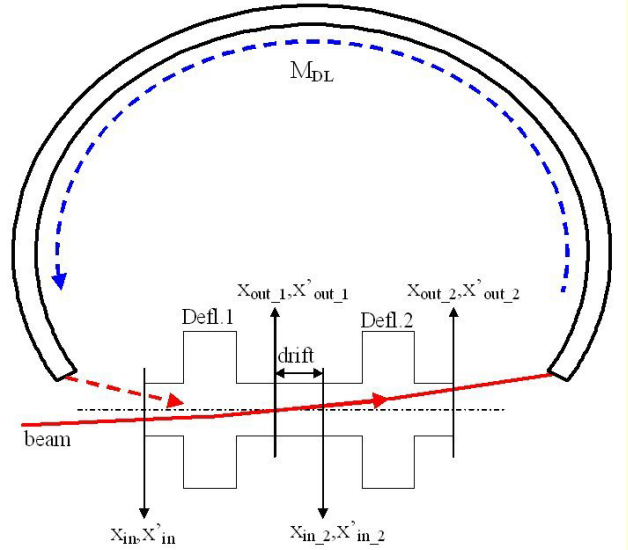
$$\underline{B}_D = \begin{cases} B_{Dz} = B_{Dx} = 0 \\ B_{Dy} = -jAE_0 J_1'(p_{11} x/a) \end{cases}$$



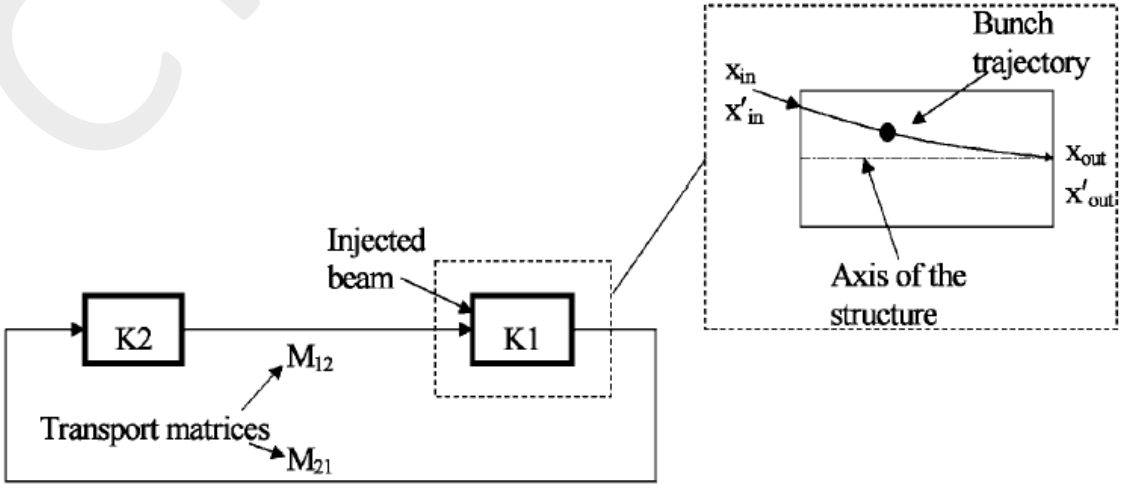
This happens, in the ***horizontal*** plane, even in the case of perfect injection and both in the DL than in the CR RF deflectors.

In the ***vertical plane there is beam loading only in case of a non-perfect steering*** of the orbit inside the structure.

DELAY LOOP



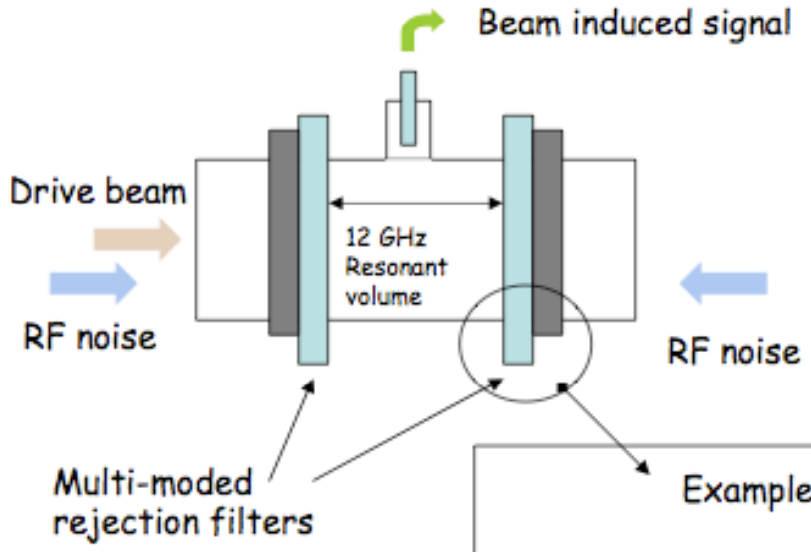
COMBINER RING



CTF3

Phase monitor per sincronizzare Drive beam su Probe beam
risoluzione temporale 10 fs
"F.Marcellini EUCARD task-leader"

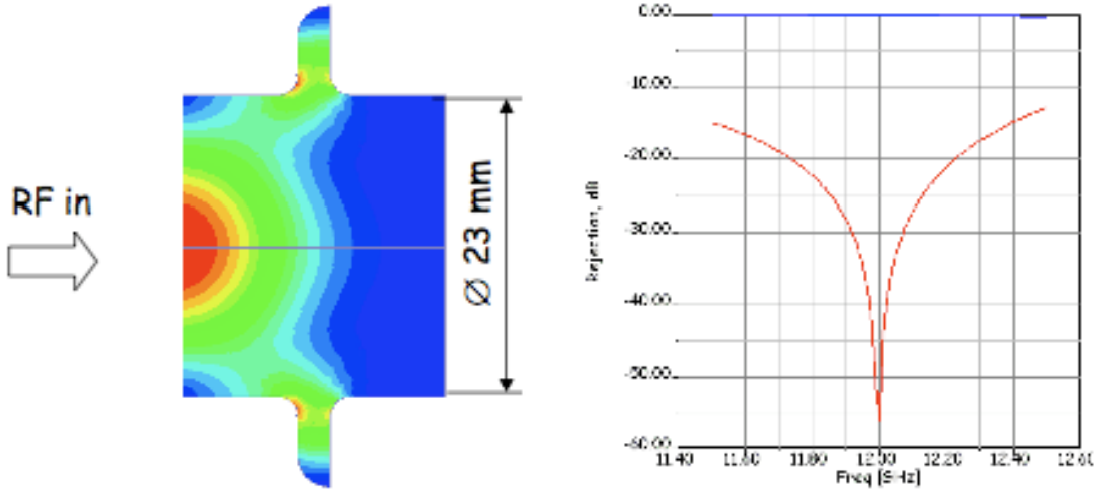
Schematic view of the 12 GHz pick-up concept

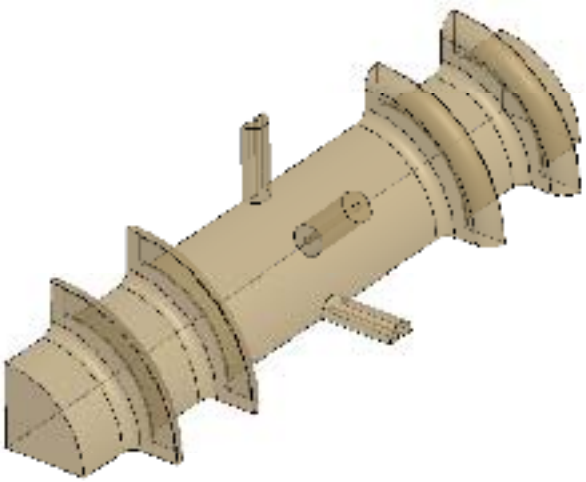


Considerations:

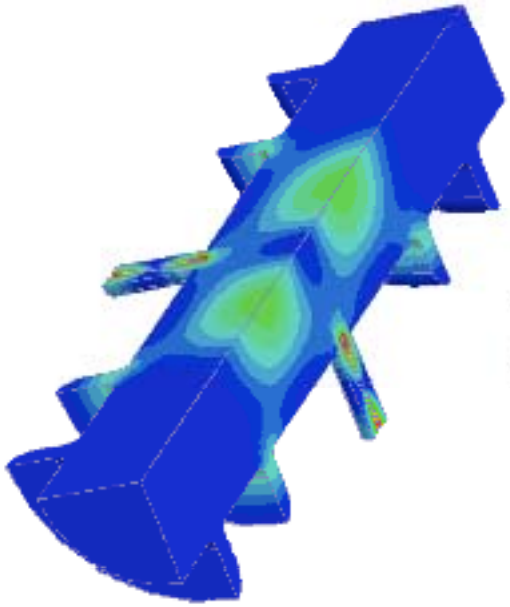
1. We have to keep big aperture of the pick up (I used 23 mm – similar to one in the PETS).
2. Low impedance!
3. The sensitivity of the device will depends on the RF nose rejection level
4. We need a resonant volume anyway (Q loaded to be defined)

Example: TM01 choke-type rejection filter





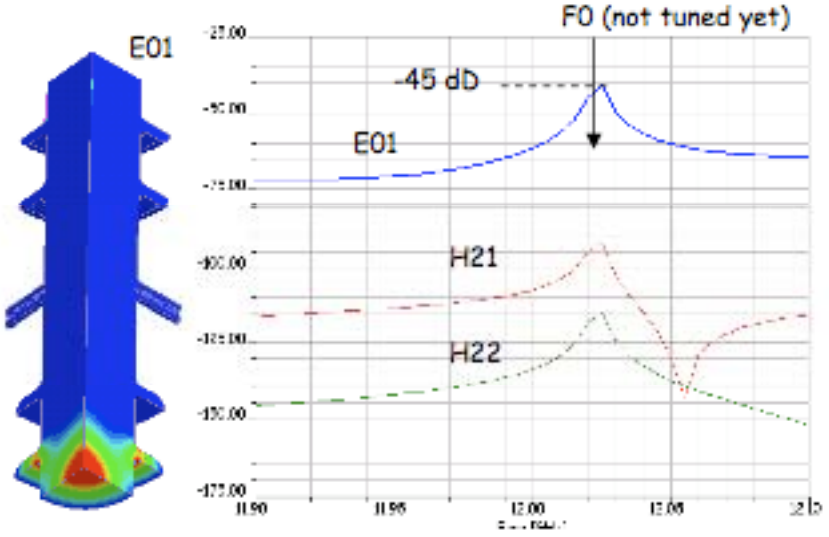
12 GHz resonant field configuration
(here excited via coax. ports)



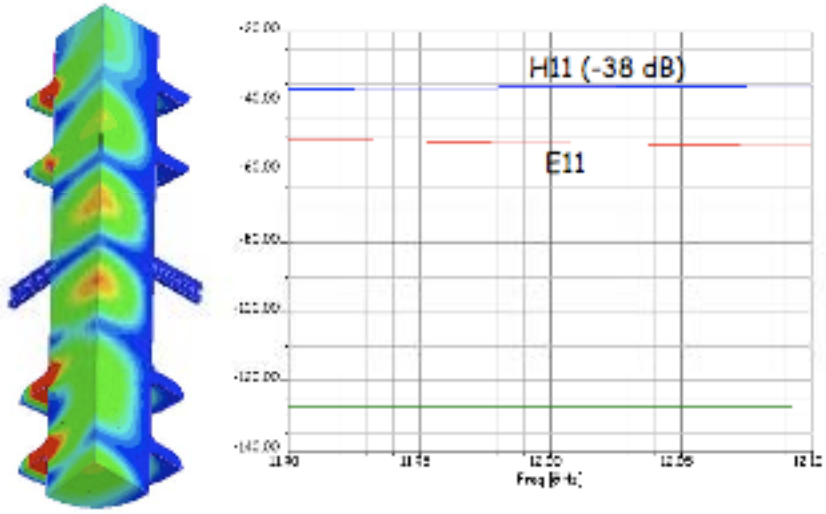
Double-mirror concept.
High Q-factor, small coupling configuration (QL ~ 3000)

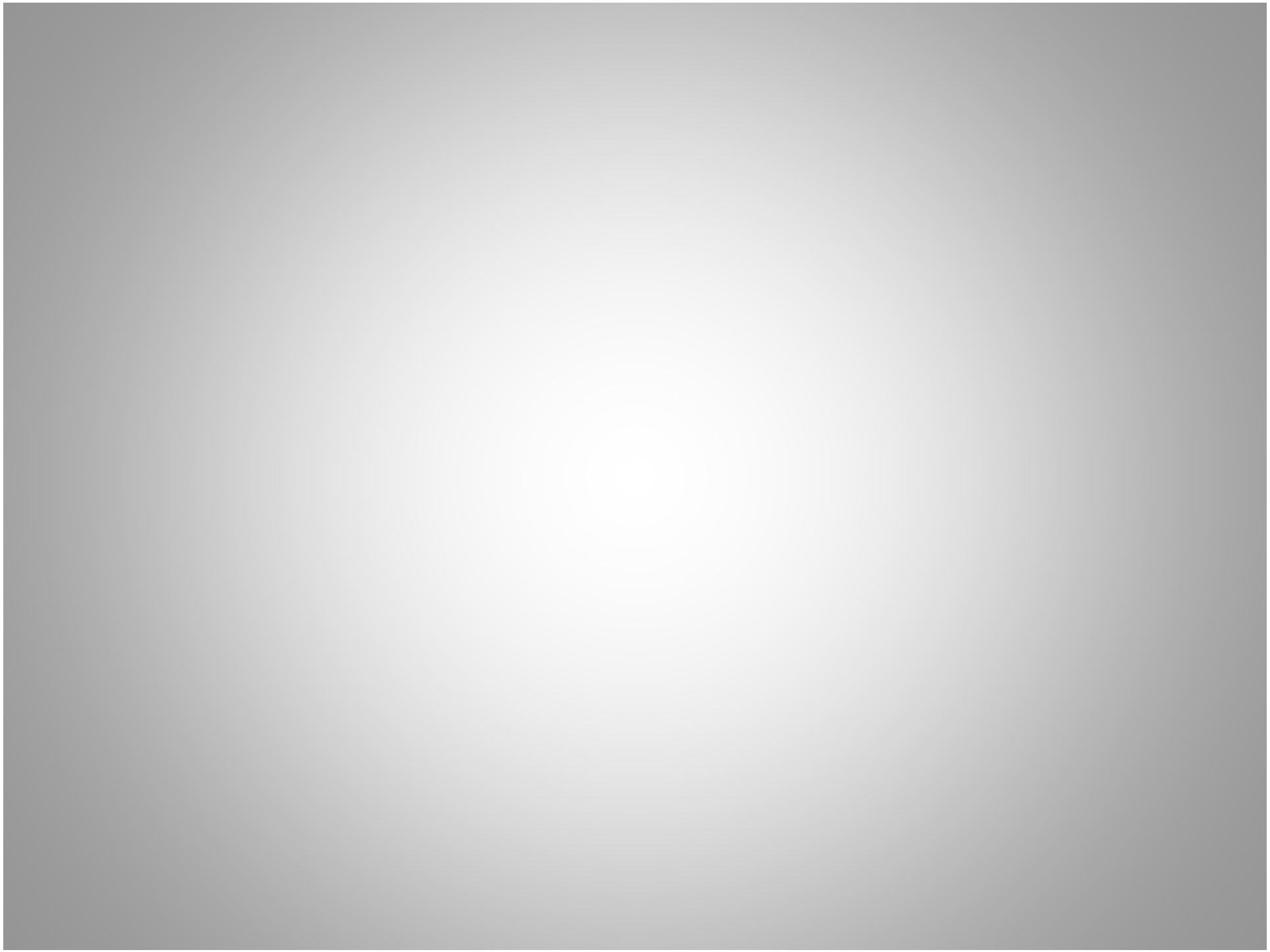
This configuration allows to reduce to ~ -40 dB coupling of the RF noise arrived/reflected with the beam to the detection point. The dipolar component will be further reduced by connecting coax. ports in pairs.

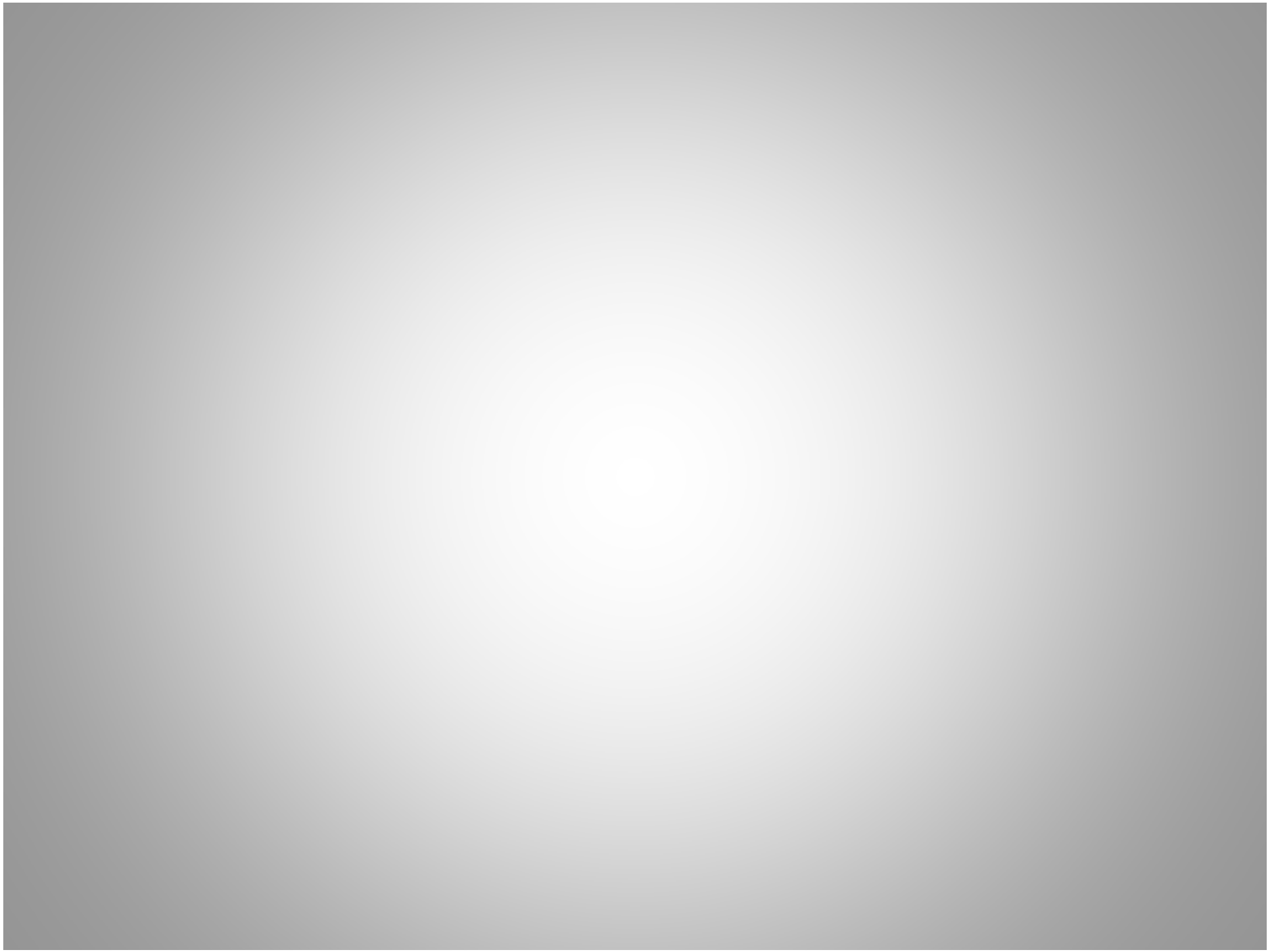
Symmetric modes rejection (coupling. to coax.)



Dipolar modes rejection (coupling. to coax.) (zero-crossing tune)



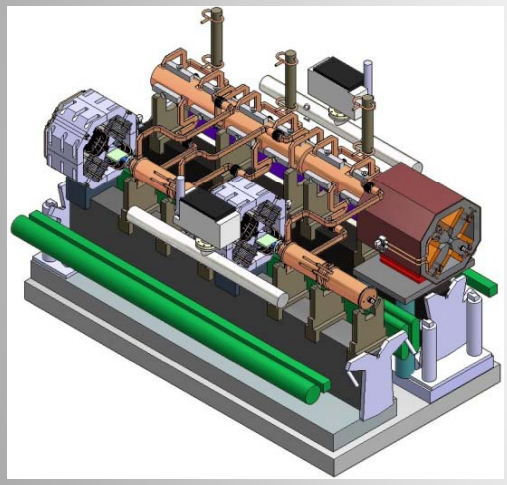


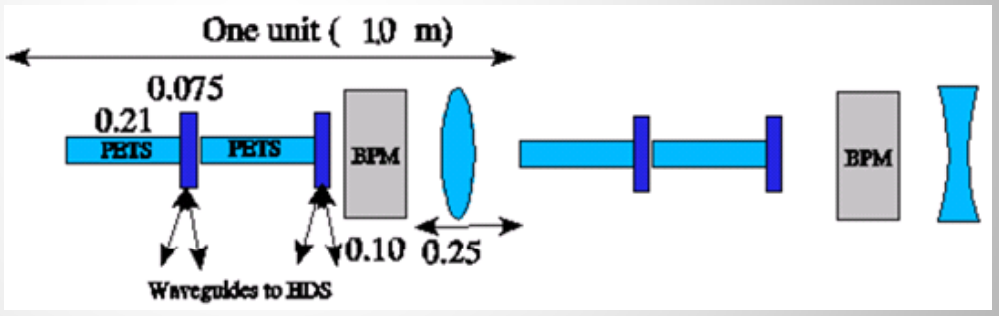


PETS: nominal usage in CLIC

- Reminder: PETS is the generator of the CLIC RF power
- In each Decelerator sector the 100A CLIC Drive Beam pass through ~1500 PETS, 21 cm long, each producing 136 MW RF power

I. Syratchev, D. Schulte, E. Adli and M. Taborelli, "High RF Power Production for CLIC", *Proceedings of PAC 2007*





- The CLIC Decelerator beam dynamics has been studied extensively, e.g.

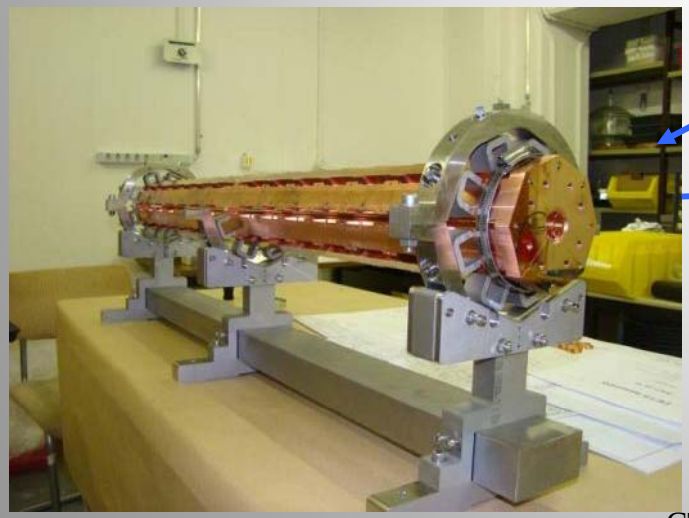
E. Adli,D. Schulte and I. Syratchev, "Beam Dynamics of the CLIC Decelerator", *Proceedings of XBAND Workshop'08*

- TBTS: provides the **first beam tests** of the 12 GHz PETS

Two Beam test Stand

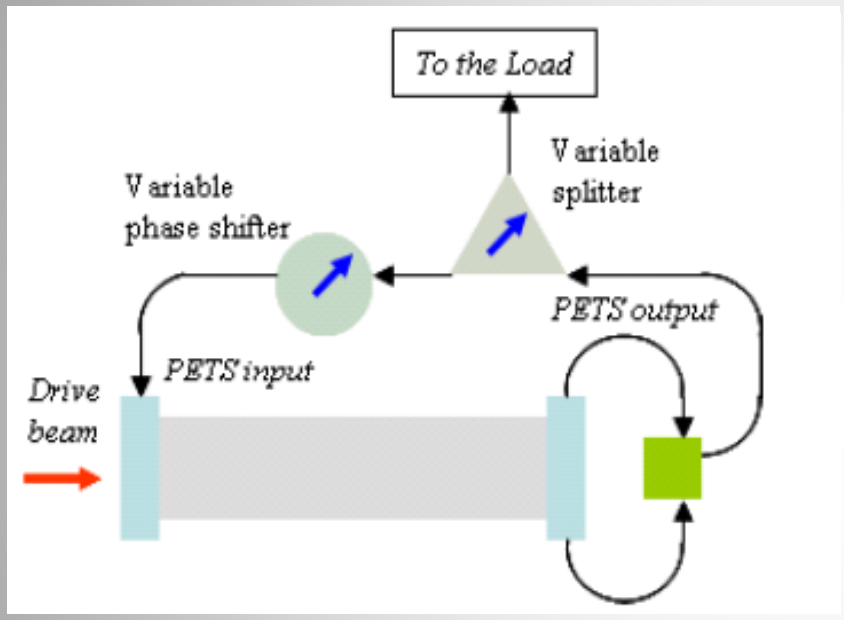
All hardware installed !
Commissioning with beam ongoing
Beam in both lines up to end !

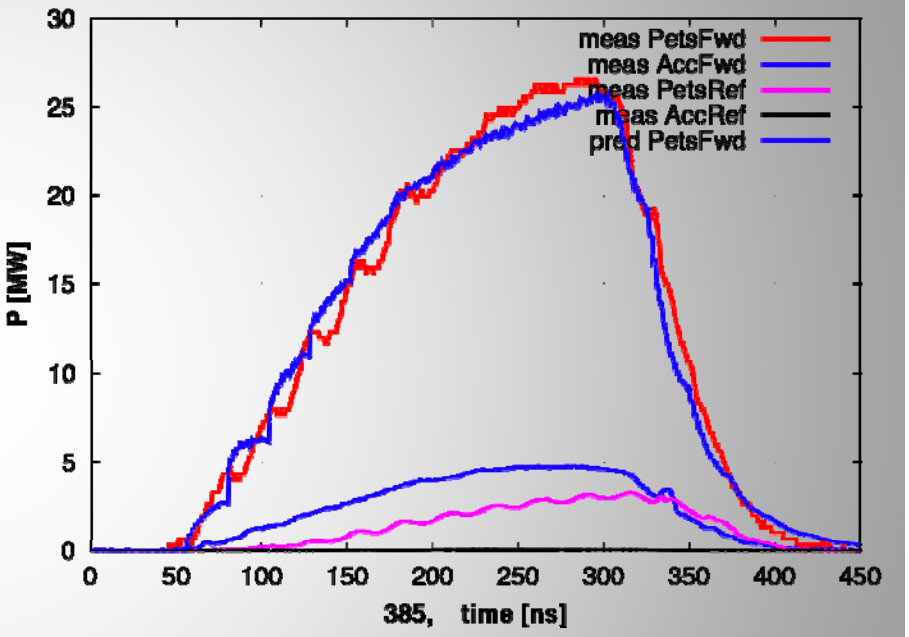
PETS (CERN) was installed in October, first accelerating structure in 2009



Simple model of recirculation

In an attemt to the recirculated power and predict the power for a given current we assume the following simple field model (we ignore the fill-time here):





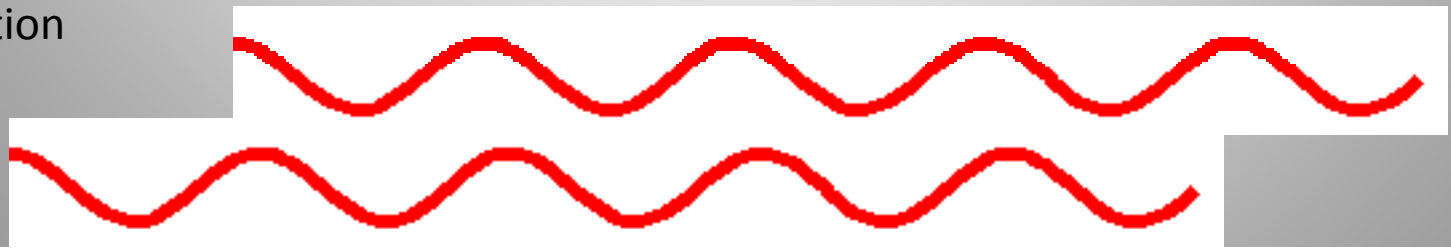
r : the ratio of the field being recirculated

η : estimated ohmic losses around the circulation

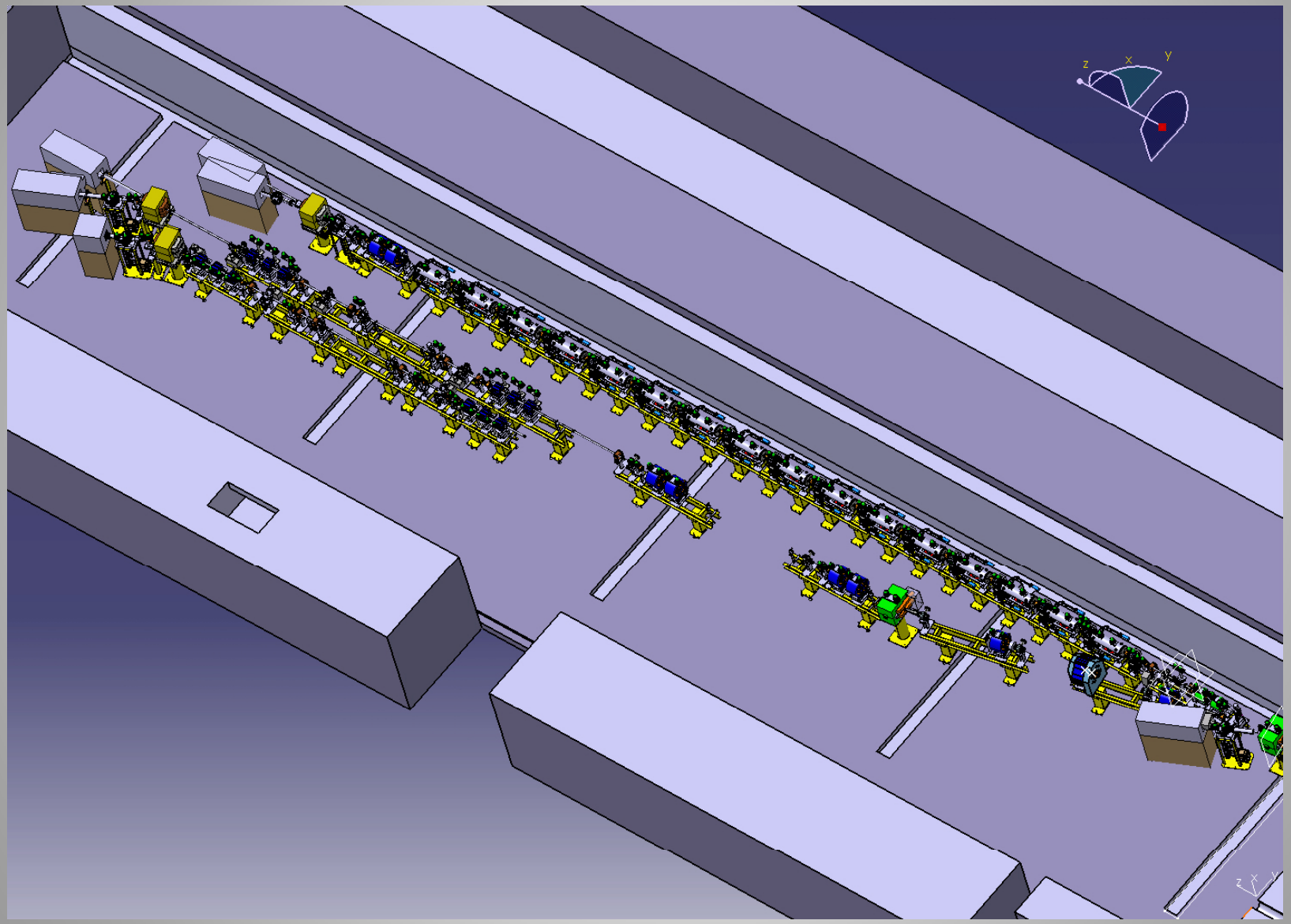
ϕ : the field phase change after one recirculation

$\lambda = r \times \eta \times \exp(j\phi)$: field reduction factor after one recirculation

Power: PETS out (red), modelled PETS out (upper blue)



TBL integration into CLEX



TBL

- All quadrupole magnets (BINP) at CERN
- Prototype BPM (BPS) installed, tested. Series ordered (IFIC)
- Read-out electronics will be provided by UPC and LAPP
- All vacuum equipment available

In summary: everything covered, except 15 PETS

Tender for 7 more will go out in the next weeks (only bars)

three tanks + assembly at Ciemat

the remaining 4 to be taken care of by CERN

installation summer 2010

Eight to be ordered in 2010.

NTA-CLIC

Richieste per 2010

Missioni Italia	Missioni Estero	Consumo	Inventariabile	Licenze Software (SJ)	Totale
2.0	30.0	8.0	5.0	6.0	45.0 + 6.0

Turni Delay Loop e Combiner Ring
Partecipazione a IPAC10
Partecipazione a riunioni di collaborazione
Meeting per la stesura TDR CLIC

Passanti da vuoto per RF-BPM
Elettronica di acquisizione RF-BPM
Licenza HFSS se approvata collaborazione sulle strutture deceleranti