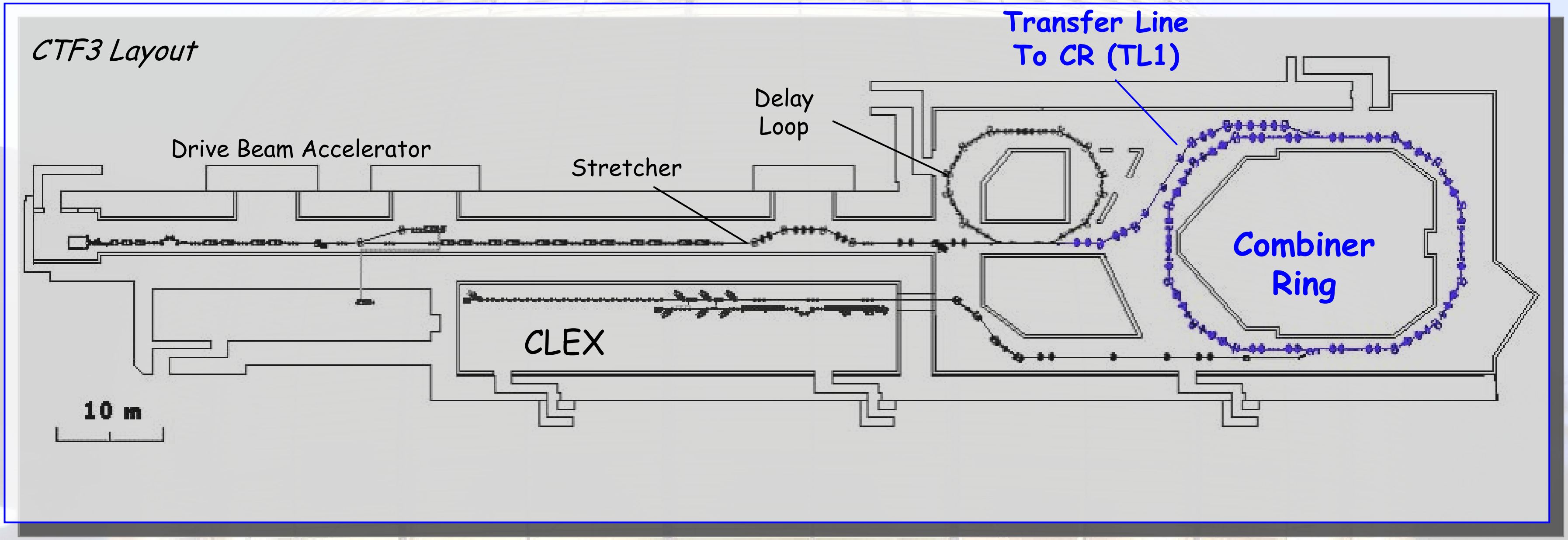
CTF3 COMBINER RING & TL1 – AN OVERVIEW

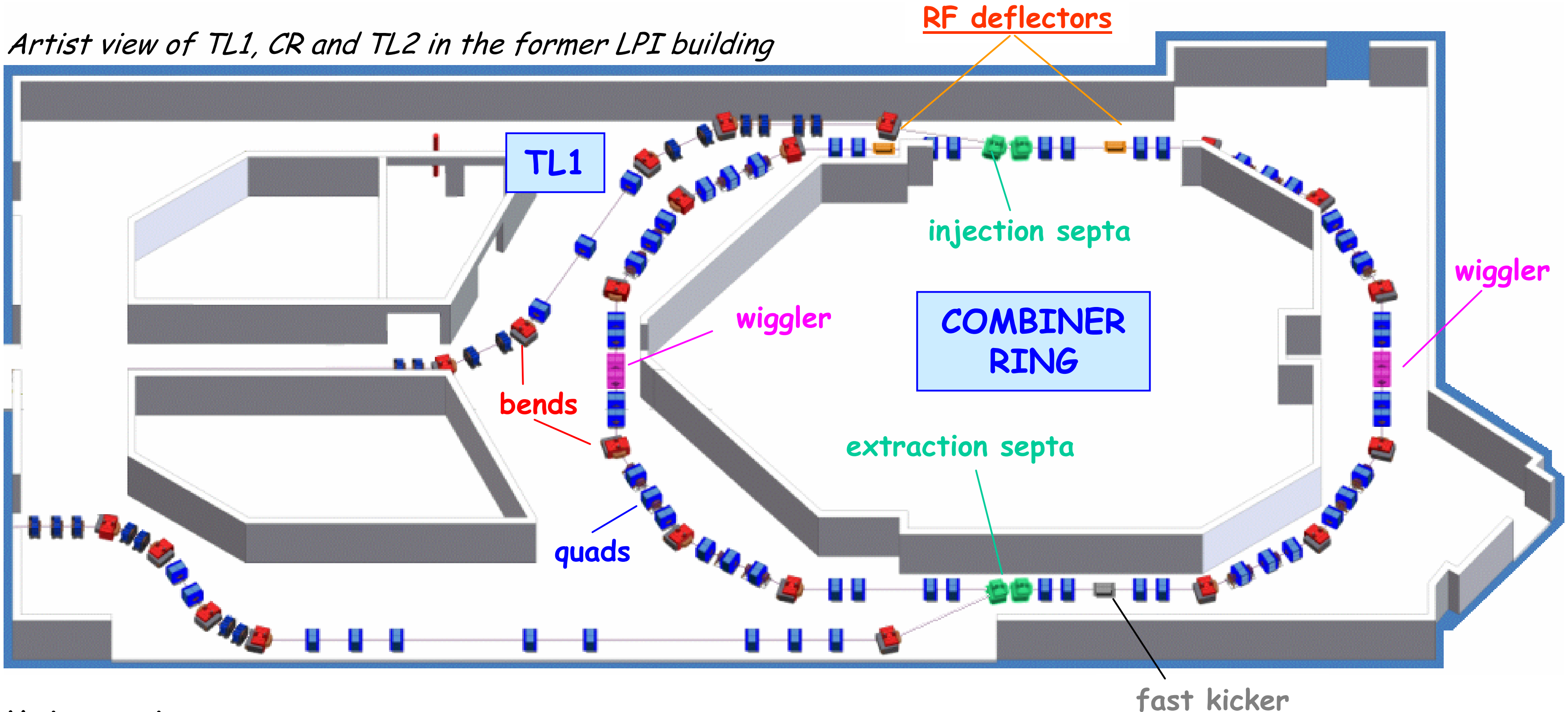
R. Corsini

The Combiner Ring (CR) and the transfer line TL1



- **TL1** transports the drive beam from the Delay Loop to the CR, preserving its time structure.
- The **CR** is used to increase the drive beam peak current from 7 A to 35 A and to obtain the required bunch spacing (bunch combination process with RF deflectors).

Artist view of TL1, CR and TL2 in the former LPI building



Main requirements:
preservation and control of beam time structure, bunch length and energy spread, transverse beam stability.

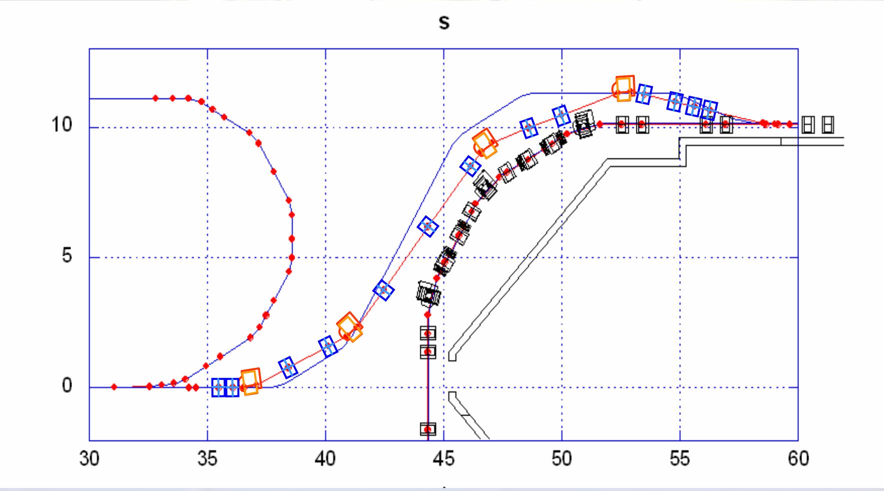
- The total length is about 124 m (40 m + 84 m)
- The nominal beam momentum is 150 MeV/c. The hardware must be compatible with a maximum beam momentum of 300 MeV/c.
- The maximum pulse repetition rate is 50 Hz.

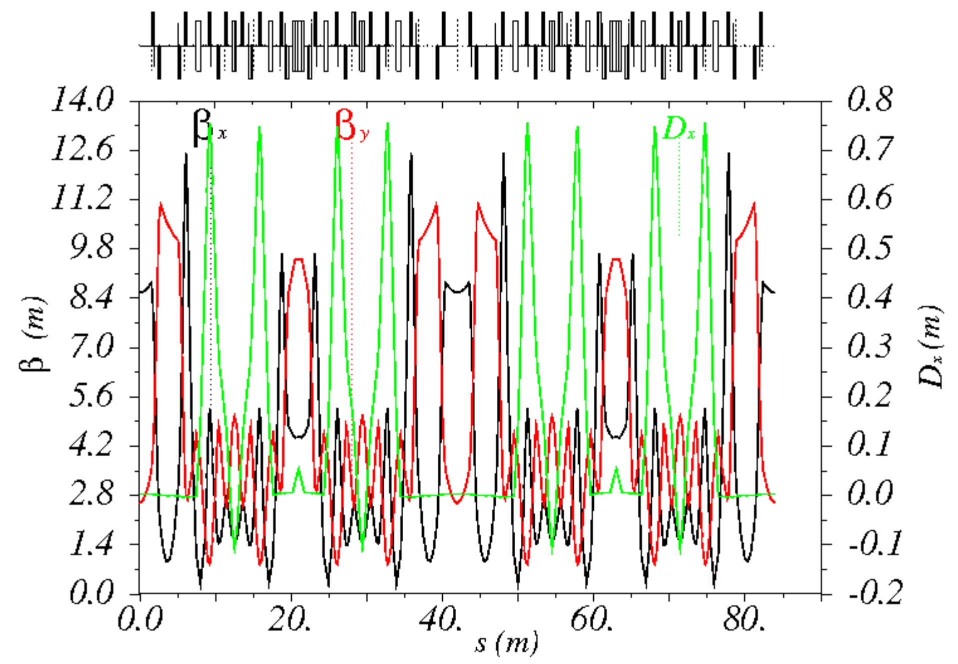
A reference optics layout exists from INFN-LNF

- The CR optics can be considered as final. To be checked depending on the final choice of quadrupoles.
- There is a new design of TL1. It satisfies the basic beam dynamics requirements. Some further modifications could be needed depending on exact layout. Second order corrections (sextupoles) to be included.

Requirements:

- Both TL1 and CR must be achromatic and isochronous.





(C. Biscari, INFN-LNF)

Magnets (including TL2 up to CLEX)

Presentation this afternoon: T. Zickler

TOTAL NEEDED

21 bending magnets $\int B\,dl \leq 0.5\ \mathrm{T\cdot m}$
78 quadrupoles $\int G\,dl \leq 1.5\ \mathrm{T}$
24 sextupoles
4 septa
2 wigglers
32 correctors

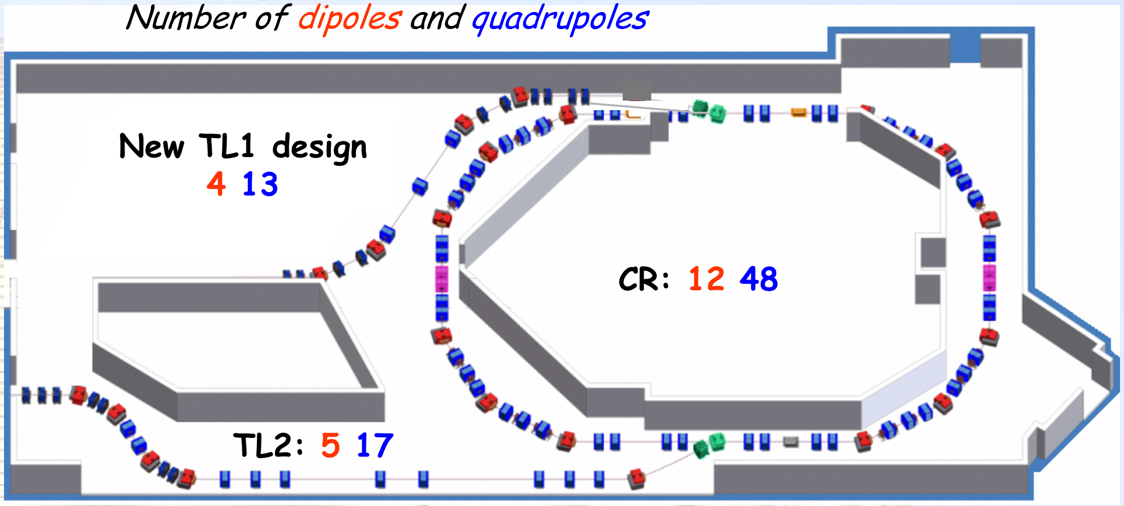
AVAILABLE

16 bending magnets
60 quadrupoles
(+30 air cooled)

TO BE BUILT (or procured)

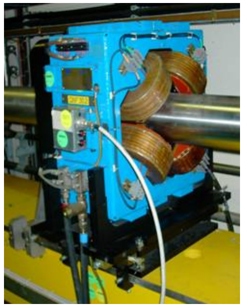
5 bending magnets
18 quadrupoles*
24 sextupoles*
4 septa
2 wigglers*
32 correctors*

* A design exists



16 bending magnets

36



15

9

30

60 quadrupoles

Magnets (cont'd)

- **Bending magnets:** all bends for TL1 and CR (16) are available (EPA combined function dipoles)
- **Quadrupoles:** Need > 18, including TL2
  32 quadrupoles can be obtained from LURE (Super-ACO dismantling)
  11 new "narrow" quadrupoles, adapted to CR injection, ordered from BINP

ID		Type	Lmagn [m]	Coeff [T/m A]	Resist [Ω]	I (1T) [A]	P (1T) kW	Need	Available	Spares	
S-ACO		QX	0.4	0.017777	0.05432	141	1.1	28	32	4	
EPA large		QE	0.38	0.03095	0.4	85	2.9	2	9	7	
QN		QF	0.328	0.016	0.045	191	1.6	13	15	2	
new		QG	0.3	0.04	0.075	83	0.5	10	11	1	
terwilliger		QH	0.38	0.03595	0.25	73	1.3	21	36	15	
EPA norm		QI	0.3585	0.02817	0.08	99	0.8	4	30	26	
								78	133	55	29

- **Sextupoles:** All sextupoles ordered from BINP. If additional sextupoles for TL1 (and TL2) would be needed, 12 old EPA sextupoles are available

- **Wigglers:** One ordered (INFN-LNF), second from LNF later ?
- **Correctors:** Under way from CIEMAT
- **Septa:** To be engineered and built by CIEMAT (waiting for approval)

Power supplies (including TL2 up to CLEX)

- Quadrupoles in TL1 and TL2 powered independently for maximum flexibility.
- Large number of quad families in CR, for flexibility and low power converters.
- Several power supplies are available from LPI (for instance, CR bends)

General type	N	used for	I_{MAX}	V_{MAX}	P_{MAX}
Small	64	Correctors	10 A	4 V	0.04 kW
Medium	60	Quads, sexts, wigglers, bends	300 A	70 V	6 kW
Special					
	2	Septa	1500 A ?	20 V	30 kW
	1	Bends CR	320 A	140 V	45 kW
	2	Bends TL	340 A ?	60 V	20 kW

Power supplies (cont'd)

	magnets	N supplies	I [A]	ΔV [V]
TL1	dipoles	2	275,340	20,24
	quads	13	*	*
CR	dipoles	1	320	140
	wigglers	2x2	240,310	11.5,12.4
	quads	20	*	*
	sext	3	150	20.5
	septa	2	1500 ?	20 ?
TL2	dipoles	1 ?	340 ?	60 ?
	quads	17	*	*

Plus a total of 64 small power supplies for correctors (10 A. 4V)

* See next slide for detailed values

Quadrupoles powering scheme

preliminary

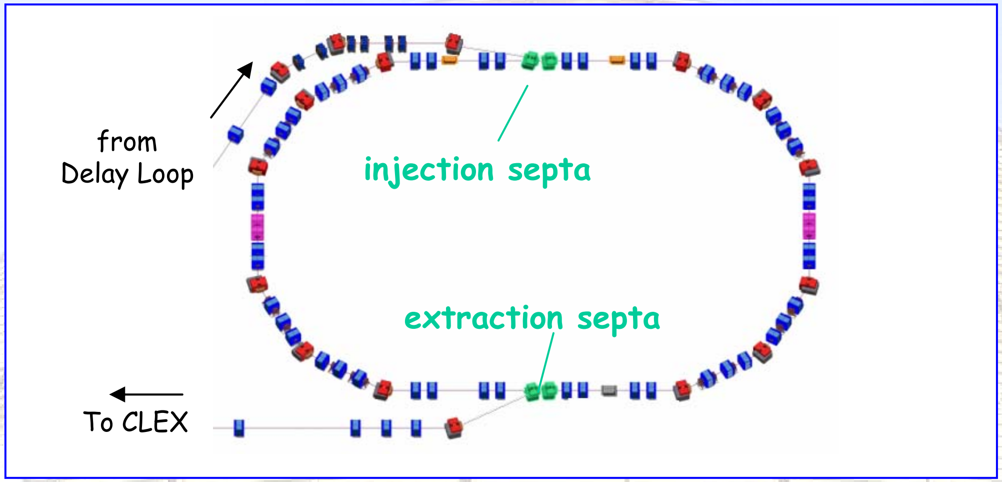
	Name	Glmax	N_supplies	N_mag/s	N_mag-tot	Type	Lmagn [m]	Coeff [T/m A]	Resist [Ω]	Curr [A]	DeltaV [V]	Power [kW]
TL1	KQTLF4	1.3	1	1	1	QG	0.3	0.04	0.075	108	8.1	0.9
	KQTLF3	1.6	1	1	1	QF	0.328	0.016	0.045	305	13.7	4.2
	KQTLF2	1.5	1	1	1	QF	0.328	0.016	0.045	286	12.9	3.7
	KQTLF1	0.7	1	1	1	QF	0.328	0.016	0.045	133	6.0	0.8
	Kqis9	1	1	1	1	QF	0.328	0.016	0.045	191	8.6	1.6
	Kqis8	0.2	1	1	1	QI	0.3585	0.02817	0.08	20	1.6	0.0
	Kqis7	1	1	1	1	QF	0.328	0.016	0.045	191	8.6	1.6
	Kqis6	1	1	1	1	QH	0.38	0.03595	0.25	73	18.3	1.3
	Kqis5	0.8	1	1	1	QH	0.38	0.03595	0.25	59	14.6	0.9
	Kqis4	1.2	1	1	1	QH	0.38	0.03595	0.25	88	22.0	1.9
	Kqis3	0.6	1	1	1	QH	0.38	0.03595	0.25	44	11.0	0.5
	KQDL6	0.9	1	1	1	QH	0.38	0.03595	0.25	66	16.5	1.1
	KQDL5	0.3	1	1	1	QI	0.3585	0.02817	0.08	30	2.4	0.1
CR	KQ01	1.4	4	2	8	QX	0.4	0.017777	0.05432	197	21.4	4.2
	KQ02	1	2	4	8	QX	0.4	0.017777	0.05432	141	30.6	4.3
	KQ03	0.9	2	4	8	QX	0.4	0.017777	0.05432	127	27.5	3.5
	KQL1IN	1.3	2	2	4	QG	0.3	0.04	0.075	108	16.3	1.8
	KQL2IN	0.7	2	2	4	QG	0.3	0.04	0.075	58	8.8	0.5
	KQL3IN	0.6	2	2	4	QF	0.328	0.016	0.045	114	10.3	1.2
	KQL4IN	0.7	2	2	4	QF	0.328	0.016	0.045	133	12.0	1.6
	KQS1C	1.2	2	2	4	QX	0.4	0.017777	0.05432	169	18.3	3.1
	KQS2C	0.6	2	2	4	QH	0.38	0.03595	0.25	44	22.0	1.0
TL2	qtle3	1.5	1	1	1	QG	0.3	0.04	0.075	125	9.4	1.2
	qtle2	1.2	1	1	1	QH	0.38	0.03595	0.25	88	22.0	1.9
	qtle1	0.8	1	1	1	QH	0.38	0.03595	0.25	59	14.6	0.9
	qtle4	0.5	1	1	1	QI	0.3585	0.02817	0.08	50	4.0	0.2
	qtle5	0.5	1	1	1	QI	0.3585	0.02817	0.08	50	4.0	0.2
	qdpp3	1.3	1	1	1	QH	0.38	0.03595	0.25	95	23.8	2.3
	qdpp2	1.5	1	1	1	QH	0.38	0.03595	0.25	110	27.5	3.0
	qdpp1	1.2	1	1	1	QH	0.38	0.03595	0.25	88	22.0	1.9
	qss1	1.5	1	1	1	QH	0.38	0.03595	0.25	110	27.5	3.0
	qss2	1.2	1	1	1	QH	0.38	0.03595	0.25	88	22.0	1.9
	qss3	0.8	1	1	1	QH	0.38	0.03595	0.25	59	14.6	0.9
	qsss3	1	1	1	1	QH	0.38	0.03595	0.25	73	18.3	1.3
	qsss2	1.2	1	1	1	QH	0.38	0.03595	0.25	88	22.0	1.9
	qsss1	1.5	1	1	1	QH	0.38	0.03595	0.25	110	27.5	3.0
	qdp1	0.6	1	1	1	QE	0.38	0.03095	0.4	51	20.4	1.0
	qdp2	0.9	1	1	1	QH	0.38	0.03595	0.25	66	16.5	1.1
	qdp3	0.6	1	1	1	QE	0.38	0.03095	0.4	51	20.4	1.0
			50		78							96.0

ID		Type
S-ACO		QX
EPA large		QE
QN		QF
new		QG
terwilliger		QH
EPA norm		QI

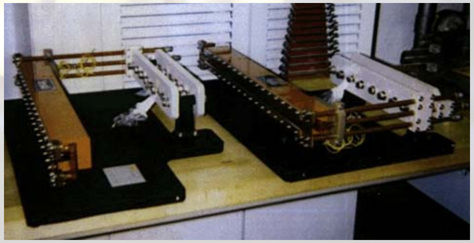
R. Corsini, 19 May 2004

Septa

Presentation this afternoon: K. Metzmacher



- New design of TL1 reduces septa requirements (smaller injection angle)
- Parameter optimization under way (CERN – INFN), in order to use a single power supply for each couple of septa.
- Present solution:
  - thick septum can be a copy of the one built for TERA (CNAO)
  - Thin septum derived from the DAΦNE one – modifications suggested by CERN
- Engineering and building by CIEMAT (waiting for funding)



Vacuum chamber

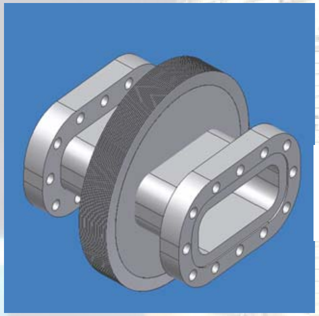
Presentation this afternoon: J. Hansen

- The vacuum chamber components must have a minimum impedance contribution.
- Aluminum alloy used whenever possible to minimize resistive wall effect.
- Typical cross sections: 100mm x 40mm (dispersive sections) and 40mm x 40mm

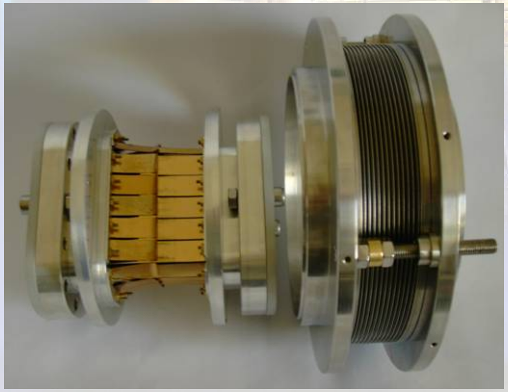
A large part of the equipment design made by INFN-LNF for chicane & DL can be used.

To be provided by INFN-LNF – waiting for approval

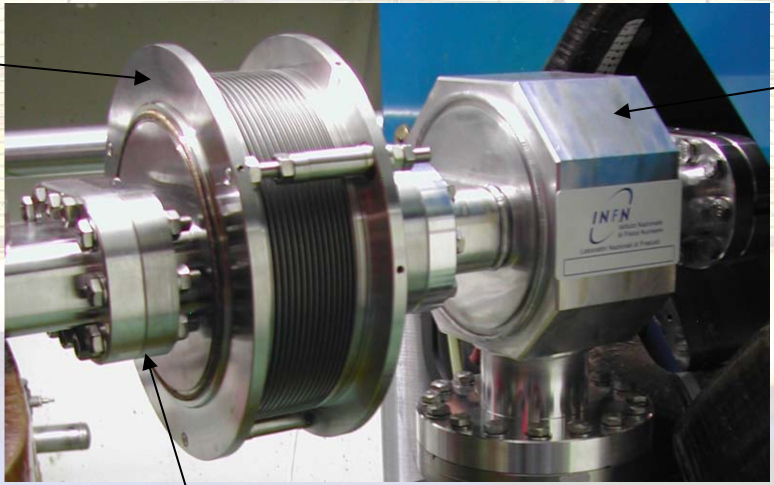
INFN-LNF VACUUM EQUIPMENT



RF shielded bellow

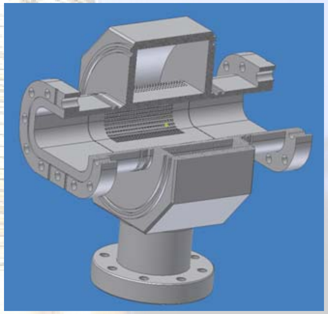


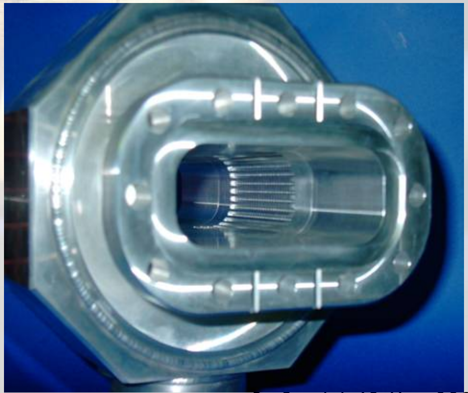
Equipment installed in CTF3



Special gasket profile for RF contact

Shielded pumping port



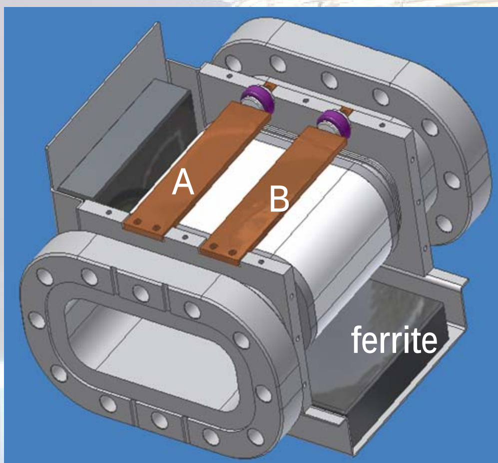


Diagnostics

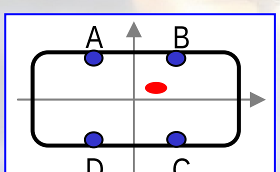
Beam position and profile measurements.

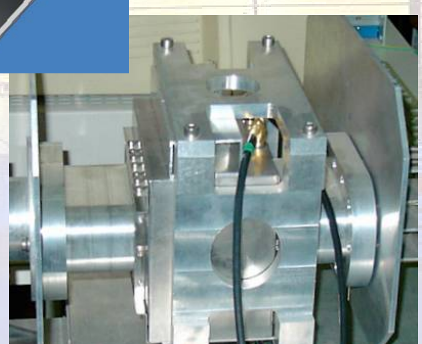
- Need about 32 beam position monitors.
- The INFN-LNF design of the chicane and delay loop BPI could be used.
- Several vacuum ports for synchrotron light, with optical lines to CCD cameras, are foreseen.

To be provided by INFN-LNF – waiting for approval

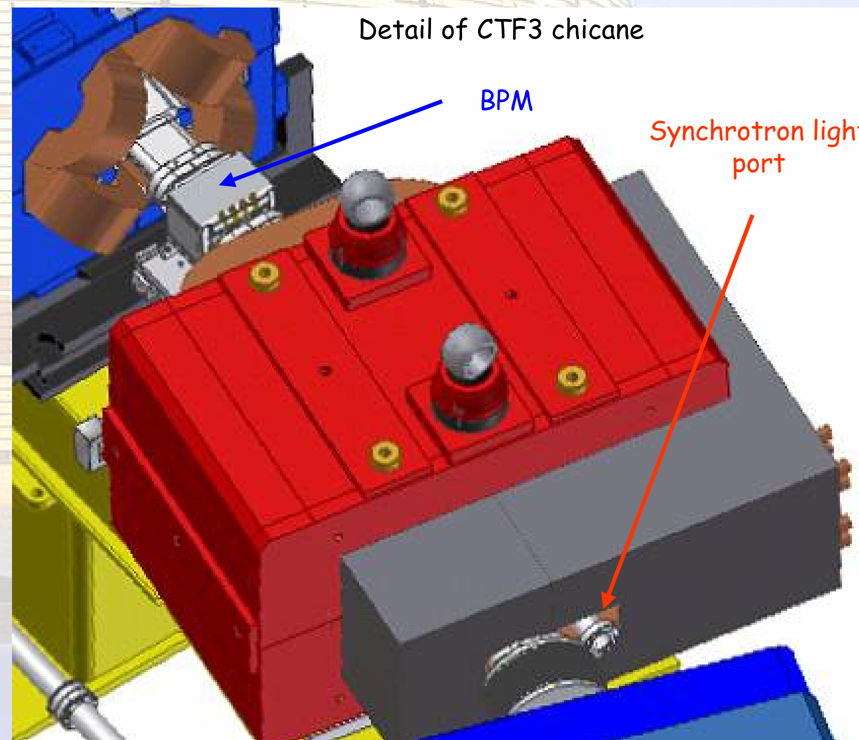


INFN-LNF BPI

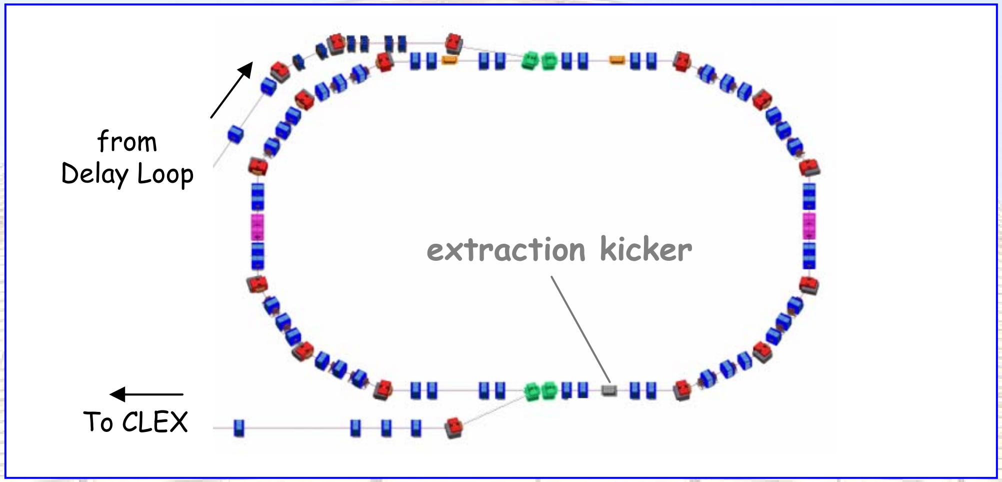


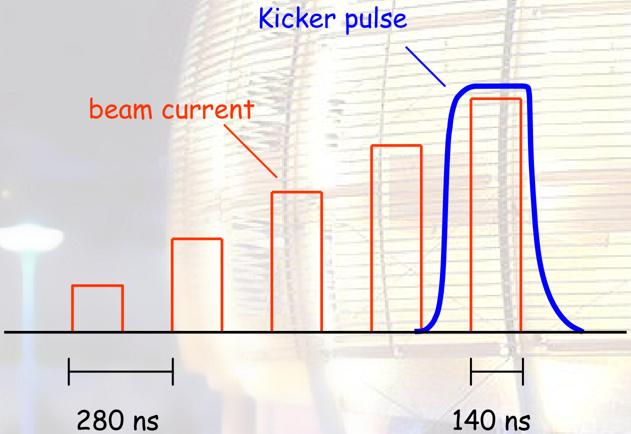


BPI during test



Extraction kicker





Evolution of beam current circulating in the ring over 5 turns & kicker pulse

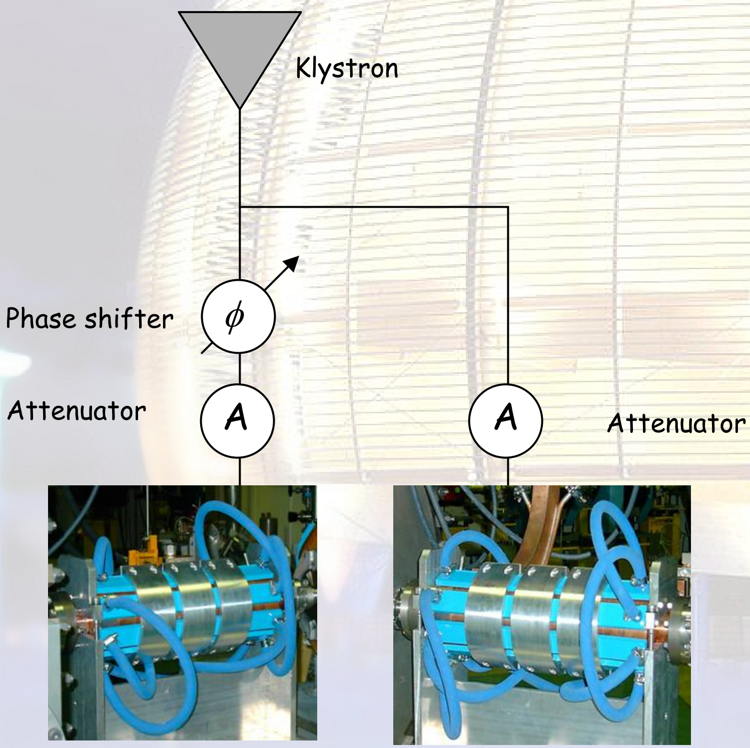
- Initial solution: old EPA kicker modules (high impedance ?)
- Final solution: strip-line kicker, using existing high voltage pulser
- Engineered and built by CIEMAT (waiting for approval)

RF system

- Frequency 3 GHz
- Power in the 10 MW range
- The waveguide system includes power splitters, attenuators and phase shifters.

- RF deflectors existing (INFN-LNF)
- Need additional modulator/klystron for independent RF network ?

Schematic RF network



RF deflectors (INFN-LNF) installed during the Preliminary Phase