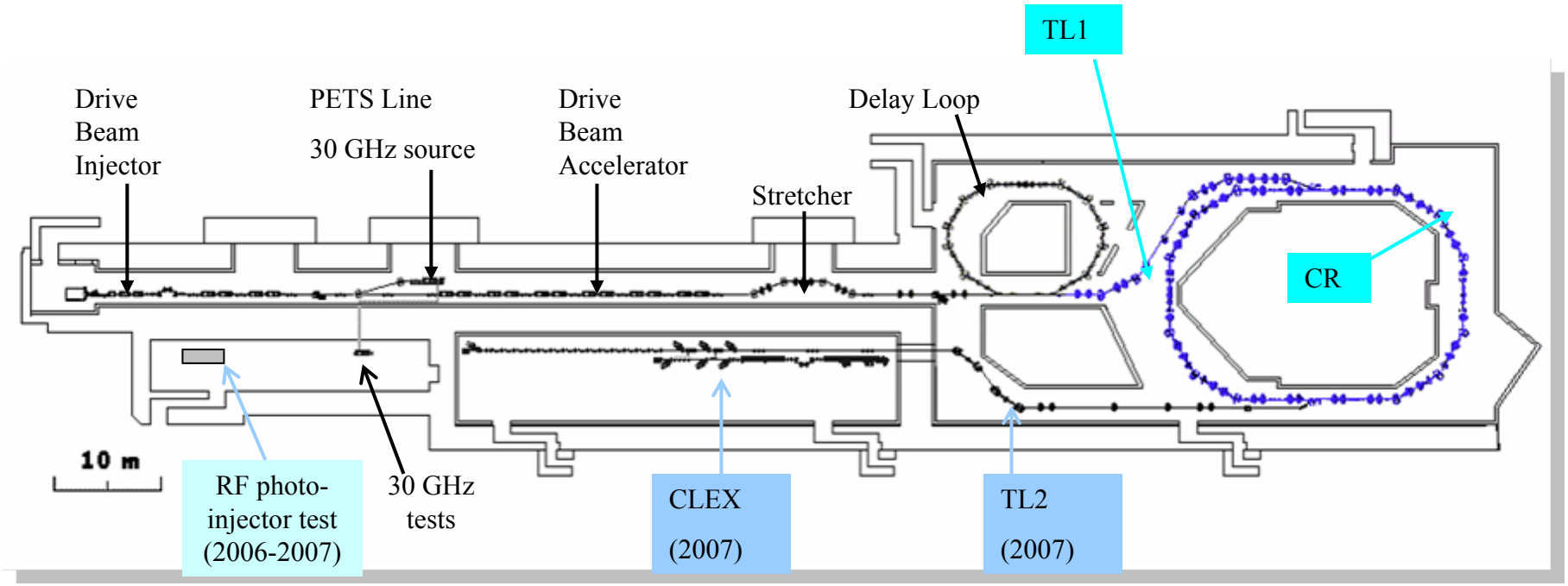
CTF3 Transfer Line and Combiner Ring

TL1 & CR

L. Rinolfi

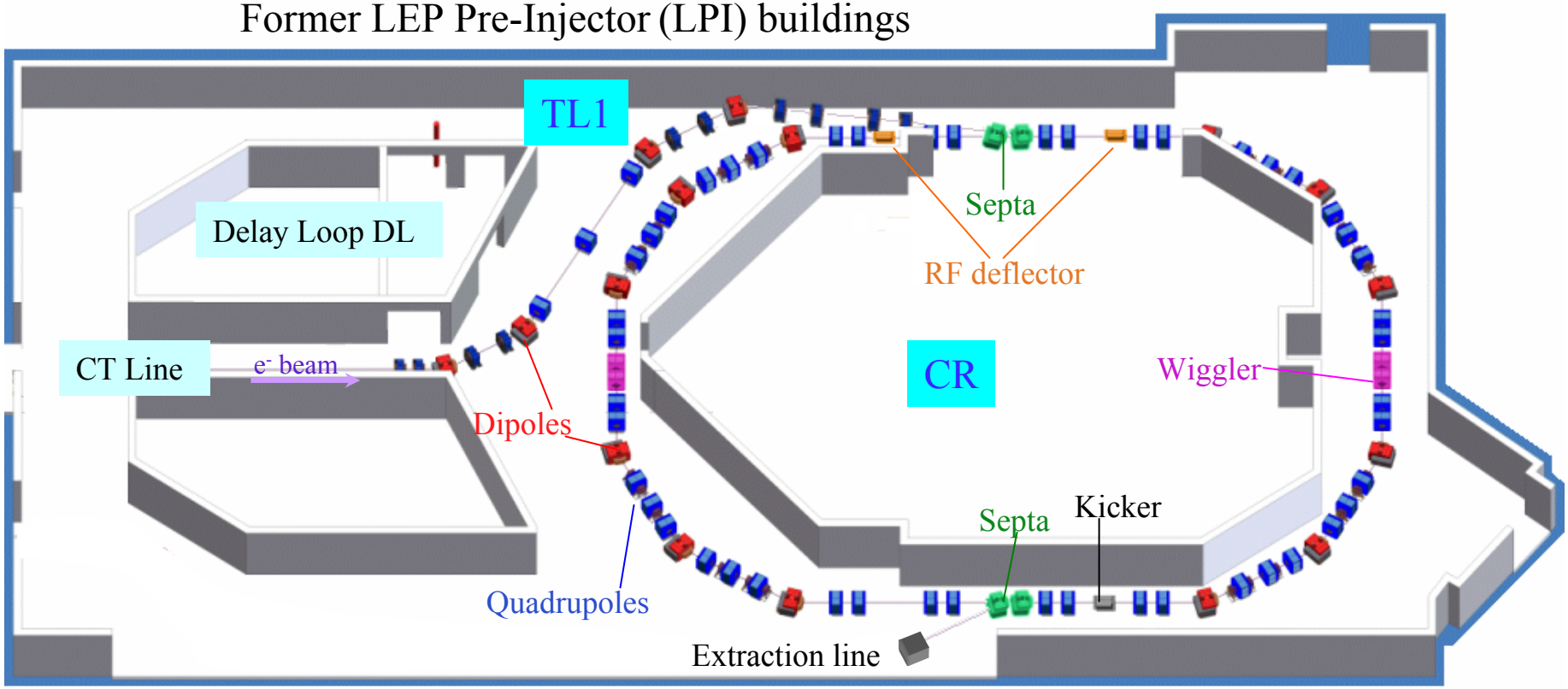
CTF3 General Layout



- The transfer line **TL1** will transport, in 2006, the drive beam from the Delay Loop (DL) to the Combiner Ring (CR), preserving its time structure.
- The Combiner Ring **CR** will perform, in 2006, frequency multiplication, from 3 GHz to 15 GHz, and will increase the drive beam peak current from 7 A to 35 A.

Artistic view for TL1 and CR

Former LEP Pre-Injector (LPI) buildings



TL1 length = 34 m

CR length = 84 m

(2 times DL length)

Nominal beam momentum 150 MeV/c.
All hardware compatible with a maximum beam momentum of 300 MeV/c.
Nominal repetition rate 5 Hz.
All hardware compatible with a maximum repetition rate of 50 Hz.

Overview

Optics

Magnets → *Dipoles*, *Quadrupoles*, *Sextupoles*, *Correctors*, *Septa*, *Kickers*, *Wiggler*

Power supplies

Beam diagnostic → *BPM*, *BPI*, *BPR*, *MTV*, *PHM*, *RF P.U.*, *PMI*

Vacuum

RF deflectors

Klystron

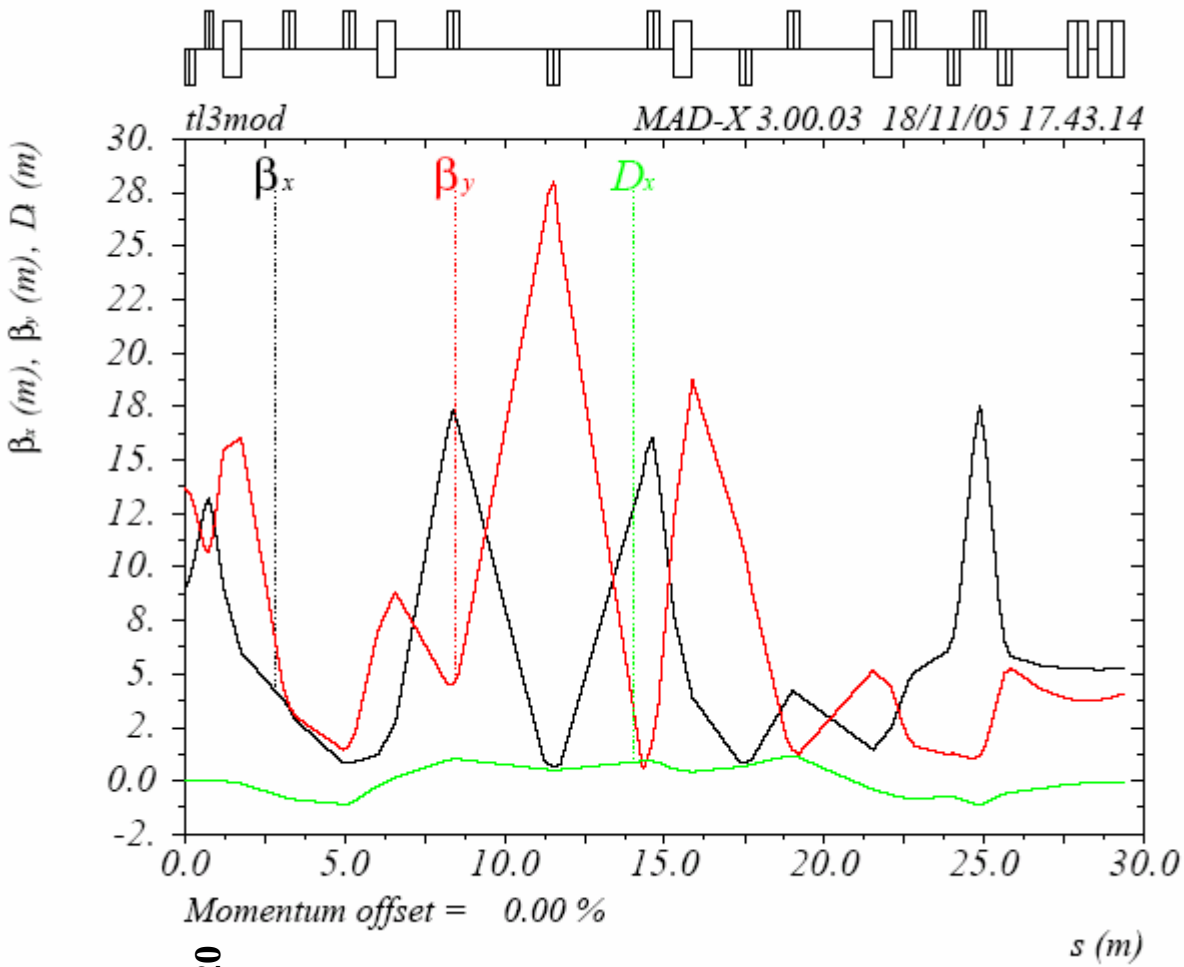
Alignment

Civil engineering

Schedule

Optics for TL1

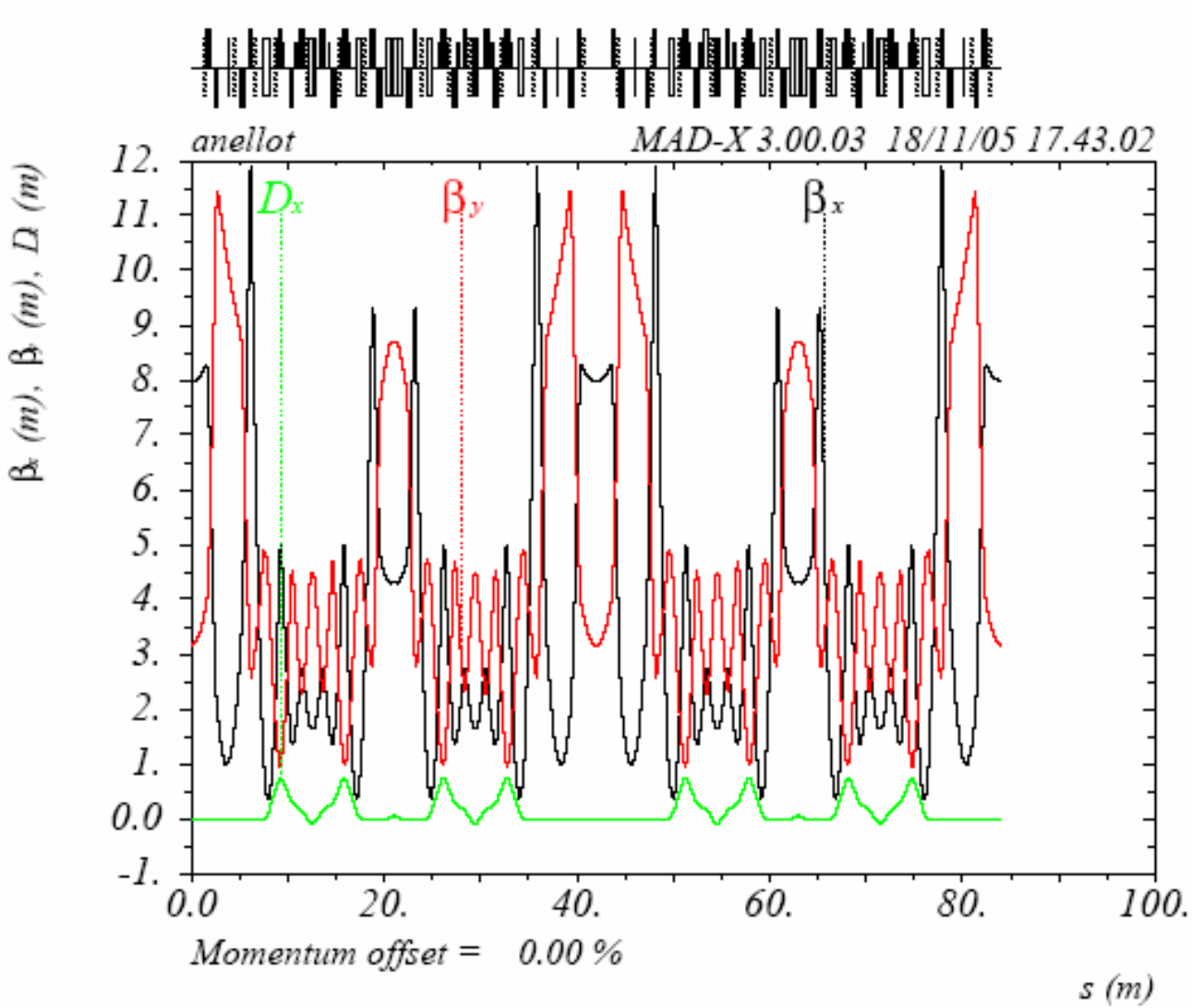
TL1 should be **achromat** and **isochrone**



C. Biscari / LNF

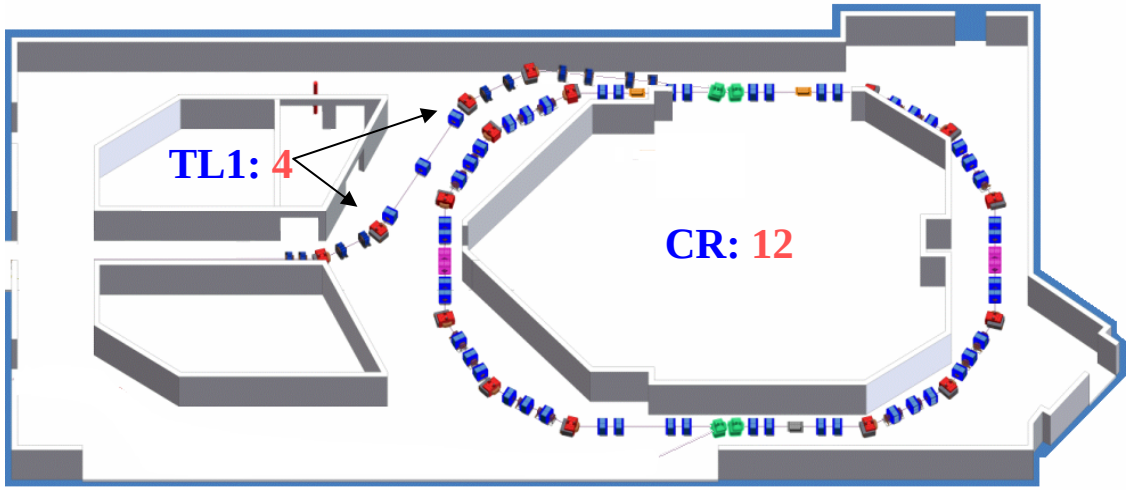
Delay Loop → **Quad CT.QDD520** … **Septum SHD100** → CR

Optics for the CR



C. Biscari / LNF

Dipoles



Type BHE: ex-EPA dipole with pure dipole field

Type	TL1	CR	Spare	Comment
E	1	0	0	Already installed
F	3	12	1	All at CERN

For I = 550 A:

B = 1.4 T and dBy / dx = - 1.1 T/m

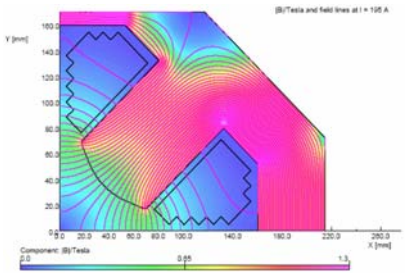
Type BHF: ex-EPA dipole with field gradient

Quadrupoles

Type	TL1	CR	Spare	Comment
D	2	0	1	Already installed
F	2	8	7	All at CERN
G	1	8	2	Ready Spring 2006
H	4	4	28	All at CERN
I	1	0	29	At CERN
J	2	28	2	Ready Spring 2006

Type Q*D: Scanditronix qadrupole

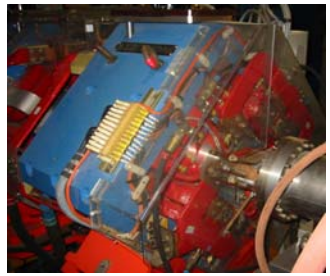
Type Q*F: LIL quad. QN



Type Q*G: new BINP qad.

Type Q*H: ex-EPA qad.

Type Q*I: ex-EPA qad.



Type Q*J: LURE qadrupole from S-ACO

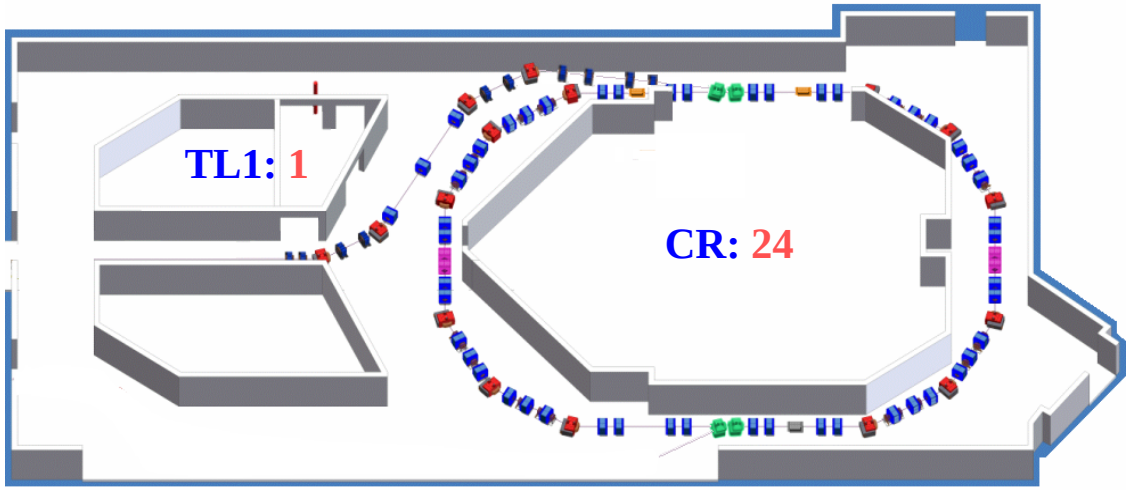
Quadrupoles

See also *Magnets* talk by T. Zickler

Some parameters for the 6 families of quadrupoles

Type	Number	L(m)	R(Ω)	I(A)	P(kW)
D	2	0.200	0.050	200	2
F	10	0.328	0.045	190	1.6
G	9	0.3	0.075	90	0.5
H	8	0.36	0.25	80	1.3
I	1	0.358	0.08	100	0.8
J	30	0.4	0.054	140	1.1

Sextupoles



Type X*B

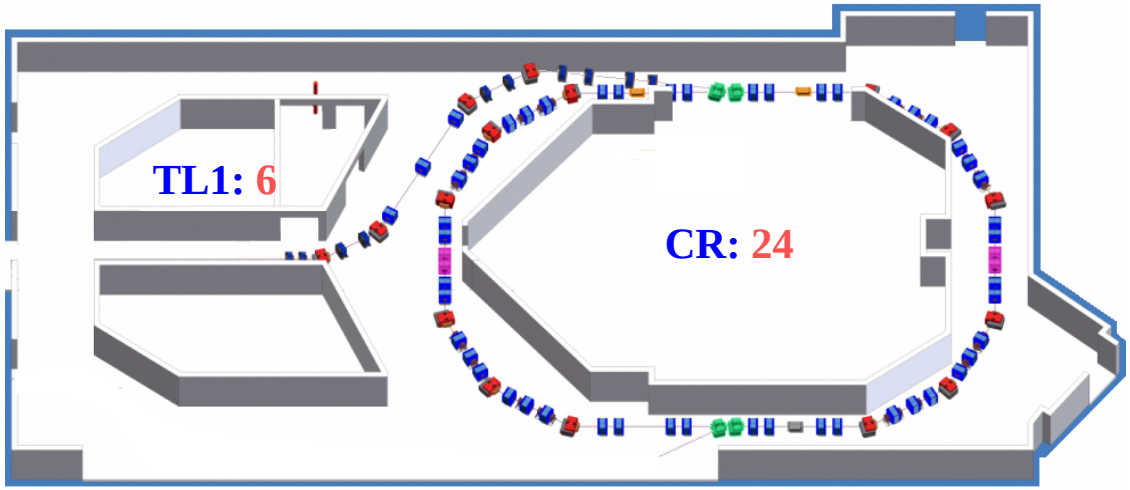
From LNF/INFN specifications

Type	TL1	CR	Spare	Comment
B	0	24	2	Built by BINP / Russia for Spring 2006
C	1	0	1	At CERN

Type X*C

Ex-EPA

Dipolar correctors



Type DHD / DVD

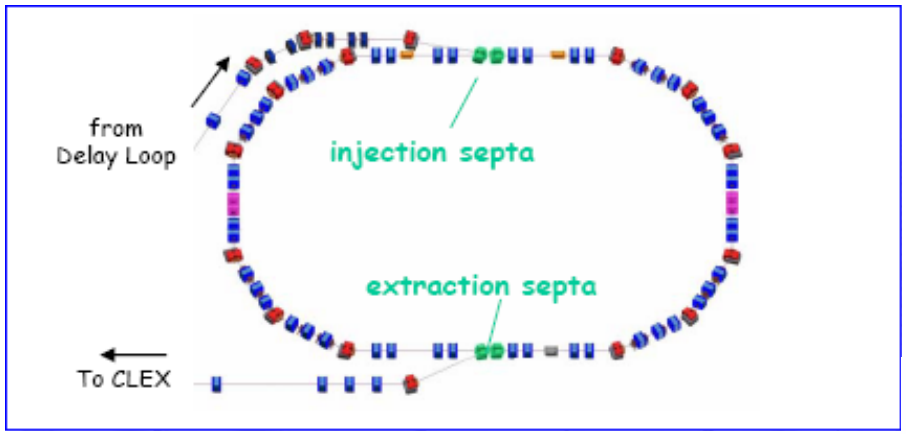
Type	TL1	CR	Spare	Comment
D	6	24	3	Built by CIEMAT / Spain For Spring 2006

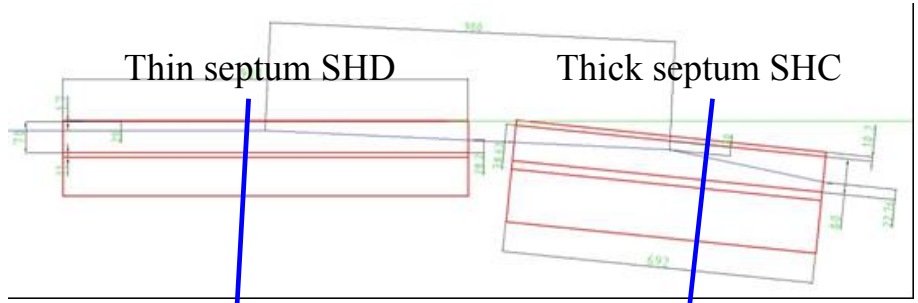
From LNF/INFN specifications

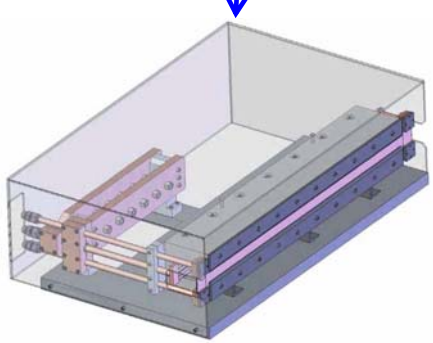
See also *Spanish Contribution* talk by L. G. Tabares

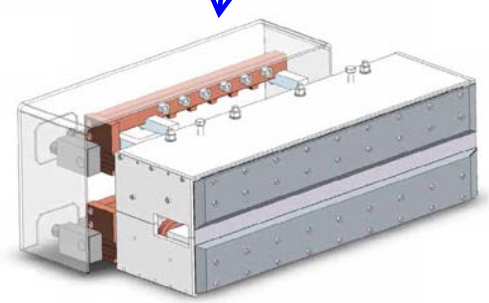
Septa

See also *Septa for CR* talk by J. Lucas







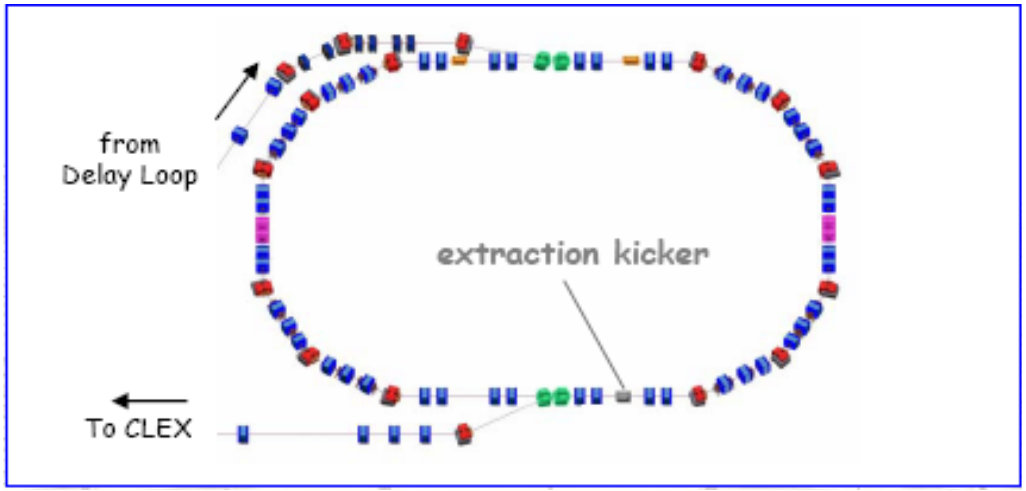


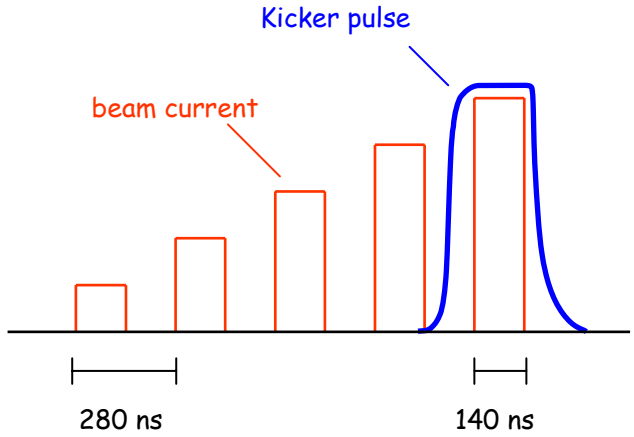
Type	CR	Comment
SHC	2	Septa built by CIEMAT / Spain for Spring 2006 at CERN
SHD	2	

Design in collaboration with LNF & CERN

Kickers

See also *Spanish Contribution* talk by L. G. Tabares



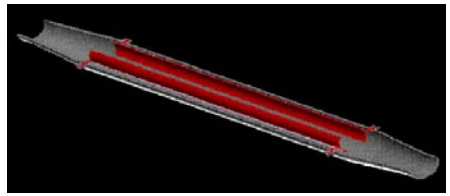


Rise time < 30 ns

For both types

Type	CR	Comment
KHA	1	At CERN (ex-EPA KFE 45) for 2006
KHB	1	Built by CIEMAT / Spain for 2007

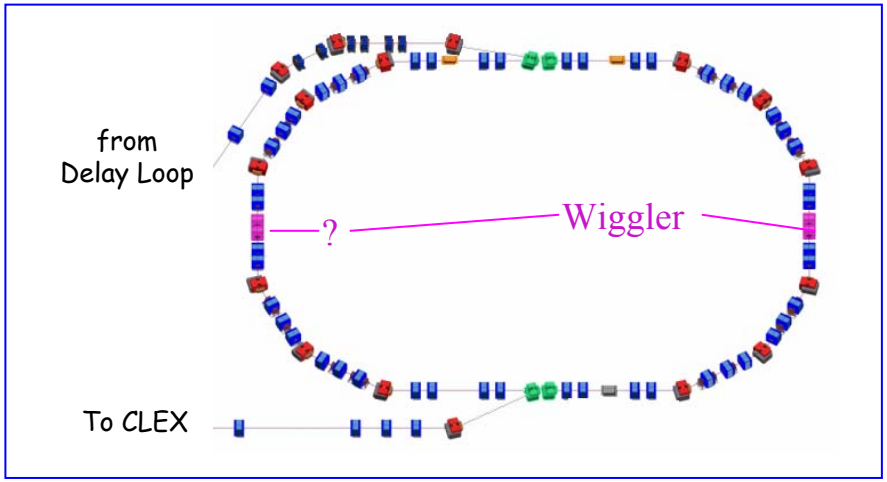
Type KHA: ex-KFE45 (EPA ferrite)



Type KHB: from CIEMAT- (Strip-line)

Wigglers

See also *Status of CTF3 work at INFN* talk by A. Ghigo



Type	CR	Comment
WHA	1 (or 2 ?)	Built by Sigmaphi / France 1 already at CERN 1 for Summer 2006 (?)

Designed by
LNF/INFN

Nom. median plan field	Tesla	0.6
Nom. magnetic Gap	mm	40
Wiggler period length	m	1.6
Number of periods		1
Number of full poles		1
Number of half poles		2
Mechanical wiggler length (inc. clamps)	mm	1708
Nom. excitation current (full pole)	Amp	308.25
Current density (full pole)	A/mm^2	4.36
Nom. Voltage (2 full poles)	V	12.2
Nom. excitation current (half pole)	Amp	235.5
Current density (half pole)	A/mm^2	3.33
Nom. Voltage (4 half poles)	V	11.3
Nom. total power dissipation	W	6,410

Summary for magnets

Type	TL1	CR	Total	At CERN today
Dipoles	4	12	16	16
Quadrupoles	12	48	60	37
Sextupoles	1	24	25	1
Correctors	6	24	30	0
Septa	0	4	4	0
Kickers	0	1 (+1)	2	1
Wigglers	0	2	2	1

Power supplies for TL1

Magnets	Number Power supplies	I (A)	U (V)	Comment
Dipoles	2	300	20	2 types
Quadrupoles	13	See next slide		
Sextupole	1	100	10	
Correctors	6 x 2	10	4	Horizontal & Vertical

All new power supplies to be built => Delivery foreseen in June 2006

Power supplies for TL1 (details)

Magnet	Alim	I_{max} [A]	R [Ω]	U_{max} [V]
CT.QDD0520	CT.QDD0540	200	0.057	11.4
CT.QFD0530	CT.QFD0550	200	0.057	11.4
CT.BHE0540 CT.BHF0630	CT.BHE0560-S	275	0.07	19.3
CT.QFH610	CT.QFH610	60	0.25	15.0
CT.XLC615	CT.XLC615	90	0.107	9.6
CT.QFH620	CT.QFH620	110	0.25	27.5
CT.QFH640	CT.QFH640	80	0.25	20.0
CT.QDH650	CT.QDH650	100	0.25	25.0
CT.QFF660	CT.QFF660	250	0.045	11.3
CT.BHF0670 CT.BHF0710	CT.BHF0670-S	275	0.07	19.3
CT.QDI680	CT.QDI680	50	0.08	4.0
CT.QDF690	CT.QDF690	250	0.045	11.3
CT.QFF720	CT.QFF720	150	0.045	6.8
CT.QDJ730	CT.QDJ730	275	0.05432	14.9
CT.QFJ740	CT.QFJ740	275	0.05432	14.9
CT.QDG750	CT.QDG750	130	0.075	9.8

Power supplies for CR

Magnets	Number Power supplies	I (A)	U (V)	Comment
Dipoles	1	320	140	At CERN (from LPI)
Quadrupoles	18	See next slide		4 families symmetry of 2
Sextupole	3	150	20	
Correctors	24 x 2	10	4	Horizontal & Vertical
Septa	2	2100	20	At CERN (from LPI)
Wiggler	2 x 2	300 250	15	

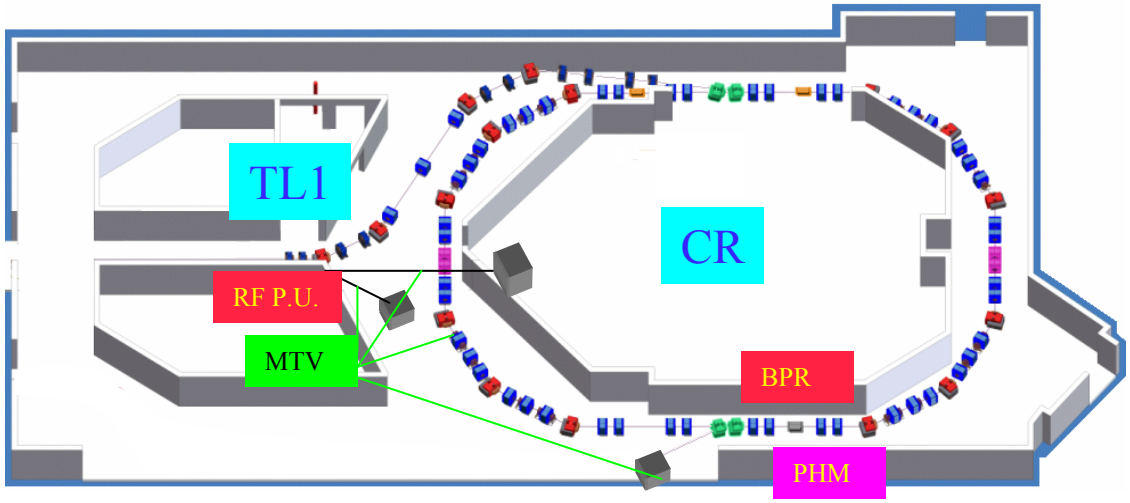
All new power supplies (except for Dipoles & Septa) => Delivery foreseen in June 2006

Power supplies for CR (Quadrupoles)

Alim	I_{max} [A]	R [Ω]	U_{max} [V]
CR.QFG0120-S	100	0.15	15.0
CR.QDG0140-S	100	0.15	15.0
CR.QDF0160-S	170	0.09	15.3
CR.QFF0190-S	250	0.09	22.5
CR.QFJ0215-S	200	0.21728	43.5
CR.QDJ0230-S	200	0.21728	43.5
CR.QFJ0245-S	200	0.21728	43.5
CR.QFJ320-S	180	0.10864	19.6
CR.QDH0340-S	50	0.5	25.0
CR.QFF0510-S	250	0.09	22.5
CR.QDF0540-S	170	0.09	15.3
CR.QDG0560-S	100	0.15	15.0
CR.QFG0580-S	100	0.15	15.0
CR.QFJ0715-S	200	0.21728	43.5
CR.QDJ0730-S	200	0.21728	43.5
CR.QFJ0745-S	200	0.21728	43.5
CR.QFJ820-S	180	0.10864	19.6
CR.QDH0840-S	50	0.5	25.0

Beam diagnostic

See also *Beam diagnostics* talk by T. Lefevre



Type	CT + TL1 + TL2	CR	Comment
BPM	4	5	CERN design
BPI	7	20	LNF design
BPR	0	1	CERN design
PHM	0	1	Uppsala design
MTV	2	3	CERN design

BPM = Beam Position Monitor (Φ 40 mm)

BPI = Beam Position Monitor (section 90 x 40 mm)

BPR = Beam Position Monitor (for bunch length behavior)

RF P.U. = RF Pick-up (for bunch length measurement)

PHM = Phase Monitor (requency measurements for recombination)

MTV = Ensemble camera & mirrors (for synchrotron light or Transition radiation)

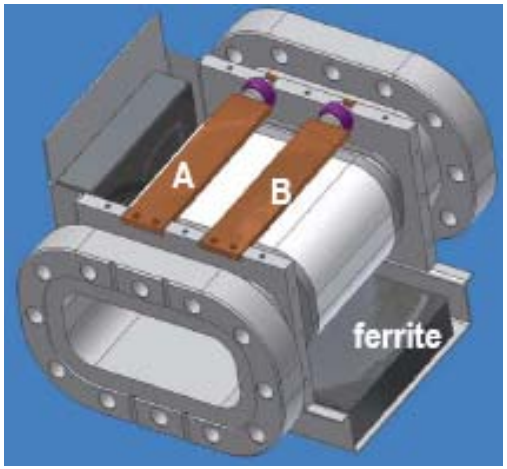
PMI = Radiation monitors

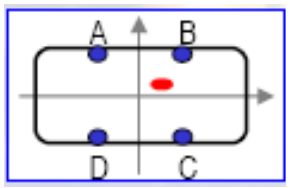
Beam diagnostic (BPI)

Beam Position Monitor (BPI)

27 BPI are necessary for TL1 and CR

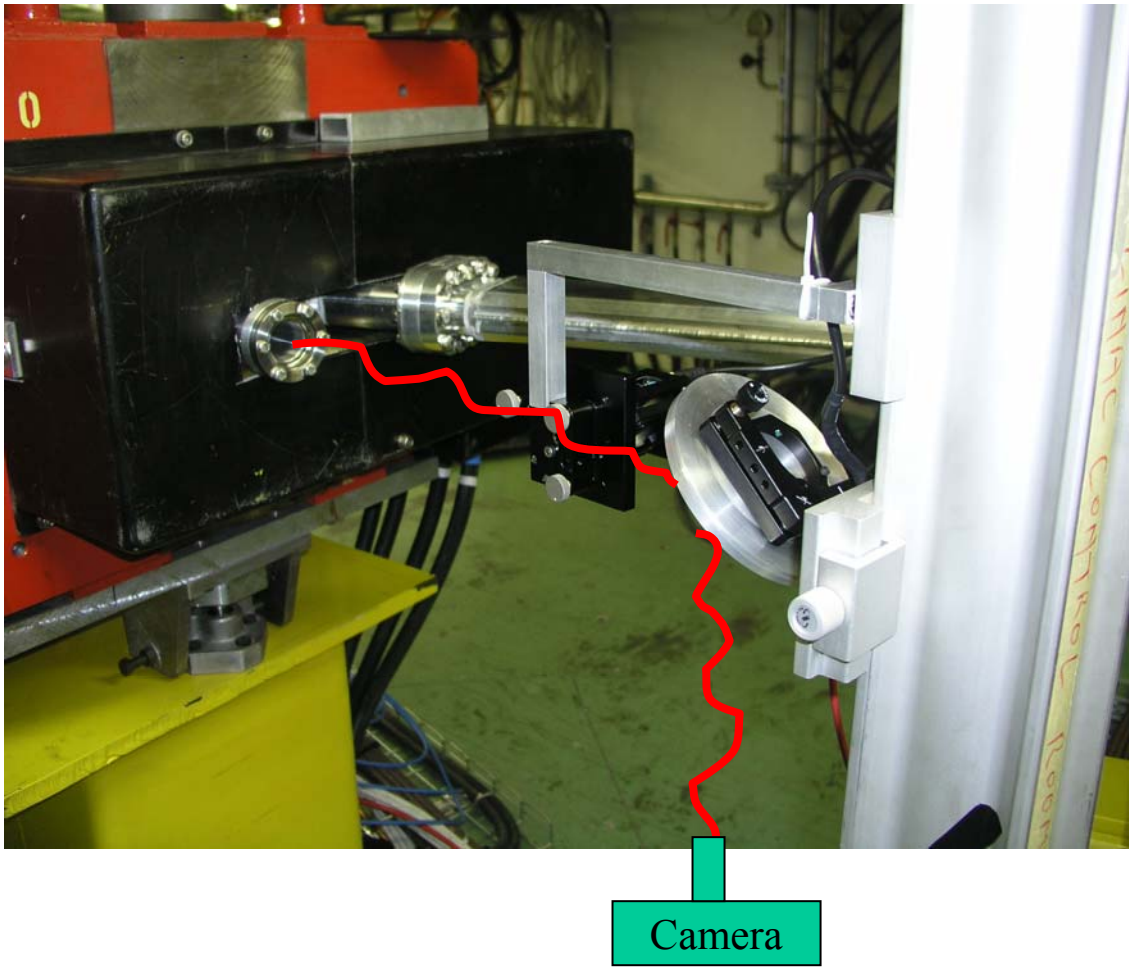
The LNF/INFN design for the magnetic chicane and Delay Loop could be used





Beam diagnostic (MTV)

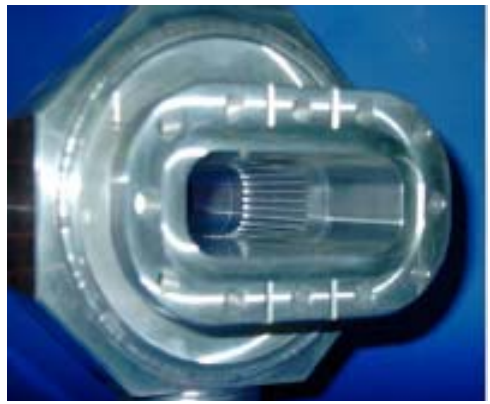
Synchrotron light output from a dipole



Vacuum

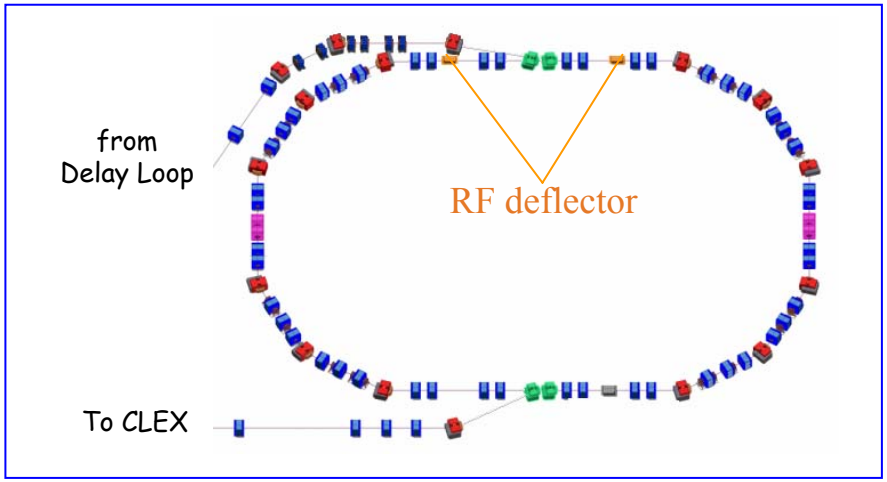
See also *Status of CTF3 work at INFN* talk by A. Ghigo

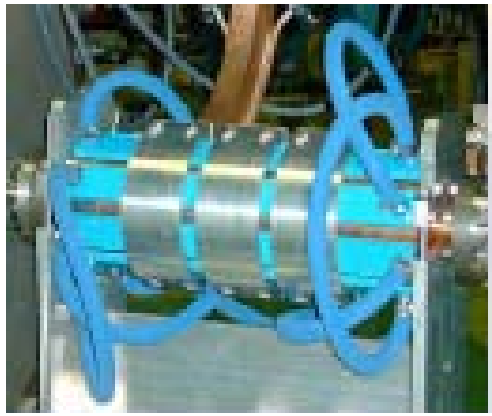
- The vacuum chamber components should have a **minimum contribution to the impedance** of the ring
- Aluminum alloy minimize the resistive wall effect.
- Typical cross sections: 100 mm x 40 mm (dispersion regions) and 40 mm x 40 mm (non dispersive regions)



Vacuum chambers, pumping ports and bellows designed, built and installed by LNF / INFN for the Delay Loop

RF deflectors





from LNF/ INFN Italy

$$\phi \approx 585 \frac{\sqrt{P}}{E}$$

Both RF deflectors conditioned up to 13 MW for the CTF3 Preliminary phase

Nominal deflection angle Φ= 12.5 mrad
Nominal Beam Momentum E = 150 MeV/c
Nominal input power P = 10 MW

Maximum Beam Momentum E = 300 MeV/c
Maximum input power P = 40 MW

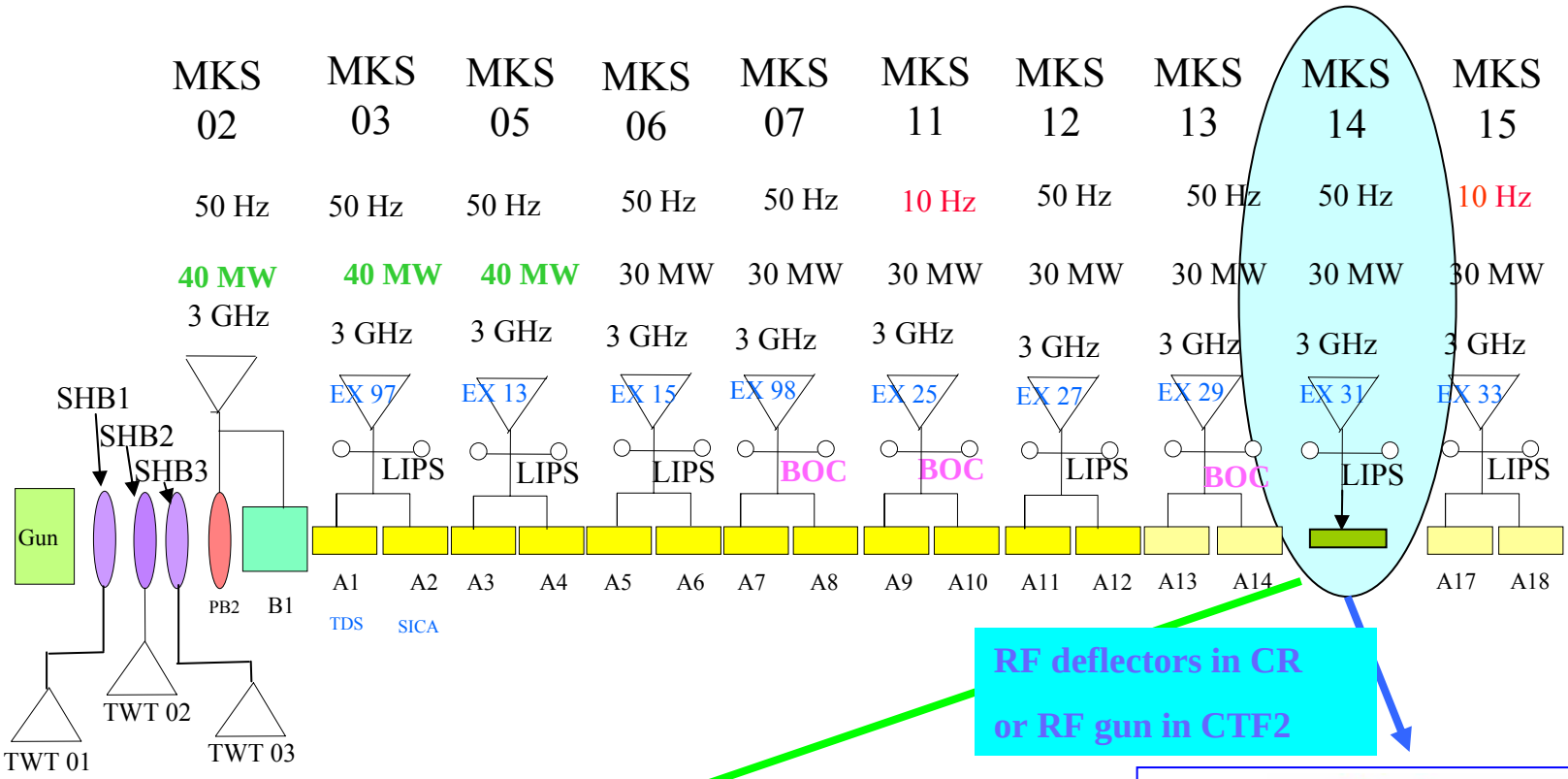
→

1) Reduce deflection angle with a bump close to the septum

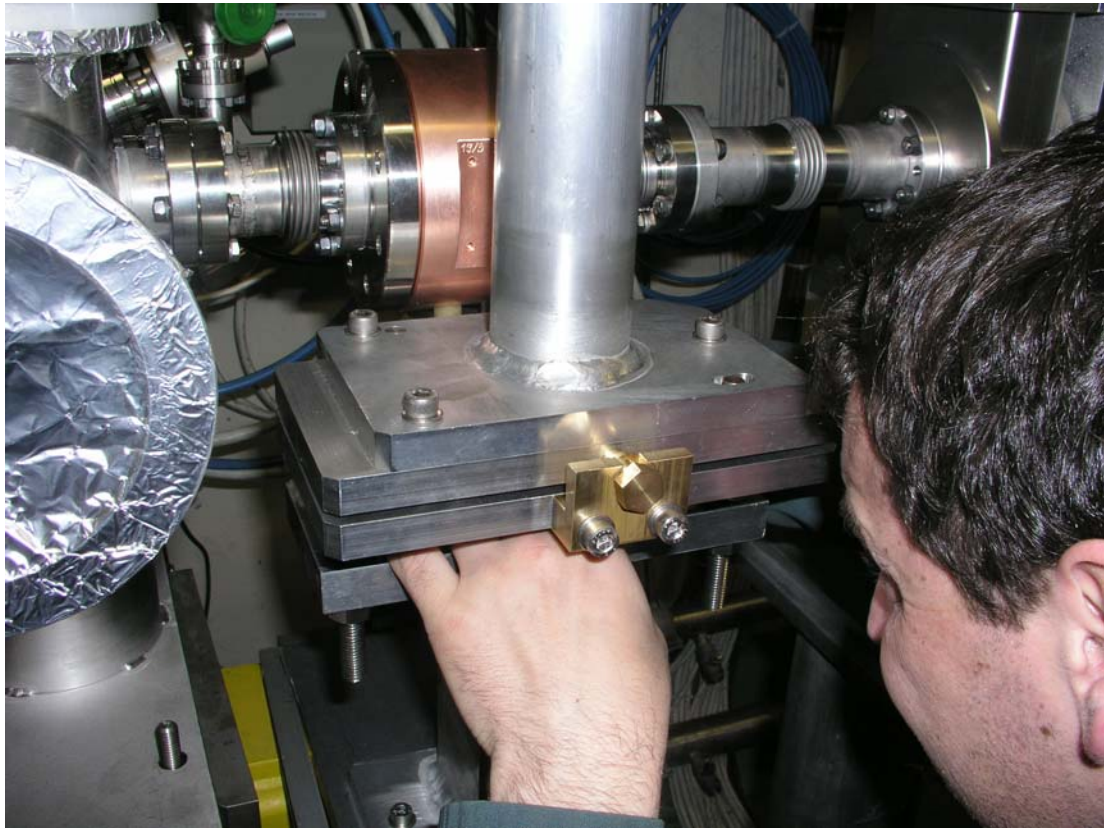
2) Use the pulse compressor LIPS on MKS14

Klystron

See also *High Power RF* talk by G. McMonagle



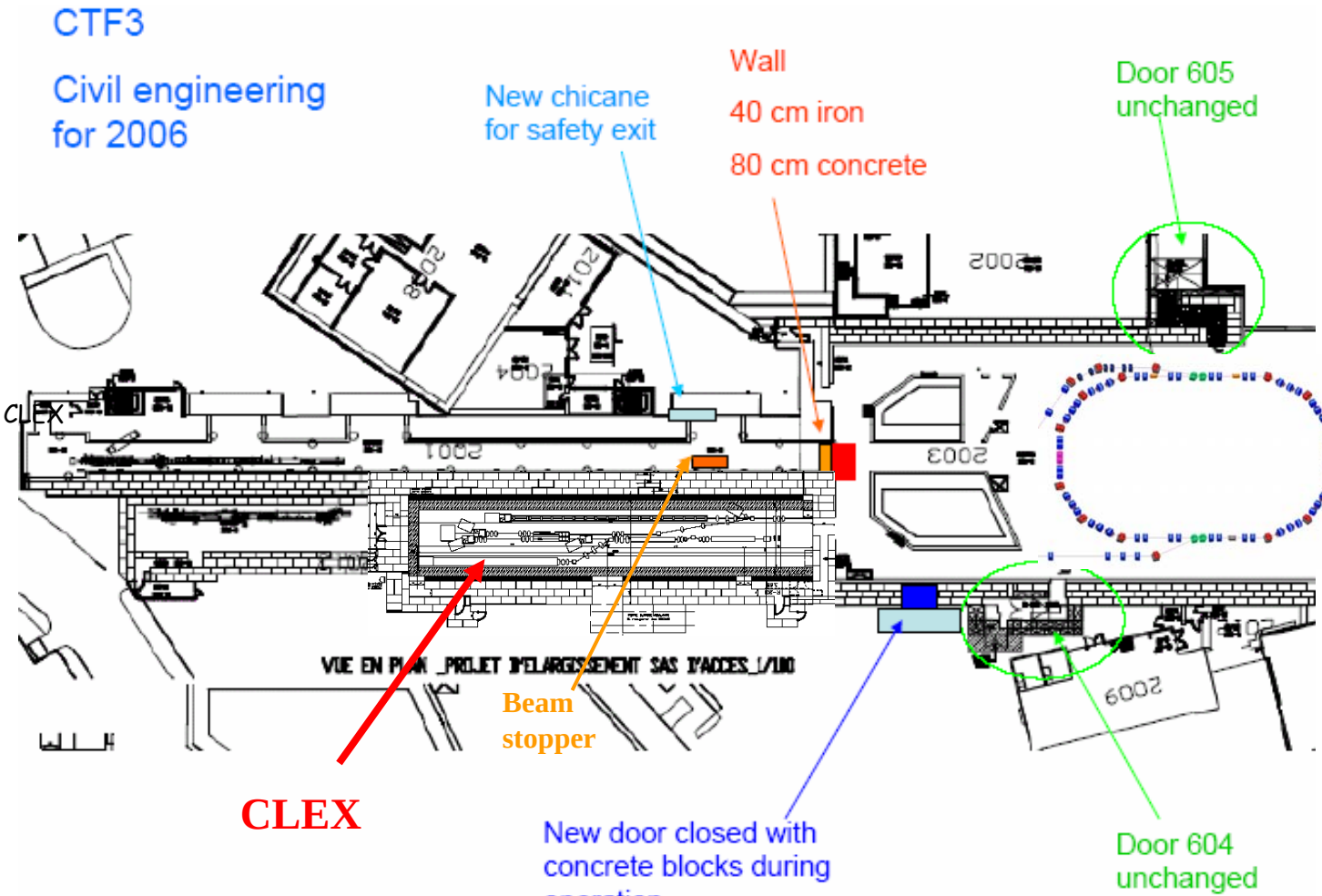
Alignment



Thanks to Survey group (TS/SU), some crucial gymnastic is performed to align all components to:

± 0.1 mm

Civil engineering

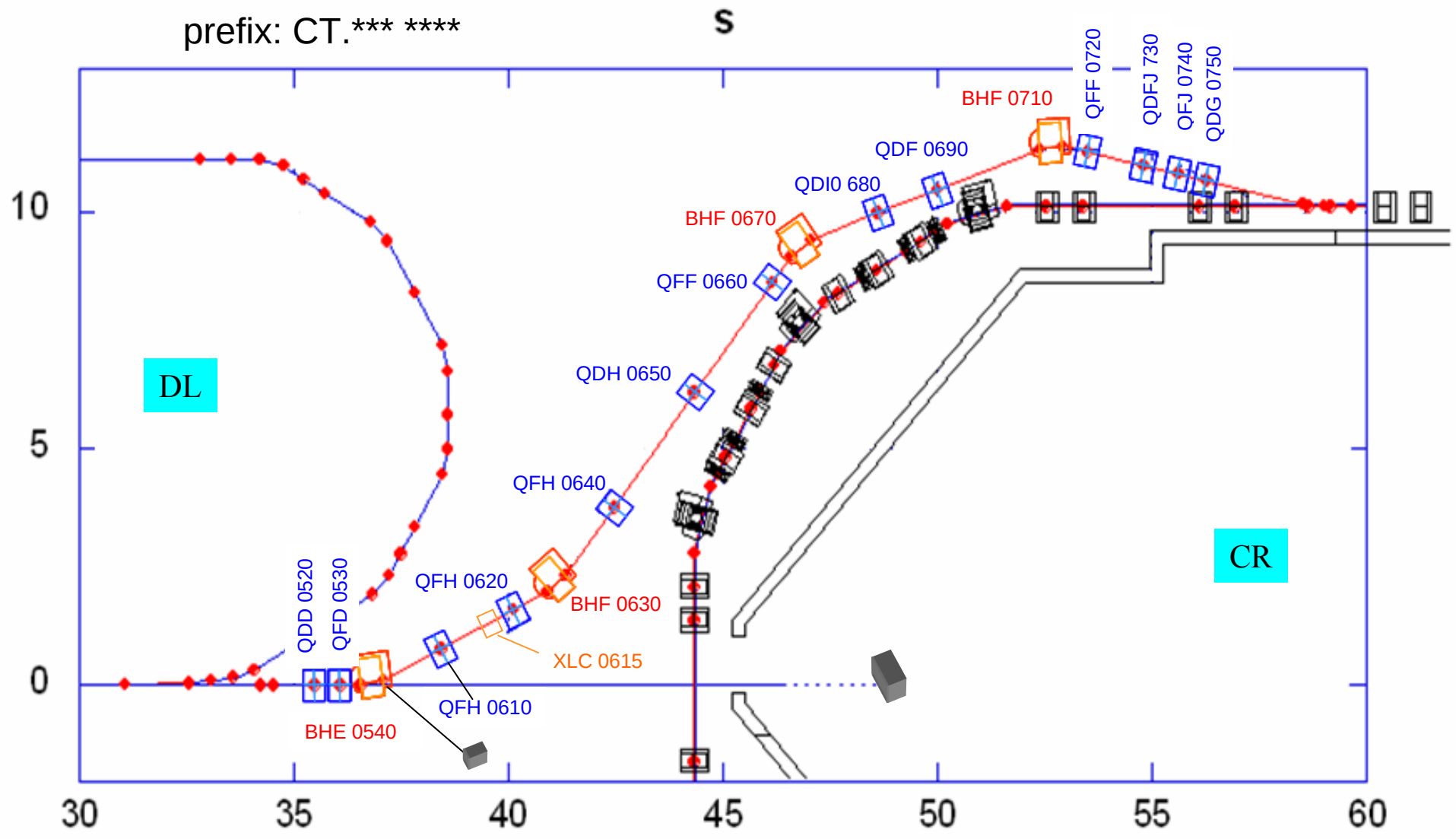


See also *Radiation issues* talk by M. Rettig

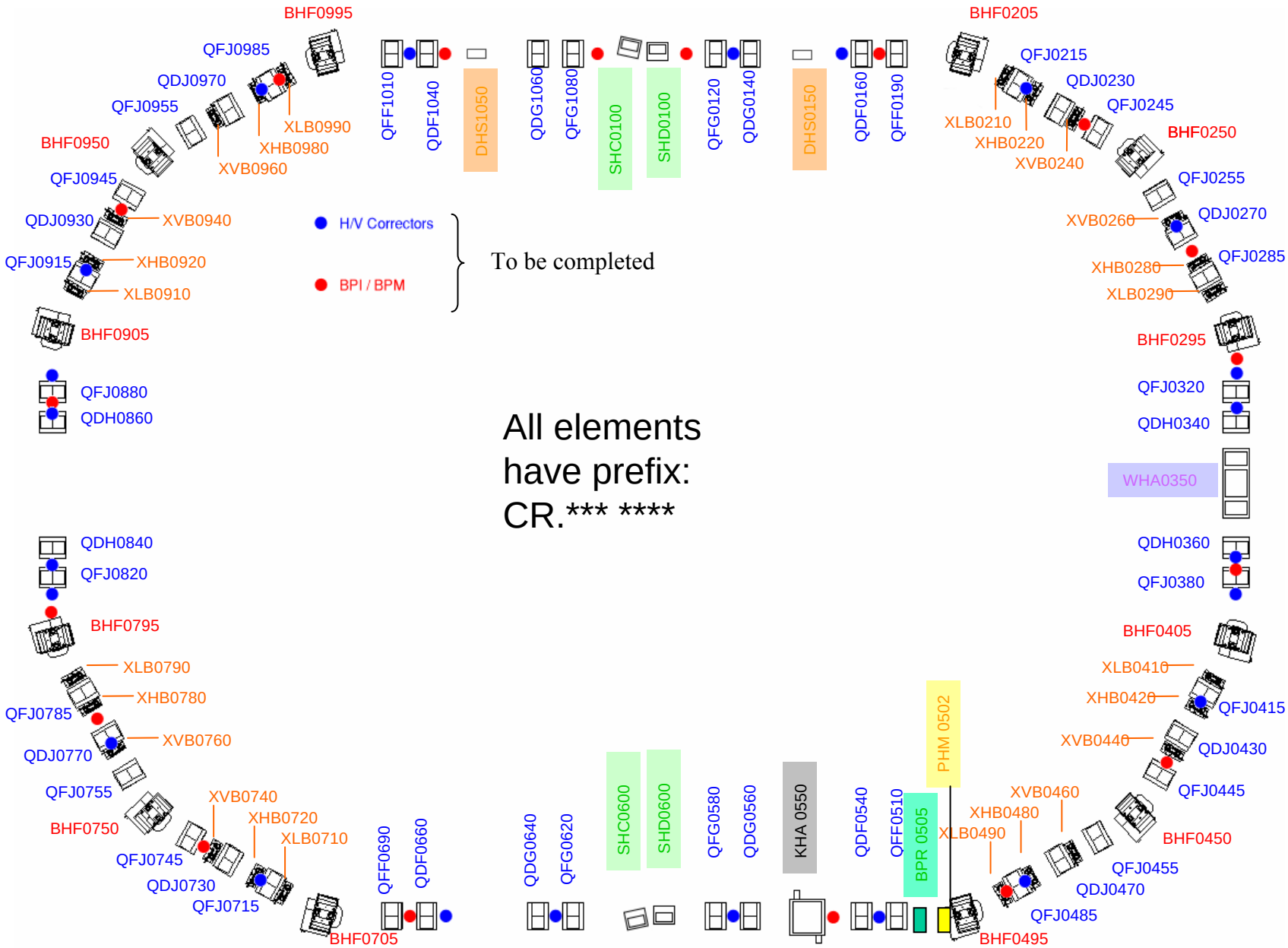
See also *Safety policy* talk by S. Doebert

TL1 names

All elements have
prefix: CT.*** ****



CR names


BHF0995
QFJ0985
QDJ0970
QFJ0955
BHF0950
QFJ0945
QDJ0930
XVB0940
QFJ0915
XHB0920
XLB0910
BHF0905
QFJ0880
QDH0860
XLB0990
XHB0980
XVB0960
QFF1010
QDF1040
DHS1050
QDG1060
QFG1080
SHC0100
SHD0100
QFG0120
QDG0140
DHS0150
QDF0160
QFF0190
H/V Correctors
BPI / BPM
To be completed
BHF0205
QFJ0215
QDJ0230
QFJ0245
BHF0250
QFJ0255
QDJ0270
QFJ0285
XLB0210
XHB0220
XVB0240
XVB0260
XHB0280
XLB0290
BHF0295
QFJ0320
QDH0340
WHA0350
QDH0360
QFJ0380
All elements
have prefix:
CR.*** ****
QDH0840
QFJ0820
BHF0795
XLB0790
XHB0780
QFJ0785
XVB0760
QDJ0770
QFJ0755
XVB0740
XHB0720
BHF0750
XLB0710
QFJ0745
QDJ0730
QFJ0715
BHF0705
QFF0690
QDF0660
QDG0640
QFG0620
SHC0600
SHD0600
QFG0580
QDG0560
KHA 0550
QDF0540
QFF0510
BPR 0505
PHM 0502
BHF0405
XLB0410
XHB0420
QFJ0415
XVB0440
QDJ0430
QFJ0445
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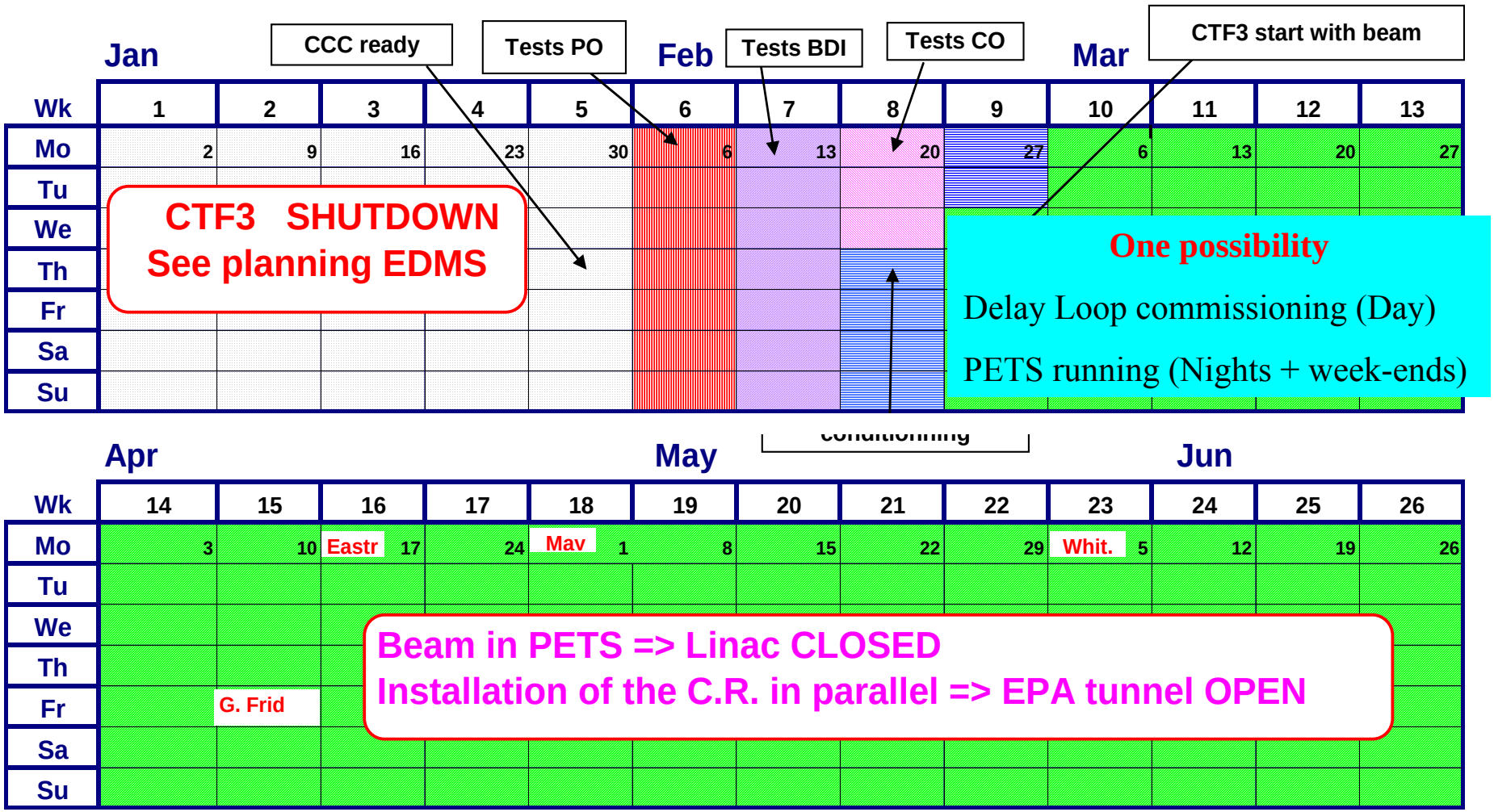
QDJ0470
QFJ0485
BHF0495

CTF3 Schedule 2006



Conclusion

1) Installation of TL1 and CR will start in January 2006.

2) Many components are already at CERN.

3) From February onwards, the installation could continue in parallel with beam running to produce 30 GHz RF power.

4) The last component should arrive in June 2006 assuming that contributions from Institutes are signed and effective.

5) Under these conditions the commissioning of TL1 and CR could start in **September 2006**.