# CTF3 WP1

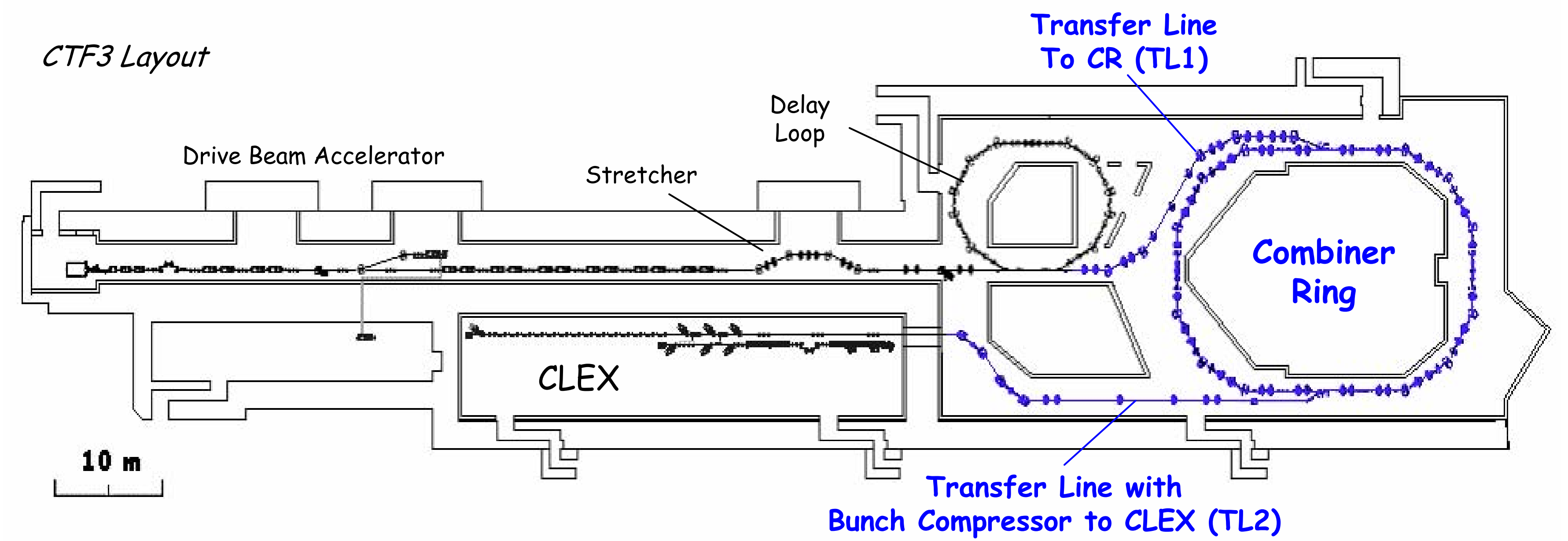
## Combiner Ring (CR), Transfer Line (TL1) to CR and Transfer Line (TL2) with bunch compressor to CLIC EXperimental Area (CLEX)

- motivations
- design considerations
- description of (sub)work-packages
- boundary conditions

# MOTIVATIONS

The ILC-TRC* report listed the "validation of the drive beam generation with a fully loaded linac" as an **R1 R&D issue** for the CLIC study.

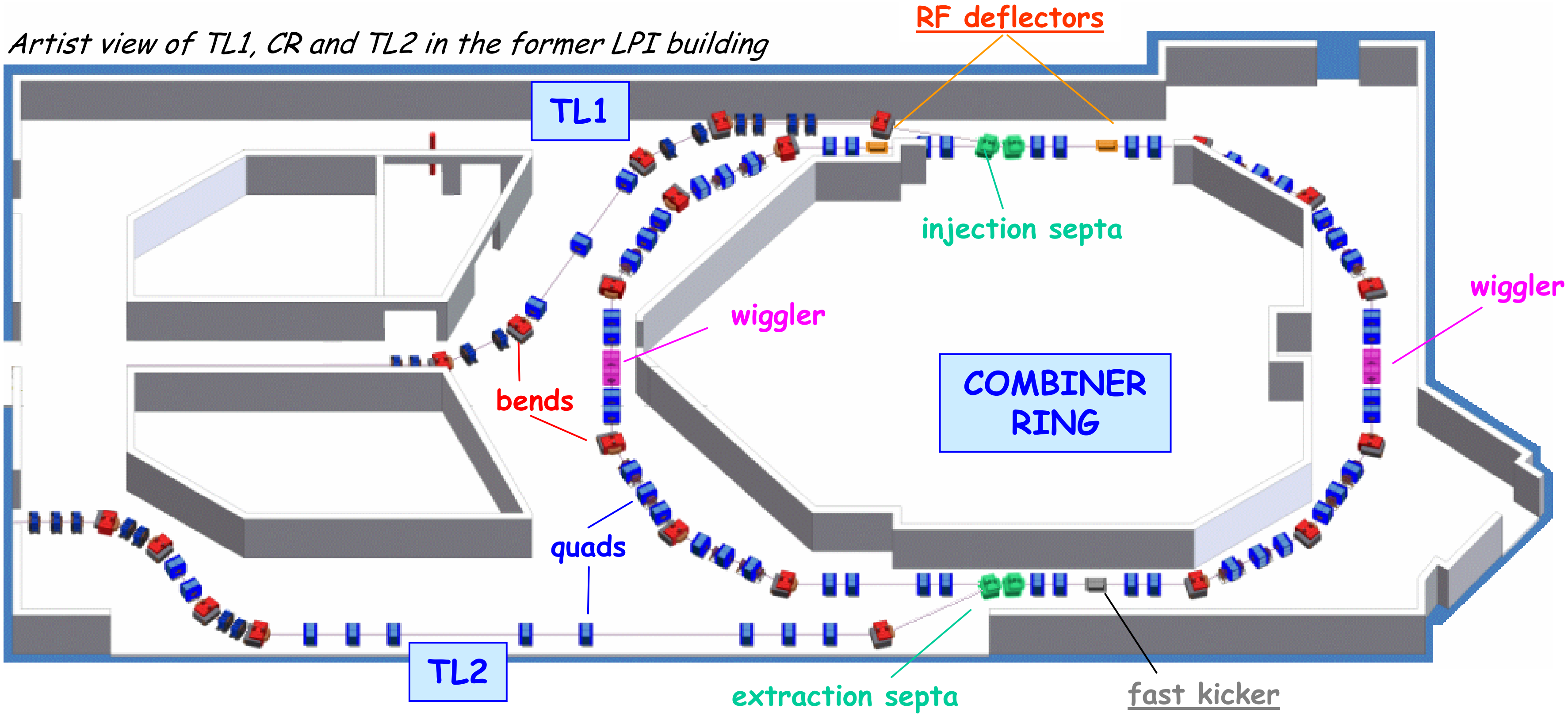
*International Linear Collider – Technical Review Committee




- **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).
- **TL2** transports the drive beam to the CLEX area. It also compresses the drive beam bunches, for optimum 30 GHz RF power generation.

# DESIGN CONSIDERATIONS

*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 170 m (40 m + 84 m + 45 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.

# WP 1.1 – OPTICS LAYOUT

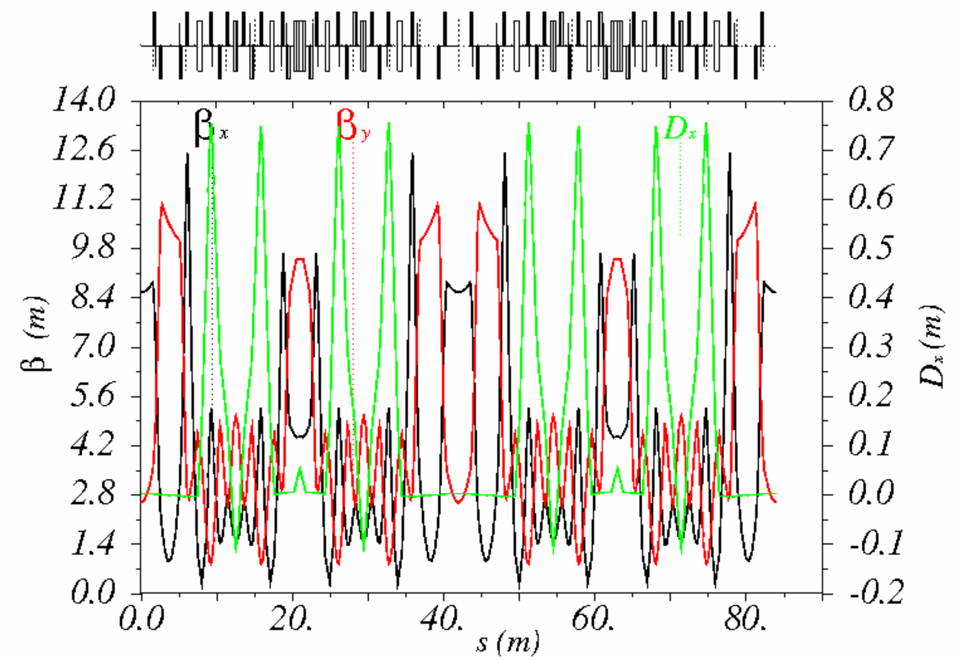
## A reference optics layout exists from INFN-LNF.

- The CR optics can be considered as final. Small changes could be needed depending on the final choice of quadrupoles.
- The design of TL1 and TL2 satisfies the basic beam dynamics requirements. Some further optimisation would be needed to optimize cost and operational aspects.

Preliminary resource estimate: 1 m•y

Requirements:

- Both TL1 and CR must be achromatic and isochronous.
- TL2 must be achromatic and provide bunch compression.




*CR optical functions (C. Biscari, INFN-LNF)*

# WP 1.2 - MAGNETS

## TOTAL NEEDED

22 bending magnets $\int B\,dl \le 0.5\,\mathrm{T\cdot m}$

78 quadrupoles $\int G\,dl \le 1.5\,\mathrm{T}$

24 sextupoles

4 septa

2 wigglers

32 correctors

## AVAILABLE

16 bending magnets

46 quadrupoles

## TO BE BUILT

6 bending magnets

32 quadrupoles*

24 sextupoles*

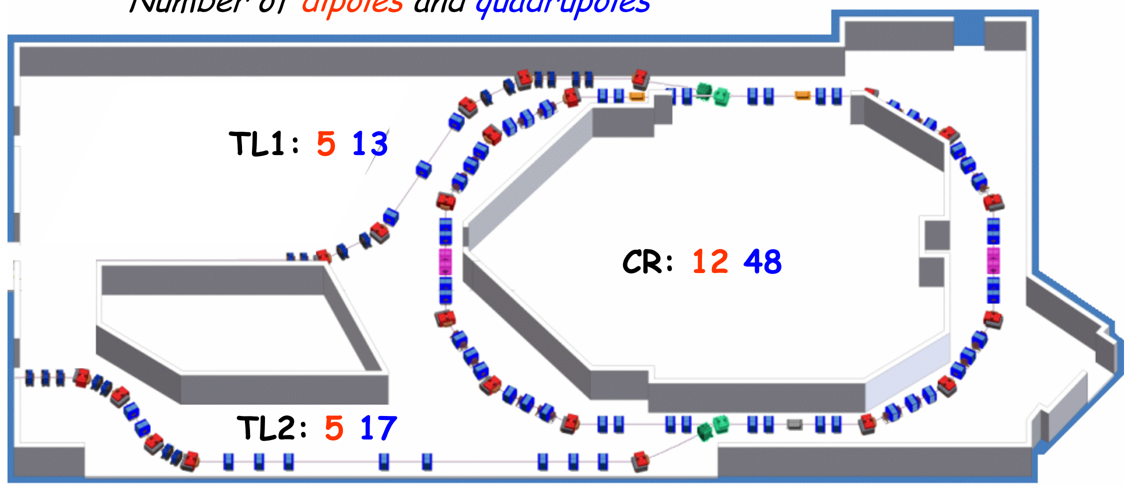
4 septa

2 wigglers*

32 correctors*

* A design exists

*Number of dipoles and quadrupoles*




16 bending magnets

36

6

4

46 quadrupoles

Preliminary resource estimate: 1.85 MCHF, 4 m·y

# WP 1.3 – VACUUM SYSTEM

R. Corsini, 19 May 2004

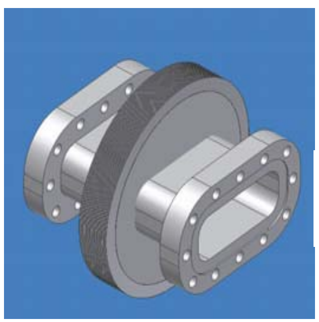
## Vacuum chamber elements and pumps.

- The vacuum chamber components must have a minimum impedance contribution.
- Aluminum alloy used whenever possible to minimize resistive wall effect.
- A vacuum level below $10^{-8}$ mbar required in the CR.
- Typical cross sections: 100mm x 40mm (dispersive sections) and 40mm x 40mm

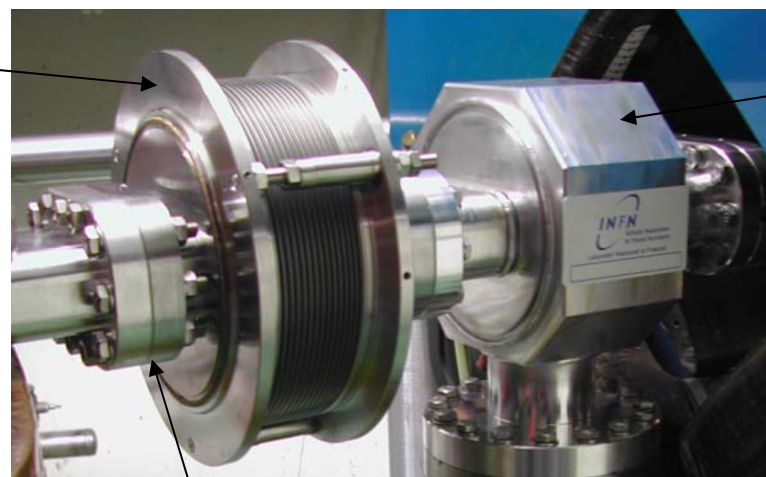
A large part of the equipment design made by INFN-LNF for Stretcher & DL can be used. Detailed design work is required.

Preliminary resource estimate: 0.7 MCHF, 2 m•y

## INFN-LNF VACUUM EQUIPMENT



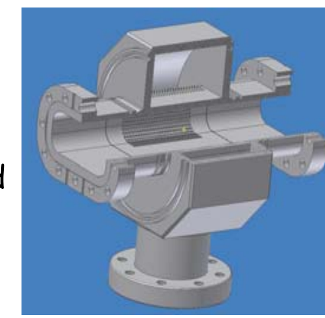
Equipment installed in CTF3

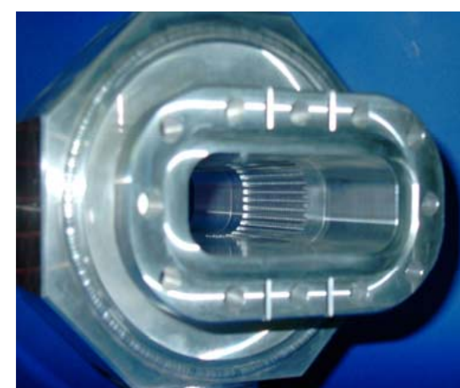



RF shielded bellow

Shielded pumping port

Special gasket profile for RF contact



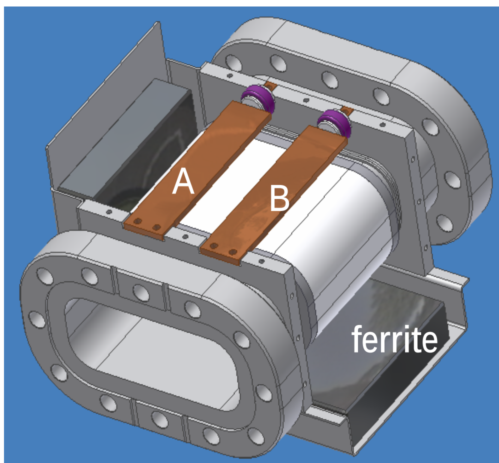


# WP 1.4 - BEAM DIAGNOSTICS

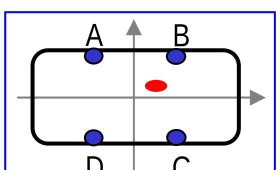
## Beam position and profile measurements.

- Need about 32 beam position monitors.
- The INFN-LNF design of the stretcher and delay loop BPMs could be used without modifications.
- Several vacuum ports for synchrotron light, with optical lines to CCD cameras, are foreseen.

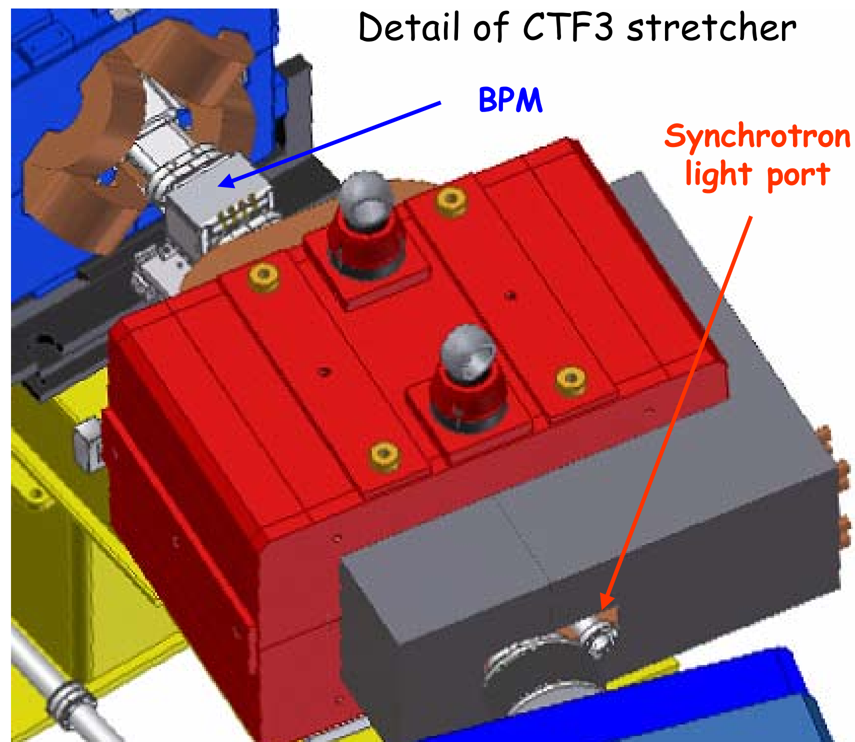
Preliminary resource estimate: 0.53 MCHF, 1 m•y




INFN-LNF Beam Position Monitor




BPM during test




Detail of CTF3 stretcher

# WP 1.5 – POWER SUPPLIES

## Power converters for all magnets.

- 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)

Preliminary resource estimate: 1.16 MCHF, 1.8 m·y

## NEEDED POWER SUPPLIES

| 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 |

# WP 1.6 & 1.7

## WP 1.6 - TECHNICAL SERVICES AND INSTALLATION

Cabling, water-cooling, alignment, air conditioning.

Preliminary resource estimate: 1.05 MCHF, 2 m•y

## WP 1.7 - CONTROL SYSTEM

Control system for the Combiner Ring and related software.

- The system has to be compatible with the existing controls infrastructure.

Preliminary resource estimate: 0.1 MCHF, 1 m•y

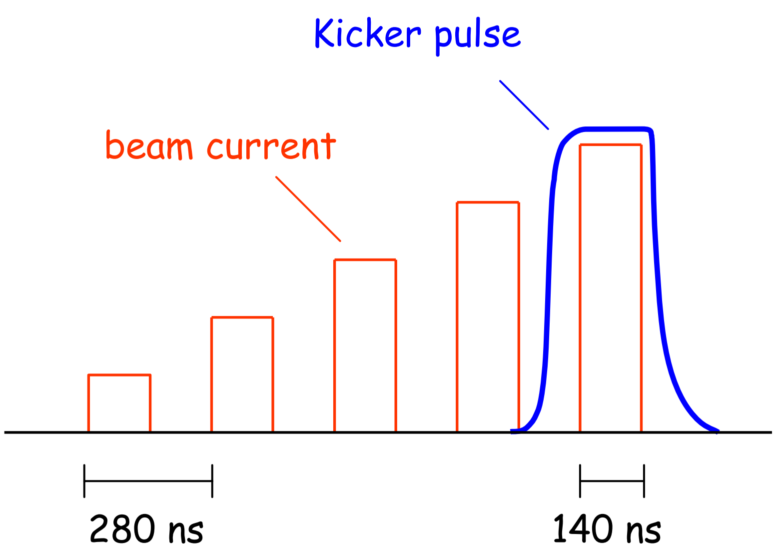
# WP 1.8 - FAST KICKER

R. Corsini, 19 May 2004

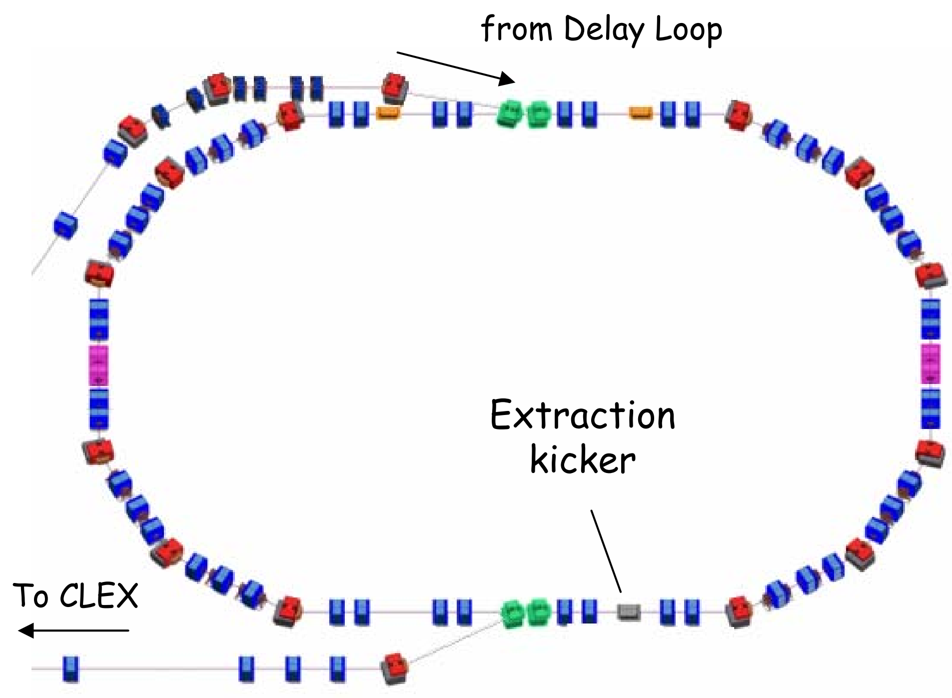
Fast extraction kicker system for the CR with high voltage pulser.

- Rise time below 100 ns, flat top of about 200 ns.
- Repetition rate up to 50 Hz.
- Required kick angle about 5 mrad (for a max beam momentum of 300 MeV/c).
- Special attention has to be given to the impedance seen by the beam

Preliminary resource estimate: 0.24 MCHF, 1 m·y




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



# WP 1.9 – RF DISTRIBUTION SYSTEM

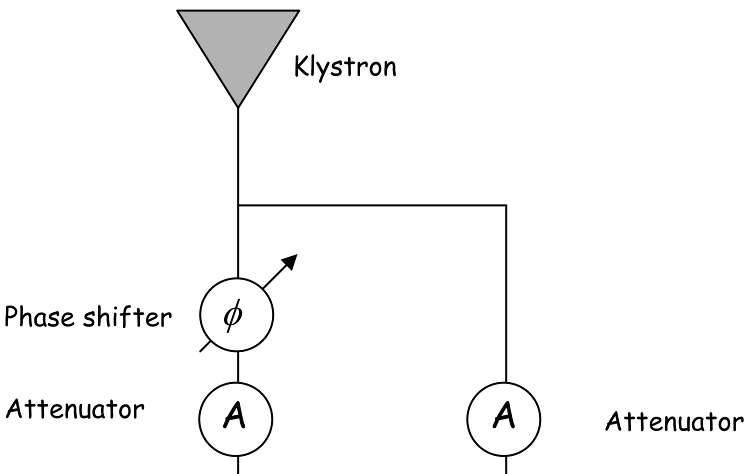
R. Corsini, 19 May 2004

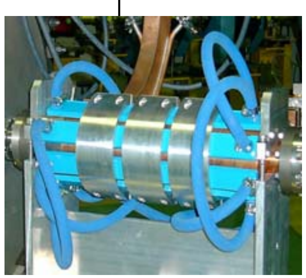
Complete waveguide system for both RF deflectors of the CR.

- Frequency 3 GHz
- Power in the 10 MW range
- The klystron is located in a gallery at ~ 30 m from the deflectors, which are ~ 10 m apart
- The waveguide system includes power splitters, attenuators and phase shifters.

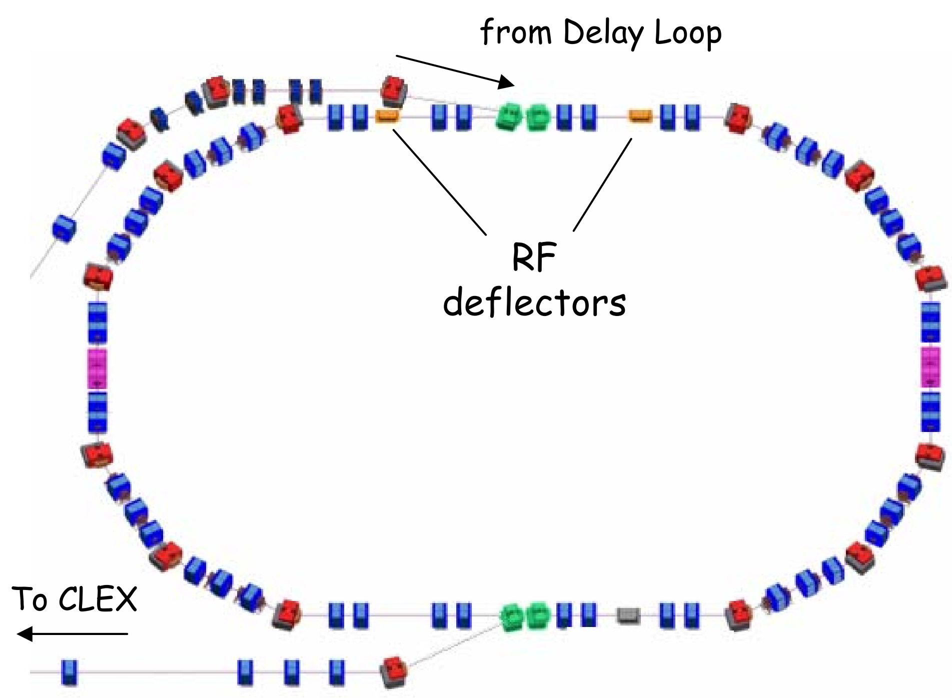
Preliminary resource estimate: 0.1 MCHF, 0.2 m·y

*Schematic RF network*



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



# BOUNDARY CONDITIONS

**Schedule:** TL1, CR must be ready for installation at the end of 2005
TL2 must be ready in 2006

**Resource estimate:** (very preliminary) A total of 5.7 MCHF and 14 m·y assuming reuse of various LPI equipment

## What is available for re-use

- Reference optics design
- Vacuum system elements and BPM design
- Magnets: 16 dipoles, 46 quadrupoles
- Several power supplies
- Part of general infrastructure
- RF deflectors & 3 GHz Klystron