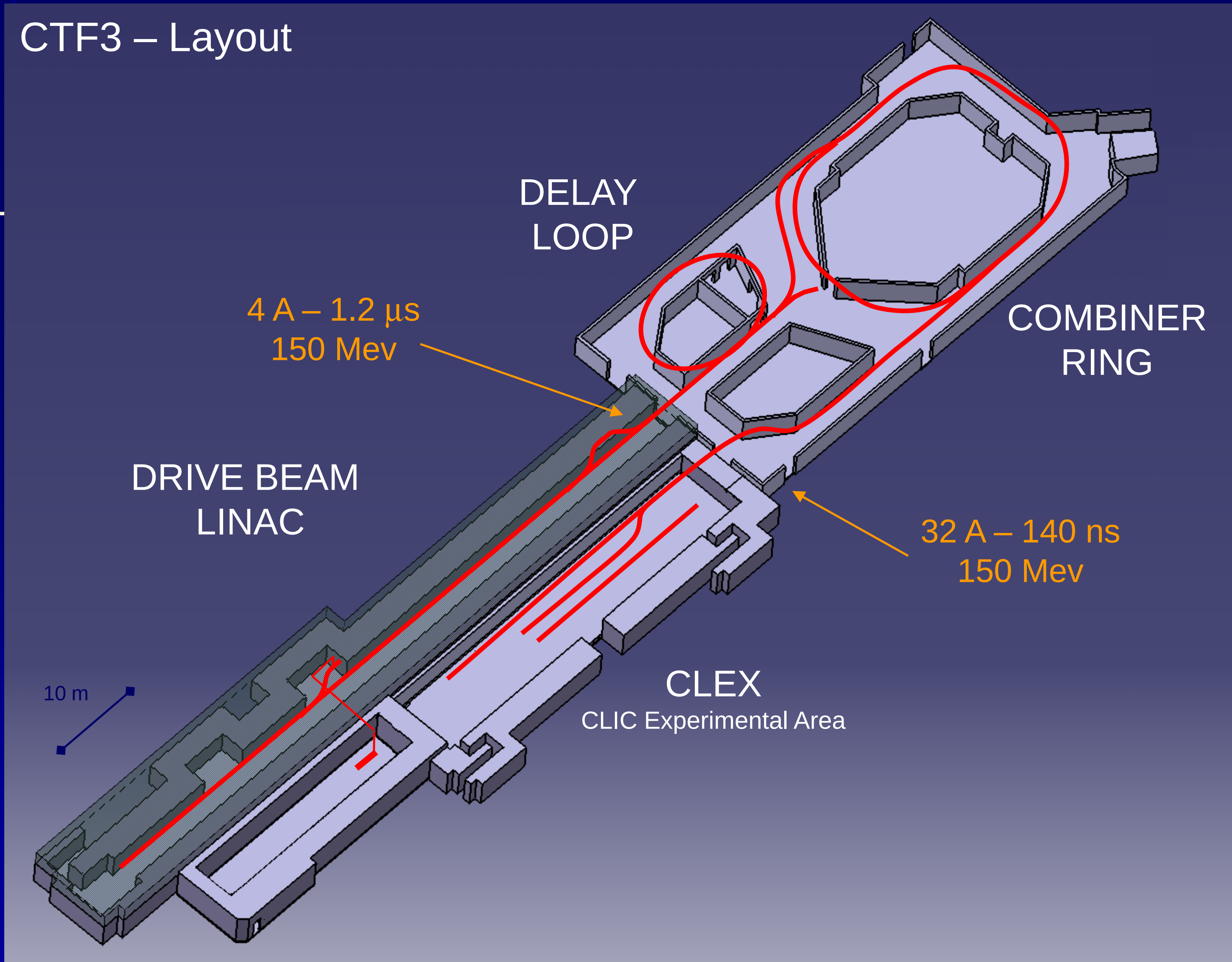
CLIC 07

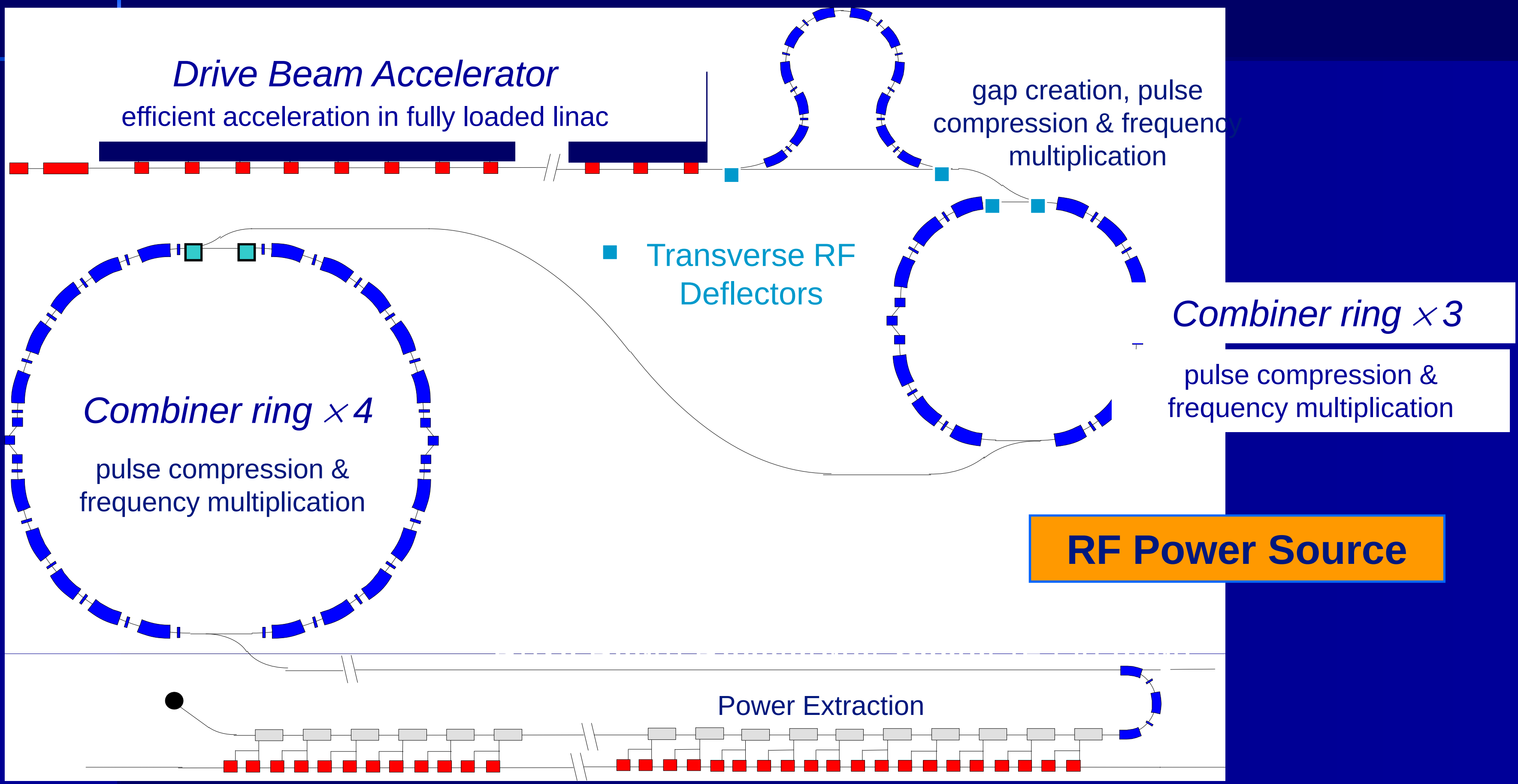
# DRIVE beam dynamics issues

*C. Biscari*

# DRIVE BEAM in CTF3



# DRIVE BEAM in CLIC (3 TeV)



# CLIC versus CTF3 Drive beam parameters

| | | CTF3 | CLIC |
|---|---|---|---|
| Energy | GeV | 0.15 | 2.38 |
| Current | A | 35 | 101 |
| Normalized (geom) emittance | mm mrad | 100 (0.3) | 100 (0.02) |
| Pulse length | ns | 140 | 241 |
| train length in linac | µs | 1.5 | 139 |
| RF Frequency | GHz | 3 | 1 |
| energy extraction | % | 50 | 90 |
| Compression factor | | 2 x 4 | 2 x 3 x 4 |

# CLIC versus CTF3 Drive beam

What can we safely scale?

What need to be simulated?

Which are the possible tests in CTF3?

# Single particle dynamics

CTF3 Optimum benchmark
Low energy more demanding than higher one

- Beam emittance preservation
- Correction procedures
- Optics matching procedures
- Effect of non linearities on isochronism and frequency generation
- Effect of different paths on different bunch trains
- Isochronicity and its manipulation
- Stability of beam parameters with gun current and linac variations
- ISR effects on emittance (not on CTF3)
- System longitudinal and transverse acceptance

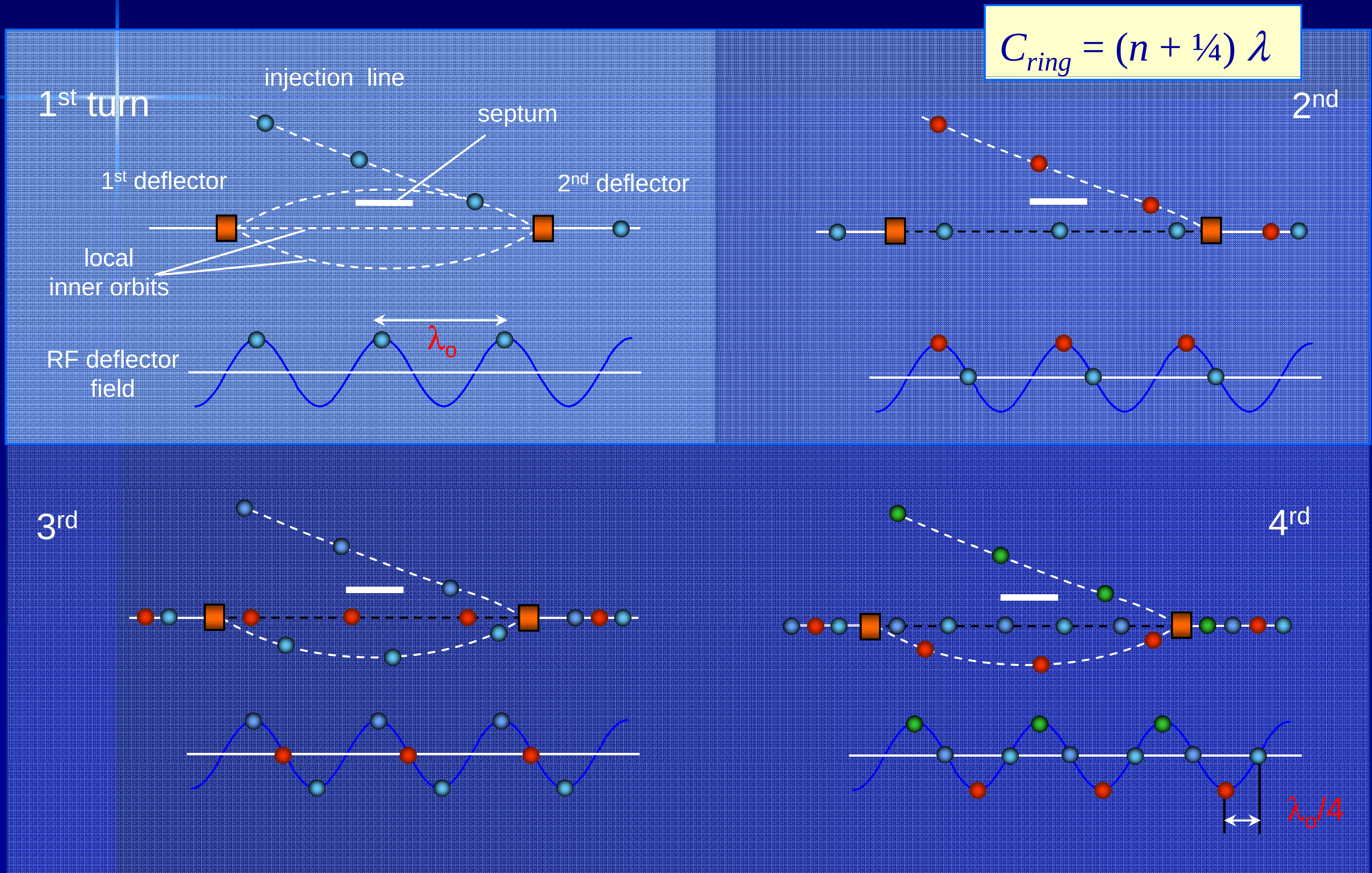
# Collective effects

- Impedance budget
- CSR effects – possibility to make tests in CR
- Beam loading in rf deflectors
- Deceleration – wake fields
- EM collective effects in CRs
- Ions production

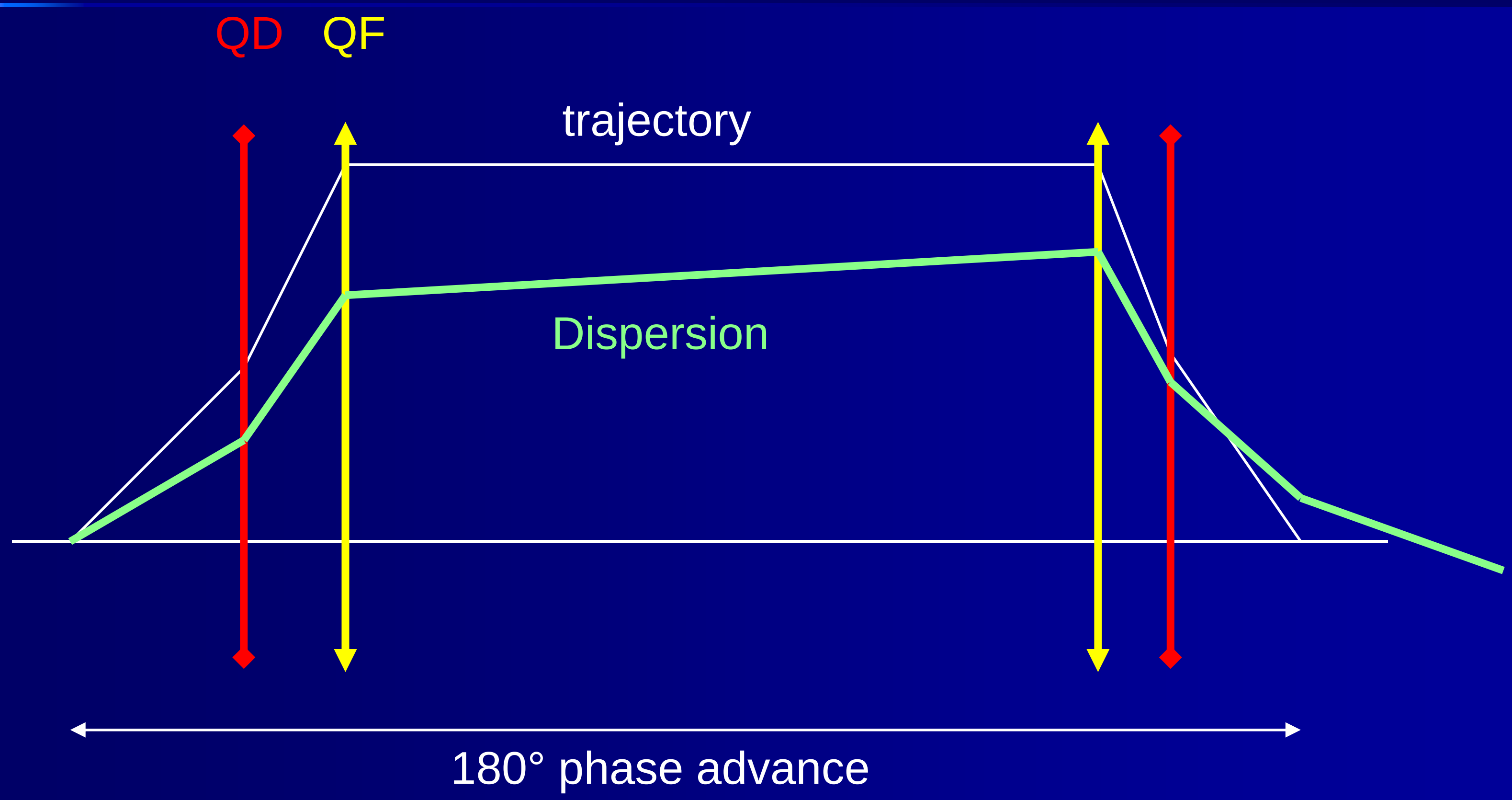
# Some example...

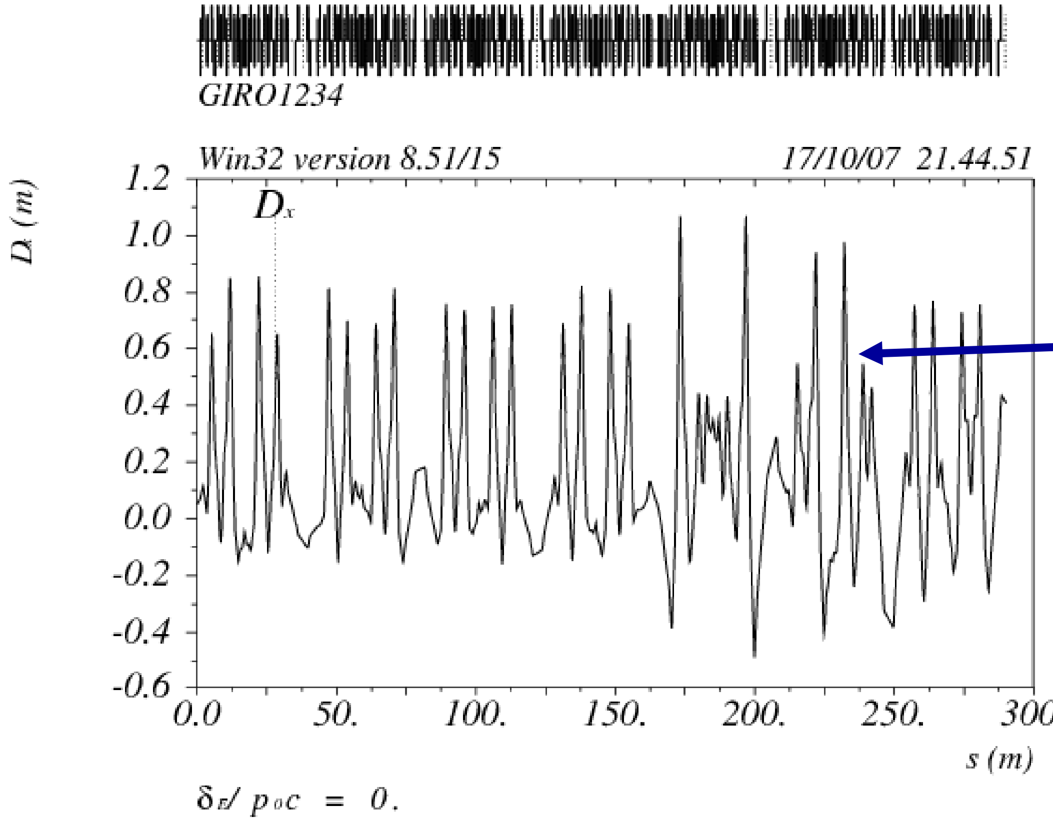
- Non achromaticity of cr injection bump
- High order effects on isochronicity and emittance growth
- Beam loading in rf deflectors
- CSR in combiner ring
- Modelling of different elements

# RF injection in combiner ring

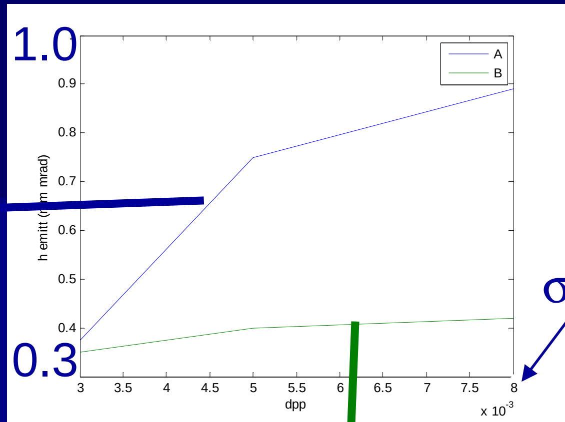


## Non achromaticity of injection bump in CR

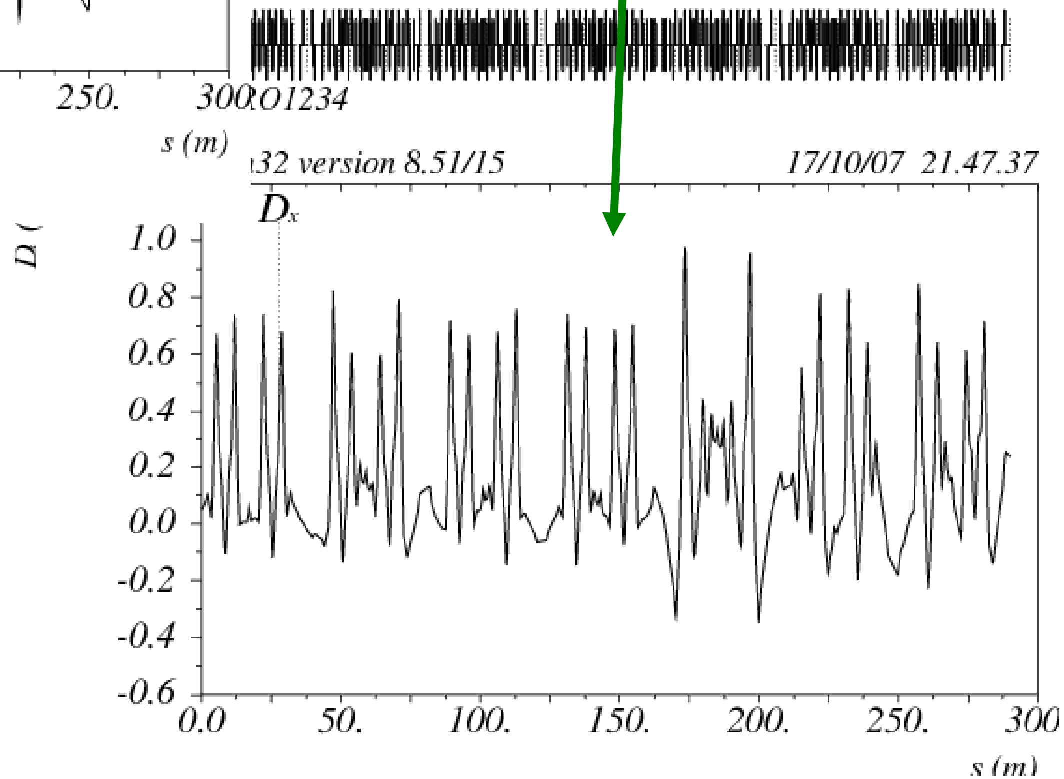





Effective emittance (mm mrad)
@ cr exit versus dp/p




$\sigma_p$ = 0.8 %




Arc matched to
initial zero dispersion

Arc matched to
$D_{bump}/2$

# From CTF3 collaboration meeting - 2003

Contribution of TL high order terms can be as strong as rings'

FLEXIBILITY in the design is essential
Sextupoles can be added in the last chicane…

Energy spread coming from the LINAC :

* stretches the bunches
(possibility of increasing $R_{56}$ in stretcher up to ~30-40 cm in order to reduce the necessary Dp/p for obtaining the 2mm long bunches)

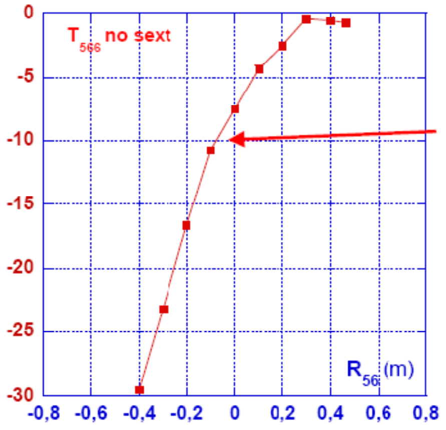
* produce emittance filamentation

For a given $R_{56}$:
Small $T_{566}$ by small dispersion -> high betatron functions
horizontal transverse plane more critical

Low betatron functions -> higher dispersion ->
longitudinal plane more critical

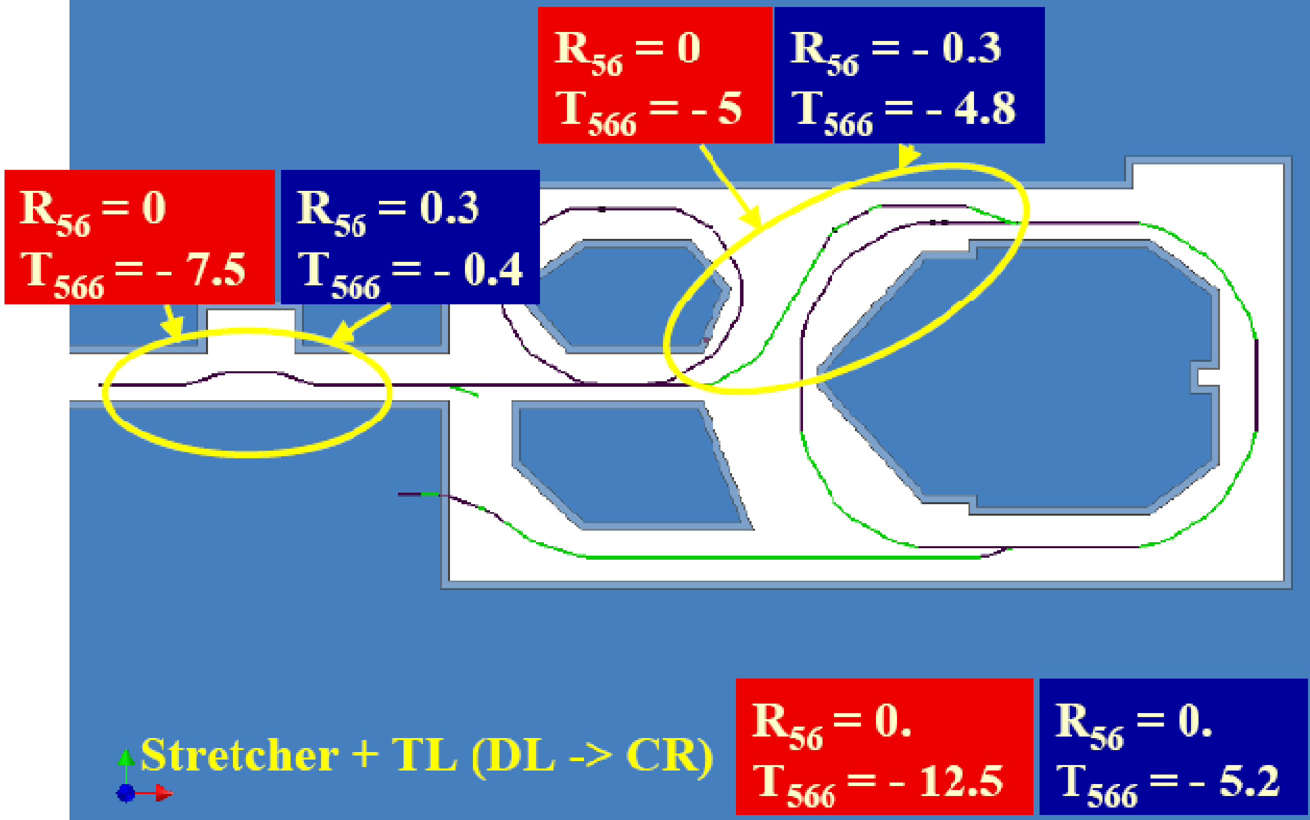
2nd order term depends on the linear optics configuration

Stretcher - compressor

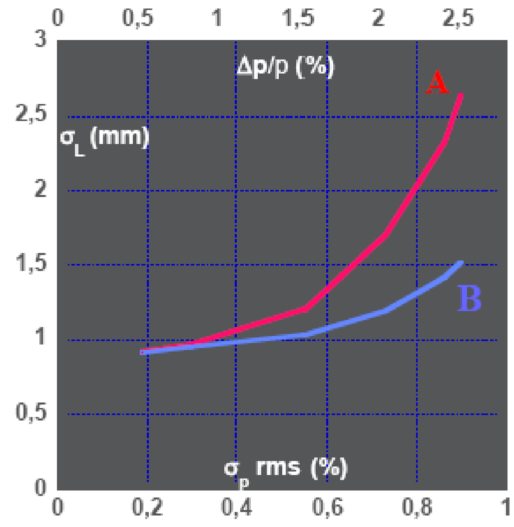



Dp/p = 1% => DL = 1 mm

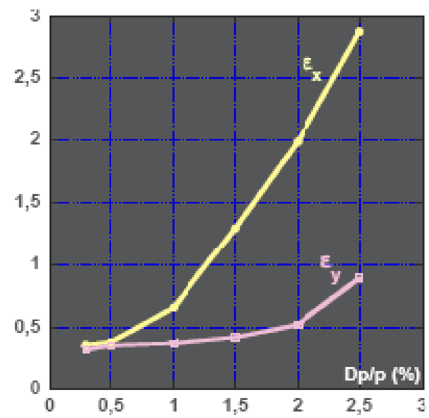
# Global optimisation



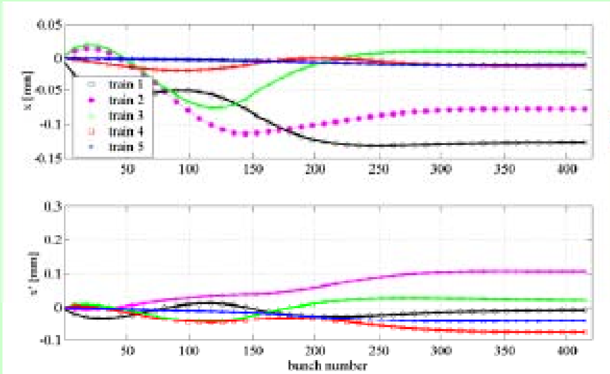

## Rms bunch length



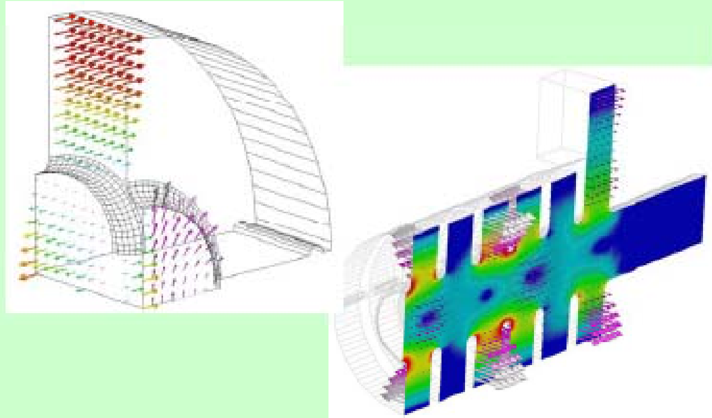

## Transverse plane

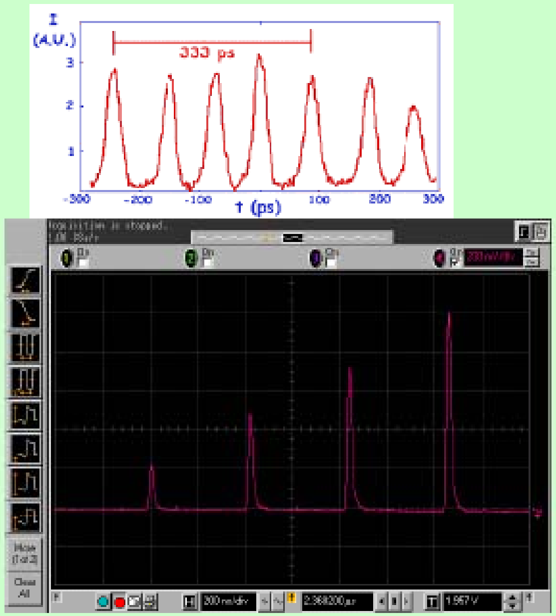


- BEAM DYNAMICS STUDY: BEAM LOADING IN THE RF DEFLECTORS



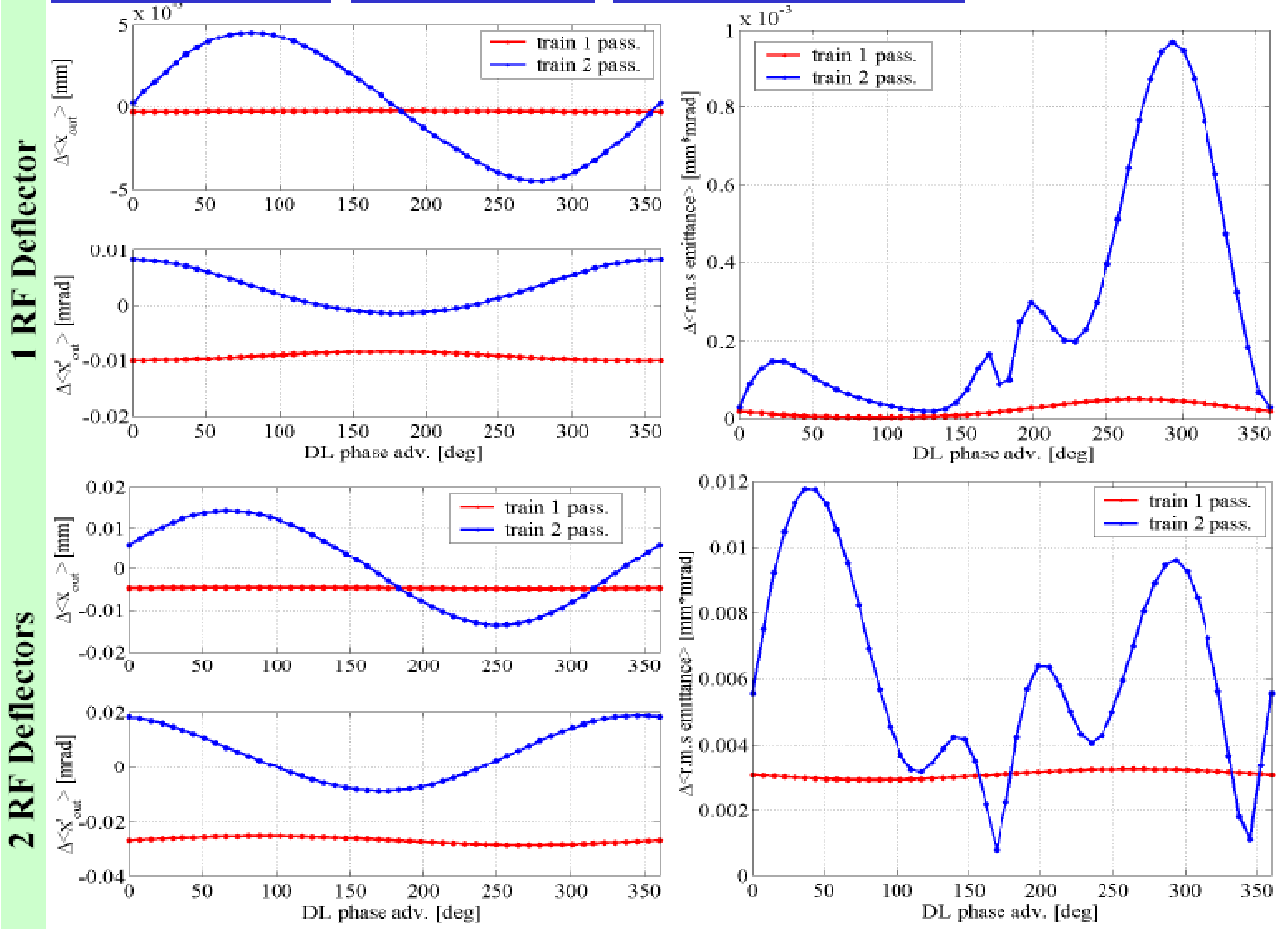

- RF DEFLECTORS DESIGN



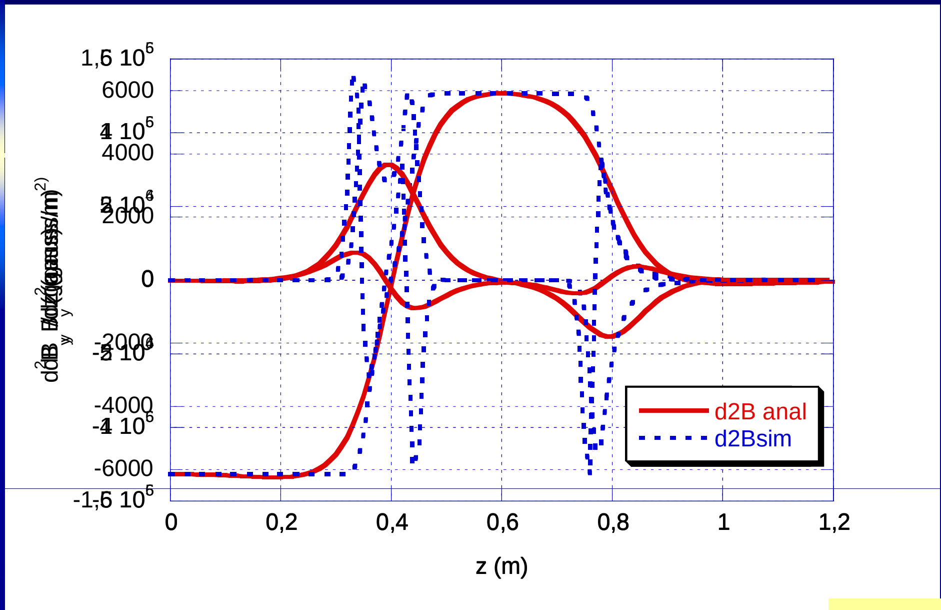



Recomb. in the CTF3 Prelim. phase

## *-With beam loading -Perfect injection -DL phase advance scan*



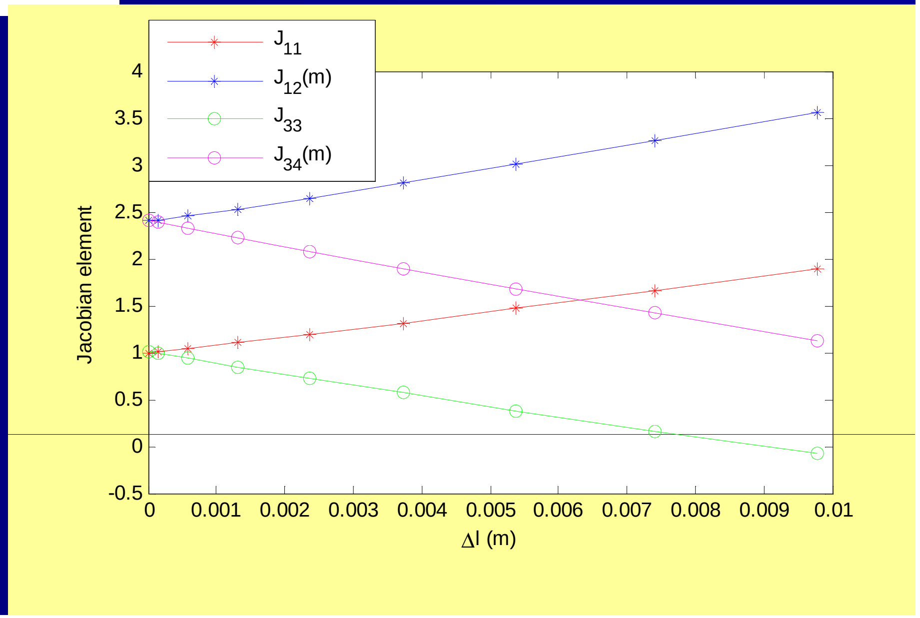
# DL and CR Wiggler modelling




$$B_r(r,\theta,z) = \sin\theta\left[G_{10}(z) + 3G_{12}(z)r^2\right] + \frac{1}{2}\sin 3\theta\, G_{30}(z)r^2$$

$$B_\theta(r,\theta,z) = \cos\theta\left[G_{10}(z) + G_{12}(z)r^2\right] + \frac{1}{2}\cos 3\theta\, G_{30}(z)r^2$$

$$B_z(r,\theta,z) = \sin\theta\, G_{11}(z)\, r$$



# Work to be done ctf3

- Optimisation of ctf3 operation
- Modelling of all elements
- Deceleration simulations
- Start to end simulations
- Use of ctf3 as benchmark
- Beam simulations along the extraction structures, to understand tolerances for the power extraction in terms of emittance and spread for the different bunches