

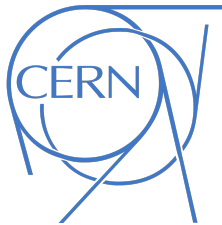
Optimisation of the Drive Beam Recombination Complex

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March 6, 2017

CLIC Workshop 2017, Geneva, Switzerland



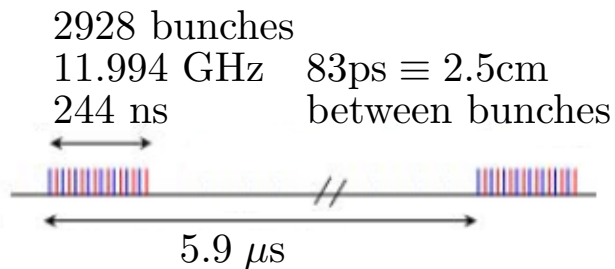
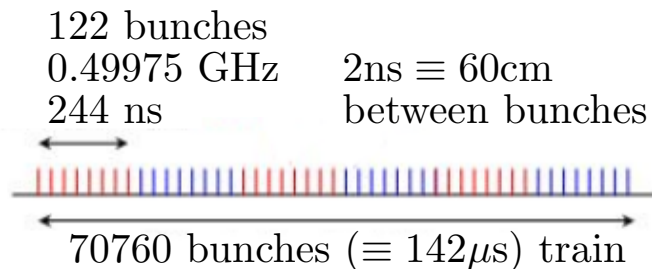
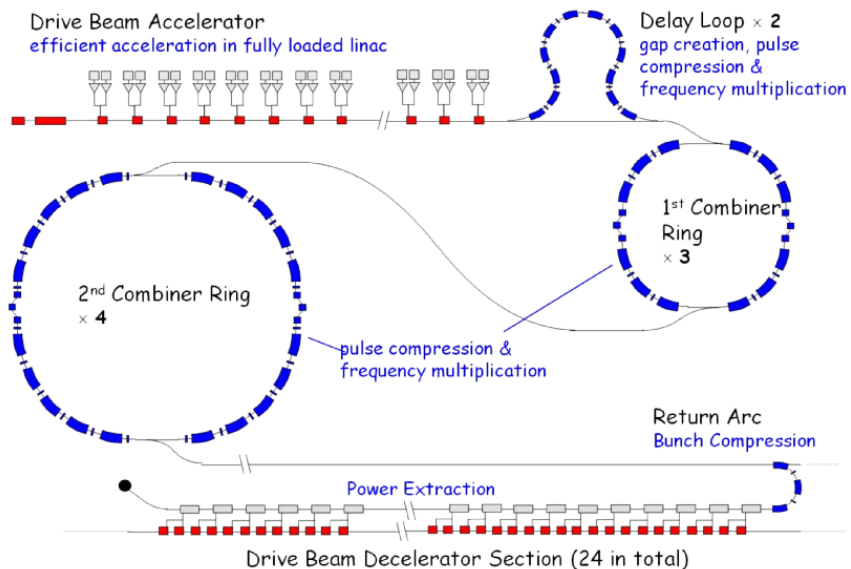
universidade de aveiro



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DBRC's role

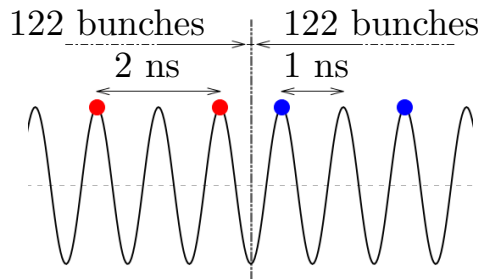
The DBRC is located after the drive beam linac. It's main role is to create high current pulses for the PETS.



DBRC's design parameters

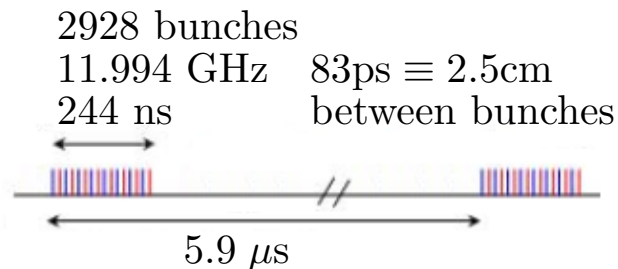
Injection:

- $E = 2.38\text{GeV}$
- $\Delta E = 0.85\%$
- $\varepsilon_{x,y} = 100\mu\text{m}$
- $\sigma_z = 1\text{mm}^1$
- Longitudinal chirp
- $f = 0.49975\text{GHz}$
- 122 bunch trains
phase-coded



Extraction:

- $E = 2.38\text{GeV}$
- $\Delta E = 0.85\%$
- $\varepsilon_{x,y} = 150\mu\text{m}$
- $\sigma_z = 1\text{mm}$
- Longitudinal chirp
- $f = 11.994\text{GHz}$
- short pulse time structure



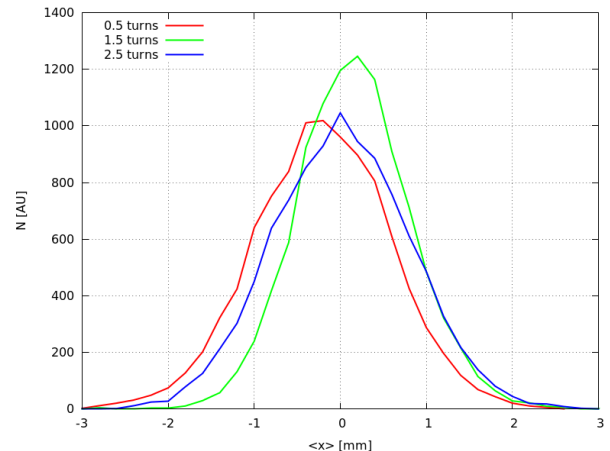
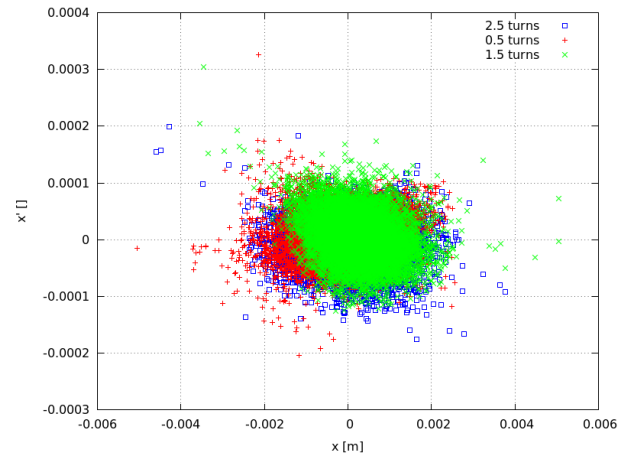
¹2mm inside the complex

Transverse Emittance

Because we have different bunches taking different paths:

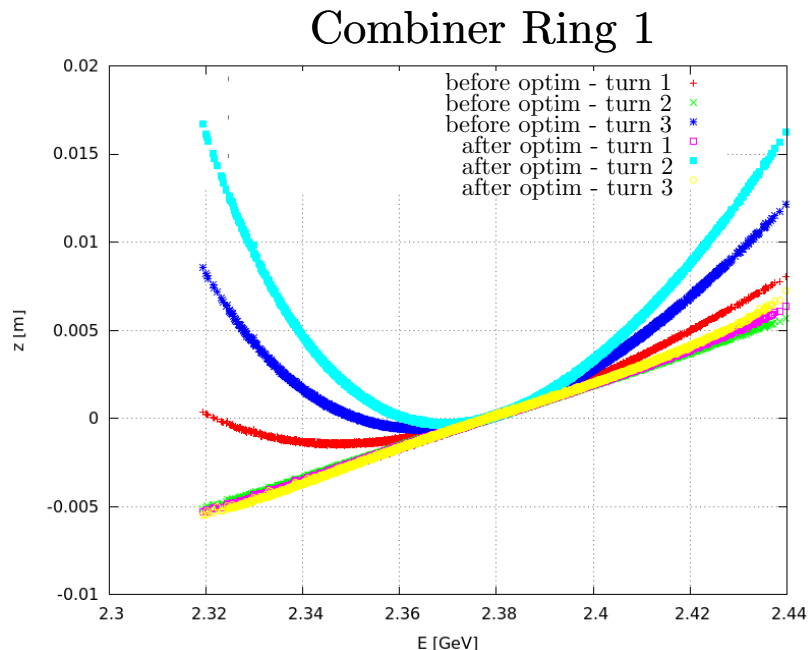
- They may not all be centred at extraction
- They may not all have the same twiss
- Individual or average emittances are not the best figure of merit
- We can project all bunches into one and compute the train emittance from there

Combiner Ring 1:



Longitudinal chirp - T_{566} aberration

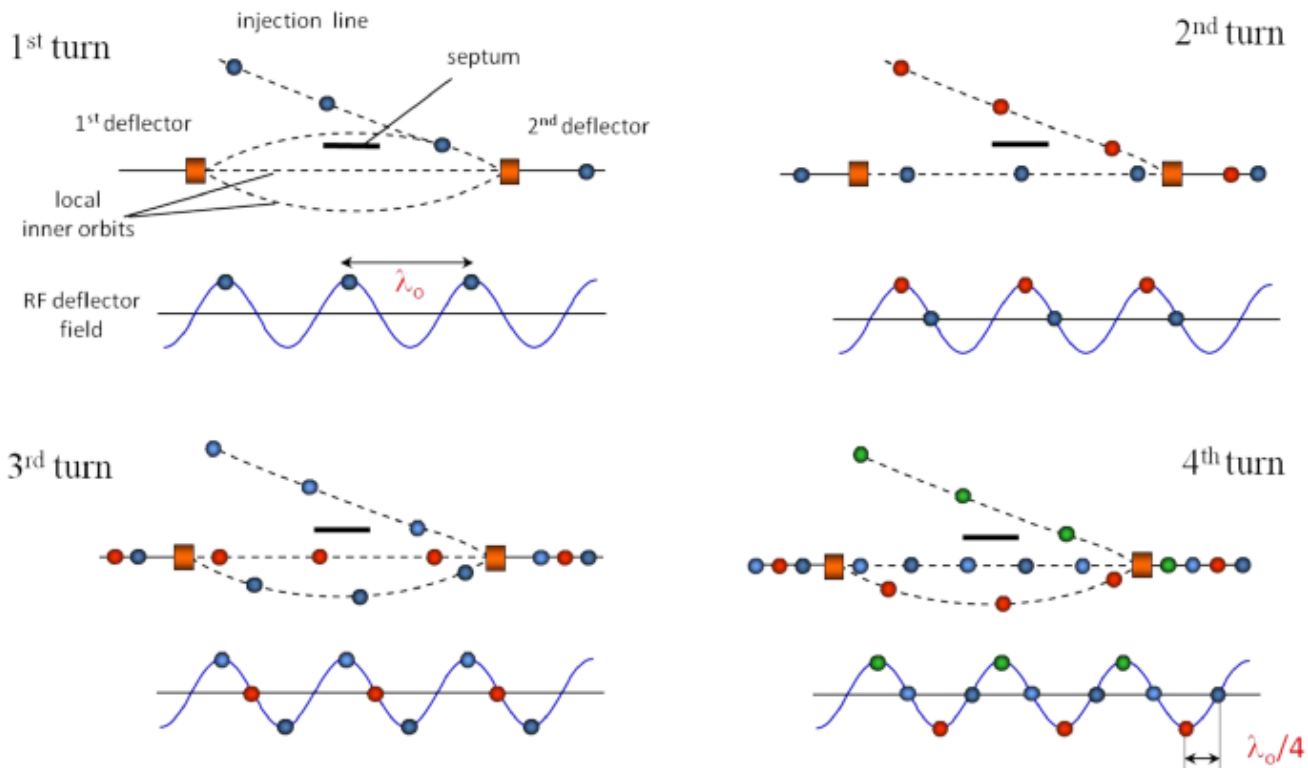
- Placet2 tracking showed a strong T_{566} aberration
- Identified has a longitudinal effect of divergence
- Corrected using sextupoles in dispersive regions



$$Z_{\text{Drift}} \sim Z_0 + L \frac{x'^2 + y'^2}{2} \propto Z_0 + L(\Delta E)^2$$

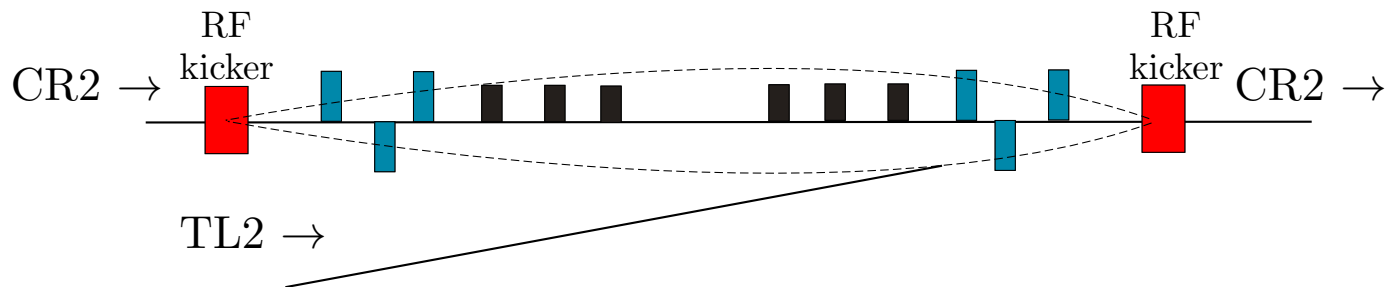
CR2 injection scheme

- CR2 uses two 3 GHz RF kickers to inject the bunches into orbit
- This means that the third turn of the ring suffers a "bump" in the opposite direction of the septum.



CR2 injection scheme (new lattice)

- Since turn 3 has an offset, the sextupoles act as quadrupoles (and sextupoles, and dipoles)
- The septum was moved to inject after the sextupoles



- With this design, we managed to obtain $\varepsilon_x = 151\mu\text{m}$, $\varepsilon_y = 147\mu\text{m}$ during 4 bunch recombination

Projected emittance growth:

sector	$\varepsilon_x [\mu\text{m}]$	$\Delta\varepsilon_x [\%]$	$\varepsilon_y [\mu\text{m}]$	$\Delta\varepsilon_y [\%]$
Dogleg	98.2	0.16	100	2.4
DL	120	22	107	6.7
CR1	141	18	122	14
CR2	151	8*	147	20*

Notes:

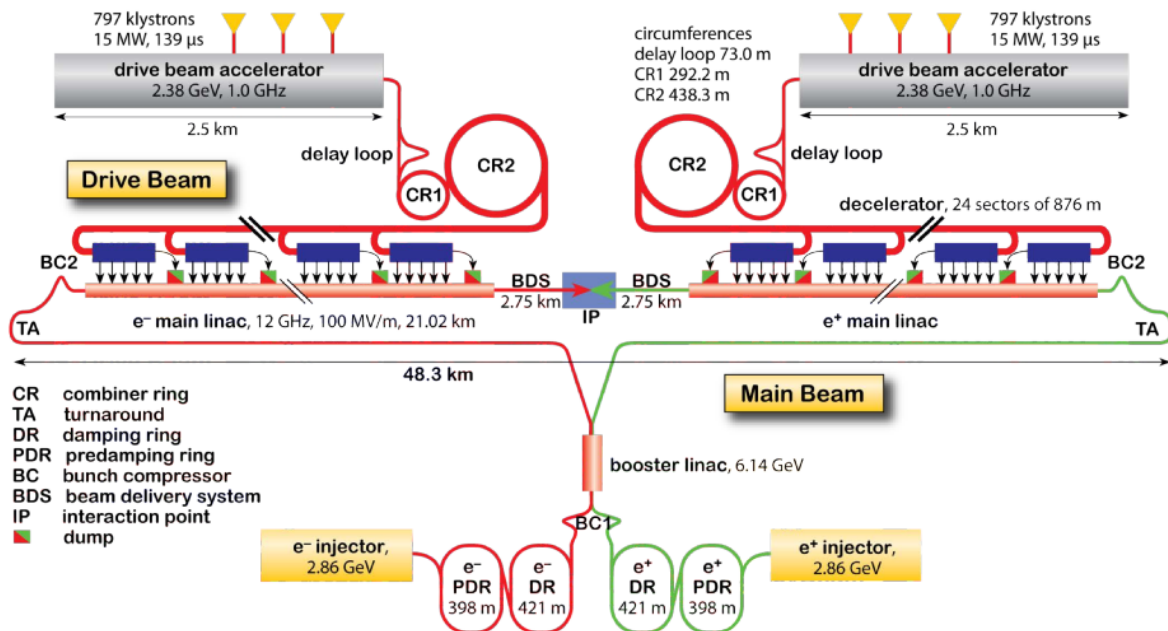
- CR2 results show only 4 bunch recombination
- If we use average emittances, CR2 optimization achieves $\varepsilon_x = 148\mu\text{m}$, $\varepsilon_y = 147\mu\text{m}$

Conclusions

- DBRC Placet2 lattices are ready for simulations and studies
- Several features (BPMs, dispersion-free readings, etc) have been added or updated in Placet2
- Lattice geometry updated (DL, CR1, TL2 and CR2)
- Projected emittance is a better optimization target
- There is a strong T_{566} aberration
- Sextupoles in dispersive regions can fix T_{566}
- CR2 injection design has been updated
- Preliminary results at CR2 are approaching design budget:
 $\varepsilon_x = 151\mu\text{m}$ $\varepsilon_y = 147\mu\text{m}$ projected over 4 bunch recombination

Next Steps:

- Optimization of CR2 for projected emittance and T_{566}
- Tracking of full recombined train to the end of TTA
- Re-optimization of DL and CR1
- Global Machine optimization
- Revisit the DL design (implement short path and update long)
- Implement more realistic septa at the joints
- Check magnet strength and longitudinal phase error tolerances
- Implement misalignments and beam-based alignment



Thank you