Progress on RCS Lattices : parameter table and apertures

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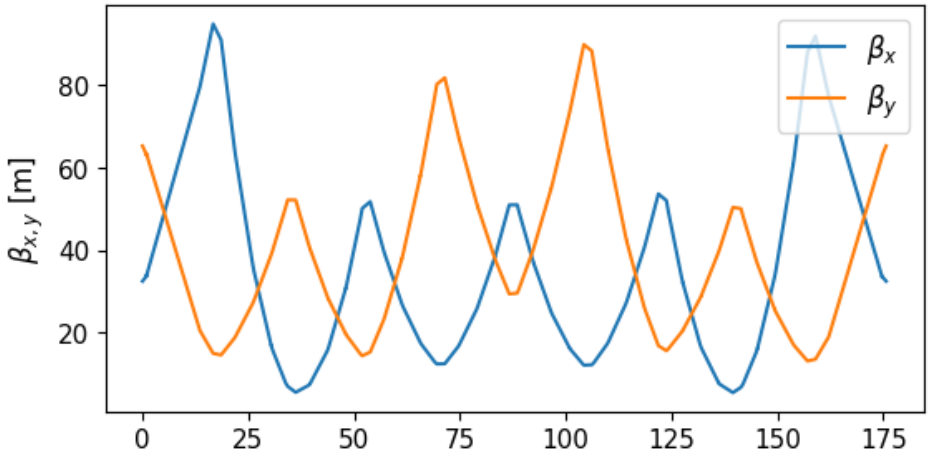
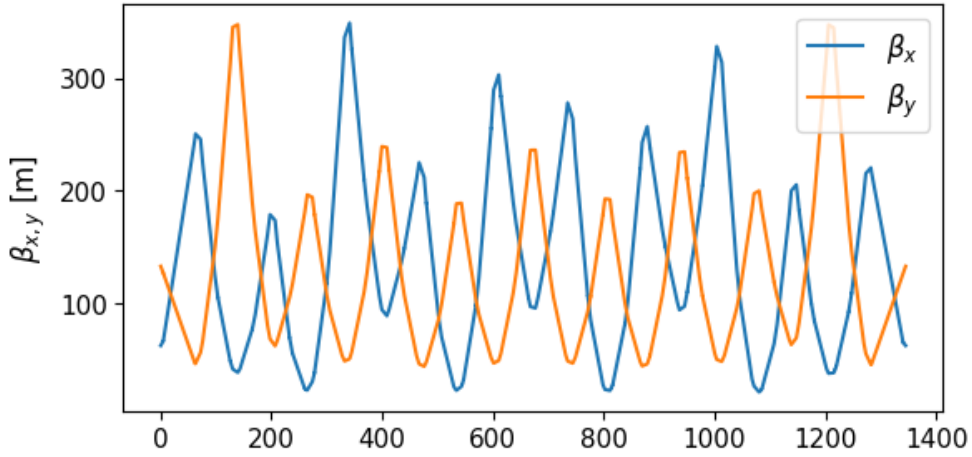
Work on RCS geometry and lattices

- Work on geometry and lattices for the greenfield proposal

- Optimization of cell length L_c to get more feasible QP strengths: reduction of n_c
- Number of arcs remains unmodified (RCS 1: 32 arcs, RCS 2,3,4 : 26 arcs)
- Generate the arc layout with a FODO structure :
  - Allocate place for thick QP and SXT in the arcs and RF insertions
  - Distribute remaining straight sections between the cells and RF insertions
- Dispersion suppressor for RF insertions
- Correct chromaticity to dqx = dqy = 5

Arc lattice for normal RCS 1 and hybrid RCS4

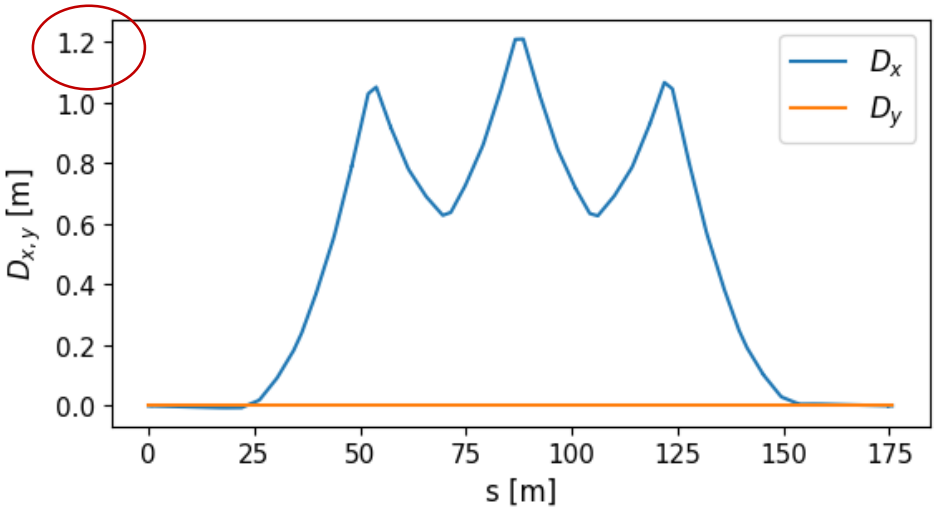


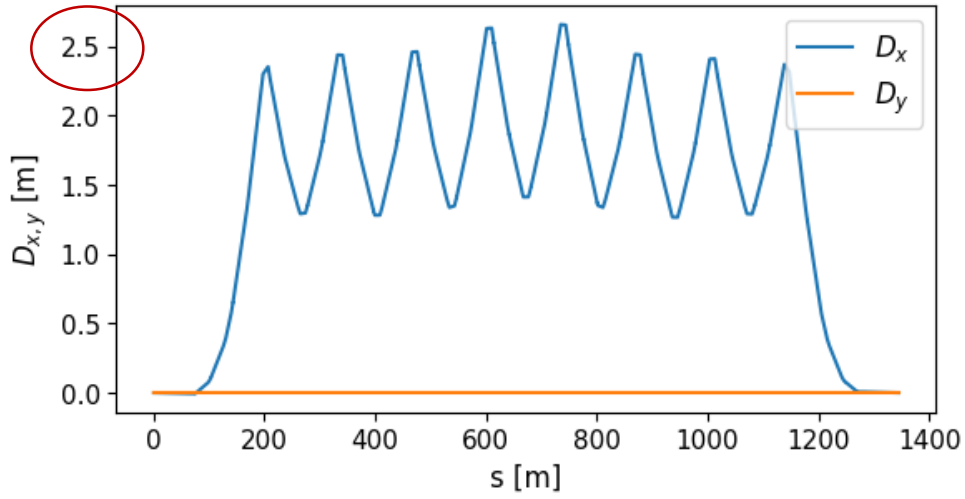


High dispersion function :

$D \propto L_{cell}\theta_{cell} \propto 1/n_c^2$

Throughout the 4 RCS, D goes from 1.2 m to 2.5 m





RCS 1

RCS 4

Parameter table

	RCS 1	RCS 2	RCS 3	RCS 4
Type	Normal	Hybrid	Hybrid	Hybrid
Circumference	5990	5990	10700	35000
Number of arc	34	26	26	26
Number of cells per arc	4	4	6	9
Filling ratio arc	0.85	0.92	0.94	0.89
Filling ratio dipole	0.37	0.61	0.63	0.70
Pattern	NC, NC	SC, NC, SC	SC, NC, SC	2 bloc: SC, NC, SC
Length NC [m]	4.06	12.21	13.99	21.77
NC traj excursion [mm]	0	71.0	44.0	43.0
NC hor. aperture [mm]	174.3	142.1	93.1	83.2
Length SC [m]	-	2.68	3.78	2.27
SC traj excursion [mm]	-	26.0	24.0	8.0
SC hor. aperture [mm]	-	98.1	67.9	61.6
Vertical aperture [mm]	42.1	33.0	28.2	29.6
Length QP [m]	1.89	3.49	4.98	9.16
Aperture min. QP [m]	177.3	79.6	64.7	63.1
Length SXT [m]	0.5	0.5	1.0	1.0
QP B_{pole} (ϕ 50 mm)	1.31	1.25	1.35	1.18
SXT B_{pole} (ϕ 50 mm)	0.17	0.2	0.12	0.13
Max path length diff. [mm]	0	49.6	21.0	59.7
Relative path length diff. [1e-6]	0	8.3	2.0	1.7
MCF	0.0006	0.0011	0.0007	0.0002
Qs	0.754	0.345	0.285	0.297
Qx	44.358	33.291	41.780	65.624
Qy	31.563	23.069	35.694	58.604
dQx	5.0	5.0	5.0	5.0
dQy	5.0	5.0	5.0	5.0

Table 1: Parameter table for the greenfield complex (FODO lattices)

NC too long, to be separated later

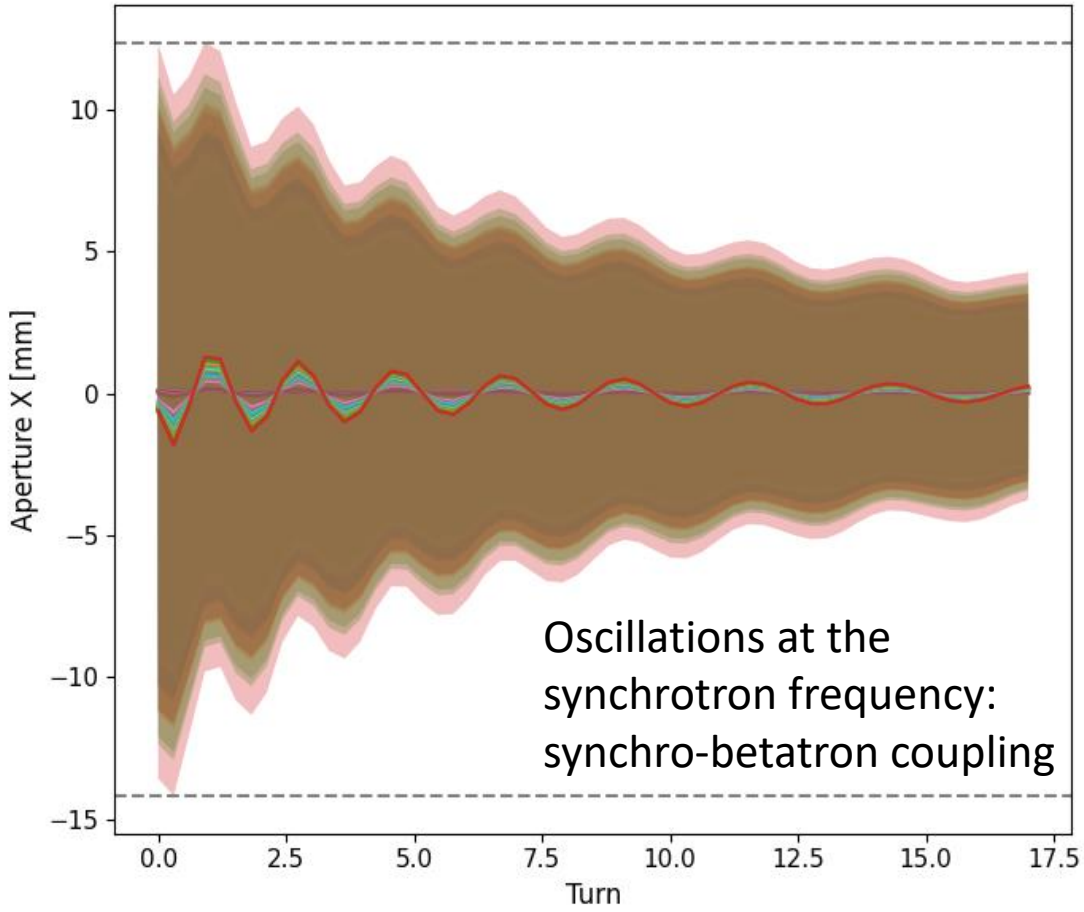
Beam excursion and beam size (from tracking) + 20 mm of margin (vacuum pipes..)

1 T recommended + large QP apertures for RCS 1&2

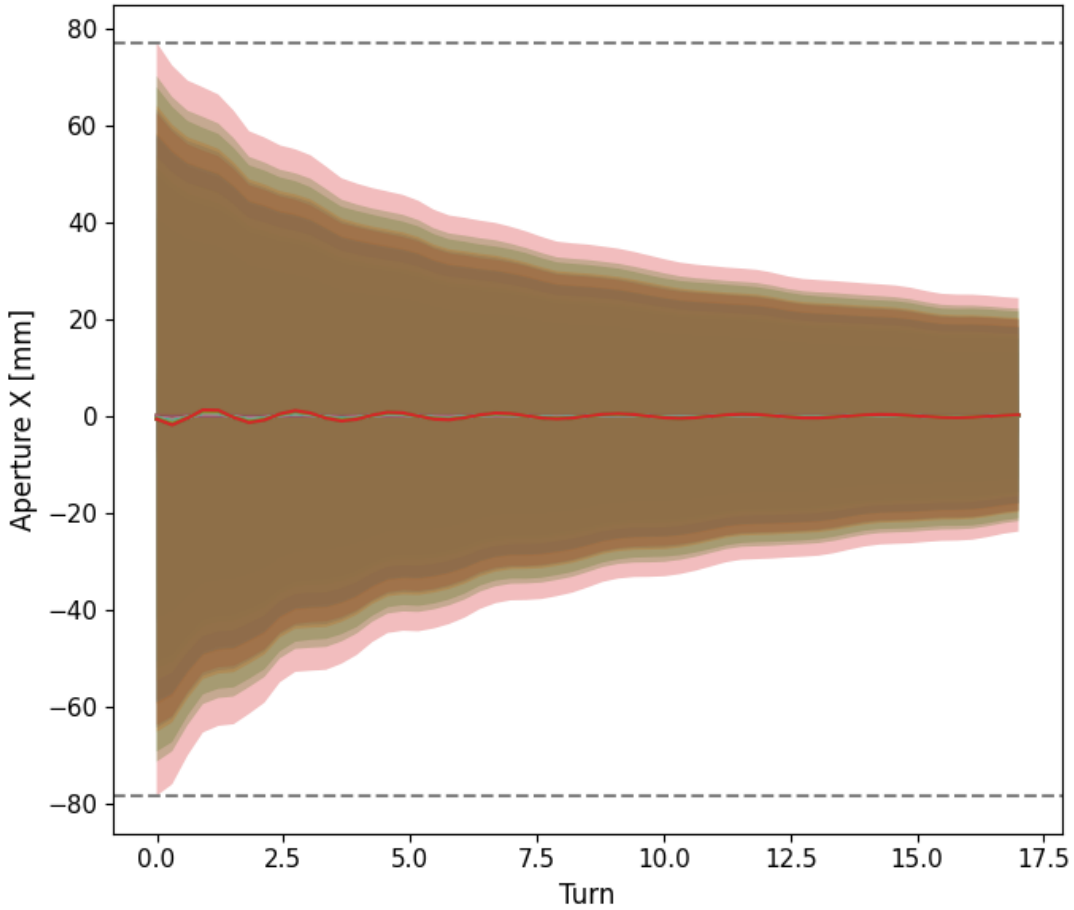
Tracking studies for apertures : example for RCS1

RCS 1

Aperture NC dipoles at 1σ



Aperture NC dipoles at 6σ



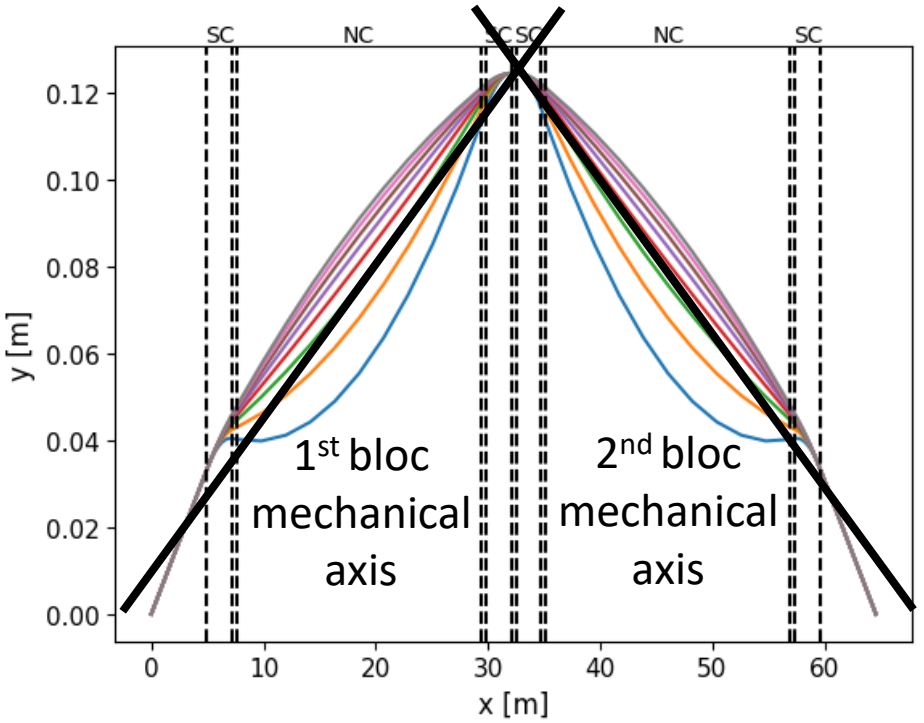
Larger apertures

- Larger excursion than what we had in the previous estimations : fewer n_c cells per arc
  - Trajectory excursion in middle dipole : $\Delta y \propto 1/n_c^2$
- High dispersion function ($D \propto L_{cell} \cdot \theta_{cell} \propto 1/n_c^2$) + high $\Delta E/E_{inj}$
  - ➢ bigger beam size

	$\Delta E/E_{inj}$ (at 99,5%)
RCS 1	2.75 %
RCS 2	0.61 %
RCS 3	0.34 %
RCS 4	0.32 %

- For a given n_c, we can reduce the
  each bloc on a different mechanic
  - Limited by minimum dipole len

cs and place



Conclusion

- First optics with thick elements for the RCS
- Quadrupoles with about 1T on the pole requires a large total length to focus the beam, resulting in a reduced number of cells per arc
- High dispersion function that greatly contributes to the beam size
- Initial tracking studies on each RCS showed no emittance growth

Next steps:

➢ Start-to-end simulations (RCS1 → RCS4)

➢ Could consider alternative lattice (combined functions, bend achromat to reduce dispersion)