NEW FCC-HH RING LAYOUT: ARC AND INSERTION OPTICS

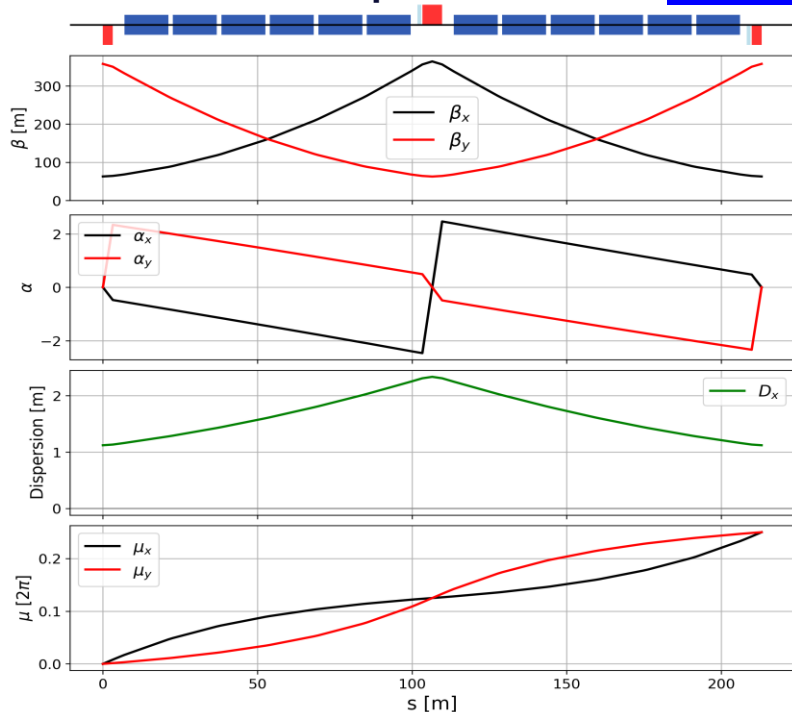G. Pérez Segurana, M. Giovannozzi, T. Risselada

Overview

- **Longer arc cells – 16-dipole configuration**

- **Dispersion suppressors**
    - Experimental insertions
    - Technical insertions

- **Insertion optics**
    - Experimental insertions
    - Momentum collimation
    - Betatron collimation
        - Low beta
        - High beta
    - RF and beam 2 injection
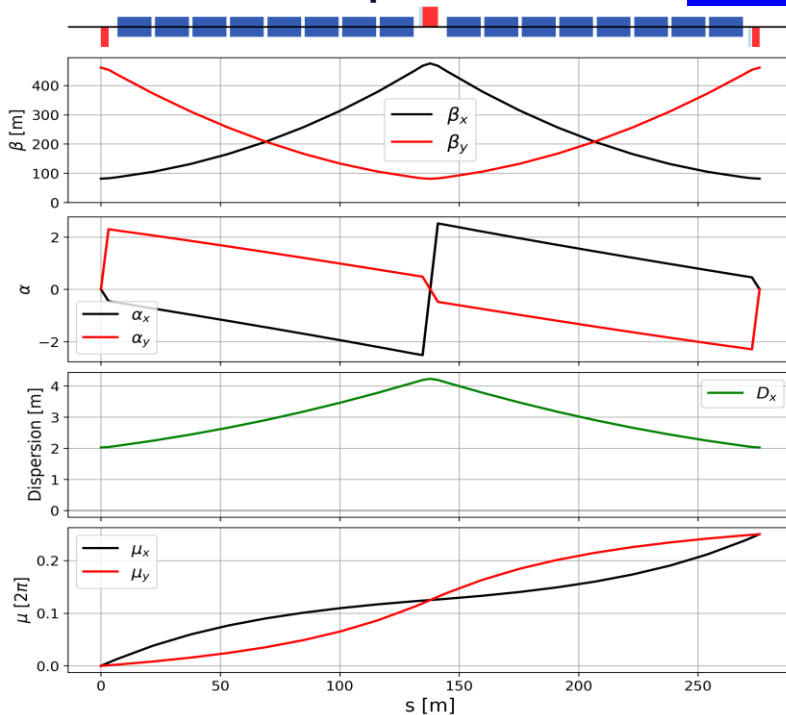   - Beam 1
        - Beam 2

Longer arc cells



12-dipole cell   ~213m

16-dipole cell   ~275m

**The new layout has been used to optimise as much as possible the ring design**

Longer arc cells

- **Increase dipole filling factor**

- **Although reduction in the number of dipoles w.r.t. CDR, ~4% increase compared to a 12-dipole configuration for the current placement**

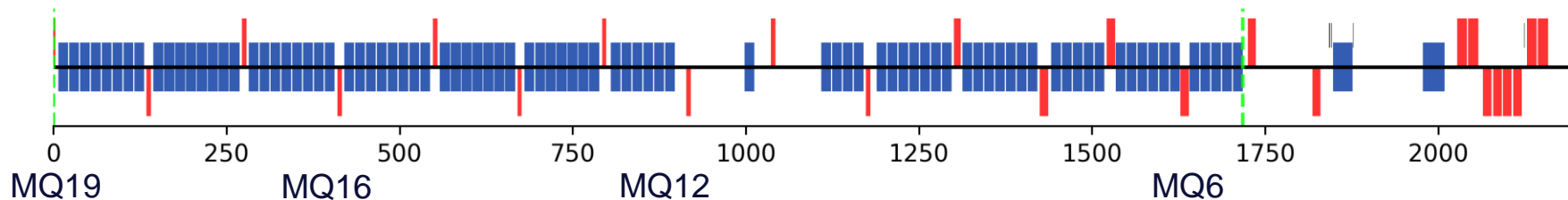- **Larger beam sizes can be compensated by a minor review of the beam screen geometry**

	CDR cell 12-dipole	New cell 16-dipole
# dipoles	4668	4464
Cell length (m)	213.030	275.792
Circunference (km)	97.75	90.657

— Initial aperture
3.75 mm half gap

--- Modified aperture
5.85 mm half gap
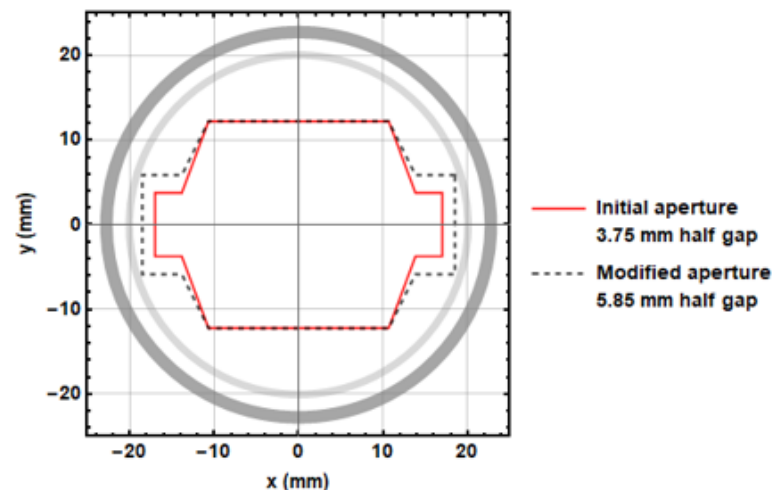
Layout
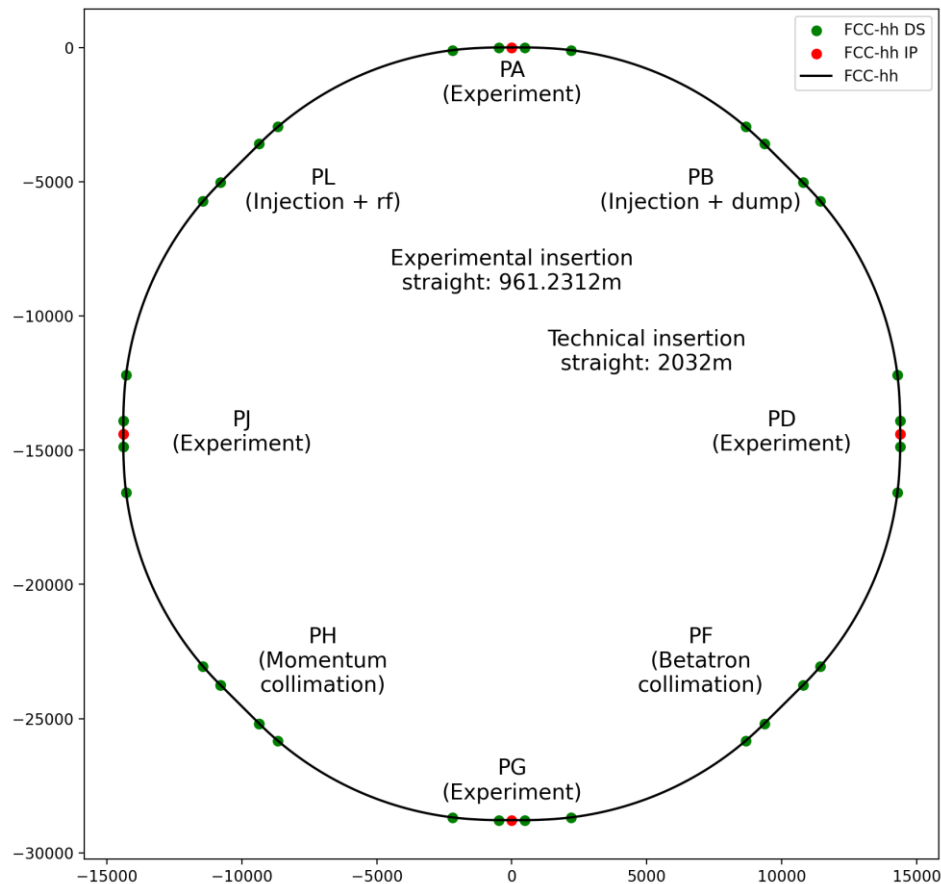
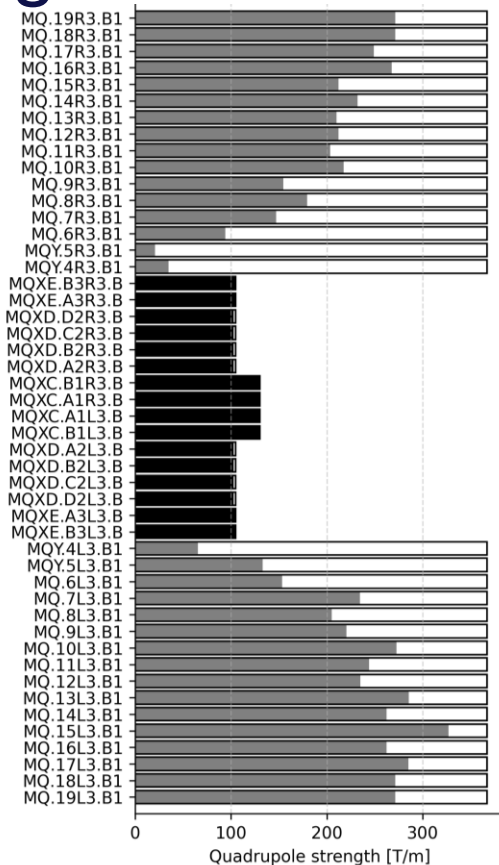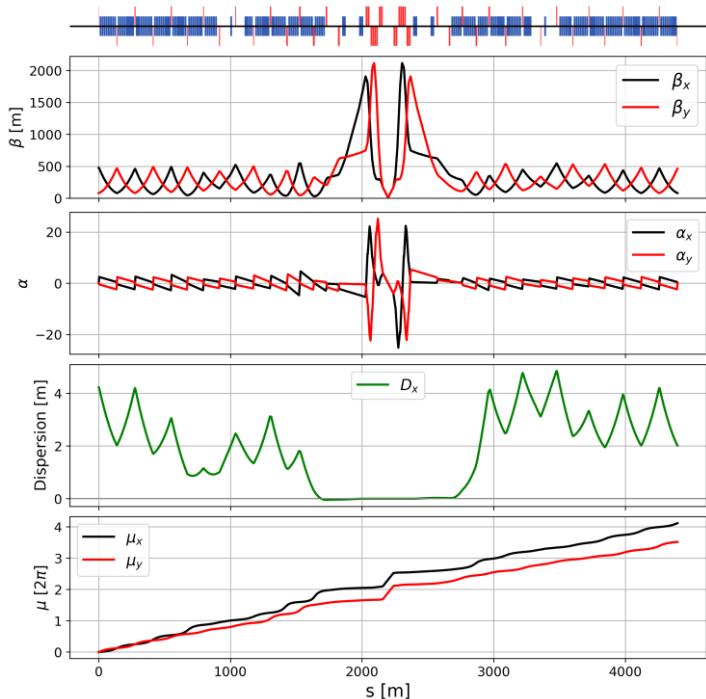# Dispersion suppressor – experimental insertion

- Displacing dipoles towards the IP moves the position of the IP outwards.
- Maintaining upstream dipole distribution makes FCC-ee and FCC-hh arcs overlap.
- Keep regular positioning of quadrupoles to ensure transverse focusing.
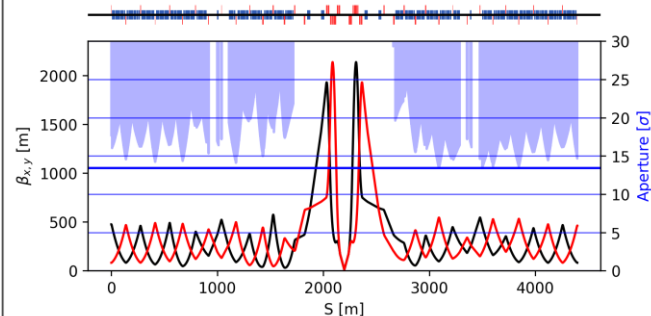- Shortening of the straight section to keep circumference constant.
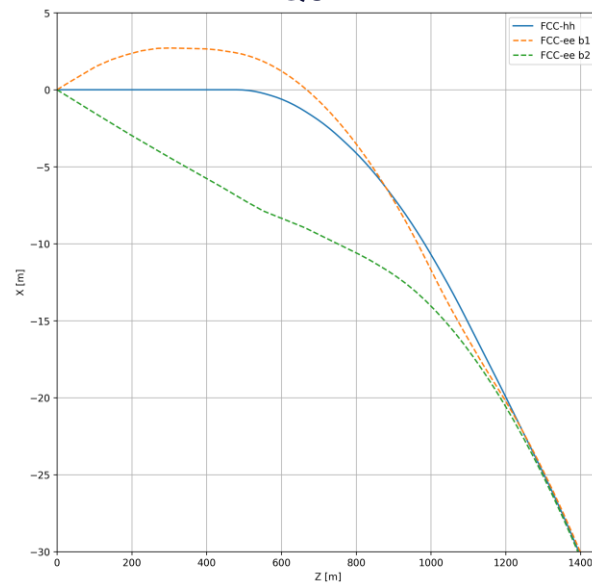
Experimental straight sections
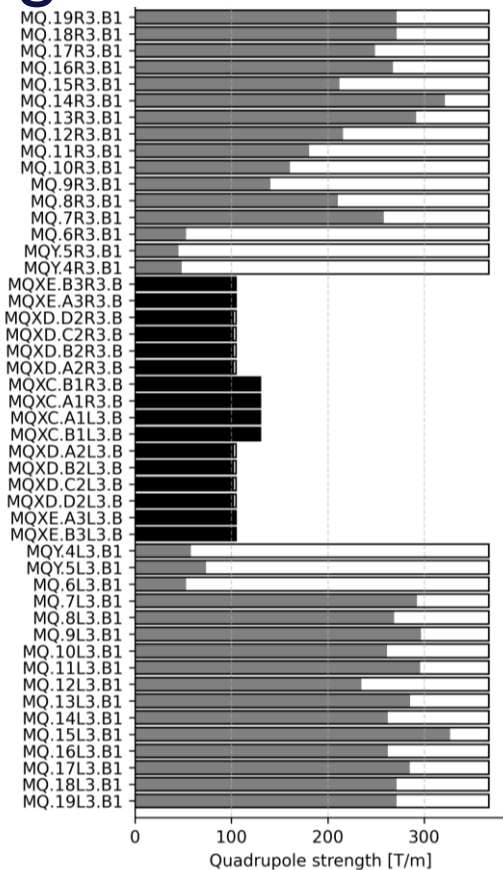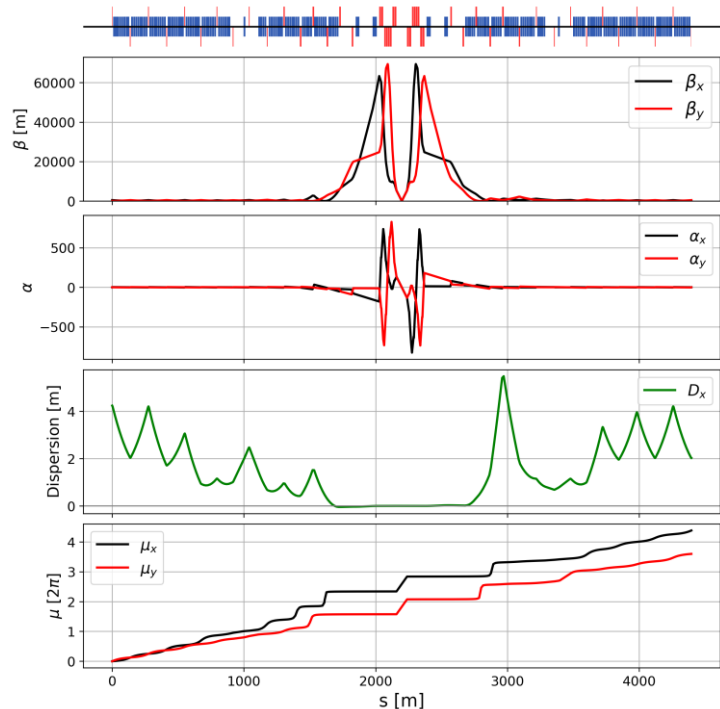
Optical functions

$$\beta^* = 10\ m$$

Aperture at injection

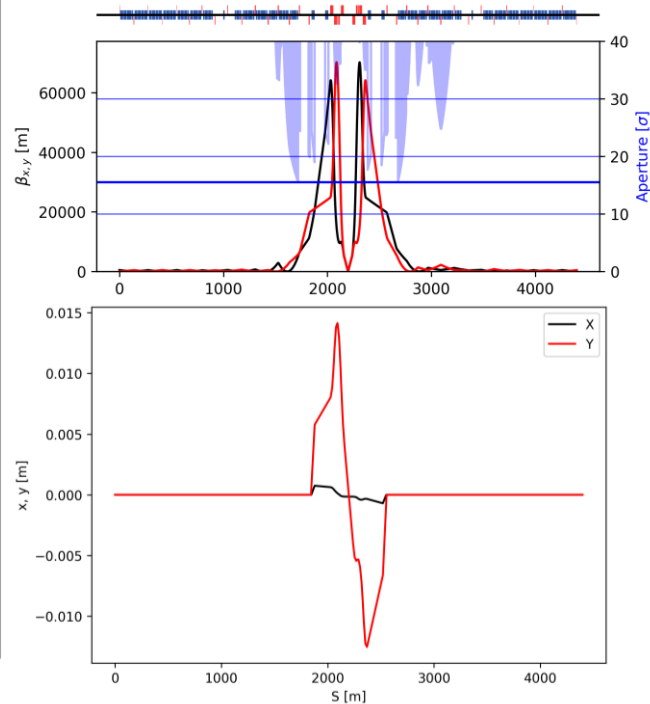New superconducting separation/recombination dipoles à la HL-LHC
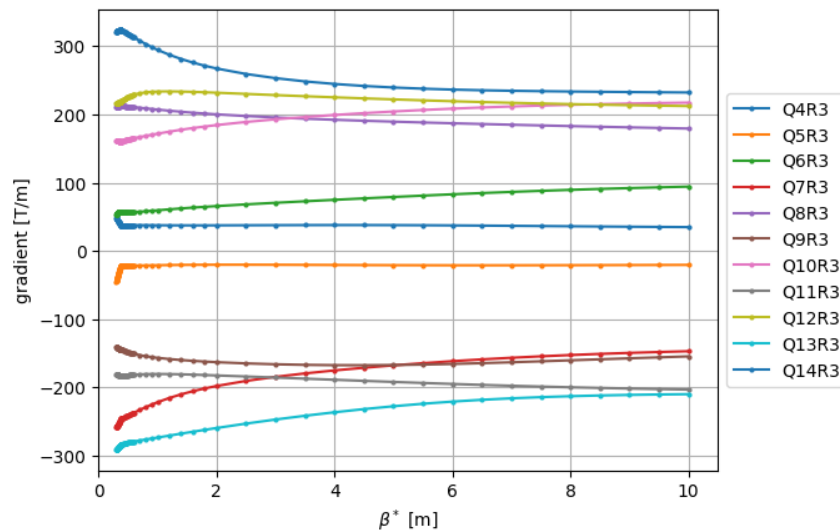
Experimental straight sections

Optical functions

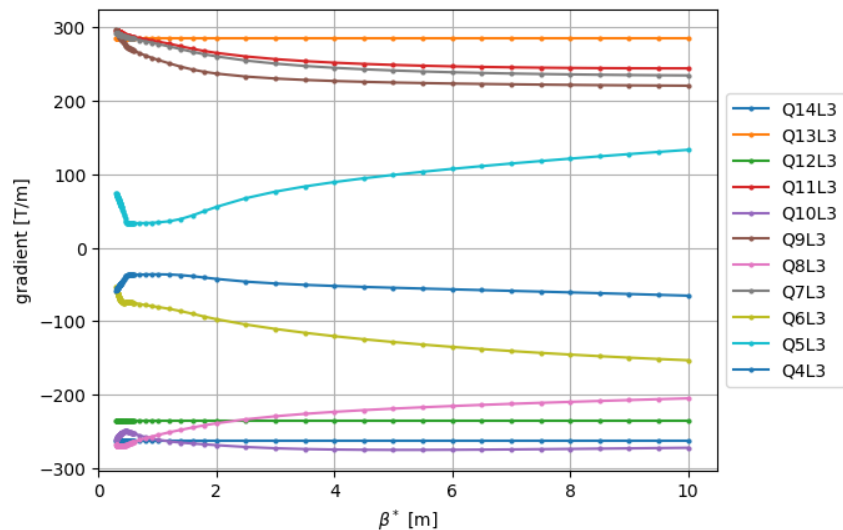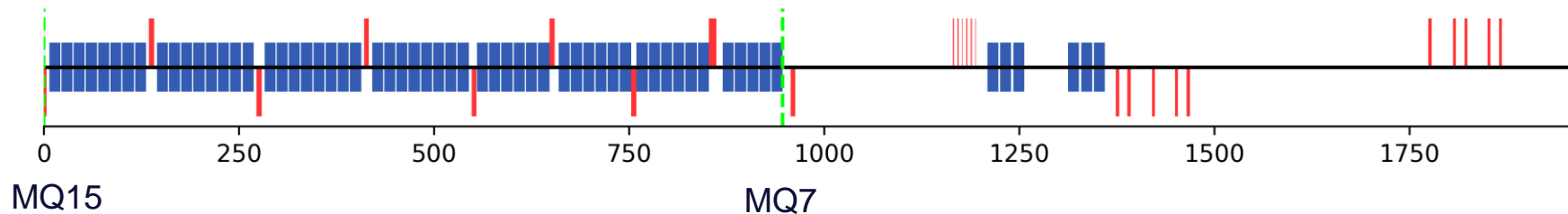$\beta^* = 30\ cm$

Aperture at collision

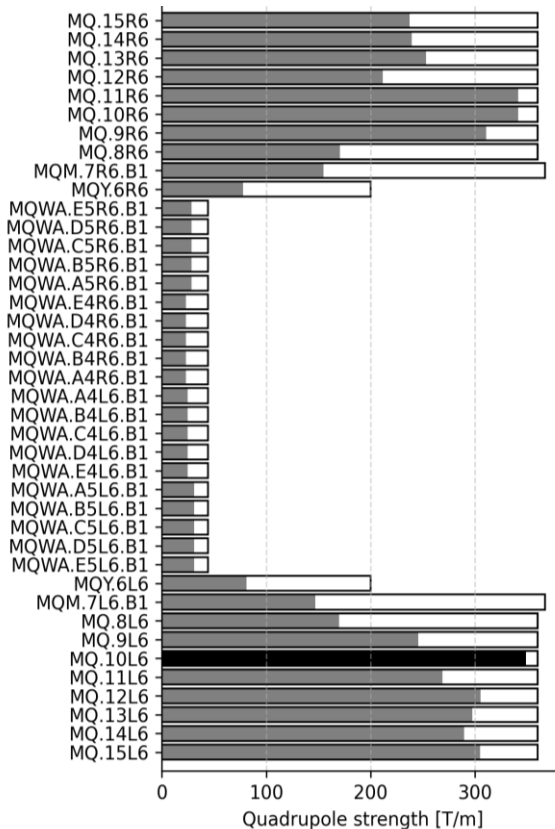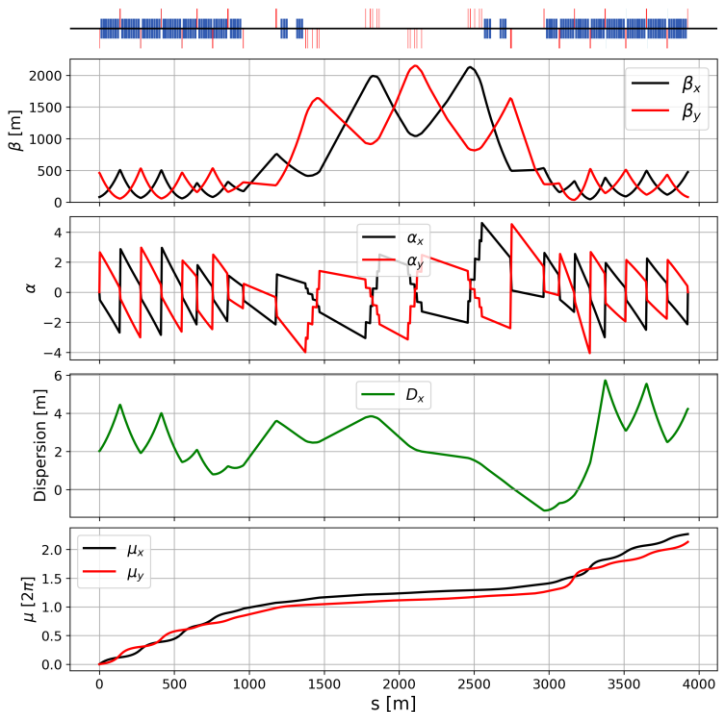# Experimental straight sections

Squeeze

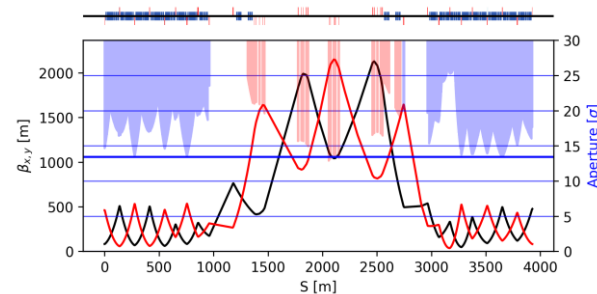# Dispersion suppressor – technical insertion

MQ15

MQ7

- Simpler than the experimental insertion.

- Space reserved too for collimators around Q8 and Q10.

- Possible to redistribute these drifts following results from collimation studies. R. Bruce

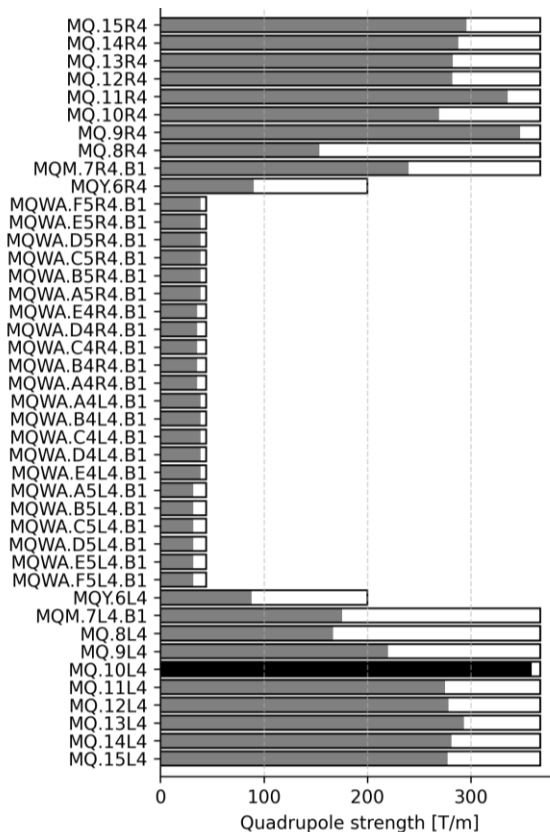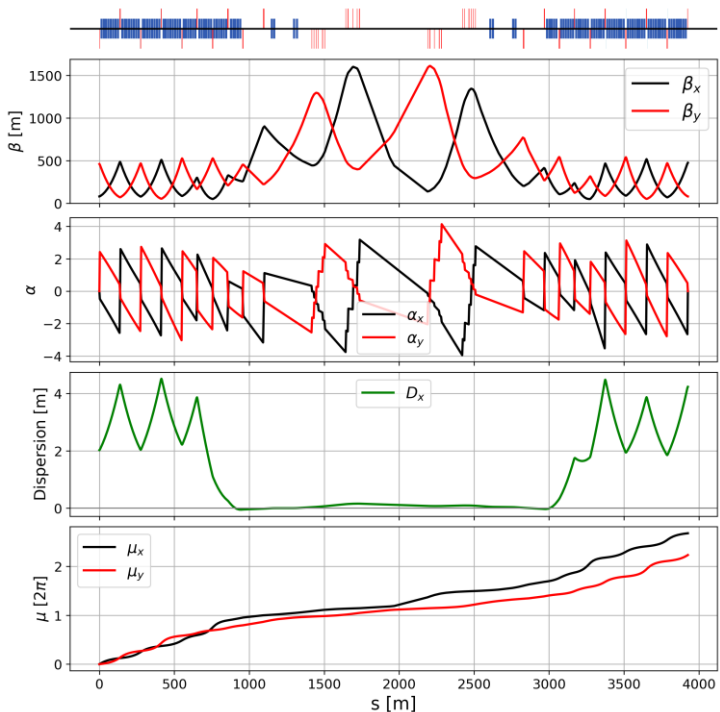# Momentum collimation - PH

Optical functions

Aperture at injection

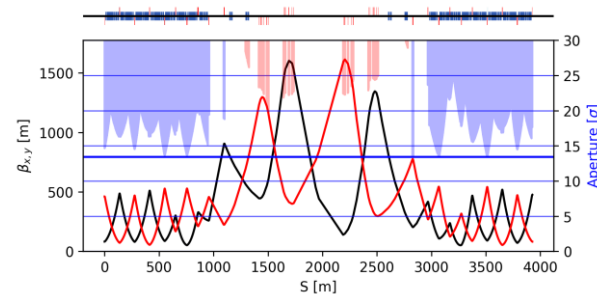New doglegs, with a constant inter-beam distance over the insertion
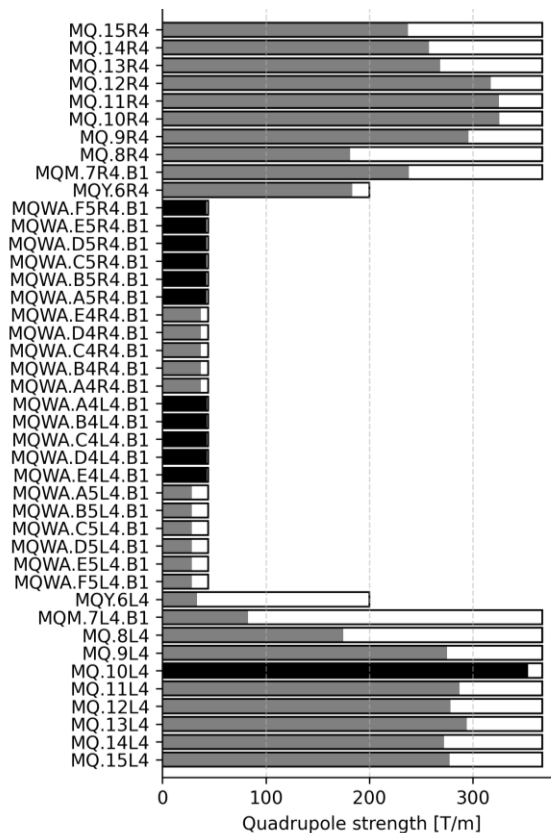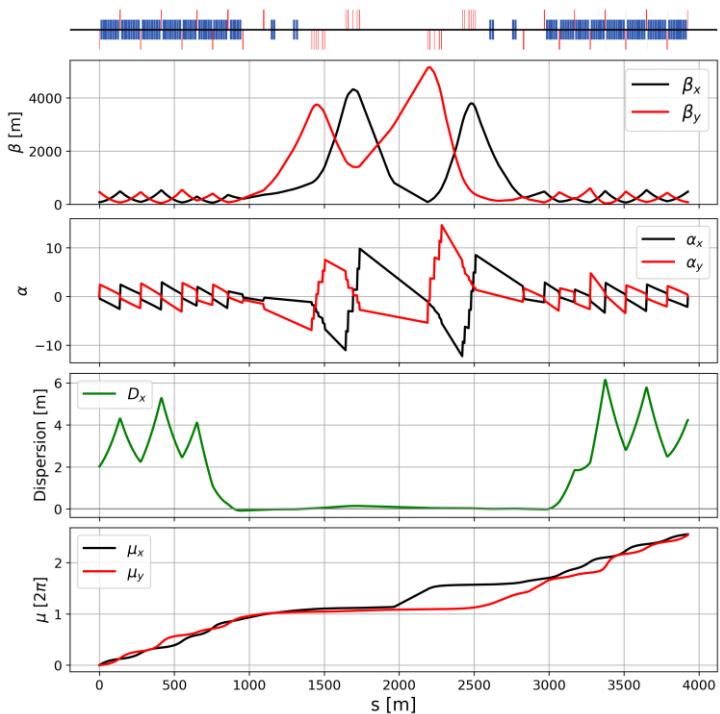
Betatron collimation – PF
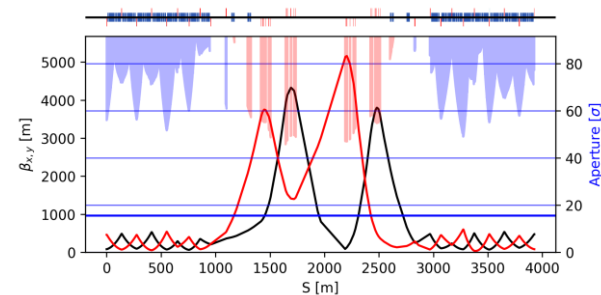
Optical functions

Low beta

Aperture at injection
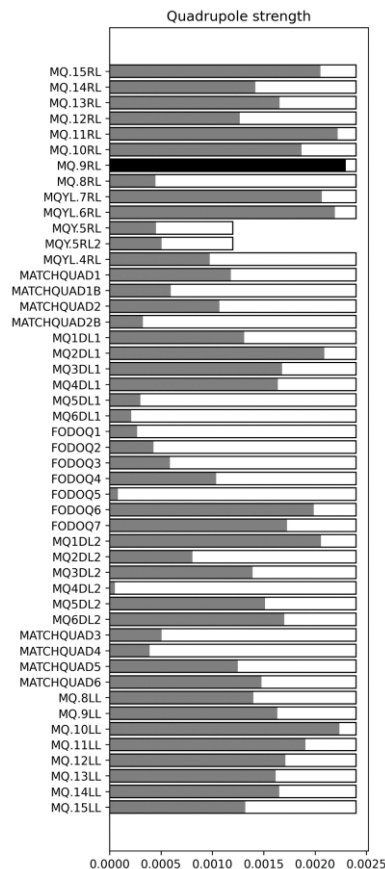
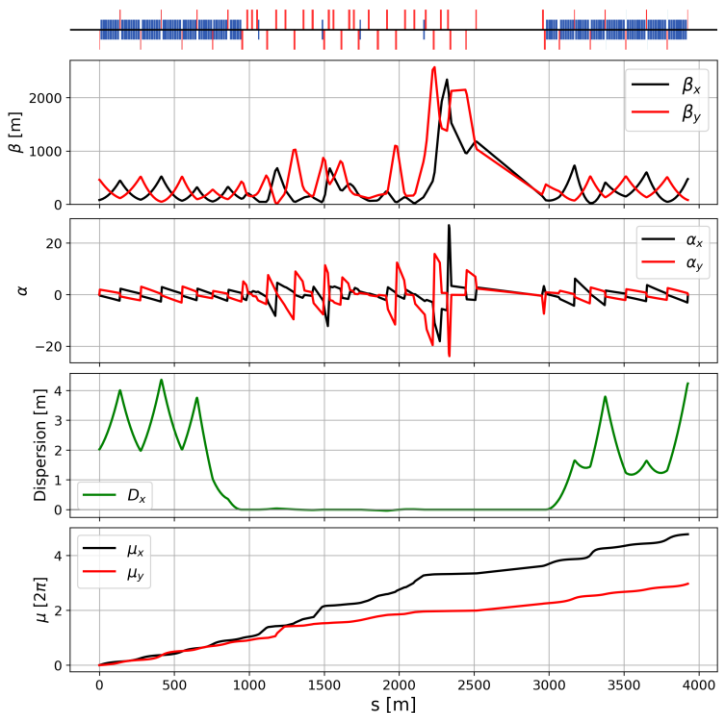# Betatron collimation – PF

Optical functions
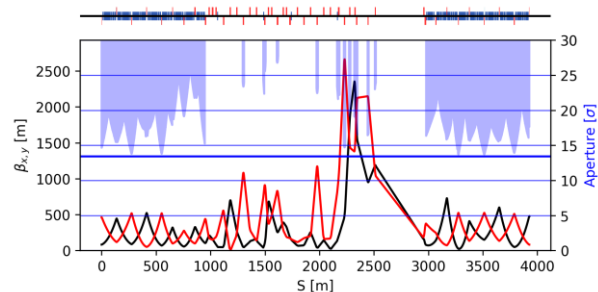
High beta

Aperture at collision

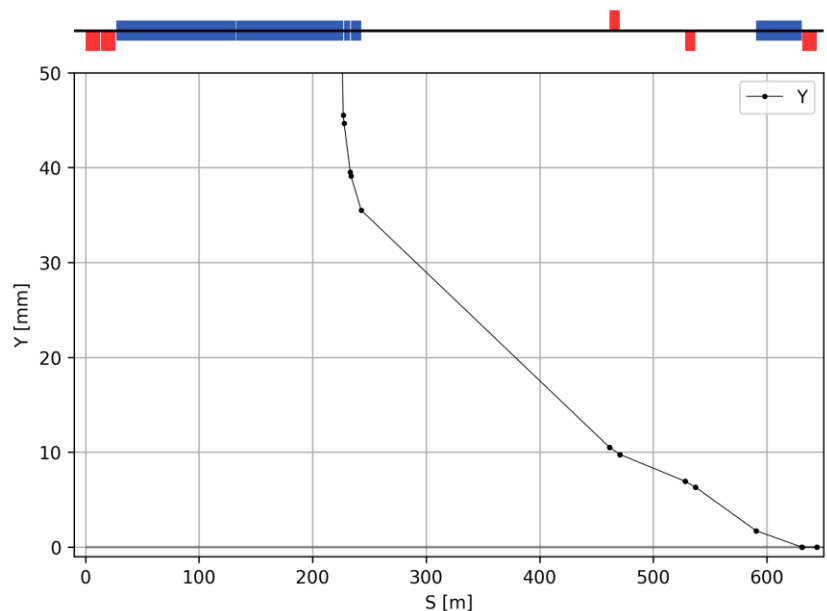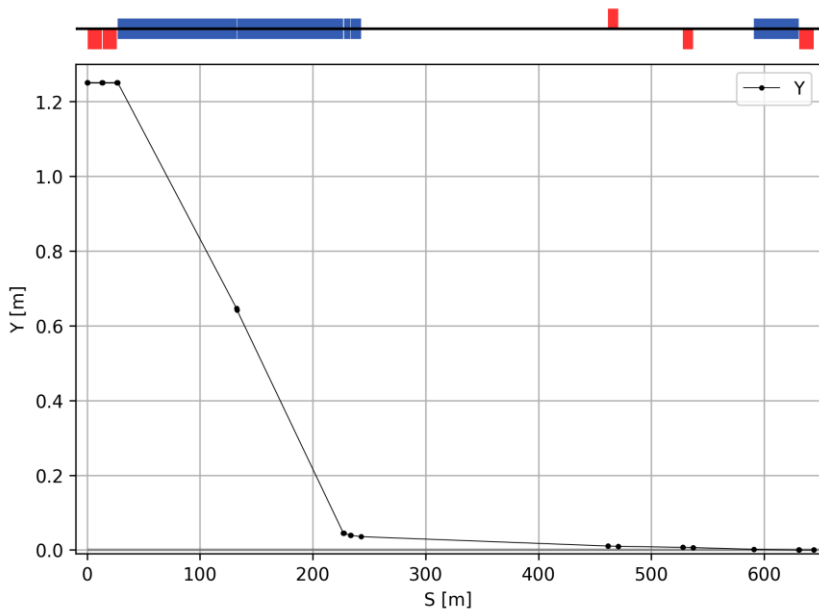# RF and Beam 2 injection – PL
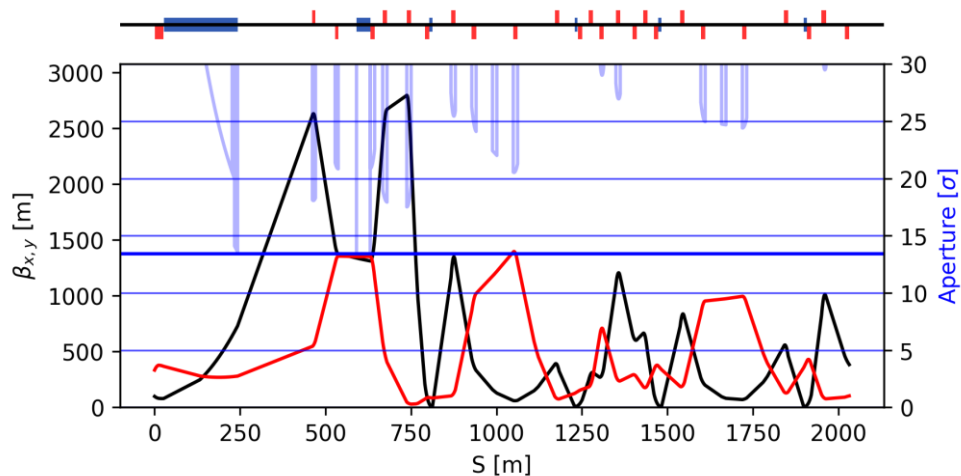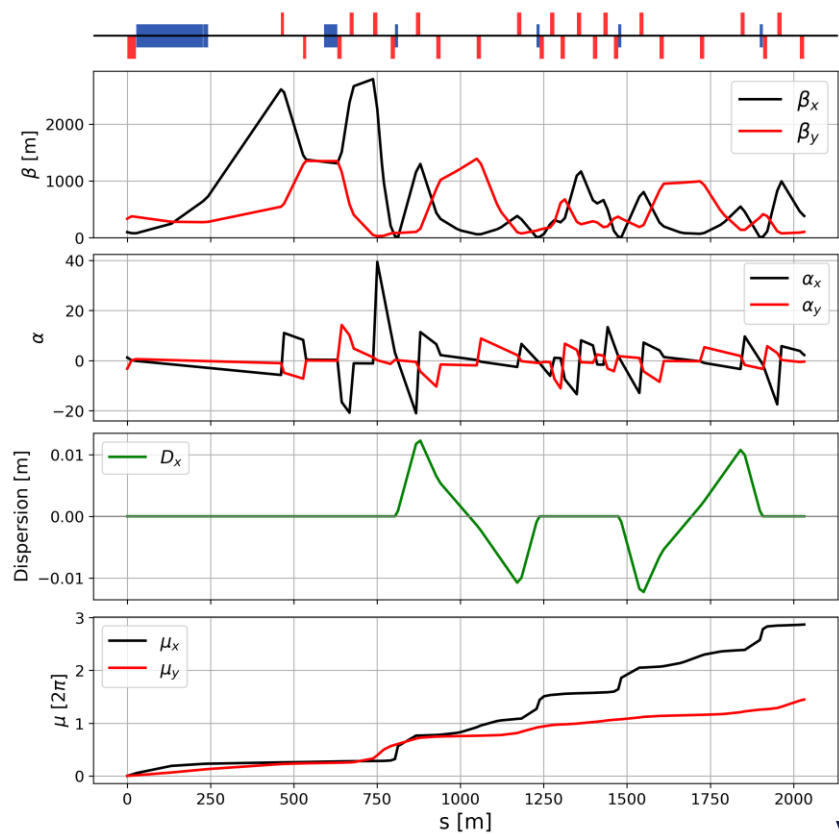
Optical functions

Aperture at injection

Beam 2 injection geometry

- 0.7T, 1T and 1.2 T septa with 8mm 12mm and 18mm blade thickness respectively.
- 40m kicker, ~0.086 mrad kick
- Hardware parameters to be homogenized in with PB (dump and beam 1 injection)

W. Bartmann

Beam 2 injection

TDI

- Larger $\sqrt{\beta_x \beta_y}$ at TDI reduces material stress.
  Maintained $\sqrt{\beta_x \beta_y} \sim 185\text{m}$ from CDR
- Ideal placement 90° downstream from MKI

Values from: FCC-hh protection absorbers and the dump - FCC Week 2018

Conclusions and next steps

- Adapted FCC-hh lattice following the outcome of **placement studies**.
- **Increased filling factor** by moving to a **16-dipole cell** configuration.

Next
- Incorporate lattice for **PB** to obtain a **complete lattice** of the ring.
- Study **tunability of PL** optics.
- Global optimization of **magnet family** definitions.
- Study of **corrector** systems.
- Resume **DA** tools and simulations.

Thank you for your attention.