FCC-ee:
Optics update

FCC-ee optics meeting

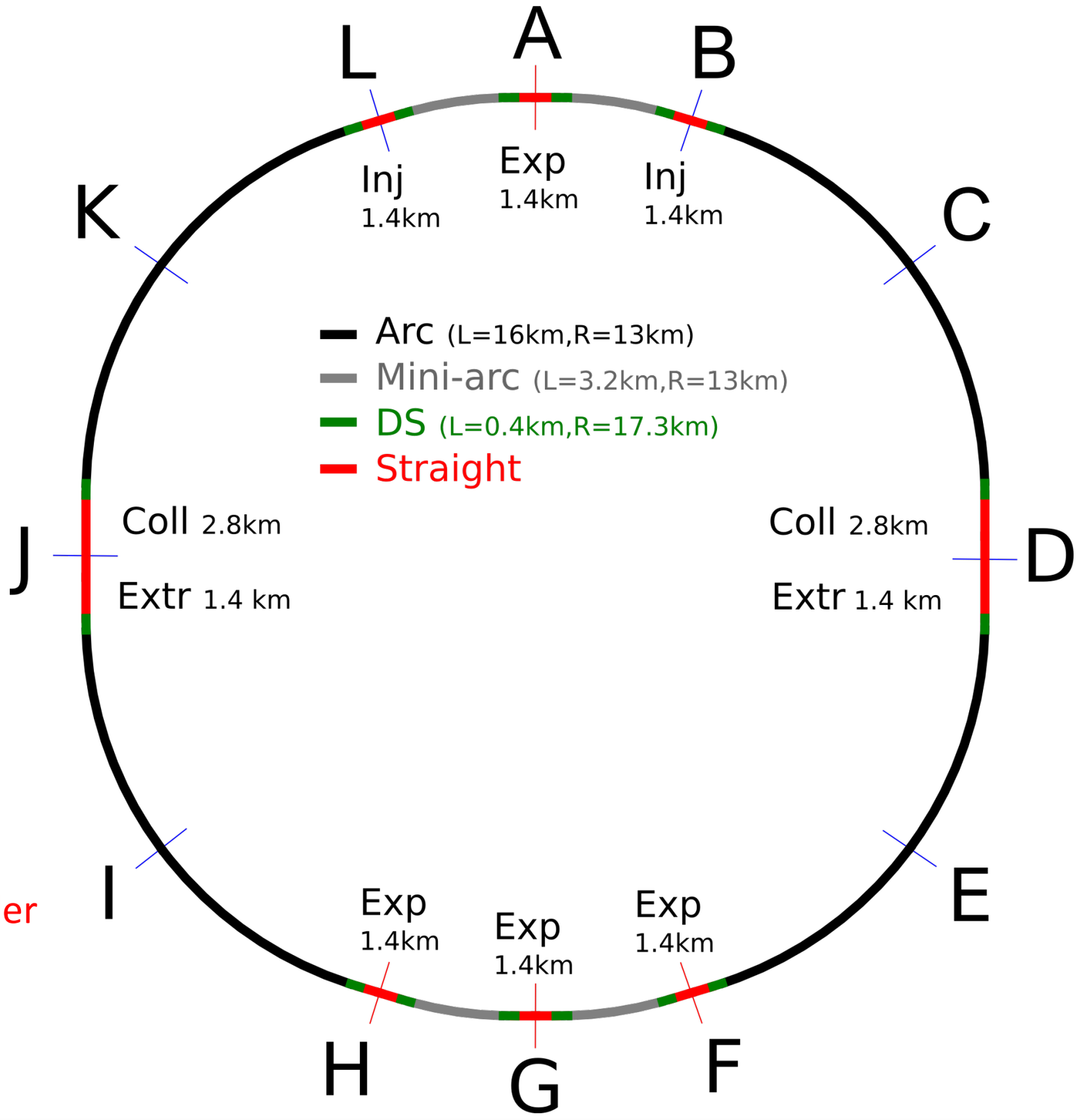
19 June 2015

K. Oide

Insertion Lengths

Insertion	Length
Exp1	***1.4 km***
Exp2	***1.4 km***
Exp3	***1.4 km***
Exp4	***1.4 km***
Inj1	***1.4 km***
Inj2	***1.4 km***
Coll1	***2.8 km***
Coll2	***2.8 km***
Extr1	***1.4 km***
Extr2	***1.4 km***

Insertion lengths are based on first order designs or even estimates, will be reviewed as optics designs are made



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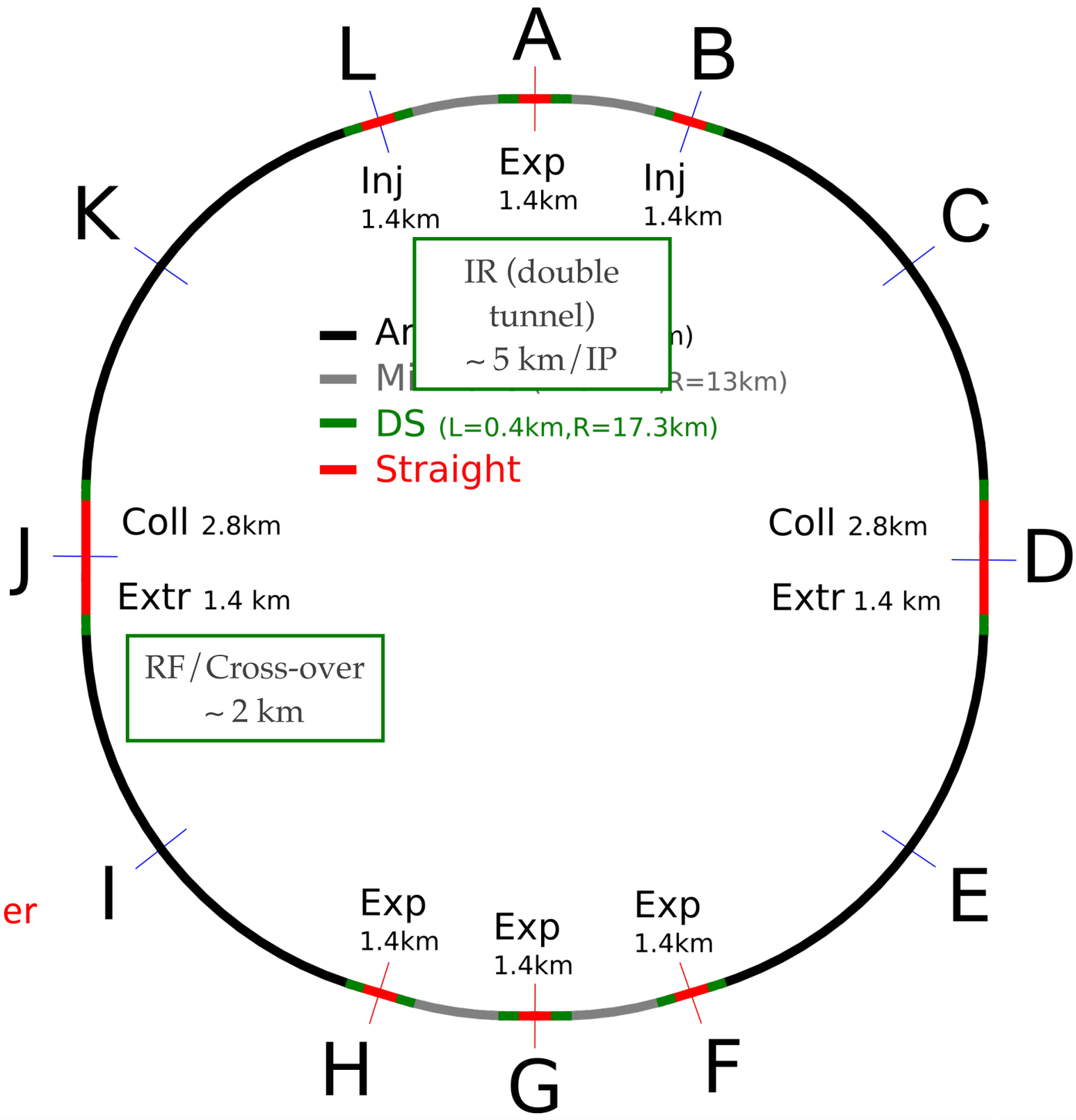
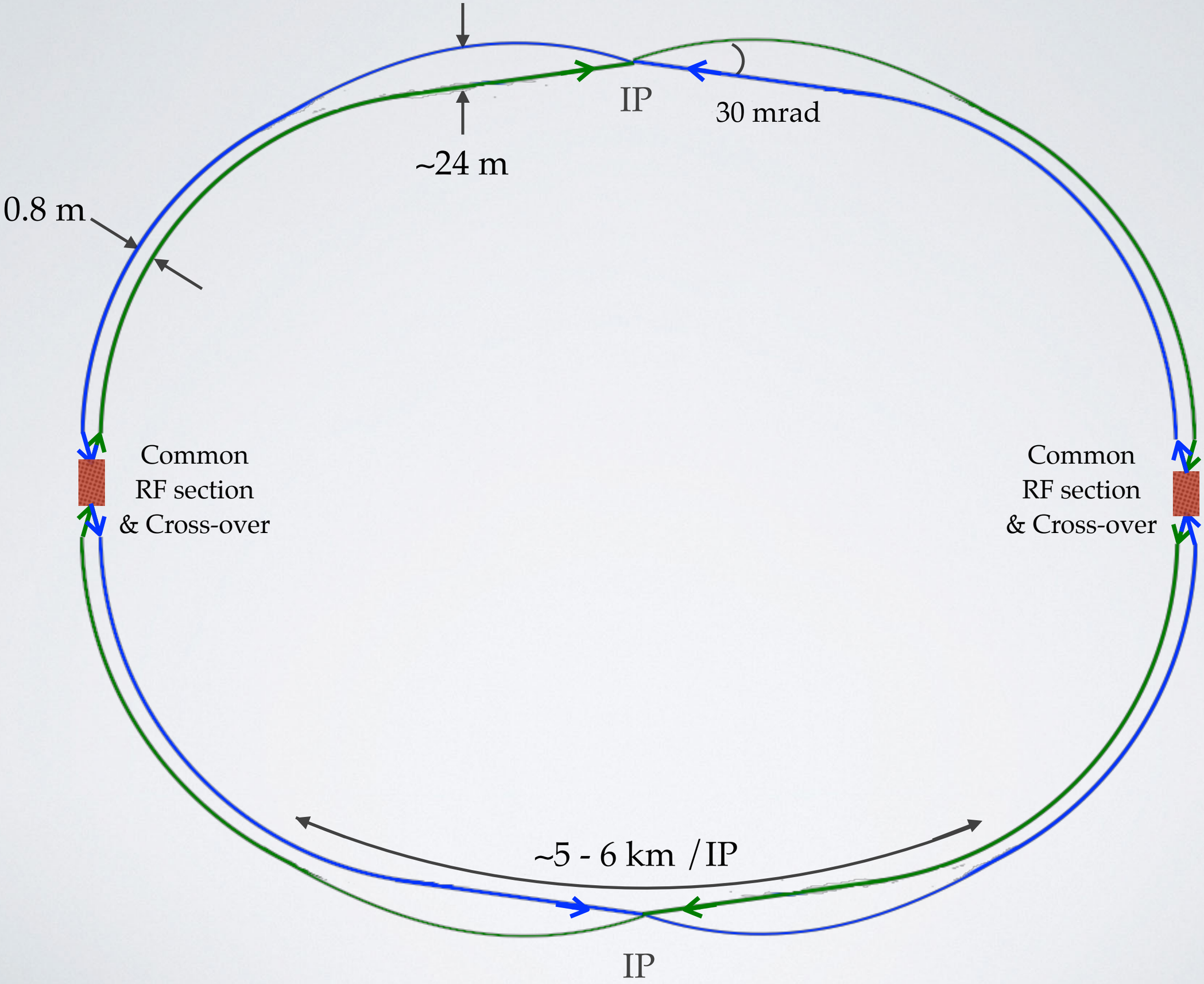
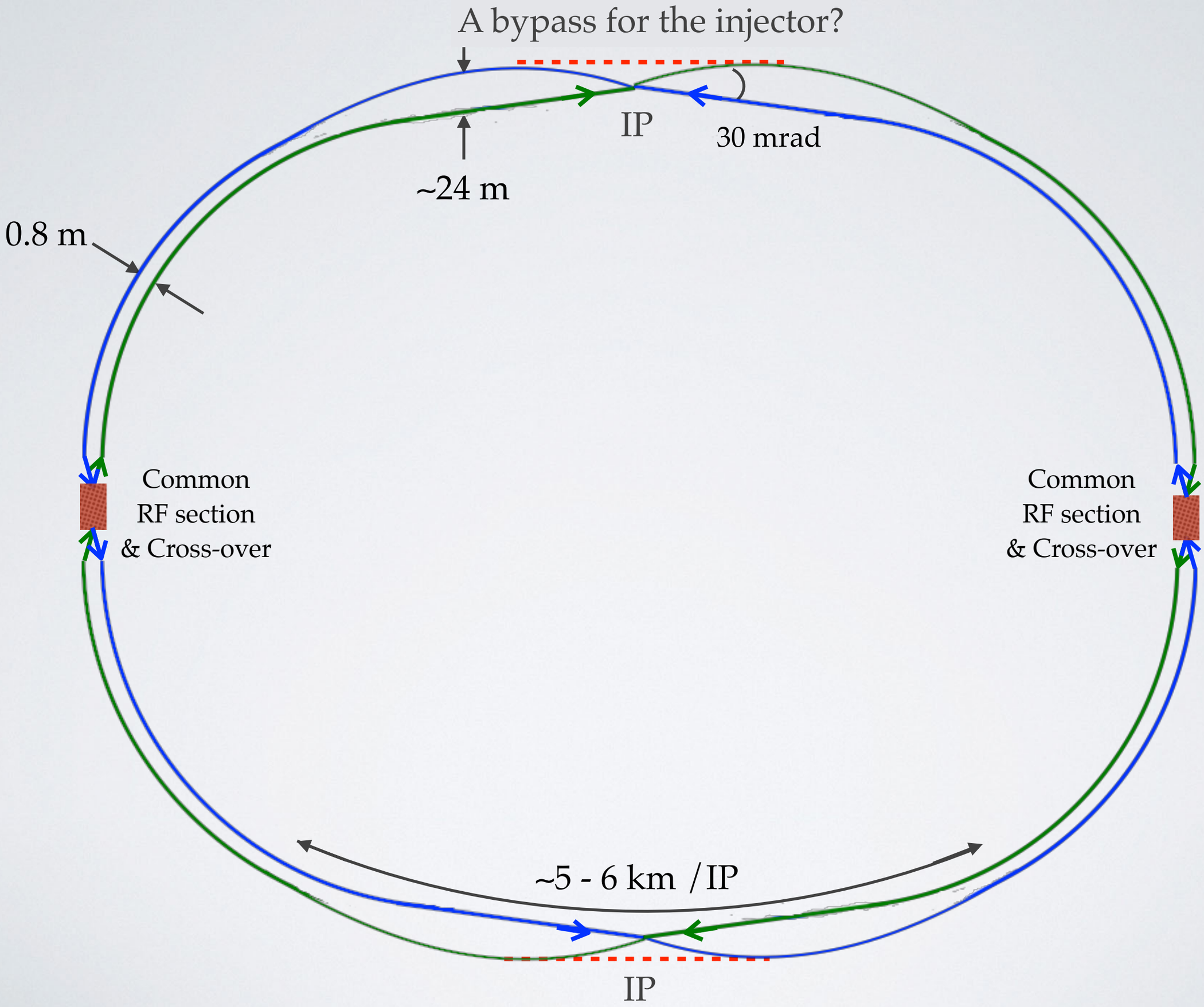


The Layout


IP
30 mrad
~24 m
0.8 m
Common
RF section
& Cross-over
Common
RF section
& Cross-over
~5 - 6 km /IP
IP

The Layout


A bypass for the injector?
IP
30 mrad
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Common
RF section
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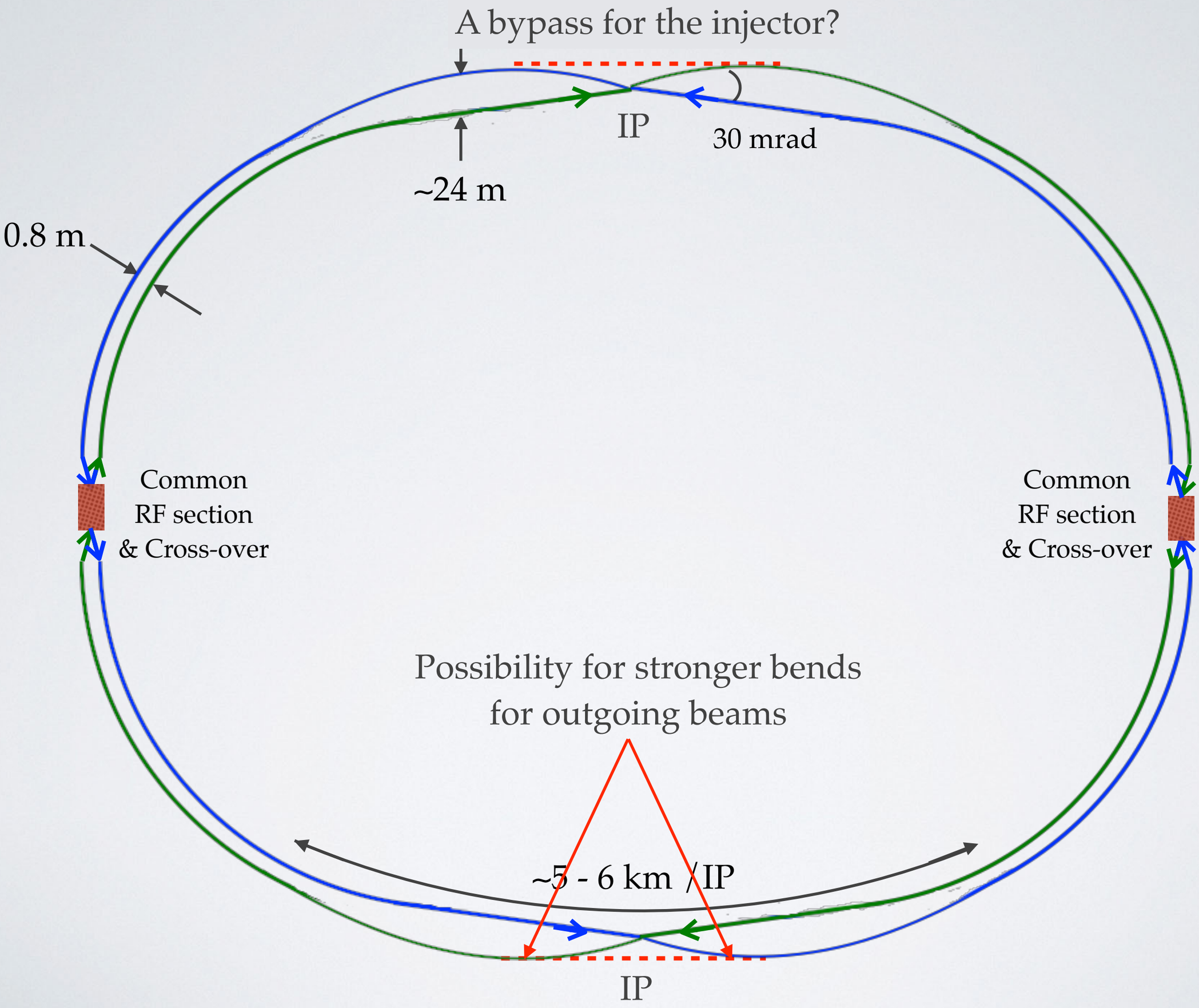
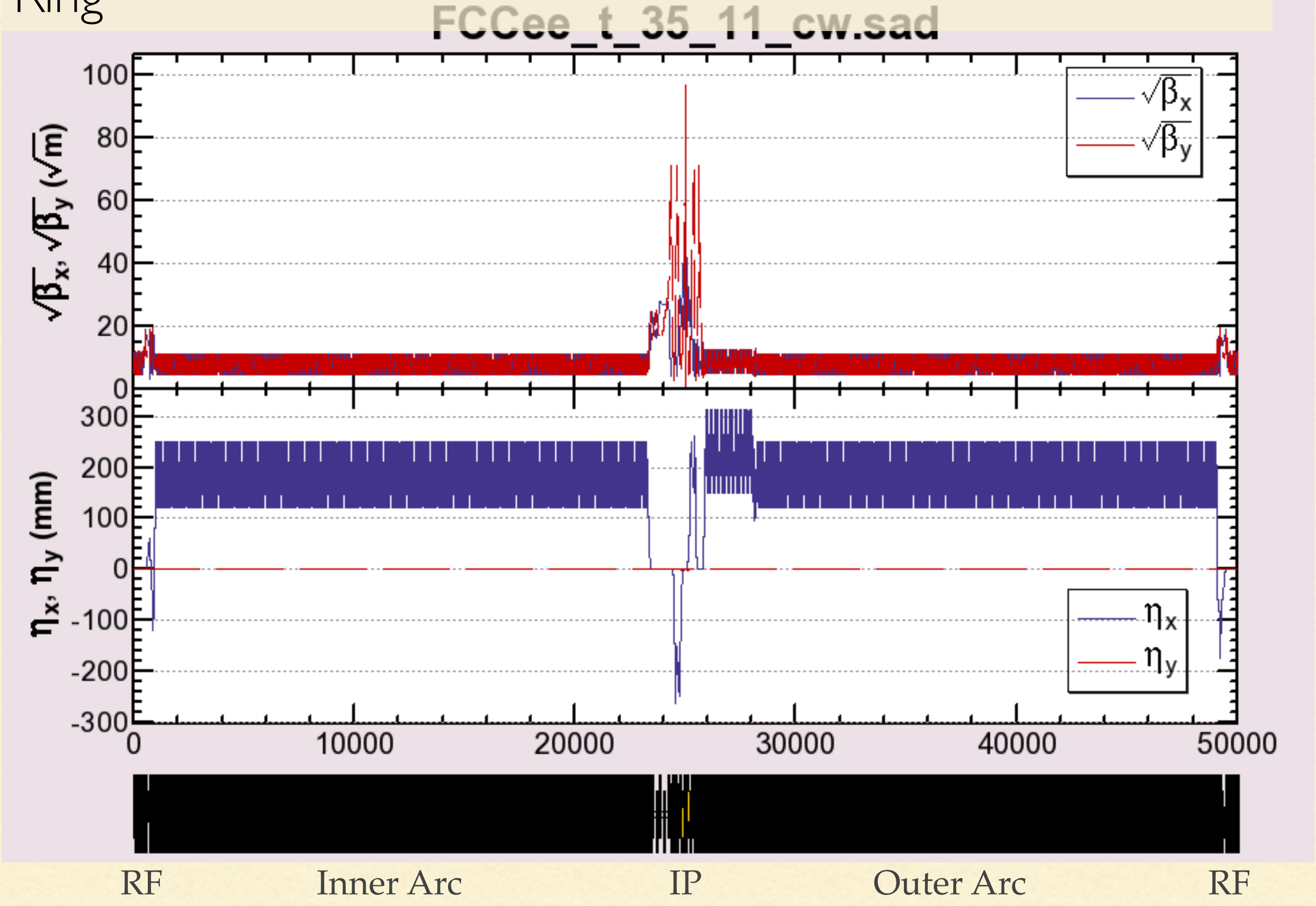
IP

The Layout


A bypass for the injector?
IP
30 mrad
~24 m
0.8 m
Common
RF section
& Cross-over
Common
RF section
& Cross-over
Possibility for stronger bends
for outgoing beams
~5 - 6 km /IP
IP

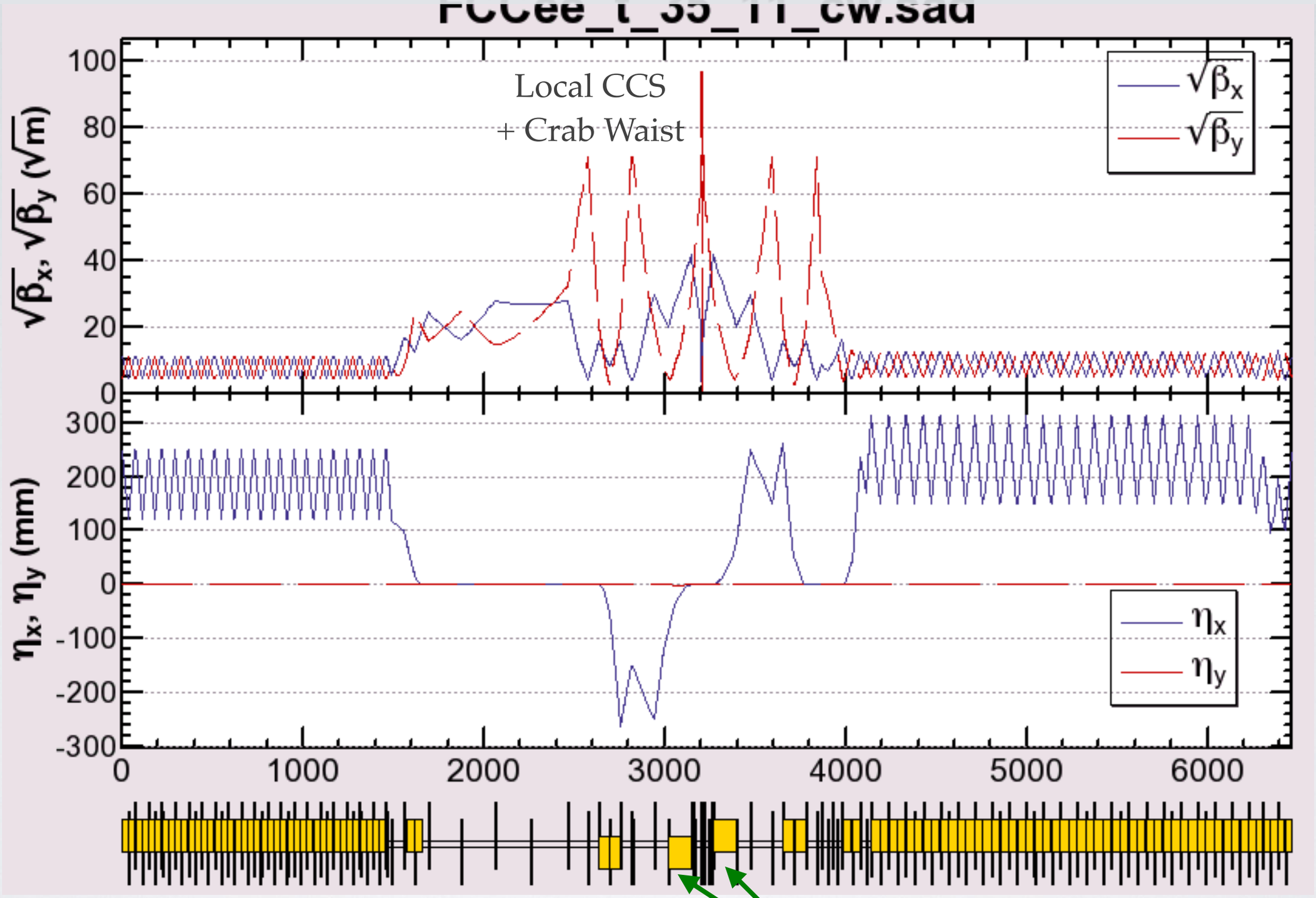
Half Ring



The geometry and the circumference have been more or less adjusted.

The SR loss and the RF voltage are reduced. U_0 = 3.1 GeV, V_c = 4.6 GV/half ring.

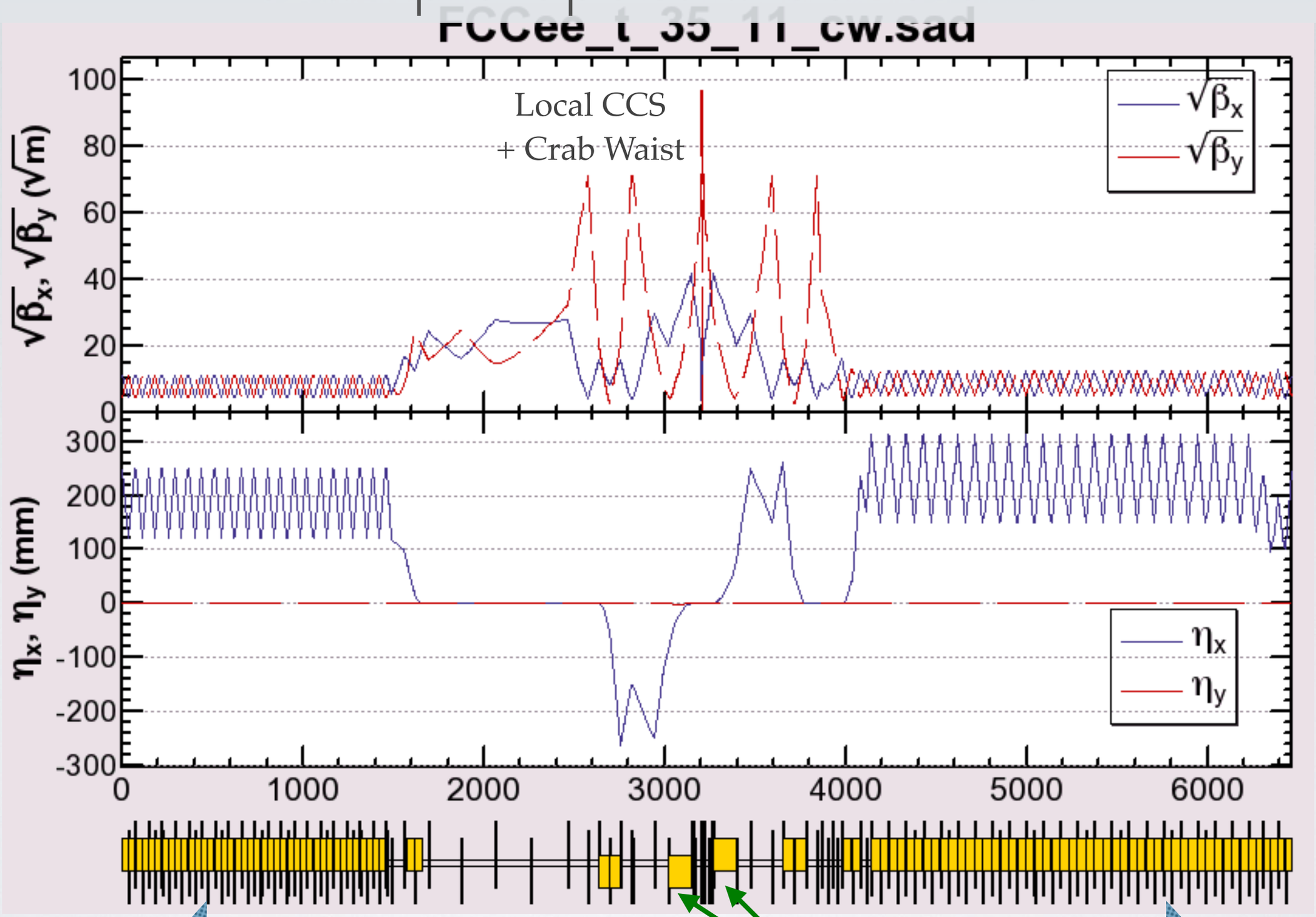
An example optics around the IR



Local CCS + 30 mad crossing
+ crab waist + solenoids

Less than 100 keV for the critical energy of photons from the dipoles near the IP.

An example optics around the IR

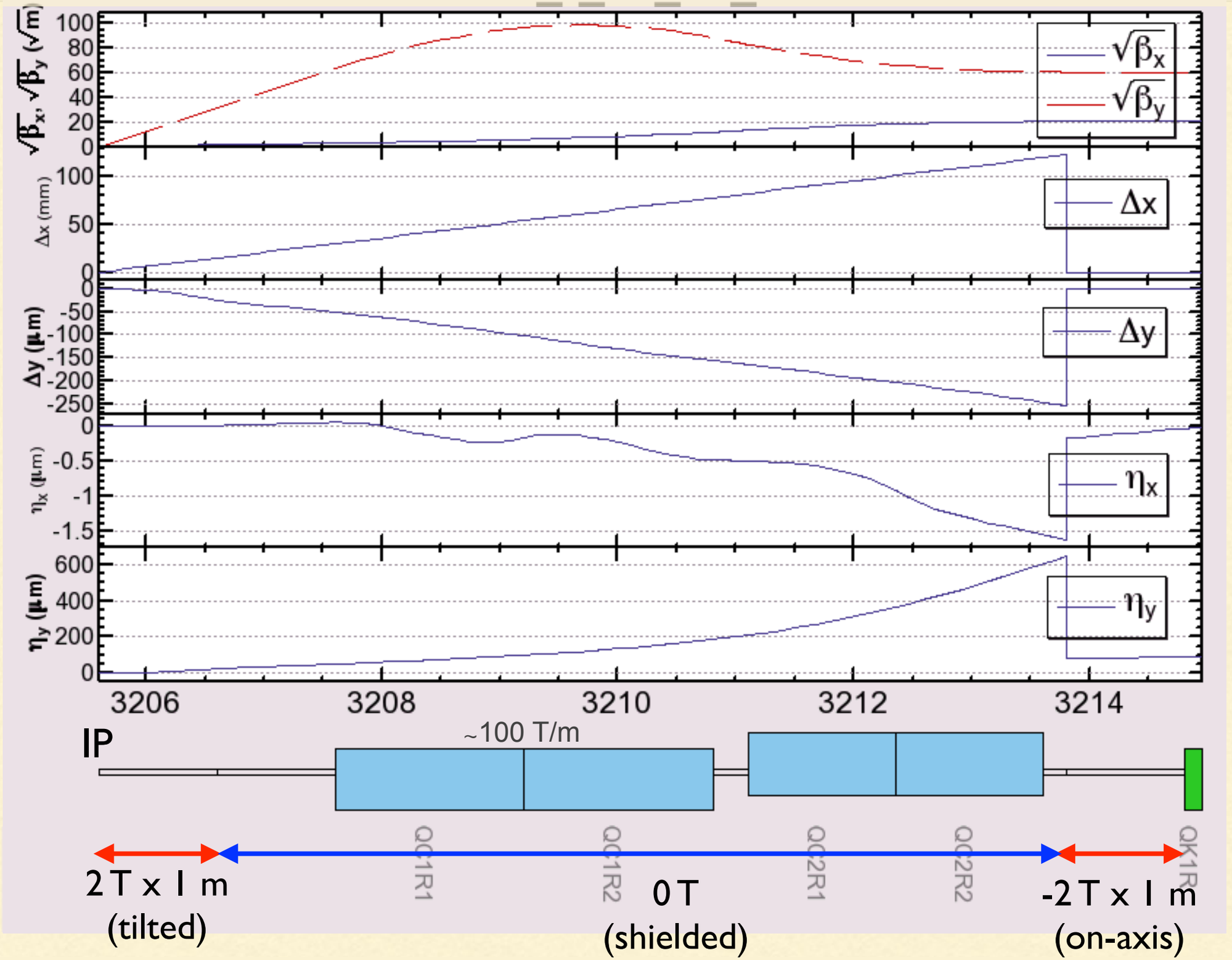


Separated tunnel, ~5 - 6 km / IP

Local CCS + 30 ma[illegible] crossing
+ crab waist + solenoids

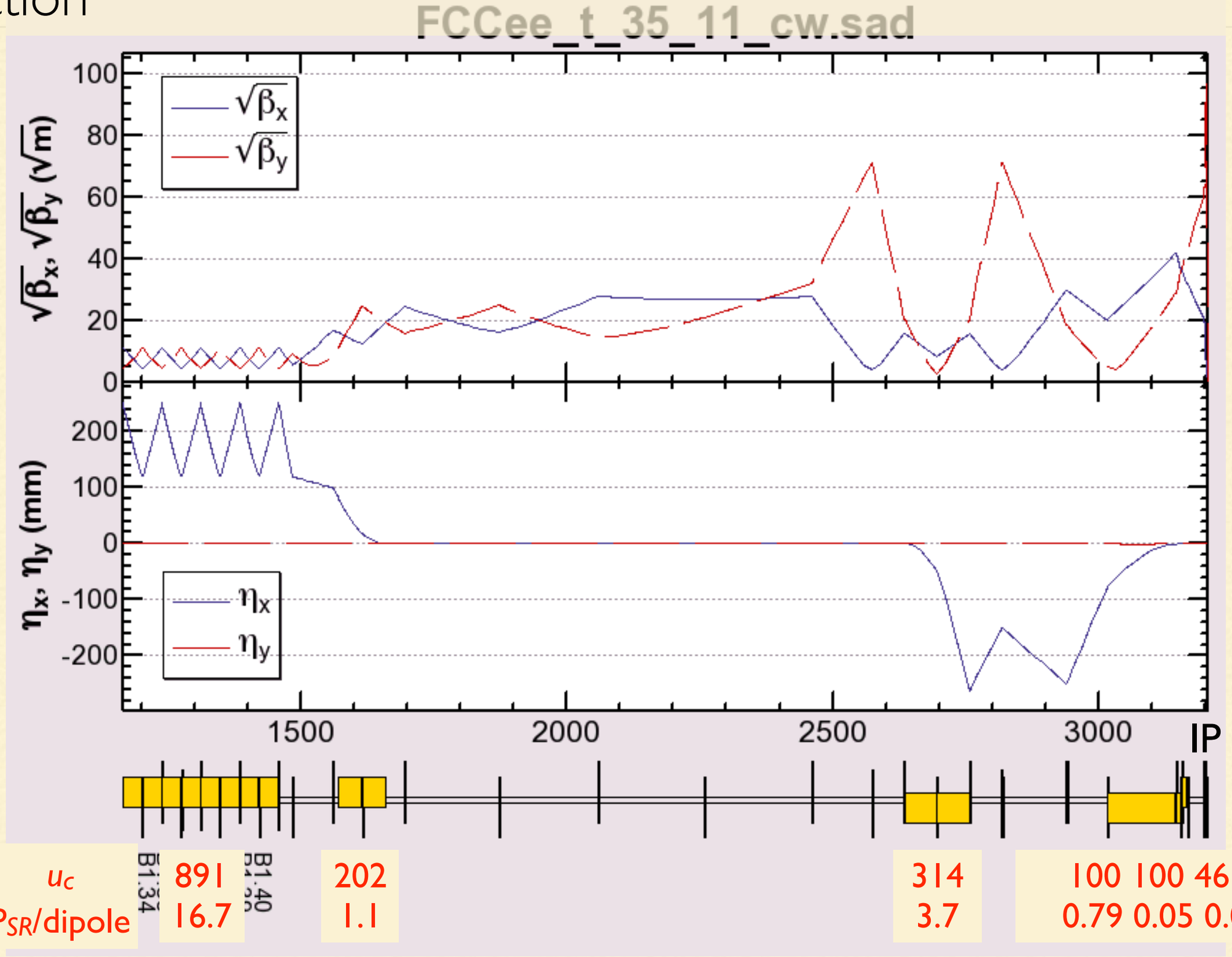
Less than 100 keV for the critical energy of photons from the dipoles near the IP.

IP Solenoid & Compensation



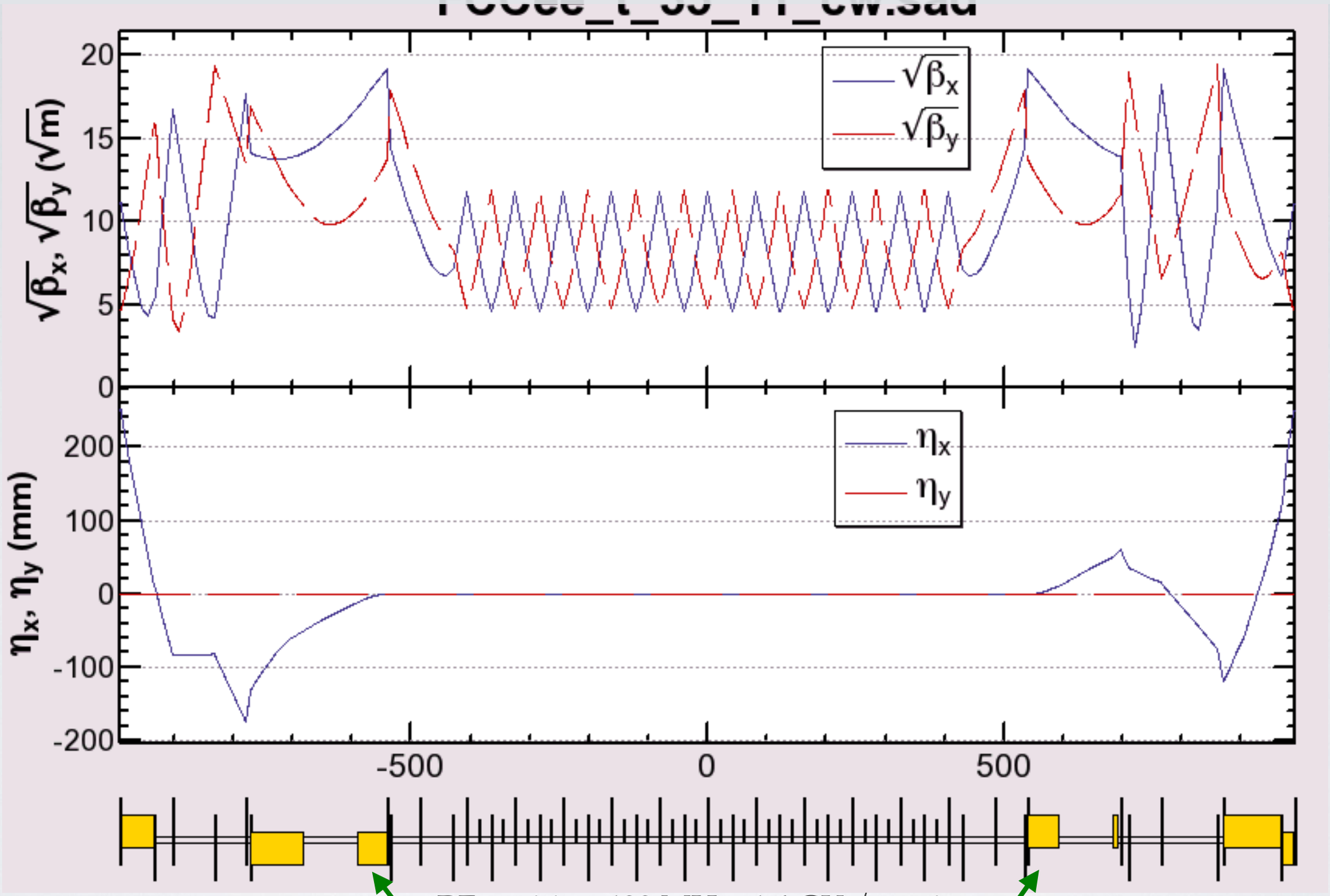
- Compensation solenoids (1) shield the final quads (2) cancel the integrated rotation.
- Residual couplings are corrected by a roll of QC2 and skew quads outside, 7 skews/side (I assume QC1 cannot roll).

IR Radiation



- The critical energy and radiation power of the dipoles are as above.

The common RF section

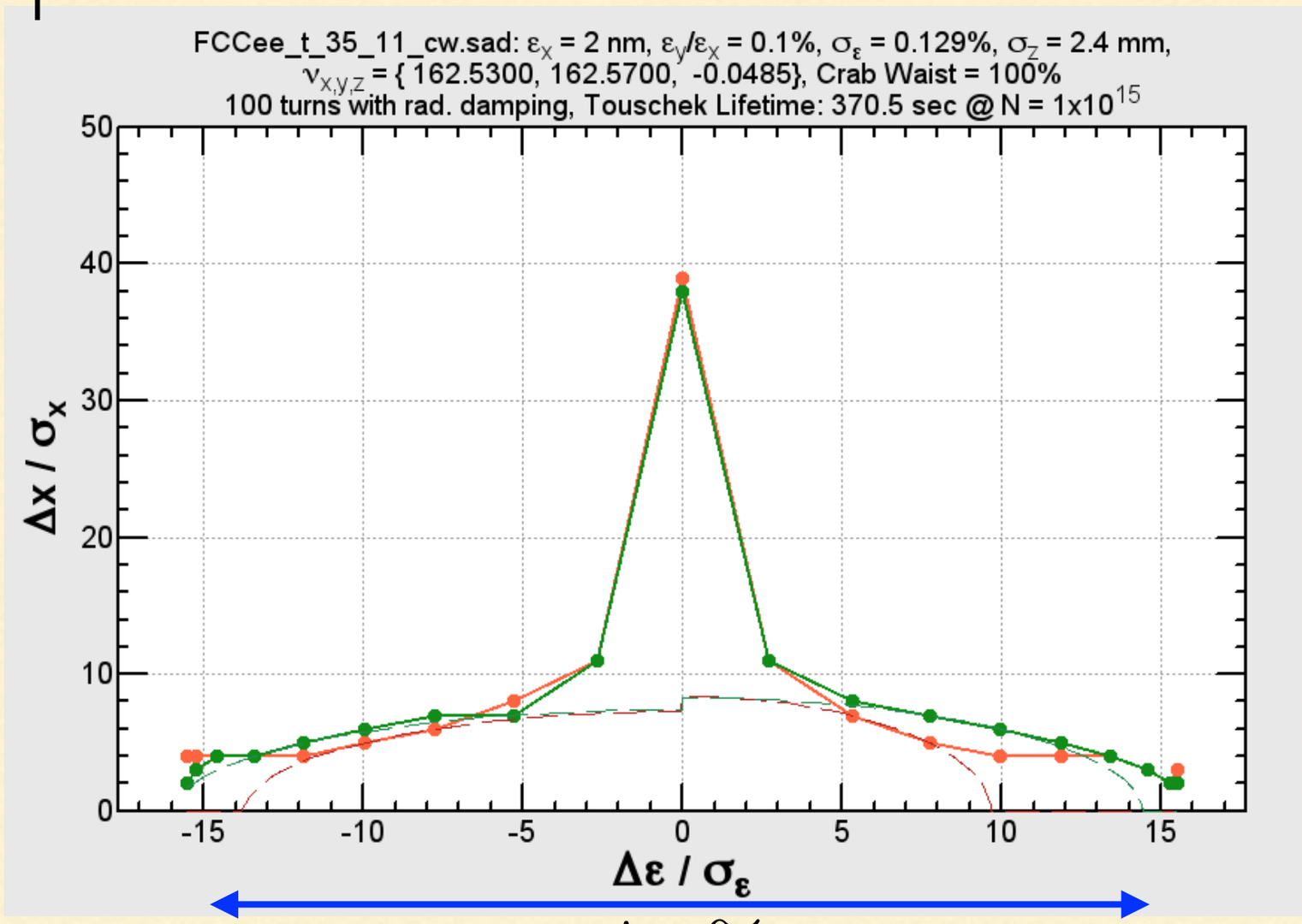


RF cavities, 400 MHz, 4.6 GV / section

Beams cross over through the RF section.

Electrostatic beam separators
150 kV, 10 cm gap, 50 m long.

Dynamic Aperture



±2%

- Momentum acceptance (dynamical) of ±2% is achieved assuming synchrotron radiation damping.
- Crab waist, solenoids, synchrotron motion, damping are included.
- Crab waist reduces the dynamic aperture, but recovered by re-optimizing the sextupoles.
- Skew sextupoles are added on some sexupoles near the IR to compensate the chromatic coupling.

Summary

- An example optics for the FCC-ee rings are presented, consisting of
  - 2 IPs/ring
  - 30 mad crossing angle.
  - Weak dipoles near the IP with $u_c < 100$ keV.
  - A local chromaticity correction system with virtual crab-waist sextupoles.
  - A solenoid/anti-solenoid configuration.
    - Separated tunnel for 5 - 6 km /IP, usable for an injector bypass.
- Two RF sections at 90/270 degrees will be the best, considering the common rf and cross-over of the beam, assuming the solution of sawtooth by tapering.
- The dynamic aperture appears to be OK, at least for tt.
- More asymmetric IR with stronger dipoles for the outgoing beam may reduce the length of separation between two beams.
- The issue of spin depolarization and generation of vertical emittance by kinks has been solved by I. Koop.