LHeC and FCC-eh IRs

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Many thanks to E. Cruz, M. Hofer, M. Klein, R. Martin, B. Parker and F. Zimmermann

Target parameters

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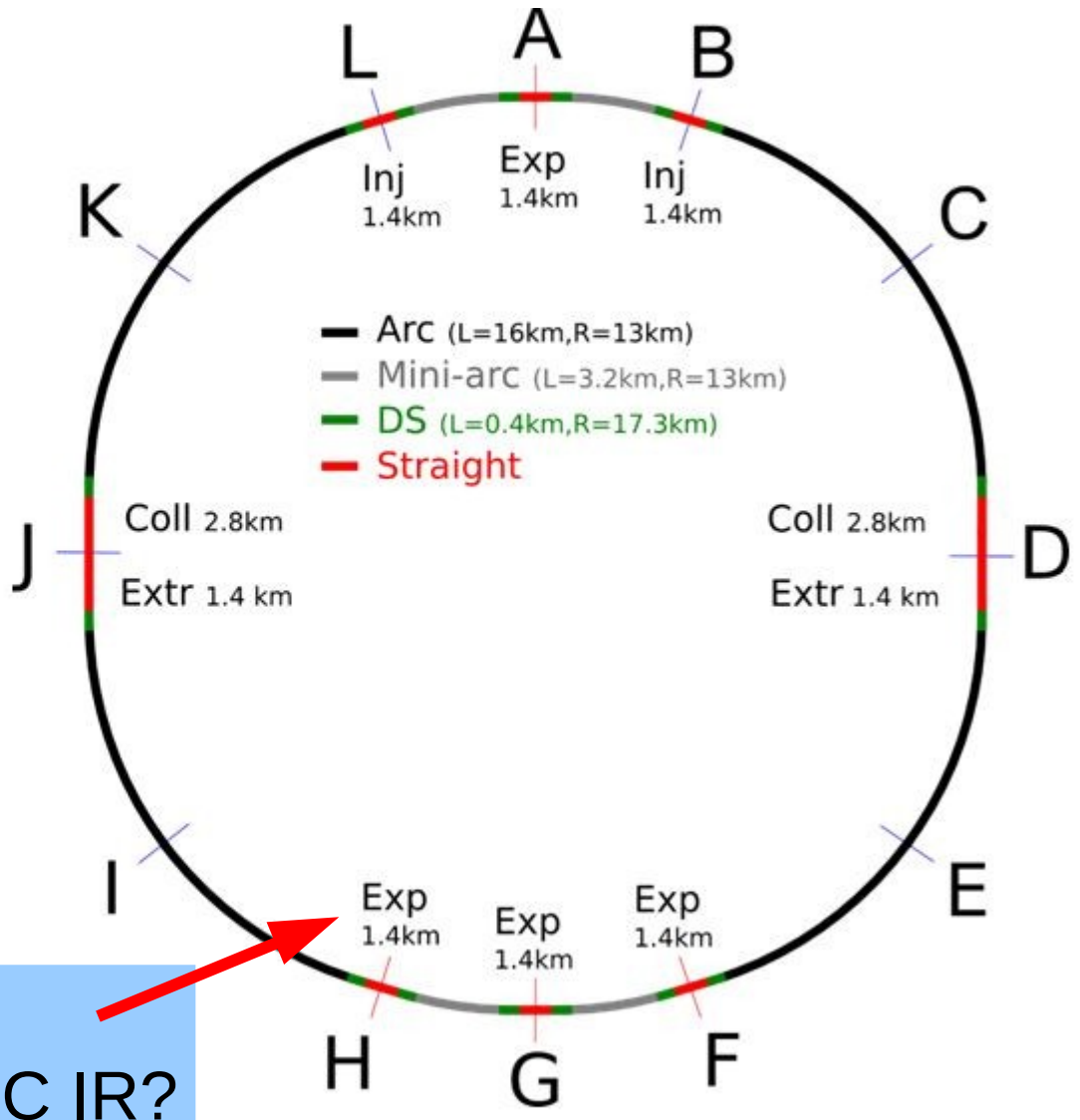
parameter [unit]	LHeC CDR	ep at HL-LHC	ep at HE-LHC	FCC-he
E_p [TeV]	7	7	12.5	50
E_e [GeV]	60	60	60	60
$\sqrt{s}$ [TeV]	1.3	1.3	1.7	3.5
bunch spacing [ns]	25	25	25	25
protons per bunch [10^{11}]	1.7	2.2	2.5	1
$\gamma\epsilon_p$ [μm]	3.7	2	2.5	2.2
electrons per bunch [10^9]	1	2.3	3.0	3.0
electron current [mA]	6.4	15	20	20
IP beta function β_p^* [cm]	10	7	10	15
hourglass factor H_{geom}	0.9	0.9	0.9	0.9
pinch factor H_{b-b}	1.3	1.3	1.3	1.3
proton filling H_{coll}	0.8	0.8	0.8	0.8
luminosity [10^{33}cm^{-2}s^{-1}]	1	8	12	15

We have

We do not have

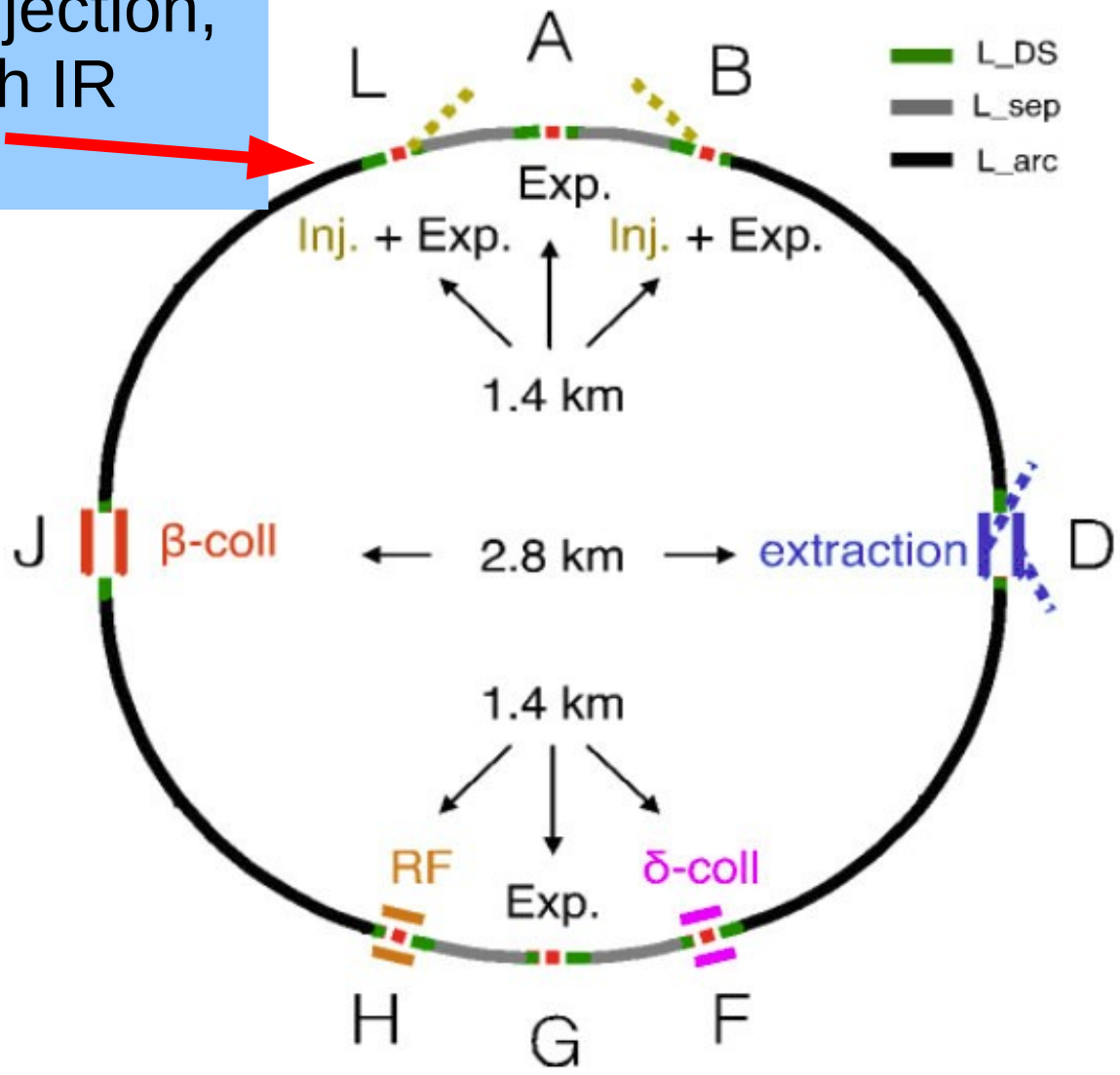
FCC previous layout



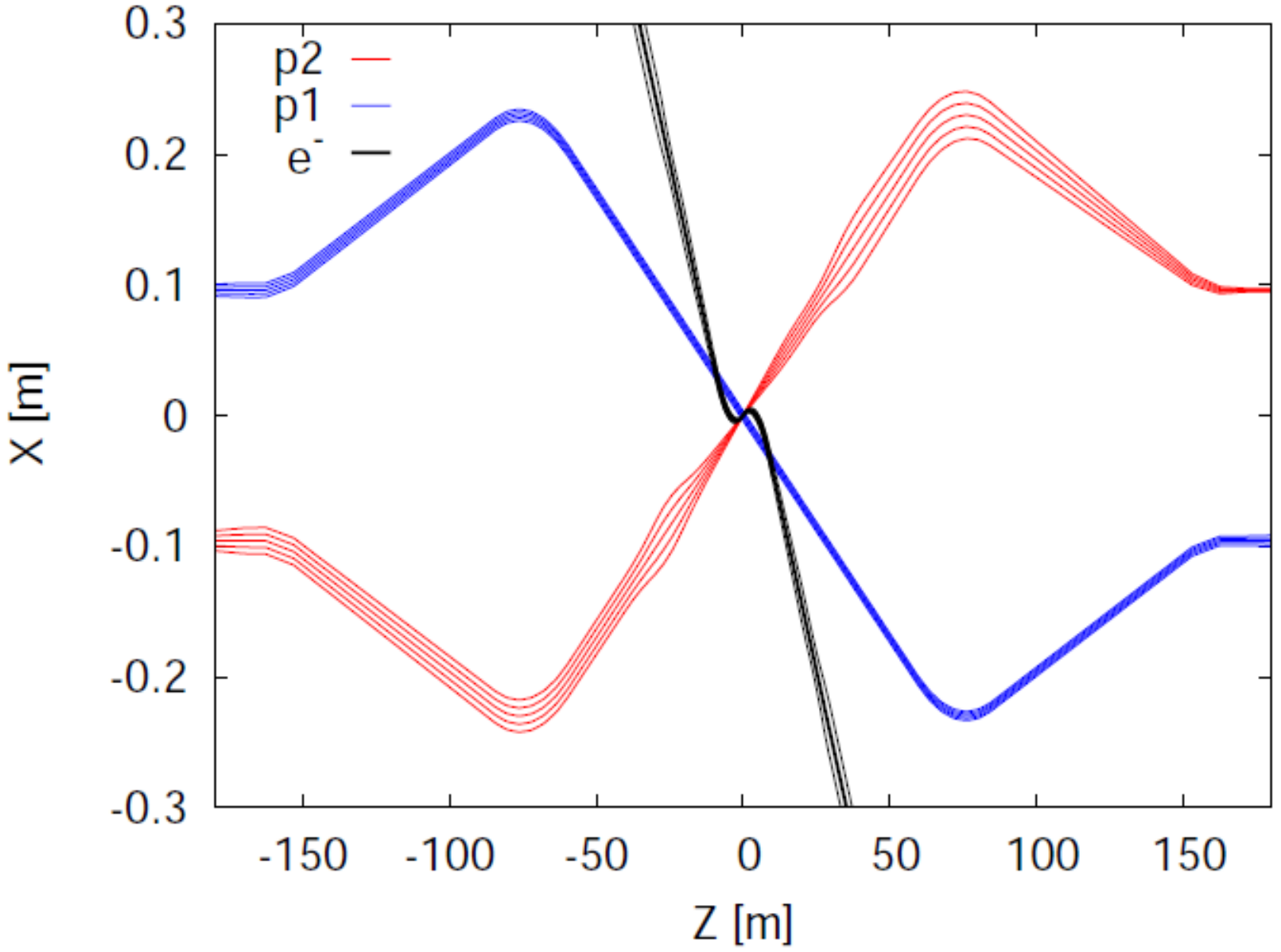
1.4 km available for LHeC IR?

FCC new layout

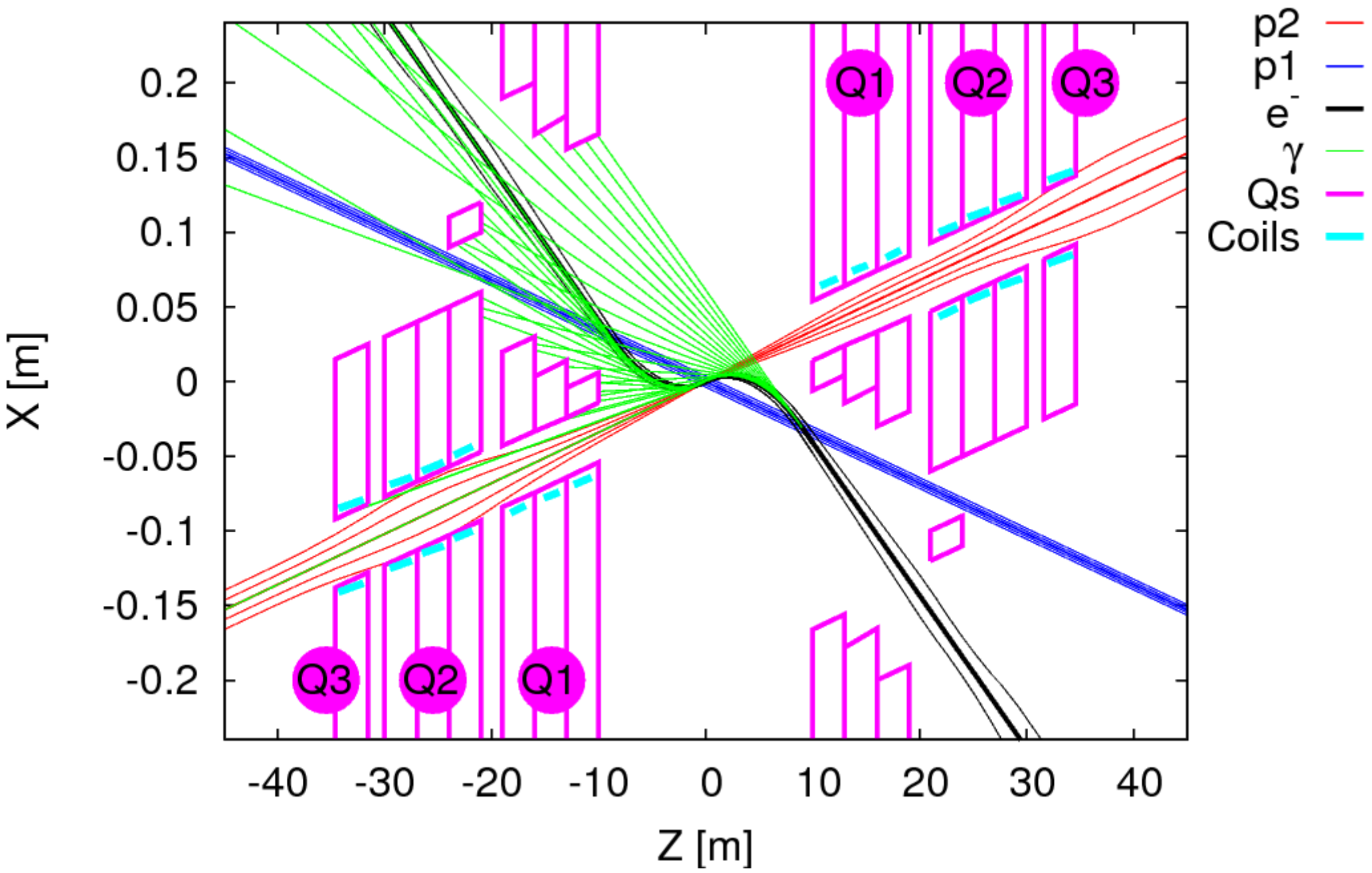
1.4 km to be shared with injection, so only 700m for FCC-eh IR



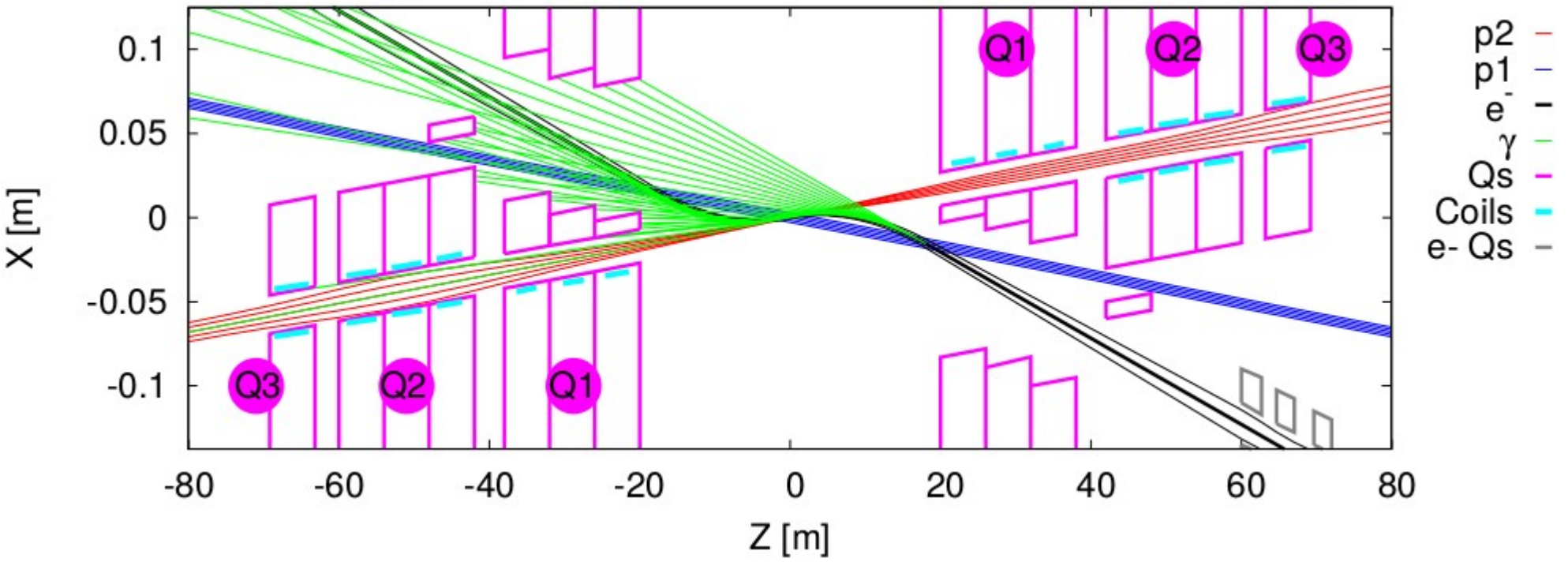
LHeC IR layout



Zooming around the IP

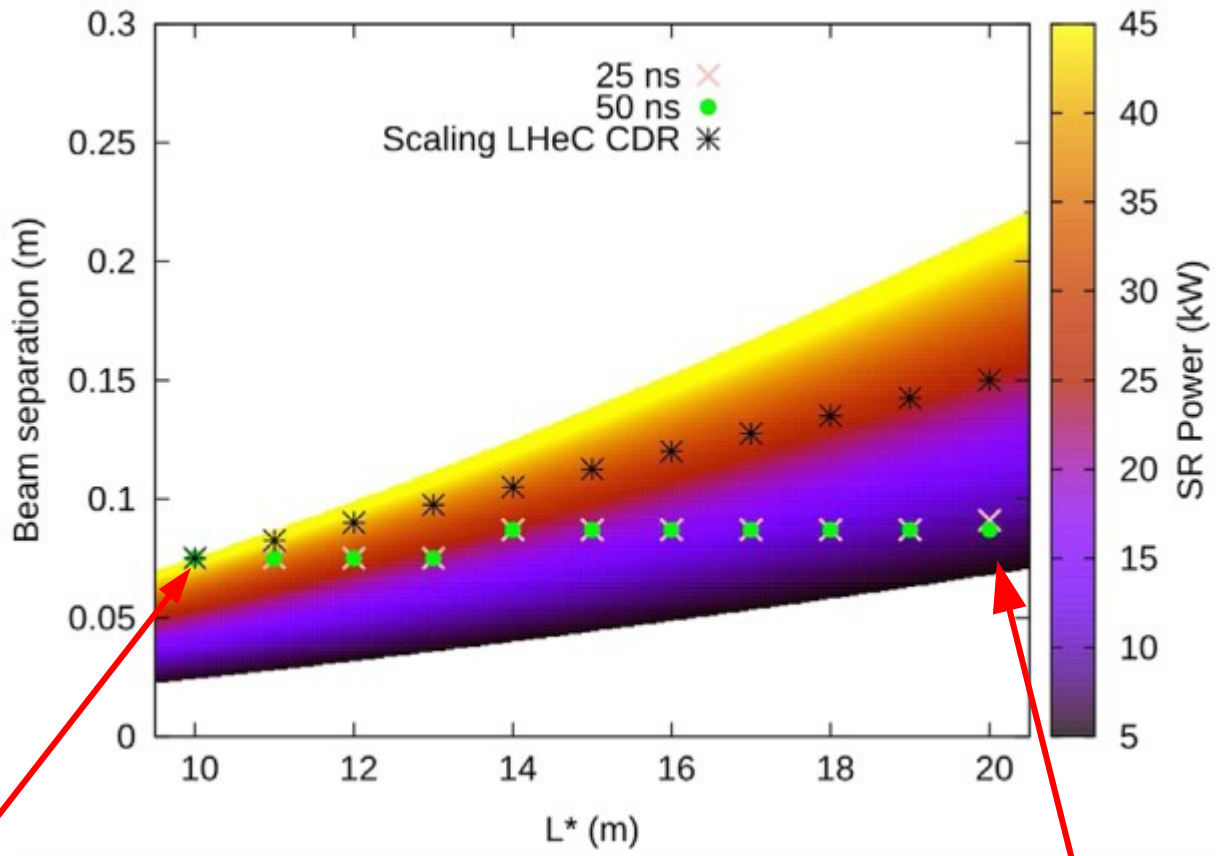


FCC-eh possible IR



Scaling LHeC design leads to beta*=20cm, L*=20m, IR total length 1080m.
(Goal is: beta=15cm in 700m)*

Synchrotron radiation in LHeC and FCC

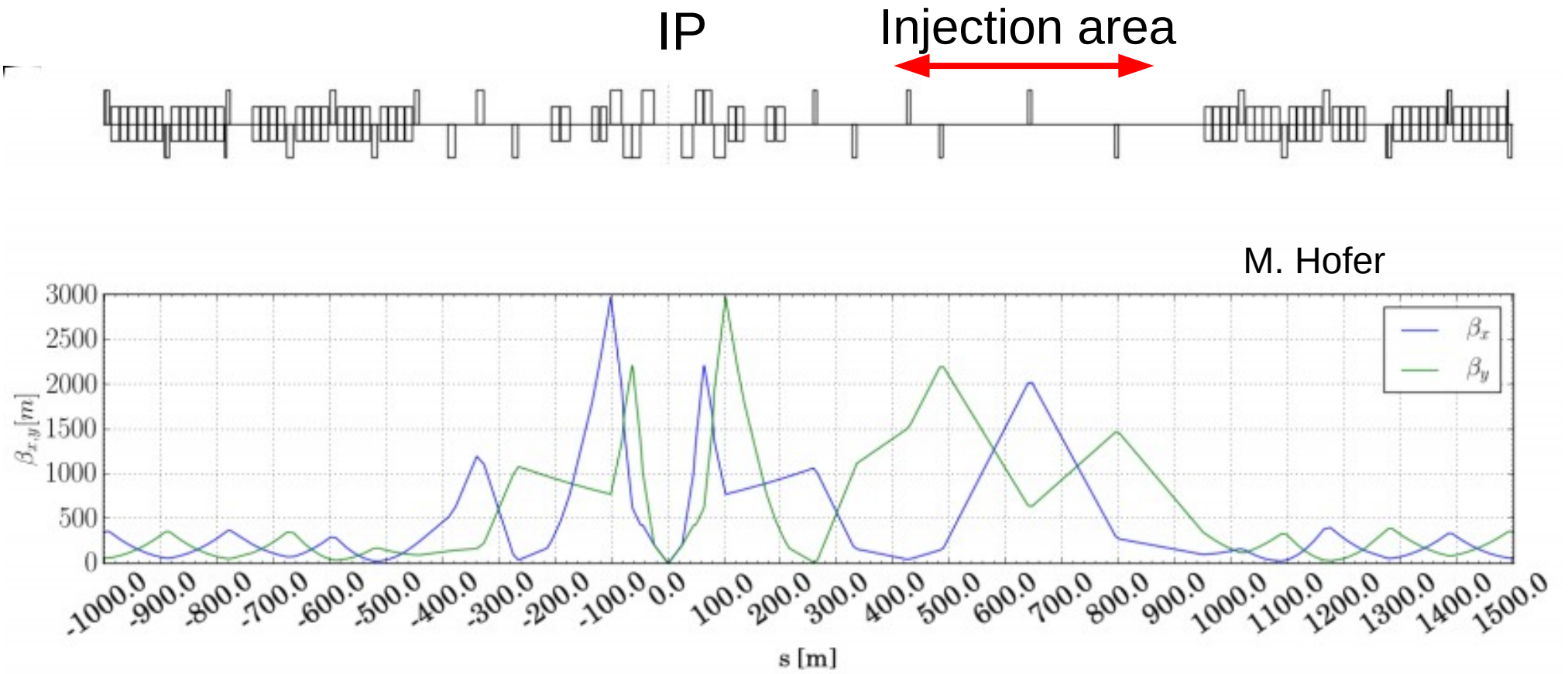


E. Cruz et al, Design of the LHeC IR, Phys. Rev. Accel & Beams 18, 1111001

LHeC 45 kw

FCC-eh ~10kw, assuming same beam separation as in LHeC

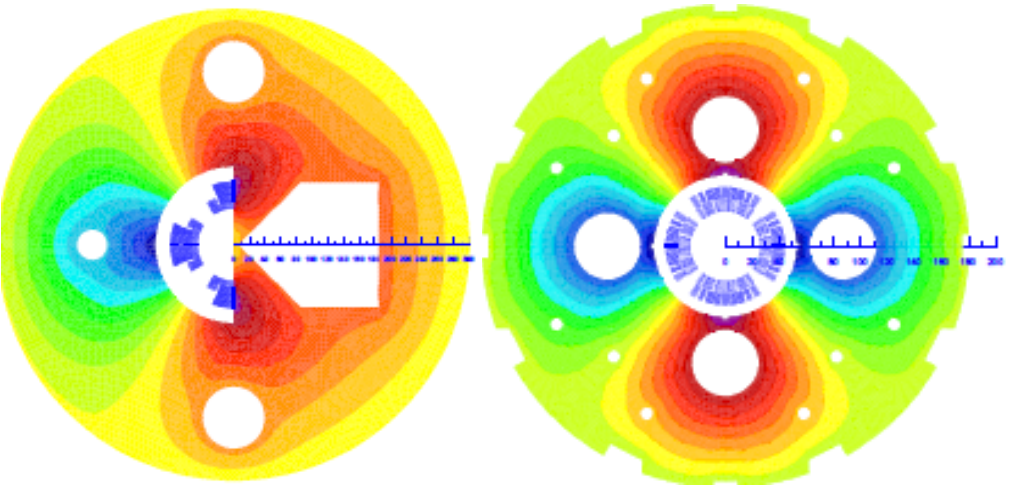
Current FCC-hh optics in Point L



So far, beta*=3m has been comfortably reached in point L.
Reaching 0.15m in 700m will require clever designs.

Linac-Ring IR magnets

-High-gradient SC IR quadrupoles based on Nb3Sn for colliding proton beam with common low-field **exit hole for electron beam and non-colliding proton beam**



Nb3Sn (HFM46): 5700 A, 175 T/m, 4.7 T at 82% on LL (4 layers), 4.2 K

Nb3Sn (HFM46): 8600 A, 311 T/m, at 83% LL, 4.2 K

-Detector integrated dipole: 0.3 T over +/- 9 m

46 mm (half) ap., 63 mm beam sep.

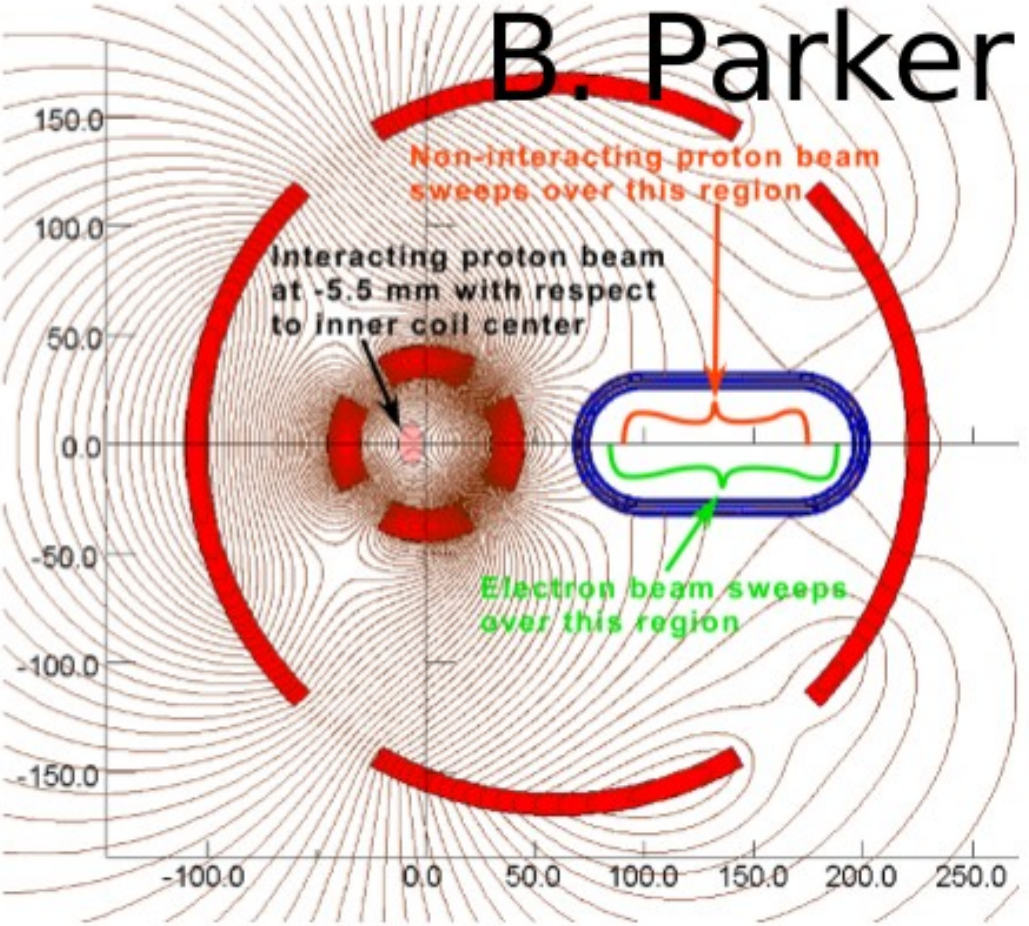
0.5 T, 25 T/m

23 mm ap.. 87 mm beam sep.

0.09 T, 9 T/m

New quadrupole design

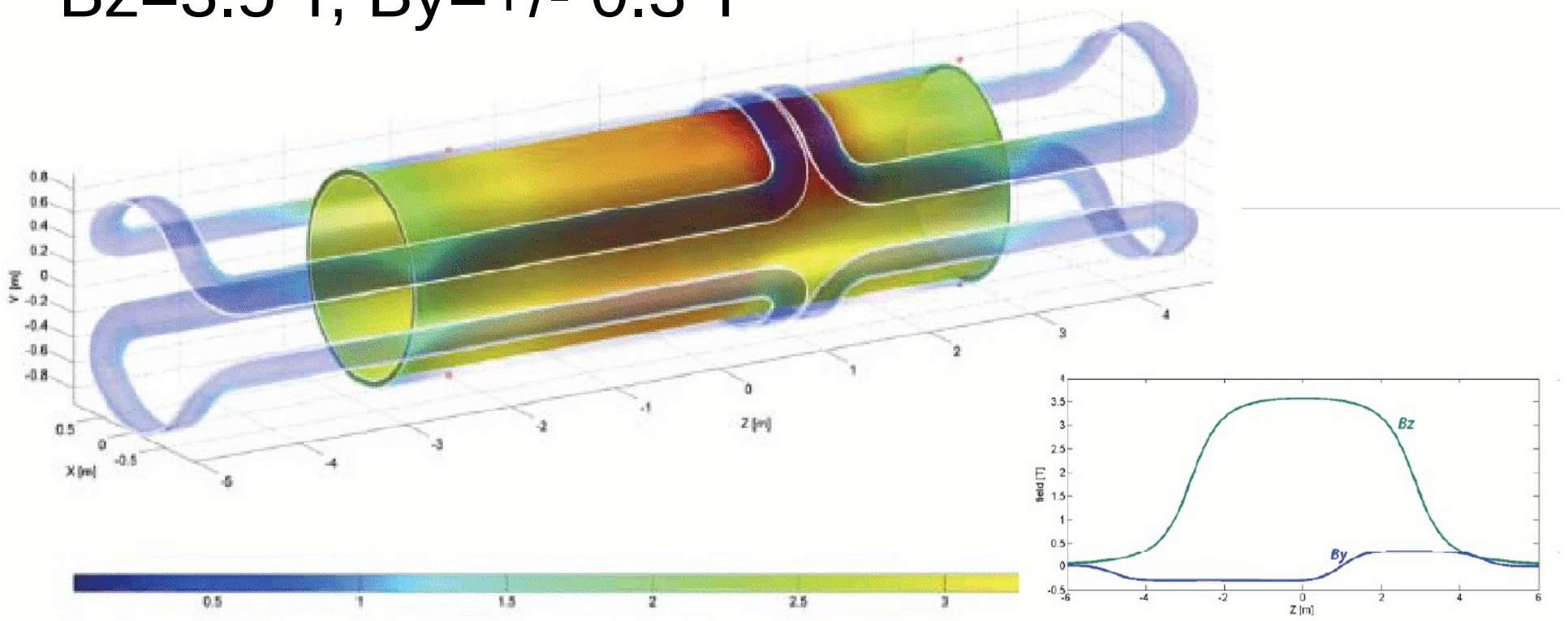
B. Parker



Very promissing! High field quality, standard apertures. Let’s see next talk!

IR magnets

Bz=3.5 T, By=+/- 0.3 T



Stolen from A. Polini, DIS12

Conclusions and outlook

- LHeC has largest challenge in the SR
- FCC-eh looks easier in terms of SR,
- However optics design is now challenged by short IR
- New magnet designs from B. Parker seem to be the way to go
- Plan:
  - Implement B. Parker magnet designs in MADX
  - Assess the feasibility of FCC-eh IR optics