HELinac to Booster Transfer

Update 05/12/2024

FCCee Injection Design

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Line geometry & beam parameters

Beam transport approx. 4.7 km long, simultaneous horizontal and vertical bending, and tight bend (R=300m) of 80 deg -> great care needed to preserve beam parameters!

Table 17: Summary of Sector Parameters.

Sector	Bunch len. (mm)	RMS dp/p (10^{-3})	$\epsilon_{x,N}$ (µm)	$\epsilon_{y,N}$ (µm)
(...)				
HE Linac	1	7.5	16	1.6
E. Compressor	4	0.9	16	1.6
Transfer	-	-	-	-
Booster Inj.	4	1	20	2
(...)				

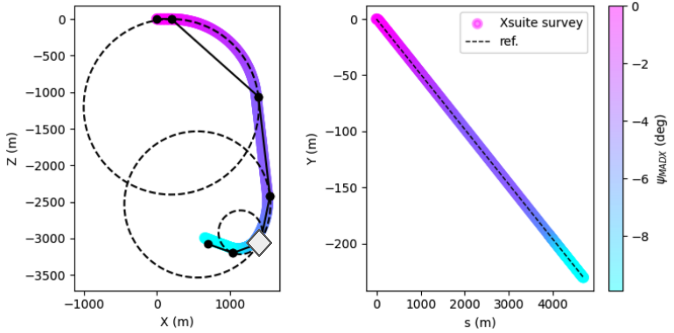

Figure 23: Xsuite survey output and reference trajectory provided by Civil Engineering. The colour bar shows the local roll angle ψ_{MADX}, which is necessary to maintain a constant vertical slope in the global frame.

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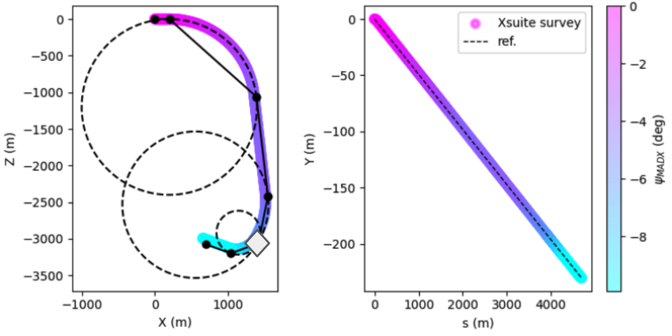

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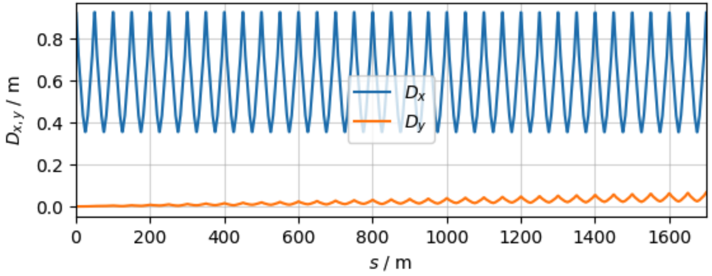
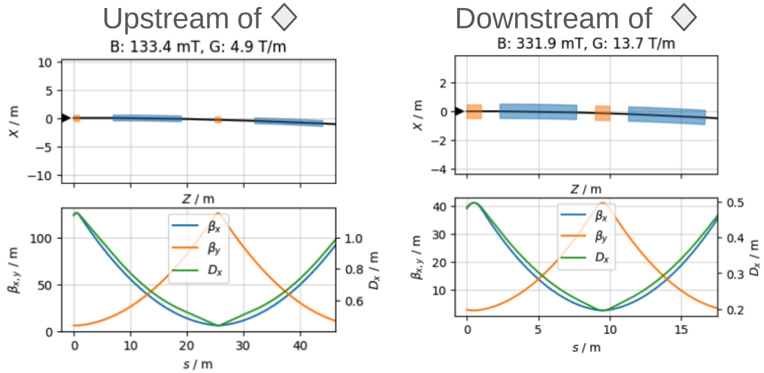
H-bends have increasing tilt to keep global vertical slope (math here)





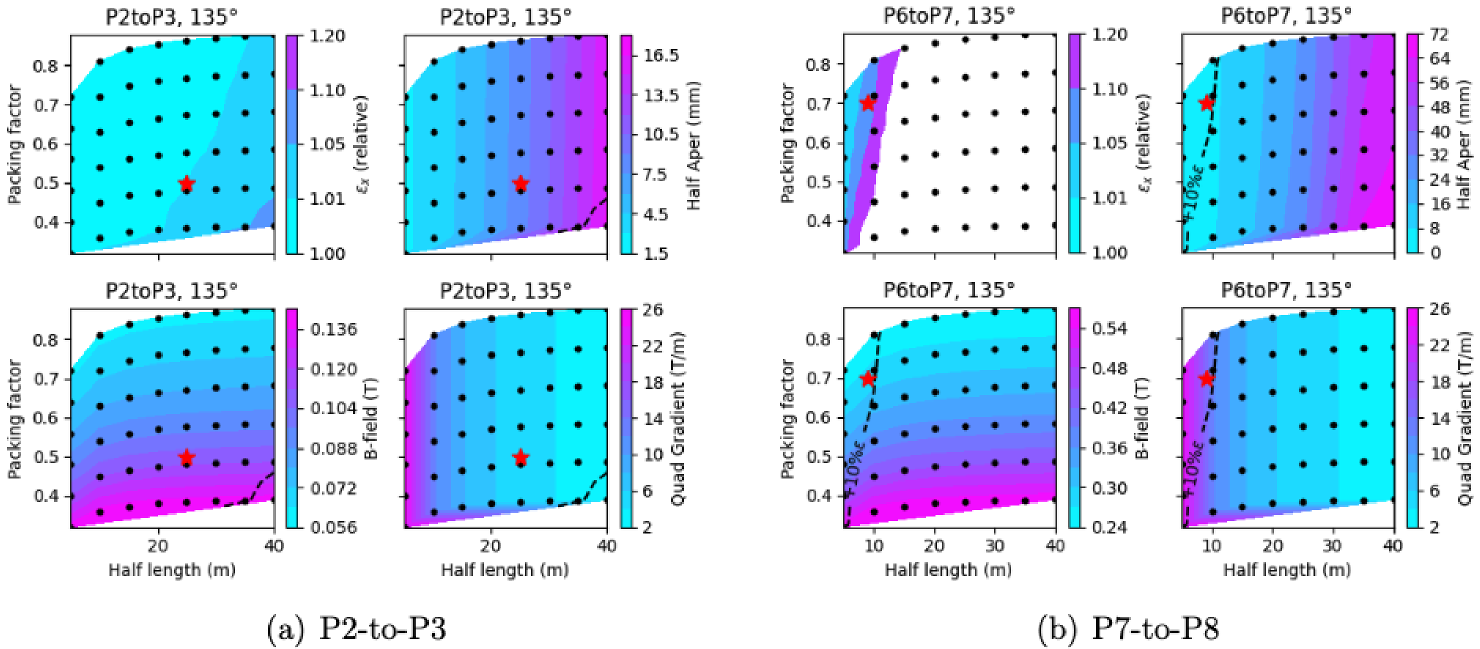
(a) Long FODO

(b) Short FODO

Conclusion & Next steps

- Cannot heavily rely on ring’s “equilibrium” parameters -> **Important to include impact of transfer line on “beam parameters” budget**
- Dispersions up to 1.2 m along the line -> **maximum dp/p jitter +-3e-3=+-3.6mm to avoid aperture limitations** (+-15 mm aper).
- With current design, **bunch length and dpp-spread blow-up below 5%**.
- Transport feasible, but **further work needed** beyond FSR:
    - Matching sections between HE-LINAC, different sectors and booster.
    - Impact of errors on beam quality.
    - Non-FODO cells to alleviate constraints from R=300m bending sector.

Extra material



(a) P2-to-P3 (b) P7-to-P8

Figure 24: Horizontal emittance blow-up, bending field, quadrupole gradient and aperture as a function of cell half length and dipole fill factor.