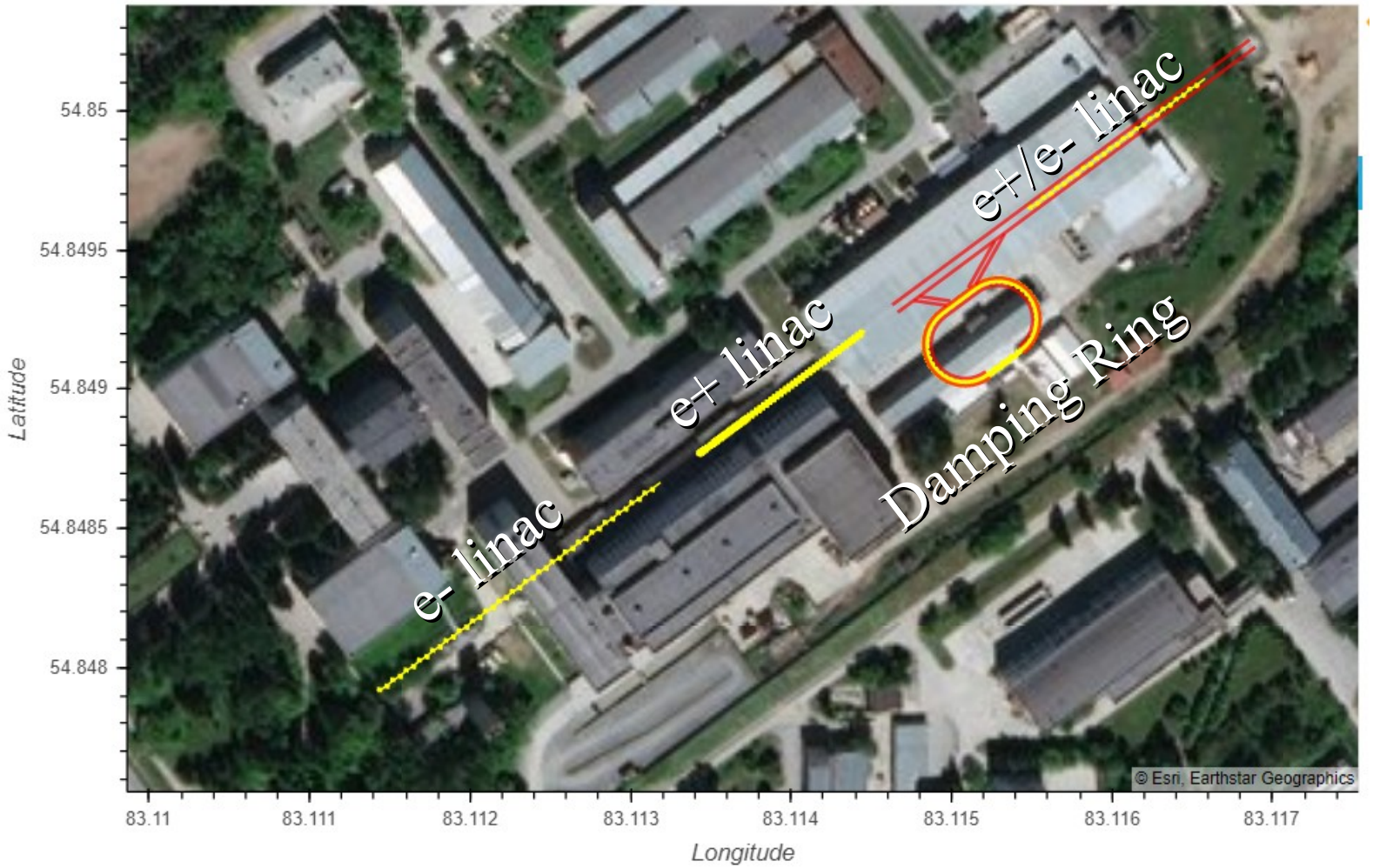
Status of injection facility for Novosibirsk SCT-Factory

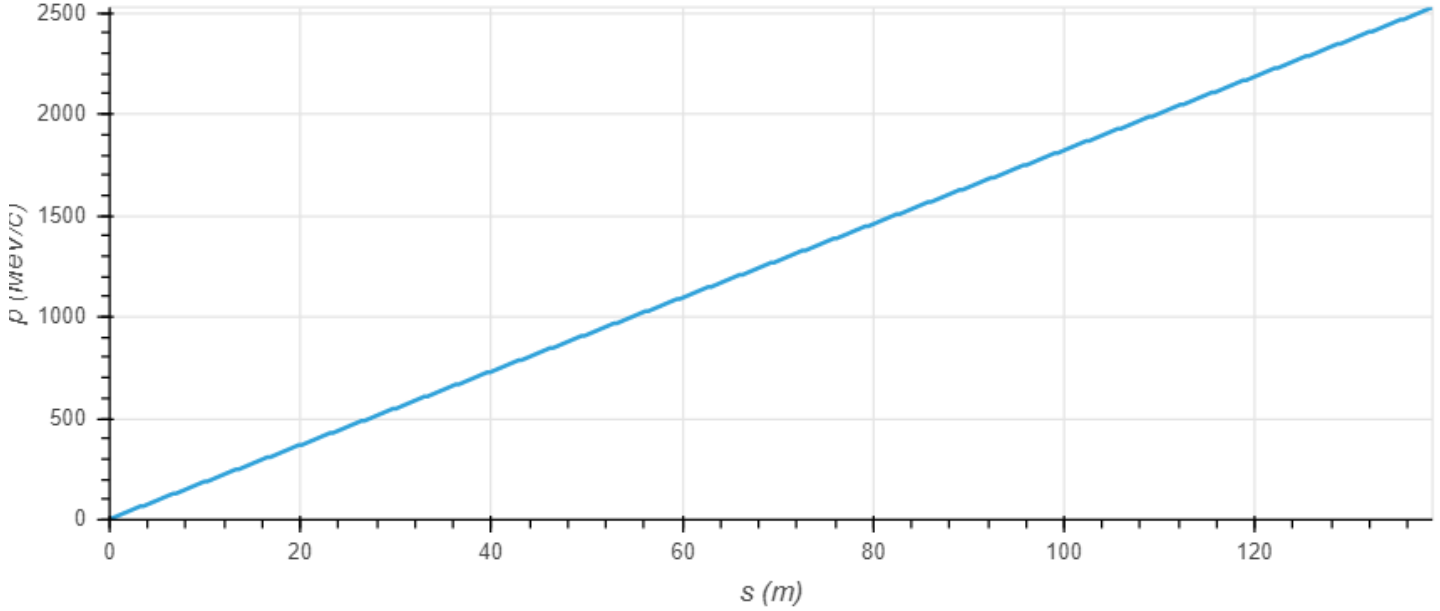
Alexey Petrenko, BINP

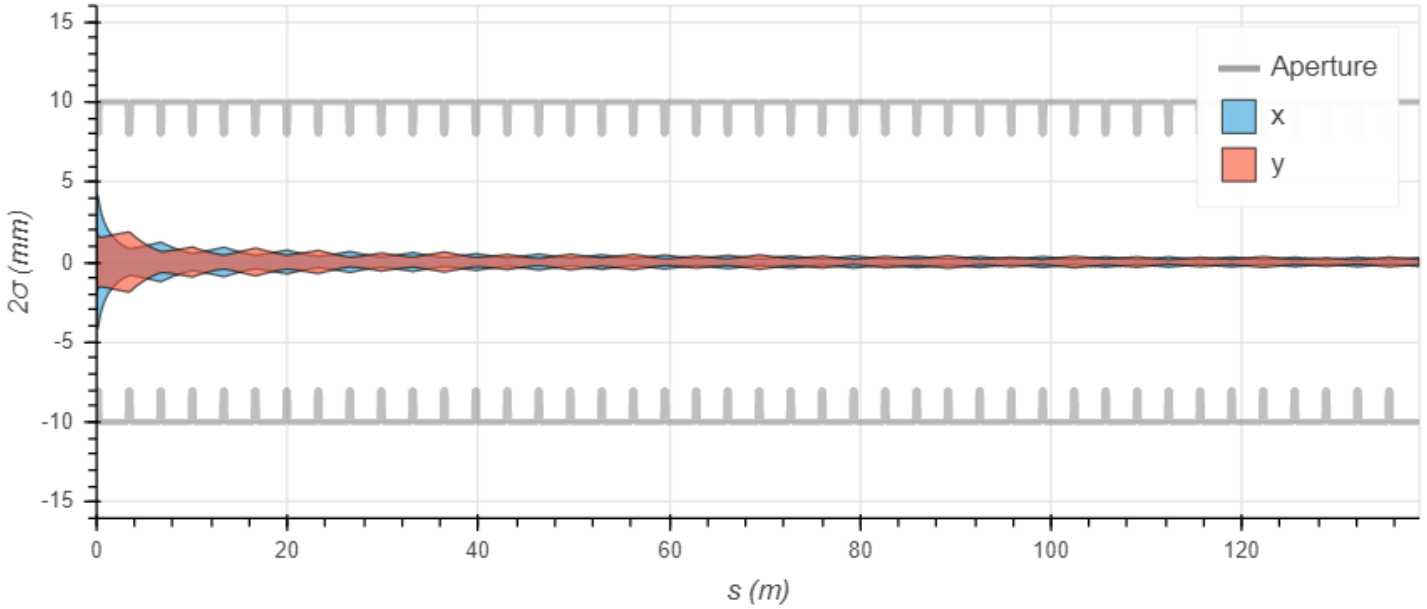
2019 Joint Workshop on Future charm-tau Factory, Sep. 26, 2019, Moscow.



http://www.inp.nsk.su/~petrenko/c-tau/Injector/GeoViews.html

2.5 GeV electron linac



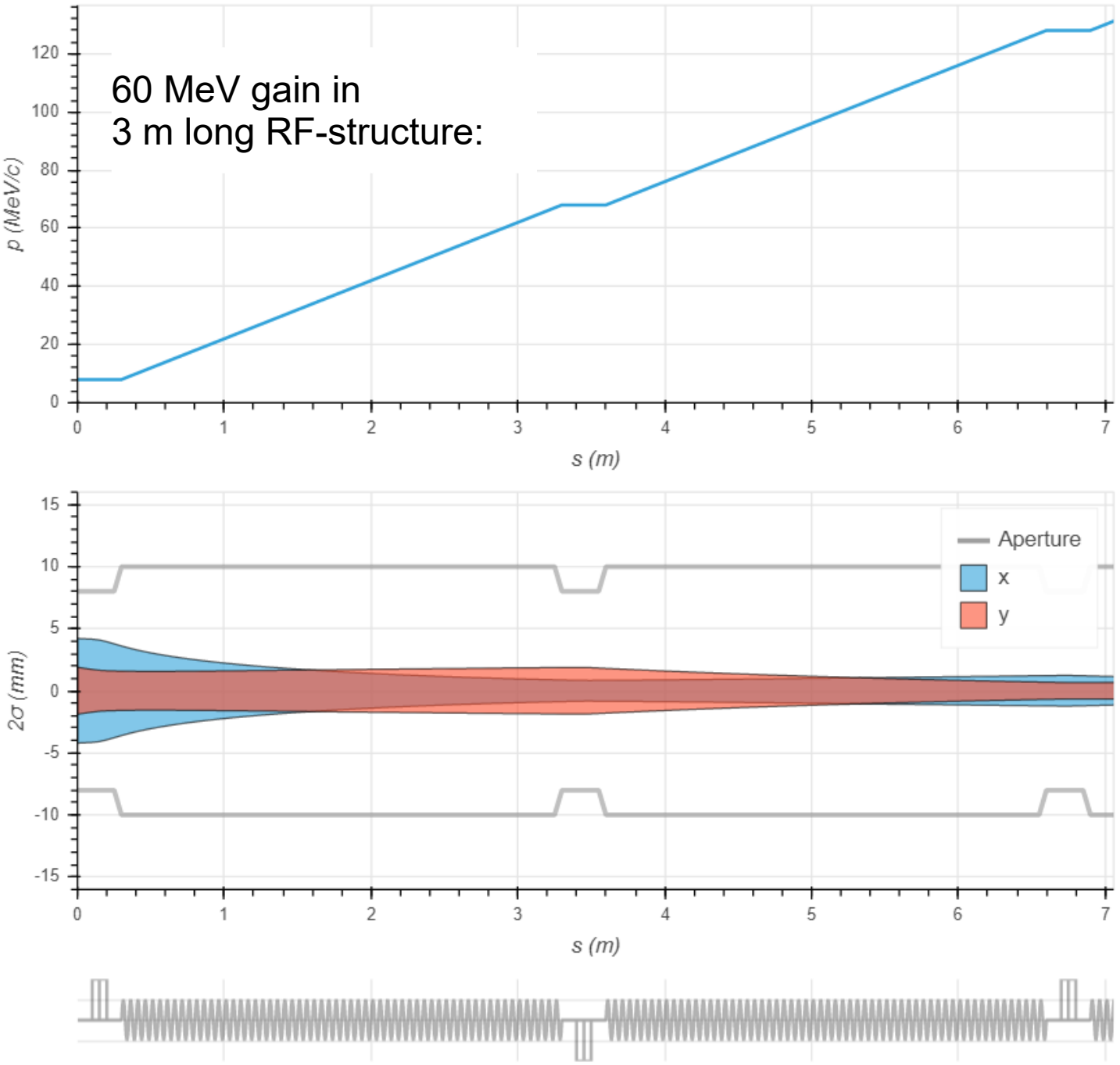


e-injector:
8 MeV,
9 mm·mrad

All calculations are performed in Elegant.

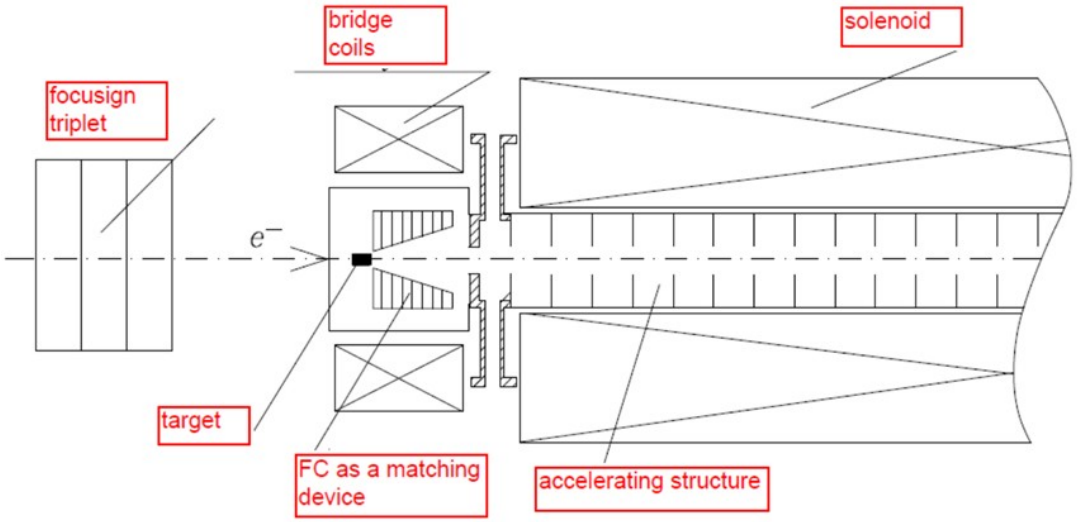
http://www.inp.nsk.su/~petrenko/c-tau/Injector/e-linac/FODO/Twiss.html

2.5 GeV electron linac



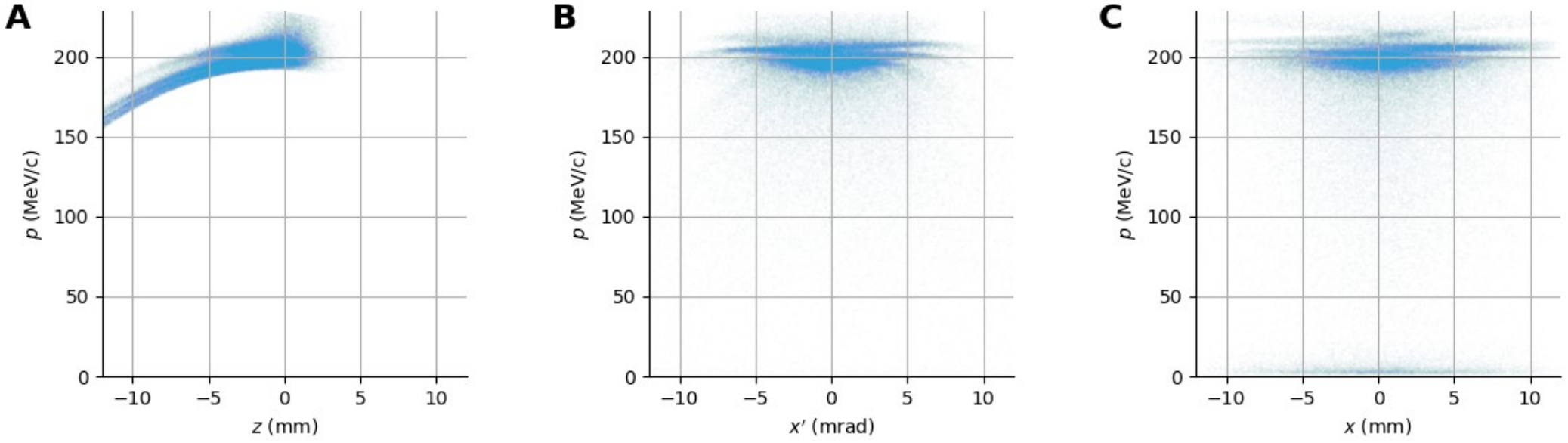
e-injector:
8 MeV,
9 mm·mrad

Positron production system



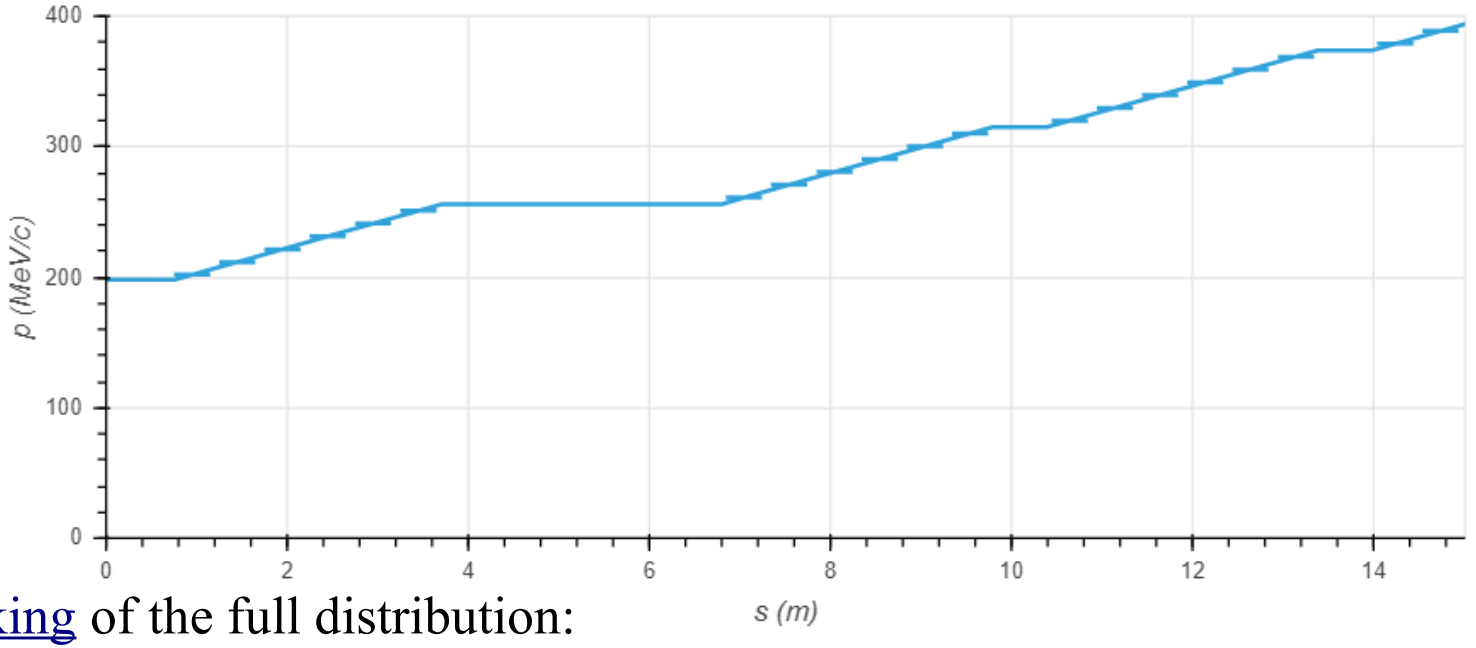
$$\epsilon_{nx} = 5422.330 \text{ mm} \cdot \text{mrad}$$
$$\beta_x = 1.215 \text{ m}$$
$$\alpha_x = 0.011$$
$$\sigma_x = 4.124 \text{ mm}$$
$$\sigma_{x'} = 3.393 \text{ mrad}$$
$$\epsilon_{ny} = 5340.169 \text{ mm} \cdot \text{mrad}$$
$$\beta_y = 1.204 \text{ m}$$
$$\alpha_y = 0.016$$
$$\sigma_t = 10.378 \text{ ps}$$
$$\sigma_z = 3.113 \text{ mm}$$
$$\sigma_{\Delta p/p} = 5.060 \text{ \%}$$
$$p_{average} = 198.038 \text{ MeV/c}$$
$$Q = 5.145 \text{ nC}$$

Positron distribution after the solenoid (Pavel Martyshkin):

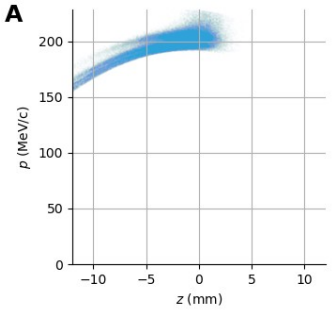


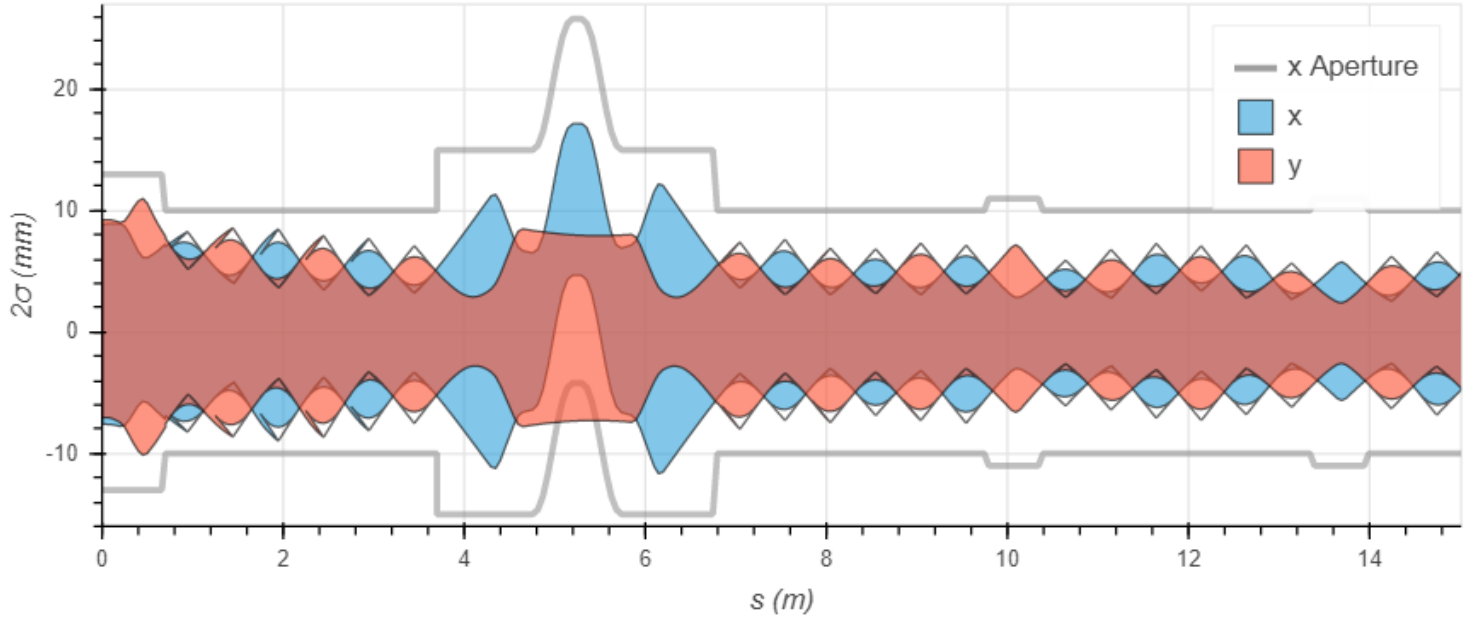
http://www.inp.nsk.su/~petrenko/c-tau/Injector/p-linac/Martyshkin/

Transition to quadrupole focusing

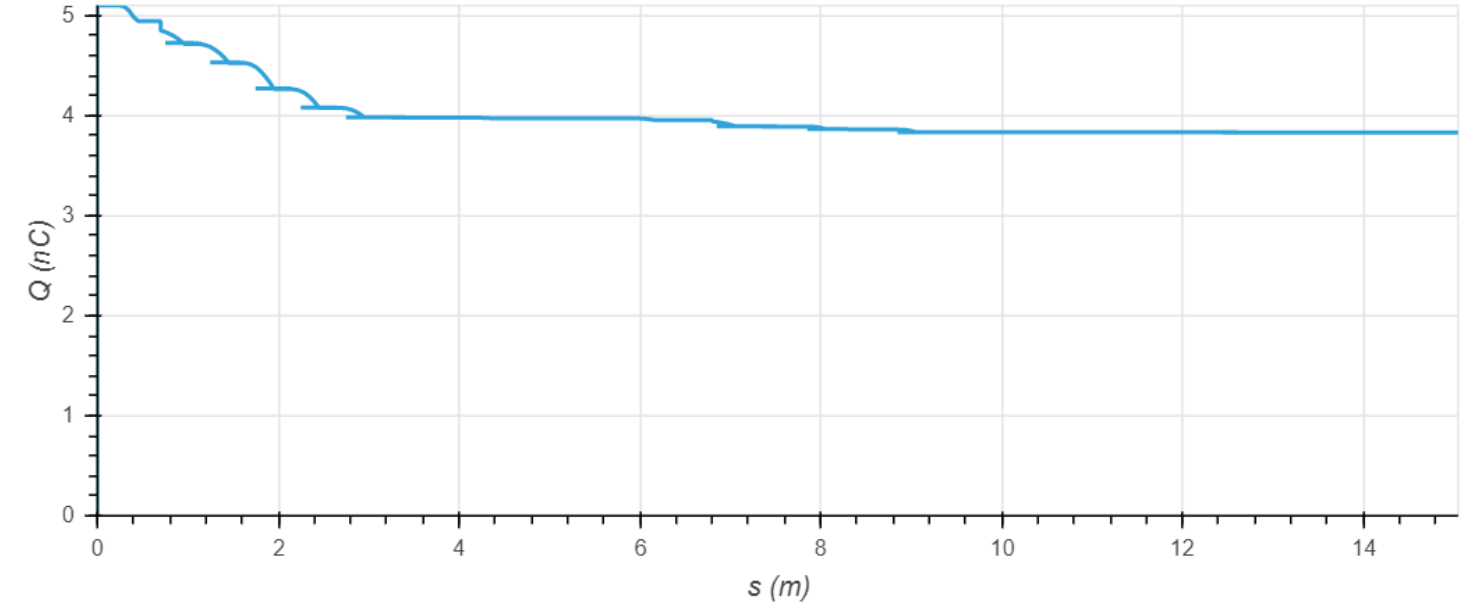


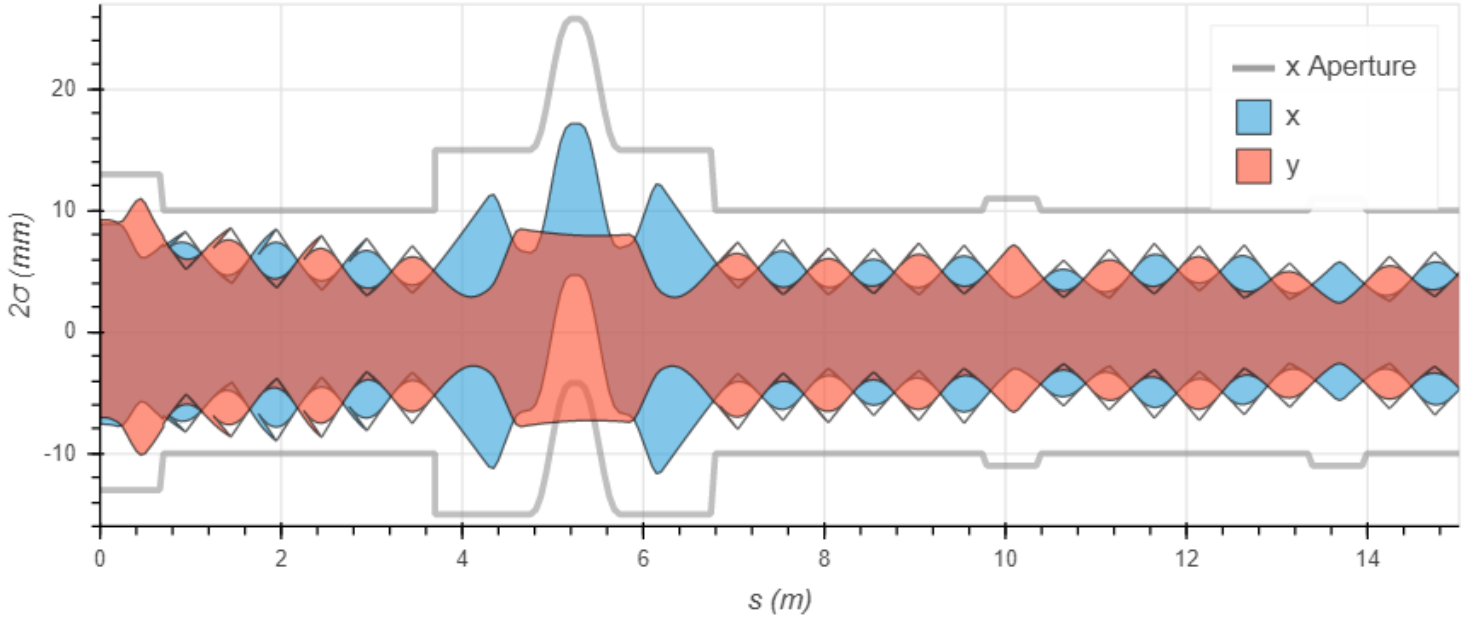
[Particle tracking](#) of the full distribution:





Losses during transition to quadrupole focusing:

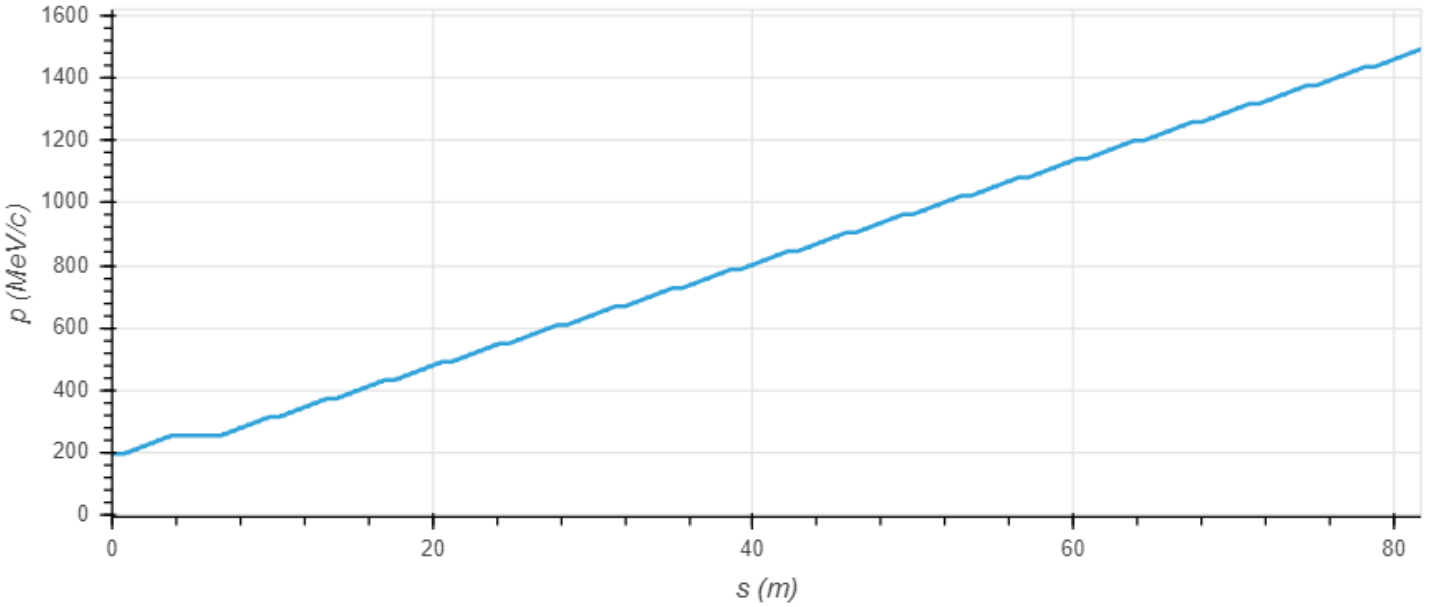


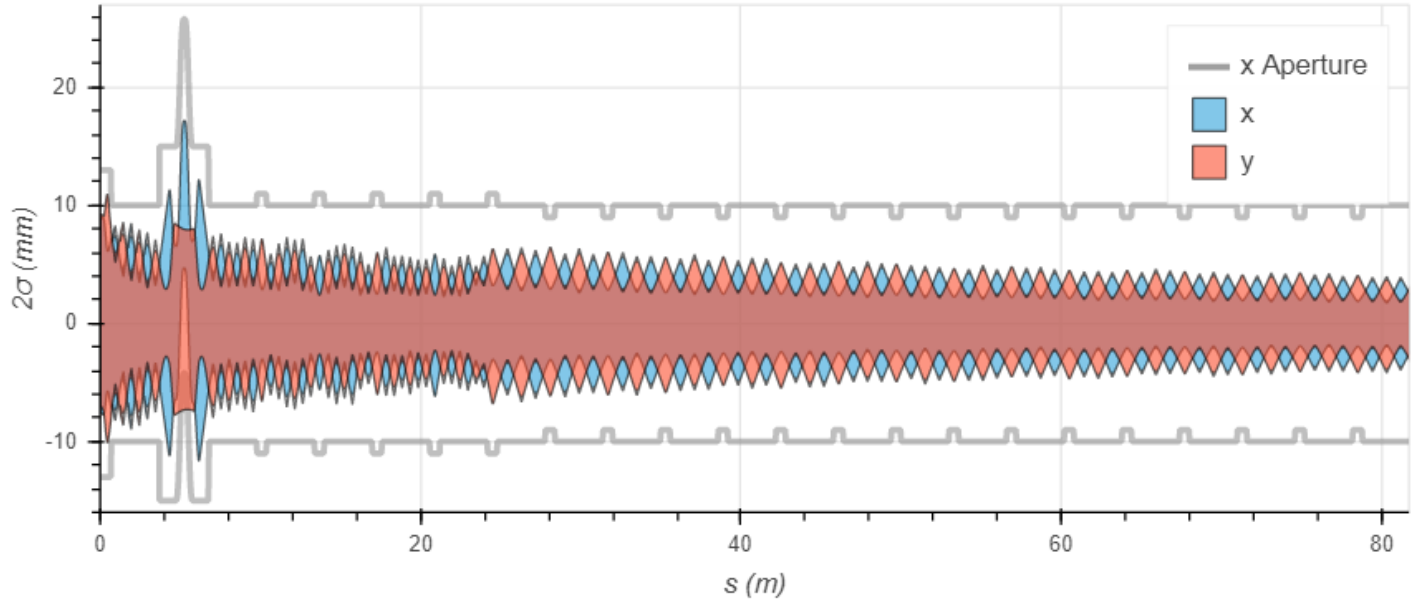


Similar system at KEK

From Pavel Martyshkin's presentation

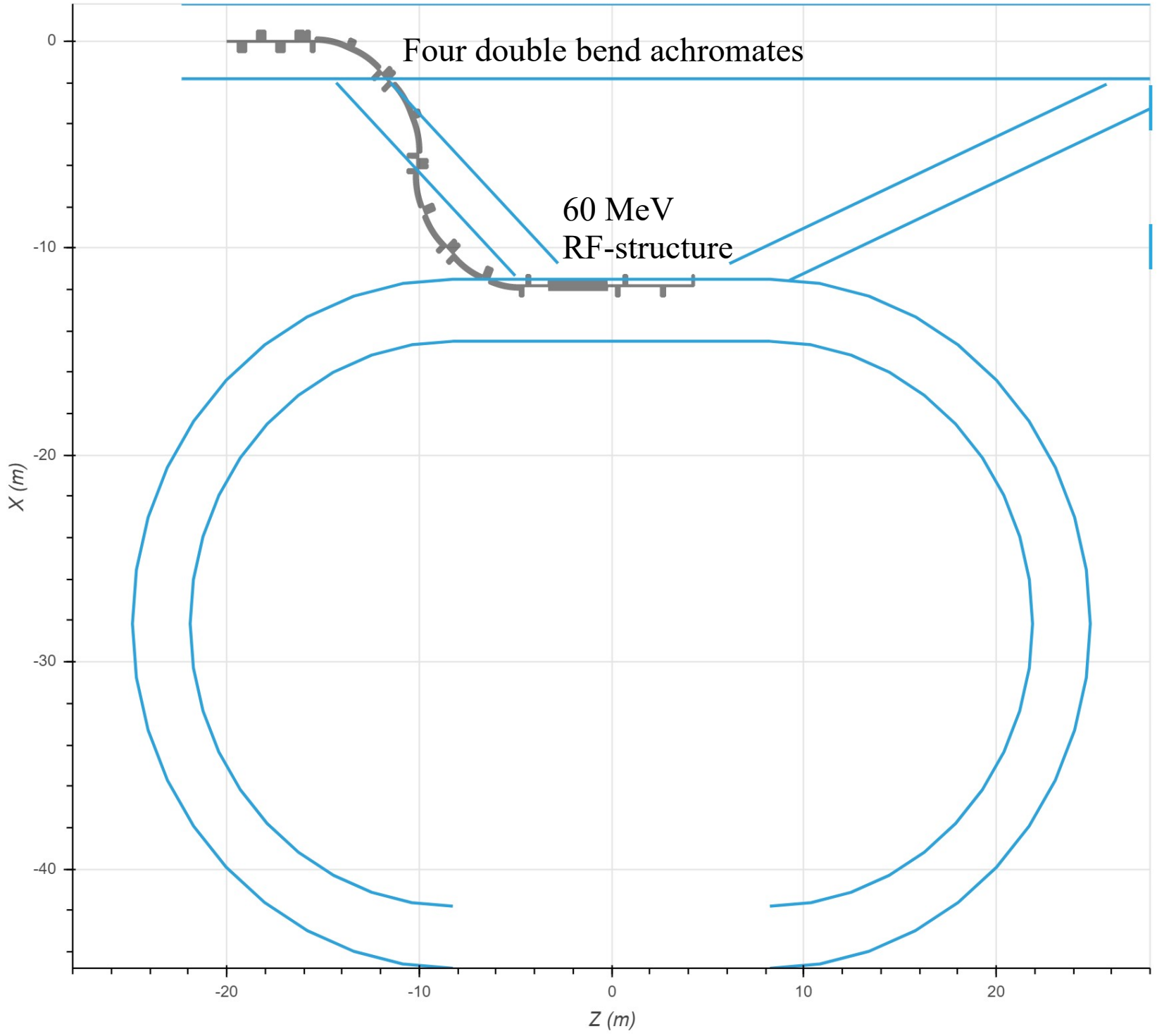
Full 1.5 GeV e+ linac:



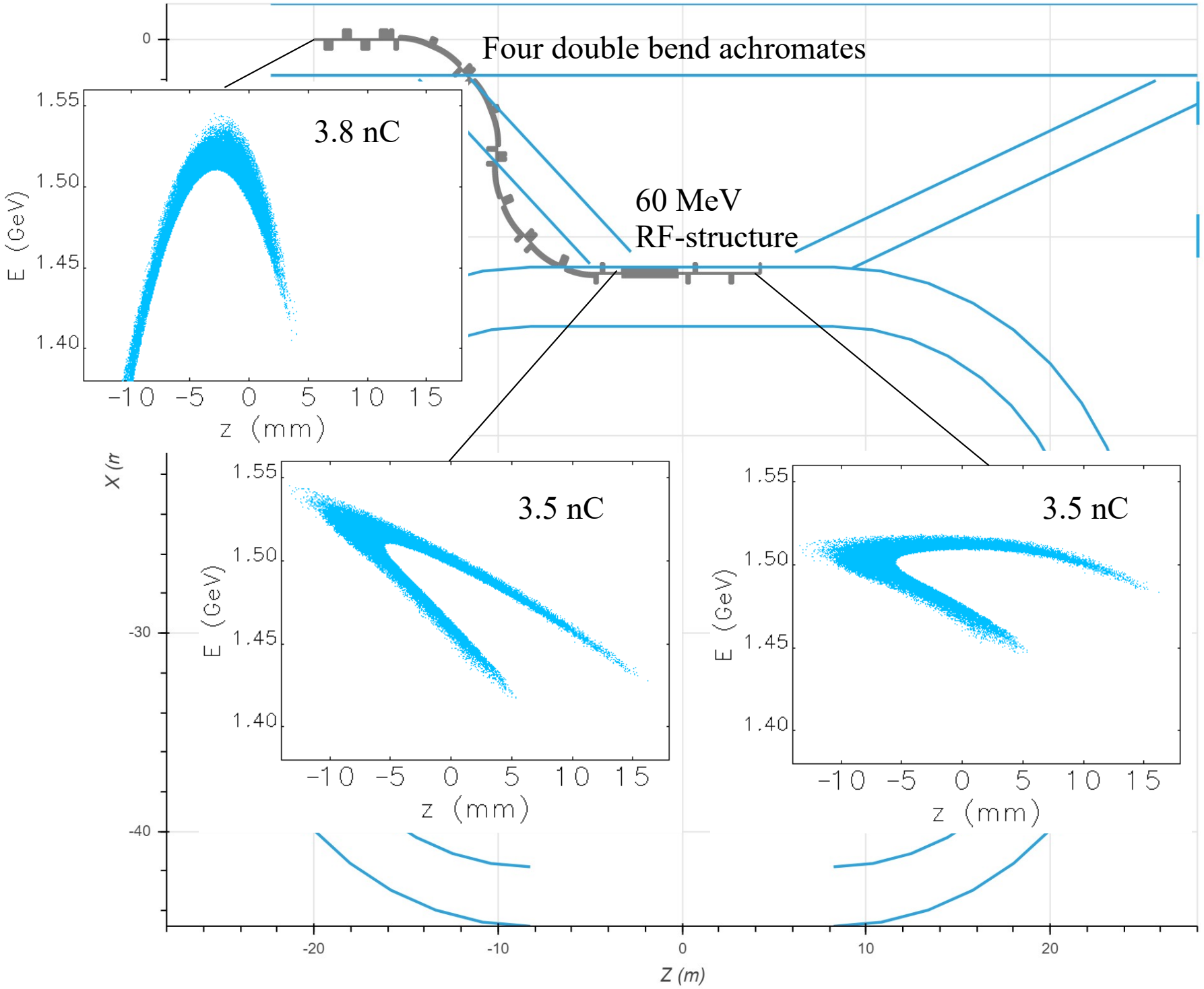


http://www.inp.nsk.su/~petrenko/c-tau/Injector/p-linac/FODO_and_e-p_sep/Track.html

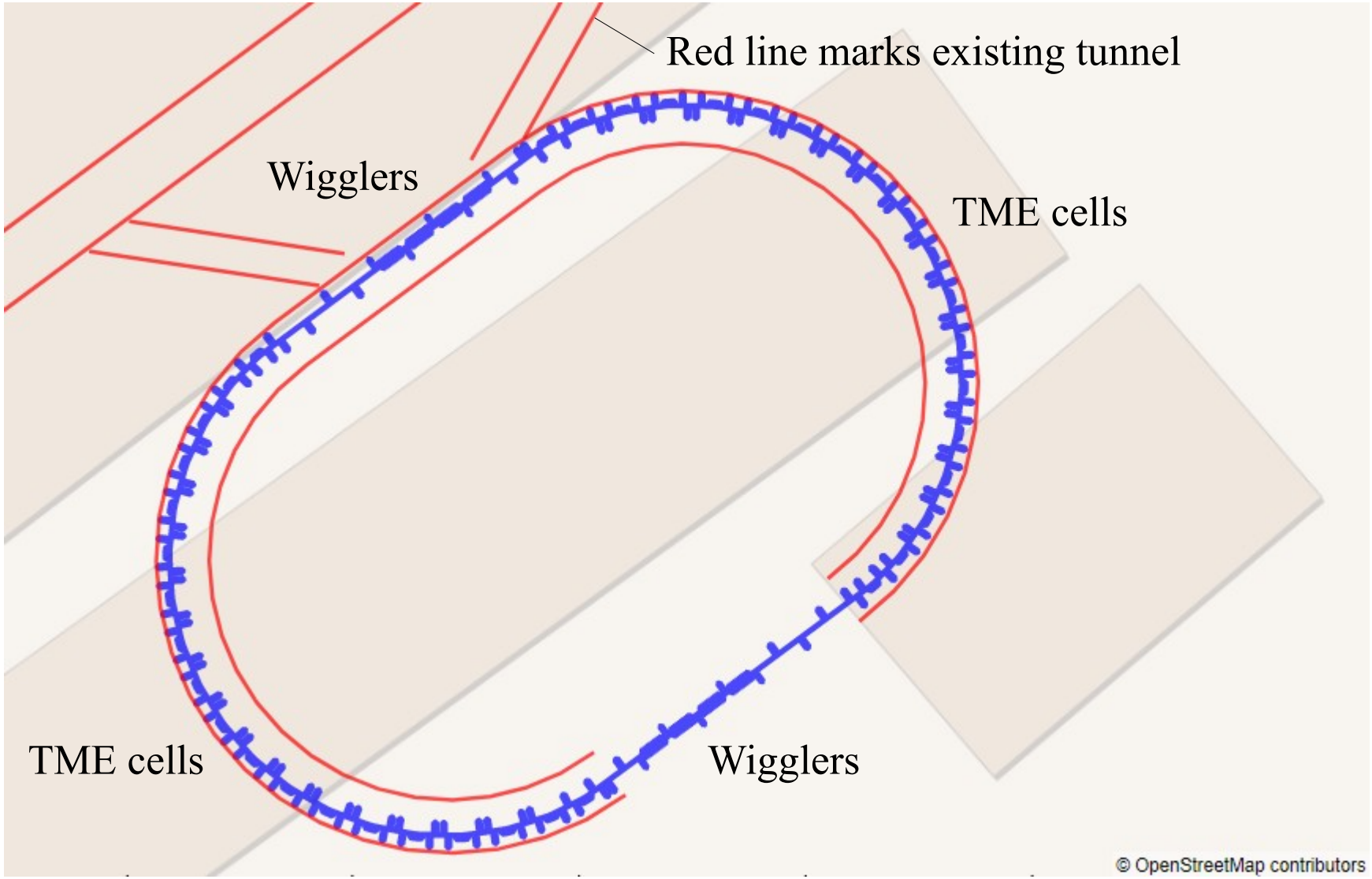
Debuncher:


Four double bend achromates
60 MeV
RF-structure
0
-10
-20
-30
-40
X (m)
-20
-10
0
10
20
Z (m)

Debuncher:


Four double bend achromates
60 MeV
RF-structure
3.8 nC
3.5 nC
3.5 nC
E (GeV)
z (mm)
X (m
Z (m)

Damping ring (scaled down CLIC Pre-Damping Ring)

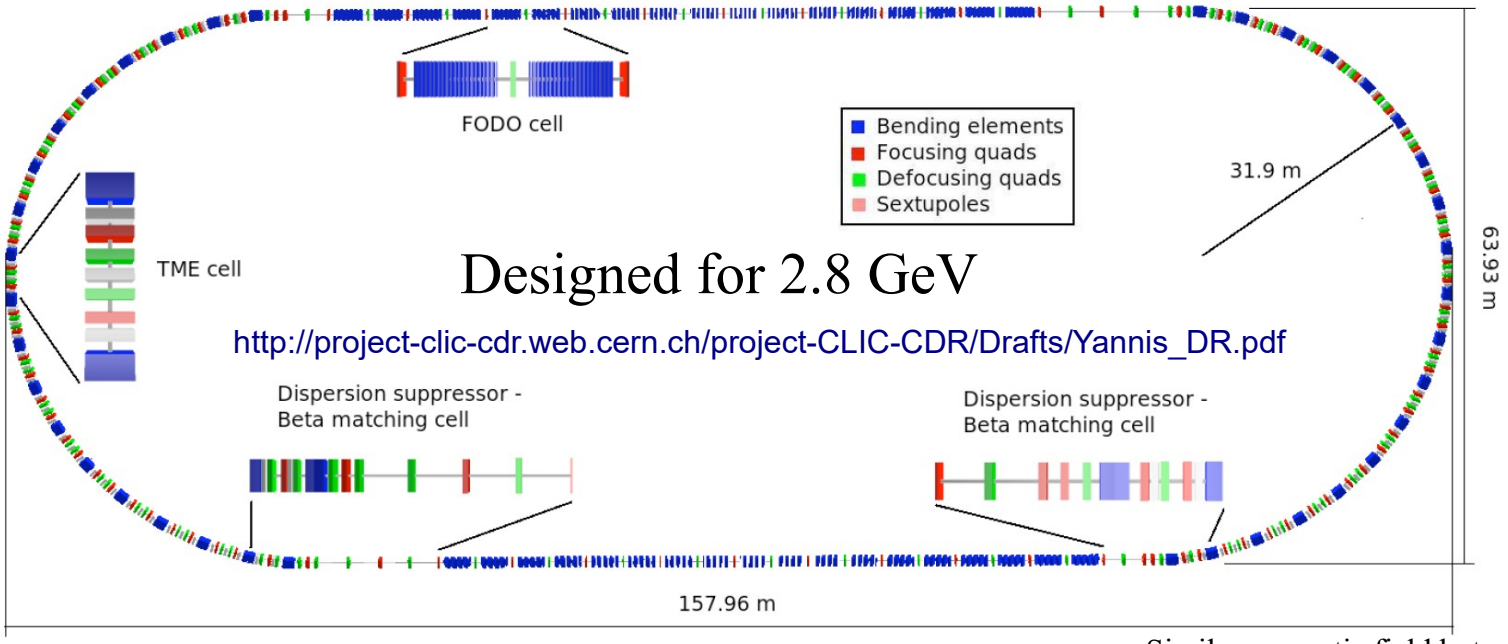


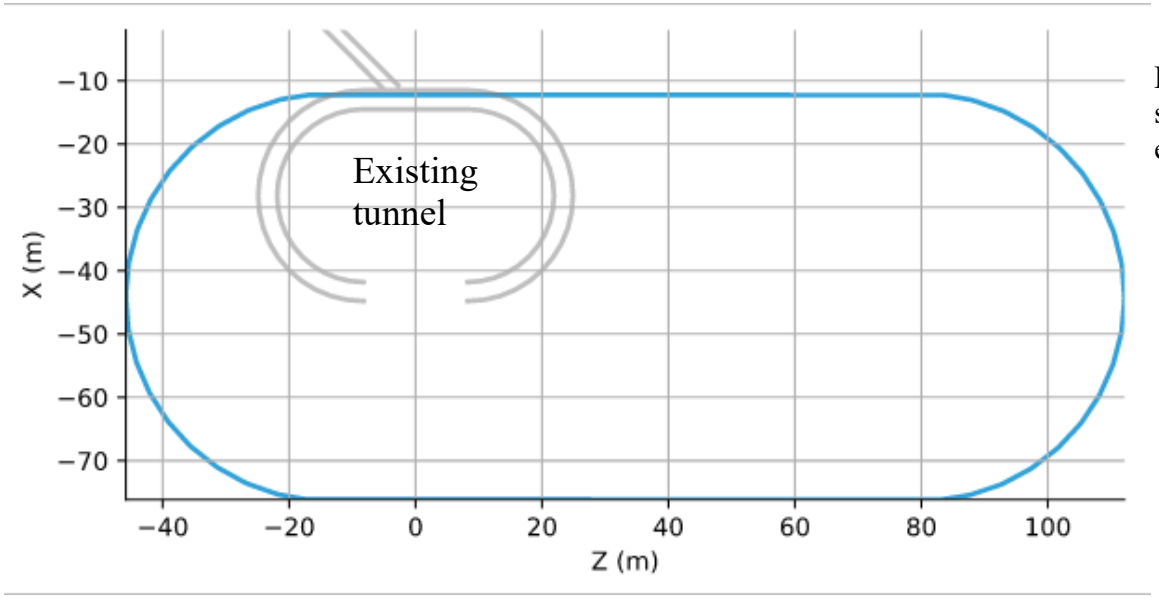
Damping times: τ_x = 7.2 ms, τ_s = 3.5 ms

Equilibrium emittance: ε_x = 6.3 nm (including IBS)

http://www.inp.nsk.su/~petrenko/c-tau/Injector/damping_ring/Twiss.html

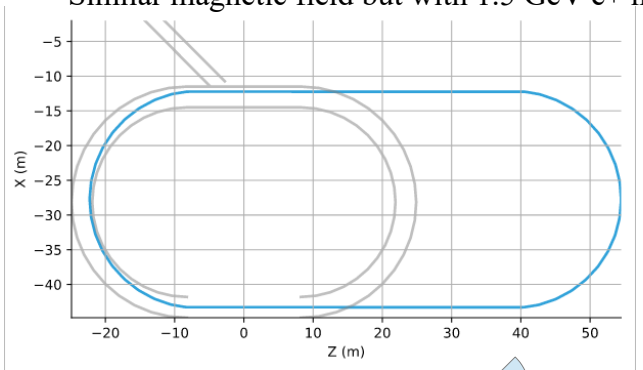
Scaling down CLIC Pre-Damping Ring

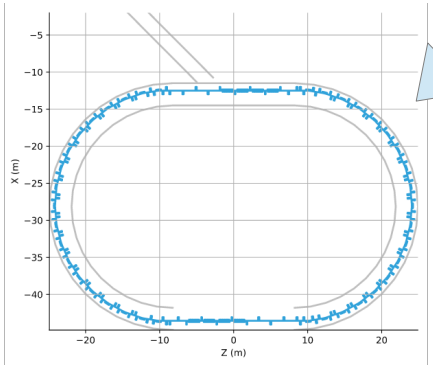




Proportionally scale all elements

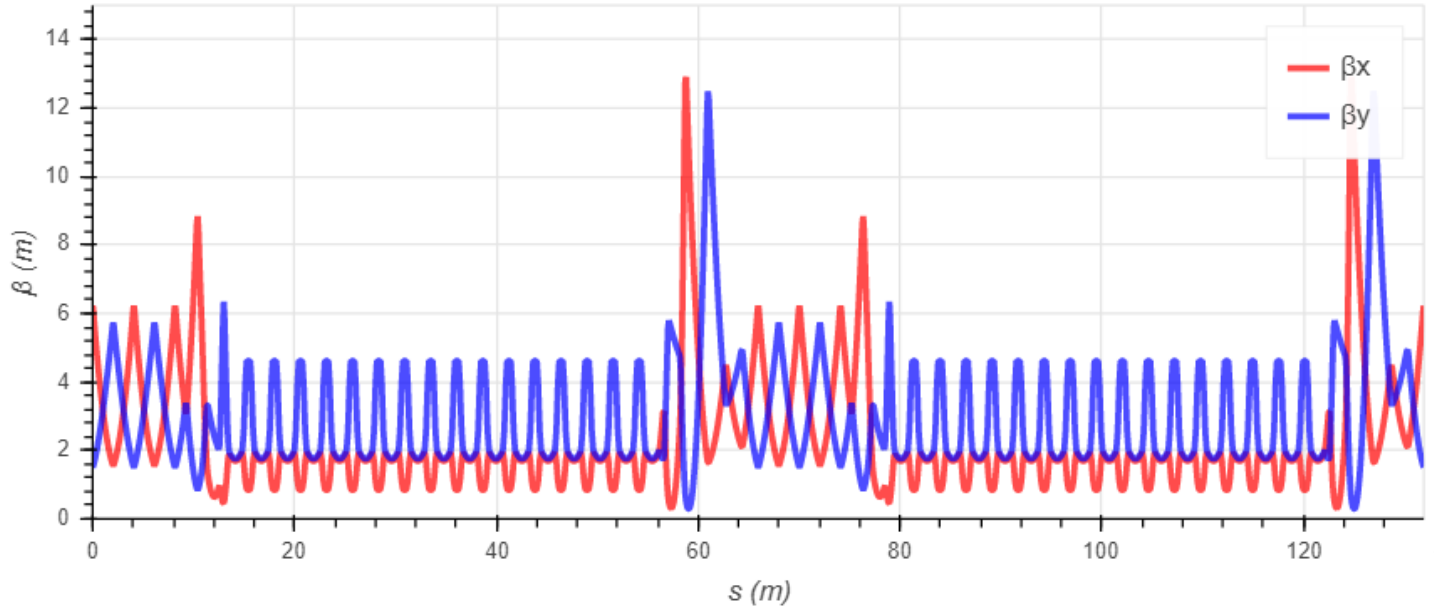
Similar magnetic field but with 1.5 GeV e+ now:

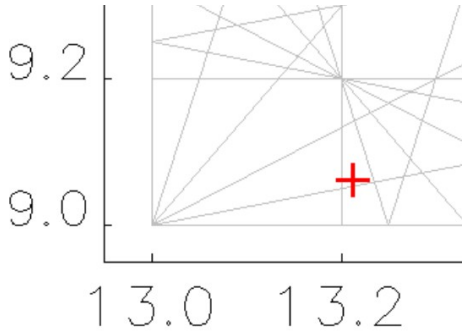




Remove several FODO-periods.

Damping ring optical functions



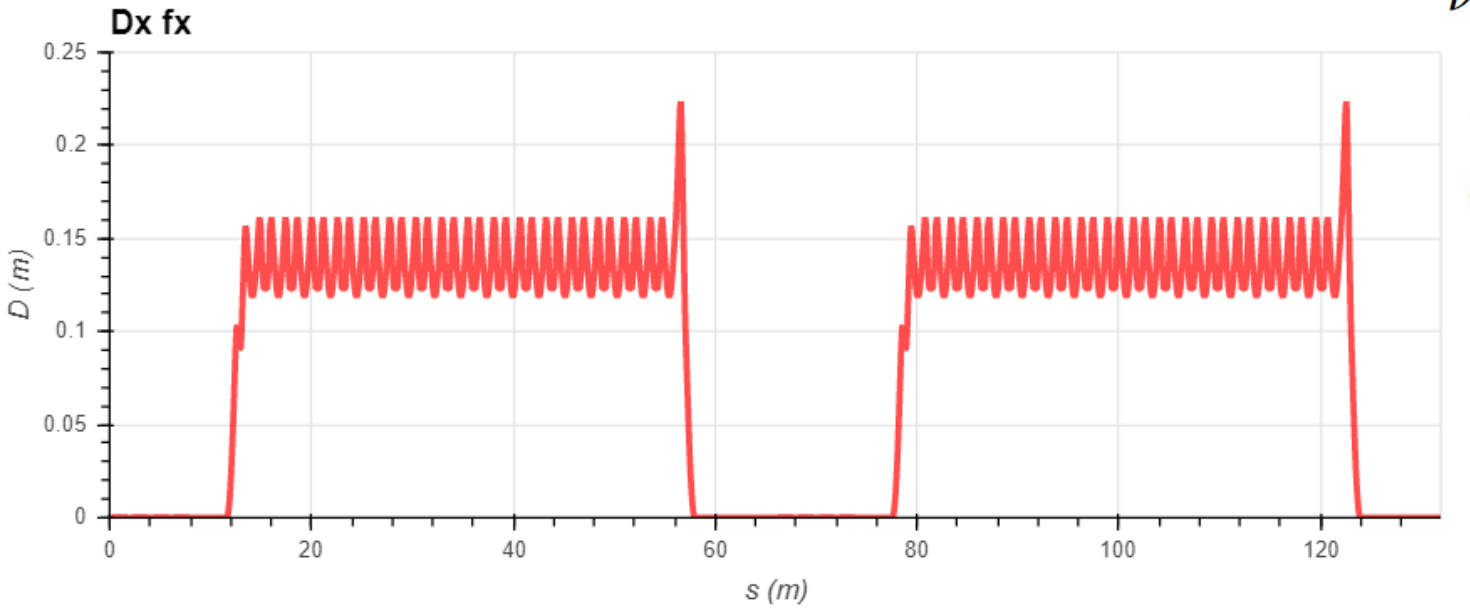


Tunes are just the first try:

$\nu_x = 13.212,\ \nu_y = 9.061$

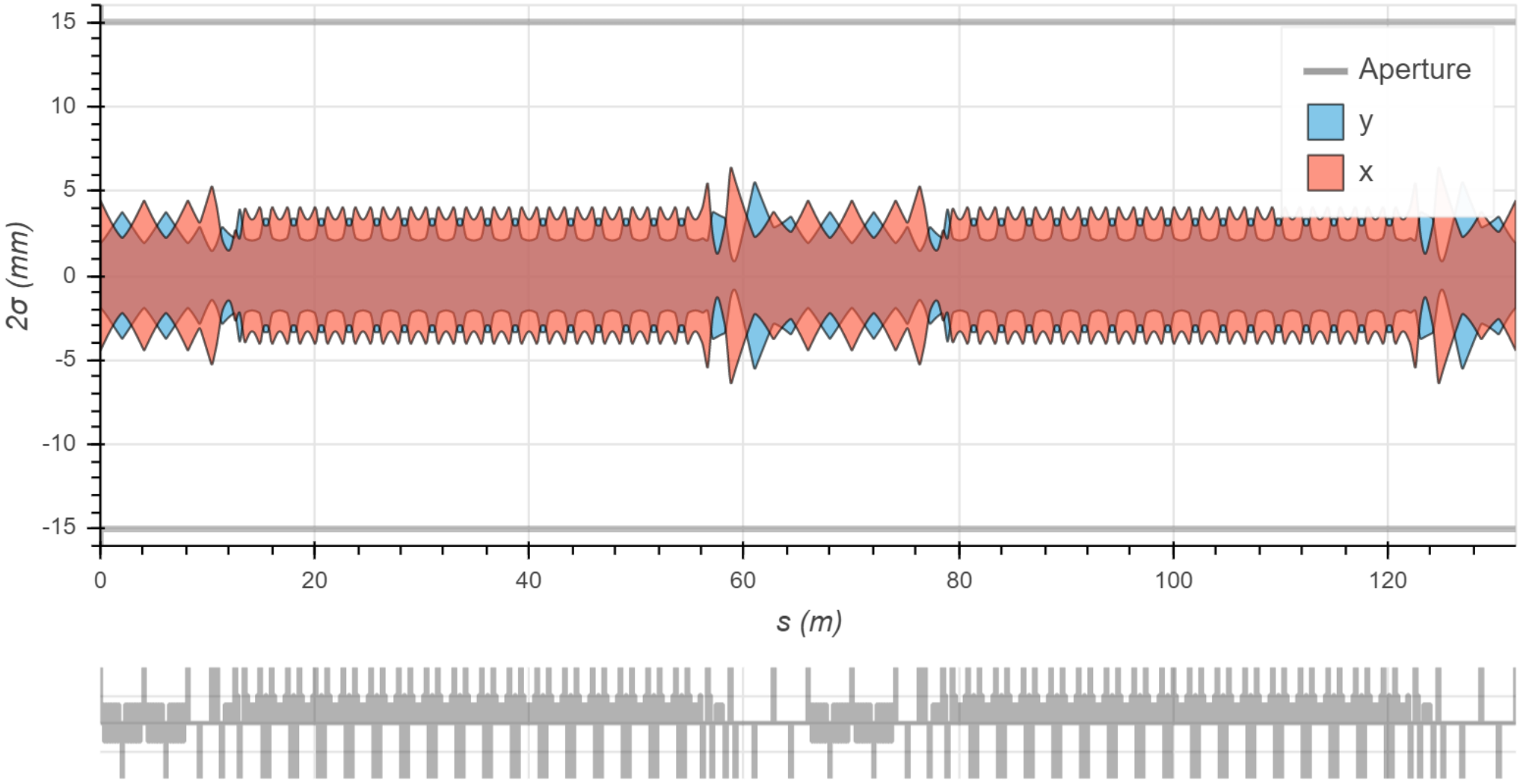
Chromaticity is corrected to some positive value:

$\xi_x = 5.2,\ \xi_y = 5.5$

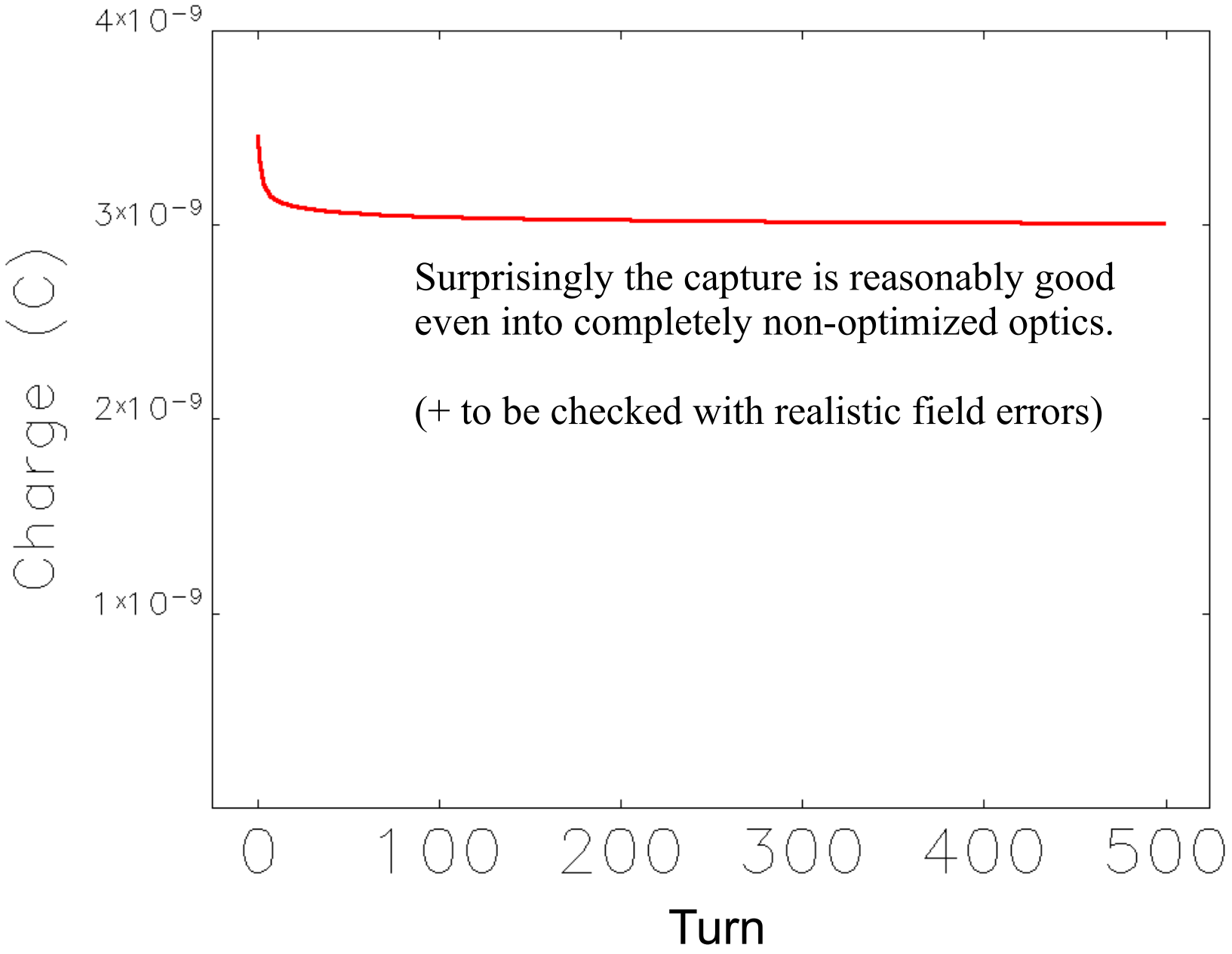


http://www.inp.nsk.su/~petrenko/c-tau/Injector/damping_ring/Twiss.html

Initial beam size at ε_x = 1500 nm, ε_y = 1300 nm and $\sigma(\Delta p/p) = 0.01$



Positron bunch capture into the damping ring

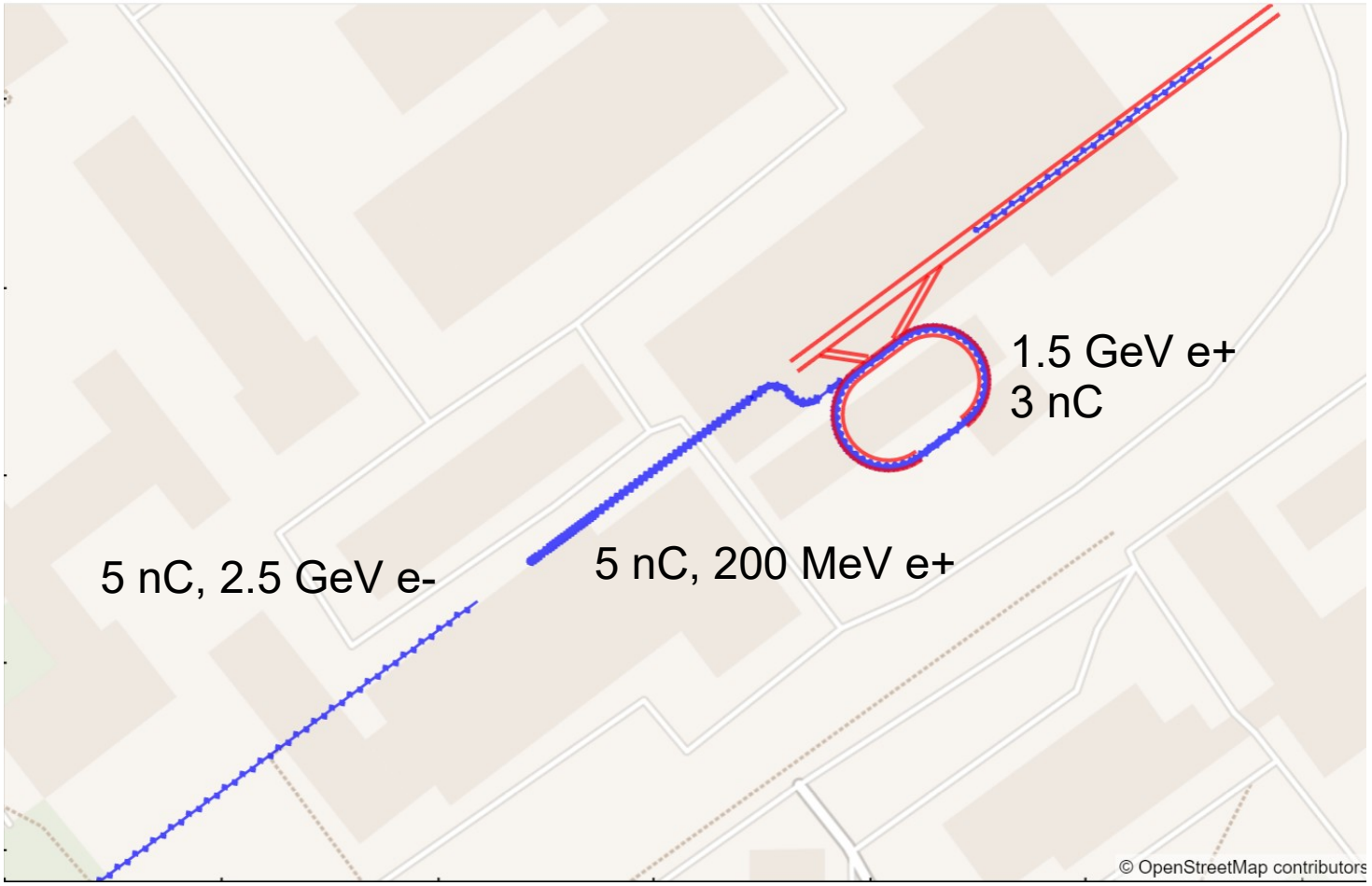


Surprisingly the capture is reasonably good even into completely non-optimized optics.

(+ to be checked with realistic field errors)

Summary

With 4.8 nC (3e10 e-), 2.5 GeV electron beam on target we get 5 nC e+ after the solenoid at 200 MeV, 3.5 nC before the damping ring and 3.0 nC e+ captured by the damping ring:



With 3.0 nC (2e10) e+ per shot it will take 10 Hz linac to get the required 2e11 e+/sec. With 7 ms damping time we can have even faster linac, 20 Hz operation will give a factor of two safety margin.