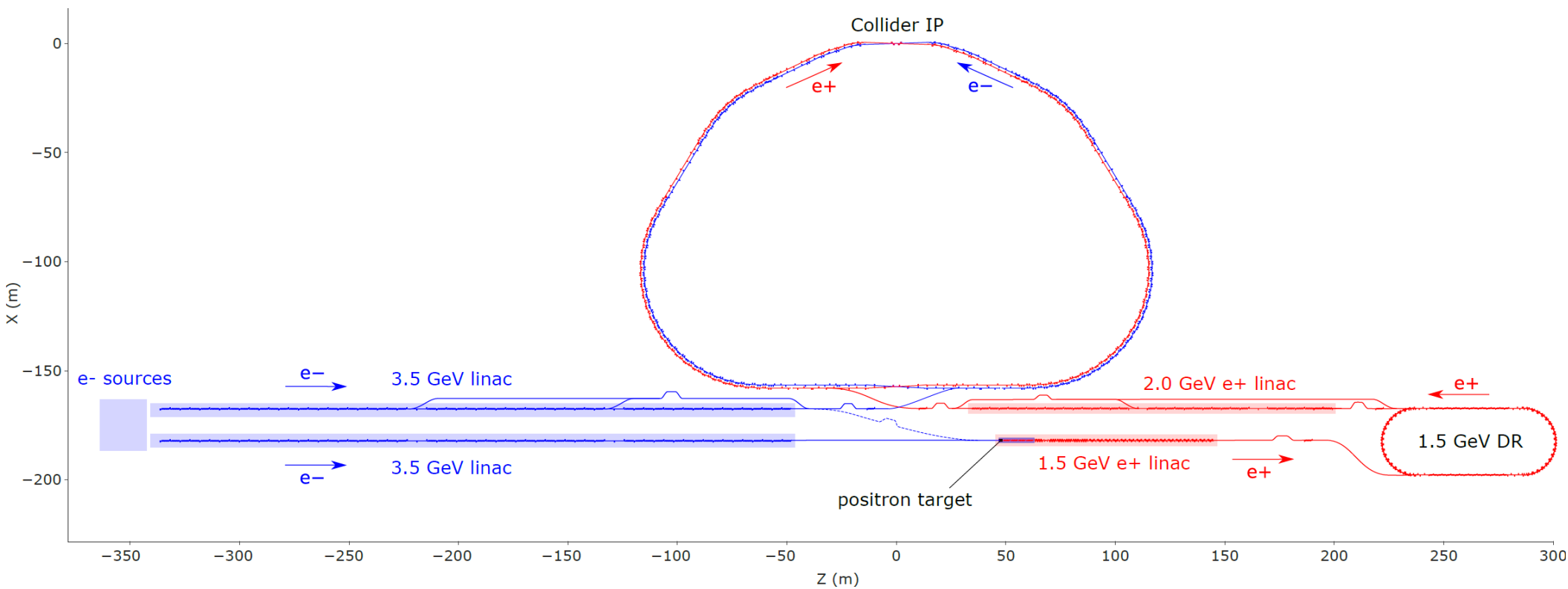


# Injection facility for SCT-Factory

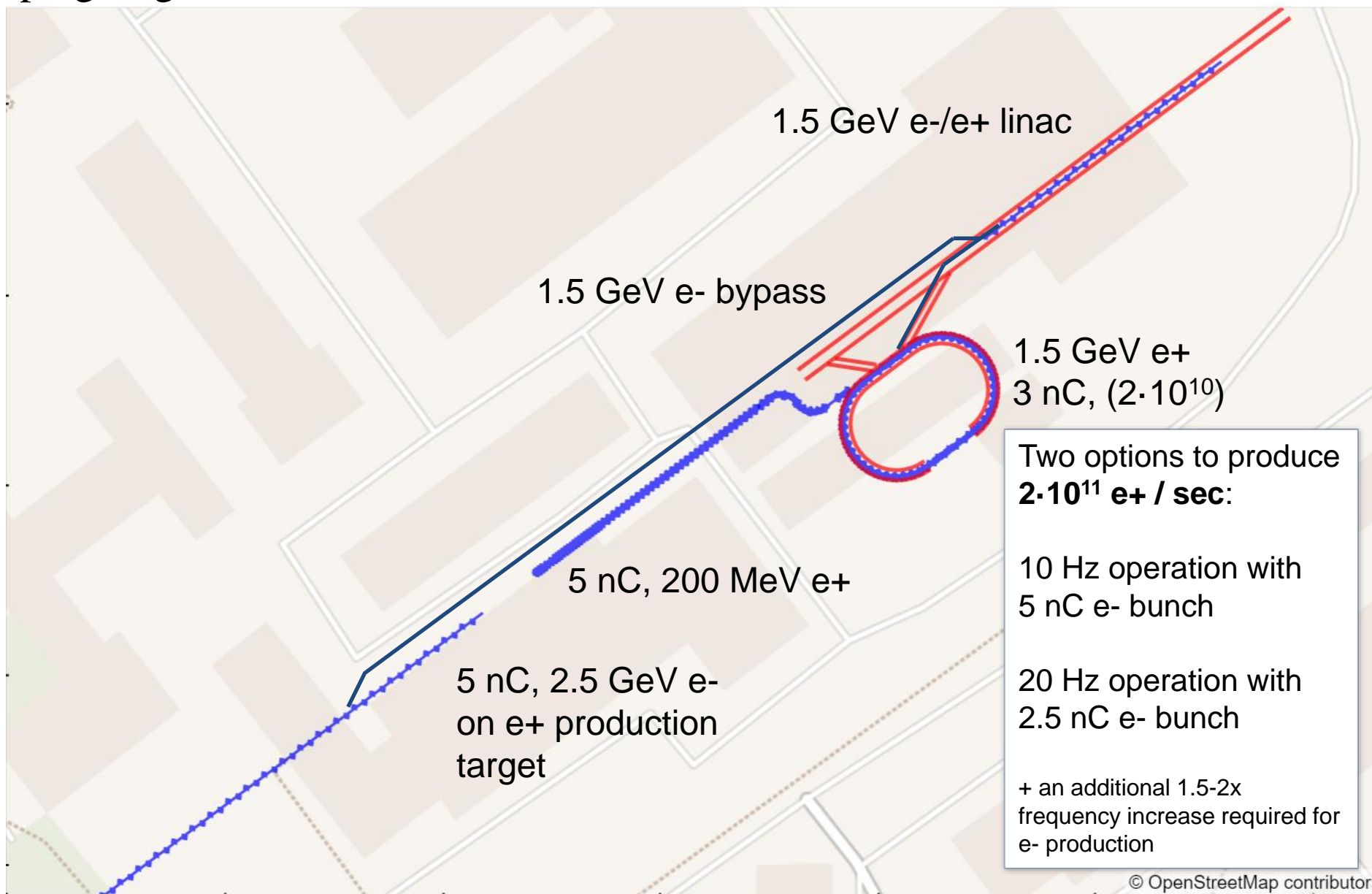
Alexey Petrenko, BINP

[2021 workshop on future Super c- \$\tau\$  factories](#), Nov. 17, 2021, Novosibirsk.

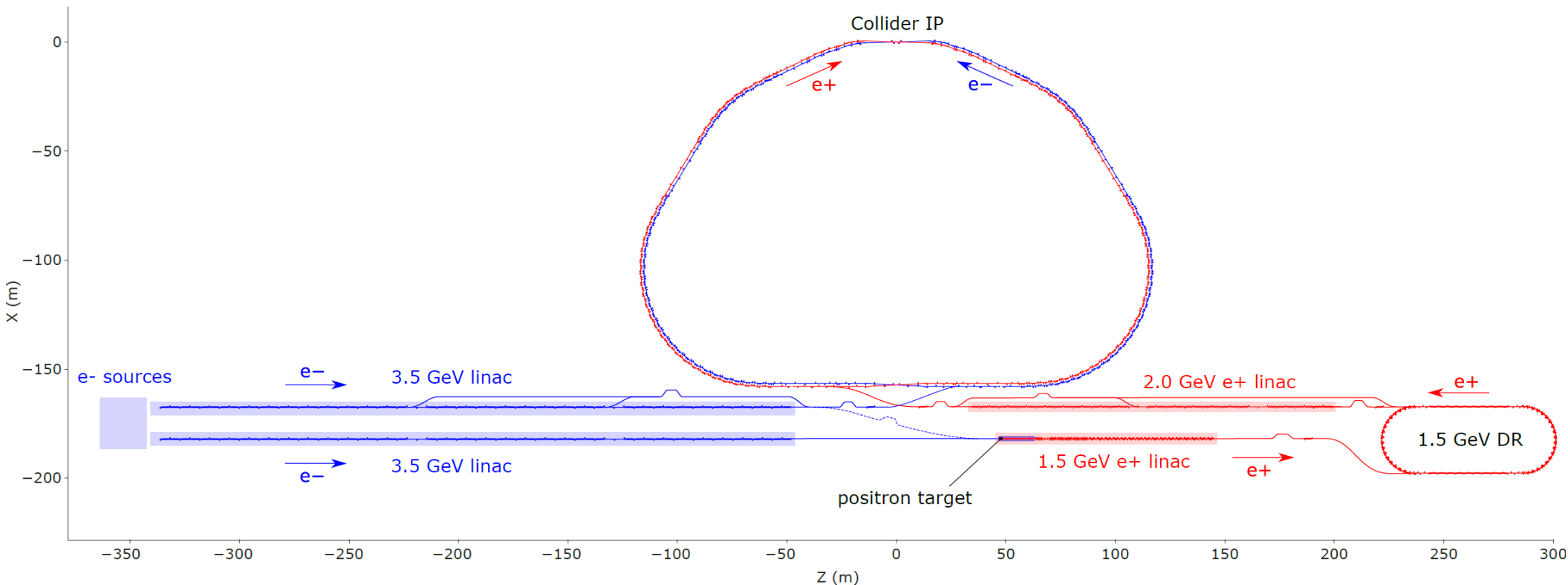


# Old injector layout for the 3 GeV BINP-based facility:

With 4.8 nC ( $3 \times 10^{10}$  e<sup>-</sup>), 2.5 GeV electron beam on target we get 5 nC e<sup>+</sup> after the solenoid at 200 MeV, 3.5 nC before the damping ring and 3.0 nC e<sup>+</sup> captured by the damping ring:



# New injector layout for the 3.5 GeV facility:

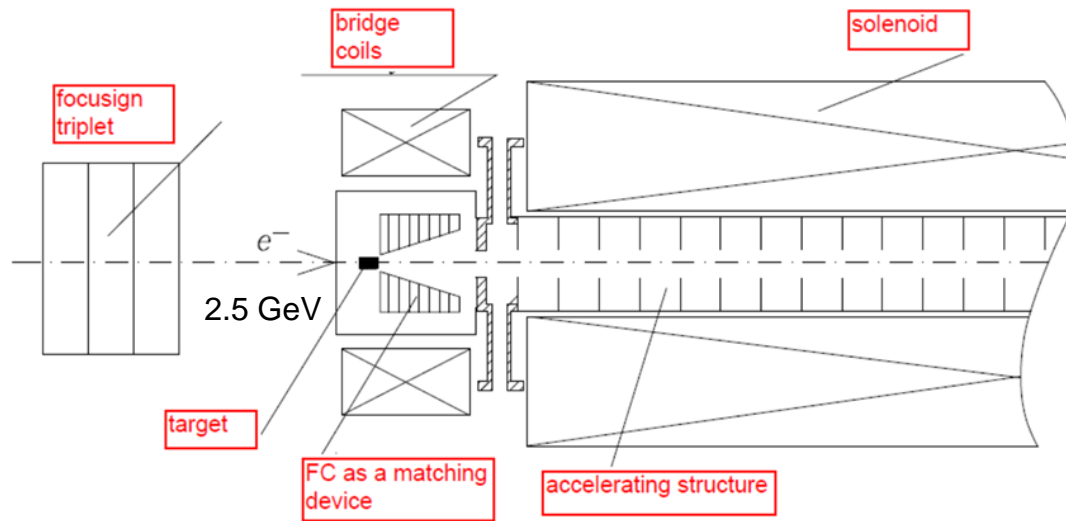


The goal is to be able to work at 50 Hz, although 20 Hz is probably enough.

With 3 nC of 3.5 GeV electrons per bunch on target we should capture at least 1.5 nC ( $10^{10}$ ) positrons per bunch, i.e.  $10^{10}$   $e^+$ /bunch at 50 Hz or  **$5 \cdot 10^{11}$   $e^+$ /sec** – good safety margin ( $2 \cdot 10^{11}$   $e^+$ /sec is required by the collider).

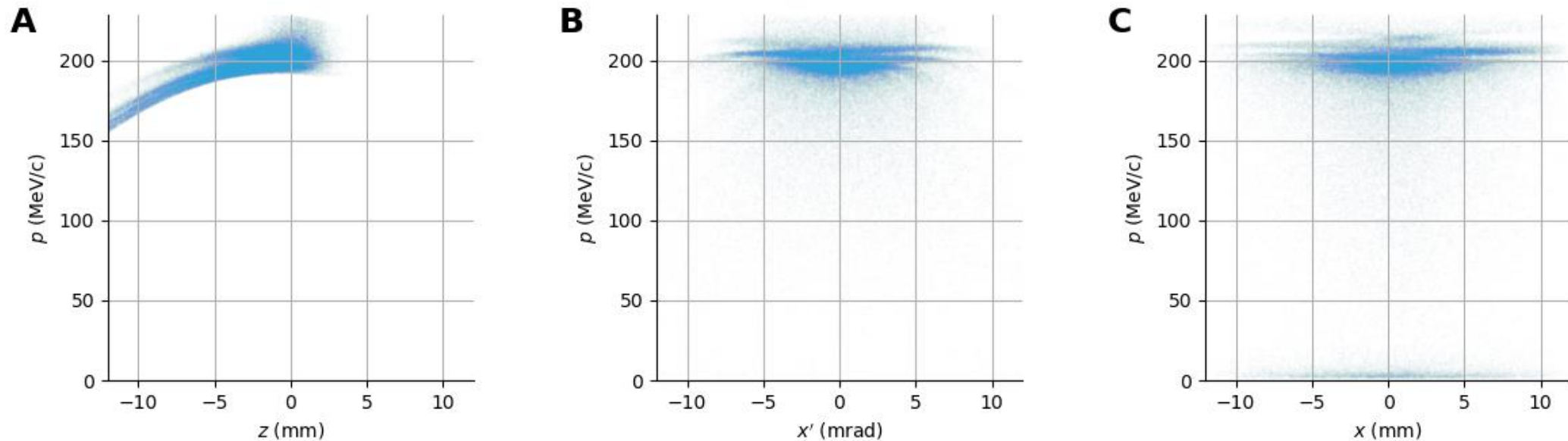
# Positron production system

Old simulation for  
5 nC 2.5 GeV e-  
bunch on target.



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

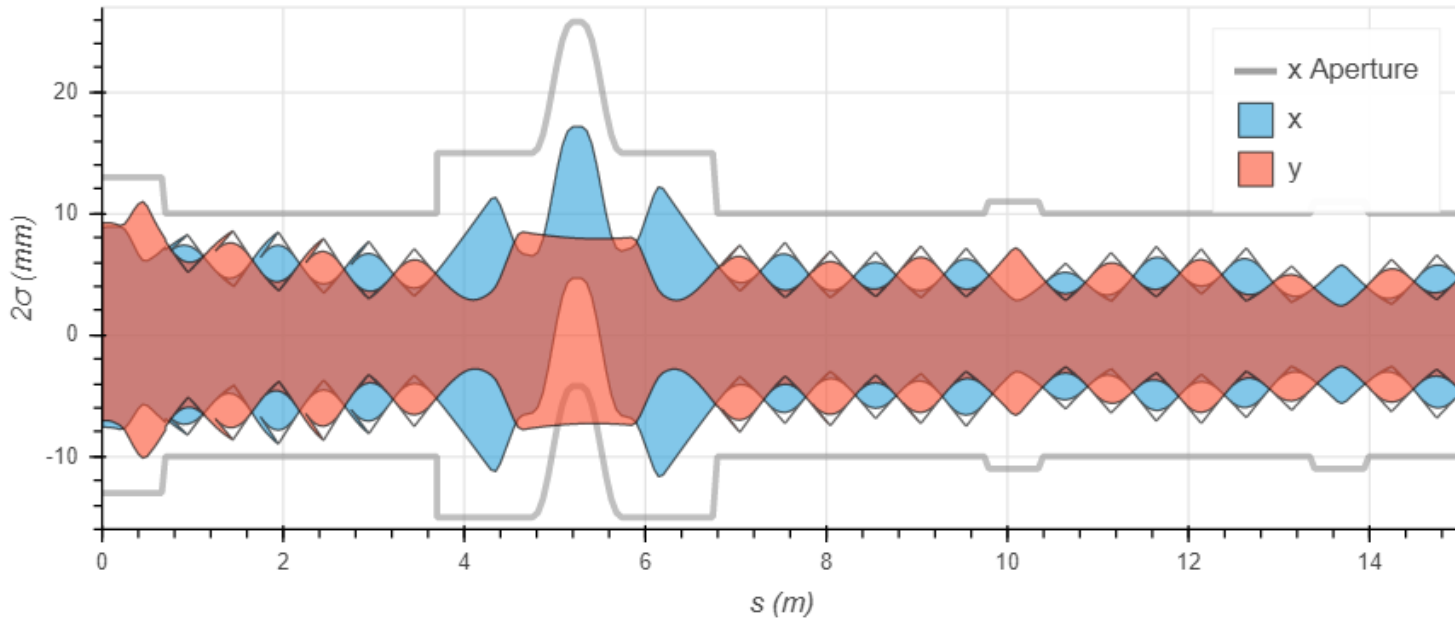
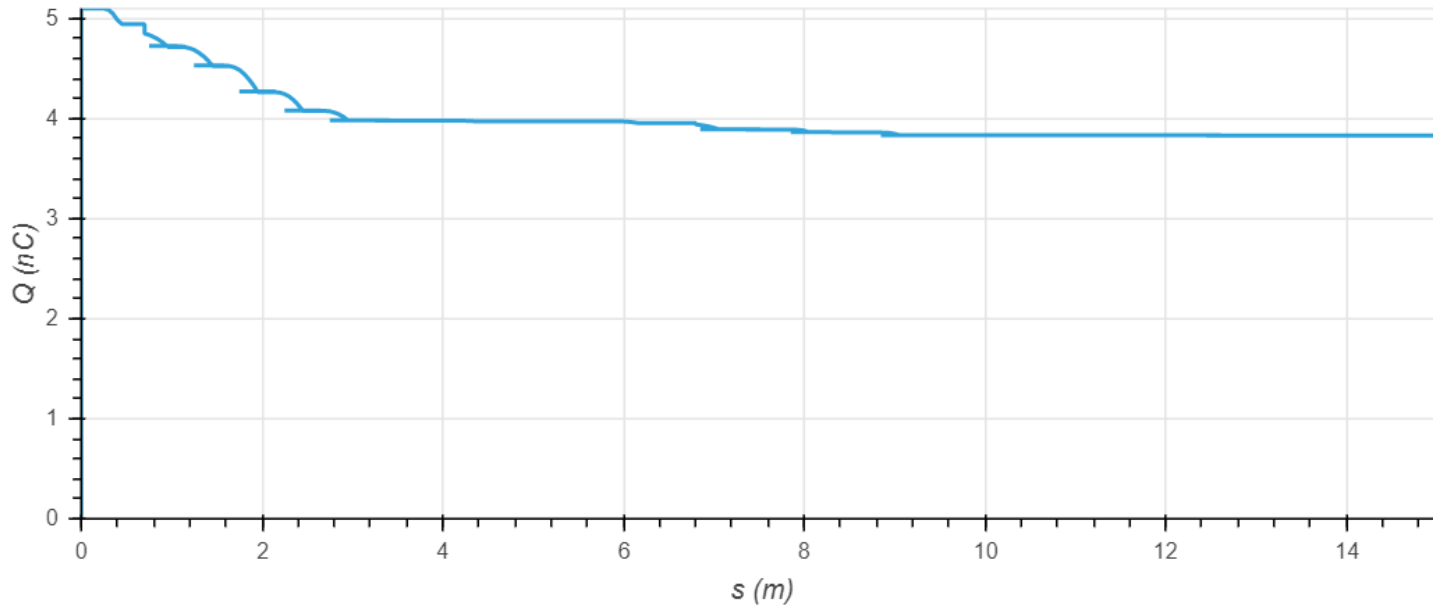
Positron distribution after the solenoid (Pavel Martyshkin):



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

# Losses during transition to quadrupole focusing:

Old simulation for  
5 nC 2.5 GeV e-  
bunch on target.

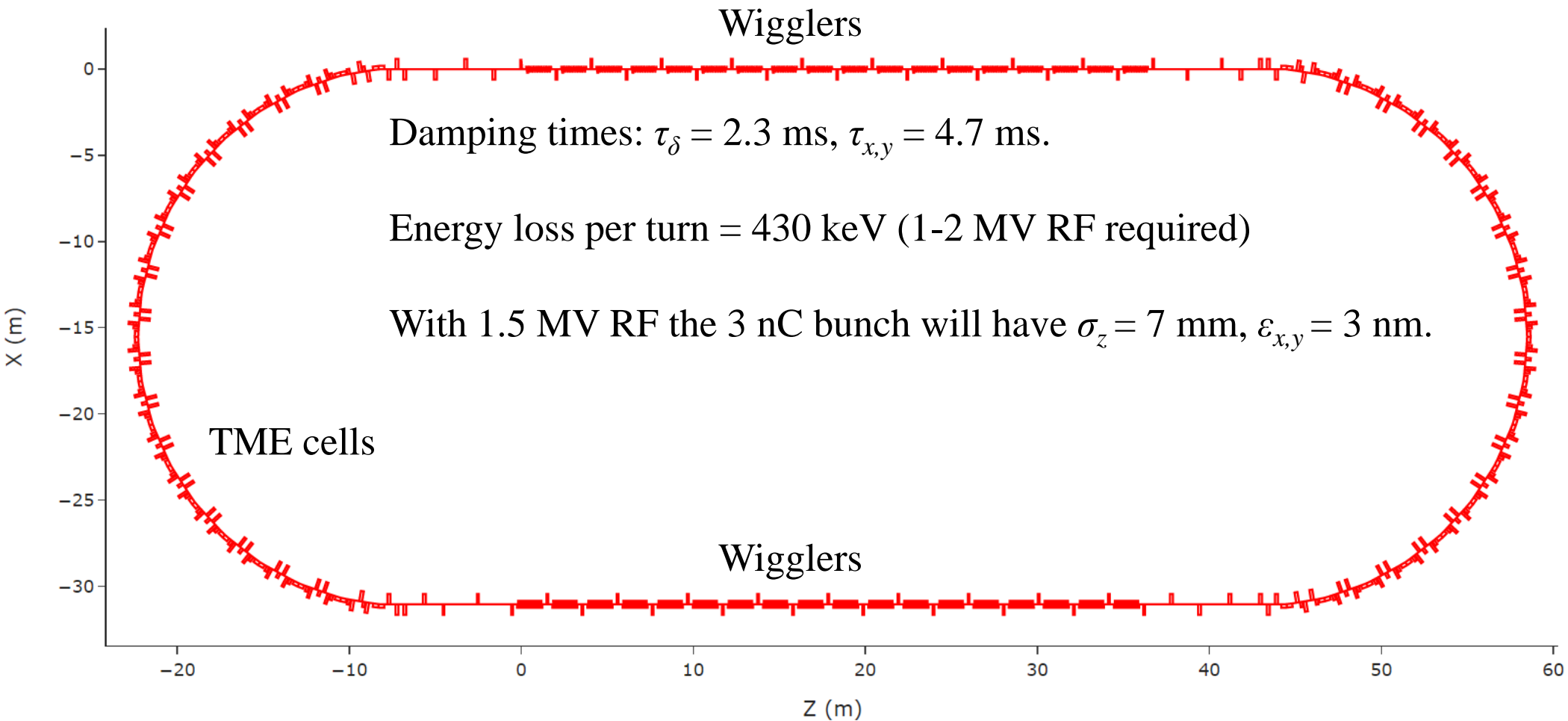


# Similar system at KEK



From [Pavel Martyshkin's presentation](#)

# 1.5 GeV damping ring (scaled down [CLIC Pre-Damping Ring](#))



This seems to be enough for 50 Hz operation even in a single bunch regime. The ring could be downsized if we assume multiple bunches stored for more than one cycle.

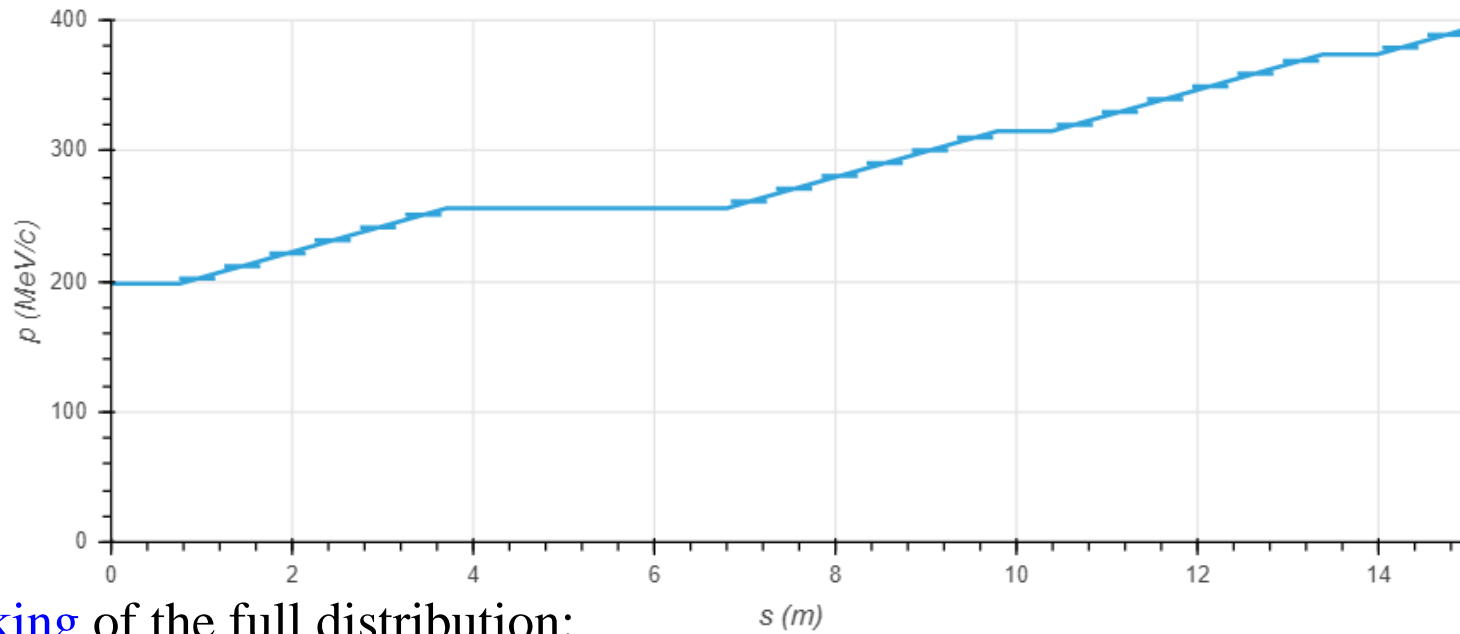
# Conclusion

- New e<sup>+</sup>/e<sup>-</sup> injector design is proposed for the 3.5 GeV SCT-factory with fully independent electron and positron linacs (total energy of linacs is 10.5 GeV).
- The 50 Hz operation with 3 nC e<sup>-</sup> bunches on target certainly meets the collider requirement of  $2 \cdot 10^{11}$  e<sup>+</sup>/sec.

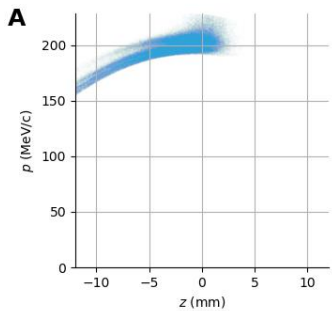
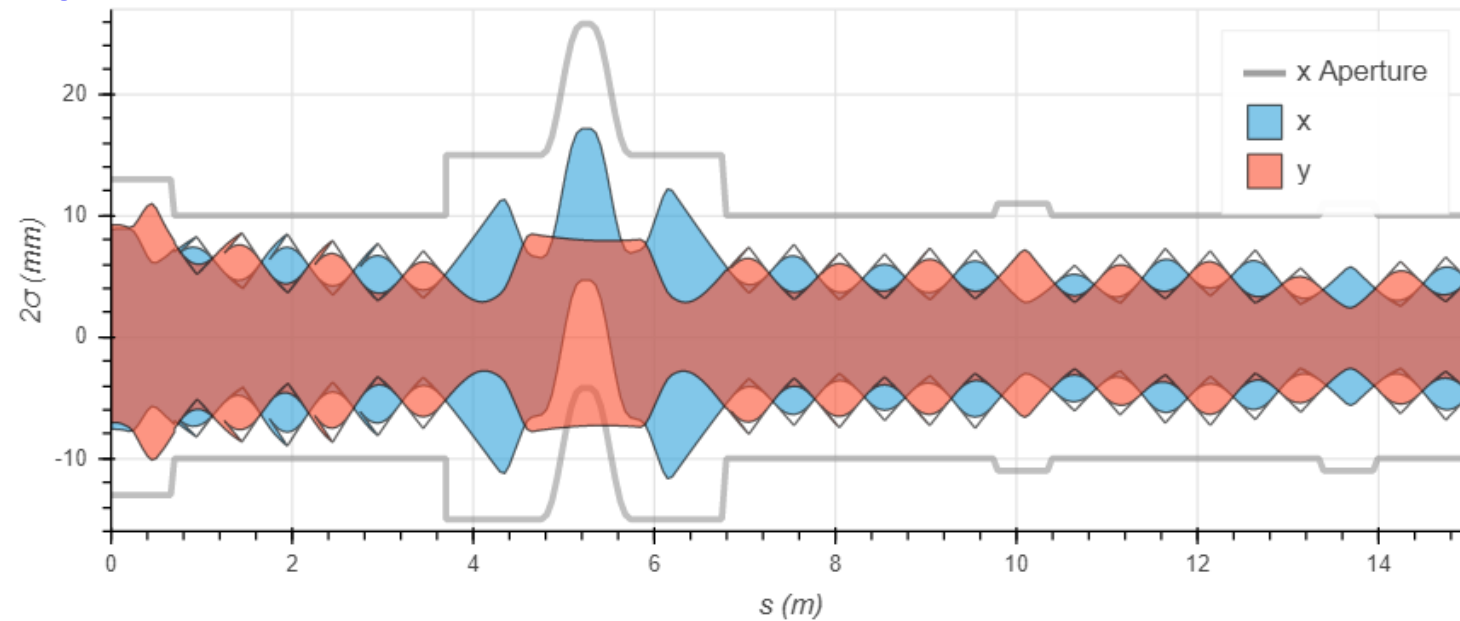


**Backup slides:**

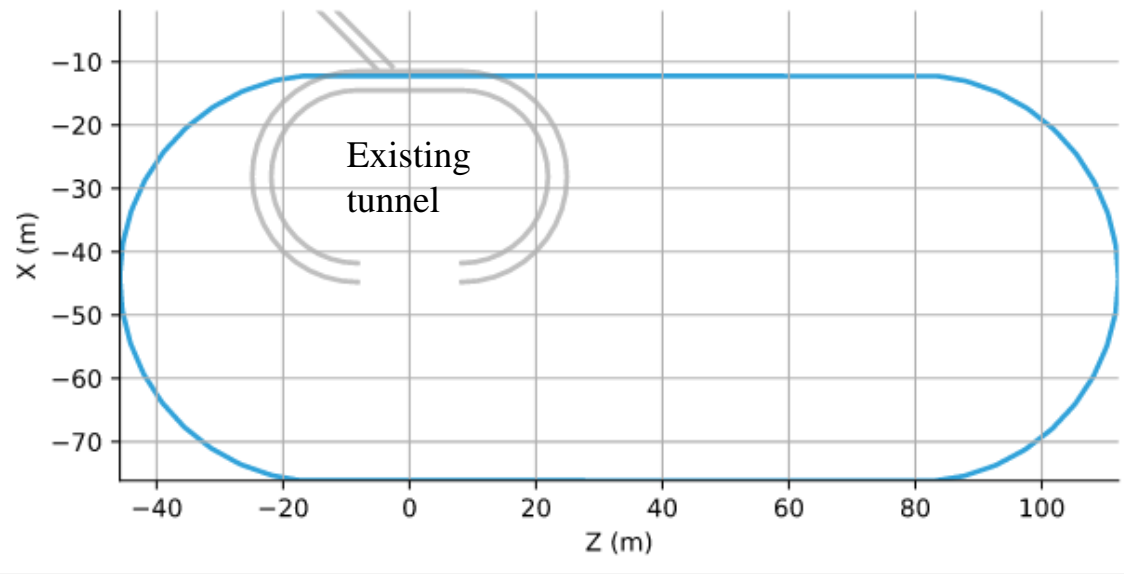
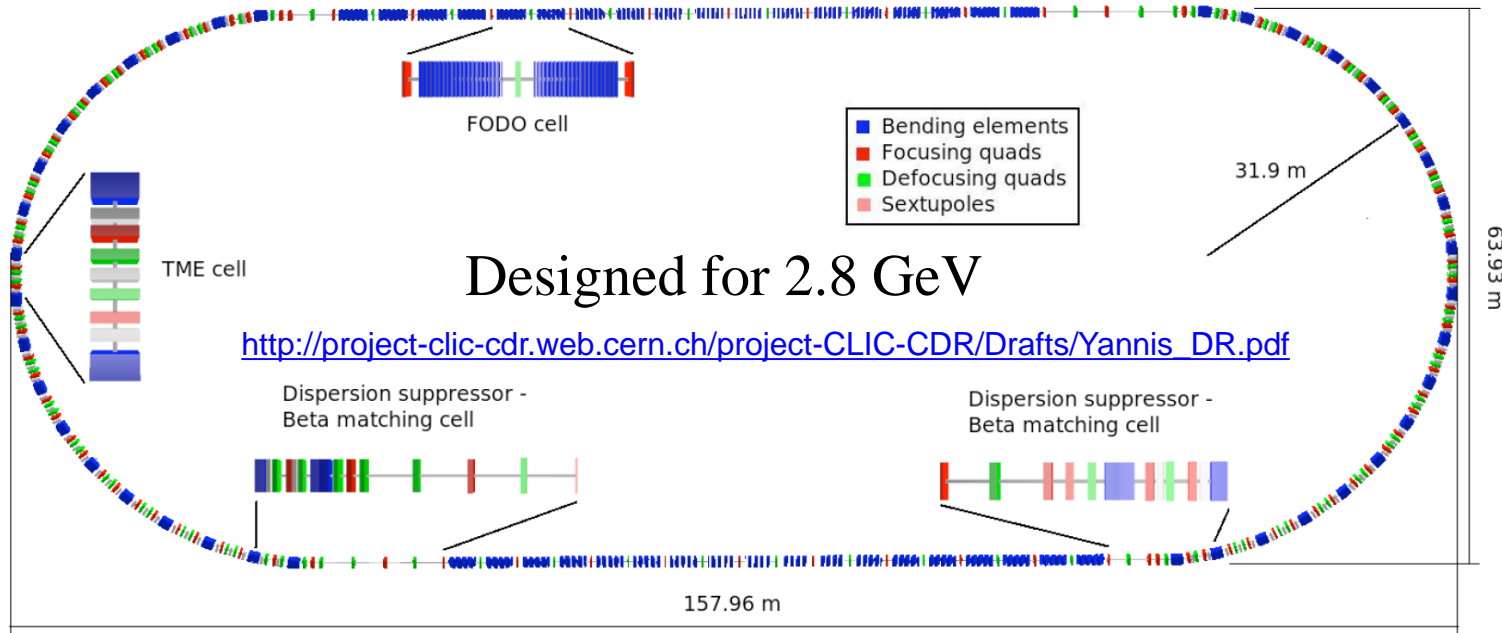
# Transition to quadrupole focusing



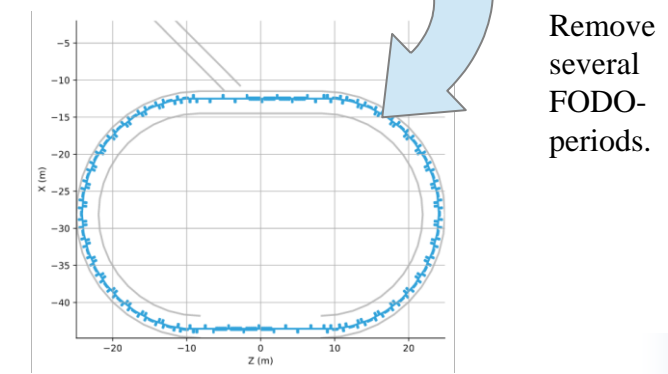
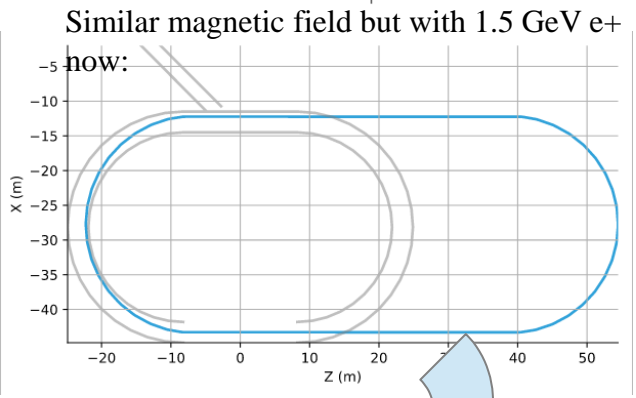
Particle tracking of the full distribution:



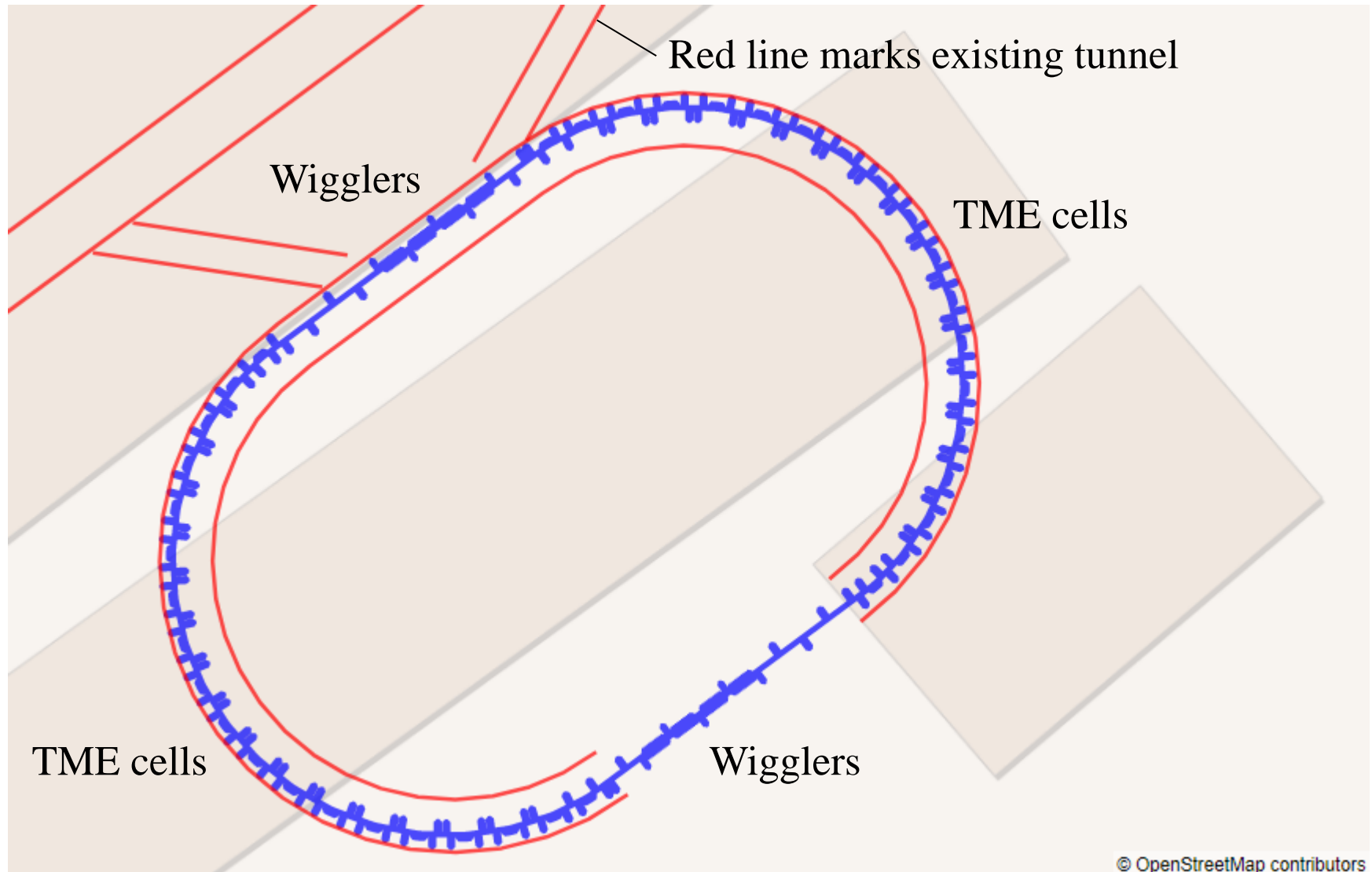
# Scaling down CLIC Pre-Damping Ring



Proportionally scale all elements



# Damping ring (scaled down [CLIC Pre-Damping Ring](#))



Damping times:  $\tau = 7.2$  ms,  $\tau = 3.5$  ms

Equilibrium emittance:  $\varepsilon = 6.3$  nm (including IBS)

# Positron bunch capture into the damping ring

