Istituto Nazionale di Fisica Nucleare
Laboratori Nazionali di Frascati

WP4 meeting
High Energy Damping Ring Developments

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Topics

FCC-ee Injector FS report status

Preliminary tracking results on HE DR

Some Longitudinal Beam dynamics considerations

Management and Manpower

A new collaboration agreement between INFN and CERN is in preparation:

- it will replace the Addendum FCC-GOV-CC-0205 (KE 4907) expired on past October,
- It must be compliant with the CHART 2025 – 2028 also under definition.

Simone Spampinati continues to contribute to WP4 thanks to an **associate contract** as well as Ozgur Etisken.

Selection to hire two new collaborators have been completed:

- Shalva Bilanishvili already started is contract
- Yongke Zhao still has to sign.

High Energy DR lattice

Three Options

1 Ring:
- FODO cell
- 3- fold symmetry (Ozgur)

2 Rings which are converging indeed
- 6-fold simmetry
- multibend arc cell
- Moderate use of wiggler magnets
- Moderate betatron oscillation amplitude

(Catia Antonio)

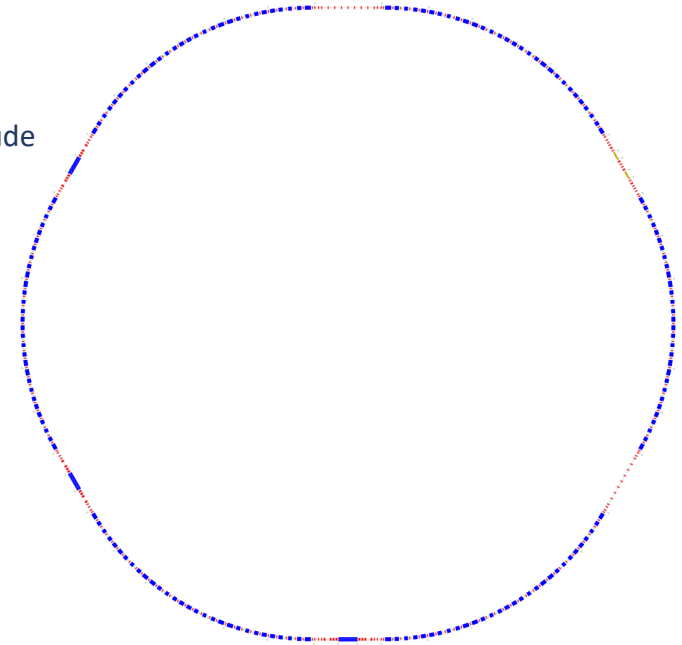

Table 7: Damping ring parameters.

Parameters	Value
Energy [GeV]	2.86
Circumference [m]	373.46
Arc Cell	multi-bend
Lattice shape	six-fold symmetry
H. emittance [nm rad] (WGL on/off)	1.3 / 2.3
Bunch Lenght	
Damping time τ_x (WGL on/off) [ms]	16.9 / 29.4
Nat. Cromaticity (x/y)	-38.2/-28.3
Nat. energy spread (WGL on/off) [10^{-4}]	7.1 / 5.2
Betatron amplitude max (x/y) [m]	9.66 / 6.49
Betatron amplitude min (x/y) [m]	0.5 / 1.1
Tune (Q_x,Q_y)	
Momentum compaction (WGL on/off) [10^{-3}]	1.55 / 1.57
Revolution period [μs]	1.2457
Dipole #, length [m], field [T]	179 , xx m, yy T
Wiggler #, length, field	3,3.5 m, 1.8 T
Cavity #, length, voltage	
Bunch # stored, charge	
Store time	
Energy loss per turn (WGL on/off) [keV]	422.2 / 246.7
SR power loss wiggler [kW]	
Kicker rise time [ns]	50

10 m

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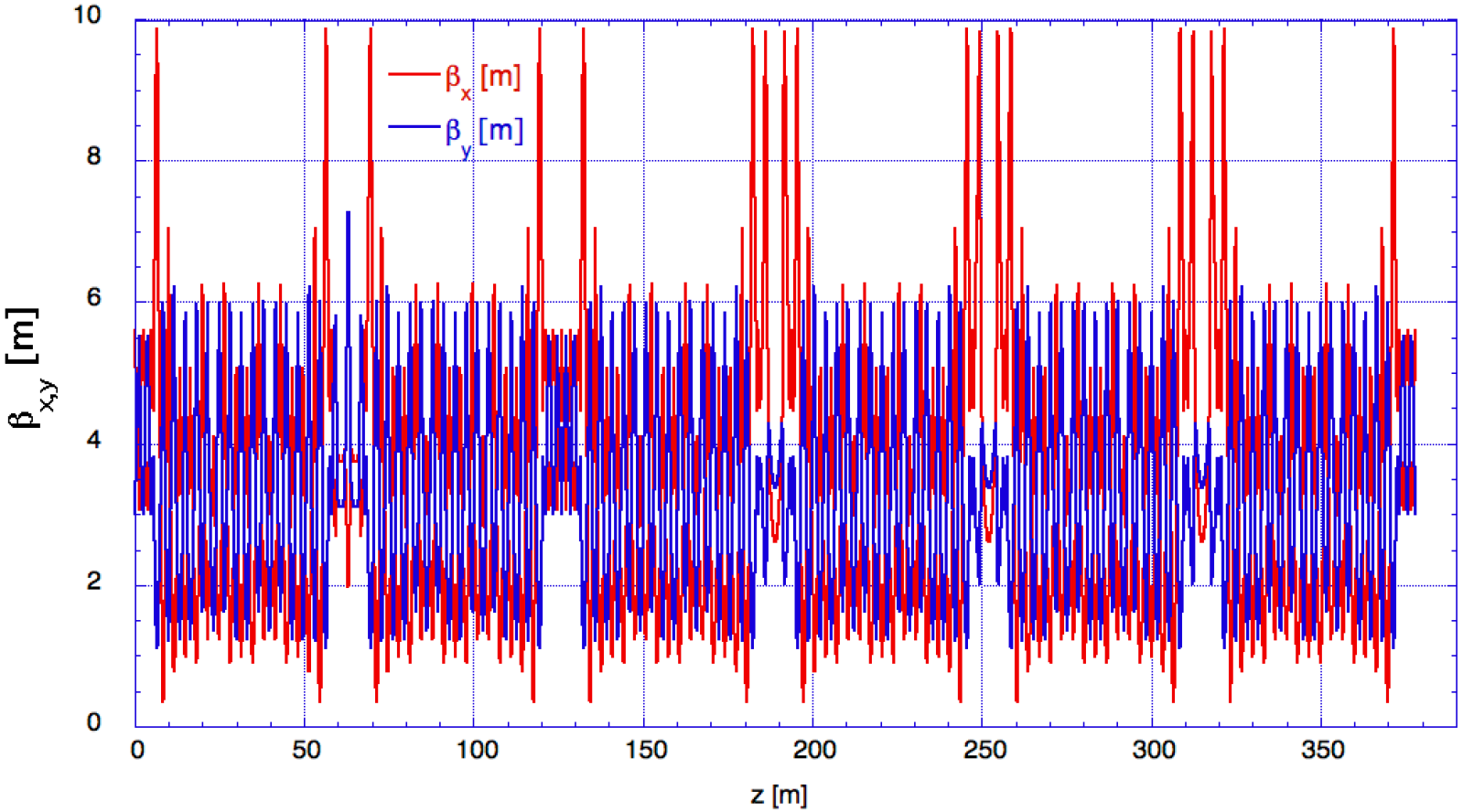
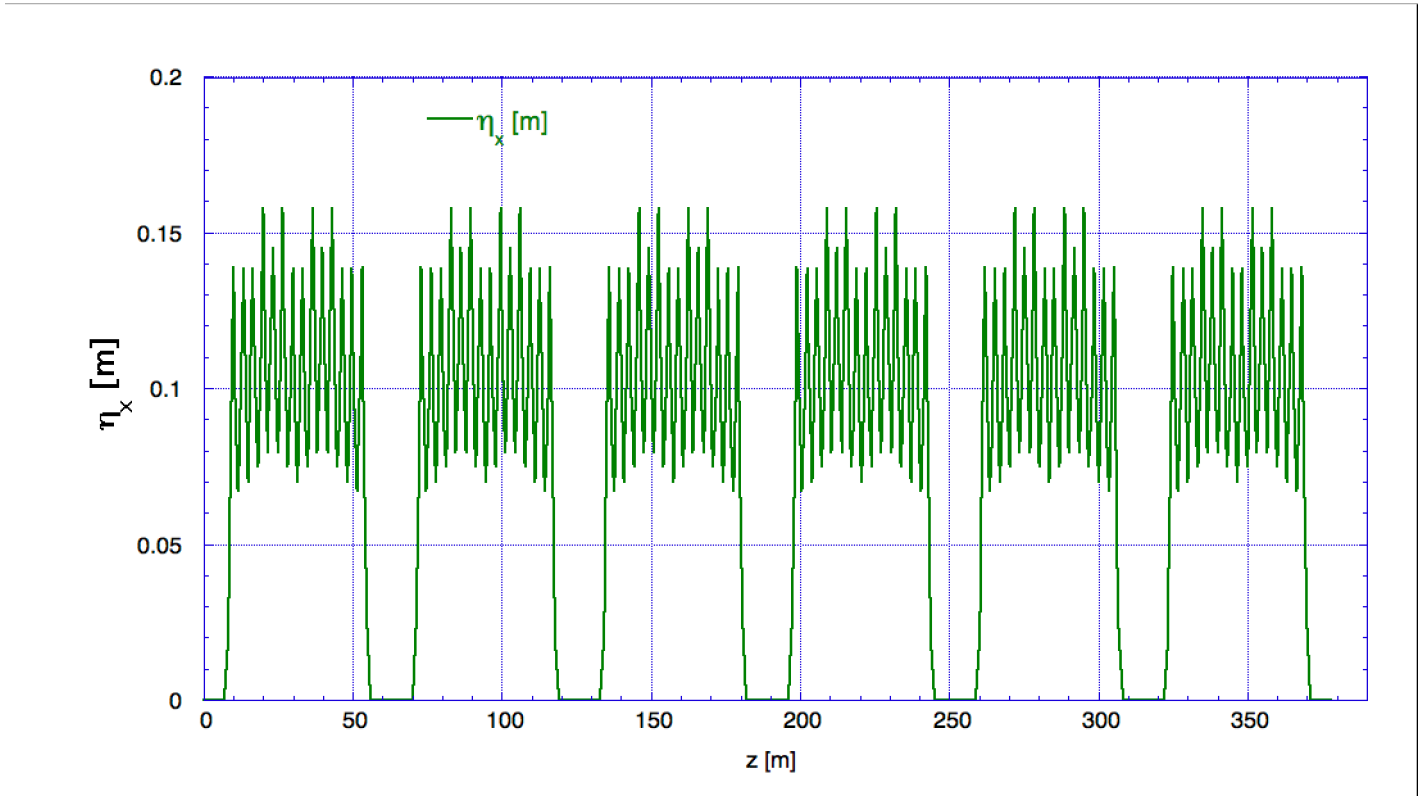
High Energy DR lattice

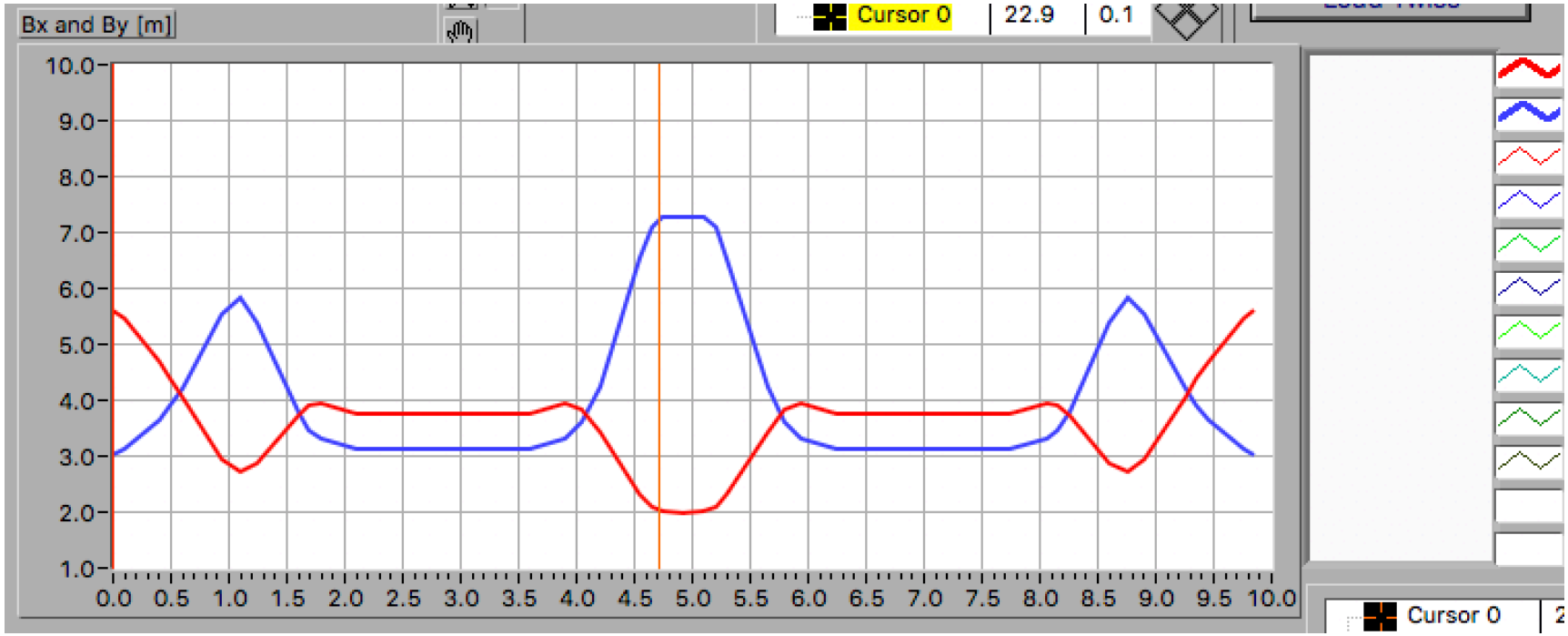


High Energy DR lattice



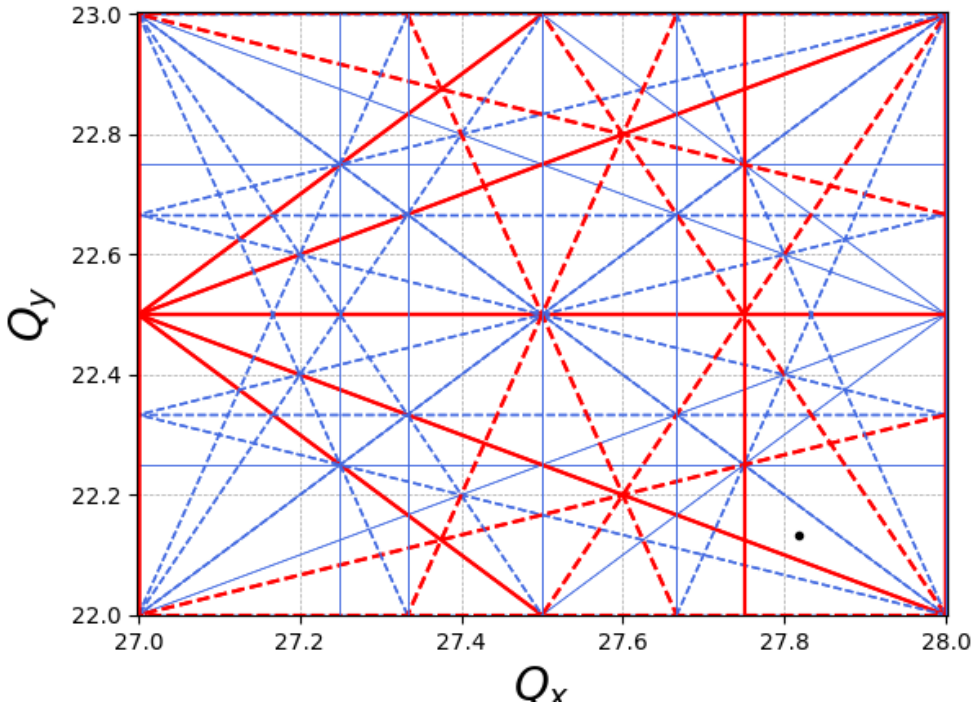
DR lattice update

RF section



Working Point Optimization

Q1 2.781730545e+01
Q2 2.213361228e+01



Preliminary tracking results

Tracking done using PTC in MAD-X

Linear Ring was tested scanning starting coordinates in the x, y place with the step of 1 mm on and off energy and tracking for 1000 turns

SXTs off DE = 0 DX(max) = +/- 18. mm
SXTs off DE = +/- 0.02 DX(max) = +/- 18. mm

SXTs off DE = 0 Dy(max) = +/- 18. mm
SXTs off DE = +/- 0.02 DX(max) = +/- 15. mm

Chromaticity correction strategy must be revised and optimized

DR Energy Acceptance

$$\left(\frac{\Delta E}{E_s}\right) = \pm\beta\sqrt{\frac{eV}{\pi h \alpha_c E_s}\mathcal{R}(\varphi_s)}$$

$$\mathcal{R}(\varphi_s) = [2\cos\varphi_s + (2\varphi_s - \pi)\sin\varphi_s]$$

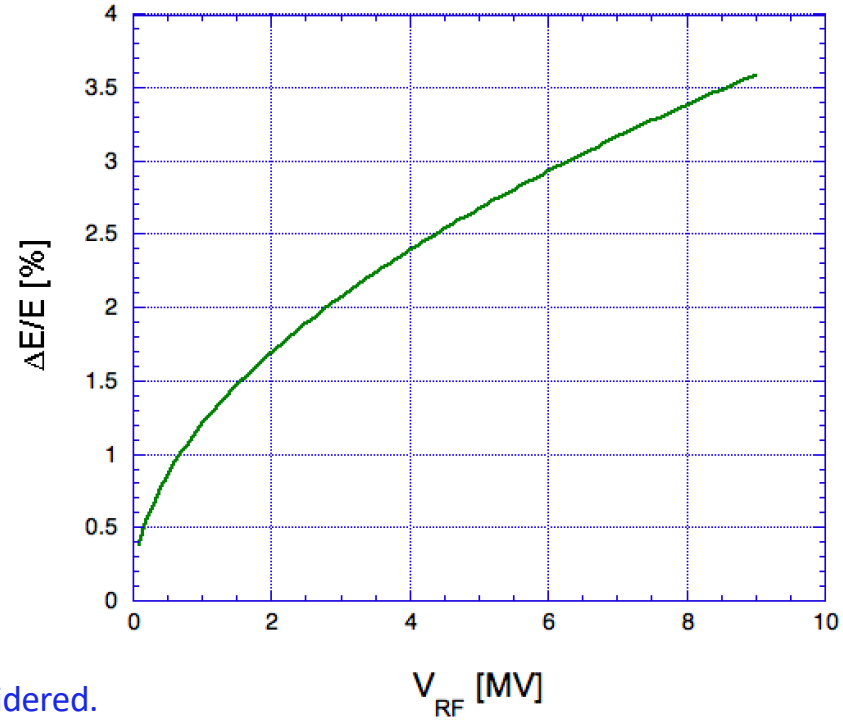
Assuming:

E_s = 2.86 GeV

L = 378.1415 m

α_c = 0.00155

$\boldsymbol{h = 504}$



SC RF cavities working at 400 MHz and providing at last 4 MV are considered.
Minimum RF cavity voltage request to compensate the energy lost per turn is

Longitudinal Beam Dynamics Parameters

	V= 4MV	V= 8MV
U_0 [KeV]	422.13	
DE	$0.7219 \cdot 10^{-3}$	
Ω_s [KHz]	10.4545	14.7849
T_0 [μsec]	1.26134	
ω_0 [s^{-1} rad]	4.98134E+6	
ν_s	0.00209874	0.002968
L_{bunch}[m]	**0.00511**	**0.00361**
φ_s [rad]	0.10573	0.0527913

Longitudinal Beam Dynamics Parameters

Assuming that each pulse from the e(p)LINAC consists of 4 bunches carryng at last 5 nC each, filling the DR with 10 pulses implies to reach the following upper limits:

Npart ~ 3.12075E+10

I_{bunch} ~ 0.00396402 A

I ~ 0.158561 A