e^+ QWT : Polarized mode

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Plan

Plan

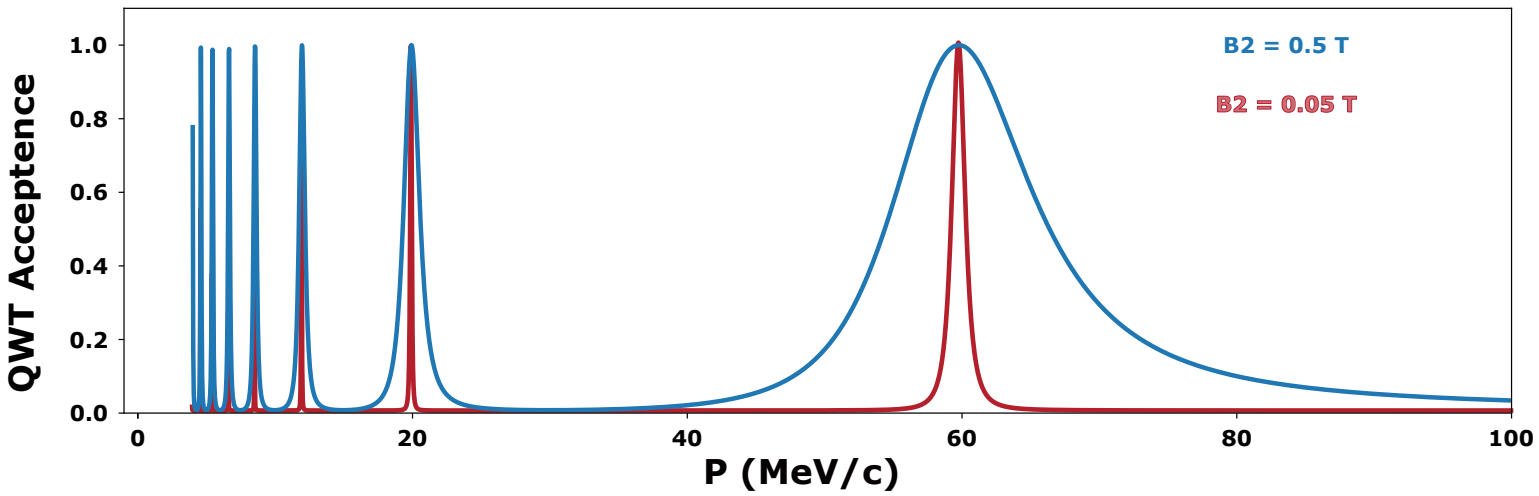
Previous results

Using optimized field combination in the QWT we were able to :

- Decrease the angular transverse spread.
- Rotate the transverse phase space (x, xp) and (y, yp) at the exit of the QWT.

- **Polarized mode**
  - $B_1 = 2.5\ T$
  - $B_2 = 0.5\ T$
  - $L_1 = 0.35\ m$
  - $L_2 = 5.1\ m$
- **Cavities configuration**
  - $f = 1497\ Mhz$
  - $E = 1\ MV/m$
  - $L_{cell} = 0.2\ cm$

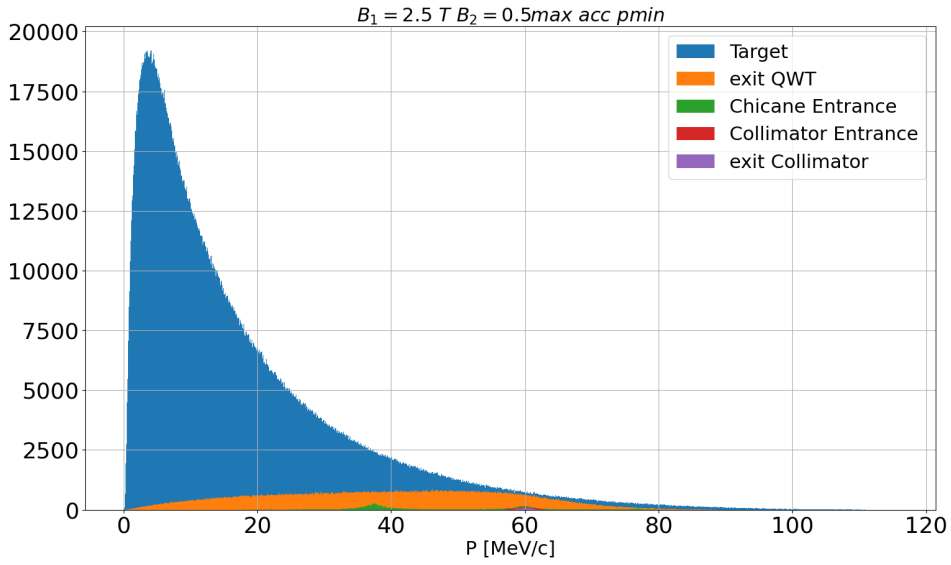
Second solenoid



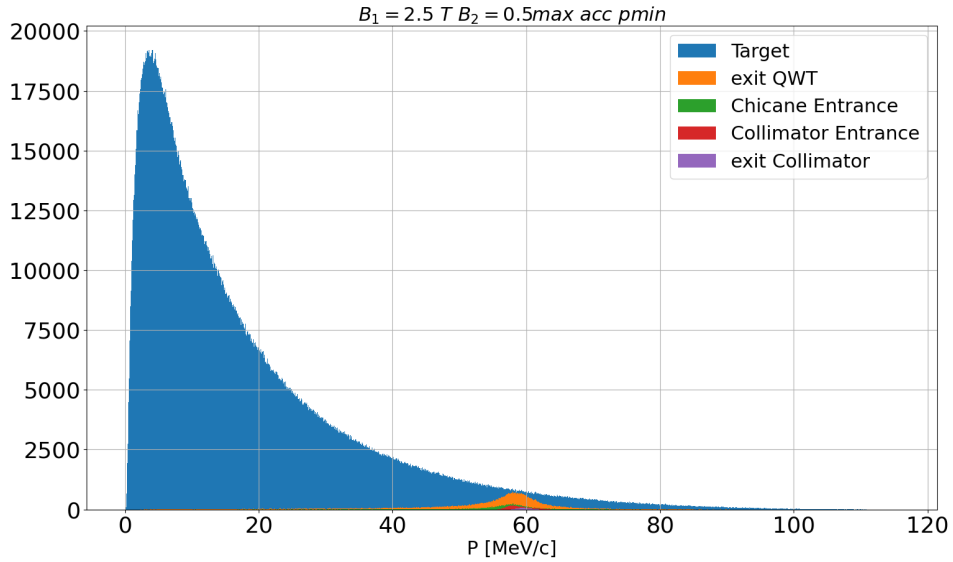
- We want to collect a small dp/p
- The variation of B_2 is important to set the energy dispersion.
- Using $B_2 = 0.05\ T$, reduce the narrow harmonics.

Second solenoid

- As expected, the QWT works as an energy filter
- Because od the harmonics function in the QWT volume acceptance, particles at lower energies goes through the collection system.



$B_2 = 0.5\ T$



$B_2 = 0.05\ T$

Beam line parameters

Params	Value
E_{e^-}	120 MeV
Target thickness	4 mm
QWT : B_1	2.5 T
QWT : L_1	0.25 m
QWT : B_2	0.05 T
QWT : L_2	5.4 m
Frequency	1497 Mhz
Cavity Gradient	1MV/m
Cavity length	0.2 m
Matching section	4 quadrupoles
Matching section: quad length	0.15 m
Matching section : Q_1	0.0276 kG/cm
Chicane dipole length	0.5 m
Beam pipe radius	0.03 m
collimator radius	0.012 m

Accelerating section

Cavities configuration

- $f = 1497\ Mhz$
- $E = 1\ MV/m$
- $L_{cell} = 0.2\ cm$
- $r_{cell} = 3\ cm$

Goal

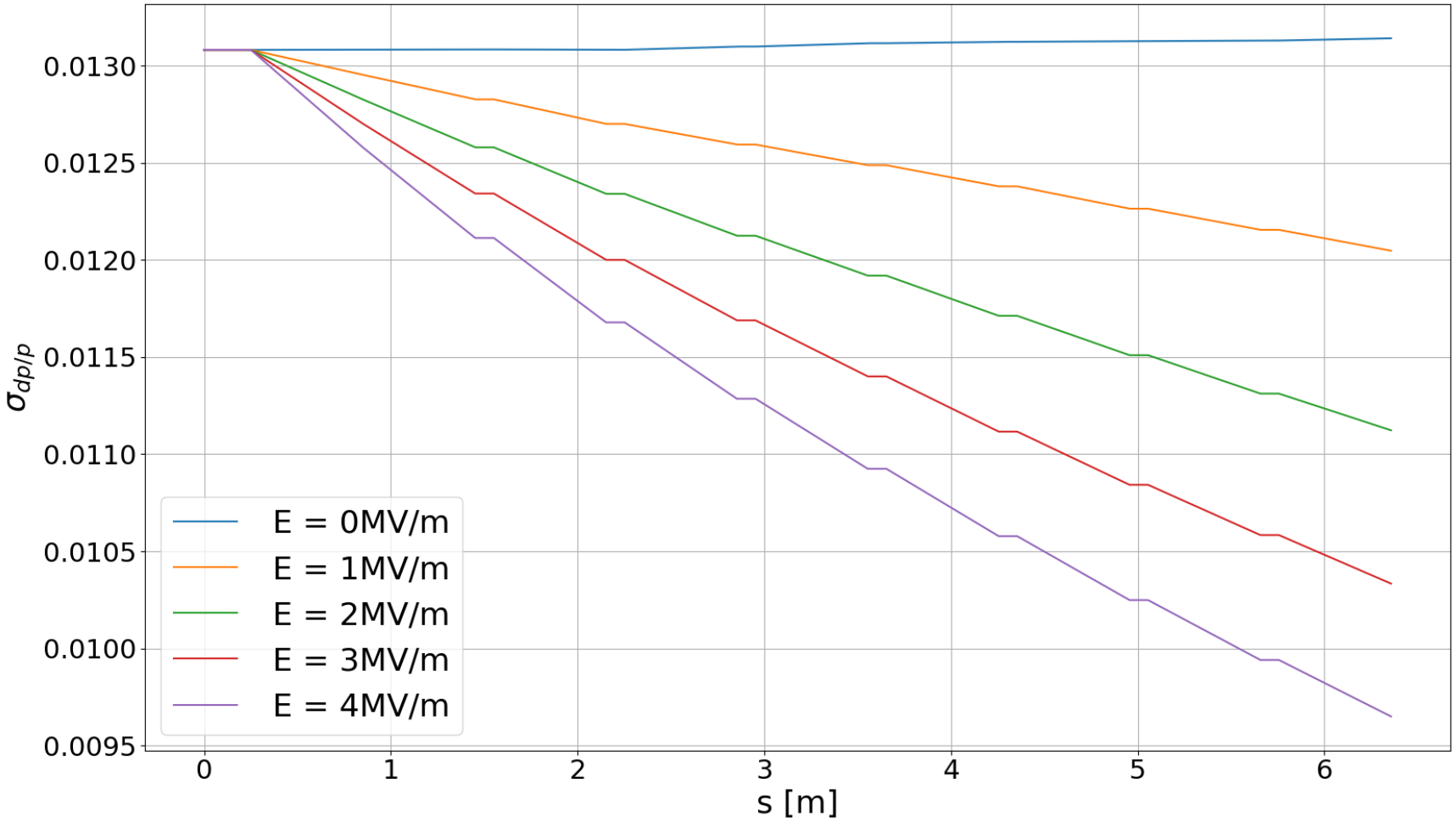
- Reduce the energy spread of the accepted e^+ @ p = 60 MeV/c

Optimization method

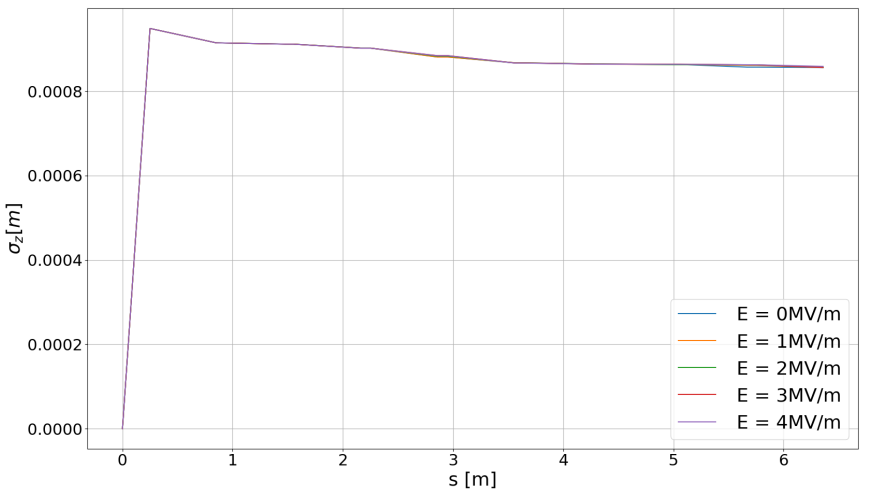
- Track e^+ distribution using the QWT and the accelerating section.
- Set the on-crest mode to the smallest momentum.
- A different Off-crest phases is used.

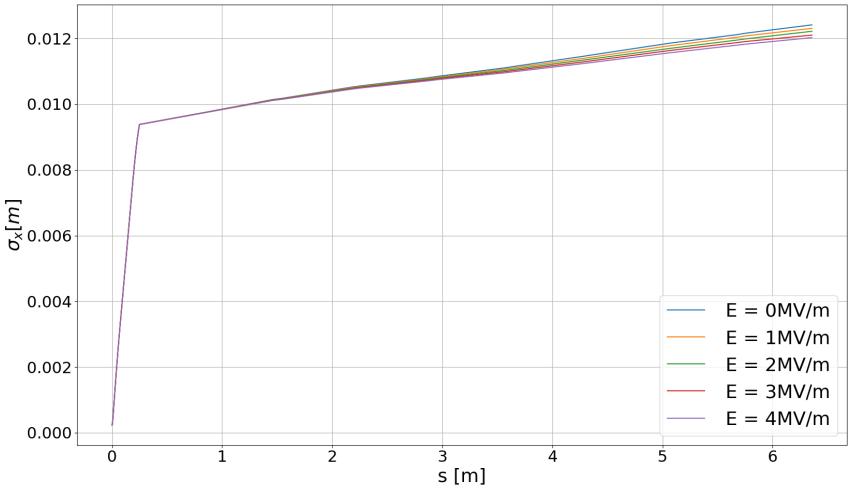
Plan

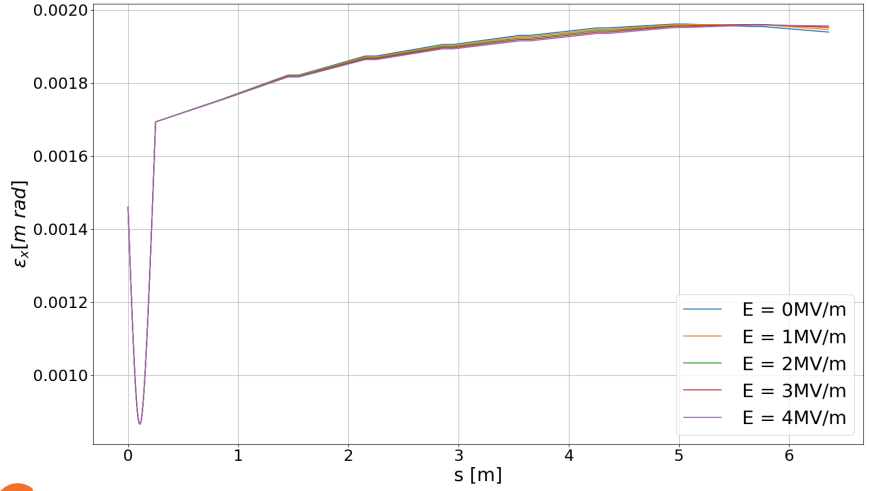
Accelerating section : Comparison

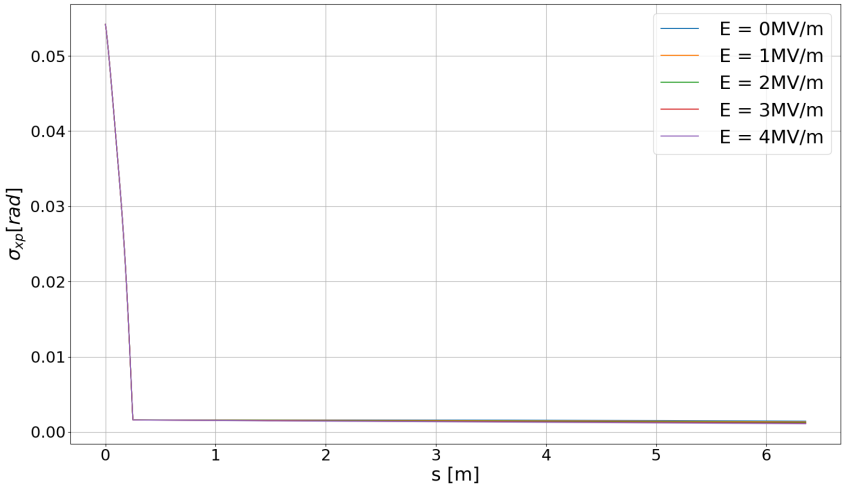


Accelerating section : Comparison





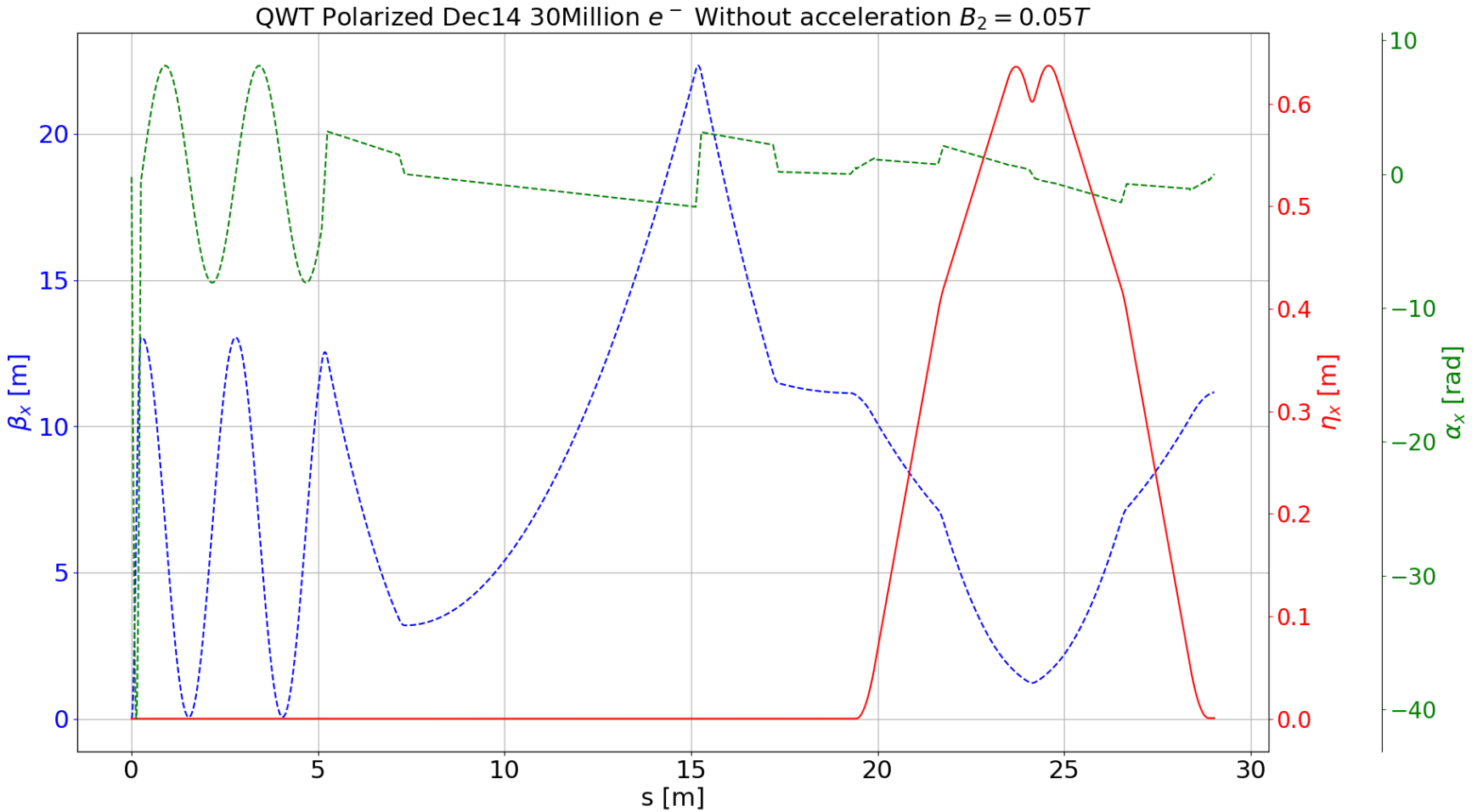




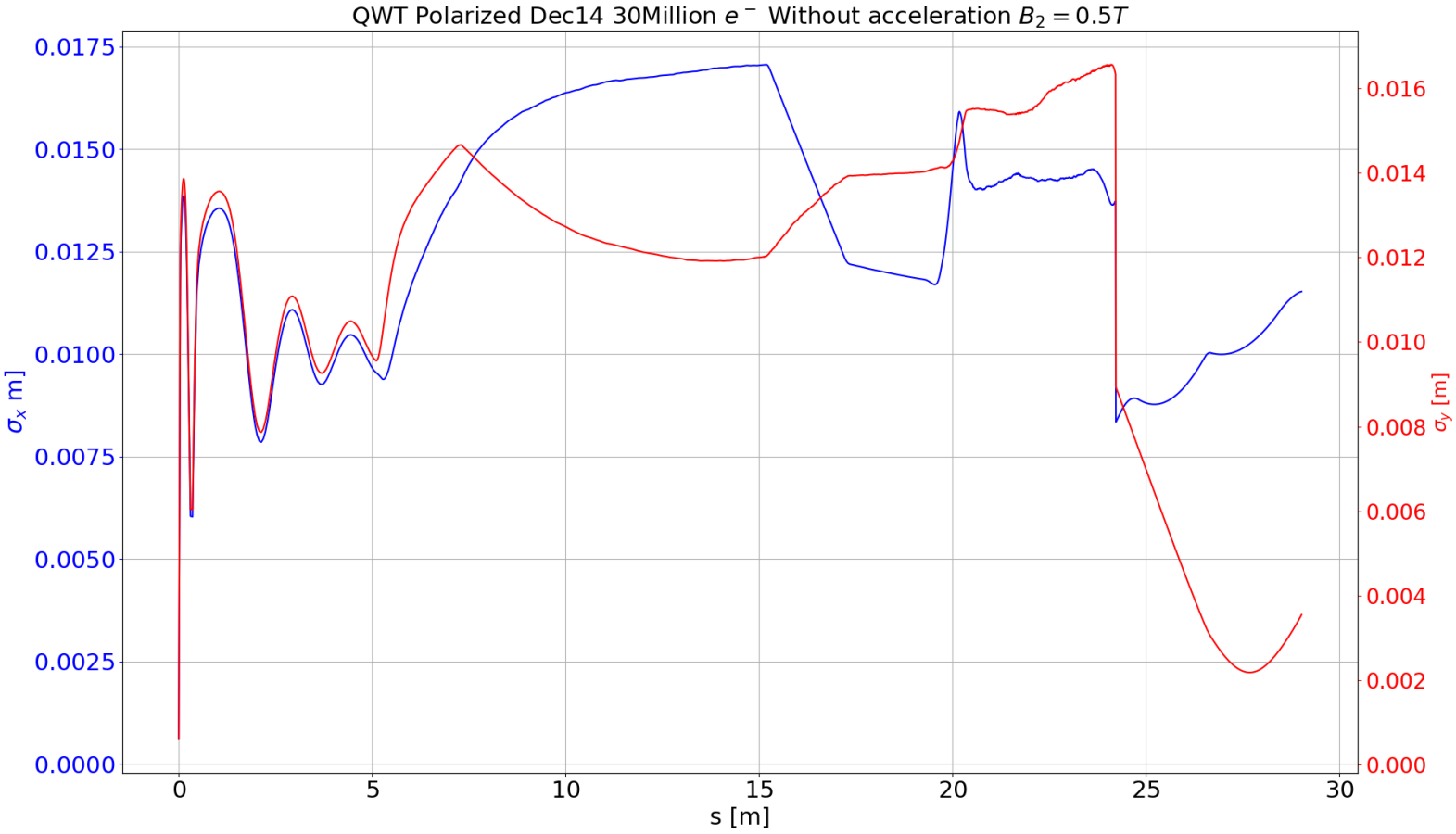
Matching section + Momentum colimation

- We use at least to shape the twiss parameters from the exit of the accelerating section.
- A chicane will be used in order to separate e^- from e^+, and to create a dispersion.
- A circular collimator of $R = 1\ cm$ is used to select positrons around p $= 60$ MeV/c.

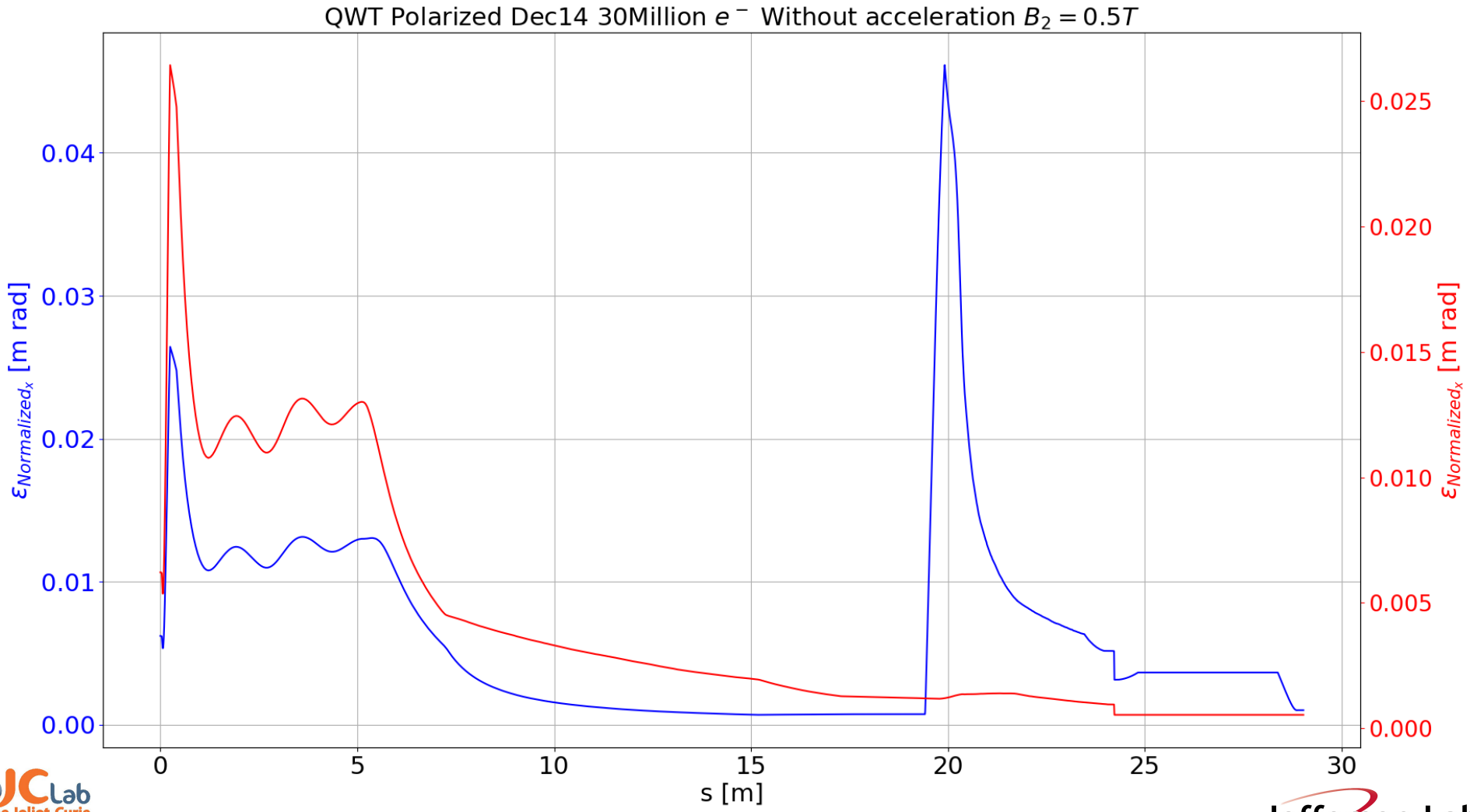
Optics


QWT Polarized Dec14 30Million e^- Without acceleration $B_2 = 0.05T$
β_x [m]
η_x [m]
α_x [rad]
s [m]
0
5
10
15
20
25
30
0.0
0.1
0.2
0.3
0.4
0.5
0.6
10
0
−10
−20
−30
−40

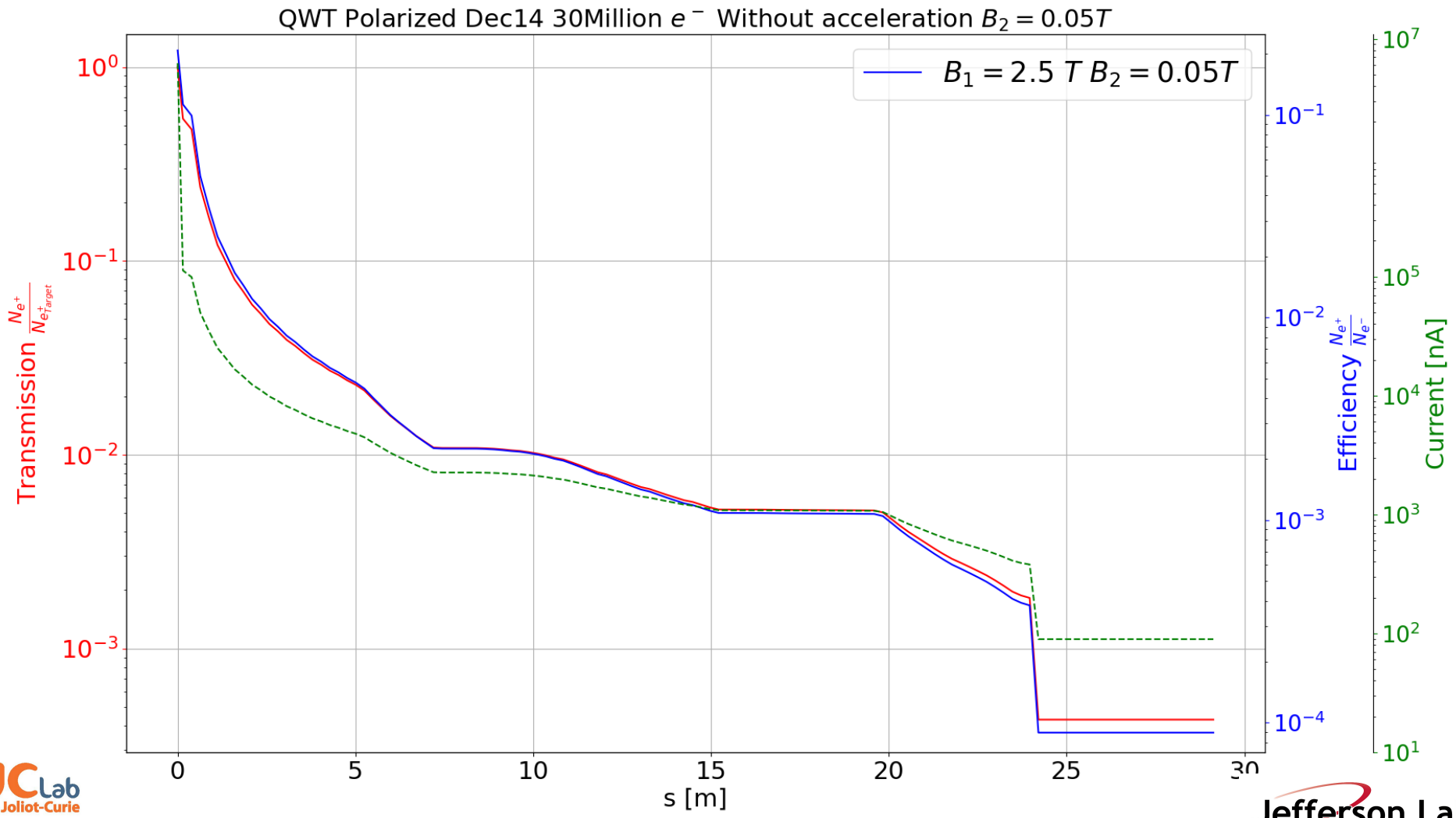
Beam size


QWT Polarized Dec14 30Million e^- Without acceleration $B_2 = 0.5T$
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
σ_x m]
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
σ_y [m]
0
5
10
15
20
25
30
s [m]

Normalized emittance



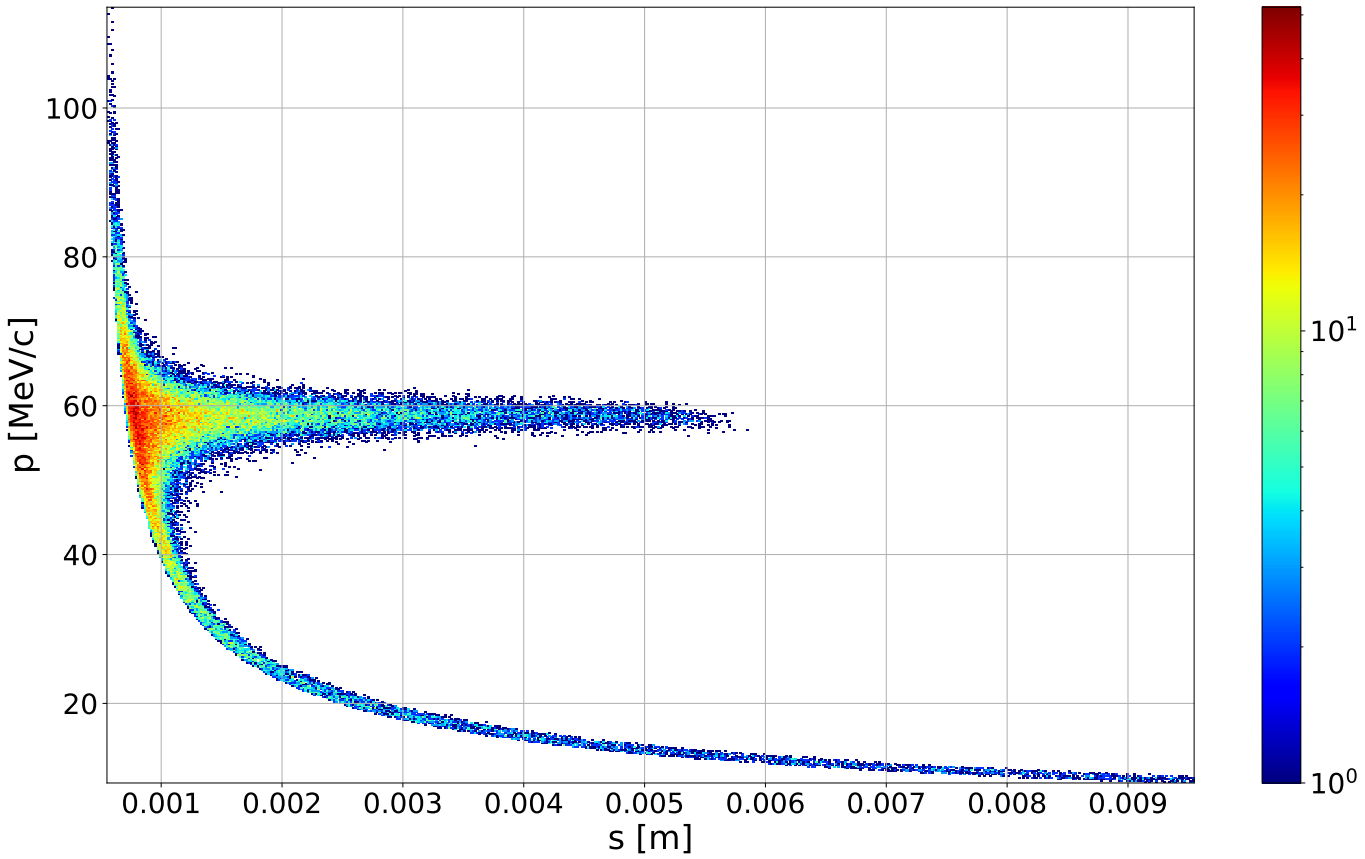
Transmission and current



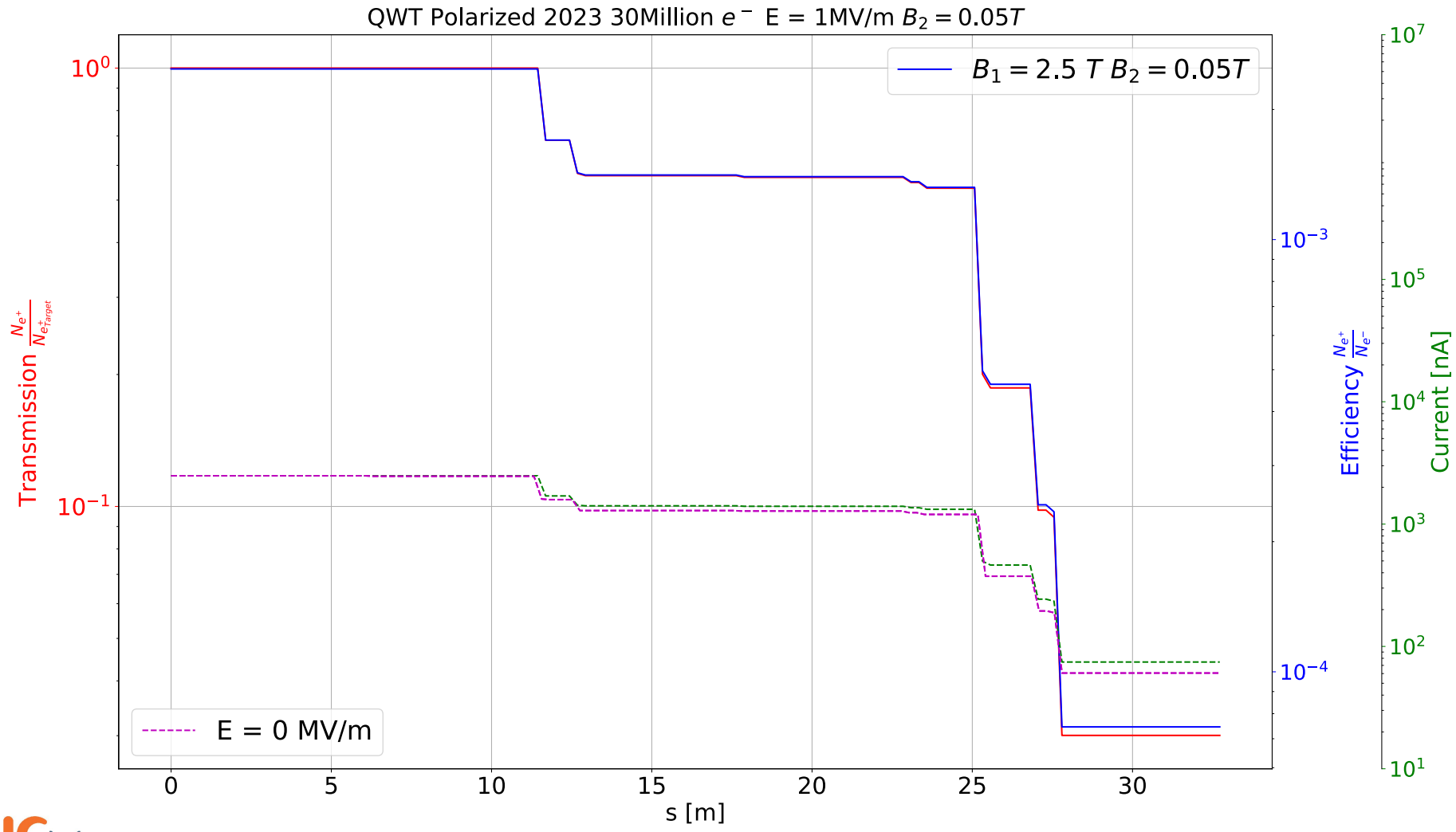
Plan

e^+ within one bunch

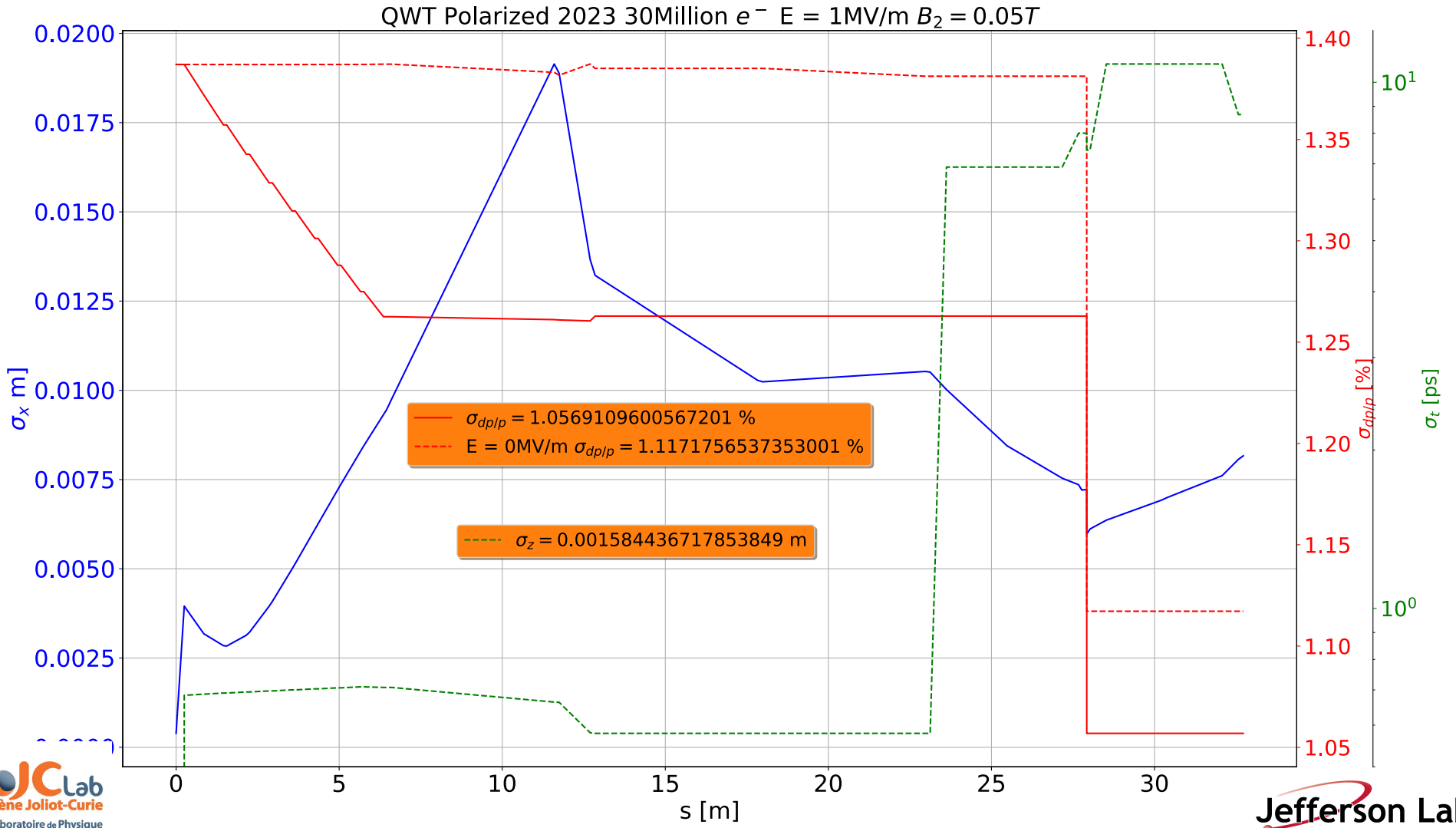
- Identification of the first bunch
- tracking of e^+ within one period
- At the exit of the QWT + AS (1MV/m):



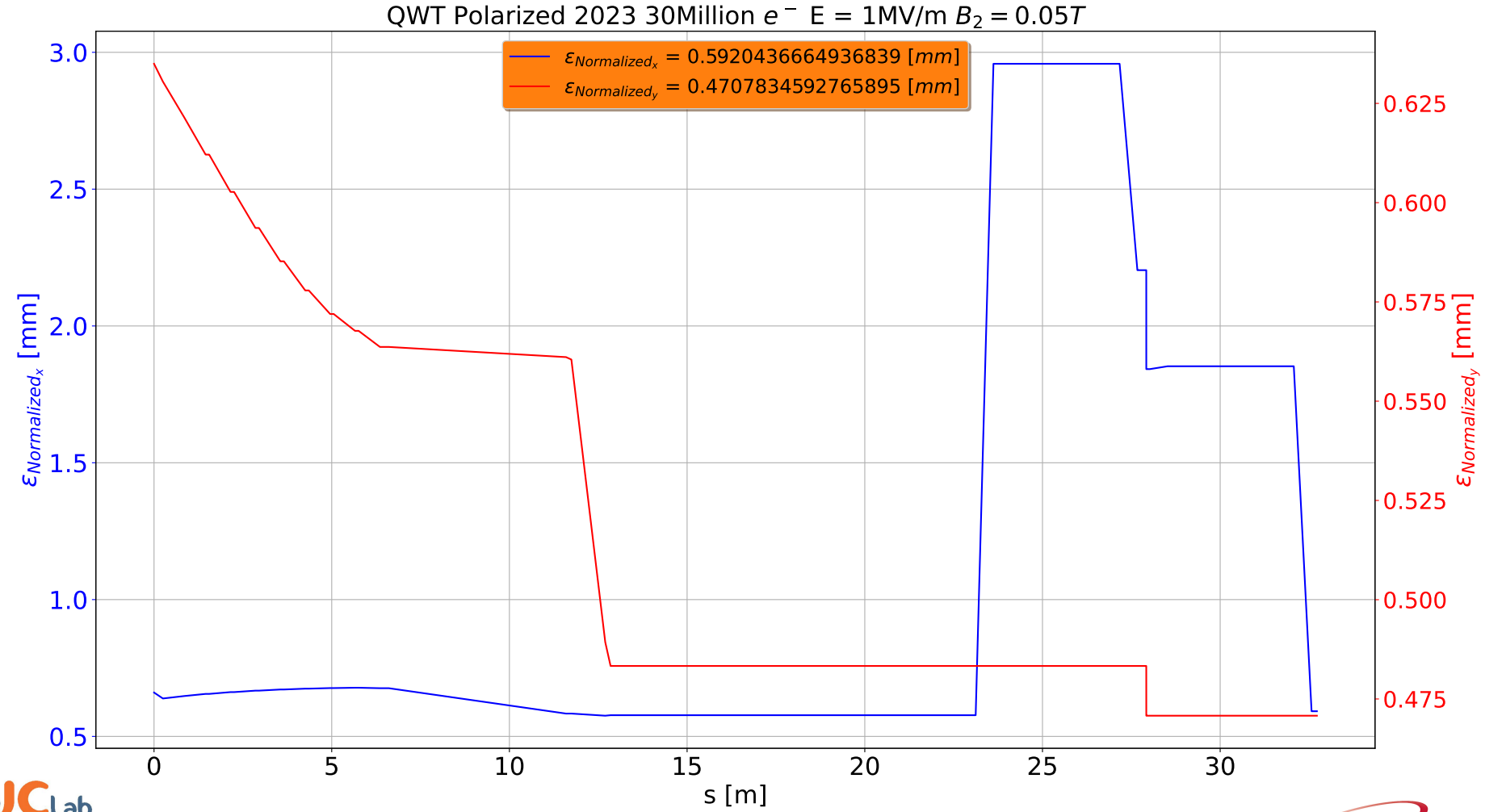
Transmission and current



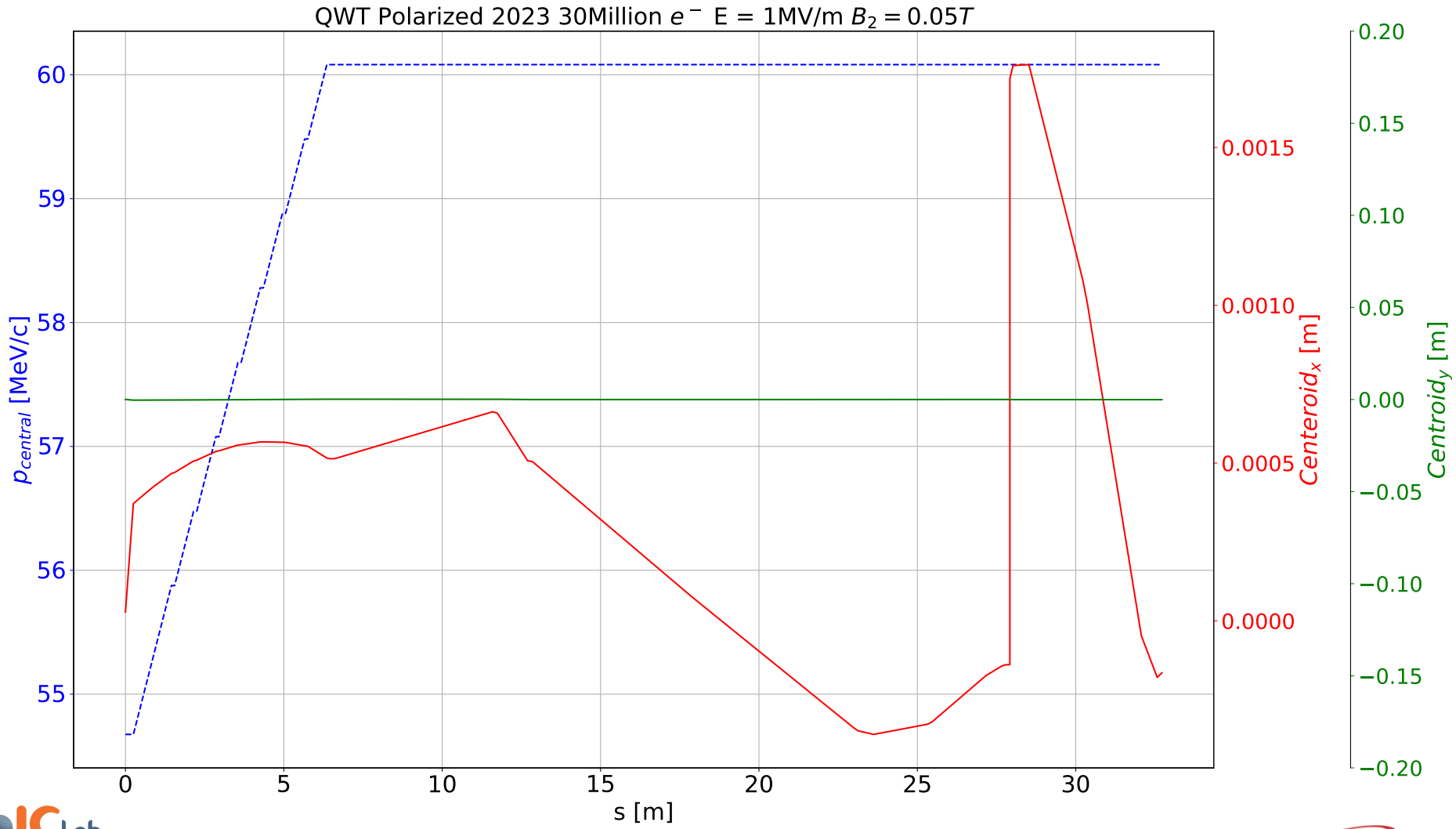
Bunch length and energy spread



Normalized emittance



Reference particle



Summury

Params	Target Exit one period	1st chicane exit	C100 exit
$\sigma_{dp/p}$ [%]	1.3870	1.0569	0.6
$\sigma_z[m]$	0.0002	0.0026	0.003
$\sigma_x[m]$	0.0028	0.0081	
σ_{xp} [rad]	0.0021	0.0007	
N $\epsilon_x[mm]$	0.66	0.592	25
N ϵ_y [mm]	0.63	0.47	25
p Central [MeV/c]	55	60	123
e^+	2482 nA	98 nA	

Plan

Conclusion

- The solnoid B_2 set the energy spread collection.
- An off-crest acceleration has been done to reduce the dp/p.
- The electric gradient 1 MV/m allow to reduce the energy spread by 10 %.
- The accelerating section has no effect on σ_z, σ_x, σ_{xp} and $\epsilon_{x,y}$.
- After a momentum collimation, we reach $I_{e^+} \approxeq 100nA$.
- The collected positrons at the exit of the chicane match with the C100's acceptances.
- We can't make any statement before using the first chicane to select the wanted central momentum, but we already know the accepted particle distribution that we have to transport to the CEBAF.