QWT for Un-polarized mode

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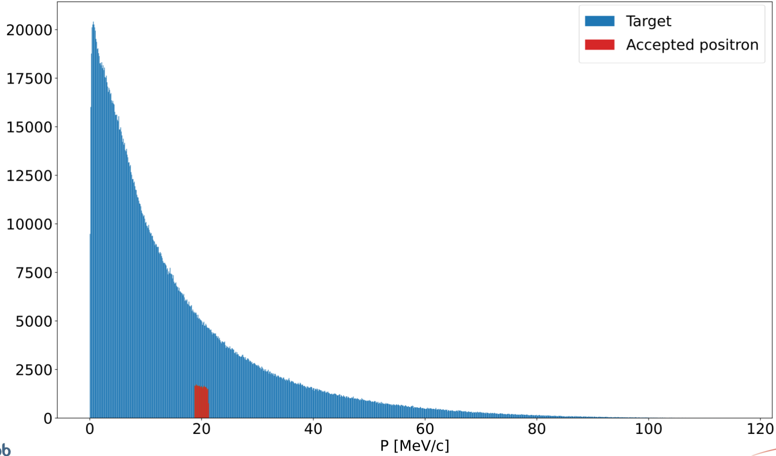
October 2022

QWT for unpolarized mode

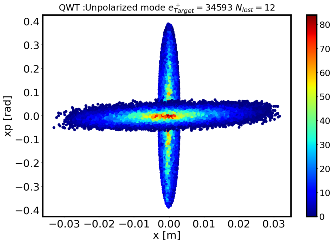
- For the Un-Polarized mode, we have set the central momentum at 20 MeV/c and used a momentum cut of 18 MeV/c to 22 MeV/c.
- The QWT parameters are :
  - $B_1 = 1.9$ T
  - $L_1 = 0.11$ m
  - $B_2 = 0.2$ T
  - $L_2 = 9.1$ m
  - $r_0^{max} = 0.0015$ m
  - $\theta_0^{max} = 0.18$
- Only e^+ contained inside the accepted red ellipse will be transmitted at the exit of the QWT.

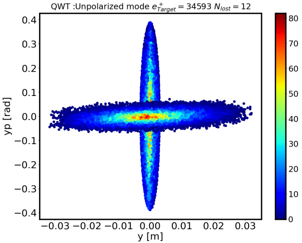
QWT for unpolarized mode



QWT for unpolarized mode: QWT Exit

- $\pi/2$ rotation with the optimized QWT for $p_{central} = 20\ MeV/c$



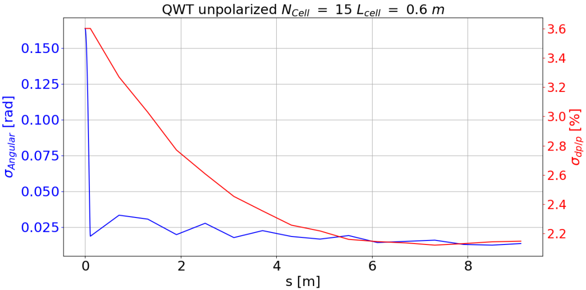


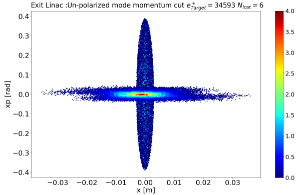
- Can we optimize the energy spread by keeping the $\pi/2$ transverse rotation?

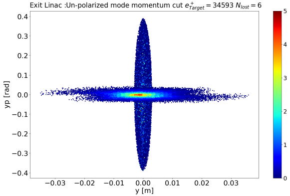
QWT for unpolarized mode: Cavity optimization

- We have two sets of cavities:
  1. $f = 500\ Mhz$, Radius aperture = 75 mm, E = 4 MV/m.
  2. $f = 1497\ Mhz$, Radius aperture = 30 mm, E = 1 MV/m.
- Optimization methods:
  1. Extract the distribution at the Exit of the short solenoid.
  2. Identify the fastest and the slowest particle.
  3. Convert the time coordinate of the slowest particle to a phase value using the period $T_{period} = \frac{2\ \pi}{f}$
  4. Set the cavity phase at $\frac{\pi}{2}$ − phase of the slowest particle.
  5. The slowest particule will see the highest gradient and will get accelerated more than others.
  6. Using the same long solenoid $L_2 = 9.1\ m$, we will get $4\ MV/m \times 9.1\ m = 36.4\ MeV$ acceleration.

QWT for unpolarized mode: Cavity optimization



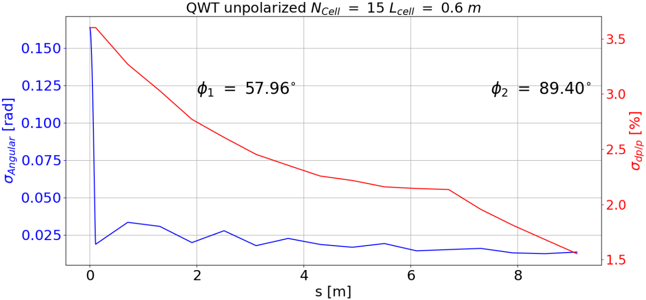


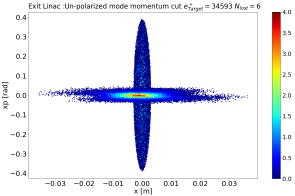


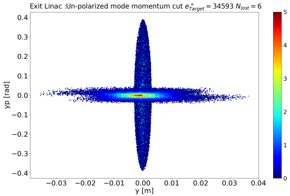
QWT for unpolarized mode: Cavity optimization

- Using the optimal phase, we can reduce the dp/p by almost a factor of two.
- What if we use different phases?
- New configuration:
  1. Same phase over $L_2 = 6\ m \longrightarrow \phi_1 = 57.96^\circ$
  2. New optimization from $L_2 = 6\ m$
  3. We repeat the same previous procedure.
  4. $\phi_2 = 89.40^\circ$

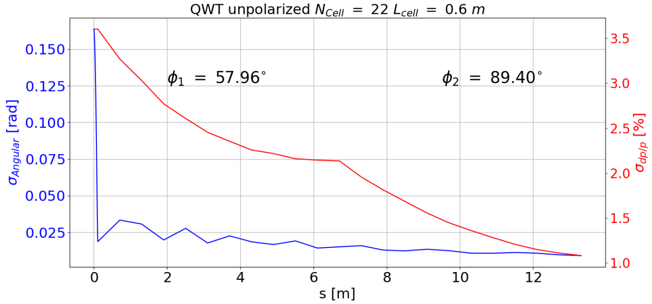
QWT for unpolarized mode: Cavity optimization

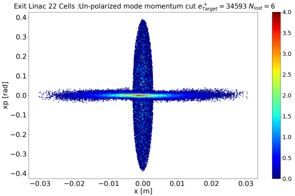


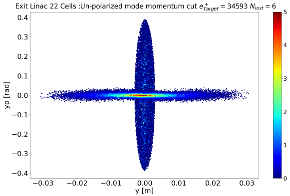




QWT for unpolarized mode: Cavity optimization







Conclusion

- The QWT does not affect the longitudinal beam parameters.
- The cavities provide acceleration in the longitudinal plane and do not affect the QWT.
- Optimizing the cavity's phase improves the energy spread.
- Need high potential gradient to improve the energy spread and keep the Linac as short as possible.
- My expectation at the entrance of the compression chicane:
  - $\sigma_{dp/p} = \pm 1\%$
  - Bunch length : $\sigma_{\Delta_t} = 1\ ns$
  - Energy = 120 MeV
  - $Yield_{\ Unpolarized} = 1.4\ 10^{-3}$

My positron injector design diagram

Positron injector design

PROJECT	[Positron Injector design]		[JLab]
	[Sami Habet]	DATE	01/10/22

Number	Task Title	Start Date	DEAD LINE	DURATION	Done Tasks (%)
1	**Conception et mise en route du projet**				
1.1	QWT optimization	24/10/22	28/10/22	4	90 %
1.1.1	AMD optimization	26/10/22	30/10/22	4	50 %
1.2	Linac collection	31/10/22	04/11/22	4	70 %
1.3	1st chicane length reduction	05/11/22	07/11/22	2	20 %
1.4	Momentum selection	08/11/22	11/11/22	3	30 %
1.5	Compression chicane	14/11/22	19/11/22	5	50 %
1.6	Test layout	21/11/22	25/11/22	4	20 %