

ThomX presentation: Injection

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Injection diagram

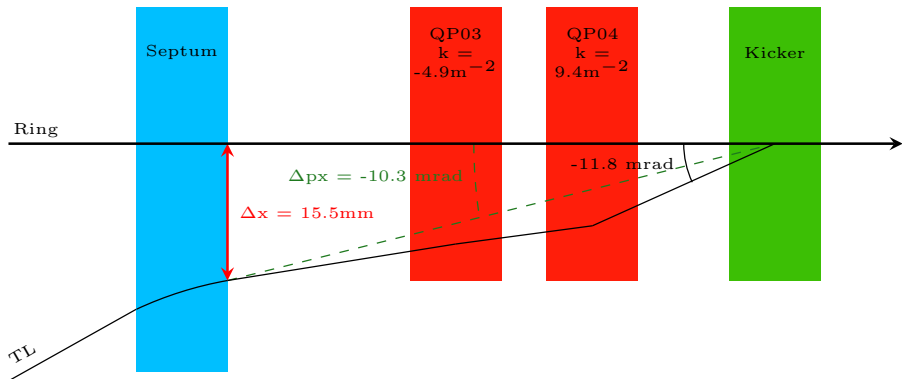


Figure: Diagram of beam injection on ThomX ring

At the end of the septum, the beam followed a reference path that is not the one of the ring. This leads to deviation of the beam in the quadrupoles QP03 and QP04 because it does not pass along their magnetic center. I chose to take it into account by doing a change of frame at the exit of the septum :

- $\mathbf{x} \rightarrow \mathbf{x} + \Delta \mathbf{x}$
- $\mathbf{p}_x \rightarrow \mathbf{p}_x + \Delta \mathbf{p}_x$

Test of frame change

Tests have been done to simulate the propagation of a particles from the end of the septum to the end of the kicker with :

- No frame change, ie :
 - ▶ $x_{\text{septum}} = 15.5 \text{ mm}$
 - ▶ $px_{\text{septum}} = -10.3 \text{ mrad}$
 - ▶ $\Delta x_{\text{septum}} = 0 \text{ mm}$
 - ▶ $\Delta px_{\text{septum}} = 0 \text{ mrad}$
- Frame change, ie :
 - ▶ $x_{\text{septum}} = 0 \text{ mm}$
 - ▶ $px_{\text{septum}} = 0 \text{ mrad}$
 - ▶ $\Delta x_{\text{septum}} = 15.5 \text{ mm}$
 - ▶ $\Delta px_{\text{septum}} = -10.3 \text{ mrad}$

Exactly the same results have been found each time.

Test of sensibility

First optimum found

Optimisation of parameters with x -offset of 15.5 mm	
at septum's exit	$x = 15.5 \text{ mm}$
	$px = -10.3 \text{ mrad}$
Kick	$\Delta px = 11.8 \text{ mrad}$
at kicker's exit	$x < 10^{-6} \text{ m}$
	$px < 10^{-3} \text{ mrad}$

15.5mm is the theoretical length between center of both septum cavity, hence it is the theoretical offset from transfer line's to ring's trajectory of references.

Parameters found for the first test of change of frame with x -offset of 14 mm.

Optimisation of parameters with x -offset of 14 mm	
at septum's exit	$x = 14 \text{ mm}$
	$px = -9.3 \text{ mrad}$
Kick	$\Delta px = 10.7 \text{ mrad}$
at kicker's exit	$x < 10^{-6} \text{ m}$
	$px < 10^{-3} \text{ mrad}$

Test of sensibility with different initial settings

Case x -offset = 14 mm

An offset on x of 1 mm at the entrance of the ring leads to an offset of approximately 1 mm on the ring.

Modification of x at septum exit		
x (mm)	Δx (% of x)	x, px at kicker exit
$x = 14.14$ mm	$\Delta x = 1\%$	$x = 0.1$ mm
		$px = -0.15$ mrad
$x = 13.3$ mm	$\Delta x = -5\%$	$x = -0.6$ mm
		$px = 0.7$ mrad

x and px error have similar impact on beam position after the kicker

Modification of px at septum exit		
px (mm)	Δpx (% of px)	x, px at kicker exit
$px = -9$ mrad	$\Delta px = 3.5\%$	$x = 0.44$ mm
		$px = -0.1$ mrad
$px = -9.5$ mrad	$\Delta px = -1.8\%$	$x = -0.22$ mm
		$px = 0.073$ mrad

A 1% error in px at the exit of the septum seems to have less consequences than a 1% error in x .

Conclusion

- To simulate correctly the beam comportment during the injection on the ring, a frame change is used at the exit of the septum.
- Some comparison have been done to check the coherence of this method
- Optimal parameters found for theoretical beam propagation
- Test of stability have been done to characterize error maid on the beam position during injection

Next step :

- Create a code to correct automatically septum's and kicker's parameters given RI-BPM2 and RI-BPM3 offset measure
- Wait for correct lattice to simulate the transfer line (Ezgi/Christelle)