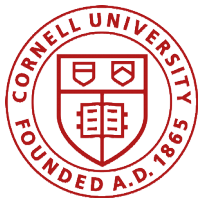


Cornell Laboratory for
Accelerator-Based Sciences
and Education (CLASSE)

Symmetric TTOSC Bypass

Michael Ehrlichman

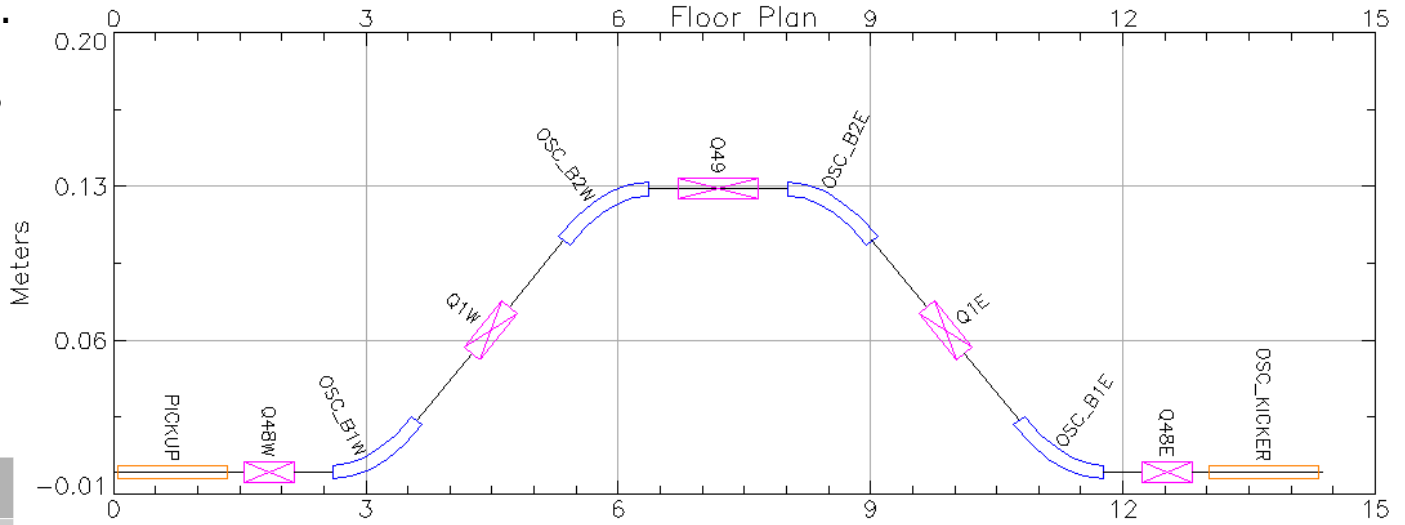
Layout & Twiss

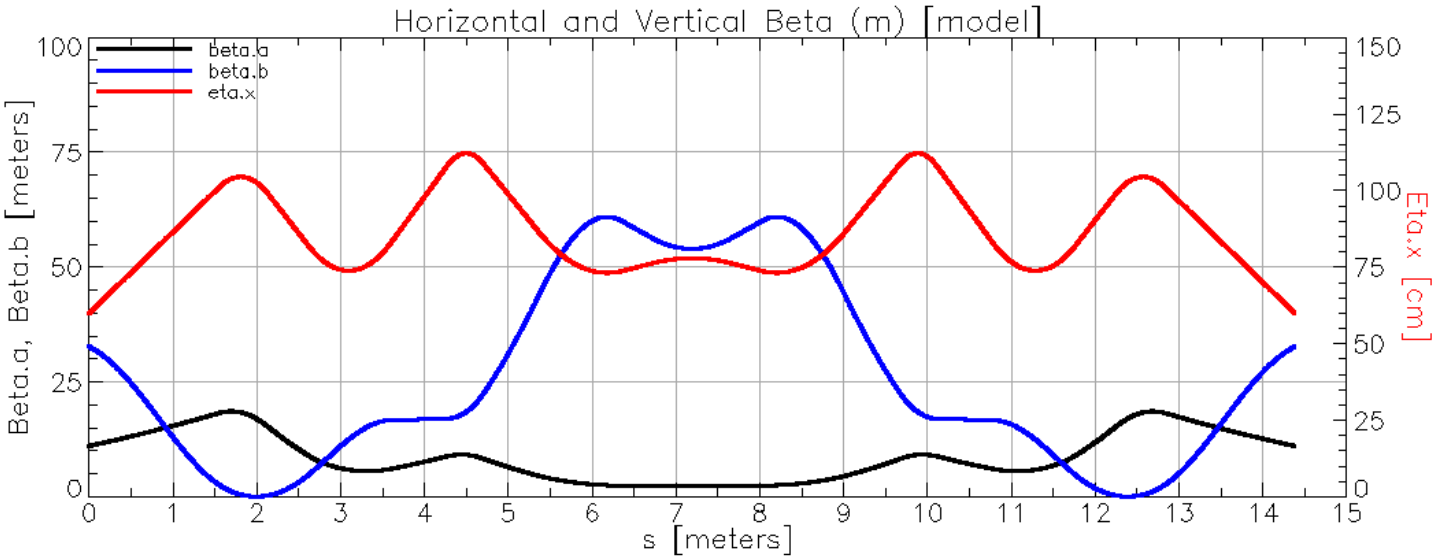
- Small adjustments to drift lengths to symmetrize layout.

- Moments are symmetric.
- 5.3 mm Δs shown
- ν_x, ν_y = 137.45°, 354.15°

- M_{51} = 0.0069
- M_{52} = -0.051
- M_{56} = 0.0082

Name	Prop	Strength
Q48	K_1	0.9996
OSC_B1	angle (deg)	-2.683
OSC_B1	K_1	-1.009
Q1	K_1	1.429
OSC_B2	angle (deg)	2.683
OSC_B2	K_1	-0.4717
Q49	K_1	0.1908





Sample Lengthening Parameters

- Recall sample lengthening metrics:

action: $$\sigma_{\Delta s\epsilon}^2 = J \underbrace{\left(\beta_p M_{51}^2 - 2\alpha_p M_{51} M_{52} + \gamma_p M_{52}^2\right)}_{\tilde{J}}$$

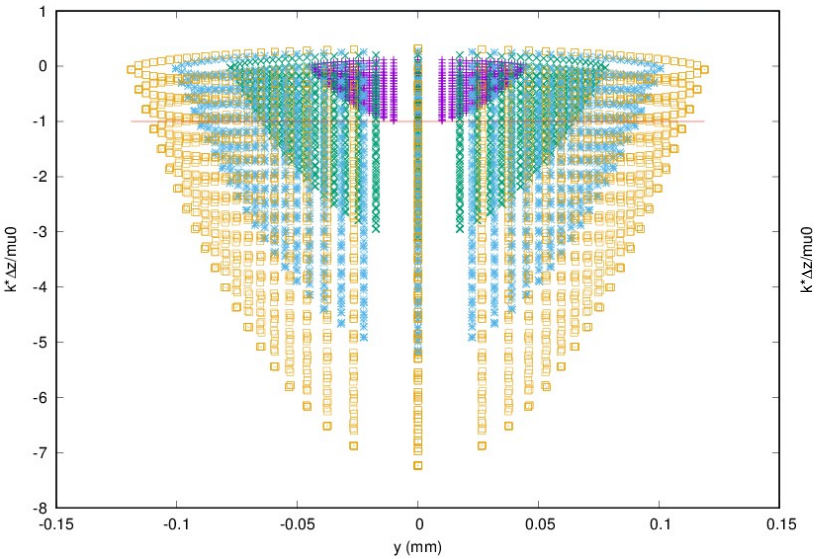
energy: $$\sigma_{\Delta sp}^2 = \left(\frac{\Delta p}{p}\right)^2 \underbrace{\left(M_{51} D_p + M_{52} D_p' + M_{56}\right)^2}_{\tilde{M}_{56}}$$

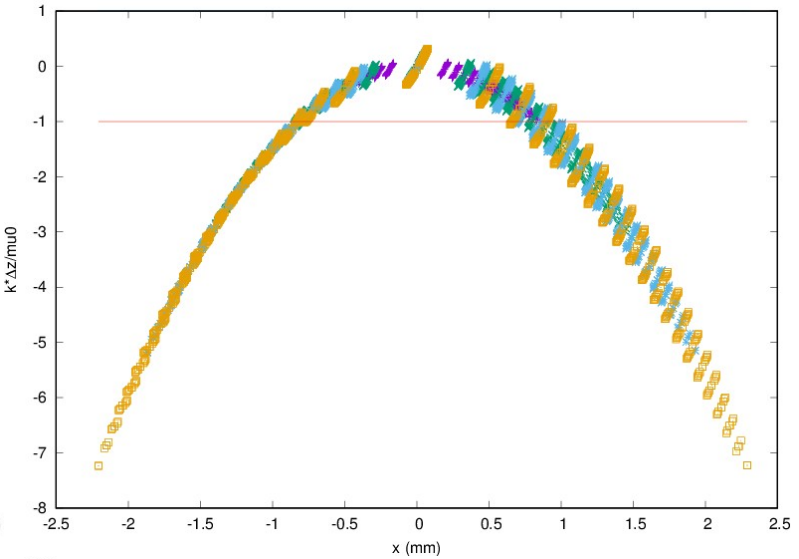
	$\tilde{\tilde{M}}_{56}$		$\tilde{\tilde{J}}$	
Δs	sym	unsym	sym	unsym
2.7 mm	4.3 x 10^{-6}	1.0 x 10^{-6}	1.3 x 10^{-4}	4.9 x 10^{-5}
5.3 mm	5.5 x 10^{-6}	6.1 x 10^{-8}	2.1 x 10^{-4}	1.5 x 10^{-4}
10. mm	6.8 x 10^{-6}	2.2 x 10^{-8}	4.5 x 10^{-4}	2.0 x 10^{-4}

Note: There are higher orders of the energy and action dependence of the sample lengehtning that are not described by these quantities.

Tracking Envelope Boundary

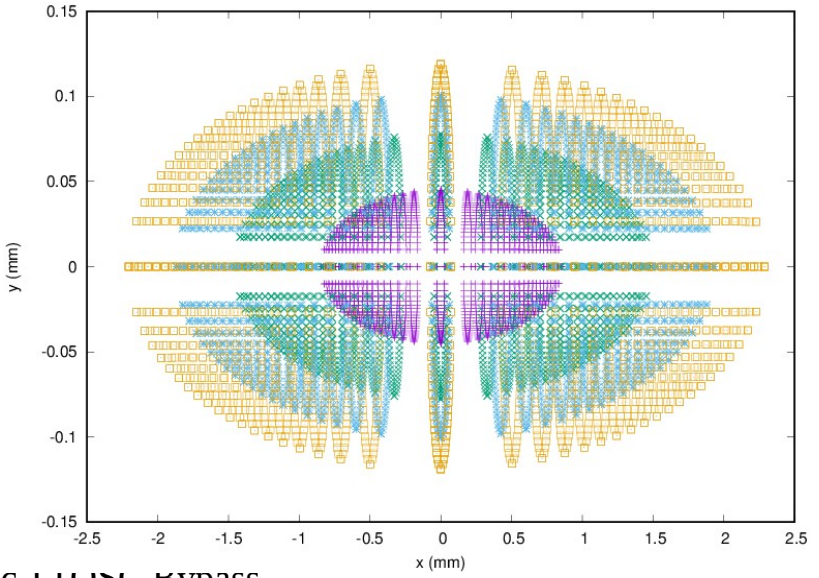
- $\varepsilon_x = \varepsilon_y = 50$ pm $\varepsilon_z = 1.17 \times 10^{-5} = \sigma_p \sigma_z = 7.6 \times 10^{-4} * 1.5$ cm



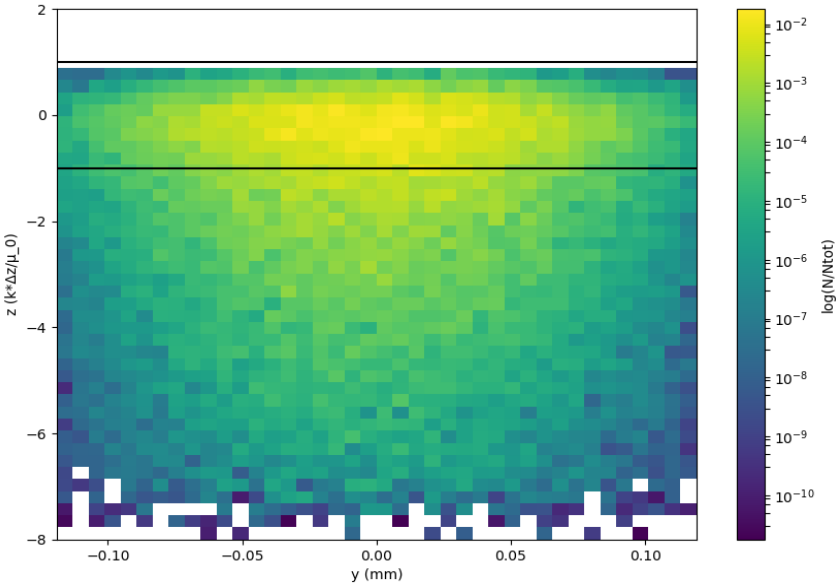


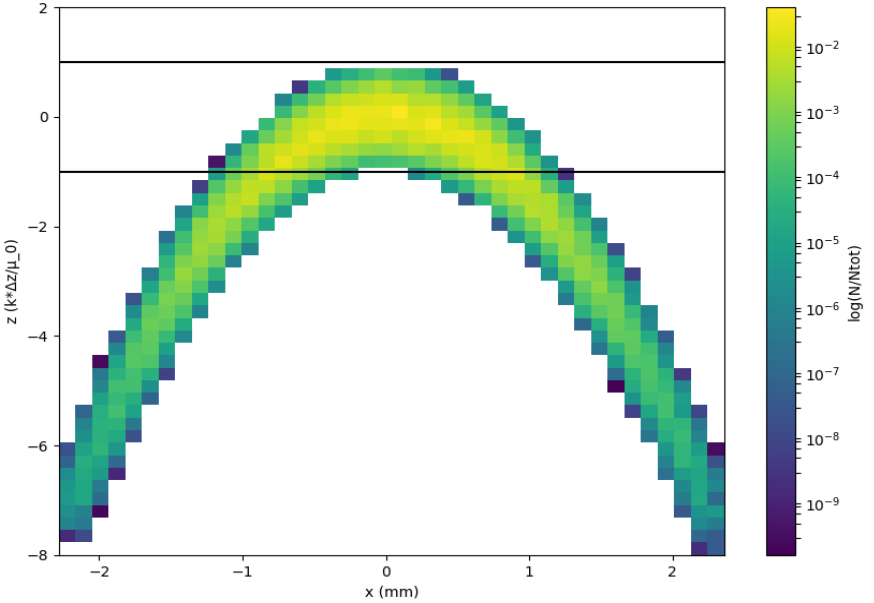
Points on beam envelope tracked from pickup to kicker. Points at kicker shown.

1-σ: Purple
3-σ: Green
5-σ: Blue
7-σ: Gold



Weighted Monte Carlo

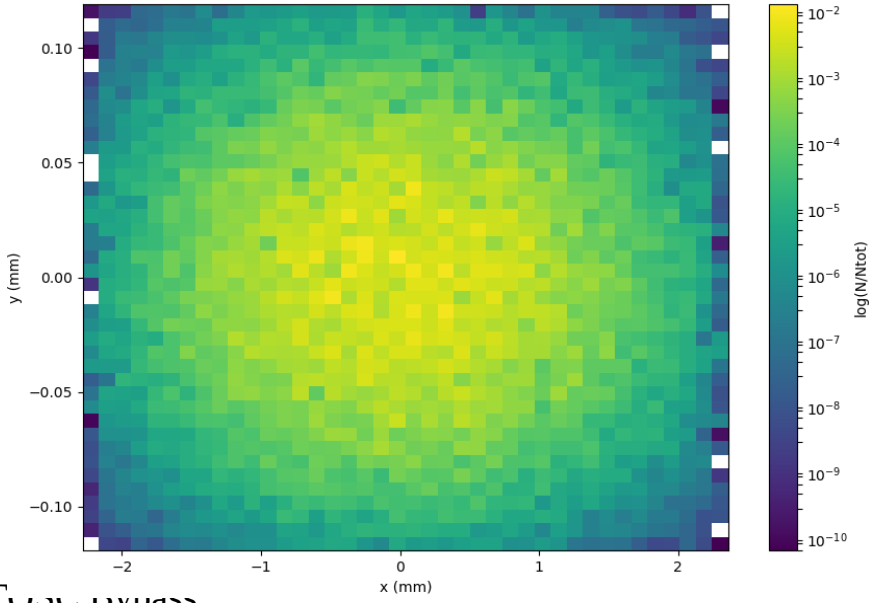




50,000 particles with flat, random distribution of J_x, J_y, and J_z, spanning 7-σ of ϵ_x, ϵ_y, and $\sigma_z \times \sigma_p$, respectively.

Weighted using

$$\rho(J) = \frac{e^{-\frac{J}{\epsilon}}}{\epsilon}$$



Plotted is 2D histogram of distribution at middle of kicker.

Parameters with % damped

	$\tilde{\tilde{M}}_{56}$		$\tilde{\tilde{J}}$		% in Damped Envelope	
Δs	sym	unsym	sym	unsym	sym	unsym
2.7 mm	4.3×10^{-6}	1.0×10^{-6}	1.3×10^{-4}	4.9×10^{-5}	94	91
5.3 mm	5.5×10^{-6}	6.1×10^{-8}	2.1×10^{-4}	1.5×10^{-4}	82	80
10. mm	6.8×10^{-6}	2.2×10^{-8}	4.5×10^{-4}	2.0×10^{-4}	63	51

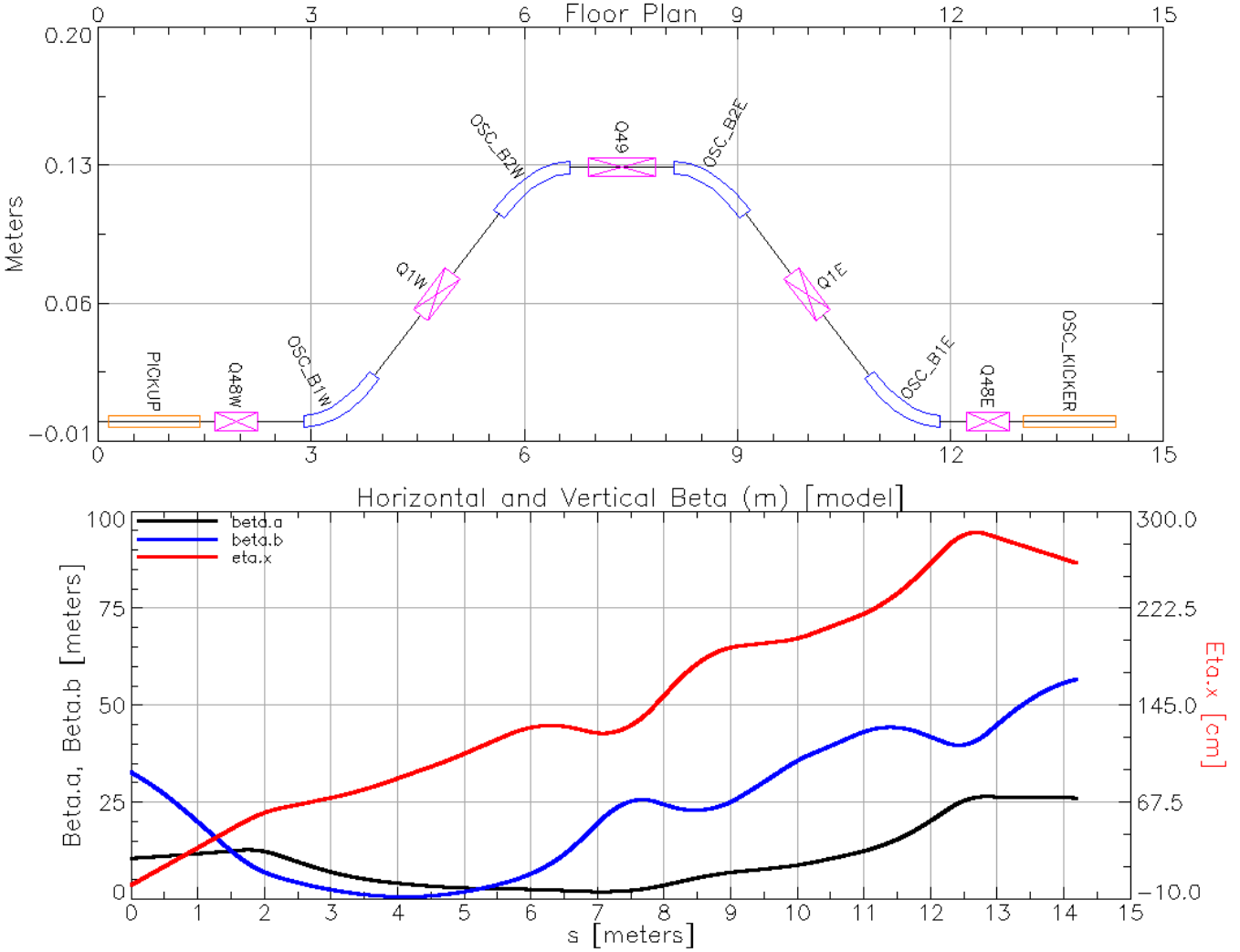
Backup Slides

unsymmetric lattice for reference

Layout & Twiss (unsym)

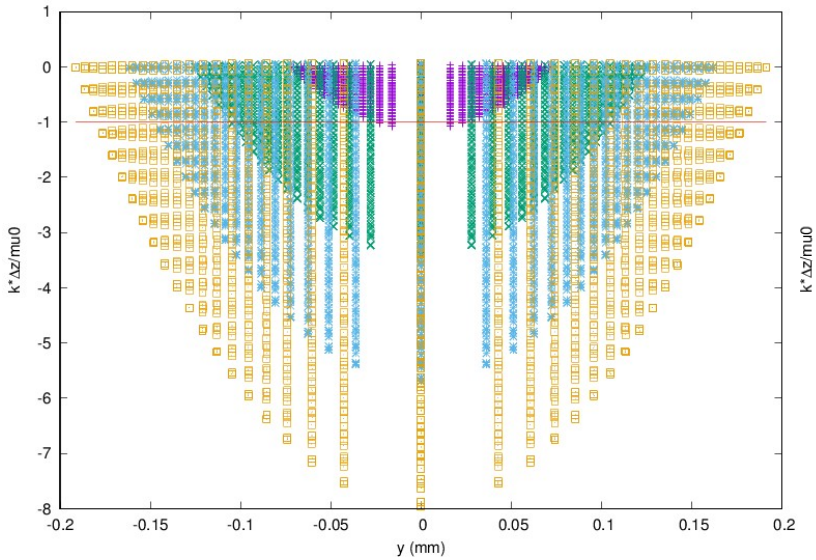
- 5.3 mm Δs shown
- $\nu_x = 140.43°$
- $\nu_y = 172.12°$

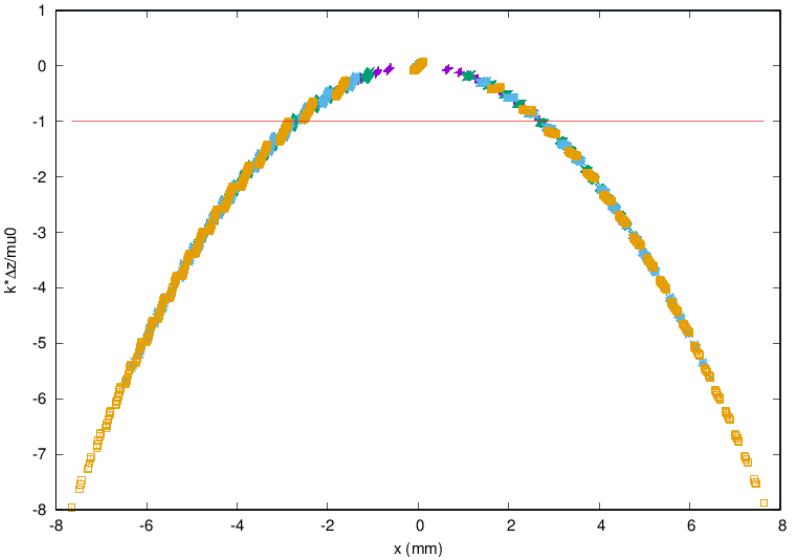
- $M_{51} = 0.0019$
- $M_{52} = -0.041$
- $M_{56} = 0.01176$



Tracking Envelope Boundary (unsym)

- $\varepsilon_x = \varepsilon_y = 50$ pm $\varepsilon_z = 1.17 \times 10^{-5} = \sigma_p \sigma_z = 7.6 \times 10^{-4} * 1.5$ cm





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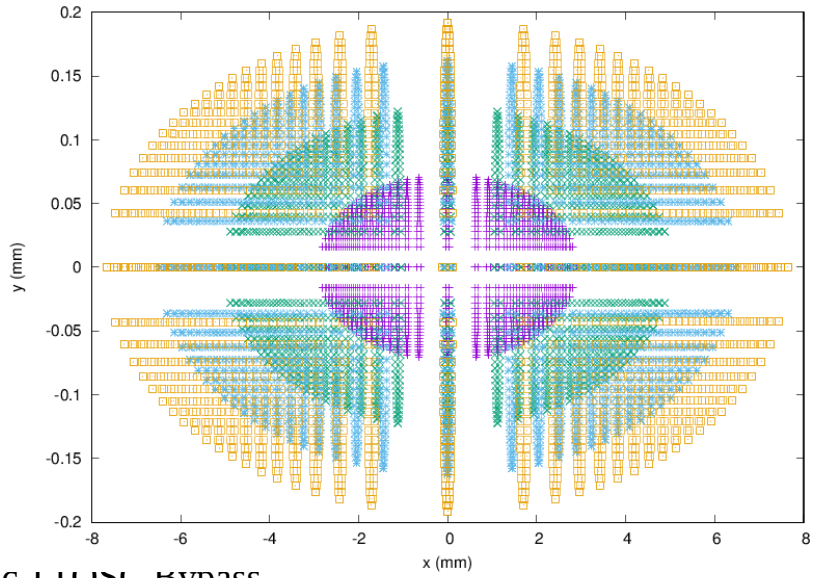
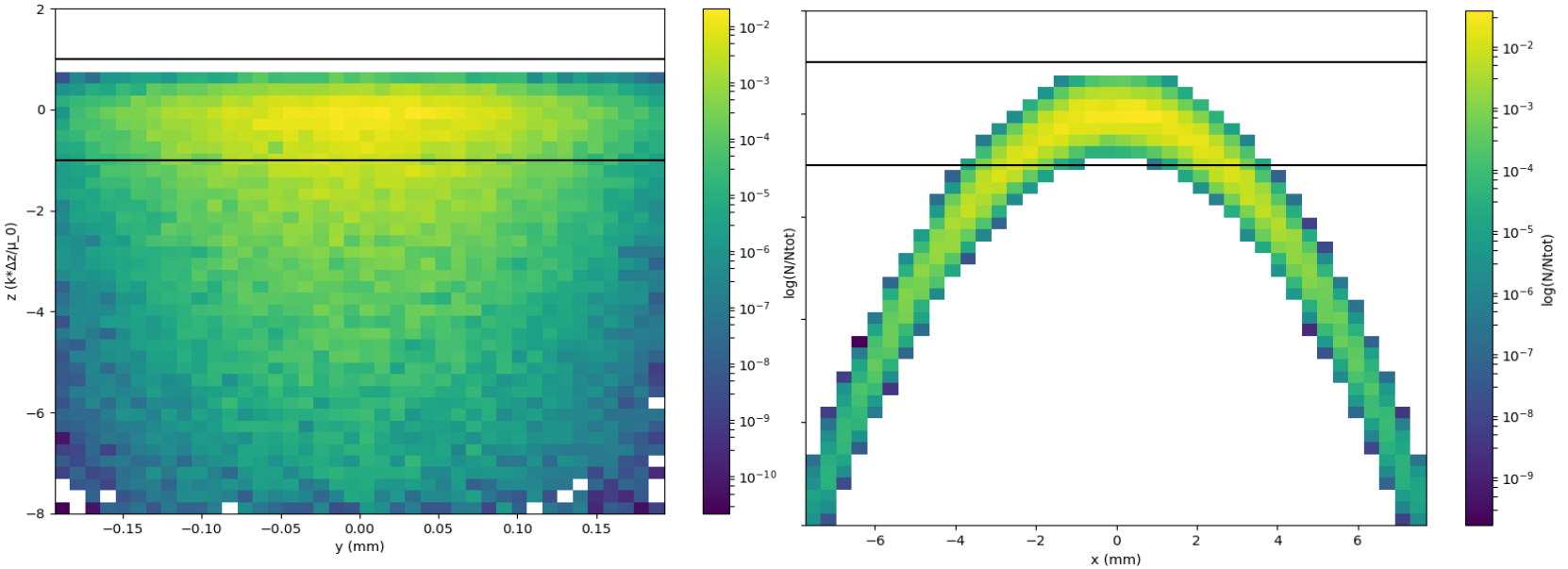


Weighted Monte Carlo (unsym)



50,000 particles with random J_x, J_y, and J_z, spanning 7-σ of ϵ_x, ϵ_y, and $\sigma_z \times \sigma_p$.

Weighted using

$$\rho(J) = \frac{e^{-\frac{J}{\epsilon}}}{\epsilon}$$

Plotted is 2D histogram of distribution at middle of kicker.