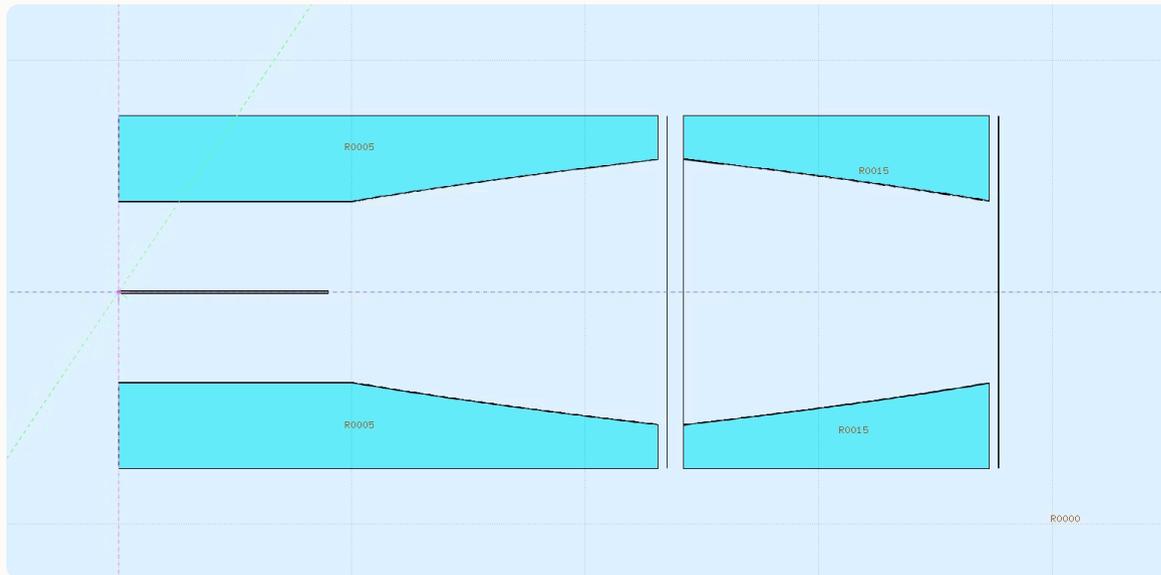# Optimized Horn Structures

P **by Prateek Rao**
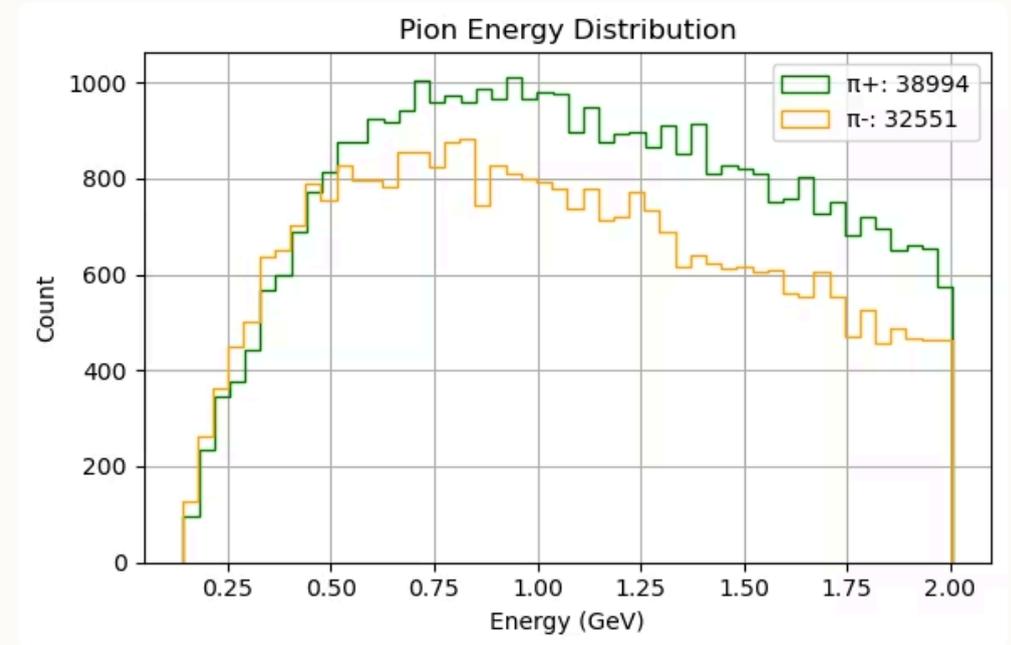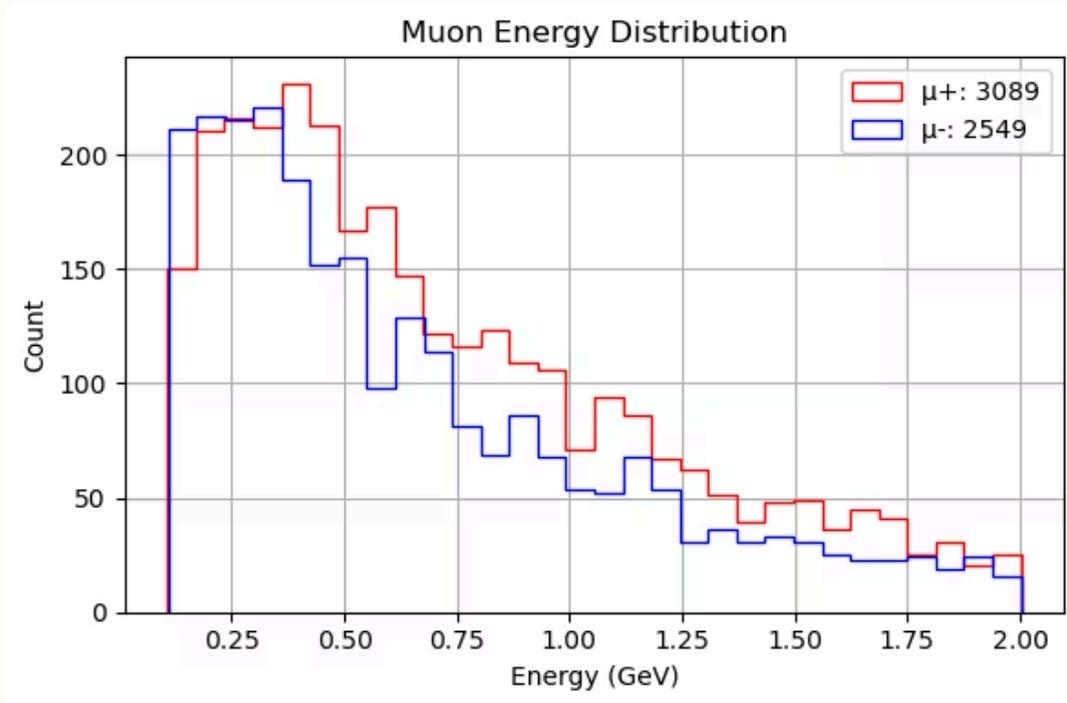
Optimized Horn (1)

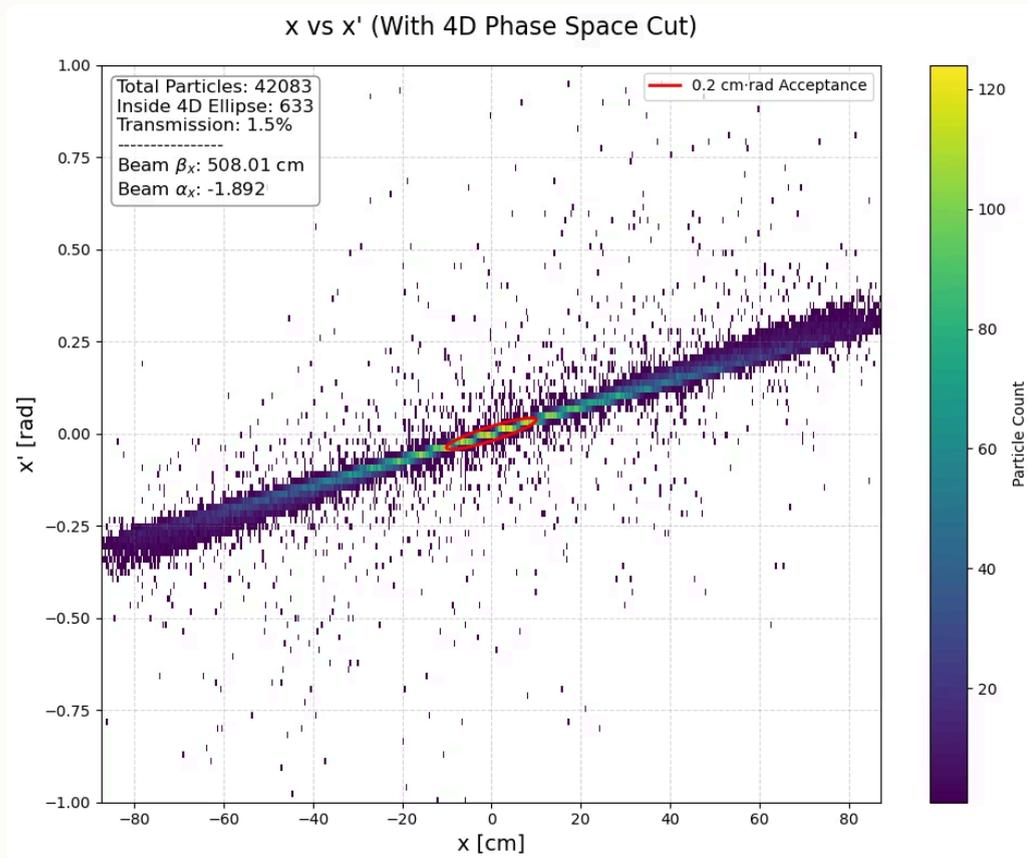| Parameter	Optim1 Value
Parabolic coefficient a_{mm}	0.00756
Radius of outer cylinder R_{out} (mm)	874.91
Start radius r_{neck} (mm)	383.05
End radius r_{max} (mm)	654.56
Drift space between horns (mm)	109.70
Length of each horn (mm)	1003.81
Current I_A (A)	52,931.15

Primary Protons $= 10^5$

Muon&Pion Energy Distribution

Muon Energy Distribution

μ+: 3089
μ-: 2549

Pion Energy Distribution

π+: 38994
π-: 32551

Beam Time Structure

π+ P_T (N=38994)

Beam Phase Space

π^+

x vs x' (With 4D Phase Space Cut)

Total Particles: 42083
Inside 4D Ellipse: 633
Transmission: 1.5%

Beam β_x: 508.01 cm
Beam α_x: -1.892

— 0.2 cm·rad Acceptance

π^-

x vs x' (With 4D Phase Space Cut)

Total Particles: 32551
Inside 4D Ellipse: 347
Transmission: 1.1%

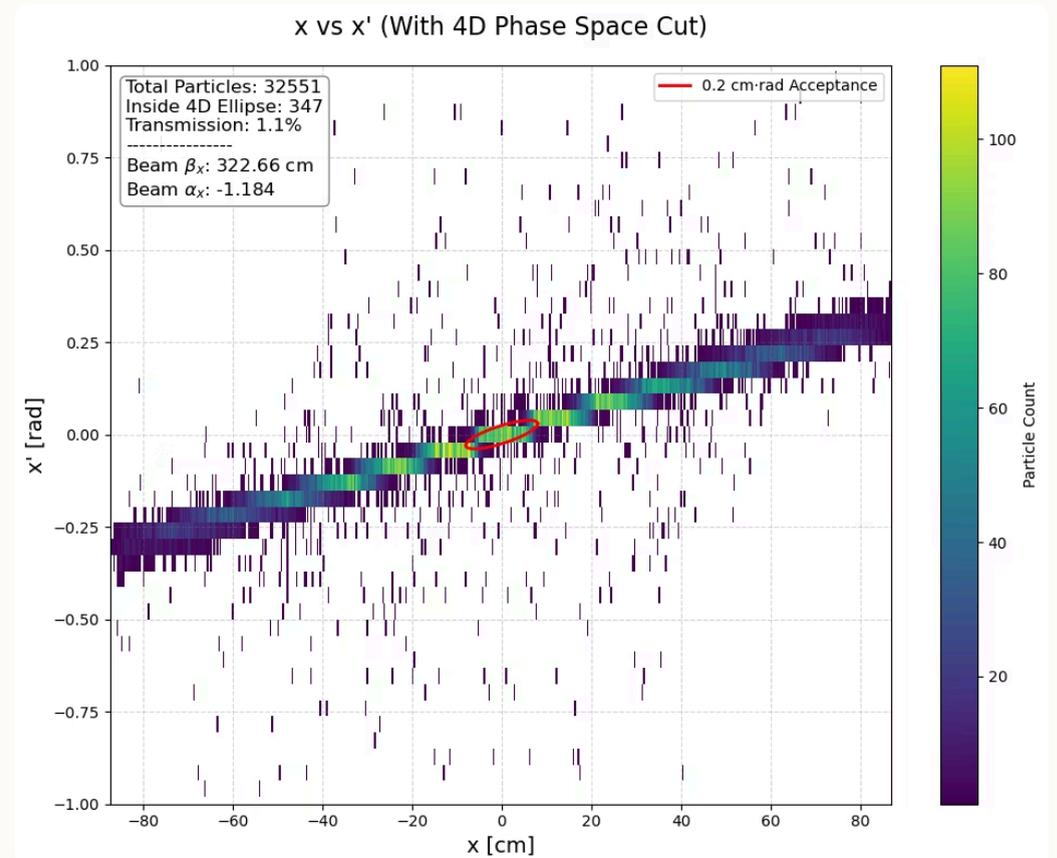Beam β_x: 322.66 cm
Beam α_x: -1.184
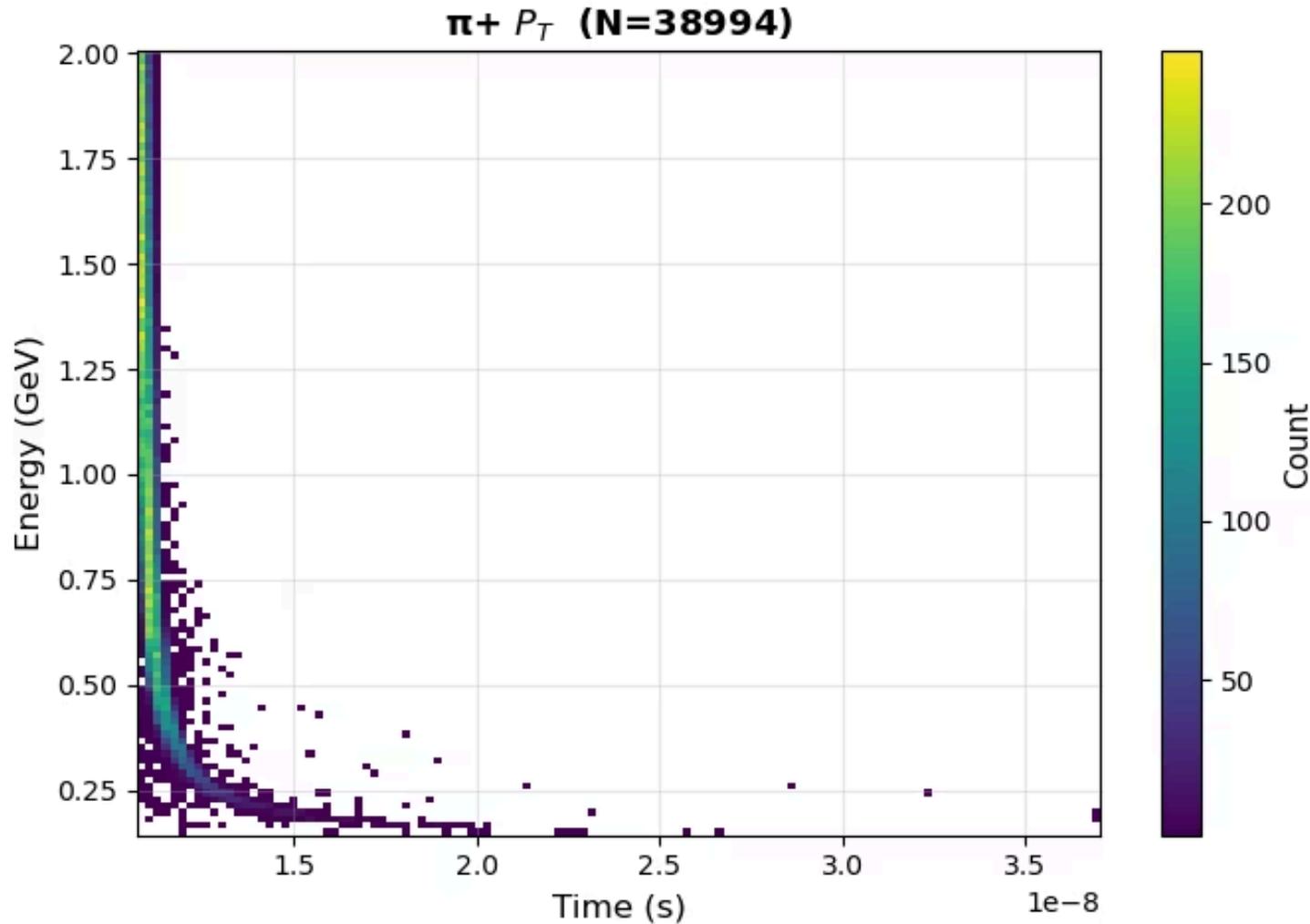
— 0.2 cm·rad Acceptance

Starting design: $\pi^+ = 13 \cdot 10^{-4}$/POT @ 220kA

Current output: $\pi^+ = 63.3 \cdot 10^{-4}$**/POT @ 52kA**

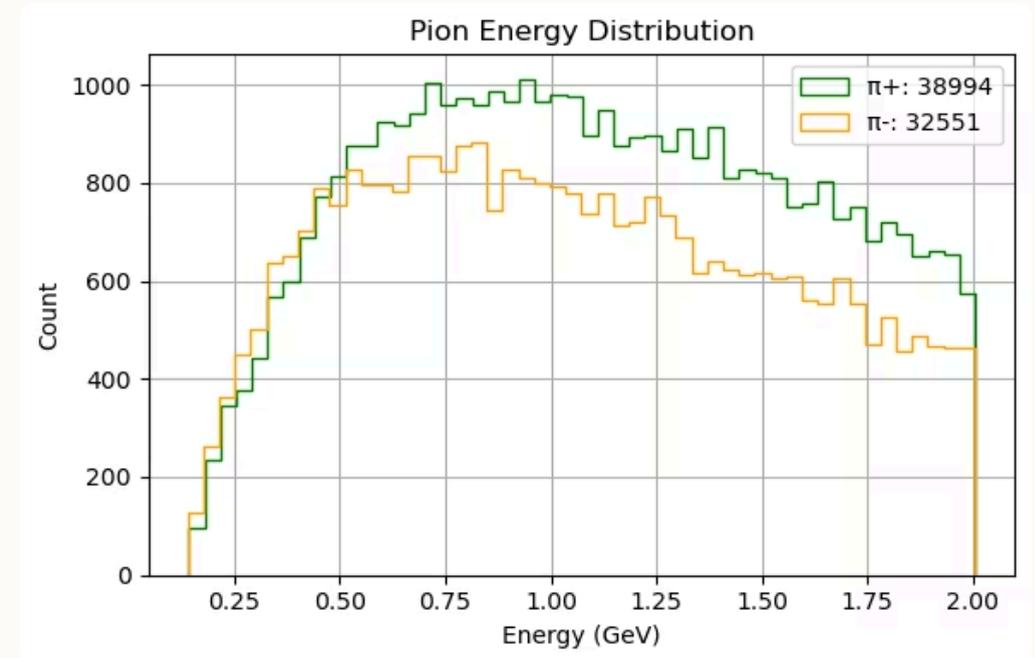Starting design: $\pi^- = 2 \cdot 10^{-4}$/POT @ 220kA

Current Design: $\pi^- = 34.7 \cdot 10^{-4}$**/POT @ 52kA**

Made with GAMMA

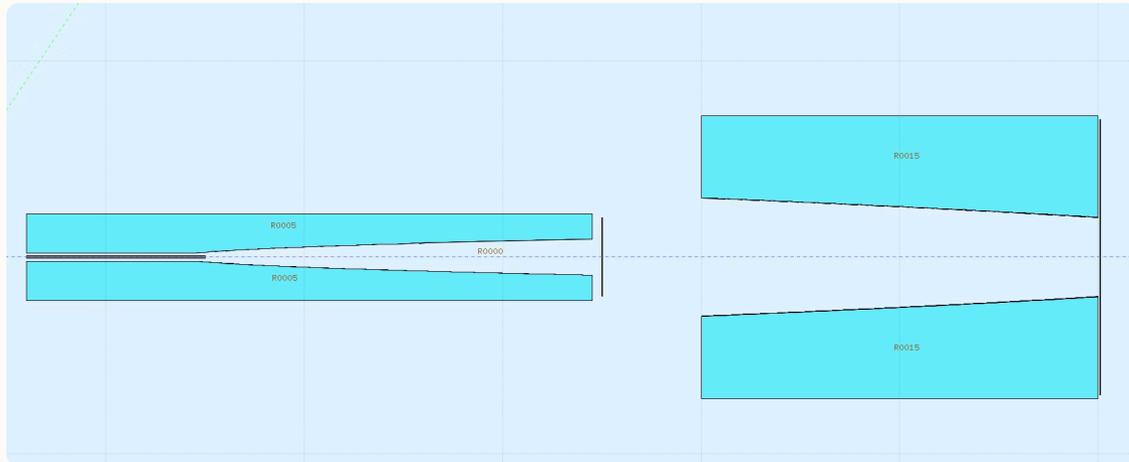# Sanity Check(with the field directions reversed)

Reversed field directions
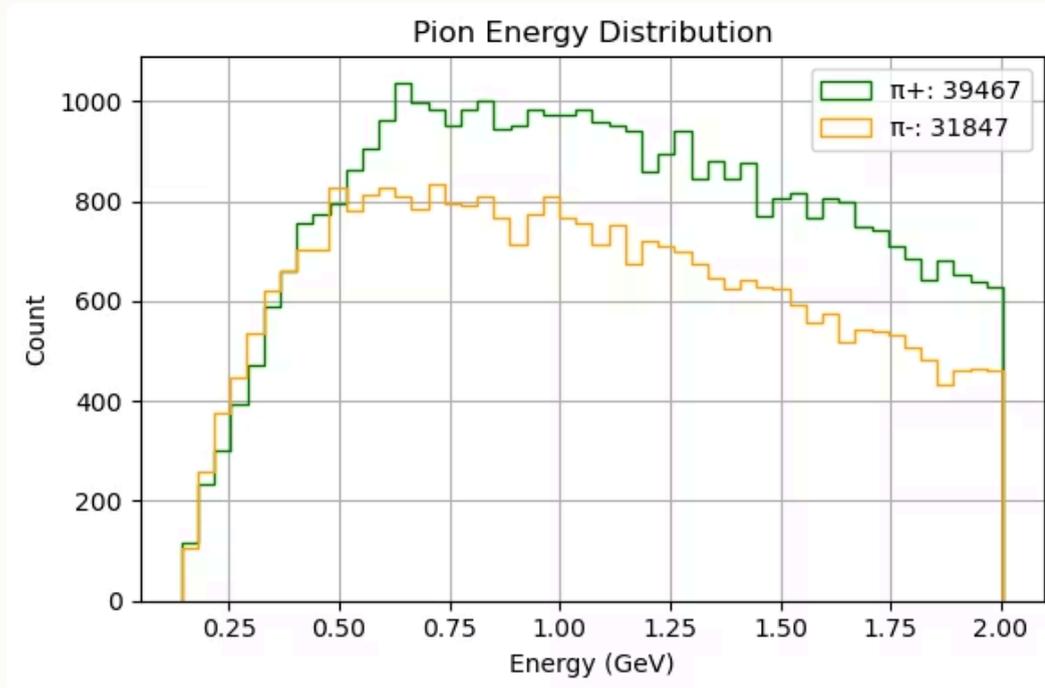
Original field directions

New Design !!

Component	Length (cm)	Global Z (cm)	Radial Dimensions (cm)	Shape / Equation (z_{local})	Current
Target	90	$0 \rightarrow 90$	$R = 0.6$	Cylinder	N/A
Neck	90	$0 \rightarrow 90$	$R_{in} = 2.0, R_{out} = 2.2$	Cylinder	N/A
Horn 1	200	$90 \rightarrow 290$	$R_{in} = 2.0 \rightarrow 9.2$	**Diverging Parabola**	+50 kA
			$R_{out} = 20.0$	$r^2 - 0.4z - 4 = 0$	
Drift	150	$290 \rightarrow 440$	N/A	Vacuum / Air	N/A
Horn 2	200	$440 \rightarrow 640$	$R_{in} = 30 \rightarrow 20$	**Converging Funnel**	-50 kA
			$R_{out} = 70.0$	$r^2 + 2.5z - 900 = 0$	

Horn 1 Output

New Design **@ 50kA** $(210 MeV \leq p_z \leq 330 MeV)$
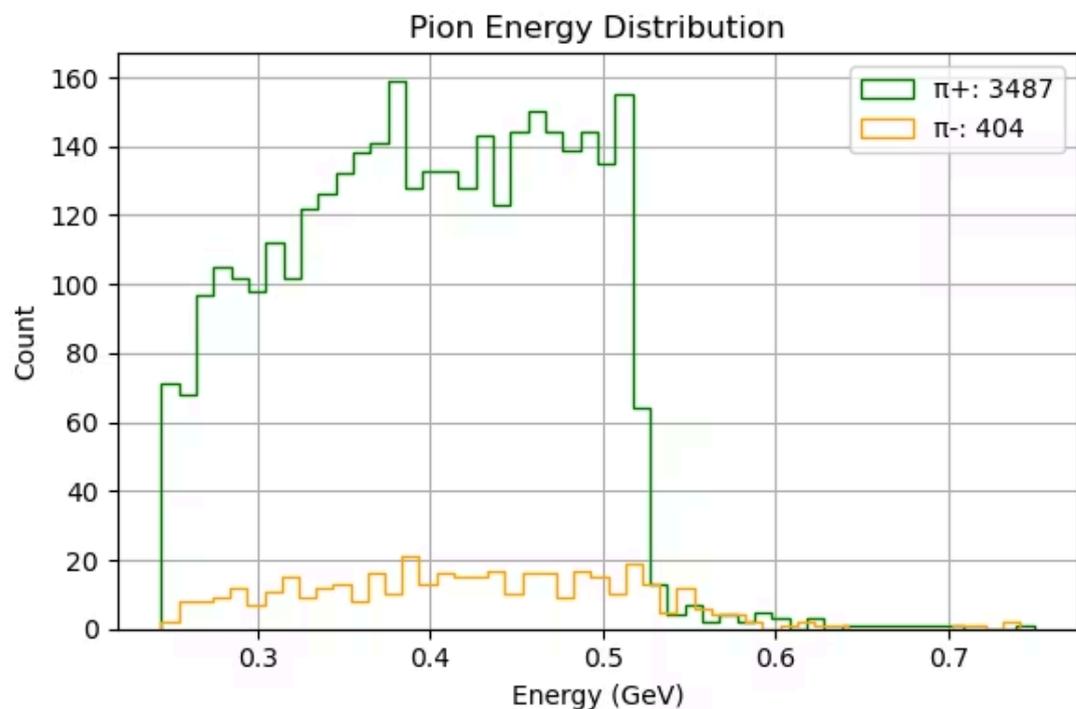
$$\pi^+ = 6.4 \cdot 10^{-4}/\text{POT}$$

x vs x' (With 4D Phase Space Cut)

Total Particles: 1302
Inside 4D Ellipse: 64
Transmission: 4.9%

Beam β_x: 74.34 cm
Beam α_x: -0.026

— 0.2 cm·rad Acceptance

Paul's Design **@ 220kA** $(210 MeV \leq p_z \leq 330 MeV)$

$$\pi^+ = 5.6 \cdot 10^{-4}/\text{POT}$$

x vs x' (With 4D Phase Space Cut)

Total Particles: 1903
Inside 4D Ellipse: 56
Transmission: 2.9%

Beam β_x: 37.60 cm
Beam α_x: -0.287

— 0.2 cm·rad Acceptance
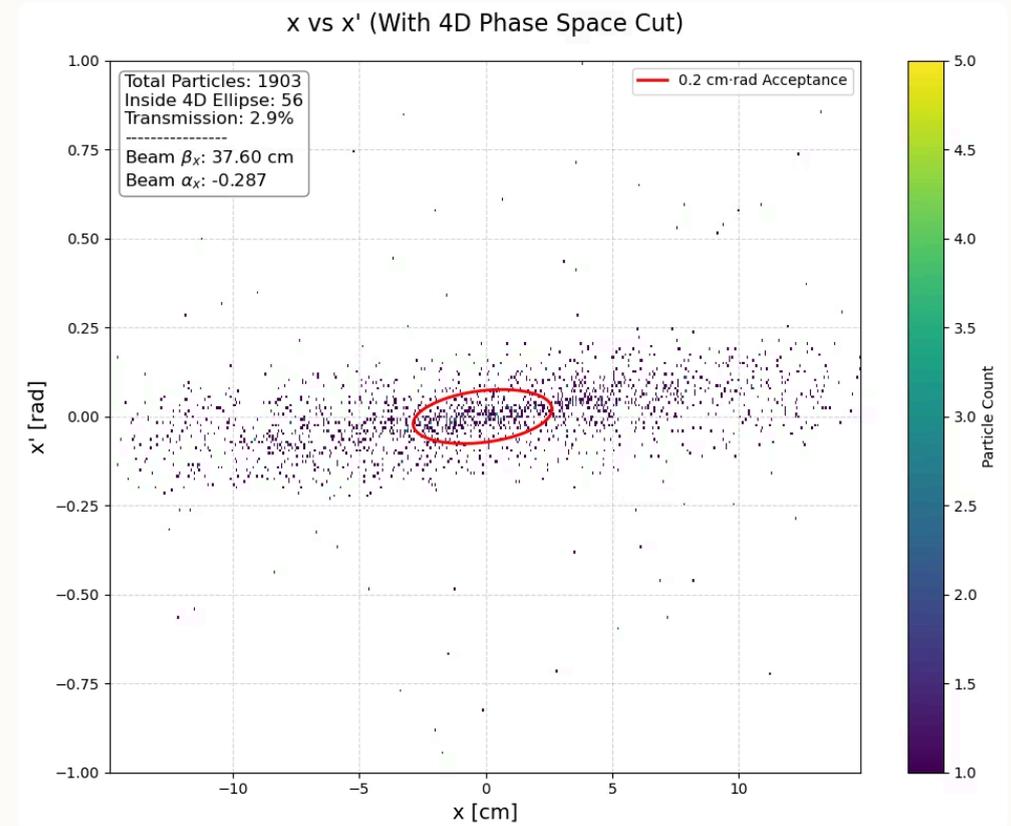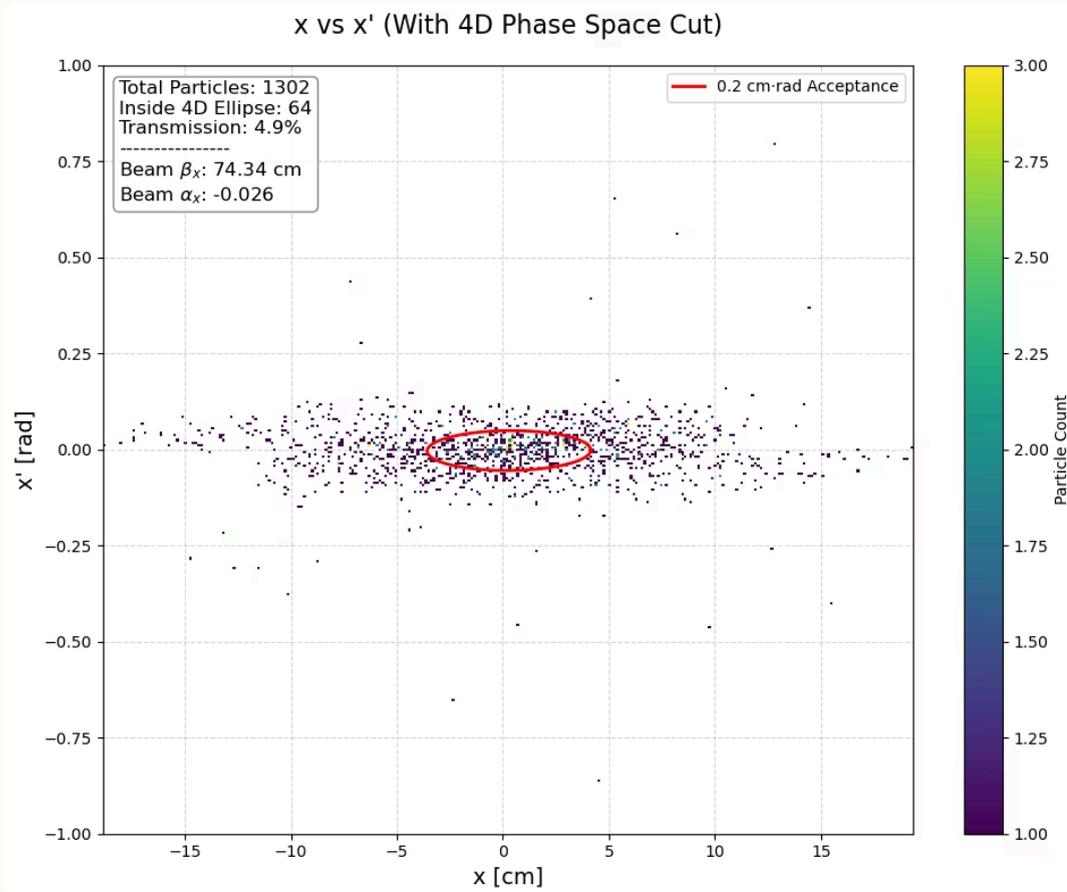
Horn 2 Output

Pion(+&-) at the end of second horn

Paul's Design(single horn)

Pi+ Phase-Space

x vs x' (With 4D Phase Space Cut)

Total Particles: 4639
Inside 4D Ellipse: 187
Transmission: 4.0%

Beam β_x: 183.85 cm
Beam α_x: -0.653

— 0.2 cm·rad Acceptance

x' [rad] (y-axis)
x [cm] (x-axis)
Particle Count (colorbar)
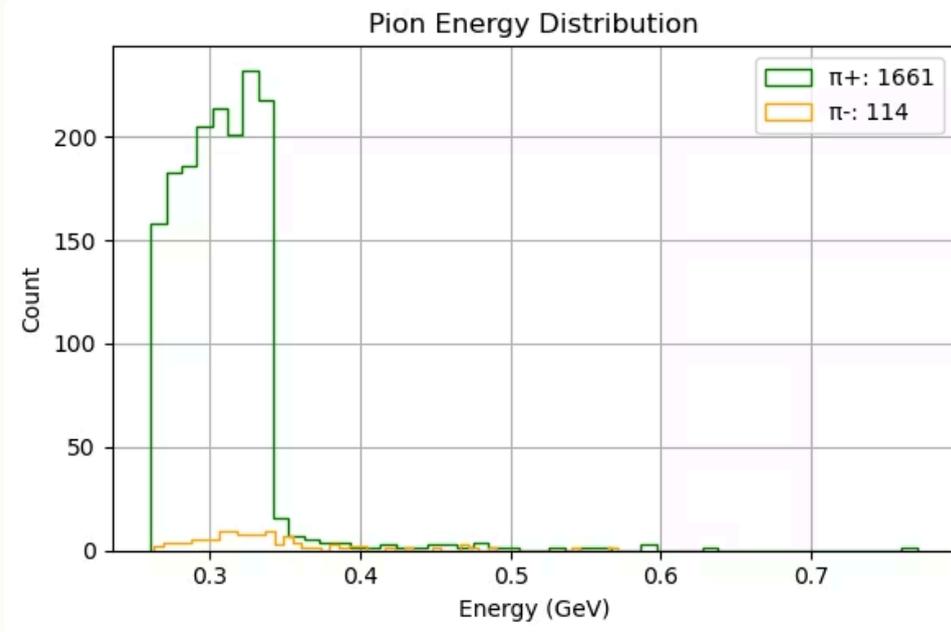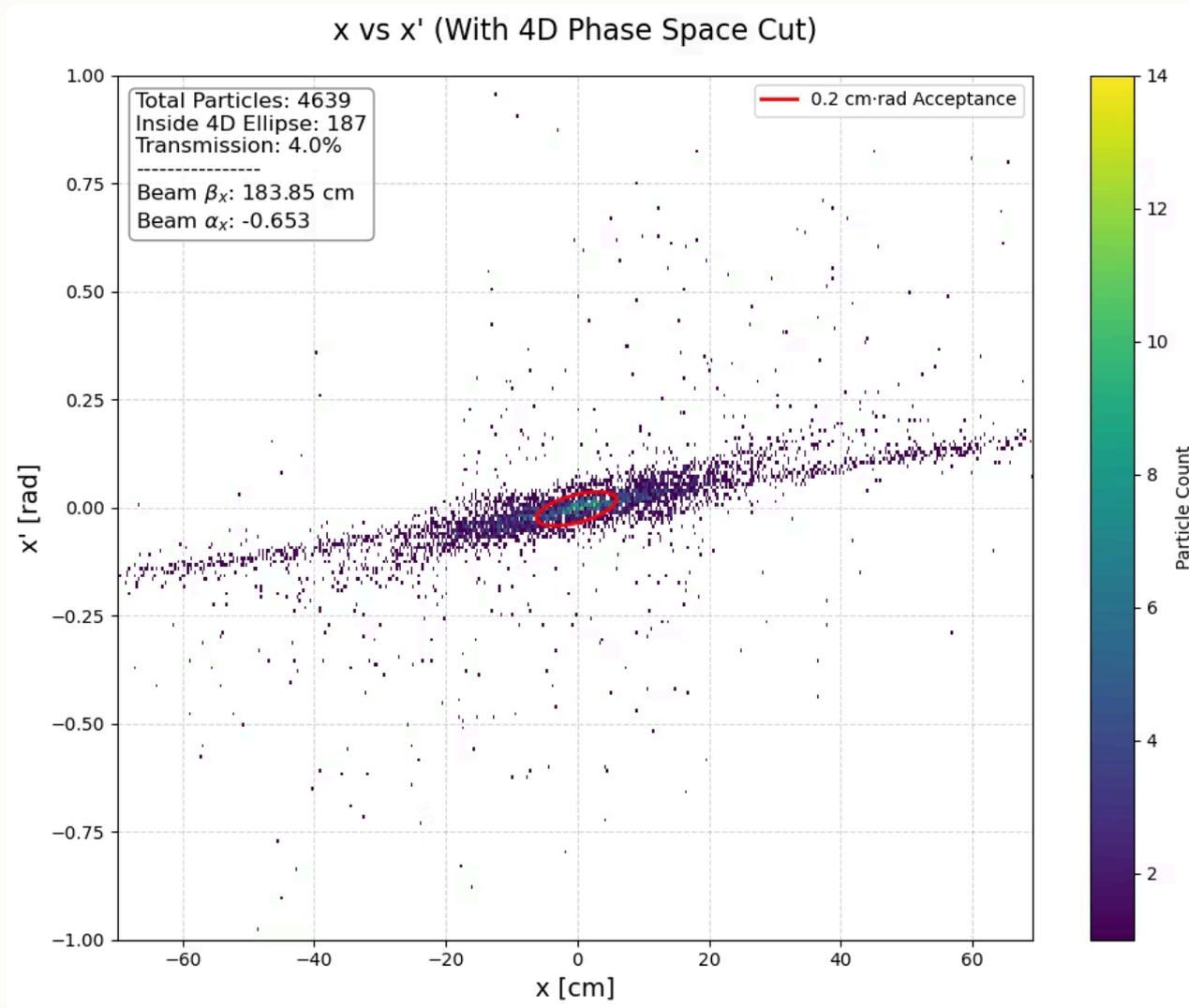
1. There is a good number of muons present in the beam as well($\sim \frac{1}{3}\pi^+$).

2. When optimized for 300MeV, it gave better results in the 300-500MeV range. Maybe try optimizing for 100Mev.

3. With appropriate optimizations, I believe we can achieve a good number for both charged particles.