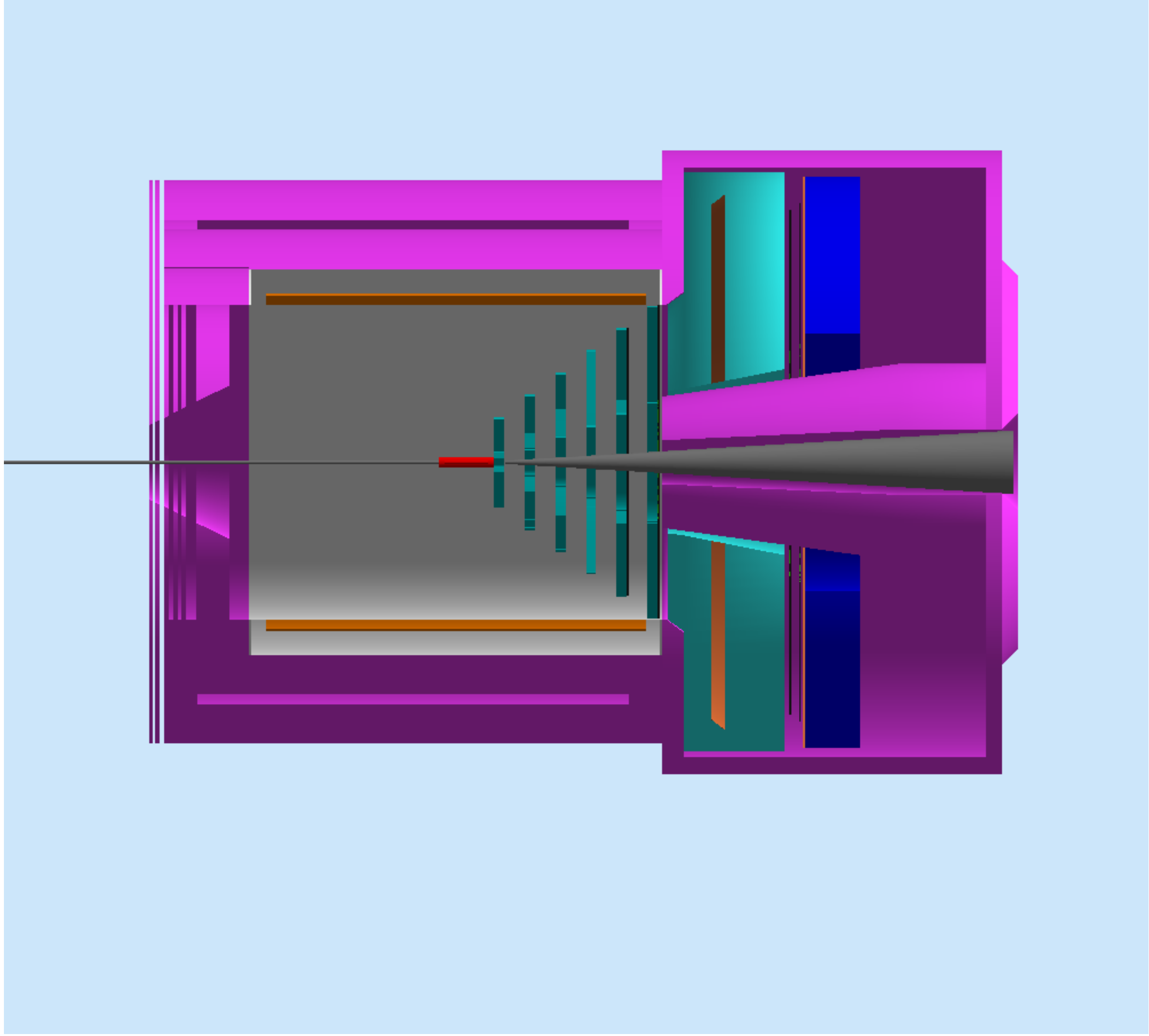
Pions Background Study : Update

SoLID PVDIS



Goals

- Pions (π^-, π^+) background generated at the target

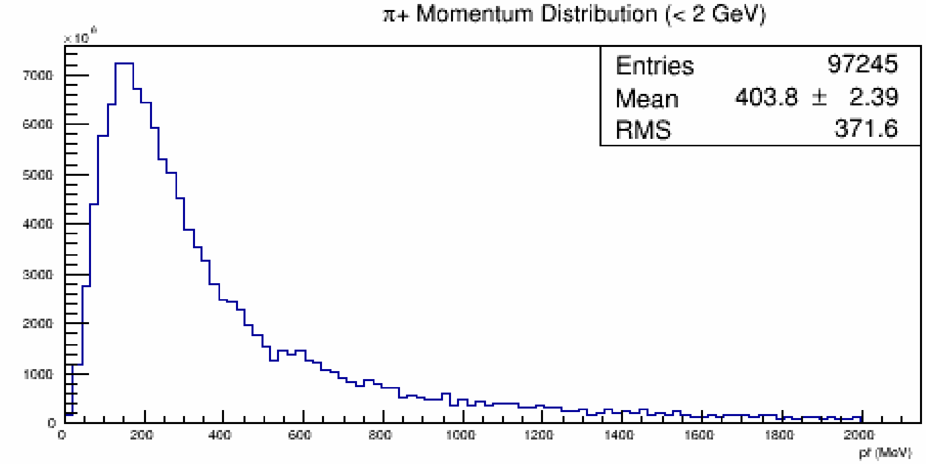
<u>To-dos</u>

- Compare rates and π/e ratios with proposed values
- Find ways to minimize the pion acceptance at the GEMs and ECAL.

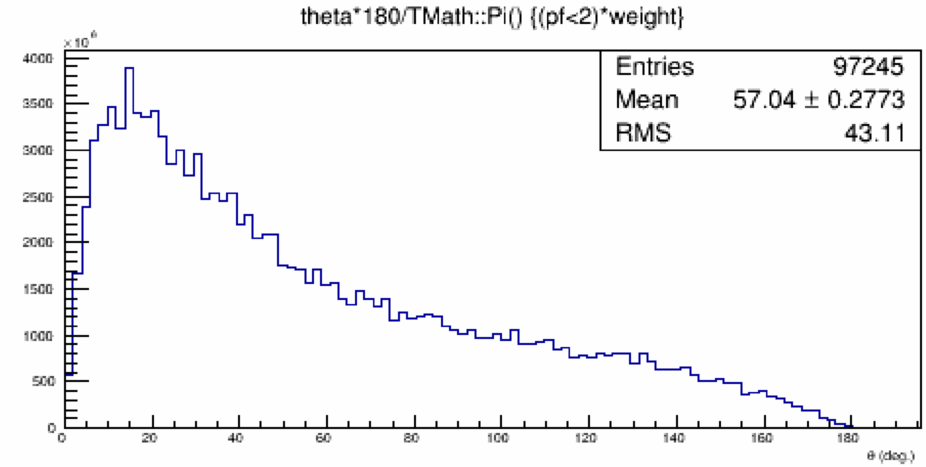
Input Summary

- Pions are generated with following input conditions,
  - LD2 target
  - Luminosity 54×10^{37} Hz/cm2 (22 uA)
  - Incident electron beam energy: 11 GeV
  - Target length: 40 cm
  - Raster: 2x2 mm^2
  - 1 million events

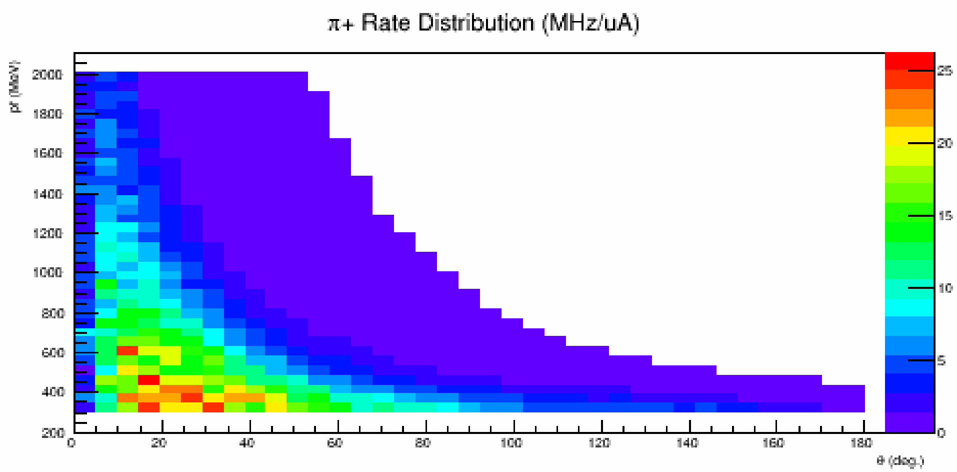
Wiser Input



Low energy Pions from Wiser fits have very high rates →Large rates at GEMs

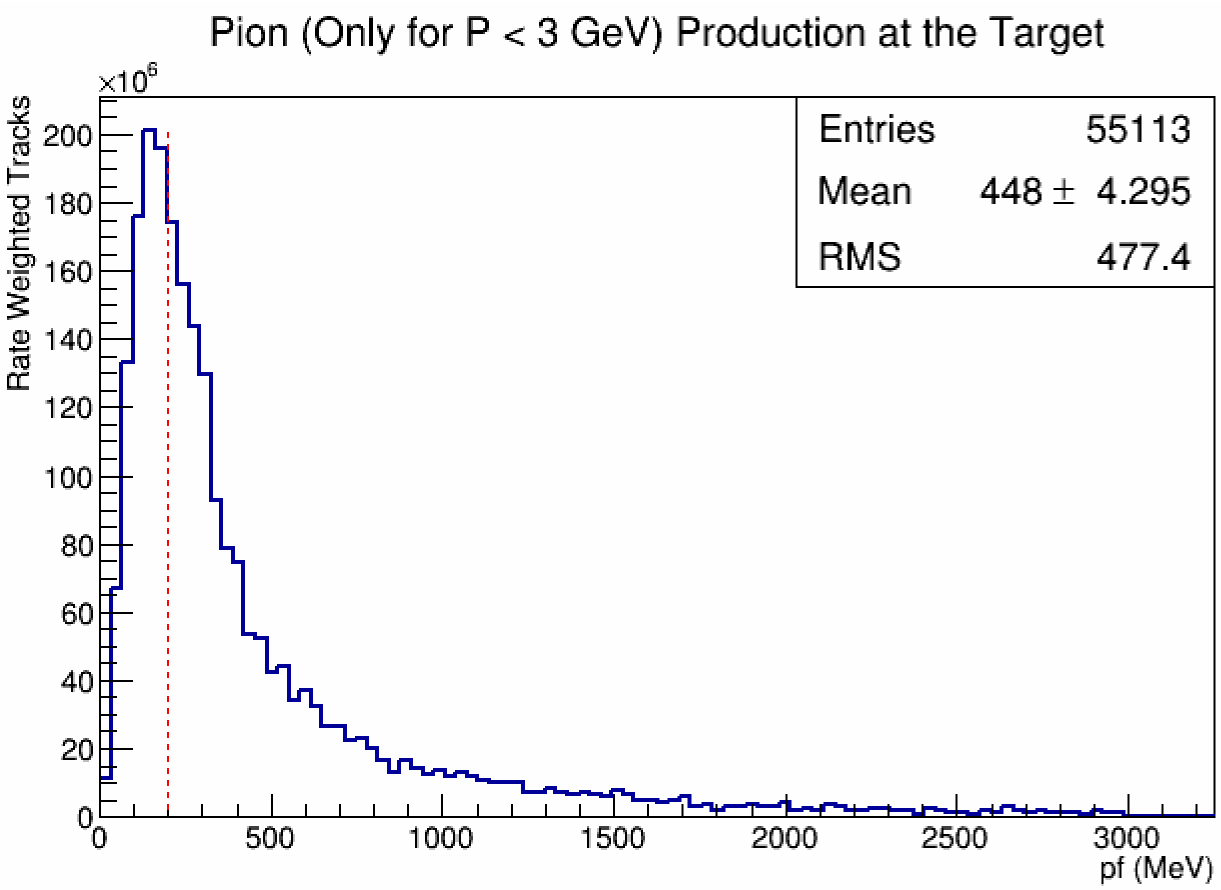


Total pi+ rate for momentum < 2 GeV = 5694 Mhz/uA
Too large?



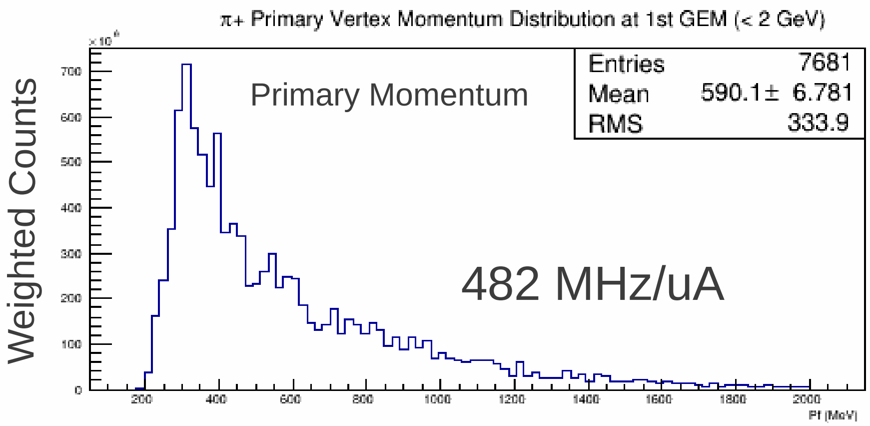
Generated Pion Momentum

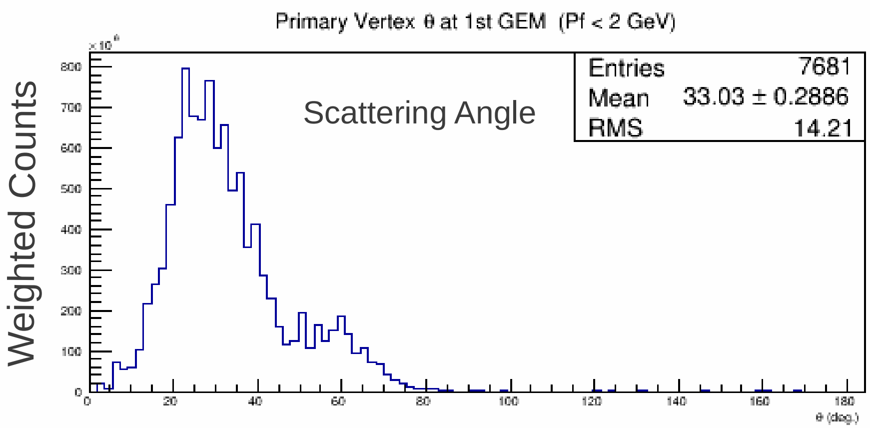
- This is the momentum distribution input into the simulation
- Pions of energies above the vertical line are seen at the last GEM

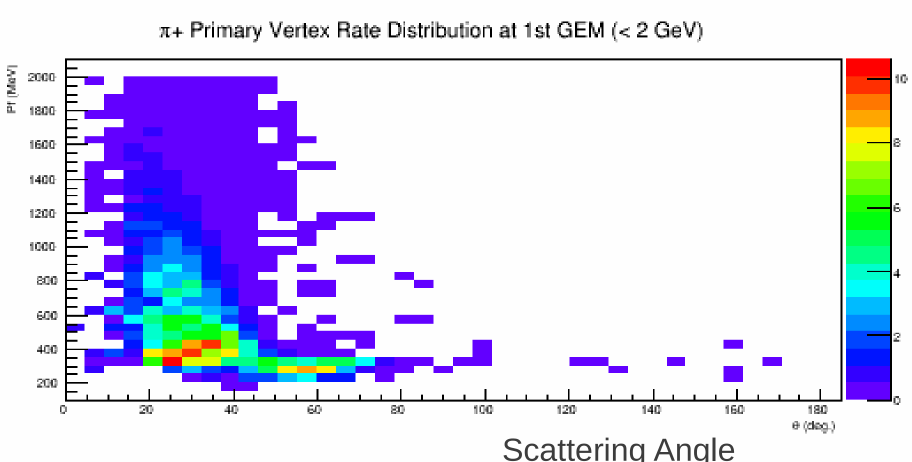


Pion rates across the GEM planes

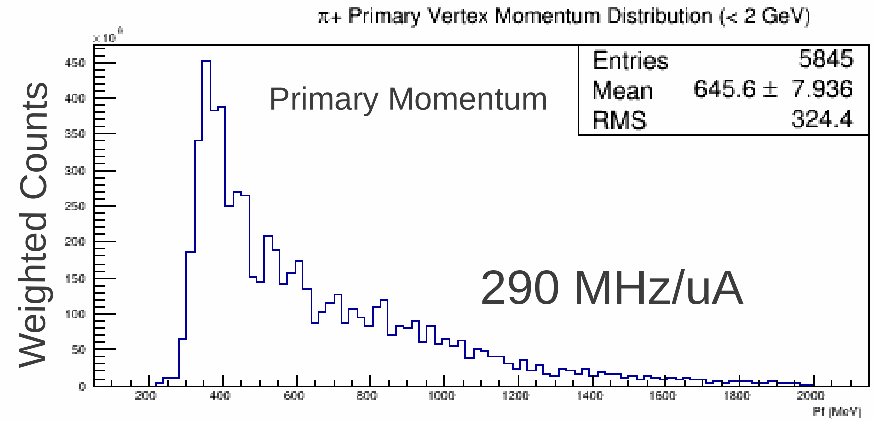
First GEM

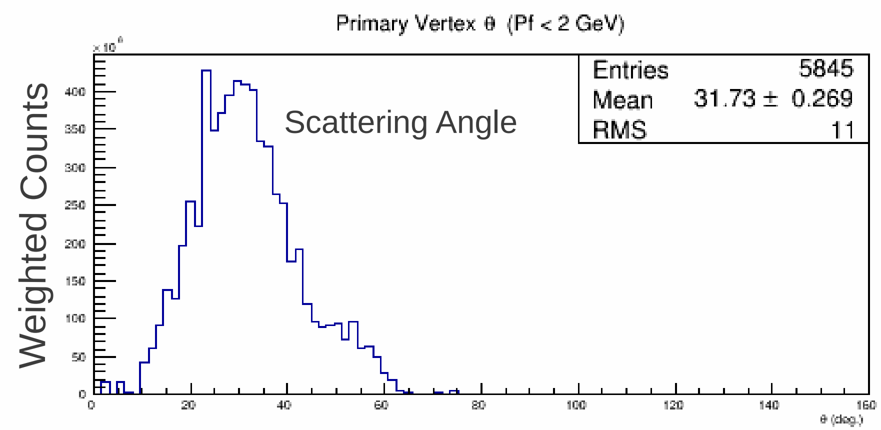


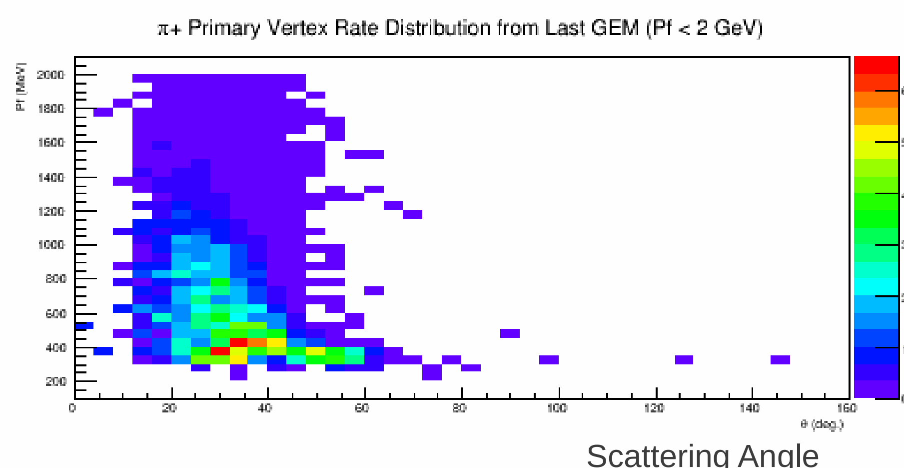




Last GEM







π Rate Summary

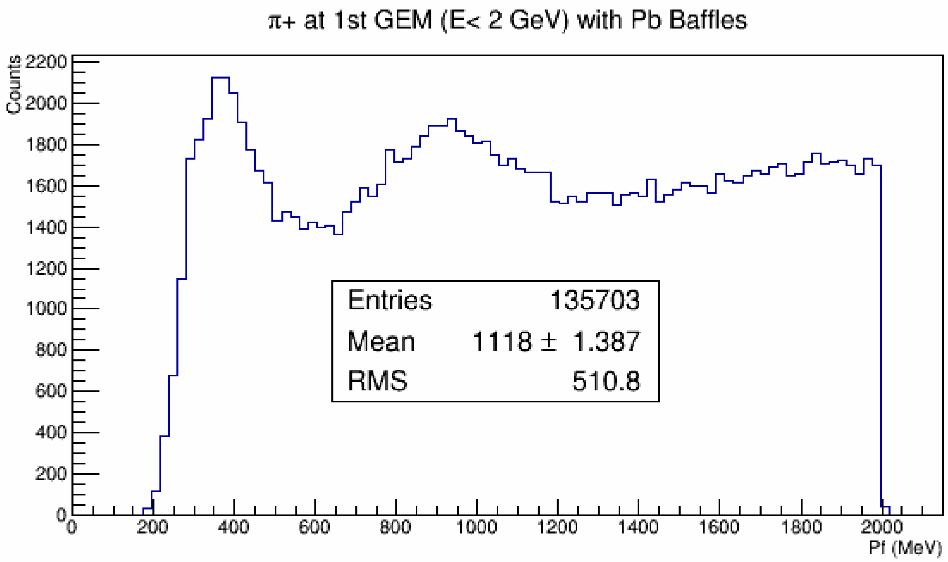
Process	Baffle Geometry	
	Lead (MHz/uA)	Kryptonite (MHz/uA)
π^+ (p> 0.3 GeV)	235	40
π^+ (p> 1 GeV)	17	1
π^+ (p> 2 GeV)	1	0.02

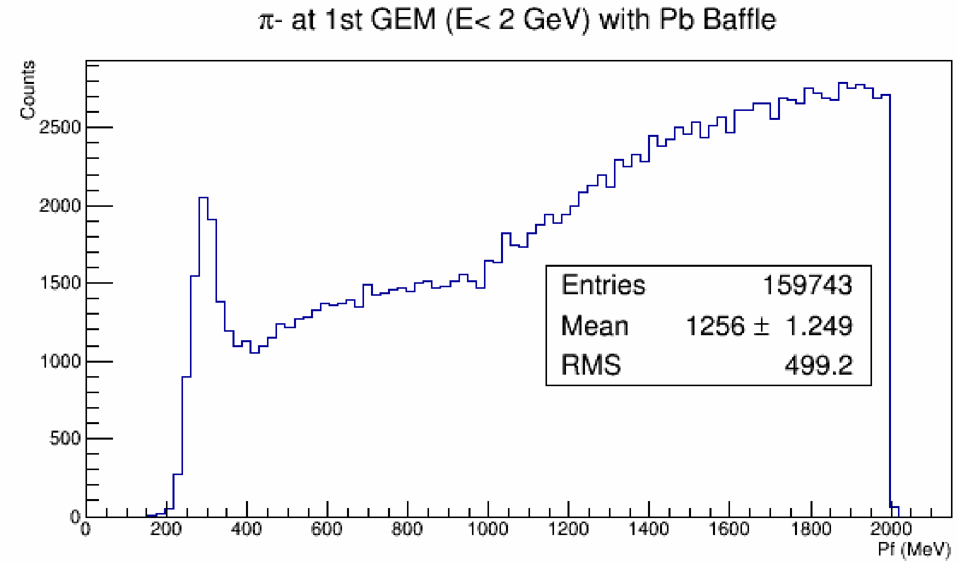
Process	Baffle Geometry	
	Lead (MHz/uA)	Kryptonite (MHz/uA)
π^- (p> 0.3 GeV)	178	25
π^- (p> 1 GeV)	31	15
π^- (p> 2 GeV)	3	2

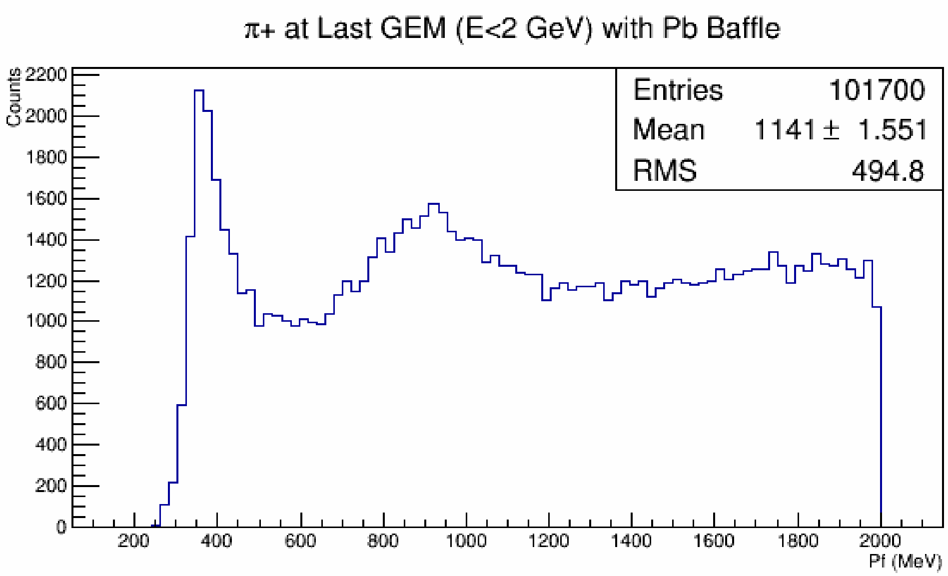
Simulation Test 1

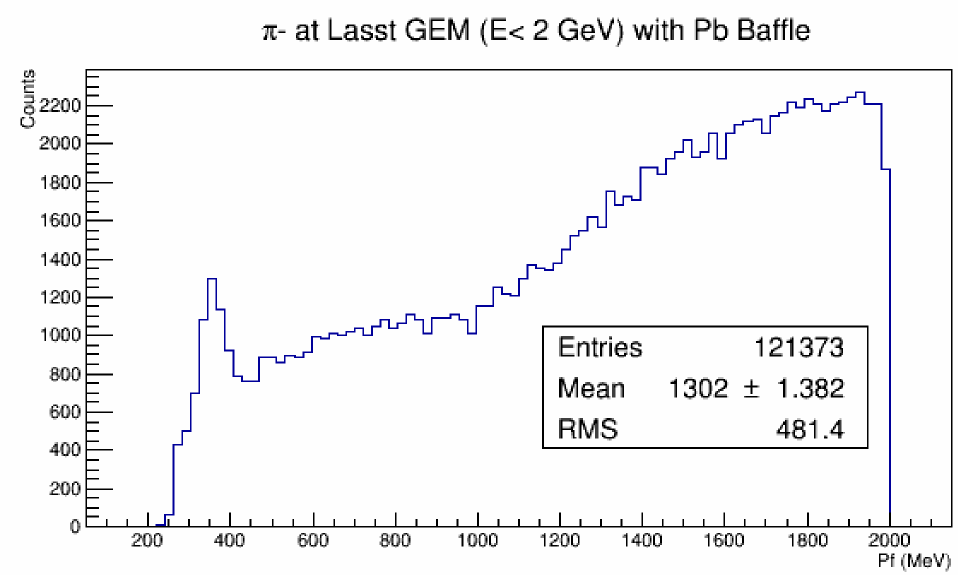
- Generated Pions (+/-) at the target (No Physics)
  - Mean : E=1 GeV, $\theta=30^0$, $\varphi=180^0$
  - Spread : ΔE=1 GeV, $\Delta\theta=30^0$, $\Delta\varphi=180^0$
  - Mean (Vertex) : (0, 0, 0) cm
  - Spread (Vertex) : (0.1, 20) cm
- Used Lead and Kryptonite baffles
- Only primary tracks are considered

Primary Momentum at GEM Planes with Lead Baffles

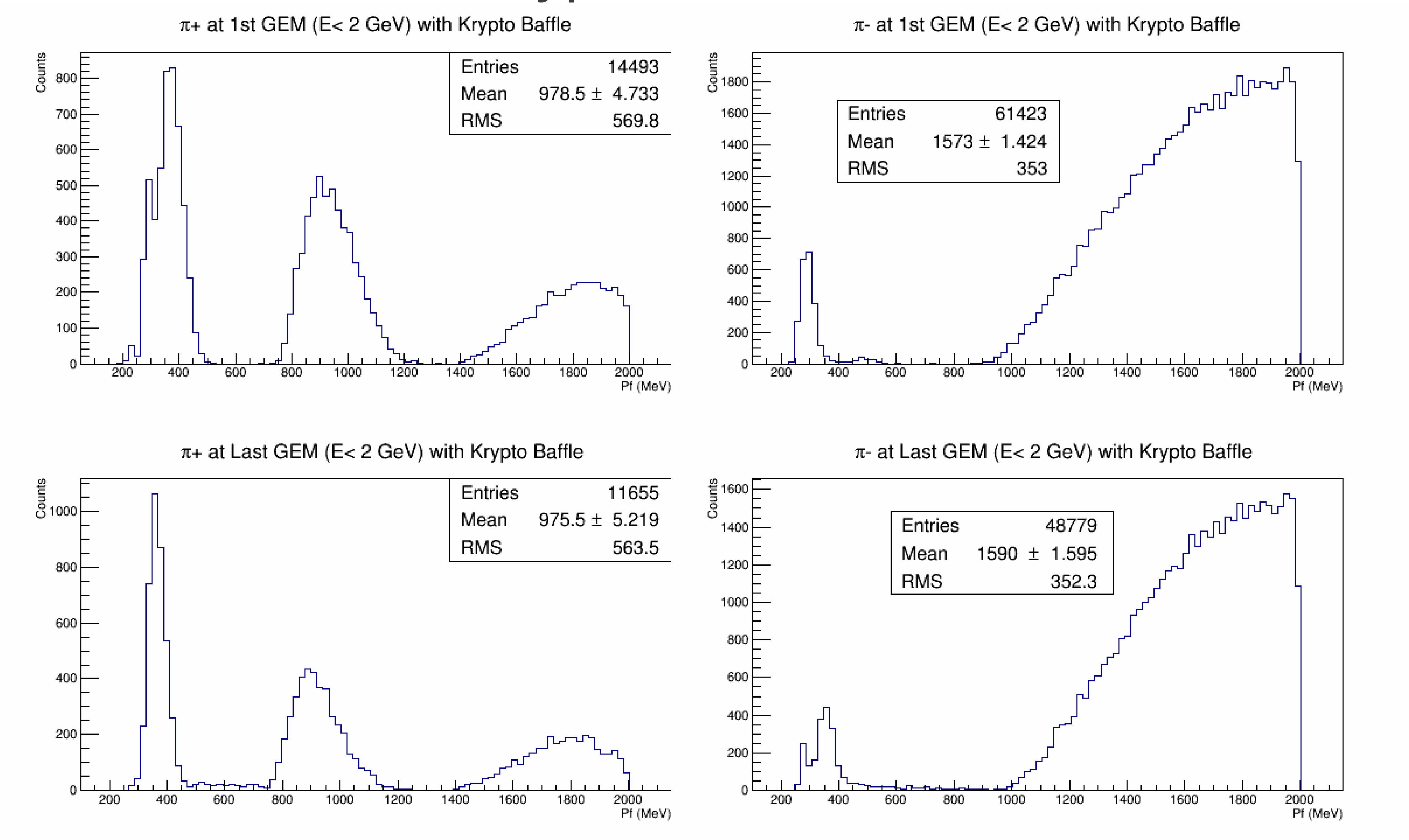




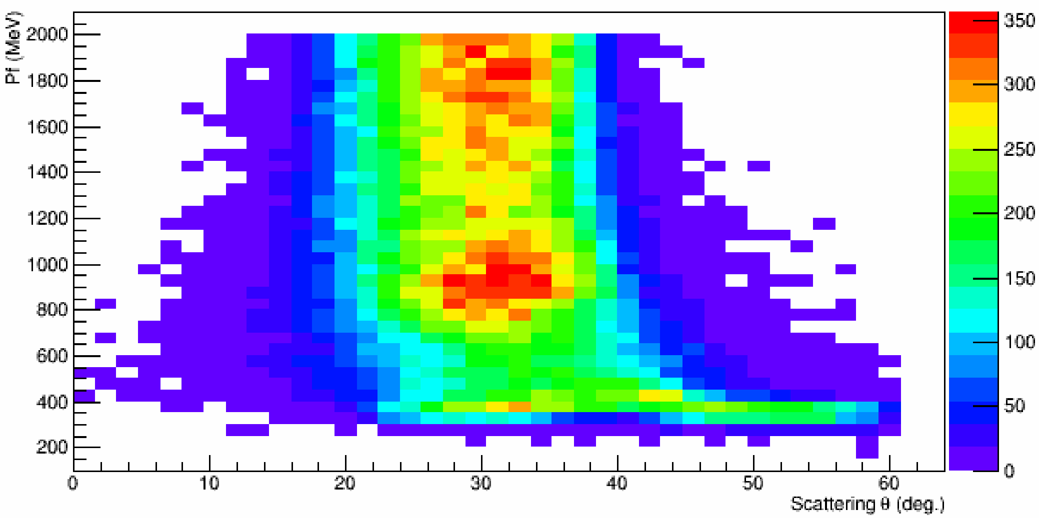




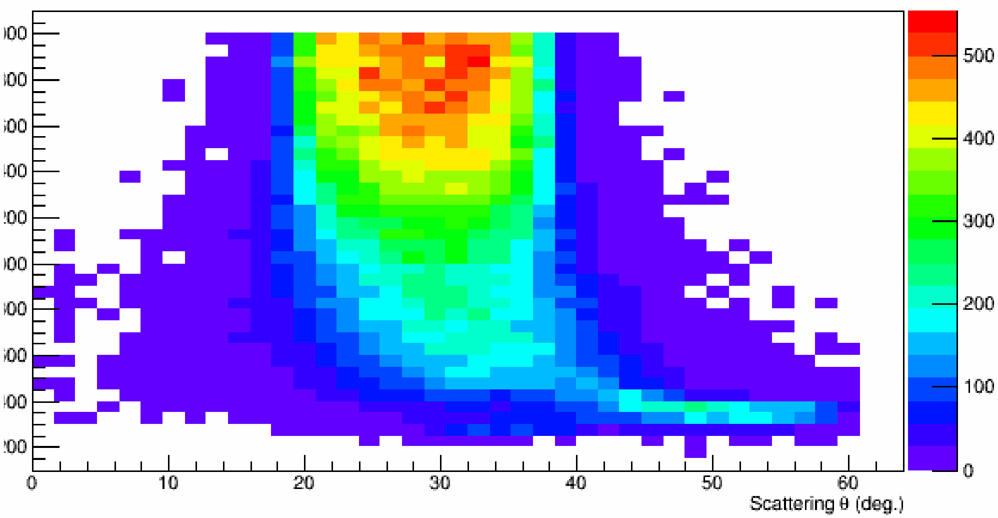
Primary Momentum at GEM Planes with Kryptonite Baffles



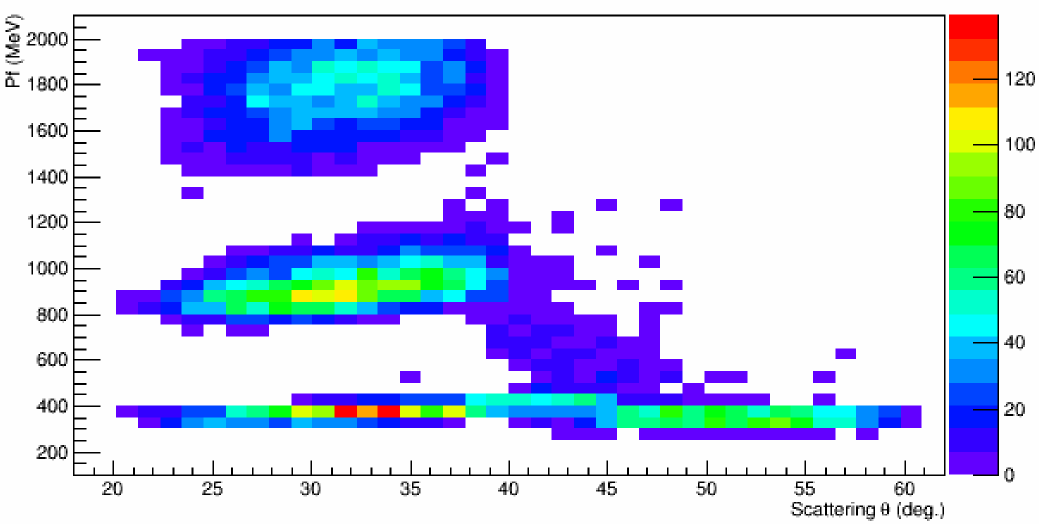
Simulation Test 1 : Kinematics Summary



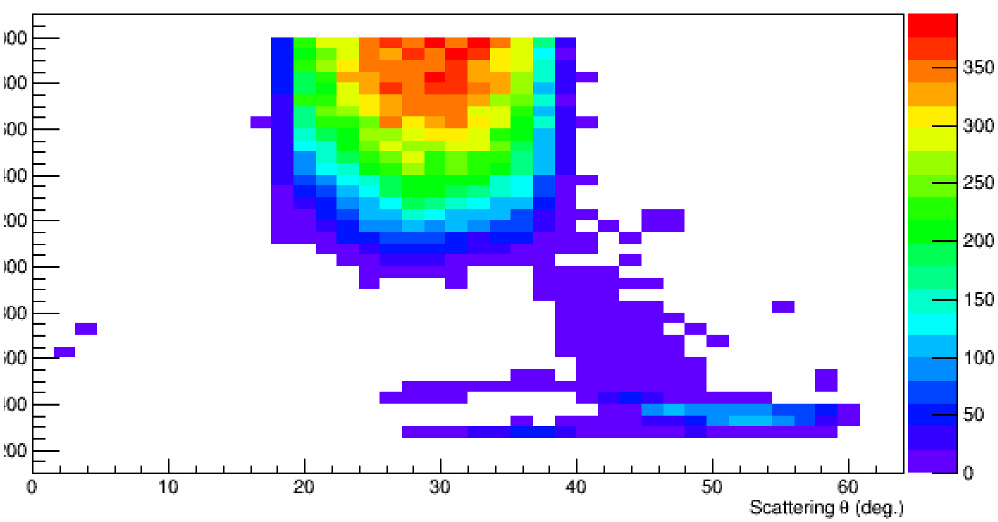
π+ at Last GEM (E< 2 GeV) with Pb Baffle



π- at Last GEM (E< 2 GeV) with Pb Baffle



π+ at Last GEM (E< 2 GeV) with Kryptonite Baffle

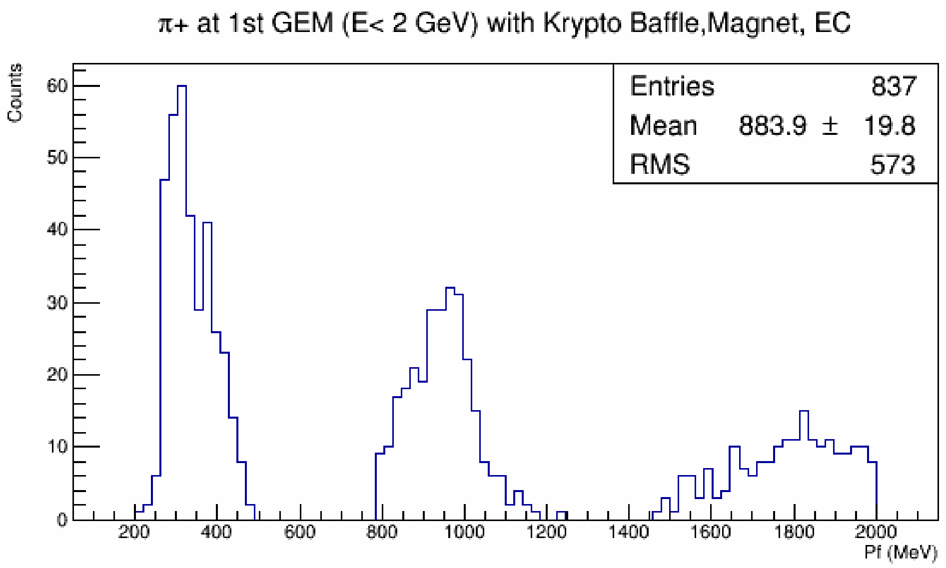


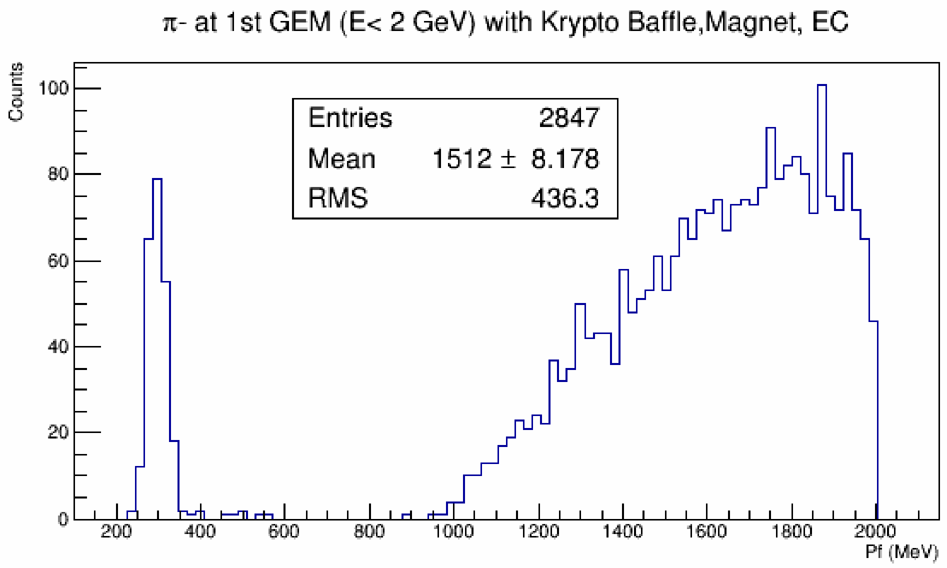
π- at Last GEM (E< 2 GeV) with Kryptonite Baffle

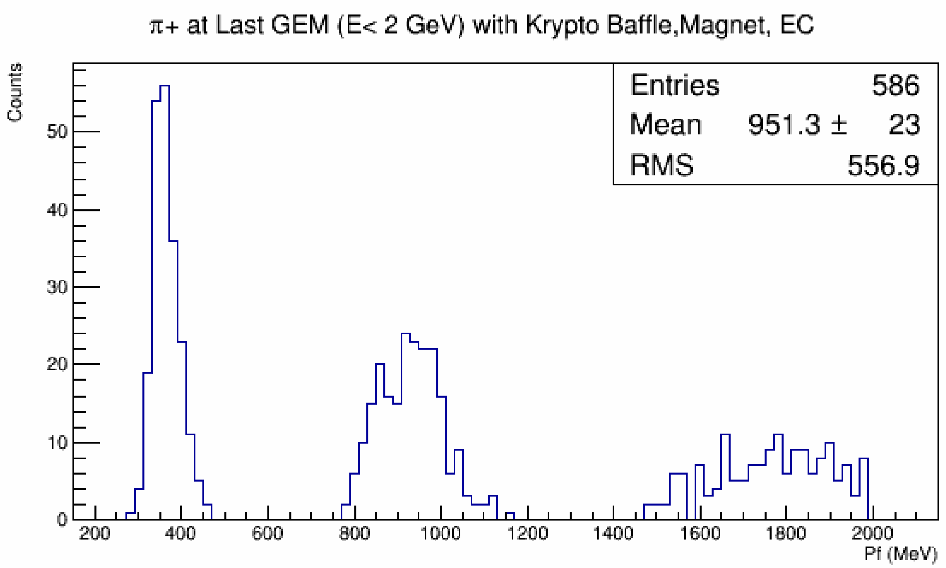
Simulation Test 2 : All Kryptonite Geometry

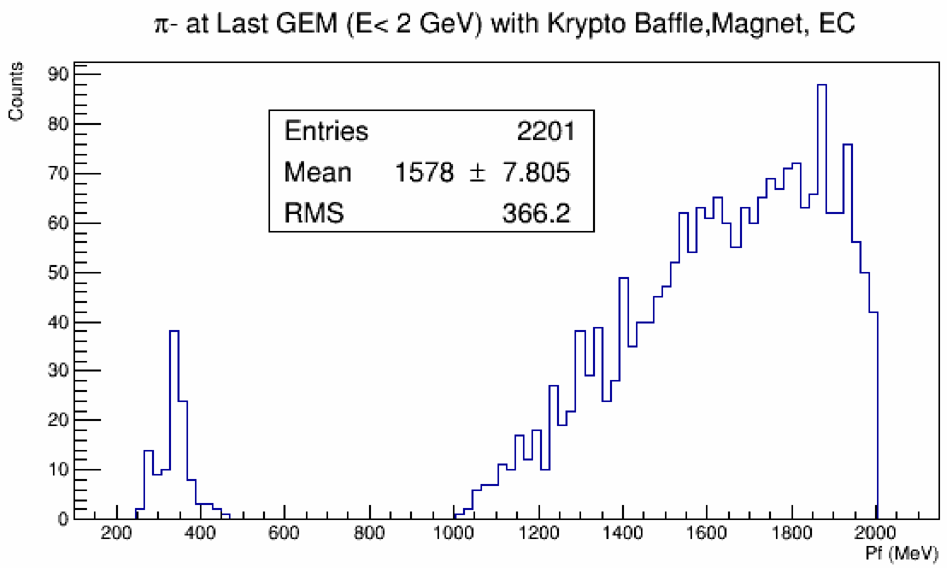
- Used kryptonite for,
  - Magnet, baffles, and EC-forward angle
- Input Wiser-fit pions (+/-)
- Only primary tracks are considered

Pi + and - : All Kryptonite Geometry

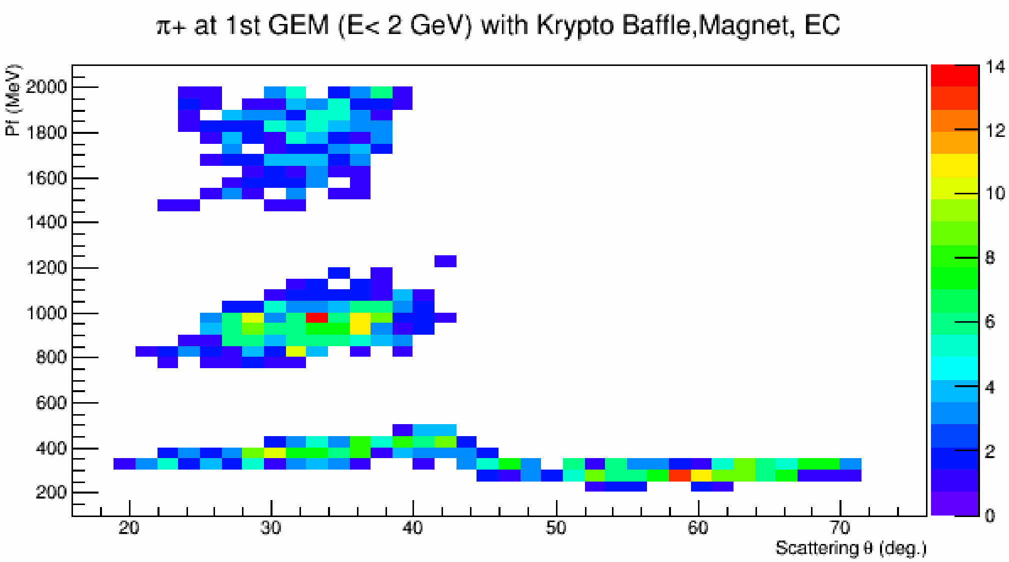


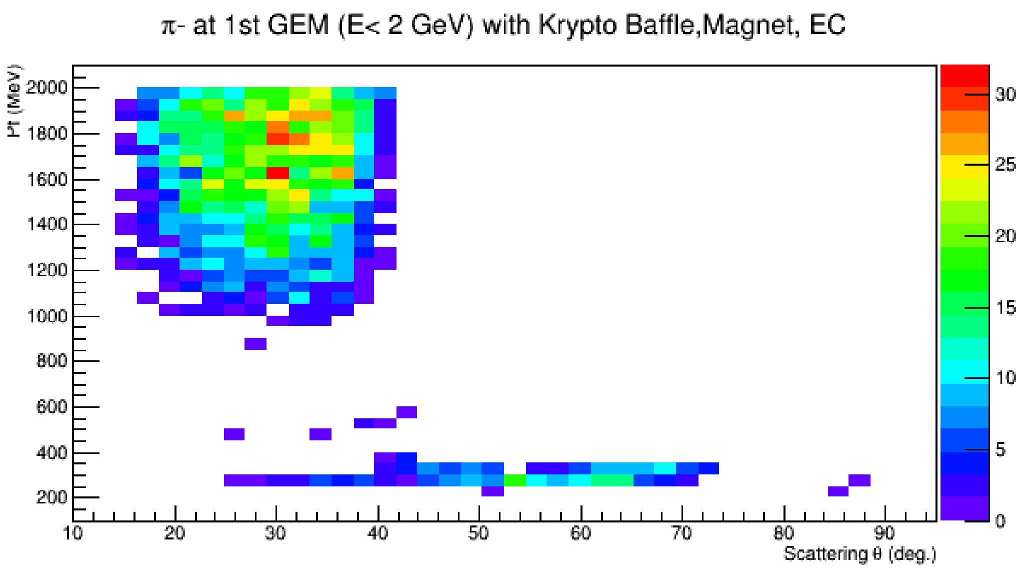


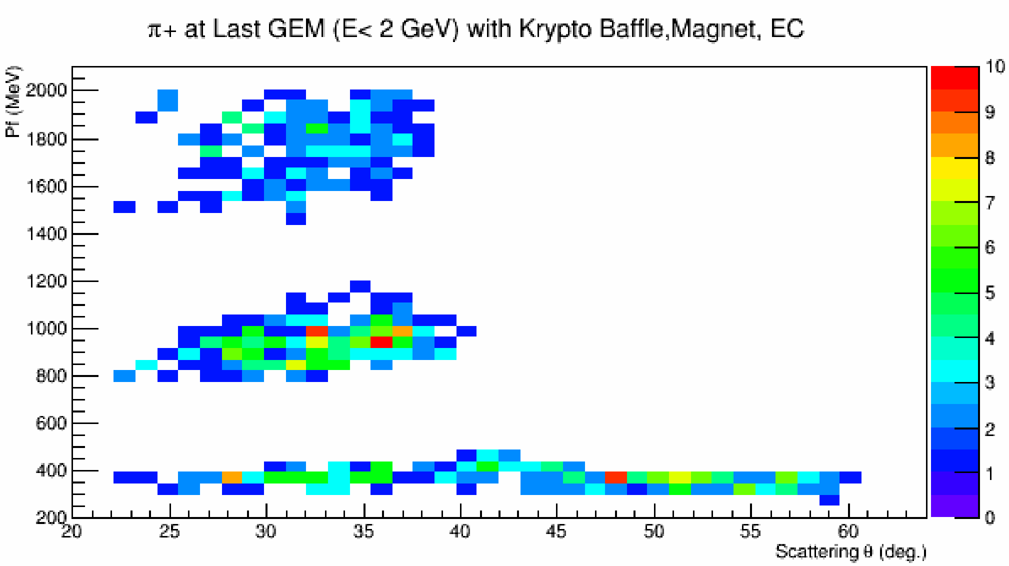


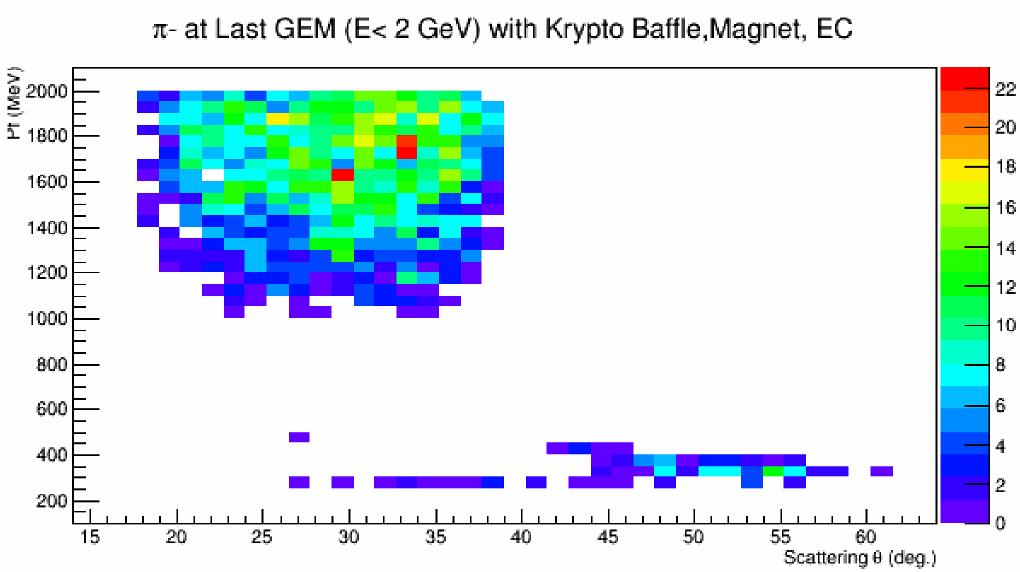


Pi + and - : All Kryptonite Geometry









Summary

- Pions that traverse through baffle slits can be minimized by increasing the no. of baffles
- Provide additional shielding for pions scattered at small (less than 20^0) and large angles (about $40^0 – 70^0$)
- Improve the baffle design (thickness and etc.) to stop pions leaking through the baffles.

Issues

- Wiser fit rates are about 50 times higher than expected rates
  - This is compared to rates given in the proposal

Supplementary

π^+ Rate Summary

Process	Baffle Geometry	
	Lead (MHz/uA)	Kryptonite (MHz/uA)
π^+ (p> 0.3 GeV)	235	40
π^+ (p> 1 GeV)	17	1
π^+ (p> 2 GeV)	1	0.02

π^- Rate Summary

Process	Baffle Geometry	
	Lead (MHz/uA)	Kryptonite (MHz/uA)
π^- (p> 0.3 GeV)	178	25
π^- (p> 1 GeV)	31	15
π^- (p> 2 GeV)	3	2

Reduction in Pion Counts

	Reduction in Pion counts w.r.t. Lead baffles			
	Pb → Kryptonite baffles		Pb → Kryptonite baffles, Kryptonite Magnet and EC	
	Reduction (%)		Reduction (%)	
	1st GEM	Last GEM	1st GEM	Last GEM
π^+	89	88	99	99
π^-	62	60	98	98

Simulation Summary

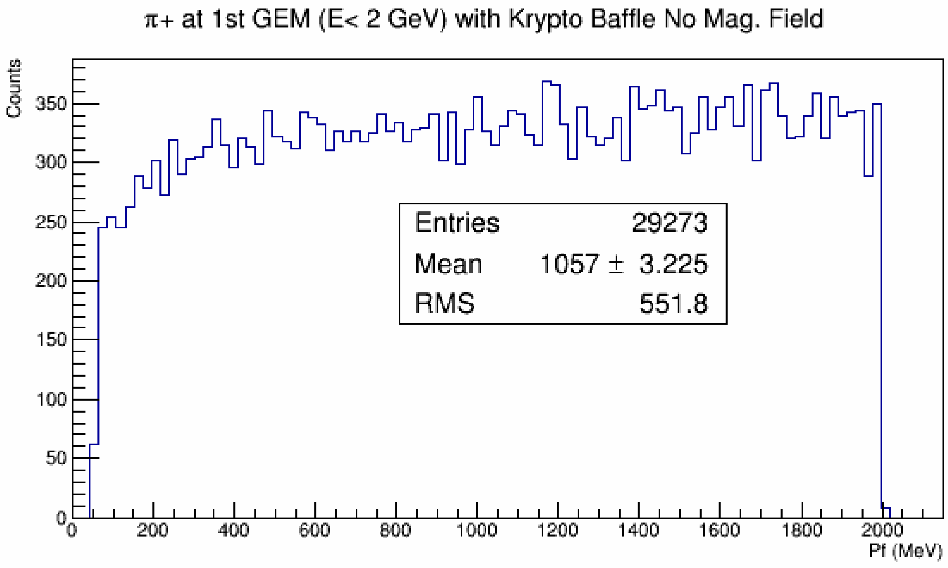
- Used solgemc and results are weighted using the pion rate
- Things included in the simulation,
  - CLEO solenoid
  - Target
  - Al Beamline
  - Pb Baffles
  - Cerenkov
  - GEM (4 GEMs)
  - EC forward-angle
- Field is ON
- Ran about 1 million events

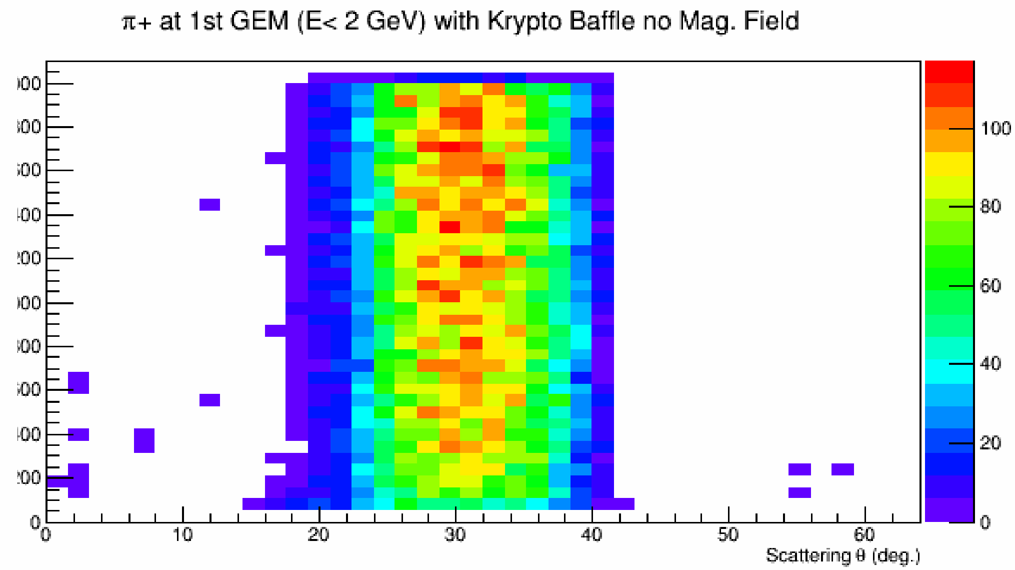
Input Generation

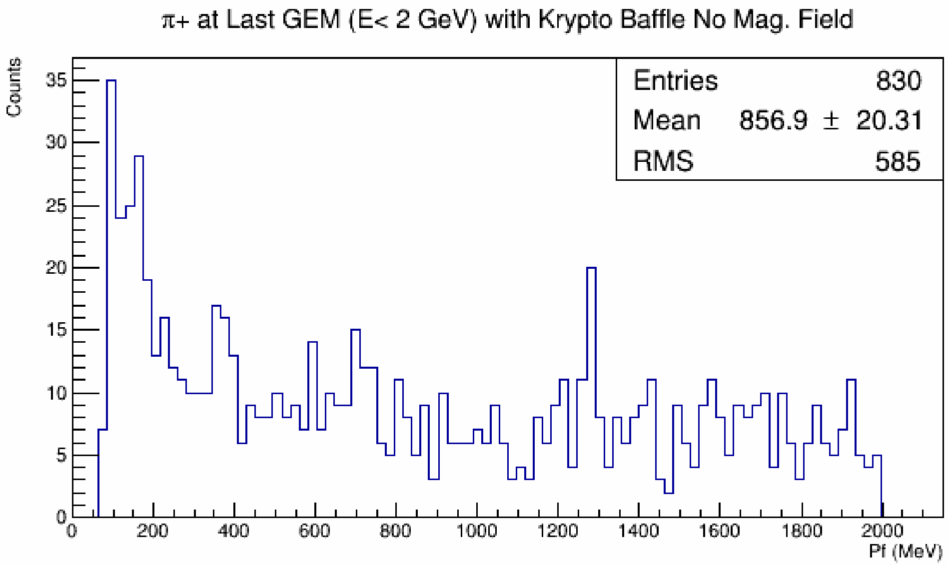
Simulation Test 3 : No Field Check

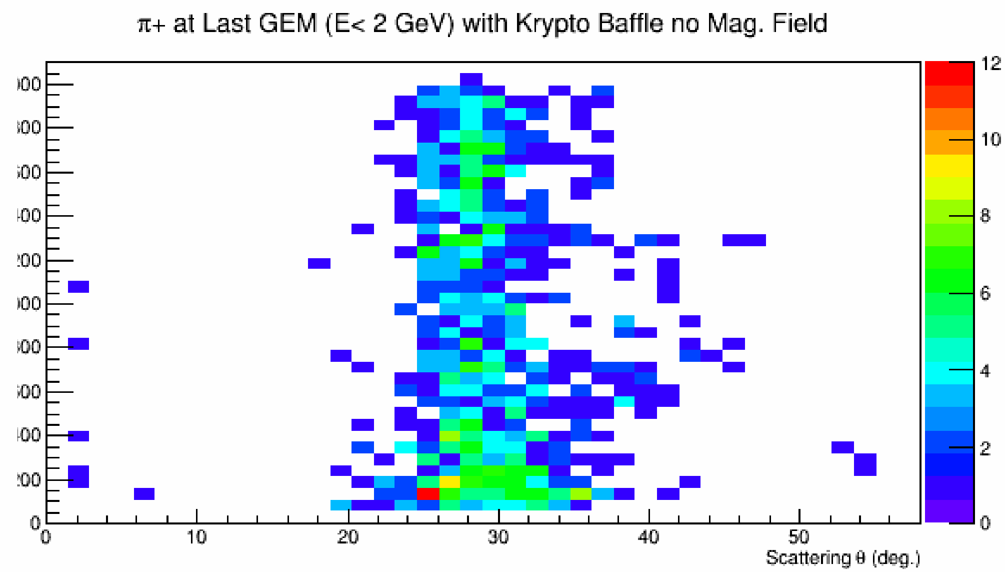
- Input Isotropic pion distribution described at the beginning
- Used Kryptonite baffles
- Simulate with no magnetic filed
- Only primary tracks are considered

Pi+ : No Field Check

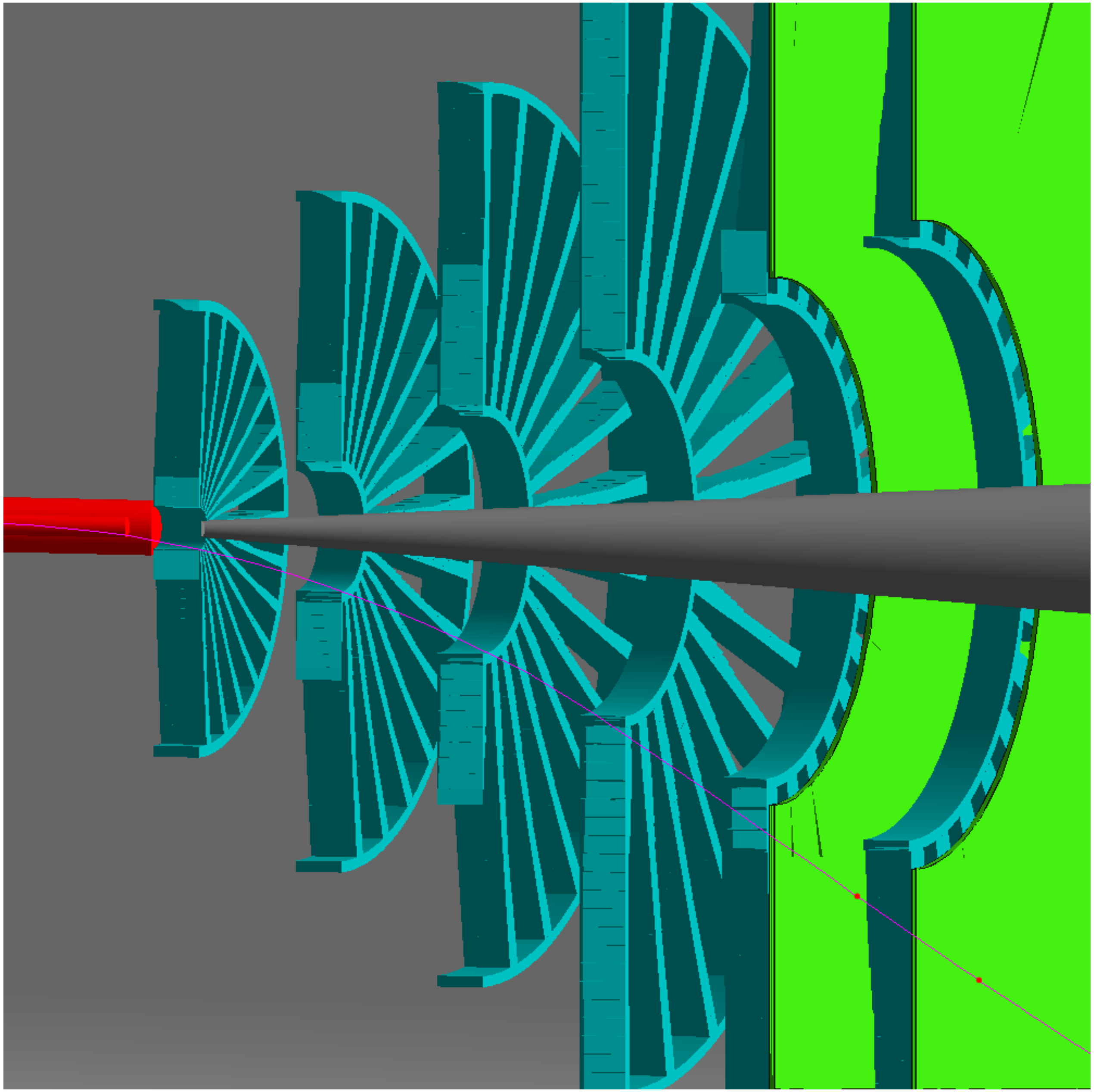




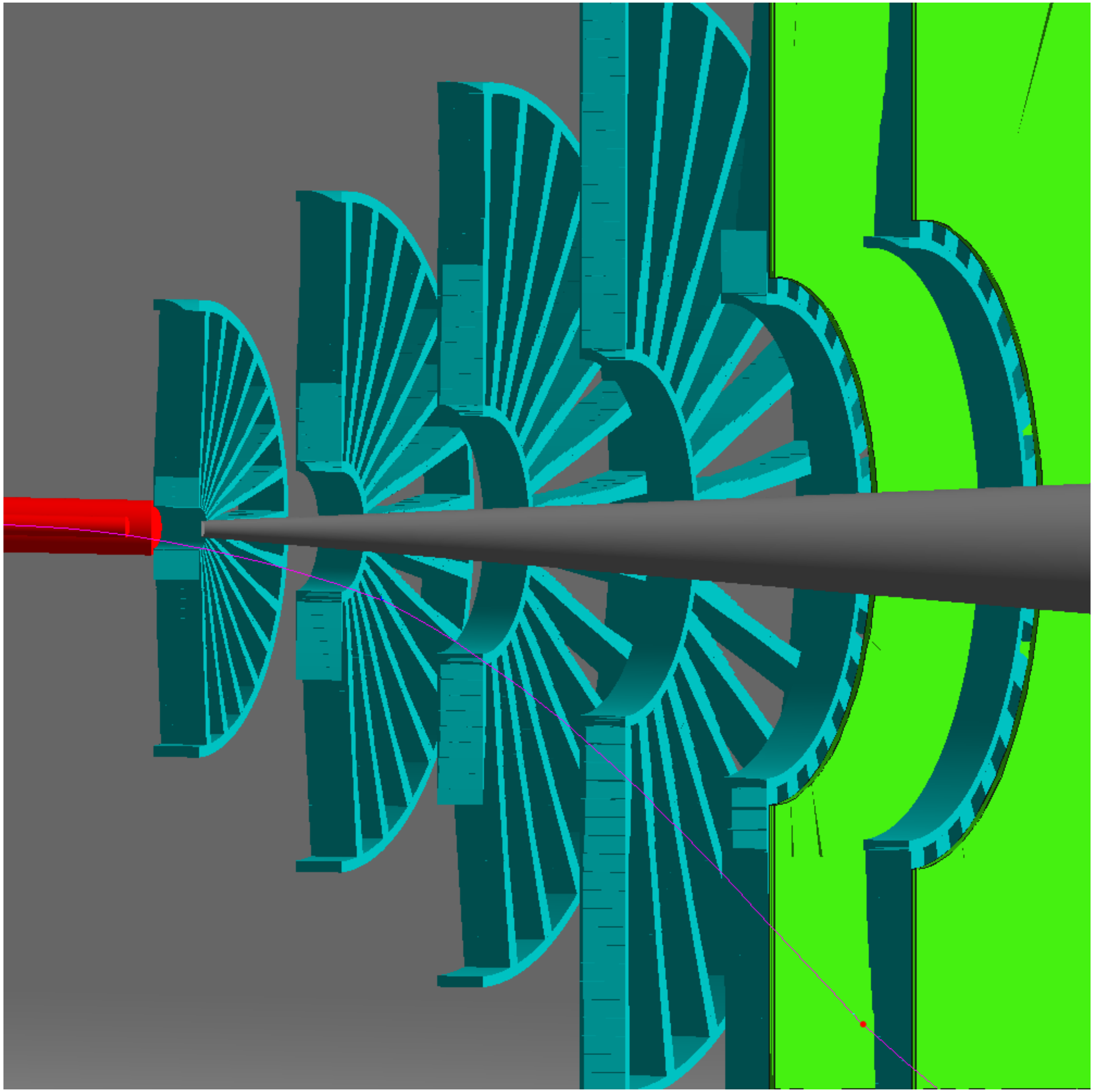




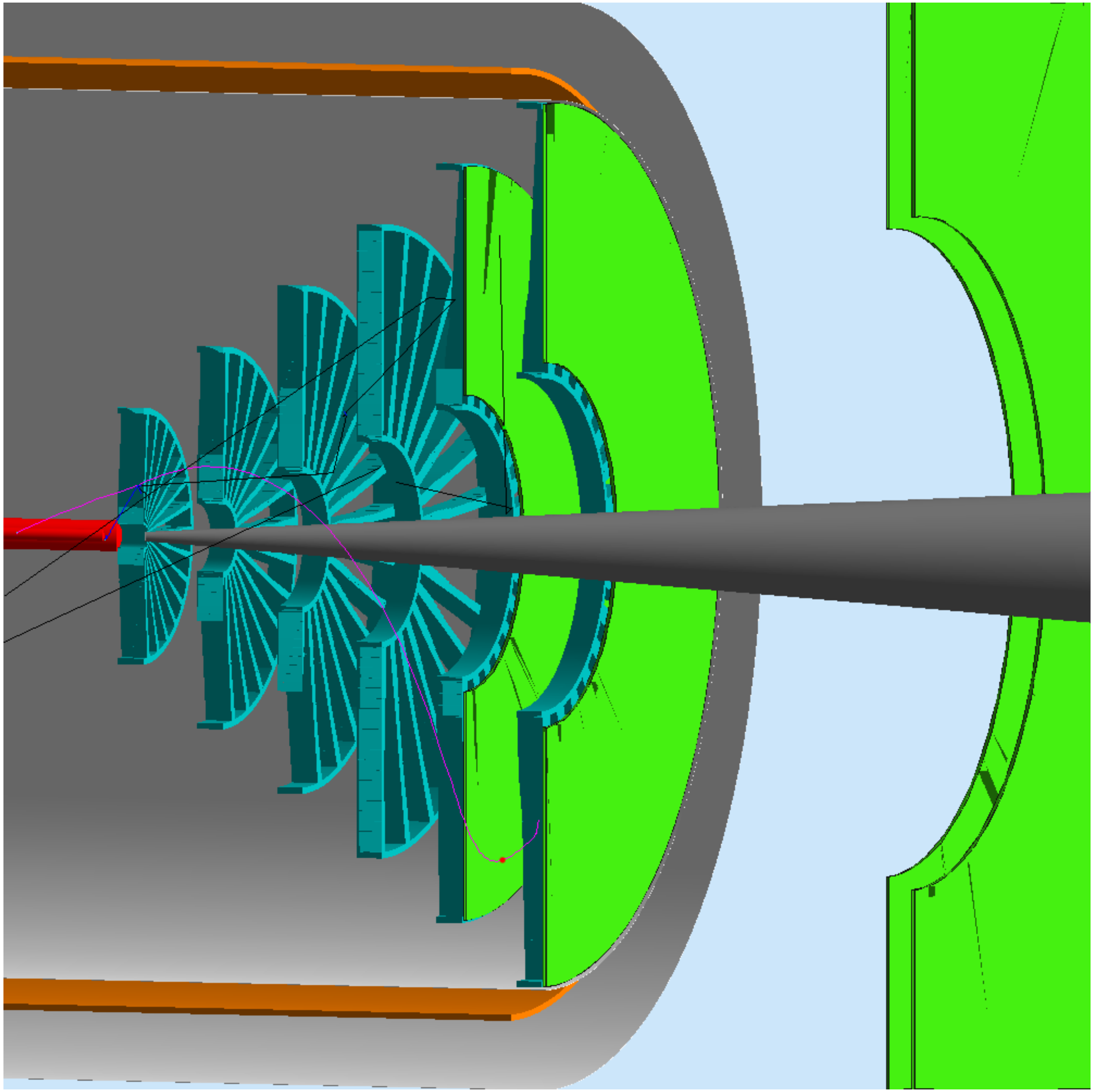
Pi+ Tracks



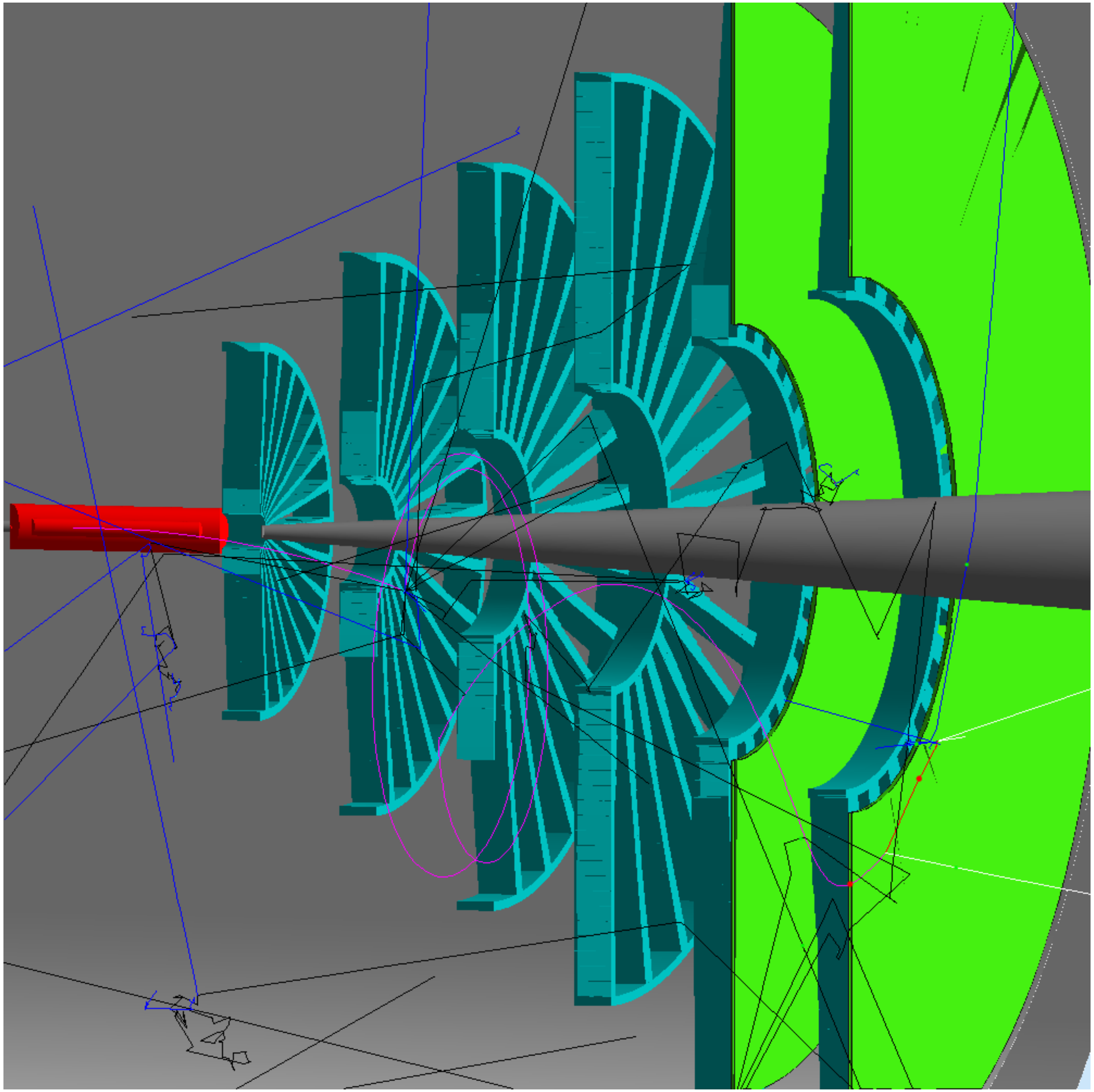
Pi+ Tracks



Pi+ Tracks



Pi+ Tracks



Pi+ Tracks