Second Look at 6 GeV Beam Data

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What's Up Next

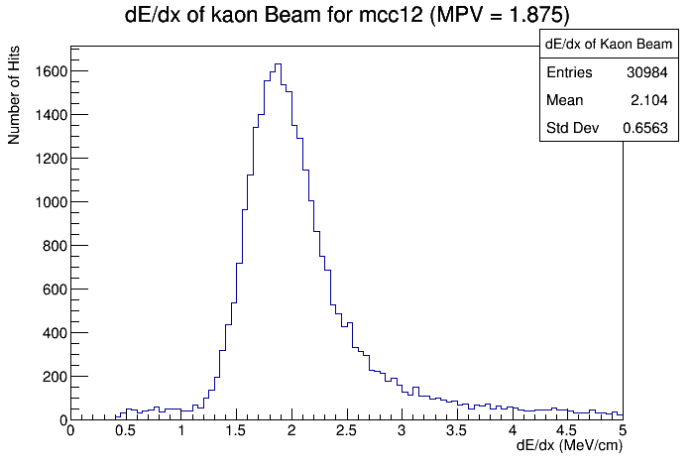
Analysis of 6-7 GeV Samples (They are identical from a beam instrumentation POV)

1. Cross-checks of Bethe-Bloche predictions and MCC 12 with SCE simulated and calibrated
2. Using Beam Tracks to Veto
3. Signal-Background Plots and Lingering Issues

"At first we didn't know what to do with all the [data]. We tried [cutting] it, [chopping] it, and [explaining] it. But in the end, we decided just to give [plots for everything]."- Spongebob Squarepants

Kaon dE/dx in MCC with SCE simulated and calibrated

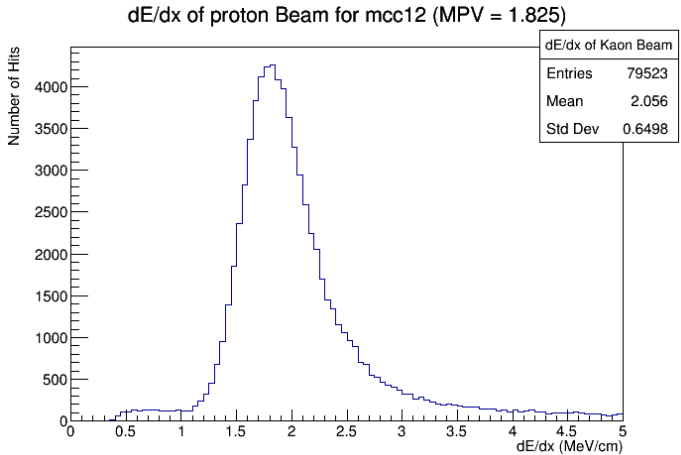
They are all in good agreement given Bethe-Bloche predicts MPV as 1.89 MeV/cm



Kaon MCC 12 dE/dx for first 20 cm in Z

Proton dE/dx in MCC with SCE simulated and calibrated

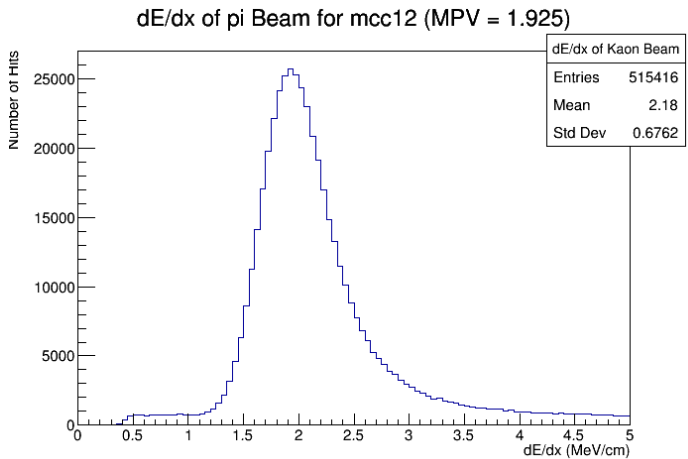
Bethe-Bloche predicts MPV as 1.86 MeV/cm



Proton MCC 12 dE/dx for first 20 cm in Z

Pion dE/dx in MCC with SCE simulated and calibrated

Bethe-Bloche predicts MPV as 1.96 MeV/cm



Pion MCC 12 dE/dx for first 20 cm in Z

Beam Particle Tagging

From Alex Booth and Jake Calcultt:

Candidates	High Pressure Cherenkov	Low Pressure Cherenkov
$\pi+$	1	1
p+	0	0
K+	1	0

Beam Instrumentation Tagging for 6-7 GeV

No need for TOF other than as a QA-check. Purely logical candidate selection.

Beam Composition using Simulation

Tested how accurate "beam inst." is after the particle reaches the TPC. Geant will give what the beam instrumentation sees in MCC and calling the MCTruth can verify what the TPC Truth saw and what Geant's beam tagging saw.

Candidates	$\pi+$	π-	K	μ	e	p	γ	other (nuclei)
$\pi+$	80.5%	3.1%	0.44%	6.7%	negl.	7.7%	1.27%	0.5%
p+	4.8%	2.5%	negl.	5.1%	negl.	85.9%.	0.8%	0.6%
K+	3.7%	2.7%	72.3%	12.1%	negl.	7.7%	1.0%	0.3%.

Beam particle from MCTruth separated as a percentage of Geant Good Particle candidates, the equivalent of beam inst. for MCC, in MCC12 at p6GeV.

Cosmic Contamination using Simulation

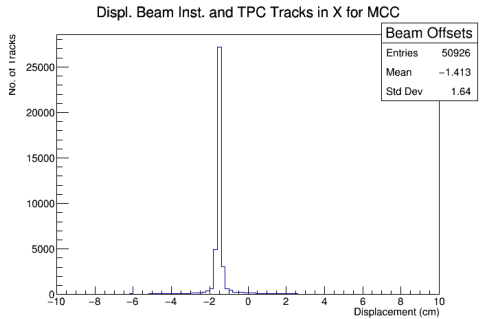
Use MCTruth to see if it was cosmic in origin and use that to test contamination of beam PFParticle.

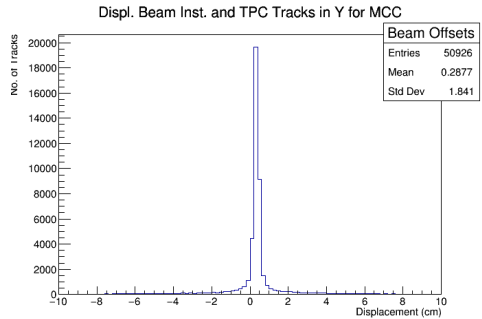
Candidates	μ	e	p	γ
$\pi+$	7.38%	0.03%	0.21%	0.04%
p+	7.5%	0.03%	0.02%	0.05%
K+	8.51%	0.04%	0.32%	0.08%

Cosmic contamination from MCTruth separated as a percentage of Geant Good Particle candidates. In this sample of MCC 6 GeV, the muon contamination for pions and protons was 10%.

Beam Tracking in MCC 12

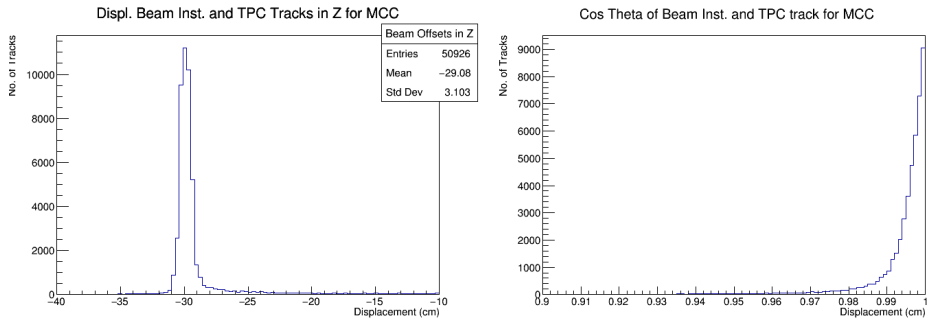
Use Jake's method to plot TPC-Beam Inst. tracking distortions to decide on cuts.





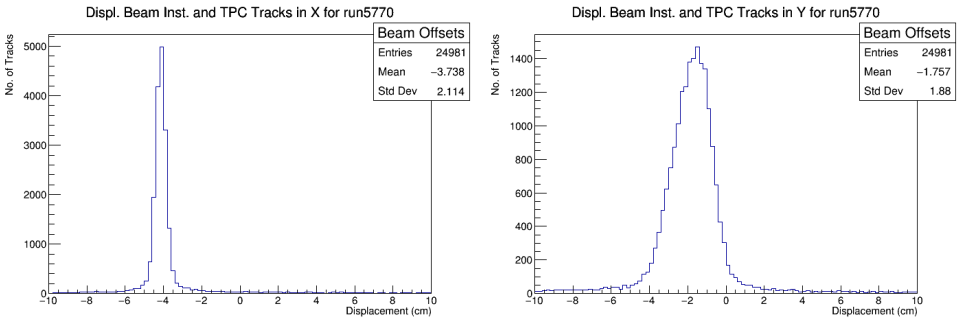
dX for MCC (left) and dY for MCC (right)

Beam Tracking in MCC 12



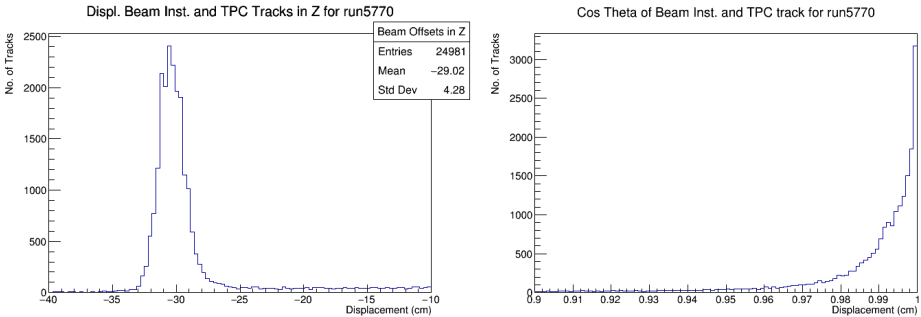
dZ (left) and cosine between the track directions for MCC (right)

Beam Tracking in Run 5770



dX (left) and dY (right) for run5770.

Beam Tracking in Run 5770



dZ (left) and cosine between the track directions (right) for run5770.

Cuts Made

Based on the plots I made the following, harsh, cuts:

- MCC: -3<dx<3, -2<dy<2, -32<dz<-22, cos>.996
- Data: -6<dx<-3, -5<dy<0, -33<dz<-25, cos>.996

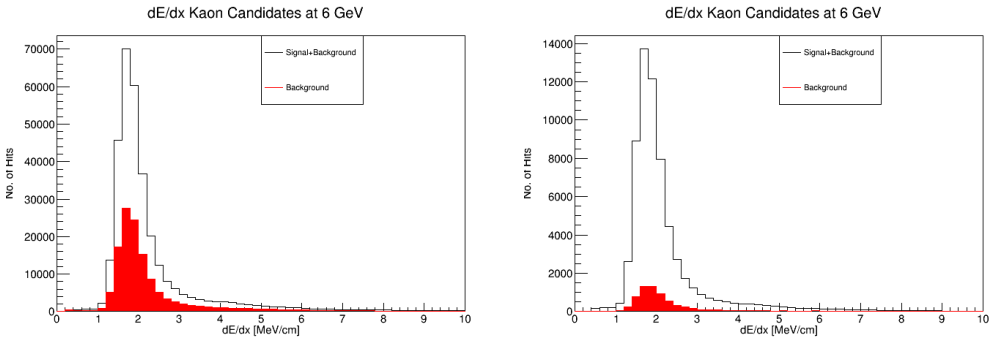
New Beam Composition after Cuts

All cosmics were cut.

Candidates	N_{tot}	N_{cuts}	π	μ	p	k	other
$\pi+$	41466	17963	95.2%	2.6%	1.2%	0.1%	0.9%
p+	7039	2777	2.1%	0.1%	97.6%	0%	0.2%
K+	2421	1073	1.2%	7.7%	1.8%	89%	1.3%

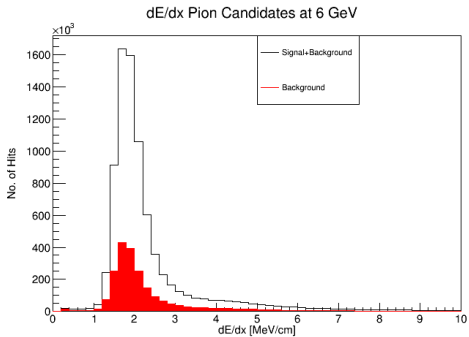
New beam composition with beam cuts

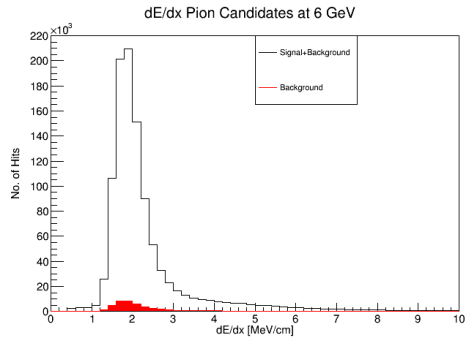
Background in MCC



Signal and background dE/dx for kaons without cuts (left) and with cuts (right) in MCC.

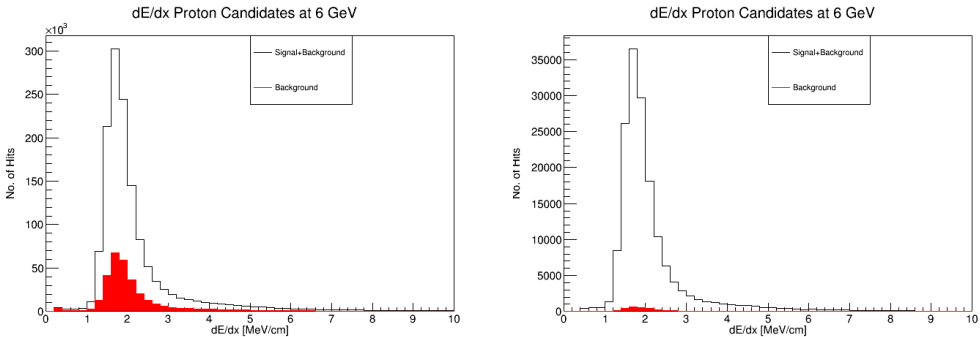
Background in MCC





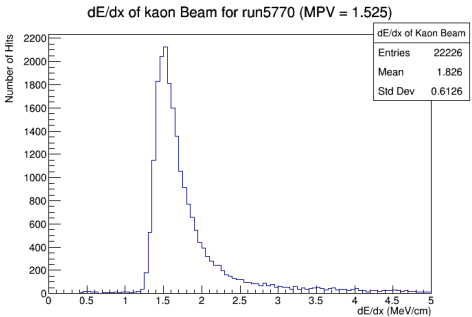
Signal and background dE/dx for pions without cuts (left) and with cuts (right) in MCC.

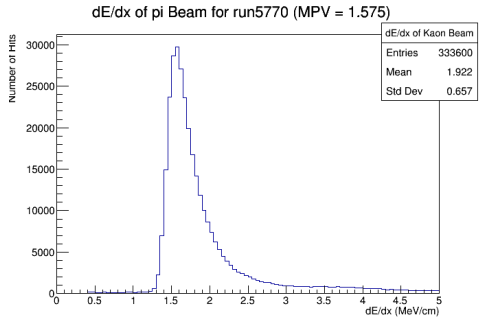
Background in MCC



Signal and background dE/dx for protons without cuts (left) and with cuts (right) in MCC.

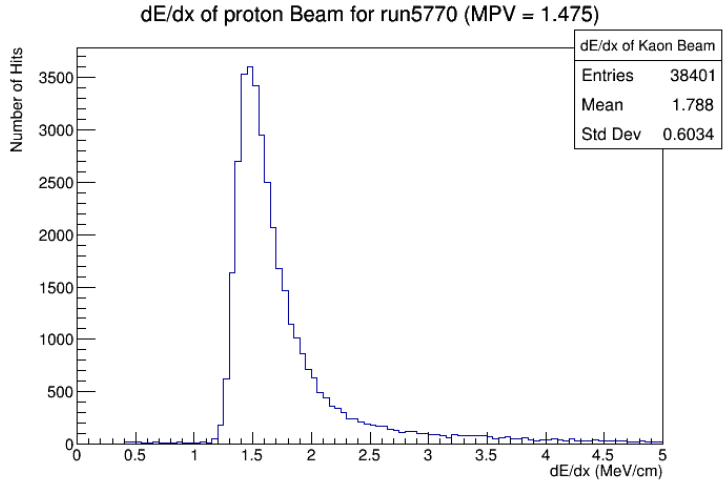
dE/dx in Data





dE/dx for the first 40 cm for kaons (left) and pions (right)

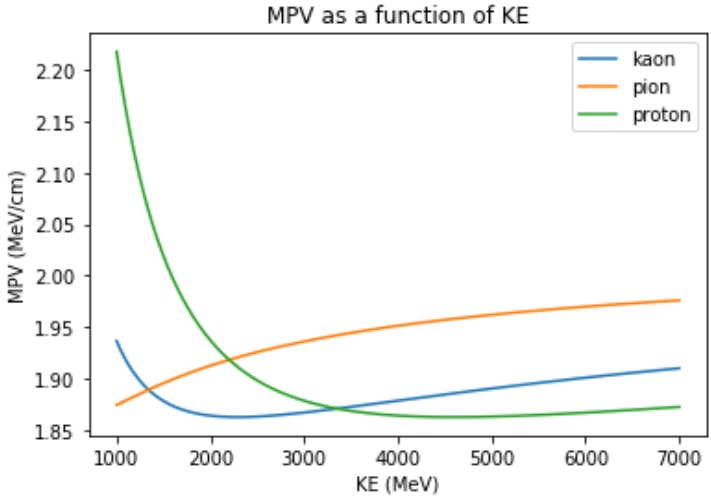
dE/dx in Data



dE/dx for the first 40 cm for protons

MPV Predicted by Bethe-Bloche

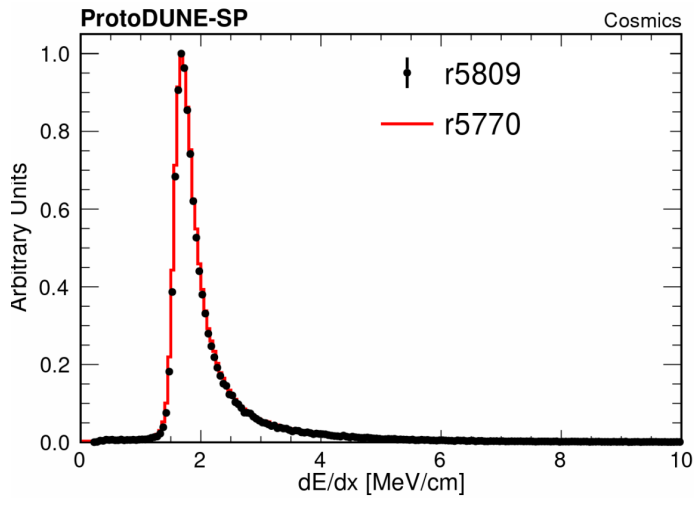
Ajib wrote a function to predict the MPV from dE/dx. The trends suggest we are missing something.



Conclusion

- Good agreement with Bethe-Bloch in MCC
- Beam tracking does a good job of vetoing bad beam particles, purity for all particles at or above .89.
- What could be wrong with the dE/dx in data?

Background: dE/dx Calibration for Data Run



dE/dx of muons used to validate calibration for runs between 1 GeV run5809 and 6 GeV run5770.