Containment for Protons and Kaons

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LAr Test Beam Meeting

10/23/2012

Outline

- Setup and definition
- Kaon containment
- Proton containment

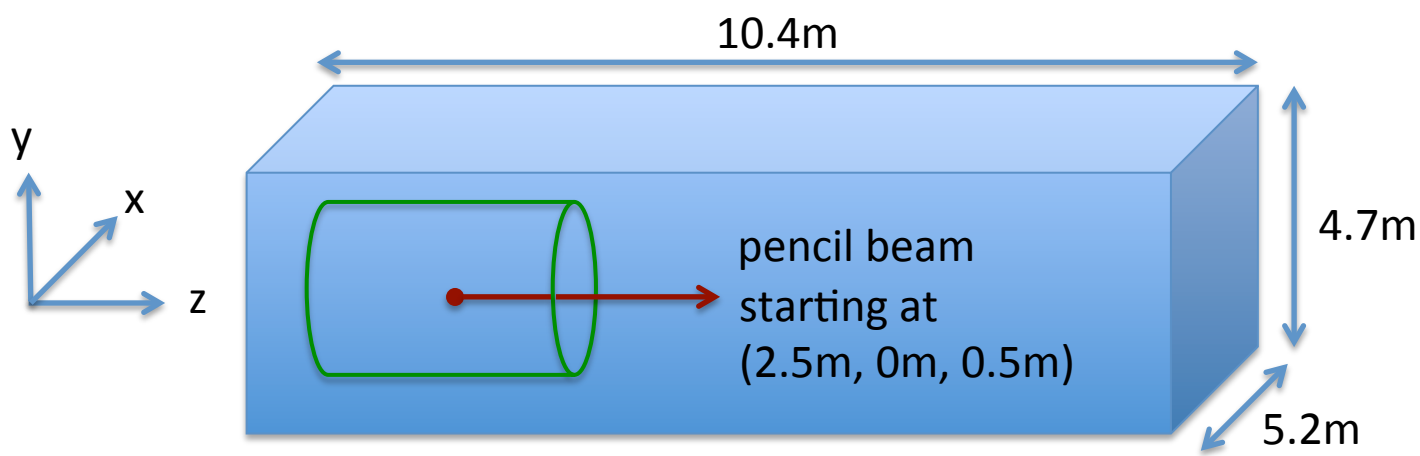
Note:

- Shower shapes (longitudinal and transverse) are put in the backup
- The original motivation is to look at containment in terms of radiation length and interaction length such that it can be compared to NOvA detector, for example for the longitudinal max position

	Electrons	Pions
NOvA	$L_{\max}/X_0 = 0.89\ln\left(E/E_c\right) - 0.65$	$L_{\max}/\lambda = 0.19E + 0.19$
LAr	$L_{\max}/X_0 = 1.07\ln\left(E/E_c\right) - 1.13$	$L_{\max}/\lambda = 0.13E + 0.14$

Setup and Definition

Define a small volume in the extended MicroBooNE geometry from Pawel



Containment is defined as

$$\text{Containment} \equiv \frac{\text{Energy deposition within the defined boundary}}{\text{Energy deposition in the full geometry}}$$

- To study longitudinal containment, vary length with full width
- To study lateral containment, vary radius with full length

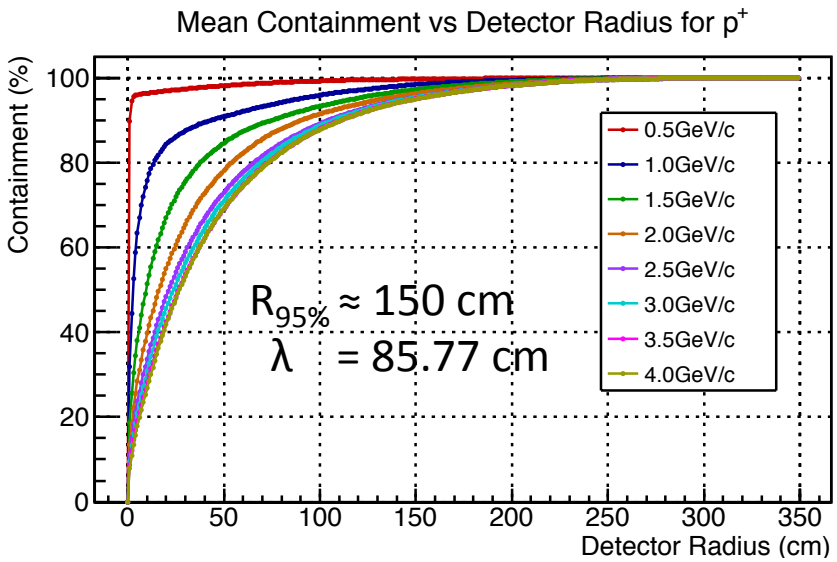
NOTE:

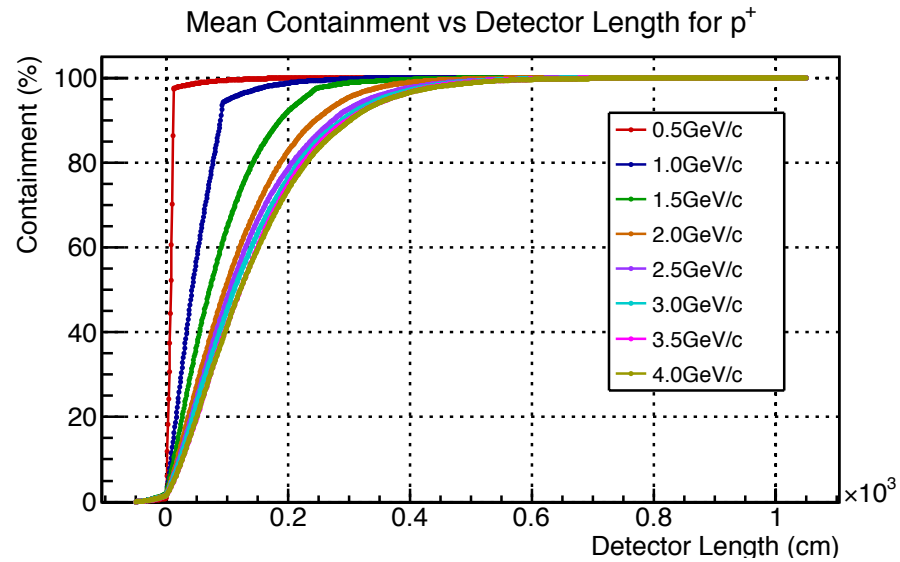
- All plots were made with MC Truth
- In producing MC files
  - ✓ generator: @local::microboone_singlep
  - ✓ largeant: @local::microboone_largeant
  - ✓ daq: @local::microboone_simwire

PROTONS

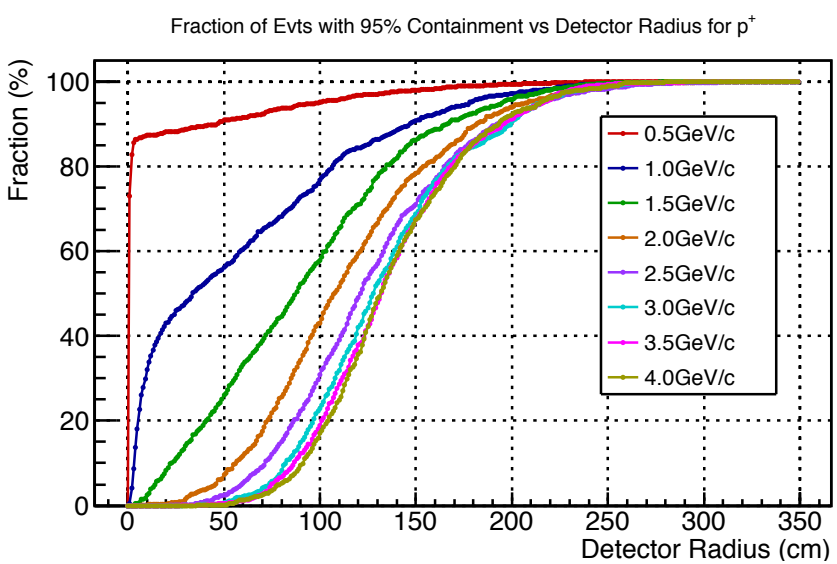
Proton Containment

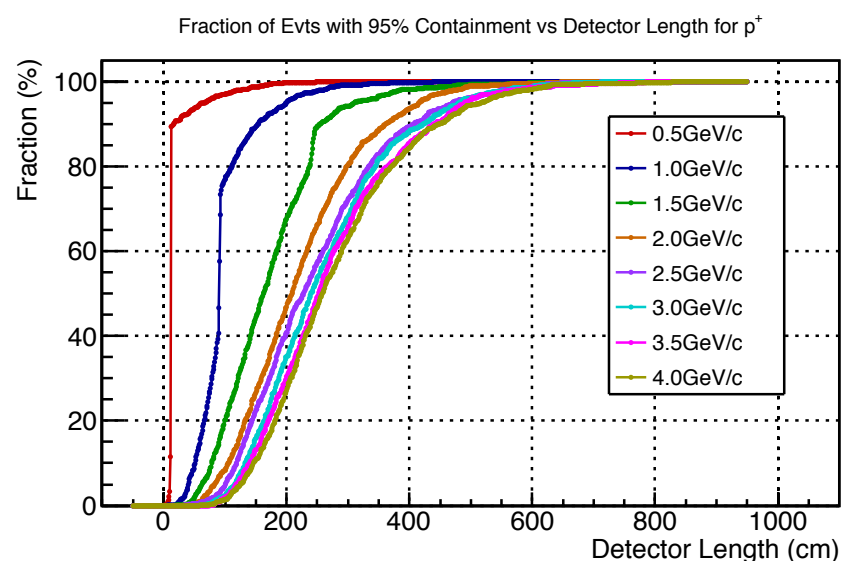
Mean containment



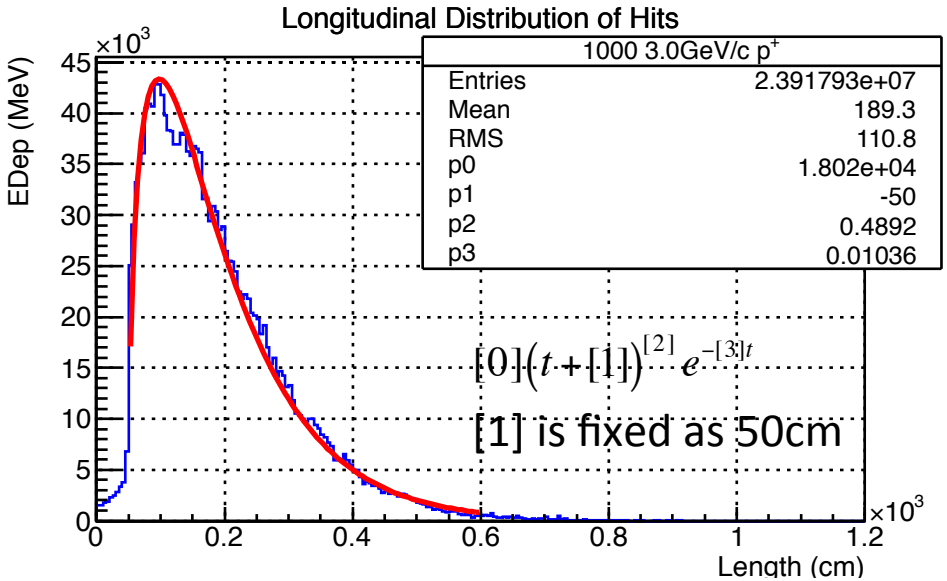


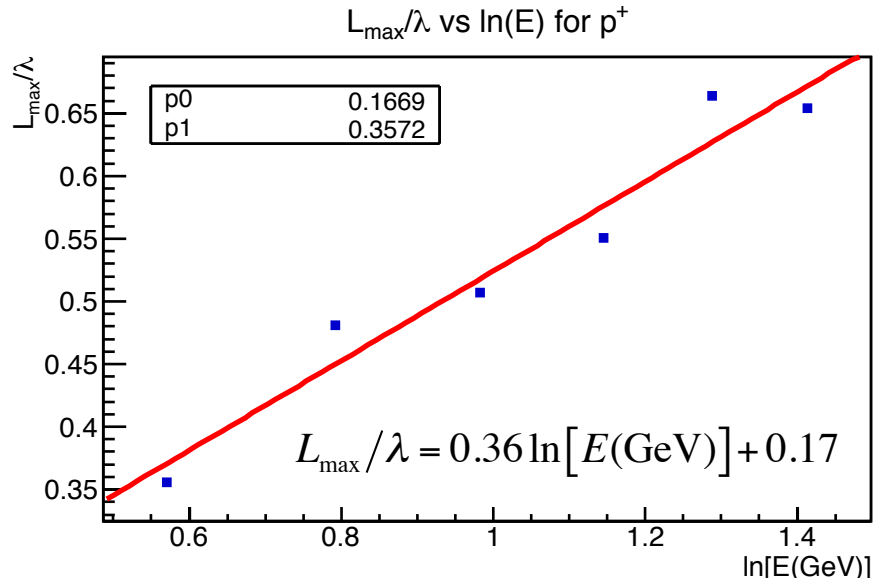
Fraction of events with above 95% containment





Longitudinal Profile





- Through fitting (upper right plot), shower max position L_{max} = *[2]/[3]* follows

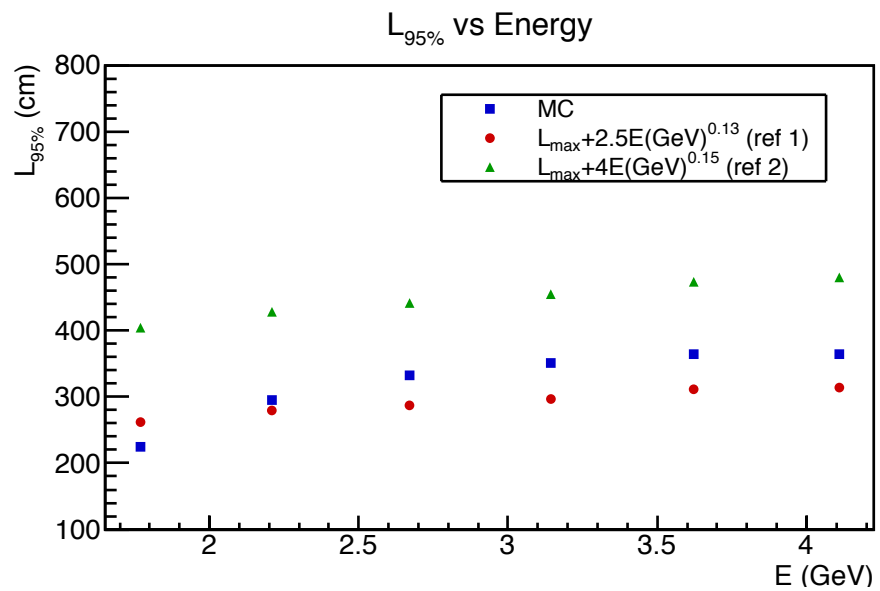
$$L_{\max}/\lambda = 0.36\ln[E(\mathrm{GeV})] + 0.17$$

whereas ref 1 and 2 suggests

$$L_{\max}/\lambda = 0.2\ln[E(\mathrm{GeV})] + 0.7$$

$$L_{\max}/\lambda = 0.6\ln[E(\mathrm{GeV})] - 0.2$$

- Length for 95% containment versus energy is shown on the right bottom plot

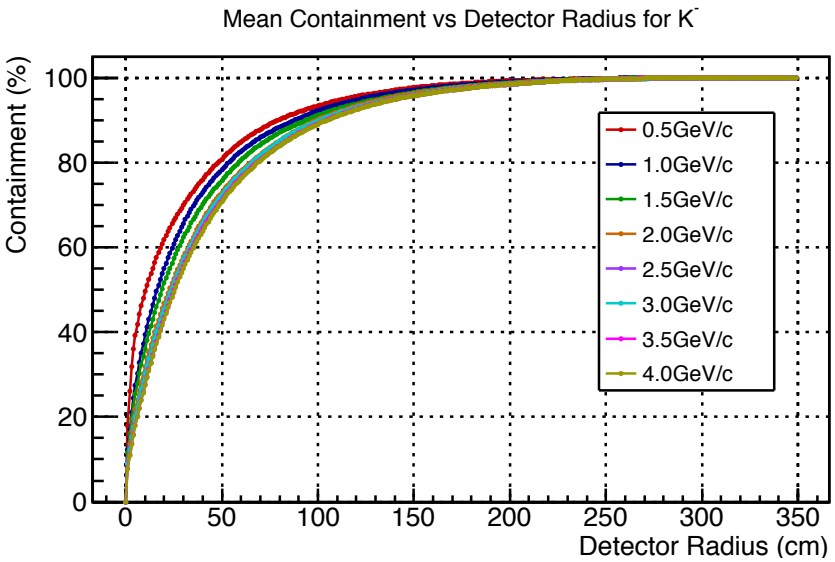


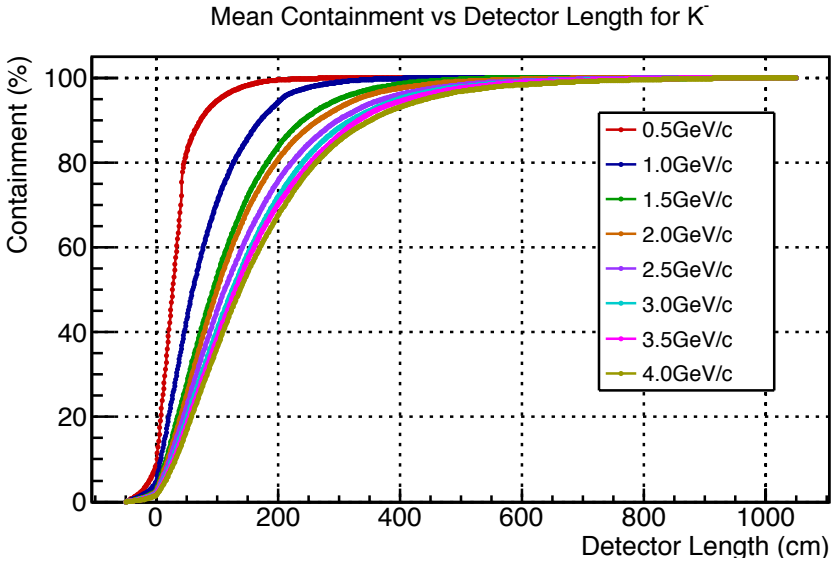
1 http://indico.cern.ch/getFile.py/access?contribId=8&resId=0&materialId=slides&confId=71806
2 http://oldweb.ct.infn.it/~rivel/Glossario/node80.html#79

KAONS

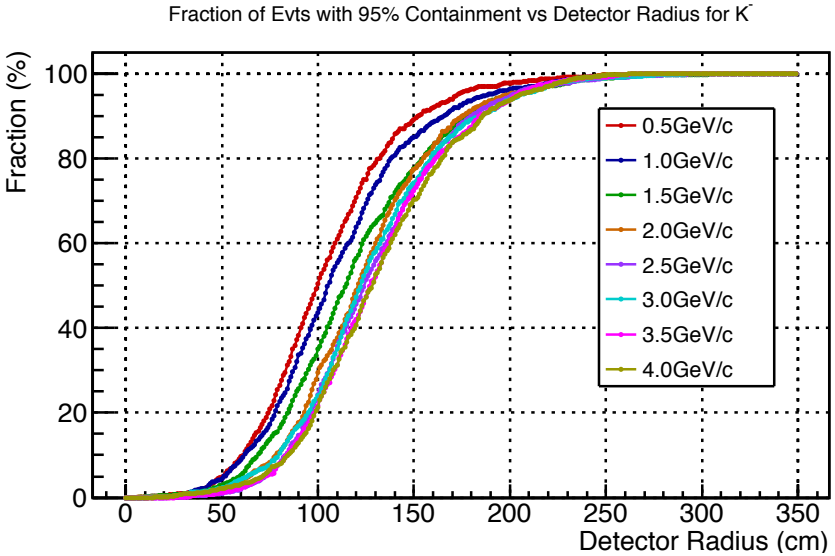
Kaon Containment

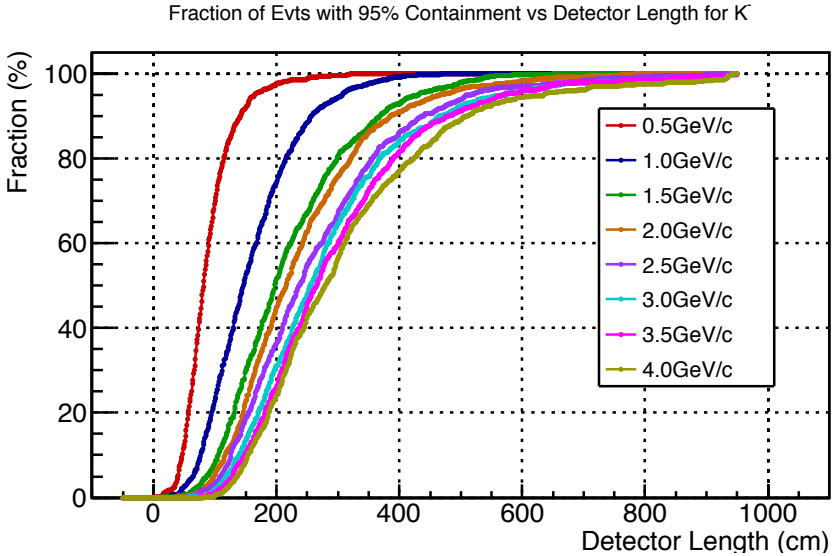
Mean containment





Fraction of events with above 95% containment



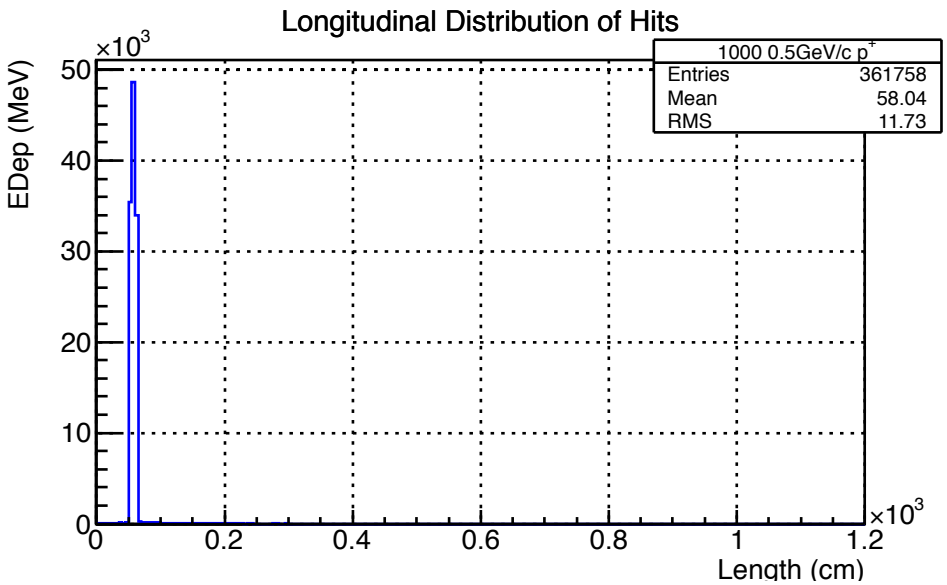


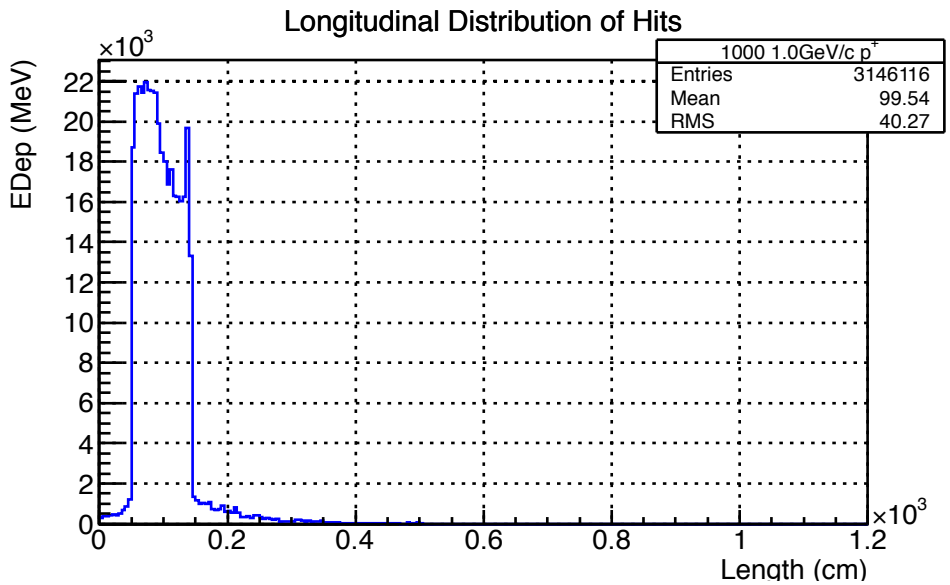
Summary and Plan

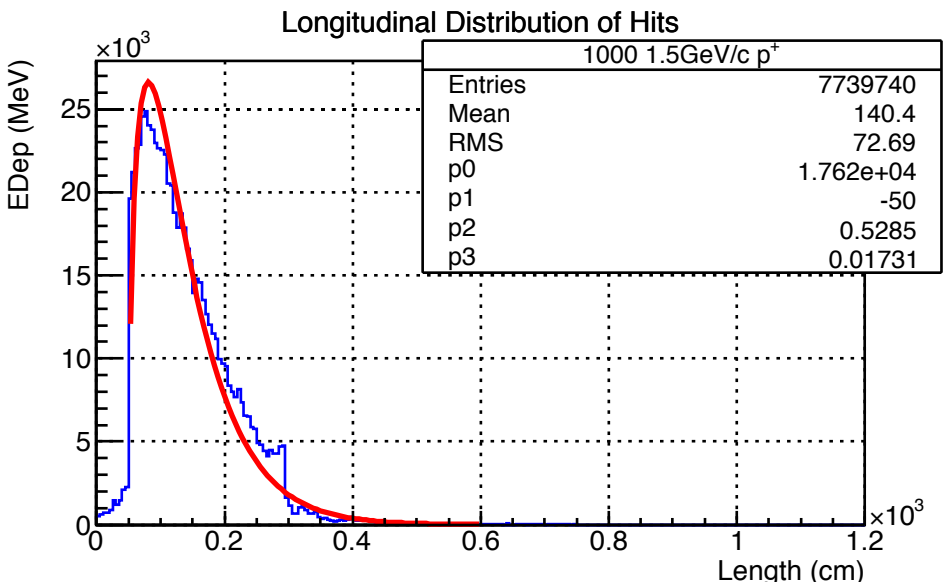
- Have provided the containment information for electrons, pions, kaons and protons with momentums ranging from 0.5 to 4GeV/c
- What's the fraction of each type of particle in the beam?
  - Will use g4beamline to address this issue

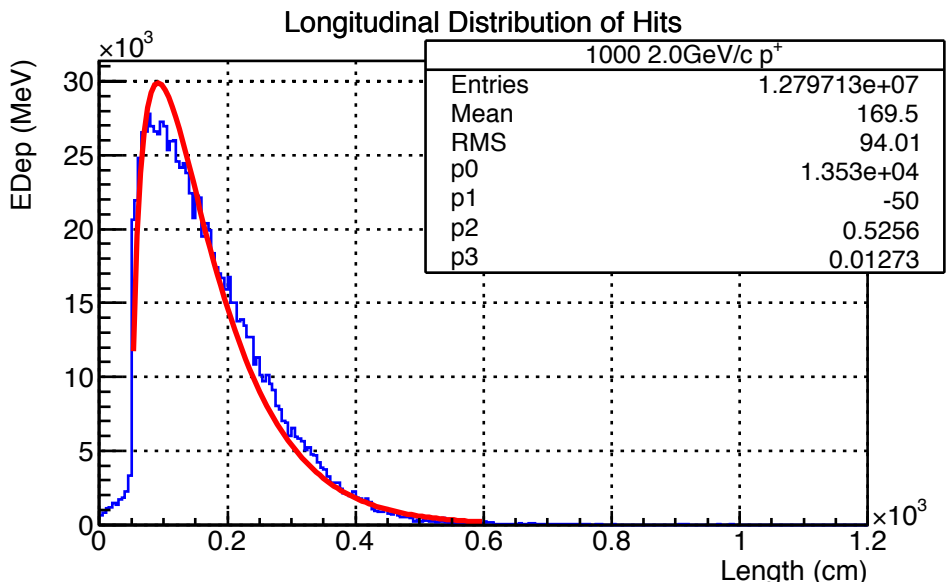
BACKUP

0.5 to 2GeV/c Proton Longitudinal Distribution

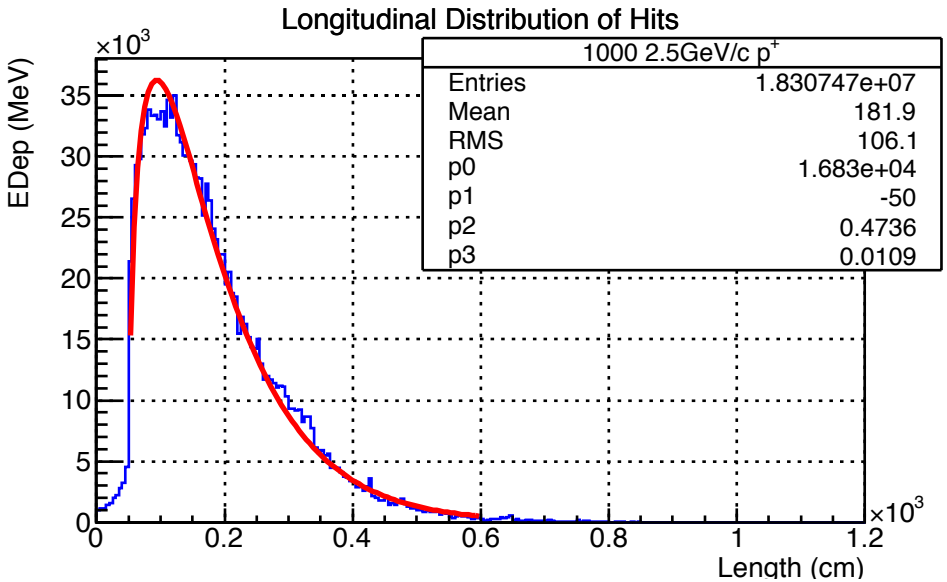


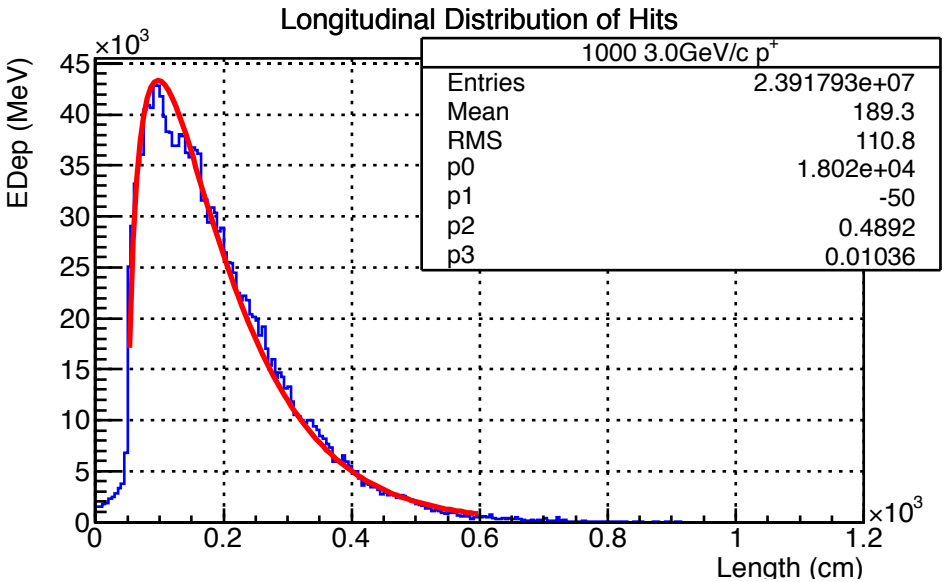


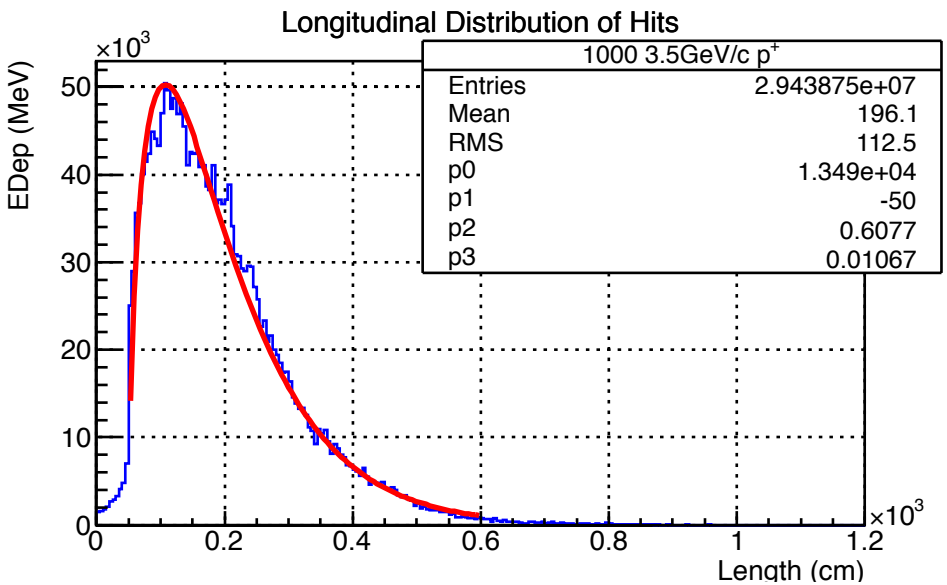


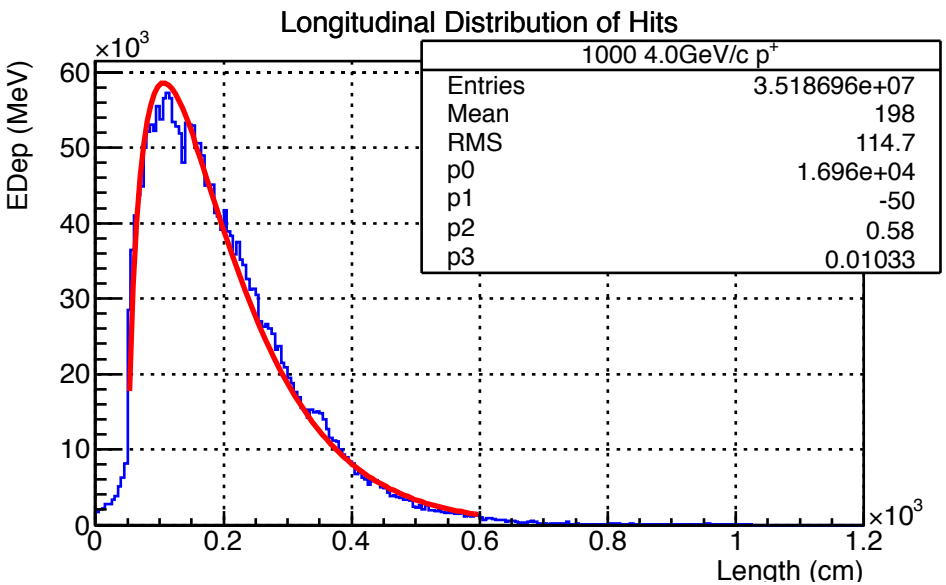


2.5 to 4GeV/c Proton Longitudinal Distribution

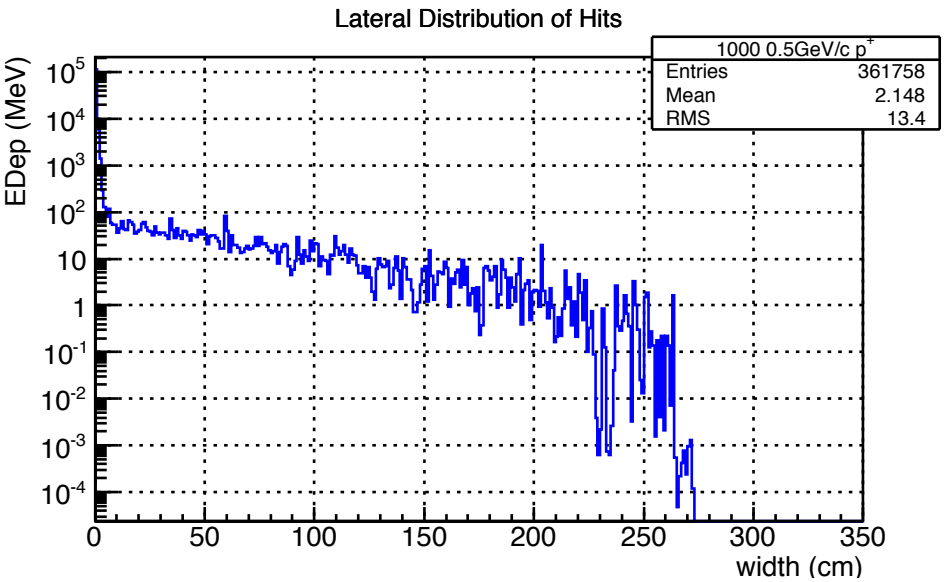


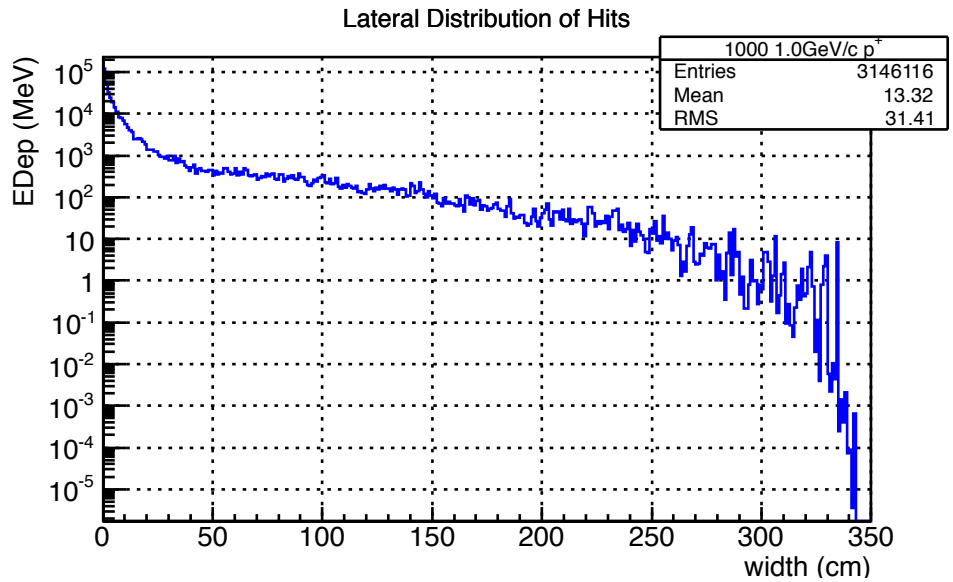


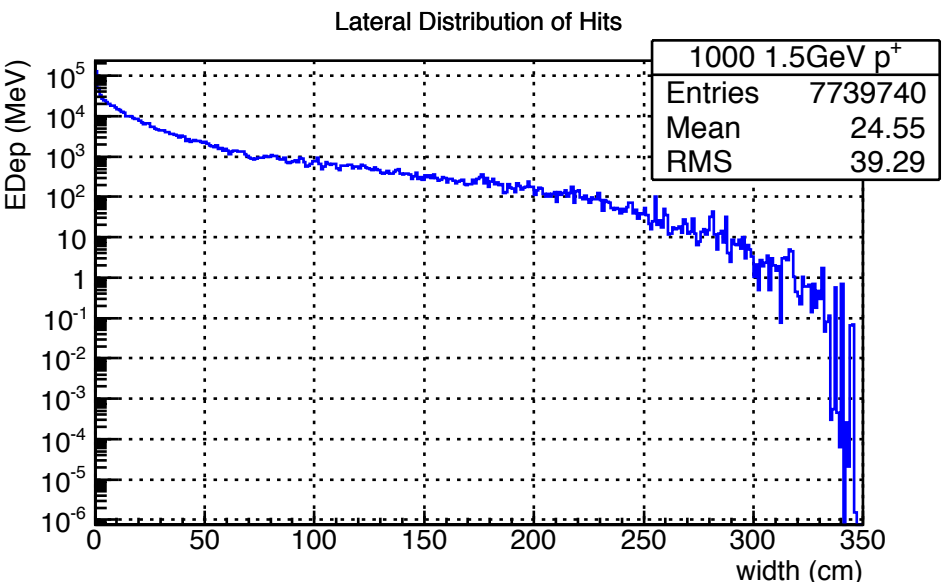


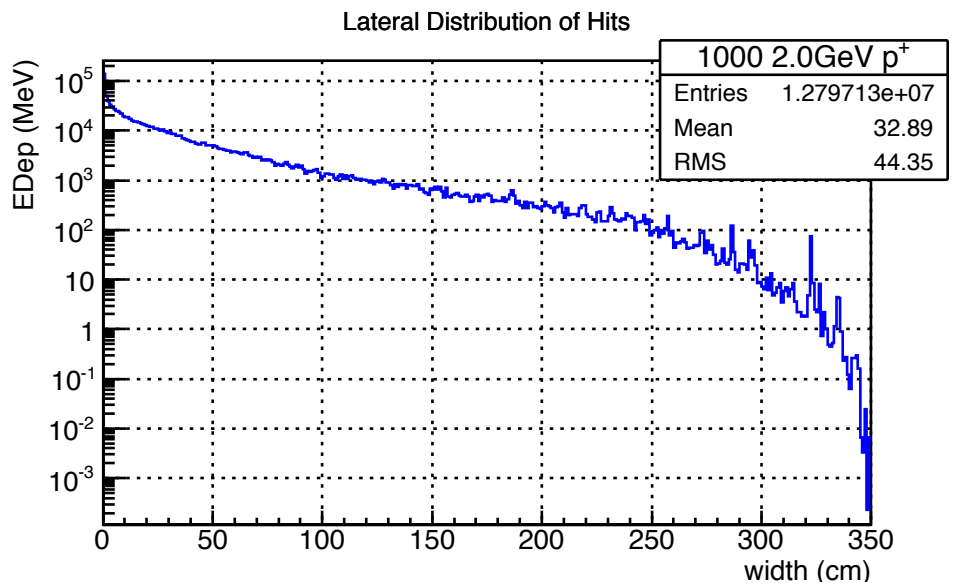


0.5 to 2GeV/c Proton Lateral Distribution

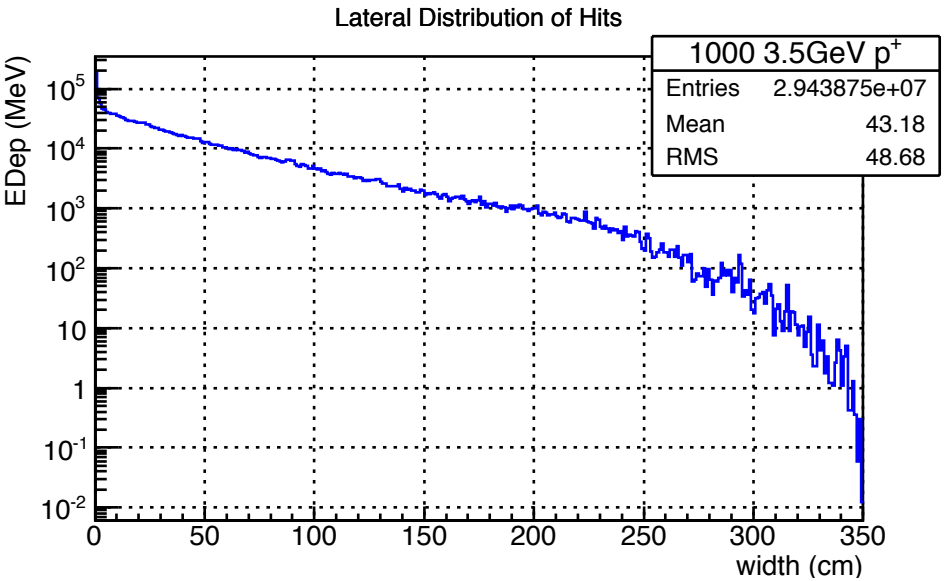


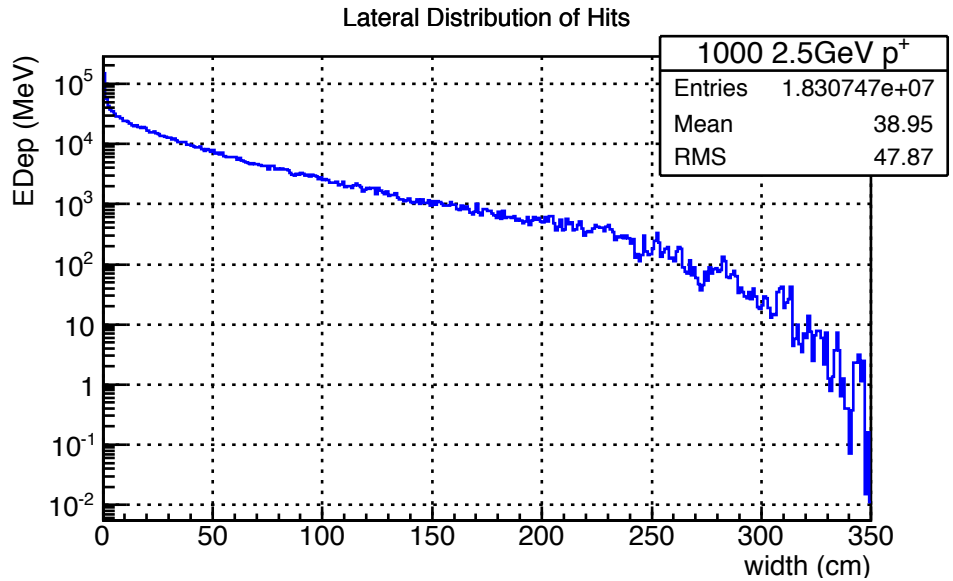


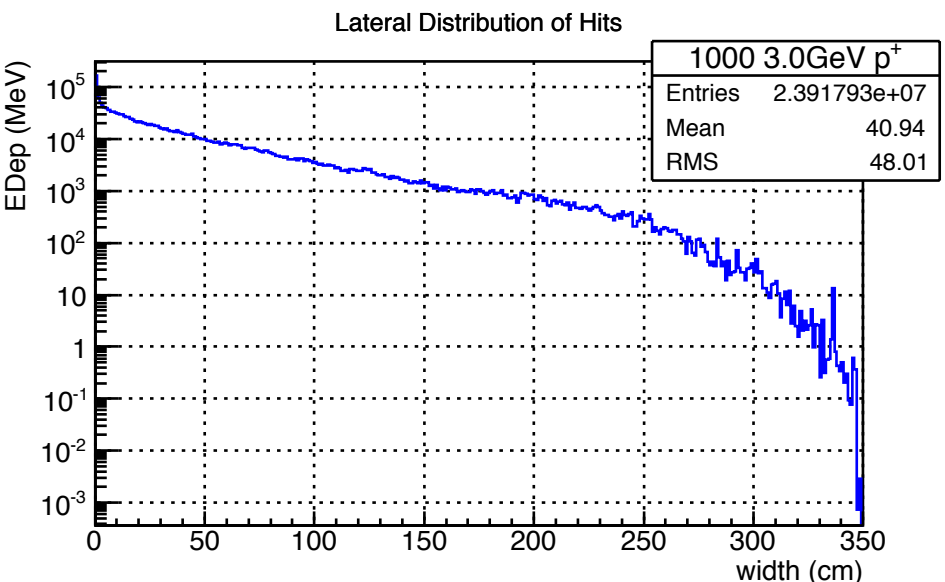


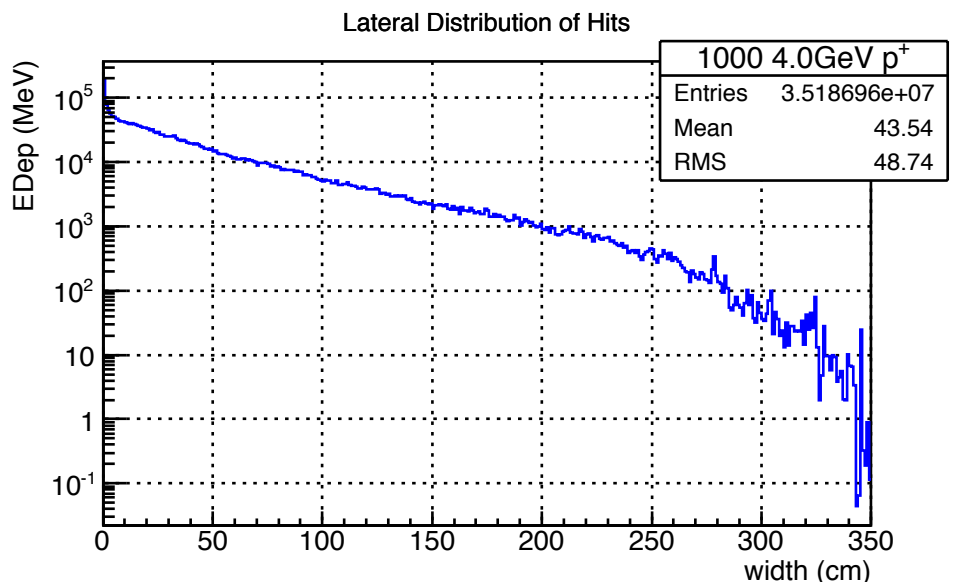


2.5 to 4GeV/c Proton Lateral Distribution

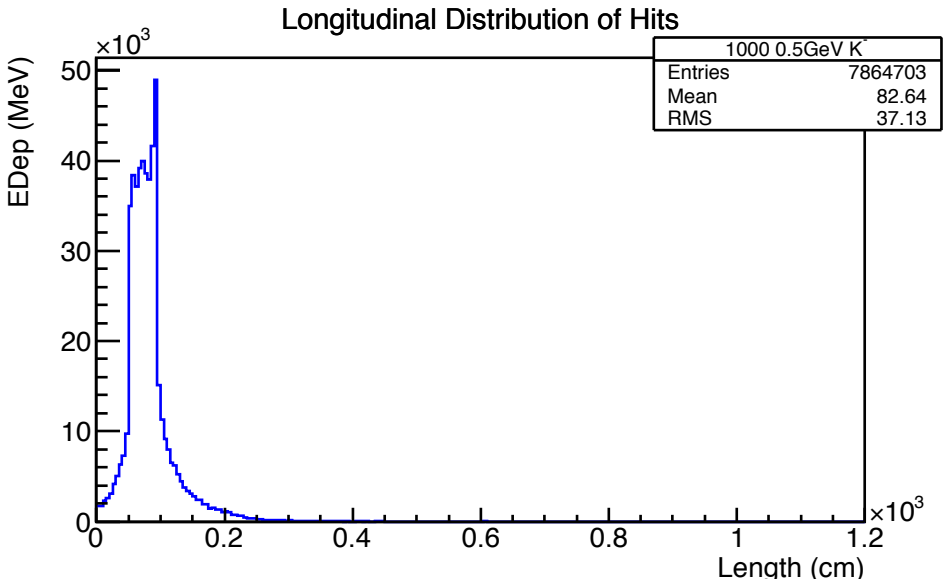


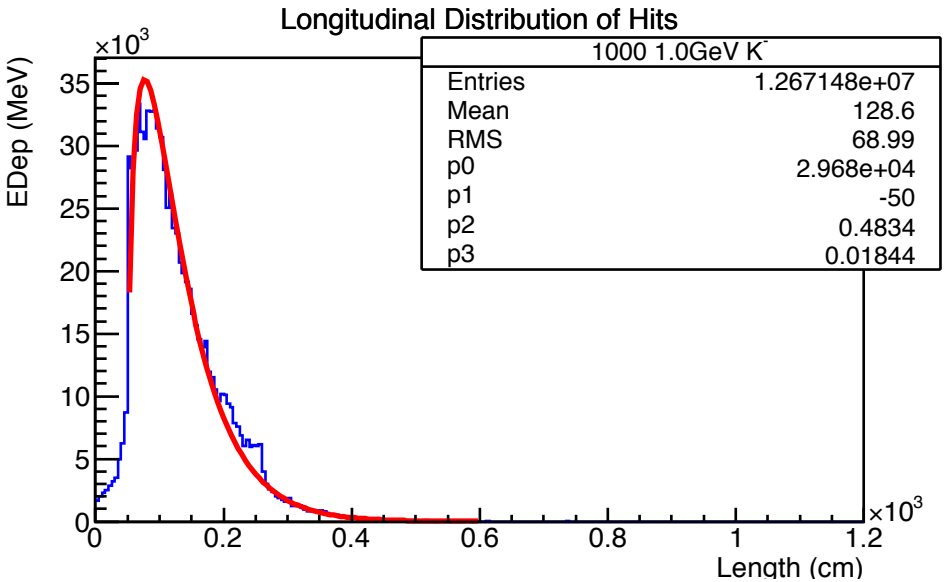


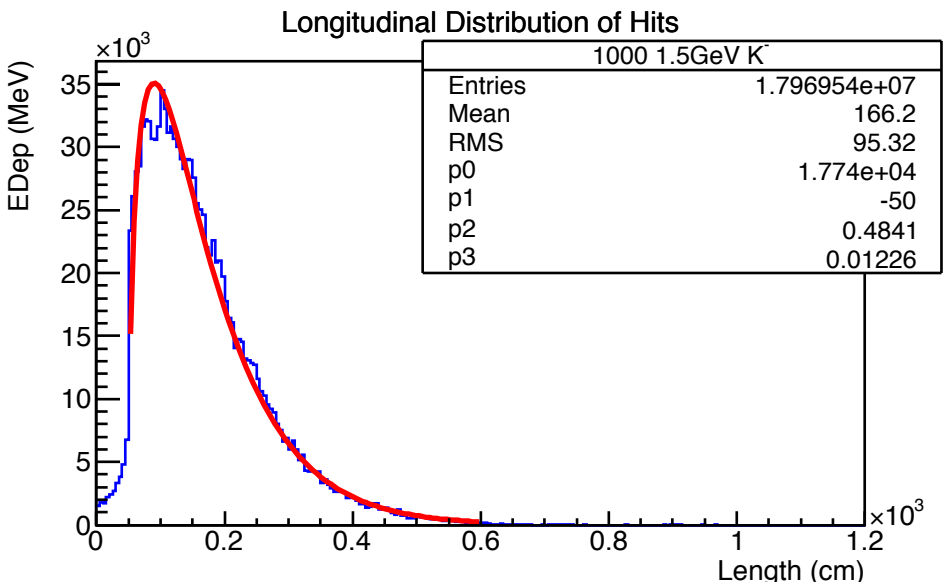


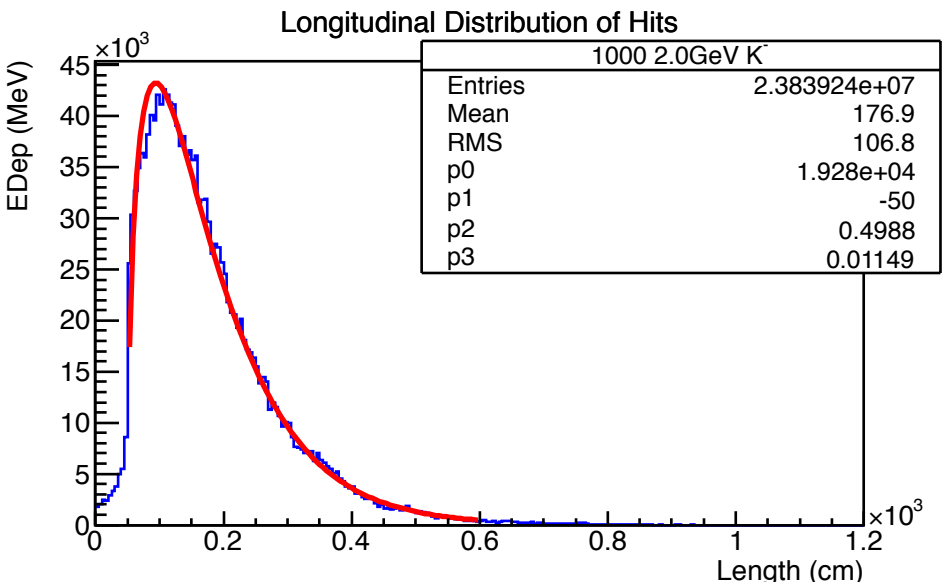


0.5 to 2GeV/c Kaon Longitudinal Distribution

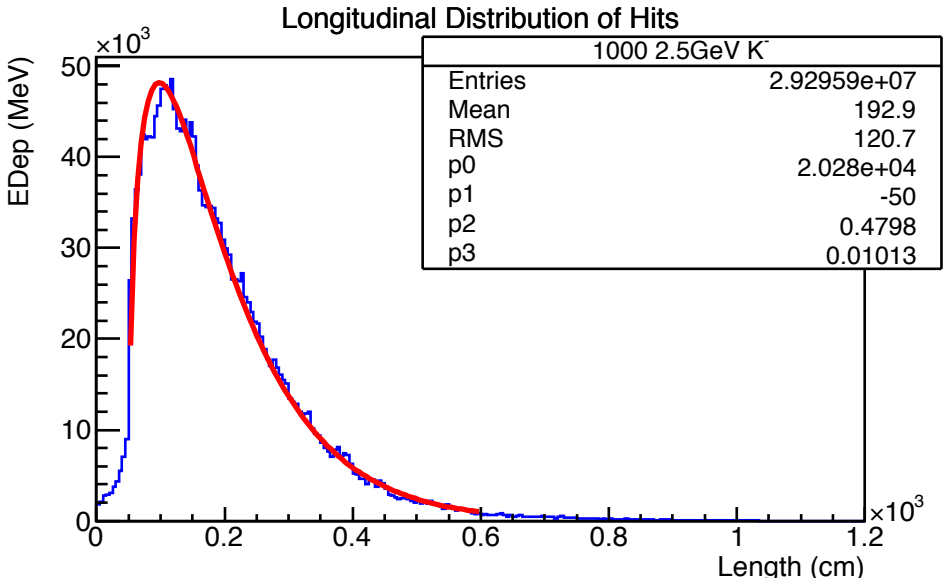


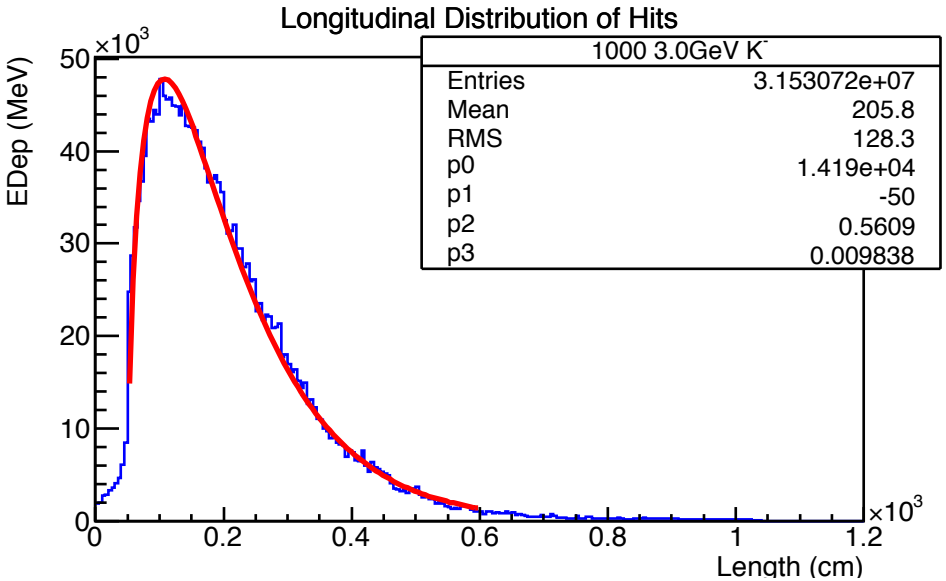


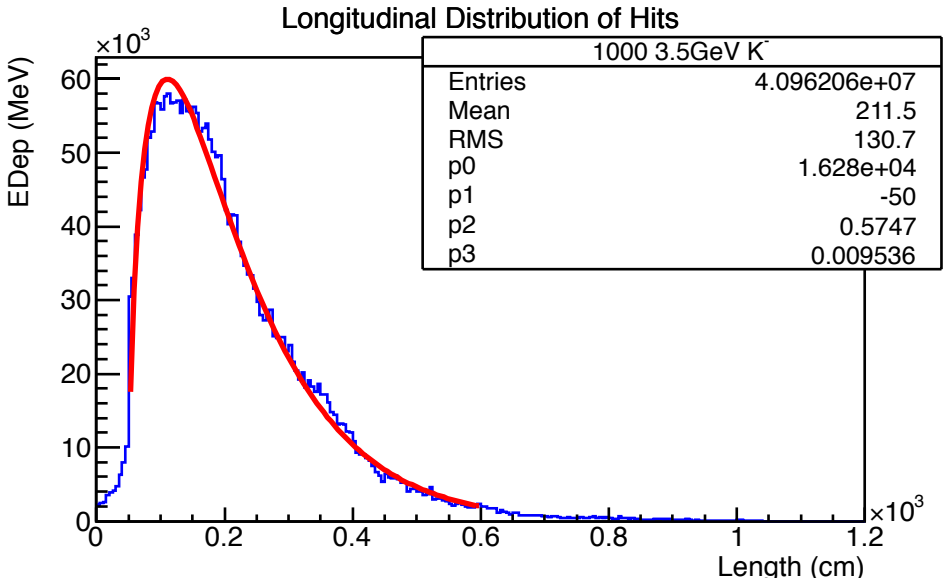


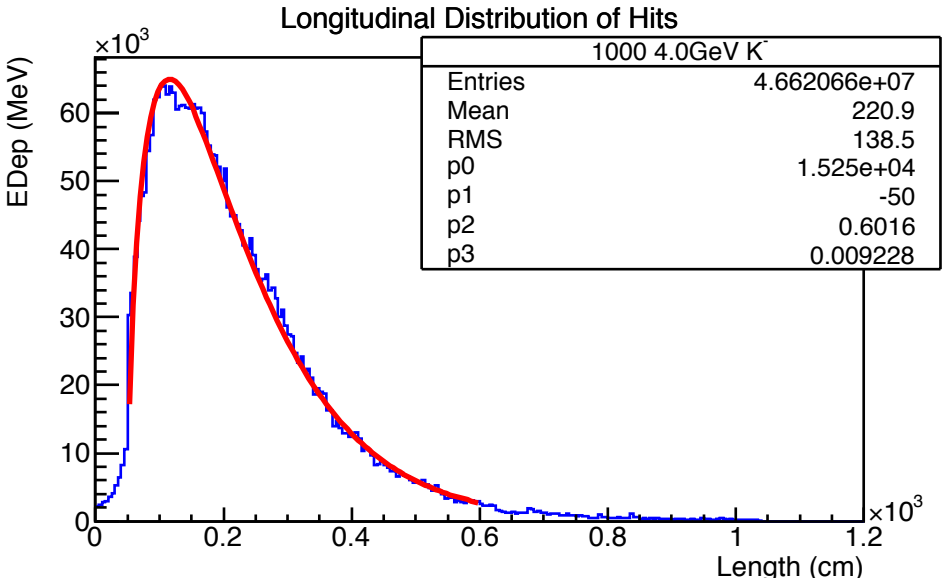


2.5 to 4GeV/c Kaon Longitudinal Distribution

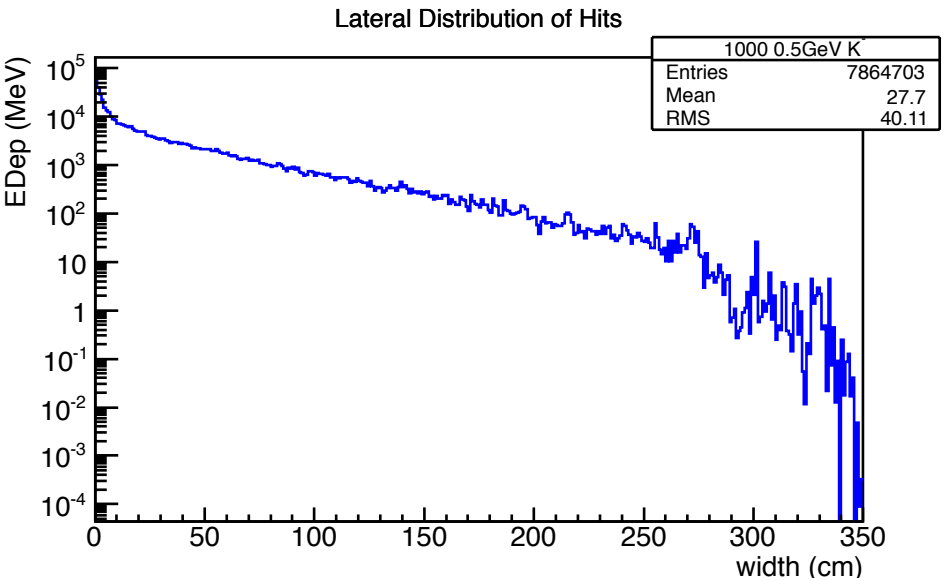


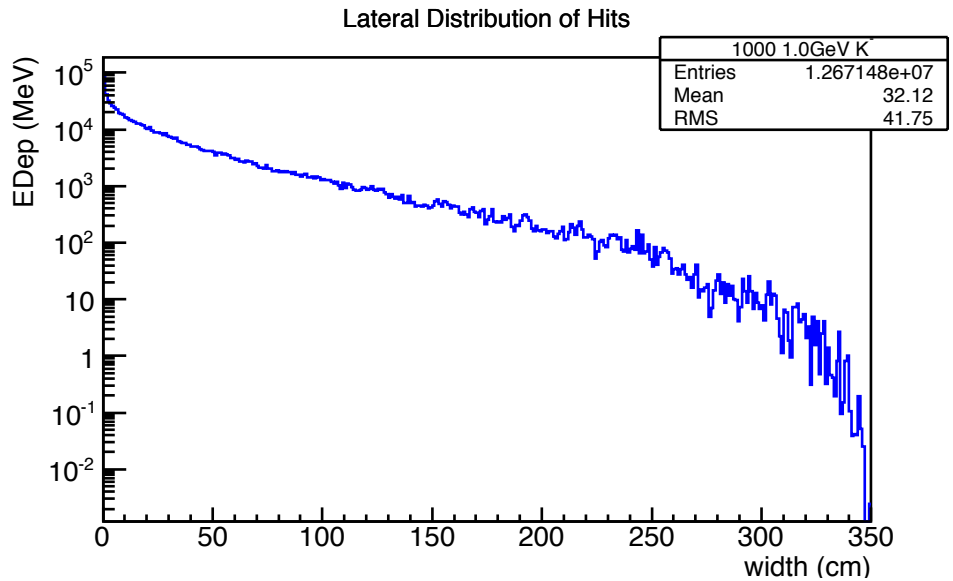


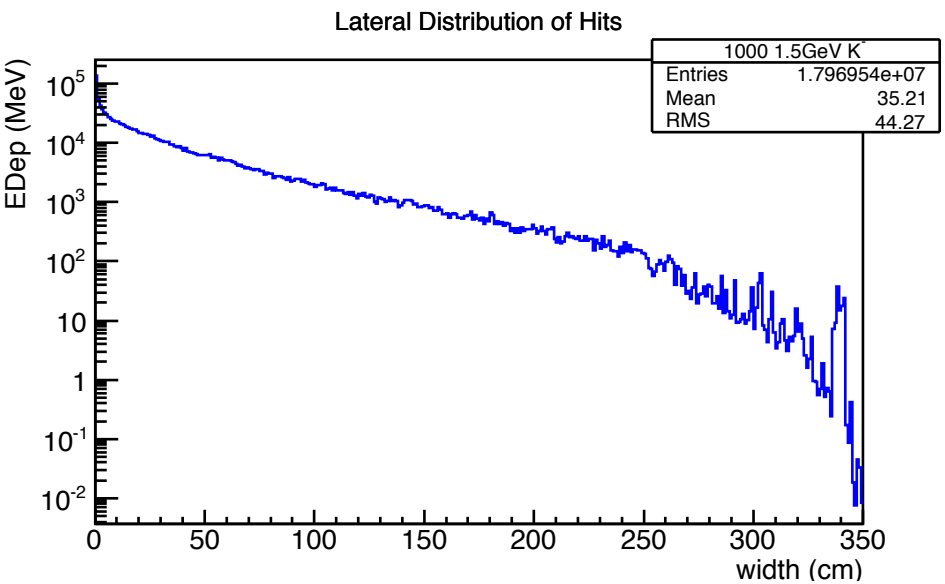


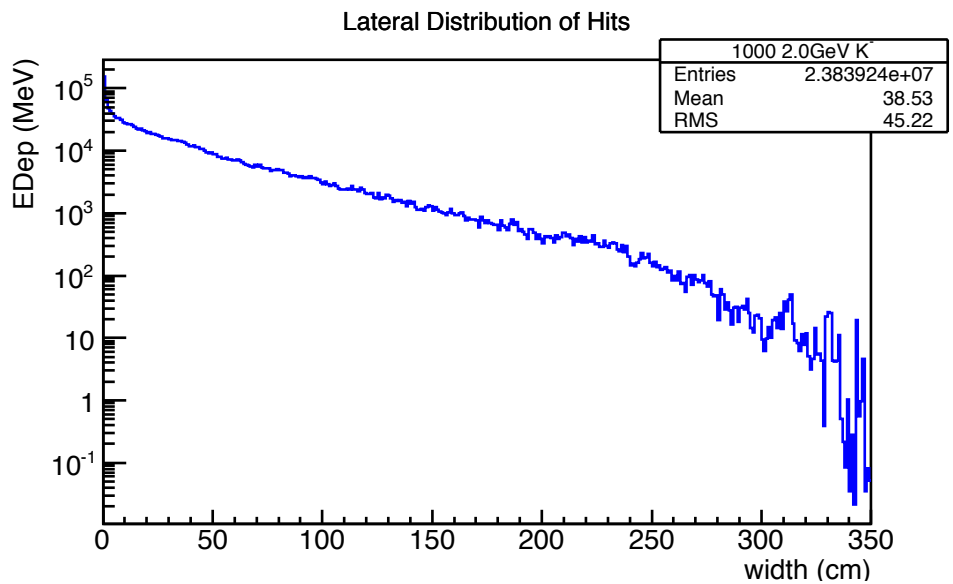
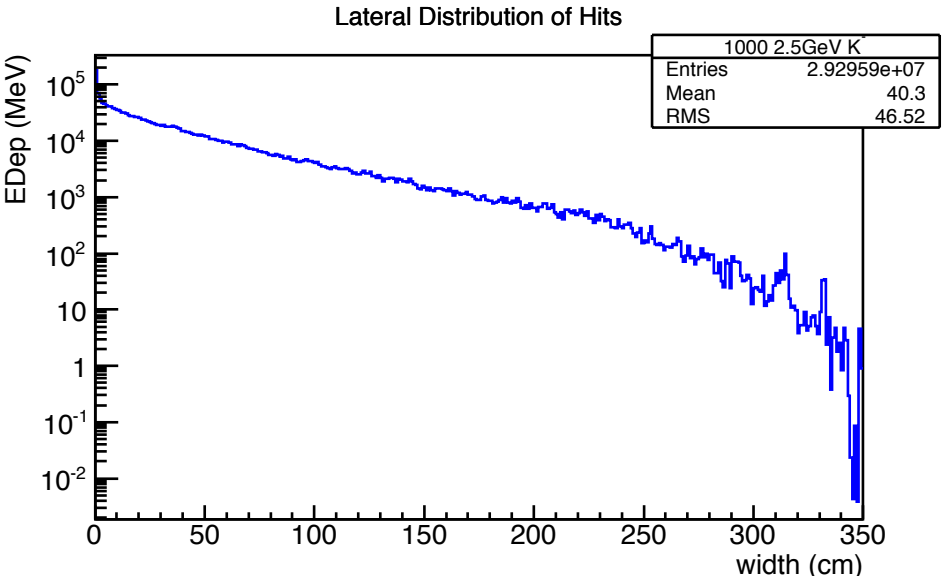
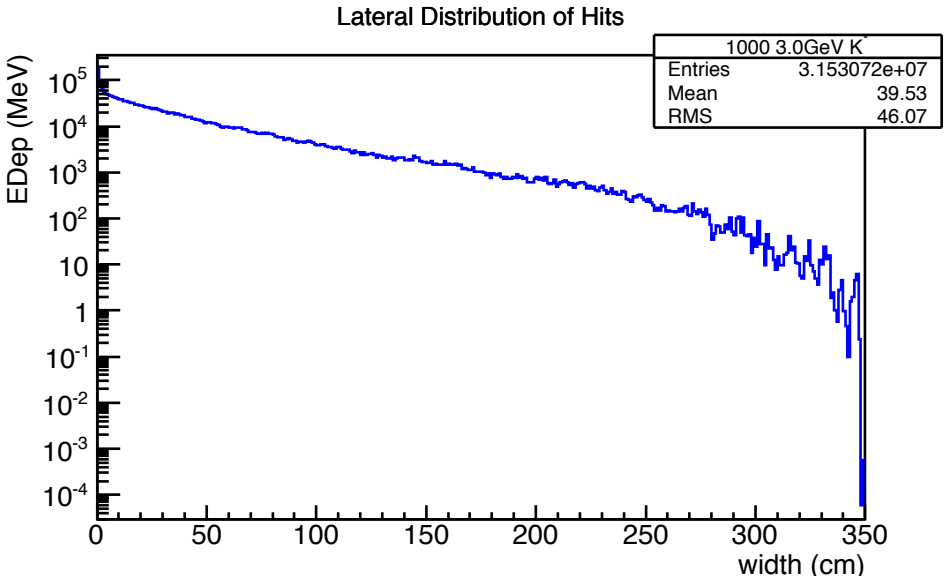
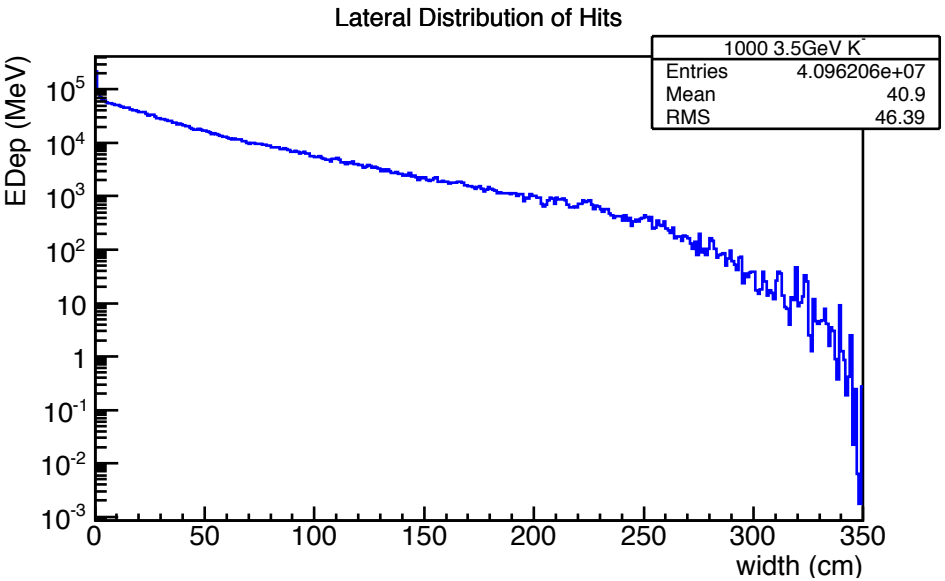
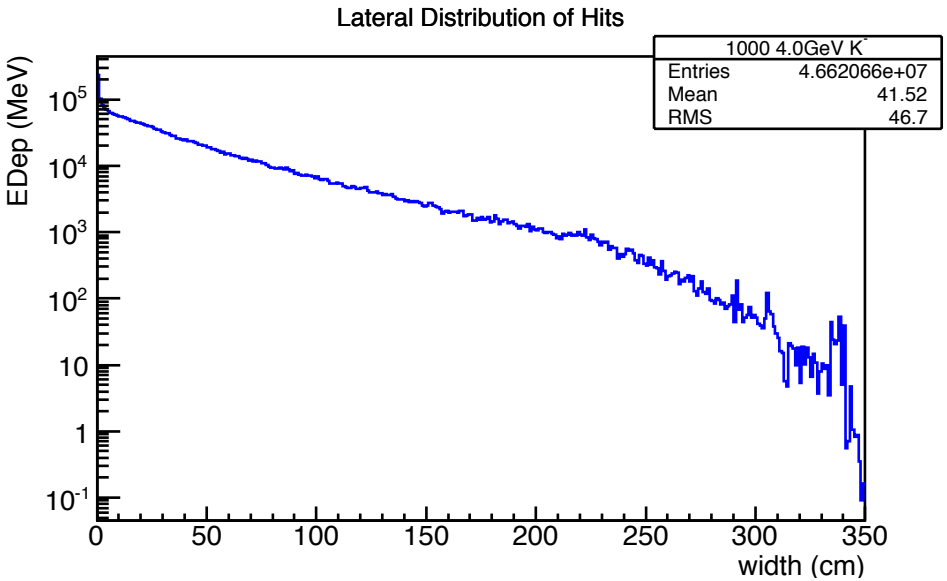


0.5 to 2GeV/c Kaon Lateral Distribution





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