Charged Pion Polarizability Update

David Lawrence JLab

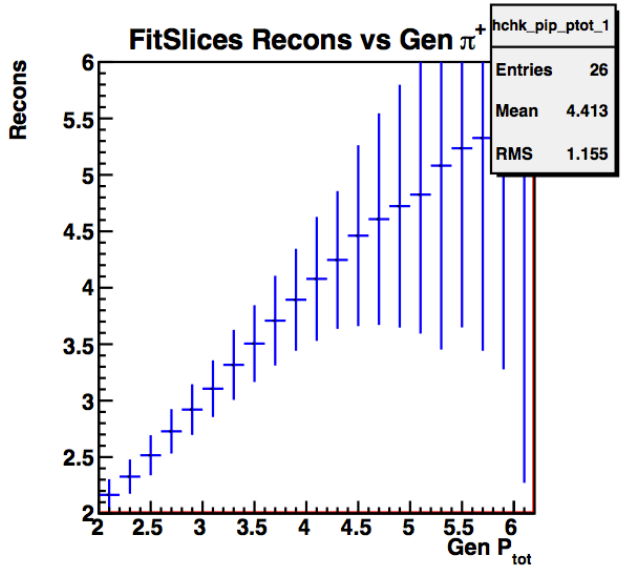
Feb. 11, 2013

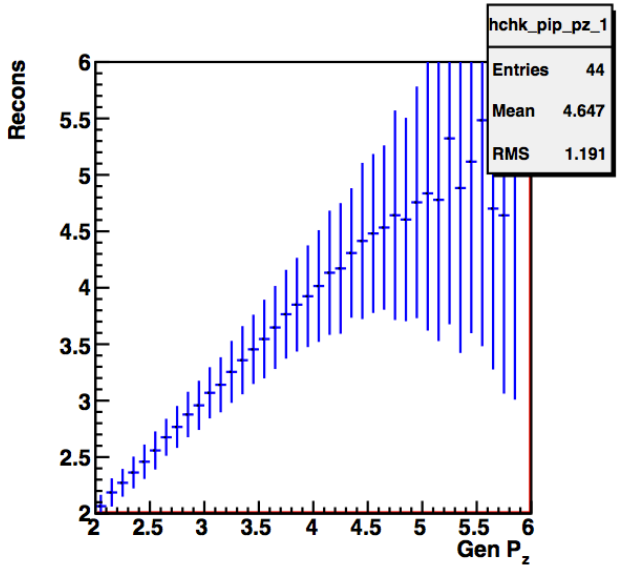
Thin Target Geometry

- 5% rad. Len. Pb target (0.028cm) is well-defined in Z
- Vertex "constraint" enabled in tracking
  - Fuzzy point added in track fitting
  - "Hit" at target location added in FDC track finder
- *hdgeant* dynamic geometry linking feature
  - MD5 checksums added (HDDM holds 3 values)
- Also removed the start counter

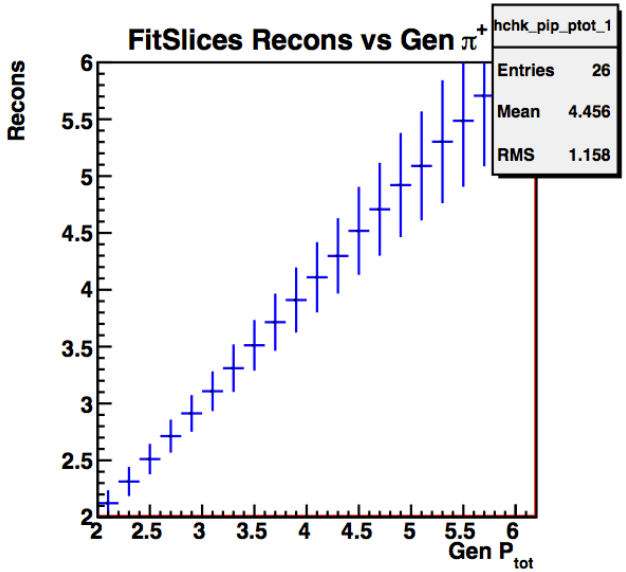
Momentum Resolution

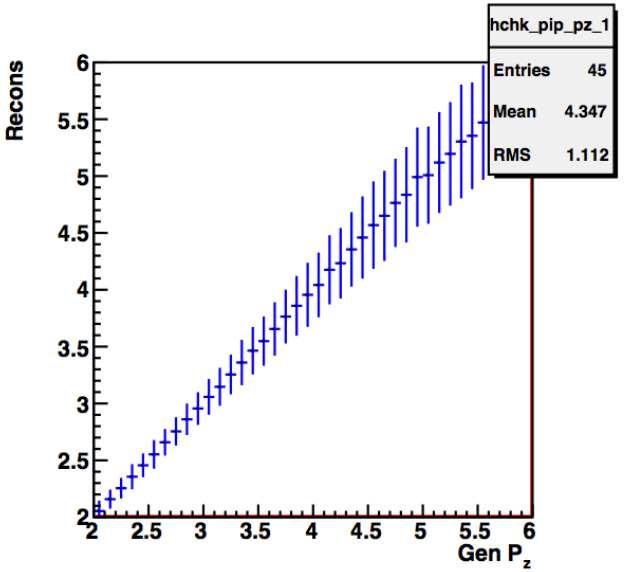
Without target vertex constraint





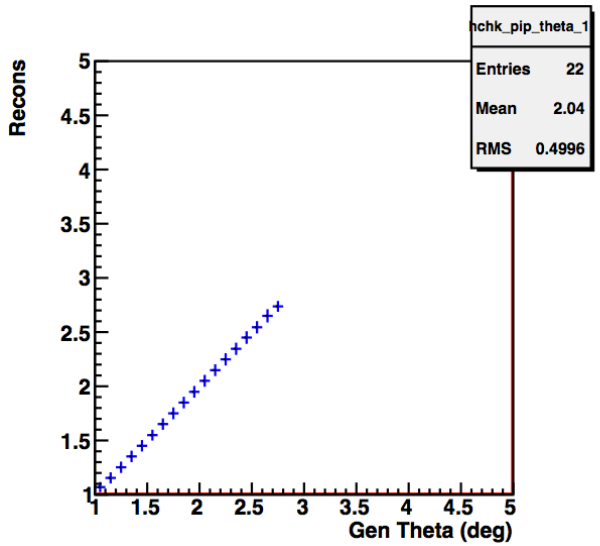
With target vertex constraint

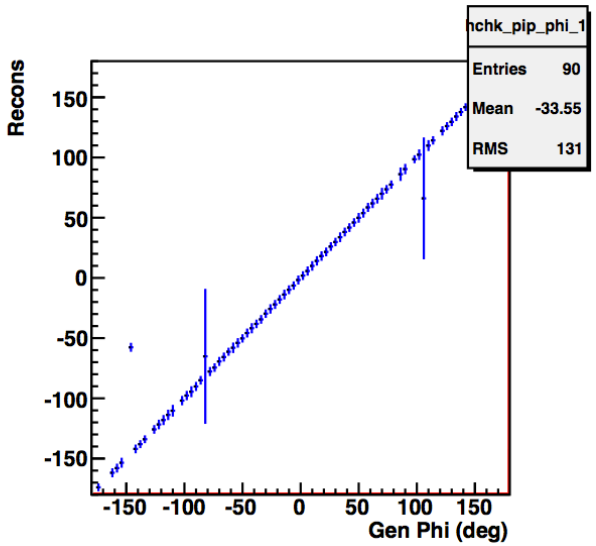




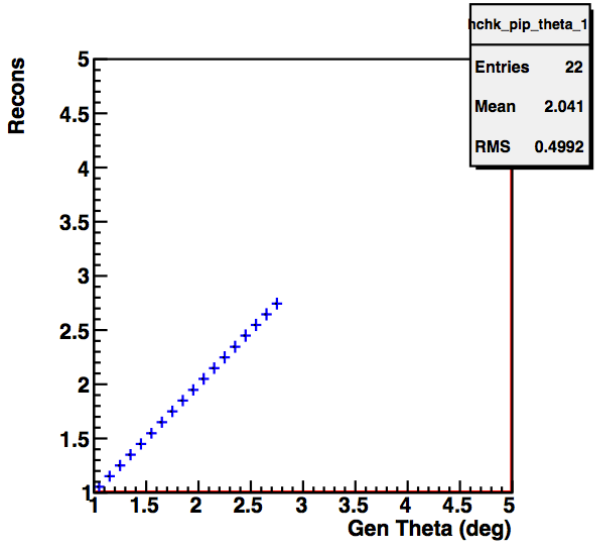
Angular Resolution

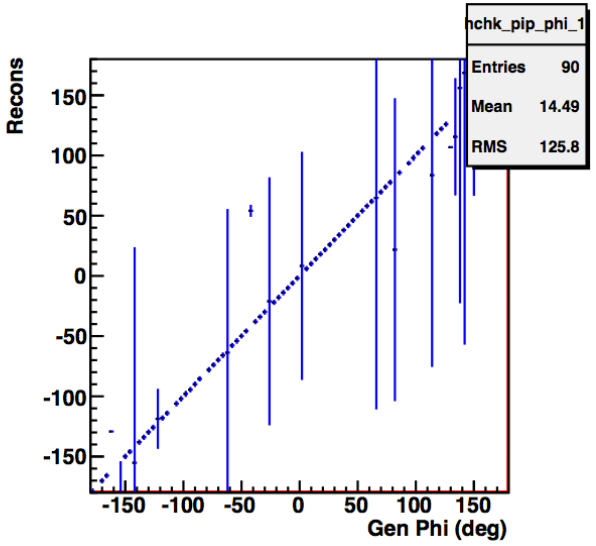
Without target vertex constraint



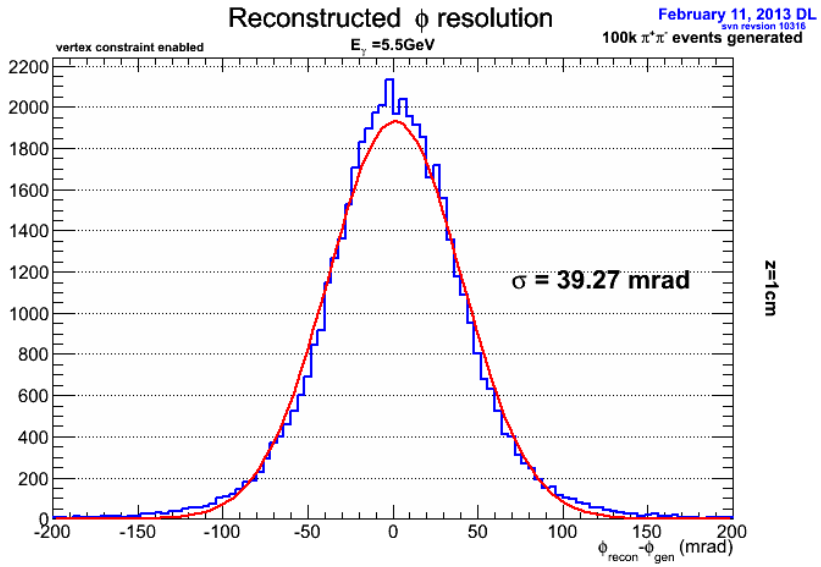


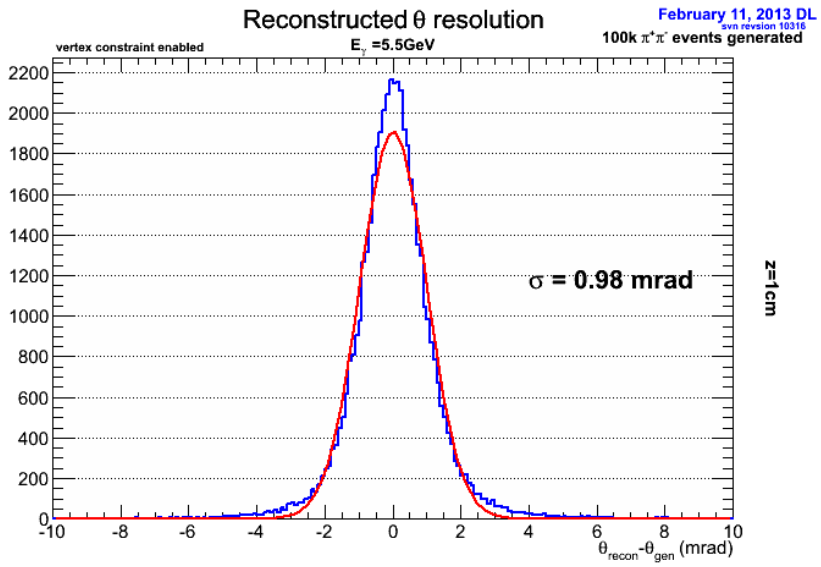
With target vertex constraint

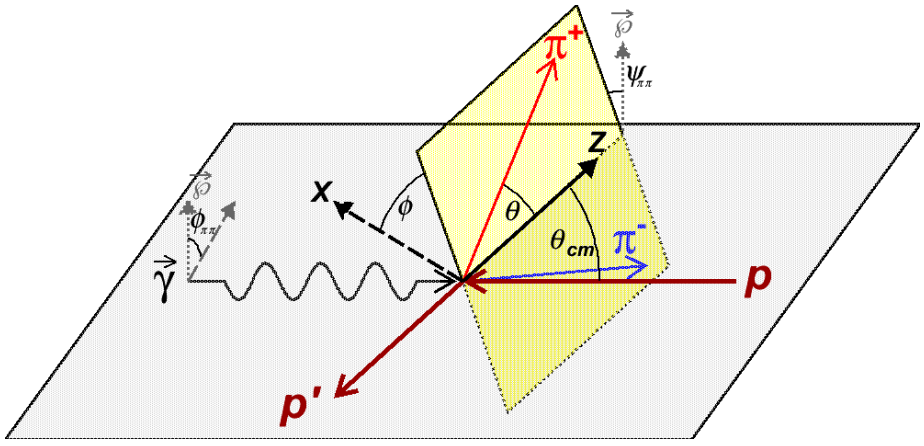


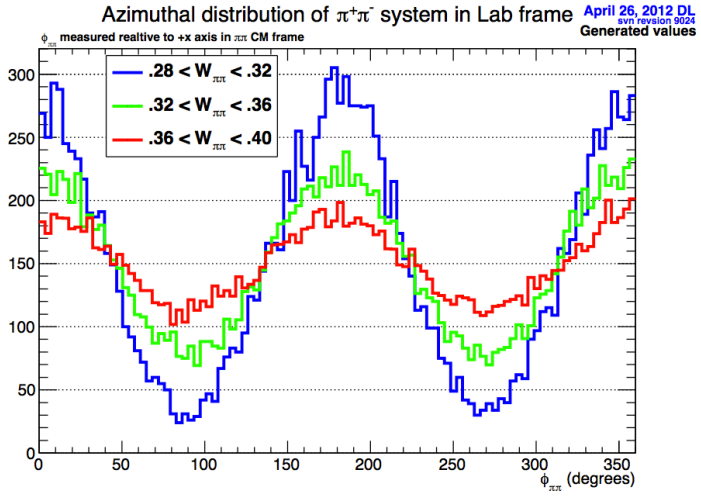


Angular Resolution

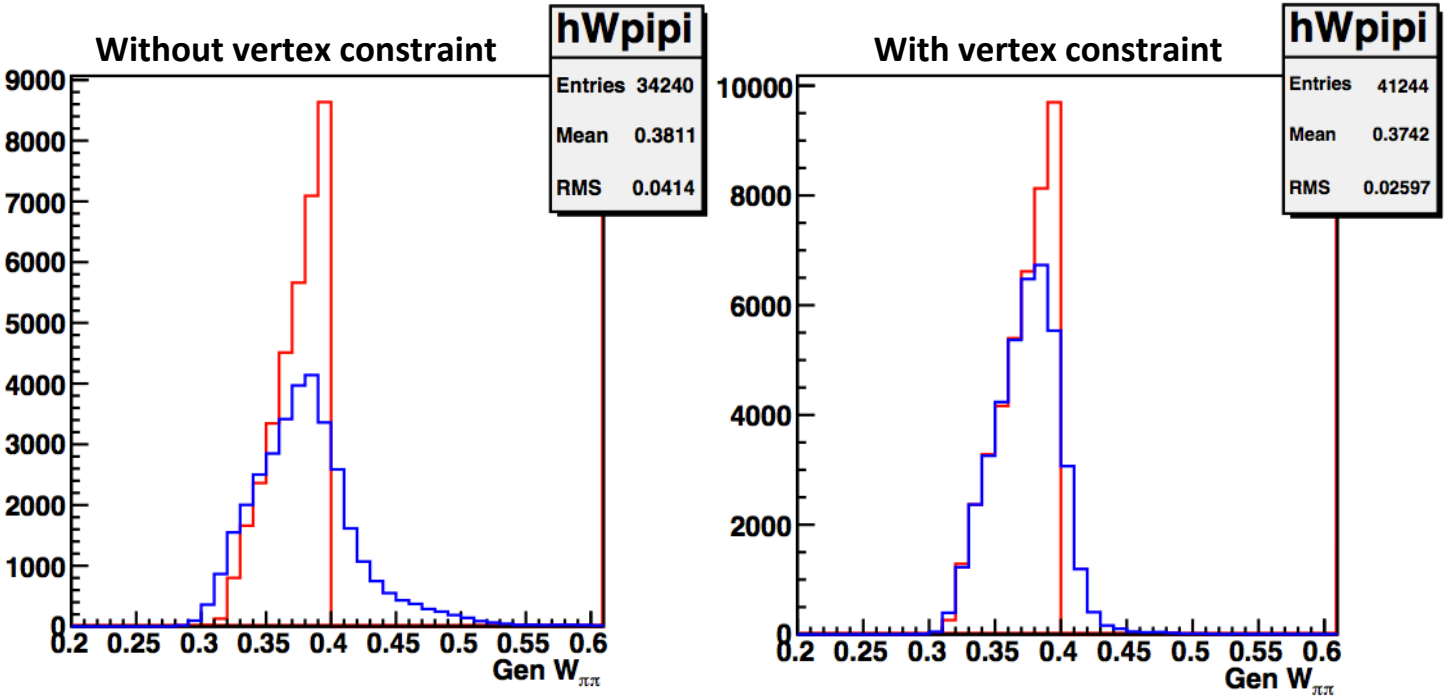




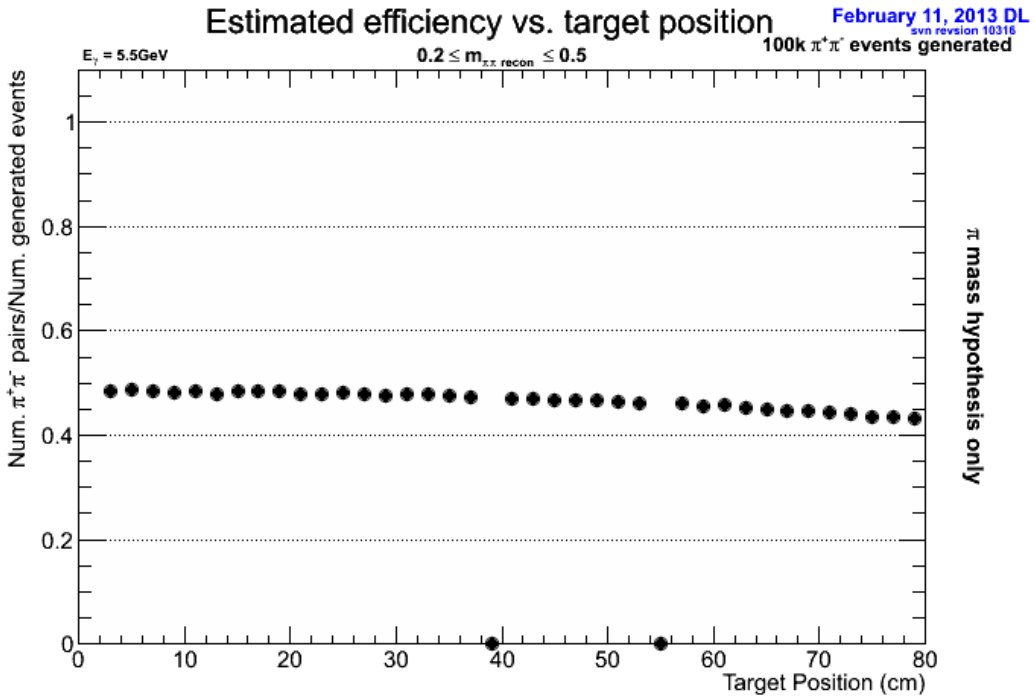


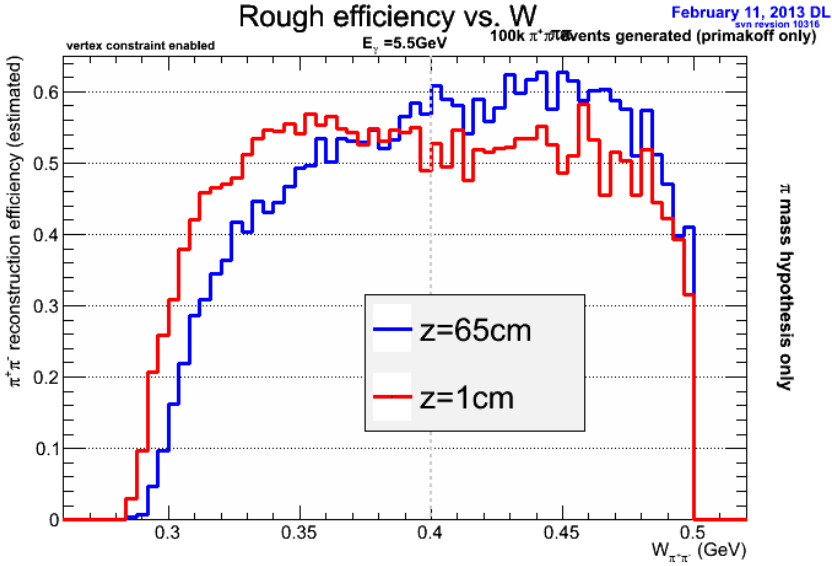


Invariant Mass Resolution



Location of Target in Z

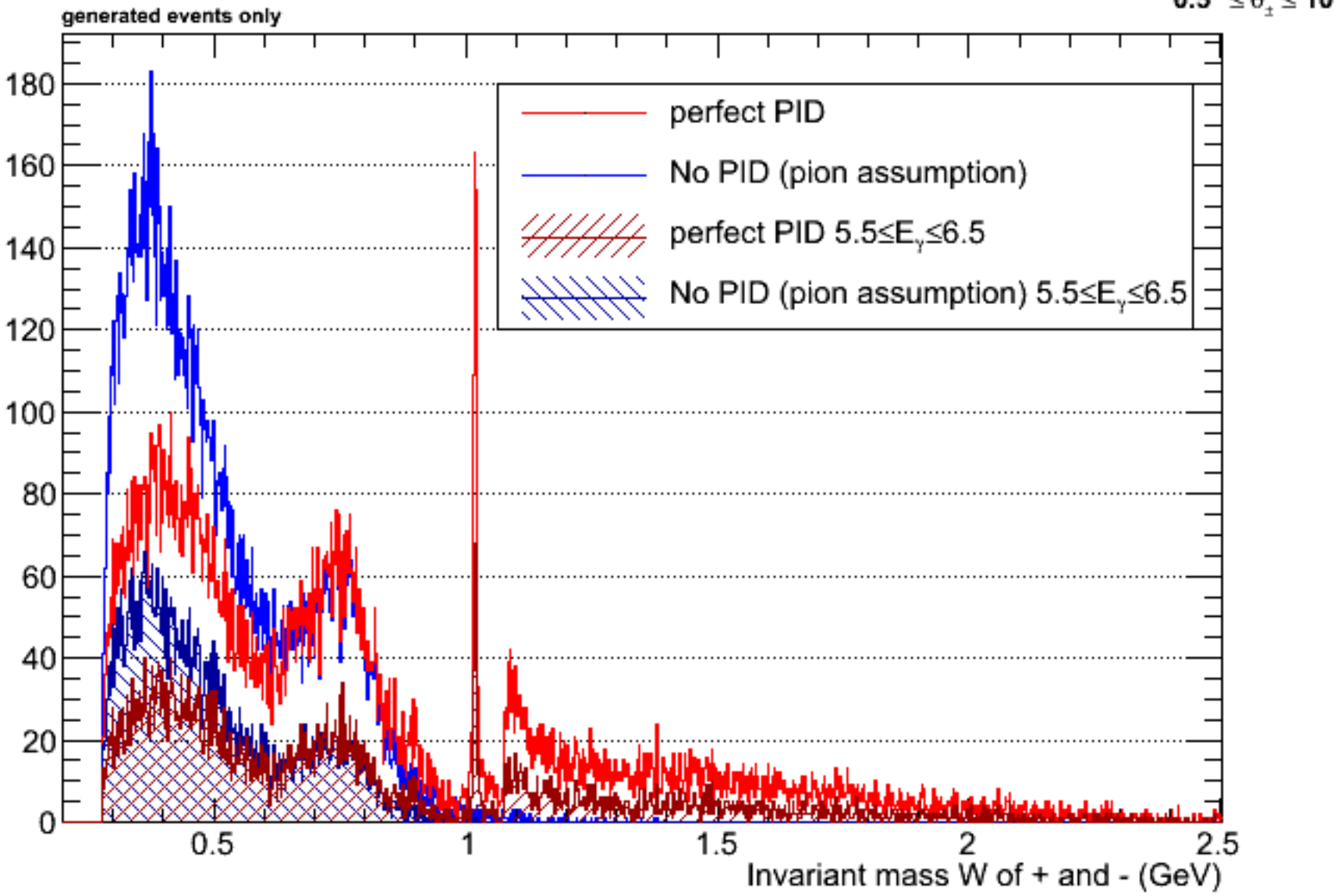




- Overall efficiency is not a strong function of z
- However, there is improvement in Primakoff region near threshold

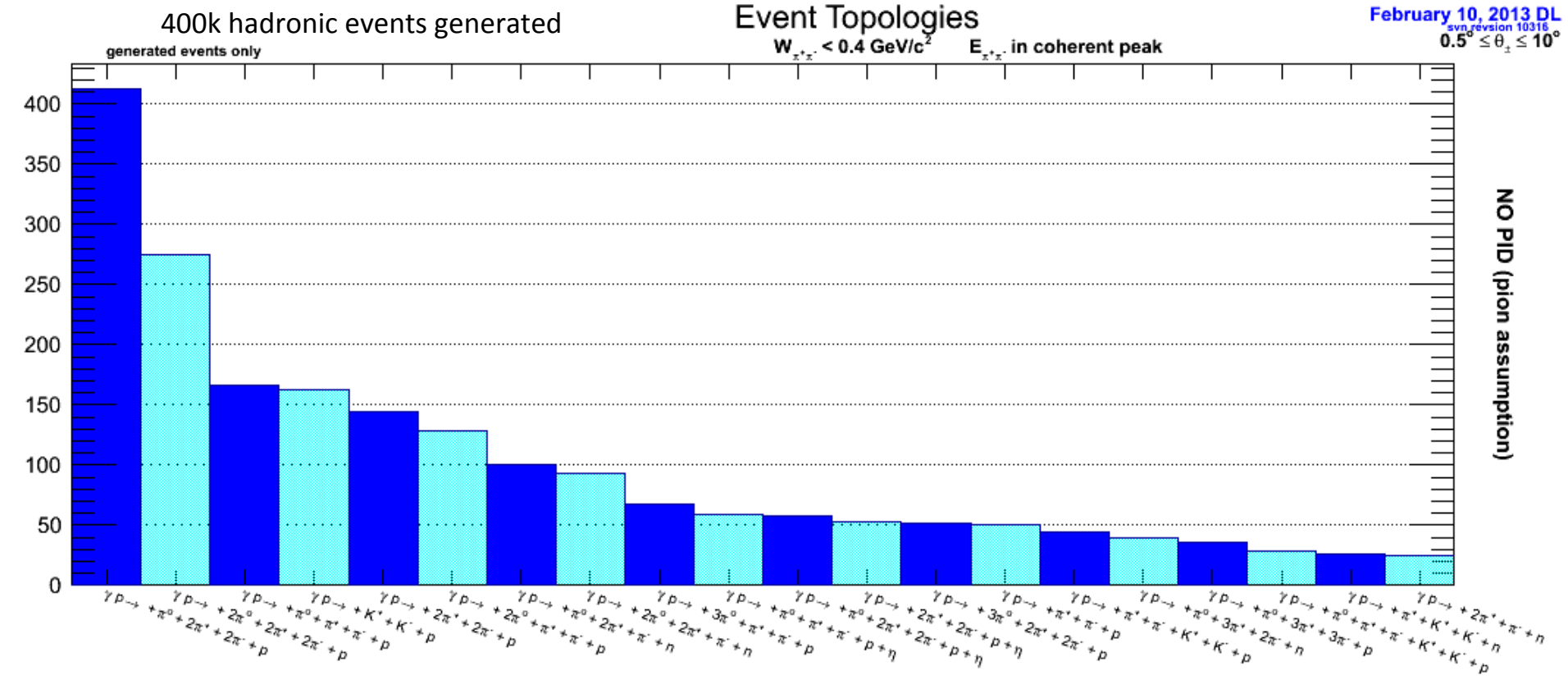
PYTHIA generated background

February 11, 2013 DL
svn revsion 10316



Signal Background

400k hadronic events generated



- *bggen (Pythia)* generated events
- Assume no PID ability so all charged particles assumed pions
- All π+π- pairs considered with:
  - 5.5GeV < E$\pi^+\pi^-$ < 6.5GeV
  - W$\pi^+\pi^-$ < 400 MeV/c^2

Trigger

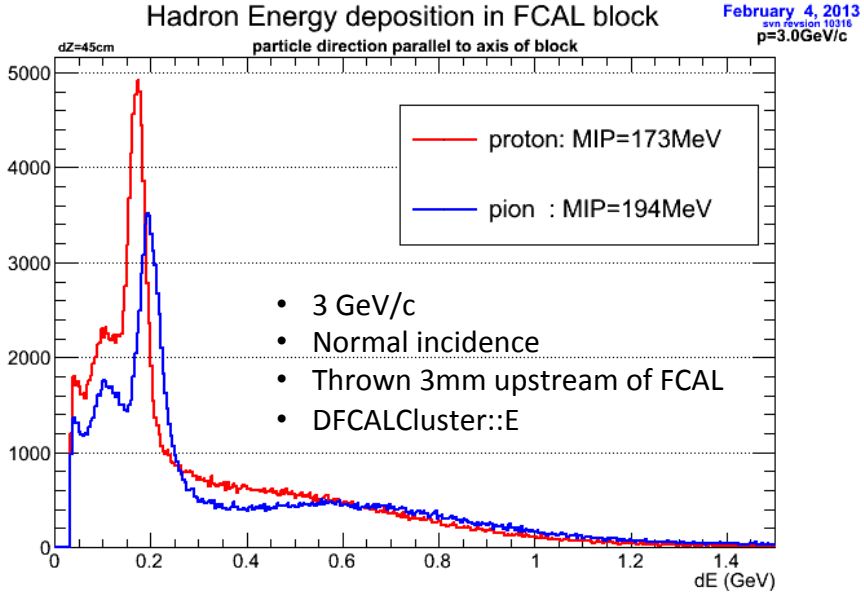
- Currently exploring use of FCAL as primary input to trigger
- Need 2 MIP

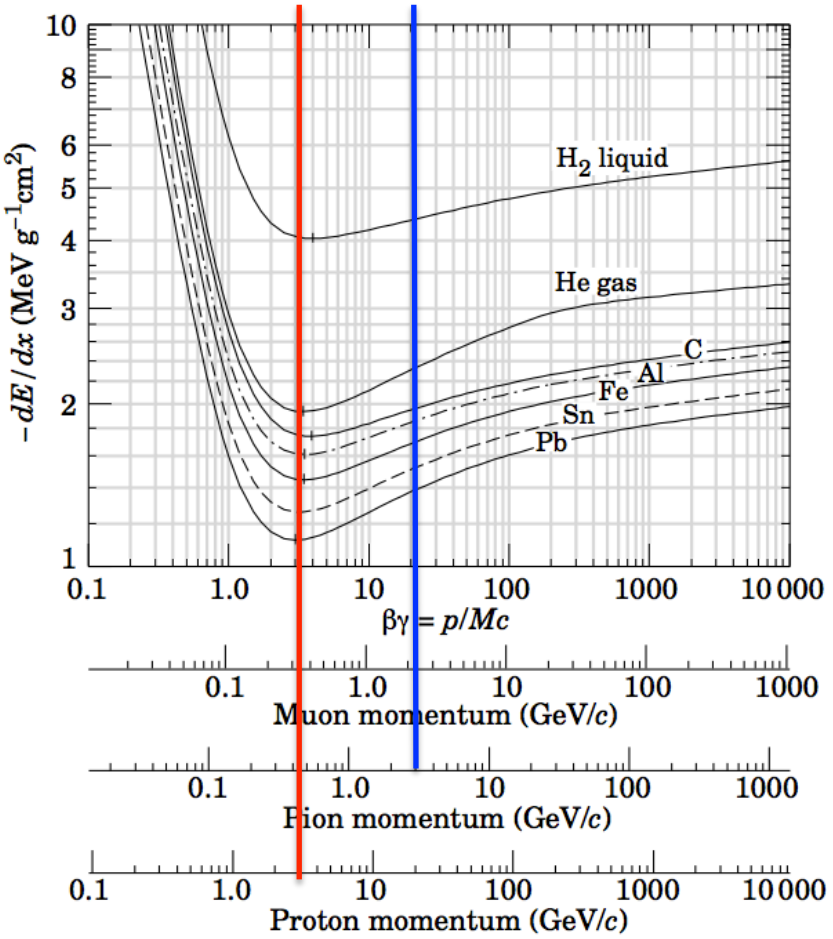
Trigger

- Currently exploring use of FCAL as primary input to trigger
  - 2 MIPs, π^+ and π^-
- Bandwidth available in trigger system to implement 2 cluster trigger
- Need better simulation of PbGlass response to hadrons

FCAL response to π's in GlueX Simulation

FCAL geometry defines active material as:
"leadGlassF800"
Density: 3.61 g/cm^3
Dimensions: 4.0 x 4.0 x 45.0 cm^3





Proton:
dE/dx = 173/45cm/3.61g/cm^3 = 1.06 MeV g^{-1} cm^2

π+:
dE/dx = 194/45cm/3.61g/cm^3 = 1.19 MeV g^{-1} cm^2

Hadrons in PHENIX Calorimeter

L. Aphecetche et al. / Nuclear Instruments and Methods in Physics Research A 499 (2003) 521–536

	pions	protons
0.15 GeV/c	25MeV	-
1 GeV/c	460MeV	80MeV
4 GeV/c	540MeV	540MeV

Cerenkov threshold: $\beta_t = \frac{1}{n}$

$$p_t = m\beta_t\gamma_t = \frac{m\beta_t}{\sqrt{1-\beta_t^2}}$$

$$p_t = \frac{m}{\sqrt{1/\beta_t^2 - 1}} = \frac{m}{\sqrt{n^2-1}}$$

TF1 PbGlass: n=1.648

proton p_t = 716MeV/c

pion p_t = 107MeV/c

"At 500 MeV/c no significant signal is observed for protons …"

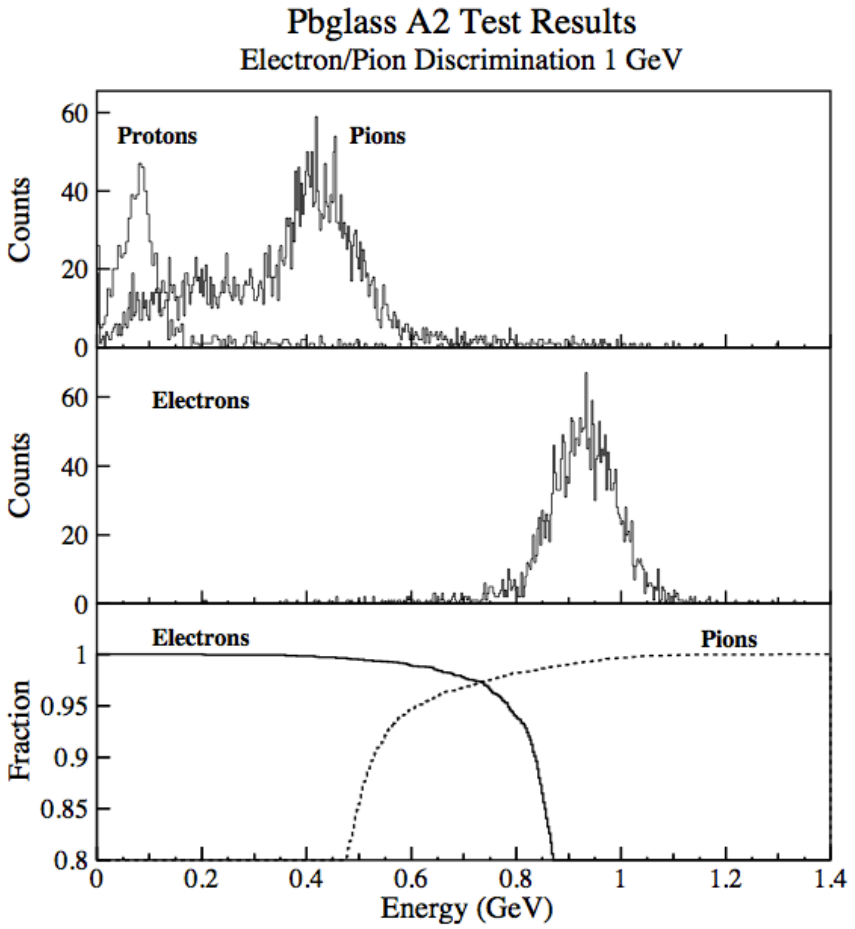


Fig. 12. Measured energy signal for protons, π^+ and e^+ of 1 GeV/c incident momentum. The lower panel shows the fraction of e^+ accepted or π^+ rejected for a varying threshold on the measured energy.

Muons and Hadrons in NOMAD

D. Autiero et al. / Nuclear Instruments and Methods in Physics Research A 387 (1997) 352–364

Calorimeter is 50cm long TF1-000 blocks

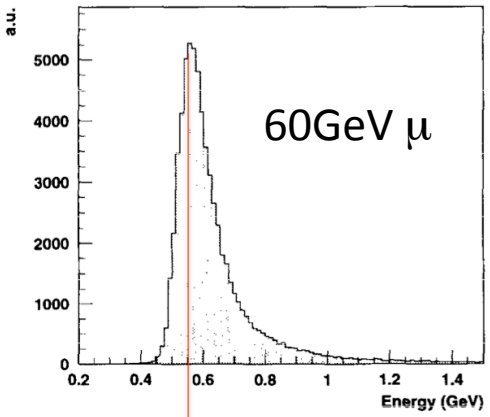


Fig. 23. Muon signal in the calorimeter.

60GeV μ gives 550MeV of apparent energy

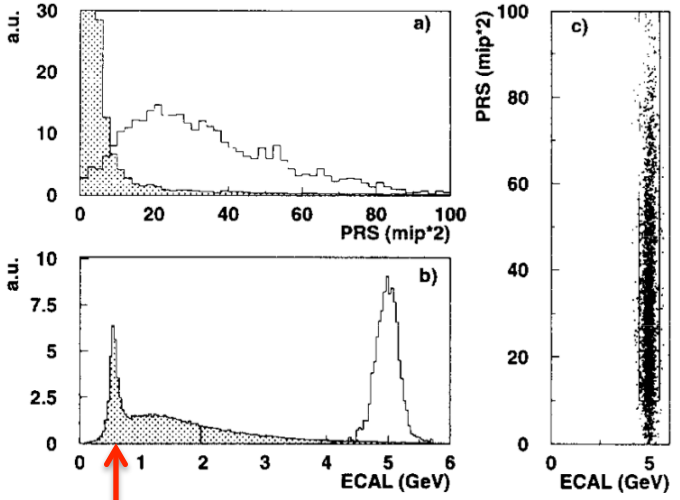


Fig. 20. 5 GeV π (shaded) and electron signals on the PRS (a) and on ECAL (b). PRS vs. ECAL signals for 5 GeV electrons (c), the limits shown in this figure define the 90% efficiency region for electrons detection.

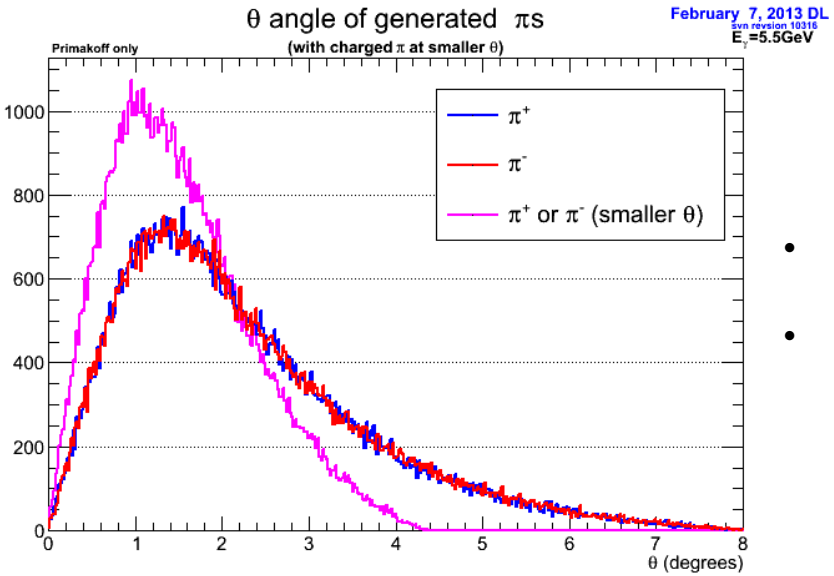
5GeV π gives ~550MeV of apparent energy

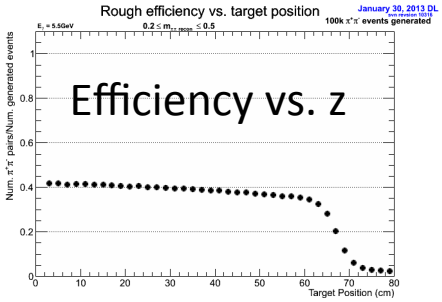
NOMAD blocks are 19Xo while PHENIX blocks are only 14.4Xo
NOMAD had PMTs angled at 45° wrt to block axis

Summary

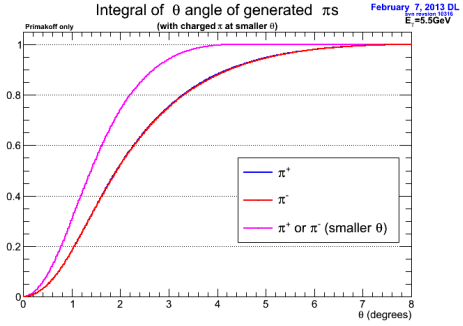
- Detector resolution is sufficient
- Modifications to *sim-recon* allow us to take advantage of knowledge of vertex location
- Primary background in ρ production, but we are also exploring additional channels
- Starting to look at level-1 trigger, but will need improved simulation of FCAL response to hadrons

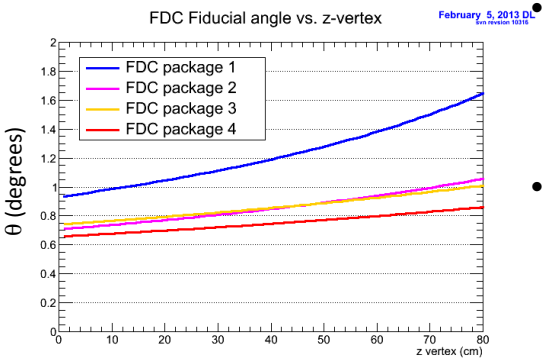
Geometric Acceptance





- Created histogram of π with lesser θ angle
- Integrated to get fraction of "fiducial" events as a function of θ





- Calculated θ for straight tracks hitting upstream layer of each package at edge of dead zone
- Mapped to integral fraction plot above to get acceptance of each package as a function of z