

Cascade Simulations Update

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Procedure

Photoproduction of $\Xi^-(1320)$ and $\Xi^0(1315)$ using 9 GeV photons

- t-channel production using the genr8 program
- Reactions and decay chains
 - $\gamma p \rightarrow K^+ Y$ with $Y \rightarrow K^+ \Xi^-$, $\Xi^- \rightarrow \Lambda \pi^-$, $\Lambda \rightarrow \pi^- p$
 - $\gamma p \rightarrow K^+ Y$ with $Y \rightarrow K_s \Xi^0$, $\Xi^0 \rightarrow \Lambda \pi^0$, $\Lambda \rightarrow \pi^- p$, $K_s \rightarrow \pi^+ \pi^-$,
 $\pi^0 \rightarrow \gamma \gamma$
 - $\gamma p \rightarrow K_s Y^+$ with $Y \rightarrow K^+ \Xi^0$, $\Xi^0 \rightarrow \Lambda \pi^0$, $\Lambda \rightarrow \pi^- p$, $K_s \rightarrow \pi^+ \pi^-$,
 $\pi^0 \rightarrow \gamma \gamma$
- Excited hyperon parameters:
 $m(Y) = 1960$ MeV and $\Gamma(Y) = 220$ MeV
from (Guo *et al.*, PRC **76**, 025208 (2007))
- t-channel slope parameter: $5 (\text{GeV})^{-2}$
- Swim particles through GlueX detectors using HDGeant (minimal control.in file with HADR==0)

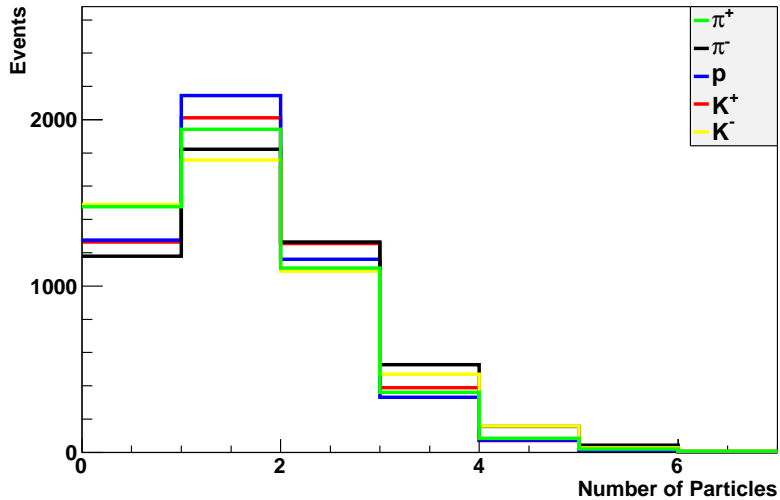
Procedure

- Standard reconstruction and PID from the offline software
- Use `hd_root` with `phys_tree` plugin to produce root file with trees
- Determine final state particle combo kinematically
 - If all particles detected, choose combo that best conserves c.m. energy
 - If one particle is missing, choose combo that gives the best missing mass
 - If there are multiple particles of the same type, use mass constraints
 - 3σ mass cut, 750 MeV change in c.m. energy cut (all detected)
- Compare results of normal offline PID to `PID_FORCE_TRUTH`

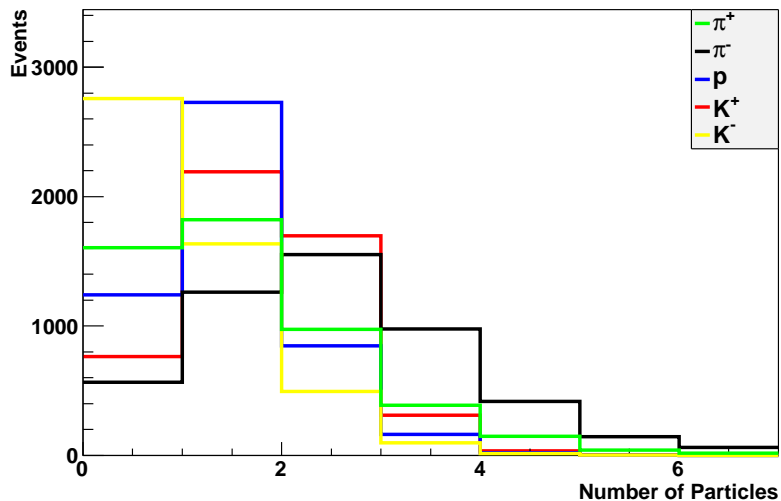
`PID_FORCE_TRUTH` (configuration parameter)

- Forces the correct PID, based on hit matching to the truth info., within `DTrackTimeBased_factory` when there is a correct track available

Normal PID



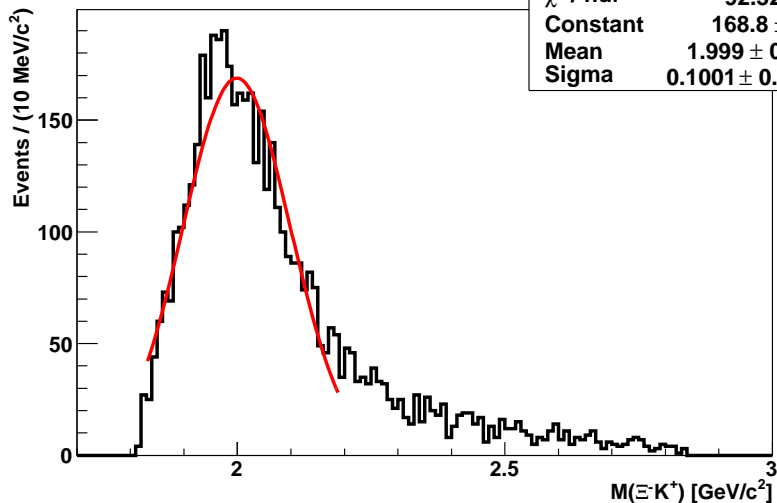
PID Force Truth



PID Force Truth

Thrown Mass of Excited Υ Baryon

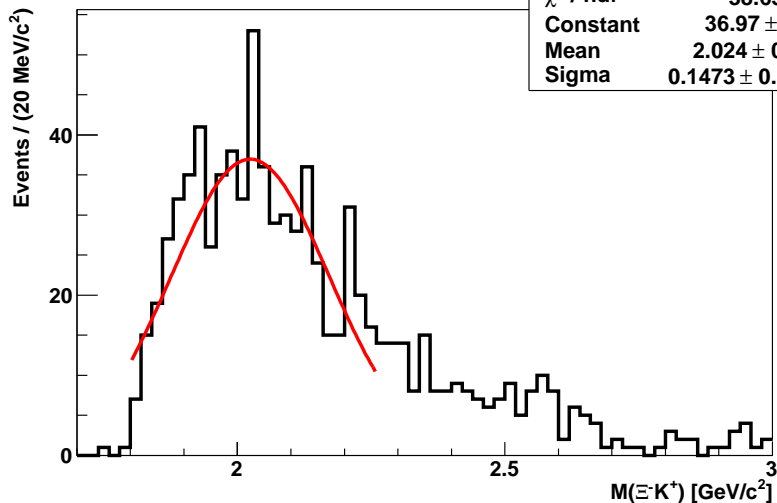
Integral	5000
χ^2 / ndf	92.32 / 33
Constant	168.8 ± 3.7
Mean	1.999 ± 0.002
Sigma	0.1001 ± 0.0021



PID Force Truth

Mass of Excited Σ Baryon

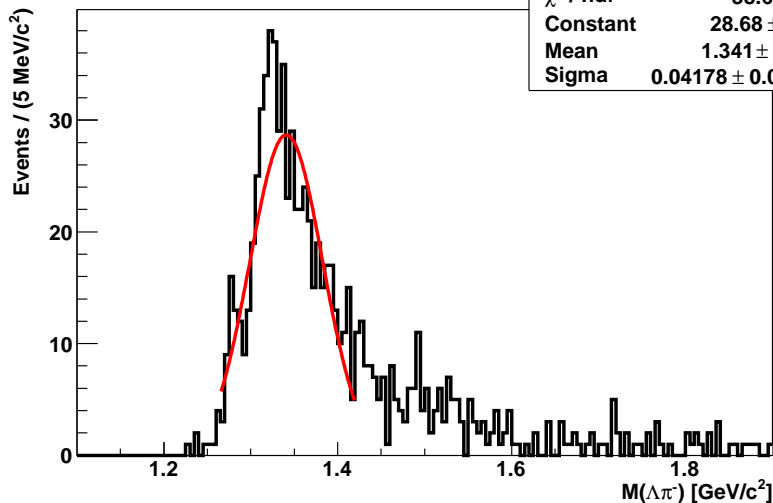
Integral	842
χ^2 / ndf	38.63 / 20
Constant	36.97 ± 2.08
Mean	2.024 ± 0.008
Sigma	0.1473 ± 0.0097



PID Force Truth

Mass of Ξ^- Baryon

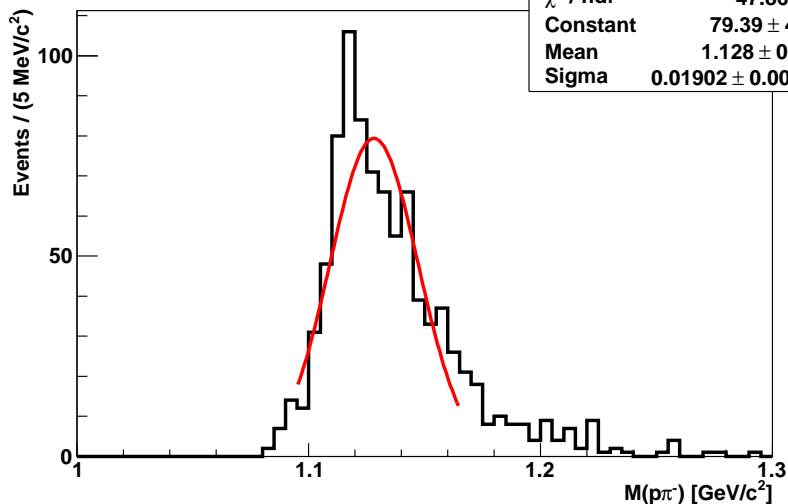
Integral	842
χ^2 / ndf	38.62 / 28
Constant	28.68 ± 1.65
Mean	1.341 ± 0.002
Sigma	0.04178 ± 0.00226



PID Force Truth

Mass of Λ Baryon

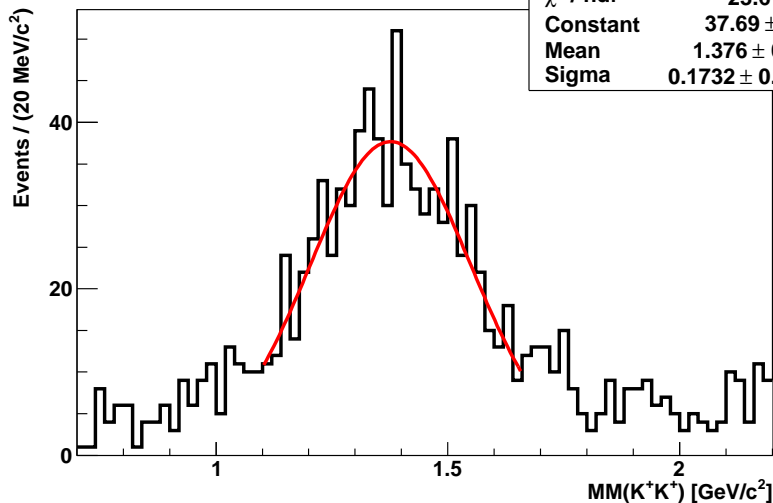
Integral	897
χ^2 / ndf	47.86 / 11
Constant	79.39 ± 4.10
Mean	1.128 ± 0.001
Sigma	0.01902 ± 0.00093



PID Force Truth

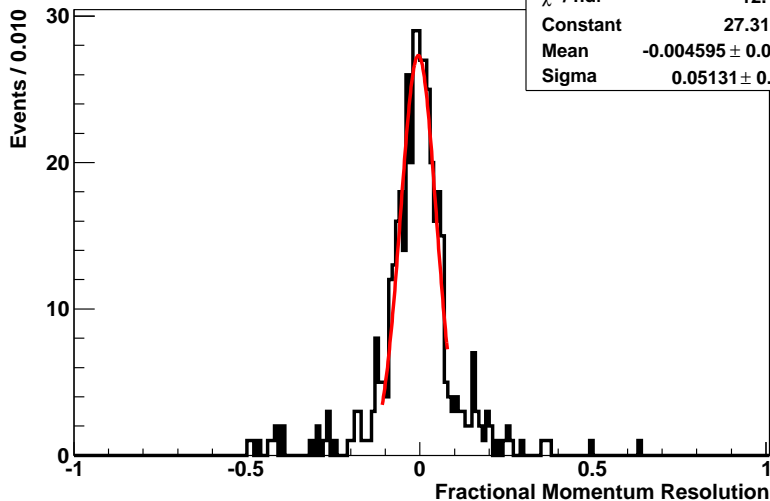
Mass of Missing Ξ^- Baryon

Integral	1085
χ^2 / ndf	23.61 / 25
Constant	37.69 ± 1.88
Mean	1.376 ± 0.008
Sigma	0.1732 ± 0.0095



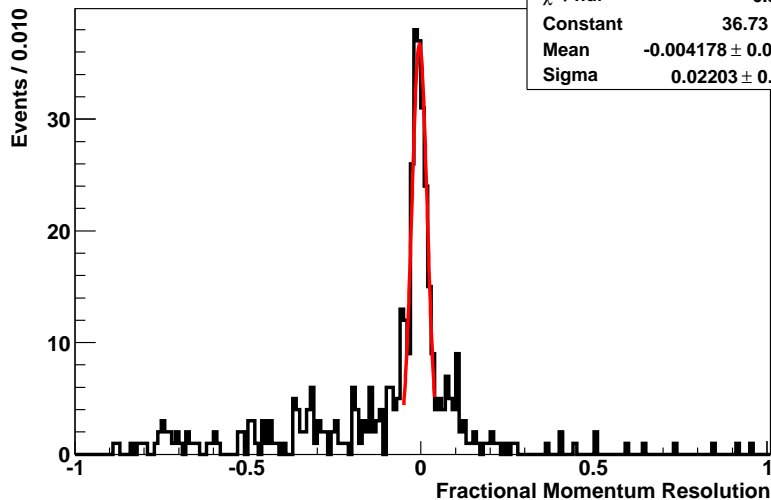
PID Force Truth

Forward Going K^+



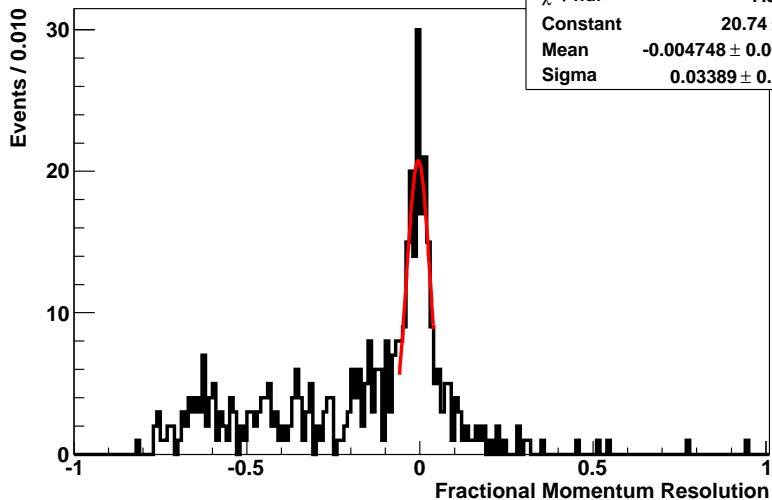
PID Force Truth

K^+ from Excited Υ Decay



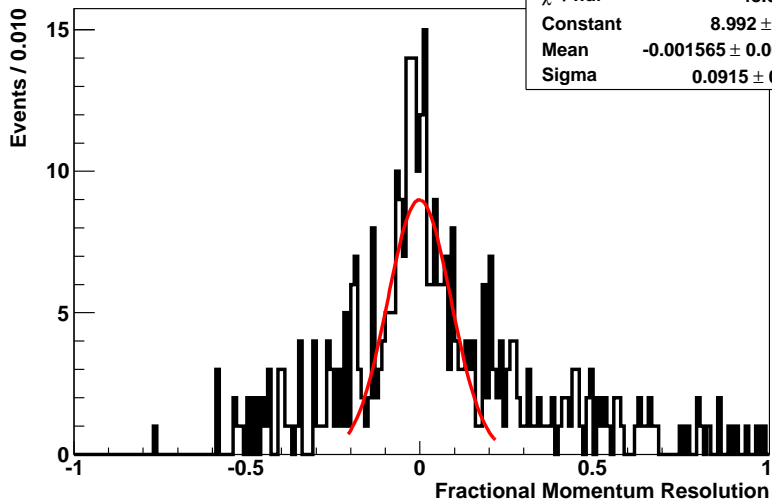
PID Force Truth

Proton



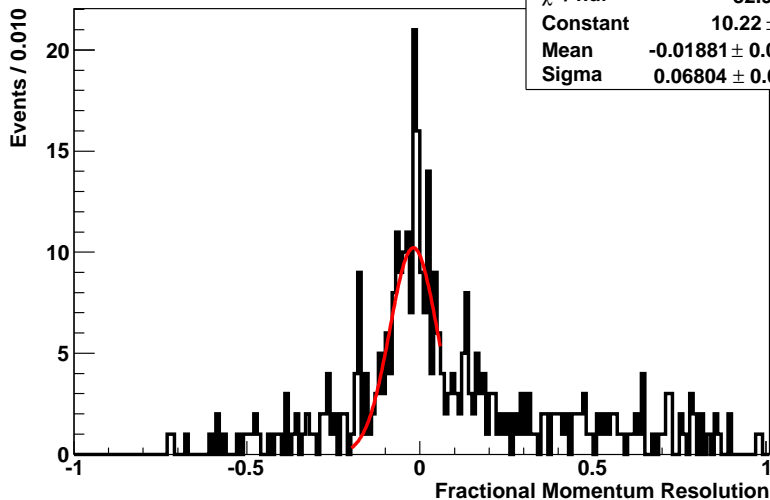
PID Force Truth

π^- from Λ Decay



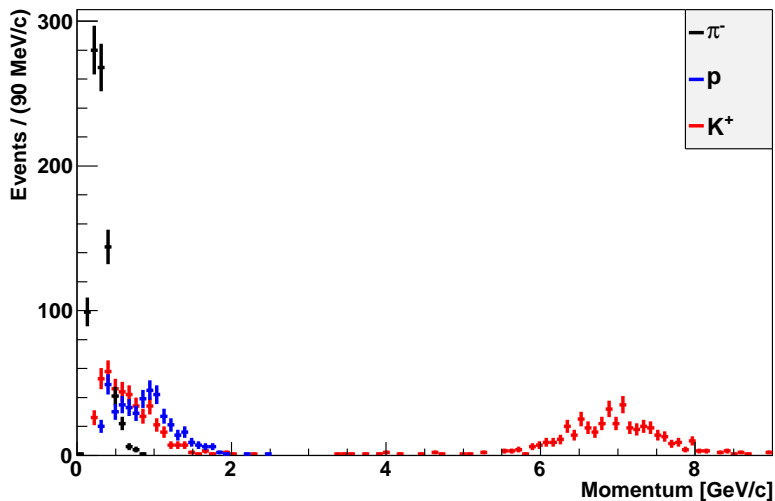
PID Force Truth

π^- from Ξ Decay

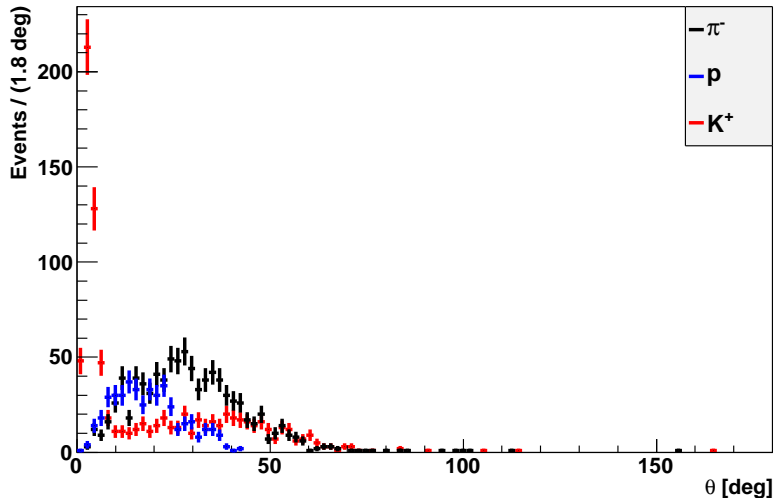


Integral	373
χ^2 / ndf	32.93 / 23
Constant	10.22 ± 1.17
Mean	-0.01881 ± 0.00874
Sigma	0.06804 ± 0.00938

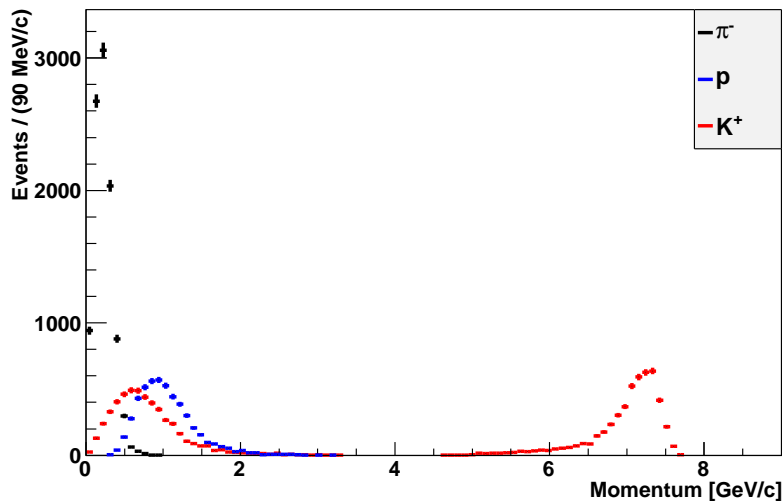
PID Force Truth: Accepted Momentum Dist.



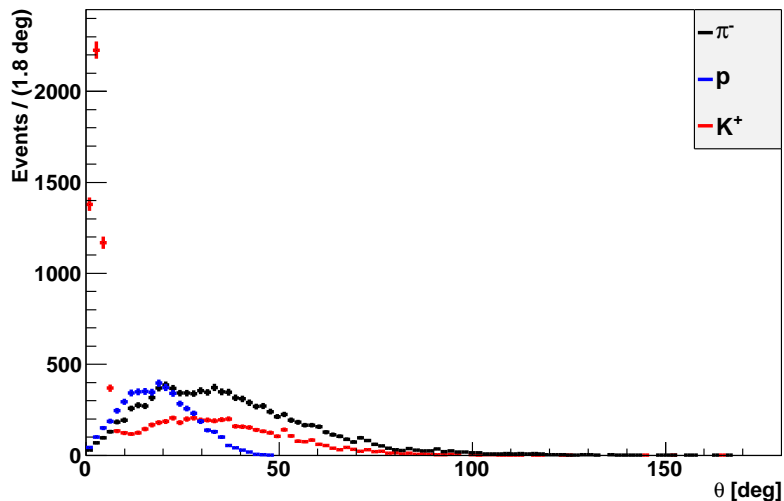
PID Force Truth: Accepted Theta Dist.



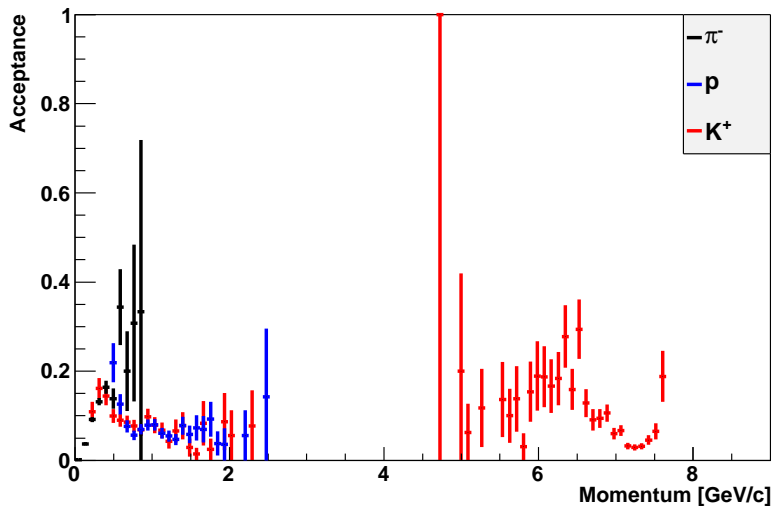
PID Force Truth: Generated Momentum Dist.



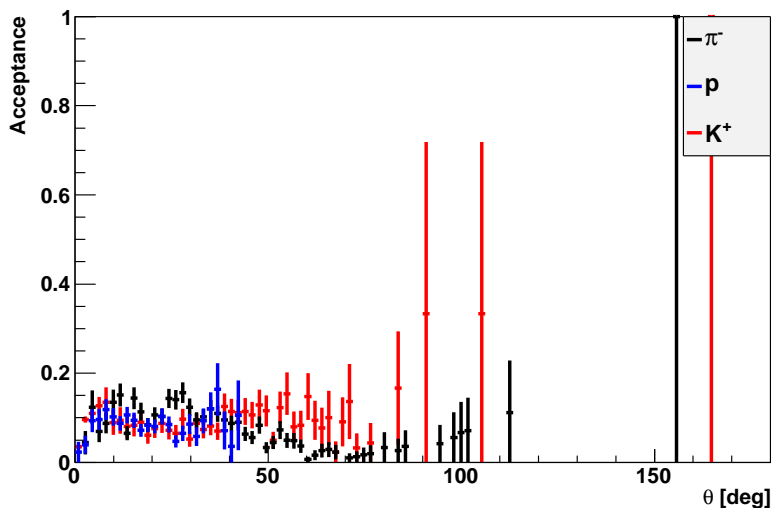
PID Force Truth: Generated Theta Dist.



PID Force Truth: Acceptance in Momentum



PID Force Truth: Acceptance in Theta



Comparison of momentum resolutions (PID Force Truth, all detected)

Final State	R(p)	R(K ⁺)	R(K ⁺ (Y))	R(π ⁻ (Ξ))	R(π ⁻ (Λ))
K ⁺ K ⁺ π ⁻ π ⁻ p	3.4	5.1	2.2	6.8	9.2
K ⁺ K _S π ⁻ π ⁰ p	2.9	4.3	R(π ⁺ (K _S)) 2.5	R(π ⁻ (K _S)) 1.7	2.7
K _S K ⁺ π ⁻ π ⁰ p	3.2	R(K ⁺ (Y)) 2.3	3.3	2.7	4.8
b1 pi	3.7	R(π ⁺ (b ₁)) 2.3	R(π ⁺ (ρ)) 2.4	R(π ⁻ (ρ)) 2.5	R(π ⁻ (X)) 2.4

R: momentum resolution in %

b1 pi: π⁺π⁺π⁻π⁻π⁰p final state

Comparison of mass resolutions (PID Force Truth, all detected)

Final State	$\Gamma(m\Xi)$	$\Gamma(\Xi)$	$\Gamma(Y^*)$	$\Gamma(\Lambda)$	$\Gamma(\pi^0)$
$K^+K^+\pi^-\pi^-p$	173	42	150	19	
	$\Gamma(K_S)$				
$K^+K_S\pi^-\pi^0p$	23	67	196	10	17
$K_SK^+\pi^-\pi^0p$	13	66	142	10	17
b1 pi	$\Gamma(mb_1)$	$\Gamma(b_1)$	$\Gamma(X)$	$\Gamma(\omega)$	
	151	104	168	43	12

Γ : mass resolution in MeV/c^2

$m\Xi$: missing Ξ

Comparison of reconstruction efficiencies

Final State	f1	f2	f3	f4	f5	f6
$K^+K^+\pi^-\pi^-p$	8.4	2.2	17.1	8.7		
$K^+K_s\pi^-\pi^0p$	3.1	1.0	10.9	4.8		
$K_sK^+\pi^-\pi^0p$		2.5		8.2		
b1 pi	19.3	12.7	51.2	38.1	43.2	31.9

f1: percent recon. with one particle missing and using normal PID

f2: percent recon. requiring all particles and using normal PID

f3: percent recon. with one particle missing and using PID Force Truth

f4: percent recon. requiring all particles and using PID Force Truth

f5: percent recon. with one particle missing and using normal PID, but without kaon mass hypotheses

f6: percent recon. requiring all particles and using normal PID, but without kaon mass hypotheses