Status of Covariance Matrix Checking

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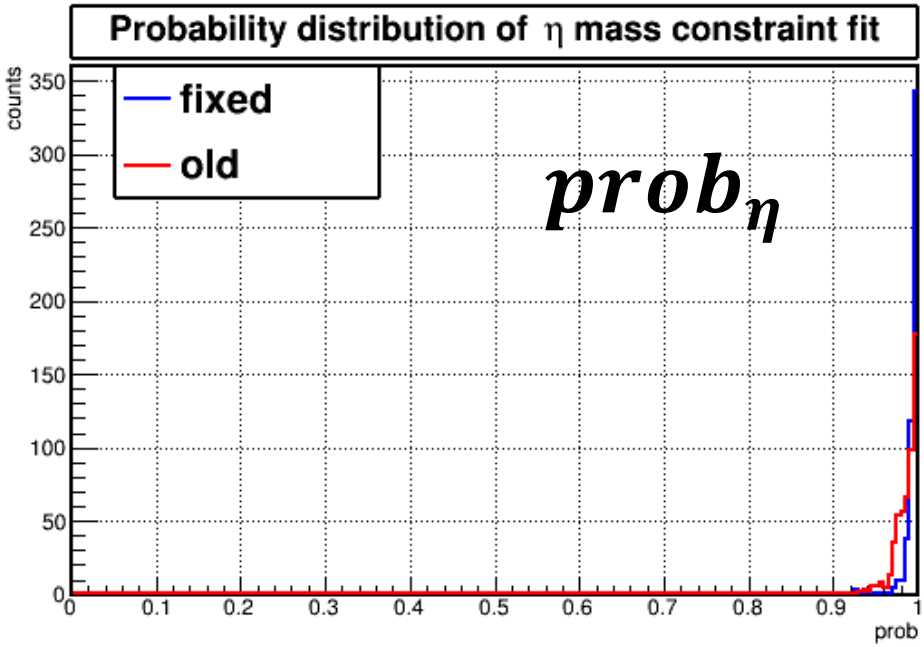
Outline

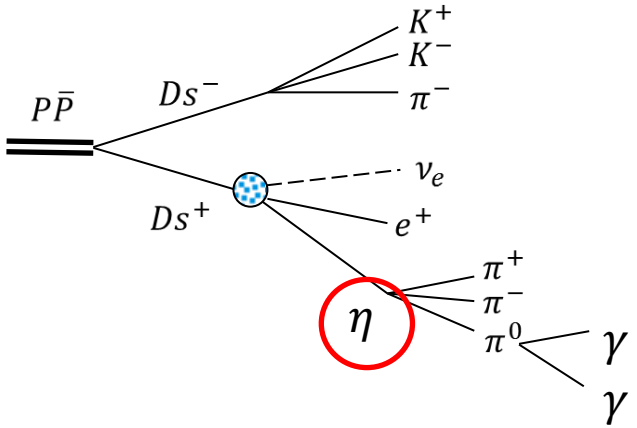
- Motivation
- Test with single photon
- Covariance matrix of π^0
- Test with single K^+
- Summary

Motivation

1k evt

1. Problem found in mass constraint fit of $\eta \to \pi^+\pi^-\pi^0$ (presented in June CM)



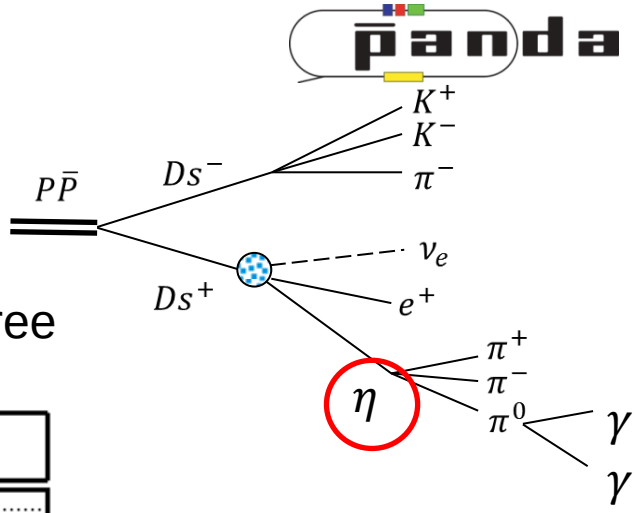


Tested with $D^0 \to K^-\pi^+\pi^0$
(charged + neutral), same problems there !

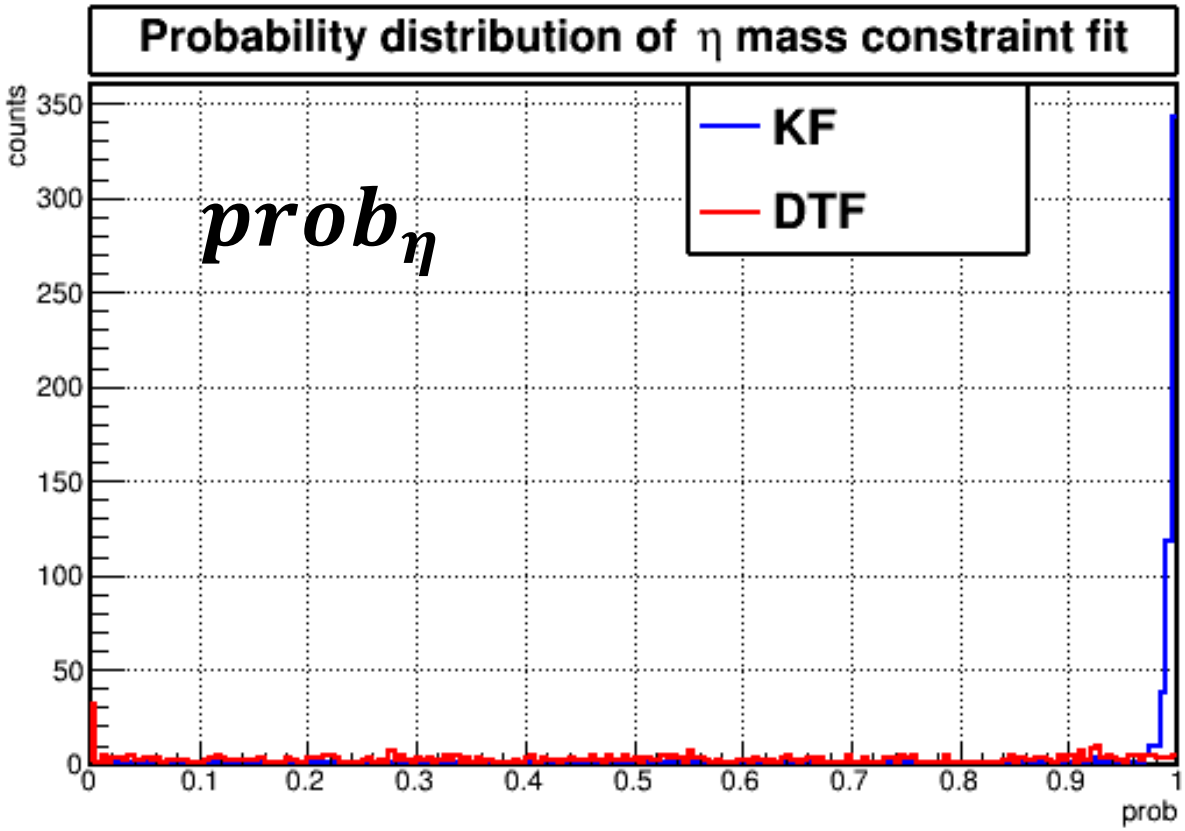
Two bugs fixed in PndKinFitter regarding to read-in/out cov. matrix, but the problem not solved… (presented in software meeting Oct04)

Motivation

2. Cross check with DecayTreeFitter



Apply a mass constraint fit for the η candi. with decay tree fitter.

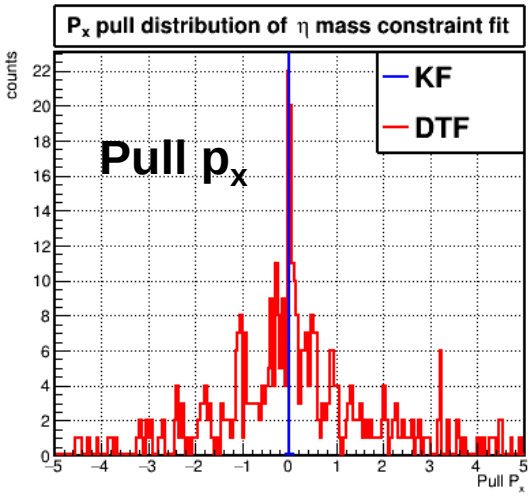


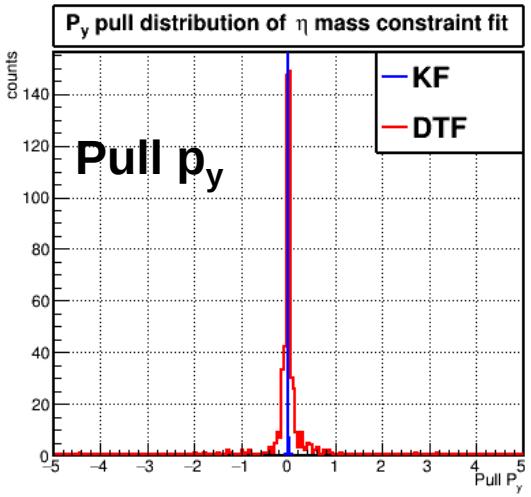
KF: PndKinFitter (fixed)
DTF: PndDecayTreeFitter

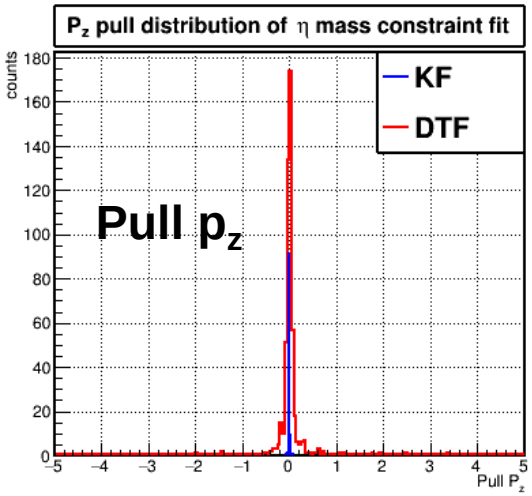
DTF prob. seems OK

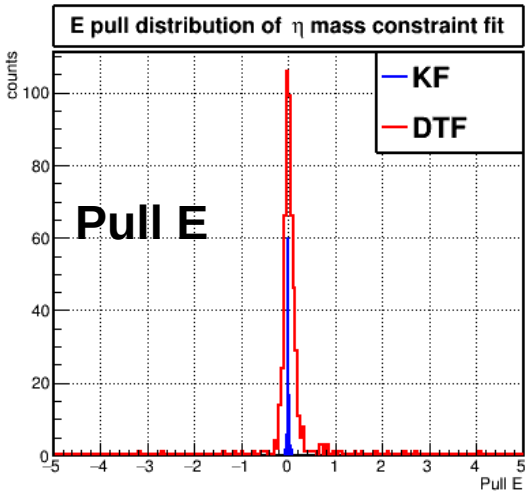
Motivation

3. Pull distributions









$$pull = \frac{A_{bf} - A_{af}}{\sqrt{|cov_{bf} - cov_{af}|}}$$

- A is p_x, p_y, p_z, E, …
- cov is corresponding diagonal element of covariance matrix
- Subscripts are “bf - before fit” and “ af - after fit”

KF: PndKinFitter (fixed)
DTF: PndDecayTreeFitter

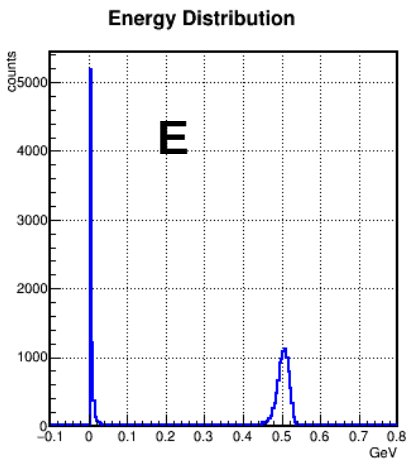
DTF pull looks better, but all of them are far away from a **Standard Gaussian**.

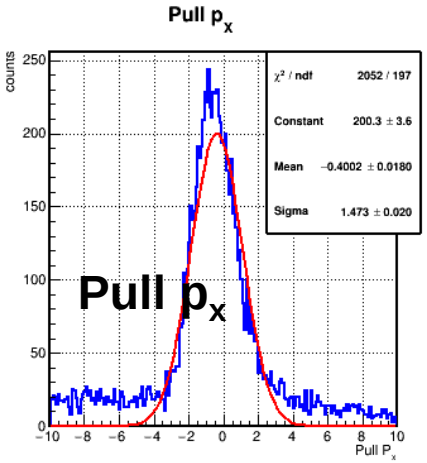
Test with Single Photon

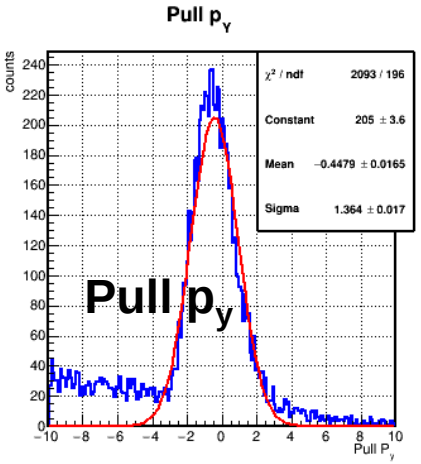
$$pull = \frac{A_{reco} - A_{MC}}{\sqrt{cov_{reco}}}$$

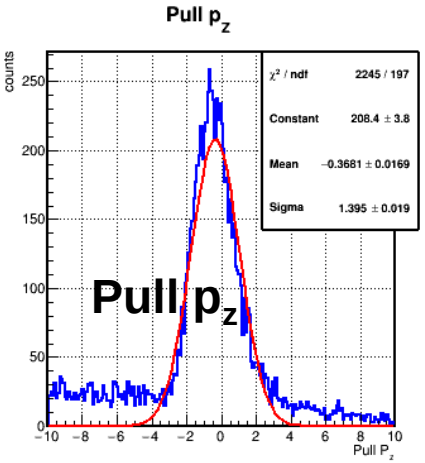
- A is Px, Py, Pz, E, …
- cov is corresponding diagonal element of covariance matrix

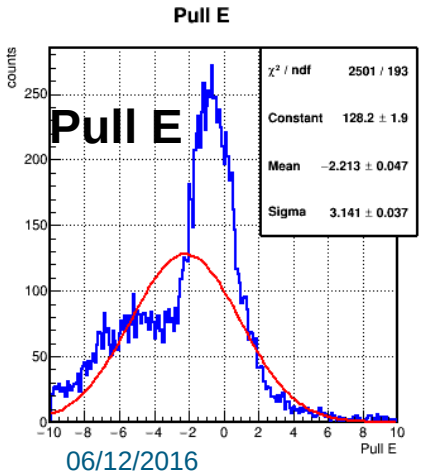
BoxGen: one photon 10k evts;
p=0.5GeV/c, phi=60°~65°, theta = 60°~65°
No E threshold

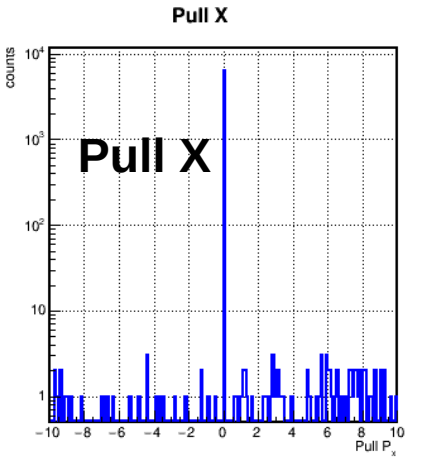


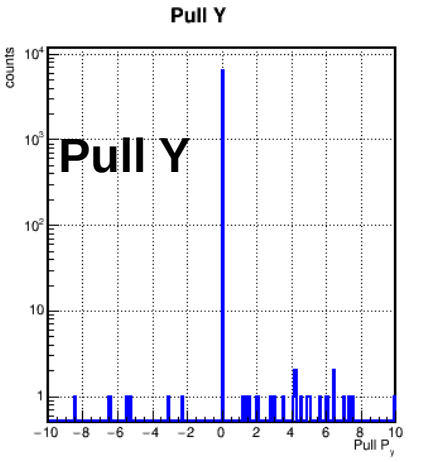


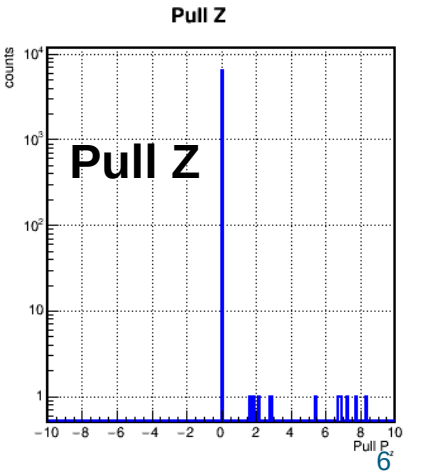




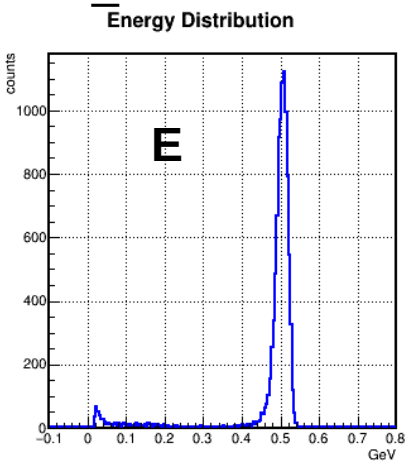


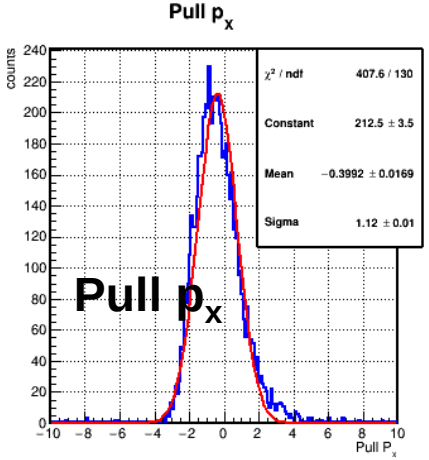


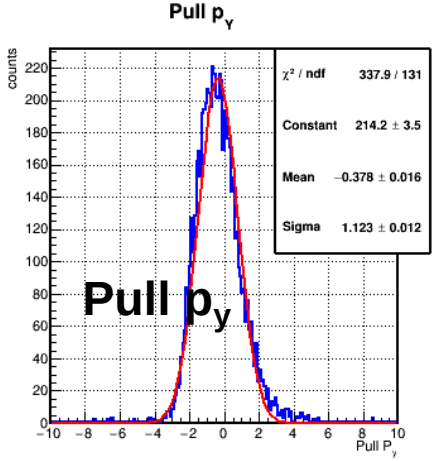


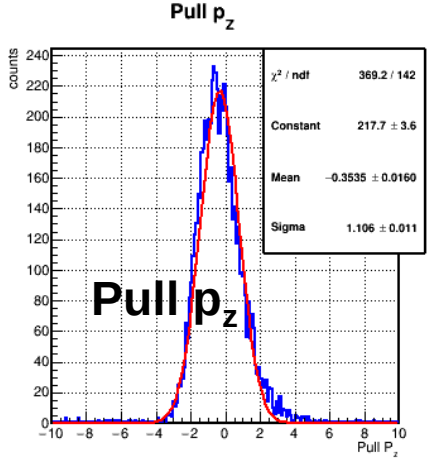


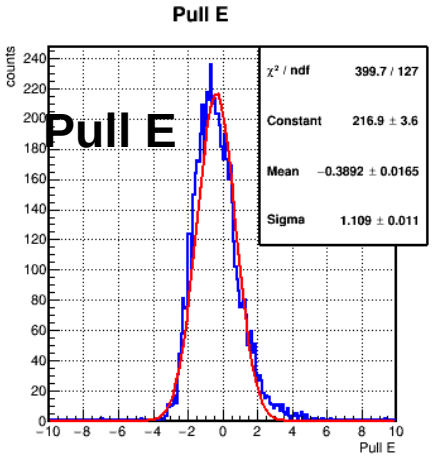
E_thr = 20 MeV applied:

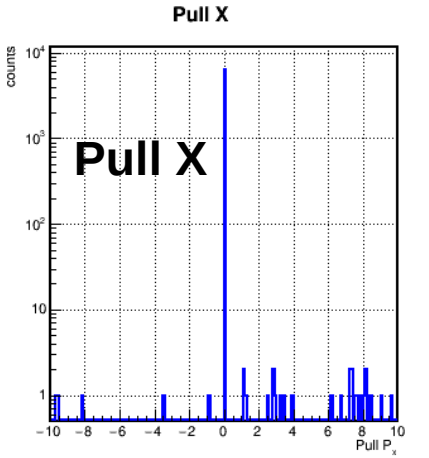


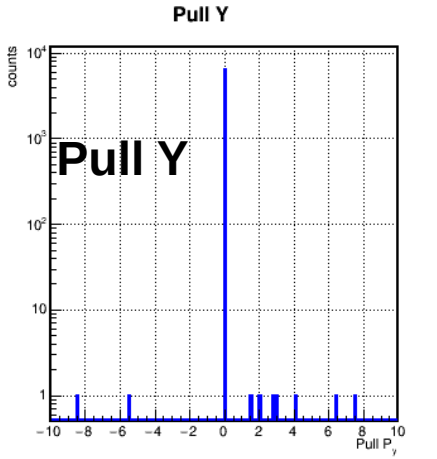


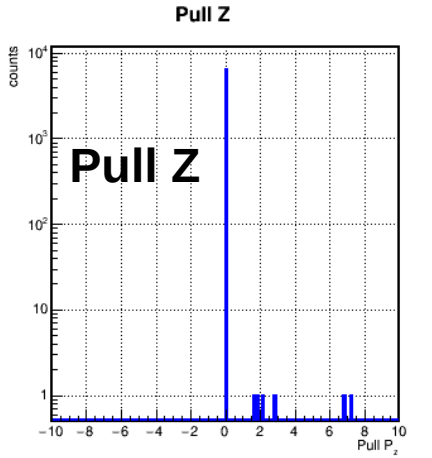






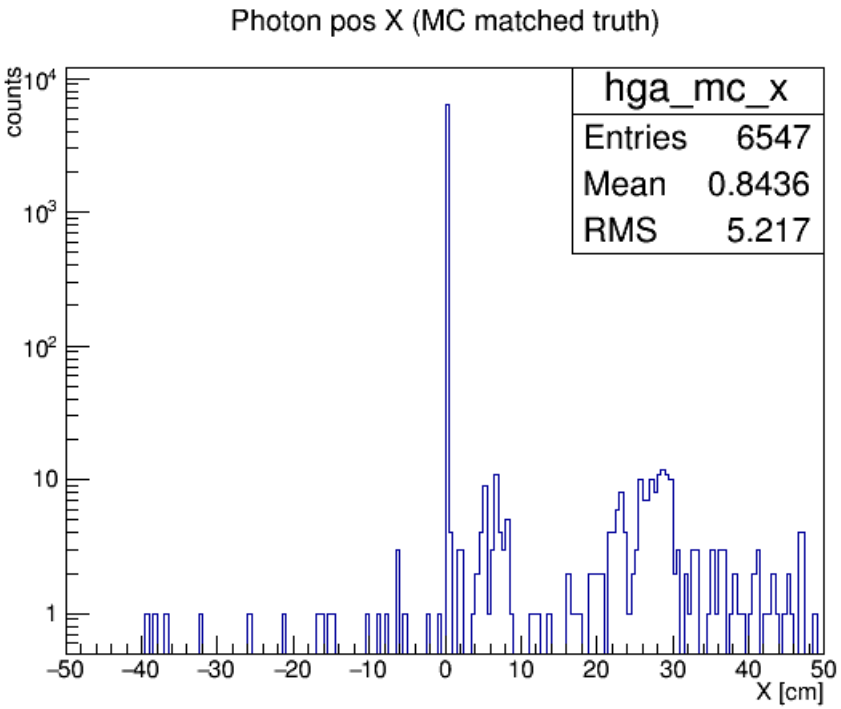


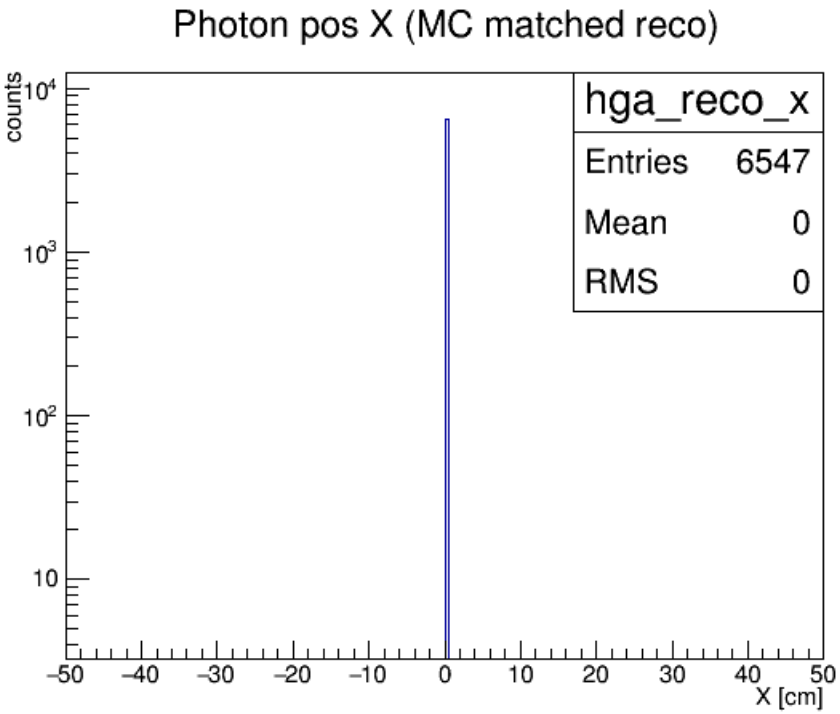




(presented in software meeting Nov14)

Test with Single Photon





Covariance Matrix of π^0

BoxGen: one pi0; p=1 GeV/c, phi=45°, theta = 45°

photon #0

gam #0:

7x7 matrix is as follows

	X	Y	Z	Px	Py	Pz	E
X	0.2922	-0.2312	-0.03136	0.0003083	-0.000244	-3.309e-05	0
Y	-0.2312	0.2083	-0.03756	-0.000244	0.0002198	-3.964e-05	0
Z	-0.03136	-0.03756	0.157	-3.309e-05	-3.964e-05	0.0001657	0
Px	0.0003083	-0.000244	-3.309e-05	7.398e-06	8.214e-06	3.405e-06	1.156e-05
Py	-0.000244	0.0002198	-3.964e-05	8.214e-06	1.038e-05	4.079e-06	1.385e-05
Pz	-3.309e-05	-3.964e-05	0.0001657	3.405e-06	4.079e-06	1.848e-06	5.622e-06
E	0	0	0	1.156e-05	1.385e-05	5.622e-06	1.889e-05

photon #1

gam #1:

7x7 matrix is as follows

	X	Y	Z	Px	Py	Pz	E
X	0.0623	-0.04793	-0.01015	0.000641	-0.0004932	-0.0001044	0
Y	-0.04793	0.06422	-0.009949	-0.0004932	0.0006607	-0.0001024	0
Z	-0.01015	-0.009949	0.01319	-0.0001044	-0.0001024	0.0001357	0
Px	0.000641	-0.0004932	-0.0001044	6.981e-05	5.689e-05	9.433e-05	0.0001301
Py	-0.0004932	0.0006607	-0.0001024	5.689e-05	6.753e-05	9.246e-05	0.0001276
Pz	-0.0001044	-0.0001024	0.0001357	9.433e-05	9.246e-05	0.0001454	0.0001964
E	0	0	0	0.0001301	0.0001276	0.0001964	0.0002679

Covariance Matrix of π^0

BoxGen: one pi0; p=1 GeV/c, phi=45°, theta = 45°

pi0_raw #0:

pi0 before m.c.f.: combination of two photons

7x7 matrix is as follows

	X	Y	Z	Px	Py	Pz	E
X	0	0	0	0	0	0	0
Y	0	0	0	0	0	0	0
Z	0	0	0	0	0	0	0
Px	0	0	0	7.721e-05	6.51e-05	9.773e-05	0.0001417
Py	0	0	0	6.51e-05	7.791e-05	9.654e-05	0.0001414
Pz	0	0	0	9.773e-05	9.654e-05	0.0001472	0.000202
E	0	0	0	0.0001417	0.0001414	0.000202	0.0002868

Non-zero elements updated by fitting could be few orders smaller than charged particle's cov. matrix.

pi0_reco #0:

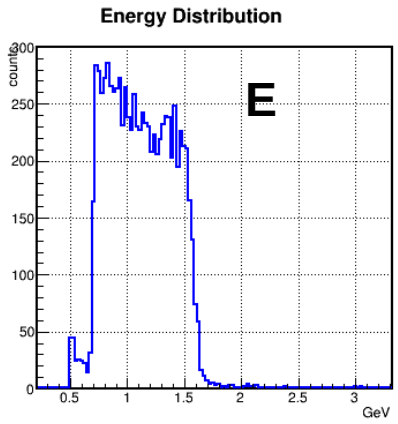
pi0 after m.c.f.

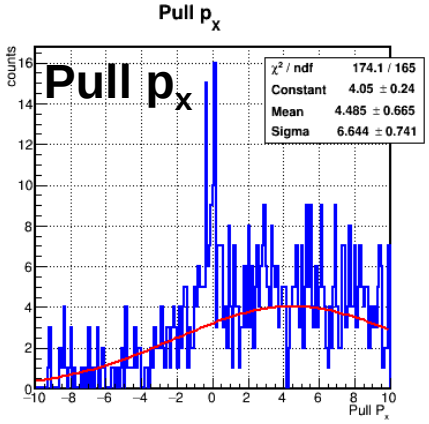
7x7 matrix is as follows

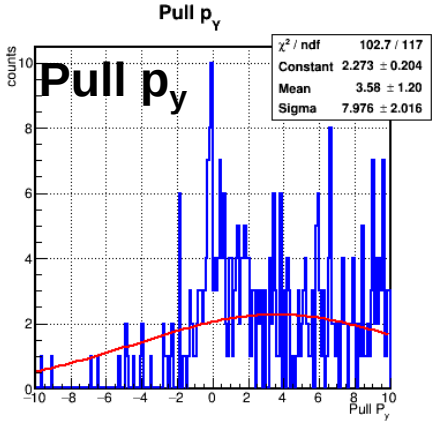
	X	Y	Z	Px	Py	Pz	E
X	6.787e-05	5.482e-05	8.956e-05	0.0001248	0.0009834	-0.0008624	0.0001579
Y	5.482e-05	6.634e-05	8.841e-05	0.0001232	-0.000695	0.000715	0.0002297
Z	8.956e-05	8.841e-05	0.0001372	0.0001862	-0.0001229	-0.0001604	0.0004055
Px	0.0001248	0.0001232	0.0001862	0.000256	5.603e-05	-0.0001931	0.0004775
Py	0.0009834	-0.000695	-0.0001229	5.603e-05	0.3543	-0.2782	-0.0434
Pz	-0.0008624	0.000715	-0.0001604	-0.0001931	-0.2782	0.2679	-0.03865
E	0.0001579	0.0002297	0.0004055	0.0004775	-0.0434	-0.03865	0.1525

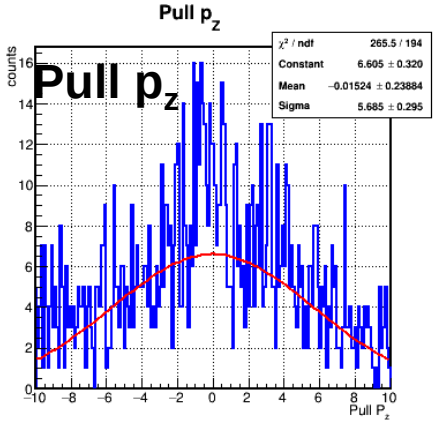
Test with Single K^+

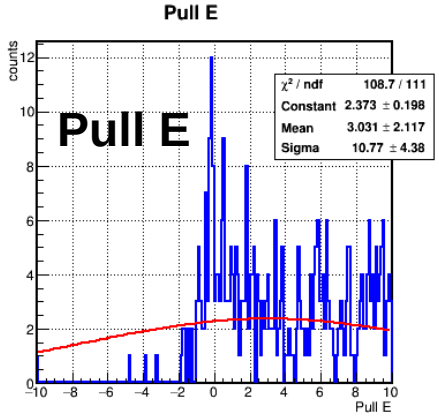
BoxGen: one K^+ 10k evts; p=1~3 GeV/c, phi=45°~125°, theta = 45°~125°

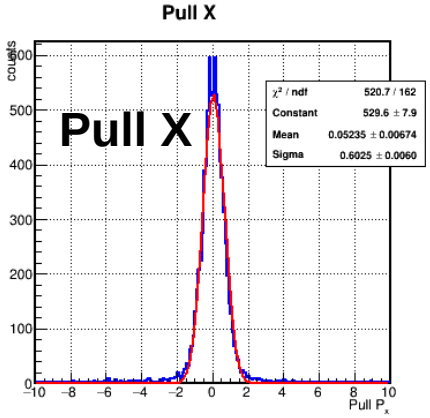


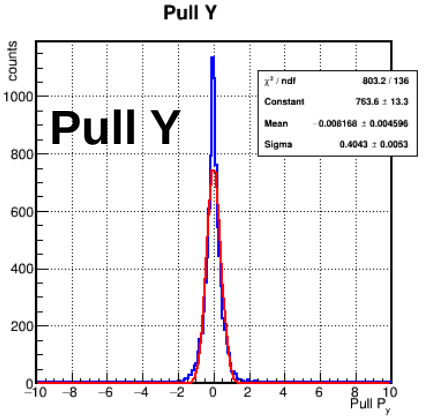


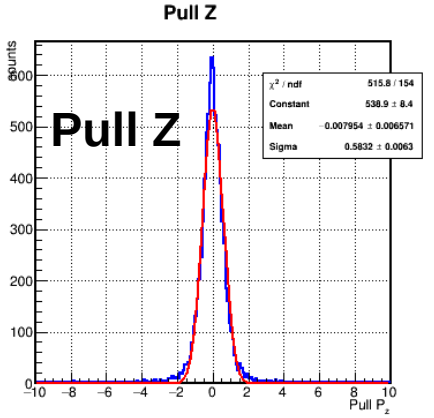












Summary

- Problem found in mass constraint fit of $\eta \rightarrow \pi^+\pi^-\pi^0$
- Two bugs fixed in fitter could not solve the problem
- Covariance matrices of neutral and charged particles have to be double checked
- Scale parameters need to be implemented in PndKinFitter

Cov. matrxi		Photon	Pi0	K+
Diagonal	p4			
	pos			
Off-diagonal				
Scale parameters				

good bad unchecked

Picture cited from internet

Thank you!

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