JÜLICH FORSCHUNGSZENTRUM

Performance and Issues of the Vertex Fitters

$\bar{P}$ANDA – Collaboration Meeting Bochum, 29.02.– 04.03.2016 | Jennifer Pütz

Outline

- What is vertex fitting?
- Performance
- Issues
- Poormantracks
- Summary & Outlook

What is vertex fitting?

- Goal: Find the decay point of a particle, which decays into two or more particles (either charged or having charged daughters)
- Vertex fitter is an algorithm to determine a point which is as close as possible to the true decay point
- Different methods; for example:

    1) Kinematic vertex fitting
    2) Kalman vertex fitting

- **Kinematic vertex fitting**: mathematical procedure using the kinematic constraints find the common point
- **Kalman vertex fitting**: based on 5 helix-parameters of the particle tracks

Simulations

- Simulation of:
  1) $\Lambda^0 \rightarrow p + \pi^-$
  2) $\Xi^- \rightarrow \Lambda^0 + \pi^-$
  3) $\bar{p}p \rightarrow \Lambda^0 + \bar{\Lambda}^0$
  4) $\bar{p}p \rightarrow \mu^+ + \mu^-$
- Each channel has 500,000 events with initial momentum p = 3 GeV/c
- vertex fit is performed on
  1) Λ^0
  2) Ξ^-
  3) & 4) $\bar{p}p$

Performance

$\Lambda^0 \rightarrow p + \pi^-$

	PndKinVtxFitter	PndKalmanVtxFitter
Δx/mm	0.2	0.6
Δy/mm	0.2	0.6
Δz/mm	0.2	0.6

- Vertex resolution determined with FWHM

$\Xi^- \rightarrow \Lambda^0 + \pi^-$

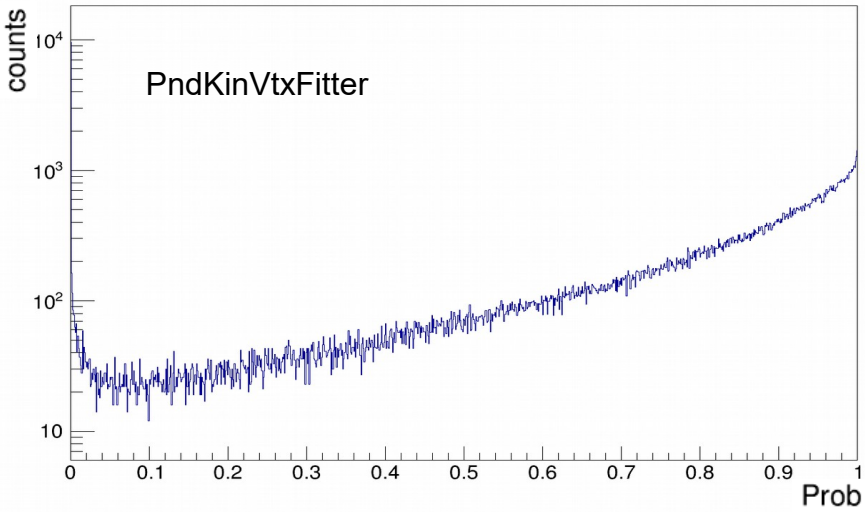
	PndKinVtxFitter	PndKalmanVtxFitter
Δx/mm	0.43	0.94
Δy/mm	0.35	0.80
Δz/mm	1.6	1.1

$\bar{p}p \rightarrow \Lambda^0 + \bar{\Lambda}^0$

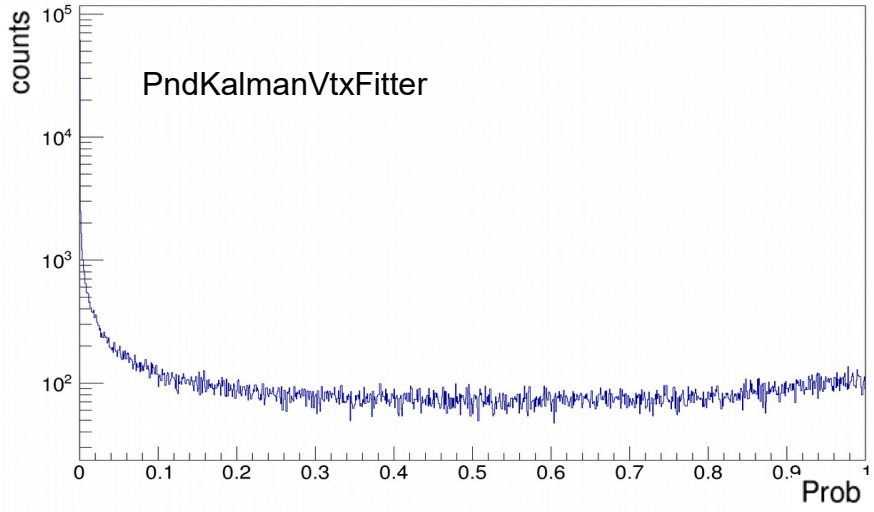
	PndKinVtxFitter	PndKalmanVtxFitter
Δx/mm	0.34	0.34
Δy/mm	0.32	0.32
Δz/mm	0.75	0.69

Issues for $\Lambda^0 \rightarrow \pi^- + p$

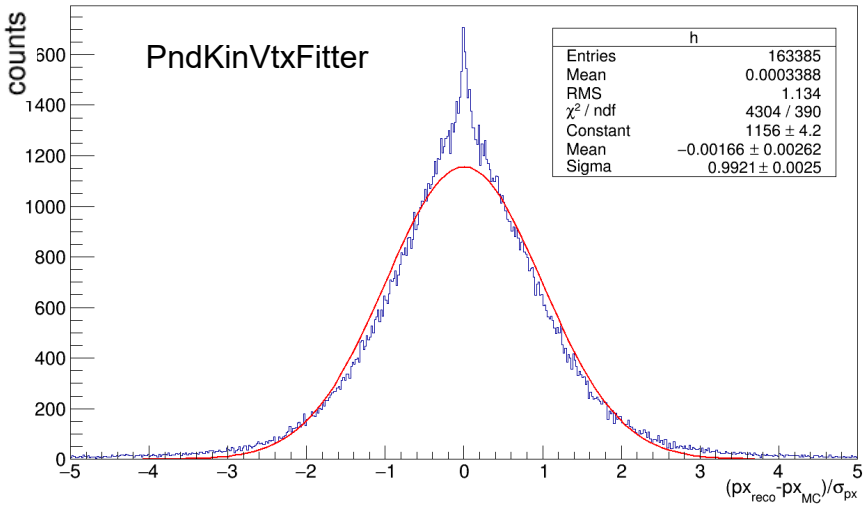
Probability for vertex Fit



Probability for vertex Fit



momentum pull distribution for x coordinate



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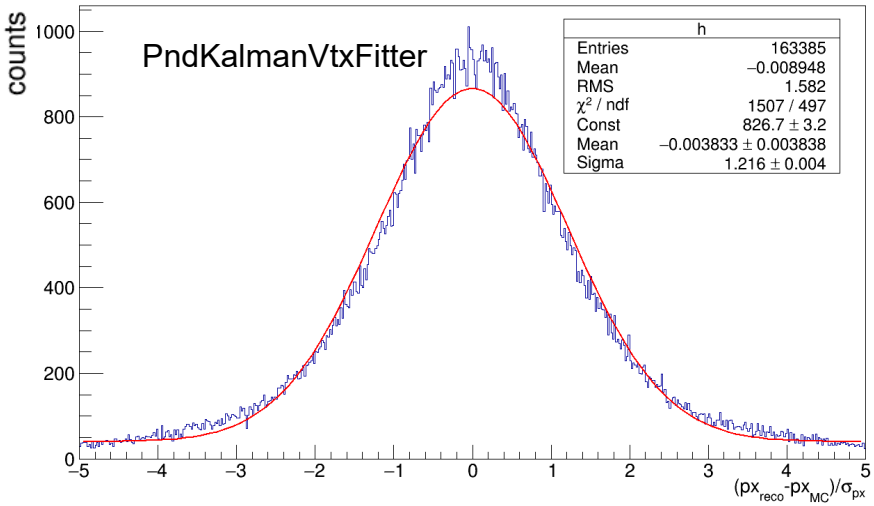
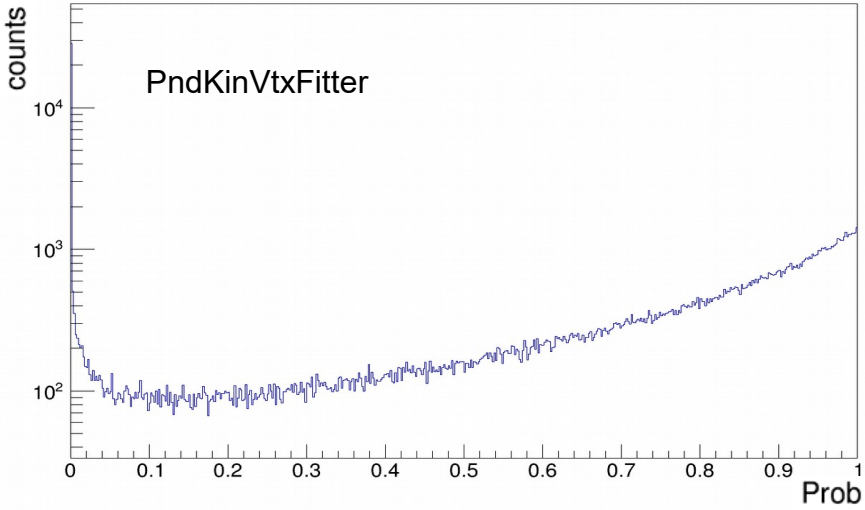


Issues for $\Xi^- \rightarrow \Lambda^0 + \pi^-$

Probability for vertex Fit



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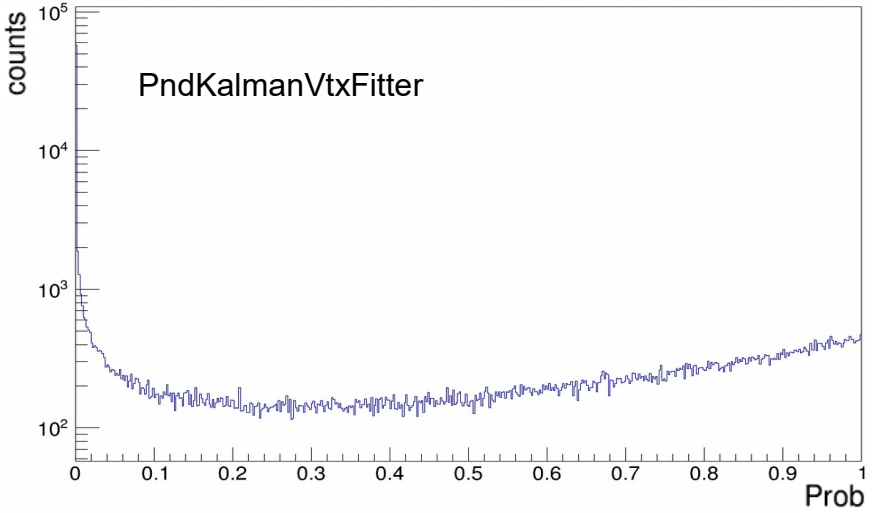

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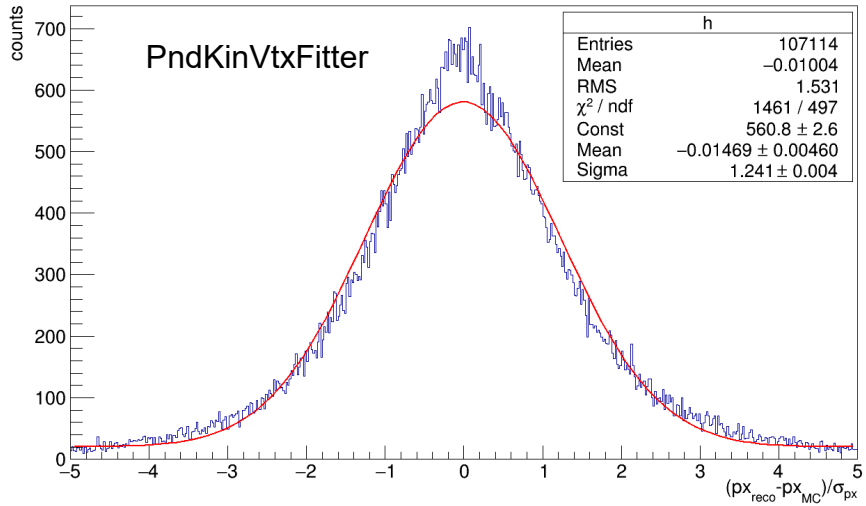
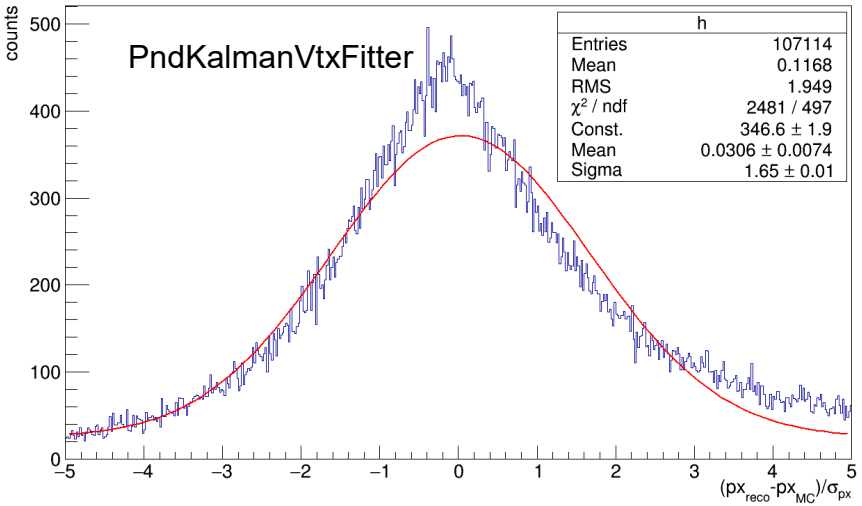
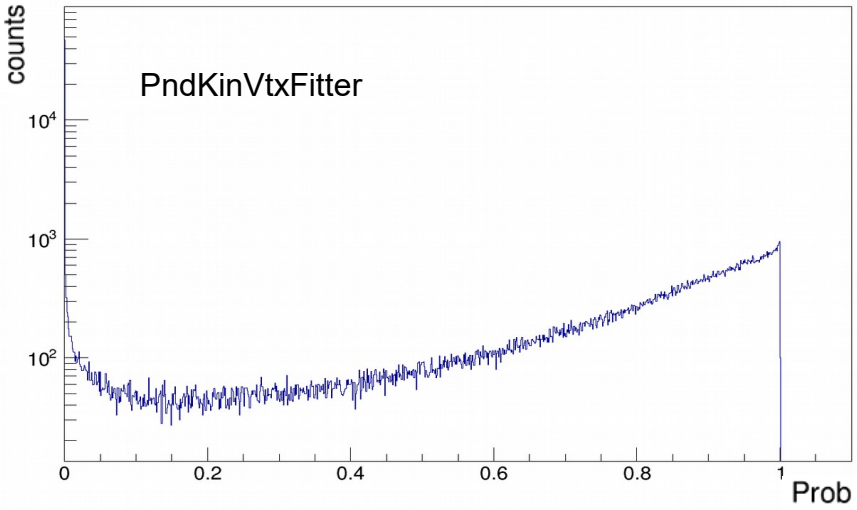


momentum pull distribution for x coordinate

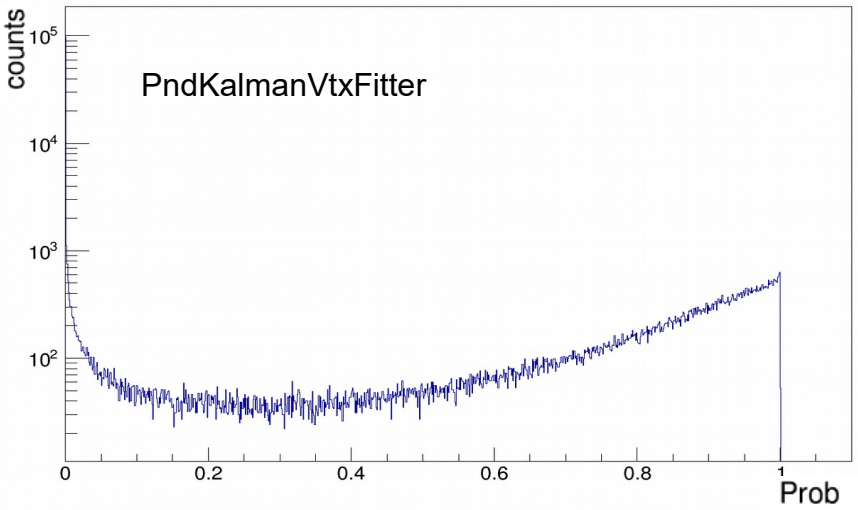


Issues for $\bar{p}p \rightarrow \Lambda^0 + \bar{\Lambda}^0$

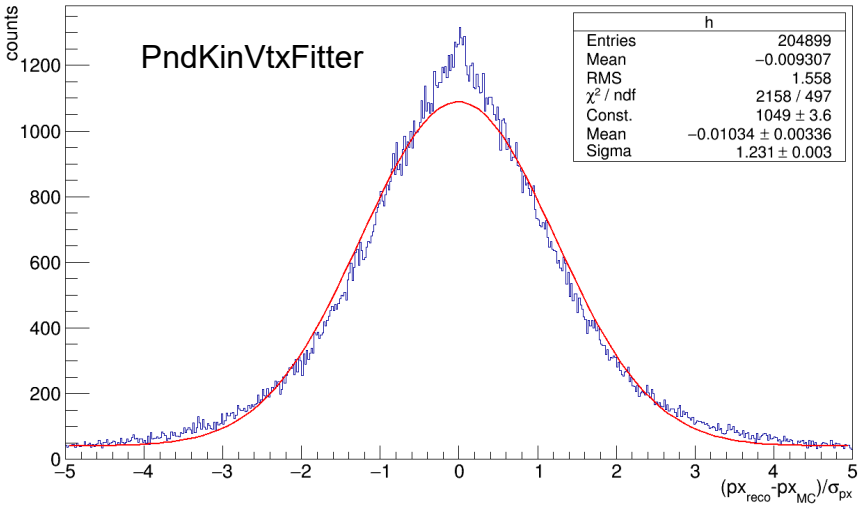
Probability for vertex Fit



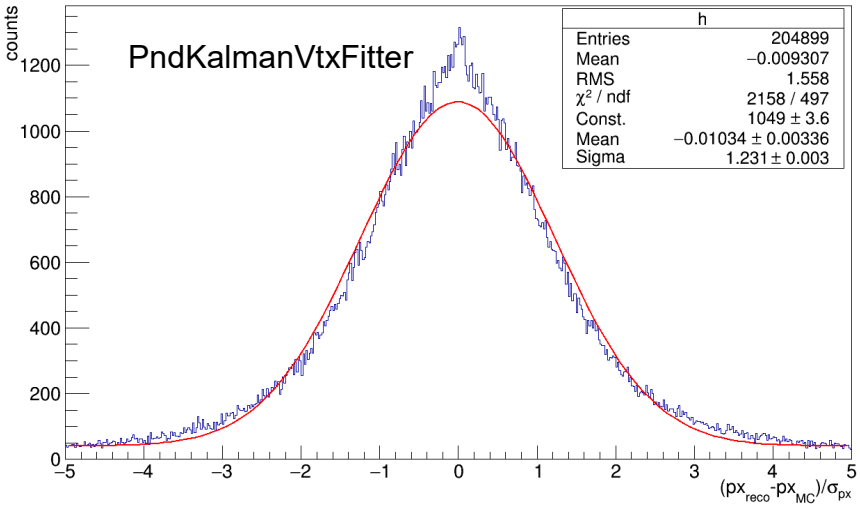
Probability for vertex Fit



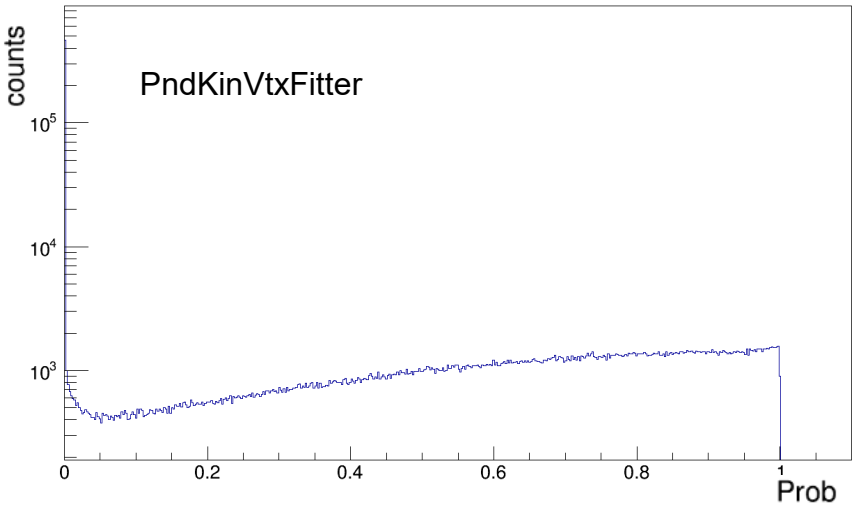
momentum pull distribution for x coordinate

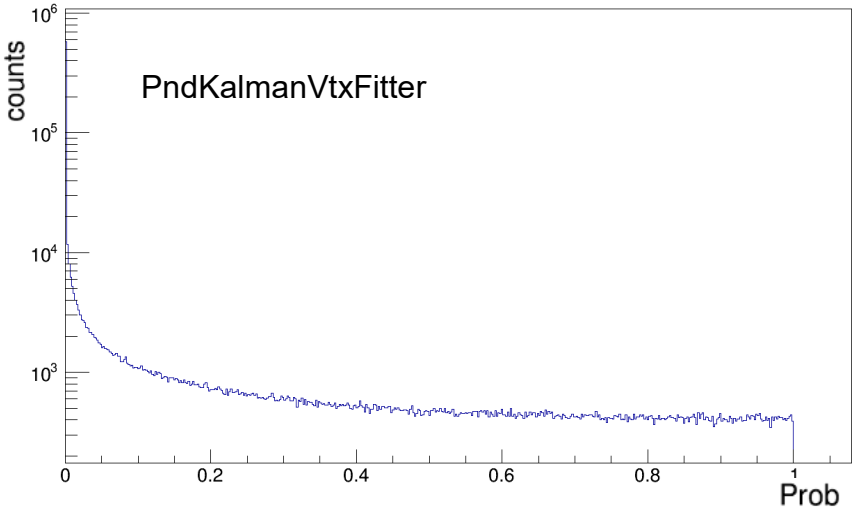


momentum pull distribution for x coordinate

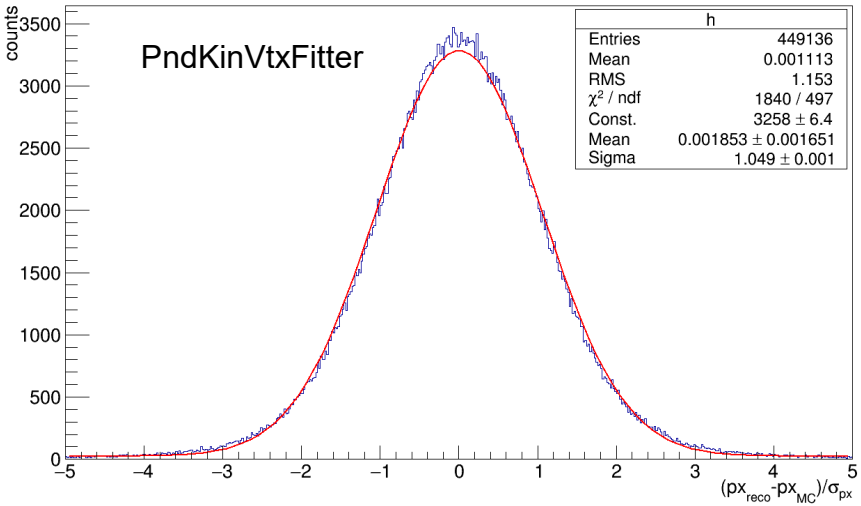


Issues for $\bar{p}p \rightarrow \mu^- + \mu^+$

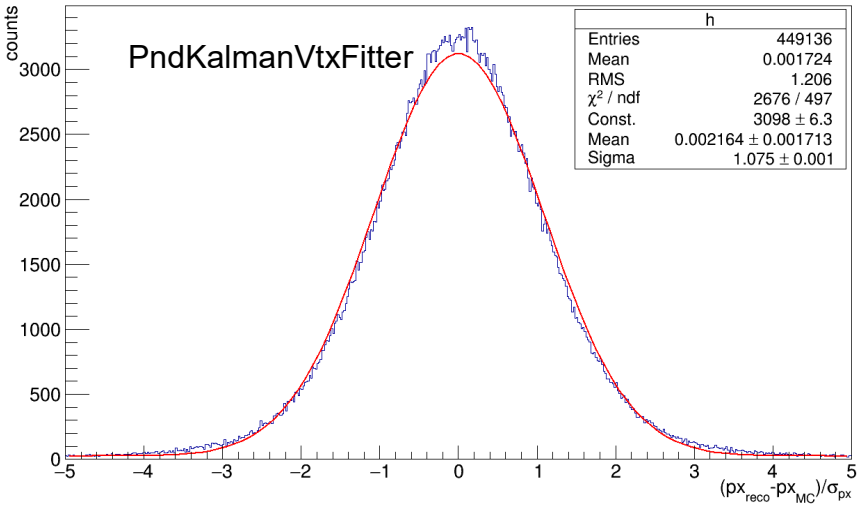




momentum pull distribution of x coordinate



momentum pull distribution of x coordinate

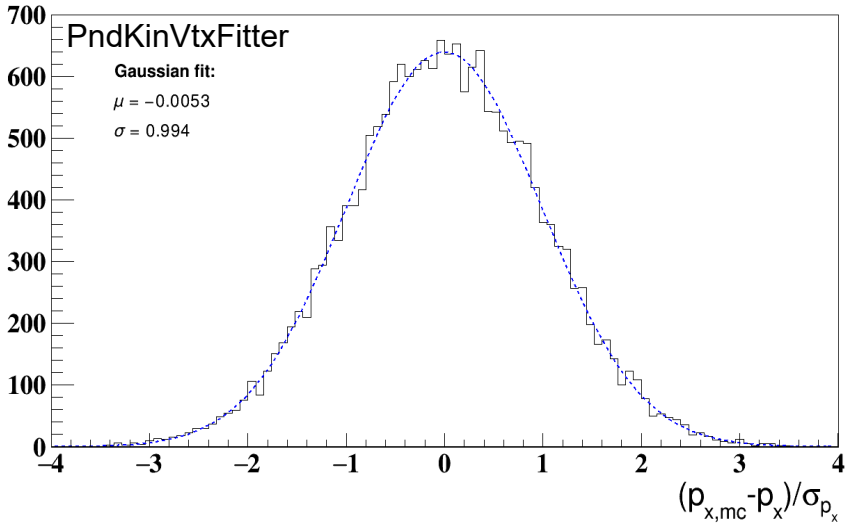


Poormantracks

- Algorithm developed by Ralf Kliemt
- Creates “simple” tracks for given particles
- No information about detector
- Tests only fitter code
- Performs vertex fit with different fitters
  - PndKinVtxFitter
  - PndKalmanVtxFitter
- Creates different performance plots
  - Pull distribution plots for momentum, vertex and energy
  - χ^2 distribution and χ^2-probability distribution

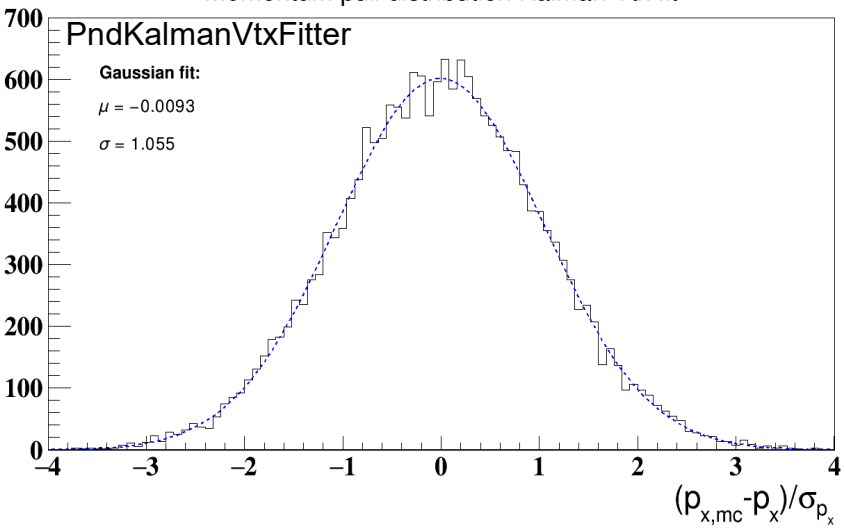
Performance of Poormantracks

Momentum pull distribution full kin

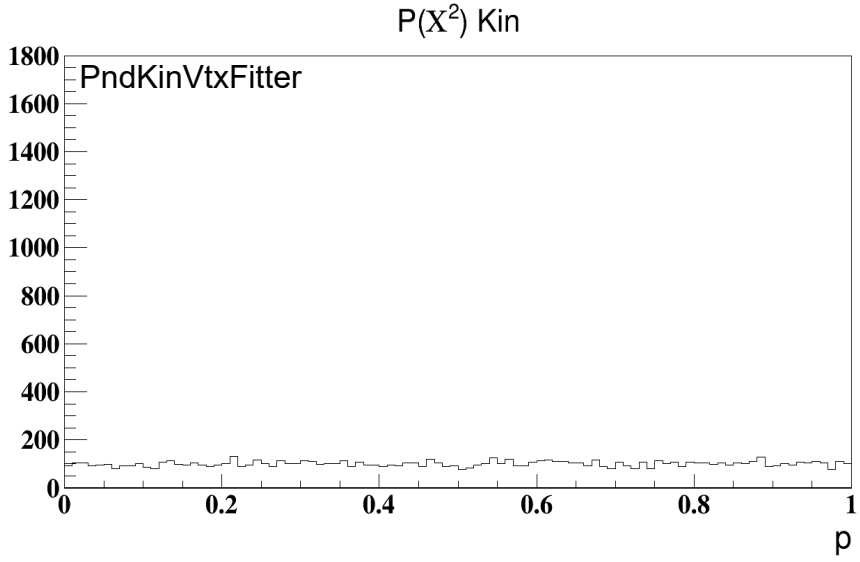


- For both fitter: Gaussian shape is matching good

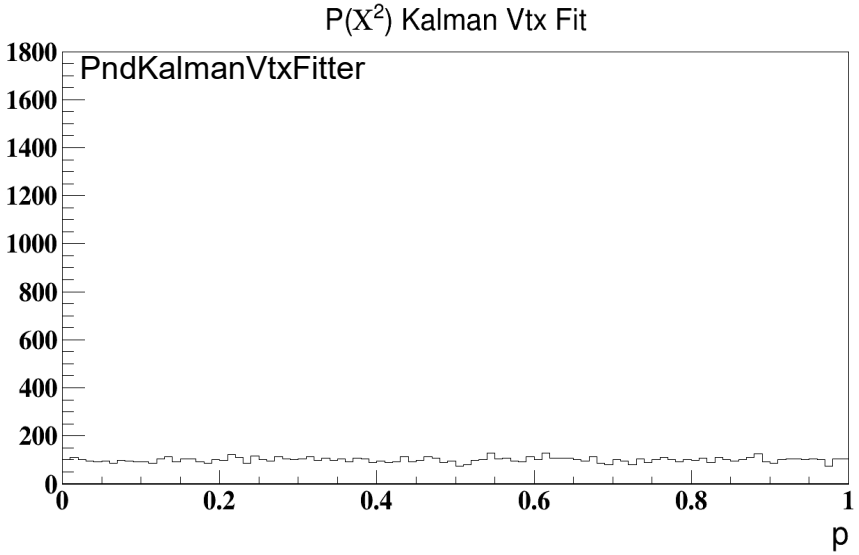
Momentum pull distribution Kalman Vtx fit



Performance of Poormantracks



- No Features with poormantracks
- Features seems to originate from covariance matrices in standard macros



Summary & Outlook

- Performance of fitters are good
- Still problems with probability distribution
- pure fitter code tested with poormantracks
  - Pull distributions are looking as expected
  - χ^2-probability is flat
- Further investigations are needed
- Test of bug fix for covariance matrices provided by Ralf Kliemt

Thank you for your attention!