Upcoming Study of $\bar{p}p \to \bar{\Lambda}\Lambda$ with Extended Target

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$\overline{\text{P}}$ANDA Collaboration Meeting
(GSI Darmstadt, Germany)

October 28, 2020

Outline

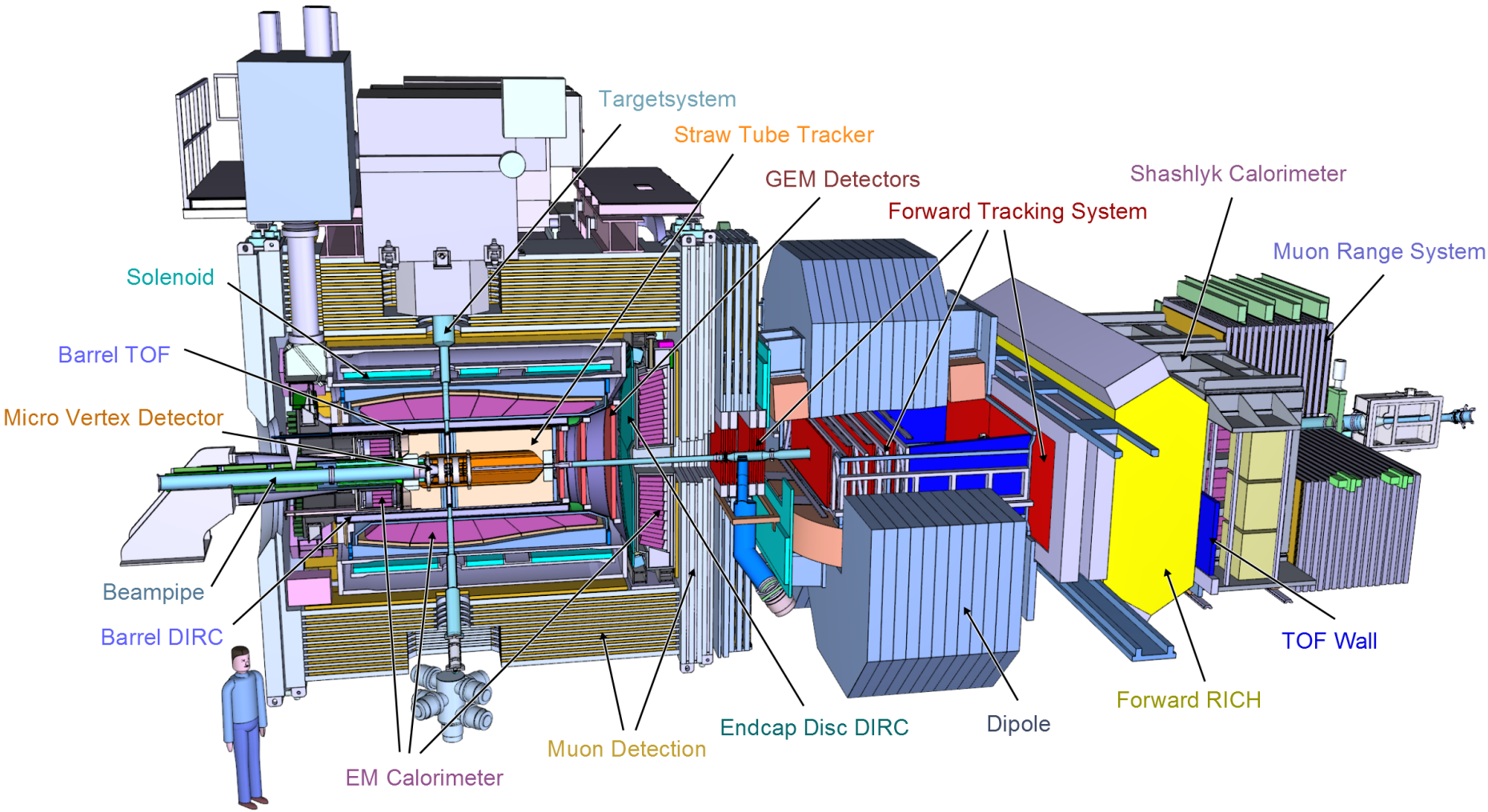
- Motivation
- Procedure
- $\Lambda\bar{\Lambda}$ analysis (Preliminary)
- Future Tasks

Motivation

- Presence of residual gas in the beam pipe
  - Effectively larger target
  - Vacuum simulations performed by Alfons Khoukaz (CM 20/1).
- $\bar{p}p \rightarrow \Lambda\bar{\Lambda}$ analysis as benchmark
  - Well studied channel
  - Displaced Vertices, similar situation of extended target
  - Expertise at Uppsala

- $\bar{p}p \rightarrow \Lambda\bar{\Lambda}$ analysis for extended target.

PANDA Experiment



Analysis Framework

The analysis is performed using PandaRoot. Following versions are used:

- PandaRoot v-Oct19
  - Rho Analysis Package
- FairRoot v-18.2.0
- FairSoft v-Jun19

Possibly, a comparison can be drawn with newer (this) and older versions (Walter).

Reference Study

Study $\bar{p}p \rightarrow \Lambda\bar{\Lambda}$ analysis with

- $10,000$ events at $1.642\,\mathrm{GeV/c}$
- EvtGen as simulator engine
- Ideal Reco and Ideal PID algorithms
- Pre-selection and final selection criteria based on Walter's doctoral thesis (for comparison)

Replicate $\bar{p}p \rightarrow \Lambda\bar{\Lambda}$ analysis for

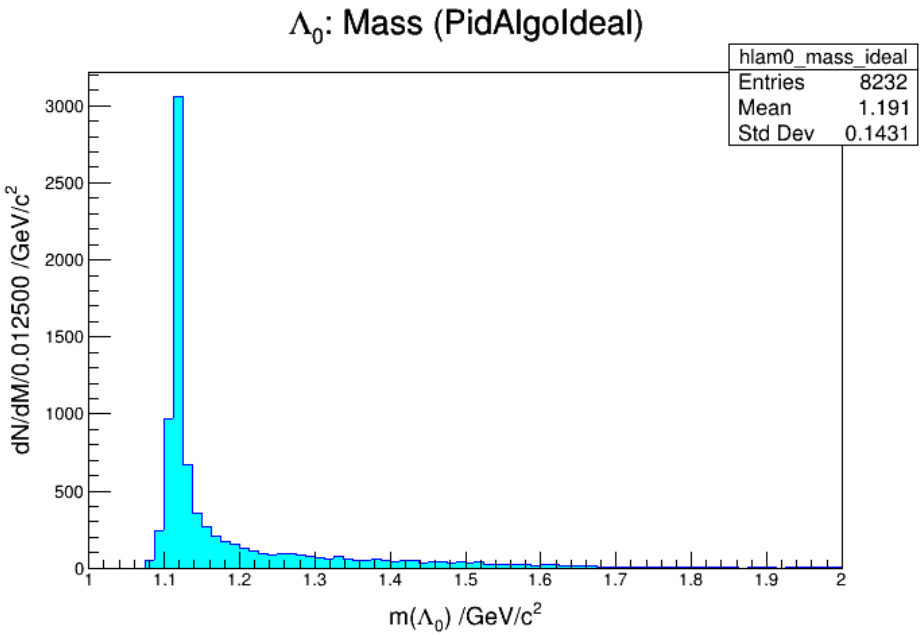
- Extended Target

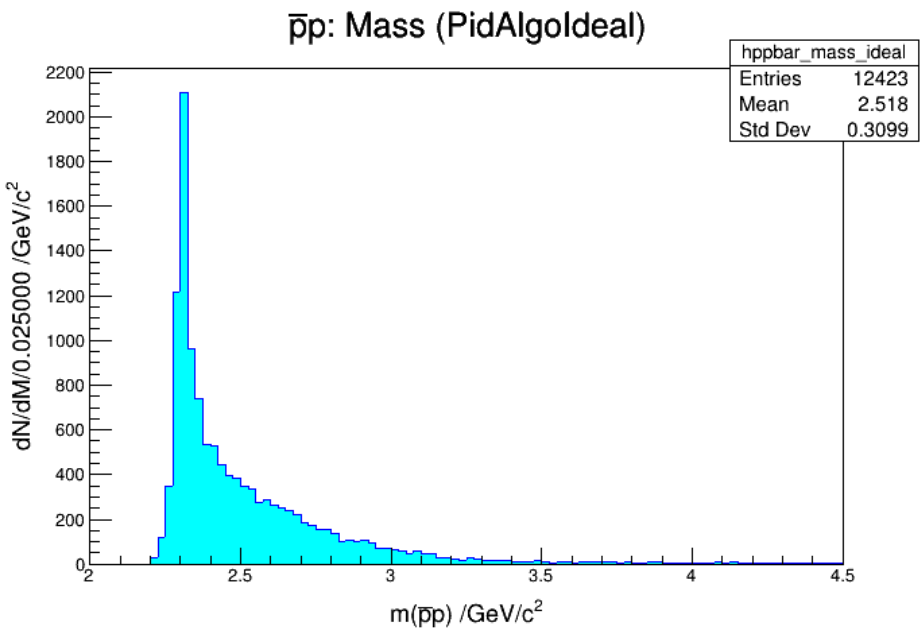
Pre-selection Criteria

The following pre-selection is used:

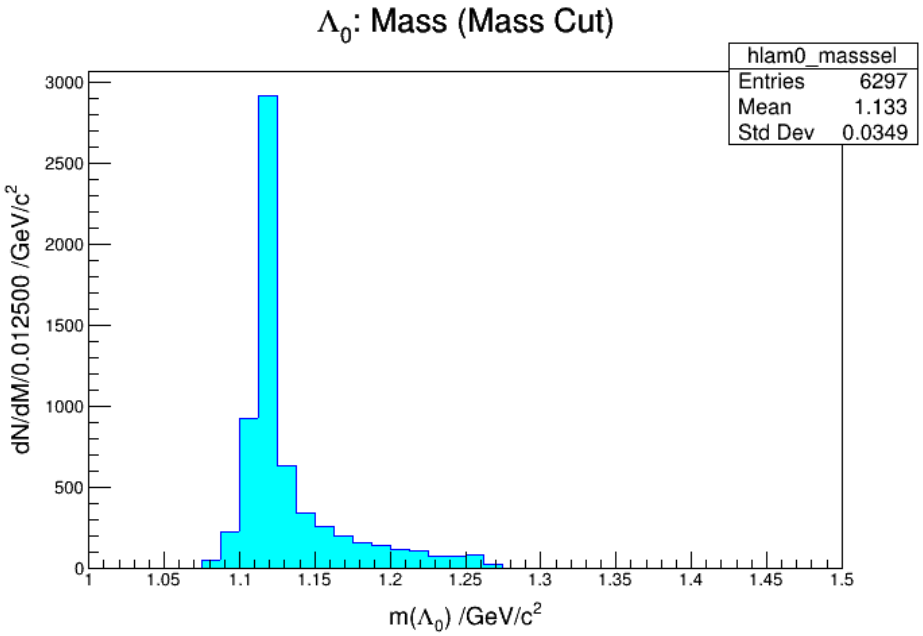
- Events with at least four charged tracks
- All possible combinations of $p\pi^-$ and $p\pi^+$ are considered.
- Invariant mass of $p\pi$ fulfills $|m(\Lambda) - m(p\pi)| < 0.3$ GeV$/c^2$.
- Vertex fit on all $\Lambda, \bar{\Lambda}$ candidates. Reject those (skipped) w/ $P(\mathrm{VF}) < 0.01$.
- For multiple $\Lambda/\bar{\Lambda}$ candidates, keep those w/ smallest χ^2.
- $\Lambda, \bar{\Lambda}$ candidates are combined to reconstruct the $p\bar{p}$ system.
- A successful 4C-fit is required to reconstruct $\bar{p}p$.

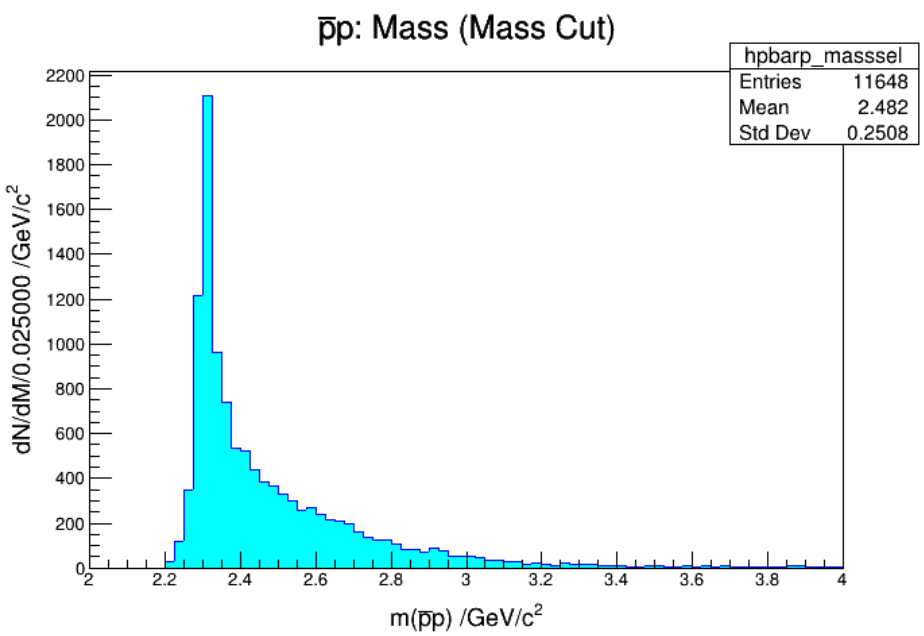
Event Reconstruction: Ideal





Event Reconstruction: Mass Cut



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RhoMassParticleSelector("lambda0", fMass0_lam, 0.3);
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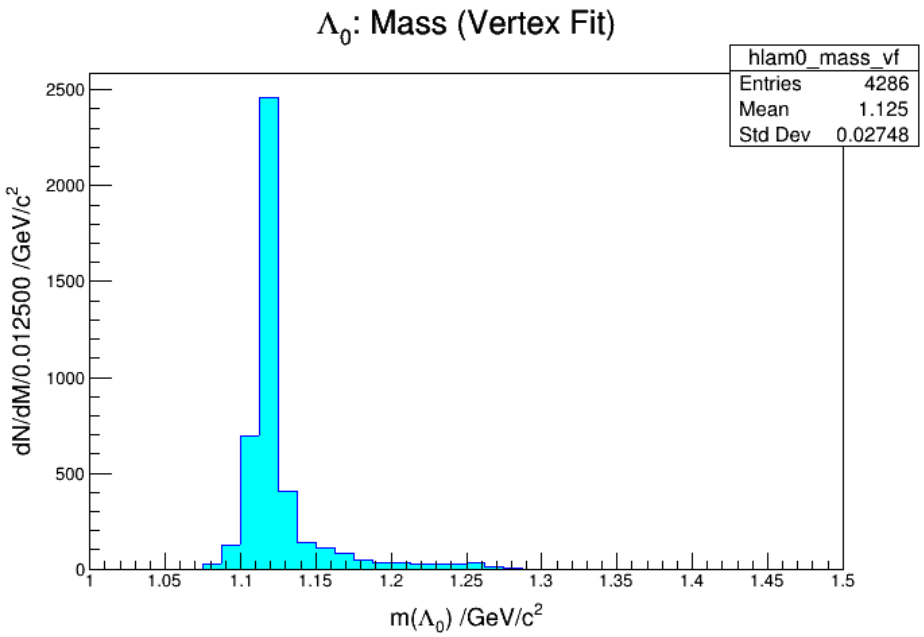
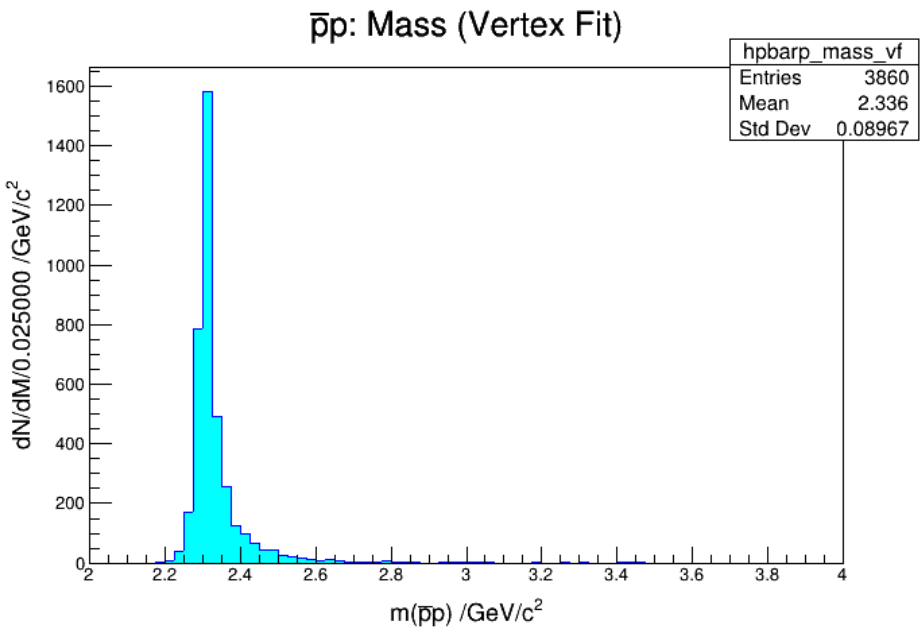
Reduction Factor: 1.3

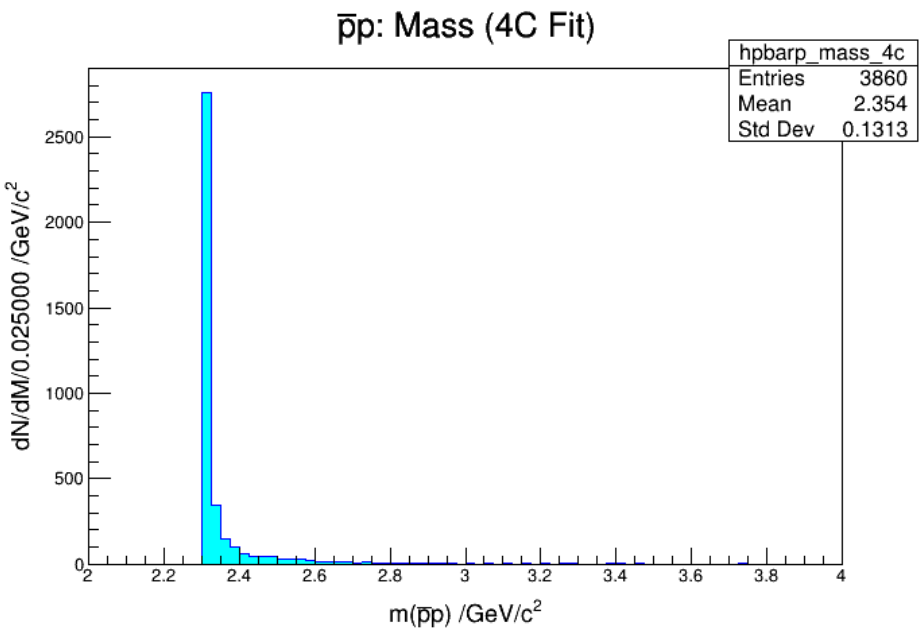
Event Reconstruction: Vertex Fit

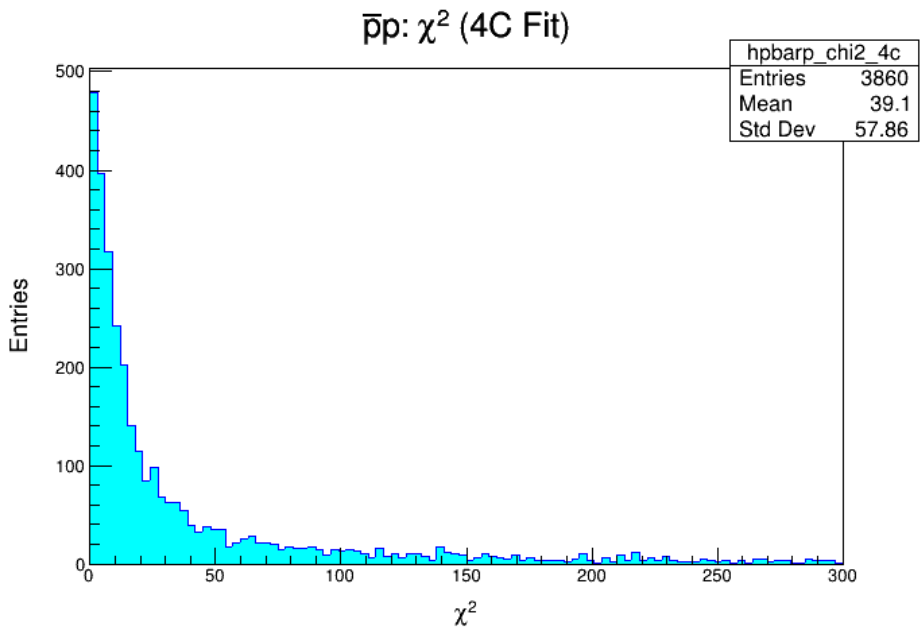




NOTE: Fitted $\Lambda, \bar{\Lambda}$ candidates with minimum χ^2.

Event Reconstruction: 4C Fit





Pre-selection Efficiency

The reconstruction efficiency (ϵ), using the pre-selection criteria, for Λ's and $\bar{p}p$ are:

$$\epsilon(\Lambda) = 42.9\%$$
$$\epsilon(\bar{\Lambda}) = 42.9\%$$
$$\epsilon(\bar{p}p) = 38.6\%$$

Efficiencies of Λ and $\bar{\Lambda}$ are same due to constraint on keeping one candidate per event.

Future Tasks

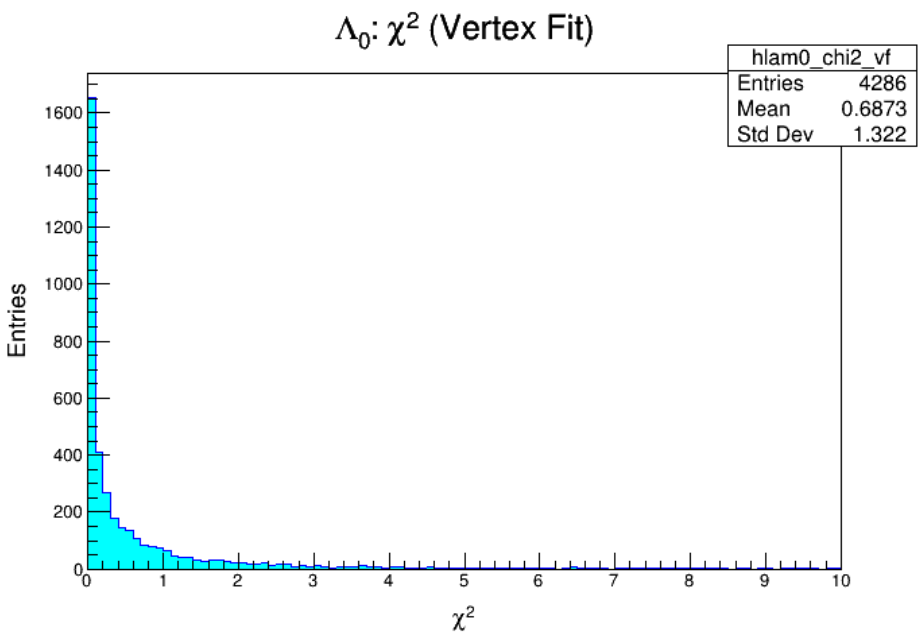
- Increase the statistics
- Apply final selection criteria
- Apply acceptance correction
- Determine reconstruction efficiency and other observables

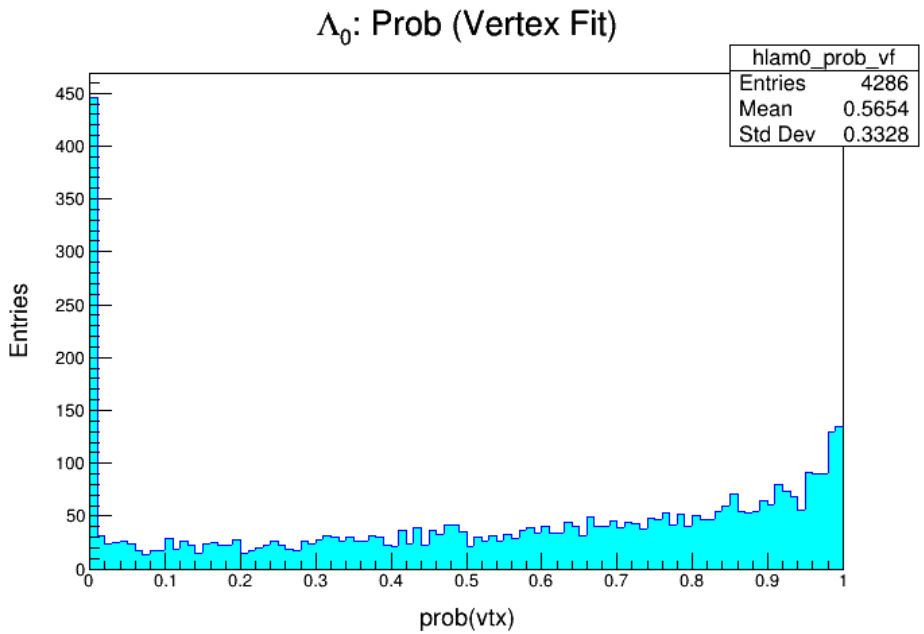
- Finally, $\bar{p}p \rightarrow \Lambda\bar{\Lambda}$ analysis for extended target (stay tuned).

Questions?

Backup Slides

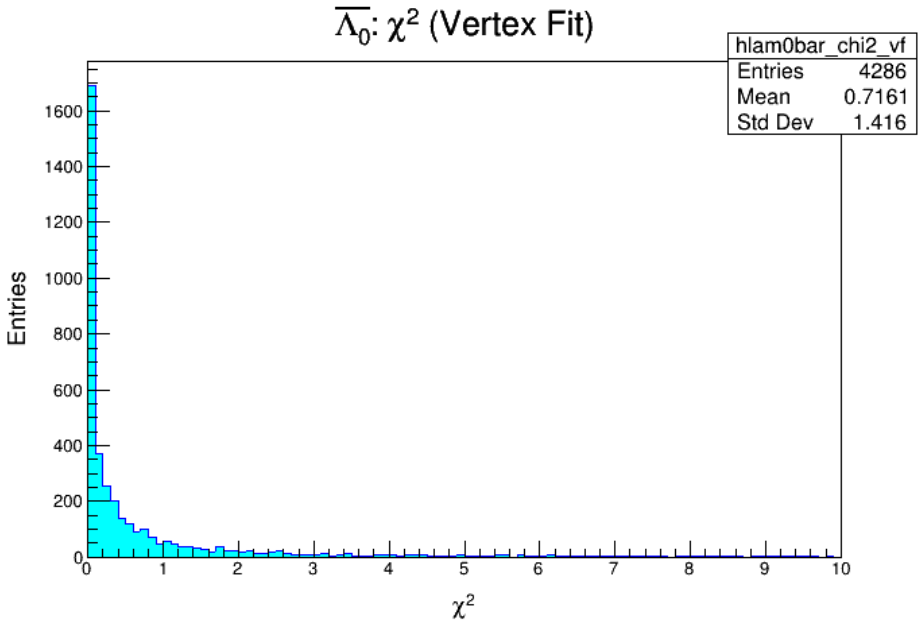
Event Reconstruction: Λ_0

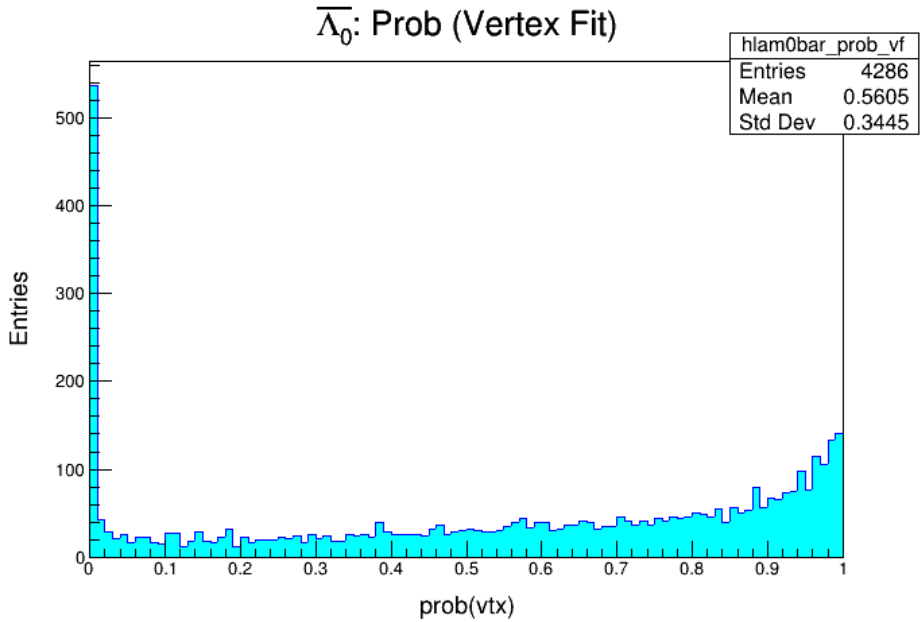




NOTE: Fitted $\Lambda, \bar{\Lambda}$ candidates with minimum χ^2.

Event Reconstruction: $\bar{\Lambda}_0$





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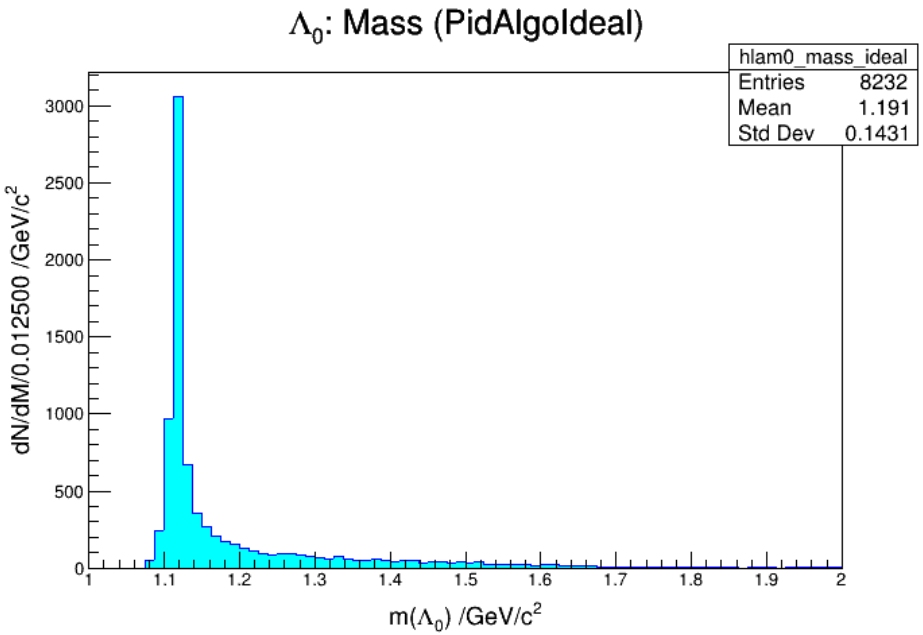
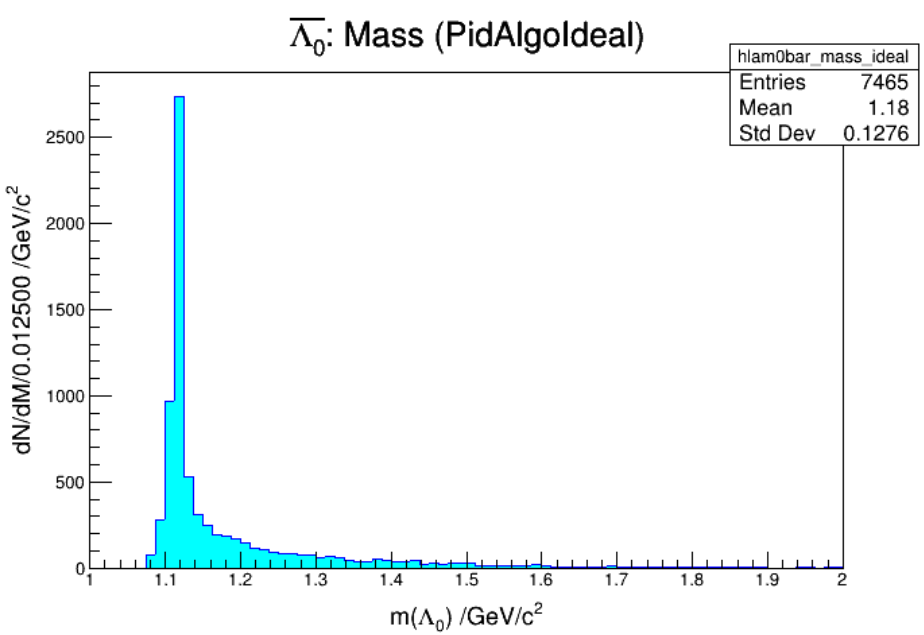
Event Reconstruction: Ideal





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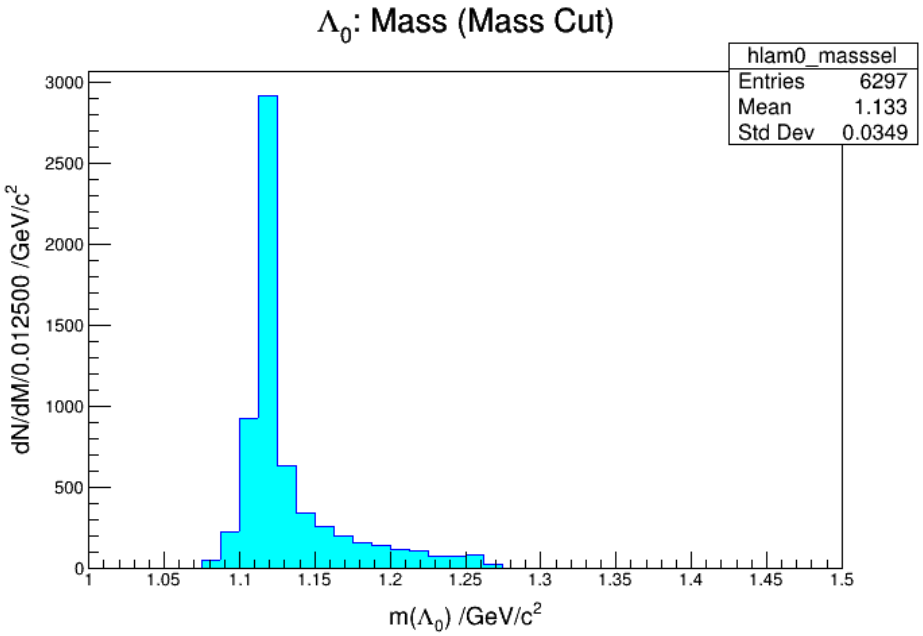

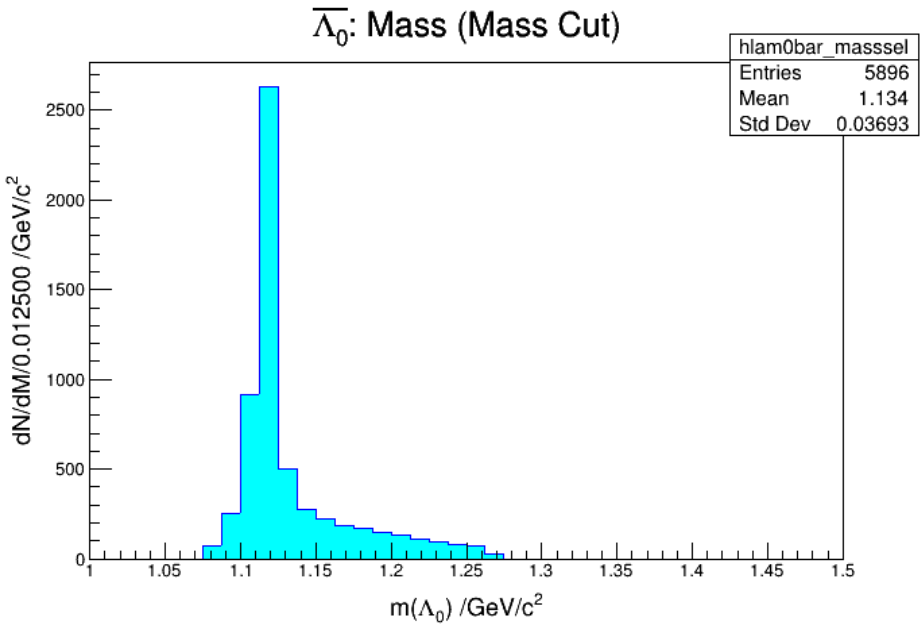


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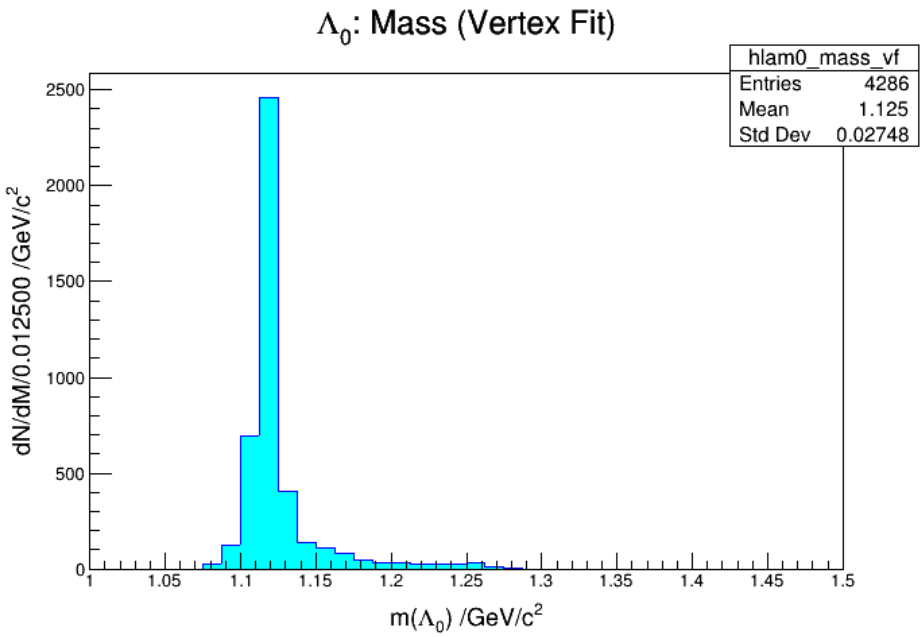

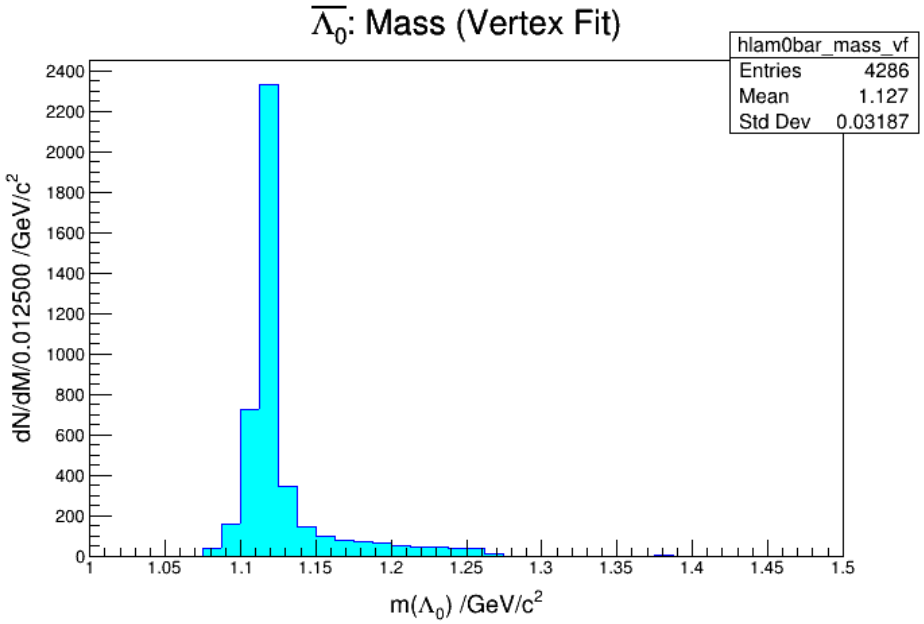

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