Study of the Hyperon reconstruction in the SPD/NICA

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Abstract

During the first stage, SPD experiment will collect and analyze data from colliding polarized and unpolarized beams of protons and deuterons up to $\sqrt{s_{NN}}$ = 10 GeV. Polarization of the Λ-hyperons produced in such events is a subject of much interest, as it can provide insight into the polarization transfer in such collisions. However, some of Λ-hyperons will be produced via decays of heavier hyperons diluting the polarization effects. This poster presents estimations of such feed-down productions among the Λ yields.

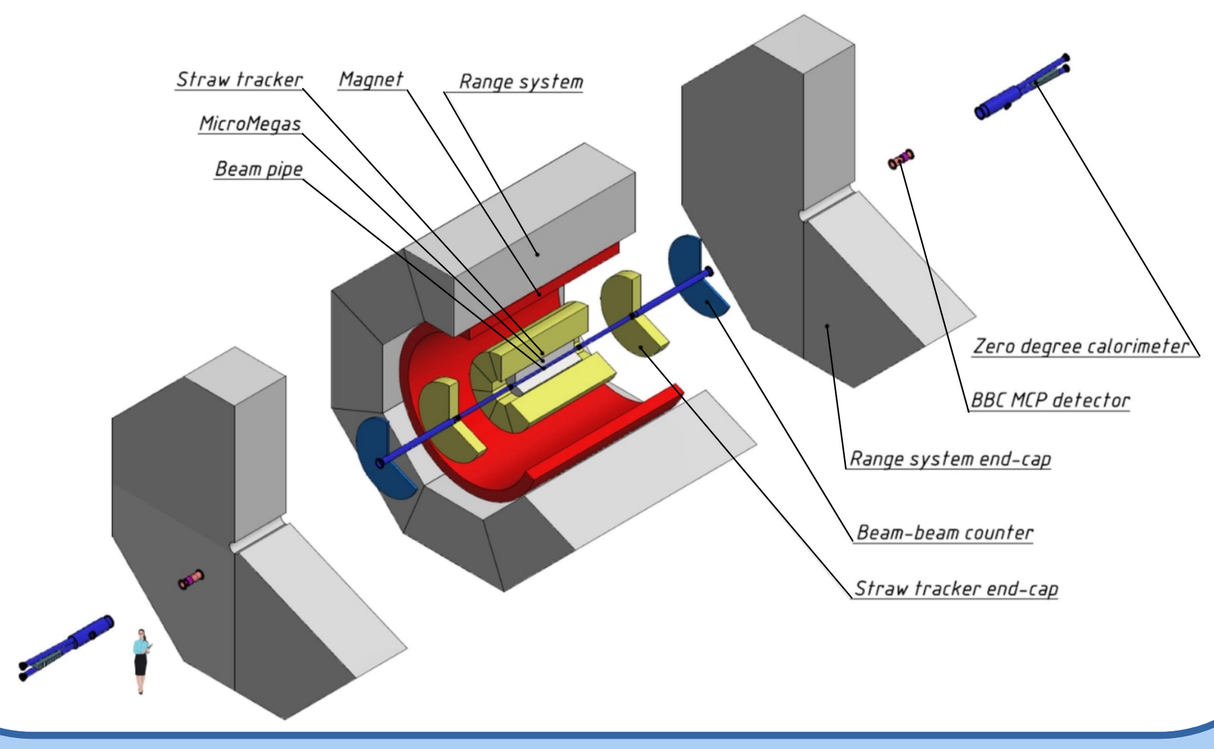
Motivation

- Reconstruction efficiency of Λ-hyperon provide understanding of detector performance.
- Information about indirect Λ-hyperon is important correction for measurments of Λ polarization parameters
- Provide first estimations on yields and reconstruction efficiency of $\Sigma^{*+}(1385)$, $\Sigma^{*-}(1385)$, $\Xi^{-}(1321)$.

Monte Carlo simulation

Monte Carlo simulation was done with SPDRoot software. For this analysis, 40 million events of pp collisions with center of mass energy $\sqrt{s}$ =10 GeV was generated by Pyhia8. Interaction of particles with detectors and material was handled by GEANT4. Track reconstruction was performed by GenFit toolkit.

Spin Physics Detector / 1-st stage

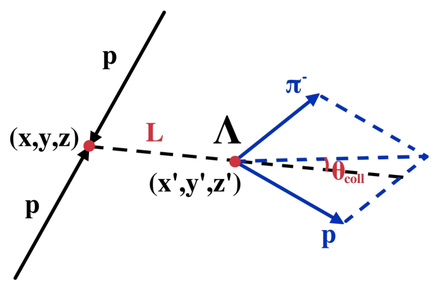


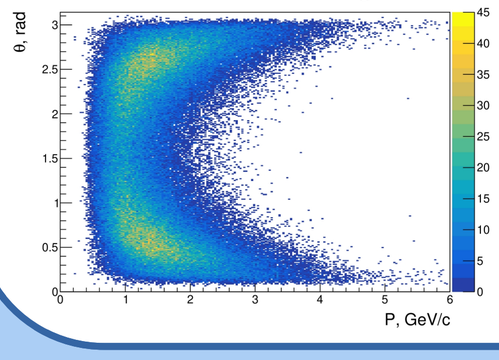
Λ candidates

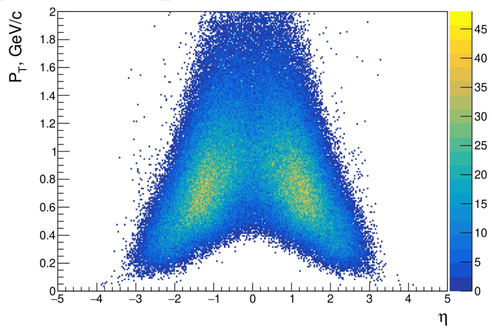
A pair of (π^- , p), representing the Λ-hyperon, and pairs of various combinations of $\pi^{\pm}$, $K^{\pm}$, p and $\bar{p}$ representing the combinatorial background, were selected from the data sample. Such pairs formed candidate Λ hyperons using the KFparticle package

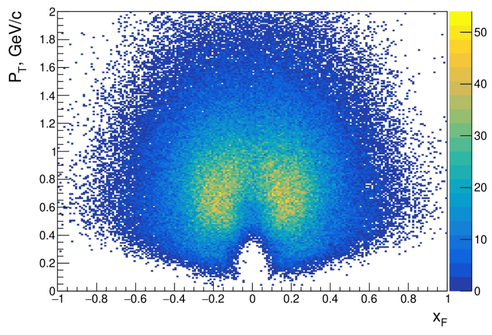
Main kinematic selection criteria:

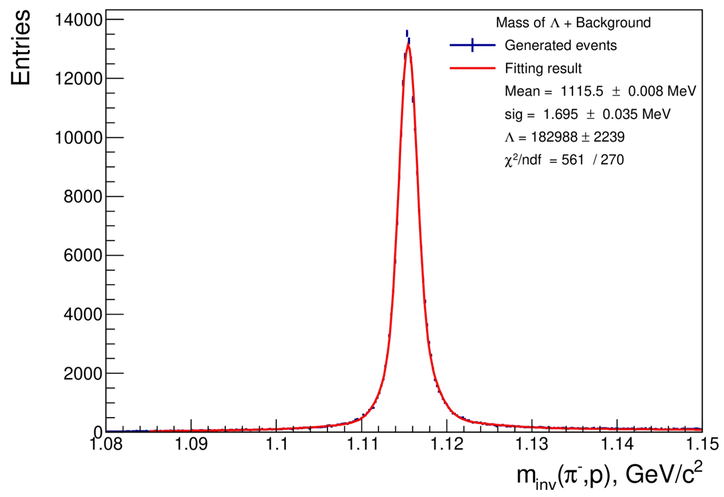
- Decay length
- Collinearity angle
- Veto on tracks with good extrapolation to primary vertex







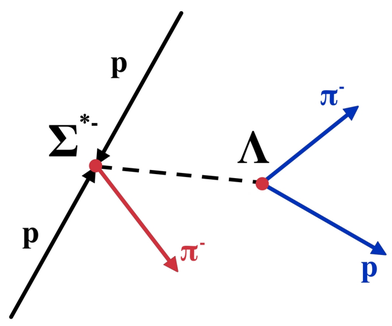


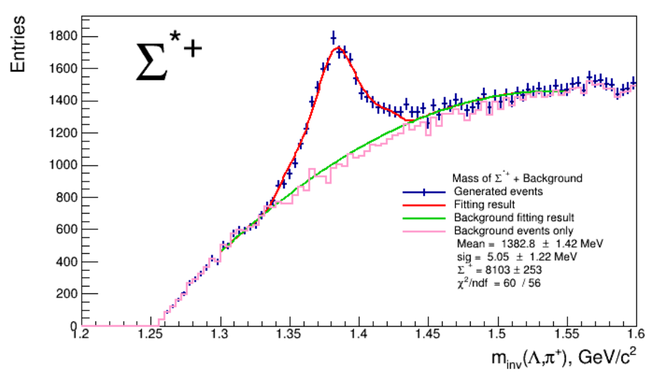


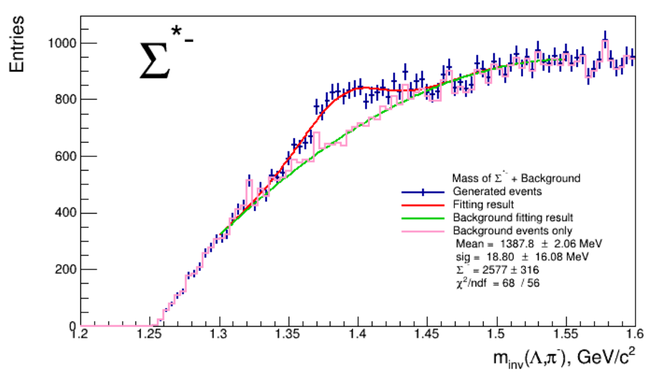
N(Λ)	N_{gen}	N_{rec}	Rec eff
Λ	2350000	183000±2200	7.8%
$\bar{\Lambda}$	140000	12600±300	9.1%

Reconstruction of cascades

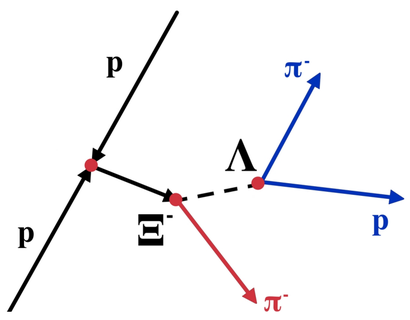
Reconstructed Λ with invariant mass in ±3σ interval from mean value was combined with π^- or π^+ to form Σ^{*-}, Ξ^- or Σ^{*+} candidates respectively. Σ^* decays by the strong channel and Ξ^- decays by the weak channel, so different selection methods must be used. Same reconstruction algorithm was applied to evaluate amount of indirect Λ. However yield of antiparticles was too small for further analysis.

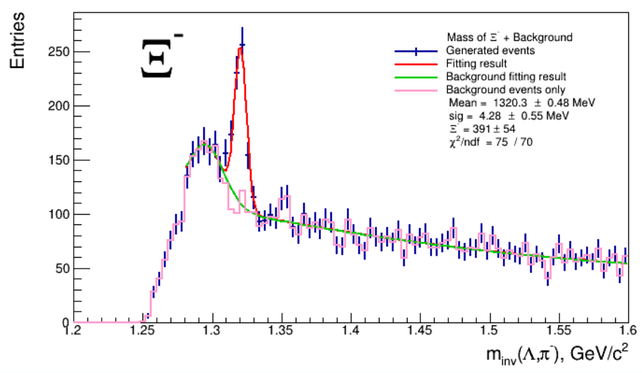






	N_{rec}	Feed-down
Σ^{*+}	8100±250	4.4%
Σ^{*-}	2600±300	1,4%
Ξ^-	400±50	0.2%





- Λ and $\bar{\Lambda}$ – hyperon reconstruction was done for 1-st stage of SPD. Selection criteria was determined with dependency on particle momentum. Reconstruction efficiency was calculated.
- Cascade reconstruction algorithm was done. Selection criteria was optimized and yields estimations was done.
- Estimations on indirect Λ production was calculated.