Reconstruction of Ξ^- hyperon

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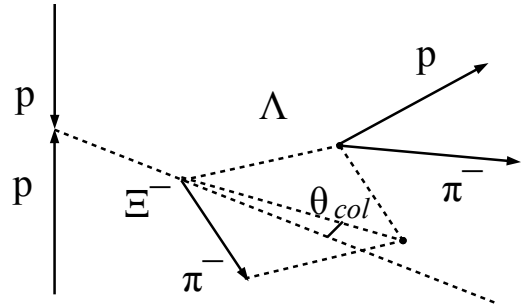
Introduction

Λ-hyperons can be produced either directly from hadron collisions or from the decay of heavier hyperons. Reconstruction of cascades is important task that can reduce amount of indirectly produced Λ-hyperons in further analysis.

Λ-hyperons can be produced by several other hyperons, such as Σ^0 (Λ, γ), Σ^* (1385) (Λ, π), Ξ (Λ, π), Ω^- (Λ, K^-). Today's talk is dedicated to the reconstruction of Ξ^-.

Ξ^- hyperon have quark composition of dss, average decay length of 4.91 cm and main decay mode of (Λ, π^-) with probability ~99%



Ξ^-	Mass	cτ	Decay mode	Fraction
	1321.71 MeV	4.91 cm	Λ π^-	~99,9%

Event generation and forming of cascade candidate

Sample

- SPDRoot version from Jul 26 2023
- Generation: Pythia 8 , (p+p) at $\sqrt{s}$ = 27 GeV, minbias setting
- 4 000 000 events
- General quality of track criteria was applied.

Forming of cascade candidate

1 step: Λ (anti-Λ) candidate was built by KFparticle from a pair of diferently charged particles.

2 step: Λ candidates with mass in $\pm 2\sigma$ of calculated mean were selected.

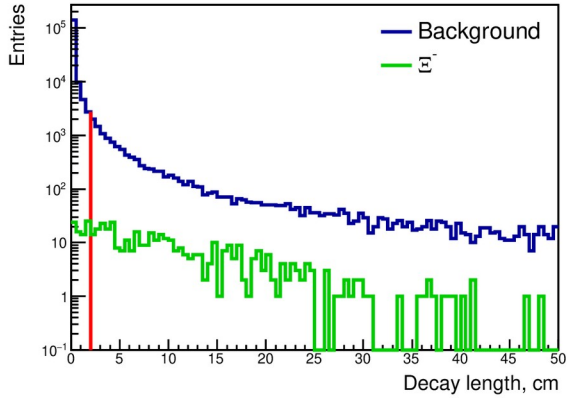
Other criteria for Λ candidate was applied to reduce background events:

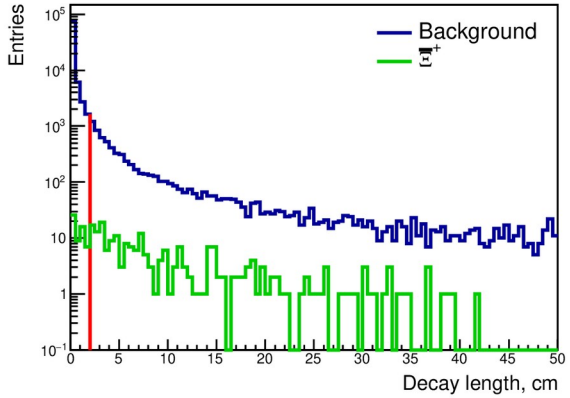
- $\chi^2_{\text{tr to PV}} > 8.7$
- Decay length > 0.76

3 step: Each Λ (anti-Λ) candidate was combined with track of π^- (π^+) and Ξ^- (anti-Ξ^+) candidate was constructed by Kfparticle for such combinations.

Decay length

Data

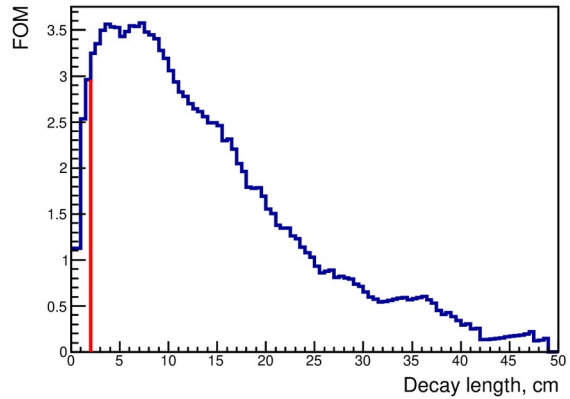


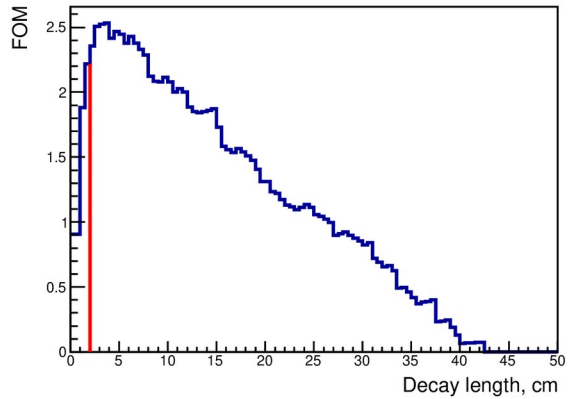


Cut on L>2 cm can clearly separate Ξ from Σ and supress significant ammount of background events.

Cut on L<50 cm can reduce background without significant loss of signal events

FOM



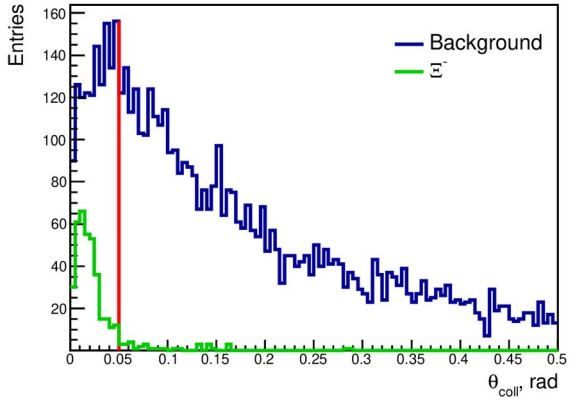


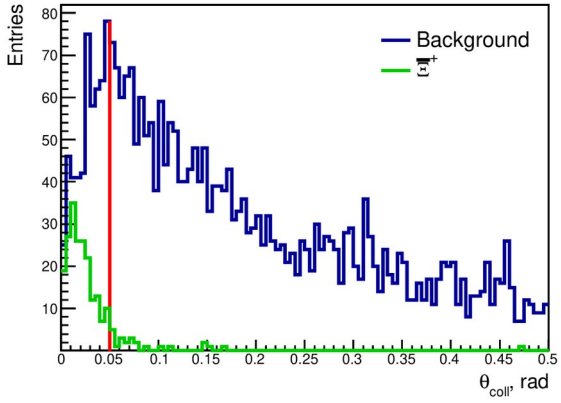
Main cut:

2 cm < L < 50 cm

Collinearity angle

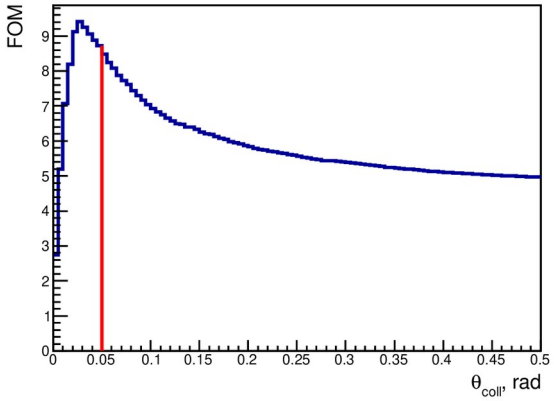
Data

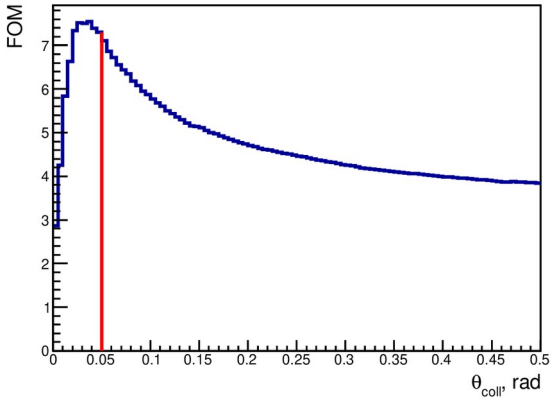




It is an angle between momentum of Ξ and direction vector.

FOM

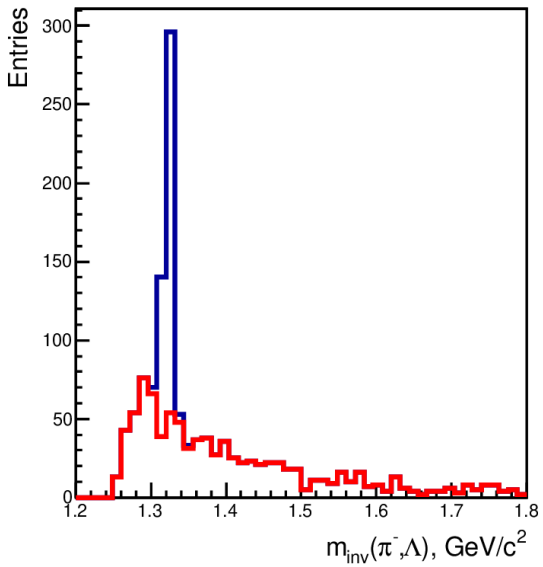




Main cut:

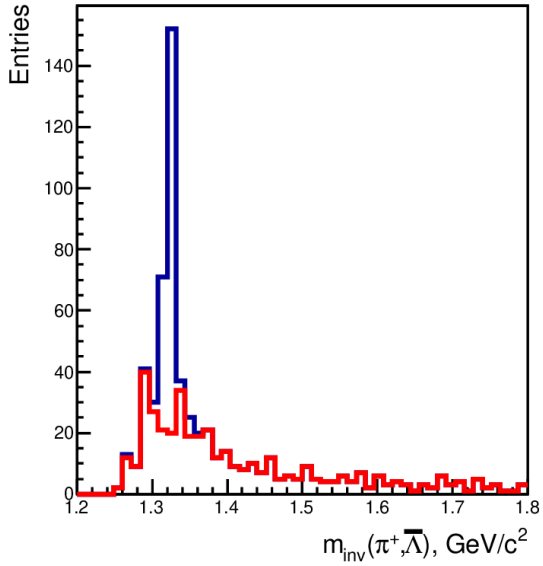
$\theta_{coll} < 0.05$ rad

Invariant masses of Ξ^- and anti-Ξ^+ candidates



	Background	Ξ^-
Before cuts	186240	480
After cuts	1290	354

~74% of Ξ^- can pass selection criteria



	Background	anti-Ξ^+
Before cuts	98700	285
After cuts	532	197

~69% of anti-Ξ^+ can pass selection criteria

Conclusions & To Do

- Search for cascade events was implemented and performed
- Main selection criteria for Ξ^- are determent and first consideration of there values are done
- Estimation of Ξ^--hyperons that could pass selection criteria is calculated

Next step:

- Search and analyze $\Sigma^{*+}(1385)$ and $\Sigma^{*-}(1385)$ hyperons
- Generate more events, up to 10 million or more
- Implement approximation of invariant mass data with function
- Get estimation on total number of Λ born from cascade events