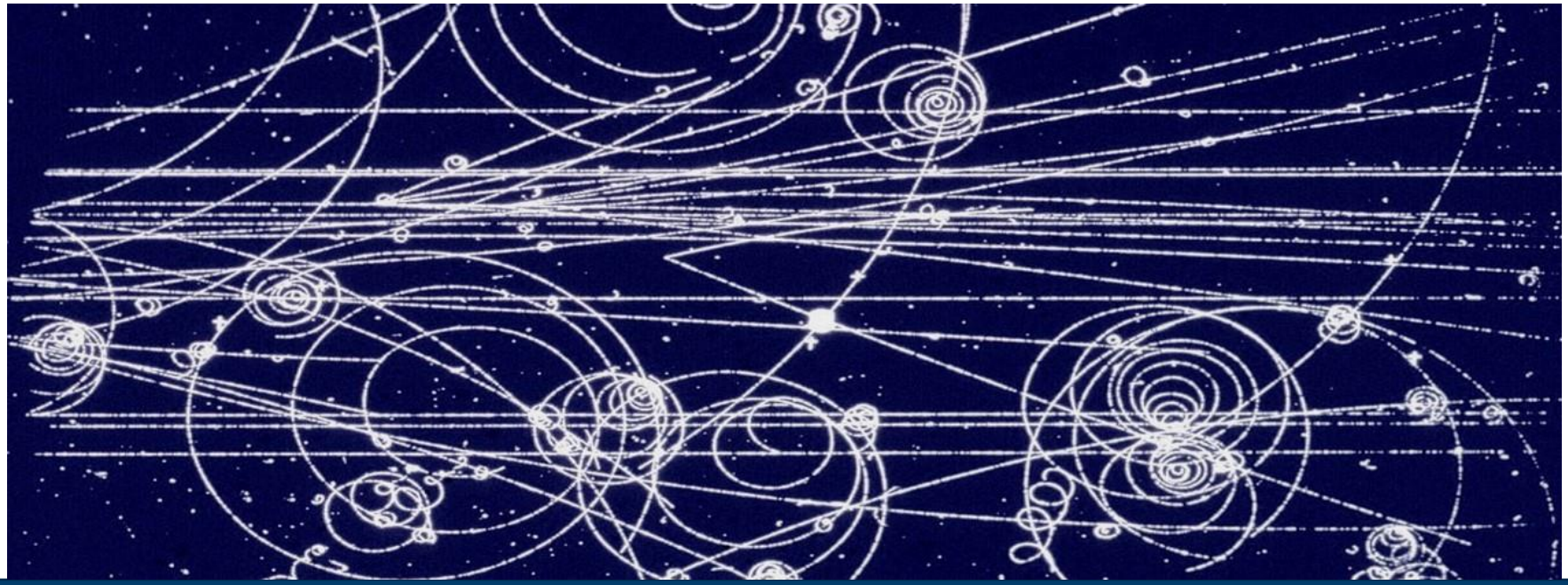

REPORT ON STUDY OF EXCITED Ξ BARYONS

07.04.2020 I PHYSICS ANALYSIS MEETING| JENNY PÜTZ

panda

JÜLICH Forschungszentrum

Overview

- Recent Studies
  - $\bar{p}p \rightarrow \bar{\Xi}^{+}\Lambda K^{-}$ with the DecayTreeFitter (RN-QCD-2020-001)
  - $\bar{p}p \rightarrow \bar{\Xi}^{+}\Xi^{-}\pi^{0}$ with step-by-step procedure (RN-QCD-2018-002)

- Planned paper including both studies -> Journal: Phys Rev C
- First draft presented here

Paper Draft

Study of Excited Ξ Baryons with the $\overline{\mathrm{P}}$ANDA Detector

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Introduction

- Physics motivation

PANDA

- General description of the PANDA detector
- Description of the Software frame with focus on track reconstruction

Content

Event Generation and Track Reconstruction & Filtering

Event Generation

- Signal events generated with EvtGen at $p_{\bar{p}} = 4.6\ \mathrm{GeV/c^2}$
- population of following resonant states
  - $\Xi(1530)^-,\ \bar{\Xi}(1530)^+$
  - $\Xi(1690)^-,\ \bar{\Xi}(1690)^+$
  - $\Xi(1820)^-,\ \bar{\Xi}(1820)^+$
- Decay channels: ΛK and $\Xi\pi^0$
- Beside resonant states also continuum contribution generated
- to avoid unwanted final states $BR(\Lambda \rightarrow\ \ p\pi) = 100\%$ instead of 63.4%

Content

Event Generation and Track Reconstruction & Filtering

Track Reconstruction & Filtering

- Ideal Pattern recognition is used
- Issue: tracks with low hit multiplicity are reconstructed
- Track filter: final state particles with at least 4 hits in MVD, STT or GEM considered as candidates

Content

Full Decay Tree Fit Procedure

- Gives overview on the method
- Which parameters are used?
- How is the decay tree fit parameterized?
- Used constraints
- Order in which the constraints are applied.

Content

Event Reconstruction

- $\bar{p}p \rightarrow \bar{\Xi}^{+}\Lambda K^{-}$ and c.c.
  - Reconstruction of the final state particles (open PID)
  - Only mass window cut on intermediate states
  - Full tree reconstruction with DecayTreeFitter (vertex + momentum resolution, reconstruction efficiency, mass and width of resonances)

- $\bar{p}p \rightarrow \bar{\Xi}^{+}\Xi^{-}\pi^{0}$
  - Final state reconstruction with ideal PID
  - Intermediate states selection based on sequential fit procedure (vertex fit and mass constraint fit)
  - Full tree reconstruction: 4C-fit, additional cut to reduce outliers

Content

Background Studies

- Generation of background sample with DPM
- Number of analyzed DPM events:
  - $\bar{p}p \rightarrow \bar{\Xi}^{+}\Lambda K^{-}$ + c.c. : 100 million
    - No surviving event
  - $\bar{p}p \rightarrow \bar{\Xi}^{+}\Xi^{-}\pi^{0}$: 22 million
    - 2 surviving events
    - Additional cuts on: proper time value of Λ and $\bar{\Lambda}$, and distance between Ξ and $\bar{\Xi}$
    - Removed the two surviving events

Content

Results

Reconstruction efficiency of the final selected samples

	$\bar{\Xi}^+ \Lambda K^-$	$\Xi^- \bar{\Lambda} K^-$	$\bar{\Xi}^+ \Xi^- \pi^0$
Reco. eff .[%]	5.4	5.5	3.5
Purity [%]	97.7	97.7	94.1

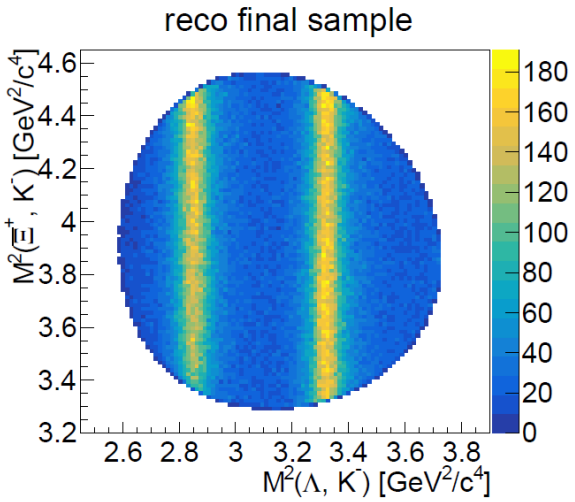
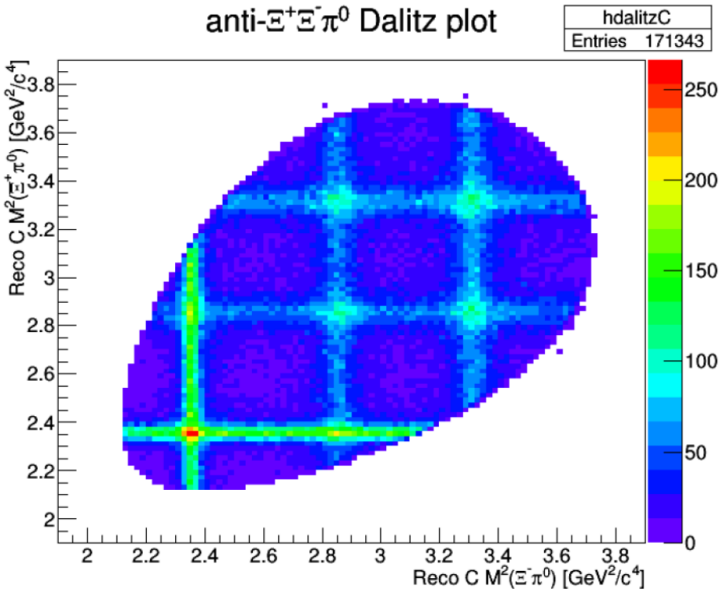
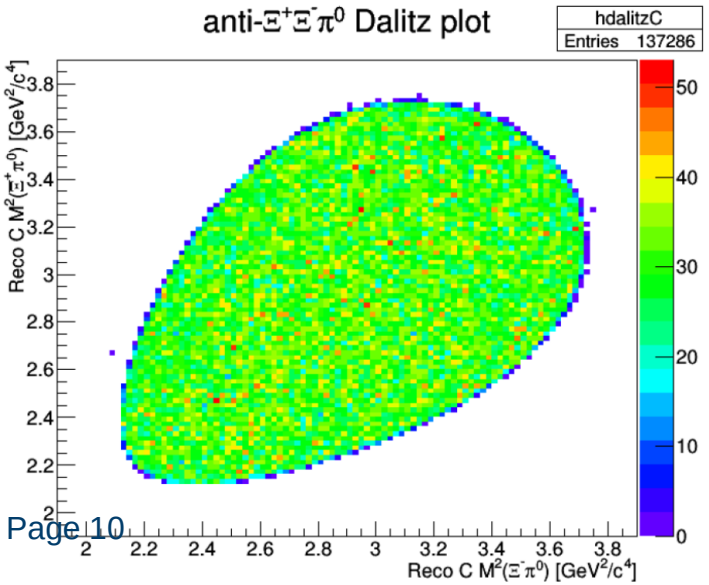


Figure 5: Dalitz plot for the final selected $\bar{\Xi}^+ \Lambda K^-$ candidates.





Content

Results

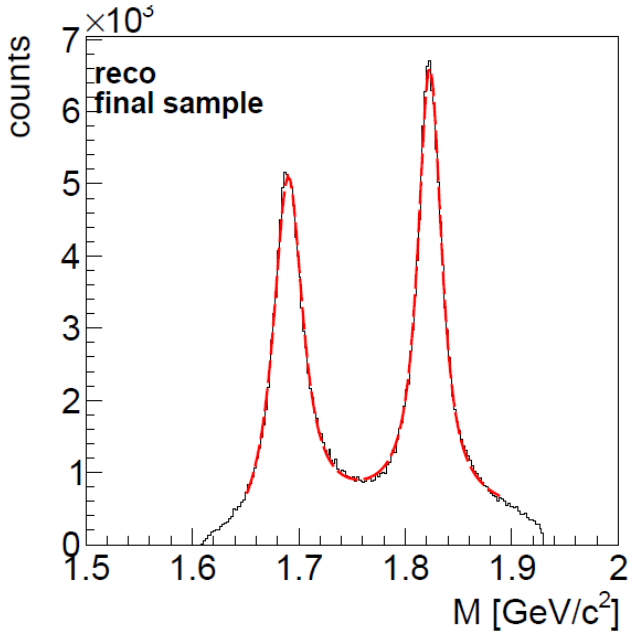


Figure 8: Mass distribution of Λ K^- with fit function containing two Voigt functions and a polynomial.

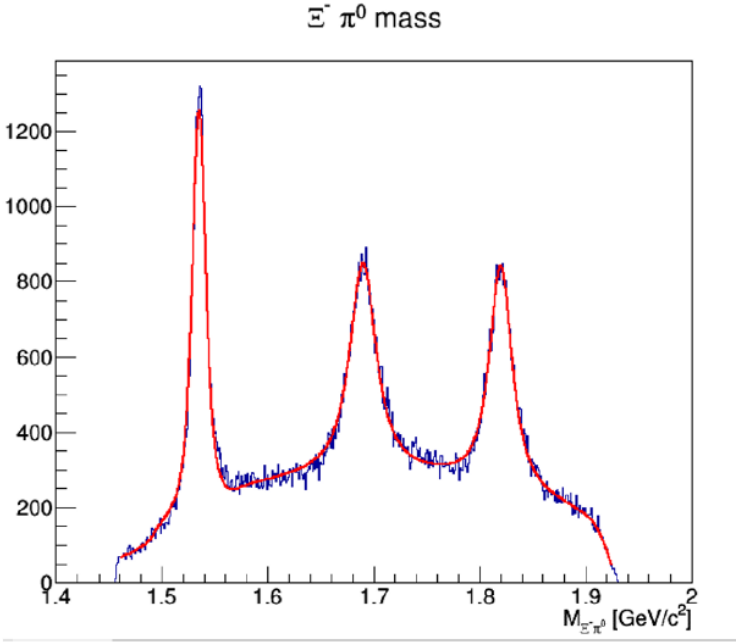


Figure 13: Mass distribution of the final selected Ξ^- π^0 sub-system. The used fit function to determine the mass and the width of the contributing resonances is shown in red.

Content

Results

	$\bar{\Xi}^+\Lambda K^-$	$\bar{\Xi}^+\Xi^-\pi^0$
$\Xi(1530)^-$	-	$1.5352\,\mathrm{GeV/c^2}$
$\bar{\Xi}(1530)^+$	-	$1.5351\,\mathrm{GeV/c^2}$
$\Xi(1690)^-$	$1.6899\,\mathrm{GeV/c^2}$	$1.6901\,\mathrm{GeV/c^2}$
$\bar{\Xi}(1690)^+$	$1.6902\,\mathrm{GeV/c^2}$	$1.6898\,\mathrm{GeV/c^2}$
$\Xi(1820)^-$	$1.8229\,\mathrm{GeV/c^2}$	$1.8202\,\mathrm{GeV/c^2}$
$\bar{\Xi}(1820)^+$	$1.8231\,\mathrm{GeV/c^2}$	$1.8201\,\mathrm{GeV/c^2}$

Table 12: Signal-to-background ratio and signal significance.

	$\bar{\Xi}^+\Lambda K^-$	$\Xi^-\bar{\Lambda}K^+$	$\bar{\Xi}^+\Xi^-\pi^0$
S/B	> 19.1	> 19.5	> 4.6
S_{sig}	> 513	> 507	> 349

Production Rates: ($L = 10^{31}\ \mathrm{cm^{-2}s^{-1}}$)

- $\bar{\Xi}^+\,\Lambda\,\mathrm{K}^-$ + c.c (σ_{sig}= 1 μb): 38,500 per day => 15 days
- $\bar{\Xi}^+\,\Xi^-\,\pi^0$ (σ_{sig} = 2 μb): 22,800 per day => 7 days

Current Status/Request

First draft

- Nearly ready for upload
- Few changes have to be made

Release Notes

- RN-QCD-2020-001 ready and no longer marked as “pending”
- RN-QCD-2018-002 still pending, last comment September 2018

Request

- Approve Release Notes
- Install committee

Thank you for your attention