

# Pattern Recognition and Detector Signatures of Hyperons

- Tracking Activities in Uppsala

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PANDA Collaboration Meeting

06/03-2018

GSI



# Outline

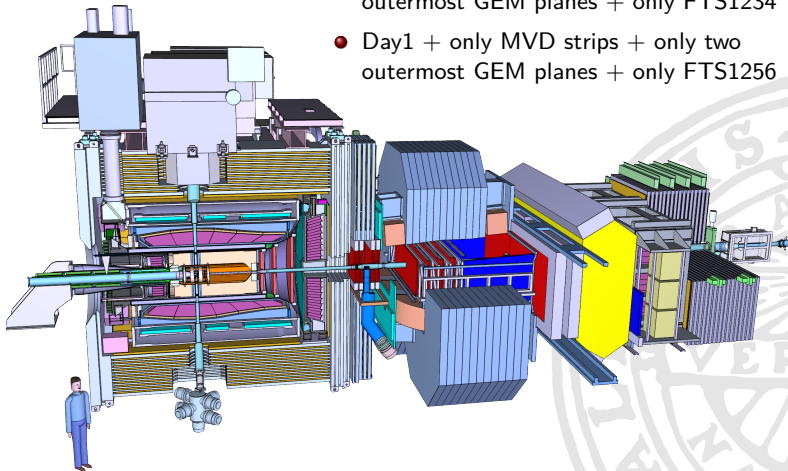
- DayOne 2017 simulations
  - $\bar{\Lambda}\Lambda$
  - $\Xi^+\Xi^-$
- $\Xi^+\Xi^-$ , decay vertex, momentum
- Test of SttCellTrackFinder



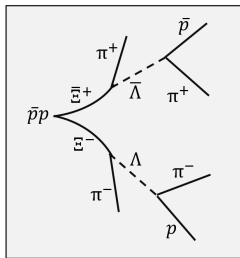
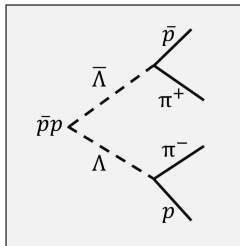
# Day1 2017 PANDA Setups

## 3 setups tested

- Full Setup
- Day1 + only MVD strips + only two outermost GEM planes + only FTS1234
- Day1 + only MVD strips + only two outermost GEM planes + only FTS1256



# DayOne 2017



$$\bar{p}p \rightarrow \bar{\Lambda}\Lambda \rightarrow \bar{p}\pi^+ p\pi^-$$

- 10,000 events
- 1.642 GeV
- Forward peaking distribution

$$\bar{p}p \rightarrow \bar{\Xi}^+\Xi^- \rightarrow \bar{\Lambda}\pi^+\Lambda\pi^- \rightarrow \bar{p}\pi^+\pi^+p\pi^-\pi^-$$

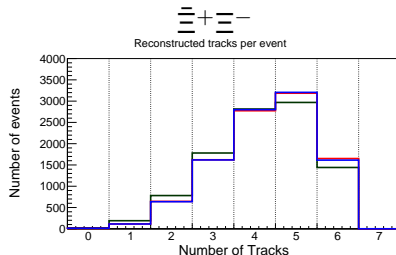
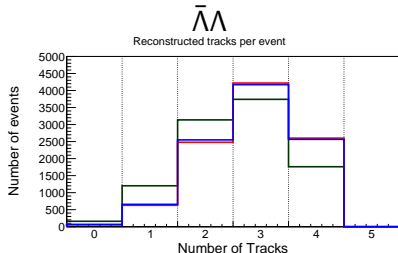
- 10,000 events
- 4.6 GeV
- Isotropic distribution

## Software:

- FairSoft mar17, FairRoot 17.03, PandaRoot trunk revision 30194
- IdealTrackFinder and StandardTrackFuncor ( $\geq 4$  MVD or  $\geq 6$  MVD+STT+GEM hits) and OnlyFtsFuncor ( $\geq 6$  FTS hits)
- Geant3

# DayOne 2017, Reconstructed final state tracks

Target spectrometer,  $\geq 4$  STT hits

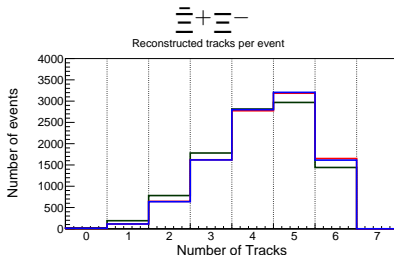
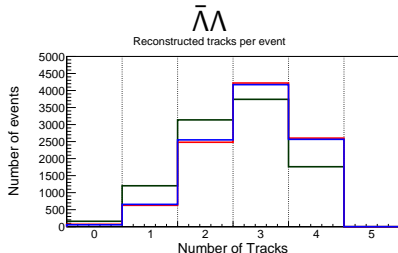


- Green Line: Full Setup
- Red Line: Reduced setup with FTS1234
- Blue Line: Reduced setup with FTS1256

- ⇒ More tracks reconstructed for reduced setup
- Less material between STT and IP for reduced setup
  - Bad quality tracks can have been reconstructed for reduced setup

# DayOne 2017, Reconstructed final state tracks

Target spectrometer,  $\geq 4$  STT hits



- Green Line: Full Setup
- Red Line: Reduced setup with FTS1234
- Blue Line: Reduced setup with FTS1256

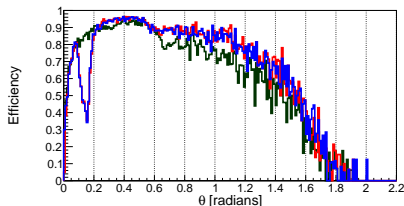
⇒ Difference larger for  $\bar{\Lambda}\Lambda$  case than  $\Xi^- + \Xi^+$  case  
– Could be effect of decay topology

⇒ No significant difference between the two reduced setups

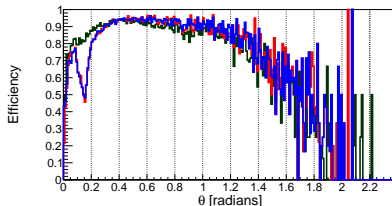
# DayOne 2017, Efficiency

Target and forward spectrometer

$\bar{\Lambda}\Lambda$



$\Xi^- + \Xi^-$

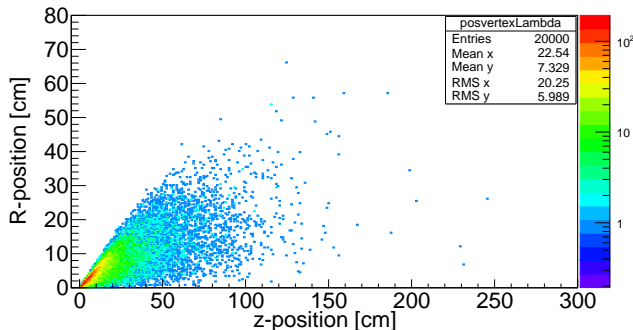


- Green Line: Full Setup
- Red Line: Reduced setup with FTS1234
- Blue Line: Reduced setup with FTS1256

- ⇒ Significant drop in efficiency at  $\sim 10^\circ$  for reduced setups
- Transition region between target spectrometer and forward spectrometer
- ⇒ Drop larger for  $\bar{\Lambda}\Lambda$  case than  $\Xi^- + \Xi^-$  case
- Could be effect of decay topology

# Decay Vertex

MC decay vertex of  $\Lambda$  and  $\bar{\Lambda}$  in  $\Xi^-$  and  $\Xi^+$  decay chain

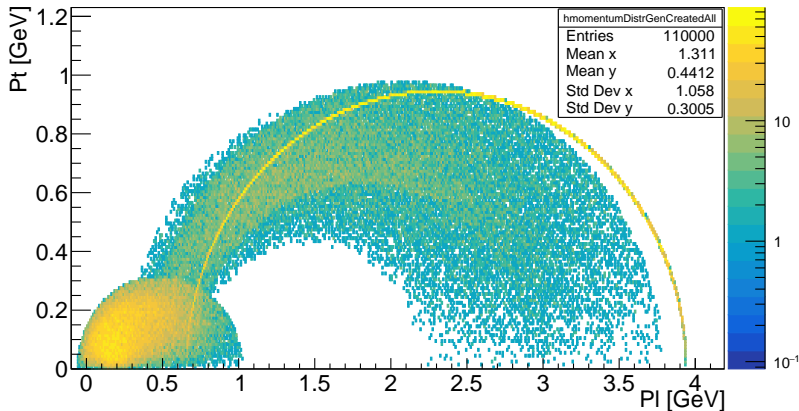


- First FT station  $295.4 \text{ cm} < z < 310.4 \text{ cm}$
- All final state particles are created before first FT station



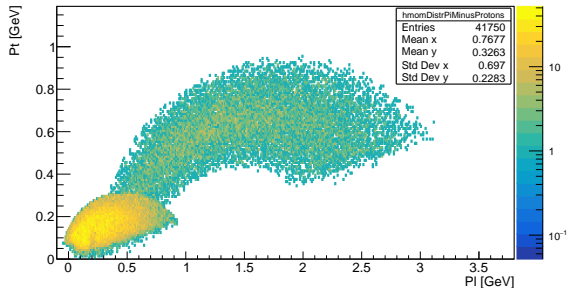
# Momentum distribution

MC Momentum distribution of all particles in decay chain



# Momentum distribution

Momentum distribution, Ideal track finder, standard track functor

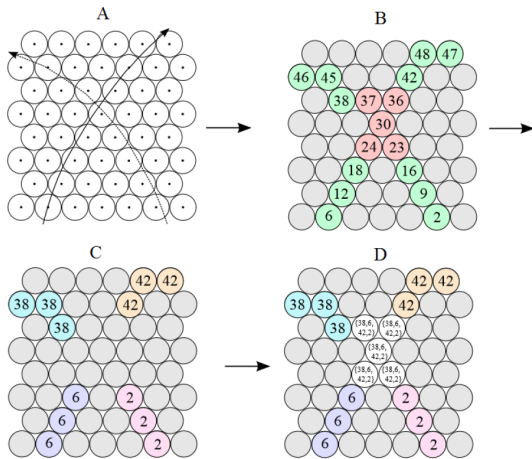
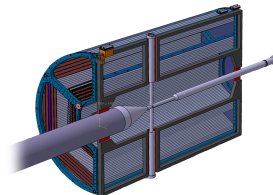


- Clearly separated regions of  $\pi^-/\pi^+$  and  $p/\bar{p}$
- Regions blend together
- Particles not going so much in forward direction reconstructed in target spectrometer
- Many forward going particles reconstructed in forward spectrometer

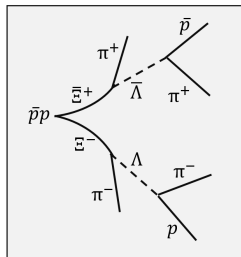
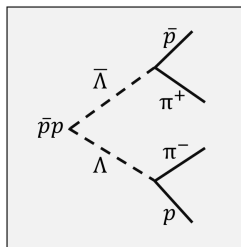
# SttCellTrackFinder

J. Schumann

- Cellular Automaton
- Riemann Fit



# SttCellTrackFinder



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- 10,000 events
- 1.642 GeV
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## Software:

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- Geant4

# TrackingQA

Evaluate performance of track finder

- **Fully found:** track is reconstructed using all hits belonging to the MC track
- **Partly found:** track is reconstructed using some (but not all) hits belonging to MC track but all hits are from one MC track
- **Spurious:** 70% of all true hits are used for reconstruction
- **(Clones:** more than one track reconstructed from one MC track)
- **Ghosts:** reconstructed track not matching a MC track



## Taking into account only STT hits

- All possible tracks with hits: 31,606
- Primary tracks possible: 24,781
  - Not Found: 684
- Secondary tracks possible: 6,825
  - Not Found: 1,205
- Fully found: 8,741 (27.7%)
- Partly found: 21,332 (67.5%)
- Spurious: 1,058 (3.3%)
- Ghosts: 2,480 (7.8%)





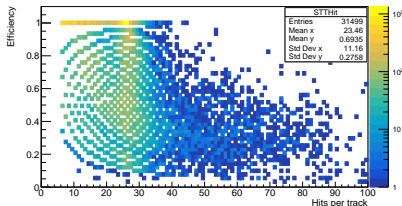
## Taking into account only STT hits

- All possible tracks with hits: 50,708
- Primary tracks possible: 42,742
  - Not Found: 3,104
- Secondary tracks possible: 7,966
  - Not Found: 2,196
- Fully found: 7,095 (14.0%)
- Partly found: 36,194 (71.4%)
- Spurious: 3,783 (7.5%)
- Ghosts: 11,970 (23.6%)

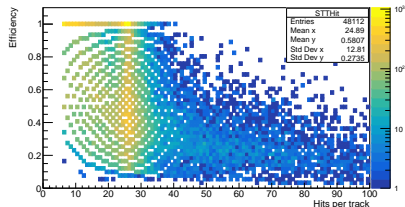


# Efficiency

$\bar{\Lambda}\Lambda$



$\Xi^- + \Xi^0$

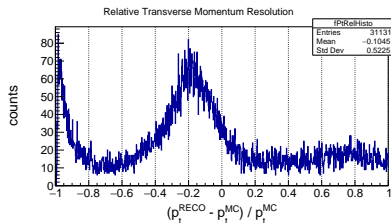
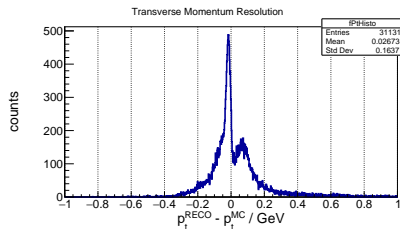


- Better efficiency for smaller number of hits per track
- Best efficiency around 27 hits per track
- No big difference in efficiency for the different decay chains



# Transverse momentum resolution

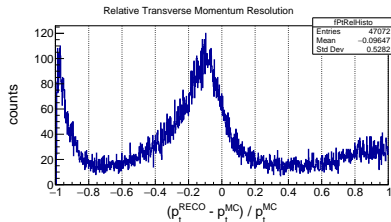
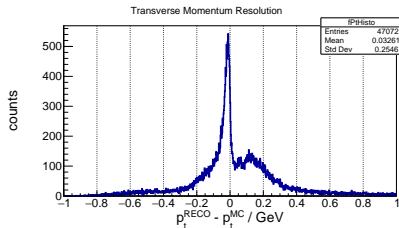
$\bar{\Lambda}\bar{\Lambda}$



- Not symmetric around 0
- Slightly higher momentum for reconstructed tracks

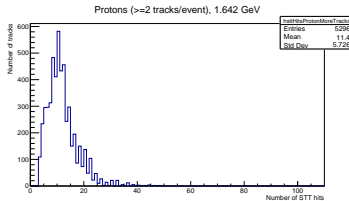
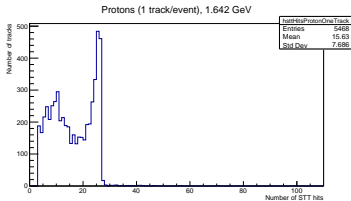
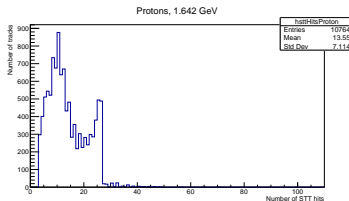
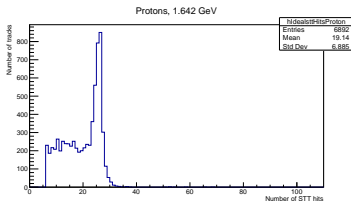
# Transverse momentum resolution

$\Xi^+ + \Xi^-$



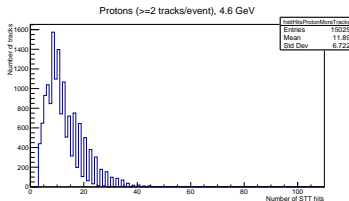
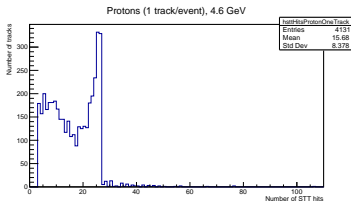
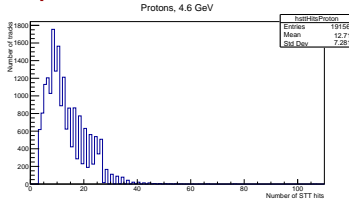
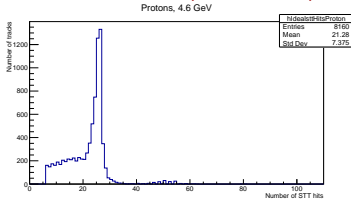
- Not symmetric around 0
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# CellTrackFinder, $\bar{\Lambda}\Lambda$ , final state protons



- Sharp cutoff after 27 hits for SttCellTrackFinder
- Pattern dominated by tracks from events with one reconstructed final state proton track per event

# CellTrackFinder, $\Xi^+\Xi^-$ , final state protons



- Sharp cutoff after 27 hits for SttCellTrackFinder
- Pattern dominated by tracks from events with several reconstructed final state proton tracks per event
- Tracks with even and uneven number of hits treated differently in clusterization
- Consistently more tracks with even number of hits

# Outlook

- Details of Clustering in STTCellTrackFinder
- Investigate SttCellTrackFinder using box generator
- Work towards time based reconstruction with STTCellTrackFinder
  - EventBurstBuilder - event mixing
  - EventGapBuilder - produce gap in between events
- Test SttCellTrackFinder for  $\Omega$  events



Thank You!

