Ξ-hadron correlations with ALICE

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Motivation

- Angular correlations are studied to determine where hadrons are produced in the event
- Different mechanisms have different signatures: near-side jet peak, away-side ridge, near-side ridge, etc.
- In this analysis, the Ξ baryon is used as a trigger to study strangeness production
- $\Xi - \mathrm{K}$ correlations are used to probe strangeness, with $\Xi - \pi$ correlations as a reference to disentangle jet-like effects and the underlying event
- Strange quarks and hadrons produced late in the event $\Longrightarrow$ strong near-side peak in $\Xi - \mathrm{K}$ correlations
- Strange quarks produced early in the event and hadrons later $\Longrightarrow$ decorrelation
- Ongoing work to extend to $\Xi - \mathrm{p}$ and $\Xi - \Lambda$ correlations to understand strange baryon production

Method

- Correlation function (actually per-trigger yields):

$$\mathbb{C}(\Delta y, \Delta\phi) = \frac{S(\Delta y, \Delta\phi)}{B(\Delta y, \Delta\phi)}$$

  Here,

$$S(\Delta y, \Delta\phi) = \frac{1}{N_{\mathrm{trig}}} \frac{\mathrm{d}^2 N_{\mathrm{pairs}}^{\mathrm{signal}}}{\mathrm{d}\Delta y \mathrm{d}\Delta\phi}$$

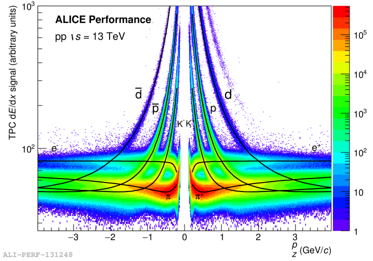
  and

$$B(\Delta y, \Delta\phi) = \frac{1}{B(0,0)} \frac{\mathrm{d}^2 N_{\mathrm{pairs}}^{\mathrm{mixed}}}{\mathrm{d}\Delta y \mathrm{d}\Delta\phi}$$

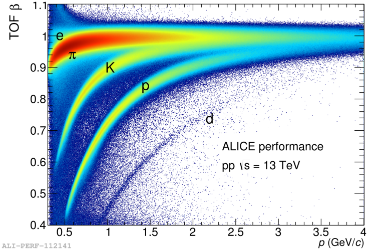
  where ‘signal’ denotes same event and ‘mixed’ mixed event. These events should be as similar as possible (both for data and MC)
- In this study, the trigger is a Ξ baryon and associated particles π, K, p, or Λ

Particle identification in ALICE

TPC:



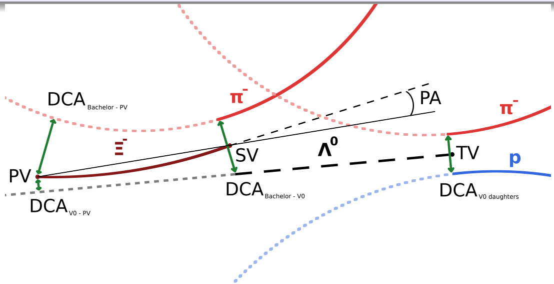
TOF:



- Pions, kaons, and protons are reconstructed by combining information from TPC and TOF detectors
- In this analysis currently limited to $0.2 < p_{\mathrm{T}} < 3\,\mathrm{GeV}/c$ due to constraints from detector simulation

Reconstruction of the Ξ baryon

- Uses the main decay branch:
  $\Xi^- \rightarrow \pi^- + \Lambda^0 \rightarrow \pi^- + \pi^- + p$
- Additionally, topological cuts and an invariant mass cut ($m_\Xi = 1321$ MeV$/c^2$) are used to remove background
- Limited to $1.2 < p_\mathrm{T} < 12\,\mathrm{GeV}/c$ with current statistics



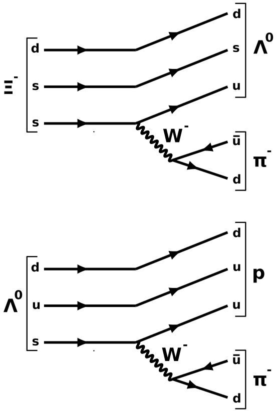
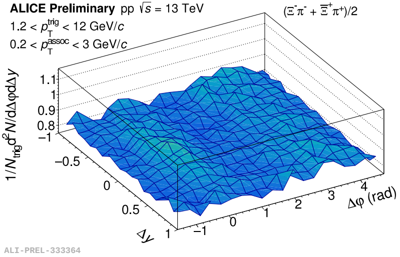


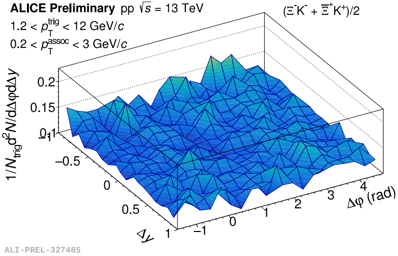
Image credit: Martin Angelsmark

$\Xi - \pi$ and $\Xi - K$ correlation results

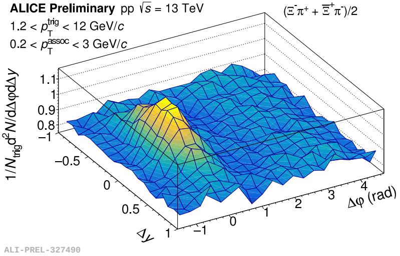
Same sign pions:



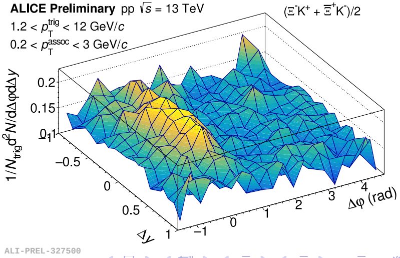
Same-sign kaons:



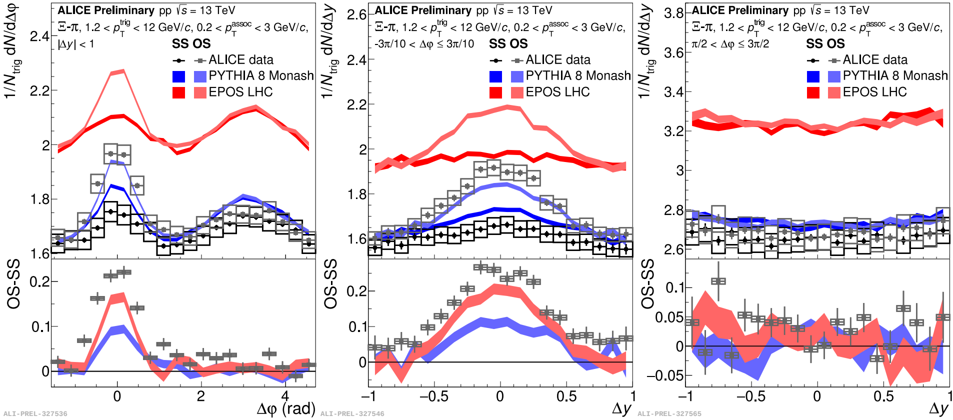
Opposite-sign pions:



Opposite-sign kaons:



$\Xi - \pi$ correlations, projections

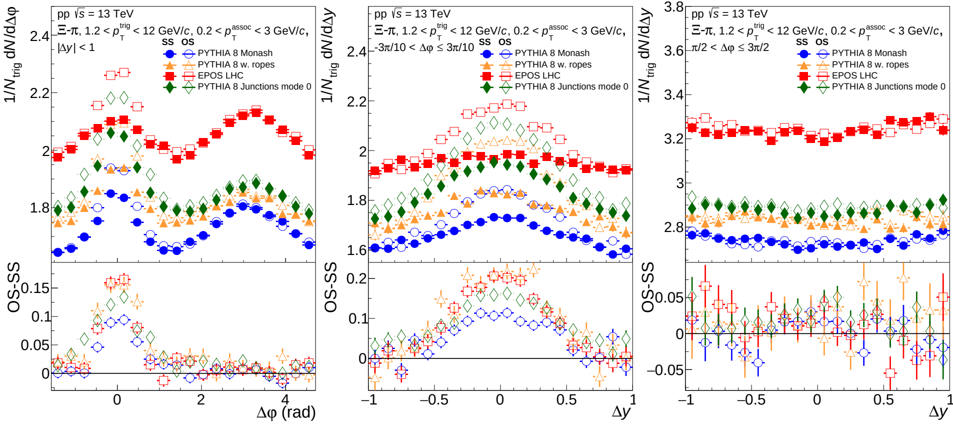


Results quite well described by both PYTHIA and EPOS, but:

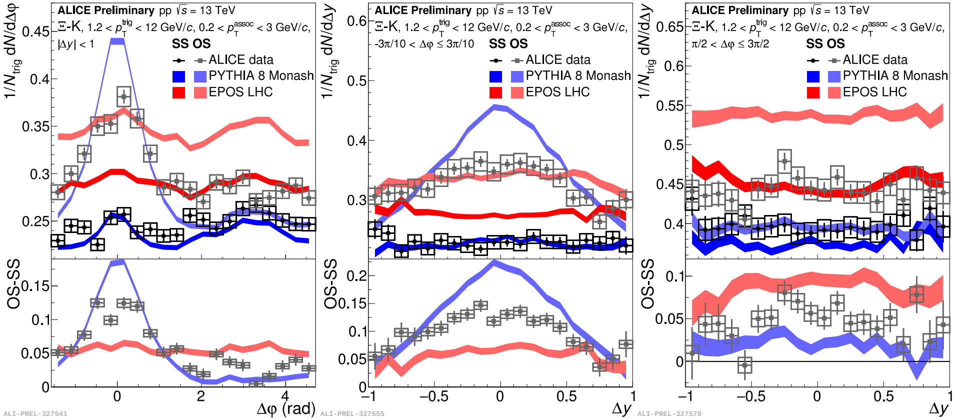
- PYTHIA does better quantitatively
- OS-SS difference better described by EPOS

Simulation results: $\Xi - \pi$ correlations

Here also including rope and junction extensions



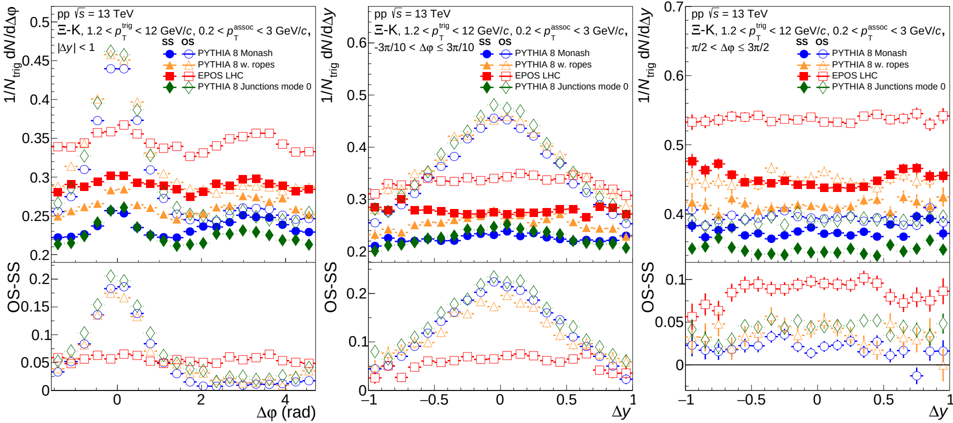
$\Xi - \mathrm{K}$ correlations, projections



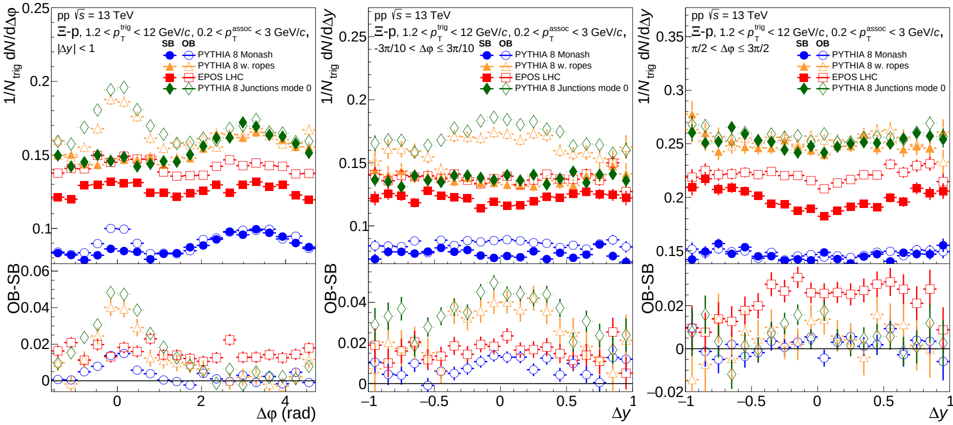
- ALICE results significantly more decorrelated than in PYTHIA, indicating collective behaviour
- EPOS results have practically no structure, likely due to lack of local strangeness conservation $\Longrightarrow$ clearly different than in data

Simulation results: $\Xi - \mathrm{K}$ correlations

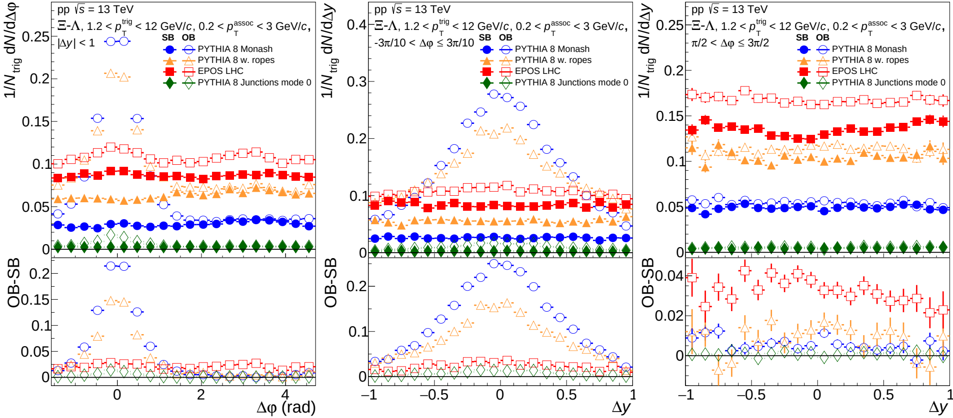
Here also including rope and junction extensions



$\Xi - p$ correlations (simulations)



$\Xi - \Lambda$ correlations (simulations)



Large quantitative difference between junction model and the others

Conclusions

- $\Xi - \pi$ correlations are dominated by underlying event and minijet fragmentation, described quite well by both PYTHIA and EPOS, including PYTHIA extensions
- $\Xi - \mathrm{K}$ correlations are more smeared out than in PYTHIA (including extensions) but not nearly as decorrelated as in EPOS
- This indicates both collective effects and local strangeness conservation
- $\Xi - \Lambda$ correlations are much weaker in the junction model than any other tested model