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Two-particle correlations with high-p_T K^0_S mesons in pp collisions at ALICE

Graduiertenkolleg 2149 Research Training Group

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Motivation

1. Results from e^+e^- collisions for gluon and quark jets show:
   - Gluon jets have higher multiplicity
   - Gluon jets are wider
   - Gluon jets exhibit 40% higher production of Λ baryons, equal production of K^0_S mesons [1]
2. Strangeness enhancement in small collision systems

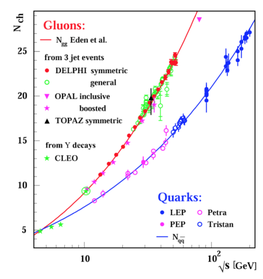


Figure 1: Multiplicity of quark and gluon jets measured at different experiments [2]

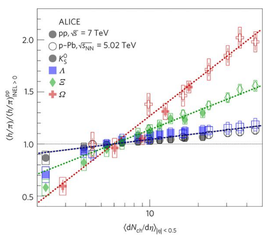
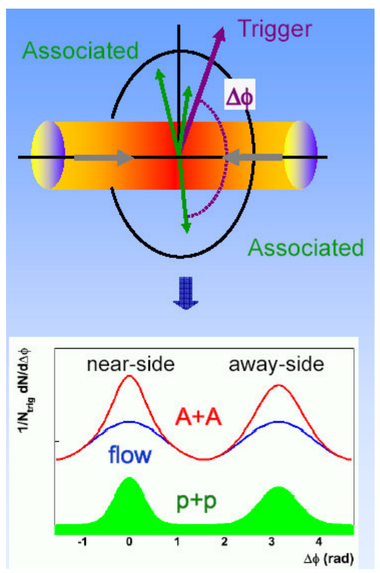


Figure 2: Double ratios of protons and (multi-)strange hadrons to pions as a function of multiplicity with respect to minimum bias collisions, in pp and p-Pb collisions [3].

Dihadron correlations



- Trigger particle - high p_T $\rightarrow$ proxy for hard-scattered parton
- Associated particle - lower p_T
- Difference:

$$\Delta\varphi = \varphi_{trigg} - \varphi_{assoc} \quad (1)$$

$$\Delta\eta = \eta_{trigg} - \eta_{assoc} \quad (2)$$

In presented results:

- K^0_S mesons and charged hadrons as trigger particles with $p_T^{trigg} > 3\mathrm{GeV}/c$
- charged hadrons as associated particles $1\mathrm{GeV}/c < p_T^{assoc} < p_T^{trigg}$
- Correlation function (schematically):

$$\frac{d^2N^{corr}_{pair}}{d\Delta\varphi d\Delta\eta} = \frac{1}{N^{corr}_{trigg}} \frac{d^2N^{raw}_{pair}}{d\Delta\varphi d\Delta\eta} \frac{1}{\epsilon_{trigg}} \frac{1-C}{\epsilon_{assoc}} \frac{1}{\epsilon_{pair}} \quad (3)$$

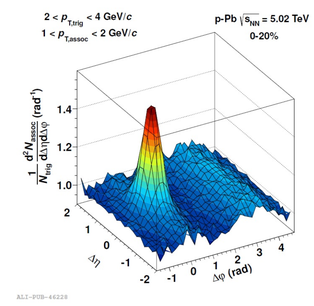


Figure 3: Example of corrected 2D correlation function [4].

- $\Delta\varphi$ projection
- Background subtraction $\rightarrow$ yield calculation:

$$Y^{\Delta\varphi}_J = \int_{\Delta\varphi_1}^{\Delta\varphi_2} \frac{d^2N}{d\Delta\phi} d\Delta\varphi \quad (4)$$

Corrections

- Detector acceptance - uses mixed events, ϵ_{pair} term in Eq. 3
- Single particle tracking efficiency - performed with MC, ϵ_{trigg} and ϵ_{assoc} terms in Eq. 3
- Secondary contamination in primary hadrons - performed with MC, factor C in Eq. 3
- Misidentified V^0 - done after $\Delta\varphi$ projection and background subtraction:

1. Correlation function built with candidates from signal interval (blue and orange areas in Fig. 4)
2. Correlation function built with candidates from side-bands intervals (green areas in Fig. 4)
3. The second correlation function is scaled with a factor proportional to background-signal size and subtracted from the first one

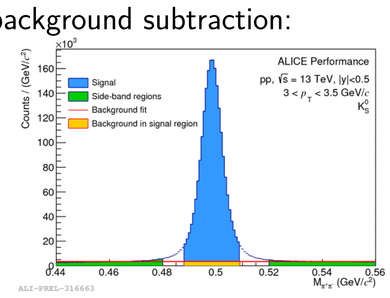


Figure 4: Invariant mass distribution of K^0_S candidates (Blue- signal, orange - background, green- side-band regions).

Per-trigger associated yields as a function of p_T^{trigg}

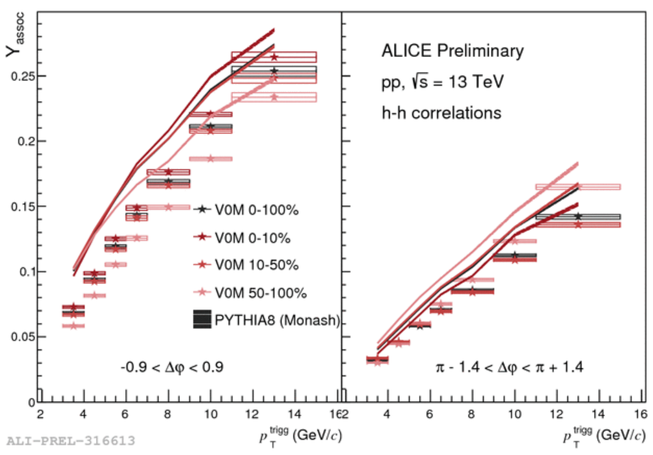


Figure 5: h-h correlations, compared with PYTHIA8-Monash.

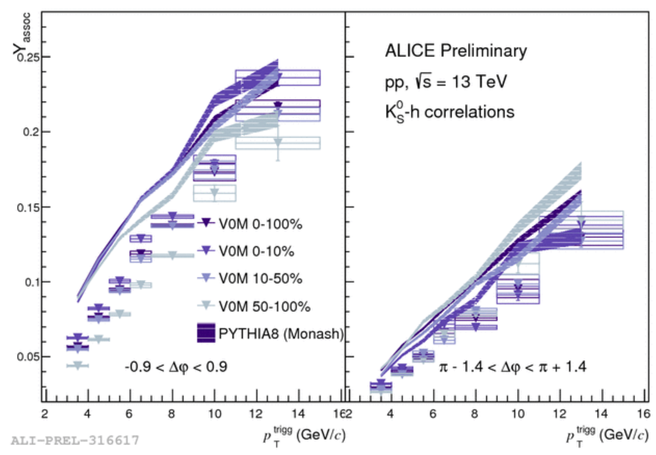


Figure 6: K^0_S-h correlations, compared with PYTHIA8-Monash.

Per-trigger associated yields as a function of p_T^{assoc}

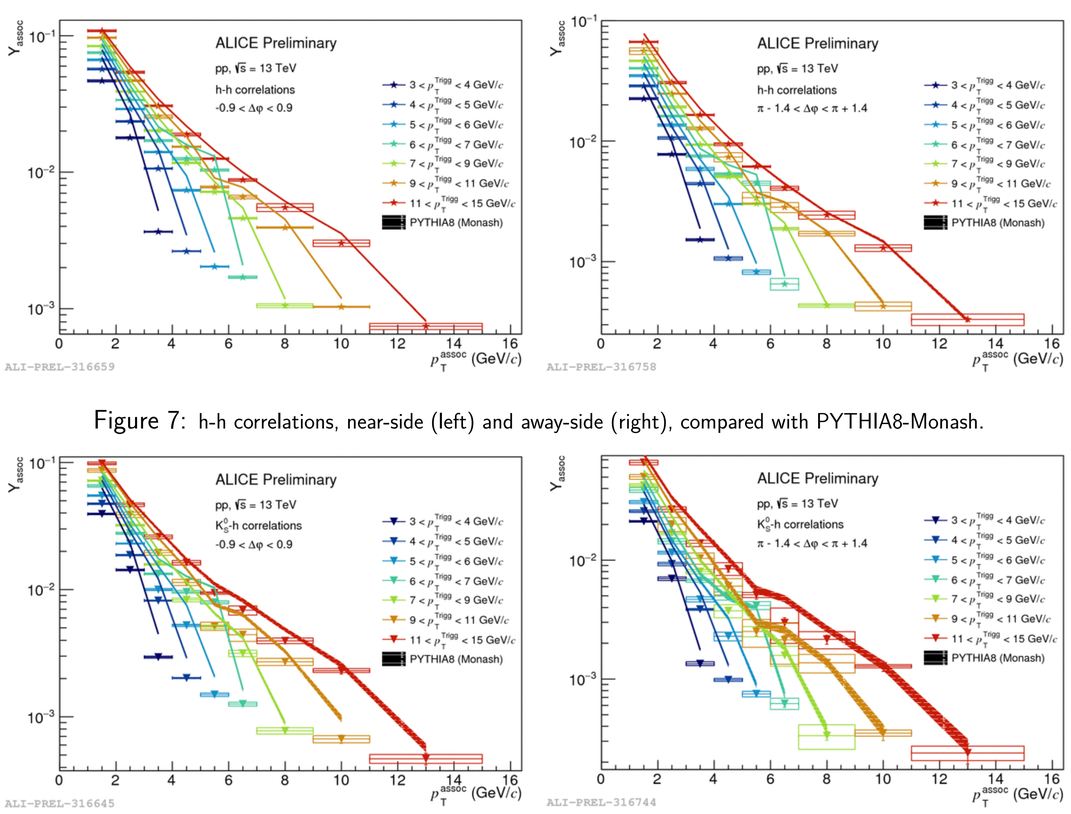


Figure 7: h-h correlations, near-side (left) and away-side (right), compared with PYTHIA8-Monash.

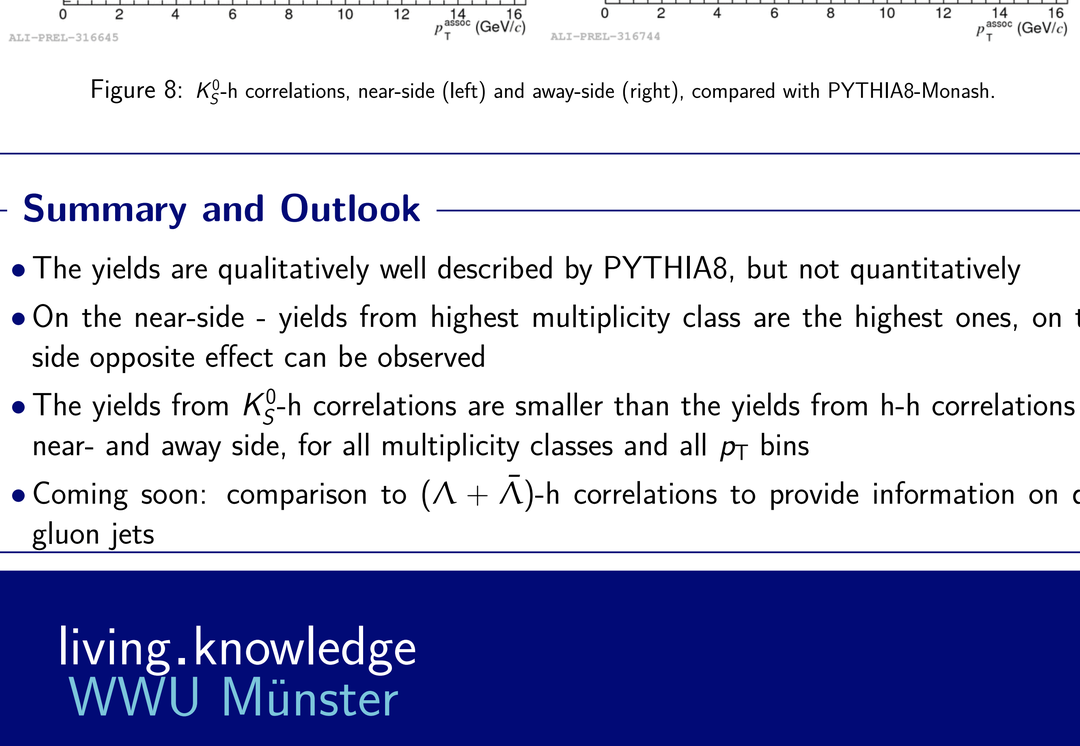


Figure 8: K^0_S-h correlations, near-side (left) and away-side (right), compared with PYTHIA8-Monash.

Comparison of different trigger particles

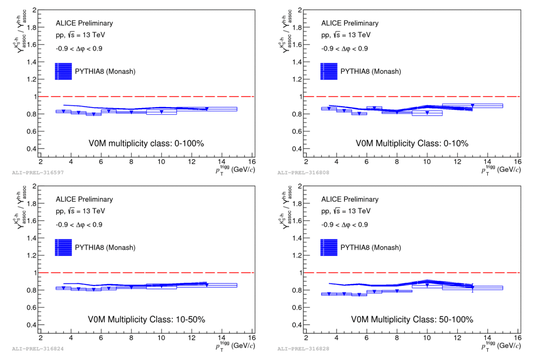


Figure 9: Ratios of K^0_S-h per-trigger yield to h-h per-trigger yield as a function of p_T^{trigg} for different multiplicity intervals on the near-side.

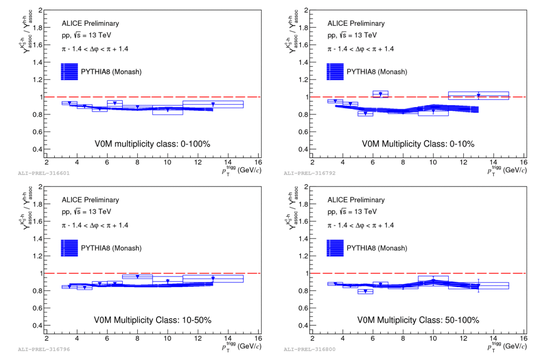


Figure 11: Ratios of K^0_S-h per-trigger yield to h-h per-trigger yield as a function of p_T^{trigg} for different multiplicity intervals on the away-side.

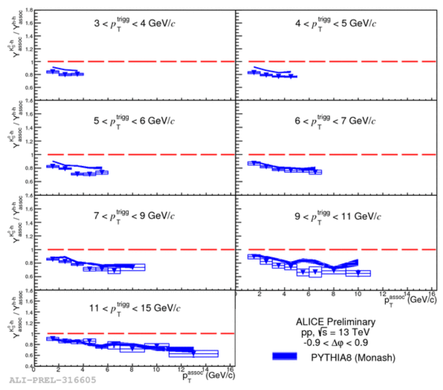


Figure 10: Ratios of K^0_S-h per-trigger yield to h-h per-trigger yield as a function of p_T^{assoc} for different p_T^{trigg} intervals on the near-side.

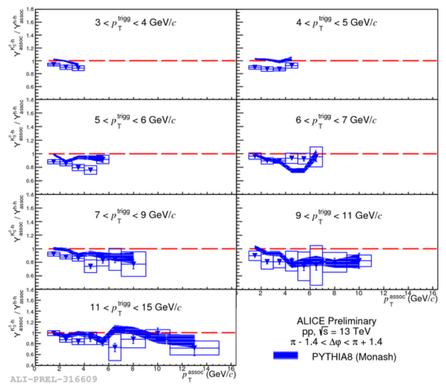


Figure 12: Ratios of K^0_S-h per-trigger yield to h-h per-trigger yield as a function of p_T^{assoc} for different p_T^{trigg} intervals on the away-side.

Summary and Outlook

- The yields are qualitatively well described by PYTHIA8, but not quantitatively
- On the near-side - yields from highest multiplicity class are the highest ones, on the away side opposite effect can be observed
- The yields from K^0_S-h correlations are smaller than the yields from h-h correlations for both near- and away side, for all multiplicity classes and all p_T bins
- Coming soon: comparison to $(\Lambda + \bar{\Lambda})$-h correlations to provide information on quark vs. gluon jets

References

[1] K. Ackerstaff, et al. Production of K^0_S and Λ in quark and gluon jets from Z^0 decay. The European Physical Journal C. 1999, 8(2): 241-254. http://www.springerlink.com/index/10.1007/s100529901058

[2] K. Hamacher, Fragmentation @ LEP, Acta Physica Polonica B, No 2, Vol. 36 (2005), page 433

[3] ALICE Collaboration, Enhanced production of multi-strange hadrons in high-multiplicity protonproton collisions. *Nature Physics* [online], 13 (2017) 535. http://www.nature.com/doifinder/10.1038/nphys4111

[4] A. Rasoanaivo, W.A. Horowitz, Two Gluon Emission from MHV: Two Particle Correlations and the Deviation from Poisson, 2017, arXiv:1712.06292