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

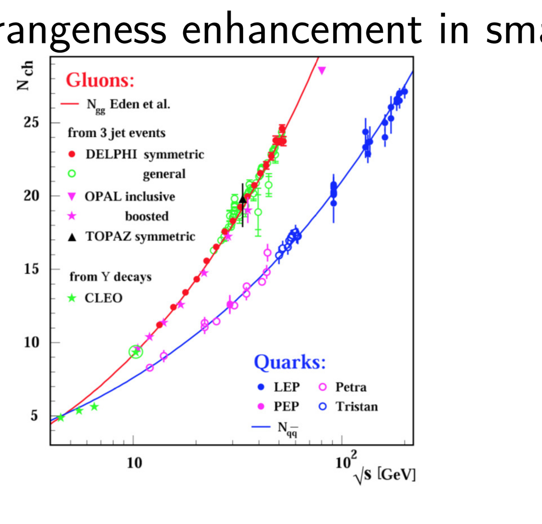


Figure 1: Multiplicity of quark and gluon jets measured at different experiments [2]

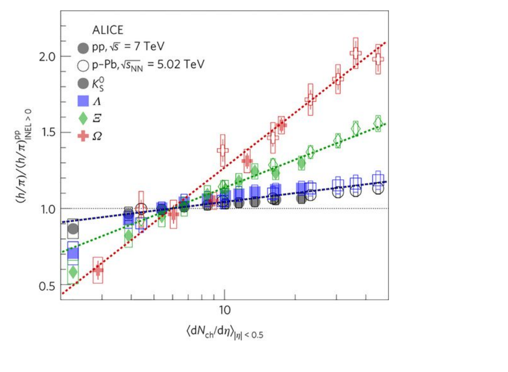
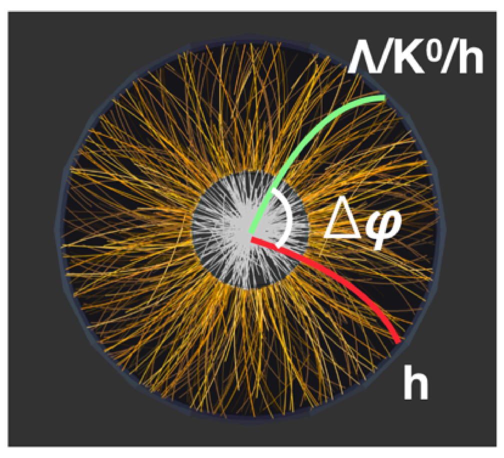
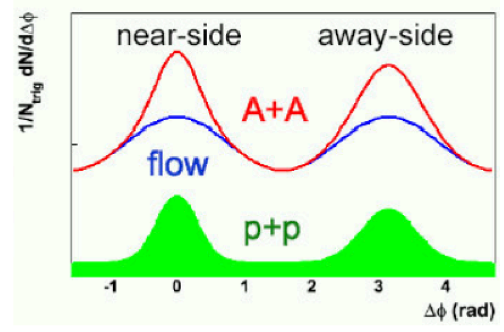


Figure 2: Double ratios of protons and (multi-)strange hadrons to pions as a function of multiplicity with respect to minimum bias collisions, in pp and p-Pb collisions [3].

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):

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

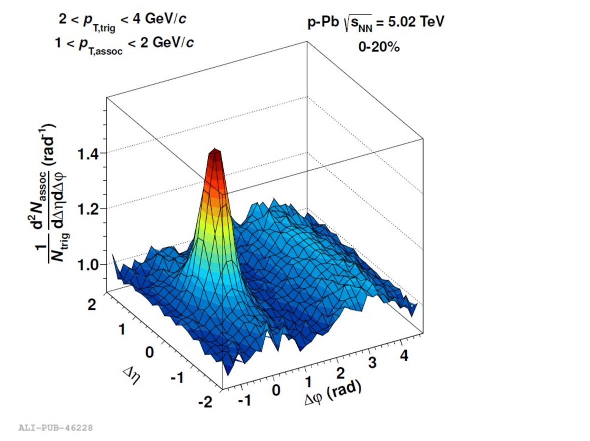


Figure 3: Example of corrected 2D correlation function [4].

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

$$Y_{assoc} = \int_{\Delta\varphi_1}^{\Delta\varphi_2} \frac{1}{N^{corr}_{trigg}}\frac{dN^{corr}_{pair}}{d\Delta\varphi}d\Delta\varphi \quad (4)$$

Corrections

- ϵ_{pair}: two-particle detector acceptance, using mixed events
- ϵ_{trigg} and ϵ_{assoc}: single-particle efficiency, from MC
- C : Secondary contamination in primary hadrons, from MC
- Misidentified V^0 - done after $\Delta\varphi$ projection and background subtraction using sideband subtraction

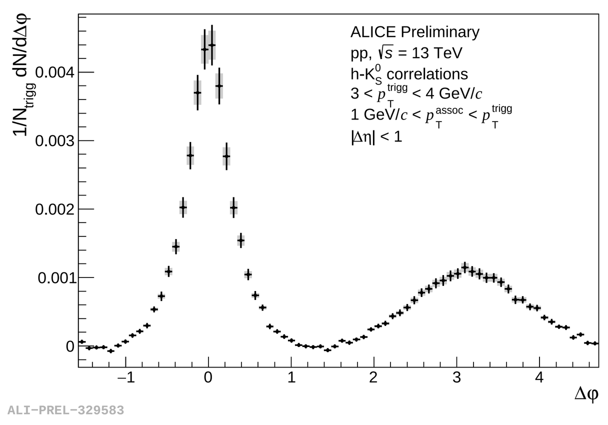
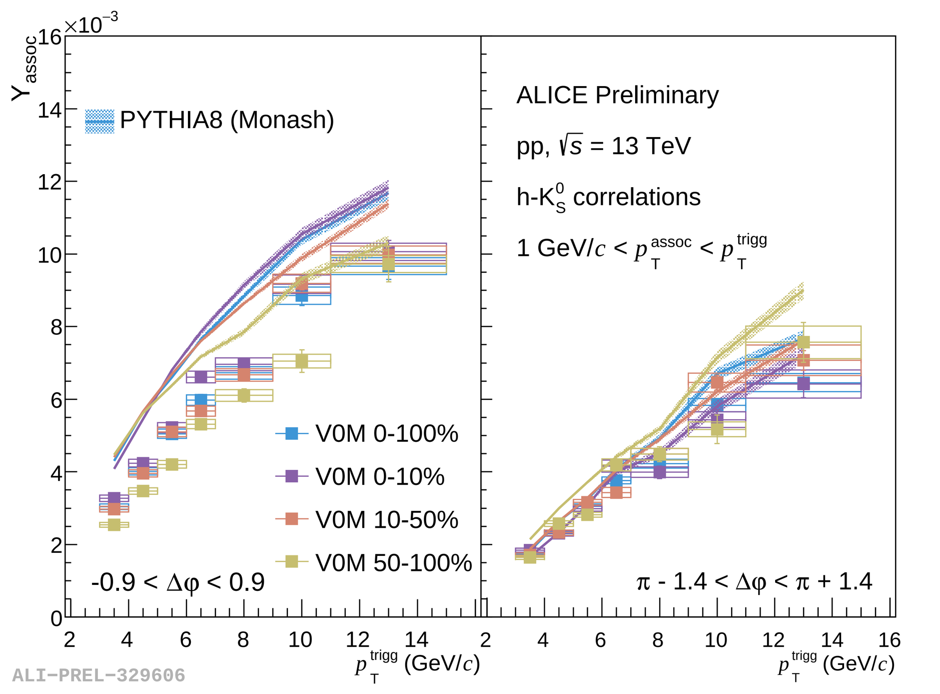
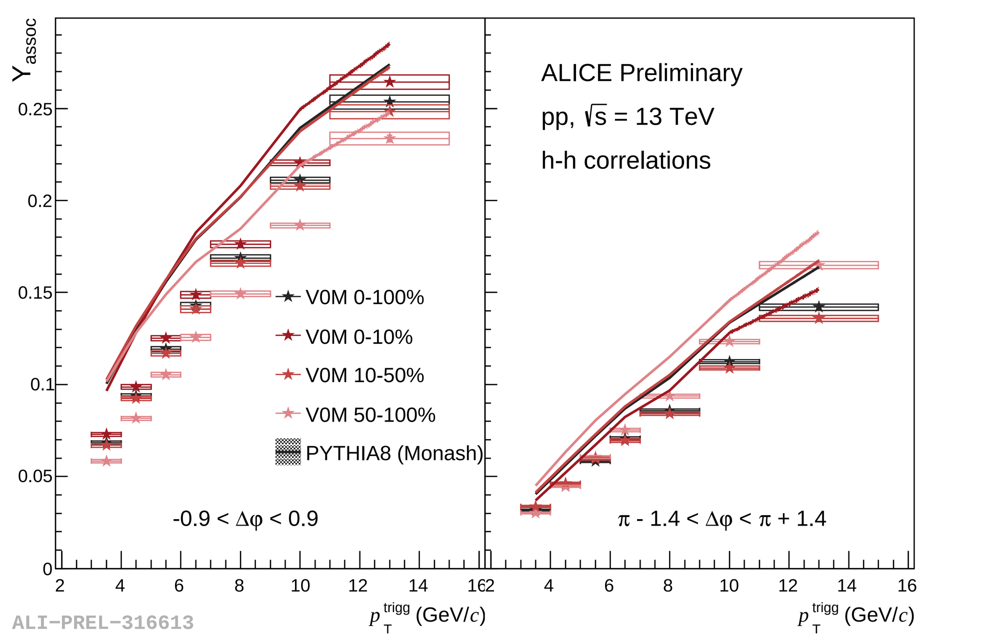


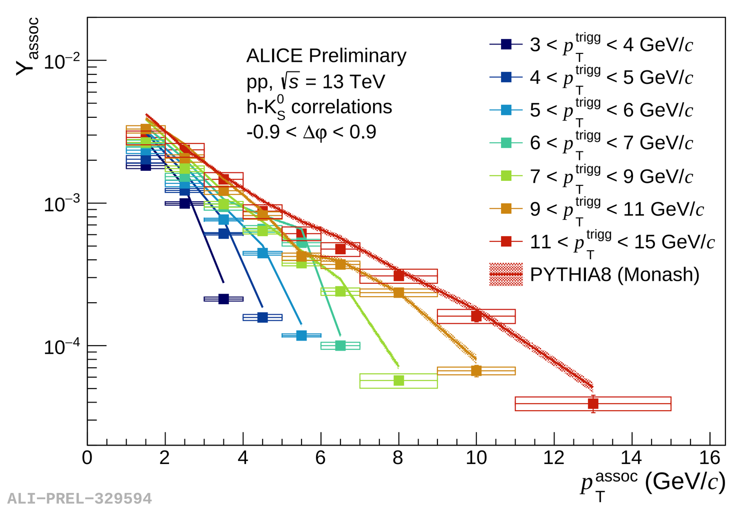
Figure 4: One dimensional fully-corrected correlation funcion.

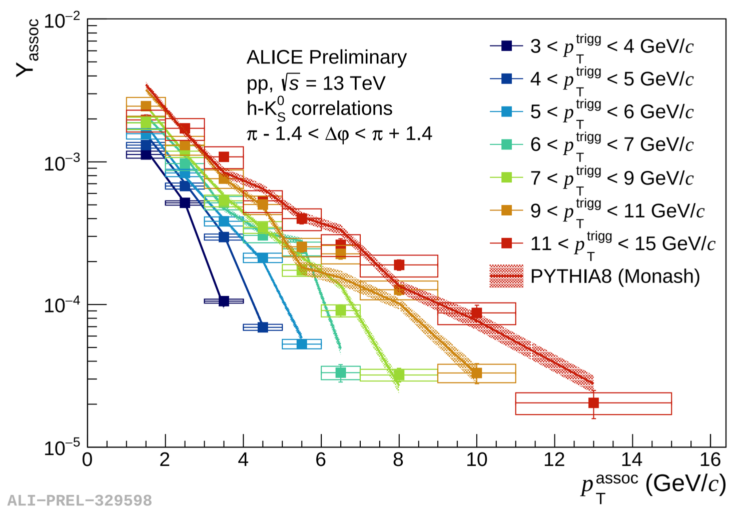
Per-trigger associated yields as a function of p_T^{trigg} and multiplicity





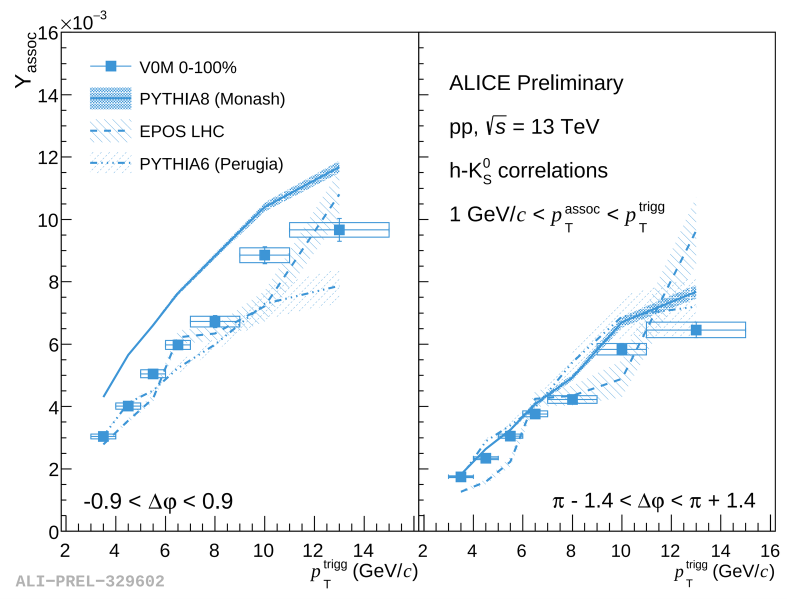
Per-trigger associated yields as a function of p_T^{assoc}



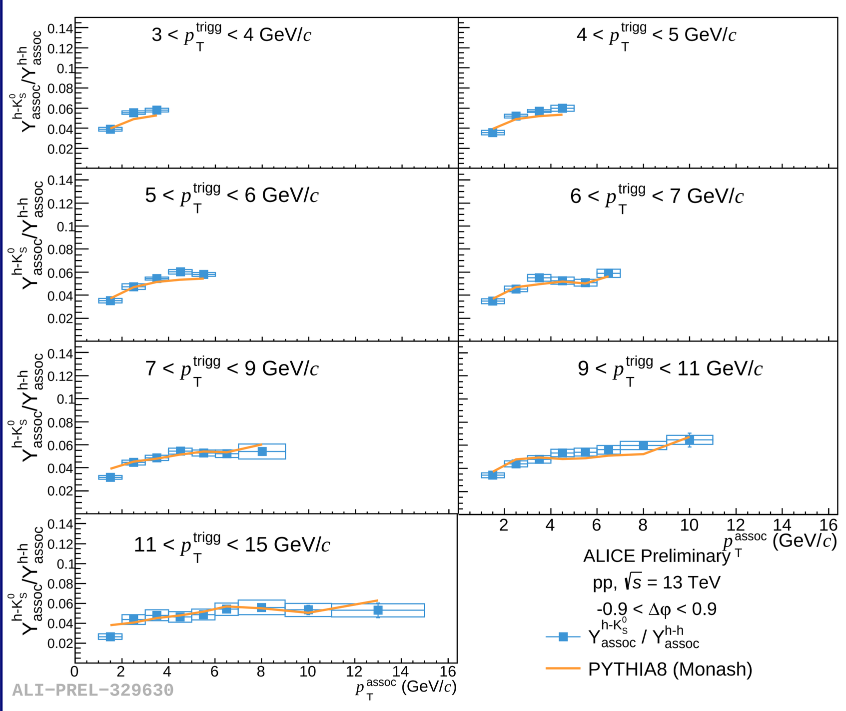


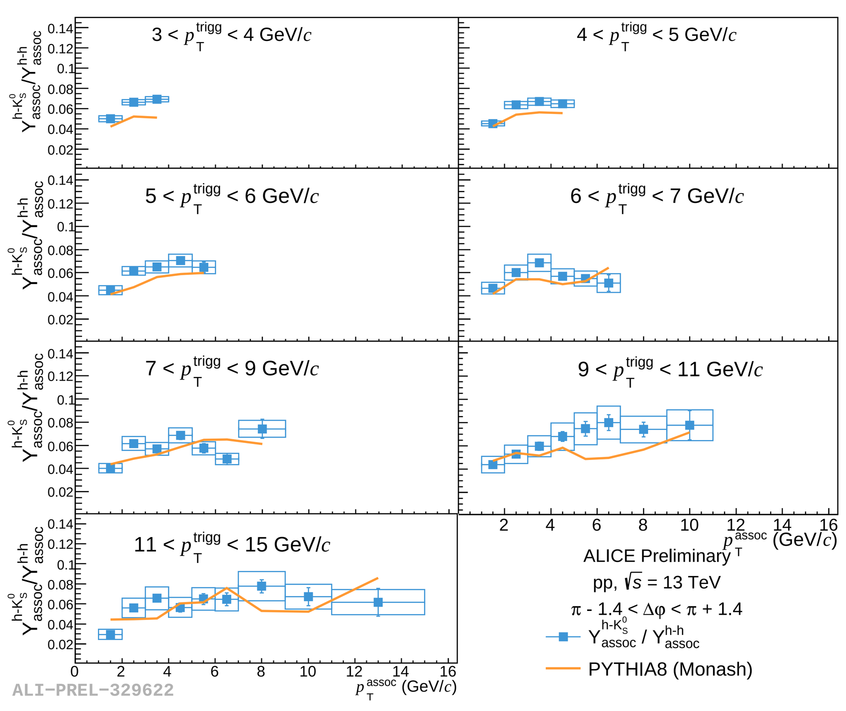
Comparison with models

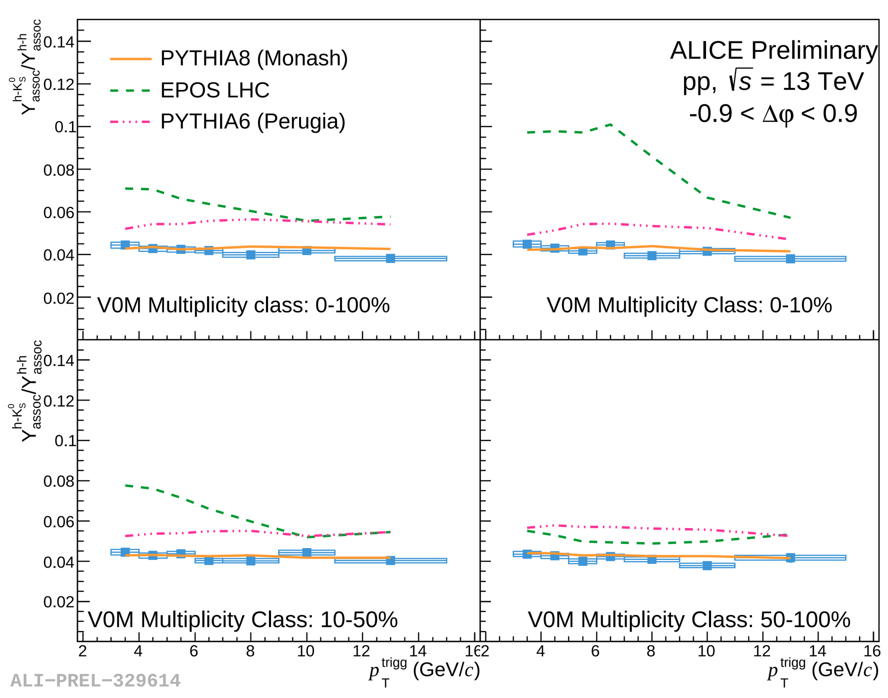
- PYTHIA8 does not describe quantitatively the yields as a function of p_T^{trigg} neither for h-h nor for h-K^0_S correlations (Plots above), which is mostly caused by the overestimation of the yield for lowest p_T^{assoc} bin (Plots left), which dominates in p_T^{assoc} inclusive bin
- EPOS and PYTHIA6 describe the yield spectra as a function of p_T^{trigg} better, mainly in the low p_T region (Plot right)
- Ratios to h-h correlations are described by PYTHIA8 best, EPOS overestimates the ratio stronger for higher multiplicity classes, PYTHIA6 describes the ratio at the away-side quite well and overestimates it slightly at the near-side (Plots below)

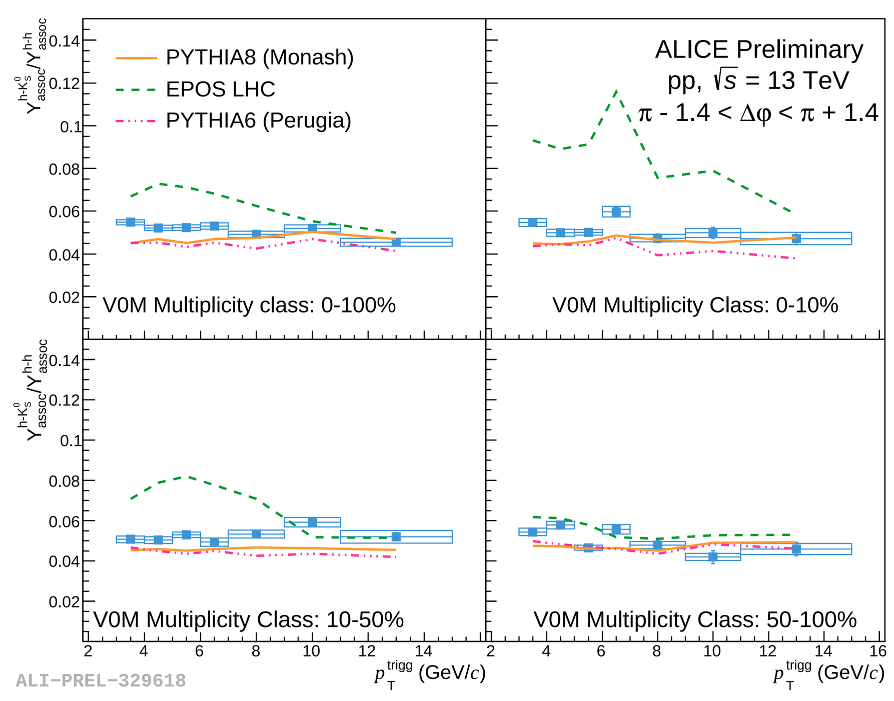


Ratios to h-h correlations









Summary and Outlook

- None of the used MC models describes both yields and ratio to h-h correlations well
- Ratios to h-h correlations as a function of p_T^{trigg} are mostly flat for all multiplicity classes
- Ratios to h-h correlations as a function of p_T^{assoc} show a rising trend with increasing p_T^{assoc}, what is described with PYTHIA8
- Coming soon: comparison to $(\Lambda+\bar{\Lambda})$-h and h-$(\Lambda+\bar{\Lambda})$ 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