K^0_S AND Λ PRODUCTION IN pp AND Pb–Pb COLLISIONS WITH ALICE AT LHC*

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We have studied the K^0_S and Λ particles production in pp interactions at $\sqrt{s} = 7$ TeV and Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV. The p_T and centrality dependence of the Λ/K^0_S ratio are presented and analyzed. Our results are compared with the previous results obtained in $\sqrt{s} = 0.9$ TeV pp collisions from ALICE experiment and with the Au–Au results from the STAR experiment at $\sqrt{s_{NN}} = 0.2$ TeV.

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1. Introduction

Two experiments (PHENIX [1] and STAR [2]) showed that the ratio $p(\overline{p})/\pi$ is growing monotonically from low p_T approximately up to 2.5 GeV/c. This baryon/meson measurement was later extended to higher p_T region (up to 6 GeV/c) with Λ/K^0_S ratio. A strong dependence of this ratio on centrality of the collision was observed. It was also observed that baryon/meson ratio reaches its maximum at p_T around 3 GeV/c. At higher p_T this ratio decreases for all collision centralities and the centrality dependence is not significant for transverse momentum above 6 GeV/c.

Experimental results were compared to several models based on different hadronization mechanisms and flow effects. Based on this comparison, the final effect could be described as an interplay between quark recombination, flow and string fragmentation [3, 4].

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We present the Λ/K^0_S ratios measured by the ALICE experiment at the LHC in 1.1×10^7 minimum bias Pb–Pb events at $\sqrt{s_{NN}} = 2.76$ TeV as a function of transverse momentum and for different collision centrality bins, as well as in pp collisions at $\sqrt{s} = 0.9$ TeV and 7 TeV.

2. Reconstruction of K^0_S and Λ

K^0_S and Λ particles can be reconstructed with the ALICE detector in a quite broad momentum range using their V0 decay topology. The p_T limits of the results presented here are defined by our current knowledge of the underlying systematic uncertainties. The extraction of V0 signal was performed using the distributions of invariant mass computed from kinematical values obtained from reconstructed daughter tracks (Fig. 1). All combinations of oppositely charged tracks which passed a certain set of topological cuts were accepted as the V0 candidates [5].

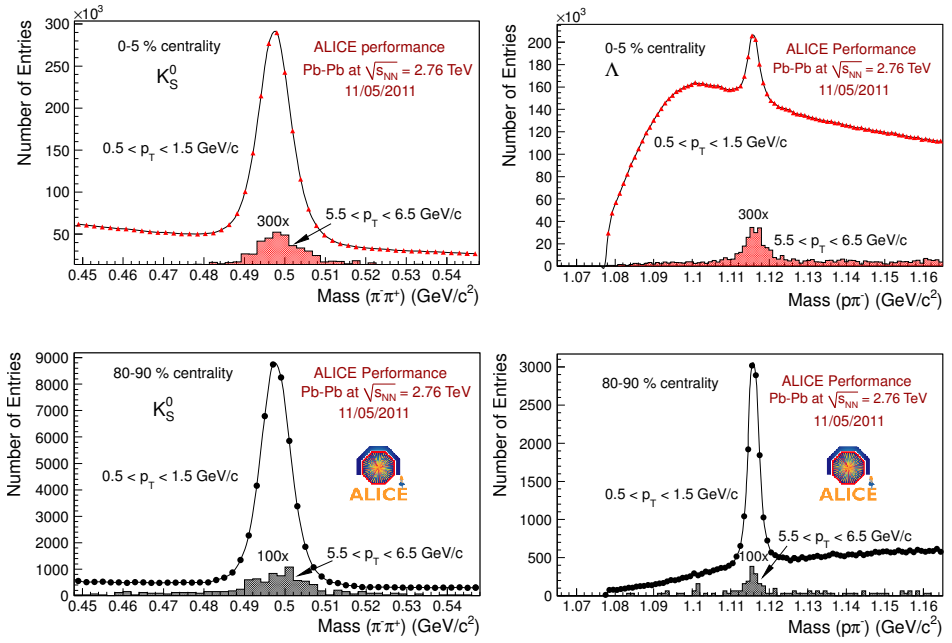

Fig. 1. Left: Invariant mass distribution for K^0_S mesons within p_T range $0.5\ \mathrm{GeV}/c < p_T < 1.5\ \mathrm{GeV}/c$ and 0–5% centrality class (left upper panel), 80–90% centrality class (left lower panel). Right: Invariant mass distribution for Λ within p_T range $0.5\ \mathrm{GeV}/c < p_T < 1.5\ \mathrm{GeV}/c$ and 0–5% centrality class (right upper panel), 80–90% centrality class (right lower panel). In all cases a high p_T bin is also shown.

Polynomial functions of first or second order (depending on the background shape) were used to fit the background and subtract it from invariant mass distributions.

Extracted yields were then corrected with a reconstruction efficiency computed for each p_T bin using Monte Carlo simulation. This efficiency saturated at 40% for K^0_S and 30% for Λ at $p_T \sim 3$ GeV/c (close to Λ/K^0_S maximum). The variations of the ratio of the efficiencies for K^0_S and Λ for intermediate p_T interval (from 2.5 GeV/c to 5.5 GeV/c) was lower than 2%.

K^0_S spectra from Pb–Pb collisions were compared to the charged $K^{\pm}$ spectra reconstructed by ALICE Time Projection Chamber and the Time-of-Flight detector. For $p_T > 1$ GeV/c the spectra were found to be compatible within 1–2% [5].

The spectra of Λ were corrected for the contribution of Λs coming from decays of Ξ^- and Ξ^0. The corresponding feed-down correction to the spectra was found to be about 20% and varied only by a few per cent within p_T and centrality range discussed here.

We considered the following sources of the systematic uncertainties listed here together with their estimations: signal extraction (3%), efficiency correction (7% for $p_T < 1$ GeV/c, 1% for $p_T > 2.5$ GeV/c), feed-down correction (5%), admixture of Λs generated in the detector material (2%).

3. Preliminary results

The Λ/K^0_S ratio was computed for minimum bias sample in pp collisions ($\sqrt{s} = 7$ TeV) and for several centrality classes in Pb–Pb collisions ($\sqrt{s_{NN}} = 2.76$ TeV) and shown in (Fig. 2). A strong centrality dependence of Λ/K^0_S

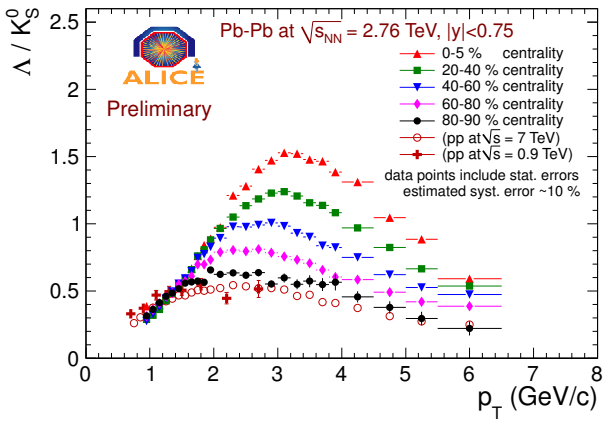

Fig. 2. Λ/K^0_S ratios measured by ALICE Collaboration. The results measured in pp collisions ($\sqrt{s} = 0.9$ TeV, $\sqrt{s} = 7$ TeV) and Pb–Pb collisions ($\sqrt{s_{NN}} = 2.76$ TeV) for several centralities are shown.

is observed. The ratio increases with centrality and for most central events reaches its maximum at $p_{\mathrm{T}} \sim 3$ GeV/c. The value of ratios for two most central classes is bigger than unity within p_{T} ranges: 2 GeV/c < p_{T} < 4 GeV/c (20–40% centrality class) and 2 GeV/c < p_{T} < 5 GeV/c (0–5% centrality class). There is a modest increase, of around 20%, in the ratio in the most peripheral centrality class (80–90%) over that observed in pp collisions (at $\sqrt{s} = 0.9$ and 7 TeV).

4. Comparison with previous measurements

The results obtained were compared to the ratios previously measured in Au–Au collisions at $\sqrt{s_{NN}} = 0.2$ TeV by the STAR Collaboration (Fig. 3). The preliminary STAR data points used for this comparison are multiplied by $\overline{\Lambda}/\Lambda = 0.8$ factor calculated from the data reported in [6] (to account for the non-unity of the anti-baryon/baryon ratio at RHIC) and subtracted a 10% feed-down correction quoted in [4]. The ALICE ratio measured in the most central events shows a considerably broader maximum than at RHIC, and converges towards the peripheral ratio at higher p_{T}.

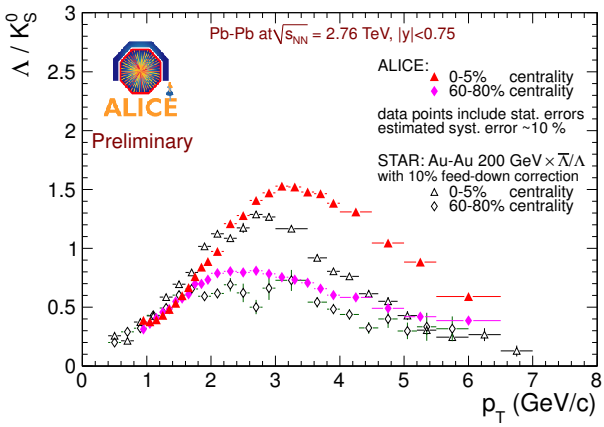

Fig. 3. Comparison of Λ/K^0_{S} ratio measured by the ALICE and STAR collaborations for two different centrality classes (0–5% and 60–80%).

A comparison of the position of Λ/K^0_{S} maximum measured by the ALICE Collaboration in pp collisions ($\sqrt{s} = 7$ TeV) and Pb–Pb collisions ($\sqrt{s_{NN}} = 2.76$ TeV) to the position of Λ/K^0_{S} maximum measured by the STAR Collaboration, shows the shift of this position towards higher p_{T} with increasing number of participants and the energy of colliding systems (Fig. 4).

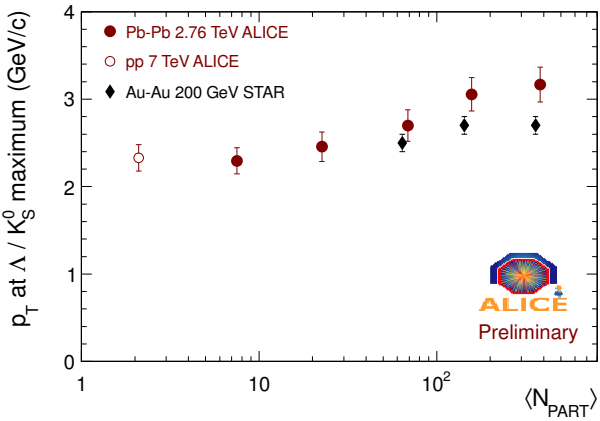

Fig. 4. The position of Λ/K^0_S maximum as a function of number of participants for different colliding systems and energies. The results from the ALICE experiment (Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV, pp collisions at $\sqrt{s} = 0.7$ TeV) and the STAR experiment (Au–Au collisions at $\sqrt{s_{NN}} = 0.2$ TeV) are compared.

Also the maximum value of Λ/K^0_S ratio increases with number of participants and with the energy of colliding systems, as seen in Fig. 5. For the most central events, this value is ~ 1.5. The Au–Au points at 62.4 GeV are plotted as they are published in [7]. To compare the STAR measurements at 0.2 TeV with ALICE measurements we multiply the STAR values from [8] by the same $\overline{\Lambda}/\Lambda$ factor and perform the aforementioned feed-down correction.

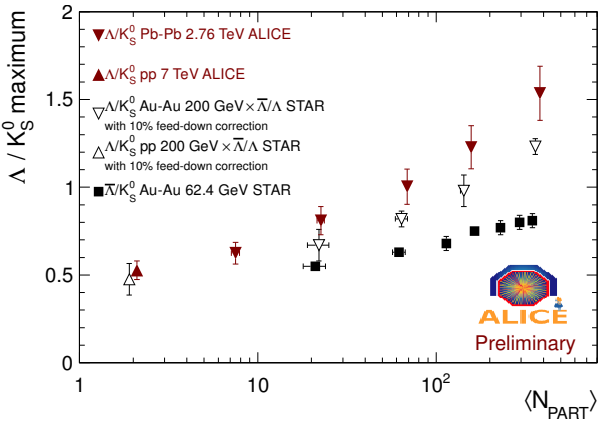

Fig. 5. The maximum value of Λ/K^0_S ratio as a function of number of participants measured by the ALICE Collaboration compared to the STAR results.

5. Conclusions

We presented the preliminary Λ/K^0_S ratios measured by the ALICE Collaboration for two different collision systems (pp and Pb–Pb) and two energies ($\sqrt{s}$ =7 TeV and $\sqrt{s_{NN}}$ = 2.76 TeV). In the case of Pb–Pb collisions, the ratios were computed for five different centrality classes (Fig. 2). The observed dependence of Λ/K^0_S ratio on collision centrality is significant. The production of baryons appears to be higher than the one of mesons for most central event classes within the p_T range: 2 GeV/c < p_T < 5 GeV/c (0–5% centrality class) and 2 GeV/c < p_T < 4 GeV/c (20–40% centrality class). The maximum value of Λ/K^0_S ratio for most central events is $\sim$ 1.5. Λ/K^0_S ratio for most peripheral events is close (within $\sim$ 20%) to the ratios computed for pp data. The ratios measured in Pb–Pb collisions decrease more slowly, than the ones measured in Au–Au collisions by the STAR Collaboration. The ratio computed for most central class and p_T bin $\sim$ 6 GeV/c is approximately two times higher then the one measured in Au–Au collisions at RHIC for same centrality class.

The position of maximum of Λ/K^0_S ratios measured in Pb–Pb collisions at the LHC are shifted towards higher p_T with respect to the ones measured in Au–Au collisions at RHIC. This shift increases with the centrality.

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