LIGHT-FLAVOUR HADRON PRODUCTION INVESTIGATED IN Xe–Xe COLLISIONS WITH ALICE EXPERIMENT AT THE LHC*

Natália Džalaiová

for the ALICE Collaboration

Faculty of Mathematics, Physics and Informatics, Comenius University
842 48 Bratislava, Slovakia

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Light-flavour hadron production has been studied in *pp*, *p*–Pb, Pb–Pb, and, most recently, in Xe–Xe collisions. In this work, the production of pions, kaons, (anti-)protons, ϕ mesons, K^0_{S}, Ξ, and Ω at midrapidity in Xe–Xe collisions at $\sqrt{s_{NN}} = 5.44$ TeV is presented. Comparison of Xe–Xe and Pb–Pb collision systems at similar multiplicities can bring us new information about the behavior of systems with different initial geometrical eccentricities. Results show that integrated yields of strange particles increase with the charged-particle multiplicity.

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1. Introduction

Studies of light-flavour hadron production at LHC energies can bring us new insights into strongly interacting quark–gluon plasma (QGP). At the ALICE experiment, *pp*, *p*–Pb, and Pb–Pb systems at various energies were examined. Investigating the light-flavour hadron production in Xe–Xe collisions can bridge the gap between *p*–Pb and Pb–Pb multiplicities.

The hadron production across different collision systems was found to have smooth evolution independent of collision energy [1, 2]. Enhanced production of strange particles in heavy-ion collisions was one of the earliest proposed signals for the QGP [3]. This was found to hold by studying various collision systems at the ALICE detector from small to large multiplicities.

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2. Particle identification and experimental setup

The experimental setup consists of a main central barrel covering full azimuthal coverage in $|\eta| < 0.8$ [4] and dedicated forward detectors. A detailed description of the ALICE detector can be found in [5].

Particle identification (PID) was used for π, proton, and kaon analysis. The inner tracking system (ITS) [4] provides the reconstruction of the collision vertex, reconstruction of tracks and low momentum ($p < 1$ GeV/c) PID through the measurement of specific energy loss ($\mathrm{d}E/\mathrm{d}x$). By using a dedicated algorithm, the ITS can be treated as a standalone detector allowing for the reconstruction and identification of low-momentum particles that do not reach the time projection chamber (TPC) [6]. The main central barrel detector is made up of TPC, which is a cylindrical gas detector with multi-wire proportional chambers and serves for PID via measurements of $\mathrm{d}E/\mathrm{d}x$ in its gas.

Topological reconstruction is used for the identification of strange $K^0_\mathrm{S} \to \pi^+\pi^-$, $\mathit{\Xi}$, and $\mathit{\Omega}$ particles. Multi-strange $\mathit{\Xi}$ and $\mathit{\Omega}$ have characteristic cascade decays in a magnetic field ($\mathit{\Xi}^- \to \mathit{\Lambda}\pi^- \to p\pi^-\pi^-$, $\mathit{\Omega}^- \to \mathit{\Lambda}K^- \to p\pi^-K^-$).

3. Results

Mean transverse momenta $\langle p_\mathrm{T}\rangle$ of $\pi^\pm$, $K^\pm$, p, $\bar{p}$, and ϕ (Fig. 1) are calculated from the measured spectra. As already noticed in other collision systems, the $\langle p_\mathrm{T}\rangle$ has an increasing trend with charged particle multiplicity

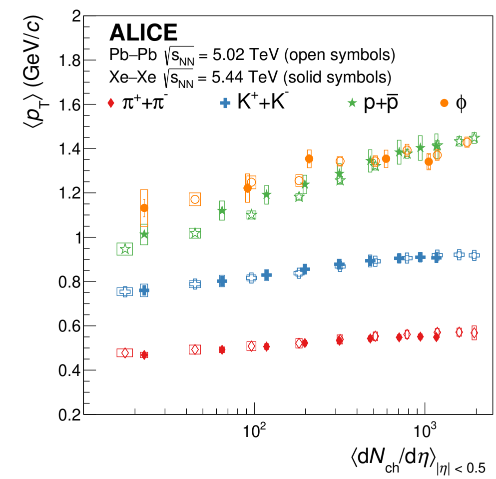

Fig. 1. $\langle p_\mathrm{T}\rangle$ of pions, kaons, protons, and antiprotons and ϕ mesons. Data from Xe–Xe collisions are compared with data from Pb–Pb collisions at 5.02 TeV. The statistical (error bars) and systematic (boxes around the data points) uncertainties are shown [7].

$\langle dN_{ch}/d\eta \rangle$. This hardening is more noticeable for particles that are heavier. The comparison with the results in Pb–Pb collisions indicates that this effect is driven by the multiplicity and not by the collision geometry.

Figure 2 shows the yield ratio of protons, K^0_S, Λ, ϕ, Ξ, and Ω to π measured with the ALICE experiment for all the available collision systems as a function of charged particle multiplicity measured at mid-rapidity. Particle yield ratios reach similar values in all the collision systems at various energies, which brings us to the conclusion that at the LHC, particle production is not only independent of collision energy but also of the collision system when studied as a function of multiplicity. The p/π ratio is around 0.05 and has the decreasing trend possibly due to baryon–antibaryon annihilation. The ϕ/π ratio shows an increasing trend with a decrease observed at high multiplicities. We observe a smooth evolution with multiplicity across all systems, from low multiplicity *pp* collisions to central Pb–Pb collisions. In Fig. 2 also preliminary results from *p*–Pb, Xe–Xe, and Pb–Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV are shown.

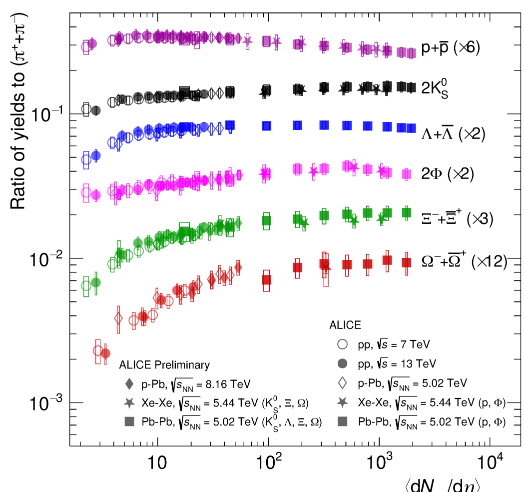

Fig. 2. Relative yields of protons, K^0_S, Λ, ϕ, Ξ, and Ω to π for all the available collision systems measured with the ALICE detector. Error bars show the statistical uncertainty, the empty boxes show systematic uncertainties [8].

4. Conclusion

The ALICE detector proved to be capable of complex studies of light-flavour hadron production in Pb–Pb collisions and also in a new colliding system — Xe–Xe collisions.

In this work, the production of pions, kaons, (anti-)protons, and ϕ mesons is presented in Xe–Xe collisions at $\sqrt{s_{NN}} = 5.44$ TeV. The study of the mean transverse momentum has shown that particles that have similar masses have a similar increase in their $\langle p_{\mathrm{T}} \rangle$. Particle production at the LHC was shown to be not only independent of collision energy but also of the collision system when studied as a function of multiplicity. The obtained integrated yields of strange particles confirm the observation of smoothly increasing production of strange particles in the multiplicity gap between *pp* and Pb–Pb collisions.

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