ISSN 0027-1349, Moscow University Physics Bulletin, 2022, Vol. 77, No. 2, pp. 176–177. © Allerton Press, Inc., 2022.

COLLIDER PHYSICS

Exploring Hadron Spectra in Small Collision Systems at PHENIX

Y. A. Berdnikov[1], A. Y. Berdnikov[1], D. O. Kotov[1], Iu. M. Mitrankov[1], M. M. Mitrankova[1], and V. S. Borisov[1]* (for the PHENIX Collaboration)

[1] *Peter the Great Saint-Petersburg Polytechnic University, St. Petersburg, Russia*

Received January 16, 2022

Abstract—The paper presents the results on $\pi^0, \pi^\pm, K^\pm, K^*$, ϕ and $p(\bar{p})$ production in small collision systems at $\sqrt{s_{NN}} = 200$ GeV as a function of transverse momentum at midrapidity ($|\eta| < 0.35$) measured by the PHENIX experiment.

Keywords: heavy ions, hadrons, QGP, nuclear modification factors

DOI: 10.3103/S0027134922020175

1. INTRODUCTION

The quark-gluon plasma QGP [1] formation in the relativistic heavy ion collisions [2] was supported by observation of various QGP effects such as strangeness and baryon enhancement [1]. However, the influence of cold nuclear mater effects (CNM) on particle production in large collision systems is still under consideration [3]. The study of light hadron production in small collision systems might help to interpret the results obtained in large collision systems and additionally provide a study of the minimal collision system size sufficient for observation of the QGP effects. To study effects affecting the particle production in ultrarelativistic collisions, nuclear modification factors R_{AB} are used [2]. The R_{AB} value is defined as a ratio of hadron production in nuclei-nuclei ($A + B$) collisions to its production in $p + p$ collisions, scaled by number of binary collisions. The deviation of R_{AB} value from unity, might indicate the presence of QGP or CNM effects.

2. RESULTS

Figure 1 presents various light hadron (π^0, $\pi^\pm$, $K^\pm$, K^*, ϕ, and $p(\bar{p})$) R_{AB} measured in the most central $p + $Al and ^{3}He + Au collisions at $\sqrt{s_{NN}} =$ 200 GeV. In both collision systems in the whole available p_T range the R_{AB} values of $K^\pm$, K^*, and ϕ mesons, containing (anti)strange quarks, are consistent with R_{AB} values of π^0, $\pi^\pm$ mesons, that contain only first-generation quarks. In central $p + $Al collisions R_{AB} values of $\bar{p}$ show conformity with light meson R_{AB} values. In ^{3}He + Au collisions (anti)proton yields are enhanced relatively to the binary scaled yields in $p + p$ collisions.

3. CONCLUSIONS

Values of R_{AB} for all light mesons fall in the same curve in both p +Al and ^{3}He + Au collisions. This might indicate that CNM effects are not responsible for the differences between light hadron R_{AB} values seen in heavy ion collisions. Nonetheless, the proton R_{AB} values are larger then light meson R_{AB} values in ^{3}He + Au collisions. This suggests the baryon enhancement might be observed and QGP could be formed in ^{3}He + Au collisions, while $p + $Al system size might be insufficient for observation of this effect.

*E-mail: borisov_vs@spbstu.ru

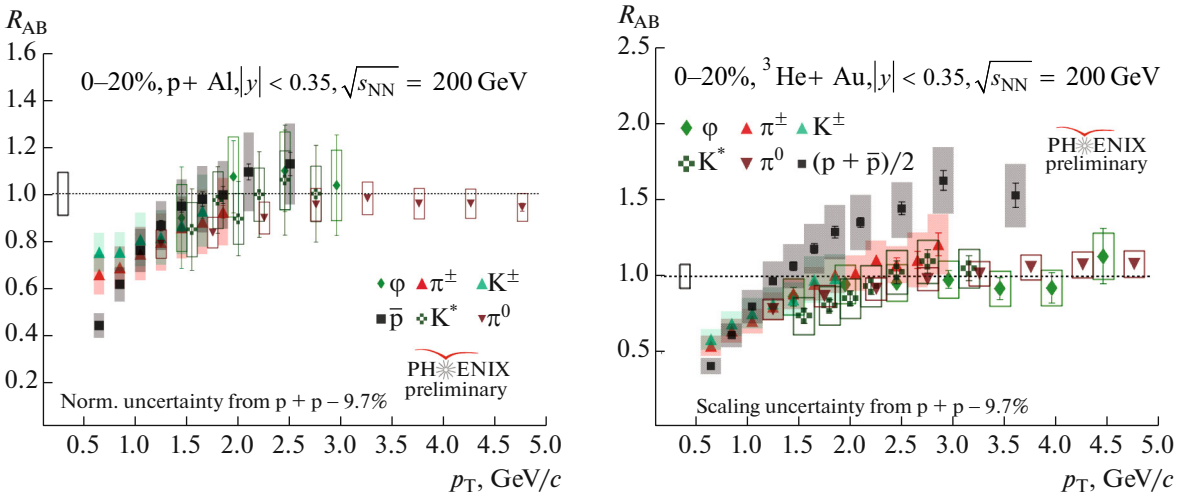

Fig. 1. The π^0, $\pi^{\pm}$, $K^{\pm}$, K^*, ϕ and $p(\bar{p})$ nuclear modification factors in (left) $p+$ Al and (right) ^{3}He + Au collisions at $\sqrt{s_{NN}} = 200$ GeV at midrapidity ($\eta < 0.35$).

FUNDING

We acknowledge support from the Russian Ministry of Education and Science, state assignment for fundamental research (code FSEG-2020-0024) in the ϕ meson part of the analysis.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. K. Adcox et al., "Formation of dense partonic matter in relativistic nucleus-nucleus collisions at RHIC: Experimental evaluation by the PHENIX Collab.," Nucl. Phys. A **757**, 184–283 (2005).
2. A. Ya. Berdnikov et al., "Phi meson measurements in Cu+Au collisions at 200 GeV and in U+U collisions at 192 GeV," J. Phys.: Conf. Ser. **1135**, 012044 (2018).
3. M. M. Mitrankova et al., "Production of light flavor hadrons in small systems measured by PHENIX at RHIC," Phys. Scr. **96**, 084010 (2021).