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Strangeness production in $\sqrt{s_{\rm NN}}$ = 54.4, 27 GeV Au+Au collisions and fixed-target program at STAR

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Strangeness (especially the multi-strangeness) production has been suggested as a sensitive probe to the early dynamics of the deconfined matter created in heavy ion collisions. The ratios of particle yields involving strange particles are often utilized to study various properties of nuclear matter, such as the strangeness chemical potential and the chemical freeze-out temperature. The yield ratios $(N_K N_\Xi)/(N_\phi N_\Lambda)$ and $(N_K N_\Omega)/(N_\phi N_\Xi)$ are suggested in [1] to be sensitive to strange quark density fluctuations. Studying these ratios as a function of collision energy may provide a unique probe to the fluctuation of strange quark densities during the phase transition from the QGP to hadronic matter. Furthermore, the STAR fixed-target program extends the low energy reach from $\sqrt{s_{\rm NN}}$ = 7.7 GeV to 3.0 GeV, corresponding to baryon chemical potential from 420 MeV to about 700 MeV. The comparison between the asymmetric system (Al+Au) and symmetric system (Au+Au) at almost equal number of participating nucleons from most central to mid-central collisions provides useful information on nucleon stopping, which is key to understanding the baryon chemical potential. Moreover, in the asymmetric Al+Au system, the peaks of the rapidity density distributions (dN/dy) are not aligned with the nucleon-nucleon center-of-mass rapidity. The magnitude of the peak shift varies with particle species and also with centrality and can serve as a measure of the baryon stopping.

In this talk, we will present new measurements of mid-rapidity K^0_S, Λ, Ξ and Ω from Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 54.4 and 27 GeV. We will report their spectra, nuclear modification factors and particle ratios compared with thermal calculations. The identified and strange particle distributions in Al+Au at $\sqrt{s_{\rm NN}}$ = 4.9 GeV and Au+Au collisions at $\sqrt{s_{\rm NN}}$ = 3.0 GeV from the STAR fixed-target program will also be presented. These fixed-target results include the transverse mass spectra, rapidity density distributions, particle ratios and centrality dependence of charged and strange hadrons. The physics implications on the collision dynamics will be discussed.

[1] Che Ming Ko, EPJ Web of Conferences 171 (2018) 03002.

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