Light hadron production measurements with Au+Au Collisions from $\sqrt{s_{\rm NN}} = 3.2 - 7.7$ GeV with STAR

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Abstract

One of the main physics goals of the Beam Energy Scan (BES) program at RHIC is to study the QCD phase diagram, especially around the phase transition between the quark-gluon plasma (QGP) and hadronic matter. BES Phase-I studied Au+Au collisions from center-of-mass energy ($\sqrt{s_{\rm NN}}$) of 7.7 to 62.4 GeV. BES Phase-II extended these measurements in several important ways, one of which was the addition of a fixed-target program that pushed the collision energy down to 3.0 GeV (or baryon chemical potential, $\mu_{\rm B}$, up to 720 MeV). Fixed-target collisions at STAR allow for a more extensive scanning of the QCD phase diagram to an important region where the QCD critical point may lie, and to a region dominated by dense baryonic matter. One key measurement in the fixed-target program is the spectrum of the lightest hadrons ($\pi^{\pm}$, $\rm K^{\pm}$, p) as a function of transverse momentum, rapidity, and collision centrality. Such measurements enable the empirical determination of the colliding system's location on the phase diagram at chemical freeze-out. Moreover, signatures regarding the production of the lightest hadrons have been proposed as a signature of a first order phase transition between hadronic matter and QGP. Specifically, studying the rapidity density distribution (dN/dy) of protons as a function of center-of-mass energy has been suggested as a way to probe the nature of the QCD phase transition from QGP to hadron gas. This talk details the latest status of the light hadron production measurements at STAR, and the proton dN/dy measurements are shown from $\sqrt{s_{NN}} = 3.0 - 4.5$ GeV .