Particle production in Au+Au collisions at Beam Energy Scan II energies at RHIC

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Abstract

Quantum Chromodynamics (QCD), the theory of strong interactions, predicts that at sufficiently high temperature and/or high energy density, normal nuclear matter converts into a deconfined state of quarks and gluons, known as the Quark-Gluon Plasma (QGP). To investigate the phase diagram of the QCD matter, the Relativistic Heavy Ion Collider (RHIC) started the first phase of the Beam Energy Scan (BES-I) program in 2010, delivering Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7 to 62.4 GeV. The success of the BES-I program justified the second phase of Beam Energy Scan (BES-II) with higher statistics and detector upgrades. Au+Au collisions at $\sqrt{s_{\rm NN}}$= 7.7 − 54.4 GeV were collected during 2017 − 2021, covering a large area of the QCD phase diagram in temperature and baryon chemical potential by varying the collision energy, centrality, and rapidity. In particular, the installed Event Plane Detector (EPD) enables the measurement of charged particle production at far-backward pseudorapidity.

In this talk, we present pseudorapidity distributions of charged particles in Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7 to 27 GeV with the EPD ($2.15 < |\eta| < 5.09$). We will also present the transverse momentum spectra of identified hadrons ($\pi^{\pm}$, $K^{\pm}$, p and $\bar{p}$) in Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7 to 54.4 GeV within mid-rapidity ($|y| < 1$). The mid-rapidity yields of identified hadrons show the expected signatures of large baryon stopping at lower energies and the dominance of pair production at higher energies. The centrality dependence of integrated yields (dN/dy and dN/dη), average transverse momenta ($\langle p_T \rangle$), particle ratios, chemical and kinetic freeze-out parameters will also be presented. These results will be compared to published results at other collision energies and the new insights to the QCD phase diagram will be discussed.