Study of Au+Au Collisions in CBM Energy Regime using HYDJET++

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Introduction

The Compressed Baryonic Matter (CBM) experiment at the future Facility for Antiproton and Ion Research (FAIR) will be devoted to heavy ion collisions in fixed target mode. The CBM experiment at incident beam energies up to 45 AGeV in Au+Au collisions will provide tool to study the properties of strongly interacting matter at moderate temperature but high net baryon densities.The main goal of the CBM physics program is to explore the QCD phase diagram in the region of high baryon densities using high energy nucleus-nucleus collisions. This includes the study of the equation of state of nuclear matter at neutron star core densities and the search for the deconfinement and chiral phase transitions [1]. Apart from this, it is also important to characterize the nuclear collisions and try to visualize underlying physics in a heavy ion experiment. In heavy ion experiments, the dynamics and other various properties of collisons can be studied via kinematic observables like particle yields, rapidity, psuedorapidity, transverse momentum distributions and elliptic flow of charged particles.The pseudorapidity distributions ($dn/d\eta$) and transverse momentum (p_T) distributions of final state particles can often be used to test different phenomenological models. In this work, an attempt has been made with HYDJET++ model [2, 3] in CBM energy regime with generation of Au+Au events at lab energy of 40 AGeV (which corresponds to 8.765 GeV center of mass energy) to investigate the produce particles with transverse momentum and the psuedorapidity variable with charge particle multiplicities.

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HYDJET++ Model

HYDJET++ is a Monte Carlo event generator for simulation of relativistic heavy ion collisions. It simulates heavy ion collisions as a superposition of the soft (hydro type state) and hard (jet type) state coming from multi parton fragmentation. HYDJET++ includes detailed treatment of soft hydroproduction as well as hard multi parton production and takes into account medium induced parton scattering and energy loss. HYDJET++ model is an upgraded version of HYDJET event generator [4] with some additional features. HYDJET++ program is written in C++ language under the ROOT framework. The hard part of HYDJET++ event is based on PYQUEN patronic energy loss model which creates initial parton spectra according to PYTHIA and jet production vertices at given impact parameter; radiative and collisional energy loss of partons traversing through their defined path in QCD medium. The soft part of HYDJET++ is the thermal hadronic state on the chemical and thermal hypersurfaces obtained from the parametrization of relativistic hydrodynamics with freeze out conditions. It is assumed that at a given temperature (T) and chemical potentials (μ_b, μ_s, μ_Q), a hydrodynamic expansion of the fireball ends by a sudden system breakup and the momentum distribution of produced hadrons keeps the thermal character of the Lorentz invariant distribution function. This thermal method provides 4-momentum and spatial positions of hadrons in the rest frame. The thermal hadronic state in HYDJET++ contains stable hadrons and resonances pro-

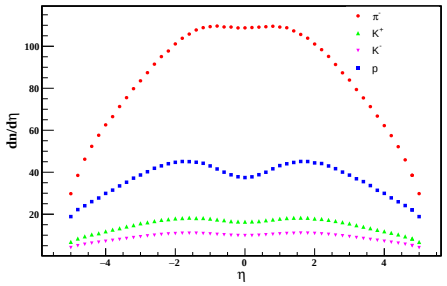

FIG. 1: The pseudorapidity distribution of chargded hadrons in Au+Au collisions at E_{lab} = 40 AGeV.

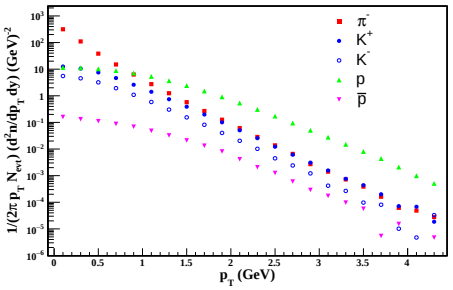

FIG. 2: The transverse momentum distribution of chargded hadrons in Au+Au collisions at E_{lab} = 40 AGeV.

duced from the SHARE particle data table [5] which contains 360 particles.

Results and Outlook

We have analyzed the charged particle pseudorapidity distributions $(dn/d\eta)$ of produced hadrons (π^-, k^-, k^+, p) and transverse momentum distribution of $\pi^-, k^+, k^-, p, \bar{p}$ for 0-5% most central Au+Au collisions at E_{lab} = 40 AGeV. It can be clearly observed from FIG. 1 that the charged particle (π^-) multiplicity is three times of proton while ten time greater than to the kions in most central Au+Au collisions with HYDJET++ model. This model also gives a reasonable p_T distribution spectra of different hadron species as shown in FIG. 2. The slope of p_T distribution increases for produced particles and actually indicates the inverse of source temperature from which these particle are produced. We have used a pseudorapidity cut as $\mid \eta \mid \geqslant 1$ to study the transverse momentum distribution. These results are preliminary in nature and obtained for only 20000 Au+Au events. Further, we are working to analyze these results by increasing the statistics and to study the elliptic flow distribution of produced charged hadrons.

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