Λ and Σ hyperon productions at CBM energies.

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The study of strangeness in the detection of quark gluon plasma (QGP) in the heavy ion collision at relativistic energies has been considered with high importance since decades. The strangeness enhancement in heavy ion collisions over proton-proton collisions at relativistic energies was proposed as a signal of quark gluon plasma (QGP) [1] formation. The experimentally observed non-monotonic structure of the ratio K^+/π^+ ($\equiv$ strangeness/entropy) and Λ/π^+ [2–5]) with center of mass energies triggered intense debate in last few years. The strangeness productions both in quark matter and hadronic matter have been investigated by many theoretical models [6–10] and some models [11–18] came up with the explanation of the horn like non-monotonic structure. In this work a similar study has been done primarily for the compressed baryonic matter to be produced at FAIR (Facilitation for Anti-proton and Ion Research) energies. The strange hadron productions have been investigated using momentum integrated Boltzmann equation for E_{lab} =10 A GeV to 45 A GeV. Basically we focus on the production of strange baryons like Λ and Σ.

The system produced in the collision of two nuclei may create a partonic or hadronic matter depending on the energy dumped at the point of collision. We investigate both scenarios for strangeness productions and consider the productions in terms of strange quarks and anti quarks in partonic medium and in terms of strange hadrons in hadronic medium. For higher colliding energies, there is a possibility of QGP formation which may under go a transformation to a hadronic matter. With such possibilities we consider the strangeness production in the following way. The processes of gluon fusion and light quarks annihilation have been accounted for production of strange quarks (s, $\bar{s}$) in a patronic phase. These quarks hadronise to strange mesons and baryons via a first order phase transition. In a hadronic medium the production of Λ and Σ hyperons along with other strange mesons are considered owing to an exhaustive set of reactions involving baryons. The possibility of formation of a fully equilibrated system in a high energy nuclear collisions is a fiercely debated issue because of the finite size and life time of system. All the constituents of the produced system may not be in equilibrium for all colliding energies. Here in a partonic medium the strange quarks are assumed to be away from equilibrium where the light flavors are in equilibrium. Similarly in a hadronic scenario the strange hadrons and nucleons are considered to be away from equilibrium where as π, ρ, η are in equilibrium. The time evolution of the densities of strange particles are treated using the Boltzmann equation.

In the present work we use momentum integrated Boltzmann equation to study the evolution of the strange quarks and anti quarks in the QGP phase or Λ and Σ hyperons in the hadronic phase. The coupled equations describing the evolution with proper time τ are solved for QGP as well as hadronic phase.

The gluon-gluon fusion and quark anti-quark annihilation processes are considered for the production of strange quarks (anti quarks). The dominant processes for Λ production in hadronic phase are $\pi N \rightarrow \Lambda K$,

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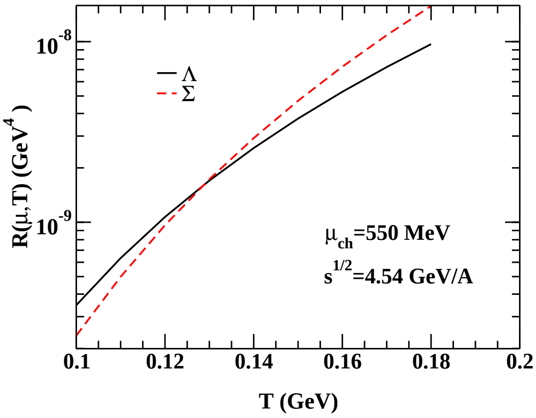

FIG. 1: The rate of Λ and Σ production for E_{lab}=10 AGeV as a function of temperature.

$\pi N \rightarrow \Lambda\pi K$, $\rho N \rightarrow \Lambda K$, $NN \rightarrow N\Lambda K$, $N\Delta \rightarrow N\Lambda K$, $\Delta\Delta \rightarrow N\Lambda K$, $NN \rightarrow N\Lambda\pi K$ and $NN \rightarrow N\Lambda\pi\pi K$. Similarly the reactions for Σ productions in hadron phase are $\pi N \rightarrow \Sigma K$, $\pi N \rightarrow \Sigma\pi K$, $NN \rightarrow N\Sigma K$, $N\Delta \rightarrow N\Sigma K$, $\Delta\Delta \rightarrow N\Sigma K$, $NN \rightarrow N\Sigma\pi K$ and $NN \rightarrow N\Sigma\pi\pi K$. The Fig. 1 describes the equilibrium production rate of Λ and Σ with temperature. The calculation is done for E_{lab}=10 A GeV ($\sqrt{s_{NN}}$=4.54 GeV). The baryonic chemical potential is taken from [15, 19]. At lower temperature the rate of Λ production is higher compared to Σ but at high temperature Σ has a higher rate for a constant μ_B. The details will be presented in the symposium. Here the aim is to calculate the Λ/K and Σ/K ratio for different energies.

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