Systematics of baryon spectra and m_T scaling in p+p and Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV

P. K. Khandai [1],* P. Shukla[2], and V. Singh[1]
[1] *Department of Physics, Banaras Hindu University, Varanasi 221005, India and*
[2] *Nuclear Physics Division, Bhabha Atomic Research Center, Mumbai 400085, India*

Introduction

In heavy ion collisions at RHIC, strongly interacting matter is under investigation and many signals point to the formation of quark gluon plasma (QGP). To disentangle the QGP signals, it is also important to understand particle production in smaller collision systems like p+p and d+A collisions. The m_T scaling of hadrons allow the extrapolation to unknown regions needed to obtain the cocktail of decay products from produced hadrons and to get hadron ratios for freeze out conditions. In an earlier study, we tested the m_T scaling method to obtain the meson spectra from measured pion spectrum for p+p, d+Au and Au+Au systems at $\sqrt{s_{NN}}$ = 200 GeV [1].

This is extended to baryons in the present work. We studied proton and strange baryons such as Λ, Ξ and Ω with different strangeness contents measured in p+p and Au+Au collisions at RHIC at $\sqrt{s_{NN}}$= 200 GeV.

Fit procedure using m_T scaling

We parameterize proton spectra with Hagedorn distribution given by

$$E\frac{d^3N}{dp^3} = \frac{A}{\left[\exp(-am_T - bm_T^2) + \frac{m_T}{p_0}\right]^n} \quad (1)$$

where A, a, b, p_0 and n are the fit parameters. The proton spectra measured in p+p and Au+Au systems are fitted using this distribution. Then we obtain the spectra of other baryons using m_T scaling. The relative normalization S of the m_T scaled spectra is then fitted to the experimental data for all other baryons in p+p and Au+Au collisions and are given in Table I.

All the data of baryons are within a rapidity range ($|y| < 0.75$).

TABLE I: The relative normalization S, for p+p and Au+Au at $\sqrt{s_{NN}}$ = 200 GeV.

	p+p	Au+Au (%)			
S	MB	10-20	20-40	40-60	60-80
Λ/p	0.725	0.701	0.700	0.685	0.731
Ξ^-/p	0.126	0.137	0.145	0.141	0.152
Ω^-/p	0.051	0.127	0.110	0.107	–

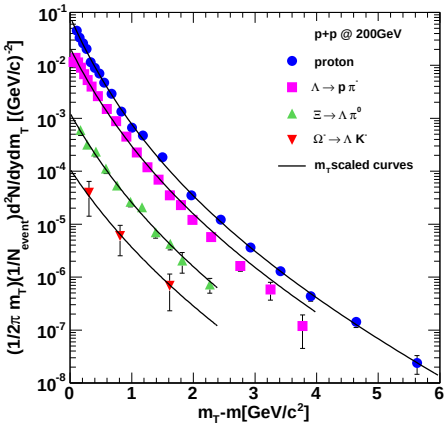

FIG. 1: The m_T spectrum of proton [2], Λ, Ξ and Ω [3] for p+p collision.

Results and Discussions

Figure 1 shows the measured proton spectrum [2] in p+p collisions along with the fit obtained using Eq. 1. The measured strange baryon [3] spectra along with m_T scaled curves are also shown. Here we see that m_T scaled

*Electronic address: pkkhandai@gmail.com

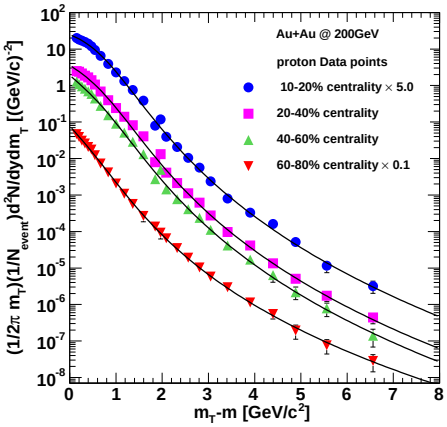

FIG. 2: The m_T spectrum of proton in Au+Au collisions.

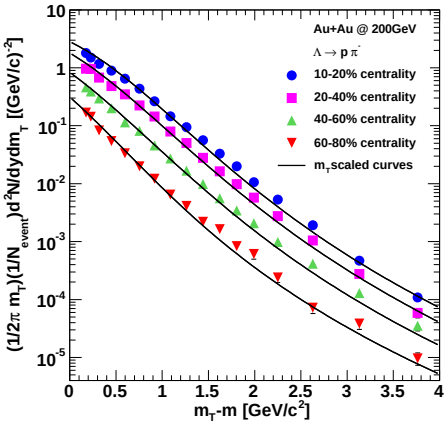

FIG. 3: The m_T spectrum of Λ in Au+Au.

spectra of baryons reproduce the data of all baryons well in p+p collisions.

Figure 2 shows proton spectra measured in Au+Au collisions for different centralities such as 10-20 % , 20-40 % , 40-60 % and 60-80 % [4] along with Hagedorn fits. The figures 3 and 4 are for measured Λ and Ξ spectra [5], respectively along with m_T scaled curves.

We observe that the Λ spectrum closely follow the m_T scaling obtained from protons. But the spectral shapes of Ξ^- and Ω^-

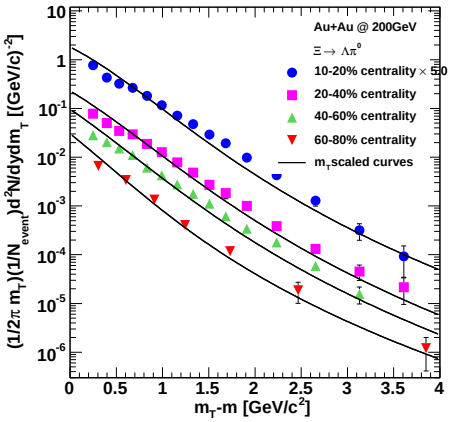

FIG. 4: The m_T spectrum of Ξ in Au+Au collisions.

(not shown here) are different from protons. The relative normalizations as shown in Table I for Ξ^- and Ω^- increase when we go from p+p system to Au+Au system showing net strangeness enhancement in Au+Au collisions. In addition, we do not observe a noticeable centrality dependence in this ratio.

To summarize, in p+p system the m_T scaling works well for strange baryons. For Au+Au system the scaling does not work for the multi strange baryons such as Ξ^- and Ω^-. The ratio of these particles over protons increases when we go from p+p system to Au+Au system but we do not observe a noticeable centrality dependence in this ratio.

References

[1] P. K. Khandai, P. Shukla and V. Singh (Submitted in PRC) (2011).
[2] B. I. Abelev et al. (STAR), Phys. Rev. **C 75**, 64901 (2007).
[3] J. Adams et al. (STAR), Phys. Lett. **B 637**, 161 (2006).
[4] J. Adams et al. (STAR), Phys. Rev. Lett. **97**, 132301 (2006).
[5] J. Adams et al. (STAR), Phys. Rev. Lett. **98**, 62301 (2007).