Mid-rapidity proton and anti-proton production at RHIC

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In the search for a decon£nded state of hadronic matter, baryons play a key role. It is baryons – namely protons and neutrons – that carry the initial beam energy. Therefore, all energy used for particle production comes from these initial baryons. Empirically it has been observed that the net-baryon number determines the chemical properties of the system. Baryons, baryon number transport and baryon production during the collision are particular interesting because of their dynamical behaviour[1].

We report proton and anti-proton transverse momentum (p_t) and rapidity (y) distributions from ^{197}Au+^{197}Au collisions at $\sqrt{s_{\rm NN}} = 130$GeV as measured by the STAR experiment at RHIC. The results reported here are from the rapidity and transverse momentum range of $|y| < 0.4$ and $0.40 < p_t < 0.85$ GeV/c. For both proton and anti-proton, the transverse momentum distributions become ¤atter as one moves from peripheral to central collisions. Thus the mean transverse momentum increases with collision centrality. This indicates the importance of rescattering. The rapidity distributions are found to be relatively ¤at within $|y| < 0.4$.

The upper panel of Fig. 1 shows the measured mean transverse momentum $\langle p_t \rangle$ for protons and anti-protons as a function of the number of negatively charged hadrons. The experimentally increasing values of $\langle p_t \rangle$ are reasonably well reproduced by results of RQMD transport model[2] calculations, shown by the solid lines. In contrast, results from the HIJING/B$\overline{\rm B}$– and HIJING[3] transport model clearly underpredict the experimental data, as shown by dashed and dashed-dotted lines, respectively. The vital difference between these two model approaches is that in RQMD multiple rescattering among hadrons has been implemented, while no rescattering takes place among hadrons in the HIJING model. The increase of $\langle p_t \rangle$ as a function of centrality indicates a stronger collective expansion in more central collisions. It should be emphasized that although RQMD reproduces the particle transverse motion to some extent, it does not necessarily mean that rescattering only occurs among hadrons. The lower panel of Fig. 1 shows the mid-rapidity yield dN/dy for protons and anti-protons as a function of the number of negatively charged hadrons. It is clear that neither model describes the mid-rapidity density of protons and anti-protons in a satisfying manner. However, the results from HIJING without the baryon-anti-baryon junction mechanism (B$\overline{\rm B}$) are closest to the experimental data.

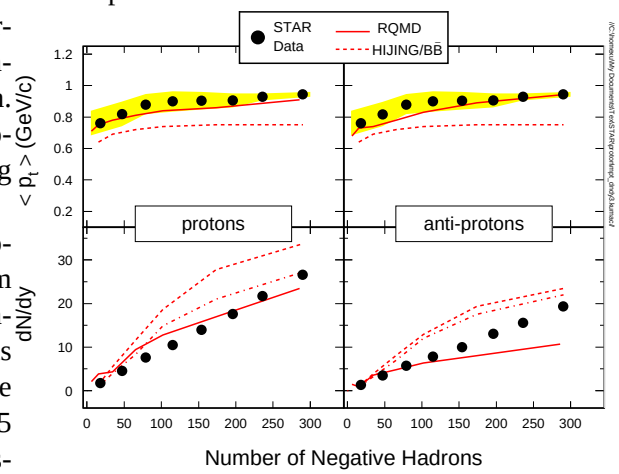

Figure 1: *Upper panel: Mid-rapidity mean transverse momentum $\langle p_t \rangle$ of protons (left) and anti-protons (right) as a function of the number of negatively charged hadrons. Lower panel: Mid-rapidity yields dN/dy for protons (left) and anti-protons (right). The lines show results of transport model calculations with RQMD (solid lines), HIJING/B$\overline{\rm B}$ (dashed lines) and HIJING (dashed dotted lines), respectively.*

Footnotes and References

[1] W. Busza and R. Ledoux, Annu. Rev. Nucl. Part. Sci. **38**, 119(1988); F. Videbaek and O. Hansen, Phys. Rev. **C52**, 2684(1995).

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