Inverse Slope Systematics in High-Energy p+p and Au+Au Reactions *

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We employ the Monte-Carlo model PYTHIA [1], version 6.115, to calculate the transverse mass spectra of various hadrons and their inverse slopes T^* at $m_T - m = 1.5 - 2$ GeV in p+p reactions at $\sqrt{s} = 200$ GeV. The fragmentation of mini-jets is expected to be the dominant source of hadrons with high transverse masses. Single-jet production is calculable within pQCD and is incorporated in PYTHIA. The Lund string scheme is used for the nonperturbative hadronization mechanism. The tunnel probability of quark-antiquark pairs in the color flux tube is proportional to $\exp(-\pi m_T^2/\kappa)$, where κ is the string tension. Mini-jets which produce hadrons with large transverse masses are oriented perpencicular to the beam axis. Then, the longitudinal momentum of produced hadrons with respect to the string axis translates into transverse momentum with respect to the beam axis. The tunnel formula leads to a strong suppression of heavy quarks. The probability for producing a light quark as compared to a charm quark is about $1 : 10^{-11}$.

Due to (multiple) minijet production and fragmentation T^* increases systematically as a function of the hadron mass, see Fig. 1. Moreover, the $T^*(m)$ systematics has a "discontinuity" at the charm threshold, i.e. the inverse slope of D-mesons is much higher than that of non-charmed hadrons and even of the heavier Λ_C baryon. The reason is that D-mesons can only be produced as the leading hadron from a $c/\bar{c}$ quark jet. The m_T-distribution of charmed or non-charmed baryons, on the other hand, is 'softer' since it involves tunneling of a diquark-antidiquark pair out of the vacuum

The experimental observation of this characteristic behaviour in Au+Au collisions would indicate the absence of c-quark rescattering. In contrast, the assumption of thermalized partons and hydrodynamical evolution would lead to a smoothly increasing $T^*(m)$, without discontinuity at the charm threshold. This is shown for different initial conditions and freeze-out assumptions in Fig. 1. Thus, the $T^*(m)$ systematics at $m_T - m \simeq 1 - 3$ GeV provides an opportunity to experimentally determine the degree of mini-jet rescattering and equilibration in relativistic heavy ion collisions.

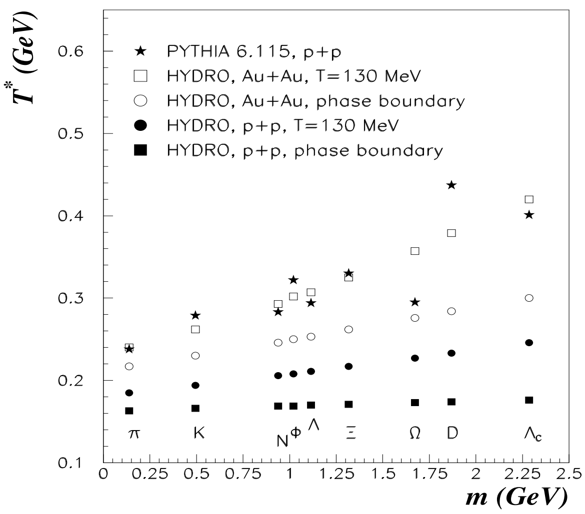

Figure 1: Inverse slopes (at midrapidity, $y = 0$) as a function of hadron mass; PYTHIA 6.115 predictions for p+p at $\sqrt{s} = 200$ GeV, and results from hydrodynamics of p+p and Au+Au (calculated on the boundary between mixed and hadronic phase and on the $T = 130$ MeV isotherm, respectively).

[1] T. Sjöstrand, Comput. Phys. Comm. 82 (1994) 74.

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