Strange Particle Production in Heavy Ion Collisions^{B}

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Strangeness production in heavy ion collisions at relativistic energies provides one of the key information about the reaction mechanism and could indicate the onset of new phenomena.

The attempts to describe the measured particle ratios including strange hadrons at AGS and SPS and recently also at RHIC using a strangeness fugacity are very successful [1]. However, the usual grand-canonical treatment of strangeness conservation is not sufficient, if the number of strange particles is small [2]. This requires local strangeness conservation which is done in the statistical model using the canonical formulation of strangeness conservation [3]. The canonical approach describes the measured particle ratios at SIS energies and is able to explain the different excitation functions of K^+ and K^- around 1 A·GeV [3].

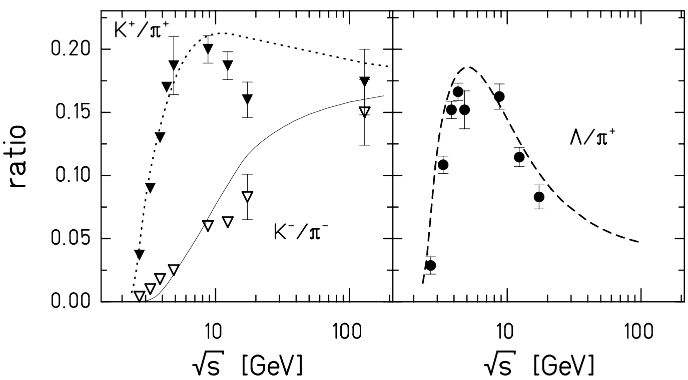

Figure 1: *Trend of particle ratios as a function of $\sqrt{s}$. The lines represent the statistical-model calculations. Left: K^+/π^+ ratio (full points, dotted line) and K^-/π^- ratio (open points, solid line). Right: Λ/π ratio.*

Recently, the evolution of the K^+/π^+ ratio as a function of $\sqrt{s}$ has attracted great interest as a maximum seemed to appear around 40 A·GeV. Figure 1 shows this ratio obtained at midrapidity from SIS energies up to RHIC [4]. Indeed, a maximum around the data point obtained at 40 A·GeV seems to show up.

The behaviour of K^-/π^-, however, is very different. At low incident energies it is much lower than K^+/π^+. Yet it rises continuously up to the highest energies.

These trends predicted by the statistical model are nicely confirmed by the new results from RHIC: With increasing energy K^+/π^+ decreases while K^-/π^- increases.

The origin of these trends can be explained by the evolution of the freeze-out parameters T and μ_B with $\sqrt{s}$ [6]. A study of the K^+/π^+ ratio or even clearer of the more general quantity strange-to-nonstrange partciles (Wroblewski factor $\lambda_s \equiv 2\langle s\bar{s}\rangle/(\langle u\bar{u}\rangle + \langle d\bar{d}\rangle)$, (where the quantities in angular brackets refer to the number of newly formed quark-antiquark pairs) has evidenced a maximum in the strangeness content around 30 A·GeV [5] as shown in fig. 2.

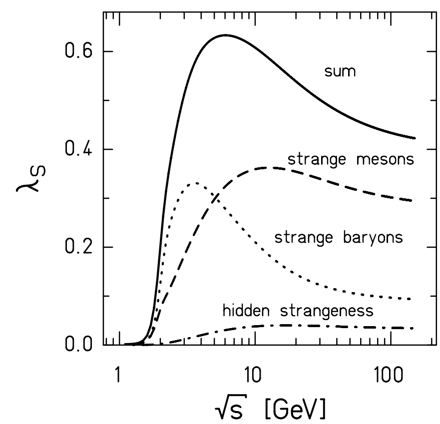

Figure 2: *Contributions to the Wroblewski factor (for definition see text) from strange baryons (dotted line), strange mesons (dashed line) and mesons with hidden strangeness (dash-dotted line). The sum of all contributions is given by the full line.*

This maximum arises from the shape of the freeze-out curve. The decrease towards higher energies occurs as T is no longer increasing but μ_B decreases strongly. The change of μ_B causes that the respective contribution of strange mesons and strange baryons as given in fig. 2. As can be seen, strange baryons exhibit a very pronounced maximum. Recent data allow to test this prediction. The measured Λ/π ratio is given in fig.1 together with the results from the statistical model confirming the strong decrease towards higher incident energies.

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