Hyperon yields in Pb-Pb collisions from the NA57 experiment

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The new results on hyperon production in Pb-Pb collisions at 158 A GeV/c and 40 A GeV/c are presented.

1. Introduction

The study of strange particle production in ultra-relativistic nuclear collisions plays an important role in the search for deconfined quark-gluon matter. The strangeness enhancement, i.e. the enhanced abundance of strange particles in central nucleus-nucleus with respect to proton–proton and proton–nucleus interactions, has been suggested as a sensitive probe of the transition to quark-gluon plasma (QGP) phase [1–3]. In the QGP scenario, such an enhancement could be created as a result of rapidly developing flavour equilibration. The equilibration time is estimated to be comparable with the interaction time of the high energy heavy-ion collision (a few fm/c). For a purely hadronic system the characteristic time scale for equilibration is expected to be an order of magnitude longer. It is predicted that the enhancement should be more pronounced for multi-strange than for singly-strange particles [4].

The aim of NA57 is to study the dependence of the strangeness enhancement on the interaction volume (measured by the number of wounded nucleons, i.e. nucleons which undergo at least one primary inelastic collision with another nucleon [5]) and on the collision energy per incoming nucleon. The centrality range of the NA57 experiment extends down to a limit of about 50 wounded nucleons. The experiment has collected data using 158 and 40 A GeV/c beams at the CERN SPS.

2. The NA57 experiment

A detailed description of the NA57 set-up can be found in [6,7].

Strange and multi-strange particles are identified by reconstructing their weak decays into final states containing only charged particles (e.g. $\Xi^- \to \Lambda + \pi^-, \Lambda \to \mathrm{p} + \pi^-$) in the silicon telescope. The acceptance windows cover about one unit of rapidity, centered at mid-rapidity for transverse momenta down to a few hundred MeV/c [6]. The centrality trigger for Pb-Pb, based on a system of scintillator detectors, selects about the 60% most central collisions at both 158 A GeV/c and 40 A GeV/c. The centrality of the collision is determined from the charged particle multiplicity, sampled at central rapidity by silicon strip detectors. Reference p–Be data at 40 GeV/c were also collected. The analysis is in progress. As a reference data at 158 A GeV/c we use the WA97 p–Be and p–Pb data samples [8].

In the following, we are describing the results on the Ξ and Ω production at both 158 A GeV/c and 40 A GeV/c.

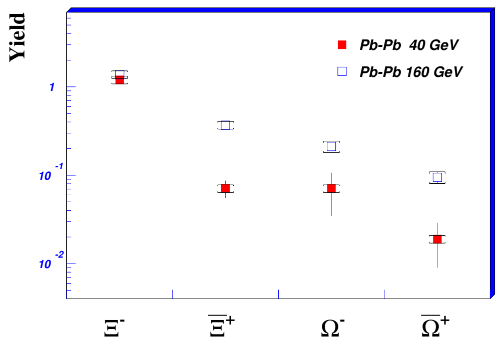

Figure 1. The Ξ^-, $\overline{\Xi}^+$, Ω^-, $\overline{\Omega}^+$ yields in 25% most central Pb-Pb collisions at 40 A GeV/c and 158 A GeV/c. Square bars represents systematic errors.

3. Results

The hyperon signals in Pb-Pb collisions at 158 A GeV/c and at 40 A GeV/c are shown in [9]. Data were corrected for acceptance and efficiency losses by calculating a weight for each particle with a GEANT based Monte-Carlo simulation.

The fully corrected yields extrapolated to $p_T > 0$ and $|y - y_{cm}| < 0.5$ for 25% most central Pb-Pb collisions, both at 158 A GeV/c and 40 A GeV/c, are shown in Fig. 1. While the Ξ^- production rates are similar at both energies, the yields for $\overline{\Xi}^+$, Ω^-, $\overline{\Omega}^+$ are smaller by a factor 3 to 5 at 40 A GeV/c relative to 160 A GeV/c. Such a behaviour can be expected due to the increase of the baryon density as the beam momentum decreases.

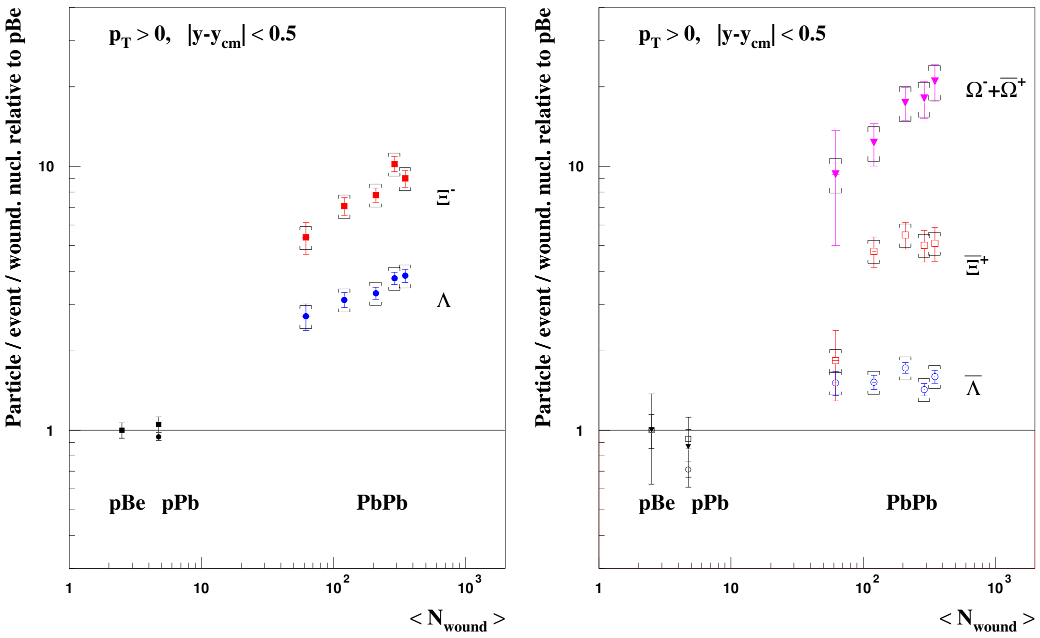

Figure 2. Yields per wounded nucleon in Pb-Pb relative to the p-Be at 158 A GeV/c as a function of number of wounded nucleons. Square bars represent systematic error.

The Pb-Pb collisions data at 158 A GeV/c were divided into five centrality bins. For the details of the multiplicity analysis see [9,10]. The dependence of the yields per wounded nucleon in Pb-Pb relative to p-Be on the centrality of Pb-Pb collisions is shown in Fig. 2.

4. Conclusions

The NA57 results at 158 A GeV/c confirm the hyperon enhancements measured by the WA97 experiment [8]. As already observed by the WA97 experiment, the enhancements increase with a strangeness content up to a factor 20 for Ω. There is indication of an increase of the enhancements with centrality of the collisions.

Ξ and Ω yields indicate larger baryon density at 40 A GeV/c with respect to 158 A GeV/c beam energy.

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