Fast Ξ^- reconstruction in Au+Au collisions at 10A GeV with the CBM experiment

I. Vassiliev[1,2] *and V. Akishina*[3]

[1]Goethe University, Frankfurt, Germany; [2]GSI, Darmstadt, Germany; [3]Moscow State University, Moscow, Russia

The main goal of the CBM experiment is to study the behaviour of nuclear matter at high baryonic densities. At these extreme states of strongly interacting matter, the transition to a deconfined quark gluon plasma phase is expected. As a signature of the deconfined phase the enhanced production of multi-strange particles is predicted. At CBM, multi-strange hyperons such as the double-strange Ξ^- will be identified by their decay into charged hadrons, which are detected with the Silicon Tracking System (STS).

To study the feasibility of the (fast) reconstruction of Ξ^- as well as Λ and K_s^0 with CBM, a set of 5k central Au+Au UrQMD events at 10A GeV was simulated. Such an event contains on average 12 K_s^0, 20 Λ and 0.18 Ξ^-. The Ξ^- decays into $\Lambda + \pi^-$ with a branching ratio of 99.9% and $c\tau$ = 4.91 cm.

The STS geometry with 8 double-sided segmented strip detectors was used for tracking. No kaon, pion or proton identification is applied. In order to reconstruct the $\Lambda \rightarrow p\pi^-$ decay, the proton mass was assumed for all positively charged tracks and the pion mass for all negatively charged ones. K_s^0 is reconstructed assuming the pion mass for both tracks. The combination of single track cut ($\chi^2_{prim} > 3\sigma$) and geometrical vertex cut ($\chi^2_{geo} < 3\sigma$) allows to see a clear signal (see Figs. 1 and 2) of K_s^0 and Λ.

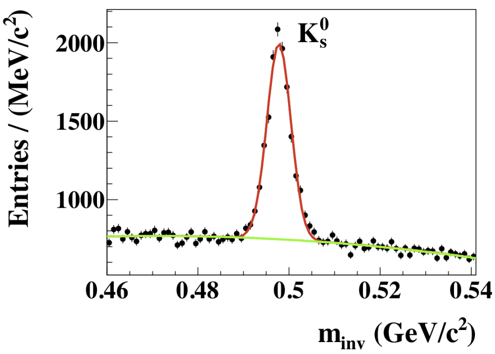

Figure 1: The $\pi^+\pi^-$ invariant-mass spectrum. About 1.6 K_s^0 per event were reconstructed. The red line shows a Gaussian fit to the signal, the green line the polynomial background.

The Ξ^- reconstruction includes several steps: tracks with $\chi^2_{prim} > 3\sigma$ are selected for a Λ search, where oppositely charged tracks were paired to form a Λ-candidate; a good quality geometrical vertex ($\chi^2_{geo} < 3\sigma$) was required to suppress combinatorial background. The invariant mass of the reconstructed pair is compared with the

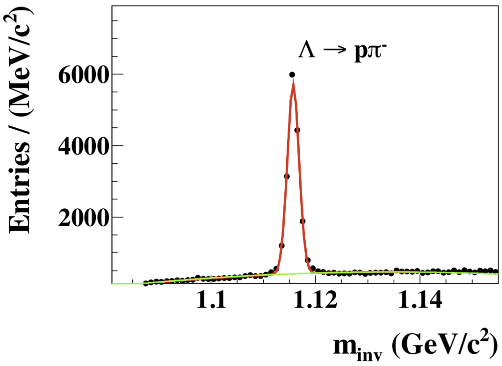

Figure 2: The proton π^- invariant-mass spectrum. About 2.8 Λ per event were reconstructed. The red line shows a Gaussian fit to the signal, the green line the polynomial background.

Λ mass value; only pairs inside $1.116 \pm 6\,\sigma = 10$ MeV were accepted; primary Λ rejection, where only Λ with $\chi^2_{prim} > 5\sigma$ and z-vertex greater than 4 cm are chosen. The selected Λs were combined with secondary π^- tracks ($\chi^2_{prim} > 3\sigma$) and Ξ^--KFParticle were created. A Ξ^--KFParticle was accepted as a Ξ^- candidate if it had good quality geometrical and topological vertex reconstructed more than 3 cm downstream the target plane.

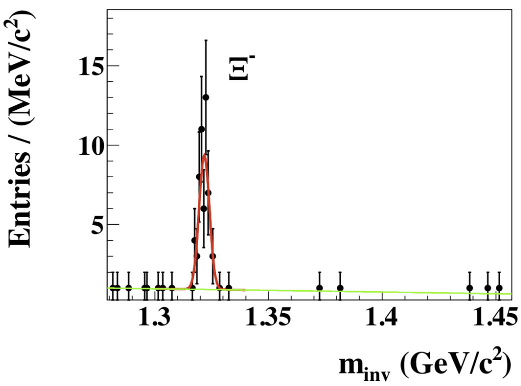

Figure 3: Reconstructed invariant-mass spectrum of $\Lambda\pi^-$ candidates. 51 Ξ^- were reconstructed. The S/B ratio is about 17, the reconstructed mass value is 1.321 GeV/c^2

The resulting invariant-mass spectrum is shown in Fig. 3. The signal reconstruction efficiency is about 5.5%. The reconstructed mass value of 1.321 ± 0.0023 GeV/c^2 agrees well with the simulated one.