Feasibility study of Ω^- reconstruction with the CBM experiment at SIS-300

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One of the predicted signatures of a phase transition from nuclear matter to a deconfined quark gluon plasma phase is the enhanced production of multi-strange particles. Also, the yield of particles carrying strange quarks is expected to be sensitive to the fireball evolution. Consisting of 3 strange quarks, the Ω^- hyperon is one of the most interesting objects. It will be identified by its decay into charged hadrons, which are detected by the Silicon Tracking System (STS) and the Time-of-Flight detector (TOF) of the CBM experiment.

To study the feasibility of the Ω^- decay reconstruction with CBM, a set of 10k central Au+Au UrQMD events at 25A GeV were simulated. The Ω^- decays into $\Lambda + K^-$ with a branching ratio of 67.8% and $c\tau$ = 2.46 cm. Since the Ω^- is rare at 25A GeV central Au+Au UrQMD events (0.022 per event), in each UrQMD event a Ω^- decay into $\Lambda + K^-$, generated by PYTHIA, was embedded.

The STS geometry with 8 double-sided segmented strip detectors was used for track reconstruction; TOF is applied for proton identification. Λ decays most often happen inside the STS detector. In order to reconstruct the $\Lambda \rightarrow p\pi^-$ decay, each identified proton track was combined with every negatively charged track assuming the pion mass for the latter.

The Ω^- event reconstruction includes the usual steps described in [1]: fast track finding and fitting [2, 3], Λ search and selection of secondary Λ.

The selected secondary Λ candidates (Fig. 1) were combined with secondary negatively charged tracks assuming the kaon mass, K^- ($\chi^2_{prim} > 7\sigma$), and Ω^--KFParticle were created. An Ω^--KFParticle was accepted if showing a reasonable quality of the geometrical and topological detached vertex: ($\chi^2_{geo} < 3\sigma$, $\chi^2_{topo} < 3\sigma$) and z-vertex > 3 cm downstream the target plane.

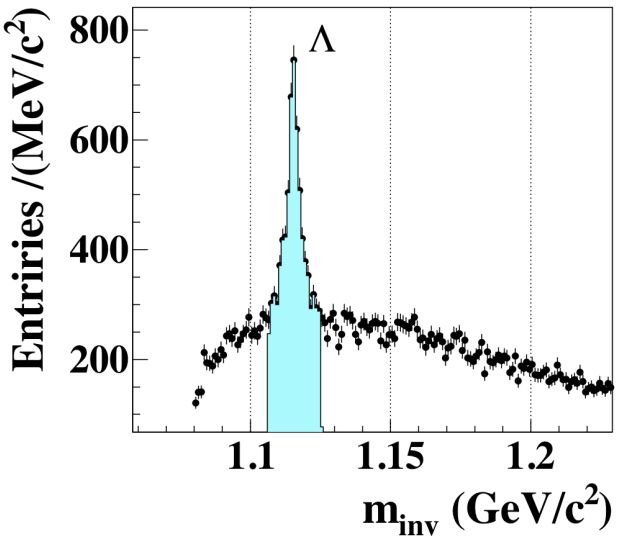

Figure 1: Secondary Λ ($\chi^2_{prim} > 5\sigma$) candidates inside a $1.116 \pm 6\sigma$ window were used for the Ω^- reconstruction

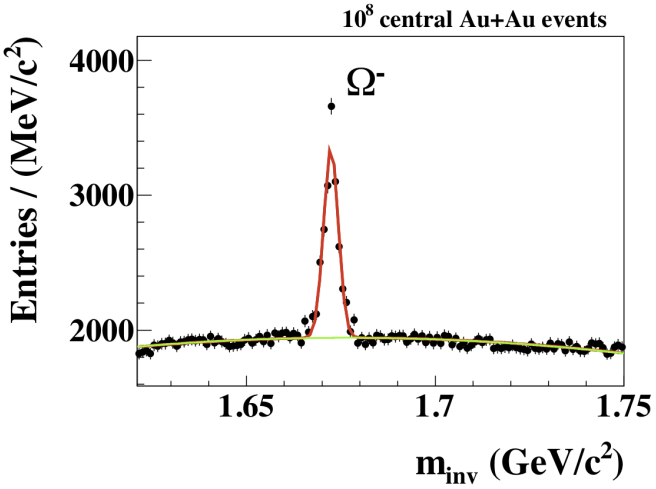

Figure 2: Reconstructed invariant-mass distribution of Λ K^- pairs. The Ω^- reconstruction efficiency is 0.55% at a S/B ratio of 0.4. The reconstructed mass value is 1.672 GeV/c^2. The red line shows a gaussian fit to the signal, the green line the polynomial background fit.

The invariant-mass spectrum is shown in Fig. 2. The Ω^- reconstruction efficiency is about 0.55% for central and about 2% for minimum bias events. The reconstructed mass value of 1.672 ± 0.003 GeV/c^2 is in good agreement with the PDG's data used for the simulation. The invariant-mass resolution accounts for 2.3 MeV/c^2.

References

[1] I. Vassiliev, I.Kisel and M. Zyzak, *CBM Progress Report 2009*, Darmstadt 2010, p. 59

[2] I. Kisel, Nucl. Instrum. Meth. **A 566** (2006) 85

[3] S. Gorbunov *et al.*, Comp. Phys. Comm. **178** (2008) 374

[4] M Zyzak and I. Kisel, *Vertexing status*, 14. CBM Collaboration Meeting, October 6-9, 2009, Split, Croatia