Antihyperon decay reconstruction in the CBM experiment

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One of the most challenging tasks of the CBM experiment is to measure yields, excitation functions and flows of antihyperons. Antihyperons like Ω^+ and Ξ^+ will be measured in the CBM-detector by its decay into charged hadrons, which are detected in the Silicon Tracking System (STS) and in the Time-of-Flight detector (TOF). The key role of the TOF detector is antiproton selection in very dense negative pions and Kaons environment. On the Fig. 1 is shown calculated by TOF tracks m^2 vs particle momentum. Negative track with $\mid m^2 - m_p^2 \mid < 2\sigma$ and $\mid m^2 - m_K^2 \mid > 3\sigma$ and $\mid m^2 - m_\pi^2 \mid > 3\sigma$ was used as an antiproton candidate to reconstruct $\bar{\Lambda}$.

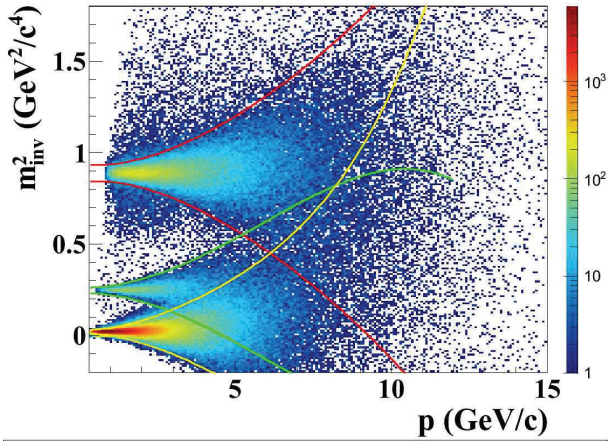

Figure 1: Tracks m^2 vs particle momentum calculated by TOF.

On the Fig. 2 is shown invariant mass distribution of $\bar{p}\,\pi^+$ pairs. Clear $\bar{\Lambda}$ peak is visible. $\bar{\Lambda}$ reconstruction efficiency is above 14% for 35 AGeV and achieve its maximum about 22% at 8 AGeV. One or two antiproton track-candidates per event allows significantly decrease the combinatorial background. Signal to background ratio is above 3.4 for central Au + Au collisions at 35 AGeV. KFParticle finder was used in order to reconstruct $\bar{\Lambda}$ combining secondary $\bar{p}$ and π^-.

Then, combining $\bar{\Lambda}$ with positive secondary Kaon or pion, the Ω^+ and Ξ^+ candidates were tested. The Ω^+ or Ξ^+ was accepted if it has good quality geometrical and topological detached vertex: ($\chi^2_{geo} < 3\sigma$, $\chi^2_{topo} < 3\sigma$) and z-vertex greater than 3 cm downstream the target plane.

To study the feasibility of multi-strange antihyperon decay reconstruction in the CBM experiment, a sets of 10^6 central Au+Au UrQMD events at 2, 4, 6, 8, 10, 15, 20, 25, 30 and 35 AGeV were simulated. Typical invariant mass spectrum is shown in Fig. 3. The Ξ^+ reconstruction efficiency is about 3.1% for central Au + Au UrQMD events at 35 AGeV. The reconstructed mass value $1.321 \pm 0.003\ GeV/c^2$ is in a good agreement with the simulated PDG's data. Invariant mass resolution is 2.3 (MeV/c^2).

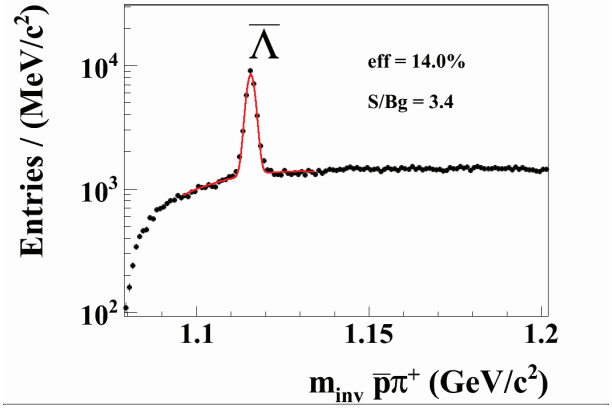

Figure 2: Reconstructed invariant mass distribution of $\bar{p}\,\pi^+$ pairs in central Au+Au collisions at 35 AGeV. Red line is polynomial background plus signal Gaussian fit.

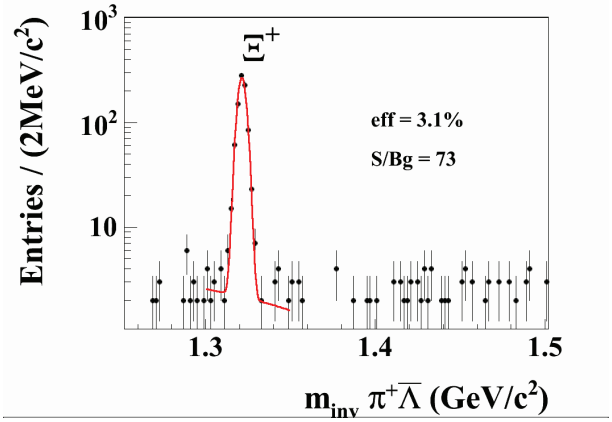

Figure 3: Reconstructed invariant mass distribution of $\bar{\Lambda}\,\pi^+$ pairs in central Au+Au collisions at 35 AGeV. Red line is polynomial background plus signal Gaussian fit.