Δ Resonance Production in ^{58}Ni + Cu Collisions at E=1.97 A GeV

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In heavy-ion collisions above 1 A GeV a significant fraction of the baryonic content is in the form of resonances, primarily the Δ resonance. Using data taken with the EOS TPC we have performed invariant mass analyses of (p,$\pi^{\pm}$) pairs which show correlations resulting from the decays of the Δ resonance, the Λ baryon and the N*(1440) resonance. A reduction in the Δ mass which is maximized in central collisions is seen, and this feature is related to the size of the reaction volume and the production mechanisms of the Δ resonance.

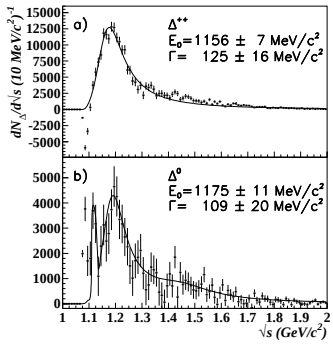

Figure 1:
The Δ^{++} resonance [a]; the Δ^{0} and N* resonances and Λ peak [b].

Figures 1a and 1b show the Δ^{++} and Δ^{0} resonance content of the data along with the best-fit Breit-Wigner functions. In the case of the Δ^{0} a second Breit-Wigner function has been included to account for N*(1440) decays. Decays of the Λ hadron into a (p,π^{-}) pair produce the narrow peak in two channels at $\sqrt{s} \approx 1.116$ GeV/c^2. The fact that the Λ mass is correct confirms the absolute momentum calibration of the TPC. The negative(positive) values in Fig. 1a(b) at $\sqrt{s} < 1.12$ GeV/c^2 result from the Coulomb repulsion(attraction) of the (p,π^{+}(π^{-})) pair.

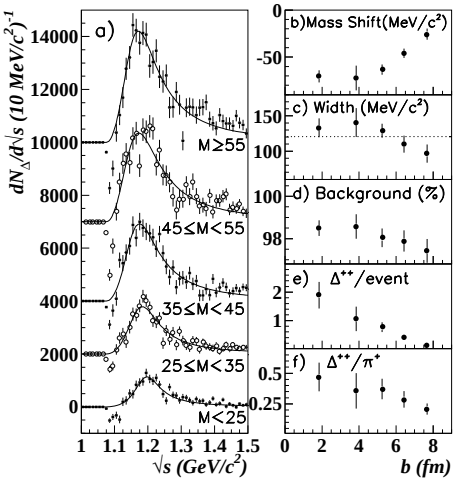

Figure 2: The Δ^{++} resonance for 5 multiplicity (M) bins [a]; and the mass [b], width [c], combinatoric background [d], yield [e] and the Δ^{++} to π^{+} ratio [f] versus impact parameter.

The Δ^{++} has also been analyzed according to the charged particle multiplicity of each event. Fig. 2a shows the resulting fits for each of 5 multiplicity bins, and Figs. 2b-e show related quantities as a function of impact parameter. A mass reduction is observed in all bins and the reduction increases by about 50 MeV/c^2 from the most peripheral collisions to the most central collisions. A larger reaction volume in central collisions increases the proportion of Δ's which are produced by pion scattering (πN$\rightarrow \Delta$), a process which has less available energy and populates a lower mass region of the resonance relative to initial nucleon-nucleon collisions (NN$\rightarrow \Delta$N), resulting in the observed mass shift.