Branching Ratio of the Electromagnetic Decay of the $\Sigma^+(1385)$

The CLAS detector was used to obtain the first ever measurement of the electromagnetic decay of the $\Sigma^+(1385)$. A photon beam was incident on a liquid-hydrogen target, resulting in the photoproduction of a kaon and Σ^* hyperon. A fitting procedure was developed to measure the relative size of the Σ^* radiative decay to the strong decay containing the π^0. The fitting algorithm exploited a new method using the detected neutron information, leading to the partial width measurement of $250.0 \pm 56.9(stat)^{+34.3}_{-41.2}(sys)$ keV. Finally, a U-spin symmetry test was used to make predictions for the $\Sigma^+(1385) \to \Sigma^+\gamma$ and $\Sigma^0(1385) \to \Lambda\gamma$ partial widths that agree with the experimental measurements from this work [1] and our previous work [2].

The approach used in this analysis is to remove as much identifiable background as possible while preserving the π^0 and radiative signals. Because of the closeness of the radiative signal to the π^0 peak in the mass spectrum from $\Sigma^{*+} \to \Sigma^+\pi^0$ decay, the radiative signal extraction requires a certain degree of finessing with a kinematic fitting procedure. The strategy in the present analysis is to understand and eliminate as much background as possible before using a kinematic fitting procedure for the competing π^0 and radiative channels.

However, even with an excellent quality covariance matrix, the size of the radiative signal to the π^0 and the similar topology makes it difficult to cleanly resolve each with a single kinematic fit. This lead to the use of a two-step kinematic fitting procedure that first fits with a missing π^0 hypothesis preserving only the low confidence level candidates, then fits these remaining events with a radiative hypothesis and preserves the high confidence level candidates. This two-step kinematic fitting procedure requires all other background channels to be previously minimized so that there is a high probability that the low confidence levels events from the missing π^0 fit are from the radiative decay of the $\Sigma^+(1385)$. The resulting counts after the final fit are then corrected by the acceptance and background subtraction to result in the true radiative counts. The same is done for the π^0 channel. Once the counts for each channel and all the acceptances for each leakage channel are known, a branching ratio can be calculated. The final extracted counts are shown in Fig. 1.

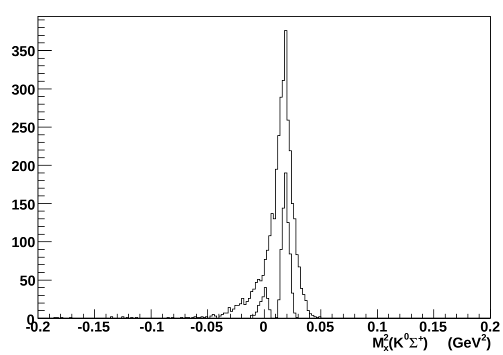

Figure 1: The missing mass off of all detected particles. The plot shows the final radiative candidates at zero missing mass after the $P^a_\pi(\chi^2) < 0.01\%$ and $P^b_\gamma(\chi^2) > 10\%$ cuts. Also shown are the final π^0 candidates after the $P^a_\gamma(\chi^2) < 0.01\%$ and $P^b_\pi(\chi^2) > 10\%$ cuts.

References

[1] D. Keller *et al. (CLAS Collaboration)*, Phys. Rev. D **85**, 052004 (2012).

[2] D. Keller *et al. (CLAS Collaboration)*, Phys. Rev. D **83**, 072004 (2011).