Radiative decays of the Σ^{*0} excited-state hyperon

The measurement of the branching ratio by Taylor [1] of the $\Sigma^{*0} \to \Lambda\gamma$ radiative decay had statistical uncertainties of about 25% (and comparable systematic uncertainty). The measurement of the branching ratio is done again with a much better hold on systematics to achieve a far better uncertainty using the CLAS G11 data set. Since the uncertainty in Taylor's result is about the same magnitude as the meson cloud effects, the reduction in statistical uncertainty to less than 10% (and comparable systematic uncertainty) in the present results [2] lead to the conclusion that meson cloud effects are necessary to include in theoretical predictions of hyperon magnetic moments.

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 $\Sigma^{*0} \to \Lambda\pi^0$ 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 $\Sigma^0(1385)$. 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 if Figure 1.

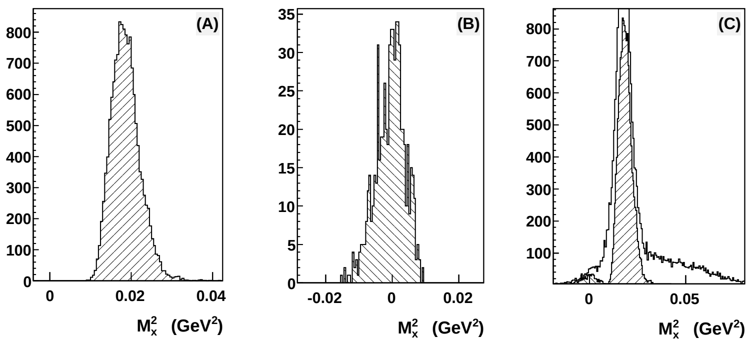

Figure 1: A) The n_π counts extracted using the confidence level cuts $P^a_\gamma < 1\%$ and $P^b_\pi > 10\%$. (B) The n_γ counts extracted using the confidence level cuts $P^a_\pi < 1\%$ and $P^b_\gamma > 10\%$. (C) The counts n_π and n_γ shown in the spectrum before any kinematic fit.

References

[1] S. Taylor *et al.*, Phys. Rev. C **71**, 054609 (2005).

[2] D. Keller *et al.*, Phys. Rev. D **83**, 072004 (2011) arXiv:1103.5701.