Bayesian model selection for electromagnetic kaon production on the nucleon

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Electromagnetic kaon-hyperon (KY) production is an important instrument to test the validity of nucleon structure models such as the constituent quark model [1]. The early studies of this reaction channel focused primarily on the estimation of parameters within one model variant [2-3]. With the increasing amount of data and the availability of polarisation information, the focus shifted to the identification of the contributing resonances, including looking for missing resonances.

This new goal, which focuses on model comparison rather than parameter estimation, requires the appropriate statistical tools. In literature, the χ^2 value is often used as a model selection criterion. We present the Bayesian evidence $\mathcal{Z}$ as a more robust and well-founded tool for model comparison. To compute the Bayesian evidence integrals, we use the Nested Sampling algorithm by Skilling [4].

We apply this method to a Regge model for $K^+\Lambda$ and $K^+\Sigma^0$ photoproduction, based on the exchange of $K^+(494)$ and $K^{*+}(892)$ trajectories in the t-channel. For different prior widths, we find [6] that the Bayesian evidence ($\Delta \ln \mathcal{Z} \approx 24$) for a $K^+\Lambda$ photoproduction Regge model with a positive vector coupling and a negative tensor coupling constant for the $K^{*+}(892)$ trajectory, and a rotating phase factor for both trajectories. Using the χ^2 minimisation method, one could not draw this conclusion from the same dataset [5]. For the $K^+\Sigma^0$ photoproduction Regge model, on the other hand, additional data is needed to determine the correct model variant.

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