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Model selection in kaon photoproduction

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New models for photoproduction of kaons on the proton were constructed [1] utilizing new experimental data from LEPS, GRAAL, and particularly CLAS collaborations. The higher spin nucleon (spin-3/2 and spin-5/2) and hyperon (spin-3/2) resonances were included using a consistent formalism and they were found to play an important role in the data description. In order to account for the unitarity corrections at the tree level, we introduced energy-dependent widths of nucleon resonances, which affect the choice of hadron form factors and the values of their cutoff parameters extracted in the fitting procedure.

Once all the ingredients of the model were well prepared, we faced the problem of selecting the appropriate set of resonances. Since a plain χ^2 minimization, which we used in our previous study [1], could not prevent us from overfitting the data, i.e. introducing more parameters (and thus resonances) than were needed for data description, we opted for a regularization method, the least absolute shrinkage selection operator, and information criteria for avoiding this issue and choosing the best fit. In the analysis of new CLAS $K^+\Sigma^-$ data [2], we were then able to arrive at a very economical model including only the most needed resonances [3]. Similarly, in our very recent study of the role of hyperon resonances in the $K^+\Lambda$ channel, we made use of ridge regression to reduce some of the couplings and arrived at a much more robust model [4].

[1] D. Skoupil, P. Bydžovský, Phys. Rev. C 93, 025204 (2016).

[2] N. Zachariou et al., Phys. Lett. B 827, 136985 (2022).

[3] P. Bydžovský, A. Cieplý, D. Petrellis, D. Skoupil, and N. Zachariou, Phys. Rev. C 104, 065202 (2021).

[4] D. Petrellis, D. Skoupil, arXiv:2212.14305 [nucl-th].

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Classifica Sessioni: Analysis tools

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