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Model selection for pion photoproduction

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Partial-wave analysis of meson and photon-induced reactions is needed to enable the comparison of many theoretical approaches to data. In both energy-dependent and independent parametrizations of partial waves, the selection of the model amplitude is crucial. Principles of the S matrix are implemented to a different degree in different approaches; but a many times overlooked aspect concerns the selection of undetermined coefficients and functional forms for fitting, leading to a minimal yet sufficient parametrization. We present an analysis of low-energy neutral pion photoproduction using the least absolute shrinkage and selection operator (LASSO) in combination with criteria from information theory and K-fold cross validation. These methods are not yet widely known in the analysis of excited hadrons but will become relevant in the era of precision spectroscopy. The principle is first illustrated with synthetic data; then, its feasibility for real data is demonstrated by analyzing the latest available measurements of differential cross sections, photon-beam asymmetries, and target asymmetry differential cross sections in the low-energy regime.

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