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The impact of the covariance matrix on the accuracy of unfolding process using Bayesian inference

The most important information of various nuclear systems is knowledge of accurate neutron flux spectrum. However it is impossible to directly measure the neutron radiation and moreover, it is extremely difficult to take measurements for complex nuclear systems over the unusually high level of radiation. The above factors led us to develop indirect methods of neutron energy distribution assessment. The activation foils method is one of the examples of the indirect method, however, this case usually generates the undetermined problem, which is not trivial to solve. There are several methods to solve the undetermined problem, which can be divided into two main groups: probabilistic and deterministic[3,4,5]. One of the probabilistic approaches proposed in this article using the Monte Carlo sampling from multivariate normal distribution (MVN) of prior distribution with Bayesian inference method [1,2]. The above methodology allows getting satisfactory results of neutron spectrum unfolding. Moreover using the algorithm presents above it is possible to obtain complex information about the error estimation of every energy group by computing the posterior covariance matrix. However, there are many factors that affect the accuracy of the neutron unfolding results, which still demand further investigation. This work focus on the impact of the covariance matrix of prior distribution to the accuracy and physically correct results of the unfolding process.

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