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NEUTRON SPECTRA UNFOLDING IN NEUTRON ENERGY RANGE FROM 0.1 TO 15 MEV FROM DIAMOND RADIATION DETECTOR RESPONSE

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Diamond radiation detectors became more popular in the neutron radiation measurements at these days. It's happen due to the such detectors advantages as small sensitive volume (which lead to less distortion from detector housing in the detected neutron spectra), high radiation, temperature and chemical resistance, low energy consumption, ability to work in high magnetic fields and low sensitivity to the background gamma- or x-ray radiation. Besides this, there is decreasing in cost of such detectors due to the development of artificial diamond growth.

In this paper, we present the results of the development and creation of two algorithms for neutron spectrum unfolding with a diamond detector responses. One of the algorithms is based on the detector response decomposing procedure into the sum of basic components, which are the product of the responses matrix. To implement the decomposition procedure, a modified nonlinear least squares method is used in which the main modification is a condition for mandatory non-negativity of the problem possible solutions. The second algorithm is a variation of the Tikhonov regularization method for solving the unfolding spectra problem. For the second algorithm there also performed searching the optimal value of the regularization parameter value. Verification of the created algorithms was carried out using model spectra and detector responses obtained using Geant4 tools. In this case, the detector model developed in Geant4 [2] was verified by comparing the simulation and experiment results for detecting neutron and alpha radiation. The model spectra and responses of radioisotope neutron sources (252Cf, PuBe), as well as the spectra of neutrons formed during the DT reaction, are considered.

Also, in this work, the quality criteria for the unfolding of neutron spectra [3] are considered. The studies showed that the use of the response matrix obtained using Geant4 allows the unfolding of neutron spectra in the energy range from 0.1 to 15 MeV from diamond detector responses a with a difference in the unfolded and the real one spectrum less than 1%. In this case, the solution of unfolding problem remains stable in the presence of uncertainty in the input data, which is determined by the inaccuracy of the simulation or modeling results.

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