DIGITAL MODEL OF X-RAY GRAZING-INCIDENCE SPECTROGRAPH AND SPECTRUM RECONSTRUCTION TECHNIQUES

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The work is devoted to the development of a digital model of a grazing incidence X-ray spectrograph and methods for reconstructing the X-ray spectra of the Z-pinch plasma at the Angara-5-1 facility [1–3]. The main problems hindering reliable qualitative and quantitative reconstruction of the initial Z-pinch X-ray spectrum in the photon energy range of hundreds of eV are the superposition of signals from different diffraction orders and the complicated form of the device instrumental function. In this paper, we present two techniques for reconstructing the spectrum. In the first technique, a digital model of the spectrograph was developed in the Geant4 Monte Carlo simulation toolkit [4], taking into account the geometry of the experiment and the processes of interaction of X-ray radiation with a diffraction grating. In the model, taking into account the specific shape of the groove profile of the diffraction grating and the differential method [5] for solving the diffraction problem, the distribution of the X-ray intensity in different diffraction orders depending on the wavelength is calculated. Using the developed model of the spectrograph, its instrumental function was calculated. The second technique does not use a particular grating groove profile shape, but constructs a dispersion equation based on the analysis of calibration spectrograms and makes it possible to reconstruct the spectrum. At the end of the work, a comparison is made of the results of reconstruction by the first and second methods, and a rather high degree of agreement between the spectra obtained by different methods is shown.

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