Numerical simulation of experiments on X-ray Diagnostics of Pulsed Plasma

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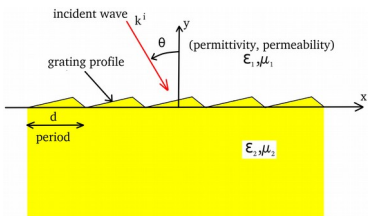
Grazing incidence spectrographs are used to record X-ray spectra of pulsed plasma radiation (for instance, in experiments with high-power lasers or Z-pinches). The main problems that prevent reliable qualitative and quantitative reconstruction of the initial spectra from the data read in the registration plane of the spectrograph (detector plane) are the superposition of signals from different diffraction orders and the complex form of the instrumental function of the spectrograph, which depends on the wavelength of the detected radiation. This problem does not have a trivial analytical solution. The construction of a full-scale model of an X-ray spectrograph makes it possible to calculate the instrumental function of the device used to reconstruct the initial X-ray spectrum.

The simulation takes into account the probabilities of reflection in the diffraction orders after interaction with the diffraction grating, taking into account the surface profile of the diffraction grating.

Intensity distribution of radiation after grating



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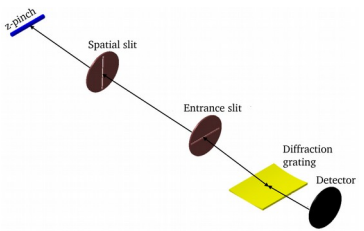
Model

Monte-Carlo model of radiation tracking



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Instrumental function to reconstruct initial soft x-ray spectrum

Main Results

The virtual full-scale model of a grazing incidence X-ray spectrograph has been developed that allows, taking into account the physical processes of the interaction of X-ray radiation with a diffraction grating and the geometry of the experiment, to build spectra on the plane of the spectrograph detector. By means of the developed model, it was possible to obtain the instrumental function of the spectrograph, which can be used to reconstruct the original X-ray spectra.