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RESTORATION OF THE DIELECTRIC CONSTANT OF THE PLASMA CHANNEL BY MODELING THE CYCLE OF ABEL-FOURIER-HANKEL TRANSFORMATIONS *)

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Laser interferometry makes it possible to reconstruct the distribution of the dielectric constant of the plasma object under study [1], since the phase shift of radiation undergoes changes when passing through the object [2]. In classical methods for solving inverse diffraction problems, it is assumed that the studied phase object has axial symmetry or can be approximated to axial symmetry. The dielectric constant of an object, as a rule, is restored by numerically solving the inverted Abel equation [3], which in some cases requires certain error control and additional studies of its accumulation along the radius of the object.

In this paper, we model the cycle of Abel-Fourier-Hankel transformations: $H\big[F[A[\tilde{\varepsilon}(x',y')](y')]\big(f_{y'}\big)\big](r) = \tilde{\varepsilon}(r)$, where $A[\tilde{\varepsilon}(r)\,](y') = \frac{k}{2}\int_{y'}^{R}\frac{2\tilde{\varepsilon}(r)rdr}{\sqrt{r^2-(y')^2}} = \delta\varphi(y')$, $F[\delta\varphi(y')\,]\big(f_{y'}\big) = 2\int_0^{+\infty}\delta\varphi(y')cos\big(-2\pi y' f_{y'}\big)dy'$, $H\big[F\big(f_{y'}\big)\,\big](r) = \frac{4\pi}{k}\int_0^{+\infty}F\big(f_{y'}\big)J_0\big(2\pi r f_{y'}\big)f_{y'}df_{y'}$. In the study of the proposed method, the computational features and the error of the method itself were described, depending on the conditions of the problem. Since the inverse diffraction problem is incorrect in the formulation, the formalism of determining the error of the method within this problem is described. The method was tested by solving the inverse problem in a model experiment for a plasma axisymmetric channel with a cosine profile of electron flatness.

The method has shown reliable numerical results, allowing the electron density of a plasma object to be restored with an error of up to 2%. In addition, the method has the advantages, in comparison with other methods, that it does not accumulate errors along the radius of the object and there are no strict restrictions on the number of calculated points.

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