1D-MODEL OF MICROWAVE PULSE REFLECTOMETRY OF PLASMA IN KTM TOKAMAK

D.E. Barkov, A.V. Sharnin, L.A. Lobes

National Research Tomsk Polytechnic University

Russia, Tomsk, Lenina ave, 30, 634050

E-mail: rokorsin@gmail.com

Microwave pulse reflectometry is a method used on fusion devices of the tokamak type to measure electron density profiles [1]. It is needed to solve the incorrect inverse task of finding electron density profile from the results of time of flight direct measurements when practically using this method. To develop and verify the algorithms of solving the incorrect inverse task, it is required to use a mathematical model, which describes the direct problem of pulse plasma reflectometry (PPR) and which is comparable to experimental results. It is impossible to prove the adequacy using data from real PPR experiment due to the fact, that KTM tokamak has not had dense plasma yet.

There is a problem of prior choosing of model expectations on the basis of the relation between "completeness of description" and "complexity of realization". The choice of this work is to minimize the complexity of realization requirements by means of developing 1D PPR models which have already been used on tokamaks and are based on applying the approximation of geometric optics and describing the plasma as planar layered medium [2].

Decisions made using the described method have been developed and adapted for KTM tokamak. Requirements for minimal acceptable completeness and description accuracy of the modeled system have been specified. 1D-model of pulse plasma reflectometry has been synthesized and verified. The task and the principles of using the model for synthesis of PPR data processing algorithms on KTM tokamak have been made and preliminary researched. The advantages and limitations of this model have been revealed.

2D and 3D computational models based on Maxwell's equations provide the most precise solutions and can be used as reference calculation methods for evaluating the applicability of simple models, and results interpretation in complex cases. Requirement for big calculations, as well as unacceptable long duration time of the calculations limits the application area of these models till now.

It requires dozens of hours to solve 3D Maxwell's equations of electromagnetic wave distribution with the FDTD method [3] once. Using a traditional technology of MPI parallel computing does not solve the problem. In [4] it is noted that data center with 80 CPUs takes 7 hours to solve a direct problem on 700 × 1400 × 940 grid with 3000 time steps once. Obviously, it is needed to solve the model a lot of times, so it is important to minimize the computing time. It is also important to have general time evaluation methods to use computational resources effectively.

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