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ON THE NUMERICAL PROBLEMS OF GYROTRON EQUATIONS

HARIJS KALIS[1] AND ANDREJS REINFELDS[2]

Institute of Mathematics of Latvian Academy of Sciences and University of Latvia

Akadēmijas laukums 1, LV-1524, Rīga, Latvia

E-mail: [1]kalis@lanet.lv, [2]reinff@latnet.lv

The electron motion in gyrotron resonator can be described by the initial-boundary value problem for the following system of $s+1$ complex differential equations

$$\begin{cases} \dfrac{\partial p}{\partial \zeta} + i(|p|^2 - 1)p = i \displaystyle\sum_s f_s \exp\left[i(\Delta_s \zeta + a_s \tau + b_s \phi)\right] \\ \dfrac{\partial^2 f_s}{\partial \zeta^2} - i\dfrac{\partial f_s}{\partial \tau} + \delta_s f_s = I_s \dfrac{1}{4\pi^2} \displaystyle\int_0^{2\pi} \int_0^{2\pi} p \, d\theta_0 \exp\left[-i(\Delta_s \zeta + a_s \tau + b_s \phi)\right] \, d\phi. \end{cases}$$

In the case $0 < |p| \leq 1$, $|p| = const$ and $s = 1$ the problem can be reduced to integro-differential equation

$$i\frac{\partial f}{\partial \tau} = \frac{\partial^2 f}{\partial \zeta^2} + \delta f - iI \int_0^{\zeta} f(\xi, \tau) \exp(i\Delta(\xi - x)) \, d\xi \tag{1}$$

with conditions

$$f(0, \tau) = 0, \quad \frac{\partial f(l, \tau)}{\partial \zeta} = -i\gamma f(l, \tau), \quad f(\zeta, 0) = \varphi(\zeta) \tag{2}$$

where i is the imaginary unit and δ, Δ, $\gamma > 0$, $I \geq 0$ are real parameters.

This problem can be solved by various modifications of grid method. We compared obtained results as well as analysed precision of calculations with respect to the relation of the time and space values. Main difficulties arises in numerical solving of problem because we have the 3rd kind boundary conditions in the right endpoint.

REFERENCES

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