Mathematical Modelling and Analysis
Abstracts of the 9th International Conference MMA2004, May 29-31, 2004, Jūrmala, Latvia

COMPARISON OF THE NUMERICAL METHODS FOR THE PROBLEM ARISING IN THE GYROTRON THEORY

JĀNIS CEPĪTIS[1], HARIJS KALIS[2] and ANDREJS REINFELDS[3]

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

Akadēmijas laukums 1, LV-1524, Rīga, Latvia

E-mail: [1]`janis.cepitis@lu.lv`, [2]`harijs.kalis@lu.lv`, [3]`reinf@latnet.lv`

The mathematical modelling of gyrotron processes we carried out because of paper [1]. Particularly, assuming for the dimensionless complexe transverse momentum of the electron p

$$|p|^2 = const, \quad 0 < |p|^2 \le 1$$

we obtain that non-stationary gyrotron oscilations for every mode can be described by the integro-differential equation

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

where the unknown function g is the high-frequency field in resonator depending on the normalized axial space and time coordinates x and t, δ classifies variation of the critical frequencies, Δ is the frequency mismatch, I is the imaginary unit. This equation with respect to the field function g is supplemented by the standard initial condition as well as the homogeneous mixed boundary conditions of the first kind at the entrance and of the third kind at the exit to the interaction space. It must be mentioned that especially the boundary condition of third kind causes the specific stability conditions for the numerical methods.

The numerical simulation of this problem with $I = 0$ was investigated in the paper [2]. At present we have completed results also for the general case. Into details it is turned out that most applicable in practice is the straight line method based on the non-uniform grid having the grid points as the roots of the second kind Chebyshev's polynomials.

REFERENCES

[1] M.I.Airila and O.Dumbrajs. Generalized gyrotron theory with inclusion of adiabatic electron trapping in the pressence of a depressed collection. *Phys.Plasmas*, **8** , 2001, 1358 – 1362.

[2] O. Dumbrajs, H. Kalis and A. Reinfelds. Numerical solution of a single-mode gyrotron equation. *Math. Model. Anal.*, **9** (1), 2004, 25 – 38.