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ON NUMERICAL SIMULATION OF NONSTATIONARY OSCILLATIONS IN GYRATRONS

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It is known that in gyrotrons stationary, periodic, automodulation, and chaotic oscillations exist. The present work extends our earlier investigations to the case when the electron transit time through the resonator is much shorter than the resonator decay time. In this case we can apply the implicit difference schemes and use the method of characteristics [1].

The amplitude $f(t,x)$ of the high frequency field in the resonator of gyrotron and the transverse orbital momentum $p(t,x,\theta_0)$ of electrons can be described by the following system of two complex differential equations which differs from the system considered in [1]:

$$\begin{cases} \kappa\frac{\partial p}{\partial t} + \frac{\partial p}{\partial x} + i(\Delta + |p|^2 - 1)p = if(t,x) \\ \frac{\partial^2 f}{\partial x^2} - i\frac{\partial f}{\partial t} + \delta f = I < p >, \end{cases} \tag{1}$$

where $i = \sqrt{-1}$, $x \in [0, L]$ and $t \in [0, t_{end}$ are the normalized dimensionless axial and time coordinates, L - the length of the interaction region, t_{end} - the length of time,
$\Delta, \delta, \kappa, \theta_0 \in [0, 2\pi]$ - the real constants, I - the current,
$< p >= \frac{1}{2\pi}\int_0^{2\pi} p\, d\theta_0$ is the averaged value of p.
Therefore the function $p = p(t,x;\theta_0)$ depends on the parameter θ_0.
The system (1) is supplemented by the initial conditions
$p(0,x,\theta_0) = \exp(i\theta_0), \quad f(0,x) = 0.1\sin(\frac{\pi x}{L})$
and by the boundary condition at the exit from the interaction space

$$f(t,0) = 0, p(t,0,\theta_0) = \exp(i\theta_0),\ \int_0^t \frac{1}{\sqrt{t-\psi}}\frac{\partial f(\psi,L)}{\partial x}d\psi + \sqrt{i\pi}f(t,L) = 0$$

The electron perpendicular efficiency η which describes the extraction of the electron transverse energy by the high frequency field in the resonator is given by the expression [1]

$$\eta = 1 - \frac{1}{2\pi}\int_0^{2\pi} |p(L,\theta_0)|^2 d\theta_0. \tag{2}$$

REFERENCES

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