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Title:Study on nonlinear theory and code of beam-wave interaction for gyroklystron
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Abstract:A nonlinear self-consistent theory of beam-wave interaction for gyroklystron with multiple cavities is analyzed in this paper. The electron motion equations and transient electromagnetic field equations in a complex form are deduced in detail. A calculation code including a time-dependent description of the electromagnetic fields and a self-consistent analysis of the electrons is designed and the corresponding software implementation is achieved using Fortran language. An example is presented for the operation of the code, namely a four-cavity, Ka-band gyroklystron operating in the TE011 mode at the fundamental of the cyclotron frequency. The numerical results show that a maximal saturated peak output power of 330 kW, corresponding to 39% efficiency and a saturated 3-dB bandwidth of 325 MHz is achieved with a 72.8 kv, 11.8 A electron beam at a focused magnetic field of 13 kG and a beam velocity ratio of 1.63 when the speed spread is 5%. By comparison, the numerical results agree with the experimental results.
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