DISPERSION CHARACTERISTICS OF BEAM-LOADED CORRUGATED WAVEGUIDES

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Beam-loaded corrugated waveguides are used in several high-power microwaves applications. Specifically, they are employed in high-power generators like traveling-wave tubes (TWT) and backward wave oscillators (BWO) [1] to enable the beam-wave interaction, or in gyrotrons to prevent the gyrotron interaction from occurring in the latter part of the beam tunnel rather than in the cavity [2]. The successful design of these structures requires an accurate estimation of the propagation characteristics of the corrugated waveguide as well as of the beam-wave interaction.

In this work, a universal method based on an eigenfunction expansion [3] and the linearized Vlasov equation [4] is presented to study the dispersion relation, the field characteristics and the beam-wave interaction regions for beam-loaded circumferentially corrugated waveguides at the small-signal regime. All kinds of modes and many different types of structures can be treated. The main advantages of the method are the ability to provide the whole dispersion relation of the beam-loaded structure very fast and with a small number of spatial harmonics, the possible regions of interaction as well as the possible parasitic modes. A user friendly numerical code has been implemented for several operating systems, like Windows, Linux and UNIX. Numerical results are given for several structures, for the case of TM modes, including field distributions, quality factors and energy transfer between the beam and the modes. Moreover, the effect of the beam parameters to the dispersion relation, the interaction regions and the energy transfer is also considered.

References

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