EIGENVALUES AND OHMIC LOSSES IN A COAXIAL GYROTRON CAVITY

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In the development of high-power high-frequency gyrotrons capable of CW operation one significant technological constrain is the resonator heating caused by the Ohmic losses of the generated microwave power on the conductive walls of the cavity [1]. In this work, we present the mathematical formulation for the calculation of the dispersion relation, the field distributions and the ohmic losses density for $TE_{m,p}$ modes in an infinitely long coaxial waveguide with a longitudinally corrugated insert which consists from *N* different, in general, grooves. The method employed is a full wave approach based on an appropriate eigenfunction expansion in order to take into account the effect of the higher spatial harmonics in the calculations. The most significant feature of this method is the very fast calculation of the eigenvalues with just a few spatial harmonics resulting in respectable savings on CPU time. This formulation is properly modified in order to calculate the eigenvalues and the ohmic losses density in a coaxial cavity with variable inner and/or outer radius. Comparison with the Surface Impendace Model (SIM) [2] and the Singular Integral Equation (SIE) [3, 4] method is presented. From the numerical results it has been found that the calculation of the eigenvalues are very close to those of previously published works, while the ohmic losses density is more accurate that SIM and provides almost similar results with SIE.

References

[1] E. Kreischer, B. G. Danly, J. B. Schutkerer and R. J. Tempkin, "The design of megawatt gyrotrons," IEEE Trans. Plasma Sci., vol. 13, pp. 364-373, 1985.

[2] C. T. Iatrou, S. Kern and A. B. Pavelyev, "Coaxial cavities with corrugated inner conductor for gyrotrons," IEEE Trans. Microwave Theory Techn., vol. 44, no. 1, pp. 56-64, 1996.

[3] G. I. Zaginaylov, Yu. V. Gandel, O. P. Kamyshan, V. V. Kamyshan, A. Hirata, T. Thumvongskul, and T. Shiozawa, "Full wave analysis of the field distribution of natural modes in the rectangular waveguide grating based on singular integral equation method," IEEE Trans. Plasma Sci., vol. 30, no. 3, pp. 1151-1159, 2002.

[4] O. Dumbrajs and G. I. Zaginaylov, "Ohmic losses in coaxial gyrotron cavities with corrugated insert," 16th Joint Russian-German Meeting on ECRH and Gyrotrons, 22-23 May 2004, IAP RAS Nizhny Novgorod.