VELOCITY DIAGNOSTICS OF ELECTRON BEAMS

WITHIN A 140 GHz GYROTRON

by

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ABSTRACT

Experimental measurements of the average axial velocity \( v_A \) of the electron beam within the M.I.T. 140 GHz MW gyrotron have been performed. The method involves the simultaneous measurement of the radial electrostatic potential of the electron beam \( V_p \) and the beam current \( I_b \). \( V_p \) is measured through the use of a capacitive probe installed near or within the gyrotron cavity, while \( I_b \) is measured with a previously installed Rogowski coil. Three capacitive probes have been designed and built, and two have operated within the gyrotron. The probe results are repeatable and consistent with theory.

The measurements of \( v_A \) and calculations of the corresponding transverse to longitudinal beam velocity ratio \( \alpha = v_t/v_A \) at the cavity have been made at various gyrotron operation parameters. These measurements will provide insight into the causes of discrepancies between theoretical rf interaction efficiencies and experimental efficiencies obtained in experiments with the M.I.T. 140 GHz MW gyrotron.

The expected values of \( v_A \) and \( \alpha \) are determined through the use of a computer code entitled EGUN. EGUN is used to model the cathode and anode regions of the gyrotron and it computes the trajectories and velocities of the electrons within the gyrotron. There is good correlation between the expected and measured values of \( \alpha \) at low \( \alpha \), with the expected values from EGUN often falling within the standard errors of the measured values.

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