Quasi-Optical Mode Generator for the Verification of a 238 GHz TE49,29 -Mode Gyrotron Launcher Antenna

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ABSTRACT

Gyrotrons are high-power electron vacuum tubes capable of generating millimeter waves in the megawatt range [1] and are a key technology for Electron Cyclotron Resonance Heating (ECRH), Current Drive (CD), and Collective Thomson Scattering (CTS) diagnostics in magnetically confined fusion plasmas. For the next generation of high-field plasma fusion devices, a megawatt-class gyrotron operating at 238 GHz is currently under development [2].

For this gyrotron, the very high-order cavity mode $TE_{49,29}$ has been identified as the designated operating mode. Efficient transmission of the generated millimeter-wave power requires conversion of this high-order TE mode into a linearly polarized fundamental Gaussian $TEM_{0,0}$ beam. This task is realized by an internal mode-converting launcher antenna in combination with beam-shaping reflectors. Due to the extremely tight manufacturing tolerances and the limited tolerance for deviations from the design, experimental low-power verification of the launcher antenna and the quasi-optical system is essential prior to high-power operation inside the gyrotron.

This contribution presents the design of a dedicated quasi-optical mode generator setup developed for cold measurements of a 238 GHz $TE_{49,29}$-mode launcher antenna. A Gaussian millimeter-wave beam is generated by a horn antenna and shaped using a set of cylindrical Teflon lenses and a quasi-parabolic mirror, enabling coupling into an optimized resonant coaxial cavity with a perforated wall. The excited rotating $TE_{49,29}$-mode is then used for the verification of the gyrotron launcher antenna.

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References

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