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Design of the HE11 mode measurement system for the ITER Gyrotrons

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The installation of the ITER Gyrotrons on the ITER site will start this summer and the tests are scheduled for next year. To transmit Electron Cyclotron (EC) beam minimising the losses, qualified test and precise alignment are required in the installation of both Gyrotrons and Transmission Lines (TL). Mode purity and suppression of Higher Order Modes (HOMs) are necessary to comply with the required value of at least 95% of HE11 mode at the entrance of the waveguide.

The mode content measurement of the beam exiting the open-ended corrugated waveguides is used to optimize the mirrors' angles inside the Gyrotron Matching Optics Unit (MOU), to get a high purity of the HE11 mode. A precise estimation of the HE11 mode is only possible by measuring the far field of the EC beam, as stated in [1]. Based on far field data and using a phase retrieval technique, we can reconstruct the EC beam produced by the Gyrotrons.

The system setup for HE11 mode measurement is mounted on a linear motorized stage for far field measurement up to 1 m distance and includes a beam target and an infrared (IR) camera. A manual 3-axis stage is used to precisely align the target and the camera. The IR camera measures the beam pattern at different distances to reconstruct the field at the aperture of the corrugated waveguide. For HOMs analysis, we have developed phase retrieval and mode contents codes [2].

Finally, we have designed a beam dump for the EC beam passing through the beam target by using the ray tracing simulation tool ZEMAX. A convex mirror is installed on the beam dump to diffract the EC beam and spread it on a large portion of the inner surface, allowing us to use a low power microwave absorber.

This paper describes the system setup for the HE11 mode measurement, the design of the beam dump and the HOMs analysis, containing the phase retrieval code. Moreover, we will present a benchmark of the proposed HOMs analysis code against existing codes used by the domestic agencies (QST, IAP, KIT, IN-DA and MIT) [3].

References

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