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Published in:
34th International Conference on Infrared, Millimeter, and Terahertz Waves, IRMMW-THz 2009
DOI:
10.1109/ICIMW.2009.5325585
Published: 01/01/2009

Document Version
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ECE system on ASDEX-Upgrade placed inline at the high power waveguide based transmission system


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Fast Directional Switch (FADIS) [5] based on the quasi-optical interferometer principle will be installed at ASDEX for switching the power of a step tunable gyrotron between different launchers FADIS can be employed also as a frequency filter in a co-aligned ECE-ECCD setup serving the purpose of separating the low-power ECE signal [6]. Because the FADIS notch width is only a few MHz wide for at least 20 dB suppression, FADIS must be synchronously tuned to follow the center frequency of the gyrotron during the frequency droop of the gyrotron within the first 2 seconds of its pulse (~0.3 GHz) to measure ECE during this period. Nevertheless the non resonant output of FADIS can produce power levels in excess of ECE receiver loads even protected by an additional notch filter.

III. PROPOSED CONFIGURATION

Since a Fast Directional Switch (FADIS) [5] based on the...
This problem can be redressed by employing a second interference filter in tandem with the FADIS. However, in order to prevent interference and isolation decrease caused by back reflections of these filters, absorptive filters are the preferred solution. A good compact filter candidate can be a non resonant two-beam Mach-Zehnder-type interferometer [6] shown in Figure 2, coupled in series with FADIS, using the non-resonant output.

Figure 2 exploded (right) and composed (left) view of the design of a polarization insensitive 4-port Mach-Zehnder-type two-beam interferometer. It is used as an absorptive separation filter, for the ECE diagnostic signal (yellow, route port 1-3) from the stray gyrotron radiation signal (purple, route port 1-4), signal goes from right to left. The interferometer consists of 2 beam splitters in opposite beam planes and 4 mitre-bends. On this way a polarization insensitive configuration is made where the additional phase path (red) could be minimized to fit the required channel width of the ECE diagnostic. In this application port 2 and 4 should be terminated by loads.

This system is very flexible in customizing frequency filter characteristics. In the regime of the gyrotron frequency the suppression notch width is only determined by the window thickness inside the beam splitters and independent from phase lag path. The reason for this is that at resonant frequencies they have maximum transmission and the phase lag path is switched off. Outside this frequency regime the beam splitters are operational and beating occurs between the frequency response of the interferometer and the window. The Mach-Zehnder design parameters are: two equal beam splitters with the parameters of the windows in the beamsplitters, n=1.951, tan δ=2.9E4 and d=4.712 mm (Infrasil 301) and a phase lag length of 303 mm for Δf=989.38 MHz=7x141.34 MHz (141.34 MHz is periodicity of the FADIS). The result is presented in Figure 3. The route 1–3 (Figure 2) offers a minimum of 30-dB suppression of the gyrotron stray radiation, coming from the Tokamak, over a 0.3 GHz band.

In [8] a system is shown to measure scattered ECRH waves along the line-of sight which could be an option for a flexible ECE feedback system with tunable spatial resolution.

**IV. CONCLUSIONS**

Novel elements of an in-line ECCD feed-back control system are presented. A polarization independent two-beam interferometer absorptive filter will be placed in tandem with FADIS. A proof of principle was delivered at TEXTOR. Next step includes the demonstration on AUG and possible implementation at ITER.

**V. ACKNOWLEDGEMENTS**

This work is supported by NWO, ITER-NL and the European Communities under the contract of Association between EURATOM/FOM, and was carried out within the framework of the European Fusion Programme. The views and opinions expressed herein do not necessarily reflect those of the European Commission. This work was supported by NWO-RFBR grant nr. 047.016.016.

**REFERENCES**


