DESIGN OF A DEDICATED ECE DIAGNOSTIC FOR FEEDBACK CONTROL OF INSTABILITIES BY ECRH

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At the TEXTOR tokamak a 140 GHz, 800 kW, 10 second gyrotron is employed for studies on ECW heating and ECCD current drive. One of the applications is the suppression of tearing modes[1], and at present a method is under development which aims to detect the ECE perturbations caused by these modes via the same line of sight as is being used to launch the gyrotron power. A considerable advantage of this scheme is that by moving the in-vessel launcher of the ECW installation, the gyrotron line of sight can be swept poloidally through the plasma. Each time a mode is encountered there will be exact spatial overlap with the gyrotron deposition profile when the mode is centred around the gyrotron frequency in the observed ECE spectrum. By applying gyrotron power at the correct time, fast and efficient suppression of the mode should be guaranteed. A major difficulty to solve in this scheme is, however, the separation of the low power ECE spectrum with frequencies of interest just around the gyrotron frequency from the high power levels at the gyrotron frequency itself.

At TEXTOR ECE temperatures around 700 eV are measured around the $q = 2$ surface. In order to positively identify fluctuations due to tearing modes it is estimated that in the reverse direction of the transmission line power levels in the order of nanowatts need to be detected at frequencies separated only a few GHz from the gyrotron frequency, at which the reflected power levels might be hundreds of watts. This paper describes the proposed frequency selective antenna to be inserted in the gyrotron transmission line, and the coupling of the antenna by means of a section of quasi optical transmission line to the radiometer, which in turn includes a notch filter at the gyrotron frequency and additional measures to reduce the gyrotron component in the receiver. In order to achieve the required frequency separation the Fabry Perot resonance principle of multiple reflections in a dielectrical plate, which will be placed in the transmission line, will be used. The dielectric plate, with low loss tangent to allow 800 kW of forward power transmission without overheating, will be placed under an angle to couple the ECE power out of the transmission line. Modest adjustments of this angle can be used to optimise the resonance condition. In order to achieve sufficient suppression of the gyrotron component two of such resonant plates are foreseen, one in the beam line, and one outside the beam line. The geometry will be such that the filtered beam with the ECE spectrum is orthogonal to the transmission line to further isolate the ECE spectrum from the forward power. The effects of polarisation are discussed as these become relevant at angles of incidence other than perpendicular. The paper also reports on laboratory measurements on the components of the frequency selective antenna which are required to validate calculations on the performance of the antenna, and to aid the selection of materials.

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[1] E. Westerhof et al, this conference