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Preliminary results of prototype Martin-Puplett Interferometer and transmission line developed for ITER ECE Diagnostic

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The ECE Diagnostic system in ITER will be used to determine the electron temperature profile evolution, the high frequency fluctuation of the plasma electron temperature, the characterization of runaway electrons and the radiated power in the electron cyclotron frequency range (70-1000 GHz). These measurements will be used for advanced real time plasma control (e.g. steering the electron cyclotron heating beams) and the ITER plasma physics studies.

In view of the ITER requirements, an ultra-wide band (70 – 1000 GHz) transmission line coupled to a fast scanning, broadband spectrometer are required to estimate the ECE radiated power loss and to study the behavior of runway electrons. Typically, the transmission lines and spectrometers are not operated in vacuum and there are consequently significant losses at certain frequencies due to water vapor line absorption over this large frequency range. To avoid these losses, both the transmission line and the spectrometer must be operated in vacuum. Further, producing an efficient high etendue long wavelength spectrometer with extremely high scan speeds in vacuum is a major challenge. Also long distance (~ 43 meters) transmission of very low in-situ calibration source power (~ nW level) with an ultra-wide frequency range is another challenge for the transmission line development. For the purpose, a prototype polarizing Martin–Puplett interferometer has been developed to operate in a low vacuum with high throughput and excellent time resolution of 10 ms with scanning length of 15 mm. And also a prototype transmission line to be used in vacuum is developed.

An experimental set up has been established at ITER-India lab to test the performance of various prototype subsystems of the ECE diagnostic. The experimental set up consists of the high temperature black body source in this frequency range, transmission line and the Martin-Puplett interferometer with data acquisition system. This paper describes the experimental set up and preliminary results of subsystems developed for ECE diagnostic.

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