



Contribution ID: 123

Type: **not specified**

Design and measuring performance of the ITER plasma position reflectometer in-port-plug antennas.

Monday, 17 September 2018 11:00 (2 hours)

Design parameters of the ITER Plasma Position Reflectometer (PPR) in-port-plug antennas are determined and then their measurement performance is assessed using 2D full wave analysis.

Two ITER scenarios were selected when considering the optimum antenna position and orientation, namely the baseline scenario (15 MA D-T) and the low density one planned for the initial non-active phase at 7.5 MA. Using them to feed a 3D ray tracing simulation, spatial position and optimum orientation angles of each set of emission and detection antennas were determined. Additionally, a far field analysis of the launching radiation patterns led to the definition of the antenna dimensions in terms of optimal power coupling.

After this preliminary work, 2D full wave simulations using a finite difference time domain (FDTD) code were performed to assess the measurement performance of the system, in terms of spatial resolution and accuracy. To this end, the detected wave amplitudes and phases were evaluated for each operating scenario and two models of the SOL plasma density. By calculating the spectrogram (STFT technique) of the phase of the detected wave, the reconstruction of the plasma density profile can be carried out and be directly compared with the input profiles. As a result from this synthetic diagnostic analysis, an estimation of the error in the determination of the last closed flux surface position was possible. Both static and turbulent plasmas have been considered, using for the latter a multimodal model to mimic the spectrum of density fluctuations.

Together with the power gain information previously obtained, the 2D characterization of the measuring performance of the system will be presented.

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Session Classification: P1

Track Classification: Diagnostics