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4.17 Development of a 30 – 165 GHz density profile reflectometer and performance evaluation for ITER

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Laboratory evaluation of an integrated 40-m transmission line (TL) that approximates the LFSR system for ITER is underway. The TL includes corrugated waveguide, miter bends, calibration mirror, waveguide switch, stray-radiation protection system, Gaussian telescope (GT), vacuum windows, and containment membranes. FMCW signals are generated by V- and D-band transceiver modules. Transmission signals are multiplexed for combined propagation through the TL. Test metrics include antenna pattern scans to determine mode content, power loss measurements, and homodyne detection of FMCW signals. A method for reference phase calibration with a modified TL-integrated miter mirror is investigated. The calibration feature is extractable from the intermediate frequency (IF) spectrum with sufficient S/N without affecting the main signal. Microwave performance with the prototype GT is relatively insensitive to GT position. A S/N estimate of the measurement on ITER is predicted by incorporating laboratory test results with calculations of expected noise levels and signal losses caused by the plasma. Current projections suggest that, with some further optimization of the transceivers, the LFSR will meet the 5-mm resolution requirement for ITER. *Work supported by PPPL under subcontract S013252-A.

Primary author(s) : MUSCATELLO, Christopher (General Atomics)

Presenter(s) : MUSCATELLO, Christopher (General Atomics)

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