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# 1.1 Tests of a Full-Scale ITER Toroidal Interferometer and Polarimeter (TIP) Prototype

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A full-scale ITER toroidal interferometer and polarimeter (TIP) prototype has been constructed and tested both in the laboratory and on the DIII-D tokamak. The TIP prototype measures electron density using two approaches. Two-color interferometry is carried out at 10.59 $\mu\text{m}$  and 5.22 $\mu\text{m}$  using a CO<sub>2</sub> and Quantum Cascade Laser (QCL) respectively while a separate polarimetry measurement of the plasma induced Faraday effect, is made at 10.59 $\mu\text{m}$ . High-resolution TIP phase information is obtained using an FPGA based phase demodulator and precision clock source. The TIP is also equipped with a piezo tip/tilt stage active feedback alignment system which minimizes noise and maintains diagnostic alignment indefinitely. A 120 m path length laboratory prototype was used to test components and demonstrate alignment techniques, feedback alignment capabilities, and determine diagnostic noise floors. Phase errors of 1.5 degrees for the interferometer and 0.06 degrees for the polarimeter have been demonstrated for 1000 seconds. The system is now operational on the DIII-D tokamak, using a geometry and path length similar to ITER, and has successfully demonstrated the ITER requirements for both interferometry and polarimetry. Work supported by U.S. DOE Contracts DE-AC-02-09CH11466 and DE-FC02-04ER54

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