Forward Modeling of Microwave Imaging Reflectometry for the Study of Edge Harmonic Oscillations in Quiescent H-Mode

Ming Chen[1], X.Ren[1], N. C. Luhmann, Jr.[1], B. J. Tobias[2], L.Shi[2], G.J.Kramer[2], C.M.Muscatello[3], X.Chen[3], A. M. Garafalo[3], F.Liu[4], G.Huijsmans[4]

1. University of California Davis, Davis, CA 95616, USA; 2. Princeton Plasma Physics Laboratory; 3. General Atomics; 4. ITER Organization

A synthetic diagnostic based on a forward modeling method employing the 3-dimensional FDTD code FWR has been used to compare experimental Microwave Imaging Reflectometry (MIR) data with linear and nonlinear modeling of the edge harmonic oscillations (EHOs) in quiescent H-mode (QH-mode). The QH mode regime is an ELM free operation mode in which EHOs provide additional edge particle transport while maintaining the operating point near but below ELM instability boundary. Therefore, understanding the nonlinear MHD mechanism is of great importance in determining the optimal operation space for QH mode which may be a potential scenario for ITER. Forward modeling of the synthetic diagnostic response to linear M3D-C1 and nonlinear JOREK modeling allows the simulation result to be compared directly with experimental data. Using this method, MIR is shown to accurately diagnose the poloidal wavenumber over a large region of the perturbation. However, including sheared toroidal rotation in M3D-C1 produces a sheared mode structure near the pedestal top. The nonlinear JOREK code also produces fine structure in this region, and it is believed that this structure is key to understanding the induced particle transport and the nonlinear saturation of the mode. The synthetic modeling employing M3D-C1 simulation results does not diagnose a single wavenumber in this region, but rather a broad wavenumber spectrum that often appears to propagate in the opposite direction, and experimental MIR data responds in a similar fashion indicating that this region does have complicated structure. New methods of data analysis, synthetic diagnostic response from JOREK data, and new configurations of the MIR diagnostic instrument are currently being developed in order to gain further insight into this structure for detailed comparison to the predictions of these simulation codes.