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Diagnosing Helicon and Lower Hybrid Wave Coupling with the Edge Plasma for Current Drive Optimization in DIII-D Using Laser Spectroscopy E.H. MARTIN, C. LAU, Oak Ridge National Laboratory, A.M. GAROFALO, M.W. BROOKMAN, B.VAN COMPERNOLLE, R.I. PINSKER, General Atomics, S.J. WUKITCH, Massachussetts Institute of Technology, S. SHIRAIWA, Princeton Plasma Physics Laboratory, A.Y. PANKIN, D.N. SMITHE, Tech-X — Over the next several years, the operational space of two novel RF actuators designed for off-axis current drive will be extensively explored in the DIII-D tokamak. The goal of these programs is focused on evaluating the potential for efficient current drive in advanced tokamak scenarios. Previous experimental work on C-Mod and NSTX determined that wave coupling with the scrape-off-layer (SOL) plasma can result in substantial core power loss. However, recent computational studies indicate that the SOL plasma can be optimized to minimize the undesired wave/SOL-plasma coupling, A diagnostic based on Doppler-free saturation spectroscopy (DFSS) has been proposed for direct measurement of the wave's electric field vector ($\mathbf{E_{RF}}$) in the edge plasma of DIII-D. The DFSS diagnostic was designed to provide a local measurement over a 2-D region with mm-scale spatial resolution and <10 V/cm electric field resolution. The measured 2-D $\mathbf{E_{RF}}$ data will be directly compared with 3-D full-wave simulations to quantitatively identify and characterize wave/SOL-plasma coupling. Utilizing 3-D full-wave simulations the expected $\mathbf{E_{RF}}$ in DIII-D will be discussed and results from mock-up performance validation testing of the DFSS diagnostic at ORNL will be presented.

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