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8.5 Forward modeling for the development of a Laser-Induced Rydberg Spectroscopy diagnostic on NSTX-U

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In fusion devices, subtle changes at the plasma edge (pedestal and scrape-off layer) can have a dramatic influence on confinement performance and anomalous transport properties of the plasma. In order to better understand physical processes happening in this region, we describe a detailed analysis of a novel diagnostic allowing the direct measurement of the local radial electric fields in the pedestal region in NSTX-U. Using a tunable probe laser to deplete the naturally populated n=3 level to a Rydberg state and the existing Thomson-scattering optics, it is shown that the local electric field can be measured through the Stark induced resonances observed as a dip in the D_α emission. The proposed diagnostic gives measurements resolved both in space and time with a 10 ms time-step. Using our simulated absorption spectrum; a precision of ˜2 kV/m in regions with a local electric field of 50 kV/m is predicted when we account for density fluctuations and statistical uncertainties due to the acquisition and fitting process.

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