Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

A Plasma Edge Electron Density Diagnostic Based on a Doppler-free Measurement of Stark Broadening[1] ABDULLAH ZAFAR, North Carolina State University, ELIJAH MARTIN, Oak Ridge National Laboratory, STEVE SHANNON, North Carolina State University — Passive spectroscopic measurements of Stark broadening have been reliably used to determine electron density for decades. A low-density limit of 1e19 mˆ-3 exists using these passive techniques due to Doppler and instrument broadening. At Oak Ridge National Laboratory, a novel diagnostic approach for measuring electron density using Stark broadening is currently under development and is capable of extending the low-density limit to 1e16 mˆ-3. The diagnostic is based on measuring the spectral line profile of a Balmer series transition using Doppler-free saturation spectroscopy, a laser-based absorption technique. The spectrum is then fit to a quantum mechanical model using the Explicit Zeeman Stark Spectral Simulator (EZSSS) code to extract the electron density. The increased sensitivity to the electron density is realized because Doppler-free saturation spectroscopy (DFSS) can greatly reduce the Doppler broadening and essentially eliminate the instrument broadening. DFSS has been successfully employed to measure spectral data in a magnetized (500-800 G), low temperature (5 eV), low density (1e17-1e18 mˆ-3), He/H2 and He/CH4 plasma in the mTorr pressure range. Experimentally measured pi and sigma H-alpha spectra, fit using the EZSSS code, will be presented. A quantitative model to accurately predict crossover peaks and dips will also be given.

[1]This work was supported by the US. D.O.E. contract DE-AC05-00OR22725

Abdullah Zafar
North Carolina State University

Date submitted: 14 Jul 2017 Electronic form version 1.4