## High Resolution H-Mode Pedestal Fluctuation Measurements with Charge eXchange Imaging on DIII-D\*

G.R. McKee<sup>1</sup>, M.R. Major<sup>1</sup>, F. Khabanov<sup>1</sup>, Z. Yan<sup>1</sup>, B. Geiger<sup>1</sup>, X. Han<sup>1</sup>, C. Seyfert<sup>1</sup>, D.R. Smith<sup>1</sup>, S. Stewart, J. Chen<sup>2</sup>, L. Schmitz<sup>2</sup>

<sup>1</sup>University of Wisconsin-Madison, Madison, WI, USA

<sup>2</sup>University of California-Los Angeles, Los Angeles, CA, USA

Author email: george.mckee@wisc.edu

2D (radial-poloidal) measurements of small-scale H-mode pedestal density turbulence have been obtained in DIII-D plasmas with a new Charge eXchange Imaging (CXI) diagnostic [1]. Instabilities arise in the H-Mode pedestal due to the large temperature and density gradients, selfdriven bootstrap current, magnetic shear, and geometry. The resulting turbulence drives transport, impacts pedestal stability, and affects Edge-Localized-Modes (ELMs) generation. The spatiotemporal scales of pedestal fluctuations pose a challenge due to the high lab-frame frequency resulting from the large ExB Doppler shift and small radial scale of pedestal modes. To address the need to measure pedestal fluctuations to characterize turbulence and validate models of pedestal instabilities, the CXI diagnostic has been deployed at DIII-D to observe the Dopplerbroadened n=8-7 ( $\lambda_0$ =529.1 nm) charge exchange emission between heating neutral beams and the intrinsic carbon impurity ion population. Customized fiber arrays deployed at the DIII-D BES viewing lens allow for measurements with a radial resolution of 3-5 mm and poloidal resolution of 1-1.2 cm per channel. A recently deployed 2D array of 12 (radial) x 5 (poloidal) channels (5.0 cm x 6.0 cm. sampled spatial area) provides intermediate radial wavenumber (kr<8 cm<sup>-1</sup>) and low poloidal wavenumber ( $k_{\theta}$ <3 cm<sup>-1</sup>) measurements across the full H-mode pedestal at the outboard midplane of DIII-D plasmas. Measurements with CXI have revealed a radially narrow ( $\Delta R \sim 1$  cm), spectrally broad turbulence structure localized to the steep gradient region of a high-density ELM'ing H-mode hydrogen plasma in the range of  $0.95 \le \rho \le 1.0$ , peaking at  $\rho \approx 0.97$ . The measured turbulence spectrum is observed from 30-180 kHz and peaks at ~60 kHz, near the Doppler-shifted electron diamagnetic frequency, with modes propagating poloidally in the electron diamagnetic direction, consistent with predicted properties of microtearing modes and trapped electron modes. The mode amplitude evolves rapidly during the inter-ELM phase, dropping at the ELM, growing rapidly, then saturating, while exhibiting a bursty nature. In addition, 2D fluctuation measurements of the Edge Harmonic Oscillation (EHO) and broadband turbulence in the pedestal of Wide-Pedestal QH-mode plasmas are presented.

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