Localized Measurement of Short Wavelength Plasma Fluctuations With the DIII-D Phase Contrast Imaging Diagnostic*

J.R. Dorris[1], J.C. Rost[1], M. Porkolab[1], and K.H. Burrell[2]

[1]Plasma Science & Fusion Center, Massachusetts Institute of Technology, Cambridge, MA, USA
[2]General Atomics, P.O. Box 85608, San Diego, California 92186-5608, USA

The DIII-D Phase Contrast Imaging (PCI) turbulence diagnostic measures density fluctuations previously line-integrated over the entire viewing chord. In 2004, a rotating mask system was installed that takes advantage of the vertical variation of radial magnetic field to make localized measurements along the PCI chord. The localized volume shrinks with increasing wavenumber making this technique more favorable for short wavelength modes ($k > 15$ cm^{-1}). However, a recently developed time-dependent analysis of the rotating mask has improved PCI localization and allows modest spatial resolution for wavenumbers as low as $k \sim 8$ cm^{-1}. In DIII-D, turbulence amplitude is seen to decrease with smaller fluctuation scale. Therefore, in 2006, a series of hardware upgrades were performed resulting in an improvement of S/N by an order of magnitude. This increase in PCI sensitivity now allows measurements for k up to 18 cm^{-1}.

Data has been obtained under a wide variety of plasma conditions during the 2006 and 2007 run campaigns. Fluctuations from the edge (r/a ~ 0.95–1.0) are larger amplitude than from the interior of the PCI chord (r/a ~ 0.75). Interpretation of localized measurements is complicated by the large number of parameters that vary over of the PCI chord (L_T, L_n, ρ_{si}). Additionally, because the PCI is only sensitive to turbulence propagating with wavevectors nearly perpendicular to the viewing chord, localized measurements also vary in $\vec{k}$-space pitch angle. Analysis will be focused on determining which of the above mechanisms, and under what plasma conditions, most affect turbulence. Measured evolution of turbulence will also be compared to nonlinear GYRO simulations through the use of a synthetic diagnostic.

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