

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

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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 ($k > 15 \text{ cm}^{-1}$). In DIII-D, turbulence amplitude is seen to decrease with smaller fluctuation scale. Therefore, the DIII-D PCI has undergone a series of hardware upgrades focused on improving S/N, and ultimately on diagnosing small amplitude ETG range turbulence.

For the 2006 experimental campaign, PCI S/N was improved an order of magnitude allowing measurements to $k < 18 \text{ cm}^{-1}$. Localized data was obtained with distinct properties. Fluctuations from the edge ($r/a \sim 0.95 - 1.0$) are larger amplitude than from the interior of the PCI chord ($r/a \sim 0.75$). Edge turbulence can be seen to propagate in the ion or electron diamagnetic direction and is seen to depend on plasma conditions including heating, density, and temperature. Analysis of localized measurements continues to develop with focus on extracting details of the turbulence spectrum as a function of chord height. Measured evolution of turbulence will be characterized in terms of changes in global plasma parameters.

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