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Progress Towards a New Technique for Measuring Local Electric and Magnetic Field Fluctuations in High Temperature Plasmas[1]

M.G. BURKE, R.J. FONCK, G.R. MCKEE, G.R. WINZ, University of Wisconsin-Madison — Local measurements of electrostatic and magnetic turbulence in fusion grade plasmas is a critical missing component in advancing our understanding of current experiments and validating nonlinear turbulence simulations. A novel diagnostic for measuring local electric and magnetic field fluctuations ($\tilde{E}$ and $\tilde{B}$) is being developed to address this need. It employs high-speed measurements of the spectral linewidth and/or line intensities of the Motional Stark Effect split neutral beam emission. This emission is split into several spectral components, with the amount of splitting being proportional to local magnetic and electric fields at the emission site. High spectral resolution ($\sim$ 0.025 nm), high throughput ($\sim$ 0.01 cm^{2}str), and high speed ($f \sim$ 250 kHz) are required for the measurement of fast changes in the MSE spectrum. Spatial heterodyne spectroscopy (SHS) techniques coupled to a CMOS detector can meet these demands. A prototype SHS has been deployed to DIII-D for initial testing in the tokamak environment, SNR evaluation, and neutral beam efficacy. In addition, design studies of the SHS interferogram are ongoing to further optimize the measurement technique. One major contributor to loss of fringe contrast is line broadening arising from employing a large collection lens. This broadening can be mitigated by making the lens at the tokamak wall optically conjugate with the interference fringes image field.

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