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**Fluctuation Analysis Techniques for Detection of Zonal
Flow Features in the DIII-D Tokamak¹**

R.J. FONCK, M. JAKUBOWSKI, G.R. MCKEE, University of Wisconsin - Madison — Time-delay estimation (TDE) analysis techniques have been developed to extract turbulent flow velocities from density turbulence measurements. They provide measurement of the flow-induced delay of density perturbations between two spatially separated sample regions in the plasma. Applications to density turbulence in the edge region of DIII-D reveals fluctuations in the poloidal velocity with characteristics very similar to those expected for one type of zonal flows. A coherent peak in the fluctuation power spectrum is observed at low frequency. This peak has a very long poloidal wavelength, consistent with $m = 0$. The radial correlation length is short and comparable to that of the density turbulence. These features are consistent with those expected for geodesic acoustic modes, or GAMs. Several upgrades to the BES diagnostic system on DIII-D are planned to increase the signal-to-noise by an order of magnitude, which in turn will allow poloidal velocity fluctuation measurements in the plasma core region.

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