Abstract

A detailed study of edge turbulence in ADITYA tokamak is reported in this thesis. The issues considered are: a) what are the spectral and temporal characteristics of edge turbulence in ADITYA? b) Are there any structures present in the edge plasma and what are their dynamical characteristics? and what are the characteristics of these structures at different scales?

The tokamak edge is a strongly turbulent environment with large electrostatic fluctuation levels and broad spectra. The propagation characteristics of the turbulence, studied using digital spectral analysis appears to be dominated by the variation of the radial electric field. A shear layer is formed near the limiter. The higher order moments of the fluctuation exhibits non-gaussianity at all radial locations indicating clear signature of intermittency.

Inspired by the observation of intermittency, we have carried out a systematic search for coherent structures at the edge plasma of ADITYA using conditional statistical analysis. It is demonstrated that structures are formed and they are of bipolar in nature. Structures are found to be radially isolated by a shear layer near the limiter and are poloidally elongated. They merge together to form larger structures, a clear indication of inverse cascade.

Further, we studied the scale dependence of potential fluctuations. To this end, the electrostatic potential fluctuation is subjected to wavelet transform to decompose into six logrithmically spaced spatial scales. It is demonstrated that the potential fluctuation at all scales are non-gaussian and the non-gaussianity varies rapidly at small scales. A conditional analysis on

each scale shows that structures are formed at all scales. Structures are observed to be poloidally elongated. Small scale structures experiences radial stretching and potential streamlines reconnects quite frequently and hence, radial isolation breaks down showing bursty nature of fluctuation induced transport Long scale structures break down into small scale structures and small scale structures are observed to merge together to form large scale structures. This observation indicates the dual cascade of energy among different scales.