Versatile Three-dimensional Tomographic Imaging System for the Plasma Turbulence Dynamic Studies

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Understanding the mechanisms of fluctuation-driven transport is a key issue in magnetically confined plasmas. The transport is mainly dominated by plasma turbulence which has intrinsically nonlinear interactions between the disparate scale fluctuations [1]. Furthermore, it is observed a turbulence asymmetry or a localization on the magnetic field flux surface, which has a strong influence on the plasma transport. On the other hand, a direct observation of the entire structure with the disparate scale fluctuations is difficult to measure simultaneously by the conventional diagnostics only to provide a measurement of local turbulence in a limited region of plasma cross-section. Hence, the versatile plasma turbulence tomography [2] is one of the strong candidates to measure the entire structure with the disparate scale fluctuations for studies more specifically.

Recently, a new three-dimensional (3D) tomographic imaging system has been developed for the plasma turbulence dynamic studies in the linear magnetized plasma [3]. Consequently, it is observed the averaged emission amplitude is decreased exponentially as away from the plasma source, and a normalized amplitude of a low-frequency fluctuation has an asymmetrical structure in radial direction. In particular, it is found that the radial structure of normalized fluctuations is changed along the z-axis. This result implies the stationary structure of plasma fluctuations is not entirely uniform in the direction of the magnetic field. In addition, the tomographic emission plasma fluctuations have the strong cross coherence with the ion saturation current fluctuations of an electrostatic probe, and the detail characteristic of the axial wavelength of low-frequency fluctuations is directly determined by the 3D tomography diagnostic.

References

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