Probability distribution function of density fluctuation in cylindrical helicon plasmas

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Intermittent phenomena in inhomogeneous magnetized plasma are considered to be associated with non-linear mechanism in turbulent fluctuation. Intermittency produces a tail in the probability distribution function (PDF) of fluctuation signals. In LMD-U, fluctuation spectrum are changed depending on neutral pressure by the damping effect of the collisions with neutral particles[1,2,3]. In this study, we characterize the PDF of turbulence fluctuation in various neutral pressure conditions ($2 - 5$ mTorr, Ar) for understanding of non-linearity of turbulence. Figures 1 (a) and (b) show the power spectrum of fluctuation on ion saturation current ($\tilde{I}_{is}$) for the case of 2 and 5 mTorr neutral pressure, measured by a 64-ch poloidal probe array, which decomposed $\theta - t$ space into $m - f$ space. Figures 1 (c),(d),(e) and (f) show the typical time evolution of I_{is} and PDF. The typical operational condition and plasma parameters are 3 kW RF power, 0.09 T magnetic field, 6×10^{18} m^{-3} peak electron density, 3 eV electron temperature. At low neutral pressure condition (2 mTorr), irregular peaks and broadband spectrum are found in power spectrum. At high neutral pressure condition (5 mTorr), spectral peaks lie along a straight line in the m - f space and a large tail is observed in the PDF. We discuss the neutral pressure dependence of the tail in the PDF.
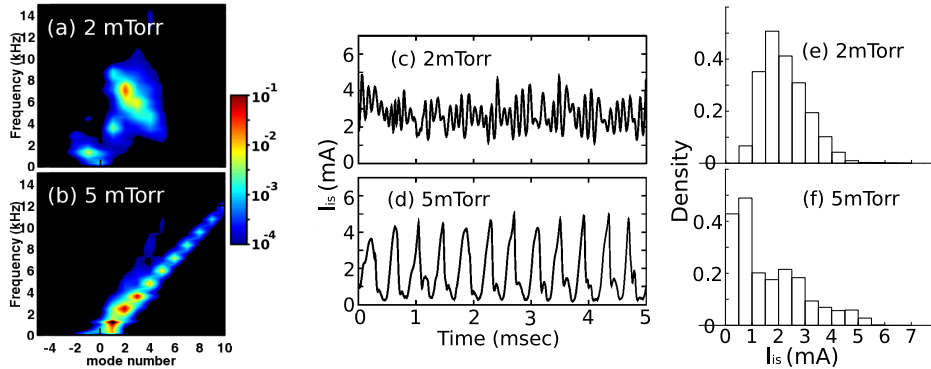

Figure 1: (a),(b)Power spectrum of $\tilde{I}_{is}$ by 64 ch probe array. (c),(d) Typical time evolution of I_{is}. (e),(f) PDF. (a),(c),(e) are 2 mTorr and (b),(d),(f) are 5 mTorr neutral pressure condition.

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