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揺動の2次元断面構造の推定法
Estimation of 2D cross-sectional structure of fluctuation

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Study of meso-scale structures, such as streamers and zonal flows, has been an important subject for understanding anomalous transports in linear and toroidal plasmas. Recently, a streamer structure was found in a linear cylindrical plasma, LMD-U [1]. In addition, a certain wave named 'mediator', which had the same frequency and poloidal wave number as the envelope of the streamer structure, was found to be strongly nonlinearly coupled with drift wave turbulence and playing an important role for the streamer formation.

In order to estimate the 2D cross-sectional structures of the streamer structure and fluctuation, a 64 channel poloidal probe array and a radially mobile probe were used. As a set of reference probes, the poloidal probe array measured the mediator mode. The phase structure of the mediator was acquired by calculating the cross spectrum between the radially mobile probe and reference. As shown in Fig. 1, it had a phase node in the radial direction. The bi-phase of the nonlinear coupling between the streamer and mediator indicates the phase difference between the envelope of the streamer and mediator. The streamer components were measured with the radially mobile probe, and the bi-phase between them and the mediator measured with the poloidal probe array showed a flat radial profile, indicating that the streamer structure was radially elongated. These features were quite equivalent with a pair of fast and slow modes predicted by a nonlinear Schrödinger equation based on the Hasegawa-Mima model [2]. The fast and slow modes correspond to the streamer structure and mediator, respectively. Such kind of a streamer structure, accompanied with a mediator, was also observed in a nonlinear simulation of drift waves in linear plasmas, using a three-field reduced fluid model [3]. The Numerical Linear Device (NLD) code clearly presented the generation of the streamer structure and clarified that the collision frequency between ions and neutrals plays an important role for the selection rule of generating meso-scale structures including streamers [3].

On the other hand, study of controlling the streamer was performed in the PANTA device by biasing the end plate. During the end plate biasing, the streamer was suppressed, the fluctuation level was reduced, and the electron density profile became more peaked. Changes in the 2D cross-sectional structures of the streamer structure and fluctuation are also reported.

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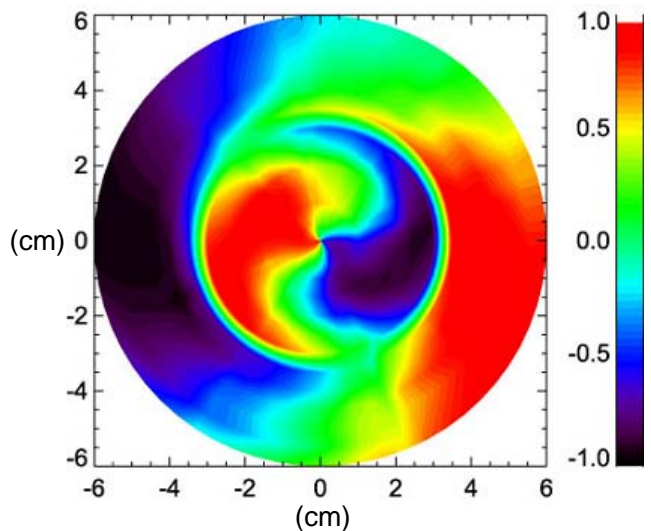[3] N. Kasuya *et al.*, Phys. Plasmas **15**, 052302 (2008).

Fig. 1. 2D cross-sectional phase structure of the mediator mode calculated from the real part of the cross spectrum between the radialy mobile probe and poloidal probe array.