3. CHS Experiments

Direct measurements of zonal flows in CHS has been admitted to be an epoch-making progress in the transport study of toroidal plasma confinement and the results have been referred to in many scientific meetings and discussions so far. In addition to the zonal structure of electric field which is very important in the discussions of the anomalous transport , the verification of the formation of zonal structure of magnetic field has been a great topic of interests in various scientific research fields because it is strongly related with the dynamo hypothesis. From the careful analyses of HIBP signals for the ECH heated plasmas in CHS, a set of magnetic fluctuation spectra and its coherence spectra was obtained which clearly show the existence of zonal structure of magnetic field created by the plasma turbulence. The wavelet bi-coherence analysis has proven the causal relationship between the zonal magnetic field and the turbulence.

In H-mode experiments, a comparison of plasma profile responses at the L to H transition for different toroidal positions (also at different poloidal positions) was made. Measurements were made by three sets of triple Langmuir probes located at the top of toroid, outboard edge and inboard edge of the toroid. Although the edge density profile suddenly changed at the transition for all three locations, the time evolutions of the radial particle flux show different time sequences.

Electron density fluctuation measurements by using YAG laser imaging method was made for H-mode experiments and the data analysis showed the clear suppression of the density fluctuations at the L-H transition. The maximum entropy method was applied to the two dimensional imaging data and the spatially resolved fluctuation spectra were obtained. The propagation direction is also identified for the fluctuation and it was shown that only the density fluctuations propagating to the ion-diamagnetic direction was suppressed at the transition.

Physics of toroidal Alfven eigenmode was investigated in CHS using the alternating magnetic field perturbations. Perturbations were applied with two antennae installed 180 degrees toroidal separation. The frequency response of magnetic probe signals called transfer function shows that the n=1 TAE with mode coupling of m=1, 2 was excited.

The analysis of the data in measurements of fast ions with a directional Langmuir probe was made. This probe can separately measure the fast ion loss in opposite directions (co-directed and counter-directed) and showed that the corresponding fast ion loss in the bursting energetic particle mode (EPM) appeared only in the co-directed flux. The analysis on the phase between the EPM and the fast ion loss signal was made and the energy transfer was discussed based on those phase relations.

The power deposition profiles were analyzed for the 2.45 GHz microwave heated plasmas with low magnetic field. The over-dense plasmas above cut-off density was created. The power modulation technique was used to identify the wave propagation and the power deposition and the mode conversion into the electron Bernstein wave was confirmed.

Electron propagation in the non-neutral experiments are discussed in terms of drift orbits of helically trapped particles. The mod-B contour plots of R_{ax}=101.6 cm configuration was considered as a region of electron drift motion and the combined effects of space potential on the particle and the drift motion were discussed.

Finally experimental results of the electron biasing experiments were summarized. For the plasmas produced by 2.45 GHz microwave, the electrode made of LaB_6 was inserted at the normalized radius 0.6. The electric current was swept (increased) externally with a current control power supply which is supposed to correspond to the poloidal flow driving force control. At certain level of current (~ 8A), a transition appeared with an increase of the density, suppression of fluctuations and the appearance of the steep density gradient at plasma edge. In order to interpret the observed transition phenomena, the neoclassical ion viscosity was calculated and compared with the measured poloidal flow. The dependence of the viscosity on the Mach number shows a good agreement between the experiment and the neoclassical modeling.

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