3. CHS Experiments

Data analysis study of CHS experiment has been continued for about three years since the operation of CHS was terminated in 2006. Fruitful results of analyses were still produced this year for various research fields : the heavy ion beam probe (HIBP) measurements, fluctuation analyses of H-mode plasmas, toroidal Alfven mode (TAE) physics study, three-dimensional dynamics of neutral particles, the electron Bernstein wave physics, non-neutral plasma study. CHS data acquisition and analysis system has been strongly supporting these researches.

HIBP is a powerful tool for measuring fluctuations in high temperature plasmas. Although it has capabilities of measuring electric potential, density and magnetic field, most of analyses in helical devices were made for only the potential and density fluctuations and discussions about the magnetic field fluctuations were rare. The CHS HIBP group was successful this year for presenting the magnetic fluctuation spectrum data for ECH plasmas by analyzing signals of multiple detectors. From the beam trajectory calculations for different detectors, it is known that the measured magnetic fluctuations are for the poloidal component.

The analyses of density fluctuation data obtained with the YAG laser imaging method for L-H transition discharges have been improved by introducing the maximum entropy method (MEM). Spatial resolution became much clearer than before and the separation of the poloidal propagation direction was clearly made. Different time behaviors of fluctuations was observed such that the fluctuation propagating in the ion diamagnetic direction was strongly suppressed at the transition and the one propagating in the electron diamagnetic direction increased gradually in the later phase of the H-mode.

The analysis was made for the coherence in the electrostatic fluctuations measured by Langmuir probes at the plasma edge region in the L-H transition discharges. Two coherent modes with about 10 and 17 kHz frequencies were observed in the frequency range of the geodesic acoustic mode. The turbulent driven particle fluxes were also estimated based on the data and they show clear change at about 2 msec after the L-H transition.

For the experiments of TAE mode excitation with external antennae installed in the CHS vacuum chamber, two resonant peaks were found in the analysis of the transfer function of the wave in the experimentally swept frequency range. Resonant frequencies and the damping rates for two peaks were calculated and the mode numbers of eigen wave are identified in calculated shear Alfven spectra. The structures of eigenfunctions were also found using AE3D code calculations.

The modeling of neutral particle dynamics using DEGAS code has been upgraded with a larger size mesh arrangement in order to compare the Hα monitoring signal in the experiments with the model calculation. A quarter of full torus was used in the modeling instead of former full torus model by introducing the periodic boundary conditions. An Hα signal was calculated for the central sight line of the monitor including both atomic and molecular contributions. The shape of wave length spectrum was compared with the measured Hα spectrum obtained in the spectrometer of the charge exchange spectroscopy. The broadening of the central part of the model spectrum fits well to the measured one. However the observed spectrum contains high energy tail component (about 7 eV) which was not produced in the DEGAS modeling.

For understanding the wave propagation in the electron Bernstein wave heating experiments in CHS, series of ray-tracing calculations were made for O-X-B conversion scenario. It was shown that the wave from two launchers propagates almost similarly and the expected mode conversion is made in the plasma core. Mode conversion efficiencies are also calculated for three experimental conditions of magnetic field.

In the non-neutral plasma experiments in CHS, it was observed that the electrons emitted from the electron gun in the stochastic boundary region got into the closed magnetic surface region within a very short instant. For the interpretation of such an effect, the electron orbit was calculated in the CHS geometry. A very complex behaviors were found for the trajectories of electrons with the phenomena of trapping and de-trapping in the helical ripples.

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