§11. Analysis of 2-dimensional Structure of Electrons and Ions in High Density Plasma with a High Angular Resolution Analyzer

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In order to investigate production and/or diffusion process of high dense plasma such as fusion plasma, 2-dimensional spatial structures of velocity distribution functions of electrons and ions should be clarified in source and downstream regions of high-density plasma.

In this work, measurement of 2-dimensional analysis of charged particles velocity distribution functions have been done by means of a directional analyzer with high-angular resolution of about 1°. We report experimental results of temperature and energy of electrons and ions in a Hyper-1 device for examining the phenomena of production and/or diffusion in the high dense plasma.

The high angular resolution analyzer \(^{1-2}\) consists of a capillary plate (25mm in outer diameter, \(L=0.4\text{mm}\) in depth, \(d=10\mu\text{m}\) in diameter of hole and 57% in transparency) as its first grid, a second grid (100mesh/inch\(^2\), tungsten), and a collector (stainless steel) as shown in Fig.1. The capillary plate was set at floating potential to avoid a disturbance to plasma.

The experiments were performed in the downstream region of Hyper-I device, whose size has 30cm in diameter and 200cm in length. Its magnetic field profile is divergent configuration. Electron cyclotron resonance plasma in Hyper-I device was produced by a few kW of microwave power. Ar and He gases were introduced into the device as working gases.

It was found that temperature of ions was 0.5-1eV at Ar 2mTorr and 1.2-1.5eV at 0.2mTorr, while at He 2mTorr was 0.4-0.6eV. Here, ion temperature was estimated from the semi-log plots of the ion collector current - grid voltage characteristics in the analyzer.

Effect of angle on electron temperature was investigated with comparison owing to two kinds of methods where it was estimated from the semi-log plot and the half width of first derivative of electron collector current - grid voltage characteristic as shown in Fig.2. Here, the angle was defined as an inset in Fig.2. It is found that both values decreases with increasing the angle. It is also seen that the value for half-width is higher than that for semi-log plot.

![Fig.1 Directional Analyzer](image)

![Fig.2 Electron temperature as a function of angle](image)

Reference