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§1. High Density Plasma Experiment HYPER-I

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High Density Plasma Experiment-I (HYPER-I) is a linear device with 10 magnetic field coils for various basic plasma experiments (Fig. 1). Being adaptable and accessible, the HYPER-I device have undertaken a number of collaborative researches. The vacuum chamber dimensions are 30cm in diameter and 200cm in length. Plasmas are produced and sustained by electron cyclotron resonance heating with an electron cyclotron wave (ECW), which is excited by a 2.45GHz microwave launched along the magnetic field line from an open end of the cylindrical chamber in the high-filed side. Since the propagation of ECW is not subjected to any density cutoff, the maximum density of the HYPER-I plasma is two orders of magnitude higher than the cutoff density of ordinary mode with the same frequency. A klystron amplifier (80kW CW max.) is available for the microwave source, which enables a wide-range control of microwave input power from low density to high density ($\sim 10^{13}$cm^{-3}) experiments. Five probe-driving systems have been installed to measure various plasma parameters such as electron temperature, plasma density, space potential and flow velocity field. To improve the accuracy of flow velocity measurements and to measure the flow velocity of neutrals, laser induced fluorescence (LIF) Doppler spectroscopy systems using a tunable dye laser and a tunable diode laser are now under development in the collaborative research program. The research activities of the HYPER-I experimental group is mainly focused on flow and structure formation as well as development of new diagnostic systems.

(i) *plasma hole formation*

A monopole vortex with a cylindrical density cavity referred to as *plasma hole* has been observed. By evaluating the detailed force balance in radial and azimuthal directions, the importance of the centrifugal force and anomalous viscosity in plasma hole formation has been pointed out.

(ii) *anti-ExB vortex*

A peculiar vortex which rotates to the direction opposite to the ExB drift with a deep background neutral density hole has been observed. A net momentum influx from flowing neutrals to ions may drive the anti-ExB rotation. Using newly developed LIF system, a preliminary observation of the flow of neutrals has been done.

(iii) *development of various probes*

We have been developing a novel method for plasma flow measurement using a facing double probe (FDP) and ion temperature measurement using an ion sensitive probe (ISP). Both probes may provide us a more easy-to-use technique in Mach number and ion temperature determination than optical methods.

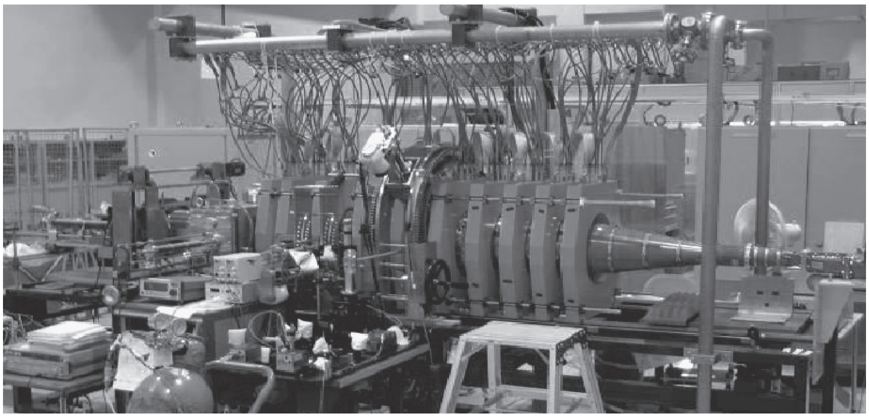

Fig. 1: The HYPER-I device