§1. High Density Plasma Experiment Using HYPER-I

Tanaka, M.Y., Yoshimura, S., Okamoto, A. (Tokyo Univ.), Tsushima, A. (Yokohama National Univ.), Saitou, Y. (Utsunomiya Univ.)

High Density Plasma Experiment-I (HYPER-I) device is a linear device with magnetic fields designed for various basic plasma experiments. Main research activities are focused on plasma flow measurements, structure formation in plasmas, and potential measurements in a rotating magnetized plasma. The HYPER-I plasma is produced and sustained by electron cyclotron resonance heating with an electron cyclotron wave (ECW) of frequency 2.45GHz. Two microwave sources are available; one is a magnetron oscillator with 15 kW output, and is used for low power experiments. A klystron amplifier with 80 kW output (CW) is also available for high-density, high-power experiments. Since there is no cutoff density for the electron cyclotron wave, the maximum plasma density produced in the HYPER-I device is two orders of magnitude higher than the cutoff density of ordinary mode with the same frequency ($1\times10^{13}\mathrm{cm}^{-3}$). The sizes of HYPER-I plasma are 30 cm in diameter and 200 cm in axial length. high density. Largeness of plasma diameter provides us various experiments without the effect of boundary or boundary layer, which is important in studying self-organized structure formation. A set of probe systems have been installed to measure the flow velocity field on a plane perpendicular to the magnetic field. This system covers 80% of the whole cross-sectional area of the plasma. The ongoing experiments are as follows;

(i) high-density plasma production

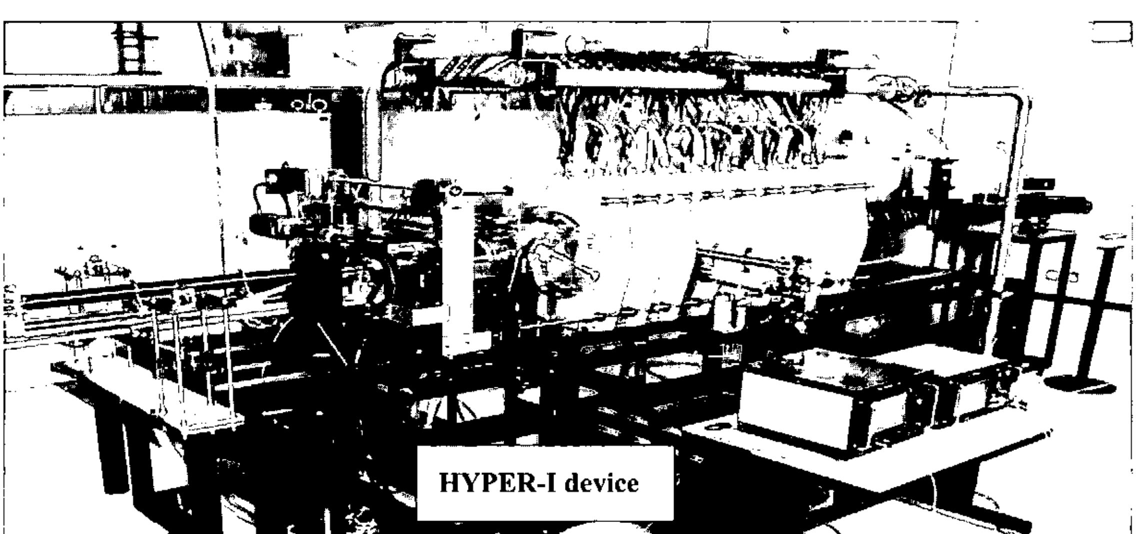
The electron temperature of HYPER-I plasma is controllable by changing the microwave input power, and the basic characteristics of the plasma is independent of gas species. Thus the HYPER-I device provides test plasmas for various experiments such as magnetohydrodynamic wave experiment, microwave reflectometer development and EUV source development. This program has been carrying out under the collaboration with Nagoya Univ., Shizuoka Univ. and Yokohama National Univ.

(ii) vortex formation and viscosity anomaly

We have observed a vortex with cylindrical density cavity (referred to as plasma hole). This is identified as a Burgers vortex, which is intrinsic in viscous fluids, and observed in a plasma for the first time. This result means that the viscosity of the plasma is much more higher (3 orders of magnitude) than expected in the classical theory. Plasma hole has been found in a He plasma and recently in an argon plasma, and the anomaly of viscosity probably the common nature of plasmas. We are planning to locally measure the viscosity coefficient using the plasma hole. We are developing the LIF Doppler spectroscopy to measure the absolute flow velocities. The preliminary experiments have been carried out, and there is fairly good agreement between the directional Langmuir probe data and the LIF Doppler data.

(iii) potential measurement

To understand the formation mechanism of plasma hole and the role of fluctuations on viscosity anomaly, potential measurement is of primary importance. Using a movable emissive probes, we have obtained the 2-dimensional potential structure of the plasma hole. This explains the azimuthal flow velocity profile. It is found that the quasineutrality condition breakes down in the core of plasma hole.



HYPER-I device