§4. High Density Plasma Experiment HYPER-I

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High Density Plasma Experiment (HYPER-I) is a linear device with magnetic fields designed for various basic plasma experiments. Main research activities are focused on flow and structure formation, vortex and its interaction, and particle accelerations in a rotating magnetized plasma. HYPER-I plasmas are produced and sustained by electron cyclotron resonance heating with an electron cyclotron wave (ECW) of frequency 2.45GHz. Two microwave generators are available now; one is a magnetron oscillator with 15 kW output for low power experiments, and the other is a klystron amplifier with 80 kW output. Since there is no cutoff density for the accessibility of ECW, a high-density plasma exceeding 1×10^{13} cm^{-3} has been obtained for an argon plasma. This density is two orders of magnitude higher than the cutoff density of ordinary mode with the same frequency. Characteristic features of HYPER-I plasma are large diameter (30 cm) and high density, which permit wave-plasma interaction experiment without noticing the boundary condition or structure formation experiments without considering the boundary layer *etc.*. Magnet-hydrodynamic wave experiments are also possible in the high-power operations. The ongoing experiments are;

(i) high-density plasma production

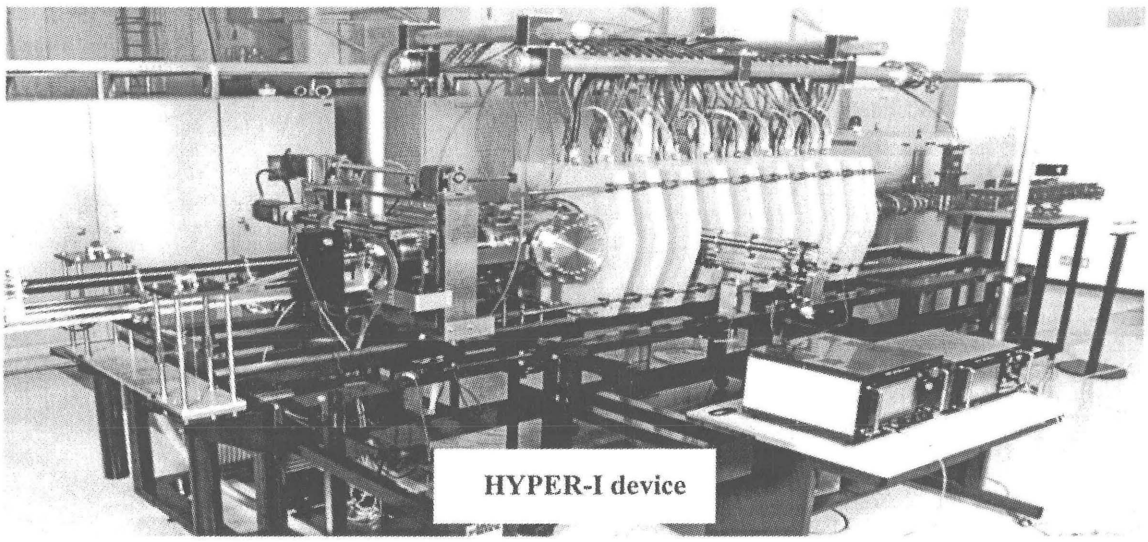
To realize high-density plasmas suitable for magneto-hydrodynamic wave experiment, we introduced a new klystron amplifier. The aging test and calorimetric measurements for the new klystron amplifier have been completed, and one-hour operation with a 72 kW output has been achieved. The microwave circuit has been changed to connect the klystron to the HYPER-I device. Preliminary experiments on high-power plasma production have been carried out.

(ii) structure formation in a rotating plasma

Spontaneous formation of plasma hole (cylindrical density cavity) has been observed. Density of the plasma hole is one tenth of that of ambient plasma, and is bounded by the steep transition layer of the order of a several ion Larmor radii. The flow velocity field on a plane perpendicular to the magnetic field has been carefully measured and revealed that the plasma hole is a sinking swirl. Potential measurements have been also carried out using an emissive probe. It is found that the potential of the hole is 100 V (~5Te), and the quasi-neutrality breaking occurs in this region.

(iii) multipole vortex in a plasma

Formation of tripolar vortex has been observed in a certain range of background pressure. The vortex pattern is stationary, although the background plasma azimuthally rotates. The tripolar vortex is always accompanied by two density hills and a well between them. The hill regions co-rotate in the direction of electron diamagnetic drift, and the well region in the opposite direction. Velocity field measurements show that the vorticity is localized in the central well region. The effect of neutral particle pressure on the vortical motion of plasma is now studied.



HYPER-I device