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直線型慣性静電閉じ込め装置の発光分光測定
Emission Spectroscopic Measurement of Linear Inertial Electrostatic Confinement Device

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The inertial electrostatic confinement (IEC) fusion device is a compact neutron generator using D-D nuclear fusion[1]. Deuterium ions are generated by glow discharge and accelerated electrostatically inside the device. Nuclear fusion reactions occur around the central cathode. In the typical configuration of the IEC device, a highly transparent cathode is used so that ions could be reaccelerated after passing through the cathode.

As the deuterium nucleon energy increases, the D-D nuclear fusion cross section drastically increases, so it is important to enhance the ion generation in the regions where the electrostatic potential is high. In order to improve the performance of the IEC device, it is necessary to elucidate the ion generation mechanism in the equipment and the various characteristics of the internal plasma.

In this study, we precisely measured Balmer-α emission spectra from a glow-discharge hydrogen plasma by a spatially-resolved spectrometer and revealed the velocity distributions of energetic plasma particles from the Doppler-shift components in the spectra.

Figure 1 shows the experimental setup. We used a linear IEC device having glass side walls type. In this experiment, hydrogen was used as the working gas instead of deuterium. The spectroscopic measurement was performed from a direction inclined by 60 degrees from the axial direction of the device.

The wavelength of interest is Hα (656.28 nm). We measured the discharge-current dependence of the emission spectrum by changing the observation position along the center axis of the device. spectroscopic measurement. Typical experimental results are shown in Fig. 2. One can see that as the current increases, the intensity of the Hα emission increases.

We extracted the information on the velocity distribution of plasma particles in the IEC device

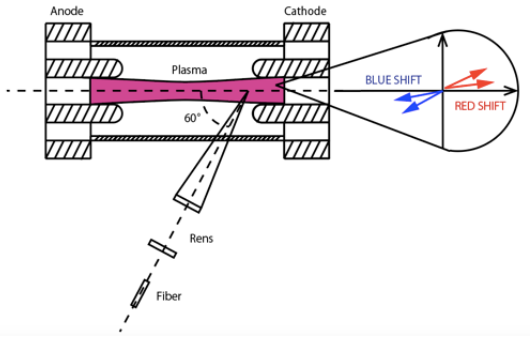

Fig. 1. Experimental setup.

from the Doppler-shift components on both sides of the central Hα peak. The changes in the discharge current affect the total light emission amount, but, the spectral shapes are almost independent of the current, which implies that increases in the total amount of plasma electrons and ions have no influence on the particle kinetics in the IEC plasma.

The dependencies of the Hα spectra on the observation positions in the plasma are also discussed in the presentation.

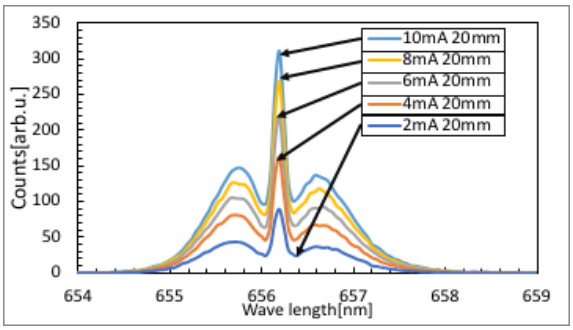

Fig. 2. Hα emission spectra under various plasma conditions.