§ 6. Reconstruction of Neutral Particle Distribution with CT Method Using Visible Lines in the HYPER-I Plasma

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In the HYPER-I device, a vortex structure is observed under a certain plasma condition. The structure has two peaks, which can be recognized as bright ovals when observed from an open end of the plasma. It is expected that a neutral particle distribution in the plasma play an important role in the vortex formation. Purpose of our investigation is to study the spatial distribution of neutral particles with computer tomography (CT) using visible lines in order to have a better understanding on the formation of the vortex structure.

Figure 1 is a schematic drawing of a cross section of the experimental device, HYPER-I, whose radius, R_c, is 15 cm. A signal detector for the visible lines is placed at R_0 = 19.5 cm as also shown in Fig. 1. A support of the detector is fixed. The detector can rotate around the support. The rotation angle is $-35° < \theta < 35°$. For the idealistic reconstruction with CT, a number of detectors are required. In the HYPER-I case, however, a geometric restriction makes the number of detectors to be less than or equal to 3, and as a first step of a series of our experiments, we used only one detector. A geometrical configuration of the detector and the peaks of vortex are shown in Fig. 1 as well. A detected signal is transmitted to a spectroscope with an optical fiber cable to select the specified line spectrum.

An argon plasma is produced by ECR heating. The wavelengths observed in the experiment are 425.9 nm of Ar I (neutral) and 488.0 nm of Ar II (Ar^+).

Figure 2 is a typical example of angular distributions of detected line intensity. It is found that both of these have asymmetric distributions with respect to 0°. In order to reconstruct the spatial distributions with CT, we have assumed axial symmetry. The results for Ar I are shown in Fig. 3. The upper (lower) half is the result obtained using the signals of positive (negative) angles. Due to the assumption of the axial symmetry, the twin peaks are not reconstructed. The lower peak around zero is considered to be the combined effect of two peaks of vortices.

To summarize, we observed a vortex structure in HYPER-I device. By observing visible line spectrum of Ar I and Ar II, we reconstruct their spatial distributions with CT method under the assumption of the axial symmetry.

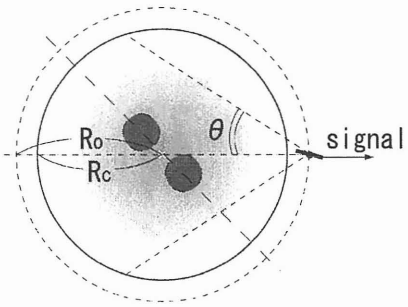

Fig. 1 Schematic drawing of a cross section of the experimental device and the visible ray detector. Two peaks of vortex structure are also shown in this figure.

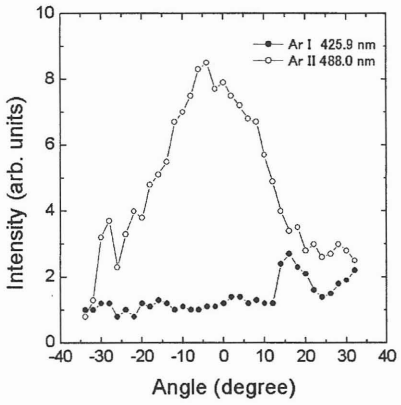

Fig. 2 Typical examples of radiations from Ar I (neutral: 425.9 nm) and Ar II (Ar^+: 488.0 nm).

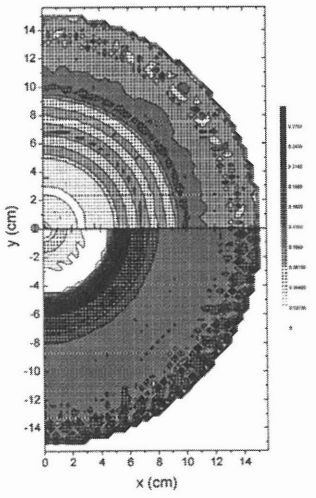

Fig. 3 Reconstructed distribution of neutrals. The upper half and the lower half are obtained using signals of 0° □ θ < 35° and -35° < θ □ 0°, respectively.