§42-20 Design Study on Electron Temperature Profile Measurement for RT-1

Nishiura, M., Yoshida, Z., Kawazura, Y., Yano, Y., Mushiake, T., Kashyap, A. (Univ. Tokyo), Yamada, I.

Plasma confinement in an advanced fusion device using a dipole magnetic field configuration has been studied in RT-1 at The University of Tokyo. The confined plasmas show the interesting phenomena; inward diffusion that is observed in a magnetosphere of the Saturn and other planets. The present studies explain the inward diffusion that organizes the peaked density profile with a model of the density profile with r^{-a} where r and a are the radial position and a fitting factor, respectively. The electron density is reconstructed by three chord interferometers with the assumption, as is shown in Fig. 1[1)]. The peaked density profile is explained by inhomogeneous magnetic fields near the dipole field which cause the homogenized electron density in the magnetic flux coordinate.

In the above context, the problems are the validity of the density profile and the unknown of the electron temperature profile. To make sure of it we begin to study the design for a Thomson scattering (TS) system in RT-1 to measure the local electron temperature and density. In RT-1, the electron density and the temperature range from 10^{16} to 10^{18} m^{-3}, and <100 eV, respectively as a typical operation. The electron density of 10^{17}-10^{18} m^{-3} is considered to be low compared with that in LHD and other devices where TS systems are applied.

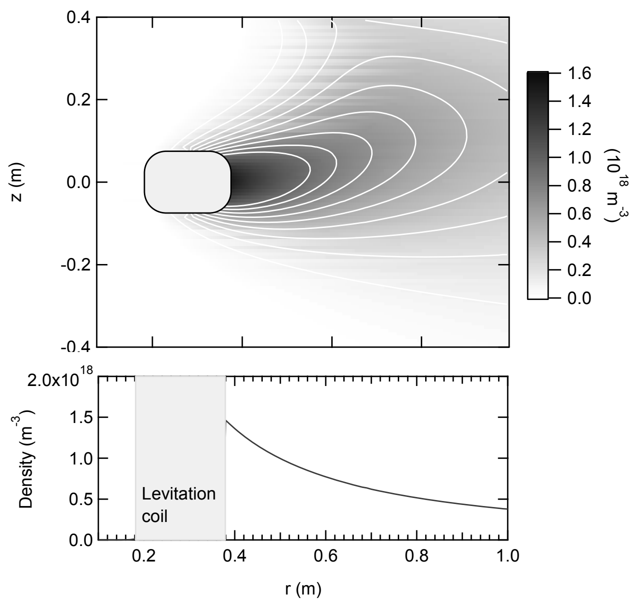

Fig.1 Typical example of electron density profile in RT-1 that is measured by three chord interferometers.

In TST-2[2)] and Gamma 10[3)], they reported that TS diagnostics under the low density conditions are possible to obtain the electron temperature. These results encouraged us to apply a TS system to RT-1 plasma diagnostic. Fig. 2 shows the design optics for a TS system in RT-1. The field of view ranges from the plasma center to the edge. With the scattering length of 10 mm, the scattered photon number is calculated in Fig. 3. The photon number more than 10^4 counts is considered to be a feasible level to obtain the adequate signal to noise ratio for a TS system. We found that the TS diagnostic in RT-1 is feasible, if the electron density is more than 10^{17} m^{-3}.

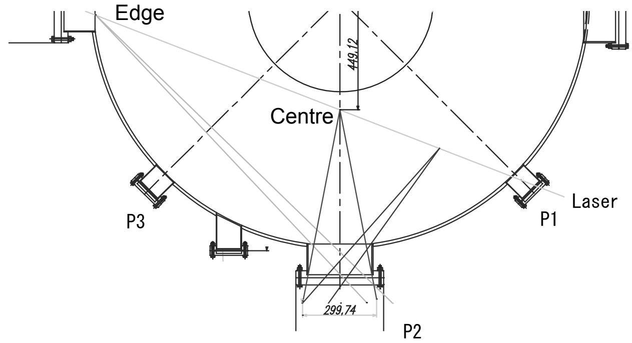

Fig.2 Geometry for TS system on the equatorial plane in RT-1. The laser injection from P1 port and the photon detection at P2 port.

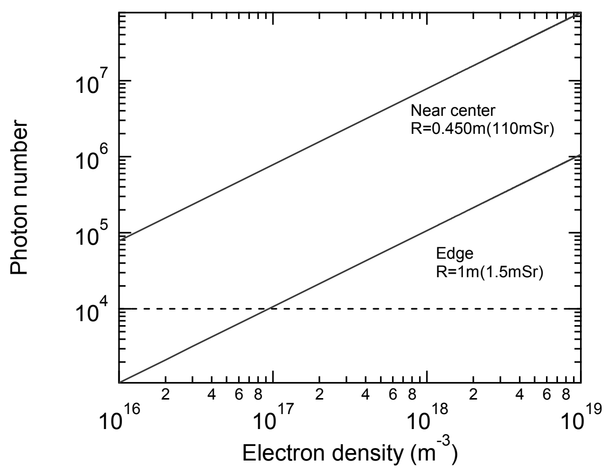

Fig.3 Photons number for Thomson scattering as a function of the electron density at the P2 port of RT-1.

1) Nishiura, M., Kubo, S., Tanaka, K. *et al.* : Nucl. Fusion **54**(2014) 023006.
2) Hiratsuka, J., Ejiri, A., Hasegawa, M. *et al.* : Plasma and Fusion Res. **7**(2012)2402092.
3) Yoshikawa, M., Yaguchi, F., Miyata, Y. *et al.* : Plasma and Fusion Res. **6**(2011)1202095.