§17. Correlation between Magnetic Field Configuration and Density Profile in Merged Compact Toroid

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Compact Torus (CT) is a toroidal confinement configuration where the magnetic field is generated almost entirely by current flowing in the plasma. In consequence, they have a potential of being a high beta configuration. The concept of CT contains various magnetic configurations. However the correlation between magnetic field configuration and density profile has not been investigated in detail. It has been considered that the density profile of the magnetically confined plasma has similar structure to the magnetic surfaces. We investigated the correlation between the magnetic field configuration and the density profile by the magnetic measurement and the interferometry. In order to obtain the density profile of the CTs, a multichannel CO_2 laser interferometer system was constructed in the TS-4 CT/ merging device [1].

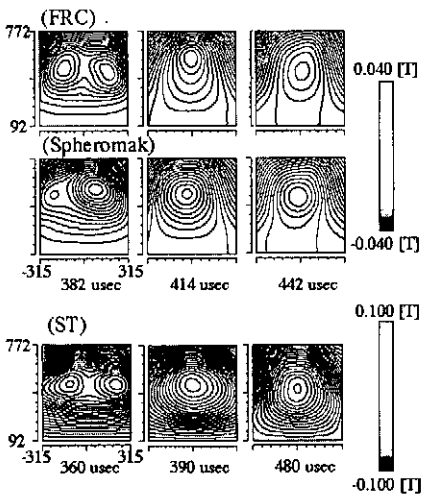

Fig. 1 The poloidal flux contours with toroidal field amplitude of an FRC, a spheromak and a Spehrical Tokamak.

Figure 1 shows the poloidal flux contours with toroidal field amplitude of an FRC, a spheromak and a Spherical Tokamak (ST). All configurations can be produced in a single device by the merging of two CTs. The spatial profiles of line-averaged density $\bar{n}_e$ of the FRCs, the spheromaks and the Spherical Tokamaks are shown in Fig. 2. The horizontal axis is the radial position of the interferometry chords normalized by the separatrix radii. The magnetic axes located at $y/r_{separatrix}$ ~0.6-0.7 in all cases. It was found that the $\bar{n}_e$ around the magnetic axis was smaller than those at inside region (small $y/r_{separatrix}$ region) in the FRCs. On the other hand, in the case of the spheromaks, the $\bar{n}_e$ around the magnetic axis was larger than those at inside region (small $y/r_{separatrix}$ region). The profiles of the $\bar{n}_e$ in the STs were observed to be flat. Figure 3 is the radial profiles of magnetic field strength of the FRC, the spheromak and the spherical

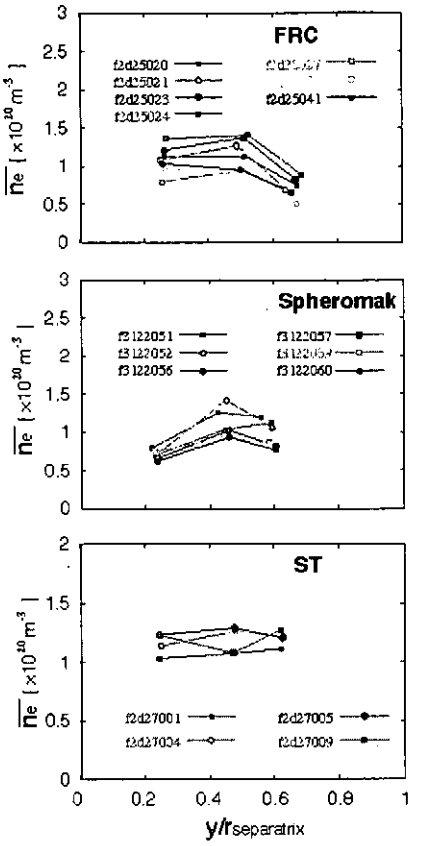

Fig. 2 The spatial profiles of line-averaged density of the FRCs, the spheromaks and the Spherical Tokamaks.

Tokamak. The magnetic axes located at r~ 0.5 m in all cases. In the FRC, magnetic null was observed at r~ 0.5 m. Similar profiles to the density profiles as shown in Fig.2 were seen. These results may indicate that density profile of magnetically confined plasma well correlates with the magnetic configuration. Extension of the measurement region of the density is required for detailed discussion.

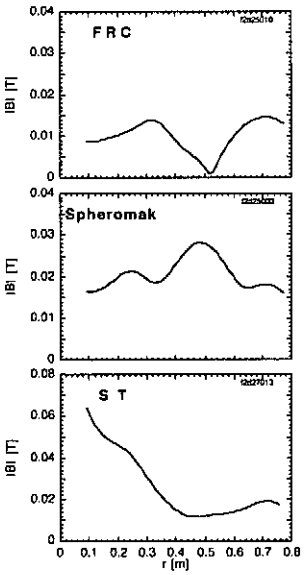

Fig. 3 The radial profiles of magnetic field strength of the FRC, the spheromak and the spherical Tokamak.

Reference

1) Y. Ono et al.,.Phys. Plasmas 7, (2001) 1863.