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TOKASTAR-2における磁気面計測方法の検討
Examination of the Method to Measure Magnetic Flux Surface on TOKASTAR-2

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TOKASTAR-2 is a plasma confinement device which has two coil systems, one for tokamak and the other for stellarator. The object of TOKASTAR-2 is to study the influence of plasma current to helical plasma and the influence of helical magnetic field application to the tokamak plasma [1].

The stellarator coil system was designed to make closed magnetic flux surfaces without any plasma current. However, due to the influence of manufactural accuracy, installational accuracy of coils and error magnetic field, the location and shape of the helical magnetic flux surface can be deviated from the analytical one. Then, the object of this study is to measure the magnetic flux surfaces experimentally.

There are mainly two methods to measure magnetic flux surface, one using a fluorescent screen [2] and the other using a probe [3] for detecting electrons emitted by an electron gun. These two methods use the property that injected electrons travel along the field lines. In the method using a fluorescent screen, a magnetic flux surface can be traced faster than the other one and a mechanical driving system is not needed. An electron gun, which can be applied to either of the two methods, was designed and fabricated. Electrons are emitted from tungsten filament and this gun has the mechanism to adjust radial position and angle of electron injection.

Figure 1 shows the orbit of electrons with different energies in the typical magnetic configuration condition. From the experiment with the fabricated electron gun in a test chamber, we estimated that the electron energy needed to be larger than about 80 eV to detect the fluorescence of P15 and P24 (ZnO:Zn). As shown in Fig. 1, the orbit of the electron with 80 eV differs largely from the magnetic flux surface. From these results, we concluded that significant improvement of the electron gun is needed to apply the method using a fluorescent screen to TOKASTAR-2.

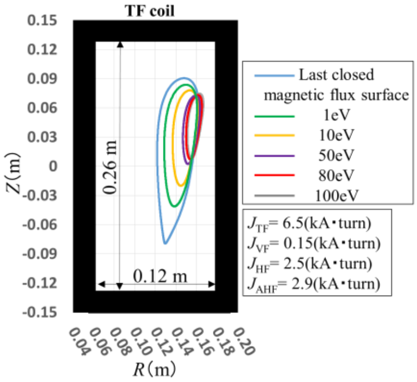

Fig. 1. Orbits of electrons in the typical magnetic configuration condition

The lowest electron energy needed for the method using a probe was also examined.

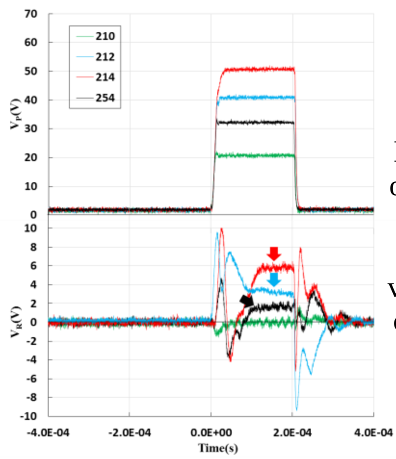

Fig. 2. Time evolution of (top) the acceleration voltage of the electron beam and (bottom) the voltage of the resistance connected to the probe.

Figure 2 shows time evolution of the voltage of resistance (1MΩ) connected to a probe. The electron beam was detected when acceleration voltage was 30V and the pulse width was 200 μs. At the present, we try to optimize the conditions of the value of resistance and pulse width. The lowest electron energy that the probe can detect is expected to be improved by change materials of filament from tungsten to the other one, for instance thoria tungsten. After that, we will put device in TOKASTAR-2.

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