19PA-034

Preliminary Experiment for Magnetic Surface Mesurements with Fuorescent Target on TOKASTAR-2
TOKASTAR-2 における蛍光ターゲットを用いた磁気面計測の予備実験

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Magnetic flux surface mapping with the electron gun and fluorescent target is planned in TOKASTAR-2, to confirm the effects of error fields due to the manufactural accuracy and installational accuracy of coils. The field line tracing reveals that the magnetic flux surface of TOKASTAR-2 is very sensitive to the installational accuracy of coils. The electron gun design is completed. Preliminary experiment without magnetic field will be conducted to investigate proper flourescent agent, acceleration voltage of electrons and exposure time of photography for the magnetic surface measurements on TOKASTAR-2.

1. Introduction

TOKASTAR-2 is a plasma confinement device which has two coil systems, for tokamak and for stellarator. The TOKASTAR-2 coil systems consists of eight Toroidal Field (TF) coils (50 turns each), two Pulsed Vertical Field (PVF) coils (20 turns each), three-block Ohmic Heating (OH) coils, two Helical Field (HF) coils (98 turns each), two Additional Helical Field (AHF) coils (126 turns each) and two Vertical Field (VF) coils (100 turns each), as shown in Fig. 1. The VF coils are installed outside of the vacuum vessel and the other coils are inside it. The object of TOKASTAR-2 is to study the influence of helical magnetic field application to the tokamak plasma and the influence of plasma current to helical plasma.The stellarator coil system is designed to make closed magnetic flux surfaces without plasma current. However, due to the influence of manufactural accuracy and installational accuracy of coils, helical magnetic flux surface can differ from analytical one. In fact, the effect of generating closed flux surfaces on plasma confinement seems to be small in the experiment [1]. Hence, the object of this study is to measure magnetic flux surface experimentally.

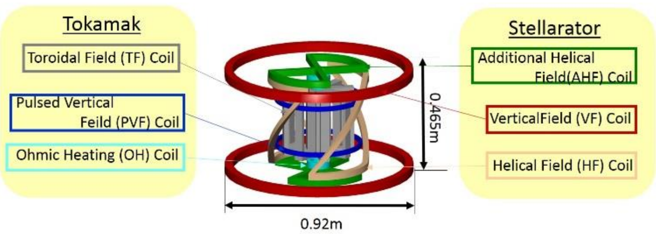

Fig. 1. Schematic view of the TOKASTAR-2 coil systems

2. Method of Measurements

To measure magnetic flux surfaces, we adopt the method using an electron gun and a fluorescent target. Commonly, highly transparent screen is used for the target. In this method, the electrons launched from the electron gun collide with highly transparent fluorescent screen each time when they circle the torus. But, since the screen is highly transparent, most of electrons pass the target and continue to circle the torus. So we can trace a large number of passes as glowing spots or as a continuous curve on the screen [2]. Figure 2 shows the layout of the equipment. The screen will be attached to one of the TF coils.

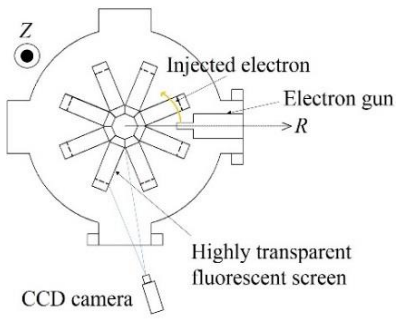

Fig. 2. The layout of the equipment from the top of TOKASTAR-2

3. Calculation of Magnetic Flux Surface

To confirm the sensitiveness of the magnetic flux surface to the error field, change of the magnetic surface by error field was evaluated. The field line was traced by a program named Helical System Design (HSD) [3]. Figure 3 shows the change of the magnetic flux surfaces for a inclination of the AHF coils. The area of the closed magnetic flux surface become smaller when AHF coils are more inclined. When the AHF coils are inclined more than 2 degrees, magnetic flux surface is not closed. From the result of this calculation, it became obvious that the magnetic flux surface of TOKASTAR-2 is very sensitive to the installational accuracy of coils because TOKASTAR-2 is a small device.

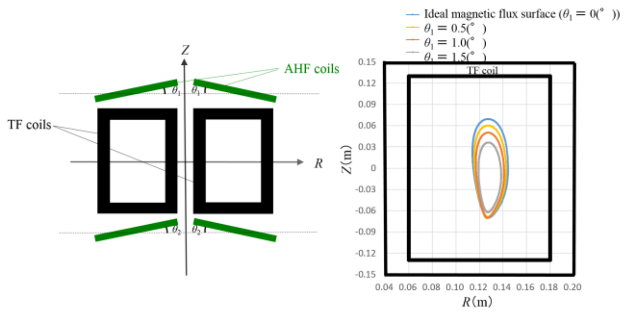

Fig. 3. The schematic depiction of definition of θ_1, θ_2 and change of the magnetic flux surface (I_{TF}=90 A/turns, I_{VF}=1.5 A/turns, I_{HF}=25.5 A/turns, I_{AHF}=90 A/turns, θ_2=0 °)

4. Design of the Electron Gun and Examination of the consistance of the Fluorescent Screen

After the calculation of the magnetic flux surface, we designed electron gun. Figure 4 shows the assembly drawing of the electron gun. The electron gun consists of a filament to supply thermoelectrons and a stainless-steel holder with a 1mm aperture. The radial position of the gun can be adjusted by using a bellows. The stainless-steel holder can be turned to adjust the angle of electron injection. For the flourescent agent, ZnO:Zn can be used because it has good flourscent property on low electron voltages and we can use the mesh composed of stainless-steel wires for the highly transparent screen.

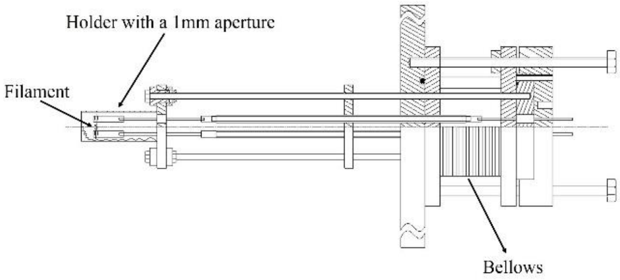

Fig. 4. The assembly drawing of the electron gun

5. Future Plan

After assembling of the electron gun and preparation of the fluorescent target, we will conduct preliminary experiment using a test vacuum chamber without magnetic field. The objective of the preliminary experiment is to investigate which flourescent agent is proper for the measurement on TOKASTAR-2, how large acceleration voltage is necessary to make fluorescent screen emit light and how long exposure time is necessary to take a photograph of the emitted light. Magnetic surface measurements on TOKASTAR-2 will be conducted after the preliminary experiment.

Acknowledgments

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Reference

[1] T. Sakito et al.: this conference (19PA-029).

[2] R.J. Colchin et al: Rev. Sci. Instrum. Vol. 60, No. 8, August 1989, **60** (1989) 26

[3] K. Yamazaki et al: Fusion Technology **21**, (1992) 147