

§23. Consideration of Experiments on Magnetic Surface Confinement of Nonneutral Plasmas on Heliotron J

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Since 2002, nonneutral plasmas on helical magnetic surfaces had been studied on the Compact Helical System (CHS) device at NIFS, and as the result of the research, several new findings about basic plasma physics came out experimentally¹⁾. While some of them could be numerically investigated without any more experimental data, there still have been a number of puzzling questions especially on the structure of parallel electric fields on closed magnetic surfaces which actually requires experimental efforts.

In Kyoto University, the Heliotron-J machine, one of middle-sized helical devices, runs extensively. The feature of Heliotron-J is similar to CHS in a sense. As seen from Fig. 1, the closed magnetic surfaces of Heliotron-J do not touch on the chamber wall, which is actually the most important issue to successfully produce nonneutral plasmas on helical magnetic surfaces. Thus this strongly suggests that using Heliotron-J we can resume the experiments on helical nonneutral plasmas.

In order to answer the question, we had planned a preliminary experiment on Heliotron-J and in fact carried it with both the electron gun and probe which were originally installed in CHS. Figure 2 shows the first data²⁾ on profiles of plasma parameters of

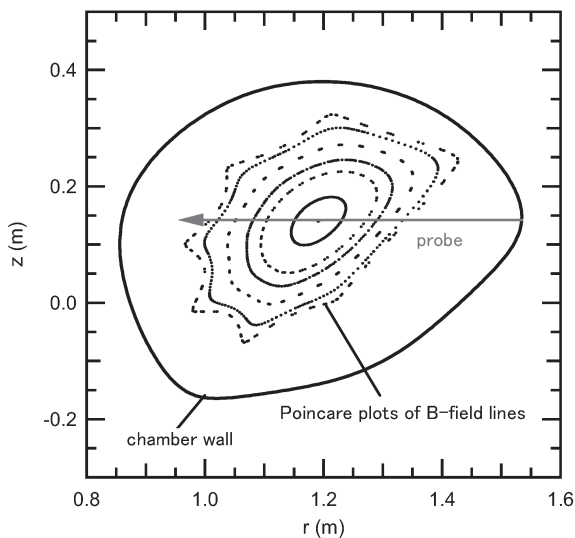


Fig. 1 A schematic drawing of the 11.5 cross section of Heliotron J.

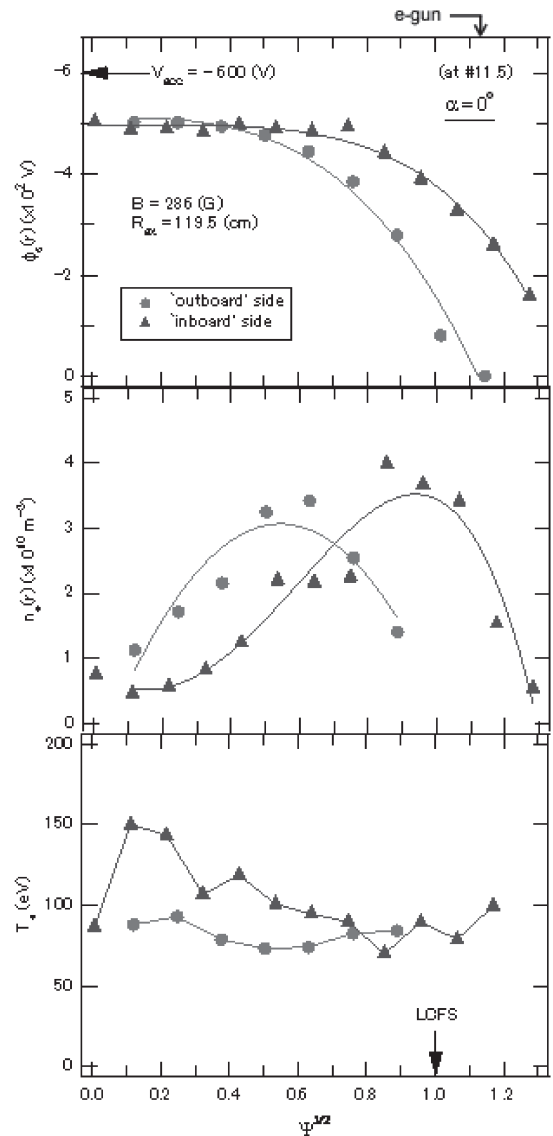


Fig. 2 Profiles of space potential, electron density, and electron temperature outputted from helical non-neutral plasmas on Heliotron-J.

helical nonneutral plasmas produced on Heliotron-J. As seen clearly from the data, non-constant space potential and density are observed on magnetic surfaces of Heliotron-J, as well. Although the detail is now analyzed and will be published elsewhere, this result means that we can start a new experiment on the device in full swing. We are now conducting a numerical calculation of the line tracing on helical magnetic surfaces to determine the next experimental setup. The next series will be performed this fall.

- 1) H. Himura *et al.*, Rev. Sci. Instrum. **74**, 4658 (2003); IEEE Trans. Plasma Sci. **32**, 510 (2004); Phys. Plasmas **11**, 492 (2004); Phys. Plasmas **14** (2007) 022507.
- 2) H. Himura *et al.*, in preparation.