§57. Construction of Heliotron Configuration with Modular Coils

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Helical fusion reactor is an attractive system for steady state reactor. For its steady state operation, the efficient divertor functions are required to control the fuel, the impurity and the thermal transport, and the modulation of helical coil is requested for easy maintenance of the reactor. Heliotron devices with continuous helical coils such as LHD[1] provide with large space for divertor pumping, however it is difficult to make the system modularized for easy maintenance of the reactor system. On the other hand, the present modular helical represented by W7-X[2] is designed to optimized the core magnetic confinement, but is not optimized on the edge and separatrix configuration. One of the most important issues for helical system is to search for good confinement with the coil modularity and closed helical divertor. We reconstruct the heliotron configuration produced by modular coils as first step of the optimizing helical system with the coil modularity and closed helical divertor. We apply the NESCOIL[3] (NEumann Solver for fields produced by external COILs) code to construction of heliotron configuration.

In the basic version of the NESCOIL code the coil configurations are determined by solving a Neumann boundary value problem: A stellarator vacuum field is completely determined by the shape of the outermost closed flux surface. On an outer closed surface surrounding the plasma domain a surface current is determined such that the normal component of the field produced is minimized at the plasma boundary. The surface current whose current lines are chosen to be poloidally ("modular") or toroidally ("torsatron-like") closed, is then discretized into a finite number of filaments.

Figure 1 shows the Poincaré plots produced by modular coils. Solid line corresponds to the outermost magnetic surface produced by the continuous helical coils. In this case, the volume closed by outermost magnetic surface is smaller than that for the continuous coils. Figure 2 shows the surface current lines, which produce the magnetic field shown in Fig.1.

The study of the dependence of separatrix and magnetic field structure in edge on the external coil structure is the future subjects.

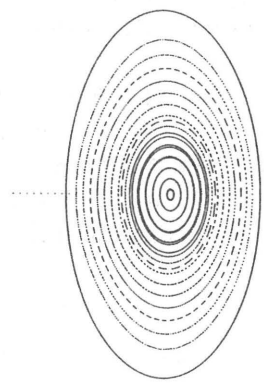

Fig.1 Poincaré plots produced by modular coils.

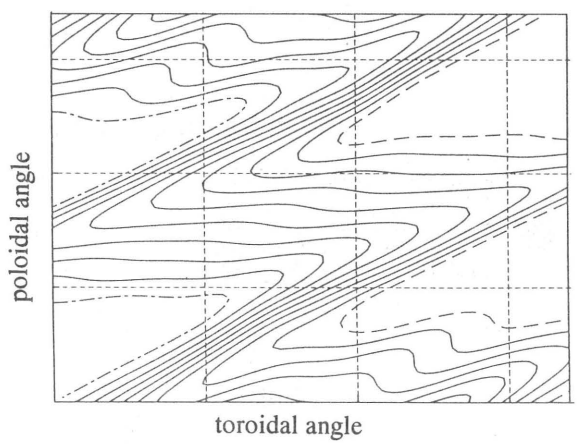

Fig.2 Surface current lines, which produce the magnetic field shown in Fig.1

References

1) Iiyoshi et al, Fusion Technol. **17**(1991)169.
2) Beidler,C., et al, Fusion Technol. **17**(1991)148.
3) Merkel, P., Nucl. Fusion **27**(1987)867.