§19. Evaluation of Boozer Coordinates Based on the Field Line Tracing Approach

Yokoyama, M., Suzuki, Y.,
Nakamura, Y., Mizuuchi, T., Sano, F., Heliotron J Experimental Team (Kyoto Univ.)

The dependence of the confinement quality of H-mode on magnetic configuration found in Heliotron J (HJ) has been attempted to understand based on the poloidal viscosity 1) depending on the magnetic structure 2). However, the VMEC2000 equilibrium calculations have been limited to rather smooth magnetic surfaces. This has excluded the corrugated magnetic surfaces located at the peripheral region, where the poloidal viscosity is expected to become larger. Thus, the evaluation of poloidal viscosity in such a region with corrugated magnetic surfaces is important to investigate the configuration dependence of H-mode quality in more detail.

For this purpose, Boozer coordinate 3) construction has been attempted based on the magnetic field line tracing 4). Since this approach does not depend on the Fourier representation of magnetic surface shape essential for VMEC2000 calculations, it is anticipated to enlarge the plasma volume where Boozer coordinates can be evaluated.

Several representative magnetic configurations in HJ have been used as test cases to validate this approach. The magnetic field lines are launched from the equatorial plane with the interval of 7 mm. The information for the trajectory in the real space and the magnetic field strength variation along that trajectory on magnetic field lines (only lines which can do 200 or more toroidal turns) are exploited to construct the Boozer coordinates.

Figure 1 shows the magnetic surfaces in the "standard" configuration where Boozer coordinates are successfully evaluated based on this field line tracing approach. As for reference, the outermost magnetic surface from VMEC2000 calculation is shown with the solid curve in a plasma region. It is recognized the corrugated magnetic surfaces are now included compared to the VMEC2000 boundary. This "enlargement of plasma radius" is the important result to promote the poloidal viscosity evaluation, which might enhance the understanding of the configuration dependence of H-mode quality in HJ.

The coordinate transformation from Boozer to Hamada 5) is required to evaluate the poloidal viscous damping coefficient in Ref. 1). In this regard, Fourier spectral decomposition for the real coordinates in Boozer coordinates is essential, which is now underway.

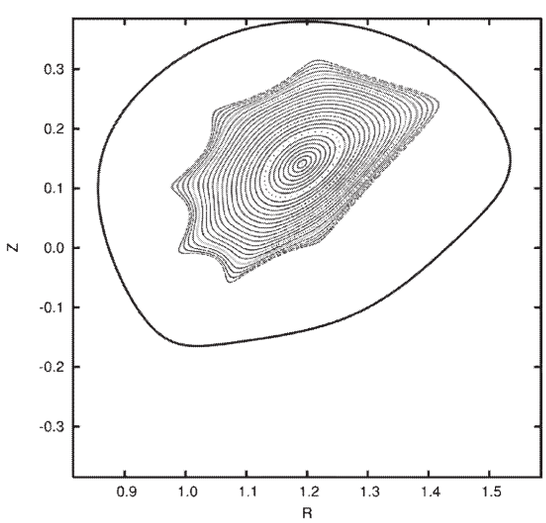

Fig. 1 The magnetic surfaces in the "standard" configuration in HJ, where the Boozer coordinates are successfully evaluated with the field line tracing approach. The solid curve denotes the outermost magnetic surfaces treated in VMEC2000.

References

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