§47. The Magnetic Structure in the Divertor Region of LHD

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In the heliotron type helical devices such as LHD, there exist built-in divertor magnetic configurations called helical divertor which are basically the same as double null divertors in tokamaks, although the separatrix surface in helical devices is fairly vague due to the toroidal effect. The closed surface region is surrounded by the naturally existing islands with toroidal mode number of 10 and the stochastic field structure generated by the overlapped islands. The field lines in this stochastic region get away from there after many toroidal circulations, then form the edge surface layers, and finally escape to the divertor tiles through the narrow channel called divertor leg. In addition to this complexity, the poloidal rotation makes this magnetic structure more complicated.

Not only in physical interest but in point of the engineering design, it is important to understand the three dimensional magnetic structure especially in the divertor leg region. In the design of the divertor tiles, for example, it becomes serious problem to determine the place and angle for tiles to be installed on the vacuum vessel wall.

In this study, three dimensional magnetic structure in the divertor leg region was numerically investigated by using the vacuum field line tracing code called MAGN. For one toroidal period (36°), the puncture plots of field lines on 32 poloidal cross sections (every 1.125° in toroidal direction) were obtained, as shown in Fig.1 which is the poloidal cross section at the horizontal port. Many starting positions of the field line tracing were employed to describe the divertor leg near tiles or the inside of the port in detail. These 32 puncture plots of field lines are now in the NIFS-PDS data base which can be shared by any terminal in NIFS. For practical designs of diagnostics or ICRF antennas, three dimensional CAD data base was also constructed as shown in Fig.2 which presents a bird's-eye view of the divertor legs and the core plasma. Using this data base, a cross section of the divertor legs and core plasma at any position or direction can be obtained. The 3-D divertor data base can be combined with other 3-D data base, for example, the vacuum vessel, cryostat and so on. In Fig.3, the cross section of the divertor legs, core plasma and vacuum vessel at the midplane is presented.

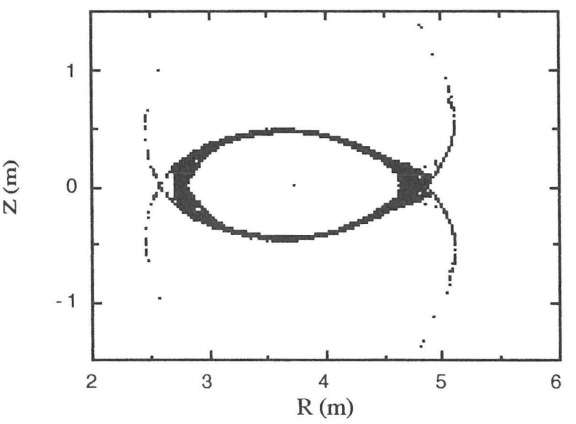

Fig.1. The puncture plot of divertor legs on the poloidal cross section.

Fig.2. The bird's-eye view of the divertor legs and the core plasma.

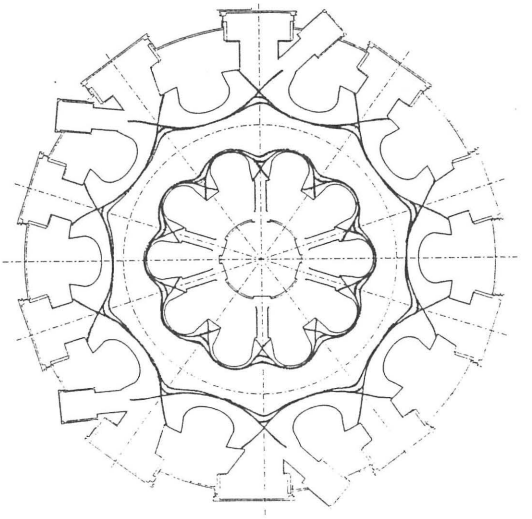

Fig.3. The cross section of divertor legs, core plasma and vacuum vessel at the midplane.