§8. Omnigenous Configuration with Strong Inward Shift of Magnetic Axis

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One of optimization methods of magnetic field ripple structure is to create the omnigenous configuration which equalizes the minimum value of field strength at all bottoms of ripple. Such ripple structure can be created by introducing the modulation of ripple amplitude (larger on the inboard side) utilizing a side-band effect of magnetic field Fourier modes. In this configuration, the drift orbits of deeply trapped particle stay in the single magnetic surface. In terms of pitch modulation, such optimization is given by taking a negative α^* value. CHS has a positive α^* which gives opposite phase of ripple amplitude modulation (larger on the outboard side). But such situation is only for the normal position of magnetic axis (R_{ax} > 95 cm) and the phase of ripple amplitude modulation changes when the magnetic axis is strongly shifted inward.

Figure 1 shows the magnetic field ripple structures at three different average minor radii for R_{ax} = 87.7 cm configuration. Though the plasma size is relatively small for this configuration because of the strong inward shift, good field structure is created such that the local minimum values of helical ripples are almost constant.

The Mod-B minimum plots are the contour plots for the minimum value of magnetic field strength along the field line within one period. It is convenient way of visualizing the drift orbit of deeply trapped particles. Figure 2 shows the comparison of magnetic surfaces and Mod-B minimum plots for three different positions of magnetic axis. The configuration of R_{ax} = 88 cm clearly shows the coincidence of the magnetic surfaces and the trapped particle orbits.

In the consideration of plasma experiment operation range for Heliotron/Torsatron device, such configuration is usually excluded because it is (supposed to be) not MHD stable. In CHS experiments, the inward shifted configuration is always almost stable. The experiment for R_{ax} = 87.7 cm was performed to confirm the MHD stability for this configuration. Discharges were successful in both ECH and NBI experiments. Because the wall conditioning for such a new configuration was not sufficient, clear evidence of improved confinement for the optimized ripple structure was not found yet.

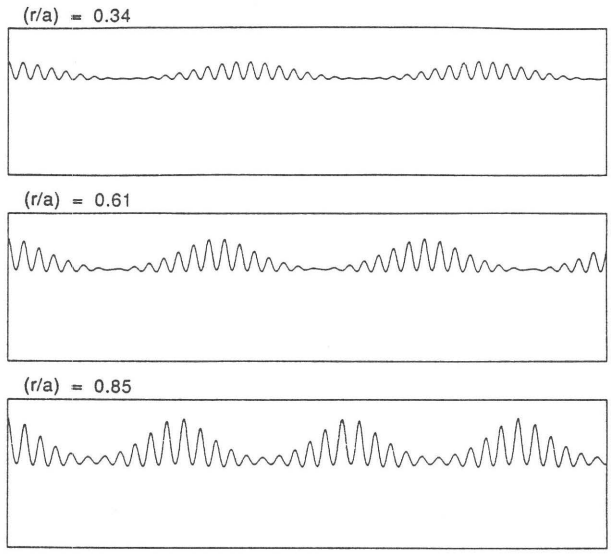

Fig. 1 Omnigenous ripple structure

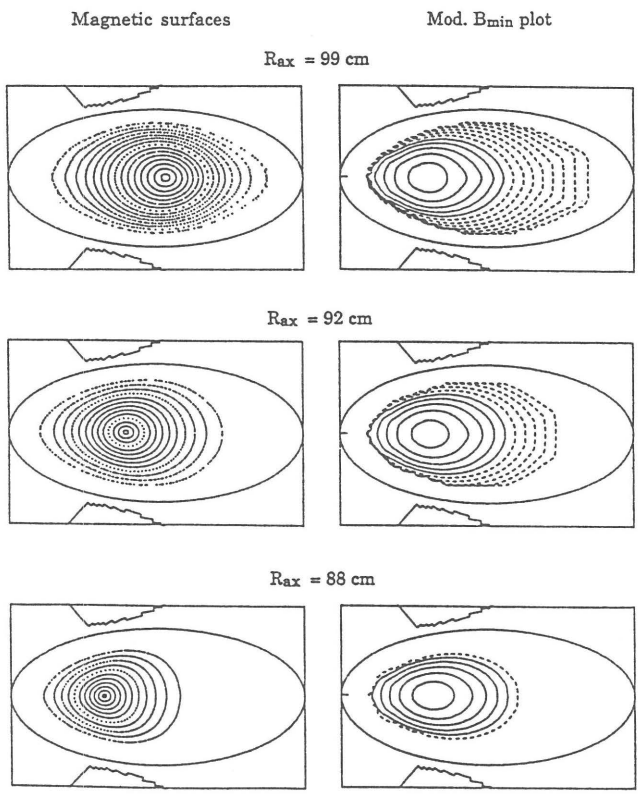

Fig. 2 Magnetic surfaces and Mod-B_{min} plot