§29. New Configuration 2b32m3 with Complete Mercier Stability

Okamura, S.

After many efforts to improve the magnetic field configuration of CHS-qa, 2b32 configuration is presently supposed to be the best candidate for the new device. Various aspects of engineering design have been made so far targeting 2b32 configuration. During the optimization procedure of 2b32, the evaluation of MHD stability was given only by the local ballooning stability criterion. However, the improvement of the configuration for the local ballooning stability brought the Mercier stability for 5% average beta as well, and the Shafranov shift was also reduced compared with the old configuration without the local ballooning stability optimization.

However, there was a little uncertainty of Mercier stability in the small central region near the magnetic axis for middle range of beta (3-4% beta). The limitation of VMEC code for the resolution of the equilibrium at the central region and the lack of numerical stability for the evaluation of Mercier stability made it difficult to solve such an uncertainty.

Recently we included the Mercier stability evaluation in the optimization code and succeeded to control its numerical stability problem. The enhanced calculation speed of the super-computer also helped us by allowing to increase the number of radial mesh to improve the resolution of equilibrium calculation. New configuration was found which has a perfect Mercier stability for all range of beta from vacuum to 5%. Fig. 1 shows magnetic surfaces of the new configuration 2b32m3 for three poloidal cross sections. The largest visible change of boundary shapes from 2b32 configuration is in the third cross section (CS.3) where the triangularity is enhanced. If we draw the toroidaly averaged cross sections for 2b32 and 2b32m3 configuration, 2b32m3 has a stronger D-shaping.

As well as an improvement in Mercier stability, new configuration has a reduced Shafranov shift (we do not have an interpretation for the relation of two characteristics). Fig. 2 shows (upper four lines) the dependence of magnetic axis position (relative to the full width of each cross section) on the averaged beta for two cross sections (CS.1 for bean shape and CS.3 for third one in Fig. 1). For both CS.1 and CS.3, 2b32m3 makes smaller shift of magnetic axis. Bottom four lines show comparisons of relative shift starting from the same point for zero beta. About 20% reduction of the Shafranov shift is obtained.

The configuration 2b32m3 is still considered as one of candidates for the CHS-qa device because the overall evaluation has not yet made including the engineering design. These work will be done as soon as possible.

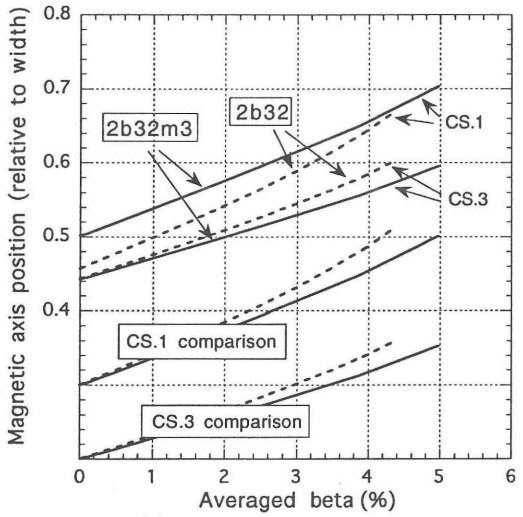

Fig. 2 Comparison of Shafranov shift for 2b32 and 2b32m3 configurations

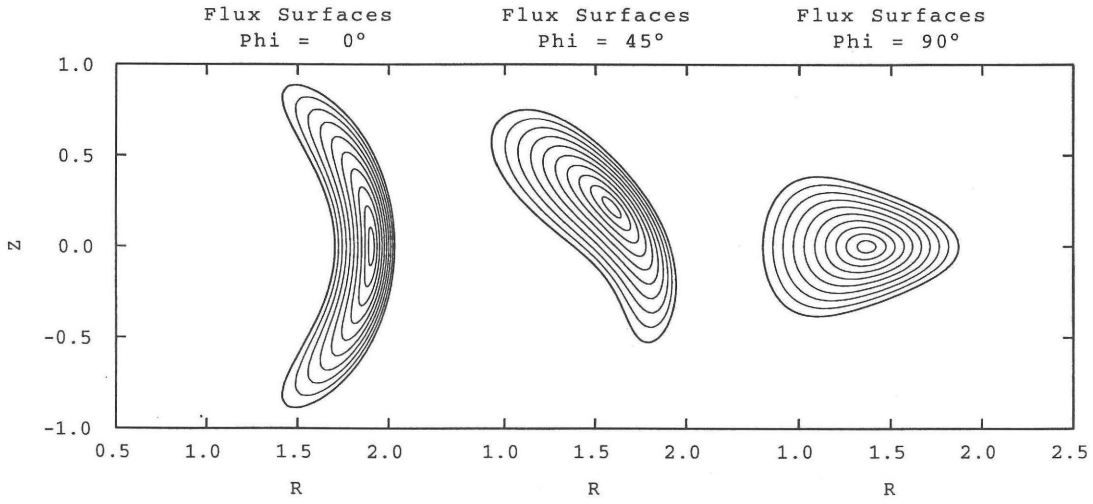

Fig. 1 Magnetic surfaces (CS.1, CS.2 and CS.3) for 3% averaged beta