§18. Direct Profile Extrapolation of the Data Obtained in the Vertically Elongated Configuration

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In the future fusion reactor, it is desired to keep the maintenance ports as large as possible for easy access to the devises inside the vacuum vessel. This is possible by reducing the poloidal coils. In Fig. 1, compared are the possible port sizes in the cases with or without a pair of poloidal coils called “IS coils” in LHD. In a normal condition in LHD experiment, the toroidally averaged plasma cross section is kept circular by cancelling the quadrupole components of the magnetic field for 100 %, which is called the “circular” configuration (B_Q = 100 %). The toroidally averaged plasma cross section becomes vertically elongated when the IS coils are not used, which is called the “vertically elongated configuration” (B_Q = 53 %, at R_{ax} = 3.75 m).

On the other hand, the direct profile extrapolation (DPE) method has been developed to predict the radial profiles in fusion reactors from the profile data obtained in the experiment.[1,2] To apply this DPE method, experiments has been carried out in the vertically elongated configuration. Although no clear difference between the circular and the vertically elongated configurations are recognized in the relation between the central density, n_{e0}, and the central plasma beta, β_0 (Fig. 2), a factor C_{exp} used in the DPE method, which is proportional to the reactor size,[1,2] has been shown to be smaller in the vertically elongated configurations, as shown in the right in Fig. 3.

1) J. Miyazawa, et al., submitted to Fusion Eng. Des.
2) J. Miyazawa, et al., in this issue.

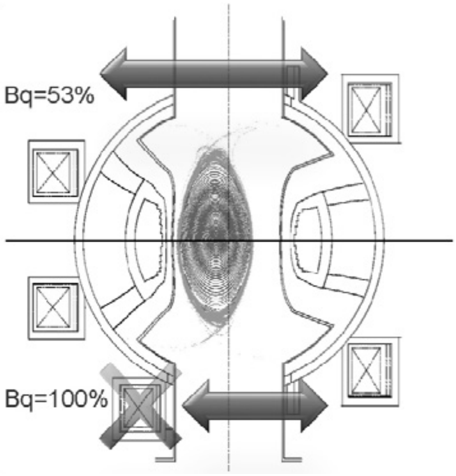

Fig. 1. Comparison of the possible port sizes with (lower half) or without (upper half) the IS coils.

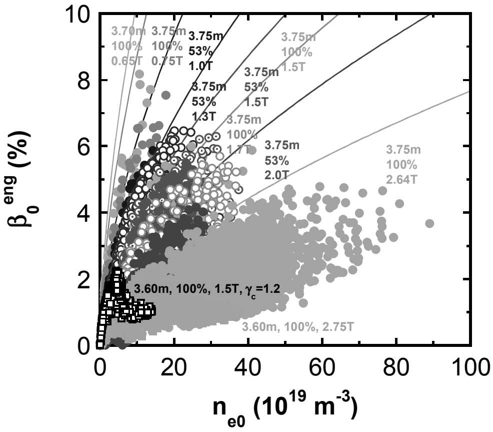

Fig. 2. Relation between n_{e0} and β_0 in various magnetic field configurations. Open and closed symbols denote the vertically elongated (B_Q = 53 %) and the circular (B_Q = 100 %) configurations, respectively. Solid lines denote the gyro-Bohm type parameter dependence of $\beta_0 \propto n_{e0}^{0.6} B_0^{-1.2}$.

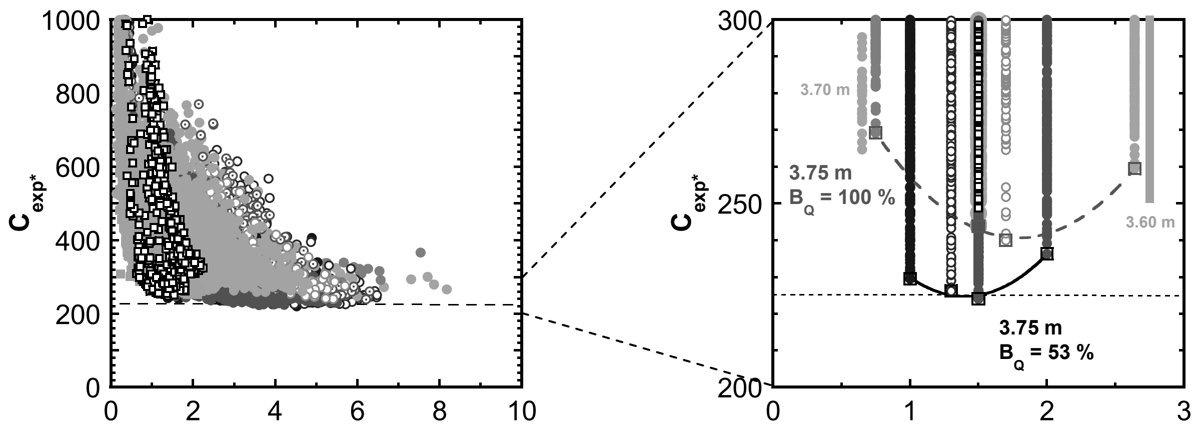

Fig. 3. Relation between C_{exp} and β_0 (left) or B_0 (right) in various magnetic field configurations. Broken and solid curves in the right figure denote the minima of C_{exp} in the circular (B_Q = 100 %) and the vertically elongated (B_Q = 53 %) configurations at R_{ax} = 3.75 m, respectively.