# §2. Production of High-Beta Plasma in High Magnetic Field

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In the LHD experiments, the volume beta value <β> achieved to about 5%. This suggests the plasma beta does not achieve to the equilibrium beta limit. Simulating the MHD equilibrium for high-β plasma, the magnetic field structure was investigated. In that study, the beta limit is higher than the achieved beta in the experiment then experimental and theoretical consideration are consistent up to now. However, in that study, the stochastizations of flux surfaces in high-β plasma was expected and the degradation of the confinement due to the stochastizations was suggested. Since the high-β experiment is done for the low filed, the plasma is low temperature and high density, so-called the collisional plasma. If the plasma changes to the collisionless, the degradation of the confinement will be expected. To aim the production of high-β plasma in the reactor-relevant regime, studying the impact of stochastic field lines to the confinement is an urgent issue.

To produce high-β plasma in more collisionless regeme, the magnetic field is increased to 0.75 and 1.0T. Figure 1 shows the achieved beta value as the function of the electron temperature on the axis. Blue squares indicate shots for 9.75T and red triangles indicate for 1.0T. For the comparison, circles indicate for $B$ < 0.5T. The electron temperature on the axis is increased higher than 1keV. To show the collisional regime, the achieved beta is shown as the function of the collision frequency in fig.2. The dataset is corresponding to fig.1. For $B$ > 0.75T, the order of the collision frequency is decreased about 1.

To see the impact of high temperature to the magnetic field, in fig.3, profiles of the electron temperature in the peripheral region are plotted for $B$=0.75 and 1T. Though the temperature on the axis is increased higher than 1keV, differences between $B$=0.75 and 1T are very small. Especially, profiles for $R$ > 4.5m are almost same. Since differences in the temperature are small in the peripheral region, comparisons of different collisional regime are difficult. In this experimental campaign, the reason why the temperature profile is almost fixed in the peripheral region is not identified. To understand the reason, the transport analysis is a future subject.

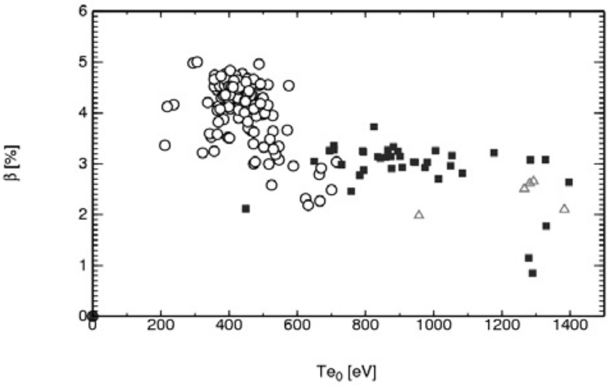


Fig.1 The achieved beta is plotted as the function of the electron temperature on the axis for $B$ < 0.5T (black) and $B$ > 0.75T (colored).

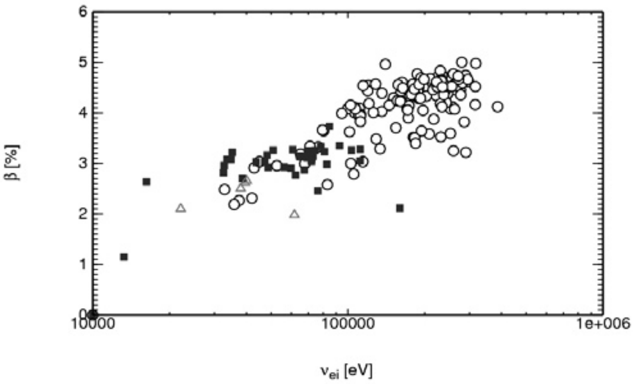


Fig.2 The achieved beta is plotted as the function of the collision frequency for $B$ < 0.5T (black) and $B$ > 0.75T (colored).

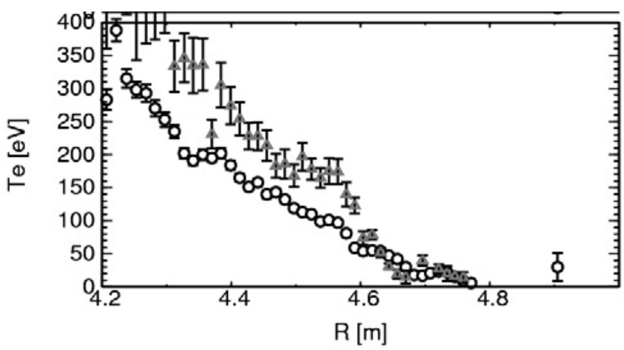


Fig.3 Profiles of the electron temperature in the peripheral region ($R$>4.2 and $Z$=0 plane) are plotted for $B$=0.75 and 1T.