§1. Achievement of High Density Discharge with Internal Diffusion Barrier

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Intensive pellet fueling experiments have been performed in order to extend an operational space of high density plasmas with an internal diffusion barrier (IDB). Central fueling by solid hydrogen pellet injection is essential for the formating the IDB, and the IDB easily appears in the outer shifted magnetic configuration. The attainable central plasma density becomes higher as the magnetic axis shifts outward ($R_{ax} > 3.75$ m).

Fig. 1 shows central electron densities, which are attained under the same neutral beam heating power (12 MW) and pellet injection conditions, versus the preset magnetic axis. The attainable central density increases as the preset magnetic axis become outwards, and the maximum attained central density exceeds 1.0×10^{21} m^{-3} above $R_{ax} > 3.90$ m. Fig. 2 shows the density profile of the highest density discharge which is attained at $R_{ax} = 3.95$ m with 9 pellets injection. On the other hand, the attainable density is decreases in extreme outer shifted case. One explanation for the achievement of such a high density is that the IDB plasmas are away from density limit which is considered to be dominated by power balance in edge plasma due to relatively low density edge plasma despite high density core plasma. However, this explanation cannot account for the magnetic axis dependence.

Fig. 3 shows central electron density versus central electron temperature. It must be note that the minimum central temperature is not less than 0.3 keV independently of the preset magnetic axis, neutral beam heating power and central density. Under such low temperature conditions, injected pellets pass through the plasma cross section before the ablation is over and the central electron density shows no effective increase with subsequent pellet injections.

A neutral beam deposit calculation by using FIT code indicates that central heat deposition become to be inhibited as the density increase in general, and this tendency is particularly true for inward shifted configuration. This result suggest that the minimum temperature which is required to ablate the solid hydrogen pellet is not kept due to lack of an effective central heating power in inner shifted configuration, and therefore high density operation is not available. The experimental fact that the attainable density decrease when the neutral beam heating power is reduced can be also explained by the lack of effective central heating power.

The attainable central density is directly related to the central heating power, and if the central heating is available even in the inner shifted magnetic configuration in which excellent global confinement property is provided, further extension of the operational space are expected.

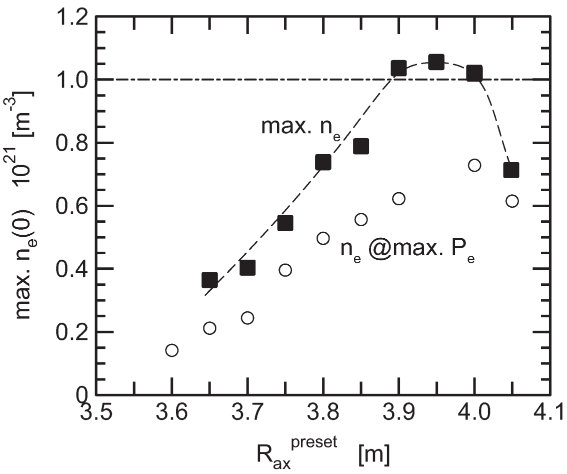

Fig. 1 Dependence of maximum attained $n_e(0)$ on preset magnetic axis; R_{ax}.

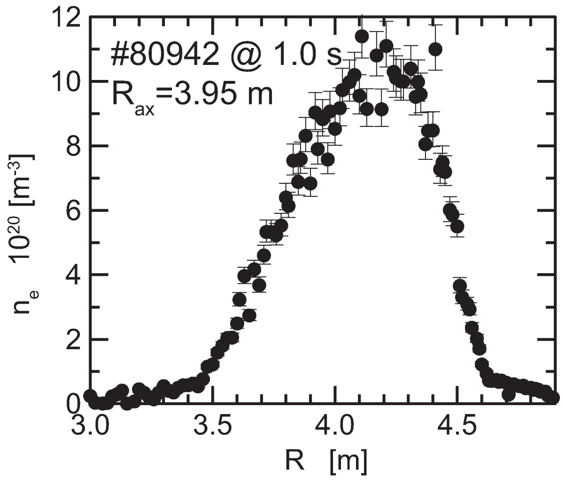

Fig. 2 Density profile of the high density discharge at R_{ax}=3.95 m with 9 pellets injection.

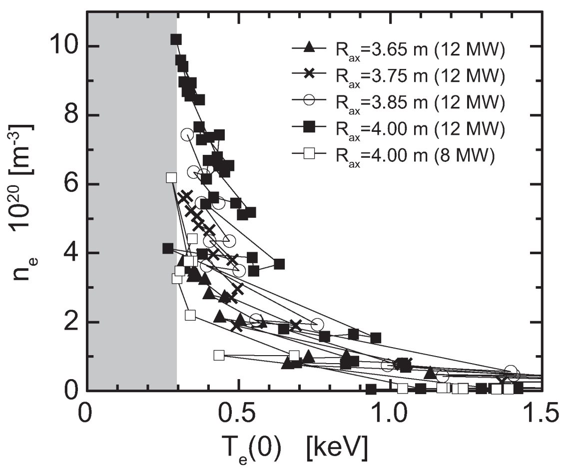

Fig. 3 Time trace of $T_e(0)$-$n_e(0)$ diagram in pellet injected high density discharge.