§24. Study of Plasma Density Profile Using Hydrocarbon Pellet Injection in CHS

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In helical devices the density profile changes largely (from hollow to flat). This drastic change is never seen in the case of tokamak. This is one of the most interesting points in helical research. In order to study the mechanism, the hydrocarbon pellet has been injected in CHS.

A typical result for the hydrocarbon pellet (0.27mmϕ) injection is shown in Fig.1. In the case of NBI (P_{NBI} = 900kW), the pellet is injected at t = 115ms for the low-density target plasma ($\bar{n}_e = 1\times10^{19}$ m^{-3}). The density increment $\Delta\bar{n}_e$ is 3.1×10^{18}m^{-3}. After the pellet injection the central-chord density is gradually increasing until the end of the NBI pulse, whereas the edge density (ρ=0.7) slightly decreases. In the case of ECH (f_{ECH} = 53GHz, P_{ECH} = 200kW), the pellet is also injected for the same target density as in the NBI case. The central-chord density after the pellet injection is kept constant, whereas the edge density (ρ=0.7) drops largely.

The electron density and temperature profiles before and after pellet injection are shown in Fig. 2. It is clearly seen that after pellet injection the electron density profiles change from flat or hollow profile to peaked profiles for both cases in the NBI and ECH plasmas. The injected pellet is mainly ablated in the plasma center for both cases. The peaked profile is kept until the end of the heating pulse (also see Fig.1). This indicates that the particle confinement in the plasma center is very long compared with the edge particle confinement time τ_p, typically 2-5ms [1], and at least it has a value more than 20ms. On the contrary, the density behavior in the outer region of the ECH plasma is entirely contrastive in comparison with the NBI plasma. The peak of the density profile at ρ=0.8 disappears after pellet injection, whereas in case of the NBI plasma the density at the same position increases (See Fig.2 (b)). It seems that these results indicate an importance of the source term on the mechanism of the density profile formation.

These results demonstrated that the impurity pellet is enough applicable to the study of the plasma particle transport. The further experiment will be made for variations of magnetic configuration, n_e and B_t in addition to the difference of heating method.

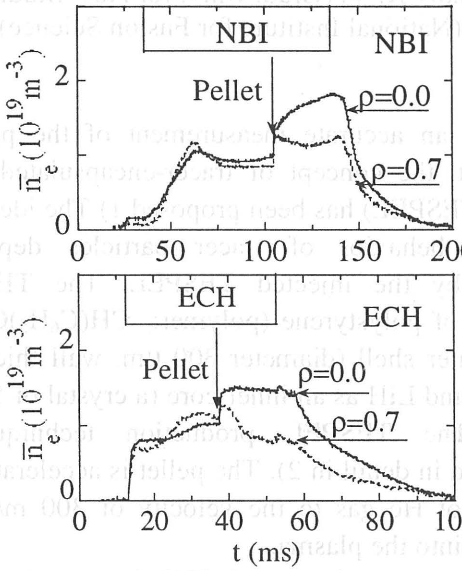

Fig. 1. Time evolution of line-averaged density with hydrocarbon pellet (ϕ=0.27mm) injection.

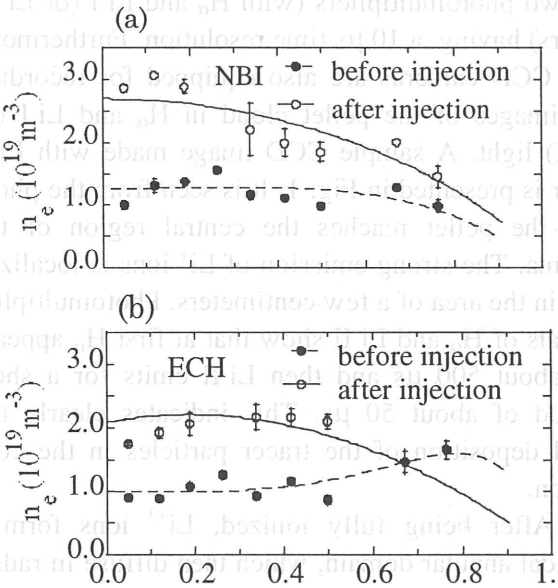

Fig. 2. Profiles of the electron density and temperature before (closed circles) and after (open circles) hydrocarbon pellet (ϕ=0.27mm) injection in NBI(a) and ECH(b) plasmas.

Reference
1) Morita, S., et al., Fusion Technology 27 239 (1995).