§23. Ice Pellet Injection into CHS

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Cryogenic pellets injection was demonstrated in CHS. In this experiment, a single barrel pneumatic gun was used to inject both hydrogen and deuterium pellets. The size of pellets produced was 1.0 mm$^{\phi}$ or 1.4 mm$^{\phi}$ x 1.4 mm^{l}, and after traveling in the guiding tube with 12 m length and 5 mm inner diameter, pellet has melted and has only about 3 x 10^{19} atoms. The average velocity measured by photosensors in the guiding tube was 300m/s. Pellets were injected in the horizontal plane of CHS, almost along the long axis of plasma, from the lower field side. The penetration depth of pellets, measured from traces of visible light along the pellet path by CCD camera, was at maximum about 150 mm, 1/3 of the minor radius. Experiments were done for D/H plasma with NBI and/or ECH heating, and the shooting timing, size and speed of pellets were controlled with discharge conditions.

The signals of Hα monitors along the torus direction show the timing that pellet was injected to plasma. Ablation process lasting about 800μs, is monitored by an Hα detector placed at the backward of pelletes path. The plasma electron density, measured by a multi Thomson scattering system shows a rather hollow profile just after pellet injection. Measurements with 3-chord HCN interferometers reconstructed the fast time dependence of the density profile during and post pellet injection phase. This shows, after density increase over the whole region, the density at edge plasma decreased rather faster in contrast to center density increase, and profiles bacame rather peaked. A combination of the measurements with Thomson scattering and HCN interferometers shows the increase in the central electron density by about two times of that before pellet injection at maximum. The electron temparature profiles also measured with multi Thomson scattering every 10 ms, show often in the NBI plasmas, the sudden decrease after the pellet injection, and that Wdiamag once decreased and about 15 ms later increased again. In other cases, we could not see any remarkable difference on Te profile with pellet injection. In the NBI plasma, ion temparature, measured by charge exchange reaction, decreased at central plasma after pellet injection. Neutron counters could not show any significant increase with deuterium pellet injection into deuterium plasma. Figure shows the typical features of discharges with pellet injection.

In contrast, in the case of lower magnetc field (about B_T<1T) plasma, the same size pellet induced the collapse of plasma.

In the case where the pellet was broken into two pieces bofore entering the plasma, the second pellet could penetrate more deeply and be more effective to increase the central electron density.

As a tentative conclusion, in these experiments among the discharges with NBI and/or ECH plasmas, the ice pellet injection has not improved confinement of any regime.

Detailed analyses are now under going.

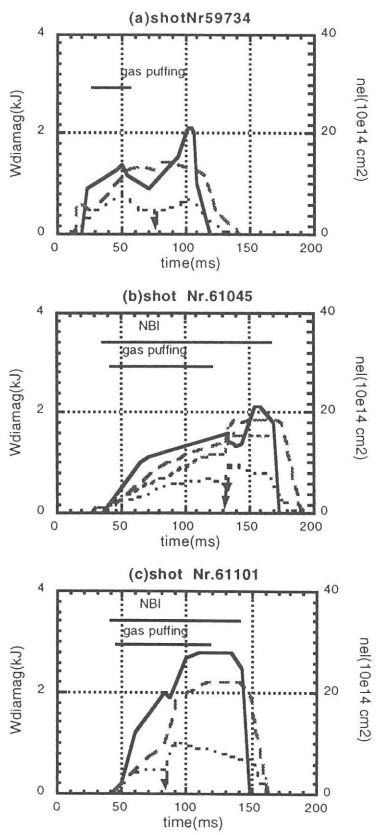

Fig.1. The time evolutions of discharge characteristics; (a)ECH plasma, (b), (c)NBI plasma. Solid line shows Wdiamag, long dashed, short dashed, and dotted lines show n_{el} measured at center chord, z = -116 mm, and +70 mm, respectively. Arrows indicate the timings of pellet injection.