§5. Experimental Results with the On- and Off-axis Pellet Injection in the JIPP T-IIU Tokamak Using the Injection Angle Controllable System

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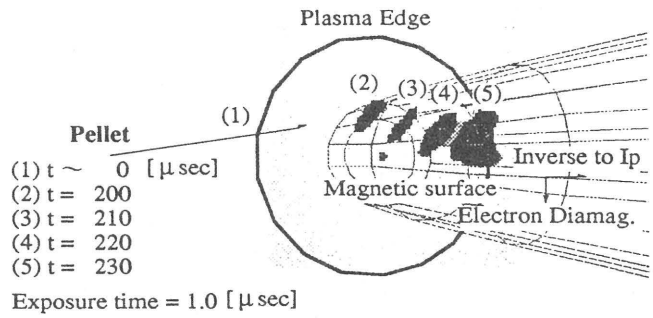
Recently a new scheme of injection system, "the injection-angle controllable system", has been developed and installed to the JIPP T-IIU tokamak.[1] By using this system, one can control the injection-angle easily and successfully during an interval of two plasma shots in the course of an experiment, not moving the whole injector, and thus we can carry out various basic experiments by changing the pellet deposition profile actively and drastically.

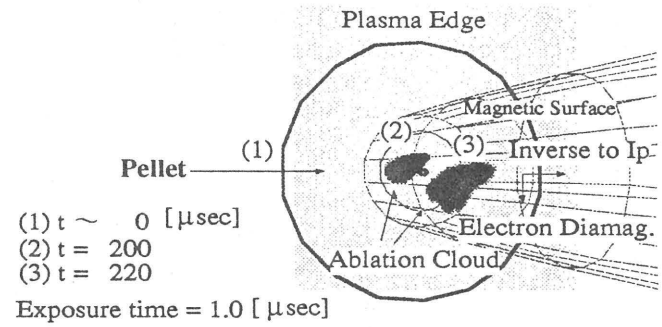
In the case of the angle smaller than a certain value ($\theta \leq 4°$), a long helical rotation ("tail") of ablation light has been observed. In addition to the measurements by CCD cameras[2], the time-dependent flow characteristics of the ablation cloud have been observed by using a high speed framing photograph as shown in Fig. 1. Here, the direction of the toroidal field is counter-clockwise (CCW) and the plasma current direction is clockwise (CW). As clearly seen here, the direction of helical tail is independent to that of the total magnetic field lines of the torus. These results show that the tail seems to rotate to the electron diamagnetic direction poloidally, and to the opposite to plasma current direction toroidally as to the almost all conditions of injection angles.

Moreover in order to measure the potential change by pellet injection, 450 keV singly-charged thallium ion beam has been injected into the tokamak as a heavy ion beam probe (HIBP). The intensity and energy of a secondary beam (Tl++) produced in a certain position of the plasma have been measured with a parallel plate analyzer to study the local density and local potential of the plasma.

Figure 2 indicates a typical case, where the injection angle is anti-parallel to the electron diamagnetic direction in poloidal plane; i.e., so-called upward injection in this situation of the tokamak. The result shows that the potential change is negative, and consequently the potential after the injection should be negative because it has been measured to be negative in usual ohmic plasmas without pellet injection. Thus, we may think that the tail-shaped structure is caused by the effect of E x B drift through the plasma potential.



(a)



(b)

Fig. 1. Time-resolved framing photographs of the ablation light by an image convertor camera. (a) Off-axis upward pellet injection. (b) On-axis horizontal pellet injection.

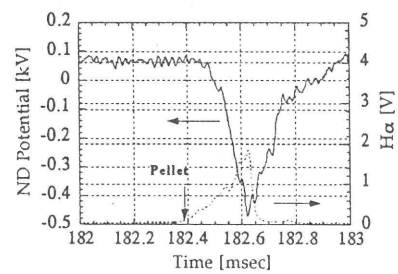


Fig. 2. Typical changes of plasma potential measured by a heavy ion beam probe (solid line) and H_α light as a monitor of an ablation light at the off-axis upward pellet injection (dotted line).

References

1) Sato, K.N., et al.,: International Conference on Plasma Physics 1, 93 (Iguacu, 1994)
2) Sato, K.N., et al.: Ann. Rep. of NIFS (Apr. 1993 - Mar. 1994) p. 156