Development of Event-triggered Thomson Scattering System for Measurement of Electron Temperature/Density Profiles during Abrupt Phenomena

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A laser Thomson scattering system in Heliotron J has two Nd:YAG lasers with a repetition rate of 50 Hz, to make measurements at equal intervals of 10 msec with alternating injections[1]. Thus, it is difficult to observe abrupt phenomena in plasma e.g. pellet injection, L-H transition, MHD events. We cannot know in advance when that phenomena will occur. In order to make the Thomson scattering measurement during the abrupt phenomena, event-triggered Thomson scattering measurement system (Event trigger system) is strongly required, i.e. laser should be injected synchronously with the onset of the event. Here we report on newly developed Event-triggered Thomson scattering measurement system in Heliotron J. The event trigger system is applied to pellet injection experiments. A strong increase in the Hα-line signal due to pellet ablation is used to generate the event trigger by a DG535 digital delay/pulse generator. After trigger, a PIC18F2550 micro-controller makes two triggers to control the flashlamp and the Q-switch respectively. The delay time of the flash lamp trigger is ~70 μsec which is due to processing delays in the PIC18F2550 and it takes 250 μsec to reach the maximum intensity of the flash lamp, as shown in Fig. 1(A). Thus, the minimum delay time from the event trigger is ~320 μsec which is shorter than typical ablation time of 0.5 msec in the Heliotron J experiment. By using this system, the density profiles during the pellet ablation were successfully observed for the first time in the Heliotron J, as shown in Fig. 1(B). At 0.5 msec from the start of pellet ablation, symmetric increase in the density with respect to magnetic flux surfaces is observed in the region of r/a > 0.3. At 1.0 msec, the core density increase is observed, and the profile shape changed from a hollow to a peak.

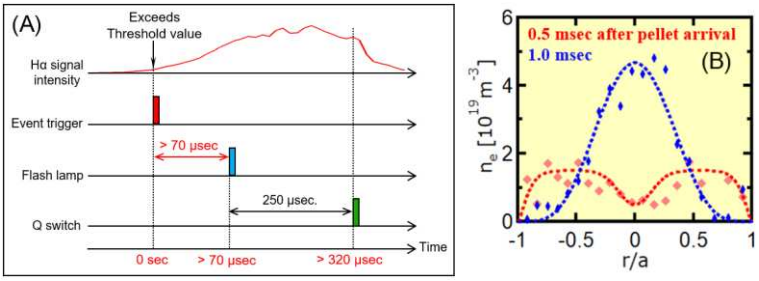

Figure 1 (A) Timing chart of control signal output by Event trigger system, (B) electron dens ity profile during pellet ablation.

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