§9. Suppression of Effect of UV Radiation by Multi-Stage Optical Trap

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Since an input slit of the analyzer is shined by the strong UV radiation from the plasma heated by the additional heating and the secondary current of HIBP in magnetic confinement experiment is very small (1 to 100 nA) to the detectors, the suppression of the effect of UV light is very important for the potential and turbulence study of the plasma. Recently Schoch et al. reported the suppression of the effect of UV light especially on the detector plates by putting the grooves on the surface of the upper electrode preventing mainly the reflection of light to the detector from the surface of the upper electrodes. There are, however, other places to place optical traps to reduce UV light to the analyzer and detectors. Here we reported the two-staged suppression of the UV light by installing several optical traps on the key places on the beam trajectory. The change of the voltage of upper electrode and the photo-current on the detectors is reduced greatly.

The measurement of the plasma potential and especially the measurement of the turbulence is limited by the electric noise of the detector circuit and the photo-electron current due to UV radiation from the plasma. Although the shaped electrodes remove the effect of the photocurrent on the resistor chain of the guard rings, the potential of the upper electrode and the detector signals fluctuate due to the photo-currents by UV radiation. To reduce this effect we installed several optical traps in HIBP system. One group of an optical trap made of carbon plates with deep grooves like a razor stack is placed at the bottom and side surfaces of the horizontal port for the prevention of the reflection of the UV light to the input-slits of the energy analyzer as shown in Fig. 2. Another optical trap is the upper electrode itself with deep grooves and sharp edge in order to reduce the reflection of the UV light from the input slit especially to the detector plates.

By the usage of these optical traps, the effect of UV radiation is greatly reduced. Figure 1 shows the effect of the plasma startup and NBI heating on the sum of detector currents with and without 450 keV Tl^{+} beam. The sample volume (point of measurement in the plasma) is at the center of the plasma column in this case. Even in the strong radiation at the initiation of tokamak discharges and at neutral beam heating of about 0.5 MW, we observe rather small change of detector currents, although the number of the input slit opening is increased to 13 for multiple points of measurement. In addition we can observe in Fig.1 that the secondary currents from the plasma center is greatly reduced when average plasma density is above $2x10^{13}/cm^3$.

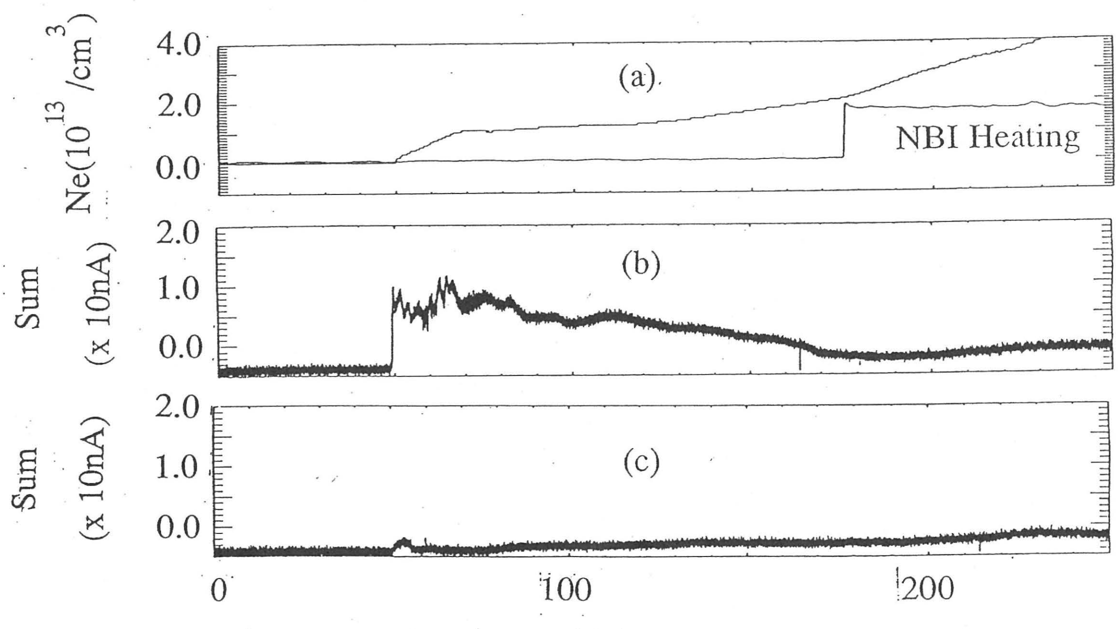

Figure 1. Time behaviour of average plasma density (a) and sum of upper and lower detector currents, in case of beam current of 25μA (b) and the sum in case of zero beam current (c). About 0.5 MW of NBI is injected.