§24. Trajectory Calibration for Potential Measurements with a 200keV Heavy Ion Beam Probe

Fujisawa, A., Iguchi, H., Lee, S., Crowley, T. P., Hamada, Y.

The 200keV heavy ion beam on the CHS has a unique feature that four sets of sweep plates are equipped to control three dimenstional complicated trajectories. Therefore, it is an indispensable procedure to confirm that a calculated voltage combination gives the proper probing beam trajectory[1]. A gas ionization process is available for this purpose; primary beams are injected into the target magnetic field configuration filled with a gas, and the injected primary beam is the ionized through collisions with neutral particles. The detectable secondary beam current is small since the ionization cross sections are smaller compared to those with the plasma, and the charge transfer from neutral gas particles to the beam particles is also a dominant process.

If the beam trajectory is controlled properly, the produced secondary beams enter into the energy analyzer with constant up-down ξ_{ud} and right-left ξ_{rl} balances during the radial scans. Particularly, to keep the up-down balance constant is quite important since the parameter ξ_{ud} is directly related to the potential measurements.

Before a calibration using the gas ionization, the primary beam injection angle was checked without magnetic field with a set of wires located about 40cm away from the octupole deflector on the injection side. The primary beam orbit with the magnetic field was also confirmed with a movable detector located on the magnetic axis. Both experiments showed that the primary beam line was in a good agreement with the assumption of the trajectory calculation.

Figure 1 shows an example of the gas calibration experiments for the target magnetic field with magnetic field axis location of R_{ax}=92.1 cm. The voltage combination at t=0 corresponds to the lower edge of the plasma, and the ionization points moves toward the upper edge with time. According to the trajectory calculation, the sample volumes become larger as the entrance slit widenes. Therefore, the singal from the upper edge may have stronger intensity. The rapid decrease around the upper edge can be ascribed to the fact that the secondary beam is scraped off by an orifice set in front of the secondary octupole to protect UV loading. In both cases, the up-down balance is kept sufficiently constant during the radial scan. The right-left (horizontal) balance is also kept nearly constant during the radial scan.

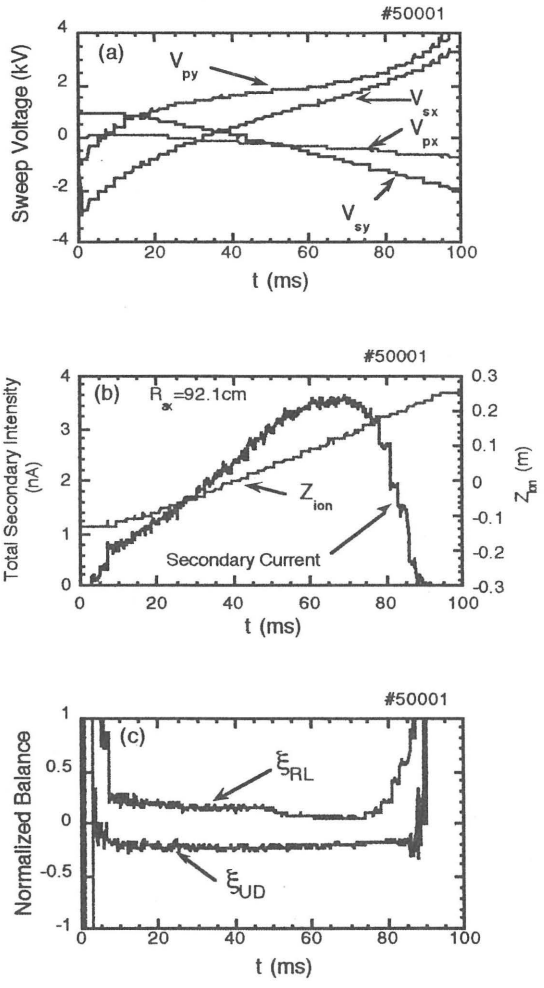

Figure 1: (a) Sweep control voltages.(b) Correspdonding toral secondary intensity.(c) Secondary beam position on the split plate detector.

References

1) A. Fujisawa. H. Iguchi, S. Lee, T. P. Crowley et al, NIFS-Report 415, to be published in Rev. Sci. Instrum.