

§18. Beam Acceleration Experiment in a Large RF-Driven Hydrogen Negative Ion Source

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We developed a high efficient large rf-driven hydrogen negative ion source. The ratio of current density to power density in volume was  $4.7 \text{ (mA/cm}^2\text{)/(W/cm}^3\text{)}$  in the pure volume operation [1].

Generally, the divergence angle of an rf ion source is larger than a filament-arc type ion source for the positive ion source. We have measured a beam profile of the rf negative ion source with a beam profile monitor.

As shown in Fig.1, the beam profile monitor is a multi-channel beam detector array, which has 11 channels in the horizontal (x) and the vertical (y) directions, respectively, arranged at a space of 3 mm. The profile monitor is installed at 400 mm downstream from the plasma electrode. A secondary electron collector is positively biased against the beam detectors for collecting all secondary electrons generated on the detectors by the incidence of the negative ions. Thus, the beam detector current distribution corresponds to the two-dimensional beam profile. A hydrogen negative ion is extracted from a single of 13 mm in diameter.

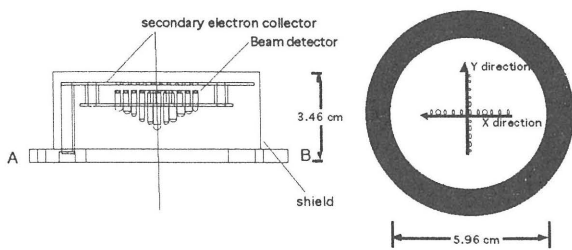


Fig.1 Schematic of a beam profile monitor

Figure 2 shows the time variation of a beam profile. The rf power is 11 kW, the gas pressure 10 mTorr, the acceleration voltage 13 kV and the extraction voltage 3 kV. The horizontal axis indicates the discharge time and the vertical axis indicates the position of beam collectors in the x and the y directions.

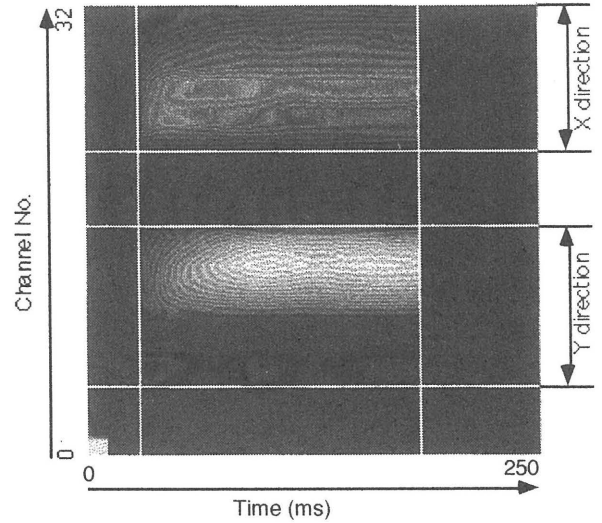


Fig.2 the time variation of a beam profile.

The shade indicates the intensity of each beam collector signal (lighter is more intense). In this image, it is found that the beam center deviates from the geometrical center, because of the beam deflection by the magnetic fields for the magnetic filter and the electron suppression.

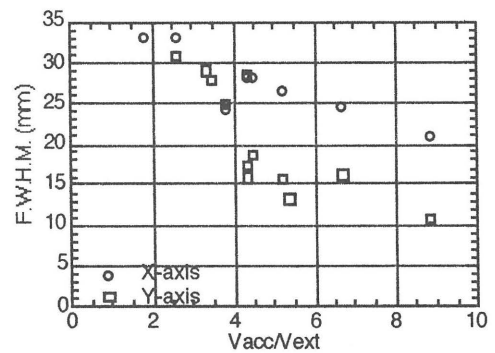


Fig.3. Vacc/Vext dependence for FWHM.

Figure 3 shows the FWHMs in the x and y directions as a function of the ratio of acceleration voltage to extraction voltage. As shown in Fig.3, the FWHMs decrease with an increase in the ratio of the Vacc to Vext. The minimum FWHM is 21 mm in the x direction and 11 mm in the y direction.

1) T.Takansahi, *et al.*, Jpn. J. Appl. Phys. **35**, 2356 (1996).