§47. Development of an Ion Beam Source for a Low Voltage/High Current Neutral Beam Injector

Ono, Y., Kawamori, E., Takase, Y., Ejiri, A. (Univ. Tokyo), Asai, T., Takahashi, T. (Nihon Univ.), Zushi, H., Sato, K. (Kyusyu Univ.)

The Low-voltage and high-current neutral beam injector (NBI) is essential to sustainment of ultra-high beta STs in the UTST experiment, one of core experiments for the all-Japan ST research project. The required properties for this NBI are its beam energy <25kV, its beam current >15A, and maintenance-free, while its pulse length can be as short as m-sec. We organized a new NBI group composed of Univ. Tokyo, Nihon Univ., Osaka Univ. AIST and Kyusyu Univ. to develop low-cost and maintenance-free ion beam source by combining the washer-gun plasma source techniques at Univ. Tokyo with the electrode design technique at Nihon Univ., AIST and Osaka Univ.

In 2007, we completed a new pulsed high-voltage power source for ion acceleration and started ion beam experiment together with our hand-made power supplies for the ion deceleration. Figure 1 shows the time evolution of the Faraday cup signals of ion beam current extracted from the plasma source in the multi-cusp magnetic field. The waveform of beam current was almost constant for about 0.4msec, which was determined by particle balance inside the plasma source. The duration time was observed to increase with the washer gun current and the puffing gas. As shown in Fig. 2, the beam profile was peaked at the center axis but tends to become flat as the plasma source is filled with gun plasma. As shown in Fig. 3, the ion beam current increases with the electrode potential V_{acc} as $V_{acc}^{3/2}$. If we increase the acceleration voltage up to 15kV, the beam current will probably exceed 20A. The next issues are to increase the beam power and the duration time of washer gun current by upgrading the present hand–made deceleration power supplies.

[1] Y. Ono et al., to be published in IEEJ Trans A.
[2] T. Asai, Y. Ono et al. to be published in RSI.

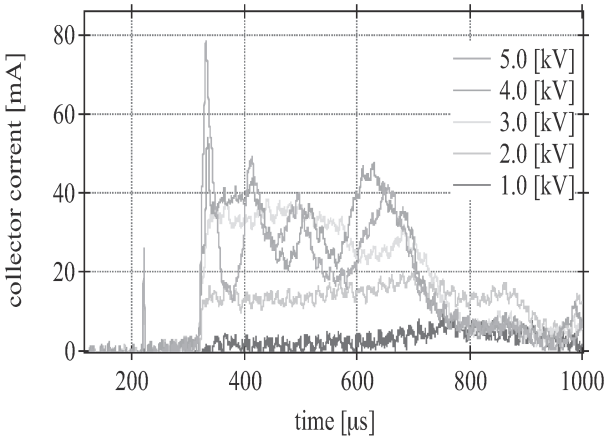

Fig. 1 Dependence of the ion beam currents measured by the center Faraday cup on the acceleration electrode potential under the condition of washer gun voltage ~ 1000 V.

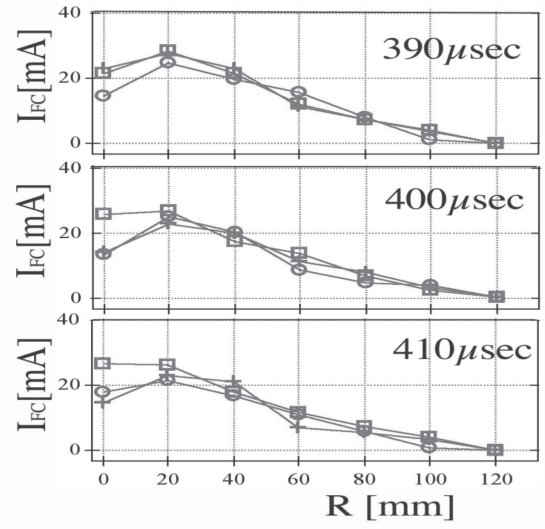

Fig. 2 Radial profile of the ion beam current measured by Faraday cup scan.

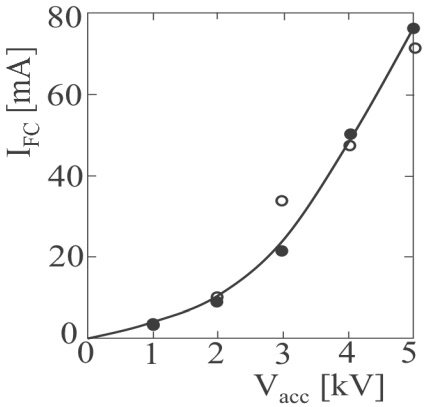

Fig. 3 Dependence of the ion beam current measured by Faraday cup on the acceleration voltage.