§17. Development of an H^- Beam Probe System for a High Intensity Positive Ion Beam Profile Measurement

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In condition of an extremely high beam intensity in a severe radiation environment such as IFMIF (International Fusion Materials Irradiation Facility) accelerator system, the beam diagnostics by conventional techniques in the beam transport line seems almost impossible because of scattering of the accelerated ions and activation of the accelerator components by collision with the scattered ions. In order to avoid the scattering of the accelerated ions and the activation of the components, we have proposed a negative ion beam probe system as a new scheme to diagnose beam profiles of high intensity positive ion beams.[1)]

We started an experimental study with a low energy intense ion beam system being tested at NIFS to validate the capability of the negative ion beam prove system. We have designed, assembled and tested an H^- ion source for the probe beam source. This source produces an H^- beam with a rectangular footprint of 70 mm × 2mm. The H^- source was installed on the diagnostic chamber of a strongly focusing He^+ ion source developed at NIFS NBI test stand for α particle measurement. We conducted an H^- beam experiment and found that an H^- beam of 10 μA with the beam energy of 3 keV was extracted at the position intersecting the He^+ beam at right angles.

After passing through the He^+ beam, the original H^- beam changes the mixed beam of H^-, H^0 and H^+ due to the collision with the He^+ ions. In order to distinguish the intensity of each species, an electrostatic particle detector with a fluorescent screen was installed down the crossing point. Figure 1 shows an experimental setup inside the diagnostic chamber. Figure 2 shows luminescence from the fluorescent screen by H^- injection.

We have prepared an experimental setup for the H^- beam probe system and will start the proof-of-principle experiment.

1) Shinto, K. et al.: Proc. of IPAC'10 (2010) 999.

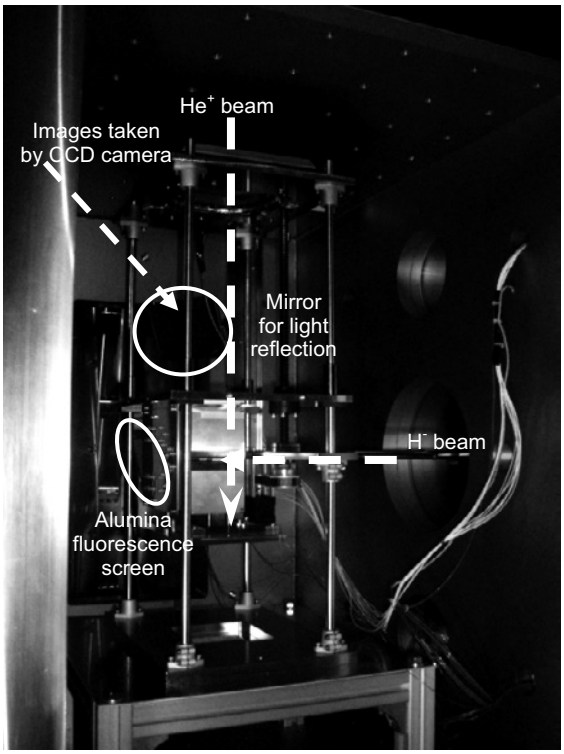
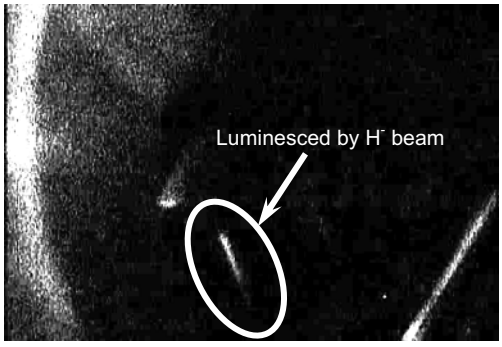


Fig. 1. Particle detector for hydrogen ion/atomic beams installed into the diagnostic chamber for a strongly focusing He^+ ion beam.

(a) without H^- beam



(b) with H^- beam

Fig. 2. Luminescence of an alumina fluorescent screen.