Measurement of EEDF and Distribution of Primary Electron in a Bucket Ion Source

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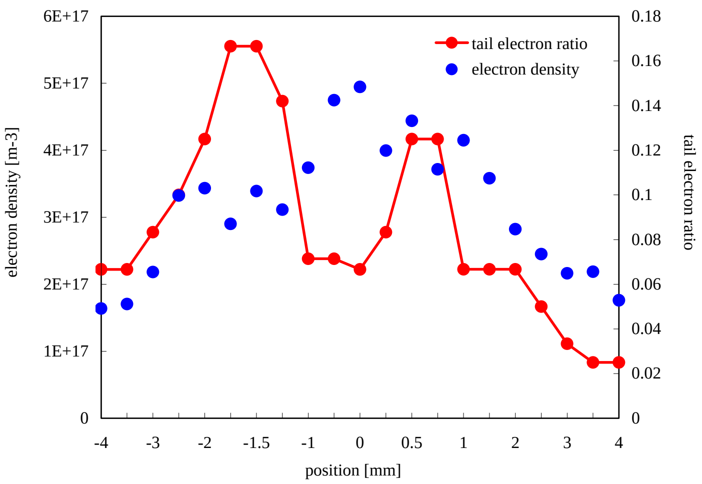
Recently, a lot of effort is put into producing negative hydrogen ion by using bucket type ion sources. The key issue in the production of negative hydrogen ion is to control primary electron penetration in the production region in which negative ion is produced. We developed an EEDF (electron energy distribution function) measurement system to investigate the primary electron distribution in ion sources.

The information of electron energy distribution function is extracted from the Langmuir probe characteristics through the Druyvesteyn method. The second harmonics current of the superimposed AC frequency on the probe bias potential, which is proportional to the EEDF, is measured. Electrical noise is carefully eliminated by use of a lock-in-amplifier and, as a result, the EEDF is determined up to 30 eV in a typical case. The EEDF measurement system was used to measure the damping of fast electron in the magnetic filter field which separates the production region from the bulk plasma. As a result, we observed that primary electron was damped effectively while thermal electron could penetrate into stronger field region without damping.

In the wall magnetic field, the similar elimination of fast electron possibly happens resulting in the narrow electron flux to the cusp line shown in the figure. Electron density and the ratio of high energy tail electron are plotted against the probe position. The center of the cusp line is shown as 0 in the figure. It is seen that the fast electron flux has peaked profile at the both side of the cusp line while thermal electron rather broad. Because discharge electrons permeate into the wall field but they are quickly attenuated, they form narrow peaks when they flow into the cusp.



It is concluded that magnetic fields in the source are more effectively affect fast electrons than thermal electrons.