§1. Electron-Ion Collision Experiment by Using the High Current Ion Source

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The understanding of the interaction of electron-ion collision process is important not only for the control of plasma but also for the atomic physics at many atomic processes in high temperature plasma. The research of ionization process in the electron-ion collision had been done for a long time, and the data were offered to the plasma control, the diagnostics of plasma and so on. At present, however, the atomic data for the excitation processes are scarce because of its experimental difficulties such as a low signal-to-noise ratio due to a low target ion density, the ion beam control at the collision region, etc.

So, we planned to do systematic research of ionization and excitation processes in electron-ion collisions. This research aims at getting the detailed information of excitation processes from ejected electron spectroscopy and measuring the ionization cross section within errors of 1%.

Therefore, first, we began with developing the ion beam source of which the ion current intensity was raised. Usually, the ion current of ion source used in the atomic collision experiments is about a few micro-ampere when the beam diameter is several mm. But, to get the data that are more trustworthy, it will be necessary that the beam diameter is limited as much as possible. And moreover, the ion current must be increased to milli-ampere order. The ion source of high intensity Freeman type was remodeled for the crossed-beam experiments, and it is testing at present in the National Institute for Fusion Science (NIFS).

The Typical mass spectrum by argon gas is shown in fig. 1. The ion current is more than 1mA and 200μA at Ar^+ and Ar^{2+}, respectively. It could get a necessary ion current for the crossed-beam experiment.

We obtained information of a beam form by measuring the ion current which pass through a wedge-shaped slit of 0.3mm width. The relations between the moving distance of slit and the ion current, which was passing through the slit, are shown in fig. 2. We suppose that the ion beam diameter is about 9mm because the wedge-shaped slit was cut at 45° . Though a quadrupole lens focused the ion beam, we have to thin down the beam diameter more than the present using other lens. Therefore, the einzel lens has been designed. After that, we are constructing the particle detector devices.

Our experimental apparatus is shown in fig.3. The device consists of three parts, which are the electron gun, the ejected electron spectrometer and the ion charge selector. The measurements of the absolute cross sections in ionization processes and ejected electron energy spectrum in excitation processes will be done using these devices.

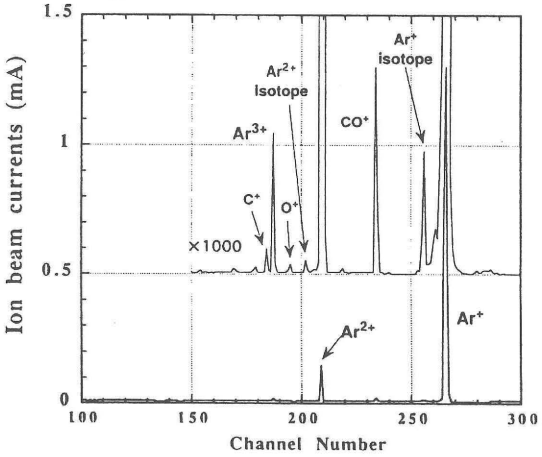

Fig. 1. Mass spectrum by argon gas.

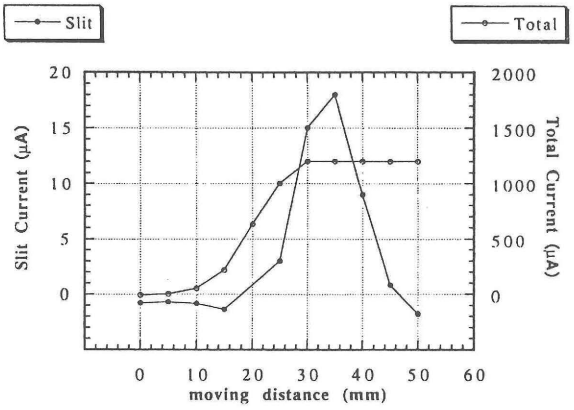

Fig. 2. The relations between the moving distance of slit and the ion current.

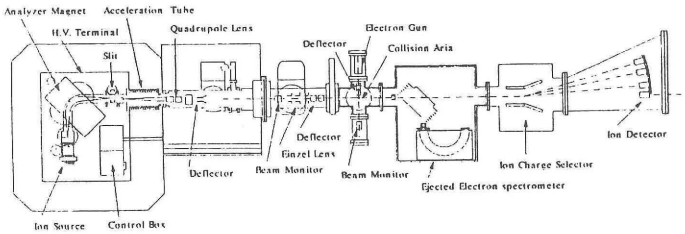

Fig.3. Our experimental apparatus.