

§15. Resonant Excitation/Ionization Processes in Electron – Ion Collisions

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The understanding of the interaction between electron and ion is very important not only for the control and diagnostics of plasma but also for the atomic physics in many atomic processes in high temperature plasma. The study of ionization process in the electron-ion collision has been done for a long time, and the data were offered to the plasma control, the diagnostics of the plasma and so on¹⁾.

At present, however, there are a very few data for the excitation processes of electron-ion collisions because of its experimental difficulties mainly due to a low signal-to-noise ratio because of a low target ion density and very small cross sections.

In this study, we have developed a high-density ion source and an original tandem-type electrostatic energy analyzer for the electron-ion collision

experiments in order to overcome the experimental difficulties. The experimental apparatus is shown in Fig. 1.

Our ion source can produce a very intense singly charged ion beam in the order of $10^{-3} \sim 10^{-4}$ A, which can greatly enhance the signal intensity, but also increase the space charge in the collision volume resulting in the serious problem in the electron spectroscopy.

In order to compensate the space charge in the collision region, we are now designing a new high-density electron gun with a circular cathode which can produce a conical electron beam. This electron beam of 20 eV with \sim mA current is expected to cancel the space charge produced by 100 keV Ba⁺ ion with 100 μ A at the collision region.

Based on the trajectory simulation which take into account the space charge effect, the design of this electron gun is in progress.

1) For example, G. H. Dunn, in “Electron Impact Ionization”, Edited by T. D. Mark and G. H. Dunn, (Springer Verlag, Wien New York, 1985).

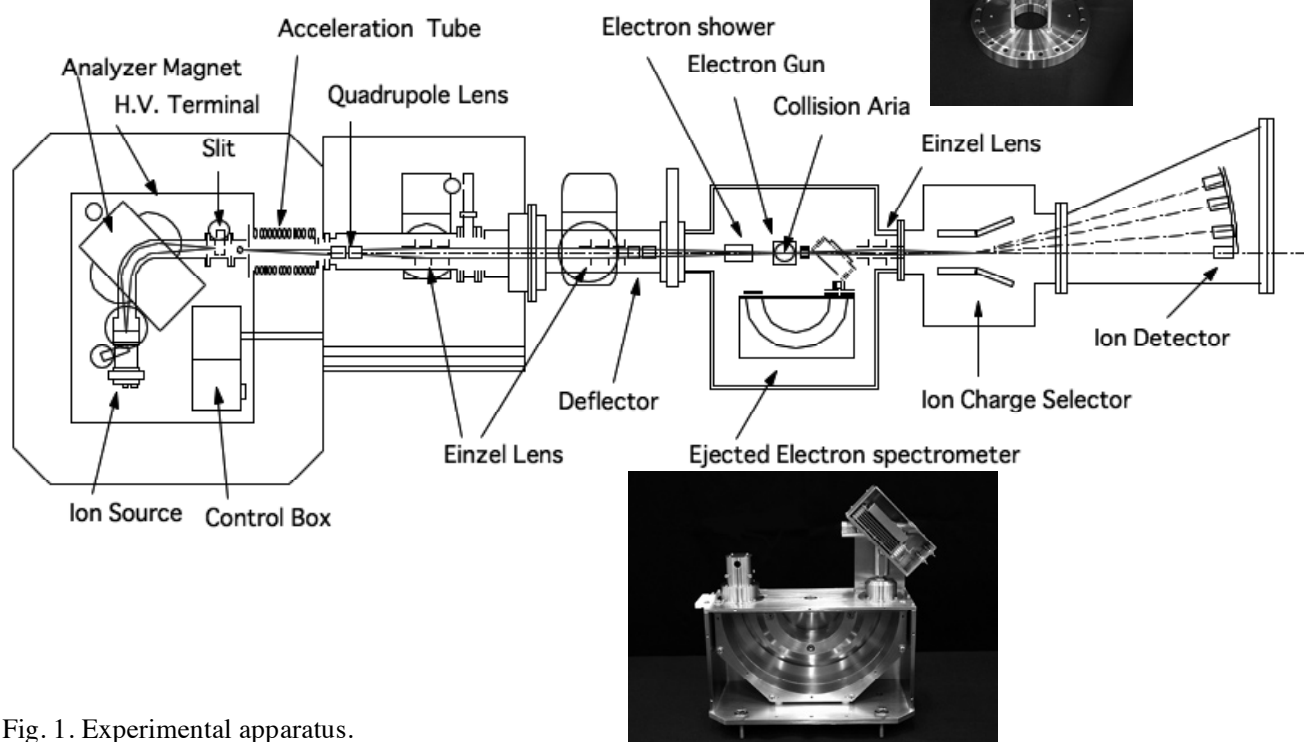


Fig. 1. Experimental apparatus.