§12. Temporal Change of an Extracted H^- Current by Injecting Pulse Laser Light into the Extraction Region of an H^- Ion Source

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To measure hydrogen negative ions (H^-) in hydrogen plasma, photodetachment technique assisted with a Langmuir probe is mainly used[1]. In this method, a pulse laser beam is injected into a hydrogen plasma along a probe tip and all H^- on laser path are converted into photoelectrons and photoatoms by laser photon energy. Then, these photoelectrons converted from same number of H^- are measured with a probe biased positive to plasma as a temporal increase of electron density. H^- density can be obtained from this photoelectron information indirectly. However, this method can measure H^- at a probe placed position only. Information on H^- extracted as an ion beam component can't be obtained. Furthermore, if the probe is inserted near to a plasma grid (PG) surface for measurement of extraction region, H^- production on PG surface may be influenced by change of the PG surface condition and that of plasma near the PG due to probe insert.

To measure H^- after extraction and avoid this disturbance, H^- was measured with new photodetachment method which does not need a Langmuir probe. A pulse laser beam is injected parallel with PG surface and destructs H^- on laser path near PG surface, when an H^- ion beam are extracted. Then the temporal change of ion beam current is detected by a faraday cup. The destructed component in H^- being transported to extraction hole can be obtained by extraction from an ion beam current when no pulse laser is injected. This temporal decrease of H^- ion beam current is photodetachment signal in this experiment and give H^- information after extraction from an ion source without disturbance caused by a probe insert.

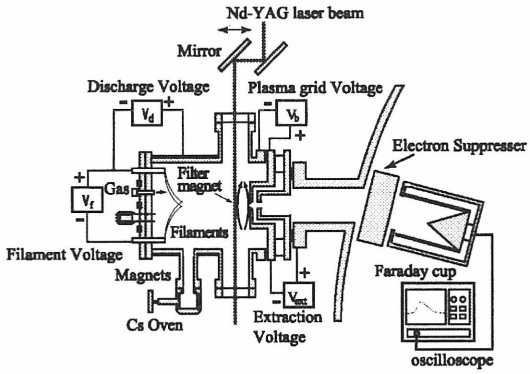

Fig.1 Schematic diagram of the experimental apparatus

Experimental apparatus is in Fig.1[2]. The Nd-YAG pulse laser beam is 9mm diameter and is injected from a window on the ion source sidewall. Movable metal mirrors can change distance between the laser axis and the PG surface (D) from 7.5cm to 31.5cm.

Fig.2 shows photodetachment signals with different three D conditions. Signals are so little that matching (50Ω) measurement circuit can not detect the signal. In order to detect photodetachment signals, high resistance (1MΩ) must be used. Therefore waveforms detected with oscilloscope are transformed by measurement circuit and different from original waveforms of photodetachment signals. But, integration of these photodetachment signals show contribution of H^- on the laser path in H^- ion beam current. Therefore the integration (ΔQ) is defined as this contribution and ΔQ dependence on D are shown in Fig.3. From Fig.3, as D is larger, ΔQ become smaller and ΔQ is maximum value in minimum D condition. In this study, ΔQ in minimum D condition is ten times larger than ΔQ in maximum D condition. Therefore, as H^-'s are nearer from PG, they are more important to the extracted ion beam current.

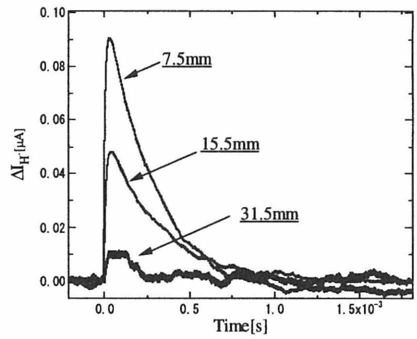

Fig.2 Photodetachment signals three different distances (D) between laser axis and PG

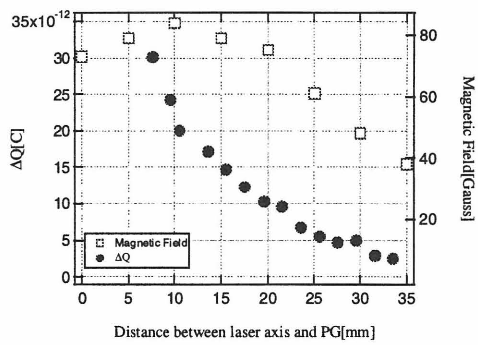

Fig.3 Contribution of H^- on laser path (ΔQ) dependence on distance between laser axis and PG surface (D).

References
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[2] Y.Matsumoto, M.Wada, T.Kasuya, M.Sasao, Rev. Sci. Instrum., **73**, 952(2002)