

## §6. Development of High-Directional Pulse Cluster Source for Fueling

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The size of each cluster particles produced by adiabatic expansion from nozzle is dependent on the operating conditions of the nozzle, such as the gas temperature and pressure at the upstream, the size of nozzle throat and so on. This year we designed and constructed a compact mass analyzer to measure the size of clusters.

The structure of the mass analyzer is shown in Fig. 1. A pair of ferrite magnets instead of magnetic coils were used to minimize the size of the analyzer. Each magnet had the area of 10 cm by 10 cm and thickness of 2 cm. The magnets were fixed by an iron core to have a gap of 1 cm. The measured strength of the magnetic field at the gap was about 0.25 T, which was consistent with the result of 3-D numerical simulation. Figure 2 shows typical orbits of argon ion and cluster ions ( $\text{Ar}^+$ ,  $\text{Ar}^{2+}$ ,  $\text{Ar}^{3+}$ ) with energy of 0.5 keV, where ions are incident from the right-hand side.

Figure 3 shows the preliminary experimental data of the mass analyzer. The experimental setup with a pulse cluster source of direct ionization type was same as that reported last year. Seven circle plates with 1 cm in diameter were aligned in every 1.5 cm at the bottom end of the exit of the mass analyzer (cf. Fig. 2). The top of the left graphs in Fig. 3 is the time variation of the electrical potential of the nearest detector to the mass analyzer. The bottom of the right graphs in Fig. 3 corresponds to the output of the furthest detector from the mass analyzer (or the left most detector in Fig. 2). The beam pulse length was about 30 ms and three pulses were shown in each graph. We see that the waveforms were different depending on the position of the detector, though the detectors were not Faraday cups but simple plates so that the waveforms may not reflect the amount of the incident ions and cluster ions directly.

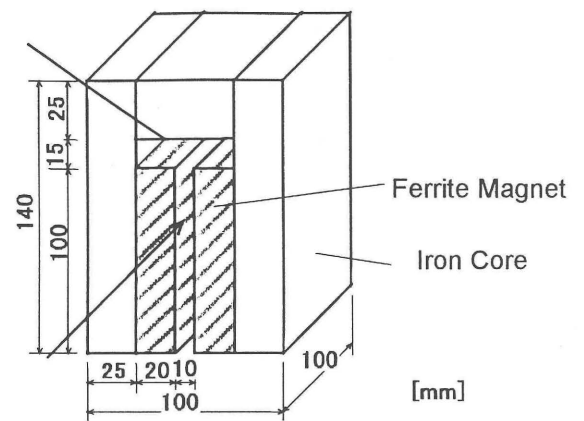


Fig. 1 Mass analyzer

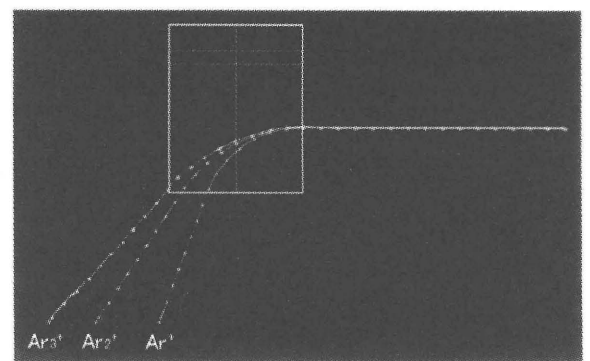


Fig. 2 Orbits of argon ion or cluster ions ( $\text{Ar}^+$ ,  $\text{Ar}^{2+}$ ,  $\text{Ar}^{3+}$ )

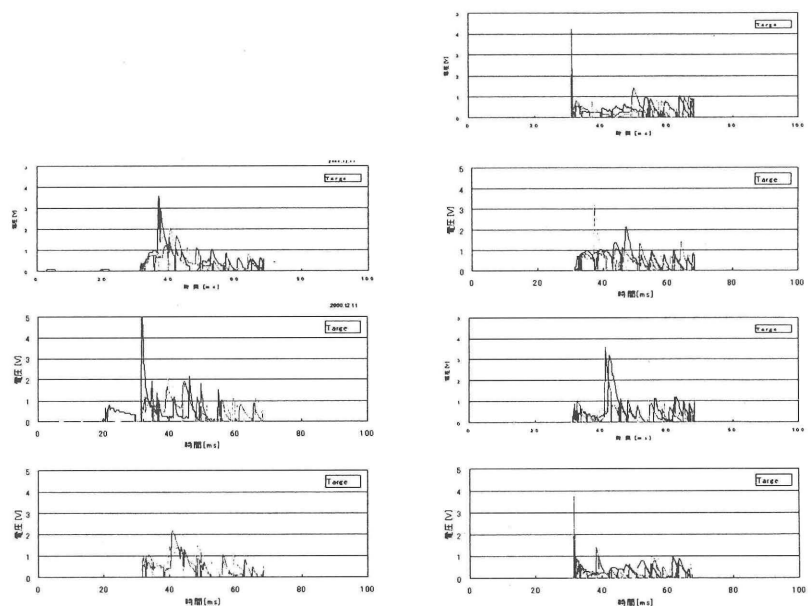


Fig. 3 Detector outputs of the mass analyzer