THE STATE OF THE ART OF TSUKUBA 12UD PELLETRON ACCELERATOR

T. Ishihara, K. Shima, T. Komatsubara, M. Tomizawa, H. Oshima, Y. Tajima,
S. Ishii, T. Takahashi, Y. Yamato, M. Kayama, and M. Yamanouchi
Tandem Accelerator Center, University of Tsukuba, Tsukuba, Ibaraki, 305, Japan

Tandem electrostatic accelerators have been used for investigations in the field of low energy nuclear physics. Besides, the tandems seem to be gaining a good evaluation as injector machines of high energy accelerators, because of their stability and low running cost. Feasibility of accelerating many kinds of heavy ions at a high efficiency also is an attractive feature of the tandem accelerator. In view of those mentioned above, the state of the art of Tsukuba 12UD is presented on the poster.

Fig.1 shows how 12UD has been running over the past 13 years. We have never experienced any damage of the accelerator even in the case of earthquakes of fairly large scale of magnitude. Frequency of tank opening for ordinary maintenance is on an average 3 times a year. Lifetime of a pellet chain is about 20,000 hours. Sometimes, not so often, we encouter an unexpected increase of lost current which is defined as (charging current)-(tube-, column-corona current). Fig.2 illustrates a relation between the lost current and removal by using a dryer system of water contaminant in SF_6 insulating gas. Curves in the figure seem to show that the lost current decreases with reducing the water content in the gas, and consequently the terminal voltage of 12UD increases. Other factors which influence the stability of machine operation are so called electron-loading in the accelerator tubes and decomposition of the insulating gas induced by corona discharge in the accelerator tank. These factors relate complicatedly to each other and cause to initiate spark discharges. In order to increase the running efficiency of the 12UD and to increase an attainable terminal voltage for everyday use, an investigation program of reducing the electron loading and of removing other factors giving rise to unstable operation of the accelerator is under way. In spite of having some imperfections which are common to electrostatic accelerators, 12UD behaves quite properly and runs quietly up to about 11.5 MV, once a regular conditioning is accomplished. From a practical point of view, we have no problem of spark discharge below 11 MV.

Fig.3 exibits ion species (including molecular negative ions) produced and partly accelerated at Tsukuba[1]. One more attainment at Tsukuba which might be of interest for accelerator personnel is a systematic study of equilibrium charge distributions of ions passing through a carbon foil[2]. In this study, mean charges of ions having equal velocity have been found to oscillate as a function of ionic atomic number. The analysis of this result enables us to predict rather reliable values of charge fractions of heavy ions over the ranges Z=4-92 and E=0.02-6MeV/u. Fig.4 is an example of the results.

References

1. K. Shima, T. Takahashi and M. Yamanouchi, Symp. on Negative Ion Source and Their Applications (KEK, April,1988) Proc.:KEK Rep. 88-7, p.45).
2. K. Shima, N. Kuno and M. Yamanouchi, Phys. Rev., **A40**, 1989, 3557.

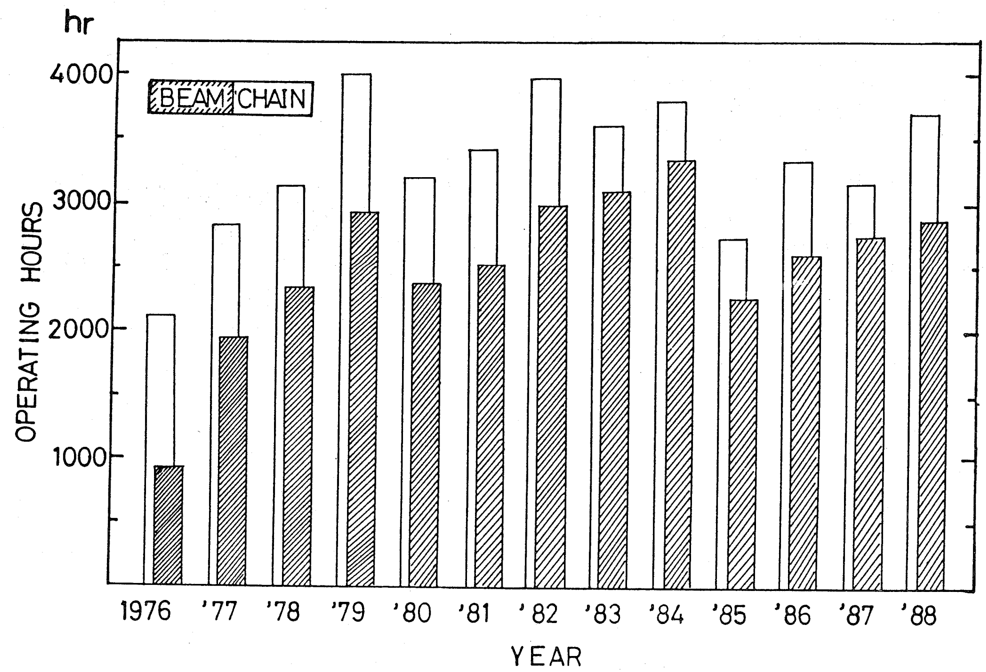

Fig.1 Accelerator operation hours per year from 1976 to 1988.

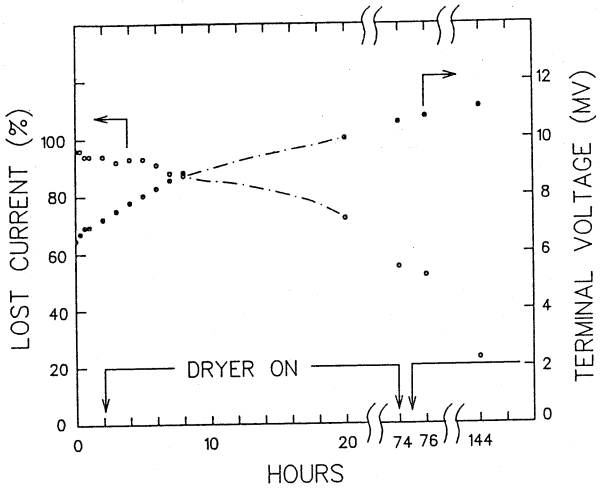

Fig.2 Effect of the water elimination in the SF_6 gas on the lost current.

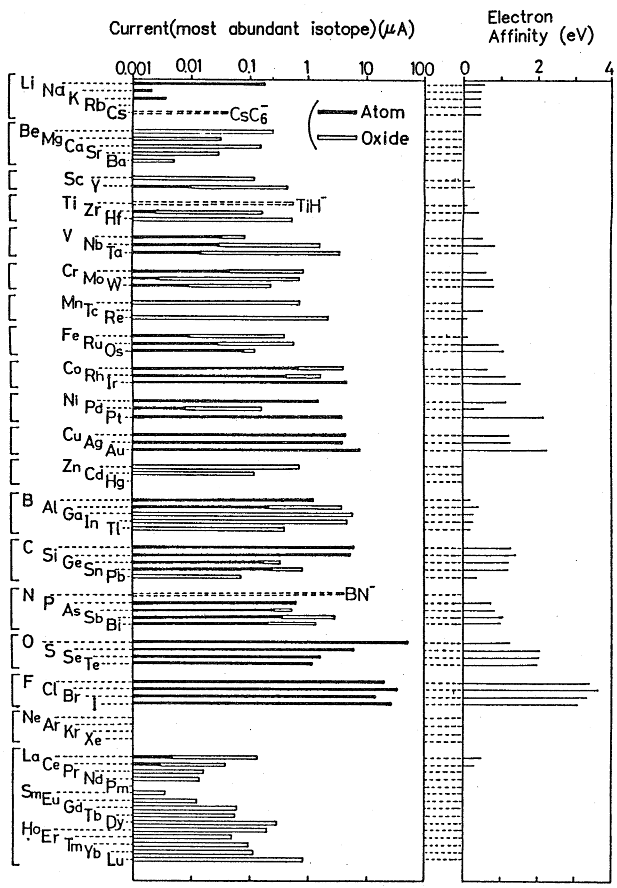

Fig.3 Beam current of 89 keV negative ions of the most abundant isotope observed after mass analysis. Solid thick lines indicates the currents of single atomic ions and the open square marks show the currents of oxide ions produced by using the oxide targets. For the production of CsC_6^-, TiH^-, and BN^- ions, the targets of C, TiH_2+Cu, and BN+Ag respectively were used.

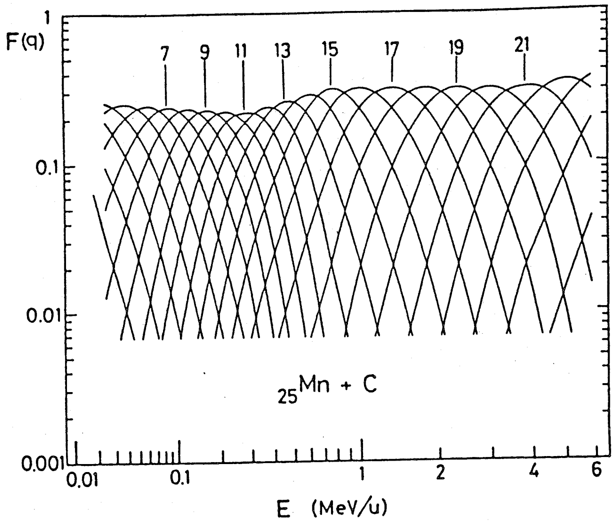

Fig.4 Result of the evaluation of equilibrium charge fractions F(q) of Mn ions after the passage through a carbon foil.