SOURCES OF NEGATIVE HEAVY IONS OF 12 UD PELLETRON AT UNIVERSITY OF TSUKUBA

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A system of heavy ion sources of the 12 UD Pelletron is illustrated schematically in Fig.1. The system comprises 1) a direct-extraction duoplasmatron (Source I in the figure), 2) a sputter source (Source II), and a source of negative helium ions (Source III). Source I was supplied by NEC. The source has been operated stably for the last two years to produce beams of protons, deuterons and oxygens. 70% of the total operation time of the source has been allocated for producing oxygen ions. For routine use, 500 nA or less of $^{16}O^-$ ions are injected to the accelerator, by using Source I.

Source II has been developed recently by one of the authors[1] and will be mounted presently on the injector platform. Structure of Source II is similar to that of Middleton sputter sources, but the source utilizes a cesium ionizer of platinum plate[2] in place of a porous tangsten button. Other features of the sputter source are as follows;

1) Charging of the source with the cesium can be performed by crashing a cesium ampoul with a edge tool in the vacuum after the ampoule is loaded in the source.
2) Sputter cones can be removed and replaced with new ones without breaking the vacuum of the source.

These two contrivances, together with a low rate of cesium consumption, enebles us to operate the sputter source almost free from touching the cesium. The rate of cesium consumption is about 1gr./100 hrs.

Heavy ion beams thus far obtained with the sputter source on a test stand are tabulated below.

Ion Species	Beam current(μA)
$^{12}C^-$	2
$^{27}Al^-$	0.015
^{56}Fe	0.03
$^{63}Cu^- + {}^{65}Cu^-$	0.7

A normalized four-dimensional emittance of beams of $^{12}C^-$ ions, for 20% of the total beam current, is 5 $mm^2 \cdot mrad^2 \cdot MeV$ which corresponds to the acceptance of the 12 UD Pelletron.

Source III is a conventional charge exchange source of helium ions, consisting of a duoplasmatron and a cesium exchange canal (lithium could be used also). So far, the He^- ions have been supplied by utilizing a cesium-cell of a Lamb-shift type polarized ion source (PIS in Fig.1). The accelerator produces 100 nA of analyzed $^4He^{2+}$ ion beams by using PIS. Judging from the above experience, Source III is expected to supply He^- ions

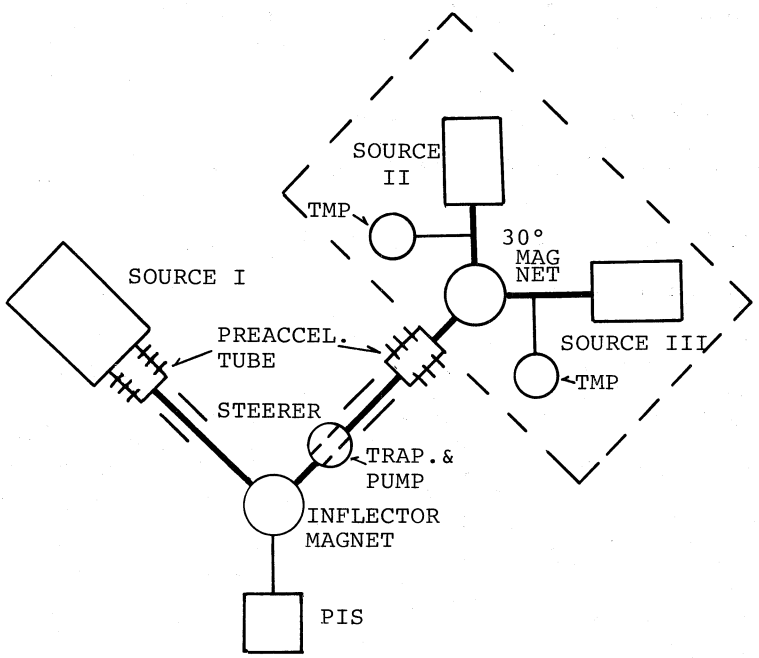

Fig.1 A schematic diagram of a system of ion sources of 12 UD Pelletron.

enough for obtaining 500 nA of the analyzed helium beams. Construction of the Source III on a test-stand is now in progress.

A trapping and pumping station are located in the injection line of Source II and III for protecting the accelerator against contamination of cesium.

References

1) M. Yamanouchi et al., Proc. Symp. on Ion Sources and Application Technology, Feb. 14th-15th, 1977, pp.81~82.
2) M. Yamanouchi et al., Proc. 1st Symp. on Accel. Sci., 1975, pp.146~147.