HEAVY ION SOURCE FOR THE IPCR CYCLOTRON

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In the IPCR cyclotron some multiply-charged heavy ions are accelerated for 4188 hours in a year at present. In order to produce the multiply-charged heavy ions three kinds of ion source are used: a heavy ion source for a gaseous material to charge (type I), ion source for a metallic material to charge (type II) and an improved ion source (type III). Some characteristics and facilities of three type sources are indicated in the table 1. the construction and the pulsed operation of the type I source was described in the previous symposium[1]. The metal ion source (type II) is of the electron-bombarded hot cathode type with a sputtering electrode installed in the anode of the source at the opposite position of the exit slit. The sputtering electrode is made of the material to charge. Figure 1 shows a block diagram of the system of the power supply for the metal ion souce. By using this source beams of several metal ions were extracted from the cyclotron with sufficient intensities as seen in table 2.

For producing Ne^{6+} ions an improved ion source (type III) has been developed, because the life time of the source (type I) was very short (3∿6 hours) in the case of production of Ne^{6+} ions. Fig. 2 shows a cross sectional view of this source (type III). In this source it takes only 30 minutes to exchange the cathodes of the source. But, intensities of Ne^{6+} beams extracted from the cyclotron are decreased compared with those in the case of type I source.

Reference 1) I. Kohno et al., Proc. 2nd symposium on accelerator science and technology, Tokyo, p23 (1978)

Table 1

Ion Source	Operation Mode	Supporting System	Upper Cathode Size(mm)	Material	Lower Cathode Size(mm)	Material	Kinds of Produced Ions
Gaseous Ion Source	CW	two stems	10^{ϕ}x10	W	11^{ϕ}x17	Moor W	C^{4+},N^{4+}
	Pulsed*	"	9^{ϕ}x11	Ta	"	W	N^{5+},O^{5+}
	Pulsed*	"	8^{ϕ}x 8	Ta	"	"	Ne^{6+}
Metal Ion Source	CW	"	10^{ϕ}x10	W	"	"	Li^{2+},Li^{3+}, Be^{3+}, B^{4+}
Improved Ion Source	Pulsed*	one	8^{ϕ}x8	Ta	7^{ϕ}x17	"	Ne^{6+}

* Duty factor 0.33∿0.44 .

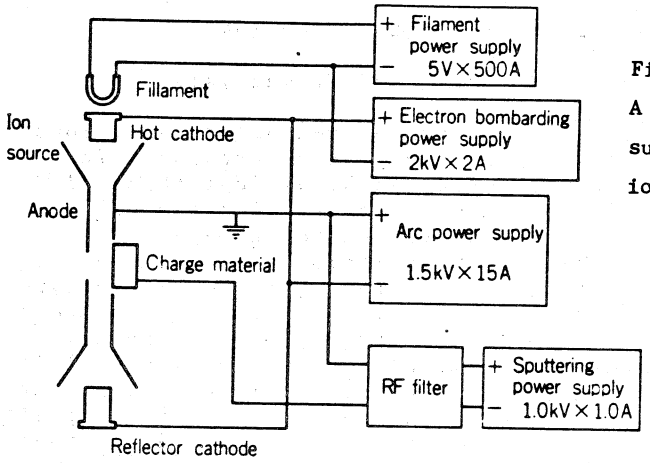

Fig. 1.
A block diagram of the power supply system for the metal ion source.

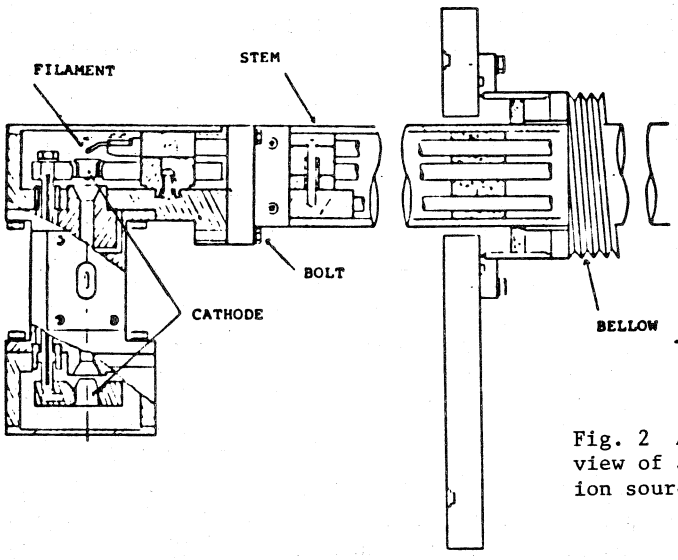

Fig. 2 A cross sectional view of an improved ion source.

Table 2

Particle	Energy (MeV)	Arc Voltage (V)	Arc Current (A)	Sputtering voltage (V)	Charge material	Intensity at the gate (μA)
$^{7}Li^{2+}$	29 - 48	320	3.7	200	LiF	1.5 - 2.0
$^{7}Li^{3+}$	29 - 75	340	5.5	50	LiF	30 - 50 nA
$^{6}Li^{2+}$	25 - 48	280	4.5	200	LiF	100 - 200 nA
Be^{3+}	45	470	4.6	700	Be	0.7 - 0.8
$^{11}B^{3+}$	66	400	4.5	0	B_2O_3	1.2 - 1.3
$^{10}B^{3+}$	60	400	4.5	0	B_2O_3	250 - 300 nA
$^{11}B^{4+}$	66	400	4.5	0	B_2O_3	3 nA
$^{11}B^{3+}$	66	400	5.0	900	BN	100 nA

Supporting gas : Ar, gas flow : 1.31 - 1.60 cc/min

BN : Boron nitride