

18 GHz superconducting ECR ion source

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An 18 GHz superconducting ECR ion source has been installed as a subject of the AVF upgrade project [1], in order to increase beam currents and to extend the variety of ions. The production development of several ion beams has been performed since 2006[2].

Operational tests for beam intensity optimization have been done for ^{16}O , ^{18}O , ^{15}N , ^{40}Ar and ^{86}Kr up to now. The obtained currents for each ion and each charge state are given in Table 1. For charge states marked with * in the table, such parameters as gas flow rate, mirror filed strength and mirror ratio, probe position and its biased voltage, were optimized to maximize the current. After the optimization, about one order stronger N and O ions were successfully obtained in comparison with the currents by the existing 10 GHz NEOMAFIOS at RCNP[3] as shown in Table 1. Highly charged heavy ions like $^{40}\text{Ar}^{11+,12+}$ and $^{86}\text{Kr}^{21+,23+}$ were also obtained and accelerated by the RCNP AVF cyclotron for the first time. $^{16}\text{O}^{5+,6+}$, $^{15}\text{N}^{6+}$ and $^{86}\text{Kr}^{21+,23+}$ beams have already been delivered to user's experiments.

In order to produce stable boron ions, a test by MIVOC (Metal Ion from Volatile Compounds) method[4] has been also performed using o-carborane ($\text{C}_2\text{B}_{10}\text{H}_{12}$). Its vapor pressure is around 1-2 Torr at the room temperature. The stable flow of the vapor from o-carborane powder to the plasma chamber enabled us to produce stable boron ion beam. The o-carborane was put in glass vessel directly connected to the plasma chamber via a buffer tank. Helium gas was used as the mixing gas. The obtained currents of Boron ions are summarized in Table 1. The stability of the highly charged boron ion beams was superior to the boron crystal sputtering method by the existing NEOMAFIOS.

Further developments are in progress to meet the demands for more intense ion beams with higher charge states.

Table 1: Intensities ($e\mu\text{A}$) of several ions and charge states.

Ion (Support gas)	2+	3+	4+	5+	6+	7+	Extraction Voltage
^{11}B (^4He)	1.3	4.1	9.3	*8.2			15kV
^{15}N (^4He)		167	477	*725	117		15kV
^{16}O (^4He)	33	192	—	*463	421	30	15kV
^{18}O (^4He)		88	235	475	*673	39	15kV
	11+	12+	13+	14+			
^{40}Ar (^{16}O)	*165	*70	*17	*3			15kV
	20+	21+	22+	23+	24+	25+	26+
^{86}Kr (^{16}O)	32	*26	*21	*13	8.1	4.5	2.1
comparable ion beams from NEOMAFIOS[3]							
			4+	5+	6+	7+	
^{14}N			110	65	6		
^{16}O			80	30	10	0.2	

References

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