Operation of the RCNP Cyclotron

K. Hatanaka, M. Fukuda, T. Yorita, T. Saito, H. Tamura, M. Kibayashi, K. Nagayama, S. Morinobu, H. Gotoh[a], Y. Inata[a], H. Yana[a], Y. Ohe[a], K. Masuda[a], M. Rikiishi[a], T. Hata[a], K. Sadano[a] and Y. Kuramochi[a]

Research Center for Nuclear Physics (RCNP), Osaka University, Ibaraki, Osaka 567-0047, Japan

[a] *Sumiju Accelerator Service (SAS)*

A summary of the operation of the AVF and the Ring cyclotron in 2007 is given in Table 1. In 2007 intensive developments were made with the 18 GHz superconducting ECR ion source and the flat-top accelerating system of the AVF cyclotron. They are described in detail elsewhere in this volume.

Table 1: A summary of operational statistics

Beam time	Beam time for experiments	G	103^h00^m
		K	237^h25^m
		WS	1670^h58^m
		WN	24^h12^m
		N0	297^h01^m
		EN	366^h44^m
		ES	235^h51^m
		Total	2935^h11^m
	Tuning of beam for experiments		319^h53^m
	Developments		2807^h28^m
	Total		6100^h51^m
Scheduled maintenance and set up for experiments			1169^h43^m
Shutdown	Scheduled shutdown and holidays		1341^h00^m
	Unscheduled shutdown		148^h26^m
	Total		1757^h40^m
Total			8760^h00^m

The cyclotrons were stably operated except for small troubles with the RF system of the Ring cyclotron. A ceramic insulator of the power feeder to the second cavity was broken by electric discharges. The tetrode, RS2042SK, of the main amplifier was also damaged and replaced in the summer maintenance.

A systematic study on the beam transportation was performed to improve the transmission efficiency in the K-course where radio isotopes are produced for nuclear chemistry. The transmission from the beam stop BS1 to the target was improved to 100 % The last quadrupole doublet in the H-cource was moved downstream by 1.4 m in order to make small images available on the target.

The lead target for producing white netrons was replaced by a tungsten block. Several through-holes were observed in the lead target. Beams of 400 MeV protons of around 1 μA had made the holes due to the low melting temperature of the lead material. The new tungsten target is 65 mm thick with the cross section of 50×50 mm^2. The thickness corresponds to the 250 MeV energy loss for the 400 MeV incident protons. The target is shown in Fig. 1.

The statistics of the beam species delivered by the cyclotron are summarized in Table 2. About 53 % of the beam time was devoted to the experimentscarried with protons. Demand for heavy ions increased to 1450 hours compared to 800 hours in 2006. The beam of $^{86}Kr^{23+}$ was delivered to experiments at 8.5 MeV/u by using only the AVF cyclotron. The operational statistics since 1977 are shown in Fig. 2.

Figure 1: Tungsten target for the white neutron production.

Table 2: A summary of the beam usage of the RCNP cyclotrons

Light ions		Heavi ions	
Proton	2630^h30^m	^{6}Li	193^h42^m
Pol. Proton	606^h03^m	^{11}B	113^h43^m
Deuteron	337^h10^m	^{15}N	357^h07^m
Pol. Deuteron	42^h57^m	^{16}O	237^h17^m
^{3}He	517^h54^m	^{18}O	54^h30^m
^{4}He	518^h47^m	^{40}Ar	108^h20^m
		^{86}Kr	383^h06^m
Total	4653^h06^m		1447^h45^m

Fig. 2 Operating Statistics