AVF operations in 2014

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In 2014, the total annual operation time of the K70 AVF cyclotron (denoted as AVF hereafter) was 2942 hours as shown in Table 1. This was increased by 311 hours compared with that in 2013. In this duration, the time for beam tuning was 1240 hours, which was 274 hours longer than that in 2013. Most of the increased time (311 hours) was spent on beam tuning because the time for beam tuning for "Injection to RRC-SRC" was increased to two to three times longer than usual, and it took considerable time to recover from problems. On the other hand, the total beam supply time was 1702 hours, which was classified into three categories: "Injection to RRC", "Injection to RRC-SRC", and "AVF standalone". The operation times for these three categories are listed in Table 1.

All of the beams accelerated by the AVF in 2014 are listed in Table 2. In this table, the following beams were accelerated for the first time in 2014: ^{16}O (4.9 MeV/u), ^{84}Kr (3.97 MeV/u), α (12.5 MeV/u), ^{11}B (5.0 MeV/u), ^{19}F (6.08 and 6.768 MeV/u), and α (7.5 MeV/u). The supplied courses were as follows (in order of the supplied time): RI production, RRC-SRC, CRIB, RRC-E5, Student Ex, and E7B.

Table 1. AVF operation statistics in 2014.

	2013	2014
Total operation time (hr)	2631	2942
Beam tuning	966	1240
Injection to RRC	738	208
Injection to RRC-SRC	118	455
AVF standalone	809	1039
Beam course (AVF standalone) (hr)		
E7A	480	335
E7B	18	58
C03	311	646

The total fault time was 118 hours. The main faults are listed in Table 3, in descending order of time spent on restoration, and details are indicated below.

Table 2. AVF beam list in 2014.

Particle	*E* (MeV/u)	Course
p	12.0	RI production
d	12.0	RI production
d	4.9	RRC-SRC
α	6.5	Student Ex.
α	7.5	RI production
α	12.5	RI production
^{6}Li	11.2	CRIB
^{7}Li	5.6	CRIB
^{7}Li	8.6	E7B
^{11}B	5.0	CRIB
^{12}C	7.0	RRC-E5
^{16}O	4.9	RRC-SRC
^{18}O	6.07	RI production
^{19}F	6.08	RI production
^{19}F	6.768	RI production
^{22}Ne	6.1	CRIB
^{40}Ar	5.2	RRC-E5
^{56}Fe	5.0	RRC-E5
^{84}Kr	3.97	RRC-E5

(1) During ^{40}Ar beam tuning, the beam stopped unexpectedly at RRC. This was due to an incorrect arrangement of the readout-cable of baffle slits, which cut across the beam trajectory in the chamber of the RRC.

(2) During ^{6}Li beam supply, the beam current decreased at the ion source. To investigate the cause, the ion source was disassembled. Consequently, some contaminations were observed and lack of ^{6}Li metal was found.

(3) During ^{12}C beam tuning, one of the hollow conductors from the magnetic channel of the AVF cracked and cooling water sprayed out from that crack. The crack was temporarily caulked by putty because it was difficult to close the crack by weld. The beam tuning was restarted without any problems.

Table 3. Main faults in 2014. See text for details.

	Date	Time for restoration (hr)
(1)	6th September	22
(2)	13th May	18
(3)	16th September	17

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