# RILAC operation

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The RIKEN heavy-ion linac (RILAC) has been operating steadily throughout the reporting period and has been supplying various ion beams for different experiments. Some statistics regarding the RILAC operation from January 1 to December 31, 2013, are given in Table 1. The total beam-service time of the RILAC accounted for 75.4% of its operation time. The two operation modes of the RILAC, namely, the stand-alone mode and the injection mode, in which the beam is injected into the RIKEN Ring Cyclotron (RRC), accounted for 62.2% and 37.8% of the total beam-service time of the RILAC, respectively. For the beam experiment and the machine study of the RI Beam Factory (RIBF), a 2.648-MeV/nucleon $^{18}$O-ion beam and a 2.932-MeV/nucleon $^{40}$Ar-ion beam accelerated by the RILAC was injected into the RRC between April and June 2013. Table 2 lists the beam-service times in the stand-alone mode of the RILAC allotted to each beam course in the RILAC target rooms in 2013. The e2 beam course in target room no. 1 was used in the machine study of a new gas-filled recoil ion separator (GARIS-Ⅱ). The e3 beam course in target room no. 1 was used in experiments involving the heaviest elements and the study of the physical and chemical properties of these elements using the GARIS. The e6 beam course in target room no. 2 was used in the analysis of trace elements. Table 3 lists the operation time of the 18-GHz ECR ion source (18G-ECRIS) in 2013.

We carried out the following improvements and overhauls during the reporting period.

1) In the RF systems, the DC high-voltage power supplies were subjected to annual inspection. In addition, the major components of mechanical parts were subjected to simple inspection.
2) Two water pumps of the cooling tower circuits were overhauled. The other water pumps were subjected to simple inspection. All cooling towers were subjected to monthly inspection and annual cleaning.
3) All the turbomolecular pumps were subjected to annual inspection. Eight cryogenic pumps used for the RILAC and CSM cavities were overhauled.

We experienced the following mechanical problems during the reporting period.

1) Water was found to have splashed in the 18G-ECRIS because of leakage from a cooling water jacket; it took approximately twelve days to repair it.
2) A section of the cooling pipe of stem-2 in the FC-RFQ cavity had a vacuum leak; it took approximately four days to repair it.
3) Water was found to have splashed in the RF power amplifier no. 3 because of leakage from a water joint outside the plate stub; it took approximately two days to repair it.
4) Water was found to have splashed in the CSM-A3 cavity because of leakage from a cooling pipe on the outside wall of the cavity; it took approximately two days to repair it.

Table 1. Statistics on RILAC operation from January 1 to December 31, 2013.

| | | |
|---|---|---|
| Operation time of RILAC | 2779.4 | h |
| Mechanical trouble | 42.9 | h |
| Stand-alone RILAC | 1304.0 | h |
| Injection into RRC | 791.3 | h |
| Total beam service time of RILAC | 2095.3 | h |

Table 2. Beam service time of the stand-alone RILAC allotted to each beam course in target rooms no. 1 and no. 2 in 2013.

| Beam course | Total time (h) | % |
|---|---|---|
| e2 | 110.8 | 8.5 |
| e3 | 1151.3 | 88.3 |
| e6 | 33.2 | 2.5 |
| RRC injection course | 8.6 | 0.7 |
| Total | 1304.0 | 100.0 |

Table 3. Operation time of the 18G-ECRIS in 2013.

| Ion | Mass | Charge state | Total time (h) |
|---|---|---|---|
| N | 15 | 3 | 72.0 |
| O | 18 | 6 | 252.1 |
| F | 19 | 6 | 105.0 |
| Ne | 22 | 6 | 599.9 |
| Mg | 24 | 7 | 338.7 |
| Al | 27 | 6 | 300.8 |
| Ar | 40 | 11 | 238.2 |
| Ca | 40 | 11 | 61.7 |
| Ca | 48 | 11 | 599.0 |
| Ni | 58 | 13 | 215.4 |
| Kr | 82 | 18 | 144.0 |
| Kr | 86 | 18, 20 | 162.3 |
| Xe | 136 | 20 | 12.5 |
| U | 238 | 35 | 128.0 |
| | Total | | 3229.6 |

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