Interlock signal application from radiation monitoring ion chamber for SRC

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Recently, we attempted to monitor the radiation due to beam loss in the RIBF using ionization chambers (ICs).[1,2] Usually, we investigate the radiation from the electrostatic deflection channels (EDC) at RRC, fRC, IRC, and SRC.[3] On the other hand, the intensities of the ion beams generated by RIBF increase in every year. Accordingly, the management of the beam loss at important positions in RIBF is increasingly important for safe and efficient operation of RIBF. In this study, we investigated the IC signal near the EDC of SRC and attempted to input the alarm signal from this IC to the beam interlock system (BIS) of RIBF in the user time of a $^{238}U^{86+}$ beam.

Usually, the alarm levels of the ICs are determined by comparing the signals from the ICs with those from thermocouples set at the septum of the EDC of SRC.[4] Hence, the temperatures of the first septum were compared with the signals of the IC set near the EDC of SRC from October 15 to December 10 in 2018. The results are shown in Fig. 1. The data demonstrated little dispersion, and we can obtain a calibration curve (red line). From this curve, we can recognize that the voltage of the IC became approximately 1.1 V when the temperature of the first septum became 42°C.[4]

From November 12 to December 6 in 2019, the $^{238}U^{86+}$ ion beam was accelerated to 345 MeV/nucleon. Before this acceleration time, we set the alarm level of IC at 1.1 V to the BIS.

Investigations were performed during this term by inputting the alarm signal to the BIS. However, in this term, we could not observe signals stronger than 1.1 V, which was the estimated alarm level. Consequently the BIS from IC near the EDC did not act in this time. From these results, we could consider that the operation of the SRC in this term was completed favorably.

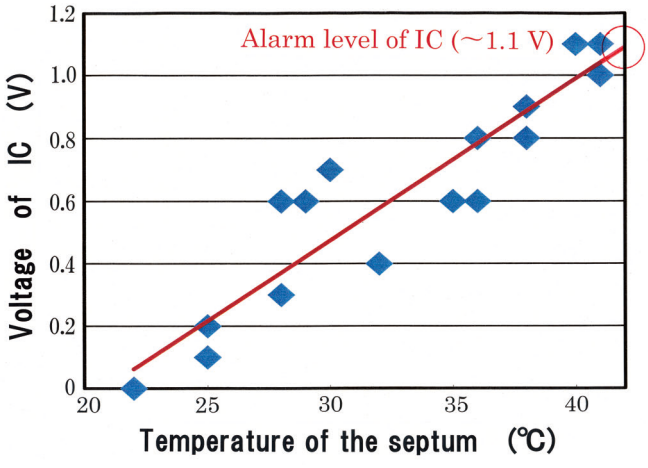

Fig. 1. Correlation between the IC voltage and the temperature of the first septum of EDC.

Table 1. Frequencies of troubles for which the BIS was engaged during the acceleration of the $^{238}U^{86+}$ beam in 2019.

SRC-EDC-ARC	1080
RF-Tr	450
PS-Tr	375
BF-Tr	282
Others	1614
Total	3801

Subsequently, we investigated the frequency at which the BIS of all RIBF systems was engaged from October 23 to December 10 in 2018. In this term, BIS was engaged 19049 times. This result shows that BIS was engaged about 389 times per day. On the other hand, from November 12 to December 6 in 2019, BIS was engaged 3801 times. This result shows that BIS was engaged about 152 times per day. By comparing these two results, we could recognize that the operations of RIBF in 2019 were completed more safety and efficiently than in 2018.

Next, we investigated the type of alarm signals put into BIS during the acceleration of the $^{238}U^{86+}$ beam in 2019. BIS engagement via arc discharge at the EDC of SRC (SRC-EDC-ARC) was observed most frequently. BIS engagement due to a trouble of RF (RF-Tr) had the second-highest frequency. BIS engagement due to troubles of a power supply in RIBF (PS-Tr) and due to troubles of baffles (BF-Tr) were also frequently observed. The frequencies of these troubles are listed in Table 1.

Considering these results, we will investigate the correlation of the IC voltage and the conditions under which the arc discharge at the EDC of SRC is generated in the next step. Subsequently, we will re-examine the alarm level of IC.

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References

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