Radiation monitoring for cycrotrons in RIBF

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Recently, we attempted to monitor the radiation due to beam loss in the RIBF by using ionization chambers (ICs).[1] Usually, we investigate the radiation from the electrostatic diffraction channel (EDC) at RRC and SRC. We would input the alarm signal from these ICs to the beam interlock system (BIS).[2,3] However, in the case of the $^{238}U^{86+}$ beam, for example, RRC, fRC, IRC and SRC are used. Hence, we have installed the ICs near the EDC of fRC and IRC. This time, we attempted to input the alarm signal from the IC near the EDC of IRC to BIS.

We considered the alarm levels of the IC from the signals of the thermocouples (TCs) set at the septum of RRC and SRC.[2,3] According to this method, when the temperature difference between the TC set near the beam-irradiated part of the septum and the temperature of the cooling water of the septum become 10°C,[4] the alarm signal is input to the BIS. Hence, we compared the temperature difference on the septum with the signal of the IC near the EDC of IRC in the machine time of the $^{238}U^{86+}$ beam. The result is shown in Fig. 1. The data showed little dispersion and the calibration curve in Fig. 1 can be drawn. From this curve, we can recognize that the voltage of the IC became about 8.5 V when the temperature difference on the septum reached to 10°C, as showed by the red dotted line in Fig. 1.

From October 10 to November 30, the $^{238}U^{86+}$ ion beam was accelerated to 345 MeV/nucleon. The IC signal from 9:00 on 10/19/2017 to 9:00 on 10/20/2017 is shown in Fig. 2(a). The adjustment for high intensity beam was started from about 11:30 on 10/19 and continued to about 9:00 on 10/20. In this figure, we could observe many peaks whose intensities ranged from 3 V to 7 V.

The IC signal from 9:00 on 11/19/2017 to 9:00 on 11/20/2017 is shown in Fig. 2(b). From 9:00 on 11/19 to 9:00 on 11/20, the ion beam current was increased from about 5800 enA to 6000 enA. These ion beam currents reached the maximum values during this machine time of $^{238}U^{86+}$ ion beam. However, in Fig. 2(b), we could observe signals whose intensities were only about 1–3 V and about 3.5 V at maximum.

We performed investigations by inputting the alarm signal to the BIS during the machine time of $^{238}U^{86+}$ ion beam. However, in this term, we could not observe signals stronger than 8.5 V which was the estimated alarm level. Then the BIS from the IC near the EDC of IRC did not act in this term. From these results, we could consider that the operation of the IRC in the machine time of $^{238}U^{86+}$ was completed favorably.

In future, we will investigate the beam loss at the EDC of IRC using other beams in addition to the $^{238}U^{86+}$ beam. In addition, in next time, we will investigate the alarm signal from fRC to BIS.

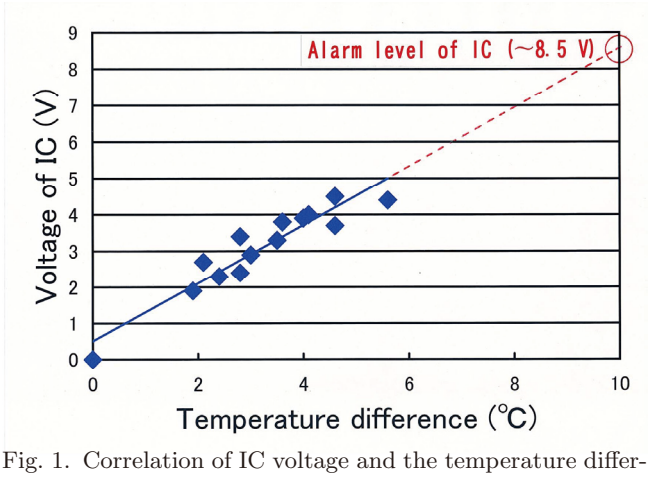

Fig. 1. Correlation of IC voltage and the temperature difference on the septum.

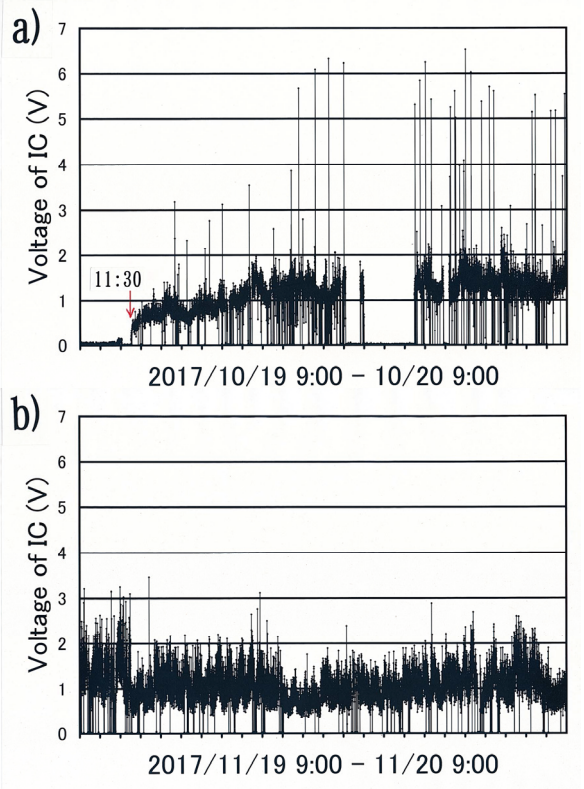

Fig. 2. Signals from the IC installed near the EDC of IRC.
a) The signal when the beam was adjusted.
b) The signal when the full beam was used.

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References

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