Renewal of control system and driving mechanism of cavity tuning devices for RILAC Rebuncher

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The RIKEN Linear Accelerator (RILAC) is used as an injector to the RIBF accelerator complex for heavy-ions up to krypton. For example, ^{48}Ca beam is accelerated by a cascade of the RILAC, RIKEN Ring Cyclotron (RRC), Intermediate-stage Ring Cyclotron (IRC), and Superconducting Ring Cyclotron (SRC). The rebuncher called X5-REB and located at the beam transport line from the RILAC to the RRC is required for this operation to adjust the longitudinal bunch length because of the long distance of the beam transport line.[1] The rebuncher system was built approximately 30 years ago[2,3] and showed problems such as low stability of rf voltage and phase because of old low-level (LL) circuits; less reproducibility of the driving mechanism for frequency tuning devices; and insufficient usability of local and remote control. Therefore, the control system as well as the driving mechanism of cavity tuning devices were upgraded to overcome these problems.

We replaced the old control system with a new system using a programmable logic controller (PLC), as shown in Fig. 1. The right side is a controller cabinet including the PLC, and the other side comprises the LL circuits and a transistor wide-band amplifier (WBA). The LL circuits were newly fabricated with rf voltage stability of ±0.1% and phase stability of ±0.1°. These circuits are compatible with the standard LL circuits of the RIBF. The frequency of the LL circuits ranges are from 36 to 76.4 MHz. The WBA was not new but unused with a maximum output power of 500 W and frequency range of 34–90 MHz. The local operation was performed using a graphical touch panel similar to those used in other rf devices of the RIBF. The remote operation was integrated into the operation terminal of the RILAC2 by using SCADA software of Wanderware InTouch.

A cavity of the X5-REB has five driving devices: two side tuners (L and R) for the coarse tuning of resonant frequency, a shorting plate for the coarse tuning of resonant frequency, a trimmer for the fine tuning of frequency, and an rf power coupler. The old driving mechanism, except for the shorting plate, used a linear actuator with a rack and pinion-geared reversible motor, the amount of rotation and driving speed of which were impossible to control. In addition, the actuator had a large backlash. Thus, we modified the four sets of driving mechanism excluding the shorting plate to use as a stepping motor and a trapezoidal screw. The reversible motor of the shorting plate was replaced with a new one because of deterioration. Figure 2 shows the cavity and the part of driving devices of the X5-REB after the modification. Tuner L and power coupler cannot be seen in the figure.

Owing to these modifications, the stability of the rf voltage and phase, the reproducibility of position for each tuning device and the usability were greatly improved; this contributed to the stabilization of beam during the RIBF experiment.

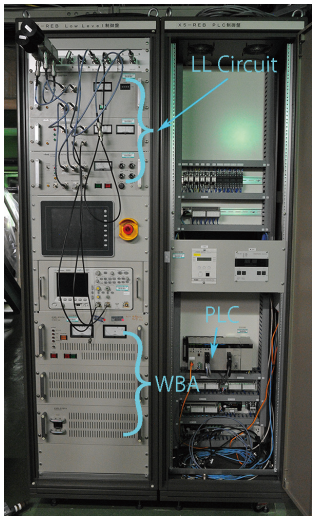

Fig. 1. New control system after the upgrade. Motor drivers are mounted on the backside of the PLC.

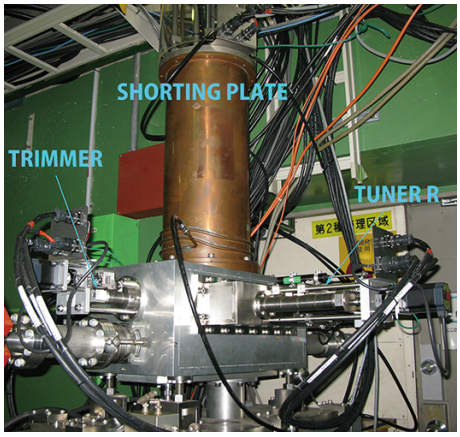

Fig. 2. Cavity and frequency tuning devices of the X5-REB after the modification.

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References
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