Update of Power Supply Control System at the SAGA Light Source Storage Ring

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Abstract

The control system for the SAGA Light Source storage ring power supplies is being upgraded to increase the ramp-up speed and allow the stored beam energy to be easily changed. By replacing the CPU module in the PLC used to control the power supplies, the ramp-up time was reduced from 4 to 2 minutes in a test bench prepared for the upgraded system. To operate the storage ring at an arbitrary energy, the algorithm used in the PLC program was changed. The resolution at which the energy can be changed is less than 1 MeV. The upper layer of the control system using National Instrument LabVIEW and Active X CA was also reconstructed for flexible GUI. Preliminary measurements of the energy dependence of the beam size and lifetime were carried out using the updated control system.

The SAGA Light Source Storage Ring

Algorithm and GUI

Algorithm for varying the beam energy

The beam energy $E$ in the storage ring is a function of the excitation electric current $I$ in the bending magnet power supply, $E = f(I)$. The current of the bending magnet power supply is controlled by an integer $I = 0, 1, \ldots, 9999$, indexed by the internal register of the PLC.

$$I = g(I).$$

Define a function $E(i)$ as, $E = E(i) = f(g(i))$. If the target beam energy $E_{\text{target}}$ is given, the integer $i_{\text{target}}$ is easily obtained by solving $E_{\text{target}} = E(I_f)$. Interpolate and round off to the nearest whole number.

GUI of energy ramp-up client PC

Sub-routine of finding an integer $i_{\text{input}}$ by linear interpolation LabVIEW

BM Excitation Curve and Related Functions

$$E = f(I)$$

$$I = g(I)$$

$$E_{\text{target}} = E(I_f)$$

Summary

We replaced the CPU module of PLC for improve the ramp-up speed. The ramp-up time was reduced from 4 to 2 minutes in a test bench prepared for the upgrade system.

The algorithm and GUI of the control system were modified to easily change the operation energy of the storage ring. Resolution < 1 MeV.

Preliminary beam size and lifetime measurement at several energies was carried out. The observed lifetime peak at about 0.6 GeV may be related to an increase in the vertical beam size.

We will investigate the energy-dependent ion trapping and intra-beam scattering effects at the SAGA-LS storage ring using the updated system.

REFERENCES