Improvement of Control System Based on Labview for Beam Emittance Measurement

Dae-Il Kim#, Jae-Ha Kim, Hyeok-Jung Kwon, Han-Sung Kim, Seok-Geun Lee, Yong-Sub Cho

Korea Atomic Energy Research Institute, KOrea Multi-purpose Accelerator Complex
181 Mirae-ro, Geoncheon-eup, Gyeongju-si 780-904
*Corresponding author: dikim@kaeri.re.kr

1. Introduction

Korea Multi-purpose Accelerator Complex (KOMAC) has several ion accelerators including a 100 MeV proton linear accelerator, a 220 keV ion implanter for gaseous ion beam, a 150 keV metal ion implanter and a 20 keV high-current ion implanter and serve the beam to users [1]. In addition, some ion sources have been developing at KOMAC. It is important to measure the beam properties to characterize the ion sources such as beam emittance. An electric sweep scanner (ESS) was used to measure the beam distribution in phase space [2]. For performance of ESS, it consists of control system based on NI PXI devices and GUI (graphic user interface) based on Labview [3]. In this paper, a control system with algorism applied reliable sequence for data acquisition is presented.

2. Beam Emittance Measurement

2.1. Electric Sweep Scanner (ESS)

An ESS of the Allison type emittance scanner was designed and fabricated to measure the beam density in phase space. The design parameters of the scanner are summarized in Table. 1. The 3ea of vacuum feed-through were installed for the measurement: One was for the deflection plate voltage, another was for the bias voltage, third was for the collector signal [2].

Table.1. Design Parameters of ESS

Chamber length	65mm
Electrode length	57mm
Plate margin	4mm
Slit width	0.1mm
Beam voltage	50keV
Gap distance	2.5mm
Maximum voltage	600V
Maximum analyzable angle	68.5mrad
Mechanical angular resolution	1.5mrad
Maximum beam radius	60mm

2.2. Control System based on Labview

The control system is schematically shown in Figure. 1. It consists of the three parts. First is for the variable bias between a pair of electric deflection plates inside scanner pod. For variable DC voltage, we installed the sub-accessory of SCB-68A linked in the extension slot of PXIe-1082. The DC output signal is transmitted to the BOP (Bipolar Operational Power Supply/Amplifier) that is amplified DC voltage. The adjustment of DC voltage is automatically step by step controlled by Labview. Second is for the monitoring system. The beam signal measured by the scanner is monitored by an oscilloscope (Tektronix DPO7104) through the current amplifier (Standford Research System, SR570). Third is for automatically the movement of the linear motion feed-through. The location of linear motion is labeled on files with a variable DC voltage value.

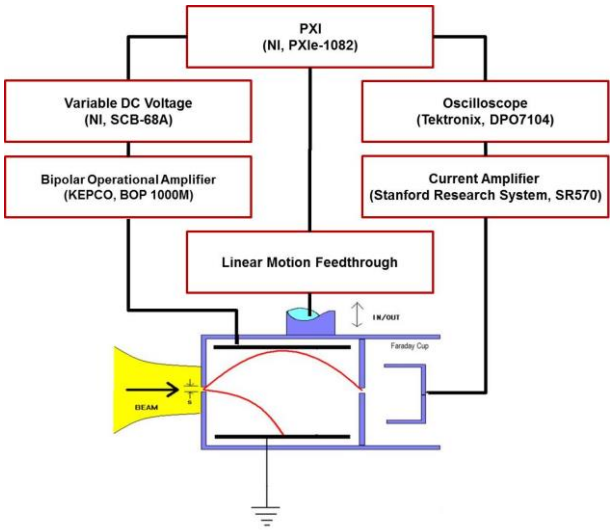

Figure.1. schematic of control system

2.3. Graphic User Interface

GUI based on Labview is shown in the Figure.2. In setup on left of panel, it shows the oscilloscope and PXIe-1082 is linked through a TCP/IP connection, and a DC output control is used the visa resource, as well. On the center of panel, it can be adjusted the oscilloscope for trigger time and DC voltage. But, in now, the location of linear motion is manually packed for the file name. On right of panel, as control panel for execution, it can see the calculated value from the oscilloscope such as a mean value, execution of sequence of DC output and latch for saving the file. The calculated value is to monitor the long-term operation in condition of no change. To save the file, it must be activated the latch of signal save as well as operation of DC output at same time.

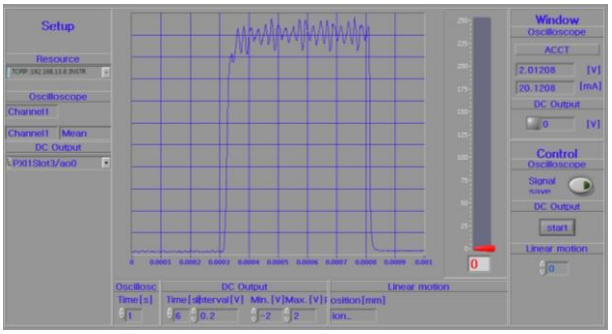

Figure.2. GUI based on Labview

3. Improvements

3.1. Improvement of Algorism

In a sequence with 1 Hz of repetition rate, in case of time 6 s and interval 0.2 V on panel, DC output voltage increases with interval of 0.2 V from -3.6 V to + 3.6 V every 6 seconds. Total period is 216 second. In this case, 6 files are saved in every step. But first one of 6 could not be used because of unreliable signal with variation of DC output voltage. To improve the sequence, it applied the delay with increase only of the DC output voltage without saving file.

3.2. Global Variable

When is arcing in the ion source, control tools are stopped until it is booted again. In particular, it occurs in the control components for linear motion from experience. To improve this situation, we have applied the global variable supported by Labview on the logic. If control tools are stopped, without booting the whole logic is solved by booting the stopped logic.

4. Conclusion

The control system based on Labview was developed for beam emittance measurement. And it was improved by the modification of algorism and the use of external tools applied global variable. In Future, the control system will be used in other ion sources of KOMAC.

Acknowledgement

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REFERENCES

[1] Yong-Sub Cho, Kye-Ryung Kim, Chan-Young Lee, Basic Design Study on 1-MV Electrostatic Accelerator for ion irradiation, Transactions of the Korean Nuclear Society Spring Meeting, Jeju, Korea, May 29-30, 2014.
[2] Hyeok-Jung Kwon et al., Emittance Measurement by using Electric Sweep Scanner, Transactions of the Korean Nuclear Society Spring Meeting, Taebaek, Korea, May 26-27, 2011
[3] P. W. Allision, J. D. Sherman, D. B. Holtkamp, An Emittance Scanner for Intense Low Energy Ion Beams, IEEE Transactions on Nuclear Science, Vol. NS-30, No. 4. p.2204, 1983.
[4] Dae-Il Kim et al., Sequential Control System and Data Acquisition for Beam Emittance Measurement, Transactions of the Korean Nuclear Society Spring Meeting, Jeju, Korea, May 18-23, 2009
[5] www.NI.com/