

## Implementation of the integrated data processing program for KOMAC beam emittance

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### 1. Introduction

A 100 MeV proton linear accelerator have been operated at Korea Multi-purpose Accelerator Complex (KOMAC). To transport a proton beam that is required by users into target, it is important to figure out the characteristic of a 100 MeV proton linac and beam profile. Beam profile measurement devices such as Beam Position monitor, Beam Phase monitor, Beam Loss Monitor have been installed to measure beam profile and wire scanner has been installed to figure out the beam profile in the transverse direction of the proton beam accelerated by the 100 MeV linac. When a proton beam is transported, wire scanner move the wire in itself and measure current data using data acquisition device and those data are analyzed by the data analysis program based on python. Each of the programs are operated on standalone, so it cannot be integrated into the KOMAC control system, and must be manually operated during the experiment. This paper will describe the implementation of the integrated data processing program for KOMAC beam emittance.

### 2. Wire Scanner

A total of eight Wire scanners have been installed at a 100 MeV proton linac. The layout of KOMAC linac and beamlines is shown in Fig. 1.

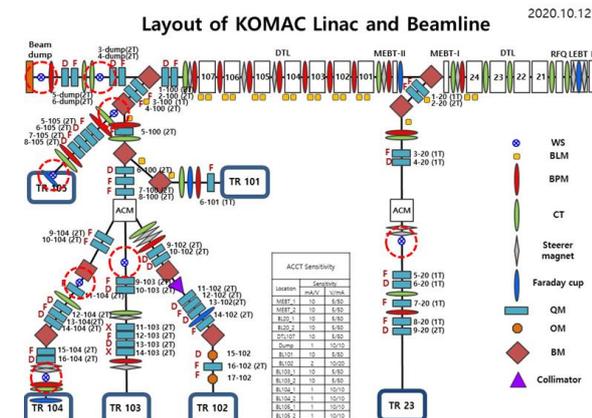


Fig. 1. The layout of KOMAC linac and beamlines.

To integrate the wire scanner into KOMAC control system, wire system control system based on Experimental Physics and Industrial Control System has been implemented.

The wire scanner control system consists of two part. The first is the hardware control part which is

responsible for driving the motor and acquisition of beam current data from wires in the wire scanner. The last is the software logic for quad scan and data analysis using python. The layout of the wire scanner control system is shown in Fig. 2.

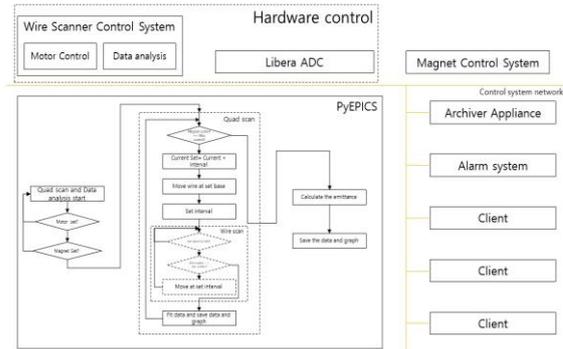


Fig. 2. The layout of the wire scanner control system.

#### 2.1 Hardware control system

The hardware control part is divided into 2 parts. The first is responsible for driving motors to move two wires in the wire scanner using SCPI commands mounted on the motor controller. The second part is data acquisition part to acquire currents data when a proton beam passes the wires using Libera digit electronics and then the data is passed into wire scanner control system based on EPICS IOC. A wire scanner control unit consisting of the motor controllers and Libera digit electronics was created and installed as shown Fig. 3.



Fig. 3. The wire scanner control units installed in KOMAC beamlines.

The wire scanner control units are operated by integrating with the KOMAC control system through Ethernet-based control network.

## 2.2 Quad scan and data analysis

The existing wire scanner interface consisted of Labview-based programs for wire scanner operation and Python-based programs for data analysis, each operating independently. In other to perform a quad scan, the operation variable was controlled manually and then the wire scan program was operated.

To reduce time spent on quad scan and data analysis, an algorithm has been configured to automatically run a quad scan and process data. The Python programming language was chosen to use the developed data analysis program based on Python, and the Pyepics module, which can communicate with the EPICS IOC, was installed to interface with the KOMAC control system. The algorithm diagram of quad scan and data analysis is shown in Fig. 4.

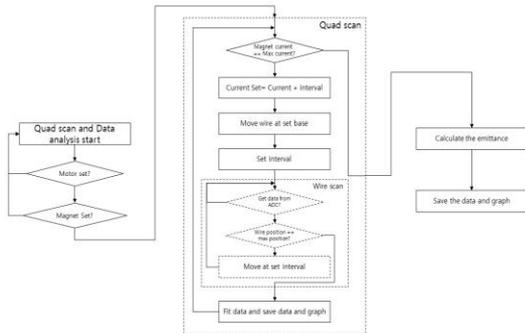


Fig. 4. The algorithm diagram of the quad scan and data analysis

After the quad scan, the analyzed data is passed to the wire scanner control system, and the content is archived through the Archiver Appliance, a KOMAC data archiving system. In addition, the data is stored in the form of a text and picture.

Without forming a new Graphical User Interface using python, the algorithm runs in daemon program in the background, and delivers analyzed data to the EPICS IOC and shown through the Control System Studio (CSS), which is adopted for KOMAC GUI toolkit.

## 2.3 Wire scanner and Data processing GUI

Before applying to the KOMAC control system and linac, a test was configured to conduct the test of the integrated wire scanner analysis program and GUI. The Data processing program receive the location of the wire and the current value at that location and show the data on GUI in real time. At the end of the wire scan,

the program proceeds fitting algorithm and plots the fitted data in GUI.

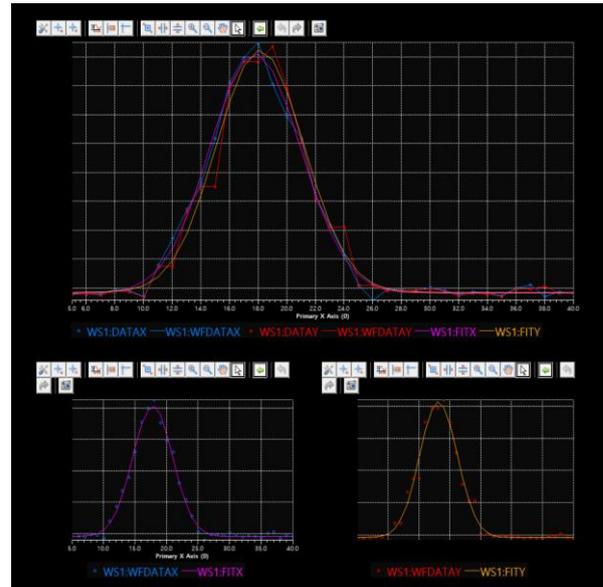


Fig. 5. The raw data and fitted data from the quad scan

The data from the quad scan is stored in text and graph file format. When the quad scan of the set range is completed, the data stored in file format are collected and analyzed to calculate the beam emittance of KOMAC linac. The beam emittance which calculated from the data processing program is shown in Fig. 6.

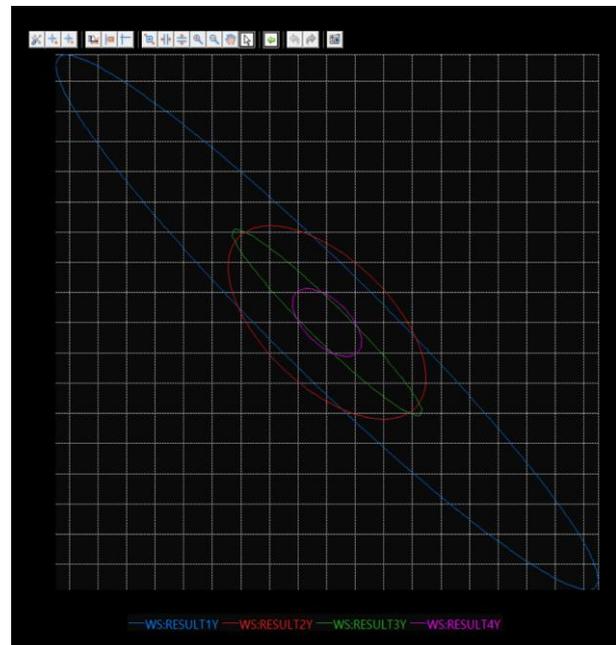


Fig. 6. The beam emittance which calculated from the data processing program through the test environment.

## 3. Conclusions

The data processing program, integrated into the KOMAC control system, improved the data

accessibility, and reduced experimental time by automatically performing quad scan and data processing. The program shows the data in real time and then figures out the fitted data and beam emittance at the end of the quad scan. In the future, the integrated data processing program will be applied to KOMAC linac to conduct the test.

#### **REFERENCES**

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