Implementation of the integrated data processing program for KOMAC beam emittance

Jae-Ha Kim a , Young-Gi Song, Sung-yun Cho, Seunghyun Lee, San-Pil Yun, Jeong-Jeung Dang

Korea Multipurpose Accelerator Complex, Korea Atomic Energy Research Institute., Gyeongju, Korea

Corresponding author: Kim, jhkim1 @kaeri.re.kr, phone: +82-54-750-5513

Abstract

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.

Introduction

Layout of KOMAC Linac and Beamline
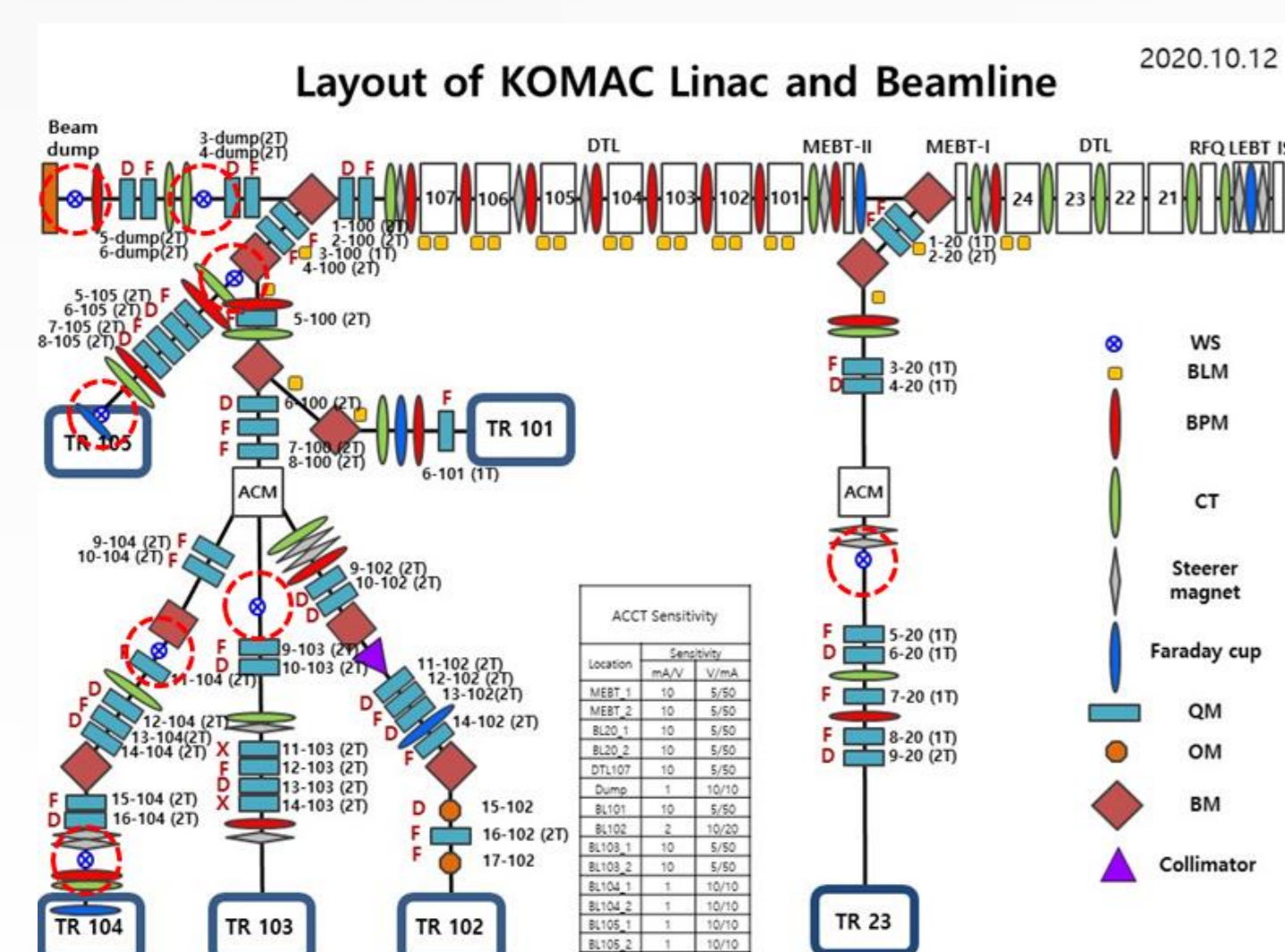
➢ Beam measurement tools for beam diagnostics such as beam positon monitor, beam phase monitor, beam current monitor, beam loss monitor and wire scanner
➢ Installed eight wire scanners : TR23 1EA, TR103 1 EA, TR104 2 EA, TR105 2 EA, DUMP 2 EA
➢ Home grown control system have been implemented

The block diagram of KOMAC control system
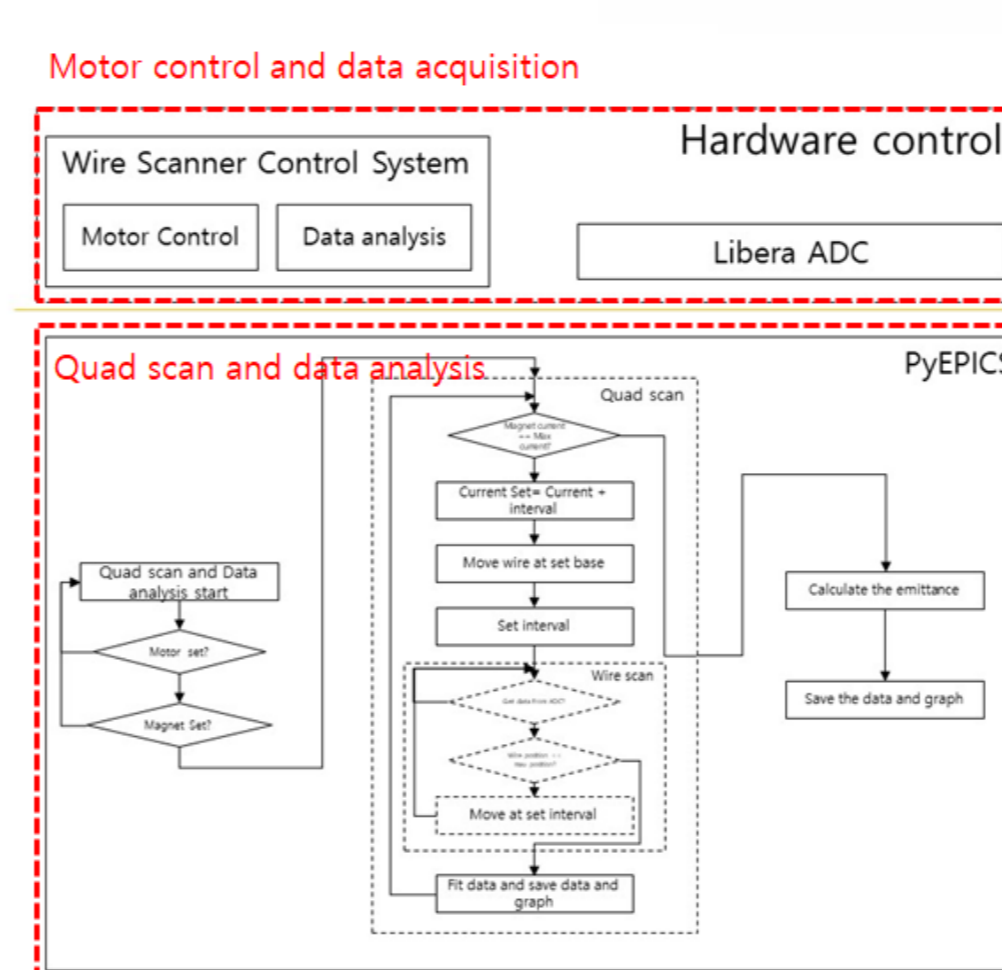
➢ The control system for KOMAC based on EPICS
➢ Implementation of EPICS IOC for the motor control and data acquisition
➢ Data process program for quad scan data analysis using python.
➢ Integrating two parts using PyEPICS module
➢ Archiving analyzed data through archive appliance

Data processing program

Test environment
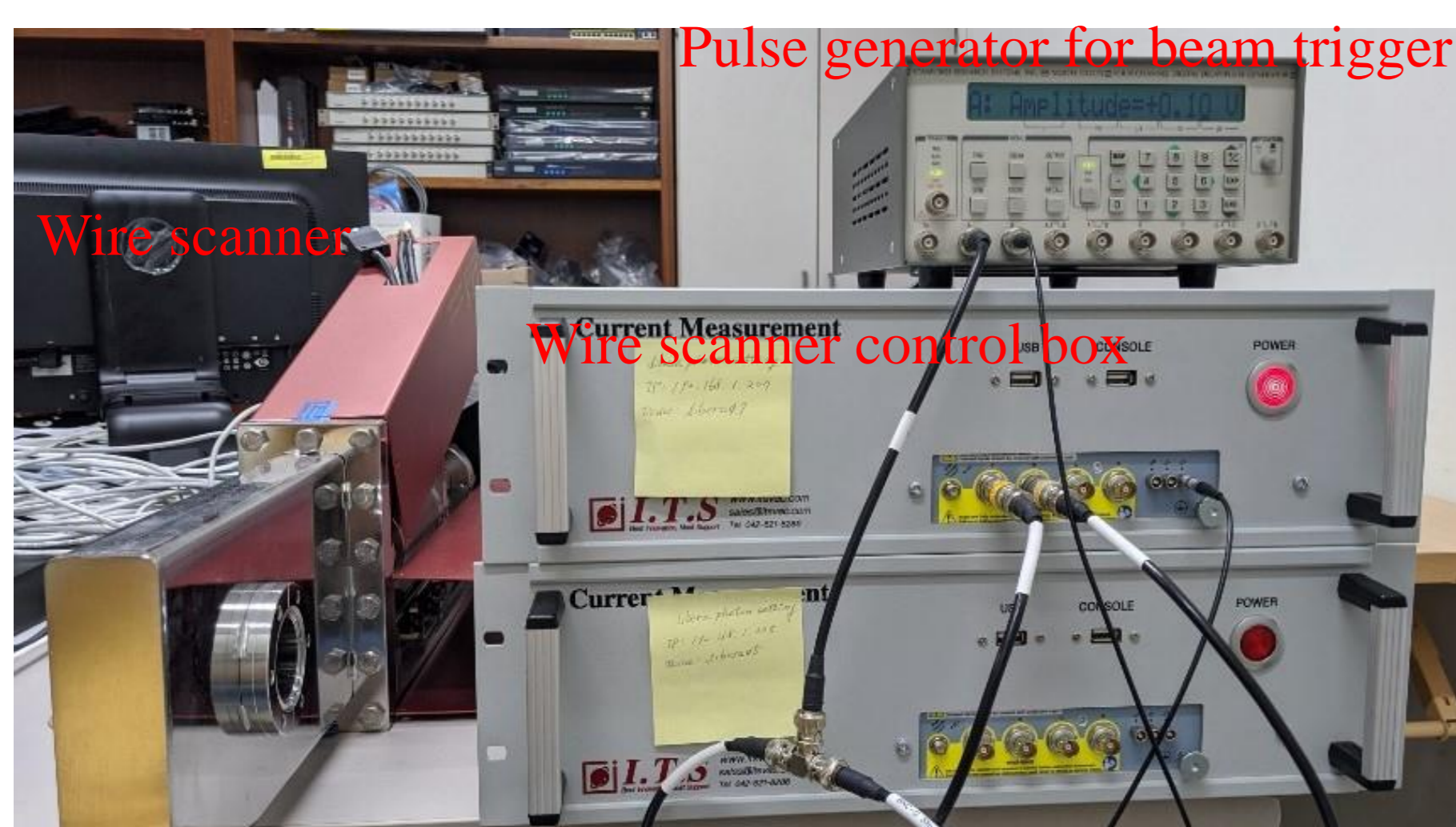
➢ EPICS base 3.15.6
➢ Implementation of Wire scanner control system using async and streamdevice EPICS module to control motor controller and waveproc for data analysis from libera ADC
➢ Controling and monitoring parameter using Control system Studio
➢ Archive appliance for saving analyzed data

Wires canner control box
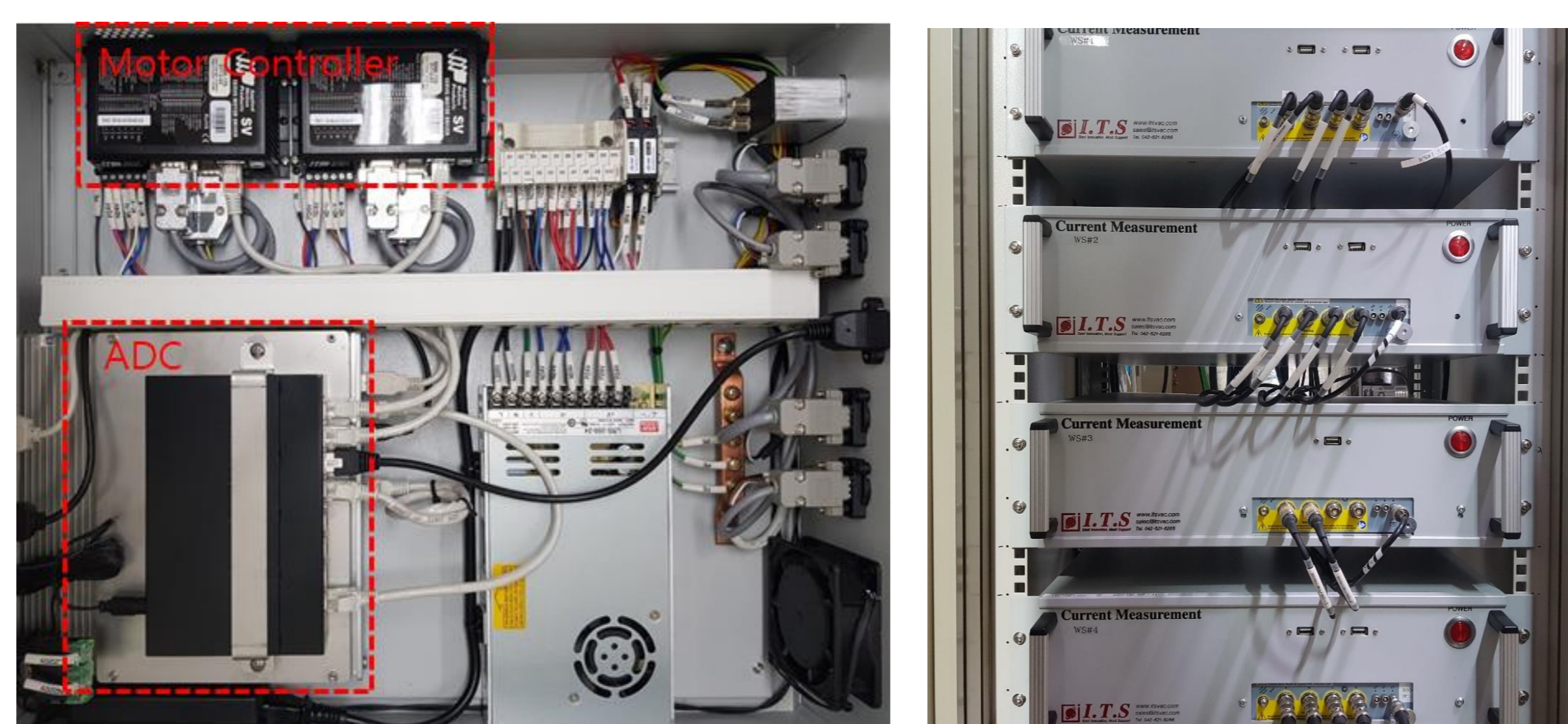
➢ Driving motors to move two wires in the wire scanner
➢ Data acquisition from Libera ADC when a proton beam passes the wire
➢ Operation in sync with the beam pulse signal using KOMAC event timing system

### The algorithm diagram of data processing
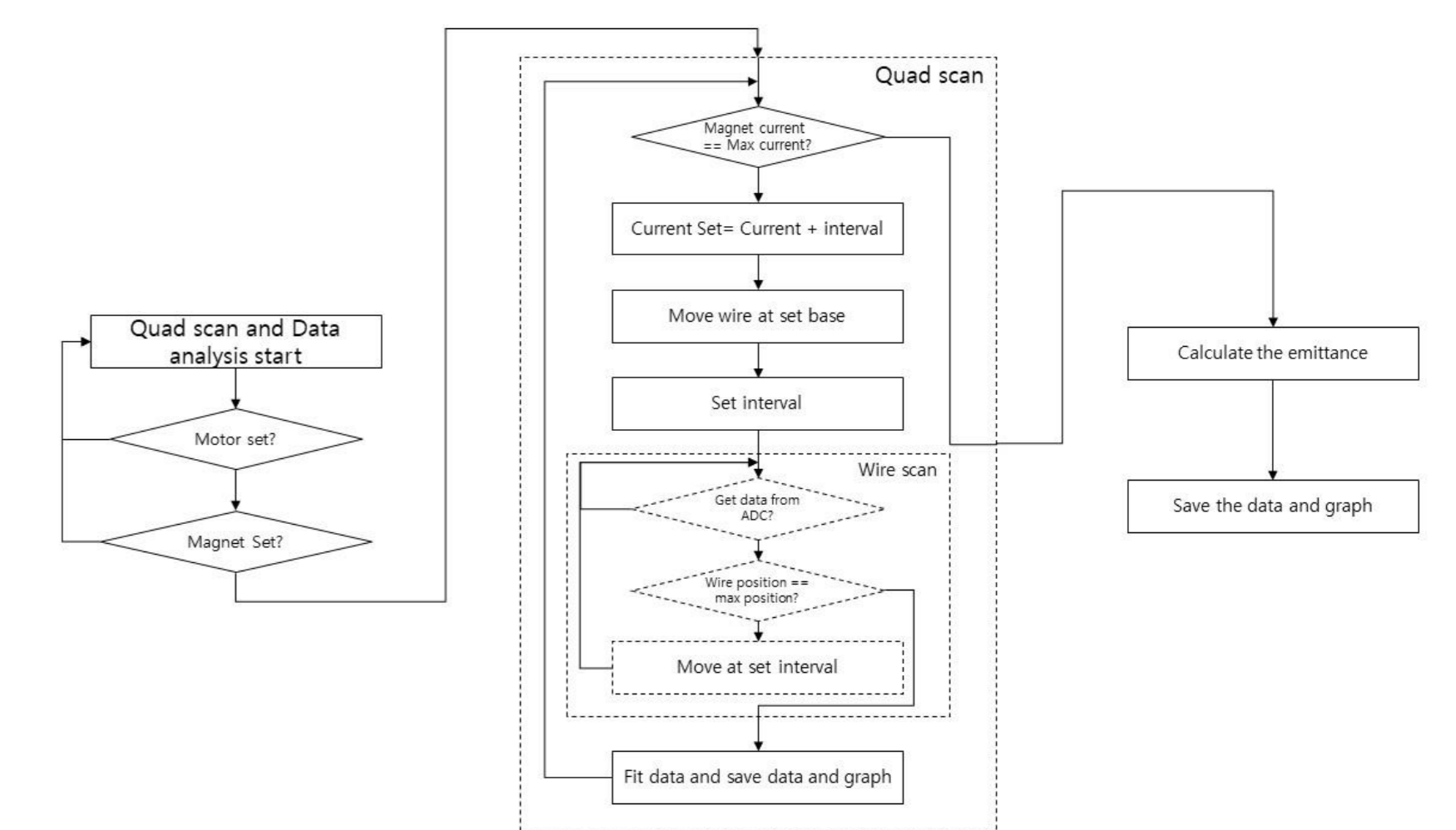
➢ Python3 and PyEPICS module for accessing EPICS IOC
➢ Collecting data by synchronizing with a beam pulse signal
➢ Plotting data in real time for wire scanning period
➢ After wire scan, plotting fitting data and saving data in file format and in archiver appliance
➢ After quad scan, calculating and plotting a beam emittance

Wire scan and quad scan control GUI
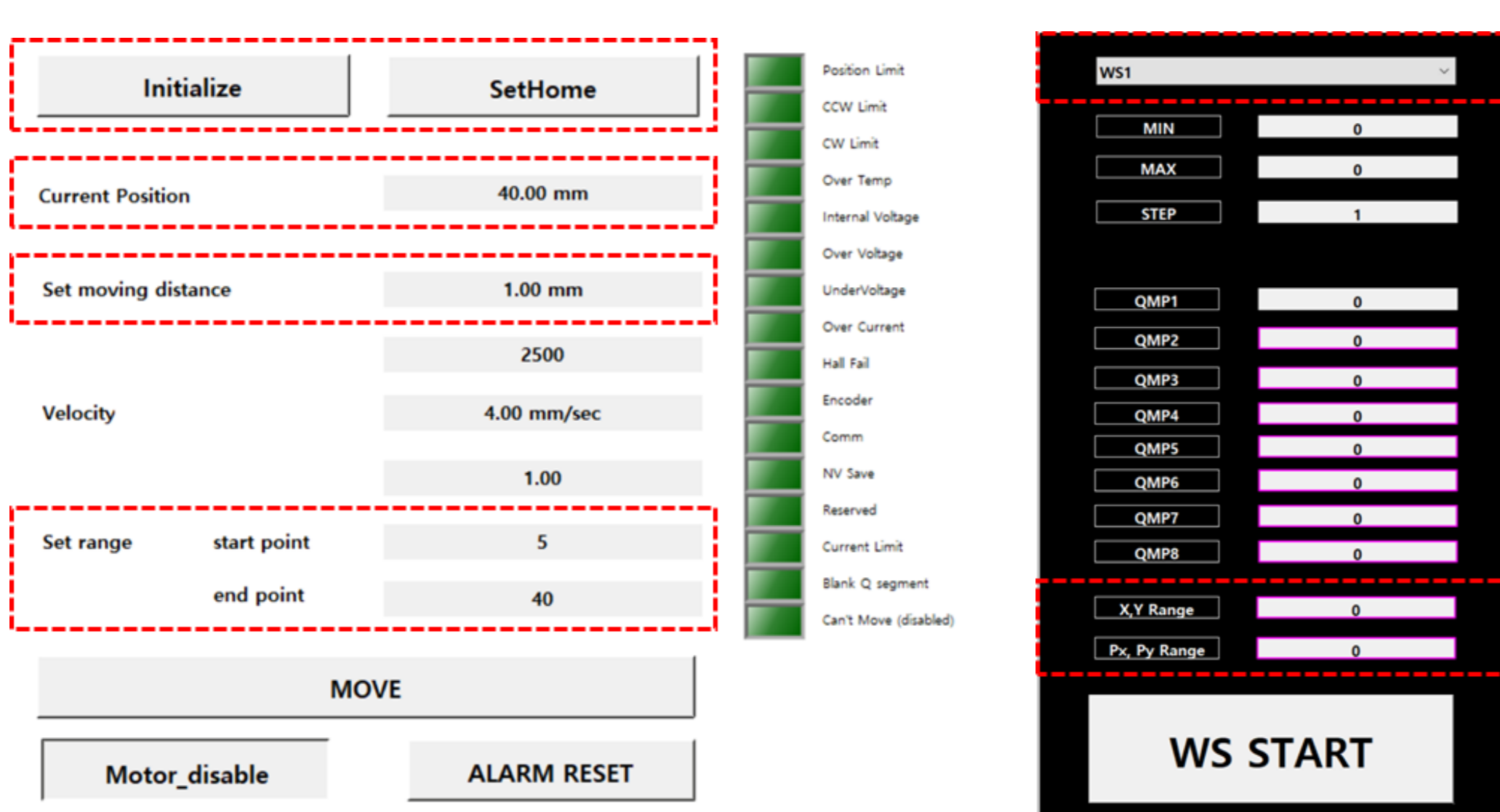
Data processing monitoring GUI
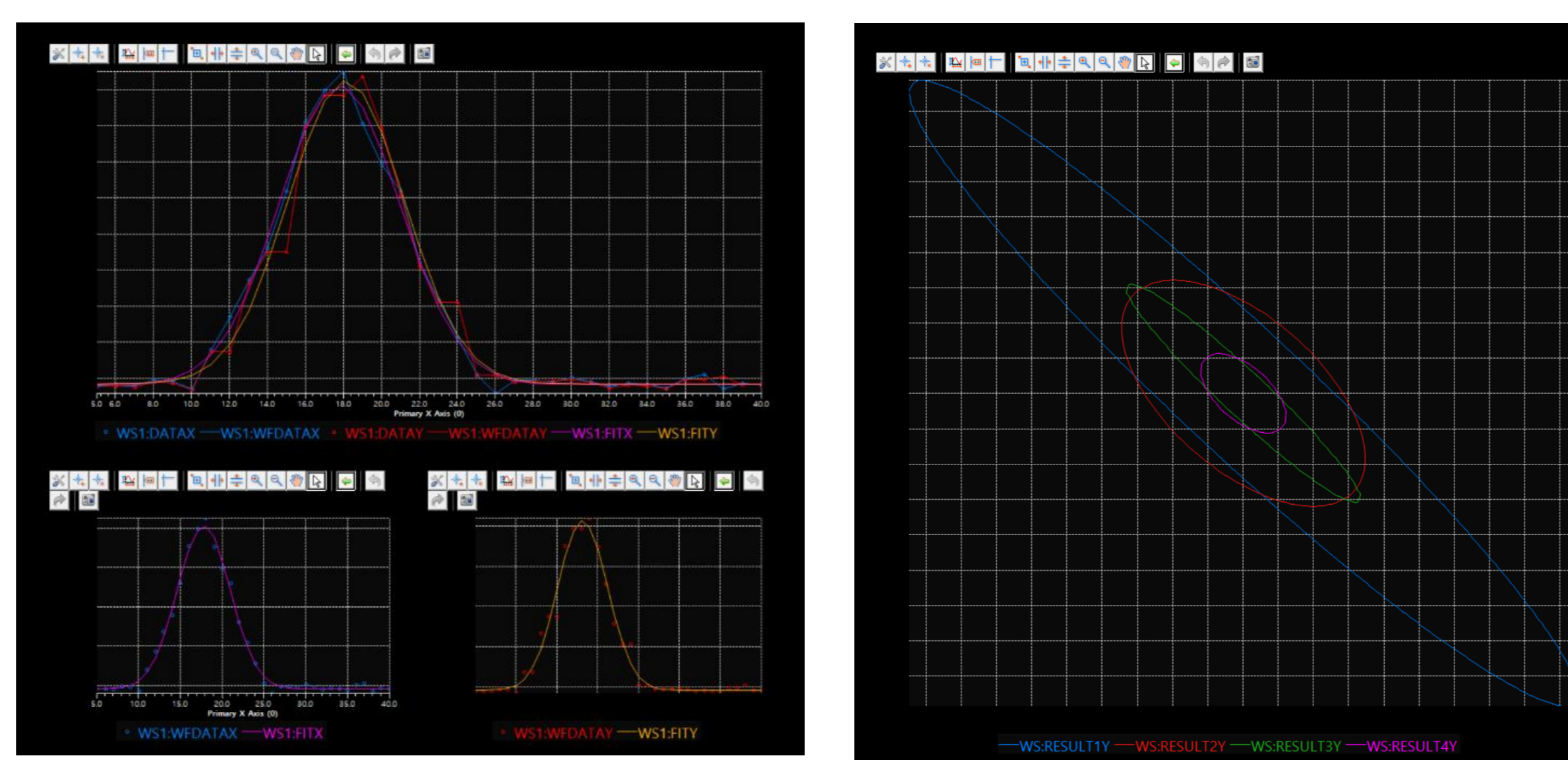
Archived data after data processing

Scan applications

➢ The data processing program based on EPICS framework and Python has been installed to measure KOMAC beam emittance
➢ the wire scanner control boxes and eight wire scanner were installed
➢ The test for the data processing program has been conducted using the wire scanner in Dump beamline.
➢ In the future, Test for all wire scanners will proceed and data processing program will be integrated with KOMAC control system