DEVELOPMENT OF THE RF PHASE SCAN APPLICATION FOR THE BEAM ENERGY MEASYREMENT AT KOMAC

SungYun Cho†, Jeong-Jeung Dang, Jae-Ha Kim, Young-Gi Song
Korea Multi-purpose Accelerator Complex, Korea Atomic Energy Research Institute, Gyeongju, Korea

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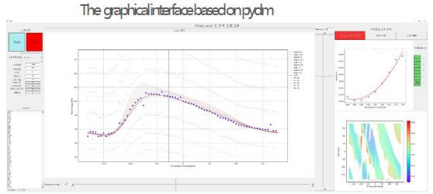
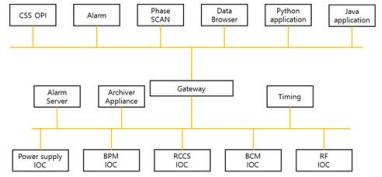
• The purpose of the development

The graphical interface based on pydm

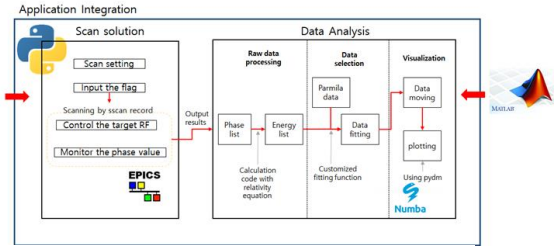


The Architecture of the KOMAC Control System



- The KOMAC has been operating the 100MeV proton linear accelerator
- The output beam energy from each drift tube linac (DTL) can be changed by the operation RF phase
- The original phase scan application was developed on the Java eclipse and the analysis application was developed on the Matlab
- The integration application has been developed based on Pydm and EPICS
- The interface has been implemented using pydm which works with the Signal & Slot
- The goal of development is high implementation and rapid data analysis speed similar to the original

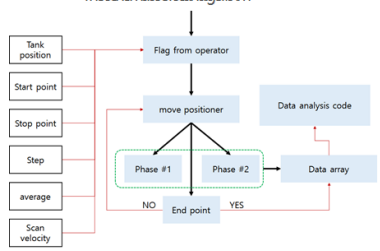
Integration of the RF phase scan application



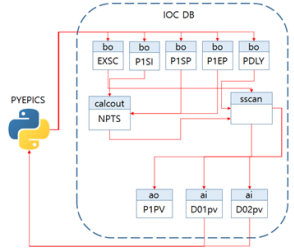
• The phase scan using sscan record

- The EPICS sscan record has a function to move positioners and record detector data at each of the positions
- The sscan record is similar to the original algorithm based on Java
- The positioner is the moving parameter for the phase setting
- When the moving of the positioner is finished, the data analysis code will be started
- The EXSC field is a flag signal for sscan record processing
- Because the NPTS is the number of points in a range of between the P1SP and P1EP fields, the step can be changed by the custom function from the NPTS using calcout record
- The detector record such as D01pv can monitor the RF phase it can be outputted the array or scalar data

The schematic of scan algorithm



The EPICS record and I/O signals from the python application



• How can the beam energy measure from the RF phase?

- The beam energy can be calculated by the phase scan signature matching
- The selected tanks are the target tank and downstream tank
- A scan experiment is conducted to change the phase set value from the setting range
- The BPM offset value is considered between -180 and 180 degree
- The velocity of the beam can be calculated from the phase difference
- The energy of the beam can be calculated according to Einstein's equation

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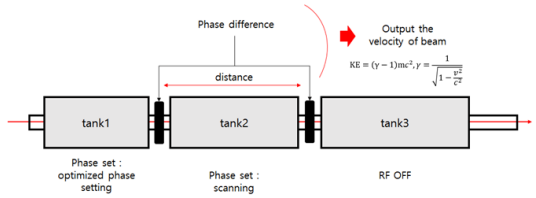

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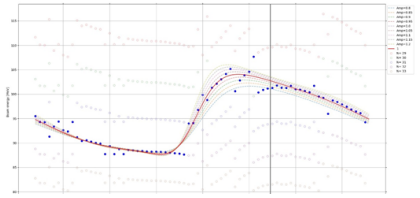

• The data analysis

- The measured results need to compare with the calculated results which are from the PARMILA calculation in order to determine the proper RF operating point
- The optimized RF operation phase can be determined from the minimum chi-square result that is calculated from each amplitude of parmila data
- If the scipy library is used in order to curve fitting, the calculation speed is slow remarkably
- The numba library is selected in order to rapid calculation processing similar to Matlab code
- Since the scipy library can't be used in the environment of numba, the custom fitting function needs to be built
- the quadratic gradient of the fitting function can determine whether it is concave or convex
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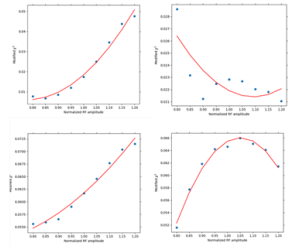
The fitting results of the measured results



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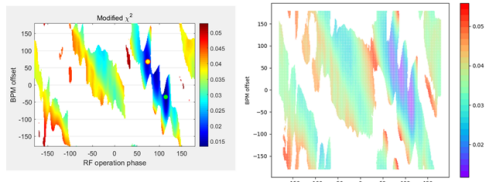

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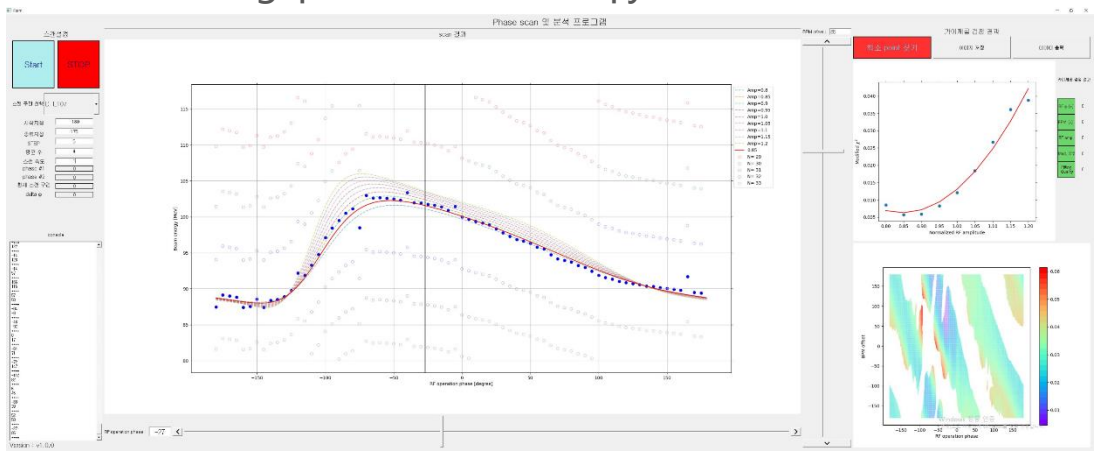

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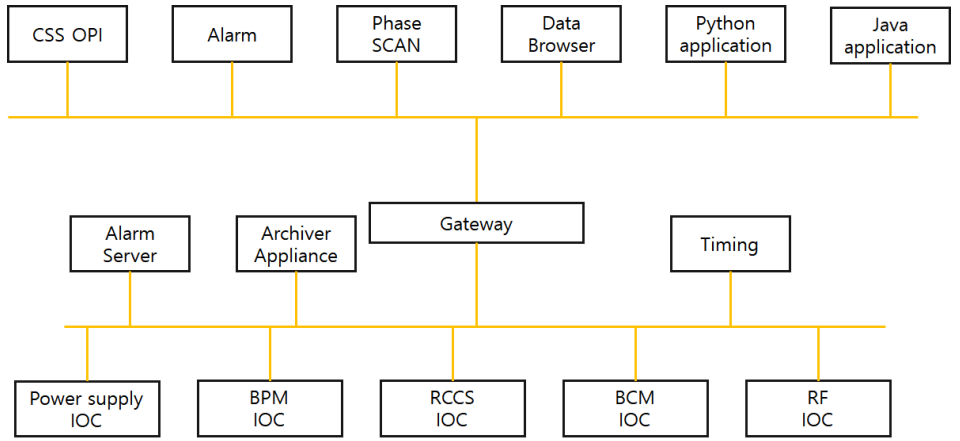

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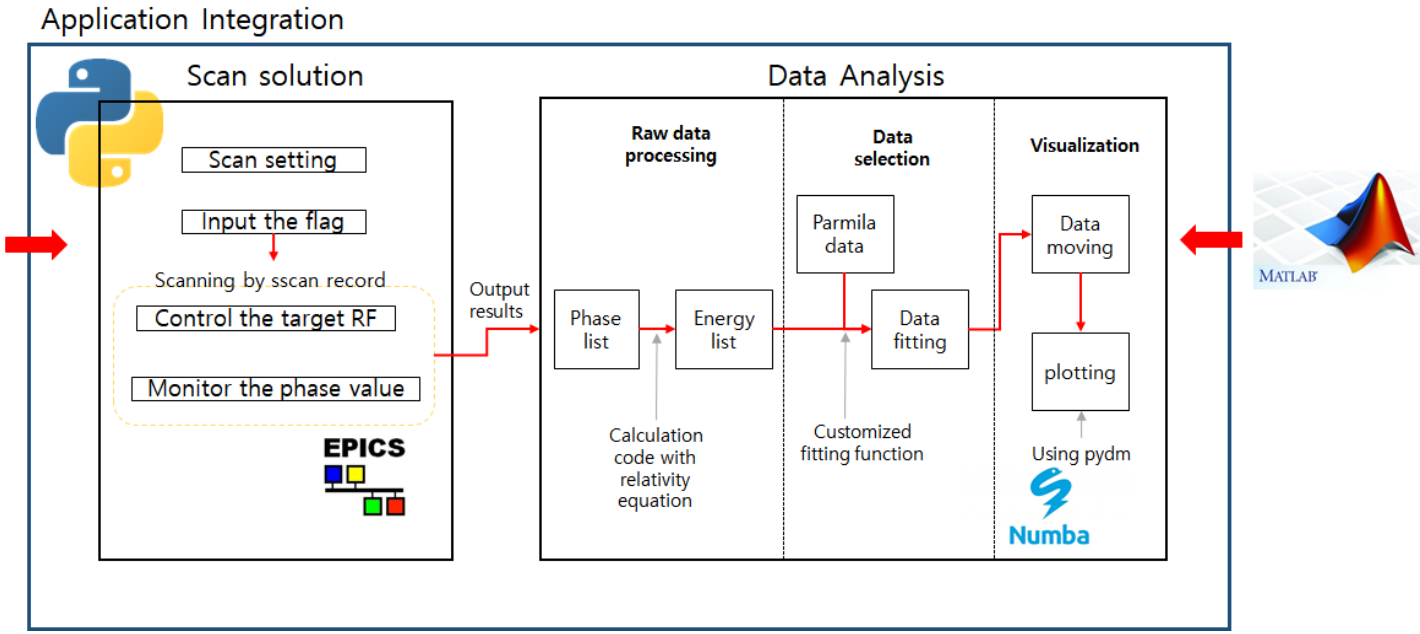

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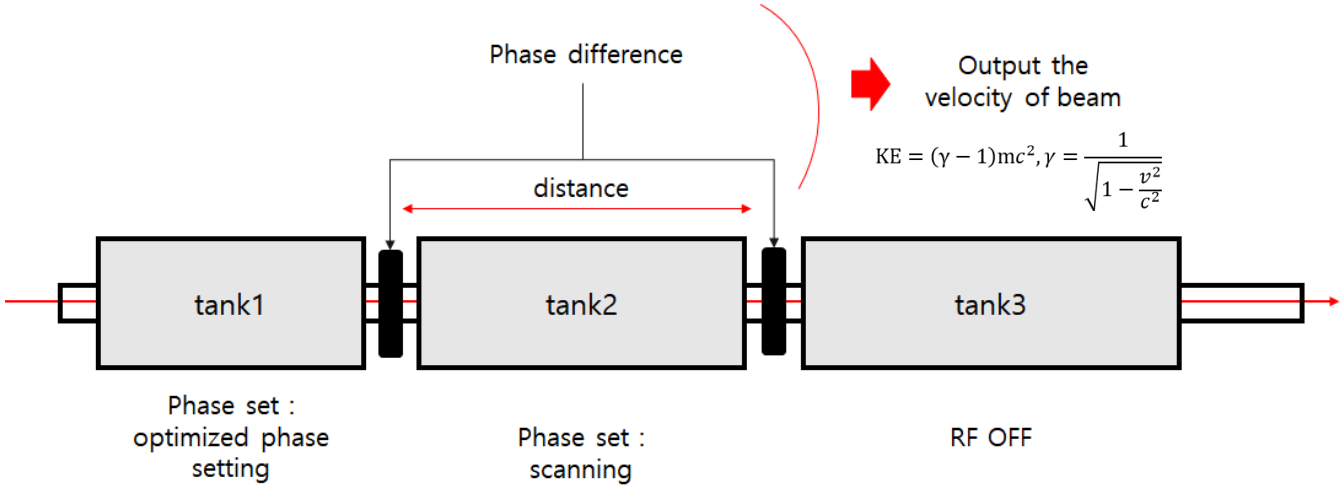

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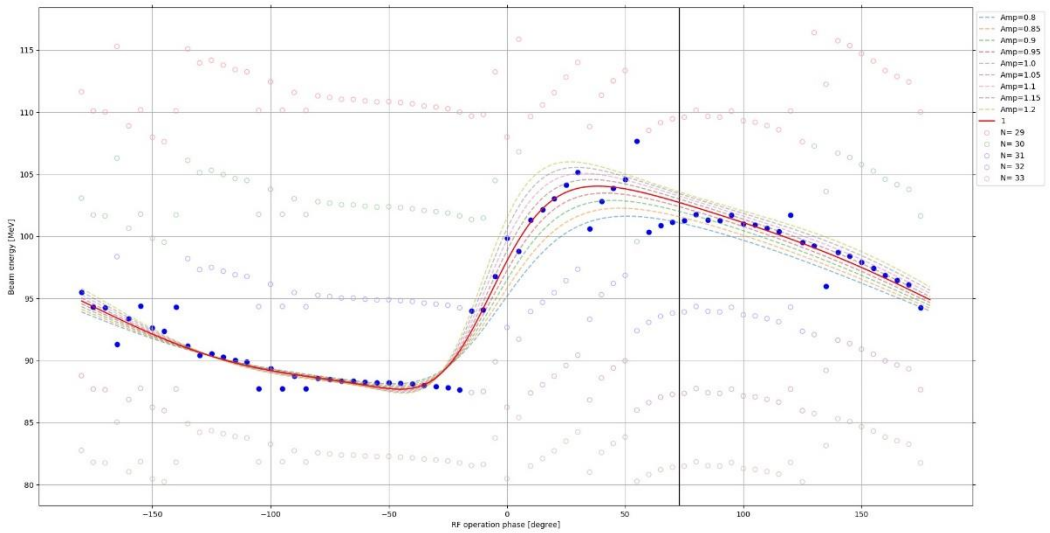

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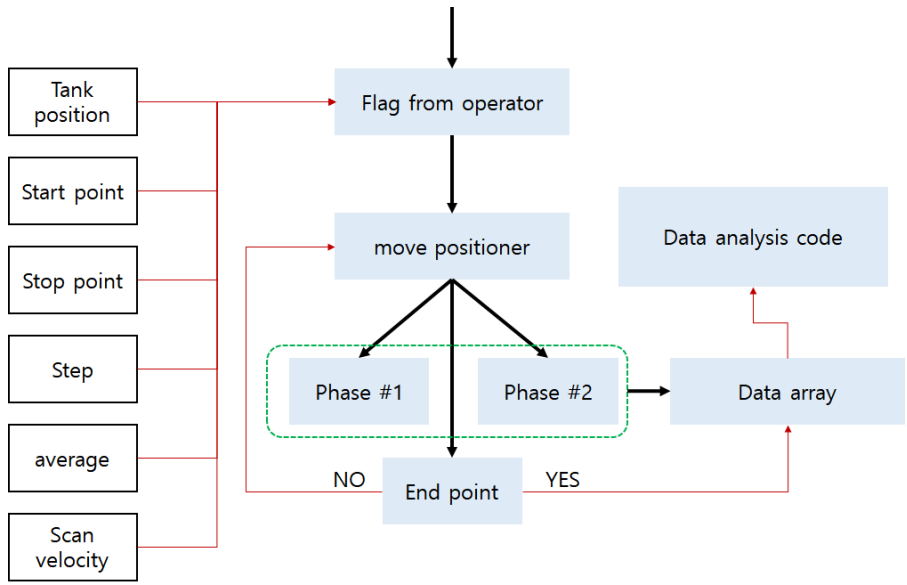

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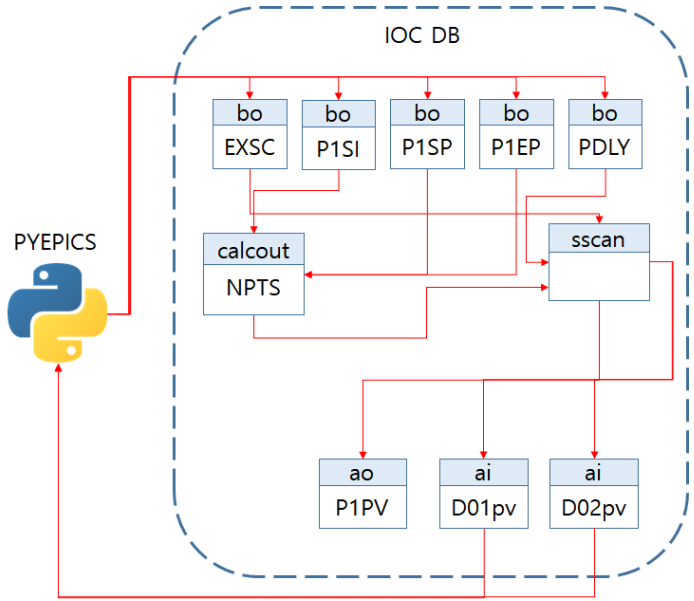

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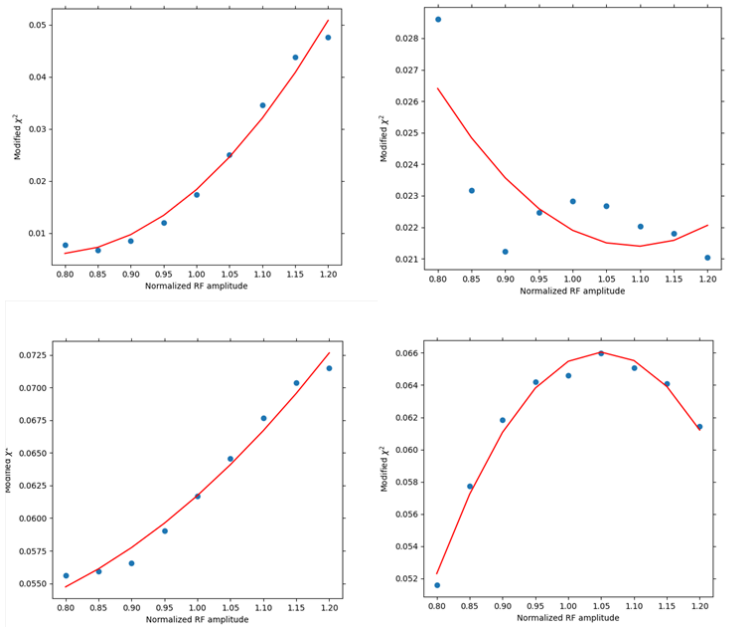

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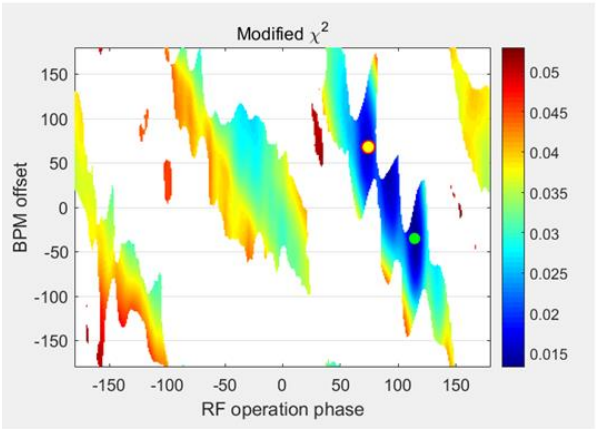

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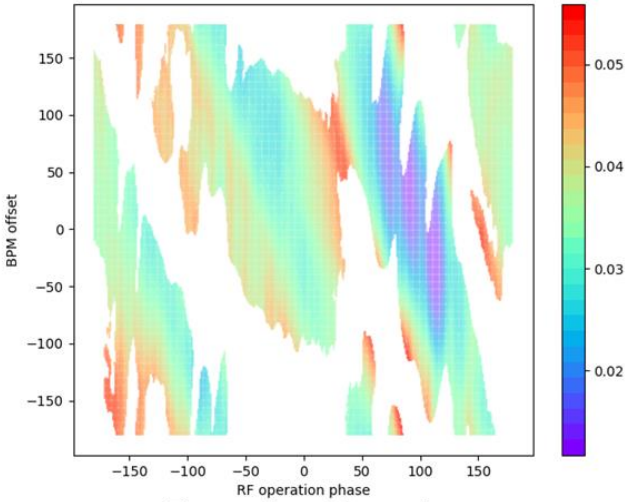

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