



Implementation of PASTA for RF Phase Scan Optimization at KOMAC

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Introduction

Beam simulation is essential for designing, operating, and optimizing particle accelerators. In particular, setting the correct phase and amplitude of RF cavities is a key factor for acceleration efficiency and beam quality. At KOMAC, RF phase scans are performed by adjusting parameters step-by-step and observing the beam energy response. This approach can be time-consuming and requires repetitive tasks, which reduces the efficiency of beam services provided to users. It also makes it difficult to respond quickly to various operational changes that occur during machine operation. To solve these problems, we adopted PASTA (Phase and Amplitude Scan and Tuning Application), an OpenXAL-based application, for the KOMAC system.

PASTA

XAL

- SNS – developed Java framework
- Supports accelerator control & simulation

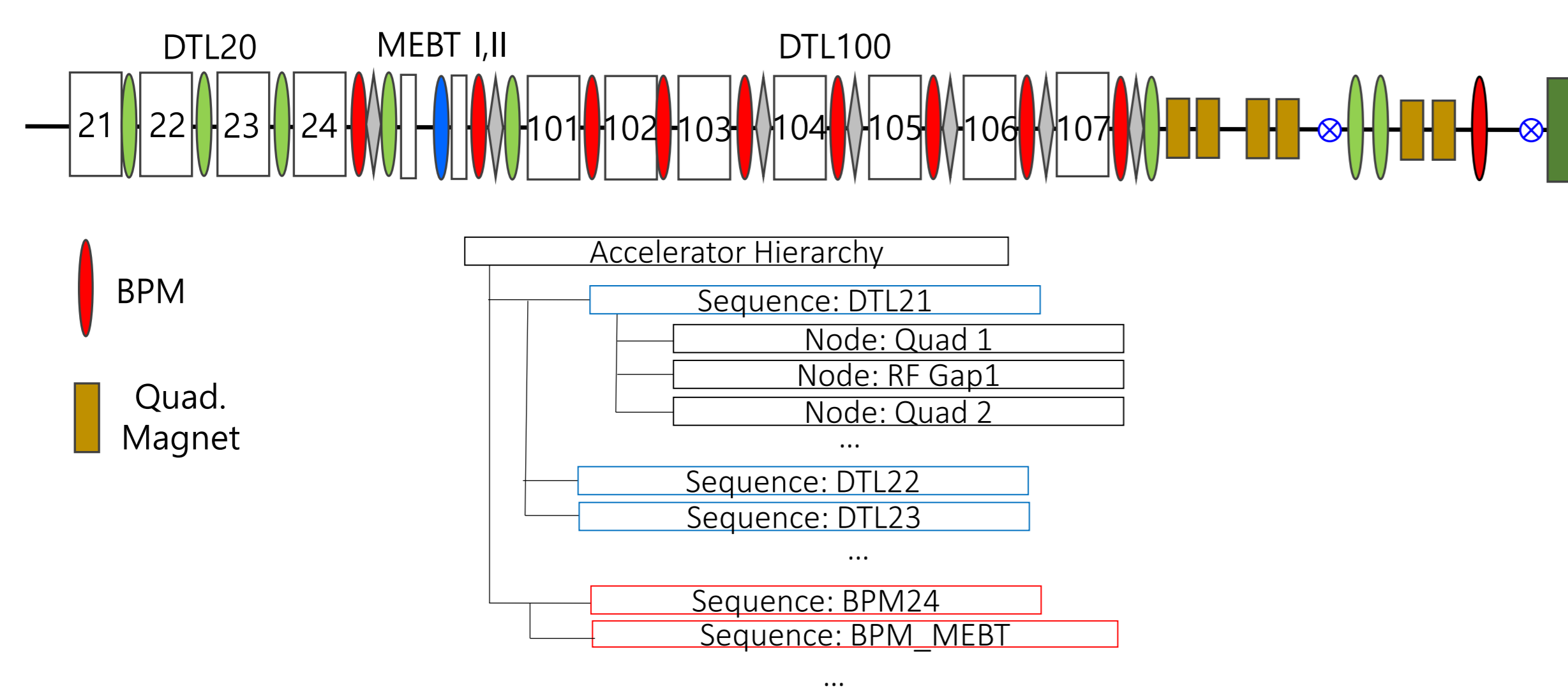
PASTA

- DTL RF Phase Scan application
- Model Reference control

- using the open-source code from the ESS GitLab
- PASTA inherits its core architecture from the OpenXAL framework
- Usage: determine the proper RF phase and amplitude for a cavity

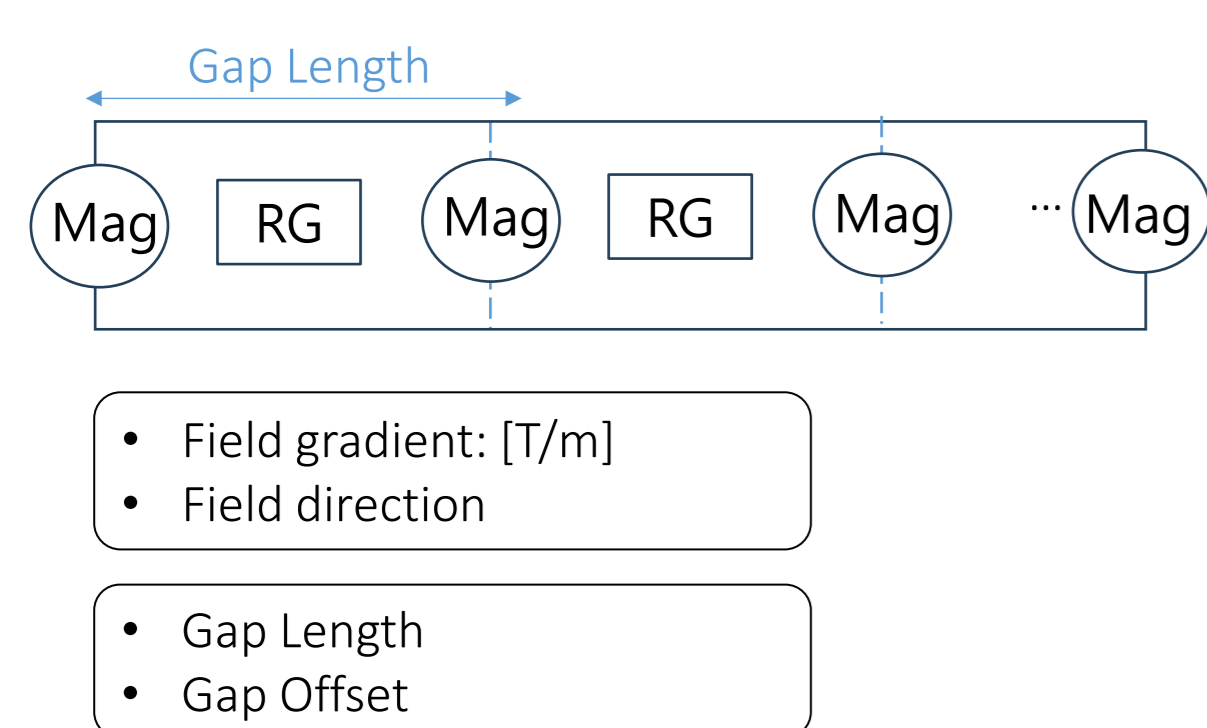
Modeling of the KOMAC Accelerator Structure

- KOMAC accelerator layout



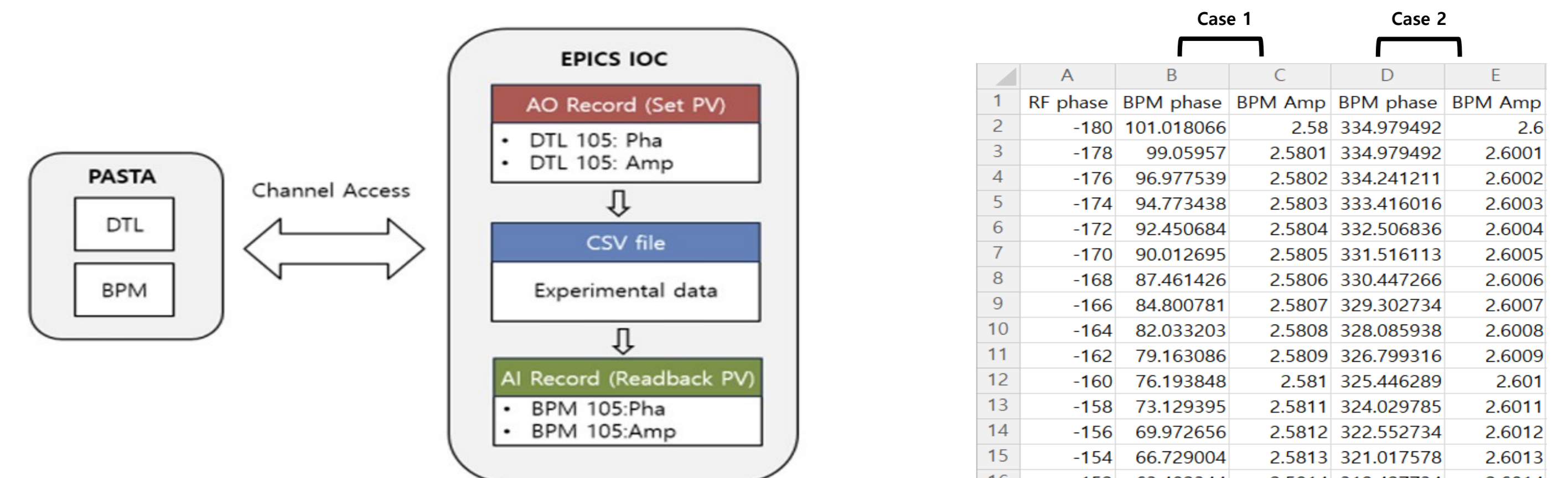
- Node: An individual hardware component (e.g., magnet, RF gap)
- Sequence: A collection of multiple nodes grouped together as a single unit, used to manage a specific section of the beamline (e.g., DTL)
- In KOMAC, the BPM is located outside the DTL and is therefore defined as a separate sequence

- DTL Tank structure



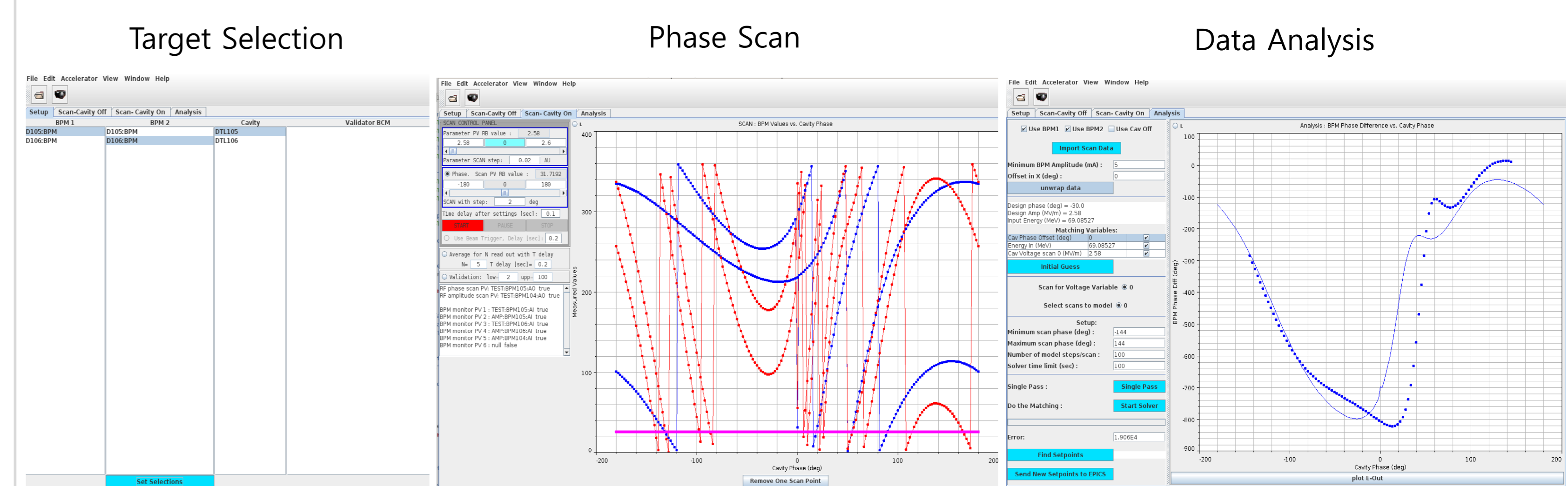
- Set Magnet/RF Gap positions using quadrupole and drift length data
- Inputted element parameters by comparing structural files from other institutions

EPICS – based virtual Testbench



- Virtual PV Environment
 - Established a Soft IOC-based virtual testbench for logic verification
 - Simulated accelerator behavior using historical experimental datasets (CSV)
- Control Logic
 - Set PV: Configures Cavity Phase and Amplitude
 - Readback PV: Fetches corresponding BPM outputs from CSV data based on input parameters

workflow of PASTA



The operational workflow of PASTA proceeds in four main stages.

- ① Lattice Loading: Select the XML lattice file representing the KOMAC structure
- ② Target Selection: Designate the target DTL cavity, and downstream BPM nodes for analysis
- ③ Phase Scan: Execute the scan by retrieving measurement data through virtual PVs
- ④ Data Analysis: Compare the collected datasets with model predictions

Conclusion

PASTA was implemented to automate phase scan procedures for the accelerator. To verify its functionality, a virtual testbench was established. Using a Soft IOC, the control logic was successfully validated against experimental data. This configuration confirmed that PASTA effectively performs phase scans within a virtual environment. Future work will involve connecting PASTA to actual accelerator PVs to evaluate its performance during real-time operation.

REFERENCES

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