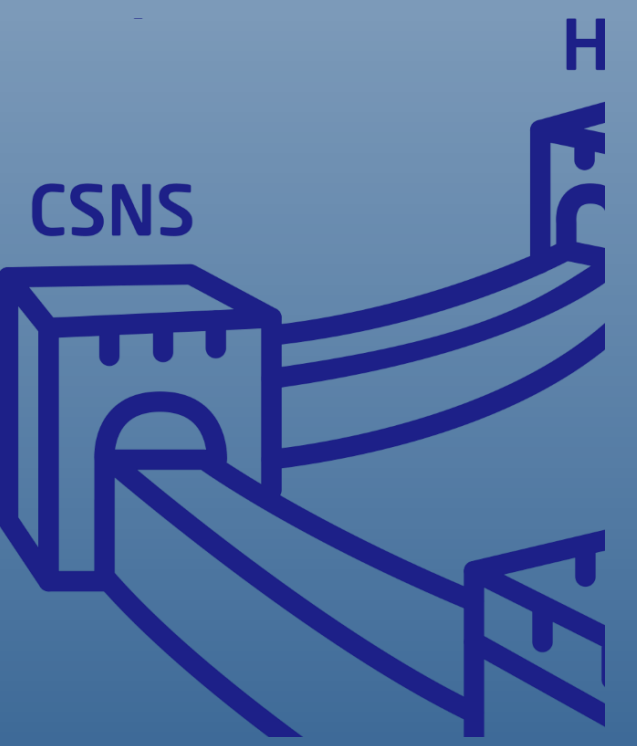


# Integrating InfluxDB and Grafana in a Dockerized CA EPICS Monitoring System

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## INTRODUCTION

The Space Environment Simulation and Research Infrastructure (SESRI) under construction at Harbin Institute of Technology (HIT), China, represents a significant leap forward in our ability to recreate the harsh radiation environment of space on Earth.

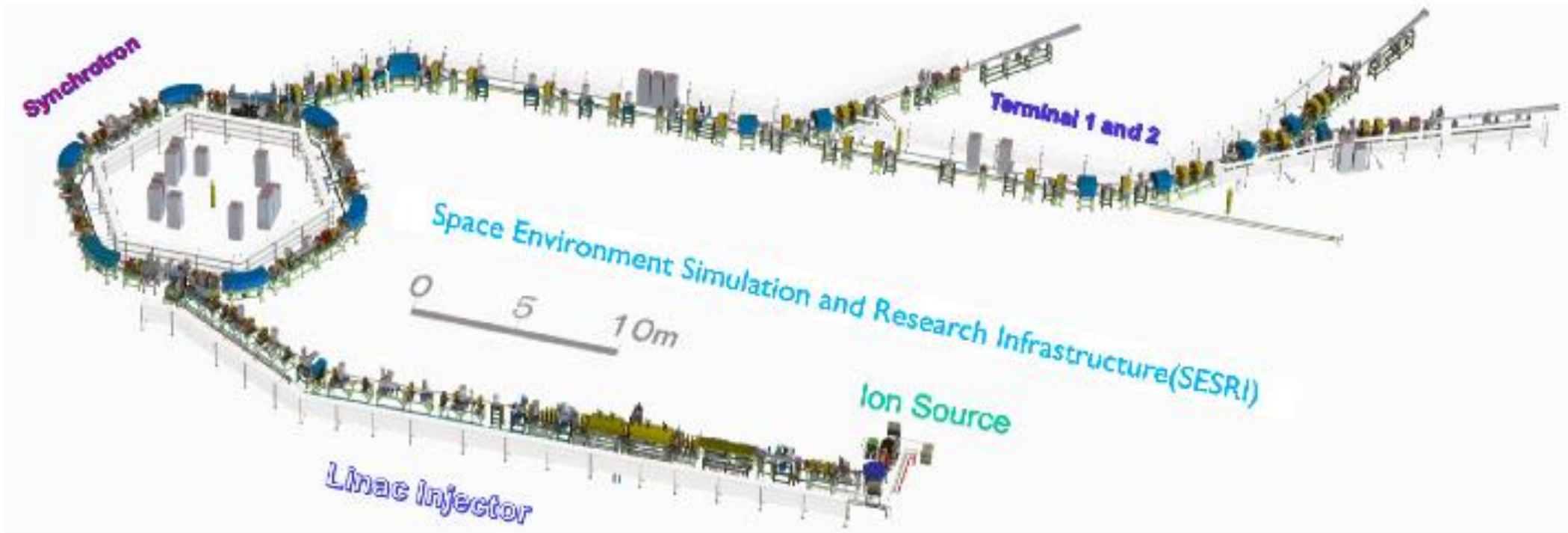


Figure 1: General scheme of the facility

The combination of a versatile ECR ion source, a multi-stage Linac injector, and a high-energy synchrotron positions SESRI's accelerator complex as a powerful tool for simulating the space radiation environment. This innovative facility holds immense potential for researchers studying the effects of space radiation on various materials, devices, biological entities, and complex space systems. The ability to control particle extraction through techniques like 3rd integer resonance and RF-KO further enhances the experimental flexibility of SESRI, paving the way for groundbreaking discoveries in space science and related fields.

## DOCKER VIRTUALIZATION CLUSTER TECHNOLOGY IN PARTICLE ACCELERATORS

Particle accelerators are complex and expensive machines that are used to study the fundamental building blocks of matter and energy, becoming increasingly data-intensive, as they generate large amounts of data from experiments. This data needs to be processed and analyzed in a timely manner to extract meaningful results.

The benefits of using Docker virtualization cluster technology in particle accelerators include:

- **Scalability:** Docker clusters can be easily scaled up or down to meet the demands of different workloads.
- **Flexibility:** Docker containers can be easily deployed and managed across different environments.
- **Portability:** Docker containers can be run on any machine that has the Docker Engine installed.
- **Resource isolation:** Docker containers are isolated from each other, which prevents them from interfering with each other.
- **Reproducibility:** Docker containers can be easily reproduced, which makes it easy to share and collaborate on research projects.

There are several use cases for Docker virtualization cluster technology in particle accelerators. Some of these use cases include:

- **Data processing:** Docker containers can be used to process and analyze large datasets from particle accelerator experiments.
- **Monte Carlo simulations:** Docker containers can be used to run Monte Carlo simulations, which are used to model the behavior of particles in particle accelerators.
- **Machine learning:** Docker containers can be used to train and deploy machine learning models, which can be used to identify patterns in particle accelerator data.

## SYSTEM ARCHITECTURE

### InfluxDB

InfluxDB stands out as a powerful solution for handling time-series data, often encountered in system monitoring and real-time analytics. This open-source database boasts several key advantages.

### Grafana

In the realm of particle accelerators, where vast amounts of data are generated at unprecedented speeds, effective data visualization and monitoring tools are crucial for extracting meaningful insights and ensuring experimental success. Grafana emerges as a powerful and versatile tool that addresses these challenges, empowering researchers to gain deeper understanding of complex accelerator data and optimize experimental workflows.

### Data collection engine

The Data Collection Engine is a sophisticated tool designed to efficiently collect data from EPICS channels, store it temporarily, and then permanently archive it on an InfluxDB server. This robust system is engineered for reliability and high performance, making it a crucial component in data acquisition and management.



Figure 2: SESRI Grafana data monitoring system.

## CONCLUSION

In this paper, a dockerized CA EPICS Monitoring System integrating InfluxDB and Grafana is proposed, which empowers researchers with a user-friendly and versatile platform for managing their data archive. From adding and modifying records to enabling/disabling specific data streams and adjusting archiving rates, data collection engine provides a comprehensive suite of tools that streamline data collection and ensure researchers gather the most relevant information for their accelerator experiments. This, coupled with robust data retrieval and visualization capabilities, positions it as a powerful solution for researchers in the field of accelerator physics.

## CONCLUSION

- [1] Docker: <https://www.docker.com/>
- [2] Docker Compose: <https://docs.docker.com/compose/>
- [3] Kubernetes: <https://kubernetes.io/>
- [4] Swarm: <https://docs.docker.com/swarm/>

