Data/Network

Introduction

We operate and upgrade data and network infrastructure (both hardware and software) to advance experimental control, data acquisition, and data analysis at SPring-8 and SACLA.

At SPring-8, detectors with high speed and high pixel count, such as the CITIUS detector, have led to a substantial increase in data generation rate. To handle such large amounts of experimental data efficiently, we constructed the SPring-8 data center. Our estimation indicates that computation demands are intermittent and have a peak comparable to those at dedicated supercomputer centers. To meet these requirements efficiently, the SPring-8 data center will be connected to the High-Performance Computing Infrastructure (HPCI) [1] system including the supercomputer Fugaku and private cloud operators. In addition to the significant data size increase, we see other demands, such as data management, the sharing of data with researchers outside SPring-8, and automation. We aim to implement a workflow service, by the commissioning of SPring-8-II, that orchestrates experiment control and data acquisition at the beamlines, the transfer of experimental data to the SPring-8 data center, preliminary analysis at the data center, detailed analysis at the supercomputing centers, and the management of experimental data and analysis results.

At SACLA, we built the SACLA data center for data acquisition and analysis, and have operated it since the first user beamtime in 2012. It can reliably store data with a maximum data rate of 6 Gbps and perform the associated data analysis with a typical data size of a few tens of TB per experiment [3,4]. Data generation will increase gradually, and further increases are expected with the introduction of the CITIUS detector system, which is scheduled to be available to users from FY2026.

Upgrade of network infrastructure at SPring-8

In FY2020, we started to build a new network infrastructure for upgrading SPring-8 beamlines and for data transfer to the SPring-8 data center. By FY2023, we had installed network branches to BL07LSU, BL09XU, BL10XU, BL13XU, BL15XU, BL28B2, BL29XU, BL35XU, BL39XU, and BL46XU. In FY2024, we introduced network branches to BL03XU, BL16XU, BL16B2, BL19B2, BL20XU, BL20B2, and BL40XU.

Development of BL-774 system

We have been developing a beamline control, data acquisition, and online analysis platform, BL-774 [5,6]. BL-774 comprises multiple highly separable components that were developed on the basis of recent trends in measuring instruments and software development methods in the scientific field.

By FY2023, we had introduced BL-774 to the optics and experimental hutches at BL07LSU, BL09XU, BL10XU, BL13XU, BL39XU, and BL46XU. In FY2024, we introduced BL-774 to the optics and experimental hutches at BL03XU, BL15XU, BL16XU, and BL28B2. We also introduced BL-774 to the front-end system at BL03XU, BL07LSU, BL15XU, and BL39XU.

Services at the SPring-8 data center

Automatic data analysis service

We have developed a data analysis service that automatically transfers the data acquired by the automatic X-ray CT measurement system installed at BL28B2 to the SPring-8 data center and automatically performs the 3D reconstruction of the CT data. Users outside the SPring-8 campus can download the analyzed data through the portal system of the SPring-8 data center. We started the data analysis service in Oct. 2023.

In FY2024, we began developing a laminography analysis tool for experiments at BL15XU by applying the BL28B2 automatic 3D reconstruction service.

Open OnDemand service

We started the Computer Cluster Service at the SPring-8 data center in Nov. 2023. We introduced Open OnDemand [7], a web portal that enables users to easily access and use the computer cluster system through a web browser. Open OnDemand at the SPring-8 data center provides users with various tools, including shell access, file access, Jupyter, ImageJ, and more.

In FY2024, we developed an analysis tool on Open OnDemand for quasi-elastic gamma-ray scattering (QEGS) data at BL35XU [8]. With this tool, users can efficiently carry out the parallel processing of QEGS data and visualize the results through a web browser (Nishino *et al.*, *in preparation*).

SPring-8 Data Flow Service

We started the Data Flow Service at the SPring-8 data center in Oct. 2023. It is a service designed for sharing data obtained in experiments at SPring-8 with researchers outside SPring-8. The principal investigator (PI) can grant access rights to the uploaded data to researchers with a SPring-8 ID, and those with access rights can easily download the data.

In FY2024, a service was launched to automatically upload large numbers of small-volume data from EH3 of BL13XU to the SPring-8 Data Flow Service.

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