Data/Network

1. Introduction

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

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 [1,2]. Data generation will increase gradually, and further increases are expected with the introduction of the CITIUS 20.2M detector system, which is scheduled to be available to users from FY2025.

At SPring-8, we foresee a significant increase in the data generation rate following the upgrade of the beamlines, which are equipped with higher speed and higher pixel count detectors such as the CITIUS detector. To handle such large amounts of experimental data efficiently, we constructed the SPring-8 data center at the end of FY2022. After its commissioning, we started user services of the data center in Oct. 2023. 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) [3] 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, sharing of data with researchers outside SPring-8, and upgrading of the beamline control software. As for data management, we plan to connect the SPring-8 data center with GakuNin RDM [4], provided by the National Institute for Informatics (NII), so that users can manage not only SPring-8 data but also other data obtained by laboratory instruments and at other facilities.

2. 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 FY2022, we had installed network branches to BL09XU, BL13XU, BL28B2, BL35XU, and BL46XU. In FY2023, we introduced network branches to BL07LSU, BL10XU, BL15XU, BL29XU, and BL39XU.

3. 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, which were developed on the basis of recent trends in measuring instruments and software development methods in the scientific field.

By FY2022, we had introduced BL-774 to the optics and experimental hutches at BL09XU, BL13XU, and BL46XU. In FY2023, we introduced BL-774 to the optics and experimental hutches at BL07LSU, BL10XU, and BL39XU. We conducted research and development of BL-774 for the front-end system control at BL07LSU.

4. Automatic data analysis service at the SPring-

8 data center

We have been developing a data analysis system 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.

5. Computer Cluster Service at the SPring-8 data center

We started the Computer Cluster Service at the SPring-8 data center in Nov. 2023. We introduced Open OnDemand [7] with the cooperation of the RIKEN Center for Computational Science (R-CCS). Open OnDemand is a web portal that allows users to easily use the computer cluster system from 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.

Using the Computer Cluster Service, experimental data acquired with the CITIUS 840k detector system in the μeV quasi-elastic scattering experiment at BL35XU were transferred to the SPring-8 data center and analyzed with user programs [8].

6. Data Flow Service at the SPring-8 Data Center

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 FY2023, research and development was carried out to enable the automatic upload of the large amount of small data acquired at BL13XU EH3 to the Data Flow Service.

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