

**SPring-8 Users Community Study Group Opinion Gathering Report (FY2022)**

Research Group: High-Resolution X-ray Imaging Group

《Summary》

Based on a survey of study group members conducted from late January to late February, the following items are proposed.

(1) R&D needs related to new fields and new areas

Introduction of high-precision CT stages and consideration of the latest technologies We would like to request the introduction of sample stages to achieve nanometer resolution and consideration of various latest technologies.

Maintenance and improvement of the current measurement mode We would like you to consider new technologies that can maintain and improve the current measurement and introduce them to user applications. We request that you consider maintaining the data format.

(2) Deployment of R&D results

We would like you to consider a system that allows us to consult and request analysis of measurement data, and to provide technical support for data analysis.

(3) Matters related to the next plan for SPring-8

We expect the light source to become more brilliant and the measurement equipment to be upgraded accordingly. We expect the light source to become more brilliant, and we would like to see the measurement equipment upgraded to accommodate this.

(4) Matters related to the new corona

Improvement of facilities for users to conduct experiments in the field, such as lodging and meals, and the way these facilities are operated.

Support for commissioned measurements and remote experiments There are a certain number of users who wish to conduct commissioned measurements and remote experiments, and we ask that consideration be given to such forms of research.

#### 《Details of the Trends Survey》

With the aim of receiving a wide range of opinions, this year's study group conducted an online survey (attached PDF) in Forms from late January to late February, and received 49 responses. Each item allowed multiple responses. Since this study group has more than 1,100 members, many of whom are students, we believe that if we consider the number of responses as the number of groups, we were able to aggregate a considerable amount of the group's opinions. Based on the results, the following items are recommended.

(1) Research and development needs related to new fields and areas (e.g., opinions on the development of utilization technologies that should be implemented at SPring-8 in order to pioneer the use of synchrotron radiation in new fields and areas)

#### Introduction of high-precision CT stages and consideration of the latest technology

In the imaging field, there is a constant need for improved spatial resolution. As a result of the development of X-ray optics with nanometer resolution, the spatial resolution of the CT method is now affected by the mechanical precision of sample rotation and sample drift. For this reason, it is desirable to consider and develop equipment with nanometer precision for the sample stage (air bearing rotation stage, piezo-driven XY stage, etc.). In terms of data processing, for example, a report has emerged that aims for 10 nm resolution in CT by correcting for drift by applying the nonrigid CT method (e.g., DOI: 10.1109/TCI.2021.3060915). We would appreciate your consideration of the latest technology in terms of both hardware and software.

#### Maintenance and improvement of current measurement modes

The various measurement modes currently in use, such as imaging at various resolutions, phase contrast, and time-resolved measurement, each have significant needs and are expected to be used in the future. If new technologies can be introduced to these current measurement methods to improve measurement time and S/N, it will lead to the

creation of new results. For various measurement-related technological elements, such as fluorescent screens and various optical elements, we would like to request that new materials and methods be considered and introduced for user applications.

In terms of the data obtained, the current data format of the imaging beamline has been established through various imaging studies. RIKEN mentioned the format change at the previous BLsUG discussion WS, but any change in data output will require a reconsideration of the processing software on the user side, making an accurate comparison with past data difficult. Even if you introduce various new technologies, we would appreciate your consideration to keep the data format unchanged as much as possible.

(2) Deployment of R&D results (e.g., opinions on the development of new technologies based on results obtained using SPring-8 and efforts to promote the spread of results)

#### Support for data analysis

In imaging experiments, terabytes of data can now be easily obtained thanks to advances in measurement technology. Data processing and analysis have come to play a major role in research, and are the key to determining the impact of results. Data analysis has been pursued by individual users through their own efforts, but the current situation is such that this is no longer possible due to the increasing volume of data, and there is a great demand for support from the user side. For example, if there is a system that allows users to consult or request data processing from data science experts, etc., analysis can be performed from a new perspective by introducing technology in the information field. We would like you to consider a support system, etc., that would allow users to consult with and request data analysis.

Alternatively, a group of software for imaging research with an easy-to-use interface that can cover a variety of samples and analysis methods could be developed and shared by users, for example, through a mechanism such as volume line sense lending, which could also help analysis. We would appreciate your consideration of this aspect.

(3) Matters related to the next SPring-8 plan (e.g., opinions on the development of utilization technologies and creation of scientific fields expected in the next SPring-8 plan)

#### Increasing the brightness of light sources

The SPRUC expects that the next plan for SPring-8 will have low emittance, and that high-brilliance beams will be obtained. Higher brilliance will lead to improved spatial and temporal resolution, which is consistent with the direction that many of the research group members are seeking. On the other hand, if the beam width becomes smaller and the field of view narrows, it will be difficult to conduct research that requires a wide field of view. There are many user opinions that call for the current measurement parameters, and we ask for your consideration so that the plan will not be suitable only for specific research.

#### Upgrading of measuring instruments to accommodate

Along with the increase in brightness, it is also necessary to upgrade the corresponding measuring instruments. In imaging experiments, for example, measurement data are obtained using a sample stage and an image detector, and the results are greatly influenced by the performance of the related equipment. If the corresponding measurement equipment is not upgraded at the same time as the increase in brightness, it is feared that the next project will not lead to the creation of results. We request that sufficient budget be allocated not only for the storage ring and beamline optics, but also for instruments directly related to measurements inside and outside the experimental hutches.

(4) Matters related to post new corona and crisis management measures (requests for methods to reschedule BT when experiments using the facility are difficult, suggestions and opinions regarding new research styles such as remote measurement, etc.)

#### (5) Improvement of facilities for field experiments and their operation

Many users' opinions request enhancement of facilities for conducting experiments in the field, such as lodging and meals, as well as their management. We understand that there are budget and cost difficulties with lodging, dining, etc., compared to experimental facilities. However, even if the next plan is realized, if the number of users decreases, it will not be possible to generate results. We ask that you consider enhancing the facilities for lodging and the cafeteria, as well as improving the

management methods. Specifically, this includes expanding and renovating the lodging building to include all single rooms, and expanding the operating hours of the cafeteria and store. If the current situation continues, not only will new users be discouraged from using the facility, but it will also damage the image of the facility to the students and graduate students who visit the facility, and may make it impossible to maintain the synchrotron radiation field in the future.

#### Support for requested measurements and remote experiments

There are a certain number of users who wish to conduct commissioned measurements and remote experiments, and we would like to ask for support for such forms of experiments. Although there were not many requests for a robot as a measurement device to be sought in the future in the aggregated user opinions, the introduction of a robot in a form operated by the facility, rather than as a device for user use, could be an option for commissioned measurements, etc. Even if automation by such a robot is implemented, it is expected to increase the workload of JASRI staff for requested measurements. We would like you to consider measures to address this issue from a human resource perspective, including increasing the number of staff in charge.