

1. Accelerator

The accelerator operations at SPring-8 and SACLA in FY2022 were very smooth with no major problems. In the medium term, the biggest concern regarding the maintenance of the accelerator complex at this site is the aging of the SPring-8 storage ring, which has been in user operation for 25 years. Currently, the operation of SPring-8 is barely in good condition, but it is in an extremely critical situation that will be difficult to maintain for a long time.

The world's third-generation large synchrotron light sources have already implemented or are in the process of implementing the most cost-effective measure against aging, which is to reuse the current storage ring tunnel and replace only the rings in the tunnel with an MBA (Multi-Bend Achromat)-type low-emittance ring. The study to replace the current ring with an MBA-type low-emittance ring, which we call SPring-8-II, started in 2007, and the design study was completed in 2014 with the issuing of a CDR (Conceptual Design Report). However, in 2017, the momentum for the construction of a 3-GeV fourth-generation soft X-ray light source in Tohoku increased, and the construction of the 3-GeV light source, later named NanoTerasu, began under a five-year construction project starting in 2019, in advance of SPring-8. The accelerator design for NanoTerasu was based on the results of SPring-8-II, for which research and development had been conducted and design studies had been completed in advance. Therefore, the construction of NanoTerasu was regarded as the final confirmation of the SPring-8-II system design using an actual ring.

Figure 1 shows the roadmap for the

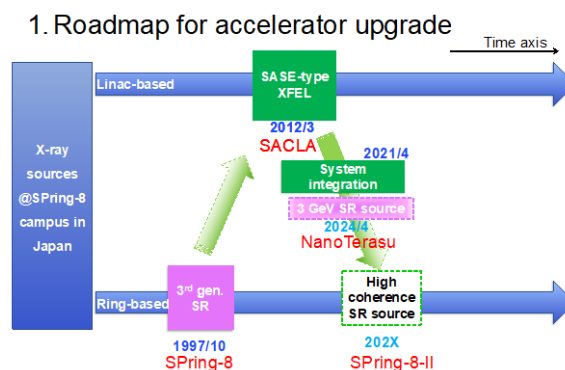


Fig. 1. Roadmap for accelerator upgrade at the SPring-8 site.

accelerator upgrade at the SPring-8 site to date, with the addition of NanoTerasu under construction at Tohoku University's Aobayama Campus in Sendai. It has been officially decided that the NanoTerasu construction will precede SPring-8-II. In response to this, we decided to accelerate the SACLA injection scheme, i.e., the direct injection of low-emittance electron beams from the SACLA linear accelerator into the ring, which is required for SPring-8-II, and to implement this method at the current SPring-8. This large-scaled modification was accompanied by a lot of research and development, but after test operations in 2020, the SACLA injection was officially introduced to user operations in April 2021. On the other hand, the electron gun system of SACLA could not be equipped with a spare unit in the tunnel because of the need to generate a low-emittance electron beam applicable to XFEL. Therefore, the SACLA injection scheme has the problem that the beam injection cannot be resumed as soon as possible in case of electron gun trouble. To solve this problem, a swap-out system was built to quickly replace the

complete electron gun system, including the electron cathode and 500 kV high-voltage deck, with another spare unit, which became operational in the fall of 2022.

With this electron gun duplication, all preparations to start SPring-8-II are now in place. Whenever the start of SPring-8-II is permitted, we will be in a position to respond promptly.

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