1. Accelerator

In the first half of 2020, especially before the summer shutdown period, many user experiments were cancelled owing to the outbreak of COVID-19. The accelerators, SPring-8 and SACLA, continued to operate in order to provide X-rays for experiments that could contribute to ending this pandemic. Over regular user operations in this period, intensive and efficient beam tests for SACLA injection (beam injection from the SACLA linac to the storage ring) were performed to finalize the SACLA injection at an applicable level for user operations. After the summer shutdown period, the test use of SACLA injection during regular user operations was continued to confirm the performance stability and operation reliability over a long operation period. The shutdown of both the old injector system and its dedicated high-voltage power substation is scheduled for April 2021.

A remaining critical issue is the purity deterioration of isolated bunches used for precise measurements of time spectra, which require a high purity of 10^{-8} to 10^{-10}. This deterioration is caused by dust electrons that are injected a few to tens of ns later than the main injection beam. Two countermeasures were developed to solve this problem. The required purity is constantly achievable by adopting a combination of these countermeasures in regular user operations. One countermeasure is to clean up the main injection beam. As described later in detail, a special dust electron sweeper was installed between the L-band correction and APS cavities in the SACLA linac to clean up the injection beam by kicking off the back-running dust electrons. The other is to purify circulating isolated bunches in the ring. A bunch cleaner system, wherein spurious satellite bunches are kicked off without the fluctuation of the main bunches, was developed by upgrading the bunch-by-bunch feedback (BBF) system.

On the other hand, the efficiency and transparency of accelerator tuning are also crucial for stable and reliable multi-beamline XFEL operations while maintaining top-up beam injections to the ring. As the first step towards reasonably rational operations, a model-free tuning tool using a Gaussian process regression (GPR) optimizer has been introduced in the regular weekly tuning as well as in the tuning after the long shutdown period.

Another important process for replacing the previous beam injection using the old injector system by SACLA injection is the building of a new compact C-band linear acceleration system providing an injection beam of 1 GeV to the NewSUBARU storage ring by the end of 2020. The above new system serves as a prototype of the injector for the 3-GeV synchrotron radiation facility under construction in the new Aobayama campus of Tohoku University. The operation of NewSUBARU was completed at the end of July 2020 and the removal of the old accelerator components in the L4 beam transport tunnel started in August. This was followed by the construction of a compact C-band system, which was successfully completed on schedule at the end of 2020. The RF conditioning operation started in January 2021, followed by the commissioning of the injector beam in mid-February 2021. The beam commissioning progressed well and a stable 1.0-GeV beam injection and a stored beam current of 350 mA were

successfully achieved in March 2021. As a result, the user operation of NewSUBARU is expected to be resumed from mid-April, which is earlier by about four weeks than the planned schedule in which the operation was to have been restarted after the May holidays.

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