SACLA Beam Performance

During 2021, timesharing of the SACLA linac as a ring injector was established as a standard operation. By means of this new standard operation, the SACLA accelerator system can provide throughout the year not only stable and high performance XFELs, but also reliable and stable top-up injections for SPring-8 experimental users.

Aiming at establishing highly efficient accelerator tuning to reproduce the XFEL performance, we previously developed a model-free tuning tool using a Gaussian process regression (GPR) optimizer. This tool is routinely used to prepare machine parameter sets that provide the XFEL performance required for user experiments. It has been utilized effectively to increase the energy of laser pulses to sufficient levels under specified wavelengths and pulse widths. On the other hand, owing to the low spectral resolution of in-line single-shot spectrometers, it is currently not possible to adequately control narrow spectral widths. The SACLA Beamline Group has developed a new in-line single-shot spectrometer with sufficiently high resolution and installed the prototype in the BL3 experimental hutch. Using precise spectral data, BL3 is now able to provide brilliant XFELs with narrow spectral widths for user experiments. Figure 1 shows an example of a narrow-spectrum XFEL obtained with this new in-line spectrometer. To fully utilize the developed spectrometer for tuning, it will be moved from the experimental hutch to the optics hutch during the summer shutdown period in 2022. The developed spectrometer will be installed in the BL2 optical hutch after winter 2022 to deliver narrow spectral XFELs at BL2.

In parallel with the improvement of tuning procedures, the upgrade of the accelerator system to achieve higher pulse energy in multi-beamline operations has been investigated. To control the electron beam envelope on a pulse-by-pulse basis, the DC quadrupole magnet system downstream of the linac after the third bunch compressor will be successively replaced by a system in which focusing force is adjustable pulse-by-pulse.

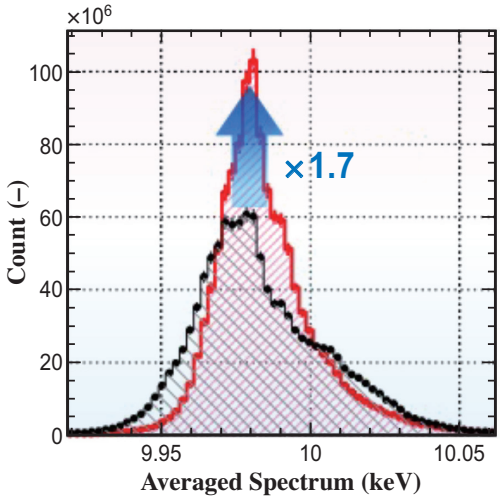

Fig. 1. XFEL spectra. Red and black lines show the spectrum obtained with and without the use of the inline spectrometer, respectively

Hitoshi Tanaka

RIKEN SPring-8 Center

Email: tanaka@spring8.or.jp