

Present Status of the SPring-8 Storage Ring and Performance Improvements

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The SPring-8 Storage Ring (SR) provides the high brilliant and stable synchrotron radiation of hard X-ray for the user experiments. The electron beam energy is 8 GeV, the stored current 100 mA, and the natural emittance 2.4 nm.rad. The top-up operation, where the electron beam is frequently injected to the SR during the user experiments, keeps the variation of the stored current within 0.03 %, which is extremely beneficial for the precise user experiments. It is one of the most remarkable characteristics of the SR operation that there are various bunch filling patterns. For the time resolved experiments the several bunch operation modes are arranged according to the user request, e.g. the 203-bunches mode, the mode of 1/7-partially filled multi-bunch with 5 isolated bunches (1/7-filling + 5 bunches), and so on. The impurity of the single bunch is kept in order of 10^{-10} by means of the bunch purifying system at the booster synchrotron.

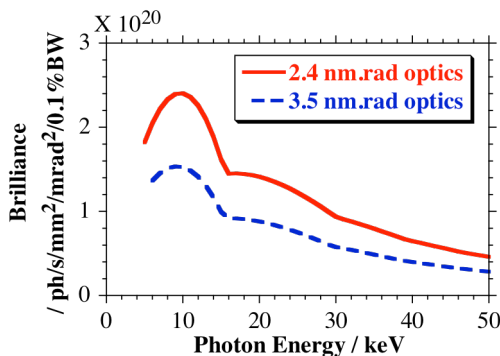


Fig. 1. Brilliance of the SPring-8 standard undulator with 3.2 cm period length and 4.5 m total length.

A new optics with 2.4 nm.rad emittance has been adopted in user operation from May of this year. Until April the emittance had been 3.5 nm.rad, and it is lowered to 2.4 nm.rad by modifying the lattice functions of the SR [1]. The emittance reduction brings the enhancement of the brilliance and the flux density of the synchrotron radiation from undulators by about 30 % as shown in Fig. 1. The operation performance, i.e. the injection efficiency, and the beam lifetime, etc., of the lower emittance optics was not degraded by means of the elaborate machine tuning.

Until November 2012 the maximum single bunch current in user operation was 3.0 mA for the filling mode of 1/7-filling + 5 bunches. The higher the bunch current becomes, the stronger the beam instability is due to the influence of the electromagnetic field generated by the high current bunch itself. This instability can be suppressed by the bunch-by-bunch feedback system (BBF) [2], and in order to achieve the higher bunch current, the upgrade of the feedback system is essential. By developing the BBF for higher bunch current [3], the new hybrid filling mode of 11/29-partially filled multi-bunch with a 5 mA isolated single bunch is now open to user operation since December 2012. In order to increase the single bunch current up to 10 mA, further improvement of the BBF is in progress.

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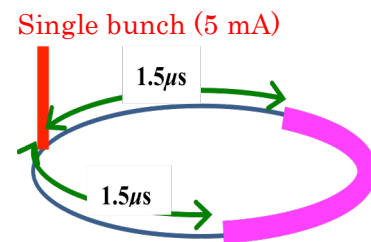


Fig. 2. 11/29-filling + single bunch.

[1] Y. Shimosaki, et al., Proc. of IPAC'13 (2013), 133.

[2] T. Nakamura and K. Kobayashi, Proc. of EPAC'04 (2004), 2649.

[3] K. Kobayashi and T. Nakamura, Proc. of ICALEPCS2009 (2009), 659.