SPring-8 Beam Performance

Insertion Device

A new insertion device (ID) capable of switching the polarization states between left-handed circular, right-handed circular, horizontal, and vertical polarizations (LCP, RCP, HP, and VP, respectively) was constructed to replace the existing ID operating in BL17SU, comprising both electromagnet and permanent-magnet arrays. Since 2020, its capability for wavelength tunability and available polarization has been largely limited because of a malfunction in one of the electromagnet coils (water leakage). The new ID, which has a magnetic period of 120 mm and is referred to as "H8U120," is based on a Helical-8 undulator concept proposed in 2011 [1]. It is advantageous in that the HP and VP are available with significant less heat load than that in conventional elliptic polarized undulators.

The construction of H8U120 started in 2021, and the assembly of the mechanical components and evaluation of the magnetic array were completed in July 2022 [2]. Figures 1(a–e) summarize the magnetic performance of the H8U120 at a minimum gap of 20 mm. Figure 1(a) shows the distributions of the horizontal magnetic fields in three different modes of operation as measured by scanning a Hall probe; the blue, green, and red lines correspond to the clockwise (CW), counter-clockwise (CCW), and figure-8 modes, respectively, in which LCP, RCP, and HP/VP are generated. Figure 1(b) is the same as Fig. 1(a); however, for the vertical magnetic field, common to the three operation modes, only one result is shown as a black line. Figures 1(c), 1(d), and 1(e) show the electron trajectories projected onto the transverse plane in the CW, CCW, and figure-8 modes calculated using the magnetic distributions shown in Figs. 1(a) and 1(b). The electrons move along the CW helix, CCW helix, or figure-8-like orbit in each mode.

The constructed H8U120 was installed in the storage ring during the summer shutdown period (August 2022) and operated without problems.

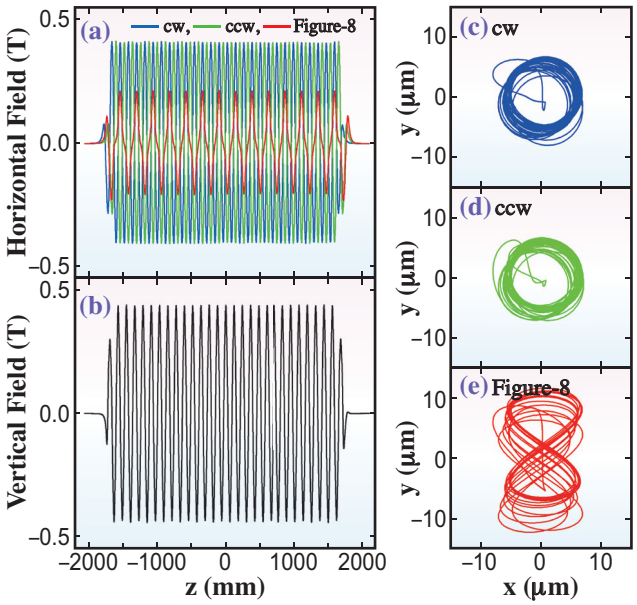

Fig. 1. Magnetic performances of the constructed H8U120 in three modes of operation: **(a,b)** horizontal and vertical field distributions, and **(c–e)** trajectories projected on the transverse plane.

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References

[1] T. Tanaka and H. Kitamura: Nucl. Instrum. Meth. A **659** (2011) 537.
[2] T. Tanaka *et al.*: J. Synchrotron Rad. **30** (2023) 301.